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Deliverable GN5-2

D1.6 Impact Report

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Abstract

Deliverable 1.6 is the first deliverable of this kind to specifically focus on project impacts. This report identifies new approaches toward instilling an “impact culture” and aims to showcase the return on investment and lasting value creation leading to transitions or transformations within GN5-2.

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Table

Table 2.1: GN5-2 Outcomes and Impact

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Executive Summary

GN5-2 implements the second period of the GN5-FPA action plan towards ensuring high-quality connectivity for excellence in Research and Education.

Deliverable *D1.6 Impact Report* is the first deliverable of this kind to focus on project impacts. The GÉANT Project Management Office (PMO) has taken strategic direction towards identifying and reporting on impact. The impact of the Horizon Europe programme is measured by how project outcomes enable change and deliver benefits for society, the economy and science. At the end of Period 1, there are already positive examples of the project advancing connectivity and security with greater threat detection, improving trust and collaborative tools for greater collaboration, developing skills as part of the eAcademy, providing federated identity services and expanding state of the art quantum technologies.

The GÉANT partnership is uniquely positioned to deliver targeted outcomes, ensure effective services and address the scalability challenges in the context of a rapidly evolving environment. This supports the increase in importance and volume of relevant data, allowing researchers to engage with EU priorities such as security, digital sovereignty, energy, climate, semiconductor, and health-related research.

To improve GN5-2's reporting of project impact and further promote an impact culture across the GN5-2 project team and work package leaders, a new Impact Liaison function was announced at the Project Management Board (PMB) meeting in October 2025.

All work packages (WPs) in GN5-2 contribute towards project outcomes, as reported at the end of each project period and in deliverable reviews conducted by the Quality Assurance and Public and External Relations (QASPER) committee. Reviewers also highlight notable information and results to be shared. Key exploitable results (KER) are tracked and collected during each period (see Appendix B for more information).

WP1 will join forces with WP2 for communications; to exploit GN5-2 results and develop narratives that illustrate examples of project impact. WP3 will continue its vital role connecting partners, ensuring community requirements are gathered and met, and supporting targeted transfer of knowledge and results to stakeholders.

A grid was prepared to internally map impact from each work package. This reflects the priorities of Horizon Europe, namely Data Security and Access Control, Innovation, Digital Transition (including Artificial Intelligence) and the Green Transition, as well as priorities of major EC programmes, including: High Performance Computing (EuroHPC), Security, Quantum Technologies, and Open Science. All of these require faster or specially featured networks, improved geographical coverage, security solutions, and trusted services.

This report includes a description of the awareness-raising and interactive approach, as well as details of interviews between the Impact Liaison and work package leaders. These interviews gave work package leaders the opportunity to express what impacts their activities led to, with regards to society, innovation, ICT industry, and education, and cover long-lasting and wider impacts.

The PMO trusts that these new approaches and instilling an "impact culture" mindset to the GN5-2 team will contribute to a new dynamic within the team and better showcase how GN5-2 activities deliver a return on investment and create lasting work with values supporting transitions or transformations.

1 Introduction

GN5-2 [1] is the latest phase in the long-running and highly successful GÉANT Project [2], which has been supporting Europe’s research and education communities for nearly 30 years in close collaboration with the European Commission. This 30-month project, which officially started on 1 January 2025, is funded under the GN5-FPA, the 72-month strategic framework within Horizon Europe, [3] the EU’s key funding programme for research and innovation. Continuing the success of the previous project phase GN5-1, and the ongoing synergies with intercontinental connectivity activities under GN5-IC1 [4], GN5-2 implements the second period of the GN5-FPA action plan towards ensuring high-quality connectivity for excellence in Research and Education.

This deliverable reports project impacts with a new methodology for tracking, exploiting results and developing narratives to showcase this work. Results and outcomes from each work package (WP) lead medium-term changes, as highlighted in project deliverables. Moreover, it also creates lasting value with impacts leading to transitions or transformations.

After discussion within the PMB and after analysing the GN5-1 final review recommendations, the PMO and WP1 have decided to launch an “impact dynamic” in the project. In addition to involving all work package leaders and including input from deliverable reviews (via QASPER reviewers), the PMO has created an Impact Liaison function in WP1 to work closer with all the WPLs, and with WP2 for communications and WP3 to connect partners and help share results with stakeholders. The idea is to adopt an impact culture mindset across the project to make reporting on the marked effects or influences of GN5-2 easier. The Impact Liaison role and objectives were first introduced at the June 2025 Project Management Board (PMB) meeting with positive feedback from attendees. As a continuous effort, there is a regular report of impacts during monthly PMB meetings, providing input to this D1.6 deliverable and to case studies for the impact website.

The strategic impact dynamic may take some time to instil in GN5-2 teams, however, impact tracking has started and will be explained further in Section 1.3.

1.1 Context and Objectives

GN5-2 will deliver GÉANT’s European, high-speed, digital infrastructure, targeting Terabit connectivity. It will scale its digital service portfolio to changing environments; enable T&I to face global challenges, including those of Open Science; reinforce security of the network and its operation in a federated approach, and foster collaborations to innovate, and strengthen Europe’s connectivity with other world regions. The results of GN5-2 will also leave a lasting, wider impact.

This deliverable is the first of its kind for the project. The aim is to focus on impact in such a way that people working in the project are able to see how results contribute to outcomes and beyond in the form of sustained impacts that may have resonance beyond the project.



The following sections describe how, through GN5-2, the GÉANT partnership provides the targeted outcomes that deliver the destination impacts. These also reflect EU priorities: e.g. security, digital sovereignty, energy, climate, semiconductor and health-related research and are grouped by pathways (Societal, Innovation, Scientific, and Education).

1.2 Project Outcomes

In terms of digitalisation, the outcomes of GN5-2 will have an impact on every institution through changes to governance, data infrastructure, roles for researchers, educators and students and greater (digital) mobility that will enable improved societal outreach/support. GN5-2 will contribute to the overall changing ecosystem with knowledge, services and infrastructures enabling digital transformation. 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. All this has been obtained through the continued commitment of project partners to develop and operate these infrastructures and services.

Planned as an evolving activity over the duration of the 72-month GN5-FPA, GN5-2 will deliver outcomes listed under GN5-FPA's 6 Actions and 39 sub-Actions. The six guiding actions of the FPA are:

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

There are also five, complementary, concrete outcomes of GN5-2 explicitly outlined in the Work Programme which are to:

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

See Appendix A for more details about GN5-2 outcomes and destination impacts.

1.2.1 Contribution to Outcomes by Work Package

All work packages in GN5-2 contribute towards project outcomes, as described in greater detail below for each WP as well as in Section 2 with societal, innovation, scientific and educational related impacts. The action or

method to achieve these, the target groups involved, and the identified user needs all vary by work package (further details are presented in deliverables, periodic reports as well as during the project reviews). WP1 Project Management ensures effective delivery, monitoring, reporting, governance, management and quality processes. This includes finance and procurement, as well as technical writing, training, quality assurance, GDPR/IPR and standards support (IETF, WBA, Wi-Fi Alliance). The Product Lifecycle Management's (PLM) pre-launch process and security audit supports WPs' product and service development.

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

WP3 User and Stakeholder Engagement provides users with a "voice inside GÉANT". Impact with user communities is a priority, especially in work across multiple work packages to ensure NREN feedback is gathered and reflected in ongoing service improvements/development. Such cooperation facilitates connection between partners, an expanding user community, stakeholder groups and improved international relations, both on technical (e.g. for standards and development) and operational levels, with international networks being developed jointly with institutions from other continents.

In addition, WP3's support of Task Forces (TFs) and Special Interest Groups (SIGs) promotes an open approach to innovation, and link to relevant EC projects, research infrastructures, and topics of interest, aiming at higher levels of integration of e-infrastructure services in Europe (e.g. EOSC, EuroHPC, and quantum) as well as EC strategic priorities (European Digital Gateways and Common European Data Spaces).

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

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

WP5, Trust and Identity incubates new or potentially disruptive T&I technologies and support for new use cases around federated authentication and new technologies, such as EUDI wallets, in addition to eduroam, eduGAIN, InAcademia, and Core AAI platform development. In order to realise the maximum potential of the T&I portfolio and make it available to the user community, development towards stronger national electronic identities (e.g. eIDAS) and self-sovereign identity (SSI), privacy preservation is also included as part of WP5's work.

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

WP7 Network Infrastructure and Service Evolution and Operations continues to develop the fibre-optic-based network infrastructure to the edges of Europe. WP6 and WP7 also explore the development, deployment and operations of multi-domain spectrum service, quantum technologies, and fibre sensing technologies for the development of new services beyond Internet packets. Migration of IP network from Juniper onto Nokia routers is ongoing, also on track for a fully automated network. As with other network-related operating costs, the plan for this equipment is to amortise costs annually over the equipment's useful economic life (i.e. the remainder of the FPA duration) using the same cost-sharing mechanism between the EC and the NRENs.

