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Abstract

This report provides an overview of global engagement activities carried out 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 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 projects and work areas that contribute to international engagement include GN5-IC1, AfricaConnect3, the Medusa project, a collaboration for the Eastern Mediterranean, a consultancy contract for TEIN*CC and the Asi@Connect project, and service contracts for ESnet and Internet2.

To provide insight into all International Engagement work, this document describes the principle work areas in 2023 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 supports service collaboration between the GÉANT community and its peers in other world regions. This report outlines changes in the status of services in other world regions, covering 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 are covered.

Overall, since the end of 2022, GÉANT's international connectivity has risen by 180 Gbps to a total of just over 2Tbps, though the number of countries connected globally has decreased by two following the disconnection of IDREN (Indonesia) and VINAREN (Vietnam). Other increases in uptake have included GÉANT Plus and perfSONAR. Services where there has been no net change are GÉANT Open, eduGAIN, TCS Trusted Introducer, and FileSender, while decreases have been seen in the number of countries with an eduroam operator (down by three) and eduVPN (a net decrease of one).

To advance the reach of services, as appropriate, and thereby improve support for global R&E collaboration, it is important that Task 1 liaises closely with GN5 service leads and with international RENs to identify areas for potential growth. Furthermore, given the value offered by the GÉANT Community Programme (GCP) Task Forces and Special Interest Groups, it is advisable that Task 1 works closely with the GCP team to identify the barriers for international participation in these activities, as wells as possible solutions to enable greater participation where there is interest in the international R&E networking community.

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 65 countries outside the GÉANT membership, either via direct interconnections, or indirectly via interconnections with regional networks (RedCLARA, TEIN*CC, UbuntuNet Alliance, WACREN) who connect the national networks directly.

To enable effective cooperation between GÉANT and 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, the Medusa project, a collaboration for the Eastern Mediterranean, a consultancy contract for TEIN*CC and the Asi@Connect project, and service contracts for ESnet and Internet2.

The report describes all activities in 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 are not in 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*CC, 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 2023. 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. A summary of R&E connectivity to regional and national R&E networks outside the GÉANT membership, and the status of GÉANT-related services by those R&E networks at the end of 2022 can also be found online [D1.21].

- Section 3 provides an update of the status of global connectivity and service deployments by international Research and Education Networks (RENs) (regional and national) in other world regions at the end of 2023, compared. 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, Medusa) and other activities (e.g., collaboration agreement for Eastern Mediterranean NRENs, a consultancy contract for TEIN*CC, and service contracts for North American NRENs.)

The majority of global engagement activities occur with Regional and National R&E Networks, 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) that GÉANT is also involved in or has an interest in.
- 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. An overview of the work areas and responsibilities relating to global engagement of each is set out in the bullets below. Specific activities carried out in 2023 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 national or regional International R&E networks, 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.

- 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

  The AfricaConnect3 project consists of four EU grant agreements for the delivery of project activities, which are held by GÉANT, ASREN[1], the UbuntuNet Alliance, and WACREN, as follows:

  ○ GÉANT Grant Agreement:
  — Overall coordination, including reporting to the EC, of the programme of the AfricaConnect3 project.
  — Support AfricaConnect3 Regional Partners (ASREN, UbuntuNet Alliance, WACREN) in connectivity planning and procurement of connectivity as agreed with the EC and the Regional Partners.
  — Coordination of outreach activities (communications, and advocacy).
  — Thematic support, e.g., support of training activities, based on Regional Partner needs.

  ○ Regional Partner Grant Agreements
  — Implementation and management of new links and network.
  — Management of local service delivery, e.g., Trust and Identity, Security, Open Science.
  — Capacity-building for the NREN communities of the corresponding Regional Network.
  — Organisation of regional conferences (e-AGE (ASREN), UbuntuNet-Connect, the WACREN Conference).

- Eastern Mediterranean Support

  Under this initiative, GÉANT provides a mechanism for ongoing collaboration with NRENs in the Eastern Mediterranean region, and their international connectivity, in the absence of EU funding for a regional development project. The principle activities are as follows:

  ○ Coordination with NRENs and ASREN for engagement with the EC for EU funding and a regional development project to support Eastern Mediterranean NRENs, and to include in the project support for North Africa beyond the end of AfricaConnect3.
  ○ Support for procurement of connectivity for Eastern Mediterranean NRENs.
  ○ Support ASREN and NRENs in the reorganisation process of the ASREN organisation.

- Medusa

  The Medusa project focuses on the provision of R&E connectivity for North African NRENs on the Medusa cable system which is due to become operational in 2025. GÉANT's involvement is focused on the following elements:

  ○ Input to the EC, EIB and AFR-IX, with liaison with ASREN and North African NRENS in the preparation of contracts for Medusa connectivity to be delivered in 2025-26.
  ○ Oversight of the progress of the construction of the Medusa project and management of related funding and Indefeasible Right of Use (IRU) contracts, in collaboration with North African NRENs and ASREN.
  ○ Liaison with North African NRENs and ASREN to prepare for the delivery and usage of Medusa connectivity.

- TEIN*CC Consultancy Contract

  ○ TEIN*CC (TEIN* Cooperation Center) is the RREN for the Asia-Pacific region and coordinates the EU-funded Asi@Connect project.
  ○ Through a consultancy contract with TEIN*CC, GÉANT provides advice regarding the implementation of the project, and support for planning future EU-funding for the region.

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[1] It is to be noted that the AfricaConnect3 Grant Agreement for ASREN terminated in November 2023.

- 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.
  - In early 2024, ESnet will deploy new transatlantic connectivity which will be delivered in Bordeaux, France. Under the service contract, GÉANT will provide backhaul to ESnet from the Bordeaux end point to the ESnet router in Geneva.

