

Annex 1 – Description of Work

Project Acronym: GN5-1

Grant Agreement Number	101100680
Grant Agreement for	HORIZON RIA
Type of MGA	HORIZON-SGA-AG
Authors:	GN5-1 Writing Group
Date of Preparation	6 September 2022
Document Code:	GN5-1-22-001

DOCUMENT HISTORY

Version number	Date	Description of change	Justification of change/dependency	Person
Proposal	18-05-22	Proposal uploaded		T.Chiotis B. Hannigan
1.0	13-07-22	Initial preparation (Including change of Milestone 27 (M8.4) title from . CLAW2024 to CLAW2023 Crisis Management Workshop and Exercise)		T.Chiotis B. Hannigan
2.0	05-09-22	Table of risks removed from Part B. For the sections of the Part B that are moved to Part A, like work package description and others, the titles of the sections were added back in Part B with a comment beneath indicating it is covered in Part A, so the overall numbering of titles are respected. In kind contributions explained in Part B (Section 3.1.24)		T.Chiotis B. Hannigan

Version number	Date	Description of change	Justification of change/ dependency	Person
3.0	06-09-22	Add a justification to PSNC subcontracting		T.Chiotis B. Hannigan
4.0	14-09-22	Add a justification to IMCS-UL travel costs		T.Chiotis B. Hannigan

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36	SWITCH	Switzerland
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1 Excellence

The GÉANT Consortium, formed by the 39 project partners and combined infrastructures of the GÉANT Association and each of the National Research and Education Networks (NRENs), 5 of which are associated organisations at present: ASNET-AM (Armenia), Jisc (UK), RASH (Albania), SWITCH (Switzerland) and URAN (Ukraine), 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, 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. Research infrastructures, such as CERN, ELIXIR, SKA, PRACE and EuroHPC, depend on GÉANT to make data and services available to users from many disciplines to increase the knowledge base. 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 international connectivity to the R&E community not available through commercial providers, which helps to diminish the impact of the digital divide within Europe.

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 nearly 30 years, and continuing under the new 72-month GN5 Framework Partnership Agreement in Horizon Europe (GN5-FPA), this

proposal responds to Horizon Europe Call HORIZON-INFRA-2021-NET-01-SGA-1 (Work Programme '21-22 Other Actions: 1. SGA for networking and collaboration services and investments in long-term capacity for Research and Education Networks in Europe), received 5 April 2022.

The work proposed in GN5-1 aims to provide scientists, researchers and students access to connectivity and collaboration services needed to support evidence-based decision making and effective collaboration of virtual research communities around the world. This implements the first period of the FPA action plan, in particular, ensuring (1) high-quality connectivity for excellence in Research and Education (SGA1a) and (2) state-of-the-art connectivity for the wider European Digital Infrastructure (SGA1b). In addition to the synergies between the two actions and the connectivity proposed in HORIZON-INFRA-2021-NET-01-SGA-2 (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 and reducing environmental impact. The strengthening of the European Communication Commons will improve support for the ERA, increasing European data sovereignty and addressing the expected increase in data volume and diversity of data sources and user communities.

GÉANT 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, 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. A recent example of the strength and reactivity of the members of the GÉANT partnership is the very rapid reaction by the NRENs to the order of magnitude increase in the demand for distance education at all levels caused by the COVID-19 pandemic. The use of open and distance learning imposed by the pandemic will have lasting influence on the educational mix offered and the recent experience gained in the GÉANT partnership will enable swift adaptation to new challenges.

1.1 Objectives and Ambition

Using the Consortium's operational and infrastructure-led expertise, the proposed GN5-1 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 and students access to near-real-time applications that support evidence-based decision-making in society, and worldwide effective collaboration of virtual research communities. 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)) expand the target audience for the GÉANT connectivity will also be addressed, in particular through the T&I developments planned.

Through GN5-1, 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 GN5-1. Further details about the services developed by the work packages (WPs) and their technology readiness level are outlined in Section 1.2.5.1.

The proposed work is complementary to and will synchronise with other projects to be proposed under the GN5-FPA, especially SGA2 (GN5-IC1). Note the ongoing work from GN4-3N will not overlap with the work proposed in GN5-1. It will rely on a common governance and decision-making structure that is already well established and tested in the current ongoing projects.

1.1.1 Objectives

GN5-1 has determined the following objectives (derived from the GN5-FPA objectives and Actions) and the EC expected outcomes in the *2021-22 Work Programme*, which are addressed in the work packages.

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).
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).
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).
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).
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).
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).

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 extensive support and services provided to them by NRENs. 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 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. 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, and data sovereignty** of the communication platform. Such characteristics are essential for excellent 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.

1.1.2 Ambition

GÉANT partners span diverse roles within their respective national environments, which determine the level of their participation in national education, 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 GN5-1.

The GÉANT connectivity services will go beyond the state-of-the-art in order to serve new research communities such as quantum key distribution (QKD) and metrology or Time and Frequency (T&F). This will require special connectivity services already actively being discussed with the relevant communities and these must be implemented at a reasonable cost without impacting the excellent availability, security 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 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 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, while access to data by international collaborations evolves 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 continue with a variety of appropriate business models 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 as following 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 GN5-1 is grouped into three **Support** work packages, five **Service DevOps** work packages and one **Operations** work package. This section describes the processes underpinning the work packages' activities, in line with the environmental priorities to Do No Significant Harm (DNSH).

1.2.1 Partnership Context

For over 50 million users, 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 radioastronomers, 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 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 GN5-1 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 GN5-1, the GÉANT partnership will continue to build on its experience, 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.

1.2.2 Project Task and Resource Allocation

The whole GÉANT Consortium as defined in the FPA participates in the GN5-1 project. GÉANT Association acts as coordinator and brings its extensive and experienced team of network engineering, procurement, 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 each of the 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.

1.2.3 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. In GN5-1, the partnership plans (for operating costs of the production network) to use part of the available EC funding that is eligible, together with a cost-sharing model agreed between the consortium partners and up to full EC funding for other actions. Building on this and to ensure service sustainability, existing and new services such as T&I, security and Above-the-Net will be considered for co-funding models where services can be part funded with some form of cost share or 'à la carte' subscriptions model.

1.2.4 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, e.g. a significant infrastructure / IP layer equipment refresh is planned for installation to start in Year 2 of this project. The current projections for funding investments in GN5-1 are focused mostly on the IP layer equipment refresh, as the current router platform is reaching end-of-life and investment in new platforms is necessary to achieve the greater Tbps capabilities required. 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.

With respect to the Part 1(b) of the Work Programme's reference to funding some investments with 100% EC funding, it is foreseen that the purchases of the IP layer equipment may, providing the cashflows can be managed, be purchased and the EC funding claimed based on the asset depreciation calculated over an asset's useful economic life, in accordance with standard accounting and consistent with the current cost-sharing model, rather than on the full 100% EC funding of acquisition. Future investments for other network infrastructure costs such as long-term IRUs on fibre would still be funded 100% with EC funding. The opportunities for IRU investment are to be determined during the first year of the project as part of the network evolution plan and following the conclusion of the GN4-3N project investment at the end of 2023. The amount available to spend on these IRUs will also depend on the available budget after the IP layer equipment investment is confirmed. In any case, the availability of the infrastructure and limited time window of 12 months between the end of GN4-3 and

the end of GN5-1 may well lead to such investments being completed at the beginning of the next project following GN5-1 (see also Section 2.1.1 Project Outcomes).

1.2.5 Innovation within Service Development and Delivery

1.2.5.1 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 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. In the case of the latter, the methodology is used to review the service to determine the service roadmap or 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 0.1 below.

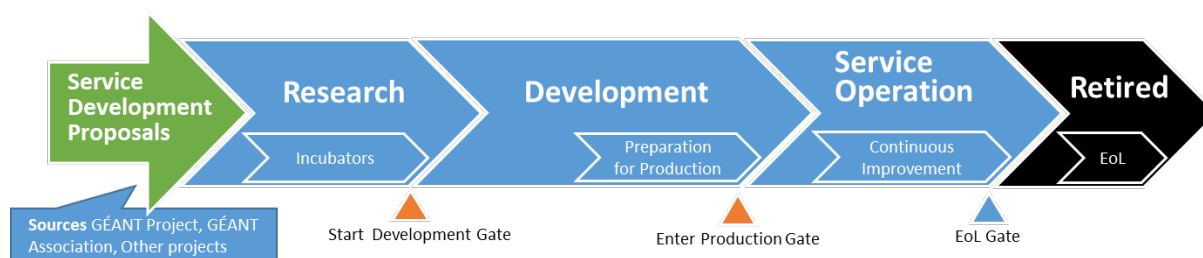


Figure 0.1: PLM process – overview

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 canvas¹, 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 core 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 include pilots and new development from incubators. For more information, please consult the publicly accessible GÉANT Project Service Catalogue [GÉANTServices].

¹ Business canvas addressing: user segmentation, value proposition, channels, key relationships, financing, essential resources, activities, partnerships, and cost structure.

- **Network Services**
 - GÉANT IP (including GÉANT Peering), GÉANT Plus, GÉANT Lambda, GÉANT Open Exchange, GÉANT L3 VPN, MD-VPN & tools (SI), GCS (**WP7**)
 - perfSONAR, NMaaS, Performance Measurement Platform (PMP), WiFiMon, TimeMap, and the GCS Service Provider Architecture (SPA) (**WP6**)
- **Trust and Identity**
 - eduroam and supporting services, eduGAIN and federation services, eduTEAMS, and InAcademia (**WP5**)
- **Security**
 - eduVPN (eduSAFE), NSHARP umbrella of tools (FoD, DDoS, CERT, blackhole, anomaly detection) (**WP8**)
- **Above the Net**
 - IaaS Cloud Catalogue, IaaS+ Framework, eduMEET (**WP4**)

In addition, the following services in service design stage are anticipated TRL6-7, with further additions from WP4, 5, 6 and 8 incubator tasks.

- Network Automation eAcademy, RARE and GP4L (**WP6**)

1.2.5.2 Innovation Management

Innovation starts with the generation of ideas, frequently as part of the GÉANT Innovation Programme (within the Community Programme), 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. The project will also provide an opportunity for young talents to develop skills to equip them for the competitive European ICT sector.

1.2.5.3 Incubators

The way to ensure that the development of services stays agile and on the front-line of innovation is to follow the approach of short incubator cycles of new or possibly disruptive technologies, business models, new market opportunities and other related innovative ideas to enhance existing services in line with sustainability requirements and the 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. The Incubator 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.

1.2.5.4 *Technology Readiness Level*

As qualified within the PLM process, GN5-1 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 Technology Readiness Level (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 TRL 6 and follow the processes to reach production service operations at least at TRL 8 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. In summary, every service in the service portfolio has at least a pre-production service available (TRL6-7).

1.2.5.5 *Quality*

The proposed GN5-1 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.

1.2.5.6 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.

1.2.5.7 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, as much as 75% price reduction in some cases.

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].

1.2.5.8 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. Distinct from GN5-1, the still active GN4-3N network infrastructure upgrade project is proceeding well towards completion at end-2023. This has been achieved 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, 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 using their national eIDS (eIDAS compliant) to eduGAIN services that allow for that.

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. Through the BELLA S1 project, GÉANT has demonstrated the ability to secure new intercontinental network infrastructure in collaboration with its global peers. There are further examples in ANA and CAE-1/AER where GÉANT has worked in

collaboration for procuring shared intercontinental infrastructure. The proposed GN5-IC1 project will, if funded, 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.

The operational setup for the GÉANT backbone network itself, as provided by the proposed GN5-1 project, is mature and provides the necessary mechanisms to control operational quality and stability in the operational phase. GÉANT's Operations Centre has the necessary skills, tools, expertise and processes in place to manage these links as part of global connectivity. In this way, the GÉANT network will be positioned to serve important European initiatives such as data lakes, EOSC, and EuroHPC.

1.2.5.9 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. Quantum communication will redefine the boundaries and configuration of traditional networking. The project's innovation cycle, with extensive dissemination and contribution from partners, ensures the inter-disciplinary approach of GN5-1.

1.2.5.10 Social Sciences and Humanities

By definition, the GN5-1 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. European NRENs have had a vital role during the COVID-19 pandemic, strengthening the community despite the difficulties posed by the switch to online learning and performing. Together, they have successfully responded with new and innovative services for artists, musicians, and students. Most universities, theatres, art institutions supported by GN5-1 partners have multi-disciplinary teams with technologists, scientists, and artists working together on national and international projects. Others are in a fledgling state and 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 research and education networks, has revolutionised the very concept of "making art".

Technology for Arts and Humanities has been an area of successful international collaboration in GN4 projects with a strong growth prospect in GN5-1. In particular, 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 in this fascinating field. The flagship activity of this unique and long-standing partnership is NPAPW (Network Performing Art Production Workshop), an annual gathering of technologists, network experts, performing 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.

1.2.5.11 Gender Dimension in GN5-1 Research and Innovation

The GÉANT consortium is committed to align to EU values of gender equality and attention to diversity, by recognising the importance of integrating gender and wider diversity issues into research and innovation to provide societal relevance as an example for the next generation. In every activity within the project and in liaising with external stakeholders, we will ensure an inclusive approach, 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 & 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.

1.2.5.12 Implementation of Open Science Practices

Open Science is a critical element of the GN5-1 project, although there is no active creation or curation of research data. 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 we have an active strategy to support this transition and embed Open Science practices across Europe via the GÉANT community.

Involvement in the EOSC Association and Research Data Alliance (RDA) enable this. Eleven NRENs and the GÉANT Association are Members of the EOSC Association, and a further 11 NRENs have been appointed as Mandated Organisations to represent national interests. GÉANT and the NRENs are also well represented on the 13 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.

1.2.5.13 Research Data and Research Output Management

The project's general Open Access and FAIR strategy will be included as part of our Data Management Plan. Open Access to research papers, public deliverables and reports, as well as other textual outputs produced within the project, will follow the "green" Open Access route; 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.

2 Impact

The purpose of the proposed GN5-1 project is, first and foremost, to ensure the continuation of the European Communication Commons, which comprises the backbone, operated and developed by GÉANT for nearly 30 years, its intercontinental reach, and the combined network infrastructures of all NRENs, in accordance with the Horizon Europe objectives and extending the required agility needed to thrive in the fast-evolving environment as agreed between the EC and the GÉANT consortium in the FPA. There is a clear need to ensure EU researchers and those serving education are equipped to increase their geographical reach and handle data volumes with higher speeds, capacity, and data security to remain competitive in a rapidly changing world. The multi-annual project of updating the IP layer infrastructure to ensure continued best-in-class IP services will be initiated, and new and faster links between the European countries will be started in a natural continuation of the GN4-3N project (extended to December 2023).

The work will be compliant with 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 wherever possible when they require faster or specially featured networks, improved geographical coverage, security solutions, and trusted services.

This proposal 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, GN5-1 will look to baseline and set measurement criteria for how the project concretely contributes to various SDGs, such as, but not limited to: 4) Quality Education, 5) Gender Equality, 9) Industry, Innovation and Infrastructure, and 13) Climate Action. The same process will also be 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 doing this, 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 RI connections.

2.1 Project Pathways Towards Impact

The results of GN5-1 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. energy, climate, semiconductor and health-related research.

2.1.1 Project Outcomes

As described in the Horizon Europe Work Programme, the outcomes of the proposed GN5-1 project will have an impact across every institution, in terms of governance, data infrastructure, roles for teachers 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, as well as a sustainable approach to funding, with a long-standing and effective cost-sharing mechanism in the Consortium.

All this has been obtained through the continued commitment of the partners in the Consortium to develop and operate what has been established in terms of infrastructures and services. The six 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.
- 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 include 39 sub-Action points which provide the fundamental guidance to the work of GN5-1, together with the three, complementary requirements of the GN5-1 call. Although planned as an evolving activity over the duration of the 6-year FPA, this GN5-1 proposal will deliver outcomes that are listed under these six Actions and also to the majority of the FPA's sub-Actions, thus establishing the start of the programme foreseen under the FPA.