WP8 Security addresses security aspects of services and the network, including the increasing threat levels. The WPs depend on WP8 to ensure the security of the GÉANT backbone network, to investigate new tools and their

use, and how to make high-speed networks secure by design. WP8 create a joint security intelligence workforce, with expertise and tools for use by R&E in addition to delivering security training, services and tools such as: cyber threat analysis and intelligence, DDoS detection and mitigation, Firewall on Demand, eduVPN, cryptographic services, and protection of DNS. It also facilitates a security innovation lab for testing tool integration and pilot proposals.

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

1.3 Tracking impact in GN5-2

In GN5-2 work is done to systematically and continuously report on the project's impacts. In addition, QASPER reviewers can identify results and impacts as part of their Deliverable Review table (see Appendix B.1). This also provides an input to WP2 communications work and identifies potential sources for case study/articles.

At the beginning of GN5-2, an impact grid was prepared to register expected impacts from each WP, considering several criteria:

- Priorities of Horizon Europe: Data Security and Access Control, Innovation, Digital Transition (including Artificial Intelligence) and Green Transition.
- Support of major programmes initiated by the European Commission relating to High Performance Computing (EuroHPC), security, quantum technologies, Open Science, and others as they require faster or specially featured networks, improved geographical coverage, security solutions, and trusted services.
- Technology Readiness Level. Each service will have a TRL, tracked as part of service development throughout the project.
- Sustainable Development Goals, especially (4) Quality Education, (5) Gender Equality, (9) Industry, Innovation and Infrastructure, and (13) Climate Action.
- EC digital values, namely European Digital Rights and Principles as the GÉANT Project and its services and achievements reflect the following:
 - Putting people and their rights at the centre of the digital transformation.
 - Supporting solidarity and inclusion.
 - Ensuring freedom of choice online.
 - Fostering participation in the digital public space.
 - Increasing safety, security and empowerment of individuals (especially young people).
 - Promoting the sustainability of the digital future.

When a GN5-2 deliverable is delivered to the EU, the impact grid is updated by the Impact Liaison. The Impact Liaison also reviews or reads all GN5-2 deliverables, as per PMO request. In addition, work package leaders are reminded to regularly check their impacts in the grid, and to highlight a specific development or update, if needed.

Work packages leaders should consider the Impact Liaison as a facilitator for them. The Impact Liaison will also update the format of impact grid during GN5-2 to make it more practical, as well as to summarise its key points as in the project's periodic reports. This grid could then become a key register for future work.

GN5-2 impacts are registered in the dedicated grid under the following categories:

- Wider scientific impact
- Economic impact: looking at both impact on market and innovation
- Societal impact
- Education impact.

Work package leaders can update the impact grid at their convenience as it is available on the GN5-2 project site [5]. The aim is to have a quite comprehensive view of all impacts by the end of GN5-2, which is a new approach to tracking impacts in the project.

In addition to work on impact identification and recording, the Impact Liaison organised a series of 30-minute interviews with GN5-2 work package leaders to stress the importance of identifying impacts and to help identification of potential success stories and to build on narratives in collaboration with WP2. More information and interview details are found in in the following section.

In addition to this tracking, project outcomes are mapped with impact destination (see Table 2.1), based on examples from project deliverables. This internal exercise helps identify and articulate impacts.

1.4 Impact Interviews with Work Package Leaders

The Impact Liaison proposed a series of interviews with work package leaders as they are best placed to know what impact their WP will lead to. It was important to put the work package leaders at the core of the process in this new approach and to start instilling the “impact culture” mindset to the GN5-2 team that way.

Launching the process, an awareness-raising and interactive approach has been taken. In order not to be time consuming for work package leaders and to be efficient, a 30-minute interview format was agreed. The objectives of the interviews were:

- To insist on the need to highlight impacts for GÉANT NREN partners and the EC (the interviews provide highlights, as further details of project progress are included in regular management reports).
- To get the view of the work package leader about the impacts his/her team is generating and involve him/her in this “rewarding” process.
- To identify if they had a story to tell about this (these) impact(s).

A set of interview questions was agreed by the PMO and WP2 leader.

Interviews were done by the Impact Liaison, a short report was written and checked by interviewees. Reports were then shared with the PMO and WP2.

As WP1, WP2 and WP3 are already part of the impact awareness effort they were not interviewed.

1.4.1 Highlights from WP3

In addition to the activities reported in the GN5-2 Management Reports, WP3 delivered the following, which demonstrate the importance of the WP's community reach.

- The Community Programme facilitates community knowledge exchange in new Areas such as AI, Time frequency and Quantum and supports innovation via the Innovation programme [6].
- AI for NRENs group provides a new platform for knowledge sharing on AI factories and AI antennas – this works alongside the existing EuroHPC co-ordination group which shares knowledge on how NRENs support the HPC scientific communities and users.
- EOSC co-ordination group enabled support for proposals such as EOSC4ALL and ideas about how GEANT and NRENs could develop the concept of an EOSC node. The group enables a common approach to Open Science activities in the community and knowledge sharing across the 12 EOSC mandated organisations who are NRENs (from 19 EOSC mandated organisations in total).
- Progress has been made on the side of the NRENs to harmonise and coordinate the actions of the various networks and to coordinate goals and objectives in the provisioning of services to EUMETSAT.
- New Special Interest Groups established re: Artificial Intelligence (SIG-AI) and Quantum Technology (SIG-Quantum) and Public Affairs (SIG-PA).
- Support was provided to ITER for its Data Challenge Proof of Concept (PoC), demonstrating 80Gbps continuous data transfers between Cadarache in France and Rokkasho in Japan (in coordination with QST, SINET, ITER and RENATER).
- Support provided to the new version of the COPERNICUS data distribution system, ensuring the democratisation of the COPERNICUS data to the global R&E community.
- GÉANT's CEO is contributing to awareness raising and understanding of digital sovereignty, including engaging with multilateral organisations e.g. the Internet Governance Forum (IGF), and presenting at the UN.

As the host of the Community Hub space at TNC25, WP3 organised a number of sessions and meetings (circa over 100 participants at each), including:

- Research Without Borders: Open Science & Infrastructures, where ideas on collaboration, innovation, community engagement, and joint advocacy activities across research infrastructures of the e-Infra Assembly members and their communities were shared.
- Enabling Open Science: NREN Research Data Management Needs, focussed on key aspects of research data management, including infrastructure needs, policy alignment, FAIR data principles, and supporting cross-border collaboration.
- Beyond the Net: Enabling Research Collaboration, included an EOSC NREN Community Meet-up.
- Building the Quantum Future: NRENs at the Forefront.
- Twinning for Collaboration, showcasing the GÉANT twinning programme and how to participate.
- Connect, Engage, Inspire - Elevate your Member Experience, showcasing what works (and what didn't) regarding NREN member engagement approaches.
- Policy session: Are We Shaping the Future or Fulfilling the Visions of Others? laid the foundations for a collaborative network of policy experts to address these challenges.

Infoshares on EOSC AAI, EuroHPC Hyperconnectivity, The OpenAIRE Graph and its API, the Destination Earth Initiative were also provided during the period to support how the community can learn from members and improve standards across Europe.

NREN Support provided by WP3

- Provided long-term membership stability for service adoption and collaboration through a unified contract framework, with all 38 Member NRENs (including NDN) signing the Master Service Agreement.
- Strengthened strategic alignment with NREN leadership via a structured series of CEO- and CFO-level meetings and face-to-face engagements, ensuring GÉANT remains closely aligned with members' strategic priorities and future needs.

- Maintained membership trust and cohesion during national changes by supporting NRENs undergoing leadership and organisational changes (including EENet, RedIRIS, FCCN, SWITCH, DFN, BREN, RoEduNET) and sustaining close engagement with URAN under wartime conditions. Further to the support via the community programme the GÉANT community has launched the Humanitarian Support Group for NRENs [7], an initiative created to coordinate structured support for European NRENs facing severe and sustained crises, including war, major infrastructure failure, and large-scale environmental or societal disruption.
- Continued enablement for students and researchers in Bosnia and Herzegovina (BiH) to connect to R&E while engaging with the regional stakeholders supporting them in their objective to create R&E infrastructure under challenging geopolitical conditions.
- Deepened global peer relations and strengthen the global NREN community via the annual CEO NREN CEO Track.

Insights

- Strengthened evidence-based decision-making through early publication and wide dissemination of the Compendium 2024.
- Embedded foresight into the Compendium, leadership discussions, and dedicated TNC sessions.
- Delivered targeted analytical value through bespoke analyses supporting NREN benchmarking, baselining activities and regional programmes such as the SEE Directors Forum.

The following sections list the interviews held with WP4–9 and highlight the impacts mentioned during the discussion.

1.4.2 WP4 – 21 November 2025

Destination impact D2.

- OCRE cloud service with central procurement and mass effect led to the attention of market players and leveraged significant influence on the market.
- The OCRE Feasibility Study addresses regions worldwide, with discussions including New Zealand, Brazil, Canada, Singapore, South Africa, as well as the US, leading to a larger influence on the market.
- Other innovation services developed under this task are relevant in the context of EOSC node.
- eduMEET is now distributed and used in many countries as software.

