

Annex 1 – Description of Work

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Table of Contents

1	Excellence	6
1.1	Objectives and Ambition	7
1.2	Methodology	11
1.3	Effectiveness and Agility in Developing New Services	13
2	Impact	19
2.1	Project's Pathways Towards Impact	19
2.2	Measures to Maximise Impact – Dissemination, Exploitation and Communication	29
2.3	Summary	33
3	Quality and Efficiency of the Implementation	35
3.1	Work Plan and Resources	35
3.2	Capacity of Participants and Consortium as a Whole	84
Appendix A	References and Glossary	87
	References	87
	Glossary	93
	GN5-2 Project Calendar	95

List of participants

Participant No.	Participant organisation name	Country
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3	UNIVERZITET U BEOGRADU (AMRES)	Serbia
4	AKADEMSKA IN RAZISKOVALNA MREZA SLOVENIJE (ARNES)	Slovenia
5	INSTITUTE OF INFORMATION TECHNOLOGY OF AZERBAIJAN NATIONAL ACADEMY OF SCIENCE (AzScienceNet)	Azerbaijan
6	BELNET BELGISCH TELEMATICA ONDERZOEKNETWERK (Belnet)	Belgium
7	SDRUZENIE BULGARSKA IZSLEDOVATELSKAI OBRAZOVATELNA MREZHA (BREN)	Bulgaria
8	HRVATSKA AKADEMSKA I ISTRAZIVACKA MREZA CARNET (CARNET)	Croatia
9	CESNET ZAJMOVE SDRUZENI PRAVNICKYCH OSOB (CESNET)	Czechia
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11	VEREIN ZUR FOERDERUNG EINES DEUTSCHEN FORSCHUNGSNETZES DFN VEREIN E.V. (DFN-Verein)	Germany
12	FUNDACAO PARA A CIENCIA E A TECNOLOGIA (FCT)	Portugal

Participant No.	Participant organisation name	Country
13	CONSORTIUM GARR (GARR)	Italy
14	GEORGIAN RESEARCH AND EDUCATIONAL NETWORKING ASSOCIATION (GRENA)	Georgia
15	NATIONAL INFRASTRUCTURES FOR RESEARCH AND TECHNOLOGY (GRNET)	Greece
16	HARIDUS- JA TEADUSMINISTEERIUM (EENET at HTM)	Estonia
17	HEANET LTD (HEAnet)	Ireland
18	LATVIJAS UNIVERSITATES MATEMATIKAS UN INFORMATIKAS INSTITUTS (IMCS UL)	Latvia
19	MACHBA - INTERUNIVERSITY COMPUTATION CENTER (IUCC)	Israel
20	KORMANYZATI INFORMATIKAI FEJLESZTESI UGYVONKSEG (KIFU)	Hungary
21	KAUNO TECHNOLOGIJOS UNIVERSITETAS (LITNET)	Lithuania
22	Ss. CYRIL AND METHODIUS UNIVERSITY IN SKOPJE (UKIM)	North Macedonia
23	JAVNA USTANOVA UNIVERZITET CRNE GORE PODGORICA (MREN)	Montenegro
24	NORDUNET A/S (NORDUnet)	Denmark
25	INSTYTUT CHEMII BIOORGANICZNEJ POLSKIEJ AKADEMII NAUK (PSNC)	Poland
26	ENTIDAD PUBLICA EMPRESARIAL RED.ES (RedIRIS)	Spain
27	RESEARCH AND EDUCATIONAL NETWORKING ASSOCIATION OF MOLDOVA (RENAM)	Moldova
28	GROUPEMENT D INTERET PUBLIC POUR LERESAU NATIONAL DE TELECOMMUNICATIONS POUR LA TECHNOLOGIE L ENSEIGNEMENT ET LA RECHERCHE (RENATER)	France
29	FONDATION RESTENA (RESEAU TELEINFORMATIQUE DE L'EDUCATION NATIONALE ETDE LA RECHERCHE) (RESTENA)	Luxembourg
30	Agentia de Administrare a Retelei Nationale de Informatica Pentru Educatie si Cercetare (RoEduNet)	Romania
31	ZDRUZENIE POUZIVATELOV SLOVENSKEJAKADEMICKEJ DATOVEJ SIETE-SANET (SANET)	Slovakia
32	SURF BV (SURF)	Netherlands
33	TURKIYE BILIMSEL VE TEKNOLOJIK ARASTIRMA KURUMU (TUITAK)	Turkey
34	UNIVERSITA TA MALTA (UoM)	Malta
35	INSTITUTE FOR INFORMATICS AND AUTOMATION PROBLEMS OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF ARMENIA (ASNET-AM)	Armenia
36	ASSOCIATION OF USERS OF UKRAINIAN RESEARCH AND ACADEMIC NETWORK URAN (URAN)	Ukraine
37	RASH INTERNATIONAL COOPERATION RASH INCO (RASH Inco)	Albania
38	Jisc LBG (Jisc)	UK
40	PRO M PROFESSZIONALIS MOBILSZOLGALTATO ZARTKORUEN MUKODO RESZVENYTARSASAG	Hungary

Participant No.	Participant organisation name	Country
Associate Partner		
39	SWITCH (SWITCH)	Switzerland

1 Excellence

The GÉANT Consortium is formed by the 38 project partners, 1 associated partner, and combined infrastructures of the GÉANT Association and each of the National Research and Education Networks (NRENs), 1 of which, SWITCH (Switzerland), is an associated organisation at present. GÉANT is a fundamental element of Europe's e-infrastructure landscape for the European Research Area (ERA) and enabler of scientific excellence, research, education and innovation. Extending and securing the global reach of the pan-European GÉANT network and its highly reliable, unconstrained access to computing, analysis, storage, applications and other resources, GÉANT ensures that Europe remains at the forefront of research worldwide and protects European sovereignty with appropriate data security standards.

The GÉANT partnership provides the platform for safe, secure and rapid transfer of data within the European research and education (R&E) community. Pan-European research infrastructures, such as LOFAR, CERN, ELIXIR, SKA, EOSC, ESFRI, and EuroHPC, as well as national research infrastructures, depend on GÉANT to make network, data, security and access services available to users from many disciplines to increase the knowledge base and extend research capabilities. Federated trust and identity (T&I) services ensure that individual access to resources is regulated in accordance with the requirements of European research and educational institutions. The technical innovation and cost-sharing principles developed over the years by the GÉANT partnership provide bespoke services and exceptional, unconstrained, pan-European and global connectivity to the R&E community not available through commercial providers, which helps to diminish the impact of the digital divide within Europe. Pan-European research infrastructures and large scientific projects such as those mentioned above already generate vast volumes of data, which will continue to increase in size. The aim of the GÉANT partnership is to serve research and education users throughout the data deluge now facing digital science, driving terabit connectivity to research and data spaces, and maintaining the service excellence established over many years.

Today, the GÉANT infrastructure serves the European knowledge economy through its open, innovative and trusted information environment (the European Communication Commons). Greater than the sum of its parts, it provides secure, cost-effective and reliable services for very high-speed connectivity, digital identity management, resource virtualisation, mobility, and security, and ensures provision of a continuum of digital services to European users.

Benefiting from the continued support and commitment of the EC for over 30 years, and continuing under the 72-month GN5 Framework Partnership Agreement in Horizon Europe (GN5-FPA), this proposal responds to Horizon Europe Call HORIZON-INFRA-2024-GEANT-01-SGA (Work Programme 2023-2024 Specific Grant Agreements to FPA 1. SGA to the FPA for Research and Education Networks (2024), updated 18 April 2024.

The work proposed in GN5-2 aims to provide scientists, researchers, educators and students access to connectivity and collaboration services needed to support evidence-based decision making, transfer knowledge, and ensure effective collaboration of virtual research and learning communities around the world. Continuing the success of GN5-1, and the ongoing work in GN5-IC1, GN5-2 implements the second period of the GN5-FPA action plan, in particular, ensuring high-quality connectivity for excellence in Research and Education. In addition to the synergies between the action and the connectivity offered by GN5-IC1, the proposed project will comply with the priorities of Horizon Europe in areas common to all projects, such as data security and access control, innovation, reducing environmental impact and contributing to data-centric collaboration and adoption of FAIR principles. The strengthening of the European Communication Commons will also strengthen the European Research Area and the European Research agenda, increasing European data sovereignty and addressing the expected increase in data volume and diversity of data sources and user communities.

The GÉANT Consortium is able to offer its distinctive services due to its human network of thousands of professionals, in a community that has a deep understanding of its users and their requirements as they evolve. Within this community, knowledge and experience are shared between partners to constantly enhance the quality of the services offered and increase their use, making research and education an indispensable element of the ERA. Each NREN is funded at a national level to operate and develop its national connectivity and support infrastructure, providing true end-to-end delivery services to users via the national mesh of research and educational institutes. One example of the strength and responsiveness of the members of the GÉANT partnership is the strengthening of distance education and more flexible learning delivery following the COVID-19 pandemic. The use of open and distance learning imposed by the pandemic has influenced the educational mix offered, as the GÉANT partnership applies such experience to support new challenges.

1.1 Objectives and Ambition

Using the Consortium's operational and infrastructure-led expertise, the proposed GN5-2 project aims to address the challenge to provide faster, resilient, agile and secure connectivity and collaboration services for an increasing amount of data, to enable scientists, researchers, educators and students access to near-real-time applications that support evidence-based decision-making in society, and effective collaboration of virtual research and learning communities, worldwide. The challenge posed by the increase in the diversity of the user community across multiple disciplines and data types as new data lakes and applications (e.g. Open Science, EOSC, quantum key distribution (QKD) and time and frequency) expand the target audience for the GÉANT connectivity will also be addressed, in particular, through planned Trust & Identity developments.

Through GN5-2, GÉANT will maintain the operational excellence of the established GÉANT services, while still achieving economies on the costs of the backbone network. The reliable, secure and state-of-the-art, high-speed network services, together with authentication mechanisms offered to researchers and other network users across Europe, will remain exceptional. In addition, maintaining state-of-the-art security for the community by developing and implementing a number of security products and services will also be vital to GN5-2. Further details about the services developed by the work packages (WPs) and their technology readiness level are outlined in Section 1.3.

The proposed work is complementary to other projects being implemented (GN5-IC1) and those to be proposed under GN5-FPA.

1.1.1 Objectives

GN5-2 aims to provide faster, more resilient, and secure connectivity infrastructure and collaboration services to enable researchers, educators, and students' access to applications that support evidence-based and effective collaboration across virtual research teams, worldwide. The project continues the development of state-of-the-art, cost-effective, secure, and resilient connectivity to provide unconstrained capacity ahead of demand in the backbone network and NREN access, proposing to provide dedicated connectivity up to Terabit capacity, where needed. GN5-2 continues to prototype, pilot and, where appropriate, procure new online above-the-net services, and deliver pervasive, innovative, and distributed trust and identity infrastructure and services to achieve strategic positioning of Trust and Identity services as a key enabler of research and education collaboration within Europe.

GN5-2 has determined the following project objectives (derived from the GN5-FPA objectives and Actions) and the EC expected outcomes in the Work Programme 2023-2024, which are addressed in Section 2.1.1 and the work packages. Links to UN SDGs are also indicated, which are monitored as part of the project output (WP2 T4 and all WPs). These form an essential part of the action.

Project Objective	Relevant Work Package	Applicable Sustainable Development Goal / Targets
1.To advance, deliver and support a secure, pan-European network connectivity infrastructure and related services able to support science, research and education requirements and connect European researchers, staff and students anywhere in the world for the wider European Digital Infrastructure	WP6, WP7 (Service DevOps)	SDG 4 Quality Education Target 4.3, 4.4, 4.5, 4B
2. To understand and serve the communication networking needs and collaboration between the European NRENs, their expanding user community and important European and global stakeholder groups	WP1, 2, 3 (Support)	SDG5 Gender Equality Target 5.1, 5.5, 5B SDG17 Partnership for the Goals Target 17.6,17.8, 17.9, 17.16
3. To enable researchers, students and staff to cooperate and exchange data with their peers through interoperable and secure connectivity infrastructure and services. (WP8) (Service DevOps)	WP8 (Service DevOps)	SDG 13 Climate Action Target 13.3 SDG17 Partnerships for the Goals Target 17.6, 17.7, 17.8, 17.16, 17.18
4. To facilitate and enable, through the project, the needs of a wide user base across multiple disciplines for excellent science and research by delivering a broad range of existing and innovative new services. These services incorporate agile incubator development and sustainable operation following thorough business model practices	All WPs (Support and Service DevOps)	SDG4 Quality Education Target 4.3, 4.4, 4.5, 4B SDG9 Industry, Innovation and Infrastructure Target 9.1, 9.4, 9.5 SDG13 Climate Action Target 13.3
5. To prototype, pilot and, where appropriate, procure new online above-the-net services and operate and continuously enhance the T&I services and underlying infrastructure to enable students and researchers to preserve privacy	WP4 and WP5 (Service DevOps)	SDG4 Quality Education Target 4.3, 4.4, 4.5 SDG9 Target 9.1,9.5, 9C SDG16 Peace, Justice and Strong Institutions Target 16.6, 16.10, 16A
6. To provide operations support for first- and second-line functions (including training) to ensure that developed applications are secure and fit-for-service before going into operation	WP9 (Ops)	SDG4 Quality Education Target 4.4, 4.5 SDG5 Gender Equality Target 5.5, 5B SDG9 Industry, Innovation and Infrastructure Target 9.1, 9.5

Table 1.1: GN5-2 Project Objectives

The project results and outcomes of these objectives are regularly measured and reported on by the work package leaders through deliverables, such as the Management Report, and monitored by WP1 Project Management, which maps progress on a monthly basis. Project Annual Internal Review (PAIR) reviews, identify potential issues and resolves or raises these to the Project Management Board (PMB), supporting work package interdependencies. Dedicated Key Performance Indicators also help measure and track results, as described in all Work Packages (Section 3). The effects of these objectives and their results feed into the project outcomes listed in Section 2.1.1 as well as an assessment of requirements and barriers that could limit their impact, which are detailed in Section 2.1.6.

These objectives will be addressed respecting the societal and scientific boundary conditions and evolutions detailed below:

- Operational excellence, delivery, and evolution of the current portfolio of pervasive services – widely known as the European Communication Commons – for the ERA. On a national level, the long-established and proven, federated, delivery model of services and support is assured by national research and educational institutions to their end users, with NRENs providing extensive support, connectivity and services. On a pan-European and global scale, the GÉANT partnership provides end-to-end connectivity, T&I and other collaborative services. Together, these form the foundation of the Commons. New challenges posed by geopolitical changes, cyber security threats, electronic identification issues and digital sovereignty will be pushing the requirements for rapid innovation without compromising operational excellence and security, as well as allowing the testing of disruptive new technologies.
- The data-driven evolution of research and education in Europe and worldwide. The connectivity requirements to allow the pre-exascale/exascale EuroHPC resources, and the new and existing research infrastructures' instrument data, to widely benefit the European scientific community, without undue limitations to geographical access, is a challenge that will be addressed. The project's commitment to secure infrastructure addresses the Common European Data Spaces commitment to harness the value of data and EOSC's aim to develop a Web of FAIR Data and services seen throughout WP4, WP5 and individual NRENs' contribution. Also, as reflected in the Digital Education Action Plan, the demand for new modes of education, including distance, remote, and blended learning will affect connectivity requirements, as has been seen during the COVID-19 pandemic [Digital Ed].
- Preservation of the principles of neutrality and transparency, security, privacy, data sovereignty, and Open Science Policy agenda of the communication platform. Such characteristics are essential for excellence in research and education, innovation in general, and for preserving European sovereignty, as health applications (viz. GDPR), advanced semiconductor research applications, energy (e.g. ITER) and other sensitive applications may all use the GÉANT network.

GN5-2 is also aligned with EU policies, ambitions and objectives as follows:

WP1 commits to the transparency, accountability and adherence to project timelines and budgets in line with EU project management standards of Horizon Europe.

WP2 Marcomms, Events and Policy Engagement and **WP3 User and Stakeholder Engagement** work with EU policymakers and stakeholders through targeted communication and events. They enable dialogue and facilitation through key projects envisioned under the Digital Decade policy programme, exploring how the project can aid EuroHPC and EOSC.

WP4 Above-the-Net Services aligns its service development with policies and legislation related to digital services, data protection, cybersecurity, and FAIR principles; prioritising user safety and data privacy. It also contributes to open science and EOSC, both by deploying and managing infrastructure cloud procurement frameworks for compliant research access to commercial services, but also through service concept development.

WP5 Trust & Identity evolves trust and identity services to meet the requirements of EU policies and legislation, enhancing these services to facilitate secure and interoperable data exchange while protecting individuals' privacy rights. It contributes to EOSC initiatives, and indirectly, to the Common European Data Spaces.

WP6 Network Development and **WP7 Network Infrastructure and Service Evolution and Operations** develop network infrastructure and services that support the European Green Deal, the Digital Single Market strategy, and Security and Resilience of Submarine Cable Infrastructures, as well as incorporating more energy-efficient

and sustainable practices into network development activities to contribute to the EU's climate and digital objectives. WP7 ensures the smooth operation and evolution of network infrastructure and services in compliance with EU policies and legislation, including cybersecurity regulations and data protection requirements, and implements robust security measures and operational processes to enhance the resilience of digital infrastructure and protect against cyber threats.

WP8 Security focusses on security services that align with the objectives of the EU Cybersecurity Strategy and contribute to the protection of digital infrastructure and services. WP8 also develops security solutions that comply with EU cybersecurity regulations and standards to ensure the safety and integrity of digital systems and data.

WP9 Operations Support provides operations support services that enable the effective implementation and management of EU-funded projects and initiatives and ensures that operational support activities comply with EU project management standards and regulations within the Horizon Europe program guidelines. Work undertaken in WP4-WP8 also indirectly contributes to the ambition of the NIS2 Directive, the Cybersecurity Act, the Cybersecurity Directive, and the DSA.

There are many additional policy considerations reflected indirectly across a number of work packages, including: European Data Strategy (WP5) European Data Governance Act (DGA) (WP1); General Data Protection Regulation (GDPR) (WP1 – all); Digital Decade (WP2, WP3, WP5), the Digital Single Market strategy, NIS2 Directive/Cybersecurity Act/Cybersecurity Directive and the Digital Services Act (WP1, WP4-WP8) and the European Green Deal (WP2, WP6, WP7).

1.1.2 Ambition

GÉANT partners span diverse roles within their respective national environments, which determine the level of their participation in national education, research, innovation, security and ecological issues, including the emerging joint EC-member state efforts in security and environment. The scope of NRENs' respective national efforts will be taken into account in the work of GN5-2.

The GÉANT connectivity services will go beyond the state-of-the-art in order to serve new research communities, such as quantum technologies and metrology or time and frequency (T&F). This will require active discussions with the relevant communities about special connectivity services, which must be implemented at a reasonable cost without impacting the excellent availability, security, resiliency, and reliability of the general services already offered to the R&E community.

The partnership between GÉANT and the EC will see delivered network capacity grow to Terabit levels, satisfying the ongoing transition to the greatly increasing volume of data in the wider R&E sector, to ensure that the European researchers and educators gain seamless secured access, regardless of location, to all relevant data, as well as processing facilities, anywhere in the world, which is essential to the strength and positioning of future European research.

There will be new developments to address the challenges created by the major projects, research infrastructures, research facilities, endeavours (such as EuroHPC, EOSC and Data Spaces), and ultimately, R&E users' needs where the EC and the national governments of its member countries jointly address issues important to European sovereignty: security of access authorisations and of the data.

With the variety of national approaches and rapid changes of the threat landscape, GÉANT's widely adopted T&I services will be developed with significant innovation to address the interoperability with the many national systems and cope with new user communities. GDPR is a pervasive and increasing challenge, as unauthorised use of personal data by national and private bodies outside the EU must be prevented. Access to data by

international collaborations is also evolving to be a critical element of research (such as health). Cyber attacks are increasingly being seen as a threat, not only for commercial exploitation but especially in the context of European conflict, which heightens the need to ensure data integrity and sovereignty.

Evolution of the GÉANT service portfolio will contribute to Europe's digital autonomy with vendor-agnostic approaches and open-source developments, where appropriate. It will continue with a variety of business models guiding service development and implementation and levels of sustainability for the different thematic service areas: Network Services, Trust and Identity, Security and Above-the-Net Services. The operational costs of keeping the established services relevant and up to today's standard will be monitored. At the same time, it will be important to follow the evolution in demand created by the priorities of the EC in areas such as climate and energy, as well as electronics, where industry and public research must work closely together while making sure that Europe will be the main beneficiary of the results.

1.2 Methodology

To deliver the above objectives, the work in GN5-2 is grouped into three Support work packages, five Service DevOps work packages and one Operations work package. This section describes the concepts, models and assumptions underpinning the work packages' activities, in line with the environmental priorities to Do No Significant Harm (DNSH).

Service development is a central aspect of WP4-WP8 activities. Agile incubators, developments and service operations follow business models that accompany new service development. These business models evaluate impact, user interest and use cases, as well as present and future investment. The Product Lifecycle Management (PLM) process monitors services through their KPIs and undertakes regular service reviews, which can also include the decision to retire an under-used service. See Section 1.3 for more details on innovative service development and delivery.

For over 50 million users and almost 30 years, the collaboration between all European NRENs has created a mechanism whereby users' requirements are consolidated and responded to (even anticipated) in a timely manner. From individual researchers to numerous, geographically distributed international groups such as radio astronomers, physicians, biologists, and high-energy physicists, providing the highest capacity, transparency, and neutrality, at a very high reliability in a sophisticated T&I environment (including AAI infrastructure) are all key to advancing research capabilities throughout the GÉANT partnership.

Open innovation and cooperation between regions and countries contribute to strengthening the digital economy. The aim of the GÉANT partnership is to serve research and education throughout the shift in digital science. European research infrastructures and large scientific projects already generate vast volumes of data, which will constantly increase in size. Over the duration of the project and for the duration of the GN5-FPA, the partnership will provide dedicated uncontended connectivity up to Terabit capacity through the partners' own national infrastructures, including access to the excellent research and data spaces and computing resources planned to be built and offered to researchers over the coming decade. The work in GN5-2 will continue to bridge the digital divide, as it supports ongoing investments in fibre infrastructure to achieve the communication speed capability throughout the European Research Area ahead of demand to grow further opportunities for cross-disciplinary and virtual research.

Under the FPA and GN5-2, the GÉANT partnership will continue to build on its experience, on its inclusive pool of talent, its unique respected position in research networking, and its collaborative culture and diversity to implement the vision of the European Communication Commons for the ERA. Each NREN's network delivers connectivity and services to their respective country's R&E user community, complemented by GÉANT's interconnecting pan-European backbone and intercontinental reach, providing the foundation for a portfolio of

additional innovative and valued services (T&I, security, etc.) responsive to the needs of users, while contributing to the development of communications technology specifically, and ICT innovation in general.

The network infrastructure must therefore be secured and operated to offer state-of-the-art services for extracting the full potential and maximise value from the investments in data sources, research infrastructures and computing resources. The network services are designed to cater for virtual research teams from different domains and affiliations, providing trusted and secure access to heterogeneous digital resources and allowing collaboration with the private sector and SMEs, when necessary. The provision should cover national (NREN) as well as international (REN) connectivity within the ERA.

1.2.1 Project Task and Resource Allocation

The whole GÉANT Consortium as defined in GN5-FPA participates in the GN5-2 project. As Coordinator, GÉANT Association brings its extensive and experienced team of network engineering, procurement, project management, communications and implementation experts. Other NRENs also bring significant expertise in technical engineering, operational and R&E collaboration.

All partners of the GÉANT Consortium contribute as they represent the national research networks of 43 countries, and participate in many other projects, giving results and gaining skills relevant to the proposed work. The project proposed is also developing training and induction/skill exchange to ensure involvement of all interested partners.

1.2.2 Nature of Funding for Project Actions

As part of a general principle of the collaboration with the project partners and the EC grant funding available, not all eligible costs are claimed for EC funding, especially where the partners wish to contribute their own resources or subsidise some of the GÉANT-incurred costs themselves through the cost-sharing model, as overseen by the Cost-Sharing and Service Portfolio Advisory Committee (CSSPAC). In GN5-2, EC funding for some costs (e.g. for operating costs of the production network) will be claimed at a lower rate than the maximum EC funding rate possible, as the Consortium will use the cost-sharing model agreed between partners to cover the remaining unrecovered costs. To ensure service sustainability, existing and new services in the project's main topic areas (T&I, Security and Above-the-Net) will also be considered for co-funding models, where services can be part-funded with some form of cost share or 'à la carte' subscriptions model.

1.2.3 Resources and Depreciation Requirements Analysis

Projecting costs requires an understanding of the context in which a service or infrastructure will operate, for example, where infrastructure investments are anticipated for new infrastructures or are due to replace existing assets as the current ones reach end of life. The current projections for funding investments in GN5-2 are focused on any remaining circuit improvements following the GN4-3N network update, mainly at the edge of continental Europe; any intercontinental investment; any equipment necessary to achieve the greater Tbps capabilities required in future; and ongoing support and maintenance. To fund such investments, it is also necessary to consider how to ensure the capital outlay is matched by the funding cash inflows, which can be significant at times of platform refresh.

1.2.4 Gender Dimension in GN5-2 Research and Innovation

The GÉANT Consortium is committed to align to EU and UN SDG5 values of gender equality and attention to diversity, by recognising the importance of integrating gender and wider diversity issues into research, education and innovation to provide societal relevance as an example for the next generation. Not only is a strong Women in STEM community very active [CONNECT_WIS], an inclusive approach is taken in every activity within the project and liaison with external stakeholders by including different socio-demographic profiles with diversity in gender and gender identification, age, but also in nationality, education, professional profile, etc. To further ensure that gender balance, diversity and inclusion remain key pillars throughout the implementation of the project, a member of the Project Management Board (PMB) will be appointed as Diversity & Inclusion Coordinator in the management structure. Mechanisms to enact gender balance at all hierarchical levels will also be adopted by the project team, including for the selection of any committee members.

1.2.5 Implementation of Open Science Practices

Open Science is a critical element of the GN5-2 project. Although there is no active creation or curation of the research data itself, the primary role is advocacy, raising awareness of good practice within the NREN community and supporting adoption of Open Science practices via engagement in EOSC and related services, such as those available under the OCRE framework. As shown in WP4, NRENs are increasing their involvement in Above-the-Net services, and GÉANT actively and strategically supports this transition to embed Open Science practices across Europe via the GÉANT community through WP3 liaison.

GÉANT's involvement in the EOSC Association and Research Data Alliance (RDA) enable this. Partner NRENs and the GÉANT Association are Members of the EOSC Association, with 12 NRENs appointed as Mandated Organisations and 2 as observers to represent national interests. GÉANT and the NRENs are also well represented on the EOSC Association Task Forces and on the Board of Directors, including roles on the Global Open Research Commons Interest Group, Technical Advisory Board and Organisational Advisory Board, which encourage greater NREN participation.

1.2.6 Research Data and Research Output Management

The project's general Open Access and FAIR strategy will be included as part of GN5-2 Data Management Plan. The Consortium will ensure open access ensured to peer-reviewed scientific publications, public deliverables and reports, as well as other textual outputs produced within the project; exceptions to this rule will be kept to a minimum. The GÉANT project will facilitate access to research data, and identity federation and other services will permit, authenticate and secure access. #CON-MET-CM\$# #COM-PL-CP\$#

1.3 Effectiveness and Agility in Developing New Services

The following section describes how roadmapping and CTO workshops help to ensure that new services developed for science and research are effectively tailored to meet the specific requirements of a wide user base, as well as the diverse needs of users across various scientific disciplines for excellent science and research. We also describe how we use the incubators to ensure that the development of services stays agile and on the front-line of innovation satisfying the need for agility in developing new services. Note all of this activity goes hand in hand with WP2 and WP3 research engagement activities.

1.3.1 Roadmapping and CTO Workshop Outputs

An important driver of further long-term coordination is the development of roadmaps across the project's main topic areas (Network, Above-the-Net, T&I and Security) with input from the community, especially at annual CTO Workshops. The workshops help improve the relevance and value of collaborative development, with the roadmaps serving as a very useful basis for understanding the impact of this work within the project NRENs. It also provides an opportunity for WPLs and stakeholders to discuss the challenges identified in the work, as well as feedback on whether the roadmaps reflect the most important priorities. Ultimately, the exercise improves the effectiveness and agility in developing new services according to the needs of a wide user base across multiple disciplines for excellent science and research, ensuring a service portfolio that is fit for current and future purposes.

1.3.2 Product Lifecycle Management

The Product Lifecycle Management (PLM) process is a gate-based approach to managing products and services. PLM is followed by, and supports, all work packages and tasks with incubator, service development and operational support activities, as well as being applied to the products and services in the GÉANT Service Catalogue. It is applicable to both new and existing services. During the process, potential opportunities and user interest in new service development are reviewed and decisions taken, even to retire a service, for example, one with poor utilisation. PLM has been designed to integrate with known industry-standard processes (such as the Information Technology Infrastructure Library (ITIL)), and incorporates compliance with Intellectual Property Rights (IPR), security, GDPR and TRL requirements. An overview of the process is shown in Figure 1.1, below.

