GÉANT

ACHIEVEMENTS OF THE GÉANT PROJECT (GN3) 2009–2013

GÉANT, the pan-European communications infrastructure serving Europe's research and education (R&E) community, delivers advanced multi-domain services and facilitates joint-research activity that drives innovation. Together with Europe's National Research and Education Networks (NRENs), the GÉANT network reaches over 50 million users in 10,000 institutions. This document charts GÉANT's main achievements during the EC funded GN3 project from March 2009 to September 2013.

GÉANT has transformed the way researchers collaborate

The core objective of GÉANT is to make collaboration seamless and straightforward enough to enable ground-breaking research. This was achieved through a four-part strategy:

- **Societal Support:** Focused on meeting (and exceeding) expectations of current and future user communities.
- **Network Expansion:** Leveraged investment in fibre infrastructure to reduce costs and increase flexibility.
- **Service Development:** Incorporated value-added services to support collaborative research.
- **Innovation:** Established a pipeline of advanced, user-focused services and network innovations.

Societal Support through connecting user communities

Every day over 1,000 terabytes of data is carried by the GÉANT network, with the majority generated by the most advanced and far-reaching research conducted anywhere in the world. With the exponential growth of research data, GÉANT's federated network and access to services is even more vital to researchers, academics, students and practitioners.

Many major projects involving partners such as CERN's Large Hadron Collider (LHC), the forthcoming Square Kilometre Array (the world's largest radio telescope), and many bioinformatics projects depend on GÉANT, which continues to provide the essential bandwidth to support disciplines from high-energy physics and deep-space research to those addressing societal challenges, such as ageing populations, disease diagnosis, food security and climate change, as well as increasing demand for e-learning capabilities.
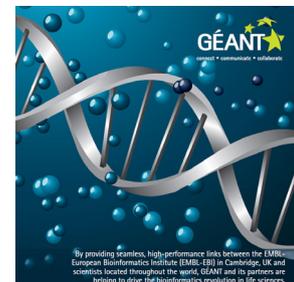
Project acronym	GN3*	EC contribution	€93m
Contract	RI-238875	Participants	More than 400 participants from 34 project partners: DANTE, TERENA, 31 NRENs and NORDUnet (representing 5 Nordic countries)
Project type	CCPCSA		
Start date	1 April 2009		
Duration	54 months		
Total budget	€182m		

*GN3 is the third iteration of the GÉANT project (following GN1 and GN2), and predecessor of the current GÉANT project (GN3plus) which operates and manages the GÉANT network, services, innovation and other initiatives.

"With this upgrade supporting capacity (the amount of data that can be carried) of up to 2Tbps across the core network, this project is essentially future proofing GÉANT until 2020. It means we can stay ahead of what has been termed the 'data deluge' that is emerging from research projects that are using more and more data in new ways.

Today data speeds and processing are as critical as the research itself, and a super-fast network means we are closer to achieving a European Research Area, and to successfully dealing with challenges such as food and energy security, health and ageing, and environmental protection."

– Neelie Kroes, Vice President of the European Commission

By providing seamless, high-performance links between the EMBL European Bioinformatics Institute (EMBL-EBI) in Cambridge, UK and scientists located throughout the world, GÉANT and its partners are helping to drive the bioinformatics revolution in life sciences.

"The European Bioinformatics Institute would not exist without GÉANT, because our primary goal is to collect and distribute biological data... without GÉANT we could not do that."

– Professor Janet Thornton, Director of EMBL-EBI and Coordinator of ELIXIR

GÉANT

NETWORK EXPANSION

GÉANT has placed Europe at the forefront of R&E networking

GÉANT has built up extensive links with other world regions through close collaboration with regional networks, including North and Latin America, the Mediterranean, South Africa, Central and Eastern Asia, the Far and Middle East and Africa.

The number of non-European countries reached has risen from 37 to 66, representing a further 60 million users outside of Europe and global capacity has risen from 32Gbps to 91.5Gbps.

GÉANT delivered flexibility in network capacity and provisioning

The most significant achievement was delivery of the capability to upgrade line speed to 2Tbps on the same fibre infrastructure. This two-year procurement and implementation was completed in 2013, with minimal disruption to services, bringing huge benefits to the GÉANT partners and the campuses, institutions and projects they serve.

- **Increased reach and capacity** to future-proof the network to 2020. This will keep GÉANT ahead of the data deluge, offering 500Gbps now and rapid scalability to 2Tbps and beyond.

