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Abstract

This report provides an overview of global engagement activities carried out in Period 2 (January 2024–December 2024) by the *International* subtask of GN5-1 WP3 Task 1, as well as by other projects, collaborations, and contracts that support global interactions between GÉANT and Research and Education Networks (RENs) in other world regions. In addition, an overview of the status of Network Services, Trust and Identity, Security and other GÉANT Services in other world regions is provided, as well as details of participation in the GÉANT Community Programme Task Forces and Special Interest Groups.



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Executive Summary

The GÉANT Strategy sets the goal of being ‘*acknowledged worldwide as a leader for developing and supporting Research and Education (R&E) networking communities, and global REN development*’ [[Strategy](#)]. This goal is in part achieved through engagement with Research and Education Networking (REN) organisations across the globe beyond the GÉANT membership. Engagement activities, however, do not occur only in the context of the GN5-1 project, in which the *International* subtask of Work Package 3 (WP3) Task 1 *Partner Relations* provides international relationship management. Other EU-funded projects and work areas that contribute to international engagement include GN5-IC1, AfricaConnect3, EUMEDplus (which includes the delivery of Medusa connectivity), a consultancy contract for TEIN*CC and the Asi@Connect project (up to May 2024), and service contracts for ESnet and Internet2.

To provide insight into all International Engagement work, this document describes the principal work areas in 2024 of these projects and activities, and demonstrates that as a whole, engagement work covers a variety of areas, from general relationship management, engagement through participation in international R&E networking events, to connectivity planning and implementation, service delivery and service collaboration, development support and project management.

The report also recognises that it is important that all of these activities are in alignment, and whilst many do not fall under the remit of WP3 Task 1, the Task monitors international engagement across these activities to ensure consistency, avoid duplicated efforts, and identify synergies wherever feasible.

Task 1 also facilitates service collaboration between the GÉANT community and its peers in other regions of the world. This report highlights updates on the status of services in these regions, focusing on the service areas of Trust and Identity, Security, and Collaboration Tools. In addition, participation levels in GÉANT Community Programme Task Forces and Special Interest Groups, from RRENs and NRENs outside of the GÉANT community, are also covered.

Overall, since the end of 2023, GÉANT’s international connectivity has risen by 1.9Tbps to a total of just over 3.9Tbps with the biggest increment happening within the ANA (Advanced North Atlantic) collaboration. The number of countries connected globally overall has remained mostly stable compared to the end of 2023, and stands at 64 countries (a net decrease of one). Increases in service uptake have been seen with GÉANT Plus, eduroam, eduGAIN (with new candidates), Trusted introducer and FileSender. Services where there has been no net change are Trusted Certificate Services (TCS) and eduVPN. A decrease has been seen in the number of GÉANT Open connectors (a decrease of one).

Looking forward, to expand the reach of services and enhance support for global R&E collaboration, it is essential for WP3 Task 1 to engage closely with the GN5 service leads and International RENs to identify potential growth areas. Additionally, recognising the value of the GÉANT Community Programme (GCP) Task Forces and Special Interest Groups (SIGs), it is recommended that Task 1 collaborate with the GCP team to identify barriers to international participation in these activities, as well as explore potential solutions to facilitate greater involvement from the international R&E networking community where interest exists.

1 Introduction

To support collaboration between researchers and academics in Europe and their peers in other world regions, GÉANT is interconnected and collaborates with Research and Education (R&E) networks across the Americas, Africa, Western Asia, Central Asia, and the Asia-Pacific region, reaching a total of 64 countries outside the GÉANT membership, either via direct interconnections or indirectly via interconnections with regional networks (RedCLARA, TEIN, UbuntuNet Alliance, WACREN) who connect the national networks directly.

To enable effective cooperation between GÉANT and these R&E networks in other world regions, engagement is carried out in the context of a number of projects and other contracts or arrangements, including GN5-1, GN5-IC1, AfricaConnect3, EUMEDplus, a consultancy contract for TEIN*CC and the Asi@Connect project (up to May 2024), and service contracts for ESnet and Internet2.

This report describes all activities comprising international engagement and service updates known to GN5-1 WP3 T1 in the context of the projects and collaboration activities described. However, it does not aim to describe collaborations outside these areas, for instance between specific National Research and Education Networks (NRENs) in Europe and other world regions that do not come under the context of those projects.

It should also be noted that in this report the term ‘international’ is used to refer to entities outside the geographic scope of the GÉANT Membership. REN refers to any type of Research and Education Network, whilst NREN designates national networks, and Regional R&E Network (RREN) refers to regional networks such as GÉANT, APAN, ASREN, CAREN CC, TEIN, RedCLARA, the UbuntuNet Alliance, and WACREN [[GN](#); [APAN](#); [ASREN](#); [CARENCC](#); [TEINCC](#); [RedCLARA](#); [UbuntuNet](#); [WACREN](#)].

This document is structured as follows:

- Section 2 describes the role of each of these activities in supporting international engagement, and highlights the key areas of work carried out in each activity in 2024. The aim is to provide an overview of the ongoing support for collaborative activity across all projects and activities with GÉANT’s international R&E networking peers.
- Section 3 provides an update and comparison of the status of global connectivity and service deployments by international RRENS and NRENs in other world regions up to November 2024. The service areas covered include Trust and Identity, Security, and Collaboration Tools. In addition, the report sets out participation levels in GÉANT Community Programme Task Forces and Special Interest Groups.
- Section 4 offers conclusions and recommendations.

2 Global Engagement

Within the GN5-1 project, relationship management for International RENs lies with the *International* subtask of Work Package 3, Task 1 *Partner Relations*, with a focus on planning and supporting collaboration across service areas, user support, and the delivery of specific service requests. Delivery of the Emerging NREN programme is also the responsibility of the WP3 T1 *International* subtask.

Nevertheless, international relationship management and collaboration support is also carried out in the context of additional EU-funded projects (including GN5-IC1, AfricaConnect3, EUMEDplus) and other activities (e.g., a consultancy contract for TEIN*CC (up to May 2024), and service contracts for North American NRENs).

The majority of global engagement activities occur with RRENs and NRENs, as well as other organisations that support global R&E networking, where one or more of the following applies:

- The organisation has or is planning a direct telecommunications interconnection with GÉANT.
- The organisation is involved in an international collaboration activity (e.g., a project or working group) in which GÉANT is also involved or has an interest.
- The country concerned plays an important role in a big science collaboration that is of interest to GÉANT (e.g., high-energy physics, astronomy, etc.).

To provide a full overview of global engagement activities in 2024, this report describes the activities carried out in all of these projects, collaborations, and contracts. For each of these, an overview of the work areas and responsibilities relating to global engagement is set out in the bullets below. Specific activities carried out in 2024 are subsequently described in Sections 2.1 to 2.7.

GN5-1 WP3 Task 1

- General relationship management, via regular online and in-person meetings with leading international RRENS and NRENs, as well as attendance at the corresponding international REN conferences and selected national events.
- Support for service collaboration activities, including liaison with GÉANT service work packages.
- Coordination of the implementation of specific service requests (e.g., GÉANT Plus services, GÉANT Open connections).
- Delivery of the Emerging NREN Programme and other community development-related activities.
- Point of Contact for GÉANT members for introductions to international NREN/RRENS (and vice-versa).

GN5-IC1

- Liaison with international R&E networking organisations on global traffic forecasting and connectivity provision planning.
- Participation in the NEA3R project led by Indiana University.
- Representation of GÉANT in connectivity collaborations (AER, ANA, BEAA, BELLA).
- Updating of the GÉANT Interactive Map [[GNmap](#)] and support for the development of the Global Interactive Map [[GRENmap](#)] (a working group of the GNA-G).

AfricaConnect3

- In 2024 the AfricaConnect3 project consists of three EU grant agreements for the delivery of project activities, which are held by GÉANT, the UbuntuNet Alliance and WACREN, as follows:
 - GÉANT Grant Agreement:
 - (i) Overall coordination, including reporting to the EC, of the programme of the AfricaConnect3 project.
 - (ii) Support AfricaConnect3 Regional Partners (ASREN, UbuntuNet Alliance, WACREN) in connectivity procurement as agreed with the EC and the Regional Partners.
 - (iii) Coordination of outreach activities (communications, and advocacy).
 - (iv) Thematic support, e.g., Identity Federation support and training activities, based on Regional Partner needs.
 - Regional Partner Grant Agreements:
 - (i) Connectivity strategy, and implementation and management of new links and the network.
 - (ii) Management of local service delivery, e.g., Trust and Identity, Security, Open Science, end user services.
 - (iii) Capacity-building for the NREN communities of the corresponding RREN.
 - (iv) Outreach activities:
 - a) Advocacy and Donor Engagement (African Union, World Bank, etc.).
 - b) The organisation of regional conferences (e-AGE (ASREN), UbuntuNet-Connect, the WACREN Conference).
 - c) Communications.
 - d) End user engagement (e.g. AfriGEO).

EUMEDplus

The EUMEDplus project began in September 2024 with beneficiaries in North Africa (up to November 2024 under AfricaConnect3) and the Eastern Mediterranean (previously benefiting from EU funding support via the EUMEDCONNECT3 project that ended in December 2021). The project is funded via a single grant agreement between the EC (DG NEAR) and GÉANT. Other contributing partners are ASREN, AUB (Lebanon), CNRST (Morocco), CYNET (Cyprus), NORUnet (Nordic countries) and SESAME (Jordan). The beneficiaries are ASREN, AUB/TechCARE (Lebanon), CCK (Tunisia), CERIST (Algeria) CNRST (Morocco), ENSTINET (Egypt), PaINREN (Palestine) and SESAME (Jordan). The project has four principal focus areas:

- Capacity and sustainability development of the ASREN and ASREN NRENs.
- Connectivity infrastructure development, including deployment and operations of Medusa and leased capacities for Eastern Mediterranean NRENs.
- Development of digital infrastructures and services.
- Outreach, advocacy and dissemination.

TEIN*CC Consultancy Contract

Through a consultancy contract with TEIN*CC (the RREN for the Asia-Pacific region and coordinator of the EU-funded Asi@Connect project), GÉANT provided advice up to the end of May 2024 through a consultancy contract regarding the implementation of the project, along with provision of support for planning future EU funding for the region.

ESnet Service Contract

ESnet network design includes a connectivity ring from London to Amsterdam to Geneva and back to London to carry Large Hadron Collider (LHC) traffic to and from its transatlantic links. This ring is provided to ESnet by GÉANT via a service contract, which also provides GÉANT Open access in London, UK. Under the service contract GÉANT also provides backhaul for ESnet from its transatlantic connectivity on the Amitié cable system between Slough and Central London and between Bordeaux and Geneva.

Internet2 Service Contract

Like ESnet, in early 2024, Internet2 deployed new transatlantic connectivity from the USA to Bordeaux, France. Under a new service contract, GÉANT provides backhaul for Internet2 from the Bordeaux endpoint to the GÉANT Open Exchange in Paris, France.

2.1 GN5-1 WP3 Task 1 – Partner Relations – International Subtask

Global Engagement activities by WP3 Task 1 fall into four categories, as follows:

- **General relationship management**, via regular online and in-person meetings with leading international RRENs and NRENs, as well as attendance at the corresponding international REN conferences.
- **Support for service collaboration activities**, including liaison with GÉANT service work packages.
- Coordination of the **implementation of specific service requests** (e.g., GÉANT Plus services, GÉANT Open connections).
- Delivery of the **Emerging NREN Programme** and other community development-related activities.