- Internet2 Service Contract
  - Like ESnet, in early 2024, Internet2 will deploy new transatlantic connectivity from the USA to Bordeaux, France. Under a new service contract, GÉANT will provide backhaul for Internet2 from the Bordeaux end point 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 in 2023 fall into four categories, as follows:

- General relationship management, via regular online and in-person meetings with leading national or regional international R&E networks, 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 2023 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 TNC23. Furthermore, in addition to regular online engagements, key in-person bilateral engagements were carried out at the following events:

- APAN Conferences (January and August) [Event1]
- Internet2 Community Exchange (May) [Event2]
- ZA·REN Week (South Africa, September) [Event3]
- CANARIE National Summit (October) [Event4]
- TICAL2023 (November) [Event5]
- Dialogue took place with RedCLARA regarding support between the GN5-1 project and RedCLARA in the context of the EU-funded BELLA-II project [RedCLARA]. Specific activities that were supported included the BELLA-II Ideathon, held in March 2023, and the subsequent Hackathon, held in July 2023, to develop technical solutions to enable better access and use of Copernicus data in Latin America, including agreement for jury participation by WP3 T2 [Ideathon], [Hackathon]. Contributions were provided via promotion of the events in Europe, representation at the opening and closing events of each activity, and arranging support from Europe for mentors and jurors for each activity. There was also participation in RedCLARA's Strategic Dialogue meeting held during the TICAL2023 conference in Panama City, in November 2023.

- The leader of the *International* subtask was invited to join the Internet2 Community Exchange 2024 programme committee, and consequently participated in conference planning meeting that was held in Washington DC in October 2023 [I2ComEx].

2.1.2 Support for Service Collaboration Activities

- The task supported WP4 *Above-the-net Services* in the preparation of a Global Cloud Side meeting that was held at TNC23, enabling participants from RENs around the globe to exchange cloud service developments and challenges [TNC23].
- 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. There was also tracking of efforts by GN5-1 WP5 regarding eduGAIN for International RENs internationally, with support for Identity Federation establishment and preparations for eduGAIN candidate status for Cambodia, Indonesia, and the Arab States (see Section 2.3.4 for eduGAIN activities relating to Africa).
- Working with WP3 T2, there was engagement with RedCLARA on e-health collaboration. This included a side meeting at TNC23 in June to explore the possibility to enhance actions between Europe and Latin America in the framework of the BELLA-II Project based on experience of the eHealth Telemedicine Network of Brazil and Latin America, RUTE [BELLAII], [RUTE]. Conclusions are to consider organising a common community event on eHealth involving GÉANT, RedCLARA and RUTE, as well as exploring EU funding opportunities for a joint eHealth project.
- Support was given in dialogue with the Ugandan NREN, RENU, and the UbuntuNet Alliance focused on an InAcademia pilot for Uganda which started in 2023 [RENU], [UbuntuNet]. Discussions were also facilitated between the InAcademia team and RNP (Brazil) and RedCLARA on Brazilian and wider Latin American interest in the creation of a similar service [RNP].
- The Task coordinated with WP8 on options for security-focused workshop for Latin American NRENs, to whom the concept was introduced during TICAL2023, in Panama City, in November.
- GÉANT also provided NKN with advice on how to increase its involvement in the cyber-security area.

2.1.3 Service Request Implementations

A total of 15 service requests with an international focus were processed in 2023.

- Seven GÉANT Plus service requests:
  - Four related to connections from SCION to International RENS, including two to Saudi Arabia, one to South Korea, and one the United States of America.
  - One for a connection from the UK to FABRIC in the United States of America.
  - One for a connection to the United States of America for a demo held at Supercomputing 23 (SC23) [SC23].
  - One for a connection from RARE to Japan.

- Three GÉANT Open service requests:
  - One for the planned migration of the Internet2 GÉANT Open connection from London to Paris (to take place in February 2024).
  - Two GÉANT Open cross-connects, one between ESnet and the NEA³R Project [ESnet], [NEAR].

- Three LHCONE service requests:
  - One for the connection of CSTNET (China) to LHCONE.
  - Two for LHCONE configuration changes related to ESnet and Internet2.
- Two GWS service requests:
  - Both related to a GWS pilot for SingAREN (Singapore).

2.1.4 International Community Development

2.1.4.1 Emerging NREN Programme

The fifth edition of GÉANT's Emerging NREN programme brought together twelve participants from ten countries: Albania, Bosnia and Herzegovina, Ethiopia, Jordan, Malawi, Palestine, Peru, Serbia, Sri Lanka, and Tunisia. Three candidates submitted and were accepted to present a lightning talk. The decision to encourage this year more senior staff to apply proved successful, achieving a diverse group of experiences and extending the impact of the programme beyond the individual level. A detailed best practice and lessons learned session was held after TNC, and participants were asked to complete a questionnaire. This ensures that next year's programme will continue to meet its objectives and be an effective enabler to further collaborations between NRENs.

Preparations for the Emerging NREN Programme to be held alongside TNC24 in Rennes, France, were started [TNC24]. The work included the drafting of the Terms of Reference, due to be shared with International Regional Networks in early 2024 for the identification of TNC candidates. Discussions with RENATER on host activities for the programme have started.

2.1.4.2 NREN Twinning Programme

The concept for an NREN Twinning Programme was developed. The idea originates from previous discussions in the AfricaConnect3 project, and the CEO Track at TNC22 where a desire was voiced to enable NRENs globally to work on solving common issues together with focus on partnerships between European and non-European RENs. The overall objective is to enable mutual organisational development by learning from and working with each other.

In October 2023 two twinning activities were initiated, each due to last six months:

- RENU (Uganda) and SIKT (Norway) [SIKT] have established a project that focuses on Campus Network as a Service (CnaaS) development in Uganda, and included a workshop hosted by SIKT in November 2023.
- MAREN (Malawi) [MAREN] and ASNET-AM (Armenia) [ASNETAM] have established a project that focuses on High-Performance Computing use cases, Ipv6 development, CERT setup and NREN service marketing. Mutual visits are planned for early 2024.

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 2023, the principal international engagement activities were as set out below.

2.2.1   North America

- Preparations were made with the US network's ESnet and Internet2 [I2] for the delivery of new transatlantic links due to be connected to the GÉANT IP backbone in London and Geneva (ESnet) and Paris (Internet2). It was expected that the links would be delivered in the latter half of 2023, but, due to delays in the completion of the submarine cable system (Amitié), this was postponed until February 2024 (see also Sections 2.7 and 2.8 for an overview of work by GÉANT to provide backhaul to ESnet and Internet2 of the Amitié connectivity from the cable end points to the corresponding GÉANT Points of Presence (PoPs)).