As outlined in the work programme, the overall aim and expected outcome of this project is to provide faster, resilient, agile and secure connectivity and collaboration services and strengthen the position of the GÉANT network as an enabling strategic digital infrastructure for European Research and Education. Additional outcomes planned include: providing unconstrained capacity ahead of demand in the backbone network and NREN access in multiples of 100 Gbps, to pave the way for Terabit connectivity where needed; continuing and developing **state-of-the art, cost-effective, connectivity** within Europe (including **trusted access** to data sources and services, including T&I services; expanding 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**; disseminating learning and training, and community building as well as aligning with EU policy and ongoing participation with standardisation bodies.

All work packages in GN5-1 contribute towards these outcomes. The GN5-1 support work packages (WP1, WP2, WP3) ensure effective delivery, reporting, governance, management and quality processes. For WP1 this includes finance and procurement as well as quality assurance, GDPR and security audits required by the Product Lifecycle Management (PLM) process before new services are introduced into production. WP2 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. WP3 works across multiple work packages to ensure NREN feedback and development, resulting in ongoing service improvements. Such cooperation facilitates connection between partners, an ever-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. Task Forces (TFs) and Special Interest Groups (SIGs), part of the governance structure of the GÉANT Consortium, promote an open approach to innovation, and link to the relevant EC projects aiming at higher levels of integration of e-infrastructure services in Europe (e.g. EDI, EOSC).

WP4 to WP8 will concentrate on stepwise improvements (DevOps) to existing services, as well as incubation and piloting of new ideas, all to promote sustainable service development and continuity of services. WP4, Above-the-Net Services, focuses on re-procurement of the expiring framework contracts for IaaS services and on the new business models and sustainable funding structures for services that are being developed within the community. T&I (WP5) and Security (WP8) ensure the maximum potential of the T&I portfolio is realised and made available to the user community, and that the security aspects across the services and the network are addressed, taking into account the development towards stronger national electronic identities (e.g. eIDAS), privacy preservation and the increasing threat levels. These WPs depend on WP8 to ensure the security of the GÉANT backbone network and, once in production, WP9 underpins the new and existing services offered, providing first-line operations support and application quality assurance.

The project will take account of the results of the GN4-3N project, which will conclude its phase of long-term network infrastructure investment at the end of December 2023, and commits to ensure there are no duplications of this work in GN4-3N with the GN5-1 project. Long-term investments described in part 1b of the work programme, such as procurement of any additional new, long-term network capacity, will be considered as part of the continual network planning exercise and may be initiated in the second year of the project (i.e., from January 2024). Due to the procedurally compliant lead times necessary, the delivery of additional network infrastructure may not be realised until the follow-on project to GN5-1 which is anticipated as part of the FPA programme. In the meantime, the major effort to procure and install a new platform of IP layer equipment will commence in GN5-1 and also carry over into this successor project. 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., 5 to 7 years, or roughly the remainder of the FPA duration) using the same cost-sharing mechanism between the EC and the NRENs.

More detailed descriptions of the outcomes are detailed in Section 3.1.

2.1.2 Project Contribution to Society, Innovation, Industry and Education

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/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, data and computing resources in a secure and non-discriminatory way, regardless of the location of the users and the resources.

The federation of National Research and Education Networks 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 Europe remains at the forefront of research.

This project is the first step towards development of the network to reach Terabit capacity and meet 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 10 years.

GN5-1 will have a number of positive impacts reaching out to society in general through the wider and influential scientific and educational community target group, with some selected important impact areas detailed below.

Societal

- Competitive, global positioning for European Research, Development and Education. 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 sovereignty 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.

- The GÉANT connectivity 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 new types of users join the network and associated above-the-net services.

Innovation

- Innovation is and will be seen in every aspect of GN5-1 work areas, and may include, but not be limited to: adding new features, covering new use cases, expanding the user base, improving existing and/or adding new techniques, technologies and tools.
- The impact on current and new users of the introduction of technological opportunities offered by quantum key distribution (QKD), metrology support and real-time capabilities well beyond state-of-the-art and artificial intelligence (AI) is important. The potential offered by QKD will require substantial innovation to be realised as the amount of accessible data and users increase.

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.

Education

- The speed, resilience, geographical footprint, security and overall excellence of the GÉANT and the NRENS' joint network service have supported students' 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, and complement 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 GN5-1 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. The standards are set by the very large platforms operated around the world with almost illimited financial power. As previously stated, the proposed project will offer coordinated training, information exchanges and secondments, providing relevant courses to partners.

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 partner. The connectivity and access to the required supporting services that this project will deliver are key for Europe to maintain this position. The project will have a wide impact, offering the European research and education community a broad network reach, which is 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 teachers located anywhere across Europe.
- Boosting 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) endorsed by the EU, especially SDG 4, 9 and 17 [SDG4, SDG9, SDG17].

2.1.3.1 Sustainability

The proposed increase in the 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. The partnership will continue to observe the quality and performance levels on which it has built its reputation for nearly 30 years.

Without the proposed investment in the enabling worldwide 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 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. 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

Environmentally, the GN5-1 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 procurement processes will also respect and emphasise the selection of more environmentally efficient equipment with reduced power consumption relative to the capacity delivered.

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.

Additional measures put in place by WP3 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 KPIs detailed in Section 3 are based on the continuing growth and increasing impact of this GN5-1 project and the GN5-FPA Actions and Outcomes. The scale of the project's contribution is measurable at both the internal project and NREN community level and 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 existence of these infrastructures and services is evidently a prerequisite if Europe's position as a lead contributor to global research is to remain viable.

In its field, the GÉANT programme and the specific projects such as GN5-1 are regarded as a leader for many developments. Where no single leading entity exists, the GÉANT consortium is always at the forefront of joint international collaborative efforts.

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. With participants from more than 70 countries, TNC attracts a greater number of international visitors than any other comparable conference, showing that it is the place to engage, share and develop new concepts and ideas of future new capabilities that bridge the digital divide, make possible distributed access to scientific instruments and cross-disciplinary scientific data sharing.

User engagement not only focuses on the cohesion and coherence of the project offerings to the 50M users across Europe, but also is increasing its community-specific events, providing GÉANT user communities with a better understanding of the increased capabilities that the infrastructures and services can bring to their research. Understanding this capability 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 needed for EuroHPC and the foreseen growth in data lake repositories. Quality as well as quantity and stability are also key, especially for the specific applications that the infrastructures can now enable, such as with the potential available with QKD, time and frequency and other low-latency applications.

The range of the service portfolio is very broad but also not static, with continual improvements and developments of new services ensuring the needs of users are met and, with the continuing investment in the development programme, will be met in the future, providing users with a portfolio they use and value. The range of trust and identity services, in particular eduroam, is used and relied on by students and academics worldwide, with around 0.5 billion authentications. Its federated, scalable design simplicity enables a forecast of 5% further continued annual growth. Other developments in this space will lead to a coherent and common core T&I platform that will make future services even more easy to develop and scale, and offer potential for commercial development and exploitation. For the other Above-the-Net services, the innovations and expertise of the procurement activities have shown how very 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 achieved by the collective purchasing power that these framework contracts bring. For the security work, the need to address the increasing threat landscape is recognised and much greater emphasis is being directed in this project to recognise and mitigate against the impact of cyber threats on the infrastructures and services offered.

2.1.6 Requirements and Potential Barriers to Success

A number of components will contribute critically to the success of the project and at the same time represent critical challenges, including:

- The continuing, **rapid development of the ICT landscape** relevant to many of the objectives will facilitate the cost-effective implementation of the elements.
- **Combined efforts of the other European e-infrastructure projects and RIs** developing or providing services for data storage and computing adapted to the needs of the research and education communities will help to identify and shape the future requirements for 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.
- **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).
- In general, security issues could greatly hamper the research community in its **effective use of the increased volumes of data** – especially in areas where European sovereignty considerations may impose constraints.

It should also be noted that rapidly changing external financial factors such as inflation are more unstable, which may disrupt anticipated timescales and increase costs of staffing, procurement activity, 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. 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 co-ordination with partners around the globe.

GÉANT's success in this endeavour will be used to perpetuate its eligibility to be considered within the telecoms market as a viable wholesale customer/partner. 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 co-ordination 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 GN5-1 (as well as GN4-3N and 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 (including the GN4-3 and GN4-3N projects) with communications and dissemination work and providing resource for the relevant Task.

The Marcomms team (or 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.

In putting together this strategic plan, 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 event organised by GÉANT and partner NRENs routinely attracts over 800 attendees, with several thousand watching streamed content online).
- 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 communication 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 will manage all IPR issues in line with the EC guidelines on the management of IPR as referred to in Regulation (EU) No 1290/2013 of the European Parliament and of the Council. It will also enable partner agreement and management of IPR, liability and future dissemination/exploitation of project results.

2.2.3.1 Open Access

The GN5-1 consortium is committed to providing free and open access of GN5-1 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 International Public 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 and analysed in the Annotated Grant Agreement, Article 17, a data management plan will be written in coordination with GDPR, Security and IT policy and issued as a deliverable in WP1 at M6, with regular updates throughout the project.

The plan will include an overview of data to be managed by GN5-1, 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 GN5-1 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 where stated in its GDPR policy or Consortium Agreement. GN5-1 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

SPECIFIC NEEDS	EXPECTED RESULTS	D & E & C MEASURES
<p><i>What are the specific needs that triggered the 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 equipped to increase their geographical reach and handle data volumes with higher speeds, capacity, and data security 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. 	<p><i>What do you expect to generate by the end of the project?</i></p> <ul style="list-style-type: none"> • A current and up-to-date connectivity service to the European scientific and educational user community, matching the expectations 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 demonstrated the robustness of its processes for governance, 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 requirements of R&E communities and evolving the Communication Commons towards data-driven research and education. • Strengthened collaborative ecosystem of GÉANT and the NRENs maintaining their position as an indispensable 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> <p>Measures ensure the sustained promotion and awareness of project activities to identified audiences, utilising 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 to relevant audiences, in collaboration with the NRENs. These actions will include:</p> <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. • 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</i></p>	<p><i>What change do you expect to see after successful dissemination and exploitation of project results to the target group(s)?</i></p>	<p><i>What are the expected wider scientific, economic and societal impacts outlined in the respective destination in the work programme?</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 GN5-1, including: researchers, students, institution staff, SME/industry researchers and citizen scientists, segmented as follows.</p> <ul style="list-style-type: none"> • GÉANT Member NRENs; in ensuring that investments realise the most benefit from the funding available and provide sufficient capacity to meet users' needs, educational or research, located in their national boundaries. • Research infrastructures/pan-European users with multi-country presence or international researchers requiring connectivity and collaboration services. • Regional/international NRENs; working in partnership with GÉANT and the respective REN to ensure network traffic reaches its ultimate destination with a resilient topology that 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, such as those coming from industry and citizen scientists. 	<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. • Disseminating learning and training and community building as well as aligning with EU policy and ongoing participation with standardisation bodies. • Increased recognition that data for research is generated from countless sources and large instruments across the globe (e.g. CERN/EuroHPC/Copernicus/Galileo/ESO/SKA) and stored in specialised data repositories which 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>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.</p> <p>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.</p> <p>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.</p> <p>Supporting the UN Sustainable Development Goals [SDG4, SDG9, SDG17].</p>

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 FPA and HORIZON-INFRA-2021-NET-01-SGA-1, comprising nine main activities, outlined below.

The work packages follow the established and proven structure from the current GN4-3 project. **Service DevOps**, the main development and service activities (WP4 to WP8), and **Operations** (WP9), are complemented by the **Support** work packages (WP1 to WP3 and WP9). This has been deemed most efficient for the thematic areas, as the development work will concentrate on stepwise improvements to existing services with a timescale of 1 to 2 years per step. These WPs do not only cover incubating, prototyping and piloting of new services within their areas, but also provision of operational services, which provides guarantees for the continuity of services. This makes it simpler to maintain production quality of developing services with fewer dependencies across WPs. WP9 will also underpin some of those operational activities, such as providing the first-line support and application quality assurance.

The Above-the-Net Services , WP4, puts most emphasis in the areas of re-procurement of the expiring framework contracts for IaaS services, and the new business models and sustainable funding structures for services that are developed by the community. In addition, the thematic areas of T&I (WP5) and security (WP8) have been allocated additional priority and resourcing to ensure the maximum potential of the T&I portfolio is realised and made available to the user community, and equally that the security aspects across the service portfolios, especially across the network, are addressed as far as reasonably possible. The network and its services included in WP6 and WP7 account for more than 50% of the total cost. To maximise effectiveness, these WPs depend on WP9 for operations support, and on WP8 to ensure the security of the GÉANT backbone network. The alignment and coordination efforts required between WP6 and WP7 are an important element and will be applied throughout the project, with continuation of the regular and structured communication between these work packages that already exists. Finally, the GN4-3N programme of work that continues in parallel with the first 12 months of GN5-1 will be assisted by efforts in GN5-1's WP1, WP2, WP3, WP7 and WP9 to ensure the integration of the results from GN4-3N into the day-to-day operations of the network going forward under the GN5 SGA projects.

An important overall objective for GN5-1 is to have a very agile development environment, bridging the user requirements to production and introduction of new features or services in a much shorter time than the duration of the project. WP3 will work across multiple work packages to ensure user-driven development and feedback from NRENs to incorporate ongoing service improvements. This approach also builds in prompt reassessment/replan when requirements change or an opportunity for new technology availability arises. The project also conducts regular reviews of all development projects for coordination and timely delivery. These reviews will also be informed by the Product Lifecycle Management (PLM) gate reviews, as well as the project output such as milestones and deliverables.

Regular service reviews will continue to ensure that the services offered remain relevant in terms of uptake, usage and KPIs.

3.1.1.1 Support Work Packages (Work Packages 1, 2 and 3)

The GN5-1 support work packages ensure that project partners can always rely on effective communication, delivery, governance, management and quality processes, including: finance, HR, procurement, and reporting,

as well as quality assurance compliance such as the General Data Protection Regulation (GDPR) and security audits demanded by the PLM process before new developments are introduced into production.

The work packages enable project cooperation and facilitate connection between partners, an ever-expanding user community, important 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. As part of the GÉANT Community Programme, Task Forces (TFs) and Special Interest Groups (SIGs) promote an open approach to coordination and innovation between partners. Over the past few years such interaction has been even more important, as GÉANT participates in an increasing number of EC projects aiming at higher levels of integration of e-infrastructure services in Europe (e.g. EDI, EOSC).

- **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. 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, liaison with other e-infrastructure projects, user needs/feedback, intelligence gathering and support for Task Forces and Special Interest Groups (TFs and SIGs).

3.1.1.2 Service DevOps Work Packages (Work Packages 4, 5, 6, 7, and 8)

Work Packages 4 and 5 address the provision of operational services and the prototyping and piloting of new services in Online Services (WP4) and in Trust and Identity (WP5) using the Product Lifecycle Management process.

- **WP4 Above-the-Net Services** aggregates NREN expertise and community demand around digital online services, engages in pan-European brokerage and development efforts, and refines an inclusive future strategy for NREN roles in these efforts
- **WP5 Trust & Identity Services Evolution and Delivery** is responsible for the enhancement and operation of the existing Trust and Identity services and for the innovation and development of new T&I (both existing and new) products and services to address the emerging requirements of the GÉANT community.

Work Packages 6 and 7 cover the backbone core network and the services linked to it.

- **WP6 Network Development** will undertake technology evaluation and development in the areas of network infrastructure, services and monitoring, and sustainably provide GÉANT project production network support services, 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 end-user-orientated services.
- **WP7 Network Core Infrastructure and Core 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.

WP8 specifically addresses the security aspects of the project.

- **WP8 Security** will keep the R&E network safe and secure at the backbone level, and support the GN5-1 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.

3.1.1.3 Operations Work Package (Work Package 9)

WP9 is primarily responsible for the first- and second-line support functions (including training) to ensure that developed applications are secure and fit-for-service before going into operation.