A summary of the activities carried out during 2024 for each of these categories is set out below.

2.1.1 General Relationship Management

Bilateral meetings with RENs from all world regions took place in the context of TNC24. Furthermore, in addition to regular online engagements, key in-person bilateral engagements were carried out at the following events:

- APAN57 Conference (January) [\[Event1\]](#)
- Internet2 Community Exchange (March) [\[Event2\]](#)
- WACREN Conference (March) [\[Event3\]](#)
- APAN58 Conference (August) [\[Event4\]](#)
- CANARIE Summit 2024 (October) [\[Event5\]](#)
- UbuntuNet Connect 2024 (October–November) [\[Event6\]](#)
- TICAL2024 (December) [\[Event7\]](#)
- e-AGE24 Conference (December) [\[Event8\]](#)

The following additional engagements occurred:

- Support was given to RedCLARA for the second BELLA II Ideathon, held between 29 February–11 March within the context of the EU-funded BELLA-II project, with a focus on food security. Support was also given for the follow-up BELLA II Hackathon held in June 2024 with a view to developing solutions for successful concept notes developed by the Ideathon. Support was given through input in planning and participation in online events during the two activities.

- Having participated in 2023 in the planning of the Internet2 Community Exchange 2024 as a member of the programme committee, the WP3 Task 1 international subtask lead attended the event in Chicago in March 2024, to conclude programme committee duties. A new representative of the GÉANT project (the WP3 Task 4 Task Leader) was proposed and accepted by Internet2 to participate in the programme committee for the Community Exchange 2024.

2.1.2 Support for Service Collaboration Activities

- Plans were developed for two regional security bootcamps run by WP8 (Security): one for the UbuntuNet Alliance and NRENs in East and Southern Africa, alongside the UbuntuNet-Connect conference, and one for RedCLARA and NRENs in Latin America, run alongside TICAL2024. The Task supported coordination of the activities with UbuntuNet Connect and UbuntuNet Alliance, respectively.
- Alongside the WP3 T1 Partner Relations Task, the International subtask engaged with the Trust and Identity service representatives to ensure an information exchange on international T&I activities, and to provide liaison support where required. Support was provided to the eduroam team in assisting Maeen, the Saudi Arabian NREN, to gain operator status for Saudi Arabia, with plans to transition all Saudi eduroam operations from KAUST to Maeen. Additionally, assistance was offered regarding eduroam in Mauritania. During the eduroam governance meeting at TNC24, Côte d'Ivoire, Mauritania, Saudi Arabia, and Somalia were recognised as new international eduroam operators. Support was also given in engaging with International RENS to secure signatures for the new eduGAIN constitution.
- Support was given to RedCLARA in the organisation and chairing of a side meeting at TNC24 on digital health, entitled *Let's Talk about Digital Health Transformation*.
- As part of a SC24 (Supercomputing 24) demo on MMCFTP (Massively Multi-Connections File Transfer Protocol) in Atlanta, USA, the WP3 T1 International subtask provided a coordination role supporting the preparation for implementation of a number of high-capacity links from the Asia-Pacific region, across the CAE-1 and IC1 links from Singapore, traversing the GÉANT backbone, and onto Internet2 and RedCLARA (from where the link was relayed to the USA. The aim of the demo was to showcase capacities of up to 800Gbps between Japan (Tokyo) and the United States (Atlanta), supported by 10x100Gbps links, supported by a large number of R&E networking organisations across the globe.

2.1.3 Service Request Implementations

A total of ten service requests with an international focus were processed in 2024.

- Seven GÉANT Plus service requests:
 - Two related to the SC24 NII/NCIT Demo between Japan and US.
 - One for a connection from Poland to the US for the Supercomputing 24 Quantum ORCA PT-1 demonstration.
 - One to support the CSNET LHCONe traffic over KAUST link due to Red Sea cables outages in 2024.
 - One to migrate the termination point in the EU of the RENATER–SINET ITER link.
 - Two related to connections from SCION to International RENS, one to WACREN in Africa and one to RNP/RedCLARA in South America.
- Two GÉANT Open connector requests:
 - A GEANT Open upgrade to 400Gbps in London for ESnet.
 - A GÉANT Open migration from London to Paris and upgrade to 400Gbps for Internet2.
- One GWS service request:
 - A request from ARN (Algeria) to adjust its GWS subscription rate.

Due to the outages on the CAE-1 and IC1 links between Europe and Singapore (see Section 2.2.4 on the Asia-Europe Ring) and with support from the AER collaboration and KAUST link, the engineering teams of CSTNET, KAUST and GÉANT also worked to re-route LHCOPN's VLAN for CERN-IHEP traffic exchange onto the KAUST routes.

2.1.4 International Community Development

Emerging NREN Programme

The GÉANT Emerging NREN Programme (ENP) has been taking place alongside TNC since 2018. The programme aims to integrate individuals from emerging NRENs from around the globe into the TNC community and create further synergies and connections at different organisational levels between European and international NRENs. The sixth edition of GÉANT's Emerging NREN Programme brought together seven participants from Algeria, Montenegro, Philippines, South Africa, Tanzania, Uganda and Zambia.

To promote gender balance, GÉANT exclusively sponsored female participants in 2024. This included participants from the Philippines, South Africa, and Montenegro. Regional NRENs were also encouraged to have women as at least 50% of their representatives, resulting in an all-female group of participants for ENP24. Since 2018, of the 74 ENP participants, 45% have been female.

Preparations for the Emerging NREN Programme to be held alongside TNC25 in Brighton, UK, were started.

NREN Twinning Programme

The GÉANT NREN Twinning Programme, designed to foster collaboration and knowledge exchange between International and GÉANT NRENs, evolved significantly in 2024.

Following the conclusion of two successful pilot projects spanning October 2023 to March 2024, between RENU (Uganda) and SIKT (Norway), and between MAREN (Malawi) and ASNET-AM (Armenia), the focus shifted towards evaluating the outcomes and refining the programme's structure. A key milestone during this period was the drafting of new Terms of Reference (ToR).

To increase awareness and attract potential participants, the revised programme was promoted at TNC2024. This event provided a valuable platform for personal discussions with NREN representatives and facilitated valuable networking opportunities. As a result of these efforts, several promising collaborations are currently in the pipeline, showcasing the programme's potential to drive innovation and strengthen the global NREN landscape.

By November 2024, submissions had been received for twinning activities to be carried out in 2025 and were undergoing assessment to identify the successful candidates.

The Case for NREN Website

The 'Case for NRENs' website [[CaseForNRENs](#)], a valuable resource for NREN stakeholders worldwide, has been redesigned to ensure it meets the current needs of NRENs and RRENs. Hosted by GÉANT, this site has played a crucial role in supporting engagement with new and emerging NRENs. To determine the site's future, contributors to the original site and others with an interest in the site met via videoconference (NORDUnet, RedCLARA, ASREN, UbuntuNet Alliance and IRD), where they unanimously agreed that the site continues to serve an important purpose and should be updated.

The group decided to restructure the website into a checklist format, providing a clear guide for newly appointed NREN leaders to follow as they set up their NREN. GÉANT will manage the structural overhaul and web design, while the participating RENs will revise and contribute updated material. A follow-up meeting is scheduled for mid-January 2025 to review progress. WP3 Task 1 is coordinating this activity whilst the contributions from other parties are provided on a voluntary basis.

2.2 GN5-IC1

In GN5-1, international engagement is carried out by Work Package 2 Task 2 *Intercontinental Partner Engagement and User Need Assessment*. In 2024, the principal international engagement activities were as set out below.

2.2.1 Traffic Forecasting

Methodology

A methodology was developed in collaboration with WP2 Task 1, based on the traffic intelligence gathered in 2023, to forecast future research and education traffic levels between Europe and other world regions. This methodology considers that historically, average traffic rates between GÉANT and RENs in other world regions have seen a typical annual increase of 34%.

For the purposes of forecasting future traffic, the methodology includes an adjustment of the average expected growth to 30%. However, as GÉANT's future intercontinental connectivity will need to support traffic surges, overall capacity needs must be based on expected peak traffic rather than average traffic. Therefore, to forecast the overall connectivity requirement (i.e., to forecast maximum required throughput) the forecast average traffic level is multiplied by three. This factor of three equates to the average ratio between average traffic and the 95th percentile of international traffic levels.

The methodology also accounts for the fact that big science infrastructures and collaborations will lead to significant changes in traffic levels. Where big science is expected to have an impact on any specific interconnection with an International REN, estimated figures for these traffic figures are also built into the model.

Forecasts are produced for all International REN interconnects, as follows:

- Canada & USA: CANARIE, ESnet, Internet2, and NISN (NASA).
- Latin America: RedCLARA.
- Central Asia: CAREN.
- West & Central Africa: WACREN.
- East & Southern Africa: UbuntuNet and TENET/SANReN.
- North Africa & Western Asia: ASREN, ANKABUT (UAE), ARN (Algeria), ENSTINET (Egypt), HBKU (Qatar), IRANet (Iran), Maeen (Saudi Arabia), KAUST (Saudi Arabia) and OMREN (Oman).
- Asia-Pacific: TEIN, AARNet (Australia), ASGC (Taiwan), CERNET (China), CSTNET (China), KREONET (Korea), NII/SINET (Japan), NKN (India), SingAREN (Singapore) and TWAREN (Taiwan).

GÉANT NREN and International REN Consultation

The model was shared for review and feedback with GÉANT member RENs and with International RENs with significant traffic levels. Confirmations of International RENs' future connectivity plans were also requested so that these can be factored into identifying where GÉANT will require additional future connectivity, either for primary links or to ensure suitable redundancy paths are in place.

In the feedback received from both GÉANT NRENs and International RENS, the methodology was generally endorsed and the data shared was also genuinely accepted with no major adjustments.

Conclusions and Next Steps

An analysis of the results was carried out and conclusions on where of the study will be carried out with WP2 Task 1, leading to recommendations being drawn up for the GÉANT community's future connectivity needs to other world regions, including options to meet those needs. The results were prepared to be presented to the Network Infrastructure Advisory Board (NIAC) in early 2025.

Traffic flow data continued to be collected and will be fed into the forecasting model on a regular basis to refine and adjust as appropriate the required connectivity over the coming years.

2.2.2 North Atlantic

CANARIE, ESnet and Internet2

- In the first half of 2024, the first 400 Gbps paths in the North Atlantic were deployed by ESnet (3x400Gbps), and by Internet2 and CANARIE (1x400Gbps). The Task liaised with both ESnet and Internet2, as well as with the GÉANT Operations team to coordinate implementation of the corresponding interconnections between GÉANT and ESnet (London and Geneva) and Internet2 and CANARIE (Paris), respectively.
- Conversations continued with ESnet, also involving GN5-IC1 WP2 Tasks 1 and 3, on the alignment of each party's procurement activities for transatlantic spectrum, as well as making spectrum available to each other across the two party's links to maximise redundancy across the diverse paths that will be deployed.
- During the CANARIE Summit 2024 [\[Event5\]](#) conversations were held on options to add resiliency to the existing interconnections between GÉANT and CANARIE that currently both connect to the same GÉANT PoP (Paris). A proposal was agreed on to be confirmed subsequently with the GÉANT Operations team prior to deployment.

