17-01-2023

Deliverable D1.21
Global Service Status and Deployment Update

Deliverable D1.21

Contractual Date:	31-12-2022
Actual Date:	17-01-2023
Grant Agreement No.:	856726
Work Package	WP1
Task Item:	Task 6
Nature of Deliverable:	R (Report)
Dissemination Level:	PU (Public)
Lead Partner:	GÉANT Association
Document ID:	GN4-3-22- 624062A
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Abstract
An update on the status of GÉANT services in world regions other than Europe, focusing on network and network support services, trust and identity, security, real-time communication, and participation in GÉANT Community Programme activities. It also provides an update on Global Service Outreach actions to improve RREN understanding and service deployment.

Table of Contents

Table of Tables

Executive Summary

In July 2020, Deliverable 1.4 *Global Service Status and Deployment Plan* reported on the status of GÉANT services in world regions other than Europe, focusing on network and network support services, trust and identity, security, real-time communication, and participation in GÉANT Community Programme activities [D1.4]. This report provides an update on the distribution outside of Europe of the services and on the specific Global Service Outreach Actions that were described in that deliverable.

At the end of GN4-3, almost two-and-a-half years after D1.4, GÉANT services have grown in a number of areas. In particular, GÉANT's international connectivity has risen approximately 50% to over 1.8 Tbps, with significant increases in connectivity to the USA (+100 Gbps), Latin America (+180 Gbps), North Africa and Western Asia (+109 Gbps) and South Africa (+200 Gbps). The GÉANT Plus service has also increased its use by International RENs.

Other uptake increases have included eduGAIN, where participant status has been granted for Bangladesh, Kenya, Mexico, Nigeria, and Thailand Identity Federations, as well as for two Identity Federations: Latin America and Africa. Trusted Introducer has seen a net addition of three CSIRTS and eduVPN has had a net increase of six deployments. In addition, there has been an increase in the number of R&E Networks from outside Europe that have participated in GÉANT Community Programme activities.

Services where no increase in uptake has been seen are GÉANT Open and TCS, although it is to be noted that TCS is principally available to GÉANT Membership NRENs, therefore growth outside Europe is neither expected, nor targeted [Membership].

Small decreases in the service and tool deployment have been seen in eduroam, with eduroam operators no longer listed for Rwanda, and perfSONAR deployments down by 4 countries.

It is to be noted that, 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, whilst also respecting the sanctions imposed on Russia.

A total of 25 Global Service Outreach actions were agreed with Regional Research and Education (R&E) Networks (RRENs) to help their understanding and further deployment of services in their respective regions. These are divided among a range of service areas, including:

- Network services: 4 actions
- Network support services: 4 actions
- Trust and identity: 6 actions
- Security: 8 actions
- Real-time communications and educational support: 1 action
- Community activities: 2 actions

Of these actions, 21 have been concluded and 1 is no longer required by the corresponding International REN. Of the remaining three actions, two (relating to GTS and eduTEAMS) require further action from International RENs for progress to be made. The remaining action relating to the concept of collective purchasing within the global R&E networking community is complex and ongoing.

1 Introduction

Deliverable 1.4 *Global Service Status and Deployment Plan* reported on the status of GÉANT services in world regions other than Europe, focusing on network and network support services, trust and identity, security, real-time communication, and also participation in GÉANT Community Programme activities [D1.4]. In addition, it listed Global Service Outreach actions that had been agreed with Regional Research and Education (R&E) Networks (RRENs) (see Table 1.1) to help their understanding and further deployment of services in their respective regions.

Regional R&E Network	Website	World Region
ASREN	www.asrenorg.net	North Africa, Eastern Mediterranean and Middle East
CAREN CC	www.icaren.org	Central Asia
RedCLARA	www.redclara.net	Latin America
TEIN*CC	www.tein.asia	Asia-Pacific
UbuntuNet Alliance	www.ubuntunet.net	East and Southern Africa
WACREN	www.wacren.net	West and Central Africa

Table 1.1: Principal target audiences

Section 2 of this report provides an update on the status of service deployments in other world regions in the areas of Network services (interconnection with GÉANT, GÉANT Plus, L3 VPN, GÉANT Open), Network support services (perfSONAR), trust and identity (eduroam, eduGAIN), security (TCS, Trusted Introducer, eduVPN), collaboration services and tools (eduMEET and FileSender), and GÉANT Community Programme participation.

Section 3 provides a summary of the work carried out in relation to the Global Service Outreach actions identified in Deliverable 1.4, in the following areas:

- Network services: 4 actions
- Network support services: 4 actions
- Trust and identity: 6 actions
- Security: 8 actions
- Real-time communications and educational support: 1 action
- Community activities: 2 actions

Section 4 summarises the main points of this document and provides conclusions.

The report includes two Appendices. Appendix A sets out service feedback information shared with all Regional R&E Networks (RRENs) outside Europe, and Appendix B lists NRENs outside Europe by world region.

2 Global Service Status Update

The status of service uptake by the regional networks national R&E networks outside the GÉANT Membership is set out in Sections 2.1 to 2.6, below.

Overall, since the publication of Deliverable D1.4 *Global Service Status and Deployment Plan* [D1.4], a major increase has been seen in GÉANT's international connectivity, which has risen by approximately half to over 1.8 Tbps. Other increases in uptake have included GÉANT Plus, eduGAIN Participants, Trusted Introducer, eduVPN and participation in Community activities.

Services where no increase in uptake has been seen are GÉANT Open and TCS, while small decreases have been seen in the number of countries with perfSONAR deployments (down by four) and countries with an eduroam operator (down by one).

It is to be noted in the context of the Russian invasion of Ukraine, that GÉANT fulfils the EC's commitment to facilitate research in the areas of COVID-19 and ITER fusion that are still permitted with Russia, whilst also respecting the sanctions imposed on Russia.

Table 2.1 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 2.4 to Table 2.9.

Region	Total Capacity	Increase since Deliverable 1.4
USA & Canada	1 Tbps	+100 Gbps
Latin America	200 Gbps	+180 Gbps
North Africa, Western Asia, and Middle East	147 Gbps	+109 Gbps
West and Central Africa	10 Gbps	No change
East and Southern Africa	220 Gbps	+200 Gbps
Central Asia	1 Gbps	No change
Asia-Pacific	240 Gbps	No change
Russia	40 Gbps	+10 Gbps
Total	**1.857 Tbps**	**599 Gbps**

Table 2.1: GÉANT global connectivity summary at end of 2022

Service	Uptake outside GÉANT Service Area	Change since Deliverable 1.4
GÉANT Plus	Service instances in operation for: • Canada and USA • Latin America • East and Southern Africa • Asia-Pacific	New service deployments for: • AARNet (Australia) • CANARIE (Canada) • Internet2 (USA) • NKN (India) • RedCLARA • NII/SINET (Japan) • UbuntuNet Alliance
GÉANT Open	9[1] connectors outside Europe	No change
perfSONAR	• Measurement Points in 34 countries	• Net decrease of 4
eduroam	• Operators in 57 countries • Pilots in 15 countries	• Decrease of 1 country • No change in pilot countries
eduGAIN	• 34 Participants • 4 candidates	• Participant number increase of 5 • No change in Candidate number
TCS	• Provided to 3 countries	• No change
Trusted Introducer	• Participation from 23 countries	• Net increase of 3
eduVPN	• Deployed in 5 countries	• Net increase of 6
Community Activities	• 4 of 6 RRENs + APAN • 33 Research and Education Networks (RENs)from 31 countries • Participation from an additional 4 non-NREN/RREN R&E networking organisations.	• Decrease of 2 RRENs though addition of APAN. • Net increase of RENs from 9 countries

Table 2.2: Service uptake summary and change

2.1   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 2022, the number of NRENs reached by GÉANT stands at a total of 75 researching and education networking organisation, across 66 countries and territories [2] outside the GÉANT Membership.