- **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, and introduces 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

	Year 1												Year 2											
	Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
WP1 Project Management																								
Deliverables						D1.1		D1.2		D1.3	▼		D1.5							D1.6	▼	▼	▼	
Milestones				M1.1							D1.4			M1.1						D1.7	1.8	1.9		
WP2 Marcomms, Events and Policy Engagement																								
Deliverables			D2.1										D2.2									D2.3		
Milestones			M2.1			M2.2			M2.3, M2.4	▼			M2.6			M2.7								M2.8
											M2.5													
WP3 User and Stakeholder Engagement																								
Deliverables									D3.1											D3.2	▼	3.5		
																				D3.3, D3.4				
Milestones				M3.1		M3.2		M3.1				M3.3					M3.4						M3.5	

	Year 1												Year 2											
	Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
WP4 Above the Net Services																								
Deliverables										D4.1	D4.2			D4.2								D4.3	▼	
																						D4.4, D4.5		
Milestones				M4.1							M4.2	4.3									M4.4			
WP5 Trust & Identity Services Evolution and Delivery																								
Deliverables											D5.1											D5.3		
Milestones						M5.1					M5.2	5.3					M5.4							
WP6 Network Technologies and Services Development																								
Deliverables														D6.1	D6.2	D6.3								
Milestones			M6.1	▼	▼																			
			M6.2	6.3												M6.4								
WP7 Network Core Infra & Core Service Evolution and Ops																								
Deliverables						▼					▼			D7.1								D7.2		
Milestones				M7.1, M7.2, M7.3						M7.4, M7.5														
WP8 Security																								
Deliverables										D8.1	D8.2											▼	D8.3	
Milestones						M8.1				M8.2	▼	▼	▼				M8.7		▼	M8.10				
										M8.3	8.4	8.5, 8.6					M8.8, M8.9		M8.11					
WP9 Operations Support																								
Deliverables	D9.1									D9.2				D9.3	9.4									
Milestones										M9.1				M9.2										

Table 3.1: Project Gantt chart

3.1.3 Project Components and Interdependencies

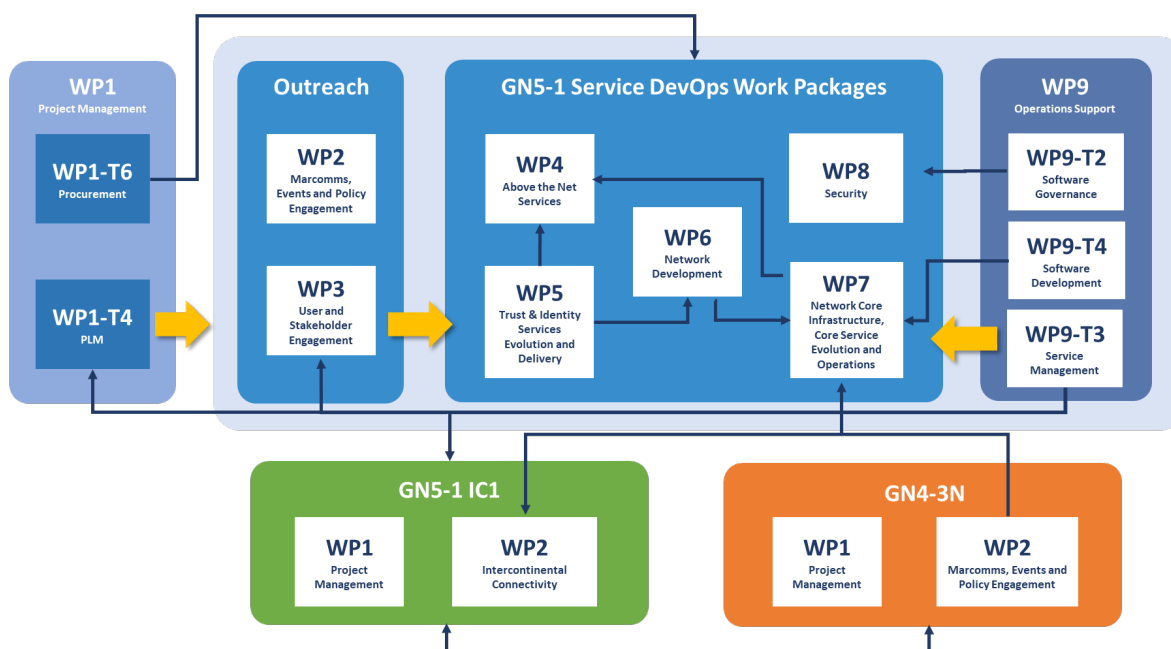


Figure 3.1: Project interdependencies by work package and task

3.1.4 Support Work Packages Work Plan

3.1.4.1 List of Work Packages

Work Package No.	Work Package Title	Lead Partic. No.	Lead Participant Short Name	Person Months	Start Month	End Month
WP1	Project Management	1	GÉANT	577.8	M1	M24
WP2	Marcomms, Events and Policy Engagement	1	GÉANT	309.6	M1	M24
WP3	User and Stakeholder Engagement	1	GÉANT	383.0	M1	M24
TOTAL MONTHS				1270.5		

Table 3.2: Support Work Package list

3.1.5 Work Package 1: Project Management

Work package number	WP1
Work package title	Project Management

Objectives

In cooperation with the other GN5-1 work packages, and in alignment with GN5-FPA, WP1 Project Management will:

- Ensure the success of GN5-1, through project management, risk prevention and mitigation, and 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 control, 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, etc.), implement a data management plan and handle all ethical, legal and IP issues.
- 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.
- 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 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.
- 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, trust & identify, as well as developing interpersonal and management skills.
- Manage GÉANT procurement and suppliers.

Key Performance Indicators

- Number of services to have costing analysis. Target: 80%.
- Number of deliverables issued on time. Target: 100%.
- Availability of monthly “flash” reporting and variance analysis. Target: within 15 days of month end.
- 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 GN5-1, liaising with the GN5-1 project work packages and project stakeholders, the NRENs, and lead WP1 as a whole, 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 GN5-1, 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 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 GN5-1, GN5-IC1 and GN4-3N programme governance bodies as described in Section 3.1.16, 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).

To manage GN5-1, the common GÉANT Project Management Framework (PMF) will be used to optimise and adjust the details of the programme of work in line with the evolving service environment. This will include Coordinators to manage the interaction and communication across work packages, to ensure a coherent and consistent approach across the project and to identify and eliminate overlaps and gaps. Coordinators are responsible for the following areas: Network Operation (Bram Peeters, GÉANT), T&I (Klaas Wierenga, GÉANT), Outreach Activity (Cathrin Stöver, GÉANT), Community (Paul Rouse, GÉANT), Security (Alf Moens, GÉANT), Services (Richard Lui, GÉANT), GDPR/IPR (Magdalena Rzaca, GÉANT), Software Governance/Development (Cezary Mazurek, PSNC), Standards (Richard Hughes-Jones, GÉANT), and the CTO function that is also led by Bram Peeters and Klaas Wierenga 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: Munyradzi 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, it 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 (Task Leader: Qaiser Ahmed – GÉANT)

Task 3 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.

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 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 adopt a Design Thinking approach and more field research/observation of end users and 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 maintains and develops the most important asset of the GN5-1 community: the exceptional skills and experience of the professional staff found in the NRENs and GÉANT. As well as being pivotal to the success of the GÉANT project, the project's human resources are highly regarded and in demand across the industry.

The key areas and activities of Human Capital Development are adaptive and responsive to the evolving requirements of the GÉANT partnership as part of GN5-1.

COVID-19 accelerated change in the way training is delivered. Increasingly, learning is delivered via online learning platforms licensed to individual users. In order to derive the best value for money and avoid inefficiency, GÉANT may coordinate and obtain these licences on behalf of partners.

The following core activities retain their significance to maintain the value of the human capital as an important asset for the GN5-1 community:

- Providing continuous access to learning: the task will develop the eAcademy, the GÉANT community's eLearning portal, and may offer access to licensed online learning platforms, thus providing continuous access to high-quality eLearning assets.
- Supporting development of the live, online GÉANT training offerings for the research and education community, NRENs and beyond.
- Ensure additional training support for Do No Significant Harm and Gender Equality is available to support and encourage NREN best practice.
- Coordination with WPL for support of their bespoke technical training programmes.
- Encourage ongoing development of emerging talent.

The task will also offer learning that contributes to the effective development and delivery of products and services as well as fostering the sustainability of the careers of project participants. This will include a Professional Competencies Programme to deliver “soft” skills training in areas such as business development, product marketing, communication, presentation skills, team leadership and management capabilities. This is aimed at increasing the value of the human capital for the project in terms of:

- Enhancing and maintaining the skills within the project partners.
- Enabling sustainability of career progression for the project and its partners.
- Enabling the effective delivery of the project's objectives through strong management and teamwork.

The task aims to encourage collaborative knowledge creation and skills transfer through a variety of learning options aimed at recognition and application of community expertise. This work also includes quality assurance of learning products. In addition, the activity will provide a mechanism for centralised support to professional development, learning and innovation across all work packages.

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 and Work Package Leaders will input any specific requirements to the Training Plan.

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 and events 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 communications.

Through collaboration with all other work packages, WP2 will plan and implement a coordinated programme of communications, services marketing, events and 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.
- Showcase innovations and initiatives as well as user success stories and their impact.
- Foster inclusion and participation among participants, partners and the wider community.
- Explore 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.
- 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.
- Coordinate and baseline 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 all platforms*) by 10% per year.
- Social media: increase total followers (as an average across all platforms) by 8% per year.
- Social media: achieve an engagement rate (as an average across all platforms) of 2% per year.
- Websites: increase total visitors to geant.org home page by 5% per year.
- Websites: increase total visitors to impact.geant.org by 5% per year.
- Websites: increase total visitors to network.geant.org by 5% per year.
- Websites: increase total visitors to connect.geant.org by 10% per year.
- Increase TNC attendance by 3% per year based on 2022 numbers.

*Twitter, Facebook, LinkedIn, Instagram

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: Cathrin Stöver – 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 GN5-1. 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: Paul Maurice 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. The task is also responsible for the development and ongoing management of the project's communications channels. 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, website content, videos 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, clouds 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.

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

The Events tasks will focus on the following main activities:

- Annual delivery of TNC, ensuring TNC continues to be the flagship event of the GÉANT and international research and education networking community.
- Organisation of project symposia and conventions, ensuring successful community collaboration.
- Ensuring GÉANT and NREN partners are prominently represented at relevant national and international events.
- Organisation 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.
- Liaise with relevant WPs/tasks within the project to agree and set measurement criteria for applicable UN Sustainable Development Goals (including Greening and Gender balance) – as referenced within the Framework Partnership Agreement to fulfil requirements of Horizon Europe.
- Liaise with relevant WPs/tasks within the project to first baseline and then set measurement criteria 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. It 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, European data spaces and any 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 co-ordinating 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, in a range of beneficial activities. 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. by supporting a dedicated programme for South East Europe NRENs.
- 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, etc.) to ensure that both the core network and services are available to support these critical European infrastructures.
- Deliver intelligence on the status of GÉANT and NREN networks and informed advice on future strategies by conducting a Foresight Study, coordination of service requirements, etc.
- Provide a central intelligence and data curation function to include an open digital repository (for use by the GÉANT community) and CRM.
- 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).
- Coordinate on topics of community interest such as EOSC, EuroHPC, Quantum, to ensure a collaborative engagement model.
- Strengthen GÉANT's community programme through facilitation of discussion, cooperative working, with a continued focus on innovation. 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 Year 1, the work package will have delivered a comprehensive stakeholder engagement plan, NREN satisfaction survey, Compendium report and review of global engagement. These will feed into the Year 2 activities. At the end of Year 2, the work package will have delivered two Compendium

reports and utilised intelligence gained from roadmap reports from other work packages to feed into an NREN foresight Study (M20). Additionally, reports on the Community and Innovation programme and Collaboration and International User support activities will be produced.

Key Performance Indicators

- NRENs' level of satisfaction with Partner Relations maintained (via satisfaction survey).
- Meet with 90% of European NRENs and global RRENs at least once per year.
- At least 1 per project period of insights which contribute to plans and/or strategy.
- Attendance at 20 or more user-specific events per year (GEO, LHC, etc.).
- 12 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 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. 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, and support collaborative activities. Finally, it will collate and monitor information via dedicated initiatives such as the Compendium, foresight study, satisfaction survey, and provide GÉANT with intelligence and a reliable evidence base to help guide strategic direction and input into practical developments in security, network and services. The objectives are as follows:

- Provide a dedicated partner relations service, acting as a “voice of the partners”, ensuring that their views are gathered and fed back.
- Coordinate procurement, financial, operational and technical activities in GÉANT amongst partners to ensure effective delivery of services to NRENs across functional boundaries.
- Address the digital divide – continue to provide additional support for countries where NRENs are less developed, e.g. via the Emerging NREN and SEE programme.
- Provide a dedicated relationship management service for day-to-day interactions with RRENs and international NRENs; representation in multi-lateral activities and globally focused working groups and feeding this information back into the GÉANT community.
- Enhance global service cooperation via engaging with international RRENs (via Regional Networks) and liaison with GÉANT services, European NRENs, etc. on service collaboration, local deployment of GÉANT services, European NREN services, standards coordination, etc.
- Seek to understand the current and future community landscape via:
 - Delivery of the Compendium resource which tracks the evolution of R&E networking in Europe.
 - Management of information collected across the work packages using appropriate repositories and tools – this information will be fed back in a structured manner, taking heed of emerging trends and themes.
 - Results from regular service requirements gathering carried out via bilateral interactions and the satisfaction survey.

- A foresight study – together with the NRENs, Task 1 will conduct a study of the future landscape and requirements which will serve to inform future product portfolio pipelines and map anticipated developments in the NREN environment over the longer term.
- Enhance transparency and ease of access to information related to the network and services by being a central point of excellence for research and providing a data curation service, e.g. central repository of research findings; working with data from independent analyst groups, e.g. Gartner; management of satisfaction survey; management of the CRM.
- Ensure that GÉANT provides excellent service to European/global NREN partners to stimulate uptake of GÉANT services and maintain and support overall NREN sustainability.
- Support an understanding of future needs, providing intelligence on developments relevant to the GÉANT project and its contributors.

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

Significant changes to researchers' operating environments mean user engagement is essential. 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, through:

- Provision of dedicated account management function for key international user projects and organisations and promotion of international user collaboration across world regions.
- Interacting with other e-infrastructure projects (PRACE, EUDAT, EGI, OCRE, Copernicus DIAS, etc.), data repositories, computing services and important research infrastructure projects to discuss and develop a federated safe environment in which their technical and operational service needs are understood to ensure users have a wide choice of services, independent of their geographical location.
- Interacting proactively with existing international users (CERN, ESA, SKA, ESS, ITER, EMBL, etc.), research infrastructures, etc. and expansion of the GÉANT and NRENs user base to new science communities, data lakes and collaborations.
- 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.
- Support to 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).
- Provide a technical business development focus for trans-national 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 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 Kuipers, SURF, Annabel Grant – GÉANT)

This task provides a central point for liaison, engagement and outreach activities to other e-infrastructure projects and wider initiatives such as EOSC, EuroHPC, EPAs, GAIA-X, and coordinates the support provided by GÉANT, the NRENs and global partners to e-infrastructures for further alignment of service portfolios and to ensure continued joint initiatives and partnerships. This task will monitor, harmonise and support the work outlined in current collaboration agreements (interoperability, consolidation,

strategy and service alignment) or joint projects (e.g. EOSC Future project). Additionally, the task will establish relationships with other industrial 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 or outreach planning.

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 and external projects and wider initiatives.
- Maintain, enhance and extend a proactive, collaborative and dedicated point of contact for e-infrastructures, other projects and wider initiatives in the external ecosystem to actively seek out/address new opportunities for collaborations (with WP3 T1 and T2).
- Identify additional collaboration opportunities (joint research projects, new services, etc.) with strategically important external projects, R&E and industry initiatives in order to ensure full use of GÉANT infrastructure and services by new communities of users.
- Stimulate the additional use of GÉANT infrastructure and services.