- **Improved support for demanding user communities**, keeping Europe at the centre of global research in disciplines such as bioinformatics, earth observation, environmental monitoring, and particle physics.

- **Added value to the services offered by NRENs** by increasing resilience, and flexibility of provision and support for multi-domain services, with dedicated circuits (GÉANT Plus) now available to all NRENs.

- **Reduced lead times for new services.** GÉANT IP and GÉANT Plus services reconfigurable in minutes rather than days; GÉANT Lambda lead times reduced from 15 weeks to less than 7 days.

- **Enhanced network security.** The security of the network was enhanced through deployment of the NSHaRP security notification system. This extended the NRENs' detection and mitigation capability to GÉANT infrastructure and deployed a comprehensive security monitoring and response team to support the increasing need for mission-critical security levels by research projects.

GÉANT delivered better value to NRENs

By the end of this GÉANT project, total NREN subscription capacity had doubled whilst subscription costs were actually reduced by 22% over the project period.

NREN Subscription Capacity and Cost (Indexed)
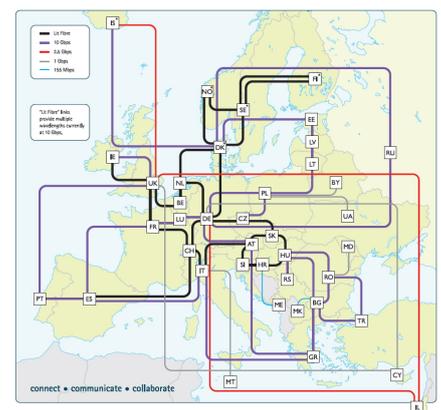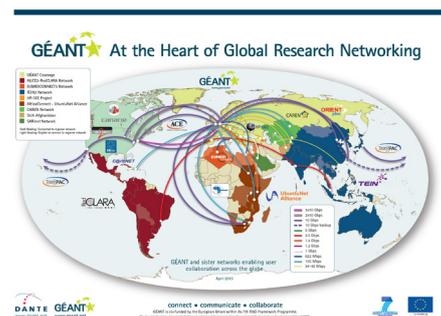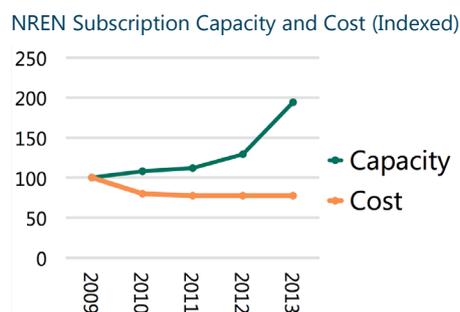
"The project to upgrade the GÉANT network involved renewing 50,000km of backbone infrastructure and the replacement of legacy equipment with leading-edge transmission and switching technologies, a significant undertaking and long term investment. The new network brings several key benefits: greatly increased capacity, faster provision of service, and even higher levels of resilience."

– Mark Johnston, Chief Network Operations Officer, DANTE

ComputerWeekly European**User Awards** | Networking

DANTE (Delivery of Advanced Network Technology to Europe) has been awarded 'Best Technology Innovation' for the research and education network GÉANT, in the 2013 Computer Weekly Awards.

SERVICE DEVELOPMENT

GÉANT expanded its portfolio of flexible, secure network access options

A platform of trusted, secure, dynamic services has been developed, providing Europe's R&E community with access to the resources and content they need, irrespective of location, timeline, platform and bandwidth requirements.

The GÉANT project delivered six new innovative products and services bringing the total of services in production or pilot to 11, including: flexible connectivity options, network performance and user access, roaming and identity applications.

Service status at end of GN3 project	Connectivity Services	User Access Services	Network Performance
Production/Pilot	GÉANT IP GÉANT Plus GÉANT Lambda GÉANT Bandwidth on Demand GÉANT Open	eduroam eduGAIN eduCONF	perfSONAR eduPKI eduPERT
Strategy/Design	Multi-domain Wavelength Multi-domain VPN/Optical VPN	Mobile Data Services	

Bandwidth on Demand: A new framework for an on-demand service provision, BoD was the result of a multi-national collaboration to drive interoperability standards (such as NSI) for network management.

eduroam: this roaming access service marked its 10th birthday in 2012, and saw huge growth in usage during the project, expanding to 43 European countries and 66 countries outside of Europe. CAT (Configuration Administration Tool) was developed to simplify installation of eduroam at campus level and increased the security features.