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[1] Due to a clerical error in Deliverable 1.4, the number of GÉANT Open connectors was listed as 8, although the actual number of connectors named was 9.

[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, USA) have more than one entity that serves an R&E networking remit.

Since the publication of Deliverable D1.4 *Global Service Status and Deployment Plan* in July 2020 [D1.4], there has been an aggregate increase in the number of NRENs and countries reached overall by five, with Benin, Burkina Faso, Burundi, Côte d'Ivoire, Democratic Republic of Congo, Russia, Vietnam and Zimbabwe newly connected, and El Salvador and Venezuela having been disconnected.

In the same period, the aggregate GÉANT Global Capacity has increased approximately 500 Gbps to over 1.8 Tbps, with capacity increases to Latin America (from 10 Gbps to 200 Gbps via the BELLA Programme), South Africa (a new direct connection of 200 Gbps), Saudi Arabia (increase from 10 Gbps to 100 Gbps), and Algeria (from 2.5 Gbps to 10 Gbps).

Table 2.3 sets out the NRENs connected by region with the corresponding capacities, as at the end of 2022.

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) - IDREN (Indonesia) - 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)	Additional links to NRENs in the region, are as follows: - SINET (Japan) – 100 Gbps - CERNET (China) – 10 Gbps - CSTNET (China) – 10 Gbps - NKN (India) – 2x5 Gbps - ASGC (Taiwan) – 10 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
			• PREGINET (Philippines) • REANNZ (New Zealand) • SINET/NII (Japan) • SingAREN (Singapore) • ThaiREN (Thailand) • ASGC (Taiwan) • VINAREN (Vietnam)	
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	• CEDIA (Ecuador) • CUDI (Mexico)	N/A

Region	Regional Network	Interconnection Capacity & Location	Global NRENs supported by Regional Network Interconnection	Direct Interconnections with National Networks
		Lisbon and Madrid	• INNOVA|RED (Argentina) • RAGIE (Guatemala) • RAU (Uruguay) • RedCONARE (Costa Rica) • RENATA (Colombia) • REUNA (Chile) • RNP (Brazil)	
North Africa and Western Asia	ASREN	10 Gbps (London)	• JUNet (Jordan) • MARWAN (Morocco) • RNU (Tunisia) • AUB (Lebanon)	• 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[3] (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)	N/A

[3] The Iranian NREN is not a member of ASREN, though 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
			• TogoRER (Togo) • NgREN (Nigeria) • 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 2.3: GÉANT Interconnections with regional and national networks outside Europe

Uptake of related network services available to RENs outside the GÉANT Memberships is set out in Table 2.4. The services are GÉANT Plus, Layer 3 VPN and GÉANT Open.

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. In addition, GÉANT 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.

Service	Canada & USA	North Africa & Western Asia	Central Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
GÉANT Plus	Multiple instances deployed for • CANARIE • ESnet Internet2	No instances	No instances	Instance deployed for: • RNP (Brazil) via RedCLARA	Instances deployed for • AARNET (Australia) • NKN (India) • SINET (Japan)	Instances deployed for: • UbuntuNet Alliance	No instances
Layer 3 VPN	Instances deployed for LHCONE for: • CANARIE • ESnet Internet2	No instances	No instances	Instances deployed for LHCONE and Copernicus: • RedCLARA	Instances deployed for LHCONE for: • AARNET (Australia) • ASGC (Taiwan) • CSTNET (China) • KREONET (Korea) • NII/SINET (Japan) • NKN (India) • TEIN*CC	No instances.	No instances
GÉANT Open	• ESnet: London • Internet2 & CANARIE (joint connection): London • Indiana University (NEA3R project): London	• HBKU (Qatar): London and Paris • Maeen (Saudi Arabia): London	No connectors	No connectors	• AARNet (Australia): London via CAE-1 • SingAREN (Singapore): London via CAE-1	• SANReN/TENET (South Africa): London	• WACREN: London

Table 2.4: Uptake of GÉANT network services by regional networks outside Europe

2.2   Network Support Services

Table 2.5, below, lists countries where at least one perfSONAR measurement point is deployed, based on the 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).

perfSONAR nodes are also deployed in Canada, Fiji, Russia and the USA.

Overall, there is a net decrease in the number of countries listed as having perfSONAR deployments, with Qatar, Tajikistan, Colombia, Afghanistan, Bhutan, Sudan and Vanuatu no longer showing perfSONAR Measurement Points, but Lebanon, Thailand and Russia are new entries.

Service	North Africa, Western Asia and Middle East	Central Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
perfSONAR	• Morocco • Jordan • Lebanon	• None	• Brazil • Chile • Ecuador • Mexico	• Australia • Bangladesh • China • Hong Kong • India • Indonesia • Japan • Korea • Laos • Malaysia • New Zealand • Pakistan • Philippines • Singapore • Sri Lanka • Taiwan • Thailand	• Kenya • South Africa • Uganda • Zambia	Ghana Nigeria

Table 2.5: Countries outside Europe with instances of perfSONAR

2.3 Trust and Identity Services

2.3.1 eduroam

Table 2.6 lists countries with eduroam operators by region. In addition to those listed in the table, eduroam operators also exist in Canada, Iran, Russia, Trinidad and Tobago, and the USA. The total number of countries and territories outside the GÉANT Membership now equals 57, one fewer than at the time of Deliverable 1.4, as Rwanda is no longer listed as having an eduroam operator.

The number of eduroam pilot countries has seen no change with the 13 shown in Table 2.6 as well as Barbados and Jamaica.