- In view of ESnet's plans to acquire additional connectivity across the North Atlantic and to procure spectrum connectivity to the USA within GN5-IC1, ongoing discussions were held with ESnet on joint planning to ensure maximum diversity of appropriate cable systems, and to explore potential spectrum-sharing and other mutual support activities.

- There was participation in the regular project management meetings for the NEA^{3}R project, led by International Networks at Indiana University [IndUni] and funded by the US National Science Foundation [NSF], which provides two 100Gbps transatlantic links between the USA and Europe.

- In the Advanced North Atlantic (ANA), a collaboration of 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) there was participation in strategic planning and operational meetings at the Internet2 Community Exchange conference, in Atlanta, Georgia, USA in May 2023. There has been subsequent engagement in dialogue on the future of the collaboration.

2.2.2   Asia-Pacific

2.2.2.1   China

- Engagement with the Chinese research network, CSTNET [CSTNET], focused on support for the delivery and signature of an interconnection agreement for a new 100Gbps interconnection at the Open Exchange in Singapore, where separate links procured by GÉANT and CSTNET respectively meet.

- Exploratory talks were also held at TNC23 and APAN56 with the Chinese NREN, CERNET [CERNET], regarding connectivity continuity after April 2025.

2.2.2.2   Japan

- Dialogue took place with the National Institute of Informatics (NII) [NII] that operates the SINET network 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 via a potential new route via the Arctic. In these discussions, the regional network for the Nordic countries, NORDUnet was also a key participant in view of its Northern EU Gateways project work which is currently investigating the possibilities for secure and resilient connectivity though 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.

2.2.2.3 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.

2.2.2.4 Asia-Europe Ring

- There was participation in the agreement for KREONET/KISTI [KREONET] to join the Asia-Europe Ring (AER) collaboration with the addition of the KREONET link from Daejeon (South Korea) to Amsterdam, with signature of a Memorandum of Understanding (MoU) APAN55 in Kathmandu, Nepal, in March.
- GÉANT contributed to discussions with a number of Asian partners: NICT (Japan) [NICT], NII (Japan), KISTI (South Korea), SingAREN (Singapore) [SingAREN], and JUCC (Hong Kong) [JUCC], together with CSTNET for backup arrangements over the Singapore-Hong-Kong route to strengthen resilience in East-Asia.
- GÉANT also coordinated with the AER Steering Group at a meeting at APAN56 on the addition of the GN5-IC1 Marseilles-Singapore link to the backup mechanism.

2.2.3 Interconnection Agreements

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).

2.2.4 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.

2.2.5 Interactive Maps

- GÉANT Interactive Map

  For updates to the GÉANT Interactive Map [GNmap], engagement with RedCLARA and the UbuntuNet Alliance was necessary to ensure accuracy on their network backbones.

- Global Interactive Map

  Coordination and technical support was provided to the GNA-G working group which aims to establish the Global Interactive Map, or GREN Map. Plans were made with CANARIE (Canada) who co-chair the working group, to increase outreach among RENs around the globe in 2024.

2.2.6   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 with DG NEAR and DG INTPA in 2023 focused on a potential Global Gateway for the Black Sea with a view to new R&E connectivity infrastructure being delivered for Armenia and Georgia.

Discussions with DG NEAR and DG INTPA in 2023 focused on potential connectivity to Japan via the Arctic (see above) as a potential gateway to Asia, and to support Copernicus data transfers to the Philippines, following an announcement on 24 April of the Copernicus Capacity Support Action Programme for the Philippines.

2.3   AfricaConnect3

In the AfricaConnect3 project, engagement focused on project management and coordination, connectivity planning and procurement, coordination of outreach activities and thematic support. Activities carried in these areas are set out below.

2.3.1   Project Management and Coordination

In AfricaConnect3 [AC3], monthly project management meetings were held with the African RREN partners (ASREN), the UbuntuNet Alliance, WACREN, and the European Commission to track project progress and agree future work.

In-person engagement took place through the WACREN Conference (March 2023) [WACREN23] and UbuntuNet-Connect (November 2023) [UbuntuNet23] which further enabled project management dialogue and planning.

It is to be noted also that, whilst outside the remit of the AfricaConnect3 project, dialogue was carried out with ASREN, the UbuntuNet Alliance, WACREN, and the EC (DG INTPA) regarding a follow-on AfricaConnect4 project, expected to begin at the end of 2024.

2.3.2   Connectivity Planning and Procurement

2.3.2.1   North Africa

Procurement activities were initiated for an upgrade to 10Gbps for the MARWAN [MARWAN] international connection, with delivery set for early 2024.

2.3.2.2   East and Southern Africa

Procurement to connect the Botswanan NREN, BotsREN, was completed and the link delivered.

A procurement exercise for a link to connect the Ethiopian NREN, EthERNet, was initiated. The resulting link is due to be implemented in early 2024.

Procurements for upgrades to the UbuntuNet backbone were carried out and completed.

2.3.2.3   West and Central Africa:

A procurement exercise for cloud services for the WACREN Community was completed. Preparations were also made with WACREN and the EC for connectivity procurements to be carried out in 2024.

2.3.3   Outreach Activities

- A paper on 'eduroam in Africa' was presented at the IST-Africa conference held in Tshwane, South Africa, in May/June 2023 [Conf1].
- The AfricaConnect3 project communications team, in collaboration with the wider African REN community, put together a comprehensive paper to demonstrate the impact of African Research and Education Networks on the United Nations Sustainable Development Goals (SDGs). The paper is available online [Paper].
- A meeting was held with the African Development Bank in South Africa to highlight how the lack of political recognition and support has long hampered the progress of the African NRENs and the establishment of a sustainable funding pipeline.
- Planning with the AfricaConnect3 partners, NORDUnet and the Guild, was carried out for a conference to be held in Brussels in February 2024 between African and Nordic NRENs on collaboration opportunities.
- Participation in the AfriLabs Annual Gathering (Kigali, Rwanda) in October 2023 [Conf2] included engagements with Smart Africa [SmartAfrica] on potential for the development of a joint strategy.
- African R&E networking was represented at the SDG Weekend held in the context of the 78th session of the United Nations (UN) General Assembly in New York, USA, in September.