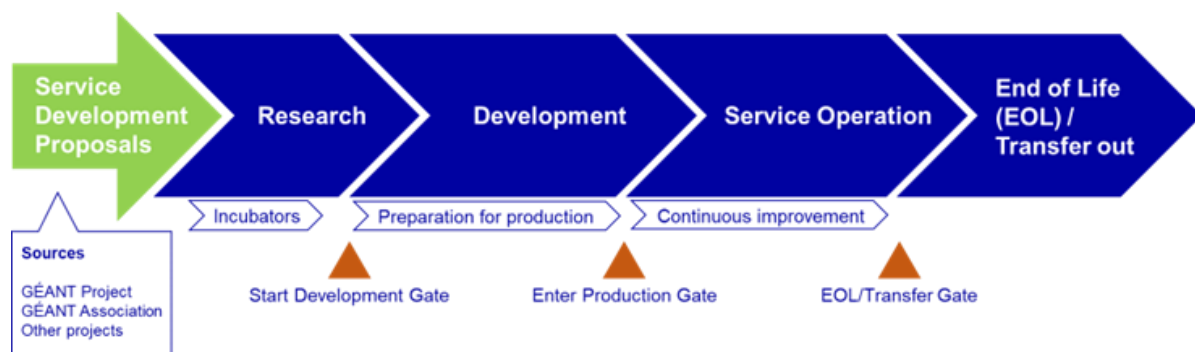


Figure 1.1: PLM Process Overview

The PLM process defines the service development framework, covering such areas as service owner, work package leaders and the services coordinator; phases; and gates. Each gate has its own checklist of areas to be assessed, including the documentation and required approvals. This starts with an initial pre-service check to establish appropriate service differentiation and definition and includes a business/sustainability model or canvas, which describes all relevant business and technical aspects of the service. An annual review of the GÉANT service portfolio takes place as part of the Project Annual Internal Review (PAIR). The benefits of the PLM process include:

- Reduced cost and time of development, e.g. through ensuring requirements are accurately captured and constantly assessed during the development phase.
- Increased take-up and usage, e.g. by ensuring end-user requirements are delivered through innovative service offerings where uptake and need are strongest, and that the evolving needs of users continue to be captured throughout the lifetime of the service.

- Increased innovation by supporting incubation of new ideas pre-service development.
- Assured quality and alignment both with GÉANT's overall vision and strategy statements and with each individual service strategy.
- Reduced compliance risk. These could be external risks, e.g. GDPR.

The following GÉANT services are anticipated at the start of Period 1 at TRL8-9. This list will be updated as part of the regular Management Report deliverables and will include pilots and new development from incubators (at TRL6-7). For more information, please consult the publicly accessible GÉANT Project Service Catalogue [GÉANTServices].

Network Services	Trust and Identity	Security
<ul style="list-style-type: none"> • GÉANT IP • GÉANT Plus and associated tools • GÉANT Managed Wavelength Service • GÉANT Spectrum Service • 10G Guaranteed Bandwidth Service • GÉANT Open Exchange • GÉANT L3VPN • Multi-Domain VPN (GÉANT MD-VPN) • GÉANT Peering • Network eAcademy • GÉANT DTN Testing Facility 	<ul style="list-style-type: none"> • eduroam • eduGAIN • Core AAI Platform • InAcademia <p>Network Management and Monitoring</p> <ul style="list-style-type: none"> • perfSONAR • Performance Measurement Platform (PMP) • TimeMap • Argus • nmaas 	<ul style="list-style-type: none"> • eduVPN • Firewall on Demand • DDoS Cleansing and Alerting service <p>Above-the-Net</p> <ul style="list-style-type: none"> • IaaS Frameworks • eduMEET

Table 1.2: GN5-2 Services

1.3.2.1 Innovation Management

Innovation starts with the generation of ideas, frequently as part of the GÉANT Innovation Programme (within the Community Programme) or in a work package following a GN5-2 incubation process, and is tested through feasibility studies, the PLM gate process and pilot development, until introduced. During the initial steps, user demand and technical possibilities are forecast using expertise from the community at large, including Task Forces and Special Interest Groups. These groups comprise experts working together, irrespective of affiliation, such as: NREN staff and researchers or staff from connected institutions, industry or other European e-infrastructure users. The budget, outcomes and impact, risks, and a cost/benefit analysis of implementation are carefully reviewed before resources are allocated. If approved, the concept will be taken up by one of the work packages and taken through the PLM process. The increased agility of new service development is therefore enhanced and encouraged by this approach to innovation and application of the processes, as highlighted in the Incubator function described below. In conjunction, the project will also provide an opportunity for young talents to develop skills to equip them for the competitive European ICT sector.

1.3.2.2 Incubators

The way to ensure that the development of services stays agile and on the front-line of innovation is to follow short incubator cycles of new or possibly disruptive technologies, business models, new market opportunities and other related innovative ideas. These incubators will enhance existing services in line with sustainability requirements and technology readiness level (TRL) constraints. The key objectives are:

- Foster the evolution of the new ideas, and efficiently deliver the results.
- Create an incubator space for working on innovative but potentially disruptive technologies, business models and trust models.
- Run incubator activities.
- Develop a methodology for assessing new incubator topics and evaluating existing ones.
- Expose the results of the incubator to a broad audience.

The incubator aims to develop, foster and mature new ideas in research and education (R&E) network services. It investigates new technologies that do not have a place in the services ecosystem of GÉANT, e.g. testing and experimenting with potential new features for existing GÉANT services. The incubator approach focuses on emerging standards and technologies that are sufficiently mature and of interest to the GÉANT community. The results of incubator activity in WP4-8 will enter the PLM process after successfully passing through a development gate.

1.3.2.3 Technology Readiness Level

As qualified within the PLM process, GN5-2 is committed to:

- Operating core network services (TRL8) and development of new ones (minimum TRL6) to cater for the new needs of institutions, research centres and end users.
- Supporting the current (TRL8+) and development and prototyping (TRL6+) of added-value services (such as security services) and collaborative tools on top of core connectivity required by scientists, researchers and students.
- Supporting researchers by developing new network and added-value services (including those based on lower TRLs) such as super-high transfer speeds, quantum network testing, high-precision time distribution, and other metrology services, for example.

The level of completeness and maturity, the TRL, of the GÉANT services is validated according to a set of mandatory criteria, equally applied to all GÉANT Service Catalogue entries. All services included in the service portfolio have been evaluated for their TRL, with those in the GÉANT Service Catalogue having been assessed as TRL8. Services already deployed in production with an associated Service Level Agreement (SLA) or Operational Level Agreement (OLA) are considered TRL9. New developments will be based on technologies available at TRL6-7 and follow the processes to reach production service operations at least at TRL8 by the end of the project; enhancements of existing services will be driven by users' requirements to match the agreed quality levels and meet availability KPIs.

1.3.2.4 Quality

The proposed GN5-2 project covers a broad number of thematic services and infrastructures vital for the needs of the R&E communities. These services have complex operational, service, and development commitments. The quality of service (QoS) of the GÉANT backbone network is continuously monitored and reported, in accordance with the KPIs defined in WP9, as is the quality of all GÉANT services. An NREN's use of such services is supported by a 24x7 GÉANT helpdesk, ensuring issue tracking and resolution by calling on second- and third-level support, as required. Network statistics also provide constant feedback for service improvement.

Network configuration changes are carefully engineered and tested with the NRENs concerned before being approved for introduction into service by the Change Advisory Board. In addition, all GÉANT services are subject to an annual quality review, including user uptake in the community and trends.

The quality control point for a service's approval for production is the final gate of the PLM process. This gate applies to all service developments, including major new versions of existing products and services. It requires sign-off for code quality, GDPR and Intellectual Property Rights (IPR) compliance, security, support training, service documentation and promotion, hardware and network resource availability, uptake expectations and future roadmaps.

The project has a specific quality approval process for all deliverables. A team of technical authors structure and edit the documents, which are then peer reviewed by the Quality Assurance and Public and External Relations (QASPER) committee.

The project thus ensures quality assurance through procedures embedded across the work packages, including:

- Quality of the services in production (KPIs and an annual review, including uptake).
- Final production gate of the PLM process before introduction of new development into production.
- QASPER committee deliverable review.
- The Change Advisory Board's internal review of operational changes to the network.

1.3.2.5 Security

Within any digital transformation, security is a major concern. A dedicated Security work package (WP8) shares expertise and knowledge in this area with involved stakeholders (including those at NREN-level). In terms of Operations Support (WP9), a Security Operations Centre (SOC) supports resiliency of both the network infrastructure and services, especially Threat Intelligence and Secure DNS. Security is also implemented by design in all connectivity, collaboration, and Trust and Identity services, authenticating and authorising access to services and making them more robust and resilient.

1.3.2.6 Key Performance Indicators

Key performance indicators (KPIs) for tasks and services, where feasible, comprising a baseline, measurable achievements, committed target values and future planning, will ensure success is appropriately and clearly assessed with the right decisions and actions can be taken accordingly. Each work package determines and regularly reports on its KPIs.

1.3.2.7 Procurement

GÉANT has extensive experience and a proven track record in successfully conducting, advising and assisting in national and international procurements for goods and services, particularly in the areas of connectivity, equipment and services. These procurements focus on fit-for-purpose solutions that meet user requirements, on value for money, and on compliance with all procurement and other (e.g. GDPR) regulations. Additional benefits delivered include significant service improvement and cost savings.

GÉANT's primary method for communicating with suppliers throughout the procurement process is through the eProcurement Portal, where suppliers are encouraged to subscribe to Tenders Electronic Daily (TED) and create a search option to identify relevant opportunities and receive notifications of new (GÉANT) business opportunities [GN-eProcPortal].

1.3.2.8 Inter-Disciplinary Approach

The evolution of the infrastructure and services is already considering inter-disciplinary approaches in two fields: artificial intelligence and quantum communication. The use of innovative results in big data analysis and artificial intelligence will be used to improve network control and management. WP6 and WP7 evaluation of this and

other future developments in line with policies such as the AI Act will help ensure steady improvement. Developing the infrastructure for precise time and frequency distribution across national borders, fibre sensing, and quantum communication will likely redefine the boundaries and configuration of traditional networking. The project's innovation cycle, with extensive dissemination and contribution from partners, ensures the successful inter-disciplinary approach of GN5-2.

1.3.2.9 Social Sciences and Humanities

By definition, the GN5-2 partners are vehicles to any research discipline as they provide strong support to social science and humanities research, including raising awareness that the combination of technical solutions with research and innovative methods will help address societal challenges. Since the COVID-19 pandemic, European NRENs have strengthened the community's response to the demand for online learning and performing with new and innovative services for artists, musicians, and students. Most universities, theatres, and art institutions supported by GN5-2 partners (via WP3 outreach) have multi-disciplinary teams with technologists, scientists, and artists working together on national and international projects. Others in a fledgling state will need support in the coming years. The synergy of ground-breaking audio/video technology, programmable art with the privileged footprint (reaching in many cases primary, secondary schools, universities, and museums) and the high quality of the connectivity offered by R&E networks, has revolutionised the very concept of "making art". GÉANT, together with Internet2, has a long tradition of working with the arts and humanities community, introducing, supporting, and coordinating the development and adoption of advanced network technologies. The flagship activity of this partnership is Network Performing Art Production Workshop (NPAPW), an annual gathering of technologists, network experts, artists, faculty members and students, focused on innovative technologies in the performing arts that utilise advanced networks provisioned by Internet2, GÉANT, and their partners, worldwide. GÉANT is also involved in data sonification, turning seismic activity – recorded in real time at Yellowstone National Park – into music, converting data to musical notes [CONNECT_SON].

1.3.2.10 Complementary Research and Innovation Activities

GÉANT has extensive experience operating a pan-European backbone network with international links extending to other continents. This network has implemented successful major network transitions and evolution without service interruption during its near-30-year existence. The GN4-3N network infrastructure upgrade project was recently delivered through the Consortium's capacity to select, procure and deliver new, complex infrastructure routes across Europe, to optimise ongoing costs and ensure digital autonomy for R&E networks. In addition to the network, eduroam has now a global reach and the Consortium has matured the T&I service portfolio to offer support for different use cases, including a bridge between eduGAIN and eIDAS, which enables users to authenticate against participating eduGAIN services using their national eIDs (eIDAS compliant).

Together with the excellent reputation and long-established collaborative relationships across other world regions, the GÉANT Consortium is positioned to ensure the best outcomes for the European research community in terms of global reach and access. The ongoing GN5-IC1 project will provide the opportunity to secure more cost-effective intercontinental connectivity services in the long run to ensure cutting-edge infrastructure exists to enable the global R&E mission. GN5-IC1 builds on the experience of BELLIA S1, ANA and CAE-1/AER's intercontinental network infrastructure and more recently, on the MEDUSA submarine cable representing the EU's first digital connectivity (North Africa and southern Europe); a tangible expression of Europe's Global Gateway strategy to boost smart, clean and secure digitalisation within and beyond Europe.

The operational setup for the GÉANT backbone network to be provided by the GN5-2 project is mature and provides the necessary mechanisms to control operational quality and stability in its operational phase. GÉANT's Operations Centre has the necessary skills, tools, expertise and processes in place to manage these links as part of a global connectivity footprint. In this way, the GÉANT network will be positioned to serve important European initiatives such as Common European Data Spaces, EOSC, and EuroHPC. #CON-MET-CM\$# #COM-PL-CP\$# #REL-EVA-RE\$#

2 Impact

The purpose of the proposed GN5-2 project is, first and foremost, to ensure the continuation of the European Communication Commons, which comprises the pan European backbone, (used, operated and developed by GÉANT and co-funded by the NRENs and the EC as a key Research and Education infrastructure for nearly 30 years), its intercontinental reach, and the combined network infrastructures of all NRENs, in accordance with the Horizon Europe objectives while extending the required agility needed to thrive in the fast-evolving environment as agreed between the EC and the GÉANT Consortium in the GN5-FPA. For Europe to remain competitive in a rapidly changing world there is a clear need to ensure that European researchers and those serving education in the European Education Area are equipped to increase their geographical reach and handle data volumes with higher speeds, capacity, and increased data security.

The work addresses the priorities of Horizon Europe in areas that reach across all projects, such as data security and access control, innovation and greening. Major programmes initiated by the European Commission relating to High Performance Computing (EuroHPC), security, quantum technologies, Open Science, and others will be supported where they require faster or specially featured networks, improved geographical coverage, security solutions, and trusted services.

This proposal also looks to bolster the wider societal ambitions of Horizon Europe, where applicable. The alignment of Horizon Europe to the Sustainable Development Goals of the United Nations are noted within the establishing regulation as being a key component for the programme's implementation. In turn, GN5-2 will look to implement recommendations that stemmed from the baselining exercise of GN5-1, for how the project concretely contributes to SDGs such as: SDG4 Quality Education, SDG5 Gender Equality, SDG9 Industry, Innovation and Infrastructure, and SDG13 Climate Action, in addition to the other 13 SDGs. The same baselining has also been applied to the European Commission's own digital values, which it looks to protect in the future, such as European digital rights and principles. In looking to use these recommendations, the project aims to demonstrate and strengthen its position as a force for sustainable good in Europe and beyond, when serving the interests of research and education.

The outcomes of this project and the framework will enable Europe to remain at the forefront of research and education, delivering high-bandwidth, end-to-end connectivity, and reliable, secure collaboration services to users, wherever they are. This will generate even more data and require more talent to make the best use of resources. Secure access to compute and data repositories will connect Research Infrastructures, which, in turn will create common data spaces on a previously unknown scale. Services for network connectivity, security and T&I will help users navigate the changing environment and links with international partners will bridge global Research Infrastructure connections.

2.1 Project's Pathways Towards Impact

GN5-2 will deliver GÉANT's European, high-speed, digital infrastructure, targeting Terabit connectivity; scale its digital service portfolio to changing environments; enable T&I to face global challenges, including those of Open Science; reinforce security of the network and its operation in a federated approach, and foster collaborations to innovate, and strengthen Europe's connectivity with other world regions. The results of GN5-2 will also leave a lasting, wider impact. The following sections describe how uniquely qualified the GÉANT partnership is to deliver the targeted outcomes, ensure effective services and address the scalability challenges within a rapidly evolving environment due to the great increase in importance and volume of relevant data allowing industry and researchers to engage in R&D on the EU priorities: e.g. security, digital sovereignty, energy, climate, semiconductor and health-related research.

2.1.1 Project Outcomes

The outcomes of the proposed GN5-2 project in terms of digitalisation will have an impact across every institution, in terms of governance, data infrastructure, roles for researchers, educators and students, and mobility that will enable improved societal outreach. The partnership will continue to observe the quality and performance levels on which it has built its reputation for nearly 30 years.

The GÉANT partnership, supported by its member states and by the EC, has established an indispensable end-to-end connectivity infrastructure for intercontinental and European research and education. It has operated best-in-class services based on this connectivity, and demonstrated the robustness of its processes for governance, service delivery and development. The partnership's approach to funding is sustainable, with a long-standing and effective cost-sharing mechanism. All this has been obtained through the continued commitment of the partners in the Consortium to develop and operate these infrastructures and services.

Planned as an evolving activity over the duration of the 6-year GN5-FPA, this GN5-2 proposal will deliver outcomes listed under the FPA's 6 Actions and 39 sub-Actions, thus continuing the programme foreseen. The six guiding actions of the FPA are:

- Action A: Understand and respond to the requirements of R&E communities.
- Action B: Evolve the Communication Commons towards data-driven research and education (e.g. including data-centric collaboration and data sharing based on findable, accessible, interoperable and reusable (FAIR) data principles).
- Action C: Deliver state-of-the-art network connectivity and operational excellence.
- Action D: Deliver interoperable and distributed trust and identity infrastructure, security and above-the-net services, and procurement.
- Action E: Ensure innovation of key infrastructures and service development as an indispensable part of the GÉANT partnership.
- Action F: Strengthen the collaborative ecosystem of GÉANT and the NRENs, and develop the human capital of the GÉANT partnership.

These FPA actions include 39 sub-Action points [GN5-FPA], which provide the fundamental guidance to the work of GN5-2. There are also five, complementary concrete outcomes of GN5-2 explicitly outlined in the Work Programme which are to:

1. Increase core network capacity and coverage
2. Improve and expand connectivity and collaboration service catalogue offering
3. Leverage Trust and Identity services
4. Take GÉANT's network and partners security to the next level
5. Develop collaboration in new fronts

The table below shows where these five outcomes are addressed in work packages and the Destination Impacts outlined in the Horizon Europe Work Programme 2023-2024.

Work Programme Outcome	WPs	FPA Action	Destination Impact
O1. Increase core network capacity and coverage	WP3, WP6, WP7, WP9	Action A Action C, Action E Action F	D1, Further increase core R&E's network capacity towards delivering Terabit connectivity, where technically and economically feasible.
O2. Improve and expand connectivity and collaboration service catalogue offering	WP4-WP9	Action A Action B Action D Action E	D2. Evolve the service catalogue to offer tailored combination of services to the scientific communities, to address new challenges in online education, such as data handling and educational connectivity beyond educational institutions.
	WP6, WP7	Action E Action F	D5. Develop collaboration in new fronts, for example, by further provisioning services through a pan-European procurement framework, or extending the NRENs' federation leveraging open platforms and doing proof-of-concepts of advanced technologies and services to support international and cross-disciplinary research like fibre sensing (SMART cables), and time and frequency (metrology), and quantum communication infrastructures, where technically and financially possible.
O3. Leverage Trust and Identity Services	WP5	Action D Action E	D3. Leverage Trust and Identity Services, including contributions to national, European, and global standardisation and regulation, and interoperable frameworks to facilitate data-centric collaboration and adoption of FAIR data principles.
O4. Take GEANT's network and partners security to the next level	WP8 (WP3)	All Actions	D4. Take the pan-European R&E network and partners security to the next level, for example by installing frameworks and processes for fast, federated and coordinated responses to computer security incidents across European's NRENs and communities.
O5. Develop collaboration in new fronts	WP1, WP3, (WP6/ WP7)	Action B Action E Action F	D5. Develop collaboration in new fronts, for example, by further provisioning services through a pan-European procurement framework, or extending the NRENs' federation leveraging open platforms and doing proof-of-concepts of advanced technologies and services to support international and cross-disciplinary research like fibre sensing (SMART cables), and time and frequency (metrology), and quantum communication infrastructures, where technically and financially possible. D6. Achieve connectivity globally and foster Europe's international cooperation policy objectives in line with the European Gateways Communication and the objectives of green and digital transition.

Table 2.1: GN5-2 Outcomes and Impact

2.1.1.1 Contribution to Outcomes by Work Package

All work packages in GN5-2 contribute towards these outcomes, as described in greater detail below for each WP.

WP1 to WP3 provide project, risk and quality management, PLM training and procurement support together with the Marcomms, Events and User/Stakeholder liaison.

WP1 Project Management, ensures effective delivery, monitoring, reporting, governance, management and quality processes. This includes finance and procurement, as well as technical writing, training, quality assurance, GDPR/IPR and standards support (IETF, WBA, Wi-Fi Alliance). The Product Lifecycle Management's (PLM) pre-launch process and security audit supports WPs' product and service development.

WP2 Marcomms, Events and Policy Engagement facilitates project and NREN channel communications, effective dissemination via web presence and design, events (external and internal), and liaison with EU and national policy bodies, regulators and funding agencies at all levels to explore synergies. Sustainability and best practice recommendations on the United Nations SDGs, digital rights and digital principles are also provided.

WP3 User and Stakeholder Engagement works across multiple work packages to ensure NREN feedback and development, resulting in ongoing service improvements. Such cooperation facilitates connection between partners, an expanding user community, stakeholder groups and international relations, both on technical (e.g. for standards and development) and operational levels, with international networks being developed jointly with institutions from other continents. In addition, WP3's support of Task Forces (TFs) and Special Interest Groups (SIGs) part of the governance structure of the GÉANT Consortium, promotes an open approach to innovation, and link to relevant EC projects, research infrastructures, and topics of interest, aiming at higher levels of integration of e-infrastructure services in Europe (e.g. EOSC, EuroHPC, and quantum) as well as EC strategic priorities (European Digital Gateways and Common European Data Spaces).

WP4 to WP8 concentrate on stepwise improvements to existing services, as well as incubation and piloting of new ideas, all to promote sustainable service development and continuity.

WP4, Above-the-Net Services, will rollout the GÉANT Cloud Framework (OCRE 2024) procured in GN5-1, alongside development of robust business cases and incubation of researcher-focussed services. Output will also include updated strategic guidance for NREN services in support of Open Science, as well as coordinating work toward an NREN federation of sovereign videocommunication services based on the GÉANT Open Source software, eduMEET.

WP5, Trust and Identity will incubate new or potentially disruptive T&I technologies and support for new use cases around federated authentication and new technologies, such as EUDI wallets, in addition to eduroam, eduGAIN, InAcademia, and Core AAI platform development. In order to realise the maximum potential of the T&I portfolio and make it available to the user community, development towards stronger national electronic identities (e.g. eIDAS) and self-sovereign identity (SSI), privacy preservation will also be included.

In addition to its network monitoring and management solutions, WP6 Network Development will help NRENs progress their digital transformation with dedicated training on Orchestration, Automation, and Virtualisation and Quantum Technologies through the Network eAcademy.

The project will take account of the results of the GN4-3N project (concluded December 2023), as well as the results of the GN5-1 project (due to conclude December 2024). Where technically and economically feasible, WP7 Network Infrastructure and Service Evolution and Operations will continue to develop the fibre-optic-based network infrastructure to the edges of Europe. WP6 and WP7 will also explore the development, deployment and operations of multi-domain spectrum service, quantum technologies, and fibre sensing technologies for the development of new services beyond Internet packets. The major effort to procure and install a new platform

of IP layer equipment commenced in GN5-1 will carry over into this successor project, GN5-2. As with other network-related operating costs, the plan for this equipment is to amortise costs annually over the equipment's useful economic life (i.e. the remainder of the FPA duration) using the same cost-sharing mechanism between the EC and the NRENs. More detailed outcomes as well as how they are monitored, tracked and delivered can be found in the individual work package descriptions (Section 3.1).

WP8, Security will address security aspects of services and the network, including the increasing threat levels. The WPs depend on WP8 to ensure the security of the GÉANT backbone network, to investigate new tools and their use, and how to make high-speed networks secure by design. WP8 will create a joint security intelligence workforce, with expertise and tools for use by R&E in addition to delivering security training, services and tools such as: cyber threat analysis and intelligence, DDoS detection and mitigation, Firewall on Demand, eduVPN, cryptographic services, and protection of DNS. It will also facilitate a security innovation lab for testing tool integration and pilot proposals.

Once in production, WP9 Operations Support underpins the new and existing services offered, providing first-line operations support and application quality assurance. It will also support WP8's work with peer security organisations to maintain the highest level of threat defence against cyber attacks that aim to compromise and degrade NREN partner services, and provide software governance and support, including Open Source and Software Developer Training.

2.1.2 Project Contribution to Society, Innovation, Industry and Education

The federation of NRENs is a fundamental building block of Europe's e-infrastructure landscape, delivering the GÉANT pan-European network for scientific excellence, research, education and innovation with an integrated catalogue of services for end-to-end connectivity, collaboration, security, and trust and identity that ensure Open Science and Europe remain at the forefront of research.

The way scientific research is conducted has dramatically changed over the last years. Network, storage and computing services provide the foundation to conduct modern scientific research. Today, the data for research is generated from countless sources and large instruments across the globe (e.g. CERN/ESS/ESFRI/EuroHPC/Copernicus/Galileo/ESO/SKA) and stored in specialised data repositories. Allowing scientists to conduct excellent research requires high-bandwidth connectivity and network services to interconnect researchers and ensure non-alteration of data and computing resources in a secure and non-discriminatory way, regardless of the location of the users and the resources.

This project continues development of the network to reach Terabit capacity across a wider geographical footprint meeting the huge growth in network demand for advanced services that will set the basis for a paradigm shift in the digital science and computational infrastructures planned for research and education over the next ten years.

Through the wider and influential scientific and educational community target group, GN5-2 has positive impacts reaching out to society in general. Selected, important impact areas are detailed below.

Societal

- Competitive, global positioning for European Research, Development and Education and enhancing the European Research and European Education Areas. The recently established EU priorities include major R&D programmes for High Performance Computing and semiconductor development, energy (fusion and Power-to-X, for example), as well as climate and health, which will all need sustained access to fast and reliable network connections across the world. Major research programmes initiated by the European Commission to improve strategic autonomy in the medium to long term will be enabled by

more data availability, but for these endeavours to contribute effectively to European prosperity, results of potential economic value will have to be protected with strong security. European values in areas like personal data protection, similarly, also require a strong emphasis on security of data and privacy.

- Connectivity provided by GÉANT will be able to offer the appropriate level of access security to enable the joint efforts of industry and public research expected to be necessary to achieve the results in areas critical to long-term prosperity for Europe, observing our values.
- The existing identity authentication and authorisation (AAI) system operated in a federated way by the GÉANT partnership for access to the network will evolve to maintain interoperability as Europe-wide electronic identity systems (e.g. eIDAS) are introduced and become available to the general public in Europe. Societal and economic impact will be significant, as more users join the network and associated above-the-net services.
- Activities in GN5-2 will be instrumental to succeed the digital transformation and favour inclusion, gender equity, as well as transfer skills to young talents and reduce digital divide. One way in which the project's contribution to these initiatives will be measured is via actions under the Sustainable Development Goals, and projected alignment with European Digital Rights and Principles (updates and deliverable D38 (D2.3)).

Innovation

- Innovation is and will be seen in every aspect of GN5-2 work areas. With an Innovation Programme, and use of 'incubator' activities and continuous product development, the project will add new features to existing services, cover new use cases, expand the user base, improve existing and/or add new techniques, technologies, software services and tools (examples across the thematic service areas include interoperability with digital wallets, Router for Academia Research and Education (RARE), and new services for cyberthreat intelligence).
- Services available through WP4's OCRE2024 framework are highly innovative. This framework is for example also a major channel for GÉANT to enable community access to leading AI platforms.
- The impact on current and new users of the introduction of technological opportunities offered by time and frequency signalling (metrology), quantum technologies, fibre sensing support, real-time capabilities and artificial intelligence (AI) well beyond state-of-the-art are all important areas. The opportunity to deliver a synchronised and newly defined accuracy of time signals across Europe will be piloted and the potential offered by quantum technologies will require substantial innovation opportunities to be assessed as the amount of accessible data and users increase.
- WP8 will deliver innovative security services and tools, including: cyber threat analysis and intelligence, DDoS detection and mitigation, Firewall on Demand, cryptographic services, and protection of DNS.

ICT Industry

- The procurement activities proposed in the project will demand that ICT and connectivity providers offer competitive advanced services, also in less-developed regions. Competitive tendering to procure faster and more comprehensive connectivity and ICT equipment will be set at very high standards, based on the constantly evolving needs of the user community. This will also help reduce the risk of technology obsolescence.
- GN5-2 will create synergies between R&E Networks and industry in the form of partnership programmes, enabling secure access for NRENs users to a range of services provided by the market (OCRE 2024,

InAcademia...), and opening the path to future services and use in the areas of RARE, GP4L, time and frequency, quantum, and fibre sensing.

- In terms of standardisation, this project will be a strong voice of the R&E community in international fora, dealing with Industry players and making the case for open and vendor agnostic standards, such as those used for eduGAIN support for example.

Education

- The speed, resilience, geographical footprint, security and overall excellence of the GÉANT and the NRENs' joint network service have supported students' mobility and access to learning and knowledge bases at home during the recent pandemic in near-real time with sufficient capacity. This will have a lasting impact to benefit the future educational mix.
- Human capital development will help bring the needed and targeted training to the R&E network and IT services sector, complementing the strategy to increase its capacity and attractiveness to work in this innovative and impactful area. This includes:
 - Education of project team members (external, building skills of the project team members).
 - Education provided by the GN5-2 project team members (provided not just to project participants, but to the whole community).
- The demands on ICT expertise in member states are increasing rapidly, as the demand for services and service quality increase. As previously stated, the proposed project will offer coordinated training, information exchanges and secondments, providing relevant courses to partners.
- The development of a universal federated identity AAI platform for education and research will allow evolution and increased digital transformation.