1.4.3 WP5 – 26 November 2025

Destination impact D2, D3.

- eduroam, eduGAIN and CoreAAI (with the two services MyAcademicID and MyAccessID) together build with the CoreAAI to deliver the value as a framework to enable collaboration using home credentials.
- eduroam is already well known as a very impactful service.

- With eduGAIN it is important to emphasise impacts on education (easy and secure access to a portfolio of services with home credentials and My Academic ID) and on science (massive impact on collaboration developments thanks to Core AAI enabling access to supercomputers, and to EOSC nodes).
- eduroam and eduGAIN are contributing to digital transformation, and the knowledge developed under GN5-2 project participates in the development of less advanced networks in the world.
- Cycle 10 of the T&I incubator is having an impact on T&I development (current topics include Bona Fide researcher verification, VC issuer IdPs, and OI DFed), creating proof of concepts and demonstrating feasibility of developments addressing users' needs.

1.4.4 WP6 – 21 November 2025

Destination impact D1, D2, D5, D6.

- The Network eAcademy has clear impact in educating the R&E community.
- Fibre sensing and QKD concur to innovation.
- Moreover, GN5-2 project has the capacity to bring together NRENs to work together.

1.4.5 WP7 – 5 December 2025

Destination impact D1, D2, D5, D6.

- Much effort has been put into providing access to GÉANT network from the edges of Europe providing universal access to connectivity, in line with EU digital priorities (equity). More meshing of the network provides resilience for this universal access to the benefit of R&E communities leading to a greater access for scientific and educational impacts.
- At intercontinental level, EU digital sovereignty and connectivity is enhanced, for example by avoiding the Red Sea bottleneck by securing spectrum on submarine cables (Medusa, Blue Raman, ...) also ensuring stability needed by R&E communities.
- GÉANT has a leverage and booster effect on both the telecoms market and on the European technology ecosystem. Securing longer-term contracts enables NRENs to be less affected by market changes and to ensure more stability.
- With GN5-2, a vendor-agnostic starter kit for NRENs helps support a more local approach to router design and supply as well as foster European innovation. It acknowledges the difference between each NREN environment. Greater cross-pollination of results will help improve NREN approach and better serve specific needs. Another impact from WP7 is energy efficiency, thanks to long-term infrastructure investment under GN4-3N project.

1.4.6 WP8 – 20 November 2025

Destination impact D2, D4.

- This task contributes to impacts in terms of building awareness and skills in threat intelligence (a new activity in GN5-2), participating into the transformation/security performance of the R&E community.

- It also contributes to economic benefits, helping to focus on some threats for a more efficient way of spending money related to security. Valuable expertise has been developed during development of the Security Hub for the benefit of the R&E and with the recognition of industry peers.
- eduVPN used to mitigate remote access vulnerabilities is another impactful service at a global scale.
- Finally, educating the community contributes to the leadership in NRENs, and to a convening and coordinating power (i.e. NRENs with their users and GÉANT with NRENs).

1.4.7 WP9 – 28 November 2025

Destination impact D2.

- In terms of innovation and cross community work, the task is using Argus developed by Sikt and adapted to the GÉANT environment. (See GN5-2 D9.2 *New GUI for NOC Alarms Dashboard* [8].)
- With software certificates, the task is mitigating risks related to software not being properly licensed and unsecure, then contributing to R&E community's stability and security. The task work is also contributing to educating the community thanks to the eAcademy
- As the NOC is a focal point for international domains/multidomain because of the backbone reach, the task has a global impact as the network support is instrumental to ensuring performance and global access for European research and education community.

Finally, it is worth mentioning that at the end of the interviews, a final question was asked “Would you like to be involved yourself in this impact work?” and all interviewed answered “yes”, which is a very positive sign for the continuation of showcasing impacts.

2 Pathways Towards Impact in GN5-2

2.1 Context

As a project, it is also important to understand the benefits of what is delivered beyond product uptake and use. Horizon Europe delivers a new approach for capturing and communicating impact to different target groups via Key Impact Pathways (Scientific, Societal and Economic), where research and innovation is viewed as a means to deliver meaningful change. The expanded pathways for GN5-2 cover societal, innovation, scientific and educational impact.

2.2 Project Contribution to Society, Innovation, Scientific/ ICT Industry and Education

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

GÉANT publishes the Compendium of National Research and Education Networks in Europe (see *GN5-2 D3.2 Compendium Report* [9]) resulting from of a broad and collective effort to gather detailed information about the NRENs' network, services, budget, and users. The Compendium has become a very strategic tool as it enables insight for each country and provides more information about individual NRENs, and their impact on users.

The way scientific research is conducted has dramatically changed over the last years. Network, storage and computing services provide the foundation to conduct modern scientific research. Today, the data for research is generated from countless sources and large instruments across the globe (e.g. CERN/ESS/ESFRI/EuroHPC/Copernicus/Galileo/ESO/SKA). Proper Research Data Management (RDM) is a mandatory Open Science obligation in Horizon Europe for projects that generate or reuse digital research data. Beneficiaries must manage data in line with Findable, Accessible, Interoperable, Reusable (FAIR) principles, stored in trusted data repositories.

Allowing scientists to conduct excellent research requires high-bandwidth connectivity and network services to interconnect researchers and ensure non-alteration of data and computing resources in a secure and non-discriminatory way, regardless of the location of the users and the resources. NRENs and GÉANT are critical to R&E because they provide the specialised, high-capacity, secure infrastructure that fosters global collaboration supports this data-intensive science and enables access to resources for millions of users.

A Data Management Plan describing how data is managed during and after a project is a Horizon Europe requirement (see Section 3.3.1).

This project continues development of the network to reach Terabit capacity across a wider geographical footprint to 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 ten years.

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

2.2.1 Societal

GN5-2 contributes to developing skills (Human capital development (WP1) and to indirectly educating society for a smooth digital journey towards a competitive Europe. The Network eAcademy has then recorded over 5,000 views of its learning units, now spanning three broad topics across Orchestration, Automation and Virtualisation, quantum computing, and optical time & frequency networks. eduroam (WP4) 1.55 billion international authentications over the Months 1 to 12 of GN5-2 period, delivering secure, world-wide roaming internet access for the global R&E community shows the wide societal impact (see Deliverable *GN5-2 D1.7 Service Review and Services Status*).

Advancement of science and research also provides impact on a much broader scale by enabling international collaboration, high-speed data transfer and trusted access to resources. It also strengthens global positioning for European Research and enhances the European Research and European Education Areas.

In addition to benefiting from GÉANT network connectivity, it is notable that MyAccessID (WP5) has been adopted within the EuroHPC Federated Platform architecture and is used as its identity and trust layer within the EOSC AAI Federation. Both the EuroHPC AAI and the EOSC EU Node AAI are implemented on top of the GÉANT Core AAI Platform. This fully demonstrates the effectiveness of GÉANT's federated identity capabilities in supporting secure and interoperable European research infrastructures as reported in GN5-2 deliverable *D1.7 Service Review and Services Status*).

The recently established EU priorities include major R&D programmes for High Performance Computing and semiconductor development, energy (fusion and Power-to-X, for example), as well as climate and health, which will all need sustained access to fast and reliable network connections across the world.

Major research programmes initiated by the European Commission to improve strategic autonomy in the medium to long term will be enabled by greater data availability, but for these endeavours to contribute effectively to European prosperity, results of potential economic value will need protection with strong security. European values in areas such as personal data protection, similarly, also require a strong emphasis on security of data and privacy. It is then worth noting that the significantly expanding adoption of GÉANT's eduVPN service, covering both secure public internet access and 'corporate' VPN use cases, entitles more many more students, researchers, and institutions to benefit from protected and private internet access, as reported in Deliverable *GN5-2 D1.7 Service Review and Services Status*).

Connectivity provided by GÉANT offers the appropriate level of access security (WP8) and trust (WP5) 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 (WP5) for access to the network will evolve to maintain interoperability as Europe-wide electronic identity systems (e.g. eIDAS) are introduced. Societal and economic impact will be significant, as more R&E users join the network. Deliverable *GN5-2 D3.2 Compendium Report* [10] highlights health and education users and associated above-the-net services.

Activities in GN5-2 are instrumental for digital transformation, and favour inclusion, gender equity, as well as transfer skills to young talents and reduce digital divide. One way in which the project's contribution to these initiatives will be measured is via actions under the Sustainable Development Goals, and projected alignment with European Digital Rights and Principles (updates in GN5-2 Management Reports and forthcoming deliverable *GN5-2 D2.3 Project Contribution to UN SDGs and European Digital Rights and Principles*).

2.2.2 Innovation

Innovation is and will be seen in every aspect of GN5-2's work.

To begin, WP1's Task 4 Project Lifecycle Management (PLM) supports innovation at the most basic level by providing the business case support and checks for the project's incubators. Task 5, Human Capital Development, not only supports dissemination of training material but also knowledge use and share.