NEA³R Project

- Engagement continued with the NSF-funded NEA³R [\[NEAR\]](#) project, coordinated by Indiana University [\[IndUni\]](#), which provides 2x100Gbps links between the USA and Europe. Discussions included options for use of project underspend, with these including the upgrade of one of the 100Gbps to 400Gbps and an extension of the link to 2027. In November 2024, NEA³R had upgraded the New York Amsterdam link to 400Gbps.

ANA Collaboration

- In the Advanced North Atlantic (ANA) collaboration, which brings together R&E networking organisations in Europe (GÉANT, NORDUnet [\[NORDUnet\]](#), and SURF [\[SURF\]](#)), Canada, the USA (CANARIE, ESnet, Internet2, Indiana University), and Japan (NII/SINET [\[SINET\]](#) for mutual back-up and coordinated planning), GÉANT met with other ANA members at the Internet2 Community Exchange held in Chicago, USA, in March 2024 to discuss existing deployments and ideas for the future of the collaboration.
- A high-level strategic meeting for the European and North American partners took place during TNC24 in Rennes in June 2024 in which it was agreed that the ANA collaboration should continue to drive resiliency of connectivity between Europe and North America. It was also agreed that a network planning group should be established to guide the ANA engineering group. For this group, a secretariat will be provided for by GÉANT.

- During 2024 the total capacity of the ANA collaboration increased from 1Tbps to 2.8Tbps following the addition (through upgrades or provisioning of new capacity) of five 400Gbps links (ESnet: 3; Internet2 and CANARIE: 1; NEA³R: 1) and the addition of a 100Gbps link by the Korean NREN, KREONET.

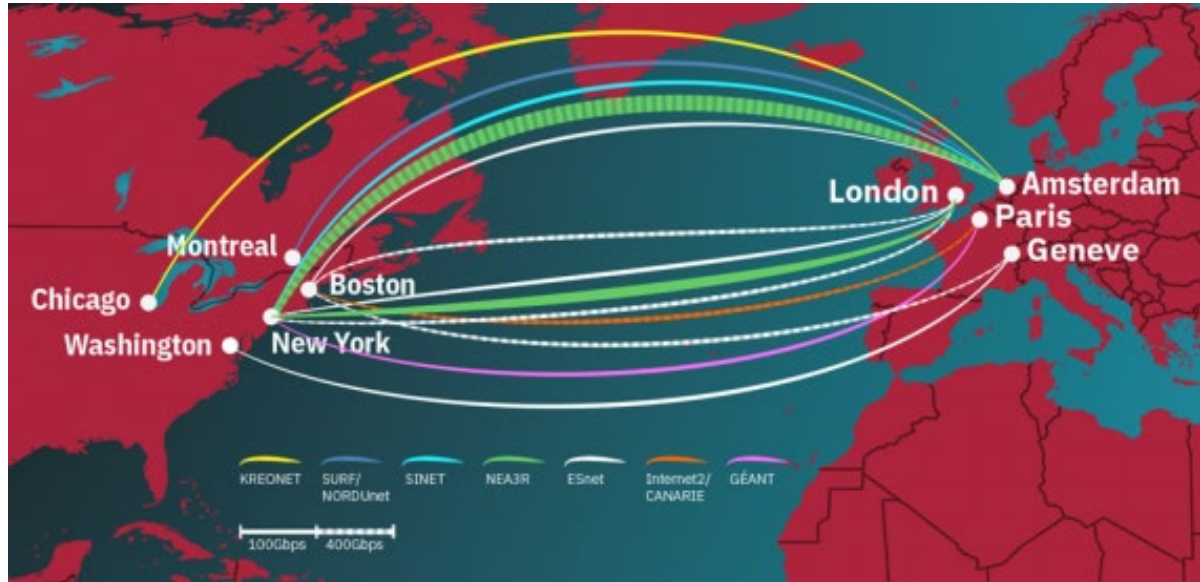


Figure 2.1: Map of ANA links (November 2024)

2.2.3 South Atlantic

A meeting of the BEAA (Bridging Europe, Africa and the Americas) collaboration took place in April 2024. The BEAA collaboration brings together links operated by GÉANT and RedCLARA (BELLA), Florida International University, RNP (Brazil), and TENET/SANReN (South Africa), together with the UbuntuNet Alliance. In the meeting, coordinated by the IC1 WP2 Task 2, it was noted that outages on BEAA links are rare but that one occurred late 2023 on the South Africa to Europe link whereby the back-up route via Latin America ensured the ongoing flow of traffic. The partners agreed that the collaboration has value and should be extended beyond the initial three-year term currently due to be completed at the end of 2024.



Figure 2.2: BEAA collaboration map

2.2.4 Asia-Pacific

China

Discussions were held with the Chinese NREN, CERNET, regarding options to upgrade the existing 10Gbps interconnection to 100Gbps. The expected outcome is that CERNET will procure its own 100Gbps link to reach an agreed GÉANT PoP in Europe or to interconnect at a mutually convenient point outside Europe (e.g., Singapore). At the time of writing CERNET's leadership is still evaluating their options, however assurances have been given that there will not be an end-to-end EU-China connectivity gap after April 2025 when the contract for the current 10G link terminates.

Japan

Dialogue took place with the National Institute of Informatics (NII) [\[NII\]](#), that operates the SINET network in Japan, and the Arterial Research and Educational Network (ARENA-PAC) [\[ARENA\]](#), a project of the Asia Pacific Internet Development Trust (APIDT), operated by the WIDE Project [\[WIDE\]](#) with support from the Asia Pacific Network Information Centre (APNIC). Discussions focused on future connectivity options to connect GÉANT and the Japan R&E networking community both via existing infrastructure and a potential new route via the Arctic. In these discussions NORDUnet, the regional network for the Nordic countries, was also a key participant in view of its Polar Connect [\[PolarConnect\]](#) project work which is currently investigating the possibilities for secure and resilient connectivity through the Arctic to Asia and North America [\[Gateway\]](#).

An online workshop 'Policy to Implementation – R&E Investment in Submarine Cables' was organised jointly with NORDUnet, bringing together 100 participants including policy makers, ministries, funding agencies, and experts from the submarine-cable environment in Japan and Europe to explore the dynamics of the telecom market, demonstrate the role of R&E networks in the realisation of the new submarine cables, and understand the case for new cable systems between Europe and the Pacific region.

India

Currently, the Indian NREN, NKN [\[NKN\]](#) is connected to GÉANT at 20Gbps with the links provided by NKN. Preliminary discussions opened with NKN to explore how to this can be upgraded.

Engagement was also carried out in the context of a potential Global Gateway activity to secure connectivity to India and Djibouti on the Blue-Raman submarine cable system, to ensure alignment with NKN's own future connectivity plans and gather feedback on the proposal (see also Sections 2.2.5 and 2.2.8).

Asia-Pacific Europe Ring

The Asia-Pacific Europe Ring (AER) provides back-up between the Asia-Pacific region and Europe. The partners in this collaboration include AARNet (Australia), GÉANT, HARNET (Hong Kong), KAUST (Saudi Arabia), KISTI (Korea), NICT (Japan), NII (Japan), NORDUnet, SingAREN (Singapore), SURF and TEIN*CC. During the reporting period, outages on cable systems in the Red Sea as well as within the Asia-Pacific region demonstrated the value of this collaboration. The contribution of the KAUST link from Europe to Saudi Arabia and on to Singapore proved to be of particular value as it was able to pick up traffic from the CAE-1 link (owned by GÉANT, NORDUnet, SURF, TEIN*CC, AARNet and SingAREN) and the 100Gbps link to Singapore operated by GÉANT (IC-1), both of which have seen outages as a result of the Red Sea cable cuts. In this instance, the Task liaised with KAUST and other AER partners to support the coordination of traffic re-routing. The collaboration was also key to the successful SC24 massive-data-moving challenge from Tokyo to Atlanta via diverse intercontinental paths.

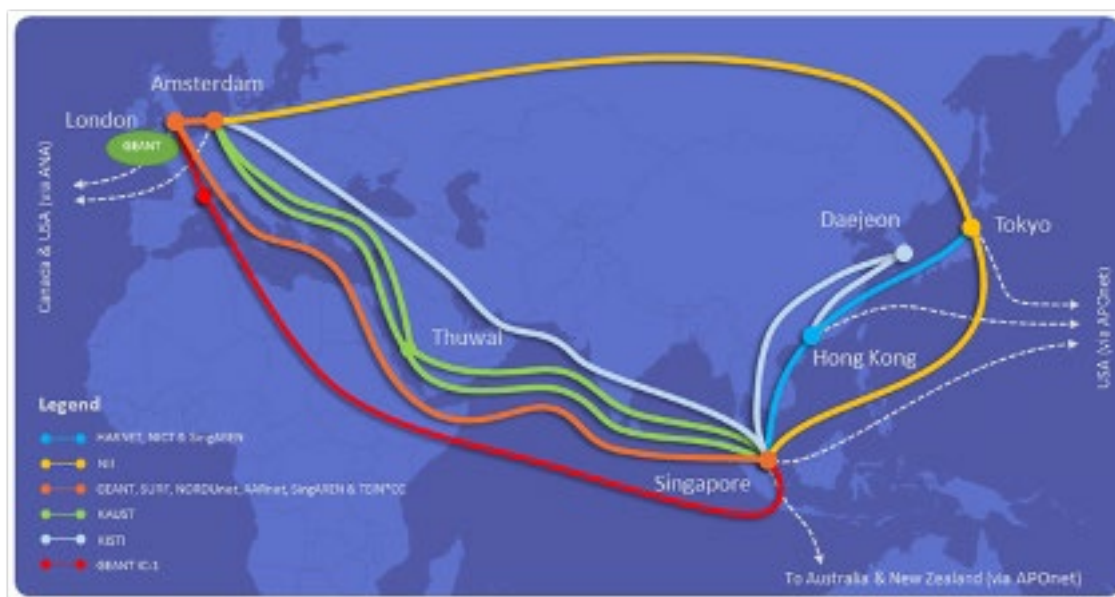


Figure 2.3: Asia-Pacific Europe ring map

- Two Interconnection service requests have been made:
 - One for ASNet-AM (replacing ASGC) in Amsterdam.
 - One for HARNET (Hong Kong) for an interconnection via GÉANT's connectivity to the SingAREN Open Exchange in Singapore.

In addition to the interconnection agreement work for North America described above, the Task has renewed agreements relating to existing interconnections for AARNet (Australia) [[AARNet](#)], ASREN (North Africa and Western Asia) [[ASREN](#)], KISTI/KREONET (South Korea), and SingAREN (Singapore).

2.2.5 East and Southern Africa

A meeting was held with the UbuntuNet Alliance Technical Manager in the context of a potential Global Gateway activity to secure connectivity to India and Djibouti on the Blue-Raman submarine cable system and to investigate alignment with UbuntuNet Alliance planning, specifically the ability for an interconnection in Djibouti where an UbuntuNet PoP has recently been established. (See also Sections 2.2.4 and 2.2.8).

2.2.6 Global Collaboration Groups

The Global Network Advancement Group (GNA-G) [[GNAG](#)] is a collaboration of RENs around the world involving a number of working groups that focus on a variety of networking-related topics. This includes the Global Interactive or GREN Map [[GRENmap](#)], as well as strategic discussions taking place in the REN community on a global level. During the reporting period, the Task provided support for the coordination of the GNA-G and its global NREN community engagement through a secretariat role. This role enables the GN5-IC1 project to have a strategic overview of global R&E networking trends, gives insights into new developments early on and increases GÉANT's visibility in the intercontinental networking environment.