2.1.3 Wider Impacts of the Project

By addressing the broad range of thematic service areas and supporting collaborations across all scientific research disciplines, the project helps position European research as an enabling actor of a wider society. The project offers the European research and education community a broad network and service reach, achieved sustainably through the focused and collaborative effort of the GÉANT partnership. Specifically, this includes:

- Providing equal opportunities for connectivity to data repositories and services located anywhere in the world for students, researchers and educators located anywhere across Europe. Boosting and strengthening international research and education collaboration for Europe.
- Delivering secure and reliable connectivity to advance Open Science internationally and enabling research to address the broader societal and climate-related challenges which we will face.
- Supporting the UN Sustainable Development Goals (SDGs) via measured progress, where deemed relevant.
- Aligning with the European Digital Rights and Principles, where deemed relevant.

2.1.3.1 Sustainability

The proposed increase in connectivity will not only grow the network capacity to meet the demand for advanced services for R&E, but it will also help support the paradigm shift in the digital science and computational infrastructures planned for research and education. Digitalisation has impacts across every R&E institution, in terms of governance, data infrastructure, roles for teachers, researchers and students, and new mobility that will enable improved societal outreach. All of these factors will contribute to the realisation of the Digital Single Market.

In a broader view, we acknowledge the increase of capacity and services that coincides with this Market realisation. Opportunities to enable access infrastructures for data infrastructures for EOSC and the Common European Data Spaces, along with developing tools that can thematically engage with Quantum, Time & Frequency and also Security initiatives. In doing so, they would complement SDGs Industry, Innovation and Infrastructure (SDG 9), Climate Action (SDG 13), Peace, Justice, and Strong Institutions (SDG 16), and Partnerships for the Goals (SDG 17).

The partnership will continue to observe the quality and performance levels on which it has built its reputation for nearly 30 years. Without this continuing investment enabling worldwide and secure connectivity infrastructure, the European research community will fall behind in data access facilities available to them and be forced to choose future research topics where this handicap is less debilitating. The long-term effects of this would be contrary to the goal of the Horizon Europe programme (and all other EU policies) and, ultimately, could prevent the EU's high-level objectives to be met.

The GÉANT partnership, supported by its member states and by the EC, has a proven track record in establishing an indispensable end-to-end connectivity infrastructure for intercontinental and European research and education, embedding vital security by design. It has operated best-in-class services based on this connectivity and demonstrated the robustness of its processes for governance, service delivery and development, as well as finding equitable funding arrangements between the global partners. It will also continue its involvement in open source development, implementation and governance.

Environmentally, the GN5-2 project does not support or carry out any research and innovation activities that cause a significant harm to any of the six environmental objectives as per Article 17 of Regulation (EU) 2020/852. The project will investigate common indicators for measuring the environmental footprint of electronic communications networks (ECNs) such as those outlined in a study undertaken by the DG JRC and DG CNECT [ECN Footprint]. The procurement processes respects sustainability goals and emphasises the selection of more environmentally efficient equipment with reduced power consumption relative to the capacity delivered. It will also monitor its sustainable energy usage.

2.1.4 Target Groups that Would Benefit

Through the GÉANT federated network, the NRENs and their peering connections, over 50 million European research and education users from all disciplines will benefit from these outcomes, including: researchers, students, institution staff, SME/industry researchers and citizen scientists:

- GÉANT Member NRENs: in ensuring that investments made in this project realise the most benefit from the funding available and provide sufficient capacity to meet the need of their users – be it educational or research users located in their national boundaries.
- Research infrastructures/pan-European users with multi-country presence or with international researchers requiring connectivity and collaboration services.

- Regional/international NRENs: working in partnership with GÉANT on one side and the respective RREN on the other will ensure network traffic reaches its ultimate destination, with a resilient topology which will provide a networking infrastructure of far greater quality than could be done by either entity alone.
- Users beyond the traditional scientific and research communities within the remit of NRENs mandate accessing through exchange points.
- Users, including commercial actors involved in non-traditional use of fibre-based infrastructures, such as time and frequency distribution, fibre sensing technologies, and quantum.
- Commercial and industrial suppliers under procurement frameworks will explore areas suitable for GÉANT partners and their users, such as providing discounted access to a selection of online services through “brokering”.

The project will ensure that user requirements and needs are understood and implemented, supported with workshops, surveys, and community events.

2.1.5 Scale and Significance of Project’s Contribution to Outcomes and Impacts

At the individual work-package level, the benchmarks and KPIs detailed in Section 3.1 are based on the continuing growth and increasing impact of this GN5-2 project and the GN5-FPA actions and outcomes in general. The scale of the project’s contribution is measurable at the internal project and NREN community level, as well as at the wider ‘macro’ level for the R&E sector and overall scientific and societal benefit. The overall significance of the project’s contribution as the core R&E infrastructure for network connectivity, T&I, security and other above-the-net services is difficult to quantify in any single or even a few metrics but the unified support of the GÉANT infrastructure and services is a prerequisite if Europe’s position as a lead contributor to global research is to remain viable. The GÉANT Partnership contributes to the effectiveness of the European Research Area by making Europe the best-connected region in the world. GÉANT offers all European researchers the network (minimum 100Gbps), communications facilities and application access that ensure the digital continuum necessary to allow them to conduct world-class research in collaboration with peers around the world (50M end users in more than 100 countries). The GN4-3N restructuring of the GÉANT backbone network, tripled the overall length of network fibre from 10,000km to near 31,000km, now carries 7 Petabytes of data each day. This will provide GN5-2 with positive effects well beyond research, as national networks benefit from the catalytic effects of access to faster international networking. The huge speed increase (significantly beyond the Digital Single Market’s 2025 goal of 16 Gbps) offered to the R&E community in partner countries will offer schools much better access. It will also influence the ambition level of the national broadband plans by offering examples of real-life upwards convergence. The improved connectivity will also greatly benefit the SMEs through their collaborations, making international projects more easily accessible.

In terms of digital inclusion, the incorporation of five EaP countries: Armenia, Azerbaijan, Georgia, Moldova and Ukraine (WP7 T2) will connect the users in these countries to other research and e-infrastructures through the GÉANT backbone network, improving access to European computing and storage services, as well as to data generated by the large research infrastructures, worldwide. This more expansive and inclusive network will help reduce the digital divide between EaP countries and rest of the Europe (see Figure 2.1, below).

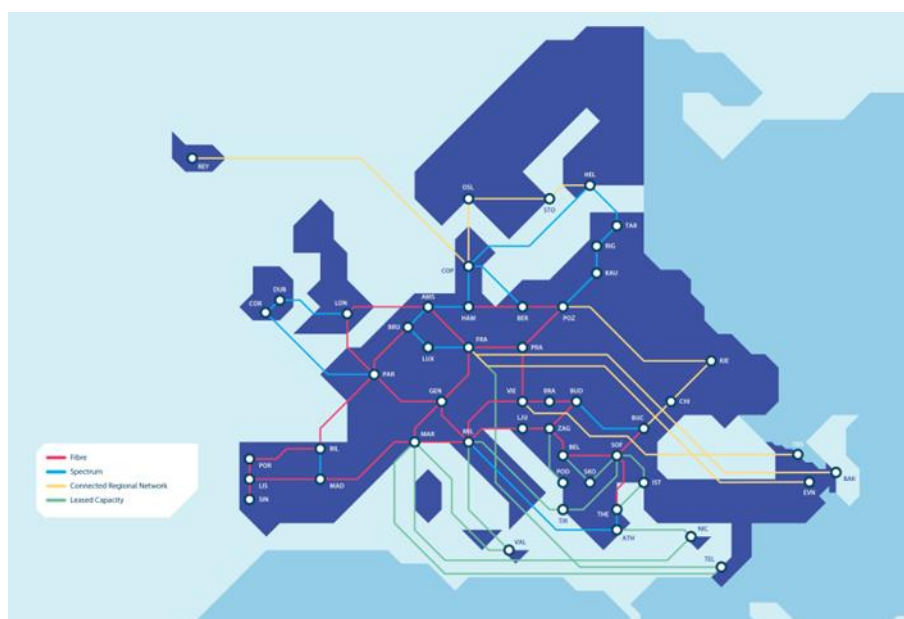


Figure 2.1: Expansion of network to include EaP countries

Note: The yellow lines of the connected regional network (former EaP countries) show the new lines (and shared costs) to be integrated as part of GN5-2)

In terms of outreach, the forecast annual growth of 5-10% in social media and website visits to the multiple channels, highlighting the capacity of the infrastructure and the impact on research and education, is expected to continue, as is the number of global attendees to the annual research and education networking conference, TNC. Routinely attracting a diverse audience of over 800 participants from more than 70 countries, and a growing online audience, TNC attracts a greater number of international visitors than any other comparable conference, and involves an increasing number of European attendees showing that it is the place to engage, share and develop new concepts and ideas of future new capabilities that bridge the digital divide and make possible distributed access to scientific instruments and cross-disciplinary scientific data sharing.

User engagement increases community-specific events and understanding of the infrastructure and services, which is key to each user community's ability to make its own long-term and significant investments in research programmes and infrastructures, knowing that its underlying network, access and other service requirements are already being or will be met by the GÉANT project consortium partners.

In terms of specific, thematic services covered, service availability is measured at 99.0% as a minimum for the basic, non-service-level critical services and in many cases exceeds even 4 or 5 'nines' levels (99.999%). The service management and the operational monitoring is well established and proven in its capacity, again providing the levels of reliability and trust in the services that are required when accessing and transferring huge amounts of data such as that needed for EuroHPC and the foreseen growth in data space repositories. Quality, quantity and stability are key requirements, especially for the specific applications that the infrastructures can now enable, such as with the potential available with quantum technologies, time and frequency and other low-latency applications. The range of the service portfolio with its continual improvements and new service development ensures the needs of users will be met now and in the future, with continued investment in the development programme providing users with a relevant, reliable and valued portfolio. The range of trust and identity services, in particular, eduroam, is used by students and academics worldwide, has now reached around 7.5 billion national and international authentications in more than 38,400 locations. Its federated, scalable design simplicity enables a forecast of 5% further continued annual growth. A coherent and common core T&I platform that will make future services even more easy to develop and scale is being developed and will offer potential for commercial development and exploitation. For the other above-the-net services, the innovation

and expertise of the procurement activities have shown how significant, multimillion-Euro savings are possible when procuring commercial commodity services through framework contracts that empower the consumer to access them at heavily discounted rates. For the security work, the need to address the increasing threat landscape is fully recognised and much greater emphasis is being directed in this project to identify and mitigate against the impact of cyber threats on the infrastructures and services offered.

2.1.6 Requirements and Potential Barriers to Success

There are a number of factors that contribute critically to the success of the project (Requirements) and/or represent critical challenges (Barriers to Success). These include:

- Combined efforts of the other European e-infrastructure projects and research infrastructures developing or providing services for data storage and computing adapted to the needs of the research and education communities will be required to help identify and shape the future demands on the GÉANT network infrastructure.
- Continued national support of the NRENs by their funding bodies to deliver nationally and to complement the pan-European infrastructure activities proposed in this project will be required.
- Resourcing in terms of the ability to recruit the highly specialist and core skills required, especially in specific technical areas, and to retain skilled staff when competing against higher and more attractively remunerated roles in the commercial world (e.g. in T&I and security).
- Security issues could greatly hamper the research community in its access and effective use of data – especially in areas where European sovereignty considerations may impose constraints.
- Lack of rapid development of the ICT landscape relevant to many of the project's objectives could impede its cost-effective implementation.
- Continuing instability in geopolitical and external financial factors such as inflation may disrupt supplies, anticipated timescales, delivering services and operating infrastructure, even within the relatively short two-year duration of the project.

2.2 Measures to Maximise Impact – Dissemination, Exploitation and Communication

2.2.1 Dissemination, Exploitation of Results and Communication

The achievements and results obtained in the project will be used by the NREN partners to deliver value-added networking services and guidance to their research and education user communities. Oversight of impact and exploitation will take place as part of WP1 coordination support. The results and offerings of the project will be promoted to the wider research and education community and beyond through the NRENs, via the marketing communications services as part of the project pathway towards impact and via the GÉANT Community Programme. Utilisation will be encouraged/facilitated through user support activities and international relations coordination with partners around the globe. The results will also reinforce GÉANTs reputation within the telecoms market as a viable wholesale customer/partner and help it to deliver highly cost effective solutions in the future. Measures intended to be in scope include:

- User-centric approach – demand qualification, user support and result promotion.

- Telecoms market engagement (including content providers).
- EC liaison – to be cognisant of complementary funding streams.

This will be done in coordination with other regional projects.

2.2.1.1 Dissemination and Exploitation of Results

The project's results will be disseminated to relevant audiences, in collaboration with the NRENs. Such actions will include presentations, training and knowledge sharing at meetings and conferences, issuing news stories, use cases and service documentation, as well as operational collaborations with, for example, international networking organisations, e-infrastructure integration projects and suppliers.

Dissemination and promotional efforts by all work packages and partners will serve to ensure the widest dissemination of project outcomes and capabilities to, and their exploitation by, all the target user groups / knowledge communities GÉANT serves.

The range of services tailored to R&E community and ongoing GÉANT network improvements in GN5-2 (as well as GN5-IC1) focus on geographical coverage, quality, and long-term sustainability in line with the changing data demands and security issues facing NRENs.

2.2.2 Communication Activities

The GÉANT Marketing and Communications (Marcomms) team has extensive experience in supporting successive GÉANT projects with communications and dissemination work and providing resource for the relevant task.

WP2 Task 1 will strategically plan and implement communications actions and initiatives to ensure the sustained promotion and awareness of project activities to identified audiences, utilising an established and continuously developed range of communications channels and tools with which to maximise the reach of messaging and content to a wide range of GÉANT stakeholder communities (both within and beyond the project's own community), and closely monitor results according to established KPIs to ensure this knowledge is fed back into the planning and implementation process.

Key communications aspects will be considered. These are the audiences that need to be addressed, which channels and tools are appropriate for addressing the different audiences, what are the main messages to convey and which messaging approach will deliver the best results. Examples of the audiences to be addressed include:

- Project participants.
- Project partners.
- Regional Research and Education Networks and National Research and Education Networks within Europe and beyond.
- The European Commission.
- Telecoms and equipment providers.
- Research and education communities.

Examples of these communications channels and tools include:

- The CONNECT family of channels:
 - The CONNECT website provides a platform for all project partners to upload news items, articles, and events.

- The CONNECT newsletter distributes this content to a subscriber list on a weekly basis.
- The CONNECT magazine is produced three times a year and features articles, interviews and supporting content on topics of strategic importance.
- An integrated range of websites that target specific audiences and cover key topics such as the network, T&I services, security, cloud services, the Community Programme, and a dedicated website to demonstrate the positive impact on research and education communities.
- Event participation (e.g. ICT and ICRI) and hosting (the TNC conference organised by GÉANT and partner NRENs routinely attracts a diverse audience of over 800 attendees from more than 70 countries and a growing online audience).
- Joint promotions with NRENs.
- A social media approach that targets all stakeholders, with different social media platforms acting as communications channels themselves, as well as driving traffic to websites.
- News items, articles, interviews, infographics, animations, video content, etc.

The Communications team will continue to nurture its relationships and collaborate with other groups to make use of additional non-project channels, such as the “In the Field” blog curated by a group of communications professionals representing the global R&E community, the Science|Business weekly newsletter, stakeholder joint collaborations, EC websites, featured opportunities and social media, and, of course, the partners’ own dissemination of information across all their channels. We will continue to use tools to monitor/measure the impact of the communications to ensure they are relevant, targeted and cost-effective.

WP1 has a core role to coordinate the project’s activities, and to ensure communication of progress, results and, importantly, of tools and information in order for participants and partners to be able to fully contribute to and benefit from the outputs and success of GN5-1. This includes an internal communications programme, aided by WP2 Task 1 and Task 3, as required, the core of which includes the weekly newsletter for project participants, the project Symposium working conference and the intranet for sharing progress and updates.

2.2.3 Intellectual Property Rights Policy

The GÉANT partnership has a long-standing Intellectual Property Rights (IPR) policy that manages the background IP, results (or foreground IP) generated within the project, and also includes reserving the rights generated by vesting ownership in the corporate project participants.

The Consortium Agreement between the partners manages all IPR issues in line with the EC guidelines on the management of IPR as referred to in Regulation (EU) 2021/695 of the European Parliament and of the Council. It enables partner agreement and management of IPR, liability and future results dissemination/exploitation.

2.2.3.1 Open Access

The GN5-2 consortium is committed to providing free and open access of GN5-2 research outputs (e.g. publications, data, software, models, algorithms, and workflows) to the end user through trusted repositories. Peer-reviewed scientific publications will be produced and shared in line with FAIR principles. Immediate open access is provided to a deposited publication via a trusted repository, under the latest available version of the Creative Commons Attribution/By Licence (CC BY) (or partner’s equivalent licence). Any digital research data generated will be managed in line with the Data Management Plan, as detailed in the following section.

2.2.4 Data Management Plan

In line with requirements for research data management of Horizon Europe as described in Article 17 of the EU's Annotated Grant Agreement, a data management plan will be written in coordination with GDPR, Security and IT policy and issued as a deliverable in WP1, with regular updates throughout the project. The plan will include an overview of data to be managed by GN5-2, the type of research data generated, what standards will be used, and demonstrate how the data will be exploited or shared and made accessible, curated and preserved. It will identify solutions, both 'existing/ already planned' and 'possibly to be developed' for meeting the FAIR principles. The initial DMP will be updated throughout the project. As GN5-2 publishes network operational data (in the form of monthly service reports), the main category of data foreseen to be managed is users' personal data generated as part of operating services and pilots. The DMP will also specify the recommended licensing schemes following project IPR management approaches. This will be handled according to best practices already in place within the project, such as those stated in its GDPR policy or Consortium Agreement. GN5-2 will comply with the EU and national regulations on data handling and publishing, in line with the consortium's exploitation plans. As such, it will carefully consider and address privacy and copyright issues prior to publicly releasing any data. All users will be made aware of the GDPR regulations.

2.3 Summary

KEY ELEMENT OF THE IMPACT SECTION

Specific Needs	Expected Results	D & E & C Measures
<p><i>What are the specific needs that triggered this project?</i></p> <p>The needs triggering the project are to:</p> <ul style="list-style-type: none"> • Ensure EU researchers and those serving education are able to function and are provided with the capability to access and handle data securely at higher capacity and over a wider geographical reach and to remain competitive in a rapidly changing world. • Maintain the quality of the GÉANT Network services, the adaptation of the AAI facilities to the new security environment being implemented by the EU nations in concert with the EC • Support major programmes initiated by the European Commission relating to High Performance Computing (EuroHPC), security, Quantum technologies, Open Science, and others. • Improve European sovereignty for research and industry in areas such as energy, electronics, etc. • Contribute to European digital autonomy (interoperability, vendor agnostic, open-source strategies) • Optimise the R&E communication between NRENs. 	<p><i>What do you expect to generate by the end of the project?</i></p> <ul style="list-style-type: none"> • An expansive and up-to-date connectivity service to the European scientific and educational user community, matching the expectations, coverage, and requirements for faster, more resilient, innovative and secure connectivity and collaboration services. • Unconstrained capacity ahead of demand in the backbone network and NREN access in multiples of 100Gbps, to pave the way for Terabit connectivity where needed. • Best-in-class services based on this connectivity and demonstrating the robustness of its processes for governance, business-plans, service delivery and development, as well as a sustainable approach to funding, with long-standing and effective cost sharing mechanism in the Consortium. • Increased understanding and response to the growing and future requirements of R&E communities and evolving the Communication Commons towards secure multidomain and data-driven research and education. • Strengthened collaborative ecosystem of GÉANT and the NRENs maintaining their worldwide position as an indispensable resilient end-to-end connectivity infrastructure for European research and education. 	<p><i>What dissemination, exploitation and communication measures will you apply to the results?</i></p> <ul style="list-style-type: none"> • Measures ensure the sustained promotion and awareness of project activities to identified audiences, optimising an established and continuously developed range of communications channels and tools. Key communications aspects will be considered, such as the audiences that need to be addressed, the most appropriate channels and tools, the main messages to convey and which messaging approach will deliver the best results. • The project's results will also be disseminated nationally and internationally to relevant audiences, in collaboration with the NRENs. These actions will include: <ul style="list-style-type: none"> • Presentations, training and knowledge sharing at meetings and conferences, issuing news stories, use cases and service documentation, as well as operational collaborations with, for example, international networking organisations, e-infrastructure integration projects and suppliers. • Open access to public project Deliverables • The CONNECT website, weekly newsletters and triannual magazines. • Event participation (e.g. ICT and ICRI) and hosting (the TNC event) • A targeted social media communication channel approach also driving traffic to websites.

Target Groups	Outcomes	Impacts
<p><i>Who will use or further up-take the results of the project? Who will benefit from the results of the project?</i></p> <p>Through the GÉANT federated network of NRENs and their peering connections, over 50 million European research and education users from all disciplines will benefit from the outcomes of GN5-2, including: researchers, educators, students, institution staff, SME/industry researchers and citizen scientists, segmented as follows:</p> <ul style="list-style-type: none"> • GÉANT Member NRENs; ensuring that investments and pooling of resources realise the most benefit from the funding available and provide sufficient capacity to meet educational or research users' needs, located in their national boundaries. • Research infrastructures/pan-European users with multi-country presence or international researchers requiring connectivity, security and collaboration services. • Regional/international NRENs; working in partnership with GÉANT and respective REN to ensure network traffic reaches its ultimate destination with a resilient topology that will provide a networking infrastructure of far greater quality and security than either entity alone. • Users beyond the traditional scientific and research communities within the remit of NRENs mandate accessing through exchange points, such as those coming from industry and citizen scientists. • Users beyond non-traditional use of fibre-based infrastructures, such as time and frequency distribution, fibre sensing technologies, quantum, and identifying /establishing synergies with commercial actors involved in these fields of innovation. • GN5-2 will continue to increase the involvement with commercial and industrial suppliers under procurement frameworks, exploring areas suitable for offering GÉANT partners discounted access to a selection of online services through "brokering". 	<p><i>What change do you expect to see after successful dissemination and exploitation of project results to the target group(s)?</i></p> <ul style="list-style-type: none"> • A continuing and developing state-of-the art, cost-effective, secure and resilient connectivity and collaboration services within Europe (including trusted access to data sources and services and AAI services, such as eIDAS). • An expansion of NREN users beyond traditional scientific and research communities. • Enabling networking and access to the Common European Data Spaces. • Ensuring access for researchers and students to the valued services required for Open Science. • Raised awareness, expertise and capability in security. • Improve NRENs' security stance, address threats in a timely matter and collaborate by providing adequate knowledge, awareness, experience and expertise with an extensive training programme, both for basic and expert levels. • Provide a security dashboard for NRENs' standards compliance. • Disseminating learning and training and community building • Aligning with EU policy and ongoing participation with standardisation bodies. • Providing secure access and connectivity to research data generated from countless sources and large instruments across the globe (e.g. CERN/EuroHPC/Copernicus/Galileo/ESO/SKA) stored in specialised data repositories. This requires specialist high-bandwidth connectivity and network services to interconnect researchers, data and computing resources in secure and non-discriminatory way, regardless of the location of the users and the resources. 	<p><i>What are the expected wider scientific, economic and societal effects of the project contributing to the expected impacts outlined in the respective destination in the work programme?</i></p> <ul style="list-style-type: none"> • Societal and economic impact will be significant, with improved competitiveness and global positioning for European research, development and education. The project acts as an enabler of major R&D programs for high performance computing and semiconductor development, energy (e.g. fusion and Power-to-X), as well as climate modelling and developing advanced health services that rely on sustained access to fast and reliable network connections across the world. • By offering the appropriate level of access security to enable the joint efforts of industry and public research, results in areas critical to long-term prosperity for Europe can be achieved. • By improving access for students, researchers and teachers located anywhere across Europe with connectivity to data repositories and services located anywhere in the world it broadens the reach, potential, and boosts international research and education collaboration for Europe. • Supporting the UN Sustainable Development Goals.

3 Quality and Efficiency of the Implementation

3.1 Work Plan and Resources

3.1.1 Overall Structure of the Work Plan

The structure of the proposed work is based on the requirements of the GN5-FPA and HORIZON-INFRA-2024-GEANT-01-SGA, comprising nine main activities, outlined below. The work packages follow the established and proven structure from GN5-1. Service development activities (WP4 to WP8) are grouped into thematic areas: Above-the-Net, Trust and Identity, Network, and Security, which are complemented by the support and operations work packages (WP1, WP2, WP3, and WP9).

The development work in WP4 to WP8 concentrates on stepwise improvements to existing services. These WPs do not only cover incubating, prototyping and piloting of new services within their areas, but also the provision of operational services. These WPs depend on WP9 for Operations Support, and on Security (WP8) to ensure the security of the GÉANT backbone network and security by design in all service development. Trust and Identity (WP5) ensure the maximum potential of the T&I portfolio is realised and made available to the user community. The alignment and coordination efforts required between these work packages for the development, deployment and operation of network services are an important element that will be applied throughout the project, with continuation of the regular and structured communication between these work packages.

- WP1 Project Management includes coordination across activities, on-track production of deliverables and milestones, governance, product management (PLM process), procurement, finance, ICT, human capital and training, and key software tools facilitating the day-to-day cooperation of the project partners (e.g. project intranet, mailing lists, Wiki facility, videoconference facilities).
- WP2 Marcomms, Events and Policy Engagement includes project communications and NREN channel communications, web presence and design, events (external and internal), and liaison with EU and national policy bodies, regulator and funding agencies at all levels as required to explore synergies.
- WP3 User and Stakeholder Engagement includes EU and global NREN account management, consultation with NRENs regarding positioning and strategy for pan-European service delivery (EuroHPC, EOSC), liaison with other e-infrastructure projects, user needs/feedback, intelligence gathering and support for Task Forces and Special Interest Groups (TFs and SIGs).
- WP4 Above-the-Net Services aggregates NREN expertise and community demand around digital online services, engages in pan-European brokerage and development efforts. It will launch the GÉANT Cloud Framework (OCRE 2024), together with a national-specific information catalogue and support services, enabling institutions with consumption tools to browse, find, select, contract, adopt and review services. It will also investigate new business models and sustainable funding structures for services that are developed by the community, and in conjunction with WP3 and the NREN stakeholders, refine an inclusive future strategy for NREN roles regarding Open Science support.
- WP5 Trust & Identity is responsible for the enhancement and operation of the existing Trust and Identity services and for the innovation and development of both existing and new T&I products and services to address the emerging requirements of the GÉANT community. The effort in this work package is used to underpin the development and delivery of T&I services in a number of areas, including: EuroHPC, Student Mobility, EOSC and others.
- WP6 Network Development undertakes technology evaluation and development in the areas of network infrastructure, services and management, and sustainably provides production-network-

related services. Supporting and relying on NRENs' collaboration, WP6 works towards the continued evolution of the GÉANT community's network infrastructures by defining, developing and implementing new functionalities and services to improve their quality, flexibility and cost-effectiveness. WP6 also operates Network eAcademy, providing learning material in as many relevant areas as possible, together with network systems' architecture analysis and maturity assessments. It disseminates work through infoshares, workshops, online and on-site events and global collaboration.

- WP7 Network Core Infrastructure and Service Evolution and Operations will ensure the continued delivery and evolution of GÉANT network infrastructure and services in a secure, sustainable, and cost-effective manner. The work package will ensure the network infrastructure is scalable and future-proof so it can continue to support growth in traffic and evolve the current core services to meet the needs of the users. It will develop open source, vendor-agnostic solutions for network management and automation. It will also support the expansion of intercontinental connectivity and the potential introduction and support of new non-data services, such as time and frequency, quantum, spectrum service, and describe how automation, orchestration and AI will become part of the network operational infrastructure.
- WP8 Security will keep the R&E network safe and secure at the backbone level and support the GN5-2 partners with up-to-date tools to keep their networks and connections to the GÉANT network safe and secure in an environment of increasing levels of cyber security threats. WP8 will also collaborate to achieve wide adoption and participation but also to deliver products and services, as well as a Security Innovation Lab.
- WP9 Operations Support is responsible for the first-line support of the GÉANT backbone network operations, security operations (CERT) and service management. It is the one key element responsible for GÉANT network service availability 24x7 and provides first-line support and escalation at all times. WP9 also supports the GÉANT Software Catalogue, as well as a general software development methodology framework, including testing processes and tools for the project through training and audits. New software products go through a systematic approval process before they enter into production.