With an Innovation Programme (WP3), use of dedicated incubator activities (WP4, WP5, WP6), and continuous product development, the project adds new features to existing services, cover new use cases, expand the user base, improve existing and/or add new techniques, technologies, software services and tools (examples across the thematic service areas include: interoperability with digital wallets (WP5), Router for Academia Research and Education (RARE) (WP6), eAcademy course development, and new services for cyber threat intelligence).

WP4's OCRE2024 framework aggregates NREN expertise and community demand around digital online services. This includes a catalogue for national-specific information bundles [11] and ensures inclusion in the EOSC services portal. Available services are highly innovative. This framework is also a major channel for GÉANT to enable community access to leading AI platforms.

The impact on current and new users of the introduction of technological opportunities offered by time and frequency distribution (metrology), quantum technologies, fibre sensing support, and artificial intelligence (AI) beyond state-of-the-art are all important areas. The opportunity to deliver a synchronised and newly defined accuracy of time signals across Europe is piloted and the potential offered by quantum technologies will require substantial innovation opportunities to be assessed as the amount of accessible data and users increase.

In parallel, WP7 has announced a record-setting 400G ZR+ optics field trial, opening new opportunities. As explained in Deliverable *GN5-2 D1.7 Service Review and Services Status*, the new platform enables 400G deployments at scale and is expected to reduce cost-per-bit by approximately 70% and energy-consumption-per-bit by around 85%. Once it will be completed (Q1 2026), GÉANT's connectivity services will be able to comfortably accommodate the data-intensive demands of scientific collaboration in Europe in coming years, while minimising the environmental impact of R&E.

WP8 delivers innovative security services and tools, including: cyber threat analysis and intelligence, DDoS detection and mitigation, Firewall on Demand, cryptographic services, and protection of DNS.

WP9 develops required, fit-for-purpose, in-house software services using agile principles and best practice. For example, the GÉANT-Sikt partnership has resulted in the development of GÉANT-Argus, a specialised frontend designed specifically for GÉANT NOC operations (*GN5-2 D9.2 New GUI for NOC Alarms Dashboard* [8]). The Network section of *GN5-2 D3.2 Compendium Report* [10] also highlights this shift to automation.

2.2.3 Scientific / ICT Industry

GN5-2 will create synergies between R&E Networks and industry in the form of partnership programmes (WP2), enabling secure access for NRENs users to a range of services provided by the market (peering with commercial networks ,OCRE 2024, InAcademia), and opening the path to future services and use in the areas of RARE, GP4L, time and frequency, quantum, and fibre sensing. WP7 explores possibilities to use NREN fibre infrastructure as a fibre sensing instrument, potentially opening new opportunities for collaboration in diverse scientific and R&E related commercial sectors. This also contributes to advancement of science and research, and to European scientific leadership.

The procurement activities in the project 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 is set at very high standards, based on the constantly evolving needs of the user community. This has a stimulation effect on the market and helps reduce the risk of technology obsolescence.

In terms of standardisation, GN5-2 is a strong voice of the R&E community in international fora, dealing with Industry players and making the case for open and vendor agnostic standards, such as those used for eduGAIN support, for example. Indeed, WP5 collaborates with the industry and standardisation bodies such as IETF, WBA, WiFi Alliance and enhances eduroam to enable roaming organisations (ROs) to continue to play a strong role in the roaming arena (i.e., OpenRoaming).

The continued evolution of OSS licence management in GN5-2 and built resources provide developers and the licensing team with consistent frameworks for managing software licences and artefacts. (*GN5-2 D9.5 Open Source and Licence Support Report* [12]). Moreover, the open-source software model is central to the impact of many GÉANT services, and builds a community of practice around network technology and software development, advancing European digital rights and principles, and helping to generate innovation-based growth (See in Deliverable *GN5-2 D1.7 Service Review and Services Status*).

2.2.4 Education

The speed, resilience, geographical footprint, security and overall excellence of the GÉANT and the NRENs' joint network service have supported students' mobility.

With eduroam, and thanks to a simplified and federated access, eduGAIN, identity federations around the world connect to learning and knowledge bases as well as access to virtual labs and testing platforms. WP5 contributes to student mobility and liaises with other relevant initiatives, such as national and international projects related to e-identities, students' mobility initiatives, University Alliances, eIDAS, EUDI wallet and EBSI. In addition, GÉANT Core AAI Platform is a cornerstone for the delivery of advanced AAI services in R&E, providing the critical infrastructure for key European initiatives such as EOSC, EuroHPC, the Erasmus Programme and other initiatives supporting student mobility across the continent. It serves as the foundational backbone for a suite of essential identity services, including InAcademia, MyAcademicID, MyAccessID and the EOSC Federated AAI, enabling the delivery of an omnipresent AAI. The development of a universal federated identity AAI platform for education and research will allow evolution and increased digital transformation.

In WP6, the Network eAcademy is an umbrella name for several activities that help NRENs progress in their digital transformation journey:

- Training (with the logistics and support from the WP1 GLAD team)
- Maturity assessment
- Orchestration, Automation and Virtualisation (OAV) terminology
- Mapping of individual digital architectures.

The training includes tracks on Orchestration, Automation and Virtualisation, and Quantum Technologies, and it can include other tracks depending on stakeholders' needs. WP7 also contributes to knowledge sharing with a comprehensive repository of knowledge, best practices, and resources focused on network automation - available for vocational training or education. WP8 and its security training programme, supports the preparedness of NRENs for crisis as well as continue the development and deployment of a security mentoring program. WP9 trains developers and delivers GÉANT eAcademy course on software licensing (*GN5-2 D9.5 Open Source and Licence Support Report* [12]). The work package safeguards the GÉANT network proactively against cyber security threats, develops a Security Operations Centre (SOC) supporting network and service resiliency, meaning that GÉANT can be considered as a trusted infrastructure for education (exams, access to content, etc.).

This will have a lasting impact to benefit the future educational mix.

Human capital development (WP1) will help bring the needed and targeted training to the R&E network and IT services sector, including ongoing vocational training, complementing the strategy to increase its capacity and attractiveness to work in this innovative and impactful area.

In addition to technical skills, GN5-2 aims at delivering “soft” skills training in areas such as business development, product marketing, communication, presentation skills, team leadership and management capabilities. This includes:

- Education of project team members (external, building skills of the project team members).
- Education provided by the GN5-2 project team members (provided not just to project participants, but to the whole community, including in the education sector more largely connected to NRENs (*GN5-2 D3.2 Compendium Report*[10])).

The demands on ICT expertise in member states are increasing rapidly, as the demand for services and service quality increase. As previously stated, the proposed project will offer coordinated training, information exchanges and secondments, providing relevant courses to partners and encouraging emerging talents.

2.2.5 Wider Impacts of the Project

By addressing the broad range of thematic service areas and supporting collaborations across all scientific research disciplines, GN5-2 helps to advance science and research and to position European research as an enabling actor of a wider society. Chances are that a student using state of the art and secure digital services to access content for example will keep those good practices and expectations in mind for his/her next professional use. He/ she can also come back to his/her family and spread those good practices to youngsters or elders. Today the society is digital and outcomes of GN5-2 support this transformation and bridge the digital divide.

GN5-2 offers the European research and education community a broad network and service reach, achieved sustainably through the focused and collaborative effort of the GÉANT partnership. Specifically, this includes:

- Providing equal opportunities for connectivity to data repositories and services located anywhere in the world for students, researchers and educators located anywhere across Europe. Boosting and strengthening international research and education collaboration for Europe.
- Delivering secure and reliable connectivity to advance Open Science internationally and enabling research to address the broader societal and climate-related challenges which we will face.
- Supporting the UN Sustainable Development Goals (SDGs) via measured progress, where deemed relevant.
- Aligning with the European Digital Rights and Principle and Digital Decade targets [13], where deemed relevant.

In terms of scalability, the knowledge developed under GN5-2 project empowers GÉANT and NREN users, as well as participates in the development of less advanced networks in the world, enabling faster uptake.

The GN5-2 project has the capacity to facilitate NRENs work together. This “stronger together” approach multiplies the potential impacts. Thus, by leveraging decades of expertise and the reach of Europe’s (NRENs), GÉANT is creating a foundation that goes beyond simple connectivity.

GÉANT has been awarded a contract by the EuroHPC Joint Undertaking (JU) to deliver high-capacity, secure, pan-European connectivity for Europe’s supercomputing infrastructure. This hyperconnected network will connect

HPC centres, national supercomputers, AI factories, quantum facilities, and research and data centres across the continent, enabling seamless collaboration for researchers, industry, and the public sector. This extension of the area of influence of NRENs and GÉANT in a vertical area is a transformative step that strengthens Europe’s digital sovereignty. It is also showcased with the choice of GÉANT Core AAI platform for the EuroHPC AAI and the EOSC EU Node AAI as mentioned in Section 2.2.1.

GN5-2 contributes to a viable European market, with a long-term return on investment as benefits are expected when reprocurring equipment. WP4’s OCRE 2024 Cloud Framework is a good example of leveraging the collective bargaining power of the GÉANT community to deliver significant cost savings for European R&E services. It also promotes European cloud services, as 40% of the services registered in the Cloud Catalogue are from European providers. (See in Deliverable *GN5-2 D1.7 Service Review and Services Status*).