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

Service	North Africa, Western Asia and Middle East	Central Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
eduroam (Operators)	• Algeria • Lebanon • Morocco • Oman • Palestine • Qatar • Saudi Arabia • United Arab Emirates	• Kazakhstan • Kyrgyzstan	• Argentina • Brazil • Chile • Colombia • Costa Rica • Ecuador • Mexico • Peru • Uruguay	• Australia • Bangladesh • China • Hong Kong • India • Indonesia • Japan • 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		• El Salvador • Nicaragua • Venezuela	• Bhutan • Vietnam	• Somalia • Sudan • Zimbabwe	• Mali

Table 2.6: Uptake of eduroam outside Europe by region

2.3.2 eduGAIN

Table 2.7 lists countries that are eduGAIN participants. In addition to those listed in the table, there are eduGAIN Participants in Canada, Iran, Russia, and the USA. 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, an increase of five compared with the results shown in Deliverable 1.4, following the addition of Identity Federations from Bangladesh, Kenya, Mexico, Nigeria, and Thailand.

The number of eduGAIN candidate countries remained the same. Lebanon, Malawi, and Tajikistan remain candidates, and Somalia has gained candidate status, whilst Mexico has progressed from being a candidate to being a participant.

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

Service	North Africa, Western Asia and Middle East	Central Asia	Latin America & Caribbean	Asia-Pacific	East and Southern Africa	West and Central Africa
eduGAIN (Participants)	• Algeria • Morocco • Oman • Saudi Arabia	• Kyrgyzstan	• Argentina • Brazil • Chile • Colombia • Ecuador • Mexico	• Australia • Bangladesh • China • Hong Kong • India • Japan • Korea • Malaysia • New Zealand • Pakistan • Singapore • Sri Lanka • Thailand	• Kenya • Mozambique • South Africa • Uganda • Zambia	• Nigeria
eduGAIN (Candidates)	• Lebanon	• Tajikistan	• None	• None	• Malawi • Somalia	• None

Table 2.7: Uptake of eduGAIN outside Europe by region

2.4   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.

Counting the countries listed for Trusted Introducer in Table 2.8, together with Curaçao and the USA, Trusted Introducer has seen a net increase of three countries now either listed of accredited by Trusted Introducer since the publication of D1.4 with the addition of Computer Security Incident Response Teams (CSIRTS) from India, Mauritius, Togo, and the United Arab Emirates, and the suspension of Russia in February 2022. 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 increased since D1.4 from five to a total of eleven, with additions by the NRENs of Chile, Kenya, Malaysia, Mexico, Somalia, South Africa, and Zambia, but removal of Australia. It should also be noted that eduVPN is also available to R&E institutions and has also been deployed outside Europe by institutions in Australia, Chile, Indonesia, Malaysia, Morocco, and Uganda. 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	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[4]	• Morocco • Saudi Arabia • Tunisia • United Arab Emirates	• Kazakhstan • Uzbekistan	• Brazil • 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	• Kenya • South Africa • Uganda • Somalia • Zambia	–

Table 2.8: Uptake of security services by regional networks outside Europe

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

2.5 Collaboration Tools

2.5.1 eduMEET

In response to the COVID-19 pandemic, GÉANT made a version of eduMEET, a lightweight web-based videoconferencing tool, available for local deployment to support NRENs' support for research and education activities. The eduMEET software is now available for download for local deployment online [eduMEET]. Given the nature of its deployment, data on the total number of installs is not available. However, known deployments outside Europe include Kazakhstan, Malaysia, Pakistan and Russia.

2.5.2 FileSender

FileSender is managed by a collaboration and GÉANT does not have direct access to deployment information. The deployments listed in Table 2.9 are, therefore, based on desktop research from information available online [FileSender]. It should be noted that instances for Morocco, Russia, and the USA that were listed in Deliverable D1.4 have been discontinued and are therefore not included in Table 2.9.

The number of deployments of FileSender by R&E networks outside Europe stands at 16 (adding Iran to the countries listed in Table 2.9), a net decrease of one, based on the removal of Morocco, Russia, and the USA, and the addition of Kenya and Somalia.

Service	North Africa, Western Asia and Middle East	Central Asia	Latin America	Asia-Pacific	East and Southern Africa	West and Central Africa
FileSender	• OMREN (Oman)[5]	–	• 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 2.9: Uptake of FileSender by regional networks outside Europe

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[5] OMREN's FileSender instance is not listed on the FileSender deployment list at https://docs.filesender.org/filesender/known-installs, but OMREN's file-sharing tool Mirsal (https://mirsal.omren.om/) is confirmed on the OMREN website as an instance of FileSender.

2.6 Community Activities

Deliverable D1.4 reported 28 organisations comprising RENs outside the GÉANT Membership that registered for meetings of GÉANT Task Forces (TFs) and/or Special Interest Groups (SIGs), and other GÉANT Community Programme activities and global collaboration activities from 2017 to 2019.

Region	Organisation
USA and Canada	ESnet (USA), Internet2 (USA), CANARIE (Canada)
Latin America	CEDIA (Ecuador); REUNA (Chile); RedCLARA; RNP (Brazil); RENATA (Colombia)
Central Asia:	CAREN CC; KRENA (Kyrgyzstan)
North Africa and Western Asia	ASREN, KAUST (Saudi Arabia), MARWAN (Morocco), OMREN (Oman)
West and Central Africa	WACREN, FasoREN (Burkina Faso), GARNET (Ghana), NgREN (Nigeria), TogoRER (Togo)
Asia-Pacific	AARNet (Australia), CERNET (China), REANNZ (New Zealand)
East and Southern Africa:	SANReN/TENET (South Africa), UbuntuNet Alliance: KENET (Kenya), MoRENet (Mozambique), RENU (Uganda), ZAMREN (Zambia)

Table 2.10: RENs outside GÉANT Membership collaborating 2017-19

Between the start of 2020 and the end of May 2022 (the date up to which GPC participation data is analysed in this report), the number of R&E networking organisations outside Europe that have participated in such events increased to 42[6], despite the fact that for much of this period, the COVID-19 pandemic impacted on the number of activities being organised. Of these,

- 5 are regional R&E networking organisations (including APAN, a sister organisation of TEIN*CC in the Asia-Pacific region)
- 32 are National R&E Networks (NRENs)
- 3 are R&E networks at a level lower than national (e.g. CENIC in California, BCNET in British Colombia, and ERNET in India)
- 2 are US organisations that support international R&E networking activities (Indiana University and NSRC).

In total NRENs from 36 countries outside the GÉANT Membership participated in GPC and other community activities from the start of 2020 to the end of May 2022.

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[6] It is to be noted that in addition to the organisations listed in Table 2.12, representatives of the Russian NREN participated in a limited number of GEANT Community Programme activities in 2020 and 2021.