3.1.2 Timing of all Work Packages and Components

Period 1 2025															Period 2																
2026															2027																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
	D9.1	D2.1	M1.1	M6.5	D1.1	D1.2	M8.2	D3.2	M2.4	D1.3	D1.4	D1.5	D1.6	D4.1	MR	PR	M2.8	D6.3	D4.2	D3.3	D1.8	D1.9	M3.2	D1.10	D1.11	D1.12	D1.13	D1.14	M2.12	MR	PR
	M2.1	M2.2	M5.1	M8.1	D3.1			D9.3	M2.5	M4.3	M7.1	D2.2	D1.7	D6.1	M1.2	D6.2	M3.1		M2.9		M2.10	M6.9	M7.2		D3.4	D4.4	D2.3	D4.5	M7.4		
		M6.1	M6.3		D9.2			M4.2	M8.3	M8.5	M9.1	M2.6	D5.1	D9.5		D7.1		M8.8		M4.6		M7.3			D4.3	D8.4	D2.4				
		M6.2	M6.4		M2.3				M8.4				D8.1	M5.2			M6.6		M8.9		M6.7				D8.3		D3.5				
			M5.1		M4.1								D8.2				M8.7				M6.8				M5.3		D5.2				
													D9.4								M8.10						D7.2				
													M2.7														D8.5				
													M4.4														M2.11				
													M4.5																		
													M8.6																		

Figure 3.1: Project output (MR = Management Report; PR Periodic report)

3.1.3 Project Components and Interdependencies

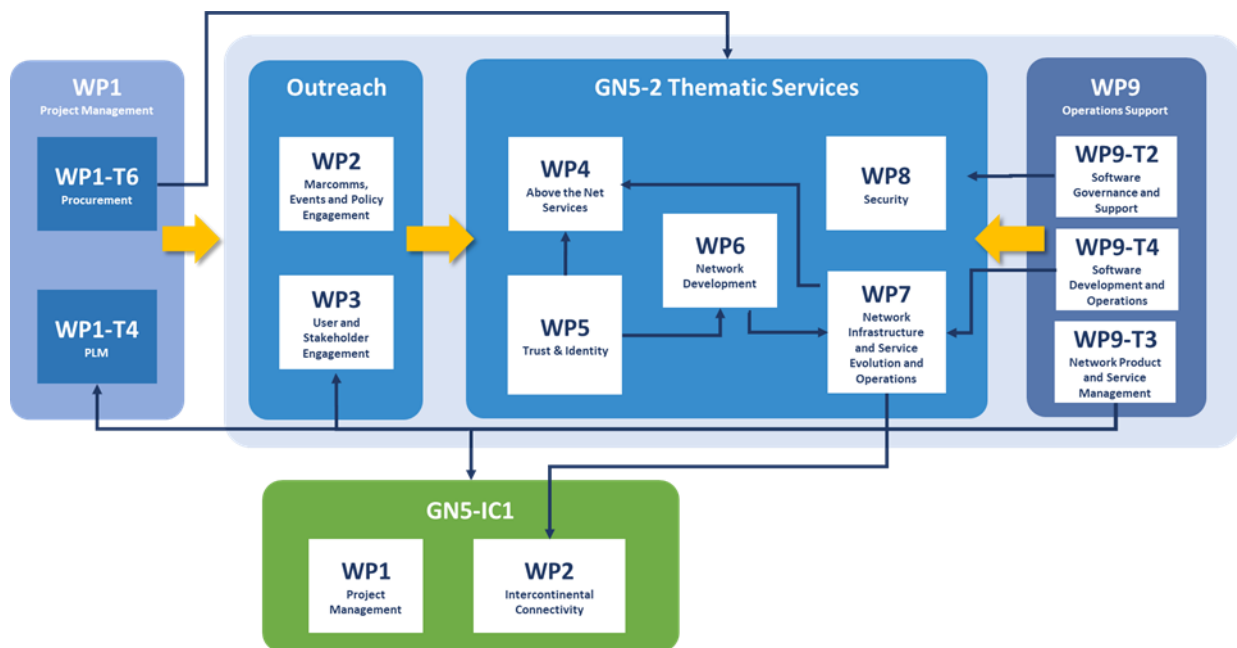


Figure 3.2: Project interdependencies by work package and task

3.1.4 Support Work Packages Work Plan

3.1.4.1 List of Work Packages

Work Package No	Work Package Title	Lead Participant No	Lead Participant Short Name	Person-Months	Start Month	End Month
WP1	Project Management	1	GÉANT	606	M1	M30
WP2	Marcomms, Events and Policy Engagement	1	GÉANT	377	M1	M30
WP3	User and Stakeholder Engagement	1	GÉANT	489	M1	M30
	TOTAL MONTHS			1472		

Table 3.1: List of Support Work Packages

3.1.5 Work Package 1: Project Management

Work package number	WP1
Work package title	Project Management
<p>Objectives</p> <p>In cooperation with the other GN5-2 work packages, and in alignment with GN5-FPA, WP1 Project Management will:</p> <ul style="list-style-type: none"> • Ensure the success of GN5-2 through: project management, risk prevention and mitigation, quality control mechanisms and an efficient and proactive relationship with the European Commission. • Provide a coherent management framework to deliver results efficiently and effectively, optimising costs, time and effort, and applying quality assurance, including technical author support, to deliver highest quality deliverable and project output, which is an important aspect of the project's quality assurance. • Handle overall project administration tasks (finance management, periodic reporting, EC review preparations, etc.), implement and update a data management plan and handle all ethical, legal and IP issues of the project. • Continue the strong engagement of GÉANT partners with standardisation bodies to influence the development of the relevant standards in a direction useful for the R&E community, further improving the community's leverage in the area of standards. • Provide financial management, administration and information for the whole project, to facilitate the delivery and monitoring of the project's objectives and costs. • Create, maintain and provide support for a coherent, easy-to-use, intuitive platform of Information and Communications Technology (ICT) tools and infrastructure to be used by the project participants in their day-to-day work. • Make sure all services offered are adequately documented in the GÉANT Project Service Catalogue, open to all, as part of the Product Lifecycle Management (PLM) process. • Coordinate and distribute training activities across the project. • Evolve the GÉANT training offering in response to the increased use of online learning by enabling access to licence-based online learning platforms to build skills in key areas such as security and trust & identify, as well as developing interpersonal and management skills. • Manage GÉANT procurement and suppliers. <p>Key Performance Indicators</p> <ul style="list-style-type: none"> • Number of services to have costing analysis. Target: 100%. • Number of deliverables issued on time. Target: 100%. • Attendance at training courses. Target: 100 participants per year. 	

Description of Work

Task 0: Work Package Leadership (Work Package Leader: Tryfon Chiotis – GÉANT)

This task will coordinate the work of GN5-2, liaising with the GN5-2 project work packages and project stakeholders, the NRENs, and lead WP1, managing and coordinating the work of all the tasks.

Task 1: Project Governance, Management and Coordination (Task Leader: Tryfon Chiotis – GÉANT)

Task 1 will ensure the success of GN5-2, through project management and quality control mechanisms, and an efficient and proactive relationship with the European Commission. It will provide a coherent management framework to deliver results efficiently and effectively, optimising costs, time and effort, and applying quality control. It will focus on achieving the highest quality standards of deliverables, on time and within budget, while ensuring the sustainability of the project activities. Task 1 will implement measures to prevent risks and to enforce a risk mitigation strategy. It will handle overall project administration tasks (finance management, periodic reporting, Project Annual Internal Reviews (PAIRs), EC reviews, etc.). It will also implement and then update a data management plan and handle all ethical, legal and IP issues.

In line with UN Sustainable Development Goals for sustainable development and the policies developed in WP2 T4, Task 1 will lead the improvement of environmental performance for the duration of the project. Task 1 connects GN5-2 and GN5-IC1 programme governance bodies as described in Section 3.1.3, including the GÉANT General Assembly, the GÉANT Board, the Oversight Committee, the Network Infrastructure Advisory Committee (NIAC), the Quality Assurance and Public and External Relations (QASPER) committee and the Project Management Board comprising work package leaders (WPLs), Project Management Office (PMO) and Coordinators that manage the interaction and communication across work packages, ensuring a coherent and consistent approach across the project and identifying and eliminating overlaps and gaps. Coordinators are responsible for the following areas: T&I (Christos Kanellopoulos, GÉANT), Outreach Activity (Cathrin Stöver, GÉANT), Community (Paul Rouse, GÉANT), Procurement (Olaf Verschoor, GÉANT), Security (Ana Alves, GÉANT), Services (Richard Lui, GÉANT), GDPR/IPR (Magdalena Rzaca, GÉANT), Software Governance/Development (Mandeep Saini, GÉANT), Standards (Richard Hughes-Jones, GÉANT), and the CTO function that is led by Bram Peeters, GÉANT (Network) and Klaas Wierenga, GÉANT (Above-the-Net) to develop and drive the strategic roadmap.

Overall project management will be fulfilled by the Project Management Office (PMO). This task will also coordinate the day-to-day administration of the project and its deliverables, including regular management reports. This includes technical author support, which is an important aspect of the project's quality assurance. The task will also ensure compliance with GDPR, IPR, standards, and other relevant regulations throughout the project.

Task 2: Finance (Task Leader: Munyaradzi Shahwe – GÉANT)

Task 2 provides financial management and administration for the whole project, and in-depth financial information to facilitate the delivery and monitoring of the project's objectives and costs. It covers the day-to-day management and administration of financial reporting, manpower reporting/timesheets and other regular tracking of costs/finance progress, as well as providing support for the project governance, PMO, work package leaders and task leaders with detailed reports of budgets/cost in their respective areas. Furthermore, Task 2 will provide advice and guidance specifically to product managers and work package leaders, and, generally, to project participants, as well as the financial aspects of cost sharing (updates to subscriptions and the cost-sharing model itself), resourcing/budgeting, financial reports, business cases, etc.

[Task 3: ICT has moved to WP9 Task 6]

Task 4: Product Lifecycle Management (Task Leader: Richard Lui – GÉANT)

Task 4 will provide the Product Lifecycle Management (PLM) Framework, a simple and low-overhead mechanism to ensure that all service development proposals are adequately justified before major development takes place and that a work package has considered all the required steps before the launch of a product or service. The GÉANT PLM process documents how the wider GÉANT community contributes to the design of new services. The first step is the research phase, where ideas from many community sources can be defined in an incubator task, where the idea can be properly funded. Community sources include the many Special Interest Groups (SIGs), two innovation programmes operated by the GÉANT Association, regular service feedback both informal and formal via the NREN Satisfaction Survey. Service concepts proposed for development are presented at the PLM gate, which includes business case assessment to ensure

there is sufficient interest from the NRENs, or the intended user base, in addition to details about the estimated development cost, timescales, and required resources.

The extended service offer will be reflected in the GÉANT Project Service Catalogue for NRENs, end-user institutions and scientists, as well as new users, such as public services and industry. It will also provide improved service development processes to achieve shorter development cycles and lower costs without compromising quality of service, as well as appropriate and improved cost allocation across the thematic service areas using a costing model that can deliver useful and repeatable management information and that considers the diverse delivery models and end users. It will provide effective support to work package leaders, increasing their ability to manage and coordinate Service Marketing (marketing). PLM will also collect and consolidate the applicable costs related to service provision and help provide the information needed for service costing and for helping to define potential cost recovery mechanisms.

Task 5: Human Capital Development (Task Leader: Sarah Hughes – GÉANT)

This task develops the most important asset of the GN5-2 community: the exceptional skills and experience of the professional staff found in the NRENs and GÉANT. Pivotal to the success of the GÉANT project, the project's human resources are highly regarded and in demand across the industry.

The following core activities are planned to develop skills in GN5-2:

- Live Learning: Deliver live training (online and in person) to meet the learning needs of project contributors, NRENs and the wider Research and Education community.
- On-demand Learning: Continue developing self-paced learning on eAcademy, the GÉANT community's eLearning portal. Provide access to licensed, third-party learning platforms such as O'Reilly Media to meet specialist technical training needs.
- Talent Development: Attract and develop the next generation to the community through the Future Talent Programmes.
- Gender Equality: Provide development opportunities for women in the community through the new GÉANT Mentoring programme using the Together platform. Once established, the offer of mentoring will be extended to the whole community.
- Do No Significant Harm: Support the work of WP2 by providing guidance to project participants on working sustainably.
- Learning Support: Coordinate and promote training offerings across all work packages through a course catalogue. Support work packages to help them deliver high-quality technical learning programmes.
- Knowledge-sharing: Build a learning community to share knowledge and best practices.

Increasingly, on-demand learning is delivered via online learning platforms licensed to individual users. To derive the best value for money and avoid inefficiency, GÉANT may coordinate and obtain these licences on behalf of partners.

In addition to developing technical knowledge, the task will offer "soft" skills training in areas such as: business development, communication (using Insights Discovery), presentation skills, team leadership and management capabilities. This may run live or on-demand and is aimed at increasing the value of the human capital by:

- Attracting and retaining talent by enhancing the skills within the GÉANT community.
- Enabling sustainable career progression for the project and its partners.
- Enhancing the effective delivery of the project's objectives through strong management and teamwork.

Task 6: Procurement & Supplier Management (Task Leader: Olaf Verschoor – GÉANT)

Task 6 will provide expert advice and assistance in the procurement of all goods and services. Improved procurement processes will be used to achieve shorter development cycles and lower costs without compromising quality of service. In alignment with the Network Infrastructure Advisory Committee (NIAC), Procurement will also help build consensus

amongst the community in how the resources will be spent to develop and operate, by developing and agreeing some principles on where and what should be procured. Suppliers under contract will be managed to ensure they deliver against their commitments and that maximum value is achieved from the project's resources.

3.1.6 Work Package 2: Marcomms, Events and Policy Engagement

Work package number	WP2
Work package title	Marcomms, Events and Policy Engagement

Objectives

WP2 provides a professional, integrated marketing, communications, design, events, and public affairs service to the project, for outreach and promotion at national, European and international level. It also supports all other work packages and project partners in their own project- and service-related communications. Through collaboration with all other work packages, WP2 will plan and implement a coordinated programme of communications, services marketing, events and public affairs support to:

- Position and promote the GÉANT network and services to European and global stakeholders.
- Demonstrate the capabilities, value and impact of GÉANT, R&E networks, NREN partners and their portfolio of services, with a particular focus on trust, identity, and security.
- Showcase innovations and initiatives as well as user success stories and their impact.
- Foster inclusion and participation among participants, partners and the wider community.
- Continue to explore and exploit synergies with EuroHPC, EOSC, Quantum, international connectivity projects, standardisation, e-Identity, cyber security, etc.
- Collaborate with other e-infrastructure providers, users, NRENs in Europe and worldwide, commercial partners and other stakeholders to maximise dissemination reach.
- Provide communication, design and events support to horizontal activities.
- Coordinate and liaise with EU and national policy bodies, regulator and funding agencies at all levels as required to explore synergies.
- Build on work started in GN5-1 around coordinating and baselining with other WPs current efforts in the project regarding i) UN Sustainable Development Goals advancement; ii) safeguarding digital rights in research and education; and iii) digital principles for research and education.

Key Performance Indicators

- Social media: increase impressions (as an average across LinkedIn and Facebook*) by 5% per year.
- Social media: increase total followers (as an average across LinkedIn, Facebook and Mastodon) by 8% per year.
- Social media: achieve an engagement rate (as an average across LinkedIn and Facebook) of 3% per year.
- Websites: increase aggregate visitors to all GÉANT websites by 5% per year. **
- Increase TNC participation by 3% per year based on 2024 numbers (includes physical and online attendees).

*Mastodon currently does not collect or track data.

**CONNECT.geant.org; IMPACT.geant.org; GEANT.org; TNC.geant.org; NETWORK.geant.org; CLOUD.geant.org; COMMUNITY.geant.org; ABOUT.geant.org; CAREERS.geant.org; TRUSTIDENTITY.geant.org and RESOURCES.geant.org. SECURITY.geant.org excluded as it does not allow tracking.

Description of Work

This work will be divided between the following tasks. Their activities and results will be reported in the regular management reports, with further detail and indications of progress provided by additional deliverables and milestones.

Task 0: Work Package Leadership (Work Package Leader: Paul Maurice – GÉANT)

Task 0 is a management task and will ensure the coordination and harmonious integration across the manpower and content in the four tasks. The task will coordinate with the other outreach activity leads in GN5-2. The WPL will attend Project Management Board (PMB) meetings and will ensure contact and coordination where possible with other GÉANT-led projects and initiatives.

Task 1: Communications and Design (Task Leaders: Silvia Fiore and Paul Hasleham – GÉANT)

Communications will work with all work packages to develop, agree, and implement marketing communications plans and initiatives to support their objectives. As part of this, Communications will explore strategic messaging and content to reflect the project's position within the evolving ICT landscape. The task is also responsible for the development and ongoing management of the project's communications channels and will ensure the channels continue to be effective by adopting clearer KPIs to track this. In addition, the task will develop messaging and create engaging content to position the project and its scope and activities as an enabler of global research, innovation and education, and to support the project's horizontal activities. The work will take the form of news items, articles, podcasts, website content, videos/animation and materials, and, together with the NRENs, the task will publish it through the most appropriate channels to reach the project's target audiences.

Design will have a watching brief over all brand and design elements for online and offline use and will provide a design and support service to ensure a coordinated, consistent brand identity, "look and feel" and usability across the project's overall web presence, digital channels, collateral and publishing of the project branding guidelines.

Task 2: Services Marketing (Task Leader: Karl Meyer – GÉANT)

The Services Marketing task increases awareness and uptake of the GÉANT Network, Trust and Identity, Above-the-Net and Security services. To achieve this, the task will:

- Aid the understanding of stakeholder relationships and the appropriate mode of communication needed to support NRENs' communication of services as the GÉANT Project Service Catalogue expands to include more value-added services.
- Ensure that the family of GÉANT services continues to have consistent and prominent visibility and brand presence through effective services marketing to stakeholders.
- Promote the services developed by the project, ensuring the value propositions are clearly communicated and strategic product messaging, branding and positioning are established within an overall portfolio, including creation and execution of per-service marcomms plans.
- Develop cross-media and cross-channel marketing content for services as appropriate for the product and stakeholder audience.
- Provide management support for the Commercial Partnership Programme.

Task 3: Events (Task Leader: Steffie Bosman – GÉANT)

The Events task will focus on the following main activities:

- Annual delivery of TNC, ensuring TNC continues to be the flagship conference of the GÉANT and international research and education networking community.
- Organisation of project symposia and conventions, ensuring successful community collaboration.
- Organisation of and participation in international events, forums or symposia to disseminate the value of GÉANT, NRENs and e-infrastructures at large.

The task will deliver large-scale, compelling events in collaboration with NREN partners and support participation at stakeholder and community events nationally, in Europe and worldwide. In collaboration with GÉANT partners, Task 3 will form the GÉANT Events Team to build and provide the networking, streaming and other audio-visual (AV) capabilities to support the host NREN for TNC, internal project events, and other joint events that require it. The project will achieve economies of scale by investing in its own equipment and building experience and expertise in event infrastructure and will develop community expertise.

Task 4: Policy Engagement (Task Leader: Hendrik Ike – GÉANT)

The key activities of this task will be to:

- Coordinate and liaise with EU and national policy bodies, regulator and funding agencies at all levels as required to explore synergies.
- Strengthen the public affairs capacity of project partners through workshops, selected events and community meetings.
- Continue to showcase the societal impact of the project to a wide range of policy-making stakeholders.
- Monitor alongside WP1 the implementation of the project deliverable D38 (D2.3 Project contribution to UN SDGs and European Digital Rights and Principles. This will be done by liaising with relevant WPs/tasks within the project to monitor actions matched to agreed realisation of applicable UN Sustainable Development Goals and where the project has an active role safeguarding i) digital rights and ii) digital principles for research and education. These are listed within the digital decade programme.

3.1.7 Work Package 3: User and Stakeholder Engagement

Work package number	WP3
Work package title	User and Stakeholder Engagement

Objectives

WP3 provides the interface between GÉANT and the communities the project serves – through extensive collaboration with key actors and stakeholders, it seeks to understand community requirements. WP3 provides relationship management to ensure NRENs, users and collaborations get the most from GÉANT services, and interfaces with global NRENs to support existing relationships. The work package also manages the relationship with international user groups, including large research infrastructures, parallel e-infrastructure projects, European Open Science Cloud, EuroHPC, EPAs, Common European Data Spaces and any other relevant strategically important initiatives. WP3 monitors trends in the NREN landscape via the Compendium, internal and external sources, and seeks feedback from stakeholders, bringing together information and coordinating work. Finally, via the GÉANT Community Programme, the work package provides a forum for the NREN and wider community to engage with one another, and with GÉANT, on a range of beneficial activities including the Innovation Programme. WP3 works across all work packages to assure a fully coordinated approach to outreach and stakeholder engagement.

The expected outcomes of the work package are:

- Maintain close relationships with NRENs in Europe and around the world, and work with them to strengthen the value proposition of the NREN network within the research and education communities.
- Ensure NREN sustainability and bridge the digital divide by enabling full access to project participation, supporting knowledge exchange and transparency across governance and ensuring strong support and help to new members, e.g. through dedicated support for Eastern Partnership (EaP) NRENs and others, as necessary.
- Maintain existing strong relationships and partnerships with European e-infrastructure providers to create a cohesive service offering and to approach users in a coordinated manner to support Open Science.
- Further develop existing relationships with research infrastructures (CERN, ESS, SKA, ESFRI, etc.) and EC flagship initiatives (e.g. Destination Earth, digital twin projects) to ensure that both the core network and services are available to support critical European research and infrastructures.
- Follow up on any needs identified in the Foresight Study (conducted in GN5-1) to ensure full alignment of outreach and engagement portfolios of work.
- Support NRENs to understand the changing landscape, including a greater integration of the wider NREN ecosystem within the EU's strategic priorities (e.g. European data gateways, European Data Spaces).
- Coordinate on topics of community interest such as EOSC, EuroHPC, Quantum, Data Spaces to ensure a collaborative engagement model and agreed community approach.

- Deliver an integrated GÉANT Community Programme through facilitation of discussion, cooperative working, with a continued focus on innovation and community development with a harmonised approach to community support (in conjunction with WP1).

Overall, WP3 will strengthen GÉANT's internal and external relationships and help develop GÉANT's collaborations through outreach, consultancy and engagement.

At the end of Period 1, the work package will have delivered a comprehensive stakeholder engagement plan, Compendium report and review of global engagement. These will feed into the Period 2 activities. At the end of the project the work package will have delivered an NREN Satisfaction Survey, two Compendium reports and utilised intelligence gained from CTO roadmap reports to feed into the Community Programme. During the last six months, WP3 will deliver reports on the Community and Innovation Programme and on collaboration and international user support activities.

Key Performance Indicators

- NRENS' level of satisfaction with Partner Relations maintained (via Satisfaction Survey).
- Meet with 90% of European NRENS and global RENs at least once per year.
- Attendance at 20 or more user-specific events per year (GEO, LHC, etc.).
- 15 news stories resulting from GÉANT Community Programme (GCP) activities per year.

Description of Work

Task 0: Work Package Leadership (Work Package Leader: Annabel Grant – GÉANT)

This task is to lead WP3 and coordinate the work of the four tasks. In addition, the Work Package Leader will coordinate across work packages with the Outreach coordinator to ensure full outreach alignment across the project.

Task 1: Partner Relations (Task Leader: Beatrix Weber – GÉANT)

Partner Relations will provide a comprehensive and bespoke relationship management function for GÉANT NRENS, with a focus on supporting and enabling NRENS to consume GÉANT services and to support the wider sustainability needs of partners. The task works to ensure that GÉANT provides excellent service to European NREN partners to stimulate uptake of GÉANT services and maintain and support overall NREN sustainability.

It will also provide a single point of contact for global NREN partners via a dedicated GÉANT Relationship Manager, with a focus on facilitating the delivery of specific service requests between European NRENS and their international counterparts as well as enabling and supporting collaborative activities.

Finally, it will collate, monitor and share information via dedicated initiatives such as the Compendium and NREN Satisfaction Survey, and provide GÉANT with intelligence and a reliable evidence base to help guide strategic direction and input into practical developments.

Key objectives are as follows:

European Partners

- Provide a dedicated partner relations service for the European NRENS and Regional Research and Education Networks (RRENS), acting as a "voice of the partners", ensuring that their views are gathered, fed back into the project and relevant changes made.
- Coordinate procurement, financial, operational and technical activities in GÉANT amongst partners to ensure effective delivery of services to NRENS across functional boundaries.
- Provide a dedicated liaison person for each Service work package supporting outreach planning and coordination.
- Address the digital divide across Europe and in collaboration with our global partners – provide additional support activities for countries where NRENS are less developed or face specific constraints.

International Partners

- Provide a dedicated relationship management service for both day-to-day interactions and longer-term planning with international RRENs and NRENs.
- Provide representation in multi-lateral activities and globally focused working groups, feeding information on developments in and with the international REN community back into the GÉANT community.
- Enhance global service cooperation, engaging with international RENs and across the project.

Intelligence

- Deliver the Compendium and its adjacent website which tracks the evolution of R&E networking in Europe.
- Curate and analyse information obtained from bilateral interactions, engagement activities and the Satisfaction Survey. This information will be fed back in a structured manner, taking heed of emerging trends and themes.
- Support an understanding of future needs, providing intelligence on developments relevant to the GÉANT project and its contributors.
- Ensure that results of the Foresight Study are embedded into the GEANT project.
- Represent as NREN champion for relevant operations systems (WP7 and WP9), supporting the Relationship function and NRENs in service delivery and transparency.
- Provision of the Partner Portal as central access point for network service information requests and changes.

Task 2: Supporting International User Groups (Task Leader: Vincenzo Capone – GÉANT)

Task 2 will coordinate the support provided by GÉANT, the NRENs and global partners for existing and innovative new user applications, as well as identify new potential European and international project users. Activities to achieve this would be:

- Interacting with existing international users (CERN, ESA, SKA, ECMWF, EUMETSAT, ITER, etc.), research infrastructures, and expansion of the GÉANT and NRENs user base to new science communities, data spaces and collaborations.
- Interacting with other e-infrastructure projects /future research infrastructure projects (EuroHPC, Copernicus, Destination Earth, etc.) to understand and meet specialist requirements.
- Dedicated relationship management function for international user projects and organisations, and promotion of international user collaboration across world regions.
- Maintaining awareness of developments that might influence the expectations of the user community of the GÉANT infrastructure services – with a focus on ensuring seamless and secure access to European and worldwide data spaces.
- Supporting both Product Management and Service Management functions through focused, use-case analysis, to support more “co-creation” activity through feedback from users on new and existing services (in conjunction with WP3 T1).
- Providing a technical business development focus for transnational user organisations, supporting alignment with existing and future community strategies, working with members to jointly find effective solutions.

The key objectives of Task 2 are to:

- Reach out to existing and new user communities to facilitate, extend and maximise the use of the GÉANT network and services.
- Act as the “voice of the customer” within the project to provide feedback on user needs and to coordinate service proposals in partnership with NRENs using a collaborative engagement model.

Task 3: External Relationships (Task Leaders: Sylvia Kuijpers – SURF; Annabel Grant – GÉANT)

This task provides a central point for liaison, engagement and strategic outreach activities to other European e-infrastructure projects and wider initiatives such as EOSC, EuroHPC, EPAs, ESFRI, GAIA-X, Common European Data Spaces, and coordinates the support provided by GÉANT, the NRENs and global partners to e-infrastructure for further alignment of service portfolios and to ensure continued joint initiatives and partnerships. The task will also ensure that multilateral organisations which are influential in shaping international policies, protocols, and initiatives that impact the

Research and Education ecosystems are tracked – for example UN Department of Economic and Social Affairs (DESA), UN Tech Envoy, ITU, UNESCO, etc.

This task will monitor, harmonise and support the work outlined in current collaboration agreements (interoperability, consolidation, strategy and service alignment) or joint projects/procurements. Additionally, the task will establish relationships with other initiatives and new user communities and pursue joint activities/collaborations wherever possible. The task will bring the community together on matters of strategic interest to agree a shared way of working, strategy, knowledge transfer (in conjunction with Task 4 and Task 2), outreach planning (for example via the development of joint community papers in areas such as: Quantum, Data Spaces, EOSC/Open Science, EuroHPC, etc.). The coordination work ensures that the community views are collaboratively sought towards the new and existing initiatives. This task will focus solely on strategic engagements (rather than Task 2, which will focus on technical requirements and delivery).

The key objectives of Task 3 are to:

- Ensure that GÉANT's work (especially with respect to services, users, requirements) is aligned with related e-infrastructure, external projects and any wider initiatives both current and future; raising awareness of important topics towards the community for a joint approach.
- Maintain, enhance and extend a proactive, collaborative and dedicated point of contact for e-infrastructures, other projects and wider initiatives in the external ecosystem – both European and global – to actively seek out/address new opportunities for collaborations (with WP3 T1, T2 and other work packages as necessary).
- Identify additional collaboration opportunities (joint research projects, new services, etc.) with strategically important external projects, R&E and industry initiatives to stimulate full use of GÉANT infrastructure and services by new communities of users and ensure no duplication of work.

Task 4: Community Programme (Task Leader: Dawn Ng – GÉANT)

GÉANT supports community-based initiatives to explore emerging issues, exchange information and collectively develop strategies and solutions. Thematic groups of experts from NRENs, user organisations, research institutions, commercial and industrial sectors collaborate via virtual platforms and hybrid meetings. These groups and activities form part of the GÉANT Community Programme, a larger initiative that supports activities from a range of funding sources. These activities act as a platform to discuss and promote project work to a wider audience than the project boundaries and to provide a forum to discuss new and innovative ideas that may become future work items. Specifically, this task will:

- Work with Tasks 1, 2 and 3 and relevant work package leads (specifically looking at incubator work) to track innovation within the community and the development and progress of ideas throughout the GÉANT community.
- Provide fora that are completely open to attendees to ensure that the GÉANT community and the GN5-2 project are promoting and engaging as widely as possible to support the innovation pipeline.
- Manage and run the GÉANT Innovation Programme (where budget is allocated by the GÉANT Board, upon GA approval).
- Provide secretariat support for GÉANT Community Programme-based initiatives and ensure harmonisation with broader GÉANT activities.

The key objectives of Task 4 are to:

- Facilitate exchange of information and best practice between experts working in the GÉANT NREN community and (much) more widely in the sector, with a focus on knowledge sharing, stimulating innovation and providing added value to the GÉANT community.
- Provide a platform to promote work from the GN5-2 project, the GÉANT community, the global NREN community and from industry partners.