In terms of sustainability, GN5-2 impacts leading to digital transformation will last after the funding for GN5-2 ends and will hopefully continue as part of GN5-3. This is perfectly aligned with “A Europe fit for a digital age”.

3 Dissemination and Exploitation

A core tenet of open science is that research is of the most use, and can generate the most impact, when it is shared.

In order to maximise the impact of the outcomes described earlier in this report, project results need to be shared through dissemination and exploitation activities that reach project stakeholders.

Dissemination and exploitation are core components of research impact, particularly in Horizon Europe, designed to maximise the visibility and uptake of project results. Dissemination includes sharing findings and outcomes with a range of stakeholders and audiences. Exploitation is when those findings can be converted into something tangible or reusable such as products or services. Exploitation can also include knowledge, technology, processes, or networks that have potential to contribute towards further work, research or innovation.

The achievements and results obtained in the project will be used by the NREN partners to deliver value-added networking services and guidance to their research and education user communities. Oversight of impact and exploitation will take place as part of WP1 coordination support, building on WP2 communications plans, strategies and targets. The results and offerings of the project will be promoted to the wider research and education community and beyond through the NRENs, via the marketing communications services as part of the project pathway towards impact and via the GÉANT Community Programme. Utilisation will be encouraged/facilitated through user support activities and international relations coordination with partners around the globe.

3.1 Key Exploitable Results

Key exploitable Results (KER) are selected and prioritised due to their high potential to be “exploited” and to be translated into benefits – down the value chain of the product, process or solution, or input to policy further research or education.

In GN5-2, KERs are collected as part of deliverable reviews and are reported at the end of each project period. They include material that is tangible (such as intellectual property or a shared process) and intangible (subject expert knowledge tracked within a pilot). We have only included some example KERs as part of this deliverable in Appendix B, as they will formally be reported at the end of each project period.

QASPER’s reviews of project deliverables are very helpful at flagging concepts found while reading project output. QASPER 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. In GN5-2 governance, QASPER reports to the Oversight Committee.

Outreach on impact is key to showcase the impact and return on investment of GN5-2.

This has been clearly highlighted in the interviews with work package leaders. Some examples:

- The project contributes to community building based on trust and enabling a perfect understanding of needs. This unique combination can lead to unexpected services based on demand aggregation, such as OCRE 2024.
- The real power of the group is that what is achieved in collaboration could not be done separately.
- GN5-2 is instrumental to R&E, and even society, digital transformation: universal access to connectivity, easy to use, capacity building for the community.

- GN5-2 is a European technology market booster (mass demand, expertise recognised by industry peers, playground for product testing) and a telecom market opener.

The following successes have been flagged as worthy of further investigation and forwarded to WP2 for elaboration.

- Thanks to network and services, “we are enabling the next Nobel prize winner” (as one interviewee explained).
- A story on diversity: 100 people in working in WP6 with 10% new people.
- A story on cost-effectiveness: since 2018 connectivity has x 2 for nearly half the price.
- A story on energy efficiency, building on long term results:
 - The GÉANT fibre footprint has expanded dramatically following the GN4-3N project, from just over 11,000 km to nearly 31,000 km of combined fibre and spectrum routes across Europe. That’s almost a threefold increase. Since then, despite the substantial expansion of the network, total power consumption has dropped from 99 kW to 95 kW. More importantly, when measured per kilometre, power usage fell from around 8.75 W/km to just over 3 W/km — a nearly 65% improvement in energy efficiency.

3.2 Stakeholder Support (WP2 and WP3)

A key objective of this work on impact is to communicate examples, finding the best support and narrative to ensure GN5-2 results are visible. Dealing with impacts means understanding the “why”.

The Impact Liaison reviewed thoroughly the Impact website [14] taking a step back and keeping in mind a comment from the previous GN5-1 EC Review, “The impact pages of GÉANT website have decreased, probably because the content doesn’t seem fresh. This should be carefully considered.”

The review focused on content, navigation, illustrations. Some recommendations were proposed to WP2 in terms of navigation, harmonisation, stories/case studies to make impact relatable, illustrations with indicators which could be re-used for outreach. Some additional topics were also suggested as HPC, Quantum, AI, T&F, Sensing.

As GÉANT is part of an ecosystem including NRENs, GN5-2 impacts will naturally resonate at both national and European levels, even widely at a global stage as the R&E community is global.

There is a plan to update the website, focusing on wider scientific and education target group (via societal, innovation, technology and education areas) as well as provide additional narratives. Work with WP1 will also increase tangible links with project output.

The Impact Liaison will work with WP2 to continue identify success stories as well as suggest the best people to interview to elaborate the narrative (users, other GN5-2 team, partners...). The Impact Liaison will also collaborate with WP3 to identify stakeholders’ return on experience as WP3 is the voice of users inside GÉANT.

The material available encompasses deliverables, KERs, KPIs, impact grid, upcoming UN SDG report, Compendium Report [10], and the GÉANT Foresight Study, *Foresight 2030 Navigating Change* [15]. The Impact Liaison will act as facilitator for both WP2 and WP3 and will interact whenever needed with work package leaders (to prepare interviews, articles, etc.).

3.3 Open Science Making Results Transparent

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

GÉANT's involvement in the EOSC Association [16] and Research Data Alliance (RDA) [17] enable this. WP3 WPL and other GÉANT staff have been active in the RDA for a number of years, fostering links and supporting the network as enabler of global research collaboration. Partner NRENs and the GÉANT Association are Members of the EOSC Association, with 12 NRENs appointed as Mandated Organisations and 2 as observers to represent national interests. GÉANT and the NRENs are also represented on the EOSC Association Task Forces and on the Board of Directors, including roles on the Global Open Research Commons Interest Group, Technical Advisory Board and Organisational Advisory Board, which encourage greater NREN participation.

EOSC is also helping to bring the requirements of European R&E together. Research activities are also becoming more transnational and pan-European and therefore need common and interoperable data platforms for collaboration across borders. Building upon what has been proven to work will accelerate the adoption and implementation of the service landscape, one example is open-sourcing of the SRC code in support of the community deployment of the DRE. The team has provided the necessary gateway documents to use the GÉANT GitLab instance and has also registered the DRE in the Conservancy Commons portal. The SURF SRC developers are now working with the GÉANT hosting team on the next steps regarding this process.

3.3.1 Data Management Plan as an Active Document

GN5-2 deliverable *D1.1 GN5-2 Data Management Plan* [18] describes how data generated, collected, and processed within the GN5-2 Project is to be managed. This impacts research by ensuring data is secure, efficiently managed, and FAIR (Findable, Accessible, Interoperable, Reusable), which reduces data loss risk, improves reproducibility, and meets privacy requirements.

The DMP identifies four main data types – administrative, network, service technical, and incubator data – each of which potentially includes personal and non-personal data. The Plan outlines how to apply the Findable, Accessible, Interoperable, and Reusable (FAIR) principles to Project data to ensure compliance with Horizon Europe best practices for data management and to support the broader goals of Open Science. A separate GN5-2 Project Privacy Policy governs the protection of any personal data within the Project in line with the General Data Protection Regulation (GDPR).

The DMP is a living document, reviewed each period by the GDPR and IPR Coordinator through consultations with Work Package Leaders (WPLs) and updated based on policy changes and stakeholder feedback. This ensures that the Plan will remain aligned with Project needs and regulatory standards throughout the GN5-2 Project lifecycle.

As such, although the GN5-2 Project does not actively create or curate research data, Open Science is a critical element of the Project. The Project supports NRENs to embed Open Science practices across Europe via advocacy, raising awareness of good practice within the NREN community and supporting the adoption of Open Science practices.

The Data Management Plan provides guidelines on making Project data FAIR, keeping in mind the need to balance the openness and protection of scientific information, commercialisation and Intellectual Property Rights (IPR), privacy concerns, security, and data management issues.

4 Looking Ahead

The deliverable presents actions taken in GN5-2 to identify, track and showcase impacts. This has started mid-Year 1 and aims at continuing until the end of GN5-2. Both processes and outcomes on this new activity will be internally reviewed at the end of GN5-2 to move from an awareness-raising and initial process trial to a more standardised approach in future projects.

This activity on impact is highly strategic. The PMO is strongly promoting this new impact culture across the GN5-2 project team by involving all work package leaders, QASPER reviewers, and by creating a new Impact Liaison function in WP1.

The key success factor here is teamwork. To capitalise on synergies and keep this dynamic functioning well, the Impact Liaison will continue ongoing interaction with all work package leaders and will collaborate with WP2 and WP3. Both work packages are instrumental in this activity to interact with stakeholders, prepare narratives and spread the message. The Impact Liaison plans to participate in more PMB meetings, as well as at TNC26.