2.2.7 Interactive Maps

GÉANT Interactive Map

Reviews and updates of the network data for the GÉANT Interactive Map [[GNmap](#)] were made throughout 2024.

Global Interactive Map

In the context of the GREN Map Working Group a demo at TNC24 demonstrated how a REN interested in providing its own network data can set up a data node on its own servers. Plans were made for a follow-up discussion of the Working Group to discuss the future and direct of the GREN Map activity.

2.2.8 EC Engagement

Whilst not always involving International RENs, dialogue with the European Commission is ongoing to consider options for future connectivity options in the context of the EC's Global Gateway objectives.

Discussions between DG INTPA and WP2 T1 in 2024 were supported by the Task, regarding future connectivity possibilities towards India, with potential for extensions to Asia-Pacific and/or south-eastern Africa on the Blue-Raman submarine cable system. Equally, discussions have been held with DG INTPA (EC) regarding a potential extension of the Medusa cable system towards Jordan. As part of its involvement, the Task is engaging with the corresponding RENs that will also benefit from the proposed connectivity options (UbuntuNet Alliance, NKN (India) and ASREN) to ensure alignment on preferences and forward planning.

In addition, the Task has acted in an advisory role to DG INTPA and EU delegations in Jakarta and Manila in relation to supporting the Philippines TEI and SCOPE Digital objectives for the deployment of a Copernicus mirror site at PhilSA in the Philippines and Copernicus data utilisation by the wider ASEAN community, respectively.

2.3 AfricaConnect

In 2024, discussions for a fourth phase of AfricaConnect progressed involving DG INTPA, GÉANT, UbuntuNet Alliance, and WACREN. It was decided that the fourth phase will continue with individual grant agreements for each partner, with GÉANT maintaining an overall coordination/secretariat role and managing procurement activities for WACREN, while the providing advice to UbuntuNet Alliance, which will handle its own procurements. North Africa is not within the remit of the fourth phase of AfricaConnect, but will be supported by the EUMEDplus project (see Section 2.4).

In June, the European Commission approved the AfricaConnect4 action document and financing decision, with €40 million in EU funding allocated. Draft descriptions of actions and budgets were prepared for GÉANT governance and EC review. The project is expected to begin in early 2025. A new national connectivity component is included, and will be delivered by UbuntuNet Alliance in Eastern and Southern Africa, and by Expertise France and IRD in collaboration with NREs in Togo, Ivory Coast and Benin in West and Central Africa.

Additionally, a no-cost extension for AfricaConnect3 was granted to extend the project duration to April 2025, allowing for the finalising of all the connectivity and equipment procurements.

2.3.1 Project Management and Coordination

In AfricaConnect3 [\[AC3\]](#), regular project management meetings were held with the African RREN partners (ASREN, the UbuntuNet Alliance and WACREN) to track project progress, discuss possible synergies and agree future work.

Two AC3 project management board meetings took place alongside the WACREN Conference (March 2024) [\[WACREN24\]](#) and UbuntuNet-Connect (November 2024) [\[UbuntuNet24\]](#), including the European Commission, which further enabled project management dialogue and planning.

2.3.2 Connectivity Planning and Procurement

North Africa

Implementation of an upgrade to 10Gbps of the MARWAN [\[MARWAN\]](#) international connection was completed with the European endpoint in London, UK.

East and Southern Africa

The implementation of a 10Gbps link for the Ethiopian NREN, EthERNET, was underway and is expected to be operational in Quarters 2 to 3 in 2024.

West and Central Africa

Contracts were awarded for five-year IRUs for The Gambia, Guinea, Guinea-Bissau, Mauritania and Senegal. An capacity increase for Togo was included, along with an additional link from Lagos to Lome. Plans were also made to create redundancy for the WACREN backbone with a link from Dakar to Marseille and a link from Marseille to London, with a WACREN PoP due to be established in Marseille. Procurement of equipment for the new Marseille PoP was started.

2.3.3 Outreach Activities

- In February, a multistakeholder meeting took place in Brussels, Belgium, convened by GÉANT, NORDUnet, and the Guild to explore the role of NRENs in strengthening collaboration between Nordic and African universities. The event built on the AU-EU Innovation Agenda, adopted in July 2023, which set a vision for a decade-long partnership in science, technology, and innovation to advance public health, green transitions, and technological development. The meeting began with a keynote on 'Bridging Borders: UNESCO's Global Perspective on Research' and featured sessions on critical themes such as 'Policy-Funding-Infrastructure' with contributions from Ariane Labat, Head of Unit at the European Commission Directorate for International Partnerships, and discussions on research infrastructures for the African knowledge society. The agenda also highlighted partnerships under the AfricaConnect project and strategies for supporting R&E institutions through sustainable and resilient NREN ecosystems. The event was attended by multiple representatives of African embassies in Brussels.
- In April, the UbuntuNet Alliance, ZIMREN, and GÉANT held an advocacy session at the 2024 Connected Africa Summit in Nairobi, Kenya. The conference was opened by the president of Kenya and attended by several ministers of ICT and Smart Africa.
- A community hub session titled 'African Innovations' was hosted at TNC24 in Rennes, France, showcasing initiatives by RENU (Uganda) on metro eduroam and solar-powered internet routers, the UbuntuNet Alliance on Utafiti Africa and Research4Life, and WACREN on Trust Broker Africa and eduID.Africa.

2.3.4 Thematic Support

- In January, and with the support of the GÉANT project and AfricaConnect3, the UbuntuNet Alliance organised an NREN Federation Operators (FedOps) training event hosted by EthERNET in Addis Ababa, Ethiopia. The training was facilitated by experts from GÉANT, AMRES, GARR, and RENATER.
- Collaboration with GN5-1 WP6 focused on the following Trust and Identity work relating to Africa:
 - Planning for eduGAIN Federation Operator (FedOps) Training for the UbuntuNet Alliance planned for early 2024 in Addis Ababa, Ethiopia, for which 27 participants are registered from Malawi, Ethiopia, Mozambique, Uganda, Zimbabwe, DRC, Rwanda, Burundi, Madagascar, Tanzania, Kenya, Zambia, and Botswana.

The following support was offered around eduGAIN membership:

- Progress in Africa, supported by GN5-1 WP6 and AfricaConnect3, was tracked; some existing federations in Eastern and Southern Africa underwent a process of re-applying to eduGAIN including Malawi, Tanzania and Mozambique.
- In addition, new candidate status began for Burkina Faso, Ghana and Togo, and dialogue started with Benin and iFARE (the Arab states' identity federation).
- Finally, EFIS (the Ethiopian identity federation) joined eduGAIN in 2024.

2.4 Support for North Africa and Western Asia

Support for North Africa and Western Asia has historically been provided via the EUMEDCONNECT projects as well as AfricaConnect2 and AfricaConnect3; via ASREN as GÉANT's principal counterpart since its establishment in 2011; and via regular engagement also with individual NRENs in the region. In this context, the following events occurred during the reporting period:

- Following the resolution of structural and staffing challenges for ASREN in 2023, ASREN made changes to its governance structure, ensuring that NRENs in the ASREN region all play a role.
- Efforts focused subsequently on preparations for and the start of EUMEDplus and the ongoing implementation of the project to deliver R&E connectivity on the forthcoming Medusa submarine cable system, which was integrated as a work task of EUMEDplus.

Sections 2.4.1 and 2.4.2 describe the work relating to EUMEDplus and the Medusa project, respectively.

2.4.1 EUMEDplus

Preparations were made for a new Neighbourhood South project to support ASREN and NRENs in the North Africa and Eastern Mediterranean (EUMEDplus). The EUMEDplus grant agreement was finalised in August 2024 and started on 1 September 2024. The project receives €12 million in EU NDICI (Neighbourhood, Development and International Cooperation instrument) funding via DG NEAR, with an additional €1.3 million to be provided in co-funding by the project beneficiaries.

EUMEDplus is coordinated by GÉANT. The other contributing partners are ASREN, the American University of Beirut – AUB (Lebanon), CNRST (Morocco), CYNET (Cyprus), SESAME (Jordan) and NORDUnet (Nordic Countries). The beneficiaries of the project are ASREN, TechCARE/AUB (Lebanon), CCK (Tunisia), CERIST (Algeria), CNRST (Morocco), ENSTINET (Egypt), PaINREN (Palestine) and SESAME (Jordan).

The project will focus on four principal areas:

- Capacity development.
- Connectivity infrastructure, including Medusa.
- Digital data infrastructure and services.
- Outreach, advocacy and dissemination.

2.4.2 Medusa

Following the signing in 2023 by GÉANT, the European Investment Bank (EIB) [[EIB](#)] and the Medusa submarine cable promoter [[Medusa](#)] of agreements for long-term EU-funded connectivity provision between Europe and North Africa on the Medusa submarine cable system, regular engagement took place via online steering committee meetings, as well as an in-person meeting at the Barcelona Cable Landing Station [[BCNLanding](#)] in September 2024.

Bi-monthly steering Medusa committee meetings have continued to take place. Medusa remains on track for completion of the first connections to go live in Quarter 4 of 2025.

In addition, discussions were held with the EC (DG NEAR), the EIB and ASREN for a potential extension of Medusa connectivity to Jordan via Egypt to support SESAME and the wider Jordanian R&E community. A final decision is expected in Quarter 1 of 2025.

2.5 TEIN*CC Consultancy Contract

The EU-funded Asi@Connect project [[AsiaConnect](#)] for the Asia-Pacific region is coordinated by the TEIN* Cooperation Centre (TEIN*CC) [[TEINCC](#)].

During the first quarter of 2024, GÉANT maintained a consultancy contract with TEIN*CC to provide support and advice relating to project management and the implementation of Asi@Connect, an extension of which was signed during the APAN57 conference.

Engagement continued during 2024 via regular online calls and face to face meetings in Bangkok and at the APAN57 conference (January), with the following key takeaways:

- The sub-contract between TEIN*CC and GÉANT to assist with developing an EU funding proposal for Phase 2 was completed.
- The aforementioned three-month extension of the consultancy contract to May 2024. The extension aimed to have GÉANT support the development of principles for overhauling the cost-sharing model among project partners for future phases.
- Various scenarios were created, and several meetings were held with partners during this period.

GÉANT, whilst no longer maintaining a contractual relationship with TEIN*CC, has continued its global engagement through explorative discussions with the EUD in Manila and Jakarta regarding Copernicus support. The organization also participated as a member of the Reference Group in the final evaluation of Asi@Connect and attended Asi@Connect governance meetings as an observer. Additionally, GÉANT is serving as an information point for the EUD in Bangkok and DG INTPA on the development of a second project phase.

In this context, bilateral discussions with selected partners, including SingAREN, CERNET, REANNZ, and TEIN*CC, are currently underway. These discussions aim to explore the content scope of a successor project and assess the potential for GÉANT's contribution therein.

2.6 ESnet Service Contract

In the first half of 2024, ESnet deployed two 400Gbps paths on the Amitié submarine cable system from the USA to Slough, UK, and Bordeaux, France, respectively. Under the ESnet service grant, GÉANT delivered the backhaul from the Amitié endpoints to the ESnet PoPs in London Harbour Exchange and Geneva.