Region	Organisation
USA and Canada (7)	BCNET (Canada), CENIC (USA), ESnet (USA) Internet2 (USA), CANARIE (Canada), Indiana University (USA), NSRC (USA)
Latin America (6)	RedCLARA, CEDIA (Ecuador), CUDI (Mexico), REUNA (Chile), RNP (Brazil), RENATA (Colombia)
Central Asia (2)	KazRENA (Kazakhstan), TARENA (Tajikistan)
North Africa and Western Asia (4)	ASREN, ARN (Algeria), MARWAN (Morocco), OMREN (Oman)
West and Central Africa (6)	WACREN, EKO-Konnect (Nigeria), NgREN (Nigeria), Niger-REN (Niger), RITER (Côte d'Ivoire), TogoRER (Togo)
Asia-Pacific (10)	APAN, AARNet (Australia), BdREN (Bangladesh), CSTNET (China), ERNET (India), MYREN (Malaysia), NII/SINET (Japan), REANNZ (New Zealand), SingAREN (Singapore), TW-GRID/ASGC (Taiwan)
East and Southern Africa (7)	UbuntuNet Alliance, Eb@le (Democratic Republic of Congo), KENET (Kenya), MoRENet (Mozambique); RENU (Uganda), SANReN/TENET (South Africa), SomaliREN (Somalia)

Table 2.11: RENs outside GÉANT Membership collaborating 2020-21

In 2022, the GÉANT Innovation Programme also included an international focus, with a project approved to carry our work towards the establishment of an NREN in Cabo Verde and establishing an eduroam pilot in the country.

The following table (Table 2.12) lists the organisations by SIG, TF or other activity, and 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-ISM (information security management)	• ESnet (USA) • Internet2 (USA) • Indiana University [7] (USA)				• CSTNET (China) • MYREN (Malaysia) • TW-GRID/ASGC (Taiwan)	• MoRENet (Mozambique) • SANReN (South Africa)	
SIG-Marcomms (marketing communications)	• CANARIE (Canada)	• ASREN • OMREN (Oman)		• REUNA (Chile) • RNP (Brazil)	• APAN • AARnet (Australia) • REANNZ (New Zealand) • SingAREN (Singapore)	• UbuntuNet Alliance • KENET (Kenya) • SANReN (South Africa)	• WACREN • EKO-Konnect (Nigeria) • NgREN (Nigeria)
SIG-Multimedia	• CANARIE (Canada)	• ASREN		• REUNA (Chile)	• AARNet (Australia) • REANNZ (New Zealand)	• SANReN (South Africa)	• WACREN

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[7] Indiana University is not a Research and Education Network. However, via funding from the US National Science Foundation (NSF) does provide R&E connectivity from the NEA3R and TRANSPAC projects, and hence is listed here given its role in the global R&E networking community.

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	• ESnet • Indiana University (USA)	• ASREN		• CUDI (Mexico)			
SIG-MSP (management of service portfolios)				• REUNA (Chile) • RNP (Brazil)	• AARNet (Australia)	• SANReN (South Africa)	• WACREN
SIG-NOC (network operations centres)	CENIC (California, USA)					• SANReN/TENET (South Africa)	
TF-CSIRT (computer security incident response teams)			• KazRENA (Kazakhstan)	• CEDIA (Ecuador) • REUNA (Chile)		• SANReN (South Africa	
TF-EDU	• BCNET (British Colombia, Canada) • Internet2 (USA) • NSRC [8] (USA)	• ASREN • ARN (Algeria) • MARWAN (Morocco) • OMREN (Oman)	• TARENA (Tajikistan)	• CEDIA (Ecuador) • REUNA (Chile) • RNP (Brazil)	• APAN • BdREN (Bangladesh) • ERNET[9] (India) • MYREN (Malaysia) • REANNZ (New Zealand)	• UbuntuNet Alliance • KENET (Kenya) • RENU (Uganda) • SomaliREN (Somalia)	• WACREN • EKO-konnect (Nigeria) • Niger-REN (Niger) • RITER (Côte d'Ivoire)

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[8] The NSRC (Network Startup Resource Center) at the University of Oregon is not an R&E network but supports the capacity building of developing NRENs around the globe via NSF-funded projects, and is listed here given its role in the global R&E networking community.

[9] ERNET is a research and education network in India that reaches the global R&E networking community via its interconnection with NKN.

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-eHealth		• ASREN (Arab region)		• RedCLARA • CEDIA (Ecuador) • CUDI (Mexico) • RENATA (Colombia) • REUNA (Chile) • RNP (Brazil)	• AARNet (Australia)	• Eb@le (DRC) • KENET (Kenya)	
Security Day	• Internet2 (USA)			• CEDIA (Ecuador)		• RENU (Uganda) • SomaliREN (Somalia) • SANReN/TENET (South Africa)	
Network Performing Arts Production Workshops	• Internet2 (USA)						
Global Interactive Map	• CANARIE (Canada) • Internet2 (USA)			• RedCLARA (Latin America) • RNP (Brazil)	• NII/SINET (japan)	• UbuntuNet Alliance (Eastern and Southern Africa)	• WACREN (West and Central 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
Global Cloud Service Collaboration meetings	• CANARIE • Internet2 (USA)	• ASREN		• RedCLARA • RENATA (Colombia) • REUNA (Chile) • RNP (Brazil)	• AARNet (Australia) • CSTNET • NII/SINET • SingAREN	• UbuntuNet Alliance • KENET (Kenya) • RENU (Uganda) • SANReN (South Africa)	
GÉANT Community Programme InfoShare (2021)				• RENATA (Colombia) • RNP (Brazil)		• UbuntuNet Alliance	• WACREN • TogoRER (Togo)

Table 2.12: Participation of NRENs and RRENs outside Europe in GÉANT Community Programme and other activities 2020–May 2021

3 Deployment Update

3.1 GÉANT Network Services

This section describes work and conclusions that have been made on each of the actions related to GÉANT Network Services, three of which have been concluded and one relating to GTS that is on hold and will be taken up, if required, by the corresponding RREN (RedCLARA) in GN5-1.

Network Services Pricing

Description of Action:	Identify and share pricing guidelines for GÉANT Lambda, Layer 3 VPN and GÉANT Open cross-connects between GÉANT Open sites.
Global Partner:	RedCLARA
Status:	Concluded
Follow-up Activities:	Pricing for specific network services for RENs that are not GÉANT Members or Associates is dependent on the specific route and service of interest. This is because pricing can vary depending on the specific route (e.g., due to the number of hops involved), and, as such, can only be provided on a bespoke basis based on specific requirements, and expectation of contract duration. For example, GÉANT has for a number of years provided a GÉANT Lambda service to ESnet (USA) in Europe, and pricing for new Managed Wavelength Services to be deployed in 2023 has been provided to Internet2 and ESnet for specific routes.
	As regards GÉANT Open cross-connects between the GÉANT Open sites, a review has been initiated and is pending completion in the early stages of GN5-1.
	This information has been conveyed to RedCLARA, with the commitment that details on GÉANT Open cross-connect pricing will be provided once available.