Showcasing how GN5-2 activities' return on investment and lasting values creation is leading to transitions or transformations not only serves the R&E community, but contributes to European Commissions' digital autonomy, sovereignty and competitiveness, and supports major programmes, including: Horizon Europe, EuroHPC, security, quantum technologies, Open Science, and AI. It certainly paves the way to new vertical areas where together, NREs and GÉANT can extend their influence and excellence.

Appendix A GN5-2 Outcomes and Destination Impacts

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

| Work Programme Outcome | WPs and Deliverables | Beneficiaries | FPA Action | Destination Impact |
|--|--|---|---|--|
| O1. Increase core network capacity and coverage | WP3 (D3.2, D3.3, D3.4), WP6 (D6.2), WP7 (D7.1), WP9 (D9.1, D9.4) | NRENS Users (education and research/scientific communities) Research infrastructures Industry/Market | Action A Action C, Action E Action F | D1, Further increase core R&E's network capacity towards delivering Terabit connectivity, where technically and economically feasible. |
| O2. Improve and expand connectivity and collaboration service catalogue offering | WP4-WP9 (D1.7, D1.11) | NRENS Users (education and research/scientific communities) Research infrastructures Industry/Market | Action A Action B Action D Action E | D2. Evolve the service catalogue to offer tailored combination of services to the scientific communities, to address new challenges in scientific research as well as on online education, such as data handling and educational connectivity beyond educational institutions. |
| | WP6, WP7 (D6.2, D6.3; D7.1, D7.2) | NRENS Users (education and research/scientific communities) Research infrastructures Industry/Market | Action E Action F | D5. Develop collaboration in new fronts, for example, by further provisioning services through a pan-European procurement framework, or extending the NRENS' federation leveraging open platforms and doing proof-of-concepts of advanced technologies and services to support international and cross-disciplinary research like fibre sensing (SMART cables), and time and frequency (metrology), and quantum communication infrastructures, where technically and financially possible. |
| O3. Leverage Trust and Identity Services | WP5 (D5.1, D5.2) | NRENS Users (education and | Action D Action E | D3. Leverage Trust and Identity Services, including contributions to national, European, and global |

| Work Programme Outcome | WPs and Deliverables | Beneficiaries | FPA Action | Destination Impact |
|--|--|--|----------------------------------|--|
| | | research/scientific communities) Research infrastructures Industry/Market | | standardisation and regulation, and interoperable frameworks to facilitate data- centric collaboration and adoption of FAIR data principles. |
| O4. Take GEANT's network and partners security to the next level | WP8 (WP3) (D8.1, D8.4) | NRENs Users (education and research/scientific communities) Research infrastructures Industry/Market Global Internet | All Actions | D4. Take the pan-European R&E network and partners security to the next level, for example by installing frameworks and processes for fast, federated and coordinated responses to computer security incidents across European's NRENs and communities. |
| O5. Develop collaboration in new fronts | WP1, WP3, (WP6/ WP7) (D3.1, D3.4, D3.5) | NRENs Users (education and research/scientific communities) Research infrastructures Industry/Market Global Internet | Action B Action E Action F | D5. Develop collaboration in new fronts, for example, by further provisioning services through a pan-European procurement framework, or extending the NRENs' federation leveraging open platforms and doing proof-of-concepts of advanced technologies and services to support international and cross-disciplinary research like fibre sensing (SMART cables), and time and frequency (metrology), and quantum communication infrastructures, where technically and financially possible. D6. Achieve connectivity globally and foster Europe's international cooperation policy objectives in line with the European Gateways Communication and the objectives of green and digital transition. |

Table A.1: GN5-2 Outcomes and Impact

From a services perspective, based on Deliverable *GN5-2 D1.7 Service Review and Services Status*), outcomes of the project will benefit different type of users.

| Service | Users of the service | Destination impacts |
|--|---|---------------------|
| Connectivity services | <ul style="list-style-type: none"> • The primary first-level users of GÉANT IP are GÉANT member NRENs. <p>The primary first-level users of GÉANT Plus are GÉANT NRENs and partners (both EU and non-EU)</p> <ul style="list-style-type: none"> • The primary first-level users of GÉANT Managed Wavelength are GÉANT NRENs and large e-infrastructures. • The GÉANT Spectrum Service is only available to GÉANT member NRENs. Requests from other potential users, e.g., R&E peers and related projects, will be reviewed on a case-by-case basis. • The users of the GÉANT Guaranteed Bandwidth Service are the NRENs. (GÉANT has no visibility or control of lower-level users) • The primary first-level users of GÉANT Open Exchange are global partners. • The primary first-level users of GÉANT L3VPN are GÉANT NRENs, global partners and large e-infrastructure. • The primary first-level users of GÉANT Peering are GÉANT NRENs. • Users of the DTN Testing Facility are individuals from the R&E community, typically part of a collaboration or large-scale scientific project whose activities involve transferring large amounts of data. • Users of perfSONAR software are organisations (e.g. universities, GÉANT NRENs and GÉANT itself), Individual users, Network researchers, Advanced (research) infrastructures (e.g., the LHC community) and research discipline communities using perfSONAR for troubleshooting and performance assessment. | D1, D2, D5, D6 |
| Network management and monitoring services | <ul style="list-style-type: none"> • PMP users are NREN NOC teams who use PMP. In several cases, PMP users are also regional networks and end institutions who showed an interest in operating PMP nodes. • TimeMap's target users are NRENs and other network providers supporting real-time applications that need a low-latency and low-jitter network transport. • Argus's target users are personnel at an NREN or other organisation's NOC or service desk. • nmaas has been designed to be as flexible as possible to support a wide range of use cases and users, including: small and emerging NRENs, small organisations, distributed research projects, GN5-2 project teams, universities. • The Network eAcademy's target users are the R&E community, mainly network and system engineers, but also management and researchers willing to learn more about orchestration, automation and virtualisation techniques and tools. | D1, D2, D5, D6 |
| Trust and identity services | <ul style="list-style-type: none"> • eduroam (first-level) users are national roaming operators (NROs), which are responsible for delivering eduroam as a national roaming service. Further service delivery is built by NROs upon the use of their member institutions, for example, campuses and regional facilities, who serve their end users from the R&E community. | D2,D3 |

| | | |
|------------------------|--|--------|
| | <ul style="list-style-type: none"> • eduGAIN (first-level) users are identity federations. Further service delivery is built by identity federations to meet the needs of their member institutions, for example, campuses and research institutions, who in turn serve their end users from the R&E community. • Core AAI Platform users are research communities engaging in international collaborations. They can be small, medium or large communities and/or long-tail collaborations. In addition, EuroHPC AAI and EOSC Node AAI are implemented on top of the GÉANT Core AAI Platform. • Customers of the InAcademia service are e-commerce service providers (merchants) – either commercial retail (business-to-consumer) organisations or not-for-profit organisations | |
| Security services | <ul style="list-style-type: none"> • Provided via NRENS, the primary first-level users of eduVPN are R&E institutions in both Europe and other regions. • The primary users of Firewall on Demand (FoD), Remote Trigger to Black Hole (RTBH), DDoS Cleansing and Alerting, are GÉANT member NRENS | D2, D4 |
| Above-the-Net services | <ul style="list-style-type: none"> • The primary first-level users of the OCRE Framework are GÉANT NRENS • The production-grade eduMEET package is offered as free open-source software to anyone. Active marketing currently targets European NRENS and beyond, along with R&E organisations including schools and hospitals. | D2 |

Table A.2: Users that will benefit from each service category

Appendix B Exploitable Results from GN5-2 Deliverables and Milestones

The following section gathers details from deliverables submitted so far (<M13) in Period 1. The purpose is to identify tangible impact, results, and value (measurable outcomes) of completed actions that can be shared.

An updated report will be included as part of the Period 1 Periodic Report.

D1 D9.1 Software Services Report

D9.1 summarises experiences, processes and practices that could be beneficial to a wider community, primarily those in Software and Licence Selection and Management and WP9 Wiki guides [19], as well as interest in further exploitation through the project results (pending further definition).

+ Free licence: The guides referenced will also be available on Zenodo under the CC BY licence.

D4 D3.1 Stakeholder Engagement Plan

A plan to ensure full coordination of all engagement activities across the project work packages.

- Overview of who the stakeholders are and how they are being engaged with, both enabling and demonstrating a coordinated approach to outreach.
- A project-wide set of engagement activities is available for all work packages, including the Project Management Board (PMB), GÉANT Symposium, TNC25 and TNC26, subject-specific infoshares, and *CONNECT* magazine.
- A range of tactical and strategic activities are in place across the project to address the increasing need for a more in-depth feedback loop between NRENs and GN5-2

D5 D9.2 New GUI for NOC Alarms Dashboard

The GÉANT-Sikt partnership has resulted in the development of GÉANT-Argus, a specialised frontend designed specifically for GÉANT NOC operations.

D6 D1.2 Management Report for M1-M5

The main achievements of the GN5-2 work packages during the reporting period are summarised below:

- Full preparations were made for TNC25 to be held in Brighton, together with host NREN Jisc, with a record 900+ registered attendees and 18 exhibitors from the Commercial Partnership Programme contracted to take part.
- *CONNECT* magazine successfully moved to a fully online version to make it easier to publish, find, share, and link articles and content; *CONNECT* issue 48 was delivered and issue 49 was prepared.
- Extensive support was provided for the successful OCRE 2024 launch, Security Days, and FOSDEM.
- 16 policy consultations were coordinated and submitted.