In addition, GÉANT started implementation work to upgrade the ESnet European connecting the ESnet PoPs in Amsterdam, Geneva and London to 2x400Gbps. An agreement was also made for an upgrade in 2025 to 3x400Gbps to include a drop in Paris where ESnet is also planning to deploy a new PoP.

2.7 Internet2 Service Contract

Like ESnet, Internet2 has acquired capacity on the new Amitié cable system, bringing a 400Gbps link to Bordeaux. In the first half of 2024 GÉANT deployed a 400Gbps backhaul link from Bordeaux to the GÉANT PoP in Paris, where it connects to GÉANT Open and the GÉANT IP backbone.

3 Global Service Status Update

This section provides a summary of the status of services at the end of November 2024 relating to interconnectivity and other service deployments by International RENS (regional and national) in other world regions. The service areas covered include Trust and Identity, Security, and Collaboration Tools. In addition, the report sets out participation levels in GÉANT Community Programme Task Forces and Special Interest Groups. These areas are covered in Sections 3.1 to 3.6, below.

Overall, since the end of 2023, GÉANT’s international connectivity has risen by 1.9Tbps to a total of over 3.9Tbps, Other increases in services uptake have included GÉANT Plus, eduroam, eduGAIN (with new candidates), Trusted Introducer and FileSender.

Services where there has been no net change are TCS and eduVPN. A decrease has been seen in the number of GÉANT Open connectors (one less as ANKABUT (United Arab Emirates) has terminated its link to Europe).

Table 3.1 provides a brief summary of the capacity of links between GÉANT and global partner networks, described in more detail in Table 3.3. A summary of the service status is set out in Table 3.2, with the detail provided from Table 3.4 to Table 3.9.

Region	Total Capacity	Increase since end of 2023
USA & Canada	2.8Tbps	+1.8Tbps
Latin America	200Gbps	No change
North Africa, Western Asia, and Middle East	158Gbps	No change
West and Central Africa	10Gbps	No change
East and Southern Africa	220Gbps	No change
Central Asia	1Gbps	No change
Asia-Pacific	540Gbps	+100Gbps
Russia ¹	40Gbps	No change
Total	3.969Tbps	+1.9Tbps

Table 3.1: GÉANT global connectivity summary at end of 2022

¹ Note: in the context of the Russian invasion of Ukraine, GÉANT fulfils the EC’s commitment to facilitate research in the areas of COVID-19 and ITER fusion that are still permitted with Russia, while respecting the sanctions imposed on Russia.

Service	Uptake outside GÉANT Service Area	Change since end of 2023
GÉANT Plus	Service instances in operation for: <ul style="list-style-type: none"> • Canada and USA • Latin America • East and Southern Africa • West & Central Africa • Asia-Pacific 	<ul style="list-style-type: none"> • One additional GÉANT Plus service in 2024, KAUST (Saudi Arabia)
GÉANT Open	9 connectors outside Europe	Decrease of one
perfSONAR	Measurement Points in 34 countries	
eduroam	<ul style="list-style-type: none"> • Operators in 61 countries • Pilots in 14 countries 	<ul style="list-style-type: none"> • Increase of 4 countries • Decrease of 1 country
eduGAIN	<ul style="list-style-type: none"> • 34 Participants • 10 candidates 	<ul style="list-style-type: none"> • No net change • 7 more candidates
TCS	<ul style="list-style-type: none"> • Provided to 3 countries 	<ul style="list-style-type: none"> • No change
Trusted Introducer	<ul style="list-style-type: none"> • Participation from 25 countries 	<ul style="list-style-type: none"> • Net Increase of 3
eduVPN	<ul style="list-style-type: none"> • Deployed in 10 countries 	<ul style="list-style-type: none"> • No change
Community Activities	<ul style="list-style-type: none"> • 4 of 6 RRENS • 14 NRENS from 12 countries • Participation from an additional 13 non-NREN/RREN R&E networking organisations 	<ul style="list-style-type: none"> • No change • Net decrease of 7 NRENS

Table 3.2: Service uptake summary and change

3.1 Network Services

RENs outside Europe are interconnected with the GÉANT IP service, as shown in Table 3.3 below, listed by region (Asia-Pacific, Central Asia, East and Southern Africa, Latin America, North Africa and Western Asia, and West and Central Africa), the USA and Canada, and Russia.

At the end of 2024, the total number of NRENs reached outside the GÉANT membership is 73 research and education networking organisations, across 64 countries and territories² outside the GÉANT Membership. The figures show a net decrease of one country compared to 2023, when both IDREN (Indonesia) and VINAREN (Vietnam) terminated their connections to the TEIN backbone for financial reasons (although new formulas to return them to a positive situation with restored connectivity are being explored). In addition, the Afghan NREN, AfgREN, and the Myanmar NREN, mmREN, are no longer connected to or participating in the Asi@Connect project in accordance with EU sanctions.

² It is to be noted that whilst most countries have one NREN only, a small number of countries and territories (China, Japan, Korea, Saudi Arabia, Taiwan, and USA) have more than one entity that serves an R&E networking remit.

In the same period, the aggregate GÉANT Global Capacity has increased by 1.9Tbps to 3.9Tbps. The increase is driven by the new transatlantic capacities deployed during 2024, following the addition of five 400Gbps links (through new or upgraded links) (ESnet: 3; Internet2 and CANARIE: 1; NEA³R: 1) and the addition in the same context of a 100Gbps link by the Korean NREN, KREONET. Additionally, a second 100Gbps link has been added to the direct interconnection with SINET (Japan).

Global capacity is expected to grow substantially in 2025, particularly within the transatlantic domain. This expansion will be driven by the completion of procurement initiatives by ESnet and GÉANT, which aim to introduce additional fibre spectrum services between Europe and the United States. These new services, leveraging diverse submarine cable systems, will enhance redundancy, scalability, and overall connectivity between the regions.

Table 3.3 sets out the NRENs connected by region with the corresponding capacities as of the end of 2024.

Region	Regional Network	Interconnection Capacity & Location	Global NRENs Reached via the Regional Network Interconnection	Direct Interconnections with National Networks
Asia-Pacific	TEIN*CC	100Gbps London (CAE-1)	<ul style="list-style-type: none"> • AARNet (Australia) • ASNet-TW (former ASGC) (Taiwan)³ • BdREN (Bangladesh) • CamREN (Cambodia) • CERNET (China) • CSTNET (China) • DIT&T/DrukREN (Bhutan) • ErdemNet (Mongolia) • HARNET (Hong Kong) • KOREN (South Korea) • KREONET (South Korea) • LEARN (Sri Lanka) • LERNet (Lao) • MAFFIN (Japan) • MyREN (Malaysia) • ErdemNet (Mongolia) • NICT (Japan) • SINET/NII (Japan) • NKN (India) • NREN (Nepal) • PERN (Pakistan) 	<p>Additional links to NRENs in the region, are as follows:</p> <ul style="list-style-type: none"> • SINET (Japan) – 200Gbps • CERNET (China) – 10Gbps • CSTNET (China) – 100Gbps • NKN (India) – 2x5Gbps + 10Gbps • ASNet-TW (Taiwan) – 10Gbps • KREONET (South Korea) 100Gbps • TWAREN (Taiwan) – peering in New York via existing GÉANT transatlantic link to New York.

³ ASGC link migrated to ASNet-TW.

Region	Regional Network	Interconnection Capacity & Location	Global NRENs Reached via the Regional Network Interconnection	Direct Interconnections with National Networks
			<ul style="list-style-type: none"> • PREGINET (Philippines) • REANNZ (New Zealand) • SingAREN (Singapore) • ThaiREN (Thailand) 	
Central Asia	CAREN	1Gbps Frankfurt	<ul style="list-style-type: none"> • KRENA (Kyrgyzstan) • TARENA (Tajikistan) 	N/A
East and Southern Africa	UbuntuNet Alliance	10Gbps London 10Gbps Amsterdam	<ul style="list-style-type: none"> • BERNET (Burundi) • BotsREN (Botswana) • Eb@le (DRC) • EthERNet (Ethiopia) • KENET (Kenya) • MAREN (Malawi) • MoRENet (Mozambique) • RwEdNet (Rwanda) • SomaliREN (Somalia) • SANReN/TENET (South Africa) • TERNET (Tanzania) • RENU (Uganda) • ZAMREN (Zambia) • ZIMREN (Zimbabwe) 	SANReN/TENET (South Africa) 2x100Gbps
Latin America	RedCLARA	2x100Gbps Lisbon and Madrid	<ul style="list-style-type: none"> • CEDIA (Ecuador) • CUDI (Mexico) • INNOVA RED (Argentina) 	N/A

Region	Regional Network	Interconnection Capacity & Location	Global NREs Reached via the Regional Network Interconnection	Direct Interconnections with National Networks
			<ul style="list-style-type: none"> • RAGIE (Guatemala) • RAU (Uruguay) • RedCONARE (Costa Rica) • RENATA (Colombia) • REUNA (Chile) • RNP (Brazil) 	
North Africa and Western Asia	ASREN	10Gbps (London)	<ul style="list-style-type: none"> • SESAME (Jordan) • RNU (Tunisia) • AUB (Lebanon) 	<ul style="list-style-type: none"> • ARN (Algeria) – 10Gbps • ENSTINET & EUN (Egypt) – 2x1Gbps • HBKU (Qatar) – 2x10Gbps • KAUST (Saudi Arabia) – 100 Gbps • Maeen (Saudi Arabia) – 2x2.5Gbps • MARWAN (Morocco) – 10Gbps • OMREN (Oman) – 155Mbps • Iran NREN⁴ (Iran) – 1Gbps
USA and Canada	N/A	8x100Gbps 5x400Gbps Diverse paths and endpoints in Europe, Canada and the USA	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • CANARIE (Canada) • ESnet (USA) • Internet2 (USA)

⁴ The Iranian NREN is not a member of ASREN, but does fall within the geographical region of Western Asia. The interconnection is funded entirely by the Iranian NREN.

Region	Regional Network	Interconnection Capacity & Location	Global NRENs Reached via the Regional Network Interconnection	Direct Interconnections with National Networks
West and Central Africa	WACREN	10Gbps London	<ul style="list-style-type: none"> • RBER (Benin) • FasoREN (Burkina Faso) • RITER (Côte d'Ivoire) • GARNET (Ghana) • NgREN (Nigeria) • TogoRER (Togo) 	N/A
Russia	N/A	N/A	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • NIKS (Russia) – connects in Amsterdam at 10Gbps • Kurchatov Institute (KIAE) – connects in Amsterdam at 30Gbps

Table 3.3: GÉANT interconnections with regional and national networks outside Europe

The uptake of related network services available to RENS outside the GÉANT memberships is set out in Table 3.4. The services are GÉANT Plus, Layer 3 VPN, and GÉANT Open. No instances are recorded for either Central Asia or Russia, and, therefore, are not included in the table. In 2024 a new instance of GÉANT Plus was implemented for KAUST (Saudi Arabia).

In addition, as part of GÉANT’s commitment to reducing the digital divide, GÉANT provides IP transit across the GÉANT backbone among Regional Networks (ASREN, CAREN CC, RedCLARA, TEIN*CC, UbuntuNet Alliance, and WACREN), and between Regional Networks and NRENS in Canada (CANARIE) and the USA (ESnet and Internet2) where they are unable to connect directly. GÉANT also offers an emergency back-up route for most GÉANT international interconnects in the event that their other external connectivity suffers an outage, until the outage is rectified.