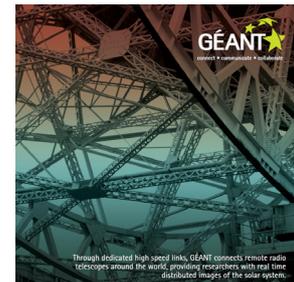European growth of the eduroam roaming access service:

	2009	2013
Countries	34	43
Locations	800	8000+
Users per month	9500	930,000
Connections per month	94,000	6,400,000

eduGAIN: eduGAIN provides a core AAI platform to support European collaboration, which has gained worldwide recognition and increasing take-up. It is a key enabler of services and applications, which has interconnected 15 identity federations around the world by the end of GN3. Development included guiding and influencing EU initiatives and legal structures for online identity and privacy – providing a positive influence to a complex and increasingly vital field.

perfSONAR Multi-domain monitoring: this service was re-developed in response to user feedback. Since its re-launch, it has been taken up in 18 countries across Europe.

GÉANT has provided greater digital inclusion across Europe

Collaboration with GÉANT's global network partners resulted in the development of common service capabilities across the globe, enhancing opportunities for collaboration. Training was carried out across emerging European NRENs to encourage service uptake and ensure digital inclusion.

Through dedicated high speed links, GÉANT connects remote radio telescopes around the world, providing researchers with real time distributed images of the solar system.

"Bandwidth on Demand from GÉANT enables us to perform world-class real-time science in a cost effective manner, respond to unexpected astronomical events and also allow efficient use of the network by other users."

– Dr. Arpad Szomoru, Head of Technical Operations and R&D, JIVE (Joint Institute for VLBI in Europe)

Bandwidth on Demand
PART OF THE GÉANT SERVICES PORTFOLIO

eduroam

eduGAIN

perfSONAR MDM

e science TALK

GÉANT received first prize at the 10th e-Infrastructure Concertation Meeting, in the Excellent Science category for its entry 'Driving technology across the digital divide'.

INNOVATION

GÉANT has influenced industry and the future of networking

Through Joint Research Activities, standards work, foresight research and coordination of eight Task Forces, GÉANT has produced class-leading research during the GN3 project in a variety of fields, influencing strategic policy, feeding service innovation and impacting industry technology roadmaps and helping to shape the internet of the future.

- **Network architecture:** developed a roadmap for innovation of future networking platforms.

- **Network management systems:** incorporated a standards-based approach to management technologies and services (such as NSI v2.0 and end-to-end service management).

- **OpenFlow and SDN (software defined networking):** realised the huge potential of high performance networking to deliver innovative, disruptive services and solutions.

- **AAI** and federated identity technologies and services (such as SAML and VOOT) to support secure multi-domain authentication and authorisation facilities, with significant impact on Radius protocol standards.

- **ASPIRE**, a study on the prospects of the internet for research and education 2014–2020, was undertaken as part of GN3 to inform and guide policy and decision making within the community, feeding into discussions on GN3plus, Horizon 2020 and on CEF (Connecting Europe Facility).

Many of the research projects in GN3 have been instrumental in the development of highly successful services. The NSI development work is the core enabler of the future of the multi-domain Bandwidth on Demand service and AAI developments have enabled the rapid, worldwide roll-out of eduroam and eduGAIN services to the R&E community.

A legacy for future GÉANT projects

The progress, achievements, structural and process changes throughout the four years of GN3 have demonstrated that GÉANT is now more able to plan and provide for its NRENs and user communities, by providing flexibility in the way networking needs are achieved, now and in the future.

The GÉANT project continues to shape the internet of the future by investing in the research and development of an advanced portfolio of technologies, to develop into services, tools and network capabilities for tomorrow's researchers.

Understanding and delivering to user needs

The close collaboration of GÉANT partners across the Activities has fostered a collaborative culture, and ensured consideration of the user perspective.

Investing in Project Management and business development processes and the creation of a dedicated Product Lifecycle Management structure during the project's lifetime has been at the heart of transforming the project from a technology-led to a market-led/user-focused organisation.

> **"GÉANT has brought together all of Europe's NRENs working towards a common goal, which continues to be an impressive achievement. GÉANT will continue its efforts to ensure Europe remains at the heart of the global research village."**
>
> – Dorte Olesen, Chair of GÉANT's Policy Committee

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