Task 4: Community Programme (Task Leader: Gyongyi Horvath – GÉANT)

GÉANT supports community-based initiatives to explore emerging issues, exchange information and collectively develop strategies and solutions. Task Forces (TFs) and Special Interest Groups (SIGs) are groups of world experts from NRENs, user organisations, research institutions, commercial and industrial sectors who collaborate via email lists, wikis and 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 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 GN5-1 project are promoting and engaging as widely as possible to support the innovation pipeline.
- Manage and run a GÉANT Innovation programme (where budget is allocated by the GÉANT board upon GA approval).
- Provide secretariat support for the GÉANT Community Committee, Task Forces, Special Interest Groups, specialist workshops and the community awards.

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 stimulating innovation and providing value to the GÉANT community.
- Provide a platform to promote work from the GN5-1 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 Partic. No.	Lead Participant Short Name	Person Months	Start Month	End Month
WP4	Above the Net Services	16/11	Harno / DFN-Verein	351.3	M1	M24
WP5	Trust & Identity Services Evolution and Delivery	24/1	NORDUnet (SUNET) / GÉANT	833.0	M1	M24
WP6	Network Development	25/3	PSNC /AMRES	562.6	M1	M24
WP7	Network Core Infrastructure and Core Service Evolution and Operations	1	GÉANT	604.2	M1	M24
WP8	Security	1	GÉANT	370.2	M1	M24
	TOTAL			2721.3		

Table 3.3: Service Activities work package list

3.1.9 Work Package 4: Above-the-Net Services

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

Objectives

WP4 develops and maintains the GÉANT community's vehicle for collective delivery of a portfolio of commercial and community cloud services, known in the GN5-1 context as Above-the-Net Services. Through collective procurement, WP4 leverages the R&E community's aggregate demand and GÉANT's unique ability to legally represent and reach thousands of institutions to make commercial cloud services efficiently consumable at favourable technical and business conditions. This provides significant community-wide cost savings due to collective bargaining power and saves time on procurement efforts. Leveraging the NRENs' national legal and operational relationships to deliver the WP4 portfolio of commercial and community cloud services to the entire European R&E community also brings opportunities for more systematic exploitation of higher-level attention and influence with the large suppliers. WP4 will propose a unified NREN approach to commercial and community cloud offerings. During the GN5-1 project WP4 will pursue the following outcomes:

- Re-procurement of the flagship IaaS+ framework agreements for the European R&E community.
- Enhanced NREN capabilities, as well as NREN- and supplier-facing delivery chain supporting a collective portfolio of commercial and community cloud services, and a community-backed strategy proposal for a joint NREN approach underpinning this.
- Candidates for further new developments and documented learnings from and about the incubator.
- Develop a framework for a holistic community/commercial portfolio of services as the basis for portfolio management
- A sustainably community-supported eduMEET and learnings from the spin-out process that may be valuable to similar cases.

To achieve these outcomes WP4 will liaise with relevant SIGs in the GÉANT community programme (SIG-CISS, SIG-Marcomms, SIG-MSP), the 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

- Top 8 platforms of 2020 IaaS+ Framework expressed intent to join 2024 frameworks by M10.
- Minimum 12 NRENs actively engaged in the strategy process by M7.
- One incubator project completed and report of the project published by M8.
- 60% of eduMEET funding comes from non-GN5-1 sources by M12.

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

- Number of NRENs signing up for the 2024 Framework.
- Number of institutions consuming the services.
- Framework contract service consumption in Euros.
- Number of framework platforms and suppliers in contract management.
- Number of eduMEET sponsors (in-kind and financial).
- Number of significant eduMEET deployments.

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: Maria Ristkok – EENet and Jakob Tendel – DFN)

This task leads WP4 and coordinates the work of all Tasks to achieve the desired objectives with efficient use of resources, while maintaining correct project processes. This task also manages resources for communication and project management and is responsible for managing WP4's portfolio of services.

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

This task enables the service delivery of WP4's portfolio of Above-the-Net services toward NRENs as the primary target group and their connected R&E institutions as the secondary target group. The objectives of Task 1 are to realise the aggregation of demand and requirements from the R&E community towards the procurement effort; and to deliver the required service information and support NRENs' efforts in their role as Above-the-Net services competence centres, facilitating the portfolio uptake by their connected institutions:

- Coordinate and support the established community of NREN Above-the-Net service delivery managers to facilitate uptake of Above-the-Net services in the portfolio, including a helpdesk for NRENs.
- 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; organise training and support to NRENs and institutions, on transitioning to the cloud in general and using the WP4 service portfolio.

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

This task will engage with vendors, execute vendor and contract management and provide operational support for shared procurements. Smooth service delivery from cloud vendors is enabled through a Business Desk and Contract Management Group, ensuring the integrity of contract relationships and consumption reporting, which is the basis for NREN cost recovery.

Task 2 is responsible for a platform for service acquisitions and delivery for the new Frameworks. This involves collaboration with the GÉANT procurement team and WP4 Task 3 on the following systems:

- A system to be used by WP4 for service acquisitions, tenders, and contract management.
- A marketplace, 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 gaining unique access and concessions 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 the GN5-1 WP4 efforts. 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 2nd-line helpdesk to/from NRENs.

- Preparing quarterly service consumption reports.
- Cultivating long-term operational and strategic relationship with suppliers.
- Facilitating the actual strategic discussions by NREN and GÉANT delegations with suppliers, based on steering inputs from the Above-the-Net Services Strategic Planning Task.

Task 3: Infrastructure-Cloud Procurement (Task Leader: Monique Pellinkhof – GÉANT)

The GÉANT projects can add excellent value by aggregating effort centrally for procurement and laying the groundwork for NRENs to build confidence (legally, operationally) in offering their institutions access to Above-the-Net infrastructure services. This aggregation saves enormous amounts of effort for individual procurements across Europe (and saves millions of euros in charges through discounts over free market rates) as well as maintaining the GÉANT community in its existing strong bargaining position with increasingly strong-willed global hyperscale providers. The collective procurement of infrastructure-cloud ensures research-relevant concessions by suppliers to increase interoperability with R&E infrastructure and is a significant contribution from the GÉANT community to EOSC's portfolio of commercial services.

The objective of this task is to prepare and run a pan-European infrastructure-cloud procurement, as a follow-on to the 2020 IaaS+ Framework from the OCRE project, and to have new frameworks signed for consumption before the 2020 IaaS+ frameworks end (no later than Q3 2024), with another run-time of four years and with best terms and conditions for the R&E community that other e-infrastructures cannot easily deliver. The goal is a Framework portfolio that gives R&E access to state-of-the-art infrastructure-cloud services while also addressing digital autonomy and data sovereignty concerns.

Task 4: Above-the-Net Services Strategic Planning (Task Leader: Jan Meijer – NORDUnet (Sikt))

The digital transformation of R&E is a challenge better navigated together as a community, to maximise effort aggregation and to mitigate the European digital divide by lowering the barrier to benefit for all NRENs. Infrastructure-cloud is of strategic interest to the NREN community, but opinions and national context around digital sovereignty and data protection vary on how to best address these challenges.

Task 4 will deliver a collective NREN strategy proposal on how to address the mix of community clouds and commercial clouds for the best interest of the entire European R&E community and to create options for balancing sovereignty with continuing access to world-class data processing for European research. It will develop a framework for a holistic community/commercial portfolio of services as the basis for portfolio management, with appropriate and sustainable acceptance and exit criteria. This task will orchestrate the NREN Above-the-Net strategic dialogue and NRENs' participation in strategic engagement with service providers and other stakeholders (e-infrastructures, projects, and organisations). The objective is to illuminate opportunities for NRENs in this space and provide actionable steering input for the GN5-1 tasks (T3 procurement) and planning of future effort to contribute to the digital autonomy and sovereignty of the European R&E community on state-of-the-art digital platforms.

Task 5: Above-the-Net Service Developments (Co-Task Leaders: David Heyns – GÉANT, Bartłomiej Idzikowski – PSNC)

This task manages the development process for new products and services into the GÉANT Above-the-Net services portfolio and pilots the transition of existing services out of the project funding.

Sub-Task 5.1 Service Incubator

The objective of this sub-task is to develop and pilot the concept of the “ideas lab” incubator itself, through executing several proof-of-concepts, incremental extensions of existing services, or knowledge-building on specific topics in 4-month “sprints”. The ultimate objective is to develop the capability to reduce risk in innovative ideas before committing resources on the level of a project task or GÉANT service. Possible topics at project start include:

- Technical solutions with commercial suppliers supporting dealing with Schrems2.
- “GÉANT as service broker for Above-the-Net services for NRENs” as preparation for Above-the-Net services strategic planning and discussion.
- GÉANT as IaaS underwriter, for NRENs in non-EU-procurement compliant countries.

Sub-Task 5.2 Spin-Out Development

This sub-task will pilot a process for guiding project-internal software developments to “standing on their own feet outside of the GÉANT project,” focusing on the business model development and maintaining the current product. This first pilot “spin-out” will undertake to apply the principle in an agile way to the transition of eduMEET videoconferencing to an independent and community-supported open-source project, and to document the resulting learnings. The objectives of this task will include in GN5-1:

- Product management and continued development of open-source software (eduMEET).
- Building up a product ownership and stakeholder community in R&E that can define a beneficial product roadmap.
- Legal-administrative framework and software governance supporting community financing.

3.1.10 Work Package 5: Trust & Identity Services Evolution and Delivery

Work package number	WP5
Work package title	Trust & Identity Services Evolution and Delivery

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 new 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 ensure that (i) the GÉANT T&I offering evolves to address the growing demand for federated access from scientific collaborations, EOSC communities and clusters by designing and developing a core AAI platform and by having dedicated service offerings built on top of that; and that (ii) innovation is addressed within the services and outside via an incubator task and the distributed identities task. This approach will grow the footprint of the provided T&I services and provide benefits of working with prominent R&E communities, such as WISE, REFEDS, AGIS and EOSC, supporting them to overcome technical and other challenges presented by service adoption.

This work package will also liaise with other relevant initiatives, such as national and international projects related to e-identities, students’ mobility initiatives, eIDAS, EOSC and EBSI. This will ensure that the GÉANT community can expand the T&I services capabilities and drive global R&E ecosystem without duplication of effort. In the first year, the team will investigate distributed technologies and sovereign identities that have been identified as a key priority by the GÉANT community, with the aim to fit some activities in this area in the Y2 work plan. The expected outcomes of the Work Package are:

- Operate T&I services (eduroam, eduGAIN, InAcademia, eduTEAMS deployments) in a secure, effective, agile and optimised manner following DevOps principles.
- Develop an AAI core platform for added value identity services, responsible for the maintenance and evolution of technical stack that is used by numerous added value services that are built on top of eduGAIN.
- Enhance the T&I services, introducing new features and improving performance, functionality and usability.
- Explore new or disruptive ideas and their applicability including user-centric technologies and cost recovery models to the T&I services and feed the results to the relevant service development and operations teams.
- 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

- eduroam: European Top-Level RADIUS (ETLR) availability. Baseline (set as a minimum of the historical average in past 32 months and the target): 99.9 %; Target: 99.9%.
- eduGAIN: Metadata Service (MDS) availability. Baseline (set as a minimum of the historical average in past 32 months and the target): 99.5%; Target: 99.5%.
- Core AAI Platform: GÉANT SP Proxy 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 2021: 401,44 million; Target: 5% annual increase.
 - eduGAIN: increase of number of IdPs. Baseline for 2021: 4666; Target: 8%.
 - Core AAI Platform: GÉANT SP Proxy Service Connected Service. Target: 100 (by the end of GN5-1).
 - InAcademia: Number of national federations participating in the service. Baseline: 9; Target: 15 (by the end of GN5-1).
- 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 Y1; 8 Y2.
 - Number of new research communities engaged with Task 4. Baseline at start of the project: 0; Target: 8.

Description of Work

Each T&I service is encoded into a task, to better manage resources, expenditure, new ideas and development. New ideas are tested in T5, T&I Incubator, and best business practice evolves alongside the forging of links with new community projects/entities in T6 Enabling Communities, which also connects WP2 and WP3 community liaison activities. 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: Marina Adomeit – SUNET, Licia Florio, GÉANT)

This task coordinates the work of the Work Package, setting and managing plans and roadmaps and ensuring cross-task coordination, including: strategy steering and implementation, project management and support for the outreach. 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. This task fosters the collaboration with relevant stakeholders and subject matter experts in the trust and identity area.

Task 0 is responsible for the development, operations and enhancement of all T&I services and underlying products. It will start with the current GÉANT T&I service offering: eduGAIN (and federation services), eduroam (and supporting services), eduTEAMS, and InAcademia and is responsible for the development, operations and enhancement of all T&I services as well as the oversight for T5, T6 and T7.

Task 1: Operations and Enhancement of eduroam (Task Leader: Paul Dekkers – SURF)

Task 1 is responsible for the development, operations and enhancement of eduroam's core services and eduroam supporting tools as well as for managing an internal audit process with the National eduroam Roaming Operators. Continuing operations, eduroam will enhance the user-facing tools (CAT, geteduroam, etc) and will develop tools to improve statistics via the existing F-Ticks tool [F-Ticks]. It will also continue to identify strategic collaborations with the industry and enhance eduroam to enable NRENs to continue to play a strong role in the roaming arena (i.e., OpenRoaming). Essential eduroam tools, such as CAT and geteduroam, will also be revamped.

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

This task is responsible for the continuous development, operations and enhancement of eduGAIN, which includes:

- Operation of eduGAIN core services, namely, the Metadata Service (including the HSM and the metadata validator), the eduGAIN Technical Portal, eduGAIN support and tickets, and eduGAIN secretariat and eduGAIN statistics/troubleshooting.
- Development and enhancement of eduGAIN discovery services, including new protocols for the Metadata Service for statistics/monitoring.

Task 2 will:

- Operationalise the central security function (eduGAIN Team) to work with the Federation Operator (feds) to improve security.
- Support national identity federations to adopt T&I community best practices and improve existing tools to support federations to comply with the agreed procedures.
- Explore the evolution of eduGAIN infrastructure and trust model if verifiable credential assertions were to become more common.

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

Building the AAI core platform for added value identity services

The core AAI platform will be responsible for the maintenance and evolution of the technical stack that is used by numerous added-value services that are built on top of eduGAIN. Task 3 will maintain and evolve the stack used for eduTEAMS, which includes the multi-protocol authentication proxy, the OpenID Connect Backend and Frontend, the SAML2 Backend and Frontend, the Consent and User Information component, the Metadata Exchange component, the Discovery Service component, the User Registry component, the Membership Management Service component, the Admin Portal and the User Portal. The main focus will be the scalability of the platform and the reduction of the overhead for the delivery of existing and new services. This core AAI platform will be used to deliver eduTEAMS services, namely:

- To support activities with NRENs and stakeholders (i.e., support new use cases, requirements gathering, analysis and design, running of pre-production eduTEAMS offering pilots).

- To maintain and enhance 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 services available to the GÉANT community and European Open Science Cloud (EOSC).
- To maintain and enhance the GÉANT SP Proxy Service, which enables GÉANT Project Services and Cloud Service Providers in the Cloud Framework(s) to authenticate users at R&E Identity Providers and/or Community AAIs for Research and Education activities.
- To maintain, operate and evolve MyAccessID Service, a common Identity Layer for Infrastructure Service Domains (ISDs) in the context of EuroHPC and the European Open Science Cloud.
- To maintain, operate and evolve the EOSC AAI Federation, the aggregation central entity to connect the community and e-infrastructure proxy AAIs.
- To explore new advanced AA services for researchers, such as an Identity Provider of Last Resort [IPoLR], Identity Vetting as a Service, passwordless authentication, multifactor authentication and self-sovereign identities.

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

InAcademia is a service that builds on eduGAIN and allows online retailers to easily validate if a customer is a student or affiliated to an education institute, and as such, eligible for discounts. InAcademia was launched during the GN4-3 project, where it demonstrated its value to ensure student access to online services in a more privacy preserving manner.