Furthermore, GÉANT provides a 400Gbps Managed Wavelength Service on three routes in Europe: Amsterdam-Geneva, Geneva-London, and London-Amsterdam.

Service	Canada & USA	North Africa & Western Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
GÉANT Plus	<ul style="list-style-type: none"> • CANARIE • ESnet • Internet2 • NISN 	<ul style="list-style-type: none"> • KAUST (Saudi Arabia) 	<ul style="list-style-type: none"> • RedCLARA 	<ul style="list-style-type: none"> • AARNET (Australia) • CSTNET (China) • KREONET (Korea) • NKN (India) • SingAREN • SINET (Japan) 	<ul style="list-style-type: none"> • UbuntuNet Alliance 	<ul style="list-style-type: none"> • WACREN: London
Layer 3 VPN	LHCONE: <ul style="list-style-type: none"> • CANARIE • ESnet • Internet2 	No instances	LHCONE and Copernicus: <ul style="list-style-type: none"> • RedCLARA 	LHCONE: <ul style="list-style-type: none"> • AARNET (Australia) • ASGC (Taiwan) • CSTNET (China) • KREONET (Korea) • NII/SINET (Japan) • NKN (India) • TEIN*CC 	No instances	No instances
GÉANT Open	<ul style="list-style-type: none"> • ESnet: London • Internet2 & CANARIE (joint connection): Paris • Indiana University (NEA³R project): London 	<ul style="list-style-type: none"> • HBKU (Qatar): London and Paris • Maeen (Saudi Arabia): London 	No connectors	<ul style="list-style-type: none"> • AARNet (Australia): London via CAE-1 • SingAREN: London via CAE-1 	<ul style="list-style-type: none"> • SANReN/TE NET (South Africa): London 	<ul style="list-style-type: none"> • WACREN: London

Table 3.4: Uptake of GÉANT network services by regional networks outside Europe

3.2 Network Support Services

Table 3.5 lists countries by world region, where at least one perfSONAR measurement point (MP) is deployed, together with the number of registered MPs in brackets, based on the registered information available on the perfSONAR Services Directory [[perfSONAR_SD](#)]. Measurement points may be deployed by the local NREN, the RREN, or another entity with network infrastructure in that country. It cannot, therefore, be assumed that the NREN in each of the countries listed has its own perfSONAR measurement point(s).

Overall, perfSONAR is currently deployed in 34 countries and running more than 3,400+ instances globally outside the GÉANT membership.

North Africa, Western Asia and Middle East	Americas	Asia-Pacific	East and Southern Africa	West and Central Africa	Other
<ul style="list-style-type: none"> • Jordan (8) 	<ul style="list-style-type: none"> • Brazil (72) • Canada (161) • Chile (8) • Ecuador (12) • Mexico (14) • Puerto Rico (12) • USA (2058) 	<ul style="list-style-type: none"> • Australia (68) • China (17) • Fiji (4) • Guam (30) • Hong Kong (12) • India (36) • Indonesia (4) • Japan (315) • South Korea (105) • Malaysia (4) • New Zealand (44) • Pakistan (27) • Philippines (24) • Singapore (16) • Taiwan (26) • Thailand (62) 	<ul style="list-style-type: none"> • Kenya (27) • Mozambique (4) • South Africa (84) • Uganda (27) • Zambia (21) 	<ul style="list-style-type: none"> • Côte d'Ivoire (4) • Ghana (11) • Nigeria (8) 	<ul style="list-style-type: none"> • Russia (67) • Belarus (20)

Table 3.5: Countries outside Europe with instances of perfSONAR

3.3 Trust and Identity Services

3.3.1 eduroam

Table 3.6 lists countries with eduroam operators by region. The total number of countries and territories outside the GÉANT membership operating eduroam now equals 61, four more than at the end of 2023, with Somalia, Burkina Faso, Ivory Coast and Andorra being new eduroam operators. The number of eduroam pilot countries decreased by one, due to Somalia migrating from pilot to operator status. Whilst there are some countries with eduroam pilots, further growth in terms of the number of countries with an eduroam operator is expected to be slow.

A complete view of eduroam operators and pilots can be found on the eduroam website [\[eduroam\]](#).

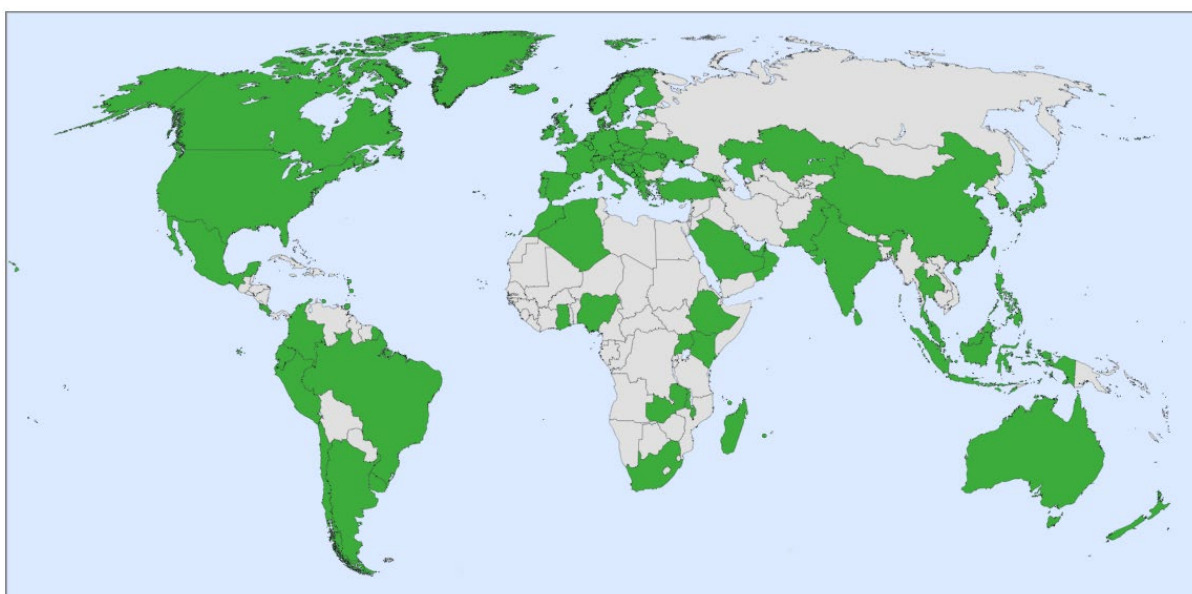


Figure 3.1: Map showing countries with eduroam operators across the globe

Service	North Africa, Western Asia and Middle East	Other	Latin America & Caribbean	Asia-Pacific	East and Southern Africa	West and Central Africa
eduroam (Operators)	<ul style="list-style-type: none"> Algeria Iran Lebanon Morocco Mauritania Oman Qatar Saudi Arabia United Arab Emirates 	<ul style="list-style-type: none"> Canada USA Kazakhstan Kyrgyzstan Tajikistan Andorra 	<ul style="list-style-type: none"> Argentina Brazil Chile Colombia Costa Rica Ecuador Mexico Peru Trinidad & Tobago Uruguay 	<ul style="list-style-type: none"> Australia Bangladesh China Hong Kong India Indonesia Japan South Korea Laos Macau Malaysia Nepal New Zealand Pakistan Philippines Singapore Sri Lanka Taiwan Thailand 	<ul style="list-style-type: none"> Ethiopia Kenya Madagascar Malawi Mozambique Somalia South Africa Tanzania Uganda Zambia 	<ul style="list-style-type: none"> Benin Burkina Faso Ghana Ivory Coast Nigeria Senegal Togo
eduroam (Pilots)	<ul style="list-style-type: none"> Egypt Jordan Kuwait Tunisia 		<ul style="list-style-type: none"> Barbados El Salvador Jamaica Nicaragua Venezuela 	<ul style="list-style-type: none"> Bhutan Vietnam 	<ul style="list-style-type: none"> Sudan Zimbabwe 	<ul style="list-style-type: none"> Mali

Table 3.6: Countries outside the GÉANT Membership with eduroam operators

3.3.2 eduGAIN

Table 3.7 lists countries that are eduGAIN participants. Furthermore, catch-all federations have been established by RedCLARA for Latin America (FIEL) and for Africa (eduID.africa) by the Regional Networks of Africa (ASREN, UbuntuNet Alliance, and WACREN).

The number of countries outside the GÉANT membership that have eduGAIN participant identity federations remains unchanged at 34 members. In 2024, Belarus and Ethiopia gained participant status, while the Argentina and Mozambique Identity Federations had their participant status removed, leaving the same number of identity federations in eduGAIN as at the end of 2023. However, the Mozambique Identity Federation is being rebuilt and now officially listed as a candidate.

The number of eduGAIN candidate countries has increased by seven, comprising Lebanon, Costa Rica, Indonesia, Tanzania, Togo, Burkina Faso and Ghana. Expectations for eduGAIN growth in 2025 include these seven countries incrementally gaining member status.

The full list of eduGAIN participants and candidates can be found on the eduGAIN website [[eduGAIN](#)].

Service	North Africa, Western Asia and Middle East	Other	Latin America & Caribbean	Asia-Pacific	East and Southern Africa	West and Central Africa
eduGAIN (Participants)	<ul style="list-style-type: none"> Algeria Iran Morocco Oman Saudi Arabia 	<ul style="list-style-type: none"> Canada USA Kyrgyzstan Belarus 	<ul style="list-style-type: none"> Brazil Chile Colombia Ecuador Mexico 	<ul style="list-style-type: none"> Australia Bangladesh China Hong Kong India Japan South Korea Malaysia New Zealand Pakistan Singapore Sri Lanka Thailand 	<ul style="list-style-type: none"> Ethiopia Kenya Somalia South Africa Uganda Zambia 	<ul style="list-style-type: none"> Nigeria
eduGAIN (Candidates)	<ul style="list-style-type: none"> Lebanon 	<ul style="list-style-type: none"> Tajikistan 	<ul style="list-style-type: none"> Costa Rica 	<ul style="list-style-type: none"> Indonesia 	<ul style="list-style-type: none"> Malawi Tanzania Mozambique 	<ul style="list-style-type: none"> Togo Burkina Faso Ghana

Table 3.7: Uptake of eduGAIN outside Europe by region

3.4 Security Services

Three security elements are considered in terms of uptake by R&E networks outside the GÉANT membership. These are the Trusted Certificate Service (TCS), Trusted Introducer, and eduVPN. The distribution of uptake of each of these is shown by region in Table 3.8.

TCS is principally available to GÉANT membership NRENS, but has historically been made available to Morocco, Lebanon, and Oman. This remains the case. It is not envisaged that TCS will be made available to additional R&E networks outside the GÉANT membership.

The number of countries listed under Trusted Introducer (see Table 3.8) has experienced a net increase, with four new members either listed or achieving accredited status: Bahrain, Botswana, the United States, and Uganda. Meanwhile, China currently holds 'Accreditation Candidate' status, following a temporary delisting. The information provided on Trusted Introducer participation is drawn from the Trusted Introducer website [[Trusted](#)].