- A Multistakeholder Policy Conference titled “GÉANT’s Role in the Digital Transformation of Europe” was prepared, to be held in Brussels in the next period.
- The Community programme has now grown significantly, adding SIG-Quantum and SIG-Time & Frequency (SIG-TF) to its list of events at which community members can share information and best practice and collaborate on areas of joint interest.
- Two twinning projects are underway, between KENET and Jisc, and between LEARN and SURF, respectively.
- The Compendium has undergone a full re-design with a focus on case studies from NRENs and expert commentary.
- In the area of research engagement, the EUMETSAT Memorandum of Understanding (MoU) and contributions to the Group on Earth Observations (GEO) workplan are of particular note, as is the joint work on EuroHPC requirements carried out by members of Tasks 1, 2 and 3 in collaboration with the NRENs.
- OCRE 2024 Framework achievements:
 - Tasks 1 and 2 finalised and distributed OCRE 2024 documentation (“What is the Framework?”, “Institutions’ Guide”, “NREN Guide”, and “Buyers Guide”) and published the Cloud Catalogue for OCRE 2024 on the refreshed GÉANT Cloud Services website.
 - All 416 OCRE 2024 Framework contracts were successfully handed over from the GN5-1 project and are now fully operational.
 - Over 1,400 NREN-specific information-pack documents were created across three iterations.
 - Several tools were developed to support suppliers and NRENs, including a validator portal, internal reporting exports for NRENs, and an objective selection spreadsheet to guide institutions with complex needs.
- The team organised and supported 13 events, including 7 Cloud Forums, the GÉANT-EUNIS workshop (11 April), and the OCRE 2024 Launch Event (8–9 May)
- eduroam continues to be a service of reference for trusted and secure roaming access worldwide, while improvements are continuously being made to keep it aligned with changing environments and future demands.
- eduGAIN governance approved the eduGAIN Strategy document defining its mission, vision and values and the path forward for implementing the REFEDS Baseline Expectations for increasing trust, to strengthen the position of eduGAIN as the Global Trust Fabric in R&E.
- The T&I Incubator started a new cycle under new leadership in this project phase, while the Enabling Communities (EnCo) task added EUDI Wallets to its activities.
- Three new participants joined eduGAIN: Burkina Faso Identity Federation, GARNET Identity Federation (Ghana), and eduID.tg (Togo).
- The Site Reliability Engineering (SRE) team in T3 completed a major project to refresh and migrate the management of the VM infrastructure from Ansible to Terraform. This project took over a year and involved the migration of the infrastructure of 25 deployments to new infrastructure, including database migrations with almost zero downtime, thus enabling thousands of lines of homegrown Ansible code to be retired.
- Two Open Quantum Group Meetings were hosted, including an official introduction/handover to the new SIG-Quantum.
- Four Learning Units (LU) were published: "Time and Frequency Network", "Introduction to Fibre", "Neural Network and Deep Learning", and "Bitbucket".
- Three incubator projects were approved, two of which – “Long-haul White Rabbit Time Distribution” [20] and “Automated Log Analysis and Management Based on Large Language Models” [21] – have

started, while the third (“Workflow Orchestrator (WFO) RAG agent and LLM integration [22]) is planned to start on 1 July.

- 1.6 Tbps backbone capacity upgrades have been deployed across the Western Ring.
- Major IP/MPLS migrations and upgrades at multiple sites have been completed.
- The core migration process has been automated using the GÉANT Automation Platform (GAP).
- A record-setting 400G ZR+ optics field trial was conducted to validate cost-effective scaling to 1 Tbps, demonstrating the feasibility of deploying pluggable coherent transceivers over ultra-long distances.
- The second annual Security Days, a 3-day R&E security conference, was held in April 2025 in Prague, attended by 166 participants from 28 different countries, with the GÉANT membership well represented among attendees.
- The WP8 Bootcamps subtask has made excellent progress in the first half of 2025 with Bootcamp sessions in a variety of formats – ranging from lightning talks to structured sessions – delivered to project members. These sessions have been instrumental in promoting the benefits of adopting best practices, understanding compliance processes, and fostering a shared culture of security.
- The first NREN Access Port (Jisc AP2) was successfully migrated to a Nokia router in January.
- In February, DFN became the first NREN to be fully 400G-connected (primary and back-up access ports).
- Also in February, GÉANT Digital Services successfully launched a new, outsourced ticket system, Ivanti Neurons, which is being used to support both GÉANT Association and GÉANT Project IT users.
- The GÉANT Operations Centre (GOC) successfully migrated its legacy ticket system OTRS to Otobo (an open source equivalent). This is an intermediate step before the GOC moves to the Ivanti Neurons system.
- GÉANT Network Service Reports were successfully migrated from Tableau to Microsoft Power BI.
- The GOC’s Dashboard GUI was upgraded based on Sikt’s Argus system, with help from the Argus developers.

D7 D3.2 Compendium Report

Especially exploitable NREN lobbying tool.

D21 D9.5 Open Source and Licence Support Report

(Swapped timing with D9.3 Software Code Reviewers’ Report, as tracked in recent project amendment)

- OSS licensing and eAcademy course on software licensing.

D10 D1.4 Management Report for M6-M10

The main achievements of the GN5-2 work packages during the reporting period are summarised below:

- Deliverable D1.1 Data Management Plan was submitted to the EC in June 2025. Following the European Commission’s recommendations, this Plan describes how the Findable, Accessible, Interoperable, Reusable (FAIR) principles will be implemented for the datasets within the Project. The objective of this Plan is to define how data will be created, how it will be documented, who will be able to access it, where it will be stored, who will back it up, and whether (how) it will be shared and preserved.
- WP1 Outreach Coordination together with WP2 organised and delivered the first GÉANT multistakeholder event, an invitation-only visibility event for GÉANT and the NRENs, “GÉANT’s Role in the Digital Transformation of Europe” which brought together different DGs and other stakeholders in Brussels on 14 October 2025.

- During the reporting period, two tender processes were conducted for frequency amplifiers and dark fibres to build the ‘northern route’ of the GÉANT Core Time and Frequency Network (C-TFN), a pan-European Time and Frequency (T&F) reference system.
- A successful TNC25 conference was held with 900 in-person participants, representing a 7% increase over TNC24.
- Three editions of the CONNECT magazine, including a printed June edition and printed special edition for TNC25 and the Multistakeholder Conference, respectively.
- Extensive support for services, including promotion of the 400G trial, eAcademy courses, and the submission of an award entry for GN4-3N.
- The preparation and rollout of GÉANT’s Cybersecurity Awareness campaign.
- WP3 continues its bespoke support for the South East Europe (SEE) region:
 - A Task 1 member chaired a panel discussion at the Western Balkans Digital Summit 2025 and facilitated a joint declaration from NREN participants on advancing secure, high-capacity digital infrastructure across the Western Balkans.
 - T1 also supported Ronan Byrne, GÉANT Board member and CEO of HEAnet, in representing GÉANT at the EU–Western Balkans Investment Forum.
- The TNC25 CEO Track welcomed a record number of 65 NREN attendees from all regions of the globe. Talks were given by seven CEOs with the addition of one external speaker, a new feature this year.
- Two newly launched SIGs – SIG-Quantum (Special Interest Group on Quantum Technologies) and SIG-CNaaS (Special Interest Group on Campus Network as a Service) – successfully established themselves further within the community, building their presence and promoting future activities.
- A new AI NREN coordination group was formed to share information and capture co-creation and collaboration opportunities in AI for NRENs in Europe.
- OCRE 2024 Framework:
 - OJEU contract award notices were published on the TED platform in August. An article about the notices was published by the team in CONNECT online.
 - OCRE 2020 and 2024 Frameworks’ consumption in Q1–Q2 2025 totalled €68.67 million, while Q1 2025 alone exceeded Q1 2024 by €13 million, with consumption still accelerating.
- Service Concept Development:
 - Detailed work plans for each service concept were produced in August, incorporating feedback from the WP4 TNC side event.
 - Cloud Strategy Forums dedicated to Object Storage and Data Movement, and to DRE strategy and concepts feedback, respectively, were held 26 September and 17 October.
 - In September, the Digital Research Environments (DRE) service concept received broad endorsement through Incubator interest and EOSC projects already using or planning to use the SURF Research Cloud platform.
 - Object Storage progress was presented at the NORDUnet Community Workshop in September.
 - The Data movement team defined a problem statement and tested and refined the concept during a EuroCC (National Competence Centres) closed webinar on 30 October, involving HPC competence centres linked to EuroHPC.
- WP4 Incubator:
 - In July, seven Incubator proposals were submitted, and four were awarded.
 - By August, two of the awarded projects (DRE and Data movement) had received strong community interest and subsequently commenced on 1 October.