Work in this task will cover:

- Operation of InAcademia core services: QA/pre-production and production infrastructure, demo shop, statistics portal, Metadata Discovery Service and other supporting tools.
- Development and service enhancement activities, which includes the design, creation and support of federation-facing/merchant-facing management information tools, adaptive IdP hinting, investigating the use of payment gateway integration and e-commerce plugins, enhancement of discovery, MDS etc, and implementation of a continuous deployment pipeline.
- Introduction of self-service management and onboarding tools to make it easier to connect more services as well as continuous deployment to reduce operational overhead.
- Use of federated authentication when accessing merchant sites.
- Improvement of performance related/statistics tools.

Task 5: T&I Incubator (Task Leaders: Niels van Dijk – SURF & Jule Ziegler – LRZ/DFN)

Task 5 will

- Foster the evolution of new ideas related to T&I services, and efficiently deliver the results.
- Continue to provide incubator space for working on innovative but potentially disruptive technologies, business models and trust models.
- Run Incubator activities.
- Develop a methodology for assessing and evaluating incubator topics.
- Expose and promote the results of the incubator to a broad audience, in collaboration with T6.

This task will support the incubation of new ideas or potentially disruptive T&I technologies that are considered sufficiently mature (minimum TRL5). It will also consider policy, business and trust model aspects that may have an impact on the existing T&I service models or that may lead to new services. To achieve this goal, the task will operate sub-projects with a predefined timeframe (for example, 6 months). After this period, new ideas will have to demonstrate results to a panel of experts. Based on the results of this evaluation, it will be decided whether the new idea has matured enough to be migrated to Task 1

for further development, be discontinued, or continue in the incubator for another cycle but with a different focus.

The T&I incubator will run a number of incubator topics per project year in parallel. These incubator topics will employ an agile methodology to enable rapid development of ideas supported by two panels:

- **Mentor team** of subject matter experts, a scrum master, dedicated developers and one or more mentors (subject matter experts from wider R&E community).
- **Review team** of senior community members will also act as a panel of experts to the T&I Incubator to assess the feasibility of new ideas to be brought into the T&I incubator. Upon completion of an incubator topic, the panel of experts will evaluate its merit and provide advice on the results.

Task 6: T&I Enabling Communities (Task Leader: Maarten Kremers – SURF)

This task will engage with the research communities, identity federations and other relevant communities for WP5 as a whole. The aim of this task is to 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 validate new features.

Task 6 will provide:

- Best practice development and engagement with key stakeholders, such as eScience and identity federations.
- Community requirements and T&I services business development (to support the uptake of T&I services outside the GN5 project) coordination in collaboration with T4 and other services in this WP and with the User Engagement WP and the Marcomms team.
- Liaison and contributions to the wider efforts to improve interoperability of research and e-infrastructures (i.e., Federated Identity Management for Research Collaborations (FIM4R), European Open Science Cloud (EOSC), Research and Education FEDerations group (REFEDS), WISE).
- Coordination of AEGIS group, which brings together global representatives from AARC-complaint AAI operators in research and e-infrastructures to discuss adoption of policy and technical best practices that facilitate interoperability across e-infrastructures. Represent GÉANT T&I services (i.e., eduTEAMS and eduGAIN) in the AEGIS group.
- Engagement with other different sectors (i.e., eGov/eIDAS, industry) and with other e-infrastructures to promote federated access and discuss interoperability use-cases.
- Liaise with TF-edu on supporting T&I tools relevant for education.
- Coordination of the enhancement and maintenance of the AARC/AARC2 project outputs' relevant results, in line with the process defined by the AARC2 project; these results are critical to ensure interoperability for the AAls operated in the R&E sector (eduTEAMS is one example of such AAI).

Task 7: Distributed Identities (Task Leader: Christoph Graf – SWITCH)

There has recently been a strong movement to make the whole identity space more user-centric to allow users greater control of their identities (and other related information) and a more active role in the process of sharing their information with other parties.

This task will explore the use cases that would be better supported via distributed technologies and the implications on the current services and infrastructure used in the R&E community. Starting at M6 of the project, Task 7 will:

- Review existing services to identify opportunities and challenges to adopt the distributed technologies paradigm.

- Gather previous work done by the NRENs/universities on using SSI technologies, as well as other sectors.
- Investigate implementation of distributed identities use cases and pilot them with the broader community and assess impacts and technological readiness.
- Establish a communication channel with relevant existing initiatives in the NRENs and beyond (i.e., EBSI).

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 sustainably provide production network support services developed in GÉANT projects and 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 enhancements 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:

- Enhancements to the 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 its monitoring and management solutions.
- Learning opportunities through organisation of and participation in different events, training and meetings focused on network technologies and services development.

Work activities and results from Y1 and Y2 WP6 will report in the regular management reports, with further detail and indications of progress 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 usage improvement, knowledge and results dissemination, 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: 10.

- Availability of production services managed by WP6. Target for a reporting period: 99%.

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 – UB/AMRES)

This task provides leadership for WP6 and coordination of the work of all remaining 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.

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

Task 1 will focus on 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 current status, usage and operation, and their further evolution.

Task 1 will investigate the ability, advantages and use cases of decoupling the data plane and control plane through continued development and support of the Router for Academia, Research and Education (RARE) open-source router platform, which has gained significant interest from the community worldwide. It will also continue to investigate options for high-performance ultra-precise time and ultra-stable frequency distribution services and to explore network requirements for implementation of quantum technologies-related services for the GÉANT community.

The key objectives of Task 1 are:

- Continue to provide and support RARE software through regular software releases and using established communication channels, collaborating closely with the GP4Lab - worldwide test implementation of RARE-powered devices.
- Support and work with NRENs in evaluation and where appropriate deployment of optical time and frequency network (OTFN) and/or quantum technologies-based solutions, disseminating the work results in reports and at events.
- Collaborate with other WP6 tasks in particular with the Task 4 incubator 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 gathers platforms available in WP6 and focuses on its service management and representation. Platforms in scope can be, but are not limited to, Network Management as a Service (NMaaS), Service Provider Architecture (SPA) and GÉANT P4 Lab (GP4Lab), all continuing from previous GÉANT projects.

The key objectives of Task 2 are:

- Continue to provide and support production services – NMaaS, and SPA platform – and work with institutions that want to use, extend or deploy it.
- Continue to provide and support GP4L through 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, in particular with the Task 4 incubator, 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: Antoine 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. It will further develop and support existing services from the previous GN4 projects, including perfSONAR, the Performance Management Platform (PMP), WiFiMon and TimeMap.

The key objectives of Task 3 are:

- Continue to provide, enhance and support GÉANT project production services – perfSONAR, PMP, WiFiMon and TimeMap.
- Collaborate with other WP6 tasks, in particular with the Task 4 incubator, 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 – CSUC/RedIRIS)

Task 4 explores the possibilities for further growth, in the range of topics that WP6 can cover, and knowledge and expertise in the community that WP6 can support and help with. It includes two main areas: Network Automation eAcademy and the incubator process.

Provided by the community for the community, which makes it unique from any commercial services, Network Automation 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 level assessment and mapping of individual digital architectures. The incubator process provides the opportunity for agile extension of the initial work throughout the project duration time. Consisting of two phases – focus groups to narrow the proposed work to a specific project and the incubator project that executes the work as defined by the focus group – the incubator process will feed topics from this task to other tasks to which they naturally belong.

The key objectives of Task 4 are:

- Continue providing and supporting Network Automation eAcademy.
- Create focus groups, one for each topic that requires more research in order to determine how best to shape the work to maximise the value for NRENs.
- Create incubator projects for topics where the value for NRENs is clearly recognised.
- Collaborate with other WP6 tasks in managing focus groups and incubator projects.

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

Work package number	WP7
Work package title	Network Core Infrastructure and Core 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 Network Core Infrastructure and Core Service Operations and Evolution work package 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.

The increasing footprint and more diverse service requirements will be catered for, with solutions that are effective and efficient, while also maintaining the reliability, availability, and cost-effectiveness of the network. Standard connectivity will be in multiples of 100 Gbps for many more NRENs. It is the objective of WP7 to be able to deliver all network services to all (geographical) parts of the GÉANT service area, with minimal exceptions.

Network automation and management tools that allow simple, yet appropriate, service integration and management will need to be further developed. This work package will focus on automating the network configuration for the IP/MPLS layer to ensure smooth transition to a new IP/MPLS platform. During the consultation with partner NRENs, automation is clearly an important work area that many NRENs are either working on or plan to work on. The work package will collaborate with NRENs with an aim to develop an open-source and vendor-agnostic approach to network management and automation. This will help lay the foundation for development of a solution that can be implemented by GÉANT and the member NRENs.

This work package will continue to work with GN4-3N during its remaining period of 12 months and work closely with the GN5-IC1 project, which will greatly improve the underlying fibre and optical system infrastructure, with the fibre network extended well beyond its current reach. The global connectivity architecture will be driven from WP7.

The objectives can be summarised as follows:

- Continued delivery and development of an efficient and effective state-of-the-art, scalable, and future-proof network infrastructure.
- Maintain cost-effectiveness and sustainability of the GÉANT infrastructure.
- Ensure that security is included by design in all the network infrastructure and services.
- GÉANT network evolution planning to leverage the long-term infrastructure investment provided by the GN4-3N project.
- Evolve the approach to international connectivity services in collaboration with GN5-IC1.
- Aim to provide technological guidance on the further evolution of GÉANT's network infrastructure and services.
- Continue to design, build, and implement collaboratively delivered, multi-domain services.
- Aim to automate the GÉANT network configuration for easier migration to a new IP/MPLS platform.
- Collaborate with NRENs with an aim to develop an open-source and vendor-agnostic approach to network management.
- Work closely with Work Package 6 to evaluate latest technologies/services that could be introduced in the GÉANT and the NREN networks.
- Further develop the workflow orchestrator that enables GÉANT and the NRENs to integrate their tools and use workflows to orchestrate services.

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.

Key Performance Indicators

- Total data volume transiting the network. Target: 30% year-on-year increase.
- Aggregate GÉANT IP backbone provisioned network capacity (also expressed as the product of bandwidth times distance). Target: 30% year-on-year increase.
- Packet loss on the backbone links. Target: to keep the packet loss below 0.1%.
- 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.

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 and WP9, and the GN5-IC1 project. 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.

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. It will produce the GÉANT network evolution plan, which provides a forward-looking view of how the GÉANT infrastructure, management software and services will evolve. This task will also work with other work packages and NRENs to evaluate and develop the use case for federated network services and operation of non-IP services alongside the existing IP service.

This task will also implement the procurement and service launch of a new digital link, once the selection of the link has been agreed in line with the network connectivity strategy.

Task 3: Network Management, Automation and Orchestration (Task Leader: Hans Trompert – SURF)

This task will focus on the evolution of GÉANT's network management systems. It will look at ways to automate network configuration for easier migration to a new IP/MPLS platform. The team will also look at ways to improve network and services monitoring, integration of internal tools for increased operational efficiencies and tools for better utilisation of network resources. Task 3 will also:

- Collaborate with NRENs to further develop an open-source and vendor-independent automation/orchestration toolbox. This should enable GÉANT and the NRENs to kickstart their journey towards network orchestration.

- Develop solutions that can be easily deployed, modified, and used by the NRENs.

Work in this task will help lay a strong foundation for further development of solutions in the next phases of the project.

Task 4: Packet Layer Renewal (Task Leader: Paul Shelswell – GÉANT)

This task will project manage the procurement and rollout of a new IP/MPLS platform and associated management tools. The task will work closely with Task 1 and Task 2 in WP7.

- Project manage the renewal of the GÉANT packet layer to support the traffic growth on the IP/MPLS platform. The packet layer renewal includes router replacement, the network packet layer management software and the associated transponders.

3.1.13 Work Package 8: Security

Work package number	WP8
Work package title	Security

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

In GN5-1 we will work towards establishing the European R&E Security Intelligence Hub, a virtual organisation aimed at collecting, analysing, classifying and actioning 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 on the threat landscape, which can help them prepare for a wide range of potential cyber attacks and crises.

Objectives

The objective of WP8 is to keep the R&E network safe and secure at the backbone level and support the GN5-1 partners with up-to-date tools to keep their networks and information systems safe and secure in an environment of increasing levels of cyber security threats. WP8 in GN5-1 will focus on collaboration: collaboration to achieve wide adoption and participation but also collaboration to deliver products and services jointly. The current pressure on the skills shortage in security (especially software developers, security operations and security engineers) forces us to be creative in making the best of the skills that are available. We plan to achieve this by combining the power of individual teams at NRENs into a distributed service operation wherever this is feasible. WP8 will:

- Provide security standards and best practices, security baseline, benchmarking and dashboards. Build on the 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 NIS-2 directive. Technical dashboards can assist in monitoring the usage of web, mail and network standards.
- Provide security training and awareness. Continue enhancing the set of training materials and webinars that were started in GN4-3, identifying high-demand subjects for multiple audiences. Security awareness will continue bringing the community together for the annual Cyber Security Month and will gradually shift focus to a more continuous approach to awareness raising by

providing materials and tools. WP8 will also 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: cyber threat analysis and intelligence, DDoS detection and mitigation, Firewall on Demand, eduVPN, cryptographic services, protection of 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.
- 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

- 2 annual cyber security training or events attended by 50 participants from 30 organisations over the duration of the project.
- 3 organisations participate in pilot joint security intelligence operations.
- Coherent set of security best practices for GÉANT and NRENs that is used completely or partially by at least 10 organisations.
- 2 pilots of new managed security services.
- Security baseline is used annually by 6 organisations or products.
- 1 scientific paper published (or prepared for publication).

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 GN5-1 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 (Task Leader: Šarūnas Grigaliūnas – LITNET)

Baseline, Standards and Best Practices

The purpose of Task 1 is to:

- Prepare the R&E community for new legislative requirements (NIS2, CES).
- Assist NRENs in improving security (and privacy) control, based on the use of the security baseline and international standards.

- 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 e-mail standards.
- Support R&E with adequate best practices in close cooperation with SIG-ISM, WISE, EOSC Future, etc.
- Work closely together with the R&E security community to identify best practices.

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 and 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.

Task 3: Security Products and Services (Task Leader 1: Jochen Schönfelder – DFN-CERT, Task Leader 2: 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.
- 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.
- Develop new cryptographic services as an addition to TCS, distinguish in types of certificates and investigate feasibility of a document signing service.
- Establish and maintain a joint view on the security threat landscape for research and education by analysing security intelligence, sharing analysis and translating security intelligence into actionable information.

Task 4: Research: Security for High-Speed Networks (Task Leaders: Alf Moens – GÉANT, Henry Hughes – Jisc)

The purpose of Task 4 is to:

- Investigate both architecture and tooling best practices for protecting high-speed networks, including establishing:
 - Whether current security controls are able to cope with high-speed networks.
 - How to protect a high-speed connection without influencing traffic patterns and traffic flows.

This subject area is on the cutting edge of security and networking. Task 4 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 Partic. No.	Lead Participant Short Name	Person Months	Start Month	End Month
WP9	Operations Support	1	GÉANT	876.0	M1	M24
	TOTAL			876.0		

Table 3.4: 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 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 and 7.
- 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 "business as usual", but there are the following specific planned outcomes:

- A new Security Operations Centre function, embedded within the Operations Centre.
- Delivery of support to legacy IP/MPLS backbone routers.

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 is concerned with the GÉANT backbone network. 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 four WP9 tasks and ensure communication with the other WPs.

Task 1: Operations Centre including CERT (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.
- Perform GÉANT's Computer Emergency Response Team (CERT) function.
- Safeguard the GÉANT network proactively against cyber security threats.

Task 1 will aim 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 build on its experience operating network security tools by forming a Security Operations Centre that will specialise in a reactive and proactive approach to security incident handling, thus further safeguarding the GÉANT assets and services. This will be designed by the end of Y1 and implemented early in Y2.