The number of R&E networks outside Europe registered as eduVPN participants has remained the same in 2024 compared to the previous year. The full list of eduVPN deployments is available on the eduVPN website [[eduVPNdeploy](#)].

Service	North Africa, Western Asia and Middle East	Central Asia	Latin America, Caribbean, & USA	Asia-Pacific	East and Southern Africa	West and Central Africa
TCS	<ul style="list-style-type: none"> • Morocco • Lebanon • Oman 	N/A	N/A	N/A	N/A	N/A
Trusted Introducer ⁵	<ul style="list-style-type: none"> • Jordan • Morocco • Saudi Arabia • United Arab Emirates • Bahrain 	<ul style="list-style-type: none"> • Kazakhstan • Uzbekistan 	<ul style="list-style-type: none"> • Brazil • Curaçao • Ecuador • USA 	<ul style="list-style-type: none"> • Bangladesh • China⁶ • Hong Kong • India • Korea • Japan • Singapore • Sri Lanka • Thailand 	<ul style="list-style-type: none"> • Botswana • Mauritius • Mozambique • South Africa • Uganda 	<ul style="list-style-type: none"> • Togo
eduVPN	<ul style="list-style-type: none"> • Morocco 	–	<ul style="list-style-type: none"> • Mexico • Chile 	<ul style="list-style-type: none"> • Malaysia • Pakistan • Sri Lanka 	<ul style="list-style-type: none"> • Ethiopia • Kenya • South Africa • Uganda 	–

Table 3.8: Uptake of security services by regional networks outside Europe

⁵ The countries listed have at least one CSIRT either listed or accredited by Trusted Introducer.

⁶ China is listed; however, its current status is 'Accreditation Candidate'.

3.5 Collaboration Tools

3.5.1 eduMEET

In response to the COVID-19 pandemic, GÉANT created eduMEET, a lightweight web-based videoconferencing tool, available for local deployment to advance NRENs' support for research and education activities. Under the GN5-1 project, a new version (eduMEET v4) was released, with improvements including simplifying the code, refreshing the look and feel, and adding functionality (breakout rooms, transcription engines, background blur, dynamic and user-controlled layout, and improved performance) [[eduMEET](#)]. Given the nature of its deployment, data on the total number of installs is not available.

3.5.2 FileSender

FileSender is managed by a collaboration and GÉANT does not have direct access to deployment information. The deployments listed in Table 3.9 are, therefore, based on desktop research from information available online [[FileSender](#)].

The number of deployments of FileSender by R&E networks outside Europe increased from 16 at the end of 2023 to 21 at end of the reporting period, with the additions of Morocco, Russia, Mexico, Bangladesh and Ethiopia.

Service	North Africa, Western Asia and Middle East	Other	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
FileSender	<ul style="list-style-type: none"> MARWAN (Morocco) IRAnet (Iran) OMREN (Oman)⁷ 	<ul style="list-style-type: none"> NIKS (Russia) 	<ul style="list-style-type: none"> RedCLARA RNP (Brazil) REUNA (Chile) CEDIA (Ecuador) CUDI (Mexico) 	<ul style="list-style-type: none"> AARNet (Australia) BdREN (Bangladesh) NII/SINET (Japan) KREONET (Korea) MYREN (Malaysia) SingAREN (Singapore) 	<ul style="list-style-type: none"> UbuntuNet Alliance EthERNET (Ethiopia) RENU (Uganda) KENET (Kenya) SANReN (South Africa) SomaliREN (Somalia) 	–

Table 3.9: Uptake of FileSender by regional networks outside Europe

⁷ OMREN's FileSender instance is not listed on the FileSender deployment list [\[List\]](#), but OMREN's file-sharing tool Mirsal [\[Mirsal\]](#) is confirmed on the OMREN website as an instance of FileSender.

3.6 Community Activities

Between January and November 2024 a total of 30 organisations, comprising RENs, R&E institutions, and other organisations (e.g., commercial, government), outside the GÉANT membership registered for one or more GCP Task Force (TF) and/or Special Interest Group (SIG) meetings [\[Community\]](#). The distribution by geographic region is set out in Table 3.10, below.

Region	Organisation
USA and Canada	ESnet (USA), Fermilab – FNAL (USA), Indiana University (USA), Northwestern University (USA), Internet2 (USA), University of Texas (USA), ORION (Canada), University of Maryland Baltimore County (USA)
Latin America	CEDIA (Ecuador), REUNA (Chile), RedCLARA, RNP (Brazil), SEDENA (Mexico)
Central Asia	Euphoria (Kyrgyzstan), TARENA (Tajikistan)
North Africa and Western Asia	ASREN
West and Central Africa	WACREN, MALIREN (Mali)
Asia-Pacific	AARNet (Australia), A*STAR NSCC (Singapore), KISTI/KREONET (South Korea), LEARN (Sri Lanka), PERN (Pakistan), Peking University (China), Tsinghua University (China), University of Karachi (Pakistan)
East and Southern Africa	Malawi Liverpool Wellcome Research Programme (Malawi), CSIR/SANReN (South Africa), RENU (Uganda), UbuntuNet Alliance

Table 3.10: Organisations outside the GÉANT Membership registered for GCP TFs & SIGs in 2024

By organisation type, four are RRENs, 13 are NRENS, one is a State Research and Education Network (ORION, Canada), and two are US institutions that support international R&E networking activities (Indiana University, and Northwestern University). The remaining organisations are universities, research institutions, commercial entities, or government bodies.

The participation of NRENS has decreased from 21 to 13 compared to the previous year. However, this decline has been offset by increased engagement across several other Special Interest Groups (SIGs), including some that are newly established and already gaining traction within the international community (i.e., SIG-AI). In some regions participation has remained consistent (e.g., Canada, the USA, Latin America, East and Southern Africa and Central Asia), but others have seen lower participation than previously (North Africa and Western Asia in particular, as well as Asia-Pacific).

Whilst TFs and SIGs continue to offer remote participation, there has been a growing trend towards in-person attendance at SIG/TF meetings in the past year, and this is expected to continue in the upcoming year. The shift towards face-to-face participation aims to enhance direct collaboration among participants as we move further from the pandemic. This shift may, however, have affected participation levels from regions outside Europe.

It is also to be noted that meetings held in-person at TNC (e.g., TF-EDU and SIG-Marcomms) see much higher participation than those held virtually or hybrid at other times of the year.

Table 3.11, below, lists registrations per SIG and TF by region.

Activity (focus of interest)	Canada & USA	North Africa, Western Asia and Middle East	Central Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
SIG-AI					<ul style="list-style-type: none"> • LEARN (Sri Lanka) 		
SIG-CISS				<ul style="list-style-type: none"> • REUNA (Chile) 		<ul style="list-style-type: none"> • SANReN (South Africa) 	
SIG-ISM						<ul style="list-style-type: none"> • SANReN (South Africa) 	
SIG-Marcomms		<ul style="list-style-type: none"> • ASREN 		<ul style="list-style-type: none"> • RedCLARA • RNP (Brazil) 	<ul style="list-style-type: none"> • AARNet (Australia) • PERN (Pakistan) • University of Karachi (Pakistan) 	<ul style="list-style-type: none"> • UbuntuNet Alliance • RENU (Uganda) • SANReN (South Africa) • Malawi Liverpool Wellcome Research Programme (Malawi) 	<ul style="list-style-type: none"> • WACREN
SIG-MSP				<ul style="list-style-type: none"> • RedCLARA • REUNA (Chile) • RNP (Brazil) 	<ul style="list-style-type: none"> • LEARN (Sri Lanka) 	<ul style="list-style-type: none"> • CSIR / SANReN (South Africa) 	

Activity (focus of interest)	Canada & USA	North Africa, Western Asia and Middle East	Central Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
SIG-RED				<ul style="list-style-type: none"> • RedCLARA • RNP 	<ul style="list-style-type: none"> • Peking University (China) • Tsinghua University (China) 		
SIG-Sustainability				<ul style="list-style-type: none"> • CEDIA (Ecuador) 			
SIG-NGN	<ul style="list-style-type: none"> • ESnet (USA) • Fermilab – FNAL (USA) • Indiana University (USA) • Northwestern University (USA) • Internet2 (USA) • University of Texas (USA) • ORION (Canada) 			<ul style="list-style-type: none"> • SEDENA (Mexico) • RNP (Brazil) 	<ul style="list-style-type: none"> • A*STAR NSCC (Singapore) • KISTI/KREONET (South Korea) 	<ul style="list-style-type: none"> • SANReN (South Africa) 	
SIG-NOC	<ul style="list-style-type: none"> • Internet2 (USA) 		<ul style="list-style-type: none"> • Euphoria (Kyrgyzstan) 			<ul style="list-style-type: none"> • CSIR/ SANReN (South Africa) 	
SIG-Procurement	<ul style="list-style-type: none"> • Internet2 (USA) 			<ul style="list-style-type: none"> • RNP (Brazil) 	<ul style="list-style-type: none"> • LEARN (Sri Lanka) 	<ul style="list-style-type: none"> • UbuntuNet Alliance • SANReN (South Africa) 	<ul style="list-style-type: none"> • WACREN

Activity (focus of interest)	Canada & USA	North Africa, Western Asia and Middle East	Central Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
TF-EDU	<ul style="list-style-type: none"> University of Maryland Baltimore County (USA) 		<ul style="list-style-type: none"> TARENA (Tajikistan) 	<ul style="list-style-type: none"> CEDIA (Ecuador) 			<ul style="list-style-type: none"> MALIREN (Mali)

Table 3.11: Participation of organisations outside Europe in GÉANT Community Programme SIGs and TFs in 2024 (current as of November 2024)

4 Conclusions

Engagement and liaison with REN organisations outside the GÉANT membership are facilitated not only through the *International* subtask of GN5-1 WP3 Task 1 but also via the GN5-1 IC1 project; the EU-funded AfricaConnect3 regional development project, and its successor, AfricaConnect4, expected to begin in early 2025; the EUMEDplus project; an existing consultancy contract with TEIN*CC until May 2024 which will continue with the ongoing support and guidance for the Asi@Connect project; as well as service contracts for ESnet and Internet2.

The work undertaken across these projects extends through a broad spectrum of activities, including general relationship management, engagement, participation in international R&E networking events, international traffic analysis, connectivity planning and implementation, service delivery and collaboration, development support and project management. Combined, these activities constitute efforts that align with GÉANT's objective, as set out in the GÉANT Strategy, to be '*acknowledged worldwide as a leader for developing and supporting R&E networking communities, and global REN development*' [[Strategy](#)].

It is important that all of these activities are in alignment, and whilst many do not fall under the remit of GN5-1 WP3 Task 1, the Task is in a place to monitor and report on international engagement across these activities to ensure consistency, avoid duplicated efforts, and identify synergies wherever feasible.

The Task also facilitates service collaboration between the GÉANT Community and its peers in other regions worldwide. Monitoring efforts by the Task to track service deployments (e.g., eduroam, eduGAIN, perfSONAR, eduVPN, etc.) outside Europe reveal year-to-year fluctuations, with some services experiencing growth while others showing slight decreases or no change. For example, global connectivity has shown consistent year-on-year growth, a trend expected to continue through 2025 and beyond. Additionally, services like eduroam and eduGAIN have expanded their reach, with an increase in the number of operators outside Europe, while other services have seen minimal growth or have remained stable. To further enhance the global reach of these services and strengthen support for international R&E collaboration, it is essential for the Task to work closely with GN5 service leads and international RENs to identify growth opportunities and strategies to achieve those.