2.3.4   Thematic Support

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, Kenia, Zambia, and Botswana.
- In terms of eduGAIN membership, progress in Africa, supported by GN5-1 WP6 was tracked, with initial components established for Malawi, Tanzania, with contact initiated also for Madagascar. In addition, dialogue for new candidate status began for Burkina Faso, Ethiopia, Mozambique and Togo, as well as iFARE for the Arab States.

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, with ASREN the Regional R&E Network as GÉANT's principal counterpart since its establishment in 2011, with regular engagement also with individual NRENs in the region.

In late June 2023, the engagement and project implementation for North Africa and the Eastern Mediterranean was impacted when GÉANT was informed of structural and staffing changes at ASREN. Significant effort was placed on engagement with temporary new management at ASREN to understand the expected changes and

impacts on working practices for the AfricaConnect3 project as well as plans around the Medusa project, support for Eastern Mediterranean NRENs, and planning for future EU funding for the ASREN region.

Following, the reinstatement of the original ASREN team, engagement has focused on supporting the involvement of ASREN in current projects and projects in planning.

Sections 2.4.1 to 2.4.3 describe the operational work that has been the focus of engagement with the Medusa project, the support for the Eastern Mediterranean, and the planning for future EU funding for the ASREN region.

2.4.1 Medusa

Significant efforts were put into preparations of the connectivity on a planned submarine cable system, Medusa [Medusa], to interconnect North African NRENs and connect them to Europe via a regional hub in Barcelona.

Whilst ASREN was originally intended to be the contracting entity, following the issues that arose with ASREN in June 2023, DG NEAR formally requested in July that GÉANT step in as contractor.

The Medusa agreements for long-term EU-funded connectivity provision between Europe and North Africa were subsequently signed by GÉANT, the European Investment Bank (EIB) [EIB], and the Medusa submarine cable promoter AFR-IX [AFRIX] in October 2023. A 'symbolic' signing ceremony, with GÉANT in attendance, took place on 25 October in Brussels in the context of the EC's high-level first Global Gateway Forum.

An ASREN partner meeting took place from 20 to 22 May in Amman in Jordan. The focus was to discuss efforts for the North African NRENs to prepare for Medusa connectivity as well as a potential future EU-funded regional development project for North Africa and the Eastern Mediterranean.

In July the EIB-Med Conference 2023 held in Barcelona, Spain, saw a contribution to a panel discussion on the benefits of Medusa for research and education. GÉANT also secured the attendance of a Moroccan scientist to provide a first-hand account of the importance of improved digital connectivity for participation in international scientific endeavours, such as the experiments at CERN.

2.4.2 Eastern Mediterranean Support

Following the end of the EUMEDCONNECT3 [EUMEDCONNECT3] project in December 2021, EU funding for NRENs in the Eastern Mediterranean region ended. Since then, GÉANT has worked with NRENs in the region to ensure activities including connectivity can continue in parallel with discussions with DG NEAR for further funding for the region.

Work in 2023 specifically focused on preparations of a connectivity refresh for Lebanon and ongoing provision of connectivity for SESAME in Jordan.

2.4.3 Future EU Funding

In view of the discontinuation of EUMEDCONNECT3 funding at the end of 2021, and the fact that North Africa will not be supported by a possible future AfricaConnect4 project, there was significant engagement with North African and Eastern Mediterranean NRENs, ASREN, and the EC regarding options for a new Neighbourhood South project (working title EUMED+).

2.5 TEIN*CC Consultancy Contract

The EU-funded Asi@Connect project [AsiaConnect] for the Asia-Pacific region is coordinated by the TEIN* Cooperation Center (TEIN*CC) [TEINCC]. GÉANT maintains a consultancy contract with TEIN*CC to provide support and advice relating to project management and the implementation of Asi@Connect.

In 2023, there was engagement via regular online calls and meetings at the APAN conferences (March and August), relating to the following topics:

- A twelve-month no-cost extension of Asi@Connect to September 2024.
- Financial management of the project
- Engagement with the EC regarding an application for further funding to support an Asi@Connect2 project, to be concluded in 2024.

GÉANT also had a bilateral meeting with TEIN*CC at APAN in Nepal in March to meet with its new leadership.

A renewal of the consultancy agreement for a three-month period was also agreed at the end of 2023.

2.6 ESnet Service Contract

To connect ESnet's existing 4x100Gbps transatlantic links to the Large Hadron Collider (LHC) at CERN, GÉANT provides a connectivity ring between the ESnet points of presence in London, Amsterdam, and Geneva.

A new agreement for the provision of the ring was finalised in September 2023. Under this agreement, the previous 2x100Gbps ring was upgraded to 400Gbps. In addition, agreements were made for the provision of 400Gbps links between the European end points of new transatlantic ESnet capacity on the new Amitié cable system, one between Slough and London, and a second between Bordeaux and Geneva.

Most of the engagement with ESnet regarding the service contract focused on drafting of the new agreement and liaison for the implementation of the ring upgrade to 400Gbps and delivery of the new Amitié-related links (due in February 2024).

2.7 Internet2 Service Contract

Like ESnet, Internet2 has acquired capacity on the new Amitié cable system, bringing a 400Gbps link to Bordeaux. GÉANT and Internet2 agreed a service contract in 2023 under which GÉANT will provide a 400Ghps backhaul link from Bordeaux to the GÉANT PoP in Paris, expected to go live in February 2024.

3 Global Service Status Update

Deliverable D1.21 *Global Service Status and Deployment Update* [D1.21]of the GN4-3 project provided a summary of R&E connectivity to Regional and National R&E Networks outside the GÉANT membership and the status of GÉANT-related services by those R&E networks at the end of 2022.