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.
- 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.
- 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:

- Maintain a set of software development common best practices for the GÉANT project.
- Perform software testing and code reviews in support of service validation and verification.
- Advise and assist developers in devising and managing software testing regimes.
- Develop and support the GÉANT Software Catalogue tool.
- Maintain and operate the software development support infrastructure.
- In cooperation with WP1 T5, deliver the Secure Code Training and School of Software Engineering.
- Provide technical and implementation support for open-source software management and strategy.

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 Management and Processes (SMP): This sub-task will focus on the refinement of software best practices 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 which support the full software development lifecycle: project management and bug tracking, service desk, source code repositories, CI/CD, static code analysis and IPR support, artifacts repository and internal reporting tools.

Software Catalogue: Maintenance and improvements of the Software Catalogue.

Open Source and Licence Support: Open Source and Licence Support (OSLS) will assist GÉANT's open-source governance by providing the technical and implementation support for open-source software management and strategy with cooperation of WP1's IPR activities.

The core team of the OSLS will be the Open Source Review Board (OSRB), which will support the GÉANT IPR policy interpretation and refinement, oversee and ensure open-source compliance and perform the related reviews and audits. Therefore, it should help in policy management and effective processes with a minimal amount of overhead on the part of the GÉANT governance and software development teams.

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

The key objectives of Task 3 are:

- Process customer network service orders.
- Conduct the Service & Technology Forum (STF) meetings for NREN Access Port Managers (APMs).
- Prepare and provide the GÉANT Network Services report on a monthly basis, plus any other GÉANT network services related report 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 WPs 6 and 7.
- 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.

Task 4: GÉANT Software Development and Operations (Task Leader: Mandeep Saini – 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.

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.

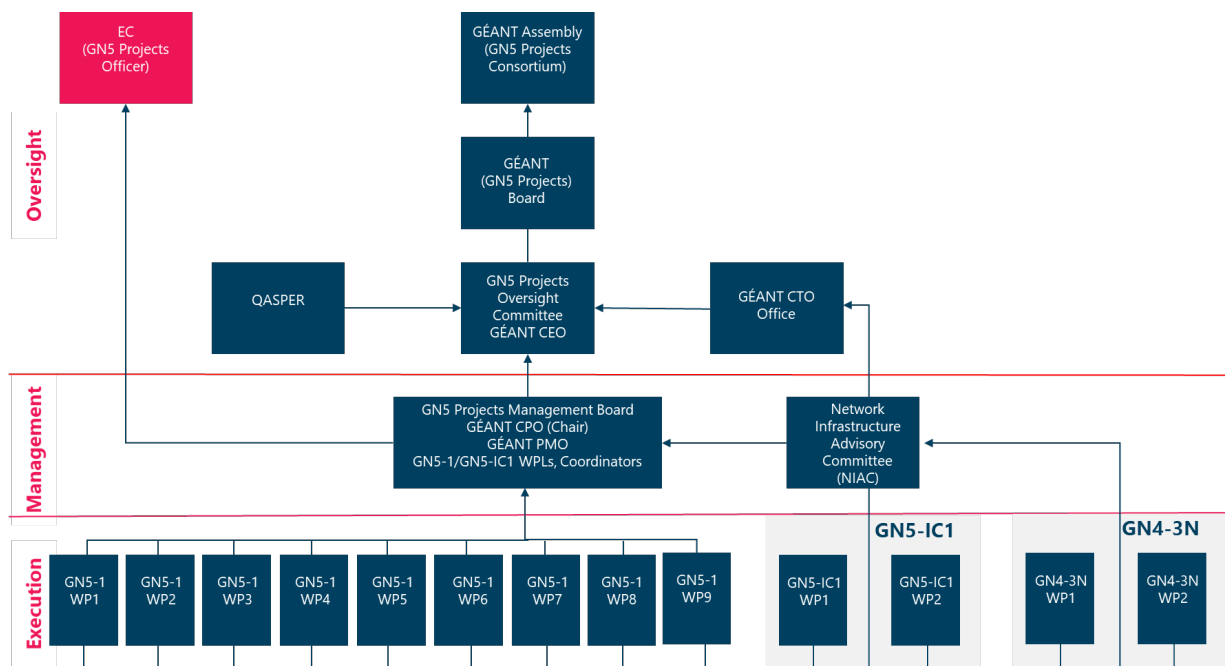


Figure 3.2: GN5-1 project governance structure

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 Committee*

The Cost-Sharing Committee (CSC) is a statutory group reporting to the Board. The CSC recommends the cost-sharing model and annual fees applicable for the Partners subscribing to GÉANT services, which are predominantly delivered by the project. Changes to an existing cost-sharing model for services delivered by the Association or to any new cost-sharing model for services delivered by the Association are approved by the GA.

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

Number	Deliverable name	Short description	Work package Number	Short name of lead participant	Type	Dissemination level	Delivery date (months)
D1 (D9.1)	Software Services Report	Performance and utilisation of software applications (Year 1)	WP9 T4	GÉANT	R	PU	M2
D2 (D2.1)	Project Communications Strategy and Plan	Initial communications strategy and plan	WP2T1	GÉANT	R	PU	M3

Number	Deliverable name	Short description	Work package Number	Short name of lead participant	Type	Dissemination level	Delivery date (months)
D3 (D1.1)	Data Management Plan	Data Management Plan	WP1	GÉANT	DMP	SEN	M6
D4 (D1.2)	Management Report M1-M6	Management Report M1-M6	WP1	GÉANT	R	SEN	M8
D5 (D3.1)	Compendium Report	Overview of NRENs + community trends	WP3	GÉANT	R	SEN	M9
D6 (D4.1)	Procurement Strategy: IaaS+ Renewal	Procurement strategy for IaaS+	WP4 T3, T4	SIKT, GÉANT	R	SEN	M9
D7 (D9.2)	Software Tools Review	Status of WP9 software tools	WP9 T2	PSNC	R	PU	M9
D8 (D1.3)	Service Review and Service Status Deliverable	Status report of all GN5-1 services	WP1	GÉANT	R	SEN	M10
D9 (D8.1)	Awareness Status Report	Security awareness in community	WP8 T2	GÉANT	R	SEN	M10
D10 (D1.4)	Procurement and Supplier Review	Procurement and supplier activity	WP1	GÉANT	R	SEN	M11
D11 (D4.2)	Spin-Out Development Report	Spin-out status	WP4 T5.2	PSNC	R	PU	M11
D12 (D5.1)	Report on Trust and Identity Services, Enabling Communities and Incubator	WP5 service update	WP5	GÉANT and SUNET	R	PU	M12
D13 (D8.2)	WP8 Management Report Year 1	Summary of WP8 highlights (end-Year 1)	WP8 T0	GÉANT	R	SEN	M12
D14 (D7.1)	Network Evolution Plan	Network Evolution Plan	WP7 T0	GÉANT	R	SEN	M12
D15 (D1.5)	PAIR Work Plan 2024	Update of 2024 Work Plan	WP1	GÉANT	R	SEN	M13
D16 (D2.2)	Project Communications Strategy and Plan	Update of communications strategy and plan	WP2T1	GÉANT	R	PU	M13

Number	Deliverable name	Short description	Work package Number	Short name of lead participant	Type	Dissemination level	Delivery date (months)
D17 (D9.3)	Software Services Report	Performance and utilisation of software applications (Year 2)	WP9 T4	GÉANT Association	R	PU	M14
D18 (D6.1)	Network eAcademy	Network eAcademy	WP6 T1	CSUC/ RedIRIS	R	PU	M15
D19 (D9.4)	Open Source and License Support Report	Report on tools, guidelines and implemented licences	WP9 T2	PSNC	R	PU	M15
D20 (D6.2)	Network Technologies and Platforms	Network Technologies and Platforms	WP6 T1/2	FAU/DFN, PSNC	R	PU	M17
D21 (D6.3)	Network Monitoring Solutions	Network Monitoring Solutions	WP6 T3	PSNC	R	PU	M19
D22 (D1.6)	Service Review and Service Status Deliverable	Status report of all GN5-1 services	WP1	GÉANT	R	SEN	M20
D23 (D3.2)	NREN Foresight Study	The NREN landscape in the next 5-10 years	WP3	GÉANT	R	SEN	M20
D24 (D1.7)	Management Report for M13-M18	Management Report for M13-M18 ²	WP1	GÉANT	R	SEN	M20
D25 (D3.3)	Compendium Report	Overview of NRENs + community trends	WP3	GÉANT	R	SEN	M21
D26 (D3.4)	Collaboration and International User Support Activities Report	Update on collaboration work and international user activities	WP3	GÉANT	R	SEN	M21
D27 (D1.8)	Data Management Plan 2 (updated)	Data Management Plan 2 (updated)	WP1	GÉANT	DMP	SEN	M22
D28 (D2.3)	Best Practice and Recommendations on SDGs, Digital	Best practice and recommendations on SDGs, Digital	WP2 T4	GÉANT	R	SEN	M22

² Note: M7 to M12 included in P1 Periodic Report and M19 to M24 included in P2 Periodic Report.

Number	Deliverable name	Short description	Work package Number	Short name of lead participant	Type	Dissemination level	Delivery date (months)
	Rights and Digital Principles	Rights and Digital Principles					
D29 (D3.5)	Community and Innovation Programme Impact Report	Impacts of Community Programme and Innovation activities	WP3	GÉANT	R	SEN	M22
D30 (D4.3)	GÉANT Community Strategy for Above-the-Net Services	GÉANT community strategy for above-the-net services	WP4 T4	SIKT	R	PU	M22
D31 (D1.9)	Procurement and Supplier Review	Procurement and supplier activity	WP1	GÉANT	R	SEN	M23
D32 (D4.4)	Updated Above-the-Net Service Portfolio	WP4 service summary/update	WP4 T1, T2, T5	GÉANT, PSNC	R	PU	M23
D33 (D4.5)	WP4 Summary Report	Final progress report of WP4 activity	WP4 T0	DFN, EENet	R	PU	M23
D34 (D5.2)	Report on Trust and Identity Services, Enabling Communities and Incubator	WP5 service update	WP5	GÉANT and SUNET	R	PU	M23
D35 (D7.2)	Network Evolution Plan (Update)	Network Evolution Plan (Update)	WP7 T0	GÉANT	R	SEN	M24
D36 (D8.3)	WP8 Management Report Year 2	Summary of WP8 highlights (end-Year 2)	WP8 T0	GÉANT	R	SEN	M24

Table 3.5: GN5-1 List of Deliverables

3.1.19 List of Milestones

Milestone number	Milestone name	Work package	Due date (Month)	Means of Verification
1 (M2.1)	Service Marketing Plans	WP2 T2	M3	Agreement with service WP Leaders (WP4,5,6,7,8) for 12 Marketing activities

Milestone number	Milestone name	Work package	Due date (Month)	Means of Verification
				through to M14 to deliver service WP KPIs
2 (M6.1)	Launch of the WP6 Incubator	WP6 T4	M3	Event held
3 (M3.1)	Stakeholder Engagement Plan	WP3	M4	Initial plan delivered
4 (M4.1)	Legal-Administrative Framework for eduMEET Spin-out PoC Established	WP4 T5.2	M4	Press release
5 (M6.2)	Network Technologies Workshop	WP6T1	M4	Event held
6 (M1.1)	Training Workplan 2024	WP1 T5	M4	Date completed
7 (M6.3)	Network Platforms Workshop	WP6 T2	M5	Event held
8 (M2.2)	Deliver TNC23	WP2 T3	M6	Event Delivered
9 (M3.2)	NREN Satisfaction Survey	WP3	M6	Survey delivered
10 (M5.1)	Services Roadmaps	WP5	M6	Roadmaps online on the wiki
11 (M7.1)	Contract Award for IP/MPLS platform	WP7 T4	M6	Contract for IP/MPLS procurement awarded
12 (M7.2)	Orchestration Platform Architecture Review and Documentation	WP7 T3	M6	Complete documentation and architecture review of R&E community developed and opensource orchestrator platform
13 (M7.3)	Document Network Service Product Common to Most NRENs	WP7 T3	M6	Complete documentation of a single network service product that is most common amongst NRENs
14 (M8.1)	Workshop on Security Intelligence Operations	WP8 T3	M6	Date held
15 (M8.2)	Business Model for a European R&E Security Intelligence Hub (Whitepaper)	WP8 T3	M10	Date released
16 (M9.1)	Implement Support of Legacy Juniper Routers	WP9 T3	M10	Date completed
17 (M2.3)	Completion of Baselining Efforts of the Project Regarding SDG Readiness and Contribution.	WP2 T4	M11	Document published and disseminated

Milestone number	Milestone name	Work package	Due date (Month)	Means of Verification
18 (M4.2)	IaaS Renewal Procurement Published in TED	WP4 T3	M11	Announcement circulated to NREN cloud service delivery managers
19 (M2.4)	Completion of Baseline Efforts of the Project Regarding Where the Project has an Active Role Safeguarding i) Digital Rights and ii) Digital Principles for Research and Education.	WP2 T4	M11	Document published and disseminated
20 (M8.3)	Business Model for Joint Delivery of Security Services	WP8 T3	M11	Date released
21 (M2.5)	Location Secured TNC25	WP2 T3	M12	Contract negotiations with NRENs have commenced
22 (M3.3)	Global Engagements Report	WP3	M12	Report
23 (M4.3)	Draft Version of GÉANT Community Strategy for Above-the-Net Services	WP4 T4	M12	Document announced on website
24 (M5.2)	Migration of Authentication and Authorisation of GÉANT SWD	WP5	M12	Date completed
25 (M7.4)	First OSS/BSS Proxy PoC and Network Product and Workflows	WP7 T3	M12	Proof of concept of a workflow implementation
26 (M7.5)	Type Approval & Lab Acceptance and Training	WP7 T4	M12	Complete Type Approval and Lab acceptance and integration testing and training sessions organised
27 (M8.4)	CLAW2023, Crisis Management Workshop and Exercise	WP8 T2	M12	Date held
28 (M5.3)	Service Roadmaps Updates	WP5	M13	roadmaps online on the wiki
29 (M2.6)	Service Marketing Plans	WP2 T2	M14	Agreement with service WP leaders (WP4,5,6,7,8) for marketing activities through to M24 to deliver service WP KPIs
30 (M8.5)	Review of Security (and Privacy) Controls Based on the	WP8 T1	M14	Report/Article

Milestone number	Milestone name	Work package	Due date (Month)	Means of Verification
	Security Baseline and International Standards Materials			
31 (M8.6)	Community Requirements for New Legislation	WP8 T1	M14	Date completed
32 (M9.2)	Implement GÉANT Security Operations Centre Function	WP9 T1	M14	Date completed
33 (M1.2)	Training Workplan 2025	WP1 T5	M15	Date completed
34 (M6.4)	perfSONAR User Workshop	WP6T3	M17	Event held
35 (M2.7)	Complete TNC24	WP2 T3	M18	Event Delivered
36 (M3.4)	NREN Satisfaction Survey	WP3	M18	Survey delivered
37 (M5.4)	Core AAI Platform	WP5	M18	Date completed
38 (M8.7)	European R&E Security Conference	WP8 T3	M18	Date held
39 (M8.8)	The NREN's Information Security and Compliance Management System	WP8 T1	M20	Date released
40 (M8.9)	Business Model for Cryptographic Services	WP8 T3	M20	Date completed
41 (M4.4)	2024 IaaS Framework Agreements Signed	WP4 T2	M21	Press release
42 (M8.10)	Toolset for Security Operations	WP8 T3	M22	Date released
43 (M8.11)	Securing High Speed Networks - Publication	WP8 T4	M22	Date released
44 (M3.5)	Global Engagements Report	WP3	M23	Report
45 (M8.12)	DDoS Managed Service Offering	WP8 T3	M23	Date Completed
46 (M2.8)	Location Secured TNC26	WP2T3	M24	Contract negotiations with NRENs have commenced.

Table 3.6: GN5-1 List of Milestones

3.1.20 Critical Risks for Implementation

The risk management processes within GN5-1 are stated within the FPA description. Fundamentally, issues are identified by the Work Package Leaders and reported through the Project Management Framework's Red, Amber, Green (RAG) process under the supervision of the PMO. Once an issue is identified, the PMO will work with the Project Management Board (PMB) to either address it or escalate it, if required.