Given the value provided by the GCP Task Forces and Special Interest Groups, it is recommended that the Task continues collaborating closely with the GCP team to identify barriers to international participation in these activities. This effort is especially important now that in-person events have become more common compared to previous years. Additionally, the Task will continue exploring solutions to facilitate broader participation among the international R&E networking community where interest exists.

Appendix A Regional and National RENs

Regional R&E Networks and National R&E Networks are listed in the sections below.

A.1 North Africa and Western Asia

Regional Network: ASREN (Arab States Research and Education Network) – <https://www.asren.net/>

NRENs in the North African and Western Asian region:

Country	NREN	Website
Algeria	ARN	http://www.arn.dz/
Egypt	EUN	https://scu.eg/pages/eun
	ENSTINET	http://www.sti.sci.eg/
Iran ⁸	IRANET	http://www.iranet.ir/
Jordan	JUNet	http://www.junet.edu.jo/
Lebanon	TechCARE NREN	https://www.aub.edu.lb/ / https://www.aub.edu.lb/articles/Pages/techcare-nren.aspx
Morocco	MARWAN	http://www.marwan.ma/
Oman	OMREN	https://omren.om/
Palestine	PaINREN	–
Qatar	HBKU	https://www.hbku.edu.qa/en
Saudi Arabia	Maeen	https://www.maeen.sa/en/
	KAUST	https://www.kaust.edu.sa/en
Tunisia	RNU	http://www.cck.rnu.tn/
United Arab Emirates	ANKABUT	http://www.ankabut.ae/

Table A.1: North Africa and Western Asian NRENs

⁸ IRANET is not a member of ASREN.

A.2 Central Asia

Regional Network: CAREN CC – <https://icaren.org/>

Country	NREN	Website
Kazakhstan	KazRENA	http://kazrena.kz/
Kyrgyzstan	KRENA	https://krena.kg/
Tajikistan	TARENA	https://tarena.tj/
Turkmenistan	TuRENA	http://science.gov.tm/
Uzbekistan	UzSciNet	https://www.uzsci.net/

Table A.2: Central Asian NRENS

A.3 Latin America

Regional Network: RedCLARA – <https://www.redclara.net/>

Country	NREN	Website
Argentina	INNOVA RED	https://innova-red.net/
Brazil	RNP	http://www.rnp.br/
Chile	REUNA	http://www.reuna.cl/
Colombia	RENATA	http://www.renata.edu.co/
Costa Rica	RedCONARE	http://www.conare.ac.cr/
Ecuador	CEDIA	http://www.cedia.org.ec/
Guatemala	RAGIE	http://www.ragie.org.gt/
Honduras	RedNESAH	https://rednesah.edu.hn/
Mexico	CUDI	http://www.cudi.edu.mx/
Nicaragua	RedRUNBA	=
Uruguay	RAU	http://www.rau.edu.uy/

Table A.3: Latin America – countries and NRENS

A.4 Asia-Pacific

Regional R&E Network: TEIN*CC – <http://www.tein.asia/>

Country	NREN	Website
Afghanistan	AfgREN	–
Australia	AARNet	https://www.aarnet.edu.au/
Bangladesh	BdREN	http://www.bdren.net.bd/
Bhutan	DIT&T	–
Cambodia	ITC	https://itc.edu.kh/about-institute-of-technology-of-cambodia/
China	CERNET	http://www.edu.cn/english
	CSTNET	https://www.cstcloud.net/cstnet.htm
Hong Kong	HARNET	http://www.harnet.hk/
India	NKN	http://nkn.in/
Indonesia	INHERENT/ITB	https://idren.id/
Japan	NII/SINET	http://www.nii.ac.jp/en/
	NICT	http://www.nict.go.jp/en/about/
	MAFFIN	http://www.maffin.ad.jp/
Korea	KOREN	https://www.koren.kr/eng/index.asp
	KREONET	https://www.kreonet.net/eng/
Laos PDR	LERNET	http://www.nuol.edu.la/index.php/en/
Malaysia	MYREN	http://www.myren.net.my/
Mongolia	ErdemNet	https://itc.edu.mn/#/network
Myanmar	mmREN	https://www.ucsy.edu.mm/home.do
Nepal	NREN	http://www.nren.net.np/
New Zealand	REANNZ	https://reannz.co.nz/
Pakistan	PERN	http://www.pern.edu.pk/
Philippines	PREGINET	https://asti.dost.gov.ph/projects/preginet/
Singapore	SingAREN	http://www.singaren.net.sg/
Sri Lanka	LEARN	https://www.ac.lk/
Taiwan	TWAREN	http://www.twaren.net/english/
	ASNet	https://www.asnet.tw/
Thailand	ThaiREN	http://www.thairen.net.th/ThaiREN/
Vietnam	VINAREN	http://www.vista.vn

Table A.4: Asia-Pacific – countries and NRENs

A.5 East and Southern Africa

Regional R&E Network: UbuntuNet Alliance – <https://ubuntunet.net/>

Country	NREN	Website
Botswana	BotsREN	–
Burundi	BERNET	–
Democratic Republic of the Congo	Eb@le	https://ubuntunet.net/category/members/eble/
Ethiopia	EthERNET	https://ethernet.edu.et/
Kenya	KENET	https://kenet.or.ke/
Madagascar	iRENALA	http://www.irenala.edu.mg/
Malawi	MAREN	http://www.maren.ac.mw/
Mozambique	MoRENnet	https://morenet.ac.mz/about-us/
Rwanda	RwEdNet	https://ubuntunet.net/category/members/rwednet/
Somalia	SomaliREN	http://somaliren.org/
South Africa	SANReN	http://www.sanren.ac.za/
	TENET	http://www.tenet.ac.za/
Sudan	SudanREN	–
Tanzania	TERNET	https://www.ternet.or.tz/
Uganda	RENU	https://www.renu.ac.ug/
Zambia	ZAMREN	http://www.zamren.zm/
Zimbabwe	ZIMREN	http://www.zimren.ac.zw/

Table A.5: East and Southern Africa – countries and NRENs

A.6 West and Central Africa

Regional R&E Network: WACREN – <https://wacren.net/en/>

Country	NREN	Website
Benin	RerBenin	–
Burkina Faso	FasoREN	–
Cameroon	RIC	–
Chad	TchadREN	–
Côte d’Ivoire	RITER	–
Gabon	GabonREN	–
Ghana	GARNET	http://garnet.edu.gh/
Guinea	Gn-REN	–
Guinea Bissau	RNEP-GW	–
Liberia	LRREN	–
Mali	MaliREN	–
Niger	NigerREN	–
Nigeria	NgREN	http://www.ngren.edu.ng/
Senegal	snRER	–
Togo	TogoRER	https://www.togorer.tg/

Table A.6: West and Central African NRENS

A.7 Canada and USA

National R&E networking in Canada and the USA is provided by the NRENS:

Country	NREN	Website
Canada	CANARIE	https://canarie.ca/
USA	ESnet (Energy Sciences Network)	https://www.es.net/
	Internet2	https://internet2.edu/

Table A.7: NRENS in Canada and the USA

References

[AARNet]	https://www.aarnet.edu.au/
[AC3]	https://africaconnect3.net/
[APAN56]	https://apan56.apan.net/
[APAN]	https://apan.net/
[ARENA]	https://www.arena-pac.net/
[AsiaConnect]	https://tein.asia/sub/?mc=1010
[ASNETAM]	https://asnet.am/
[ASREN]	https://asrenorg.net/
[BCNLanding]	https://barcelonacls.com/
[BELLAI]	https://bella-programme.eu/index.php/en/about-bella/bella-ii
[CaseForNRENs]	https://caseforrens.org/
[CARENCC]	https://icaren.org/
[CERNET]	http://www.edu.cn/english
[Community]	https://community.geant.org/community-programme-portfolio/thematic-areas/
[Conf1]	http://www.ist-africa.org/Conference2023/
[Conf2]	https://www.afrilabs.com/event/afrilabs-annual-gathering-2023/
[CSTNET]	https://www.cstnet.cn/
[D1.21]	https://resources.geant.org/wp-content/uploads/2023/01/D1-21-Global-Service-Status-and-Deployment-Update.pdf
[eduGAIN]	https://technical.edugain.org/status
[eduMEET]	https://edumeet.org/
[eduroam]	https://eduroam.org/where/
[eduVPN]	https://www.eduvpn.org/
[eduVPNdeploy]	https://www.eduvpn.org/countries/
[eduVPNdown]	https://www.eduvpn.org/client-apps/
[EIB]	https://www.eib.org/en/index
[ESnet]	https://www.es.net/
[EUMEDCONNECT3]	https://eumedconnect3.net/
[Event1]	https://apan57.apan.net/
[Event2]	https://internet2.edu/2024-internet2-community-exchange/
[Event3]	https://wacren2024.wacren.net/
[Event4]	https://apan58.apan.net/
[Event5]	https://www.canarie.ca/event/canarie-summit-2024/
[Event6]	https://ubuntunet.net/uc2024/
[Event7]	https://tical2024.redclara.net/en/
[Event8]	https://eage24.asren.net/
[FileSender]	https://filesender.org/
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Glossary

AER	Asia-Europe Ring
APAN	Asia vPacific Advanced Network
APIDT	Asia Pacific Internet Development Trust
APNIC	Asia Pacific Network Information Centre
ASREN	Arab States Research and Education Network
BEAA	Bridging Europe, Africa and the Americas
CAREN CC	Central Asia Research and Education Network Coordination Centre
CSIRT	Computer Security Incident Response Team
EC	European Community
EIB	European Investment Bank
ENP	Emerging NREN Programme
EU	European Union
GCP	GÉANT Community Programme
GNA-G	Global Network Advancement Group
GWS	GÉANT World Service
IP	Internet Protocol
IRU	Indefeasible Right of Use
LHC	Large Hadron Collider
LHCONE	Large Hadron Collider Open Network Environment
MMCFTP	Massively Multi-Connections File Transfer Protocol
MoU	Memorandum of Understanding
MP	Measurement Point
NIAC	Network Infrastructure Advisory Board
NII	National Institute of Informatics
NREN	National Research and Education Network
PoP	Point of Presence
R&E	Research and Education
RARE	Router for Academia Research and Education
RedCLARA	Cooperación Latino Americana de Redes Avanzadas (Latin American Cooperation of Advanced Networks)
REN	R&E Network
RREN	Regional R&E Network
SDG	Sustainable Development Goal
SESAME	Synchrotron-Light for Experimental Science and Applications in the Middle East
SIG	Special Interest Group
SIG-ISM	SIG on Information Security Management
SIG-Marcomms	SIG on Marketing Communications
SIG-MSP	SIG on Management of Service Portfolios
SIG-NOC	SIG on Network Operations Centres
T	Task
T&I	Trust and Identity
TCS	Trusted Certificate Service
TEIN*CC	Trans-Eurasia Information Network Cooperation Center
TF	Task Force

TF-CSIRT	TF on Computer Security Incident Response Teams
TF-EDU	TF on Educational Services and Activities
TF-eHealth	TF on eHealth
ToR	Terms of Reference
UN	United Nations
VPN	Virtual Private Network
WACREN	West and Central African Research and Education Network
WP	Work Package