This report provides a further update of the status at the end of 2023 of interconnectivity with and 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 2022, GÉANT's international connectivity has risen by 180 Gbps to a total of just over 2Tbps, although the number of countries connected globally has decreased by two following the disconnection of IDREN (Indonesia) and VINAREN (Vietnam). Other increases in uptake have included GÉANT Plus and perfSONAR.

Services where there has been no net change are GÉANT Open, eduGAIN, TCS Trusted Introducer, and FileSender. Decreases have been seen in the number of countries with an eduroam operator (down by three) and eduVPN (a net decrease of one).

Table 3.1 provides a brief summary of the capacity of links between GÉANT and global partner networks, described in more detail in Table 2.3. A summary of the service status is set out in Table 2.2, with the detail provided from Table 3.4 to Table 3.9.

Region	Total Capacity	Increase since Deliverable 1.4
USA & Canada	1 Tbps	No change
Latin America	200 Gbps	No change
North Africa, Western Asia, and Middle East	147 Gbps	No change
West and Central Africa	10 Gbps	No change
East and Southern Africa	220 Gbps	No change
Central Asia	1 Gbps	No change
Asia-Pacific	440 Gbps	+180 Gbps
Russia[2]	40 Gbps	No change
Total	**2.058 Tbps**	**+180 Gbps**

Table 3.1: GÉANT global connectivity summary at end of 2022

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[2] 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 2022
GÉANT Plus	Service instances in operation for: • Canada and USA • Latin America • East and Southern Africa • West & Central Africa • Asia-Pacific	New service deployments in 2022 for: • Japan • Saudi Arabia • South Korea • USA
GÉANT Open	10 connectors outside Europe	No change
perfSONAR	Measurement Points in 42 countries	Net increase of 7
eduroam	• Operators in 57 countries • Pilots in 15 countries	• Decrease of 3 countries • No change in pilot countries
eduGAIN	• 34 Participants • 3 candidates	• No net change • One Candidate fewer
TCS	• Provided to 3 countries	• No change
Trusted Introducer	• Participation from 22 countries	• No net change
eduVPN	• Deployed in 10 countries	• Net increase of 1
Community Activities	• 4 of 6 RRENs • 21 National Research and Education Networks (RENs)from 31 countries • Participation from an additional 14 non-NREN/RREN R&E networking organisations.	• Decrease of 1 RREN (APAN) • Net decrease of 11 NRENs

Table 3.2: Service uptake summary and change

3.1 Network Services

Research and Education Networks outside Europe are interconnected with the GÉANT IP service, as shown in Table 2.3 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 2023, the total number of NRENs reached outside the GÉANT membership is 73 research and education networking organisations, across 65 countries and territories[3] outside the GÉANT Membership. The figures mark a reduction of two NRENs and countries in 2023, with both IDREN (Indonesia) and VINAREN (Vietnam) terminating their connections to the TEIN backbone for financial reasons. Options continue to be explored to connect them. In addition, whilst the Afghan NREN, AfgREN, in principle remains connected to the TEIN network, traffic levels with Europe are effectively null.

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[3] 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, 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 180 Gbps to 2.058 Tbps. The increase follows an upgrade to the previous 10 Gbps interconnection with CSTNET, with GÉANT providing 100Gbps to the SingAREN Open Exchange where the link connects to a new 100 Gbps link provided by CSTNET between Beijing and Singapore. The KREONET link from Seoul to Amsterdam has also increased from 10Gbps to 100Gbps.

Global capacity is expected to increase significantly in 2024, with the first transatlantic links due to be deployed by ESnet and Internet2 in early 2024, as well as additional procurement activity by ESnet and GÉANT expected to add additional 400Gbps links between Europe and the USA.

Table 3.3 sets out the NRENs connected by region with the corresponding capacities, as at the end of 2023.

Region	Regional Network	Interconnection Capacity & Location	Global NRENs supported by Regional Network Interconnection	Direct Interconnections with National Networks
Asia-Pacific	TEIN*CC	100 Gbps London (CAE-1)	- AARNet (Australia) - AfgREN (Afghanistan) - BdREN (Bangladesh) - CERNET (China) - CSTNET (China) - DIT&T/DrukREN (Bhutan) - ErdemNet (Mongolia) - HARNET (Hong Kong) - CamREN (Cambodia) - KOREN (South Korea) - LEARN (Sri Lanka) - LERNet (Lao) - MAFFIN (Japan) - mmREN (Myanmar) - MyREN (Malaysia) - KREONET (South Korea) - NICT (Japan) - NKN (India) - NREN (Nepal) - PERN (Pakistan) - PREGINET (Philippines) - REANNZ (New Zealand) - SINET/NII (Japan)	Additional links to NRENs in the region, are as follows: - SINET (Japan) – 100 Gbps - CERNET (China) – 10 Gbps - CSTNET (China) – 100 Gbps - NKN (India) – 2x5 Gbps + 10 Gbps - ASGC (Taiwan) – 10 Gbps - KREONET (South Korea) 100 Gbps - TWAREN (Taiwan) – peering in New York via existing GÉANT transatlantic link to New York.

Region	Regional Network	Interconnection Capacity & Location	Global NRENs supported by Regional Network Interconnection	Direct Interconnections with National Networks
			• SingAREN (Singapore) • ThaiREN (Thailand) • ASGC (Taiwan)	
Central Asia	CAREN	1 Gbps Frankfurt	• KRENA (Kyrgyzstan) • TARENA (Tajikistan)	N/A
East and Southern Africa	UbuntuNet Alliance	10 Gbps London 10 Gbps Amsterdam	• BERNET (Burundi) • Eb@le (DRC) • KENET (Kenya) • MAREN (Malawi) • MoRENet (Mozambique) • RwEdNet (Rwanda) • SomaliREN (Somalia) • SANReN/TENET (South Africa) • TERNET (Tanzania) • RENU (Uganda) • ZAMREN (Zambia) • ZARNet (Zimbabwe)	SANReN/TENET (South Africa) 2 x 100Gbps
Latin America	RedCLARA	2 x 100 Gbps Lisbon and Madrid	• CEDIA (Ecuador) • CUDI (Mexico) • INNOVA|RED (Argentina) • RAGIE (Guatemala) • RAU (Uruguay) • RedCONARE (Costa Rica)	N/A