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 try to acquire more funds and manpower. Engage external contractors if absolutely necessary.
3 Insufficient resources allocated to the WP to either replace the lost workforce or plan and take steps towards an unforeseen activity impacted by external infrastructures, policies, innovative technologies, and opportunities. (Likelihood MEDIUM ; Impact MEDIUM)	All WPs	Informing early the Project Management Office, planning joint meetings with other WPs and stakeholders. Re-arrange available resource in the WP or across WPs, seek project external resources, or re-prioritise activities.
4 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.
5 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 process.
6 Lack of NRENs willing to host and/or contribute to TNC in the future (likelihood: MEDIUM ; severity: MEDIUM).	WP2	Securing TNC locations up to 2026.
7 The procurement team is not able to complete the tender according to	WP4 T2	WP4 will monitor the progress and track expected date of Framework publication.

Description of risk (indicate level of (i) likelihood and (ii) severity low/medium/high)	Work Package(s) involved	Proposed risk-mitigation measures
<p>schedule; to complete the tender in Q3 of 2024.</p> <p>This can impact the GÉANT framework agreements, which are valid until the end of November 2024. (Likelihood: LOW; Impact: HIGH).</p>		<p>Mitigation for delays would be to help existing Framework users sign short-term extensions under the 2020 IaaS+ Framework until availability of the 2024 Framework.</p>
<p>8 Volume of providers: Sheer volume of providers in 2020 IaaS+ Framework will pose resource challenges. (Likelihood: LOW; Impact: HIGH).</p>	WP4 T2	<p>Prioritise countries where consumption is taking place which will receive support as necessary.</p>
<p>9 Inability to successfully engage with service providers: interest from providers is too low.</p> <p>The supplier interaction in earlier GÉANT projects shows there are enough providers willing to engage, but any future Framework must include the top 8 platforms from the previous Framework to be useful for the community (KPI). (Likelihood: LOW Impact: HIGH).</p>	WP4 T3	<p>Early and ongoing market engagement will be performed to ensure valid bids from the required providers, but ultimate mitigation measure must be a re-run of the procurement.</p>
<p>10 Community engagement: not enough community members are engaged in the work.</p> <p>On cloud Framework: the tentpole NRENs are highly engaged and motivated to see the procurement succeed. (Likelihood LOW; Impact MEDIUM)</p> <p>On spin-out: There are many indications of sufficient community interest and will to support eduMEET sustainability, but the proof will be in the doing. (Likelihood MEDIUM; Impact LOW)</p>	WP4 T5.2	<p>On cloud Framework: restrict the procurement to the actively participating NRENs.</p> <p>On spin-out: Ultimately, project funding is not expected to be renewed after GN5-1.</p>
<p>11 Adoption of InAcademia is dependent upon merchants (commercial services) agreeing to implement it within their workflow.</p>	WP5 T4	<ul style="list-style-type: none"> • Develop added-value features • Work with national identity federations on national policy concerning commercial use cases

Description of risk (indicate level of (i) likelihood and (ii) severity low/medium/high)	Work Package(s) involved	Proposed risk-mitigation measures
If they choose alternative technical solutions, uptake will be low. (Likelihood: MEDIUM) (Impact: HIGH)		<ul style="list-style-type: none"> Promote the benefits of the service to commercial organisations
12 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.
13 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 and determining its relevance to individual tasks' work. Regular reviews of the work plans.
14 Some services are targeted at users at end institutions, but our main channel of communication is only via the NRENs who serve those end institutions, which risks very low service uptake. (Likelihood: MEDIUM ; Impact: HIGH).	WP4, WP5, WP6, WP8	Work with NRENs and WP3 to promote services to the end institutions. Communication and an action plan are in place with WP3.
15 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.
16. 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 3.7: Critical risks for implementation

3.1.21 Resources to be Committed

GN5-1 is a 24-month project that will mobilise some 4867.8 person months – c. 202.8 full-time equivalent staff.

Participant Number /Short Name		WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person Months per Participant
1	GÉANT	544.4	214.4	304.0	108.2	391.8	20.0	419.0	53.0	670.4	2725.3
2	ACOnet	1.0	0	0	0	0	0	0	0	0	1.0
3	AMRES	0	0	0	0	7.2	74.4	16.8	4.8	21.6	124.8
4	ARNES	0	0	0	0	0	0	0	4.0	0	4.0
5	AzScienceNet	1.0	0	0	0	0	0	0	0	0	1.0
6	Belnet	0	0	0	0	6.0	4.8	0	8.8	0	19.6
7	BREN	1.0	0	0	0	0	0	0	0	0	1.0
8	CARNET	0	0	6.4	8.2	44.0	25.2	4.8	4.0	0	92.6
9	CESNET	0	0	0	0	35.4	19.2	15.0	4.8	0	74.4
10	CyNet	0	0	0.6	7.2	0	14.4	0	22.0	0	44.2
11	DFN-Verein	0	2.4	11.0	24.0	67.0	30.0	16.8	58.6	30.0	239.8
12	FCT	0	0	0	4.8	0	0	8.0	0	0	12.8
13	GARR	0.4	0	0	6.2	17.6	10.2	6.0	3.6	0	44.0
14	GRENA	2.0	0	0	0	0	12.0	0	22.0	0	36.0
15	GRNET	0	0	0	8.0	27.0	21.0	6.0	4.0	0	66.0
16	Harno	0	0	0	24.0	0	0	0	0	0	24.0
17	HEAnet	0	0	0	24.0	0	4.0	0	11.0	0	39.0
18	IMCS UL	1.0	0	0	0	0	0	0	0	0	1.0
19	IUCC	0	0	4.4	7.2	0	0	0	12.0	0	23.6
20	KIFÜ	0	0	2.0	9.2	32.6	7.2	0	0	0	51.0
21	LITNET	0	8.0	2.0	0	1.0	4.8	0	6.0	0	21.8
22	MARnet	0	0	6.0	18.0	10.0	29.2	0	18.0	14.0	95.2
23	MREN	4.0	0	0	2.0	0	0	0	0	0	6.0
24	NORDUnet A/S	0	14.0	15.6	21.5	54.8	21.6	4.0	58.0	0	189.5
25	PSNC	18.0	61.2	15.6	33.8	33.4	153.6	10.8	22.0	128.0	476.4
26	RedIRIS	0	0	0	0	0	39.0	37.0	0	0	76.0
27	RENAM	0	0	0	4.8	12.0	12.0	0	7.0	0	35.8
28	RENATER	0	1.2	0.6	0	7.0	24.0	0	3.0	0	35.8
29	RESTENA	0	0	0	0	4.8	0	0	0	0	4.8
30	RoEduNet	2.0	0	0	0	0	0	0	1.0	0	3.0
31	SANET	1.0	0	0	0	0	0	0	0	0	1.0
32	SURF	0	0	5.0	20.8	43.4	2.4	60.0	33.6	0	165.2

Participant Number /Short Name	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person Months per Participant
33 TUBITAK	0	0	0	2.4	10.0	0	0	0	0	12.4
34 UoM	1.0	0	0	0	0	0	0	0	0	1.0
35 Jisc	0	0	9.8	0	19.0	4.8	0	6.0	0	39.6
36 SWITCH	0	0	0	0	7.0	0	0	0	0	7.0
37 ASNET-AM	0	0	0	9.0	2.0	7.2	0	0	0	18.2
38 RASH	0	8.4	0	8.0	0	21.6	0	3.0	12.0	53.0
39 URAN	1.0	0	0	0	0	0	0	0	0	1.0
Total Person Months	577.8	309.6	383.0	351.3	383.0	562.6	604.2	370.2	876.0	4867.8

Table 3.8: Summary of staff effort

3.1.22 Subcontracting Costs

25 PSNC	Cost €	Description of tasks and Justification
Subcontracting	200,000	Task 3 Monitoring 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), WiFiMon and TimeMap.

Table 3.9: Subcontracting costs items

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

1	GÉANT	Cost €	Cost €	Justification
Network Costs				
Dark fiber (annual recurring costs)		4.03M		Dark fiber (annual recurring costs)
Leased circuits		2.91M		Leased circuits
Maintenance		6.14M		Maintenance
Software licenses		1.55M		Software licenses
PoP Housing Costs		4.81M		PoP housing costs
Other network Costs		1.46M		Other network costs
Equipment		4.86M		Network equipment cost for GÉANT network

1	GÉANT	Cost €	Cost €	Justification
Network Costs sub total			25.76M	
Other WP costs			4.87M	Other WP costs (events, contractors, training, subscriptions, etc.)
Travel and Subsistence			1.87M	
Total			32.50M	

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		80,000	Contract management data platform, software
Total		85,000	

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

20	KIFÜ	Cost €	Justification
Travel and Subsistence		5,000	Travel cost
Other goods, works and services		59,520	Secondment of personnel
Total		64,520	

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	533,000	Secondment of personnel, seamless access tools, CDN, VMs), HSM
Total	538,000	

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

31 SANET	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	



Table 3.10: Purchase costs items (travel and subsistence, equipment and other goods, works and services)

3.1.24 In-Kind Contributions Provided by Third Parties

Third-Party Name	Category	Cost €	Justification
	<i>Manpower, Person Months PMs</i>		<i>List WPs</i>
1 GÉANT (KREN)	7.2	2,500	WP6
T2 TechLab / TL support (Astrit Kadriu, 7.2 PM)			
3 UB (AMRES)	58.8	127,890	WP6, 7, 8
WP6 T1 OTFN (Aleksandar Garčević, 6 PM) T1 (Milan Kuželka PM TBD but will input to this task – allocation is in WP8 in first instance) T3 Monitoring (Dragan Stanković, 4.8 PM) T3 perfSONAR (Andrijana Todosijević, 7.2 PM, Katarina Simonović, 7.2 PM) T3 PMP (Nikola Gaćeša, 12 PM) WP7 T2 Testbed (Miloš Zdravkovic, 12 PM) T2 Automation (Jovana Vuleta Radoičić, 4.8 PM) WP8 T0 (Milan Kuzelka 4.8 PM)			
8 CARNET (SRCE)	44.0	188,100	WP5
T1 eduroam Coco monitor, fticks devops; (12 PM (note 50% funding) T1 eduroam tools, devOps, support etc; (20 PM (note 50% funding) T2 DevOps tools (Dubravko + Mijo, 7.2 PM) T5 Incubator work (Marko Ivančić, 4.8 PM)			
11 DFN-Verein (F-AUEN)	58.8	411,600	WP6, 7, 9

Third-Party Name	Category	Cost €	Justification
WP6 T1 Task Leadership (Susane Naegele-Jackson, 12 PM) T3 Monitoring: perfSONAR, Timemap (Ivan Garnizov, 6 PM)			
WP7 T2 Automation (Hakan Calim, 16.8 PM)			
WP9 T1 perfSONAR, Monitoring Services (Ivan Garnizov 12 PM) T2 SMP and CBP (Ivan Garnizov 6 PM)			
11 DFN-Verein (BADW-LRZ)	62.4	434,070	WP5, 6, 8, 9
WP5 T5 Incubator Task Leader (Jule Ziegler, 9.6 PM) T5 Scrum master (Michael Schmidt, 7.2 PM) T6 Enabling Communities: eScience interoperability and global engagement (7.2 PM) T2 Product manager Tools (7.2 PM)			
WP6 T2 Platforms: P4 testing (David Schmitz, 6 PM)			
WP8 T1 Security Mgt (Michael Schmidt, 7.2 PM) T3 FoD (David Schmidt, 6 PM)			
WP9 T2 Teset Team Leader (Reinhard Gloger, 12 PM)			
11 DFN-Verein (DFN-CERT)	50.4	414,540	WP5, 8
WP5 T1 eduPKI (2.6 PM) T2 eduGAIN security (2.5 PM)			
WP8 T2 Human Factor (Christine Kahl (2.8 PM), Klaus Möller (6.2 PM), Stefan Kelm (3.2 PM), Tobias Dussa (4.8) T0 Piracy/security officer Michel Gerdes 6 PM T3 DDOS Ewgenij Brin 14 PM Jochen Schönfelder 6 PM and crypto services Jürgen Brauckmann 2.4 PM			
11 DFN-Verein (KIT)	22.0	152,700	WP5
T5 Incubator Developer and Domain Experts (Diana Gudu 8 PM, Gabriel Zachmann, 8 PM) T6 Enabling Communities - eScience interoperability and global engagement (6 PM)			
13 GARR (FBK)	4.8	29,280	WP6
P4 (Matteo Gerola) 4.8 PM			
13 GARR (UNIPI)	12.0	73,200	WP5

Third-Party Name	Category	Cost €	Justification
T2 eduGAIN service owner 12 PM			
13 GARR (Quavlive)	2.2		WP6
T5.2 eduMEET (Carlo Croce)			
15 GRNET (ICCS)	6.6	28,545	WP6
T3 WiFiMon Nikolaos Kostopoulos – (3.6 PM)			
T1 P4 Marinos Dimolianis – (3 PM)			
20 KIFÜ (MTA SZTAKI)			WP5, WP6
WP5	29.6		
T3 Core AAI platform SRE (20 PM)			
T5 Incubator/eduGAIN (Mihály Héder, 9.6 PM)		159,100	
WP6			
T2 RARE (Mate Csaba 19.2M)			
22 MARnet (UKIM)	65.2	180,830	WP3, 6, 8
WP3			
T1.1 Partner relations (Anastas, 6 PM)			
WP5			
T5 Incubator Domain Expert Boro Jakimovski 4 PM			
WP6			
T2 SPA: (Sonja Filiposka 7.2 PM)			
T2 NMaaS: (Vojdan Kjorveziroski 10.8 PM)			
T4 NAA: (Anastas Mishev, 4 PM, Aleksandra Dedinec, 7.2 PM)			
WP8			
T1 Security Mgt (Vladislav Bidikov, 6 PM)			
T3 SOC Tools (Kiril Kjirovski, 6PM)			
T3 DDoS (Vladislav Bidikov, 6 PM)			
WP9			
T2 License Compliance Kiril Kjiroski 8 PM			
22 MARnet (USC)	6.0	13,650	WP5
T2 eduGAIN Development tools (Boro + Kiril, 6 PM)			
24 NORDUnet A/S (SIKT)	41.6	373,200	WP4, 6, 7, 8
WP4			
T3 Infr Cloud Procurement, Tender execution (Lars Skogan, 2 PM, Børge Aune, 4 PM)			
T4 Task Leader (Jan Meijer, 8 PM)			
T5.2 Above Net, Development (Stefan Otto, 6 PM)			
WP6			
T1 OTFN (Kurosh Bozorgebrahimi, 2.4 PM)			
T3 perfSONAR (Otto Wittner, 7.2 PM)			

Third-Party Name	Category	Cost €	Justification
WP7 T2 Non-IP (Kurosh Bozorgebrahimi 4PM)			
WP8 T3 SOC Tools (Emil Flakk, 8 PM)			
			
24 NORDUnet A/S (DeIC)			
WP4 T3 Infr Cloud Procurement Support (Morten Kjelgaard, 1.5 PM)			WP8
WP5 T1 eduroam ETLR hosting and ops, support (50% funding, 8 PM)			
T6 Enabling InAcademia (4.8 PM)			
WP8 T2 Human Factor (Henrik Jenssen, 4PM)			
T3 CTA/CTI DEIC CERT 4 PM			
eduVPN Francois Kooman 11 PM			
eduVPN Tangui Coulouarn 8 PM			
24 NORDUnet A/S (UMEA)	5.0	37,000	
T2 Human Factor (Maria Edborn Tauson, 5 PM)			
24 NORDUnet A/S (SUNET)	53.0	925,200	WP5, 8
WP5 T0 WP Leadership T2 eduGAIN; Seamless access: Product Manager 5 PM, Ops 6 PM, Tools, CDN, VM, + HSM (50% funding) T3 AAI core development lead T4 InAcademia: Infrastructure ops (6 PM), production service debugging (12 PM), release testing (SCS, stats, MDX) (6 PM), VMs			
WP8 T3 Task Leader (David Heed, 9 PM) T3 DDoS (Ernst Wilderberg, 4 PM) T3 CTA/CTI (Fredrik Pettai, 5 PM)			
24 NORDUnet A/S (DTU)	12.0	111,300	WP6
T1 P4 (Mingyuan Zhang, 4.8 PM, Henrik Wessing, 2.4 PM) T2 GP4L / SPA (Jose Soler, 4.8 PM)			
24 NORDUnet A/S (CSC)	10.0	72,500	WP3, 5
WP3 T3 External Relations (Sara Garavelli, 3 PM)			
WP5 			