MD-VPN

Description of Action:	Share technical documentation. Organise technical InfoShare if required.
Global Partner:	RedCLARA, UbuntuNet
Status:	Concluded

Follow-up Activities: Multi-domain VPN is a feature of the GÉANT network and, while GÉANT continues to maintain the feature on its backbone, its ongoing availability on the refreshed/updated network infrastructure delivered by GN4-3N cannot be guaranteed. Furthermore, it is not feasible for an MD-VPN service to be implemented across the GÉANT backbone and the backbone of a global peer (e.g., RedCLARA or UbuntuNet). However, in the event that RedCLARA and/or UbuntuNet wish to explore the possibility of deploying an MD-VPN instance across their own backbones and making it available among NRENs within their respective constituencies, GÉANT has shared the following MD-VPN documentation:

- GN3plus Deliverable D7.1 (MDVPN Service Architecture) [D7.1]
- GÉANT MD-VPN White Paper [MDVPNWP]

GTS (GÉANT Testbed Service)

Description of Action: Share technical documentation. Organise technical InfoShare if required.

Global Partner: RedCLARA

Status: On hold

Follow-up Activities: The GÉANT Testbed Service (GTS) has been discontinued during the GN4-3 project. At the same time, RedCLARA has yet to develop or deploy its own testbed service. However, in 2023, and in the context of the BELLA-II project, RedCLARA expects to begin work on a testbed or digital incubator service. At which time, GÉANT remains available to RedCLARA to share its testbed experiences.

GWS (GÉANT World Service)

Description of Action: Share indicative pricing of GWS rates together with service levels (e.g., redundancy).

Global Partner: UbuntuNet

Status: Concluded

Description: The GÉANT Procurement Team shared GWS pricing information with UbuntuNet Alliance in support of the UbuntuNet Alliance's work to access commodity pricing in Europe. UbuntuNet has subsequently secured commodity internet access pricing via its European Point of Presence (PoP) that is an improvement compared with pricing available within the East and Southern African region.

3.2   Network Support Service Actions

This section sets out the four actions related to GÉANT Network Support Services and describes subsequent work and conclusions that have been made on each of those actions.

NMaaS (Network Management as a Service)

Description of Action: Organise participation in GÉANT InfoShare, or organise separate InfoShare for global partners, as appropriate.

Global Partner: ASREN

Status: Concluded

Follow-up Activities: A GÉANT InfoShare on NMaaS was held on 25 November 2020, which was open to RENs across the globe. The recording of the InfoShare is available on the GÉANTtv YouTube channel [Clip1].

The NMaaS Service Definition document provides an overview of NMaaS including the following [NMaaSSD:

- Introduction (NMaaS, service description, service benefits).
- Service users (small/emerging NRENs, small organisations, GÉANT Community).
- Technical description (architecture, user roles and processes).
- Service operations (supporting infrastructure, operations and support team, service policies, service metrics).
- Service roadmap.

The Regional Networks have been informed that other useful information and links related to NMaaS are available on the GÉANT Network website [GNweb]. Further enquiries can be raised by contacting nmaas@lists.geant.org.

This information has been shared with RRRENs outside Europe (see the Global Service Outreach Feedback Document in Appendix A).

White Box

Description of Action: Organise participation in GÉANT InfoShare, or organise separate InfoShare for global partners, as appropriate.

Global Partner: RedCLARA

Status: Concluded

Follow-up Activities: A GÉANT InfoShare on White Box in the NREN context was held on 8 December 2021, setting out the results of the White Box work in the GN4-3 project. The recording of the InfoShare was made available on the GÉANTtv

YouTube channel [Clip2]. Presentations from the InfoShare were made available online [Events].

GN4-3 Deliverable D6.3 White Box Evaluation also provides an overview of work on White Box, as follows [D6.3]:

- White Box for Research and Education (NREN requirements and concerns, buffer size, performance tests).
- Use cases – selection and work methodology.
- Data plane programmability (use cases – in-band network telemetry, DDoS detection).
- Router for Academia Research and Education – RARE (project status)

Other useful links related to this topic and Network Technology Evolution are as follows:

- GÉANT White Box wiki page [WBwiki].
- RARE wiki page [RAREwiki].
- Deliverable D6.5 *Network Technology Evolution Report* [D6.5]..

This information has been shared with Regional Networks outside Europe (see the Global Service Outreach Feedback Document in Appendix A).

It is also to be noted that the GÉANT project has been collaborating with the Brazilian NREN, RNP, on the RARE project.

perfSONAR

Description of Action: Share link to online perfSONAR resources and perfSONAR Consultancy and Expertise Service.

Global Partner: TEIN*CC

Status: Concluded

Follow-up Activities: Links for perfSONAR resources, where all information, documentation, software downloads, etc. are available, have been shared with TEIN*CC and included in the Global Service Outreach Feedback Document (see Appendix A), made available to all Regional Network partners outside Europe. An e-mail address was also provided for perfSONAR-related queries (perfsonar@lists.geant.org)

- perfSONAR website [perfWeb]
- The GÉANT Network website's perfSONAR page [GNperf].

NetMon

Description of Action: Organise InfoShare.

Global Partner: UbuntuNet

Status: Concluded (NetMon discontinued).

Follow-up Activities: During the GN4-3 project NetMon was discontinued as most NetMon features were provided by perfSONAR. Where features were not covered by perfSONAR, the demand for those additional features was low. The UbuntuNet Alliance has therefore been informed that perfSONAR is the corresponding tool for consideration for network monitoring.

3.3 Trust and Identity Service Actions

FaaS (Federation as a Service)

Description of Action: Update on FaaS status in next phase of Service Outreach.

Global Partner: ASREN

Status: Concluded

Follow-up Activities: FaaS is deployed as a Platform as a Service, using infrastructure provided by the Polish NREN. At present the service remains only available for GÉANT Member and Associate RENs, and consequently is not available for use by ASREN at the current time.

At such a time that the constituent components of FaaS are available as open-source software so that they can use them to establish their own FaaS offering to their member NRENs, ASREN will be informed.

An update on FaaS status has been provided to ASREN.

eduTEAMS

Description of Action: Gather details of international use cases for eduTEAMS; liaise with WP5 Trust & Identity on how international use cases can be served.

Global Partner: ASREN, RedCLARA, UbuntuNet

Status: Ongoing

Follow-up Activities: No specific use cases have been identified to GÉANT by ASREN, RedCLARA or the UbuntuNet Alliance. However, RedCLARA continue to explore the relevance of a service like eduTEAMS for their own Trust and Identity offering in Latin America, and dialogue with the eduTEAMS team is expected to continue in the GN5-1 project.

InAcademia

Description of Action: Liaise with WP5 Trust & Identity on the feasibility of InAcademia availability outside Europe and provide update to global partners.

Global Partner:	ASREN (AUB, EUN), RedCLARA, UbuntuNet.

Status:	Concluded

Follow-up Activities:	Due to the complexities around legal and regulatory frameworks for international service delivery of InAcademia, GÉANT's focus remains on the delivery of the service for the GÉANT Membership. At any such time that an international delivery model is identified, this will be shared with international RENs as appropriate. ASREN, RedCLARA and the UbuntuNet Alliance have been informed of the current status of InAcademia.