Region	Regional Network	Interconnection Capacity & Location	Global NRENs supported by Regional Network Interconnection	Direct Interconnections with National Networks
			• RENATA (Colombia) • REUNA (Chile) • RNP (Brazil)	
North Africa and Western Asia	ASREN	10 Gbps (London)	• JUNet (Jordan) • MARWAN (Morocco) • RNU (Tunisia) • AUB (Lebanon)	• ANKABUT (UAE) – 1 Gbps • ARN (Algeria) – 10 Gbps • ENSTINET & EUN (Egypt) – 622 Mbps • KAUST (Saudi Arabia) – 100 Gbps • Maaen (Saudi Arabia) – 2x2.5 Gbps • HBKU (Qatar) – 2x10 Gbps • OMREN (Oman) – 155 Mbps • Iran NREN[4] (Iran) – 1 Gbps
USA and Canada	N/A	10 x 100 Gbps Diverse paths and end points in Europe, Canada and the USA	• N/A	• CANARIE (Canada) • ESnet (USA) • Internet2 (USA)
West and Central Africa	WACREN	10 Gbps London	• ReRBenin (Benin) • FasoREN (Burkina Faso) • RITER (Côte d'Ivoire) • TogoRER (Togo) • NgREN (Nigeria)	N/A

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[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 supported by Regional Network Interconnection	Direct Interconnections with National Networks
			• GARNET (Ghana)	
Russia	N/A	N/A	• N/A	• NIKS (Russia) – connects in Amsterdam at 10 Gbps • Kurchatov Institute (KIAE) – connects in Amsterdam at 30 Gbps

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 2023 new instances of GÉANT Plus were implemented for CSTNET (China) and KREONET (South Korea).

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 400 Gbps 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	• CANARIE • ESnet • Internet2 • NISN	No instances	• RedCLARA	• AARNET (Australia) • CSTNET (China) • KREONET (Korea) • NKN (India) • SingAREN (Singapore) • SINET (Japan)	• UbuntuNet Alliance	• WACREN: London
Layer 3 VPN	LHCONE: • CANARIE • ESnet • Internet2	No instances	LHCONE and Copernicus: • RedCLARA	LHCONE: • AARNET (Australia) • ASGC (Taiwan) • CSTNET (China) • KREONET (Korea) • NII/SINET (Japan) • NKN (India) • TEIN*CC	No instances.	No instances

Service	Canada & USA	North Africa & Western Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
GÉANT Open	• ESnet: London • Internet2 & CANARIE (joint connection): London • Indiana University (NEA3R project): London	• ANKABUT (UAE): London • HBKU (Qatar): London and Paris • Maeen (Saudi Arabia): London	No connectors	• AARNet (Australia): London via CAE-1 • SingAREN (Singapore): London via CAE-1	• SANReN/TENET (South Africa): London	• 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 42 countries outside the GÉANT membership, a net increase compared with the end of 2022, with additional listings now recorded against Guam, Kazakhstan, Vanuatu, Puerto Rico, Mozambique, Benin, Côte d'Ivoire and Togo, but Sri Lanka no longer listed.

North Africa, Western Asia and Middle East	Americas	Asia-Pacific	East and Southern Africa	West and Central Africa	Other
• Morocco (4) • Jordan (8) • Lebanon (4)	• Brazil (76) • Canada (115) • Chile (16) • Ecuador (12) • Mexico (14) • Puerto Rico (22) • USA (2296)	• Australia (60) • Bangladesh (10) • China (15) • Fiji (4) • Guam (25) • Hong Kong (29) • India (36) • Indonesia (8) • Japan (122) • South Korea (106) • Laos (4) • Malaysia (4)	• Kenya (21) • Mozambique (4) • South Africa (96) • Uganda (19) • Zambia (24)	• Benin (7) • Côte d'Ivoire (4) • Ghana (15) • Nigeria (7) • Togo (4)	• Kazakhstan (12) • Russia (87)

North Africa, Western Asia and Middle East	Americas	Asia-Pacific	East and Southern Africa	West and Central Africa	Other
		• New Zealand (46) • Pakistan (24) • Philippines (37) • Singapore (19) • Sri Lanka • Taiwan (26) • Thailand (104) • Vanuatu (4)			

Table 3.5: Countries outside Europe with instances of perfSONAR

3.3   Trust and Identity Services

3.3.1   eduroam

Table 2.6 lists countries with eduroam operators by region. The total number of countries and territories outside the GÉANT membership now equals 54, 3 fewer than at the end of 2022, as Palestine, Kyrgyzstan and Russia are no longer listed as having an eduroam operator. The number of eduroam pilot countries has seen no change. 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].
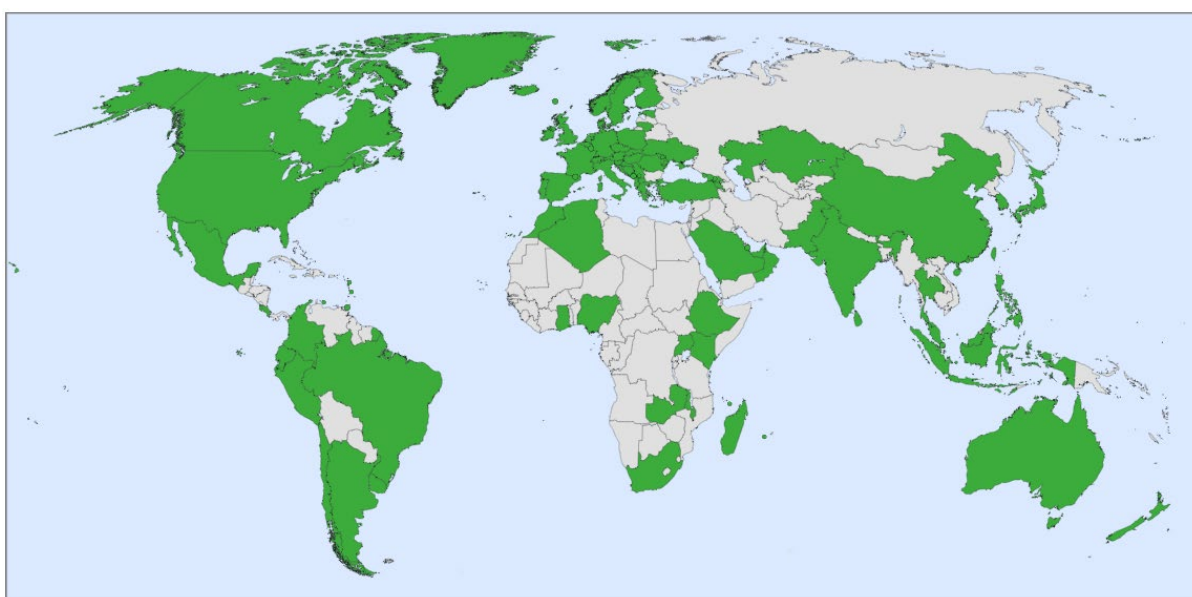
Figure 3.1: Map showing countries with eduroam operators across the globe