3.1.8 Service DevOps Work Plan

3.1.8.1 List of Work Packages

Work Package No	Work Package Title	Lead Participant No	Lead Participant Short Name	Person-Months	Start Month	End month
WP4	Above-the-Net Services	16/11	EENet of HTM / DFN-Verein	412	M1	M30
WP5	Trust & Identity	24/1	NORDUnet (SUNET)/ SURF	1064	M1	M30
WP6	Network Development	25/3	PSNC /AMRES	828	M1	M30
WP7	Network Infrastructure and Service Evolution and Operations	1	GÉANT	881	M1	M30
WP8	Security	1	GÉANT/Jisc	610	M1	M30
	TOTAL MONTHS			3795		

Table 3.2: List of Service DevOps work packages

3.1.9 Work Package 4: Above-the-Net Services

Work package number	WP4
Work package title	Above-the-Net Services

Objectives

The Above-the-Net Services work package (WP4) is responsible for the operation and enhancement of the existing cloud services delivery chain and for innovation and the development of service proposals and strategy to address the emerging requirements of the GÉANT community's research data stakeholders and end users.

Service delivery tasks are user-facing (T1 – towards NRENs, for all service topics) and supplier-facing (T2 – towards commercial service providers of procured services). The GÉANT Cloud Framework (OCRE 2024) will be the major current subject of WP4's service delivery chain during GN5-2, while WP4 service innovation and strategy will be forward-looking, scoping and aggregating future service demand (T1 & T2), as well as service concept and proposal development (T3) and incubation activities (T4). WP4 also contains an activity focused on maintaining a longer-term, collective strategy perspective for Above-the-Net services in support of Open Science (T4).

WP4 pursues a unified R&E approach to commercial and community cloud offerings, and will deliver the following outcomes:

- Rollout of the GÉANT Cloud Framework OCRE 2024.
- Maintenance of an NREN- and supplier-facing delivery chain to deliver a collective portfolio of commercial and community cloud services.
- Demand aggregation for commercial services in the NREN community, towards potential collective procurements.
- Continued community-backed strategy for a joint-NREN approach to supporting Open Science.
- Developing robust service concepts, business cases, and investment proposals for three community-proposed services:
 - Research dataset transfer service.
 - Common PaaS cloud middleware for integrated Trusted Research.
 - Pan-European, sovereign, research data object storage (feasibility study).
- Services incubator to enable proofs-of-concept for services.

To achieve these outcomes, WP4 will liaise with relevant parties in the project and wider GÉANT community (particularly WP2 and WP3, as well as other WPs, SIGs, NRENs, research infrastructures) and maintain contact with the appropriate channels, including EOSC Association and NRENs outside of the EU, to foster European and global R&E cooperation in the domain of cloud services.

Key Performance Indicators

- Of OCRE 2024 suppliers with call-offs signed by Q2 2025, percentage of those onboarded into the consumption reporting system [75% by M11] (T2).
- OCRE 2024 launch event held within 6 months of Framework commencement date (T2).
- Service concept development: Endorsement by a representative group of at least 10 GÉANT members and 3 pan-European research communities(T3):
 - 3.1: Research dataset transfer service: Sufficiently endorsed? [M22]
 - 3.2: Common PaaS cloud middleware: Sufficiently endorsed? [M22]
 - 3.3: Sovereign research data object storage: Sufficiently endorsed? [M22]

In addition, WP4 will track and report on several service metrics:

OCRE 2024:

- Number of countries with reported consumption.
- Number of institutions with reported consumption.
- Framework contract service consumption in euros.
- Number of framework platforms and suppliers in contract management.

Other Above-the-Net services:

- Known installations at NRENs/institutions.

Community coordination:

- Engagement in Strategy Forum.
- Engagement in service concepts/investment proposals.
- Engagement in service manager channels.

Description of Work

This work will be divided between the following tasks. Their activities and results will be reported in the regular management reports, with further detail and indications of progress provided by deliverables and milestones where indicated.

Task 0: Work Package Leadership (Work Package Leaders: Maria Ristkok – EENet of HTM, Jakob Tendel – DFN)

T0 serves as the leadership and coordination hub within WP4, overseeing and harmonising the efforts of all tasks to efficiently achieve objectives, ensuring adherence to project processes, managing resources for communication and project management, and taking responsibility for the representation and alignment of WP4 activities across and beyond the project.

Task 1: User-Facing Service Delivery Chain (Task Leader: Eva Nestorovska – PSNC)

This task enables the service delivery of WP4's portfolio of Above-the-Net services to NRENs and their connected R&E institutions. This includes the GÉANT Cloud Framework (OCRE 2024) and eduMEET as well as any future service developments, with communication, dissemination and community engagement needs. It focuses on coordinating and supporting NREN Above-the-Net service delivery managers, maintaining central documentation, supporting innovation in the delivery chain, and enhancing NREN and institutional capabilities to facilitate the uptake of WP4's Above-the-Net service portfolio. Task 1 will:

- Collaborate with T2 to orchestrate the rollout of the OCRE 2024 Framework to the NREN community, including a launch event where NRENs can meet representatives of the awarded suppliers.
- Coordinate and support the established community of NREN Above-the-Net service delivery managers to facilitate uptake of services in the portfolio, including a helpdesk for NRENs.
- Facilitate the community Cloud Forum for the Cloud Service Delivery Managers and the Above-the-Net Services Strategy Forum's regular meetings and outcomes.
- Produce and maintain central documentation pertinent to service delivery, to prepare and support NRENs to deliver maximum value to their institutions.
- Further innovate the delivery chain to improve efficiency and effectiveness on an ongoing basis.
- Evolve the Above-the-Net service usage skills and capabilities of the NRENs and their institutions.
- Enable NRENs and institutions on transitioning to the cloud in general and using the WP4 service portfolio.
- Monitor service use, and systematically gather requirements and user satisfaction information.

Task 2: Vendor-Facing Service Delivery Chain (Task Leader: Garvan McFeeley – HEAnet)

This task engages in vendor and contract management and provides operational support for GÉANT's role as Central Purchasing Body and holder of Framework Agreements in shared procurements, such as OCRE 2024. Smooth service delivery from cloud vendors is enabled through a Business Desk and Contract Management Group, which ensure the integrity of contract relationships and consumption reporting.

Task 2 is responsible for the platform of services and delivery for the OCRE 2024 framework, planned to be procured and ready for implementation by the end of 2024. In the event of a delay, Task 2 will address any remaining actions required to ensure the OCRE 2024 framework is launched. This includes a catalogue for national-specific information bundles, presenting the service portfolio to the R&E community, ensuring inclusion in the EOSC services portal, enabling institutions to adopt the services with consumption tools to browse, find, select, contract, and review services. The task will seize further opportunities for central effort aggregation on topics such as procurement legal support or data protection and will gain unique access and concessions for NRENs and their institutions with suppliers.

Task 2 provides portfolio and contract management for WP4's portfolio of services, consisting of service agreements established during previous GÉANT projects, the OCRE project, and services acquired through WP4's efforts in GN5-1. Activities include:

- Monitoring contract fulfilment by suppliers and NRENs.
- Being the single point of contact towards suppliers on a range of operational business subjects.
- Providing a second-line helpdesk to/from NRENs on contractual and procurement matters.
- Preparing quarterly service consumption reports.
- Cultivating long-term operational and strategic relationship with suppliers.

Task 3: Services Concept Development (Task Leader: Morten Kjeldgaard – DeiC; Co-Task Leader: Jan Meier – Sikt)

This task will develop investment proposals for three service concepts, with a large, long-term expected impact that may require significant future investment and commitment from the NREN community. These are:

Common PaaS Cloud Middleware for Integrated Trusted Research

A common baseline suite for Platform as a Service cloud research data environment, integrating NREN services such as T&I and security by design, deployable to any Infrastructure Cloud (commercial or community), offering Virtual/Trusted Research Environment functionality to end -users, anchored in the R&E trust ecosystem and with federating capabilities.

Data movement infrastructure for research datasets

A research data transfer infrastructure aims to make large transfers of significant size (i.e. sub-CERN, 0.5 TB < X < 1PB) trivial for any researcher, by integrating available tooling and protocols into a coherent, widely deployed, easy-to-use

and secure infrastructure that goes where the network goes. It simplifies many of the challenges around point-to-point data transfers, allowing users to move on from bits and files to managing datasets. This solution will fully leverage the available network capabilities to all researchers.

Pan-European, Sovereign Object Storage for Research Data

This topic will investigate a pan-European infrastructure for research data storage. Baseline requirements include a collectively procured, built and managed technology platform that offers simple object-storage interfaces, deployed in a distributed way that satisfies digital sovereignty requirements. This targets research data repositories with the promise of providing better and cheaper low-level storage by leveraging European-size economies of scale. Such storage will manage technical complexity with great potential savings by unlocking the benefits of building a collective, European infrastructure while recognising the national character of most sovereign data storage infrastructure efforts.

These services are envisaged to be valuable additions to GÉANTs infrastructure portfolio, uniting existing, stand-alone NREN activity into a collective effort. Collectively they also cover functionality that many NRENs are expecting to need to provide in the emerging EOSC node federation.

Subject-matter experts will explore the business case for each of these potential services, propose technical and service architectures, and develop sufficient NREN and research community support for the next steps following the PLM process. The task will liaise with WP8 and external regulatory, policy and technical security experts, where appropriate, to ensure security-by-design on all levels. The task will work with WP2 and WP3 for outreach to the NREN and research community, and with WP5 and WP6 to ensure integration with the GÉANT collective network and T&I infrastructures. The task will investigate the role the proposed infrastructures can play to support NRENs and research infrastructures in their respective roles in the emerging EOSC node federation. Task 3 will work closely with Task 4 to align its work with and provide input to evolving the collective GÉANT cloud strategy from the GN5-1 results.

These three service concepts emerged from the GN5-1 cloud strategy activity and are supported on the collective Above-the-Net roadmap. The task will target the “start development” gate of the GÉANT PLM process. The envisaged regular interaction with the targeted user and stakeholder community will ensure the relevance of the work, and milestones offer an opportunity for point-in-time checks by the project management to evaluate the course of the work. Task 3 may leverage the Task 4 incubator for proof-of-concept implementations when appropriate. The target is for investment proposals to have matured enough and received enough endorsement to be actionable input for GN5-3 planning.

eduMEET

In addition to the above concept development work, Task 3 will continue providing some specific central support for eduMEET. Following core feature implementation to version 4.0 in GN5-1, the next step will be to polish the software to a higher standard of usability from an NREN’s perspective, and work in the community to broaden its user base. To this end, T3 will fill the role of “product owner / chef evangelist” for eduMEET, to pursue establishing a NREN-based federation of eduMEET deployments. Task 3 will also support maintenance and stability development to keep the codebase up to date, as well as support the continued availability of key eduMEET team members.

Task 4: Services Strategy and Incubator (Task Leader: David Heyns – GÉANT)

The concept of an NREN acting as a national node of the European Open Science Cloud (EOSC) is taking shape. Nodes would provide above-the-net services in support of their national science communities. These services focus on those communities and support all aspects of research data management – but could also include other emerging platform/software services in support of Advanced Analytics, Machine Learning (ML), and Artificial Intelligence (AI).

Task 4 will take on the coordination and evolution of the ongoing GÉANT cloud strategy work as begun in GN5-1. It will contribute to a strategic position on questions such as how do NRENs support the ERA Open Science agenda, including EOSC, from an Above-the-Net point of view, and considering emerging platforms in support of data management, advanced analytics, etc. This position will be captured in a deliverable D25 (D4.2 representing the 2026 GÉANT Cloud Strategy. Another intended output is a “Dummies Guide to Digital Autonomy”, *Data Management Guidelines*

deliverable D19 (D4.1 for the GÉANT community, unpacking European data governance; GDPR; data sovereignty considerations in cloud hosting; the management and ethical exploitation of an institution's own data assets (AI).

This task will also manage an incubator function for above-the net services with a strategic perspective, including ones in support of Open Science. The incubator provides a bridge between the work package and related activities focused on the support of Open Science elsewhere in the project, particularly as they relate to EOSC, and the development of the Common European Data Spaces and SIMPL interoperability framework (FAIR sharing of research data across the region).

In order to achieve this, the incubator will run a series of calls for **limited PoCs** focused on those NRENs pursuing the concept of the EOSC national node in order to prioritise digital services in support of a core services template. The incubator will score and award limited resources to proposals that could demonstrate service incubators in line with the priorities/template. These PoCs could well relate to the motivation for the three core services being unpacked in Task 3. The activities and outcomes pertaining to the incubator will be detailed in the third task deliverable D35, (*D4.4 Incubator Outcomes*).

This task will:

- Coordinate the further strategy development around Above-the-Net services and towards supporting the project's Open Science objectives.
- Collaborate with T3 regarding the possible realisation of technical proofs-of-concept for their services focused on the support of Open Science.
- Provide incubator resourcing for working on innovative but untested technologies, operational/business models and concepts.

3.1.10 Work Package 5: Trust & Identity

Work package number	WP5
Work package title	Trust & Identity y

Objectives

The Trust and Identity work package (WP5) is responsible for the enhancement and operation of the existing Trust and Identity services and for the innovation and development of T&I (both existing and new) products and services to address the emerging requirements of the GÉANT community.

WP5 will engage with WP1 and WP3 to ensure wider community engagement and outreach and with other work packages that need identity management support.

WP5 proposes an ambitious plan to increase the impact of the provided T&I services, by ensuring that:

- The GÉANT T&I offering continues to evolve to address the growing demand for federated access from the GÉANT community, scientific collaborations, EOSC, HPC, research infrastructure clusters, student mobility initiatives, etc. This will be done by leveraging eduGAIN and augmenting the Core Authentication and Authorisation Infrastructure (AAI) Platform to enable services in support of the advanced use cases, such as the MyAccessID service.
- Innovation is addressed within the Service tasks (T1–T4) and the T&I Incubator task (T5).
- Continuous collaboration with the relevant initiatives, such as WISE, REFEDS, AEGIS, AARC, EuroHPC and EOSC, is ongoing, providing support to overcome technical and other challenges for adoption of a federated approach (use of trust and identity federations, based on national identity federations, essentially a collection of organisations that agree to interoperate under a certain rule set).

This work package will also liaise with other relevant initiatives, such as national and international projects related to e-identities, students' mobility initiatives, eIDAS, EUDI wallet and EBSI. This will ensure that the GÉANT community can

expand the T&I services capabilities and drive the global R&E ecosystem without duplication of effort. To support the paradigm shift that the EUDI wallet is carrying, enhancements to the service models and underlying technologies will be investigated by the relevant Service tasks and the T&I Incubator, while the Enabling Community task will facilitate information sharing among NRENs about related national and European initiatives and unfold the business cases for wallets in the R&E sector.

The expected outcomes of the work package are:

- Deliver the T&I services (eduroam, eduGAIN, InAcademia, Core AAI Platform and its related services) in a secure, effective, agile and optimised manner.
- Evolve the capabilities of the Core AAI Platform in order to support the advanced use cases and enable NRENs to bring forward these capabilities and enrich their identity federation portfolio.
- Enhance the T&I services, introducing new features and improving performance, functionality and usability.
- Explore new or disruptive ideas and technologies in the T&I space and feed the results to the relevant audience.
- Engage with the relevant stakeholders to understand their requirements and use them to drive the evolution of the GÉANT T&I services and products.

Key Performance Indicators

KPIs for services' availability, measured throughout the project's duration (baselines are set as a minimum of the historical average in the past 24 months and the target):

- eduroam: European Top-Level RADIUS (ETLR) availability. Baseline: 99.9%; Target: 99.9%.
- eduGAIN: Metadata Service (MDS) availability. Baseline: 99.5%; Target: 99.5%.
- Core AAI Platform GÉANT AAI Service availability. Baseline 99.5%; Target: 99.5%.
- InAcademia: availability of the InAcademia service. Baseline: 99.5%; Target: 99.5%.

KPIs for services' uptake, measured throughout the project's duration:

- eduroam: number of international authentications. Baseline for 2023: 1,223.7 million; Target: 5% annual increase.
- eduGAIN: start the eduGAIN Baseline Expectations programme with an initial target of 40% of entities that will pass the requirements (by the end of GN5-2).
- Core AAI Platform: GÉANT AAI Service, connected services. Target: 100% of the services developed in the project and which require user authentication.
- InAcademia: number of national federations participating in the service. Baseline: 10; Target: 15 (by the end of GN5-2).

KPIs for innovation and engagement measured for the duration of the entire project:

- Number of topics that went through the incubator cycles. Baseline at start of the project: 0; Target: 4 topics per project period.
- Number of initiatives, standardisation bodies and research communities engaged with Task 6 and Service tasks. Baseline at start of the project: 0; Target: 8 (by the end of GN5-2).

Description of Work

The focus of this work package is the strategic evolution and delivery of Trust & Identity (T&I) services. WP Management (Task 0) provides overall coordination, ensuring consistency and seamless integration of the T&I programme across the tasks. Task 1 is dedicated to advancing eduroam, a service for secure, worldwide roaming access. Task 2 focuses on eduGAIN, aimed at facilitating interconnectivity between identity federations. Task 3 is centred around developing the Core AAI Platform as a foundation for delivering advanced services. Task 4 supports the InAcademia service, simplifying online verification for academia. The T&I Incubator (Task 5) serves as a vessel for testing and nurturing innovative ideas and disruptive service improvements, while Task 6, Enabling Communities, aims to strengthen community engagement and collaboration. This structured approach in WP5 ensures a comprehensive, balanced development of T&I services, keeping pace with the evolving needs of the R&E community.

Task 0: Work Package Leadership (Work Package Leaders: Marina Adomeit – NORDUnet (SUNET), Maarten Kremers, SURF)

This task is responsible for the overall management and coordination of the work package, ensuring the strategic steering, execution of the project plans and the required cross-task coordination. It will collaborate with WP1, WP2 and WP3 for procurement, training, marketing and stakeholder engagement, and with WP9 for operational support. This task will also ensure that the GÉANT PLM processes are followed, as required. The WP5 management embraces the trust-based team culture, collaboration with the task leaders towards collective leadership and ensures collaboration with relevant stakeholders and subject-matter experts in the trust and identity area.

Task 1: eduroam (Task Leader: Paul Dekkers – SURF)

eduroam (education roaming) provides a secure, worldwide roaming access service for the international research and education community. The eduroam service allows students, researchers and staff from participating institutions to obtain Internet connectivity on their mobile devices and laptops across their campuses and when visiting other participating institutions.

This task will:

- Continue the development, operation and enhancement of the eduroam service, which includes:
 - eduroam core services, namely, the RADIUS eduroam Top-Level Servers (ETLR), eduroam monitor, eduroam F-Ticks and database.
 - eduroam supporting services, namely, the Configuration Assistant Tool (CAT), eduPKI, Managed IdP, Managed SP and geteduroam.
- Provide business development, support and secretariat functions for managing European membership.
- Continue to enhance the user-facing tools (CAT, geteduroam, Managed IdP, etc.) and continue to develop software essential for the eduroam infrastructure (such as radsecproxy) and tools to improve data and statistics via the eduroam database and F-Ticks.
- Perform work on novel ideas such as new EAP types (EAP-FIDO), working together with standardisation bodies to realise the ideas.
- Continue to identify and engage with strategic collaborations with the industry and standardisation bodies (such as IETF, WBA, Wi-Fi Alliance) and enhance eduroam to enable roaming organisations (ROs) to continue to play a strong role in the roaming arena (i.e., OpenRoaming).

Task 2: eduGAIN (and Federation Services) (Task Leader: Davide Vagheti – GARR)

eduGAIN is one of GÉANT's key Trust and Identity services, allowing identities issued by trusted organisations (Identity Providers) to be used to simply and securely access available web content and services (Service Providers). The eduGAIN service interconnects identity federations around the world, simplifying access to content, services and resources for the global research and education community.

This task will:

- Continue the development, operation and evolution of the eduGAIN service, which includes:
 - eduGAIN core services: the Metadata Service (including the HSM and the metadata validator) and the eduGAIN database.
 - eduGAIN supporting services: the technical portal and checking tools, eduGAIN F-Ticks, eduGAIN reporting and Federation as a Service.
- Provide business development, support, CSIRT, training and secretariat functions for managing the global membership.
- Contribute to the SeamlessAccess coalition's operational and product management efforts, safeguarding the interests of the GÉANT community.
- Establish and run the eduGAIN Baseline Expectations programme. This work will include collaboration with the eduGAIN Steering Committee in defining the baseline, providing business development, training and

support to federation operators to catalyse the adoption and adaptation of eduGAIN tools and processes to track and enforce the compliance.

- Strengthen position of eduGAIN as the Global Trust Fabric in R&E. In this direction, the task will:
 - Continue the work on introducing a new technical profile for OpenID Federation, providing support for new use cases around federated authentication and new technologies, such as EUDI wallets.
 - Collaborate with other initiatives to provide eduGAIN as a solid, global and technology-agnostic trust framework for delivering services in R&E.

Task 3: Core AAI Platform (Task Leader: Christos Kanellopoulos – GÉANT)

The GÉANT Core AAI Platform is a cornerstone for the delivery of advanced AAI services in R&E, providing the critical infrastructure for key European initiatives such as EOSC, EuroHPC, Erasmus+, and other initiatives supporting student mobility across the continent. It serves as the foundational backbone for a suite of essential identity services, including eduTEAMS, GÉANT AAI service, InAcademia, MyAcademicID, MyAccessID and the EOSC Federated AAI, enabling the delivery of an omnipresent AAI. This task will:

- Maintain and enhance the Core AAI Platform. This includes developing and upgrading key components, such as the multi-protocol authentication proxy, OpenID Connect and SAML2 backend and frontend, Consent and User Information systems. It also involves improving the Metadata Exchange, Discovery Service, User Registry, Membership Management Service, and both the Admin and User Portals. The primary objective is to significantly enhance the platform's scalability and to streamline the process for deploying existing and new services, thereby reducing operational overhead.
- Engage with NRENs, research infrastructures and other stakeholders to support collection of new use cases, requirements gathering, analysis and design, and running of pre-production pilots.
- Operate, enhance and support:
 - eduTEAMS, which is provided to small and medium-sized communities who want to get started with their virtual collaborations and take full advantage of the federated access without having to deal with the complexity of operating and supporting their own AAI, including secure collaboration and use of services available to the GÉANT community and EOSC.
 - GÉANT AAI Service, which enables GÉANT Project Services and Cloud Service Providers in the Cloud Framework(s) to make use of federated authentication.
 - MyAccessID Service, a common identity layer and advanced AAI services for services in the context of EuroHPC and EOSC.
- Explore the introduction of new, advanced capabilities in the Core AAI Platform, such as: Identity Provider of Last Resort, Identity Vetting as a Service, passwordless authentication, multifactor authentication and OIDC issuer and validator capabilities, to foster interoperability with the eIDAS 2.0 and EUDI wallet.
- Evolve the Core AAI Platform using an API-first approach. This strategy focuses on providing a robust programmatic control plane, essential for delivering advanced AAI services efficiently, in order to establish a more agile, responsive, and scalable Core AAI platform.

Task 4: InAcademia (Task Leader: Michelle Williams – GÉANT)

Building on eduGAIN, for the NREN users, InAcademia allows a student affiliated to an education institute to be easily validated by online retailers, and by doing so, prove eligible for special offers. InAcademia was launched during the GN4-3 project, where it demonstrated its value to ensure student access to primarily commercial and retail online services in a more privacy-preserving manner than traditional methods such as uploading student cards or services' direct membership in identity federations. This task will:

- Operate, maintain and provide support for the InAcademia core services: QA/pre-production and production infrastructure, demo shop, statistics portal, Metadata Discovery Service, the e-commerce plugin and other supporting tools.

- Perform development and service enhancement activities focused on the InAcademia codebase and its supporting tools, including: investigating adaptive IdP hinting, exploring the implementation of additional plugins for commercial e-commerce platforms beyond those already supported, continuous improvement of discovery, metadata publishing services and the continuous deployment pipeline.
- Provide dedicated outreach towards national identity federations, and an interface to commercial business development activities performed outside of the project.
- Increase integration with the Core AAI Platform.
- Explore (and implement, if appropriate) a model that interoperates with wallet technologies.

Task 5: T&I Incubator (Task Leaders: Andrijana Todosijevic – AMRES and Mihály Héder – Pro-M / MTA SZTAKI)

This task will support the incubation of new ideas or potentially disruptive T&I technologies that are considered sufficiently mature (minimum TRL5) and may also consider policy, business and trust model aspects. This endeavour emphasises close cooperation with T&I services and other GÉANT innovation initiatives and related work areas. To achieve this goal, the task will operate sub-projects with a predefined timeframe. The ideas for the incubator are defined based on the GÉANT T&I strategic goals with input received by the T&I service owners and from the wider community.

This task will:

- Foster the evolution of new ideas and improvements related to T&I services, and efficiently deliver the results.
- Continue to provide incubator space for working on innovative but potentially disruptive technologies, business and trust models.
- Run incubator activities, when appropriate in collaboration with T&I services (T1–4), Enabling Communities (T6) and other related work packages.
- Continuously enhance and run a methodology for assessing and evaluating incubator topics.
- Expose and promote the results of the incubator to a broad audience, in collaboration with T6.

Task 6: T&I Enabling Communities (Task Leader: Casper Dreef – GÉANT)

This task will engage with the research communities, identity federations and other relevant communities and initiatives in the T&I space for WP5 as a whole. It will provide a bi-directional channel with key stakeholders to understand their requirements and use them to drive the evolution of the T&I services and it will engage in the area of EUDI wallets.

This task will:

- Liaise and contribute to the wider efforts to improve AAI interoperability of research and e-infrastructures (i.e. best practice and framework development, etc.), including Federated Identity Management for Research Collaborations (FIM4R), EOSC, REFEDS and WISE.
- Collaborate with the AARC Tree project on enhancement and maintenance of the AARC project results, critical to ensuring interoperability for the AAI operators in the R&E sector.
- Support coordination of the AEGIS group to discuss adoption of best practices that facilitate interoperability across AARC-compliant AAI operators.
- Coordinate the T&I services business development and outreach in collaboration with the services and the incubators, in this WP and with the User Engagement WP and the Marcomms team.
- Complementary to technical developments in the services and incubator tasks in this WP, in the area of eIDAS 2.0 and EUDI wallets, T6 will:
 - Explore the research and education use cases for the wallet.
 - Facilitate information exchange around the wallet developments in the GÉANT community.
 - Foster collaboration towards global interoperability for the R&E use cases.

- Support participation in relevant forums, standardisation bodies, industry working groups, etc., fostering liaison and bringing in the position of the GÉANT community.

3.1.11 Work Package 6: Network Development

Work package number	WP6
Work package title	Network Development

Objectives

The objective of the Network Development work package is to undertake technology evaluation and development in the areas of network infrastructure, services and monitoring, as well as to sustainably provide production network support services developed in GÉANT projects and those provided by project partners. Supporting and relying on NRENs' collaboration, WP6 will work towards the continued evolution of the GÉANT community's network infrastructures by defining, developing and implementing new functionalities and services to improve the quality, flexibility and cost-effectiveness of services.

WP6 will contribute to:

- Evolution and enhancement of NREN network infrastructures and services through the evaluation, prototyping and implementation of relevant existing and emerging underpinning technologies grounded in practical use cases, and considering aspects such as utility, warranty, performance, security and sustainability.
- Exploration of the applicability of emerging technologies towards new services and capabilities for the GÉANT and NREN communities.
- Information and knowledge sharing within the community including, but not limited to, organisation of knowledge-sharing events, training material, documentation, etc.

The expected outcomes and value of WP6 are:

- Enhancement to existing and/or creation of new services/products/tools through the assessment, validation and implementation of relevant network technologies and services.
- Enabling and supporting collaboration in the GÉANT community on future directions of network technologies and services, as well as monitoring and management solutions.
- Providing learning opportunities through organisation of and participation in different events, training and meetings focused on network technologies and services development.

WP6 will report work activities and results in the regular management reports, with further detail and progress updates provided by additional documents, deliverables, milestones and community events, where indicated.

Key Performance Indicators

WP6 key performance indicators (KPIs) are defined from the perspective of development and service usability, dissemination of knowledge and results, and service stability.

- Number of technologies/tools/services innovations considered. Target for project end: 10.
- Number of service and/or usage reviews per year. Target: 1 per service, per year.
- Number of knowledge-sharing/community events. Target for project end: 20.

Description of Work

The work will be divided between four tasks, coordinated by the management task.

Task 0: Work Package Leadership (Work Package Leaders: Ivana Golub – PSNC, Pavle Vuletić – FAU AMRES (UB))

This task provides leadership for WP6 and coordination of the work of all tasks. It will liaise with other work packages and project stakeholders as needed, ensuring close coordination, particularly with WP7, to avoid overlaps, oversights

and gaps, and to make sure that a rapid and agile exploitation of the results of one WP promptly benefits the other. It will collaborate with project partners and international R&E organisations to maximise interoperability and service uptake.

In addition, the task will manage the incubator process in its promotion, proposal gathering, evaluation and processing. The incubator process provides the opportunity for agile extension of the initial work throughout the project duration. The incubator process will feed topics from this task to other tasks to which they naturally belong.

Task 1: Technology (Task Leader: Susanne Naegele-Jackson – DFN (FAU))

Task 1 will focus on network infrastructure technologies, both those used in the GÉANT network and those in the networks of partner organisations, from the perspective of the services they enable, their status, usage and operation, and their further evolution.

Task 1 will investigate the ability, advantages and use cases of open and programmable network elements in the R&E environment through continued development and support of the Router for Academia, Research and Education (RARE), which has gained significant interest from the community worldwide. It will also continue to explore network requirements for implementation of quantum technologies-related services for the GÉANT community and to explore possibilities to use NREN fibre infrastructure as a sensing instrument. Results will be disseminated as white papers and/or at events.

The activities in scope of Task 1 are:

- Explore new network protocols and features for NREN use cases, building upon RARE software and programmable network solutions and platforms.
- Support and work with NRENs and GÉANT in evaluation and, where appropriate, deployment of quantum technologies-based solutions and/or fibre sensing solutions, disseminating the work results in reports and at events.
- Collaborate with other WP6 tasks and manage incubator projects for T1-related topics where the value for NRENs is clearly recognised, presenting the work results and uptake in reports and community events.