IdP for SESAME

Description of Action:	Continued engagement with ASREN on how SESAME can be delivered and whether GÉANT support is required.

Global Partner:	ASREN (SESAME, Jordan)

Status:	Concluded

Follow-up Activities:	The SESAME user portal has a successfully deployed IdP, which enables access for researchers to submit requests for beam time via the SESAME user portal [SESAMEPortal]. Further support from GÉANT has not been required.

eduGAIN

Description of Action:	Share link to eduGAIN Database Explorer; engage on whether meets RedCLARA requirements. Further liaison with WP5 Trust & Identity, if applicable.

Global Partner:	RedCLARA

Status:	Concluded

| Follow-up Activities: | RedCLARA's interest relates to being able to promote the value of eduGAIN to NRENs and for NRENs to their user institutions, by providing information on the services the users can access via eduGAIN. The URL of the eduGAIN Entities Database listing all Service Providers and IdPs in eduGAIN, has been shared with RedCLARA [EntitiesDB].

However, it has also been clarified to RedCLARA that access to any given service is determined by the service provider itself. In this sense, access can be permitted based on pre-defined entity categories supported by the eduGAIN entities or on bilateral agreements between the IdP and the Service Provider and that this information is not available, nor can be made available, in the eduGAIN Database Explorer. |
|---|---|

eduroam

Description of Action: Identify and share eduroam dissemination materials to encourage eduroam deployment and best practices at institutions.

Global Partner: UbuntuNet

Status: Concluded

Follow-up Activities: A large range of materials relating to eduroam is available online ranging from technical information on eduroam deployment, to communication materials to support marketing. An overview of the materials has been included in the Global Service Outreach Feedback Document (in Appendix A), shared with all Regional Networks outside Europe, as set out below.

- eduroam "how to" wiki site on the deployment, promotion and support of eduroam [HowTo].
- eduroam media and resources webpage [MediaRes].

It is also to be noted that in early 2023, the AfricaConnect3 project will be running an "eduroam in Africa" communications campaign that will contribute to supporting the UbuntuNet Alliance in its development of eduroam, alongside ASREN and WACREN.

3.4 Security Service Actions

eduVPN

Description of Action: Direct ASREN to online eduVPN deployment information and support links.

Global Partner: ASREN (Ankabut; AUB; EUN)

Status: Concluded

Follow-up Activities: The following links relating to eduVPN have been provided to ASREN for further distribution as appropriate among the ASREN membership. The information has also been added to the GÉANT Service Outreach Feedback document (see Appendix A) made available to all Regional Networks outside Europe:

- eduVPN GitHub site [eduVPNgit1]
- eduVPN documentation (github site) [eduVPNgit2]
- eduVPN website [eduVPN]
- eduVPN download link [Download]
- Added general eduVPN queries contact address: eduvpn-support@lists.geant.org

TCS (1) & (2)

Description of Actions: Confirmation of continued service delivery for existing subscribers. Liaise with TCS to obtain best practices.

Global Partner: ASREN

Status: Concluded

Follow-up Activities: GÉANT has confirmed that the TCS remains available to ASREN NRENs that have been using the service to date. The service continues to be used by the NRENs of Morocco, Lebanon, and Oman.

SOC Tools and NSHaRP

Description of Actions: Liaise with GN4-3 WP8 Security on information that can be shared with global partners on security tools identified by SOC tools work.

Organised InfoShare on GÉANT security tools open to all global partners.

Global Partner: ASREN, RedCLARA, TEIN*CC

Status: Concluded

Follow-up Activities: The GN4-3 project has produced deliverables relating to various aspects of security (see below).

Document Name	Description	Link
Security Baseline for NRENs (March 2020)	Sets out a Security Baseline for organisational security against which NRENs can assess their own security position internally, recognise gaps that need development and plan for future projects.	https://geant.org/wp-content/uploads/2021/11/D8-2_Security-Baseline-for-NRENs.pdf
GÉANT Community Requirements for Business Continuity Planning (May 2021)	Gives an overview of Business Continuity Management (BCM) and provides guidelines for NRENs on implementation. It shows relations with and dependency on other processes and gives guidance on how to make optimal use of combining security and continuity improvements from different angles.	https://geant.org/wp-content/uploads/2021/11/D8-12_GE%CC%81ANT-Community-Requirements-for-Business-Continuity-Planning.pdf
Best Practices for Security Operations in Research and Education (June 2022)	A report on the concepts of security operations, including its goals, benefits and best practices, and of operational intelligence, as well as Security Operations Centres (SOCs) as a means to realise their practical implementation. It presents three research and education SOC case studies, including utilisation of the SOCTools package developed by GN4-3 WP8 Security, Task 3.1 Security Operations Centre.	https://geant.org/wp-content/uploads/2022/07/D8-9_Best-Practices-for-Security-Operations-in-RE.pdf

Table 3.1: GN4-3 deliverables relating to security

In addition, a series of training events have been carried out between 2020 and 2022 which are available to view online. The full list of these, including links to presentations and recordings, can be found online [Training].

On 15 December 2022 an "R&E SOC Workshop" will be held and is open to R&E networks around the globe. Further information and registrations are available online [InfoReg].

Firewall on Demand

Description of Action: Coordinate service request for deployment of Firewall on Demand (FoD) IdP to ARN (Algeria).

Global Partner: ASREN (ARN)

Status: No longer required

Follow-up Activities: WP1 Project Management, Task 6 Global Partnerships/Service Outreach has continued to engage with the Algerian NREN (ARN) on their interest in FoD. However, the focus of ARN since the initial request has been placed elsewhere and at the end of the GN4-3 project, the requested support is considered no longer required.

TRANSITS

Description of Action: Liaise with TRANSITS regarding interest in a virtual model for TRANSITS and report conclusions to UbuntuNet.

Global Partner: UbuntuNet

Status: Concluded

Follow-up Activities: In a response to the COVID-19 pandemic, one TRANSITS training course has been carried out virtually, though it proved not to be as effective as in-person capacity-building, and there is a strong preference for future TRANSITS courses to continue to be organised as in-person events. In response to the UbuntuNet Alliance's interest in a TRANSITS event for the East and Southern African region, an in-person TRANSITS course was held in Nairobi, Kenya, in the week of 7 November 2022, with a total of 15 participants benefiting from the training.

3.5   Real-time Communications and Educational Support Actions

openUp2U

Description of Action: Promote openUp2U survey to all global partners, and share conclusions and plans

Global Partner: All

Status: Concluded

Follow-up Activities: openUp2U was developed and offered in direct response to the COVID-19 pandemic. It provided a digital learning environment, including tools for course management, videoconferencing, and file sharing that were integrated into a learning management system. The service was set up specifically to provide support for educational institutions who have no alternative solution for remote teaching and learning during a very challenging 2020. While it was intended to run until the end of 2020, openUp2U was extended for three months in early 2021 and then discontinued from 14 April 2021.