Service	North Africa, Western Asia and Middle East	Other	Latin America & Caribbean	Asia-Pacific	East and Southern Africa	West and Central Africa
eduroam (Operators)	• Algeria • Iran • Lebanon • Morocco • Oman • Qatar • Saudi Arabia • United Arab Emirates	• Canada • USA • Kazakhstan	• Argentina • Brazil • Chile • Colombia • Costa Rica • Ecuador • Mexico • Peru • Trinidad & Tobago • Uruguay	• Australia • Bangladesh • China • Hong Kong • India • Indonesia • Japan • South Korea • Laos • Macau • Malaysia • Nepal • New Zealand • Pakistan • Philippines • Singapore • Sri Lanka • Taiwan • Thailand	• Ethiopia • Kenya • Madagascar • Malawi • Mozambique • South Africa • Tanzania • Uganda • Zambia	• Benin • Ghana • Nigeria • Senegal • Togo
eduroam (Pilots)	• Egypt • Jordan • Kuwait • Tunisia		• Barbados • El Salvador • Jamaica • Nicaragua • Venezuela	• Bhutan • Vietnam	• Somalia • Sudan • Zimbabwe	• 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 is 34. In 2023, the Somalian Identity Federation gained eduGAIN participant status, whilst the Russian Federation had its participant status removed, leaving the same number of identity federations in eduGAIN as at the end of 2022.

The number of eduGAIN candidate countries has lowered by one, due to the transition of the Somalian identity federation from candidate to participant status. Expectations for eduGAIN growth in 2024 are limited at present to the three with candidate 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)	• Algeria • Iran • Morocco • Oman • Saudi Arabia	• Canada • USA • Kyrgyzstan	• Argentina • Brazil • Chile • Colombia • Ecuador • Mexico	• Australia • Bangladesh • China • Hong Kong • India • Japan • South Korea • Malaysia • New Zealand • Pakistan • Singapore • Sri Lanka • Thailand	• Kenya • Mozambique • Somalia • South Africa • Uganda • Zambia	• Nigeria
eduGAIN (Candidates)	• Lebanon	• Tajikistan	• None	• None	• Malawi	• None

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 2.8.

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 for Trusted Introducer (see Table 2.8) has seen no net change since the end of 2022, although Jordan has been added to the list, and Tunisia no longer appears. 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 fallen from eleven to ten since the end of 2022, with the removal of Somalia and Zambia, and the addition of Ethiopia. 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	• Morocco • Lebanon • Oman	N/A	N/A	N/A	N/A	N/A
Trusted Introducer[5]	• Jordan • Morocco • Saudi Arabia • United Arab Emirates	• Kazakhstan • Uzbekistan	• Brazil • Curaçao • Ecuador	• Bangladesh • China • Hong Kong • India • Korea • Japan • Singapore • Sri Lanka • Thailand	• Mauritius • Mozambique • South Africa	• Togo
eduVPN	• Morocco	–	• Mexico • Chile	• Malaysia • Pakistan • Sri Lanka	• Ethiopia • Kenya • South Africa • Uganda	–

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

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

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 support NRENs' support for research and education activities. Under the GN5-1 project, a new version (eduMEET version 4), simplifying 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 stands at 16, with no change from the end of 2022.

Service	North Africa, Western Asia and Middle East	Central Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
FileSender	• IRAnet (Iran) • OMREN (Oman)[6]	–	• RedCLARA • RNP (Brazil) • REUNA (Chile) • CEDIA (Ecuador)	• AARNet (Australia) • NII/SINET (Japan) • KREONET (Korea) • MYREN (Malaysia) • SingAREN (Singapore)	• UbuntuNet Alliance • RENU (Uganda) • KENET (Kenya) • SANReN (South Africa) • SomaliREN (Somalia)	–

Table 3.9: Uptake of FileSender by regional networks outside Europe

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[6] 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 December 2023 a total of 39 organisations, comprising RENs, research and education institutions, and other organisations (e.g., commercial, government), outside the GÉANT membership registered for one or more GÉANT [Community] Task Force (TF) and/or Special Interest Group (SIG) meetings. The distribution by geographic region is set out in Table 3.10, below.