Task 2: Platform (Task Leader: Roman Lapacz – PSNC)

Task 2 provides network infrastructure and service support platforms and tools suitable for use in production as well as for state-of-the-art technological showcase demonstrations. Starting examples this task will focus its efforts on are the Network Management as a Service (nmaas) platform, used by small organisations and projects as a network management supporting system or as a highly orchestrated user-specific cloud instance supporting research and education laboratory environments, and Global Platform for Labs (GP4L), which enables wide-scale network programmability development, simulation, validation and testing. Together with managing and supporting production services and tools, this task will work on proofs-of-concept and demonstrations of tools and technologies for network automation and orchestration and its underpinning tools. It will also review tool and technology use and usefulness for network infrastructure providers and service users, roles that are both integral to each NREN. The activities in scope of Task 2 are:

- Provide and support nmaas production service and work with institutions that want to use, extend or deploy it.
- Provide and support GP4L in collaboration with the Task 1 RARE team and work with institutions that want to use and/or connect to it.
- Collaborate with other WP6 tasks and manage incubator projects for T2-related topics where the value for NRENs is clearly recognised, presenting the work results and uptake in reports and community events.

Task 3: Monitoring (Task Leader: Lætitia Delvaux – PSNC)

Task 3 will work on further development and evolution of network monitoring tools and services, as well as continue investigation and assessment of new monitoring approaches and tools potentially benefiting operational networks. T3

will further develop and support existing services from the previous GÉANT projects, including perfSONAR, the Performance Management Platform (PMP), TimeMap and Argus.

The activities in scope of Task 3 are:

- Provide, enhance and support GÉANT project production services, including, but not limited to, perfSONAR, PMP, TimeMap and Argus, and explore the needs and opportunities for new models, tools or services to support and help the network's daily operations.
- Collaborate with other WP6 tasks and manage incubator projects for T3-related topics where the value for NRENs is clearly recognised, presenting the work results and uptake in reports and community events.

Task 4: Academy (Task Leader: Maria Isabel Gandia Carriedo – RedIRIS (CSUC))

The main area in this task is the Network eAcademy production service. Provided by the community for the community, which makes it unique from any commercial services, Network eAcademy is an umbrella name for several activities that help NRENs progress in their digital transformation journey, such as training (with the logistics and support from the WP1 GLAD team); maturity assessment; Orchestration, Automation and Virtualisation (OAV) terminology; and mapping of individual digital architectures. The training includes tracks on Orchestration, Automation and Virtualisation, and Quantum Technologies, and it can include other tracks depending on the needs of the research and education community.

The activities in scope of Task 4 are:

- Support and further develop Network eAcademy.
- Collaborate with other WP6 tasks and manage incubator projects for T4-related topics where the value for NRENs is clearly recognised, presenting the work results and uptake in reports and community events.

3.1.12 Work Package 7: Network Infrastructure and Service Evolution and Operations

Work package number	WP7
Work package title	Network Infrastructure and Service Evolution and Operations

Objectives

The use of the GÉANT network will continue to grow, making scalability, efficiency, and cost control essential factors. In addition, the network will need to support demand for a diverse range of reliable and accessible services, from a diverse set of users.

The focus of WP7 will be to leverage the recent advancements and successes to further enhance and develop the GÉANT network infrastructure and services. The completion of the GN4-3N project and the expansion of GÉANT's fibre footprint and optical network to the edges of Europe marks a significant milestone. These achievements enable GÉANT to offer 100 Gbps connectivity to all National Research and Education Networks (NRENs) within the expanded fibre footprint, thereby addressing the network capacity needs for the foreseeable future.

With the new Optical Open Line systems in place, adding new capacity is now more cost-effective. GÉANT's optical network infrastructure is scalable, efficient, and future proof. The packet layer devices procurement concluded in Period 1 of GN5-1 (2023). The deployment of these devices started in Period 2 of GN5-1 (2024) and will continue in Period 1 of GN5-2 (2025). The new platform supports multiple 400G and will support multiple 800G when it becomes available, significantly boosting network performance and cost efficiency.

The automation of network configuration, particularly for the IP/MPLS layer, has shown promising progress. In GN5-2, WP7 will deepen its commitment to this area, aiming to further advance the GÉANT network's automation journey. The work package will maintain its collaborative approach, working closely with NRENs to develop open source, vendor-

agnostic solutions for network management and automation. The development of the workflow orchestrator will continue, enabling better integration and orchestration of services across GÉANT and NRENs.

As always, the network's sustainability and cost-effectiveness remain a priority. WP7 will continue to seek ways to optimise resources while maintaining the highest standards of service. The work package will work together with WP6 and WP8 on exploring new areas of advancement in optical fibre-related technology such as quantum, metrology and sensing; these will require the development of new services beyond Internet packets. Ensuring security by design in all network infrastructure and services remains a cornerstone of WP7's strategy. The reliability and availability of the network are paramount.

In collaboration with GN5-IC1, delivering the first phase of GÉANT's Intercontinental Connectivity investment under GN5-FPA, Task 2 will continue to evolve GÉANT's approach to international connectivity services, leveraging the long-term infrastructure investments. Task 2 will also aim to provide technological guidance on the further evolution of GÉANT's network infrastructure and services, staying ahead of emerging trends and requirements.

Key Performance Indicators

- Packet loss on the backbone links. Target: to keep the packet loss below 0.1%.
- GÉANT point of presence (PoP) availability: 99.9%.
- GÉANT IP network service availability to each NREN: 99.9%.
- Number of workshops and knowledge-sharing events. Target for project end: 2.
- Number of new and upgraded services successfully delivered. Reporting at end of each period.

Description of Work

This work will be divided between the following tasks. Their activities and results will be reported in the regular management reports, with further detail and indications of progress provided by additional deliverables and milestones, where indicated. (See Section 3.1.23 for equipment and line cost distribution).

Task 0: Work Package Leadership (Work Package Leader: Mian Usman – GÉANT)

Task 0 covers the coordination of WP7, including the interaction between the four other tasks that form the core of this work package. In addition to this, Task 0 will ensure coordination and liaison between WP7 and all its stakeholders, including other work packages and projects, most specifically the network-related work packages WP6, WP8, and WP9. This coordination effort will also contribute to and facilitate a GÉANT network strategy.

Task 1: Network Engineering and Implementation (Task Leader: Rick Havern – GÉANT)

This task manages, develops, and implements the physical network infrastructure. Task 1 determines the optimum solutions to ensure that the network is economically and effectively utilised and that its capabilities can grow organically over the coming years. This includes the management of: site providers, power configuration, racks, rack layouts, structured cabling, cross connects, equipment interface and port availability, spares, and consumables. It ensures the continued delivery, management, and operations of the GÉANT network and network services. The task will continue the replacement of the current IP/MPLS platform and replace it with the newly procured Nokia platform.

This task will also have a sub-task focused on technical product management. This sub-task will work closely with the Network Product Management task in WP9 to ensure alignment of network services with the broader product management objectives. The main objectives of this sub-task are to:

- Focus on the technical aspects of network services offered by WP7. This includes, but is not limited to, evaluating current services capabilities, identifying areas for improvement, and implementing enhancements.
- Ensure that network services are not only meeting current demands but are also designed to be scalable and adaptable for future requirements. The task will also identify any services that are no longer fit for purpose and propose the decommissioning of such services. This involves working closely with WP7 Task 2 and staying abreast of the upcoming and planned changes and integrating them into the services as appropriate.

Task 2: Network Infrastructure and Services Evolution (Task Leader: Sebastiano Buscaglione – GÉANT)

This task will focus on the evolution of GÉANT's network technology and the network services. This task is pivotal in shaping the future trajectory of the GÉANT infrastructure, including its management software and the range of services it provides. It plays a crucial role in the strategic planning and implementation of enhancements to the network's capabilities and efficiency.

- **Network Evolution Plan Development:** Produce a comprehensive GÉANT network evolution plan. This plan will offer a forward-looking perspective on the development of GÉANT's infrastructure, management software, and services, ensuring they remain cutting-edge and responsive to the evolving needs of the user community.
- **Addressing Connectivity Gaps:** Focus on identifying and bridging any existing gaps in connectivity, with a particular emphasis on regions and areas that still require additional connectivity post-GN4-3N projects to ensure all GÉANT PoPs have robust and resilient connectivity. Post GN5-IC1, this task will also focus on enhancing the intercontinental connectivity to ensure GÉANT's global connectivity is robust and capable of supporting the growing needs of its users.
- **EaP Inclusion:** Integrate the EaP connectivity into the GÉANT network. The inclusion of Eastern Partnership (EaP) countries will ensure a more expansive and inclusive network reach, subject to budget allowances. The inclusion or integration of EaP countries into the GÉANT network will reduce the digital divide between EaP countries and rest of Europe. The inclusion also extends GÉANT network reach and will provide EaP countries with global connectivity through the GÉANT network.
- **Sustainability and Energy Usage Monitoring:** Implement a robust framework for monitoring energy usage across the network. This initiative aligns with the broader goal of sustainability, aiming to reduce the environmental impact of network operations and promote eco-friendly practices.
- **Future Network Expansion and Technology Integration:** Lay out plans for future network expansion, upgrades, and the integration of new technologies. This objective is central to ensuring that the GÉANT network remains at the forefront of technological advancements, capable of adapting to future demands and integrating emerging technologies seamlessly.

By focusing on these key areas, Task 2 will significantly contribute to the continuous improvement and expansion of GÉANT's infrastructure and services, aligning them with the latest technological trends and the growing needs of the research and education communities it serves.

Task 3: Network Management (Task Leader: Simone Spinelli – GÉANT)

Building on the input received from the NREs during the CTO workshop, Task 3 will focus on enhancing network management and automation by leveraging advancements made in GN5-1 and GN4-3N, and incorporate new objectives to ensure the network's continuous evolution and efficiency, including:

- **Automated Service Delivery:** By the end of the project, ensure that all standard layer 2 and layer 3 network services are delivered using automated processes. This approach will increase efficiency, reduce the potential for human error, and allow more rapid deployment and scaling of services.
- **Vendor-Agnostic Network Management:** Continue the development of a vendor-agnostic approach to network management. This framework will facilitate a more flexible and adaptable network environment, allowing easier integration of various technologies and platforms.
- **Vendor-Agnostic Starter-Kit for NREs:** Create and distribute a vendor-agnostic starter-kit (Milestone M7.3), empowering NREs to implement and adapt network automation tools and processes. This kit will provide the foundational elements necessary for NREs to embark on or advance their automation journey.
- **Knowledge Repository and Best Practices for Automation:** Develop and maintain a comprehensive repository of knowledge, best practices, and resources focused on network automation. This repository will serve as a central hub for information sharing and learning, facilitating skills development and knowledge transfer within the GÉANT and NREN communities.

Task 4: Non-Data Services (Task Leader: Guy Roberts – GÉANT)

T4 will consider advances in cross-border non-data services, such as time and frequency, Quantum Key Distribution (QKD) and fibre sensing technologies.

- Explore the development and operations of multi-domain spectrum service, Quantum Key Distribution (QKD), and fibre sensing technologies, focusing on advancing all non-data services offered by GÉANT. Work will be carried out to understand the security implications for GÉANT of building QKD testbeds and potential engagement in EuroQCI.
- Ensure any deployment meets forthcoming regulatory requirements, in relation to the EC risk assessment for critical technology areas.

T4 will embark on the development of the GÉANT Time and Frequency Network (TFN) as envisaged in the CLONETS-DS project. This initiative, which adopts the recommendations from the GN5-1 Time and Frequency incubator, is aimed at developing the infrastructure for precise time and frequency distribution across national borders. Using the PLM gate process to ensure the business case aspects are addressed, the GÉANT TFN is set to significantly expand the capabilities of the metrology community to transfer time and frequency by federating existing national time and frequency networks. The objectives are to build fibre links that will connect the eastern and the western islands of existing national time and frequency networks and connect the big four NMIs to enable them to redefine the SI second. Figure 3.3 shows current links built by NRENs in collaboration with national NMIs, shown in green, and links built by NMIs/researchers shown in blue. Task 4 will procure, deploy and operate the links shown in red; these links fill in the gap in existing national infrastructure. The task will:

- Focus on the long-term sustainability of the TFN and operational plans to ensure continuity and, subject to generating the planned impact, the ability to connect more countries beyond the GN5-2 timeframe.
- Build, operate, and support cross-border time and frequency fibre links and associated equipment essential for time and frequency distribution to connect existing national infrastructure.
- Coordinate with other tasks to fulfil procurement, support and outreach activities.
- Foster a collaborative environment by establishing an NREN and NMI coordination forum to facilitate consensus on the operation and use of the federated time and frequency network, actively engaging NMIs and NRENs, ensuring the full capabilities of the planned infrastructure are used.

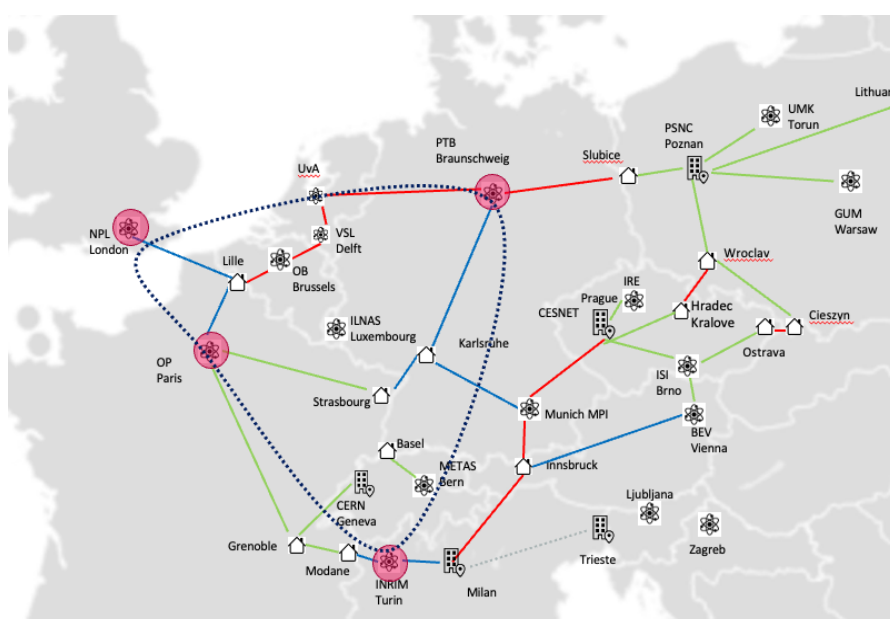


Figure 3.3: Proposed links

Note: Proposed links are shown in red, current links built by NRENs in collaboration with national NMIs are green and links built by NMIs/researchers are blue

These links will enable the national islands to interconnect and enable the big four NMIs to have better connectivity to support the redefinition of the SI second.

Expected impact:

- **Enhanced Knowledge Exchange and Development Expertise:** By sharing knowledge and best practices with NRENs, this initiative fosters the development of expertise in time and frequency network deployment and management. This collaborative approach elevates the technical proficiency across the NRENs, enabling NRENs to build and maintain technically complex national T/F networks.
- **Strengthened Collaboration between NMIs and NRENs:** The initiative acts as a bridge, enhancing the flow of information and support between National Metrology Institutes (NMIs) and NRENs. This collaboration is crucial for supporting NRENs in developing their own national time and frequency networks, ensuring a more integrated European time and frequency infrastructure.
- **Direct Engagement with the Research Community:** By working closely with researchers, GÉANT and NRENs can contribute significantly to the development of science data repositories and scientific workflows. This direct involvement not only enhances the quality of research output but also ensures that the infrastructure meets the needs of the scientific community.
- **Opportunities for New Services and Applications:** The expanded capabilities of the TFN will enable NRENs and GÉANT to explore and offer new non-data services, potentially opening new opportunities for collaboration in diverse scientific and commercial sectors.
- **Contribution to European Scientific Leadership:** By fostering an integrated European T/F network, this initiative significantly contributes to Europe's standing as a global leader in high-impact scientific research and technology. It underscores Europe's commitment to advancing scientific infrastructure and collaboration.

3.1.13 Work Package 8: Security

Work package number	WP8
Work package title	Security

Objectives

In GN5-2, WP8 builds upon the results of GN4-3 and GN5-1 and continues with training, awareness, product development and security research and innovation. The upscaling for security happens not only in the project but also within the NRENs. The R&E community can only counter the security challenges it is facing by working together tightly and strongly.

In GN5-2, WP8 will continue to work towards establishing the European R&E Security Intelligence Hub, a virtual organisation focused on collecting, analysing, classifying, actioning and sharing security intelligence in combination with providing tools, processes and procedures resulting in actionable information for both GÉANT, NRENs and NREN constituents. GÉANT and the NRENs will have a view of the threat landscape, which can help them prepare for a wide range of potential cyber attacks and crises.

WP8 Security aims to coordinate other security-related activities in the project including those positioned in the network and network services area. WP8 will also track security (research and service deployment) initiatives employed by NREN teams in order to be able to share good practices and steer towards joint development.

The objective of WP8 is to keep the R&E network safe and secure at the backbone level and support the GN5-2 partners with up-to-date tools to protect their networks and information systems in an environment of increasing cyber security threats. WP8 will continue to focus on collaboration: collaboration to achieve wide adoption and participation but also collaboration to jointly deliver products and services. The WP8 team will increase GN5-2's research and innovation

with the establishment of a Security Innovation Lab. The current pressure on the skills shortage in security (especially software developers, security analysts, security operations and security engineers) forces WP8 to be creative in making the best of the skills that are available. The work package plans to achieve this by combining the power of individual teams at NRENs into a distributed service operation with a strong core at GÉANT. WP8 will:

- Provide security standards and best practices, security baseline, benchmarking and dashboards. Build on the GÉANT Security Baseline and set of best practices to guide and assist with raising the maturity level of organisations and services, and work towards compliance with, for instance, the NIS2 directive. Technical dashboards can assist in monitoring the usage of web, mail and network standards.
- Investigate and provide intelligence on the status of compliance with security regulations and requirements of and for the project partners.
- Provide security training and awareness. Continue to improve training materials and webinars that were started in GN4-3 and GN5-1, identifying high-demand subjects for multiple audiences. Security awareness will continue to bring the community together for the annual Cyber Security Month and will gradually shift focus to a more continuous approach to awareness raising with support materials and tools. WP8 will build upon its mentorship programme to start a career development and mentoring programme for security professionals and persons interested in becoming a security professional.
- Provide enhanced incident response and crisis management capability. Enhance training and cross-training of security incident response teams and crisis management teams, supply policies, procedures, playbooks, exercises and exercise material. Work together with the security incident response teams to improve the preparedness for security incidents by improving skills and by jointly improving situational awareness.
- Deliver security services and tools, including: cyber threat analysis and intelligence, DDoS detection and mitigation, Firewall on Demand, eduVPN, cryptographic services, protective DNS. Work closely together with NRENs and e-infrastructures to develop and implement these services and tools. Identify services developed and/or deployed by NRENs and e-infrastructures that are of interest for others.
- Create a joint security intelligence workforce that brings together expertise for analysing, classifying and actioning security intelligence for research and education, supported with tools, intelligence feeds, processes and procedures.
- Build the foundation for an extensive protective service for end users in R&E based upon sharing threat intelligence feeds and using these feeds in protective DNS services either by NRENs themselves or provided as a central service for NRENs with fewer capabilities. This a long-term effort that started in GN5-1 and has a 5-to-7-year perspective for implementation and operation.
- Research subjects on securing high-speed networks and implement the use of intelligence feeds coming out of this research, such as feeds on domain-name-based intelligence.
- Research the impact of network security technologies for protecting transport layers and network equipment.
- Research best practices for securing high-speed networks, including investigation of how security is perceived, whether existing tools can be used, as well as how to make high-speed networks secure by design.
- Provide work package management and user engagement coordination.

Key Performance Indicators

- Delivery and operation of existing security services.
- Annual pan-European (and beyond) cyber security conference for Research and Education., with an anticipated 250 participants.
- 2 annual cyber security training or events attended by 50 participants from 30 NRENs over the duration of the project.
- 4 NRENs participate in joint security intelligence operations in 2025 and 6 in 2026.
- Coherent set of security best practices for GÉANT and NRENs that is used completely or partially by at least 10 NRENs.

- 2 pilots of new managed security services.
- Operation of 3 security services.
- New major releases of eduVPN, FoD and NeMo.
- Security baseline is used annually by 10 NRENs or products.
- (Contribute to) 2 publications in relevant scientific papers.
- 5 research projects carried out in the Security Innovation Lab.

Description of Work

This work will be divided between the following tasks. Their activities and results will be reported in the regular management reports, with further detail and indications of progress provided by additional deliverables and milestones, where indicated.

Task 0: Work Package Leadership (Work Package Leaders: Alf Moens – GÉANT, Henry Hughes – Jisc)

This task will coordinate the work of WP8 and lead and support WP8 as a whole; manage and coordinate the work of all the tasks; and liaise with the other GN5-2 project work packages and project stakeholders, the NRENs. Part of the coordination work will be to set up a senior stakeholder group for security.

Task 1: Security Management and Compliance (Task Leader: Ana Ribeiro Alves – GÉANT)

Baseline, Standards and Best Practices

The purpose of Task 1 is to:

- Prepare the R&E community for the implementation of new legislative requirements (NIS2, CES, CRA).
- Assist NRENs in improving security (and privacy) control, based on the use of the security baseline and international standards. Work closely together with the R&E security community to identify best practices in close cooperation with SIG-ISM, WISE, etc.
- Stimulate the use of international standards to reduce complexity and strengthen position and visibility.
- Promote the use of benchmarks and dashboards to monitor compliance with the security baseline and international Web- and email standards.
- Development a model for peer reviewing and independent auditing to ensure compliance with international standards and quality of service requirements.
- Investigate and provide intelligence on the status of the project participants in terms of security management and compliance.

Task 2: Human Factor (Task Leader: Charlie van Genuchten – SURF)

The purpose of Task 2 is to:

- Continue with the security training programme: keep training courses up to date; develop and deliver new security training courses, both basic security training and training for professionals.
- Continue the support for Cyber Security Month and the sharing of security awareness material. Work closely together with bio security and communications professionals from the R&E community to identify and share good practices.
- Support the preparedness of NRENs for crisis through enhancing skills and expertise with sharing best practices and with at least one annual crisis event.
- Organise an annual security conference for R&E to bring together security experts and communities for learning, sharing and training.
- Continue the development and deployment of a security mentoring programme that supports the development of new security talent for the R&E community.

Task 3: Security Operations Support (Task Leader: David Heed – SUNET)

The purpose of Task 3 is to:

- Continue the development of GÉANT DDoS detection and mitigation (NeMo + FoD).
- Continue the support of the development and governance of eduVPN.

- Research, develop and implement new services for cyber threat analysis and cyber threat intelligence, building upon the results of SOCTools and Vulnerability as a Service (VaaS), with a strong emphasis on joint security operations and use of tools developed in the R&E community, either as a development or as a brokerage service.
- Develop new cryptographic services as an addition to TCS, distinguish between types of certificates and investigate feasibility of a document signing service.
- Develop a pilot for a protective DNS service and, when successful, prepare for large-scale deployment.

Task 4: Threat Analysis and Intelligence Sharing (Task Leader: Roderick Mooi, GÉANT)

The purpose of Task 4 is to:

- Establish and maintain a joint view of the security threat landscape for research and education by analysing security intelligence, sharing analysis, and translating security intelligence into actionable information, both key statistics and trends.
- Build and maintain a joint, hybrid security Intelligence team with a strong core.
- Procure and provide intelligence feeds for distribution amongst participating NRENS.

Task 5: Research and Innovation (Task Leader: Jochen Schönfelder, DFN-CERT)

The purpose of Task 5 is to:

- Facilitate an incubator for security proposals from NRENS and other partners using the usual PLM gate and development processes.
- Facilitate a security innovation lab for testing integration of tools and running tools and protocols in pilot; consider integration of the CESNET DDoS tooling and security testing the SCION routing protocol.
- Continue investigation of both architecture and tooling best practices for protecting high-speed networks.
- Network research and big data analysis of relevant datasets, for instance aimed at developing additional intelligence feeds for protecting networks and services.
- Research the impact of network security technologies for protecting transport layers and network equipment.

Task 5 will not design or develop any hardware but instead investigate and track best practice to inform future development.

3.1.14 Operations Work Plan

3.1.14.1 List of Work Packages

Work Package No	Work Package Title	Lead Participant No	Lead Participant Short Name	Person-Months	Start Month	End month
WP9	Operations Support	1	GÉANT	1013	M1	M30
	TOTAL MONTHS			1013		

Table 3.3: Operations Work Package

3.1.15 Work Package 9: Operations Support

Work package number	WP9
Work package title	Operations Support

Objectives

The main objectives of WP9 are to:

- Actively manage network faults and security incidents to maximise availability and reduce risk of backbone congestion.
- Develop software according to GÉANT's specific needs and objectives in a flexible manner to react to changing requirements and priorities.
- Provide a first point of contact for non-fault network issues, in order to prioritise requests, engage other Operations teams as appropriate, and ensure services are delivered as promptly as possible.
- Ensure that, through the involvement of Access Port Managers (APMs), network services continue to be designed and operated in accordance with the wishes of the GÉANT community.
- Provide coordinated network services product management across WPs 6, 7 and 8.
- Improve the quality of GN project-developed software through training, testing, audits and the provision of support applications, tools and Common Best Practices.

Outcomes

Most of WP9's work and results are network operations "business as usual", but there are the following specific planned outcomes:

- The Security Operations Centre (SOC) function, embedded within the Operations Centre, will become its own task within the work package and will be expanded to support new WP8-developed services, such as Threat Intelligence and Secure DNS.
- New support for WP7's pilot time and frequency service expected to be ready during GN5-2.
- An expansion of the coordination of network services Product Management to include network-related services developed by WP8.

Key Performance Indicators

- GÉANT Operations Centre to update new and existing incident tickets within the specified Service Level Targets in 95% of cases.
- Complete 95% of software evaluations within 12 weeks of starting.
- Software Development Support Infrastructure to be available 99% of the time (excluding planned maintenance periods).
- GÉANT Service Management team to categorise all service requests (as either "standard" or "bespoke") within one working day of formal submission.

Description of Work

WP9 provides operational support to the project's DevOps work packages, WP5 to 8. The activities and results of the tasks will be reported in the regular management reports, with further detail and indications of progress provided by additional deliverables and milestones where indicated. WP9 will work particularly closely with WP6 and WP7 (for developing and supporting network services) and WP8 (for setting up a GÉANT Network Security Operations Centre).

Task 0: Work Package Leadership (Work Package Leader: Toby Rodwell – GÉANT)

This task is to coordinate the work of all five WP9 tasks and ensure communication with the other WPs.

Task 1: Network Operations and Support (Task Leader: Tony Barber – GÉANT)

The key objectives of Task 1 are to:

- Monitor the status of GÉANT services and systems 24x7.
- Resolve incidents and problems on the GÉANT backbone network and any other GÉANT system.
- Investigate and resolve any degradation in, or sub-optimal performance of, the GÉANT network.
- Safeguard the GÉANT network proactively against cyber security threats.

Task 1 aims to resolve all service incidents and respond to all communications within service level targets set out. In doing so it will maintain service availability to the membership at the highest possible level.

Task 1 will:

- Maintain a 24x7 coverage of the GÉANT network services portfolio.
- Further build on its proactive management of devices and network elements with appropriate tools to minimise uncontrolled service loss of network services.
- Continue to commission new services into operation with minimal delay.

Task 2: Software Governance and Support (Task Leader: Marcin Wolski – PSNC)

The key objectives of Task 2 are:

- Perform software testing and code reviews in support of service validation and verification.
- Advise and assist developers in devising and managing software testing regimes.
- Maintain and operate the software development support infrastructure.
- In cooperation with WP1 T5, deliver the Secure Code Training and School of Software Engineering.
- Provide advice and support for software management and software licensing (both selection and use).

This task will provide comprehensive governance and support for software development within the project, to guarantee a consistent level of software product reliability and resilience and ensure the overall quality level of the GÉANT services that rely on these products. Specifically, Task 2 will support software development in WP5, WP6, WP7, and WP8.

Software & License Management (SLM): This sub-task will assist GÉANT's open-source governance by providing the technical and implementation support for open source software management and strategy with the cooperation of WP1's IPR activities. SLM will facilitate the Open Source Review Board (OSRB), which provides advice and interpretation of the GÉANT IPR Policy in order that SLM can perform any required licence reviews. It will also maintain the common best practices (CBPs) for software development that have been developed and refined in previous GN projects, based on practical experience and user feedback.

Software Developer Training: This training will focus on two core areas: the School of Software Engineering (SSE) and Secure Code Training (SCT). SSE will provide instruction on the project's selected best practices and processes for software development (ensuring quality and value). SCT will specifically train developers in methodologies to write secure software programs.

Software Testing and Analysis: This sub-task will provide independent code reviews and related software assessments, which will be a mix of manual and automated tests.

Software Development Support: Continued development and improvements of the existing suite of tools and processes that support the full software development lifecycle: project management and bug tracking, service desk, source code repositories, CI/CD, static code analysis and IPR support, artefacts repository and internal reporting tools. This task will also maintain the GÉANT Software Catalogue.

Task 3: Network Product & Service Management (Task Leader: Craig Volp – GÉANT)

The key objectives of Task 3 are:

- Process customer network service orders.
- Manage the portfolio of network services developed by WP6, WP7 and, where applicable, WP8.