Third-Party Name	Category	Cost €	Justification
T1 eduroam WiFi monitoring probes, NRO Audits (Wenche Backman, 6PM) T6 eScience interoperability and global engagement (1 PM)			
26 RedIRIS (i2CAT)	30.0	120,000	WP7
T2 Automation (Carolina Fernández, 7.2 PM) T3 Orchestration (Adrián Pino, Andrés Cárdenas, Sergio Giménez 22.8 PM)			
26 RedIRIS (UPV/EHU)	34.0	167,450	WP6, 7
WP6 T1 P4: (Jorge Sasiain 6 PM, David Franco 6 PM) T2 GP4L (Asier Atutxa, 6 PM) T4 NAeA (Jasone Astorga, 3 PM) T1 QT (Ane Sanz, 6 PM) WP7 T2 Automation (Jorge Sasiain 7PM)			
26 RedIRIS (CSUC)	7.2	42,840	WP6
T4 Task leadership (Maria Isabel Gandia Carriedo, 7.2 PM)			
26 RedIRIS (UMU)	4.8	29,040	WP6
T2 RARE/GP4L (Jordi Ortiz, 4.8 PM)			
32 SURF (NIKHEF)	7.4	69,242	WP5
T6 Enabling communities: eScience interoperability and global engagement, 5 PM) T2 security team 2.4 PM			

NOTE THE FOLLOWING WAS SUBMITTED AS PART OF PART B SO WE NEED TO CARRY OVER THE MARKUPS FROM ABOVE FOR NEXT AMENDMENT

Third-Party Name
1 GÉANT (KREN)
T2 TechLab / TL support (Astrit Kadriu, 30%, 7.2 PM)
3 UB (AMRES)
WP6 T1 OFTN (Aleksandar Garčević, 6 PM) T3 Monitoring (Dragan Stanković, 4.8 PM) T3 perfSONAR (Andrijana Todosijević, 7.2 PM, Katarina Simonović, 7.2 PM) T3 PMP (Nikola Gaćeša, 12 PM) WP7 T2 Testbed (Miloš Zdravkovic, 12 PM) T2 Automation (Jovana Vuleta Radoičić, 4.8 PM)

Third-Party Name	
WP8	
T0 Milan Kuzelka (4.8 PM)	
8 CARNET (SRCE)	
T1 eduroam Coco monitor, fticks devops; (12 PM (note 50% funding)	
T1 eduroam tools, devOps, support etc; (20 PM (note 50% funding)	
T2 DevOps tools (Dubravko + Mijo, 7.2 PM)	
T5 Incubator work (Marko Ivančić, 4.8 PM)	
11 DFN-Verein (F-AUEN)	
WP6	
T1 Task Leadership (Susane Naegele-Jackson, 50%, 12 PM)	
T3 Monitoring: perfSONAR, Timemap (Ivan Garnizov, 12 PM)	
WP7	
T2 Automation (Hakan Calim, 16.8 PM)	
WP9	
T1 perfSONAR, Monitoring Services (Ivan Garnizow 12 PM)	
T2 SMP and CBP (Ivan Garnizow 6 PM)	
11 DFN-Verein (BADW-LRZ)	
WP5	
T5 Incubator Task Leader (Jule Ziegler, 9.6 PM)	
T5 Scrum master (Michael Schmidt, 7.2 PM)	
T6 Enabling Communities: eScience interoperability and global engagement (7.2 PM)	
T2 Product manager Tools (7.2 PM)	
WP6	
T2 Platforms: P4 testing (David Schmitz, 6 PM)	
WP8	
T1 Security Mgt (Michael Schmidt, 7.2 PM)	
T3 FoD (David Schmidt, 6 PM)	
WP9	
T2 Teset Team Leader (Reinhard Gloer, 12 PM)	
11 DFN-Verein (DFN-CERT)	
WP5	
T1 eduPKI (2.6 PM)	
T2 eduGAIN security (2.5 PM)	
WP8	
T2 Human Factor (Christine Kahl (2.8 PM), Klaus Möller (6.2 PM), Stefan Kelm (3.2 PM), Tobias Dussa (4.8)	
T0 Privacy/security officer Michel Gerdes (6 PM)	
T3 DDOS Ewgenij Brin (14 PM), Jochen Schönfelder (6 PM)	
Crypto Services Jürgen Brauckman (2.4 PM)	
11 DFN-Verein (KIT)	
T5 Incubator Developer and Domain Experts (Diana Gudu 8 PM, Gabriel Zachmann, 8 PM)	
T6 Enabling Communities - eScience interoperability and global engagement (6 PM)	
13 GARR (FBK)	
P4 (Matteo Gerola) 4.8 PM	
13 GARR (UNIFI)	
Task 2 eduGAIN service owner 12 PM	
15 GRNET (ICCS)	

Third-Party Name	
Task 3 WiFiMon Nikolaos Kostopoulos – (3.6 PM)	
Task1 P4 Marinos Dimolianis – (3 PM)	
20 KIFÜ (MTA SZTAKI)	
T3 Core AAI platform SRE (20 PM)	
T5 Incubator/eduGAIN (Mihály Héder, 9.6 PM)	
22 MARnet (UKIM)	
WP3	
T1.1 Partner relations Anastas Mishev (6 PM)	
WP5	
T5 Incubator Domain Expert Boro Jakimovski (PM)	
WP6	
T2 SPA: Sonja Filiposka (7.2 PM)	
T2 NMaaS: Vojdan Kjorveziroski (10.8 PM)	
T4 NAeA: Anastas Mishev (4 PM), Aleksandra Dedinec (7.2 PM)	
WP8	
T1 Security Mgt Vladislav Bidikov (6 PM)	
T3 SOC Tools Kiril Kjirovski (6PM)	
T3 DDoS Vladislav Bidikov (6 PM)	
WP9	
T2 License Compliance Kiril Kjirovski (8 PM)	
22 MARnet (USC)	
T2 eduGAIN Development tools (Boro + Kiril, 6 PM)	
24 NORDUnet A/S (SIKT)	
WP4	
T3 Infr Cloud Procurement, Tender execution (Lars Skogan, 2 PM, Børge Aune, 4 PM)	
T4 Task Leader (Jan Meijer, 8 PM)	
T5.2 Above Net, Development (Stefan Otto, 6 PM)	
WP6	
T1 OFTN (Kurosh Bozorgebrahimi, 2.4 PM)	
T3 perfSONAR (Otto Wittner, 7.2 PM)	
WP7	
T2 Non-IP (Kurosh Bozorgebrahimi 4PM)	
WP8	
T3 SOC Tools (Emil Flakk, 8 PM)	
24 NORDUnet A/S (DeIC)	
WP4	
T3 Infr Cloud Procurement Support (Morten Kjelgaard, 1.5 PM)	
WP5	
T1 eduroam ETLR hosting and ops, support (50% funding, 8 PM)	
T6 Enabling InAcademia (4.8 PM)	
WP8	
T2 Human Factor Henrik Jenssen, 4PM	
T3 CTA/CTI DEIC CERT 4 PM	
eduVPN Francois Kooman 11 PM	
eduVPN Tangui Coulouarn 8 PM	

Third-Party Name	
24 NORDUnet A/S (UMEA)	
T2 Human Factor (Maria Edborn Tauson, 5 PM)	
24 NORDUnet A/S (SUNET)	
WP5 T0 WP Leadership T2 eduGAIN; Seamless access: Product Manager 5 PM, Ops 6 PM, Tools, CDN, VM, + HSM (50% funding) T3 AAI core development lead T4 InAcademia: Infrastructure ops (6 PM), production service debugging (12 PM), release testing (SCS, stats, MDX) (6 PM), VMs WP8 T3 Task Leader (David Heed, 9 PM) T3 DDoS (Ernst Wilderberg, 4 PM) T3 CTA/CTI (Fredrik Pettai, 5 PM)	
24 NORDUnet A/S (DTU)	
T1 P4 (Mingyuan Zhang, 4.8 PM, Henrik Wessing, 2.4 PM) T2 GP4L / SPA (Jose Soler, 4.8 PM)	
24 NORDUnet A/S (CSC)	
WP3 T3 External Relations (Sara Garavelli, 3 PM) WP5 T1 eduroam WiFi monitoring probes, NRO Audits (Wenche Backman, 6PM) T6 eScience interoperability and global engagement (1 PM)	
26 RedIRIS (i2CAT)	
T2 Automation (Carolina Fernández, 7.2 PM) T3 Orchestration (Adrián Pino, Andrés Cárdenas, Sergio Giménez 22.8 PM)	
26 RedIRIS (UPV/EHU)	
WP6 T1 P4: (Jorge Sasiain 6 PM, David Franco 6 PM) T2 GP4L (Asier Atutxa, 6 PM) T4 NAeA (Jasone Astorga, 3 PM) T1 QT (Ane Sanz, 6 PM) WP7 T2 Automation (Jorge Sasiain 7PM)	
26 RedIRIS (CSUC)	
T4 Task leadership (Maria Isabel Gandia Carriedo, 7.2 PM)	
26 RedIRIS (UMU)	
T2 RARE/GP4L (Jordi Ortiz, 4.8 PM)	
32 SURF (NIKHEF)	
T6 Enabling communities: eScience interoperability and global engagement, 5 PM) T2 security team 2.4 PM	

Table 3.11 In-kind contributions 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 the collaboration of network engineers 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. Although this proposal is being submitted with five Associated Partners, we expect most of them to become partners during the grant agreement preparation phase.

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 on 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 background 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 and many Horizon2020, and now 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 etc), a number of roles drive and support its delivery, such as work package leaders, task leaders, team members, subject matter experts, 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. 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

GN5-1 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 is expanding its engagement with commercial retail services that offer a range of discounts to academic users.

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).

Glossary

AAI Authorisation and Authentication Infrastructure

AI	Artificial Intelligence
AER	AsiaPacific-Europe Ring
ANA	The Advanced North Atlantic collaboration
APM	Access Port Manager
AV	Audio-Visual
BSS	Business Support System
CA	Consortium Agreement
CAE-1	Subsea cable connecting Asia and Europe between London and Singapore
CERN	European Organisation for Nuclear Research
CERT	Computer Emergency Response Team
CI/CD	Continuous Integration / Continuous Delivery
CPO	Chief Programmes Officer
CRM	Customer Relations Management
CSC	Cost-Sharing Committee
DDoS	Distributed Denial of Service
IDAS	electronic IDentification And trust Services
EMBL	European Molecular Biology Laboratory
EPA	European Partnership Agreement
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
GCS	GÉANT Connection Service
GDPR	General Data Protection Regulation
GEO	Group on Earth Observations
GLAD	GÉANT Learning and Development
GP4L	GÉANT P4 Lab
CPO	Chief Programmes Officer
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
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
NPAPW	Network Performing Art Production Workshop
NREN	National Research and Education Networks
OC	Oversight Committee
OLA	Operational Level Agreement
OSLS	Open Source and Licence Support
OSRB	Open Source Review Board
OSS	Operational Support System
PAIR	Project Annual Internal Review
PCP	Pre-Commercial Procurement
PLM	Product Lifecycle Management
PMB	Project Management Board
PMO	Project Management Office
PMP	Performance Measurement Platform
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
SCT	Secure Code Training
SDG	UN Sustainable Development Goal
SEE	South East Europe
SGA	Specific Grant Agreement
SIG	Special Interest Group
SIG-CISS	Special Interest Group on Cloudy Interoperable Software Stacks
SIG-ISM	Special Interest Group on Information Security Management
SIG-Marcomms	Special Interest Group on Marketing Communications
SIG-MSP	Special Interest Group on Management of Service Portfolios
SKA	Square Kilometre Array
SLA	Service Level Agreement
SMP	Software Management and Processes
SPA	Service Provider Architecture
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
TF	Task Force
TRL	Technology Readiness Level
VaaS	Vulnerability as a Service
WISE	Wise Information Security for collaborating e-infrastructures
WP	Work Package

References

[BELLA-S1]	https://cordis.europa.eu/project/id/731505
[CERN]	https://home.cern/
[Communication]	A common enabling infrastructure comprising network, trust and

Commons]	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.
[Digital Decade]	https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en
[Digital Ed]	Digital Education Action Plan https://education.ec.europa.eu/focus-topics/digital-education/about/digital-education-action-plan
[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/
[EMBL]	https://www.embl.org/
[ERA]	https://op.europa.eu/en/web/eu-law-and-publications/publication-detail/-/publication/aae418f1-06b3-11eb-a511-01aa75ed71a1
[ESS]	https://www.europeansocialsurvey.org/
[EuroHPC]	https://eurohpc-iu.europa.eu/
[F-Ticks]	https://monitor.eduroam.org/f_ticks_about.php
[ITER]	https://www.iter.org/
[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
[GÉANTServices]	http://www.geant.org/Services
[GN-eProcPortal]	GÉANT's eProcurement Portal https://supply2.geant.org/
[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]	The GN5 International Connectivity (proposed) project
[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.
[PRACE]	https://prace-ri.eu/
[SDG4]	Equitable Quality Education. The federated GÉANT authentication and authorisation services (eduGAIN and eduTEAMS) enable end users to

follow courses at universities other than their own using their existing credentials. Convenience of access is assured by 10,000 eduroam roaming hotspots free-of charge to authorised users in public libraries, airports, train stations, museums, etc. Other programmes such as Erasmus+ also support, through lifelong learning, the educational, professional and personal development of people in education, training, youth and sport. This will contribute to sustainable growth, quality jobs and social cohesion, to driving innovation, thereby strengthening European identity and active citizenship.

[SDG9] Inclusive Infrastructure to Foster Innovation. The international links connect Europe's Research facilitating research, innovation and collaboration at a European level in addition to the global reach of the network to facilitate Global Research programmes.

[SDG17] Implementing Global Partnerships for Sustainable Development. GÉANT's global partnerships and projects help to bridge the digital divide across different regions and provide an example for other organisations for fostering deep, collaborative partnerships to address societal needs.

[SKA] <https://www.skatelescope.org/>

Project Calendar

For planning purposes, it is assumed that GN5-1 will start on 1 January 2023. January 2023 is therefore month 1 (M1) of GN5-1. All subsequent months are numbered accordingly.

Project Period	Calendar Year	Project Month	Calendar Month	Period/Quarter
Period 1	2023	1	January 23	P1, Q1
Period 1	2023	2	February 23	
Period 1	2023	3	March 23	
Period 1	2023	4	April 23	
Period 1	2023	5	May 23	P1, Q2
Period 1	2023	6	June 23	
Period 1	2023	7	July 23	
Period 1	2023	8	August 23	
Period 1	2023	9	September 23	

Project Period	Calendar Year	Project Month	Calendar Month	Period/Quarter
Period 1	2023	10	October 23	P1, Q3
Period 1	2023	11	November 23	
Period 1	2023	12	December 23	
Period 1	2024	13	January 24	P1, Q4
Period 1	2024	14	February 24	
Period 1	2024	15	March 24	
Period 1	2024	16	April 24	
Period 2	2024	17	May 24	P2, Q1
Period 2	2024	18	June 24	
Period 2	2024	19	July 24	
Period 2	2024	20	August 24	
Period 2	2024	21	September 24	P2, Q2
Period 2	2024	22	October 24	
Period 2	2024	23	November 24	
Period 2	2024	24	December 24	