Region	Organisation
USA and Canada	CANARIE (Canada), ESnet (USA), Internet2 (USA), ORION (Canada), Fermilab – FNAL (USA), Florida International University (USA), Indiana University (USA), Jefferson Lab (USA), Northwestern University (USA), University of Maryland Baltimore County (USA), University of Michigan (USA), University of Victoria (Canada)
Latin America	RedCLARA, CEDIA (Ecuador), CUDI (Mexico), RAGIE (Guatemala), REUNA (Chile), RNP (Brazil), State University of Ceará (Brazil)
Central Asia:	TARENA (Tajikistan)
North Africa and Western Asia	ASREN, CCK (Tunisia), KAUST (Saudi Arabia), MARWAN (Morocco), Ministry of Higher Education (Palestinian Territories),
West and Central Africa	WACREN, GARNET (Ghana), Senate Committee on Science and Technology (Nigeria)
Asia-Pacific	AARNet (Australia), CERNET (China), KISTI (South Korea), REANNZ (New Zealand), ISI Markets (China), Sapporo Gakuin University (Japan)
East and Southern Africa:	UbuntuNet Alliance, RENU (Uganda), SANReN (South Africa); SomaliREN (Somalia), ZAMREN (Zambia),

Table 3.10: Organisations outside GÉANT Membership registered for GCP TFs & SIGs in 2022

By organisation type, 4 are Regional R&E Networks, 21 are National Research and Education Networks, 1 is a State Research and Education Network (ORION, Canada), and 3 are US institutions that support international R&E networking activities (Florida International University, Indiana University, and Northwestern University). The remaining organisations are universities or research institutions, commercial entities or government bodies.

Compared with participation in GCP TFs and SIGs in the latter part of the GN4-3 project, the number of RREN organisations has fallen by one (APAN)

In addition, the number of NRENs has seen a significant fall (from 32 to 21). In some regions participation has remained consistent (e.g., Canada, the USA, Latin America, North Africa, and Western Asia), but others have seen lower participation than previously (East and Southern Africa, West and Central Asia-Pacific).

Whilst TFs and SIGs continue to offer remote participation, this is now not always the case, which may have had some impact on participation.

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-CISS	• iRODS Consortium (USA)	CCK (Tunisia)		• RAGIE (Guatemala) • REUNA (Chile) • RNP (Brazil);		• RENU (Uganda)	
SIG-Marcomms	• CANARIE (Canada) • Internet2 (USA)	• ASREN • MARWAN (Morocco)		• RedCLARA • CEDIA (Ecuador) • REUNA (Chile)	• AARNet (Australia) • CERNET (China) • ISI Markets (China)	• UbuntuNet Alliance • RENU (Uganda) • SomaliREN (Somalia) • SANReN (South Africa); • ZAMREN (Zambia)	• WACREN • GARNET (Ghana) • Senate Committee on Science and Technology (Nigeria)
SIG-MSP				• REUNA (Chile) • RNP (Brazil)		• SANReN (South Africa)	• 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
SIG-NGN	• CANARIE (Canada) • University of Victoria (Canada) • ESnet (USA) • Florida International University (USA); • Fermilab – FNAL (USA) • Indiana University (USA) • Internet2 (USA) • Jefferson Lab (USA) • Northwestern University (USA) • ORION (Canada) • University of Michigan (USA)	• KAUST (Saudi Arabia)	• TARENA (Tajikistan)	• CUDI (Mexico) • RNP (Brazil) • State University of Ceará (Brazil)	• IHEP (China) • A*STAR NSCC (Singapore) • KISTI (South Korea)	• SANReN (South Africa)	• AARNet (Australia) • KISTI (South Korea) • REANNZ (New Zealand) • KISTI (South Korea)
SIG-NOC				• RNP (Brazil)			

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	• Internet2 (USA) • University of Maryland Baltimore County (USA)	• MARWAN (Morocco) • Ministry of Higher Education (Palestinian Territories);		• RedCLARA • CEDIA (Ecuador) • REUNA (Chile) • RNP (Brazil)	• Sapporo Gakuin University (Japan)		• WACREN

Table 3.11: Participation of organisations outside Europe in GÉANT Community Programme SIGs and TFs in 2022

4 Conclusions

Engagement and liaison with Research and Education Networking organisations outside the GÉANT membership is provided not only via the activities of the *International* subtask of GN5-1 WP3 Task 1, but the GN5-1 IC1 project, the EU-funded AfricaConnect3 regional development, as well as the Medusa project, support for the Eastern Mediterranean, a consultancy contract for TEIN*CC and the Asi@Connect project, and service contracts for ESnet and Internet2. The work carried out across these projects covers a range of topics, from general relationship management, engagement, and participation in international R&E networking events, to connectivity planning and implementation, service delivery and service 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 supports service collaboration between the GÉANT Community and its peers in other world regions. Efforts by the Task to track the number of service deployments (e.g., eduroam, eduGAIN, perfSONAR, eduVPN, etc.) outside Europe show that there is some fluctuation (increases and decreases) from year to year. For instance, global connectivity continues to increase year on year, eduroam tends to see little or no growth in terms of the number of operators outside Europe, and eduGAIN sees gradual growth. However, to progress the reach of services, as appropriate, and thereby improve support for global R&E collaboration, it is important that the Task liaise closely with GN5 service leads and with international RENs to identify areas for potential growth and how to achieve that.

Furthermore, given the value offered by the GCP Task Forces and Special Interest Groups, it is advisable that the Task works closely with the GCP team to identify the barriers for international participation in these activities as well as possible solutions to enable greater participation where there is interest in the international R&E networking community.

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://asrenorg.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[7]	IRANET	-
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	PalNREN	-
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

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[7] 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	-
Tajikistan	TARENA	https://tarena.tj/
Turkmenistan	TuRENA	-

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://redclara.net/index.php/es/somos/miembros/honduras-rednesah
Mexico	CUDI	http://www.cudi.edu.mx/
Nicaragua	RedRUNBA	https://redclara.net/index.php/es/somos/miembros/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/
Lao 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	–
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	–
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	MoRENet	–
Rwanda	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	ZARNet	–

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	–

Country	NREN	Website
Mali	MaliREN	–
Niger	NigerREN	–
Nigeria	NgREN	http://www.ngren.edu.ng/
Senegal	snRER	http://snrer.edu.sn/
Sierra Leone	SLREN	–
Togo	TogoRER	–

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

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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
CAREN CC	Central Asia Research and Education Network Coordination Centre
CSIRT	Computer Security Incident Response Team
EC	European Community
EIB	European Investment Bank
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
MoU	Memorandum of Understanding
MP	Measurement Point
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
UN	United Nations

VPN	Virtual Private Network
WACREN	West and Central African Research and Education Network
WP	Work Package