- Conduct the Service & Technology Forum (STF) meetings for NREN Access Port Managers (APMs).
- Prepare and provide the monthly GÉANT Network Services Report, plus, where appropriate, assist with other GÉANT network services-related reports needed by members of the community.
- In conjunction with WPs 6 and 7, design and (where appropriate) implement in-life service support measures for new and updated services.
- Within the guidelines and scope of WP1's Product Lifecycle Management framework, manage the portfolio of network services developed by WP6, WP7 and (where applicable) WP8.
- Project-manage small and medium GÉANT network service projects and lead appropriate workstreams in larger projects.

The Service Management team is the first point of contact for all enquiries related to GÉANT infrastructure and core services, and will involve or defer to the other teams within Operations as required.

With regard to Network Product Management, the task will:

- Review the current working practices of the network service work packages and identify synergies.
- Align workstreams and where appropriate work towards a coherent, cross-work-package roadmap.
- Document best practice in the form of guidance, or a framework methodology.
- Raise awareness of the network product portfolio through the use of roadmaps and information-sharing opportunities.

Task 4: GÉANT Software Development and Operations (Task Leader: Erik Reid – GÉANT)

The GÉANT Software Development (SWD) team develops and operates a range of Operational Support Systems (OSS) and Business Support Systems (BSS) for the backbone network which need to be configured, maintained, and administered in a formal and controlled manner. These OSS/BSS are specific to the GÉANT backbone network; they are not a project-wide resource to support NRENs. The management of future network and software dependencies is the responsibility of WP7.

WP9 T4 has the following main objectives:

- Identify whether there are suitable applications from the R&E community or third parties to meet the needs of GÉANT and the R&E community, before committing to in-house development for new services.
- Develop required fit-for-purpose in-house software services using agile principles and best practices.
- Collaborate with WP9 T2 to benefit from the tools/services and best practices they offer.
- Provide a holistic, customer-focused approach for all in-house supported software.
- Review and update existing OSS/BSS to maintain quality of design and operation.
- Audit and improve the SWD infrastructure, taking full advantage of cloud solutions and automation wherever possible to ensure the most efficient and reliable support to OSS/BSS.
- Collect and analyse usage and performance data for software services to identify areas of improvement and reduce cost.
- Continue to ensure all development and operations are fully compliant with GDPR and GÉANT's security and IPR policies.

In GN5-2, Task 4 will develop and release a new major version (v4) of the GÉANT Dashboard monitoring system. This will include a new GUI application for monitoring/managing the NOC Alarms Dashboard that is functionally equivalent to the existing GUI but rewritten using a modern stack. This is necessary because the existing codebase is convoluted, tightly linked to legacy versions of various tools and stacks, and has become increasingly difficult to maintain.

Task 5: Network Security Operations (Task Leader: Tony Barber – GÉANT)

The key objectives of Task 5 are to:

- Contribute to and coordinate GÉANT's Computer Emergency Response Team (CERT) function.
- Safeguard the GÉANT network proactively against cyber security threats.

GÉANT's Security Operations Centre, which performs this task, combines a reactive and proactive approach to security incident handling, in order to safeguard GÉANT's assets and services. The SOC works closely with WP8 in order to implement and operate the network security-related services that work package develops.

Task 5 will:

- Work with peer security organisations to maintain the highest level of threat defence against cyber attacks that aim to compromise and degrade NREN partner services.
- In conjunction with the Security team, adopt and evolve a new GÉANT security threat analysis service based on work from WP8 Threat Intelligence.
- Respond to network security incidents in line with standard GOC service level targets.
- Further develop GÉANT's network traffic anomaly analysis.

Task 6: ICT (Task Leader: Linda Ness – GÉANT)

Task 6 will create, maintain and provide support for a coherent, easy-to-use, intuitive platform of Information and Communications Technology (ICT) tools and infrastructure to be used by project participants in their day-to-day work. This includes providing a project intranet for participants to share and store information on the work as it is carried out, mailing lists and a Wiki facility for collaborative working, the GÉANT public website, videoconference facilities and messaging systems. The Task will also assist Work Package 9 Task 2 in their provision of software repository tools for project participants. To derive best value for money and avoid inefficiency GÉANT may coordinate and obtain licenses on behalf of partners.

3.1.16 Organisational Structure and Decision Making

3.1.16.1 Consortium Agreement

Under the Consortium Agreement (CA) signed by all partners, the partners agree to adopt the governance structure of the GÉANT Association to manage the project.

The CA defines the roles and responsibilities of all partners and includes the following main provisions: 1. Project organisation and management structure, including the decision-making and reporting process. 2. Financial issues (costs, budget, and payments schedule). 3. Knowledge management. 4. Access rights principles included and excluded. 5. Consortium membership management and new participants. 6. Provisions for the settlement of disputes within the partnership. 7. Legal provisions of the agreement.

3.1.16.2 The GÉANT General Assembly

The GÉANT General Assembly (GA) is the ultimate decision-making body for the Consortium. In the GA, the partners have specified voting rights. The GA meets at least three times a year.

3.1.16.3 The GÉANT Board

The GÉANT Board (the Board) manages and administers the GÉANT Association, which acts as Coordinator to the project. The Board comprises a Chair and up to eight members elected by the GA.

The GA delegates the strategic governance of the project to the Board. The Board will also act as the supervisory body for the execution of the project and will report to, and be accountable to, the GA. Amongst other committees reporting to the Board, the GÉANT Oversight Committee (OC) oversees the progress and management of the project.

3.1.16.4 Oversight Committee

Through the Oversight Committee and established tiered levels of Grants of Authority, the Board delegates the management and administration of the project to the GÉANT Chief Executive Officer (CEO) and Chief Programmes Officer (CPO).

3.1.16.5 Quality Assurance and Public and External Relations Committee (QASPER)

QASPER's reviews of project deliverables provide quality assurance, both for the EC and internally, as well as ensuring that the results of the programme and its deliverables are effectively promoted. QASPER reports to the Oversight Committee.

3.1.16.6 Programme Management

The Chief Programmes Officer (CPO) is responsible for the execution of the overall project and reports to the CEO and the OC. The CPO leads the Project Management Board (PMB) and, with the support of the Project Management Office, ensures the PMB delivers according to the project work plan.

3.1.16.7 Project Management Office

Programme Management is assisted by the Project Management Office (PMO). The PMO acts as the central hub for the financial and manpower reporting (timesheets), information management, editing/technical authoring, intranet and collaboration tools for all participants, IT management and support. The PMO also organises issue/risk/change management and control.

3.1.16.8 Work Package Leadership

Work packages in the project are managed by the Work Package Leaders (WPLs) who report to the Project Management Office and Programme Management. Work Package Leaders are experts in their fields, senior project managers, budget holders and team leaders.

3.1.16.9 Project Management Board (PMB)

The Project Management Board (PMB), comprising the CPO, PMO, and Work Package Leaders meets monthly to exchange information, coordinate common work and ensure that interdependencies between work packages are followed up on an ongoing basis and escalated in a timely fashion.

3.1.16.10 Network Infrastructure Advisory Committee (NIAC)

The Network Infrastructure Advisory Committee (NIAC) is formed of CTO-level experts from Partners across the European network footprint to give technical and financial advice on the long-term network infrastructure. The objectives of the NIAC are to build and sustain NREN consensus during network infrastructure planning and rollout, to advise on decisions to be made in the project (such as choices between connections or alternative technologies), to exchange information about changes in the market, on international consortia and advise on the long-term sustainability of choices.

3.1.16.11 The Coordinator

GÉANT Association, as project Coordinator, is the legal entity acting as the intermediary between the Parties and the Funding Authority. The Coordinator shall, in addition to its responsibilities as a Consortium member, perform the tasks assigned to it as described in the Consortium Agreement and this Agreement.

3.1.16.12 The Cost-Sharing and Service Portfolio Advisory Committee

The Cost-Sharing and Service Portfolio Advisory Committee (CSSPAC) provides oversight and guidance on the portfolio of all services offered by the GÉANT Association. The committee will also develop and maintain, for adoption by the General Assembly, one or more cost sharing models for sharing the costs of the GÉANT Association to participating members. Based on the cost sharing model(s), the committee shall calculate on an annual basis (or as otherwise required) a set of individual membership and subscription costs to members for services delivered by the GÉANT Association.

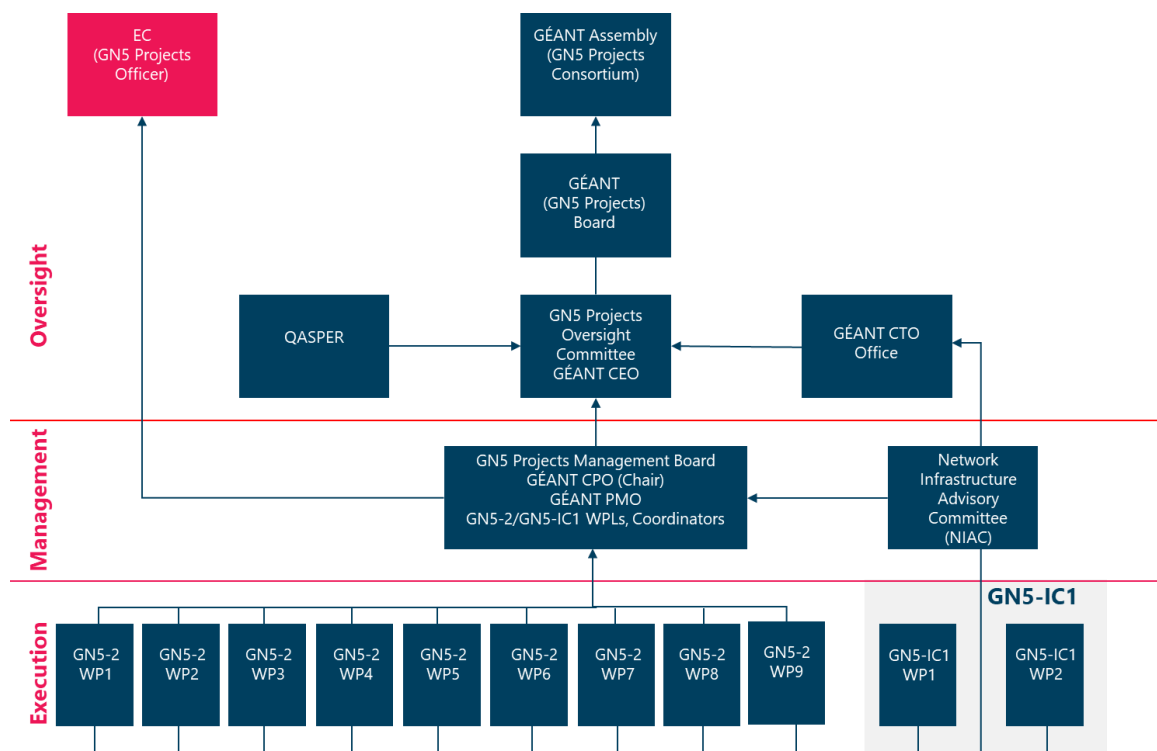


Figure 3.4 GN5-2 project governance

3.1.16.13 GÉANT Chief Technology Officers' (CTO) Office

The GÉANT Chief Technology Officers' (CTO) Office consists of senior technical managers from GÉANT Association, to exchange information on technical topics and to advise the CEO and OC on the technical direction and suggest new initiatives relevant to the project.

3.1.17 Decision-Making Process

Decisions will be reached, as often as possible, by consensus and according to the procedures defined in the Consortium Agreement.

3.1.17.1 Conflict Resolution

The Consortium decision-making process is aimed at building consensus throughout the project. In the event that disputes or differences arise that cannot be resolved, the following process should be followed: Disputes within or between work packages that cannot be resolved by the Work Package Leaders will be referred to the PMO and then Programme Management, who will attempt to reconcile differences. If this does not resolve the

dispute, the matter will be brought for discussion at the earliest opportunity with the Programme Management. If an agreement is not reached, the dispute will be passed to the Oversight Committee, the Board, and, if still required, further to the GA. If the issue is particularly pressing, a special meeting of the GA will be called. Final settlement of outstanding disputes will be managed according to the provisions set in the Consortium Agreement.

3.1.18 List of Deliverables

#	Deliverable Name	Short Description	Work package	Short name of lead participant	Type	Dissemination level	Delivery date
D1	D9.1 Software Services Report	Performance and utilisation of software applications	WP9 T4	GÉANT	R	SEN	M2
D2	D2.1 Project Communications Strategy and Plan	Initial communications strategy and plan	WP2 T1	GÉANT	R	PU	M3
D3	D1.1 Data Management Plan	Data Management Plan	WP1 T1	GÉANT	DMP	SEN	M6
D4	D3.1 Stakeholder Engagement Plan	Plotting the project's engagement priorities	WP3 T1	GÉANT	R	SEN	M6
D5	D9.2 New GUI for NOC Alarms Dashboard	NOC Alarm development	WP9 T4	GÉANT	R	SEN	M6
D6	D1.2 Management Report for M1-M5	Management Report for M1-M5	WP1 T1	GÉANT	R	SEN	M7
D7	D3.2 Compendium Report	Overview of NREs + community trends	WP3 T1	GÉANT	R	PU	M9
D8	D9.3 Software Code Reviewers' Report	Software Code Review	WP9 T2	GÉANT	R	SEN	M9
D9	D1.3 Procurement and Supplier Review	Procurement + supplier activity	WP1 T6	GÉANT	R	SEN	M11
D10	D1.4 Management Report for M6-M10	Management Report for M6-M10	WP1 T1	GÉANT	R	SEN	M12
D11	D1.5 PAIR Work Plan 2026	Update of 2026 work plan	WP1 T4	GÉANT	R	SEN	M13
D12	D2.2 Project Communications Strategy and Plan (2)	Update of communications strategy and plan	WP2 T1	GÉANT	R	PU	M13
D13	D1.6 Impact Report	Update on project impact, inc exploitable	WP1 T1	GÉANT	R	PU	M14
D14	D1.7 Service Review and Service Status Deliverable	Status of GN5-2 services	WP1 T4	GÉANT	R	SEN	M14

#	Deliverable Name	Short Description	Work package	Short name of lead participant	Type	Dissemination level	Delivery date
D15	D5.1 Report on Trust and Identity Services, Enabling Communities and Incubator	WP5 service update	WP5 T0	SURF and SUNET	R	PU	M14
D16	D8.1 Pilot Installation Operational for Protective DNS Service	Protective DNS Service pilot	WP8 T3	GÉANT	R	SEN	M14
D17	D8.2 WP8 Management Report Year 1	Summary of WP8 highlights (end-P1)	WP8 T0	GÉANT	R	SEN	M14
D18	D9.4 Software Services Report (2)	Performance and utilisation of software apps	WP9 T4	GÉANT	R	SEN	M14
D19	D4.1 Data Management Guidelines	Community data management support	WP4 T4	GÉANT	R	PU	M15
D20	D6.1 Network eAcademy	Network eAcademy	WP6 T4	CSUC/ RedIRIS	R	PU	M15
D21	D9.5 Open Source and License Support Report	Review of open source and license support	WP9 T2	GÉANT	R	SEN	M15
D22	D6.2 Network Technologies and Platforms	Network Technologies and Platforms	WP6 T1/2	DFN (FAU)	R	PU	M17
D23	D7.1 Network Evolution Plan	Network Evolution Plan	WP7 T0	GÉANT	R	SEN	M17
D24	D6.3 Network Monitoring Solutions	Network Monitoring Solutions	WP6 T3	PSNC	R	PU	M19
D25	D4.2 GÉANT Cloud Strategy 2026	Cloud Strategy	WP4 T4	GÉANT	R	PU	M20
D26	D3.3 Compendium Report	Overview of NREs + community trends	WP3 T1	GÉANT	R	PU	M21
D27	D1.8 Management Report for M16-M20	Management Report for M16-M20	WP1 T1	GÉANT	R	SEN	M22
D28	D1.9 Procurement and Supplier Review	Procurement + supplier activity	WP1 T6	GÉANT	R	SEN	M23
D29	D1.10 PAIR Work Plan 2027	Update of 2026 work plan	WP1 T4	GÉANT	R	SEN	M25
D30	D1.11 Service Review and Service Status Deliverable	Status of GN5-2 services	WP1 T4	GÉANT	R	SEN	M26

#	Deliverable Name	Short Description	Work package	Short name of lead participant	Type	Dissemination level	Delivery date
D31	D3.4 Community and Innovation Programme Impact Report	Impact of Community and Innovation activity	WP3 T4	GÉANT	R	SEN	M26
D32	D4.3 Report on Service Concept Development	Service Concept Development Report	WP4 T3	NORDUnet (DeiC, Sikt)	R	PU	M26
D33	D8.3 WP8 Management Report Year 2	Summary of WP8 highlights (end-P2)	WP8 T0	GÉANT	R	SEN	M26
D34	D1.12 Management Report for M21-M25	Management Report for M21-M25	WP1 T1	GÉANT	R	SEN	M27
D35	D4.4 Incubator Outcomes	Incubator results	WP4 T4	GÉANT	R	PU	M27
D36	D8.4 Analysis of Incident and Crisis Communication Across Organisations	Crisis coms assessment	WP8 T2	SURF	R	SEN	M27
D37	D1.13 Data Management Plan Update	Update of Data Management Plan	WP1 T1	GÉANT	DMP	SEN	M28
D38	D2.3 Project Contribution to UN SDGs and European Digital Rights and Principles	Review and recommendations for project UN SDGs and European Digital Rights and Principles	WP2 T4	GÉANT	R	SEN	M28
D39	D2.4 Status Report on Public Affairs Capacity of Project Partners	Update on partner public affairs capacity, work and recommendations	WP2 T4	GÉANT	R	SEN	M28
D40	D3.5 Collaboration and International User Support Activities Report	Update on collaboration work and international user activities	WP3 T2/3	GÉANT	R	SEN	M28
D41	D5.2 Report on Trust and Identity Services, Enabling Communities and Incubator	WP5 service update	WP5 T0	SURF and SUNET	R	PU	M28
D42	D7.2 Network Evolution Plan (2)	Network Evolution Plan (Update)	WP7 T0	GÉANT	R	SEN	M28
D43	D1.14 Update of Impact Report	Update on project impact, inc exploitable	WP1 T1	GÉANT	R	PU	M29
D44	D4.5 WP4 Summary Report	Summary of achievements	WP4 T0	DFN, EENet	R	PU	M29
D45	D8.5 International Crisis Exercise	Exercise to test / inform participant response	WP8 T2	GÉANT	R	SEN	M29

Table 3.4: GN5-2 Deliverables

Note P1 and P2 Management Reports for M11-15 and M26-30 will be included in the Periodic Reports

3.1.19 List of Milestones

Milestone number	Milestone name	Related work package	Due date (Month)	Means of Verification
M1	M2.1 Commercial Partnership Programme Engagement Strategy and Plan	WP2 T2	M2	Date completed
M2	M2.2 Service Marketing Plans	WP2 T2	M3	Agreement with service WPLs (WP4,5,6,7,8)
M3	M6.1 WP6 Incubator Infoshare	WP6 T0	M3	Event held
M4	M6.2 Network Technologies Workshop	WP6 T1	M3	Event held
M5	M1.1 Training Workplan 2025	WP1 T5	M4	Date completed
M6	M6.3 Network Platforms Workshop	WP6 T2	M4	Event held
M7	M6.4 Network Performance and Monitoring Workshop	WP6 T3	M4	Event held
M8	M5.1 Services Roadmaps	WP5 T0	M4	Roadmaps online
M9	M6.5 Network eAcademy Infoshare	WP6 T4	M5	Event held
M10	M8.1 Security Days 2025	WP8 T2	M5	Event held
M11	M2.3 Deliver TNC25	WP2 T3	M6	Date completed
M12	M4.1 Service Concepts Socialised at TNC Side Workshop (Initial Business Case and Technical Proposals)	WP4 T3	M6	Workshop held
M13	M8.2 Quarterly Trend Reports R&E Threat Landscape	WP8 T4	M8	Document published
M14	M4.2 OCRE 2024 Launch Event	WP4 T1, T2	M9	Event held
M15	M2.4 Progress Report on Project Contribution to UN SDGs and European Digital Rights and Principles (1)	WP2 T4	M10	Date completed
M16	M2.5 Assessment of Current Public Affairs Capacity of Project Partners	WP2 T4	M10	Document published
M17	M8.3 Setup for International Crisis Exercise	WP8 T2	M10	Document published (Plan)
M18	M8.4 Cybersecurity Month	WP8 T2	M10	Event held
M19	M4.3 One Incubator Project Completed	WP4 T4	M11	Document published

Milestone number	Milestone name	Related work package	Due date (Month)	Means of Verification
M20	M8.5 Proposal for Security Peer Reviews in R&E	WP8 T1	M11	Date completed
M21	M7.1 Select Equipment Provider to Operate the Time and Frequency Network	WP7 T4	M12	EAP link migration to GÉANT core date completed
M22	M9.1 Product Management Review	WP9 T3	M12	Date complete
M23	M2.6 Commercial Partnership Programme Engagement Strategy and Plan (2)	WP2 T2	M13	Date completed
M24	M2.7 Service Marketing Plans (2)	WP2 T2	M14	Agreement with service WPLs (WP4,5,6,7,8)
M25	M4.4 Support for Open Science (Above-the-Net Services) Strategy Draft	WP4 T4	M14	Document published
M26	M4.5 Submission to PLM Start Development Gate: Business Case and Technical Proposals Prepared for Selected Service Concept(s)	WP4 T3	M14	Proposals submitted to PLM
M27	M8.6 Security Innovation Lab in Operation	WP8 T5	M14	Date completed
M28	M5.2 Service Roadmaps Updates	WP5 T0	M15	Roadmaps online
M29	M1.2 Training Workplan 2026	WP1 T5	M16	Date completed
M30	M6.6 perfSONAR User Workshop	WP6 T3	M17	Event held
M31	M8.7 Security Days 2026	WP8 T2	M17	Event held
M32	M2.8 Deliver TNC26	WP2 T3	M18	Event held
M33	M3.1 NREN Satisfaction Survey	WP3 T1	M18	Survey delivered
M34	M2.9 Location secured TNC27/TNC28	WP2 T3	M20	Date completed
M35	M8.8 Maturity Status Report Information Security R&E	WP8 T1	M20	Document published
M36	M8.9 Six NRENs Actively Participating in R&E Security Intelligence Hub	WP8 T4	M20	Date completed
M37	M2.10 Progress Report on Project Contribution to UN SDGs and European Digital Rights and Principles (2)	WP2 T4	M22	Document published
M38	M4.6 Service Proposal Endorsement	WP4 T3	M22	Date completed
M39	M6.7 Network Technologies Workshop	WP6 T1	M22	Event held
M40	M6.8 Network Platforms Workshop	WP6 T2	M22	Event held
M41	M8.10 Cybersecurity Month	WP8 T2	M22	Event held

Milestone number	Milestone name	Related work package	Due date (Month)	Means of Verification
M42	M6.9 Network eAcademy Infoshare	WP6 T4	M23	Event held
M43	M3.2 Update to Stakeholder Engagement Plan	WP3 T0	M24	Update to plan
M44	M7.2 Establish Dedicated Cross-Border Fibre Links for Time and Frequency Distribution	WP7 T4	M24	Date complete
M45	M7.3 Vendor-Agnostic Starter-Kit for NRENs	WP7 T3	M24	Date complete
M46	M5.3 Service Roadmaps Updates	WP5 T0	M26	Roadmaps online
M47	M2.11 Progress Report on Project Contribution to UN SDGs and European Digital Rights and Principles (3)	WP2 T4	M28	Document published
M48	M2.12 Deliver TNC27	WP2 T3	M30	Event held
M49	M7.4 Development of Long-Term Sustainability and Maintenance Plans for C-TFN	WP7 T4	M30	Date complete

Table 3.5: GN5-2 Milestones

3.1.20 Critical Risks for Implementation

Description of risk (indicate level of (i) likelihood, and (ii) severity: Low/Medium/High)	Work package(s) involved	Proposed risk-mitigation measures
1 Demand for services is either below or above expectations. (Likelihood: MEDIUM ; Impact: MEDIUM).	All WPs	Increase outreach and collaboration with the NRENs and wider community (e.g. workshops, trainings), to increase institutional awareness and involvement, as higher demand means more opportunities for the NRENs to work with their communities. Work with stakeholder engagement teams to map the interest and share the information. Continuously evaluate the work that follows the PLM process.
2 Essential expertise is not available. (Likelihood: HIGH ; Impact: HIGH).	All WPs	Reschedule tasks and adjust manpower. Engage external contractors if absolutely necessary.
3 Planned external technology projects or regulation do not evolve as expected (e.g. EUDI Wallets) (Likelihood LOW ; Impact MEDIUM)	WP4, 5, 6, 7, 8, 9	Regular monitoring and involvement with policy and standards. Regular reporting and risk assessment with remapping task activity if necessary.
4 Insufficient resources allocated to the WP to plan and take steps towards an unforeseen activity impacted by	All WPs	Informing early the Project Management Office, planning joint meetings with other WPs and stakeholders.

Description of risk (indicate level of (i) likelihood, and (ii) severity: Low/Medium/High)	Work package(s) involved	Proposed risk-mitigation measures
external infrastructures, policies, innovative technologies, and opportunities. (Likelihood MEDIUM ; Impact MEDIUM)		Re-arrange available resource in the WP or across WPs, seek project external resources, or re-prioritise activities.
5 Keeping pace with the rapid development of the ICT landscape and avoid obsolete technology choices. (Likelihood MEDIUM ; Impact MEDIUM)	WP7 (also WP4/5/6/8/9)	Ensure strong vendor/supplier relationships...regular conference sessions (and discussions), overall aim for future-looking, cost-effective implementation and increased awareness of new policy and regulation.
6 Reduced or slower than planned effort from key partners will impact ability to deliver. (Likelihood: HIGH ; Impact: HIGH).	All WPs	Monthly checks of effort consumption and results. Early intervention of WPLs/PMO, leading to escalation and potential reallocation of budget to other partners able to deliver.
7 Decreasing NREN interest and support for a particular work item. (Likelihood: MEDIUM ; Impact: LOW).	All WPs	The WP will conduct continuous engagement with the community on specific topics (workshops, etc.) and continuous evaluation of the work. This work will follow the PLM (annual service review) process.
8 Lack of NRENs willing to host and/or contribute to TNC in the future. (Likelihood: MEDIUM ; severity: MEDIUM).	WP2	Securing TNC locations for next 3 years on a rolling basis (e.g. until 2028).
9 Impact of OCRE 2024 tender delay on GÉANT framework agreements. (Likelihood: LOW ; Impact: HIGH)	WP4 T2	WP4 will assess Framework publication status at GN5-2 project commencement and act accordingly. Mitigation measures to limit the impact may be expected to be taken by the existing GN5-1 activity, e.g. timely guidance to existing users to extend existing OCRE 2020 Call-off Agreements into 2025.
10 Adoption of InAcademia is dependent upon merchants (commercial services) agreeing to implement it within their workflow. If they choose alternative technical solutions, uptake will be low. (Likelihood: MEDIUM) (Impact: HIGH)	WP5 T4	Develop added-value features. Work with national identity federations on national policy concerning commercial use cases. Promote the benefits of the service to commercial organisations.
11 WP-specific hardware, software or licenses (or similar resources) or existing or future testing platforms not available, not provided on time or lack features for technology or service evaluations. (Likelihood: MEDIUM ; Impact: MEDIUM).	WP4, WP5, WP6, WP7, WP8	Raise awareness early enough about the needs, look for alternatives, or invoke the PLM process to retire the work. For testbeds, explore provision of additional features or alternative testing platforms by consulting with WP7.

Description of risk (indicate level of (i) likelihood, and (ii) severity: Low/Medium/High)	Work package(s) involved	Proposed risk-mitigation measures
12 Significant alternative or new initiative for an existing area of work becomes available, potentially rendering the work irrelevant or obsolete. (Likelihood: MEDIUM ; Impact: MEDIUM).	WP4, WP5, WP6, WP7, WP8	Continuously exploring relevant and new projects and work, determining its relevance to individual tasks. Regular reviews of the work plans and inclusion in discussions at CTO workshops and roadmapping for thematic service areas.
13 Some services are targeted at users at end institutions, but our main channel of communication is only via the NREs who serve those end institutions, which risks very low service uptake. (Likelihood: MEDIUM ; Impact: HIGH).	WP4, WP5, WP6, WP8	Work with NREs and WP3 to promote services to the end institutions. Communication and an action plan are in place with WP2 and WP3.
14 There is a risk that GN Software development teams will use publicly available software modules in a way which is incompatible with that software's license (Likelihood: LOW ; Impact: HIGH).	WP1, WP4, WP5, WP6, WP7, WP8, WP9	Following WP1 supplied guidance, and WP9 software audit process, review licenses used in software submitted for review.
15. Evolving landscape also brings risk of cyber-attack and breach of operational security and infrastructure resilience (Likelihood HIGH ; Impact: HIGH)	WP5, WP7, WP8, WP9	Implement prevention and monitor infrastructure for unusual behaviour. Products and services will use the GÉANT security baseline to assess adequate security protection.