- The team organised and supported 19 events, including TNC25 side event “GÉANT Cloud – New Framework Agreements and Sovereign Service Concepts”, 7 Cloud Forums, 2 Strategy Forums, and a EuroCC webinar on data movement.
- New versions of geteduroam and CAT have been released.
- Contributions were made to IETF standardisation relating to RADIUS/TLS (RadSec) and RADIUS proxy.
- The eduGAIN service improved its technical resilience and is enhancing its baseline. The eduGAIN OpenID Federation Pilot started, involving the participation of 12 eduGAIN members, 6 of whom are already running components.
- EOSC Nodes have been enrolled to the acceptance environment of MyAccessID and a large overhaul of the underlying VM infrastructure of the CoreAAI platform has been undertaken.
- The Incubator successfully concluded its first cycle in GN5-2.
- Three white papers were published in the reporting period: Programmable Networks: Current State and Trends [23]; Towards Quantum-Safe Networking [24]; and Intelligent Networks: The Rise of Generative AI in Network Management [25].
- Two Infoshares were held: ‘Operational Aspects of Quantum Communication Networks’ and ‘Orchestration solutions for network development – WP6 update’.
- Two learning units – ‘Product Catalogue’ and ‘Unsupervised learning’ – were published in the Network eAcademy.
- The first open meeting of the GNA-G Network eAcademy WG was held.
- A new metro map was produced for the Quantum Technology (QT) training track.
- Two feature releases of Argus, 2.1 and 2.2, were issued.
- perfSONAR version 5.2 was released in June.
- During the reporting period, 12 Juniper routers were successfully replaced with Nokia routers at locations in Budapest, Marseille, Poznan, Bucharest, Prague, Bilbao, Vienna, Madrid, London 2, Bratislava, Milan and Amsterdam.
- True pan-European Terabit-scale capacity was achieved, with the Western Ring (FR, CH, DE, NL, UK ring) upgraded to 1.6 Tbps and the outer rings upgraded from 400 Gbps to 800 Gbps, providing a robust network capacity to support projected traffic growth and meet EuroHPC requirements.
- Successfully validated ZR+ in live network conditions, confirming its production readiness and enabling significant cost reductions in future backbone upgrades.
- Successfully demonstrated White Rabbit time transfer over the DWDM L-band, proving time distribution can coexist with production internet traffic.
- Completed the equipment procurement process for the Time and Frequency Network with the selection of an equipment vendor.
- Enabled automation-led migration from Juniper to Nokia devices by introducing “Massive Service Migration”, enabling all services on a given interface or port via a single automated workflow.
- The 2025 Cybersecurity Campaign was successfully executed, with four webinars, four interviews, and downloadable resources, along with promotional social media animations and video testimonials as part of the campaign’s social media output in seven different languages.
- The first two quarterly R&E Cyber Threat Reports were published in August and October 2025, covering Q2 and Q3 2025, respectively. These reports provide R&E security staff with operational details on observed attacks and threat actors and suggest recommended threat remediation techniques to improve the security posture of European R&E institutions.
- A new Software Certificates website was launched. Software certificates are awarded to GN software projects and applications that comply with the project’s licensing requirements.

- Following a procurement process, a new contract was signed with Kentik for NetFlow Analysis Software, with improved terms.
- Framework Contracts for the supply of NetFlow Analysis Software to NRENs were signed with Kentik and BENOCS. BENOCS, a relatively new entrant to the market, gave an Infoshare to introduce their product to the NRENs.
- The re-procurement of GWS was successfully concluded.
- Based on NREN feedback, improvements were made to the NREN dashboards in BRIAN to show more granular details on levels and types of traffic on NREN networks.
- The Invitation to Tender (ITT) for a new Service Desk was issued. The current contract expires in March 2026.

D12 D2.2 Project Communications Strategy and Plan (2)

WP8 Security: Support Material

In addition, WP8 delivered five Security Milestones, updated software packages, standards and best practices in addition to drafting security awareness material. (Trend and threat report material shared restrictions for some security awareness material).

B.1 Example Form for Exploitable Results.

This form is for internal use only by authors and QASPER reviewers as part of deliverable review (to be deleted or hidden before publication of deliverable).

| | |
|--|------------------------------------|
| Does this deliverable have any exploitable results ¹ (dataset/software, etc), including foreground information ² ? (If yes, please describe.) | Yes/No |
| Who is the owner partner(s)? Single or joint ownership? | |
| Is there interest in further exploitation through the project results? | Yes/No |
| In which form will the results be made available to other partners? | Licensing/Open Access/Free licence |
| Does the exploitation of the results require access to background information ³ ? | Yes/No |
| Does the exploitation of the results require access to third-party IPR? | Yes/No |

¹ Exploitable results are generally defined as products, processes, services, methods, etc., which are new, improved or more efficient. They are the direct or indirect utilisation of foreground in further research activities (other than those covered by the project) or for developing, creating and marketing a product, a process or a service. An exploitable result is defined as an outcome of the project (achieved or expected) that has commercial/social/academic relevance or can be commercialised/exploited as a standalone result (product, process, service, etc.) (a patent for licensing is also an exploitable result). Results might need further R&D, prototyping, engineering, validation, etc. at the end of the project – before they become commercially exploitable.

² Foreground information includes results, protected or not, which are generated under the project and belong to the beneficiary generating it. Foreground info can be jointly generated (joint ownership) and can be transferred (third parties).

³ Background information is Information held by beneficiaries, owned or controlled by project partners and brought to the project. Background may come from existing knowledge as well as copyright or other IPR. It must be relevant to the project result, needed to carry out the project or for use with foreground, and is somehow embedded in the result.

Appendix C Quantitative and Qualitative Indicators: Project KPIs

For reference, the project set out the following KPIs for each work package. These are monitored throughout the project and regularly reported in the GN5-2 Management Reports.

WP1

- Number of services to have costing analysis. Target: 100%.
- Number of deliverables issued on time. Target: 100%.
- Attendance at training courses. Target: 100 participants per year.

WP2

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

**Mastodon currently does not collect or track data.*

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

WP3

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

WP4

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

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

OCRE 2024:

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

Other Above-the-Net services:

- Known installations at NRENs/institutions.

Community coordination:

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

WP5

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

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

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

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

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

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

WP6

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

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

WP7

- GÉANT point of presence (PoP) availability: 99.9%.
- GÉANT IP network service availability to each NREN: 99.9%.
- Number of workshops and knowledge-sharing events. Target for project end: 2.

- Number of new and upgraded services successfully delivered. Reporting at end of each period.

WP8

- Delivery and operation of existing security services.
- Annual pan-European (and beyond) cyber security conference for Research and Education., with an anticipated 250 participants.
- 2 annual cyber security training or events attended by 50 participants from 30 NRENs over the duration of the project.
- 4 NRENs participate in joint security intelligence operations in 2025 and 6 in 2026.
- Coherent set of security best practices for GÉANT and NRENs that is used completely or partially by at least 10 NRENs.
- 2 pilots of new managed security services.
- Operation of 3 security services.
- New major releases of eduVPN, FoD and NeMo.
- Security baseline is used annually by 10 NRENs or products.
- (Contribute to) 2 publications in relevant scientific papers.
- 5 research projects carried out in the Security Innovation Lab.

WP9

- 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.

Glossary

| | |
|---------|--|
| AAI | Authentication and Authorisation Infrastructure |
| AI | Artificial Intelligence |
| DDoS | Distributed Denial of Service |
| DNS | Domain name system |
| EOSC | European Open Science Cloud an environment to provide researchers and innovators in Europe with an open and trusted multi-disciplinary environment where they can publish, find and reuse data, tools and services for research and innovation |
| GN4-3N | GÉANT Network 4, Phase 3 Network, a project funded by the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 856728. |
| GN5-1 | GÉANT Network 5, Phase 1, a project funded by the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101100680 and one of the projects implementing the actions defined in the GN5-FPA |
| GN5-2 | GÉANT Network 5, Phase 2, a project funded by the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101194278 and one of the projects implementing the actions defined in the GN5-FPA |
| GN5-FPA | The GN5 (GÉANT Network 5) Framework Partnership Agreement, a 72-month strategic framework that outlines the overall direction, objectives, and impacts of individual projects within that timeframe as part of the EU's Horizon Europe research and innovation programme |
| GN5-IC1 | GÉANT Network 5, Phase 1, International Connectivity 1, a project funded by European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101086099 and one of the projects implementing the actions defined in the GN5-FPA |
| KER | Key Exploitable Results |
| NOC | Network Operations Centre |
| PLM | Product Lifecycle Management |
| PMB | Project Management Board |
| PMO | Project Management Office |
| QASPER | Quality Assurance and Public and External Relations Committee |
| QKD | Quantum Key Distribution |
| R&E | Research and Education |
| RDA | Research Data Alliance |
| SDG | Sustainable Development Goals |
| SIG | Special Interest Group |
| SOC | Security Operations Centre |
| SSI | Self Sovereign Identity |
| T&I | Trust & Identity |
| TF | Task Force |
| TRL | Technology Readiness Level |
| WP | Work Package |

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