3.6   Other Global Service Outreach Actions

FileSender

Description of Action: Direct Ankabut (United Arab Emirates) to deployment and support information on FileSender website.

Global Partner: ASREN (Ankabut), TEIN*CC

Status: Concluded

Follow-up Activities: FileSender software is available to download, and a GitHub page is available [FileSenderSW], [FileSendergit]. This information has been shared with ASREN and TEIN*CC.

Cloud

Description of Action: Promote participation in Global Cloud Collaboration activities.

Global Partner: ASREN / All

Status: Concluded

Follow-up Activities: Historically, GÉANT has organised Global Cloud Collaboration Meetings held alongside the GÉANT TNC conference. The meetings enable RENs from around the globe to share experiences and challenges in the delivery of cloud services, whether commercial or in-house solutions. In 2021 and 2022, the Global Cloud Collaboration meetings have been held virtually, each year with two sessions held at different times of the day to enable participation from around the globe. In 2021 the sessions were held in June, and in 2022 in October. Participation was made available via the GÉANT Events page [GNEvents] and also via direct information sent to the Regional Networks around the world, as well as to participants from previous events. Participation in these two events is described in Section 2.6.

Collective Purchasing

Description of Action: Explore options to respond to interest in collaborative space for collective purchasing activities.

Global Partner: RedCLARA

Status: Pending

Follow-up Activities: The concept of collective purchasing builds on the idea of RENs around the globe collaborating to promote their profile with suppliers across the globe, with a view to obtaining comparable conditions in contracts for RENs wherever they may be located. Whilst discussions on this approach have taken place, for instance in the Global NREN CEO Forum, further discussion is required to determine if this work is feasible and how best to proceed. Discussions on this topic will continue with RedCLARA, and as appropriate with other RENs.

4 Conclusions

Since the *Global Service Status and Deployment Plan* was published in July 2020, GÉANT services have seen worldwide growth in a number of areas. In particular, international connectivity, with significant increases in connectivity to the USA, Latin America, North Africa and Western Asia and South Africa. The GÉANT Plus service has also had greater take-up by International RENs.

Other growth has included eduGAIN, granting Participant Status for five identity federations, as well as for two catch-all Identity Federations. The Trusted Introducer service has seen a net addition of three CSIRTS and eduVPN deployments have a net increase of six. There has also been an increase in the number of NRENs from outside Europe participating in GÉANT Community Programme activities.

Services without increase in uptake are GÉANT Open and TCS, although it is to be noted that TCS is principally available to GÉANT Membership NRENs only, and so growth outside Europe is not expected, nor targeted.

Small decreases in the services and tools reported on have been seen in eduroam, with an eduroam Operator no longer listed for Rwanda, and perfSONAR deployments down by 4 countries.

Of a total of 25 Global Service Outreach actions listed in D1.4, 84% have been concluded, and three of the remaining four actions have either been cancelled by the requesting REN or require further input from the requesting REN for progress to be made.

Interest at RRENs and NRENs in services developed within the GÉANT Community remains strong, and there remains room for wider deployment of some services (e.g. eduroam and eduGAIN) and collaboration and dialogue in other areas (e.g. security).

Increased global participation in GÉANT Community Programme activities is welcome, and a focus on encouraging further participation should be a priority for the future.

Appendix A GÉANT Service Outreach Feedback

A.1 Introduction

As part of the WP1 Project Management, Task 6 Global Partnerships work of the GN4-3 project, the Task team reached out to Regional Research and Education Networks (RRENs) around the globe (ASREN, CAREN CC, RedCLARA, TEIN*CC, UbuntuNet Alliance and WACREN) to engage on services, tools and GÉANT Community Programme (GCP) activities. In these discussions, the RRENs requested further information in a number of service areas. This document brings together information on each of these areas which may be of interest to all RRENs across the globe in the following service areas:

- Network Support Services
- Trust and Identity
- Security Services
- Cloud Services

A.2 Network Support Services

NMaaS (Network Management as a Service)

A GÉANT InfoShare on NMaaS was held on 25 November 2020, which was open to RENs worldwide. The recording of the InfoShare is available on the GÉANTtv YouTube channel [GÉANTtv].

GN4-3 Deliverable D8.7 Network-Management-as-a-Service-Production-Service [NMaaSSD] (provides a service description of NMaaS, including the following:

- Introduction (NMaaS, service description, service benefits).
- Service users (small/emerging NRENs, small organisations, GÉANT Community).
- Technical description (architecture, user roles and processes).
- Service operations (supporting infrastructure, operations and support team, service policies, service metrics).
- Service roadmap.

Other useful information and links related to NMaaS are available on the GÉANT Network website [NMaaS]. An email for partners' further enquires was made available: nmaas@lists.geant.org.

White Box

A GÉANT InfoShare on White Box in the NREN context was held on 8 December 2021, setting out the results of the White Box work in the GN4-3 project. The recording of the InfoShare was made

available on the GÉANTtv YouTube channel [WBInfoShare]Presentations from the InfoShare were also posted online [WBpresentations**]**

GN4-3 Deliverable D6.3 White Box Evaluation [D6.3] also provides an overview of work on White Box, as follows:

- White Box for Research and Education (NREN requirements and concerns, buffer size, performance tests).
- Use cases – selection and work methodology.
- Data plane programmability (use cases – in-band network telemetry, DDoS detection).
- Router for Academia Research and Education – RARE (project status). [D6.3]

Other useful links related to this topic and Network Technology Evolution are as follows:

- GÉANT White Box wiki page [WB wiki]
- RARE wiki page[RARE wiki]
- Deliverable D6.5 – Network Technology Evolution Report [D6.5]

perfSONAR

Links for perfSONAR resources, where all information, documentation, software downloads, etc. are available online as follows:

- perfSONAR website [perfSONAR]
- GÉANT Network website perfSONAR page [GNperf]:
- An email for perfSONAR enquiries was also made available: perfsonar@lists.geant.org

A.3   Trust and Identity Services

eduroam

A large range of materials relating to eduroam is available online ranging from technical information on eduroam deployment, to material, to supporting marketing.