Table 3.6: GN5-2 List of Critical Risks

3.1.21 Resources to be Committed

Participant Number/ Short Name		WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person Months per Partici pant
1	GÉANT	539	259	394	89	381	48	635	131	761	3237
2	ACOnet	1	-	-	-	-	-	-	-	-	1
3	AMRES	-	-	-	-	28	51	15	8	28	129
4	ARNES	-	-	-	-	-	-	-	2	-	2
5	AzScienceNet	1	-	-	-	-	-	-	-	-	1
6	Belnet	-	-	4	6	6	-	-	8	-	24
7	BREN	5	-	-	-	-	-	-	-	-	5
8	CARNET	-	-	3	6	62	29	-	8	-	108
9	CESNET	-	-	-	-	43	6	10	25	-	83
10	CyNet	1	3	-	12	-	21	-	26	-	63
11	DFN-Verein	2	3	15	27	53	51	23	78	30	282
12	FCT	-	-	3	9	-	5	-	-	-	16
13	GARR	6	-	-	11	31	39	5	8	-	98
14	GRENA	2	-	-	-	-	29	-	27	-	57
15	GRNET	-	-	9	6	60	34	-	16	-	125
16	EENET at HTM	-	-	-	30	-	-	-	-	-	30
17	HEAnet	1	-	-	36	-	5	20	15	-	77
18	IMCS UL	-	-	-	-	-	5	-	-	-	5
19	IUCC	-	-	1	12	-	-	-	2	-	15
20	KIFÜ	-	-	5.5	11.5	32	-	-	-	-	49
21	LITNET	-	-	-	-	-	6	-	-	-	6
22	UKIM	-	-	5	6	5	43	-	19	15	94
23	MREN	5	-	-	6	-	5	-	2	-	18
24	NORDUnet A/S	-	21	15	47	144	78	10	98	36	447
25	PSNC	35	79	8	57	80	237	20	42	132	690
26	RedIRIS	-	-	3	-	-	53	63.3	-	-	119.3
27	RENAM	-	-	-	6	9	15	-	7	-	37
28	RENATER	-	-	1	-	6	21	-	3	-	31
29	RESTENA	-	-	-	-	5	-	-	3	-	8
30	RoEduNet	1	-	-	-	-	-	-	-	-	-

Participant Number/ Short Name		WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person Months per Partici pant
31	SANET	-	-	-	-	-	-	-	-	-	-
32	SURF	-	-	6	36	61	-	75	45	-	223
33	TUBITAK	-	-	-	-	15	-	-	-	-	15
34	UoM	1	-	-	-	-	-	-	-	-	1
35	ASNET-AM	0	0	0	0	4	12	0	0	0	16
36	URAN	1	-	-	-	-	-	-	-	-	1
37	RASH Inco	-	12	-	-	15	23	-	9	10	68
38	Jisc	4	-	18	-	18	9	-	17	-	66
40	Pro-M	-	-	5.5	11.5	32	-	-	-	-	49
39	SWITCH*	1	-	-	-	7	6	6	13	1	35
Total Person Months		606	377	489	412	1,064	828	881	610	1,013	6,280

*Associate Partner

Table 3.7: Summary of staff effort

In addition to the resources presented in Part A 38 SWITCH will also provide resources without funding.

Activity	Task	Description	Total
WP1	1 Governance	SWITCH representation in GA Christoph Witzig	1.25
WP5	1 eduroam	RadSec proxy development Fabian Maucle	3.00
	6 Enabling Communities	Task Lead Christoph Graf	4.00
WP6	1 Technology	Alexander Gall - 10%	3.00
	1 Technology	Simon Leinen 10%	3.00
WP7	4 Packet Layer Renewal	Fabian Mauchle	6.00
	2 Human Factor	Cornelia Puhze 6 PM Jessica Schumacher 0.8 PM Renato Furter 2.5 PM Silvio Oertli 0.8 PM	10.10
WP8	5 Research	Simon Leinen 3PM	3.00
WP9	3 Software Governance and Support	Daniel Bertolo, Simon Leinen	1.25
Total			34.60

3.1.22 Subcontracting Costs

#	PSNC	Cost €	Description of tasks and Justification
			Contribution on further development and evolution of network monitoring tools and services, as well as continue investigation and assessment of new monitoring approaches and tools potentially benefiting operational networks and further develop and support existing services, including perfSONAR, the Performance Management Platform (PMP), and TimeMap.
	Subcontracting	300,000	

Table 3.8: Subcontracting costs

3.1.23 Purchase Costs (travel and subsistence, equipment and other goods, works and services) exceeding 15% of participants' personnel costs

1	GÉANT	Cost €	Justification
Network Costs			
	Connectivity investment	1,612,000	Circuits leased, IRUs
	Leased circuits	10,776,000	Leased circuits
	Maintenance	4,815,000	Maintenance
	Peering	1,021,000	Peering costs
	Software licenses	2,284,000	Software licenses
	PoP Housing Costs	5,613,000	PoP housing costs
	Other network Costs	1,234,000	Other network costs
	Equipment	6,785,000	Depreciated network equipment cost
	Network Costs sub total	34,140,000	
	Other WP costs	5,630,000	Other WP costs (events, contractors, training, subscriptions)
	Travel and Subsistence	2,125,000	
	Total	41,895,000	

2	ACOnet	Cost €	Justification
	Travel and Subsistence	5,000	Travel cost
	Total	5,000	

4	ARNES	Cost €	Justification
	Travel and Subsistence	5,000	Travel cost
	Total	5,000	

5	AzScienceNet	Cost €	Justification
	Travel and Subsistence	5,000	Travel cost
	Total	5,000	

7	BREN	Cost €	Justification
	Travel and Subsistence	5,000	Travel cost
	Total	5,000	

17	HEAnet	Cost €	Justification
	Travel and Subsistence	5,000	Travel cost

Other goods, works and services	75,000	Contract mgt data platform, software
Total	80,000	

19 IMCS-UL	Cost €	Justification
Travel and Subsistence	5,000	Travel cost
Total	5,000	

21 LitNet	Cost €	Justification
Travel and Subsistence	5,000	Travel cost
Total	5,000	

23 MREN	Cost €	Justification
Travel and Subsistence	5,000	Travel cost
Total	5,000	

24 NORDUnet A/S	Cost €	Justification
Travel and Subsistence	5,000	Travel cost
Other goods, works and services	687,500	Secondment of personnel, seamless access tools, CDN, VMs), HSM
Total	692,500	

25 PSNC	Cost €	Justification
Travel and Subsistence	5,000	Travel cost
Other goods, works and services	133,000	Licenses
Total	138,000	

30 RoEduNet	Cost €	Justification
Travel and Subsistence	5,000	Travel cost
Total	5,000	

34 UoM	Cost €	Justification
Travel and Subsistence	5,000	Travel cost
Total	5,000	

36 URAN-P	Cost €	Justification
Travel and Subsistence	5,000	Travel cost
Total	5,000	

40 Pro-M	Cost €	Justification
Travel and Subsistence	5,000	Travel cost
Other goods, works and services	132,500	Secondment of personnel
Total	137,500	

Table 3.9: Purchase costs items (travel and subsistence, equipment, and other goods, works and services)

3.1.24 In-Kind Contributions Provided by Third Parties

	Participant/Third-Party	Category	Cost, €	Justification, PMs
1	UoB (AMRES)	Seconded personnel	203,050	WP5T2,3,5 WP6T3 WP8T0 65.5PMs
2	CARNet (SRCE)	Seconded personnel	296,360	WP5T1,2,5 - 62PMs
3	DFN Veren (F-AUEN)	Seconded personnel	686,370	WP6T1,3,4 WP7T3 WP9T1 81PMs
4	DFN Veren (BADW-LRZ)	Seconded personnel	302,525	WP5T6 WP6T1 WP8T3 WP9T2 40PMs
5	DFN Veren (DFN-CERT)	Seconded personnel	647,330	WP5T1,2 WP8T1,2,3,4,5 77PM
6	DFN Veren (KIT)	Seconded personnel	203,580	WP5T5,6 26PMs
7	GARR (UNIFI)	Seconded personnel	93,150	WP5T2 15PMs
8	GRNET (ICCS)	Seconded personnel	50,040	WP6T3,4 12PMs
9	Pro-MKIFÜ (MTA SZTAKI)	Seconded personnel	211,400	WP5T5 15PMs
10	NORDUnet (CSC)	Seconded personnel	41,730	WP3T3 WP5T1 6.5PMs
11	NORDUnet (DeiC)	Seconded personnel	695,489	WP4T3 WP5T1,3 WP6T1 WP8T2,3,4 87.9PMs
12	NORDUnet (DTU)	Seconded personnel	106,650	WP6T1,2 15PMs
13	NORDUnet (Sikt)	Seconded personnel	1,030,841	WP4T1,2,3 WP6T1,3 WP7T4 WP8T4 WP9T4 115PMs
14	NORDUnet (SUNET)	Seconded personnel	1,841,720	WP3T2 WP4T3 WP5T2,3,4,5,6 WP6T1 WP7T4 WP8T2,3,4 164PMs
15	RedIRIS (CSUC)	Seconded personnel	90,315	WP3T4 WP6T4 13.5PMs
16	RedIRIS (i2CAT)	Seconded personnel	310,236	WP6T1,4 WP7T3 75.3PMs
17	RedIRIS (UPV/EHU)	Seconded personnel	154,330	WP6T12,4 30.5PMs
18	SURF (NIKHEF)	Seconded personnel	113,500	WP5T2,6 10PMs
19	SURF (UTwente)	Seconded personnel	167,040	WP8T5 14.5PMs

Table 3.10: In-kind contribution provided by third parties

3.2 Capacity of Participants and Consortium as a Whole

3.2.1 The GÉANT Partnership

The European NRENs are permanent, national bodies providing national infrastructure. Together they have created the GÉANT Association as the basis for their collaboration and for overseeing their joint infrastructure. In addition to the NRENs, the GÉANT Association plays a crucial role in the operation of the GÉANT infrastructure and each major development project.

The governance of the Communication Commons, its richness and effectiveness, is rooted in its multiple stakeholders and is structured to respect the subsidiarity principle. The combined European view of the IT sector will effectively contribute inputs to regulatory process enhancement.

The GÉANT Association has many successful years' experience as project Coordinator, fulfilling a role that it has played in all the cooperative NREN networking projects since TEN-34 in 1996. During these years, it has demonstrated highly proficient and effective managerial, financial and project management and liaison skills. The GÉANT Association employs several ways to share knowledge and collaboratively develop ideas and visions of the future. It reaches out to a wide variety of stakeholders to ensure that future network infrastructure and services address the requirements of the research and education community using the most cost-effective implementations. The GÉANT Association supports an inclusive team of network, security, trust and identity,

cloud ... engineers, project managers, communication/outreach specialists and managers from all over Europe and beyond, thereby mobilising the expertise and experience of hundreds of professionals in the research and education networking area and industry. The coordination effort is constantly ongoing and is based on the provision of the communication fabric and the developed services. The objective is to ensure that the collaboration and coordination targets optimisation and effectiveness of the services and avoids competition.

The GÉANT partnership is well established and recognised as truly pan-European, with 43 NRENs and 2 international organisations (GÉANT Association and NORDUnet, representing the 5 Nordic NRENs: DeiC/Denmark, FUNET/Finland, SUNET/Sweden, Sikt/Norway and RHnet/Iceland). National research and education network (NREN) organisations are unique internet and service providers dedicated to supporting the needs of the research and education communities within their own country. Any partners from countries not associated to Horizon Europe will contribute to the project, without claiming any costs.

The primary focus of NRENs is to provide universities and research institutes with high-quality network connectivity and related services by connecting campuses and institutions to each other and to the rest of the Internet. NRENs in the GÉANT region provide services to more than 80% of all university-level students, as well as to researchers, educators and other campus staff and visitors. Many NRENs reach extends beyond this by also connecting schools, institutes of further education, libraries, museums, hospitals and other public service institutions.

Most NRENs also specialise in providing expertise and support in a range of other technologies and service areas, such as trust and identity, security, storage and collaboration. These may be bespoke to an NREN or part of a pan-European service offered by many NRENs in the GÉANT collaboration but delivered in a federated manner. NRENs have pioneered networks, technologies and services for research and education since the internet's inception.

The partnership will build on its collective experience of providing services and sharing costs, and therefore, has the capability to fulfil the objectives expressed in this proposal. It has a proven track record in maintaining interoperability, transparency, as well as aligning and coordinating the networking and service offering between all European NRENs.

3.2.2 Access to Critical Infrastructure

The successful achievement of the impacts and outcomes of the project relies of the partners having access to the sufficient network and services infrastructure to serve the European R&E entities within their respective countries. The Compendium data of GÉANT partners connecting their constituencies, as well as the appropriate data (maps) from the eduGAIN and eduroam sufficiently demonstrate that project partners have access to the necessary critical infrastructure to ensure the end-to-end connectivity and services researchers and students across Europe.

3.2.3 Partner Complementarity

The Consortium has extensive experience of collaborating to provide the backing of the GÉANT e-infrastructure, as well as many other European and international R&E projects. The intense exchange of ideas and knowledge between partners helps to develop common values. The Consortium provides the underlying e-infrastructures for more than 10,000 Research and Education organisations through Horizon Europe projects, reaching an estimated 50 million end users. The Consortium is indispensable for the successful exploitation of the data generated by almost all large scientific infrastructures (ESFRI-initiated and earlier) by European researchers. Thanks to the success of collaboration between the European Commission, the European NRENs, and their users, GÉANT services are second to none and frequently surpass those of its international counterparts.

In addition to the technical and professional skills needed to deliver the work (e.g. service development, network development, software development, operations support, IT and systems, security, outreach, communications, subject specialists.), a number of roles drive and support its delivery, such as work package leaders, task leaders, team members, deliverable reviewers, governance participation (NIAC, GPPC, GA). The WPLs and TLs are identified in Section 3, while the specific skills contributed by each of the partners are identified and separately set out in Section A. Due to the wide spectrum of NRENs across Europe and the specific skills needed, some partners are more active in some tasks than others. A few partners, typically the smaller, less well-resourced ones may not show significant budgeted levels of funded effort in, for example, new service developments, but are, nevertheless, still important contributors to the distribution of the GÉANT services in their NREN network and service domains, and for the end-to-end delivery across Europe, also benefiting from transfer of knowledge/skills. All NRENs' roles as consortium partners, active engagement in the governance structures and cost sharing of the services should be considered as a vital element of the cohesion of the project partnership.

3.2.4 Industrial / Commercial Involvement

GN5-2 will continue to increase the involvement with commercial and industrial suppliers under procurement frameworks, exploring areas suitable for offering GÉANT partners discounted access to a selection of online services through "brokering". In addition, the InAcademia service engages with commercial retail services that offer a range of discounts to academic users.

3.2.5 Other Countries and International Organisations

None of the project participants requesting EU funding is based outside of the EU Member States, Associated Countries and the list of International Cooperation Partner Countries (ICPCs).

Appendix A References and Glossary

References

[Copernicus]	https://www.copernicus.eu/en
[CERN]	https://home.cern/
[Common European Data Spaces]	https://digital-strategy.ec.europa.eu/en/policies/data-spaces
[Communication Commons]	A common enabling infrastructure comprising network, trust and identity and security for European Research and Education and global reach. A conduit for Europe's researchers to collaborate and share knowledge. As a Communication Commons, all users and countries should be able to access on equal terms irrespective of their status or location.
[CONNECT_SON]	https://connect.geant.org/2023/05/08/will-yellowstones-geology-produce-rock-music
[CONNECT_WIS]	https://connect.geant.org/womeninstem
[Digital Decade]	https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en
[DigitalEd]	https://education.ec.europa.eu/focus-topics/digital-education/action-plan
[EC REC SUBSEA]	Recommendation for on the Security and Resilience of submarine cable infrastructures (https://digital-strategy.ec.europa.eu/en/library/recommendation-security-and-resilience-submarine-cable-infrastructures)
[ECN FOOTPRINT]	Identifying common indicators for measuring the environmental footprint of electronic communications networks for the provision of electronic communications services https://publications.jrc.ec.europa.eu/repository/handle/JRC136475
[EEA]	https://education.ec.europa.eu/
[eIDAS]	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.257.01.0073.01.ENG
[ELIXIR]	https://elixir-europe.org/
[EOSC]	https://open-science-cloud.ec.europa.eu/
[ERA]	https://op.europa.eu/en/web/eu-law-and-publications/publication-detail/-/publication/aae418f1-06b3-11eb-a511-01aa75ed71a1
[ESFRI]	https://www.esfri.eu/
[ESO]	https://www.eso.org/public/
[ESS]	https://www.europeansocialsurvey.org/
[EuroHPC]	https://eurohpc-ju.europa.eu/

[F-Ticks]	https://monitor.eduroam.org/f_ticks_about.php
[IETF]	https://www.ietf.org/
[ITER]	https://www.iter.org/
[Galileo]	https://www.esa.int/Applications/Satellite_navigation/Galileo/What_is_Galileo
[GÉANT Infrastructure]	R&E network/multi-domain service platform interconnects Europe's NRENs + circuits related to other projects that use the GÉANT backbone as their terminating point + the trust and identity infrastructures i.e. eduroam and eduGAIN)
[GÉANT Partnership]	As formed in GN5-FPA, this includes GÉANT Association (Coordinator) and 39 NREN partners
GÉANT PLM]	https://wiki.geant.org/display/GSD/Common+Best+Practices+from+the+PLM+perspective
[GÉANT Services]	http://www.geant.org/Services
[GN-eProcPortal]	GÉANT's eProcurement Portal https://supply2.geant.org/
GN5-1]	GN5 Phase 1 project https://geant.org/gn5-1/
[GN4-3]	The GN4 Phase 3 project https://www.geant.org/Projects/GEANT_Project_GN4-3
[GN4-3N]	The GN4-3N Phase 3 Network project https://www.geant.org/Projects/GEANT_Project_GN4-3/Pages/GN4-3N.aspx
[GN5-FPA]	The GN5 Framework Partnership Agreement
[GN5-IC1]	GN5 Intercontinental Connectivity project https://network.geant.org/gn5-ic1/
[GNe-ProcPortal]	https://supply2.geant.org/
[IDPoLR]	Identity Provider of Last Resort: Identity providers used by service providers when one or more users do not have access to authentication/ authorisation credentials via their home institution.
[NIS2]	https://digital-strategy.ec.europa.eu/en/policies/nis2-directive
[OCRE2024]	https://www.ocre-project.eu/services/cloud-suppliers
[SKA]	https://www.skatelescope.org/
[WBA]	https://www.worldbenchmarkingalliance.org/
[WiFi Alliance]	https://www.wi-fi.org/

UN SDG mapping to Objectives

Note this is reference mapping that will be supported by ongoing action and monitoring throughout the project as part of WP2 T4 and with support from all WPLs.

Objective 1
To advance, deliver and support a secure, pan-European network connectivity infrastructure and related services able to support science, research and education requirements and connect European researchers, staff and students anywhere in the world for the wider European Digital Infrastructure (WP6 & WP7 (Service DevOps))
Applicable SDG: SDG 4: Quality Education
Specific SDG Targets / Actions for baselining <ul style="list-style-type: none"> • Target 4.3: Ensure equal access for all women and men to affordable and quality technical, vocational, and tertiary education, including university. • Target 4.4: Substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship. • Target 4.5: Eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples, and children in vulnerable situations. • Target 4.B: Expand the number of scholarships available globally to developing countries for enrolment in higher education, especially in science and technology.
Objective 2
To understand and serve the communication networking needs and collaboration between the European NRENs, their expanding user community and important European and global stakeholder groups (WP1, 2, 3) (Support)
Applicable SDG: SDG 5: Gender Equality; SDG 17: Partnerships for the Goals
Specific SDG Targets / Actions for baselining <p>SDG 5: Gender Equality</p> <ul style="list-style-type: none"> • Target 5.1: End all forms of discrimination against all women and girls everywhere. • Target 5.5: Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic, and public life. • Target 5.B: Enhance the use of enabling technology, particularly information and communications technology, to promote the empowerment of women. <p>SDG 17: Partnerships for the Goals</p> <ul style="list-style-type: none"> • Target 17.6: Enhance North-South, South-South, and triangular regional and international cooperation on and access to science, technology, and innovation, and enhance knowledge sharing. • Target 17.8: Fully operationalize the technology bank and the science, technology, and innovation capacity-building mechanism for the least developed countries. • Target 17.9: Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans for sustainable development. • Target 17.16: Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, and technology.

Objective 3
To facilitate and enable, through the project, the needs of a wide user base across multiple disciplines for excellent science and research by delivering a broad range of existing and innovative new services. These services incorporate agile incubator development and sustainable operation following thorough business model practices. (all WPs) (Support and Service DevOps) .
Applicable SDGs SDG 13: Climate Action, SDG 17: Partnerships for the Goals
Specific SDG Targets / Actions for baselining SDG 13: Climate Action <ul style="list-style-type: none"> • Target 13.3: Improve education, awareness, and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning. • Action: Providing climate scientists with secure, interoperable data infrastructure ensures they have the resources to conduct impactful research, develop strategies, and share knowledge on climate action. SDG 17: Partnerships for the Goals <ul style="list-style-type: none"> • Target 17.6: Enhance regional and international cooperation on and access to science, technology, and innovation while improving knowledge sharing. • Target 17.7: Promote the development, transfer, dissemination, and diffusion of environmentally sound technologies to developing countries on favourable terms. • Target 17.8: Fully operationalize the technology bank and the science, technology, and innovation capacity-building mechanism for the least developed countries. • Target 17.16: Enhance the global partnership for sustainable development by mobilizing and sharing knowledge, expertise, technology, and financial resources. • Target 17.18: Increase the availability of high-quality, timely, and reliable data that is disaggregated to address specific data needs for sustainable development.
Objective 4
To prototype, pilot and, where appropriate, procure new online above-the-net services and operate and continuously enhance the T&I services and underlying infrastructure to enable students and researchers to preserve privacy (WP4 and WP5) (Service DevOps)
Applicable SDGs SDG 4: Quality Education, SDG 9: Industry, Innovation, and Infrastructure, SDG 13: Climate Action
Specific SDG Targets / Actions for baselining SDG 4: Quality Education <ul style="list-style-type: none"> • Target 4.3: Ensure equal access for all to affordable and quality technical, vocational, and tertiary education, including university. • Target 4.4: Increase the number of people who have relevant skills, including technical and vocational skills, for employment and entrepreneurship. • Target 4.5: Eliminate disparities in education and ensure equal access to all levels of education for marginalised groups. • Target 4.B: Expand scholarships globally, particularly in science and technology.

SDG 9: Industry, Innovation, and Infrastructure

- **Target 9.1:** Develop quality, reliable, sustainable, and resilient infrastructure to support economic development and human well-being, focusing on affordable and equitable access for all.
- **Target 9.4:** Upgrade infrastructure and industries to make them sustainable, with increased resource efficiency and the adoption of clean technologies.
- **Target 9.5:** Enhance scientific research and upgrade the technological capabilities of industrial sectors, encouraging innovation.

SDG 13: Climate Action

- **Target 13.3:** Improve education, awareness, and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning.

Objective 5

To provide operations support for first- and second-line functions (including training) to ensure that developed applications are secure and fit-for-service before going into operation. (WP9) (Operations) (SDG4, 5, 9).

Applicable SDG SDG 4: Quality Education, SDG 9: Industry, Innovation, and Infrastructure, SDG 16: Peace, Justice, and Strong Institutions

Specific SDG Targets / Actions for baselining

SDG 4: Quality Education

- **Target 4.3:** Ensure equal access for all to affordable and quality technical, vocational, and tertiary education, including university.
- **Target 4.4:** Increase the number of people with relevant skills, including technical and vocational skills, for employment and entrepreneurship.
- **Target 4.5:** Eliminate disparities in education and ensure equal access to all levels of education for marginalised groups.

SDG 9: Industry, Innovation, and Infrastructure

- **Target 9.1:** Develop quality, reliable, sustainable, and resilient infrastructure to support economic development and human well-being.
- **Target 9.5:** Enhance scientific research, upgrade technological capabilities in all sectors, and encourage innovation.
- **Target 9.C:** Significantly increase access to information and communication technology and strive to provide universal and affordable internet access.

SDG 16: Peace, Justice, and Strong Institutions

- **Target 16.6:** Develop effective, accountable, and transparent institutions at all levels.
- **Target 16.10:** Ensure public access to information and protect fundamental freedoms.
- **Target 16.A:** Strengthen national institutions to prevent violence and combat terrorism and crime.

Objective 6

To provide operations support for first- and second-line functions (including training) to ensure that developed applications are secure and fit-for-service before going into operation. (WP9) (Operations) (SDG4, 5, 9).

Applicable SDG: SDG 4: Quality Education, SDG 5: Gender Equality, SDG 9: Industry, Innovation, and Infrastructure

Specific SDG Targets / Actions for baselining

SDG 4: Quality Education

- **Target 4.4:** Substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment and entrepreneurship.
- **Target 4.5:** Eliminate disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples, and children in vulnerable situations.

SDG 5: Gender Equality

- **Target 5.5:** Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic, and public life.
- **Target 5.B:** Enhance the use of enabling technology, particularly information and communications technology, to promote the empowerment of women.

SDG 9: Industry, Innovation, and Infrastructure

- **Target 9.1:** Develop quality, reliable, sustainable, and resilient infrastructure to support economic development and human well-being, focusing on affordable and equitable access for all.
- **Target 9.5:** Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, particularly developing nations, and encourage innovation.
- **Target 9.C:** Significantly increase access to information and communication technology, striving to provide universal and affordable internet access.

Glossary

AAI	Authorisation and Authentication Infrastructure
AI	Artificial Intelligence
ANA	The Advanced North Atlantic collaboration
APM	Access Port Manager
BSS	Business Support System
CA	Consortium Agreement
CAE-1	Subsea cable connecting Asia and Europe between London and Singapore
CC BY	Creative Commons Attribution /By Licence
CERN	European Organisation for Nuclear Research
CI/CD	Continuous Integration / Continuous Delivery
CPO	Chief Programmes Officer
CSSPAC	Cost-Sharing and Service Portfolio Advisory Committee
CTO	Chief Technology Officer
DDoS	Distributed Denial of Service
DNSH	Do No Significant Harm
DSA	Digital Signature Algorithm
DTN	Data Transfer Nodes
ECN	Electronic Communications Networks
EEA	European Education Area
eIDAS	electronic IDentification And trust Services
ERA	European Research Area
ESFRI	European Strategy Forum on Research Infrastructures
ESS	European Social Survey
ETLR	European Top Level Radius servers
FAIR	Findability, Accessibility, Interoperability, and Reusability
FoD	Firewall on Demand
FPA	Framework Partnership Agreement
GA	General Assembly
GCP	GÉANT Community Programme
GDPR	General Data Protection Regulation
GEO	Group on Earth Observations
GLAD	GÉANT Learning and Development
GP4L	GÉANT P4 Lab
HPC	High Performance Computing
IaaS	Infrastructure as a Service
ICT	Information and Communications Technology
ICPC	International Cooperation Partner Countries
ICRI	Interdisciplinary Centre for Law and ICT
IPR	Intellectual Property Rights
IRU	Indefeasible Rights of Use
ITER	International Thermonuclear Experimental Reactor
ITIL	Information Technology Infrastructure Library

KPI	Key Performance Indicator
LHC	Large Hadron Collider
MDS	Multi-Domain Security
MPLS	Multi-Protocol Label Switching
NeMo	Network Monitoring, tool for Netflow-based DDoS and traffic anomaly detection and analysis
NIAC	Network Infrastructure Advisory Committee
NIS2	Network and Information Security Directive
nmaas	Network Management as a Service
NMI	National Metrology Institutes
NPAPW	Network Performing Art Production Workshop
NREN	National Research and Education Networks
OC	Oversight Committee
OLA	Operational Level Agreement
OSRB	Open Source Review Board
OSS	Operational Support System
PAIR	Project Annual Internal Review
PLM	Product Lifecycle Management
PMB	Project Management Board
PMO	Project Management Office
PMP	Performance Measurement Platform
PoP	Point of Presence
QA	Quality Assurance
QASPER	Quality Assurance and Public and External Relations committee
QKD	Quantum Key Distribution
QoS	Quality of Service
R&E	Research and Education
RARE	Router for Academia, Research and Education
RDA	Research Data Alliance
REN	Research and Education Network
RI	Research Infrastructure
RO	Roaming Organisation
SCT	Secure Code Training
SDG	UN Sustainable Development Goal
SGA	Specific Grant Agreement
SIG	Special Interest Group
SIG-ISM	Special Interest Group on Information Security Management
SKA	Square Kilometre Array
SLA	Service Level Agreement
SLM	Software and Licence Management
SSE	School of Software Engineering
STF	Service and Technology Forum
SWD	Software Development
T&F	Time and Frequency
T&I	Trust and Identity

Tbps	Terabits per second
TCS	Trusted Certificate Service
TED	Tenders Electronic Daily
TF	Task Force
TFN	Time and Frequency Network
TRL	Technology Readiness Level
VaaS	Vulnerability as a Service
WISE	Wise Information Security for collaborating e-infrastructures
WP	Work Package

GN5-2 Project Calendar

Project Period	Calendar Year	Project Month	Calendar Month
Period 1	2025	1	Jan-25
Period 1	2025	2	Feb-25
Period 1	2025	3	Mar-25
Period 1	2025	4	Apr-25
Period 1	2025	5	May-25
Period 1	2025	6	Jun-25
Period 1	2025	7	Jul-25
Period 1	2025	8	Aug-25
Period 1	2025	9	Sep-25
Period 1	2025	10	Oct-25
Period 1	2025	11	Nov-25
Period 1	2025	12	Dec-25
Period 1	2026	13	Jan-26
Period 1	2026	14	Feb-26
Period 1	2026	15	Mar-26
Period 1 Review June 26? (TBC)			

Period 2	2026	16	Apr-26
Period 2	2026	17	May-26
Period 2	2026	18	Jun-26
Period 2	2026	19	Jul-26
Period 2	2026	20	Aug-26
Period 2	2026	21	Sep-26
Period 2	2026	22	Oct-26
Period 2	2026	23	Nov-26
Period 2	2026	24	Dec-26
Period 2	2027	25	Jan-27
Period 2	2027	26	Feb-27
Period 2	2027	27	Mar-27
Period 2	2027	28	Apr-27
Period 2	2027	29	May-27
Period 2	2027	30	Jun-27
Period 2 Review Sept 27? (TBC)			