- eduroam "how to" wiki site on the deployment, promotion and support of eduroam [eduroam wiki]

A.4   eduroam media and resources webpage [eduroam site]Security Services

eduVPN

Information on eduVPN can be obtained via the following links:

- eduVPN GitHub site [eduVPNgit1]
- eduVPN documentation (GitHub site): [eduVPNgit2]
- eduVPN website [eduVPN]
- eduVPN download link [eduVPNdown]: https://www.eduvpn.org/client-apps/

General eduVPN queries contact address was also made available to partners eduvpn-support@lists.geant.org

SOC Tools

GÉANT has produced deliverables relating to various aspects of security in Table A.1

Document Name	Description	Link
Security Baseline for NRENs (March 2020)	Sets out a Security Baseline for organisational security against which NRENs can assess their own security position internally, recognise gaps that need development and plan for future projects.	https://geant.org/wp-content/uploads/2021/11/D8-2_Security-Baseline-for-NRENs.pdf
GÉANT Community Requirements for Business Continuity Planning (May 2021)	Gives an overview of Business Continuity Management (BCM) and provides guidelines for NRENs on implementation. It shows relations with and dependency on other processes and gives guidance on how to make optimal use of combining security and continuity improvements from different angles.	https://geant.org/wp-content/uploads/2021/11/D8-12_GE%CC%81ANT-Community-Requirements-for-Business-Continuity-Planning.pdf
Best Practices for Security Operations in Research and Education (June 2022)	A report on the concepts of security operations, including its goals, benefits and best practices, and of operational intelligence, as well as Security Operations Centres (SOCs) as a means to realise their practical implementation. It presents three research and education SOC case studies, including utilisation of the SOCTools package developed by GN4-3 WP8 Task 3.1 Security Operations Centre.	https://geant.org/wp-content/uploads/2022/07/D8-9_Best-Practices-for-Security-Operations-in-RE.pdf

Table A.1:Security Deliverable list

In addition, a series of training events have been carried out between 2020 and 2022 which are available to view online, including links to presentations and recordings [SecurityTr]

On the 15 December 2022 an "R&E SOC Workshop" was held for R&E networks around the globe.

A.5 Cloud Services

Cloud Collaboration

GÉANT has organised Global Cloud Collaboration Meetings alongside the TNC conference in recent years. The meetings enable RENs from around the globe to share experiences and challenges in the delivery of cloud services, whether commercial or in-house solutions. In 2021 and 2022, the Global Cloud Collaboration meetings were held virtually, each year with two sessions held at different times

of the day to enable participation from around the globe. Recordings and presentations from the 2022 virtual sessions are available to view and download from the GÉANT International wiki [Intlwiki].

Further sessions are expected to be organised in the future. Information will be distributed in advance.

A.6   GÉANT Community Programme

The GÉANT Community Programme (GCP) helps support the Research and Education networking community with Task Forces (TFs), Special Interest Groups (SIGs), workshops and other activities on the following thematic areas:

- Security
- Media Services
- Support Services
- Identity and Privacy
- Cloud Services
- Organisational Services
- Education Services and Technologies
- Network Services and Technologies
- Health Services

Participation open to R&E Networks around the globe. More information on the SIGs, TFs and other activities in the GCP can be found on the GÉANT website [Community]

Appendix B Regional RENs, Countries and NRENs

Regional R&E Networks and National R&E Networks are listed in sections B.1 to B.7, as follows:

- B.1 North Africa and Western Asia
- B.2 Central Asia
- B.3 Latin America
- B.4 Asia-Pacific
- B.5 East and Southern Africa
- B.6 West and Central Africa
- B.7 Canada and USA

B.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 are listed in Table B.1, below.

Country	NREN	Website
Algeria	ARN	http://www.arn.dz/
Egypt	EUN	https://scu.eg/pages/eun#
	ENSTINET	http://www.sti.sci.eg/
Iran*	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 B.1: North Africa and Western Asian NRENs

* IRANET is not a member of ASREN

B.2   Central Asia

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

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

Table B.2: Central Asian NRENs

B.3   Latin America

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

Country	NREN	Website
Argtentina	INNOVA|RED	–
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	http://www.runba.edu.ni/
Uruguay	RAU	http://www.rau.edu.uy/

Table B.3: Latin America – countries and NRENs

Argentina (Innova|Red); El Salvador (RAICES - http://www.raices.org.sv/);

B.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	www.dit.gov.bt
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/kor/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/
	ASGC	http://www.twgrid.org/en/
Thailand	ThaiREN	http://www.thairen.net.th/ThaiREN/
Vietnam	VINAREN	http://en.vinaren.vn/

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

B.5 East and Southern Africa

Regional R&E Network: UbuntuNet Alliance - https://ubuntunet.net/

Country	NREN	Website
Burundi	BERNET	https://ubuntunet.net/members/nren/bernet/
Democratic Republic of the Congo	Eb@le	https://www.ubuntunet.net/ebale
Ethiopia	EthERNet	https://www.ubuntunet.net/ethernet
Kenya	KENET	https://kenet.or.ke/
Madagascar	iRENALA	http://www.irenala.edu.mg/
Malawi	MAREN	http://www.maren.ac.mw/
Mozambique	MoRENet	https://www.ubuntunet.net/morenet
Namibia	Xnet	https://www.ubuntunet.net/xnet
Rwanda	RwEdNet	https://www.ubuntunet.net/rwednet
Somalia	SomaliREN	http://somaliren.org/
South Africa	SANReN	http://www.sanren.ac.za/
	TENET	http://www.tenet.ac.za/
Sudan	SudanREN	http://www.suin.edu.sd/
Tanzania	TERNET	https://www.ternet.or.tz/
Uganda	RENU	https://www.renu.ac.ug/
Zambia	ZAMREN	http://www.zamren.zm/
Zimbabwe	ZARNet	http://www.zarnet.ac.zw/

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

B.6 West and Central Africa

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

Country	NREN	Website
Benin	RerBenin	http://www.rerbenin.net/
Burkina Faso	FasoREN	–
Cameroon	RIC	http://www.minesup.gov.cm/site/

Country	NREN	Website
Chad	TchadREN	–
Côte d'Ivoire	RITER	http://www.riter.ci/
Gabon	GabonREN	http://www.enseignement-superieur.gouv.ga/
Ghana	GARNET	http://garnet.edu.gh/
Guinea	Gn-REN	–
Mali	MaliREN	http://www.maliren.ml/
Niger	NigerREN	https://map.geant.org/NigerREN
Nigeria	NgREN	http://www.ngren.edu.ng/
Senegal	snRER	http://snrer.edu.sn/
Sierra Leone	SLREN	–
Togo	TogoRER	http://rer.togorer.tg/

Table B.6: West and Central African NRENs

B.7 Canada and USA

National R&E networking in Canada and the USA is provided for by the NRENs listed in Table B.7, below.

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

Table B.7: NRENs in Canada and the USA

References

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Glossary

APAN	Asia Pacific Advanced Network
ASREN	Arab States Research and Education Network
CAREN CC	Central Asia Research and Education Network Coordination Centre
CSIRT	Computer Security Incident Response Team
FaaS	Federation as a Service
FoD	Firewall on Demand
GTS	GÉANT Testbed Service
GWS	GÉANT World Service
IdP	Identity Provider
IP	Internet Protocol
L*n*	Layer *n*
LHCONE	Large Hadron Collider Open Network Environment
MD-VPN	Multi-Domain Virtual Private Network
NMaaS	Network Management as a Service
NREN	National Research and Education Network
NSHaRP	Network Security Handling and Response Process
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
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
SOC	Security Operations Centre
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
VPN	Virtual Private Network
WACREN	West and Central African Research and Education Network
WP	Work Package