GÉANT

# Transforming the way researchers collaborate

connect • communicate • collaborate

# GÉANT – A Gateway for European Research

The GÉANT network is the high-bandwidth, high-performance pan-European communications infrastructure serving Europe's research and education community.

Through interconnections with Europe's National Research and Education Networks (NRENs) GÉANT serves some 40 million users in 40 countries across the continent. The provision of worldwide connectivity through extended links with other regional networks gives GÉANT unrivalled geographical coverage. Together with its high transmission speeds, reliability, innovative networking technology and range of user services and applications, GÉANT remains the most advanced international network in the world.

Co-funded by Europe's NRENs and the European Commission (EC) under the Seventh Framework Programme for Research and Technological Development (FP7), the GÉANT network, along with associated development activities, is in its third generation.

GÉANT's core objective is to deliver real value and benefit to society by enabling research communities across Europe, and the world, to transform the way they collaborate on ground-breaking research.

The GÉANT project advances all aspects of European research and education networking, encompassing:

- The fast and reliable GÉANT network.
- A portfolio of advanced connectivity, network support and access services for NRENs, projects, institutions and end users.
- Initiatives to address the digital divide in research and education networking around Europe.
- Technological research to ensure GÉANT continues to be at the forefront of networking on a global scale.

GÉANT is building on the success of its predecessors. The previous GÉANT project (2004–2009) focused on establishing the world's most advanced network of its type, using innovative hybrid technology to deliver a flexible service model. With this now in place, the new GÉANT project will focus, in collaboration with the NRENs, on the development and introduction of an enhanced portfolio of tools and services to enable the research and education community to benefit from the best performance possible from the network.

The project partners are 32 European NRENs, DANTE and TERENA, with DANTE providing overall coordination of the project.

## Developing the GÉANT Service Area

Users rely on secure and seamless access to the network and resources they require. The data they exchange in collaborating with their peers across the globe often travels across multiple network domains, creating the need for transparent point-to-point connectivity and cooperative network management.

To deliver this, the pan-European GÉANT backbone network and European national networks combine to create the GÉANT Service Area, a common pan-European service infrastructure that enables a range of advanced network services and applications to be offered at a national level by NRENs.

# Project Partners

Together with Europe's NRENs, GÉANT connects 40 million users in over 8,000 institutions across 40 countries.

| | | |
|---|---|---|
| DANTE | | www.dante.net |
| TERENA | | www.terena.org |
| ACOnet | Austria | www.aco.net |
| AMRES | Serbia | www.amres.ac.rs |
| ARNES | Slovenia | www.arnes.si |
| BELNET | Belgium | www.belnet.be |
| BREN | Bulgaria | www.bren.acad.bg |
| CARNet | Croatia | www.carnet.hr |
| CESNET | Czech Republic | www.cesnet.cz |
| CYNET | Cyprus | www.cynet.ac.cy |
| DFN | Germany | www.dfn.de |
| EENet | Estonia | www.eenet.ee |
| FCCN | Portugal | www.fccn.pt |
| GARR | Italy | www.garr.it |
| GRNET | Greece | www.grnet.gr |
| HEAnet | Ireland | www.heanet.ie |
| IUCC | Israel | www.iucc.ac.il |
| JANET | UK | www.ja.net |
| LITNET | Lithuania | www.litnet.lt |
| MARNet | F.Y.R. Macedonia | dns.marnet.net.mk |
| MREN | Montenegro | www.mren.ac.me |
| NIIF | Hungary | www.niif.hu |
| NORDUnet | Nordic region | www.nordu.net |
| PSNC | Poland | www.man.poznan.pl |
| RedIRIS | Spain | www.rediris.es |
| RENATER | France | www.renater.fr |
| RESTENA | Luxembourg | www.restena.lu |
| RoEduNet | Romania | www.roedu.net |
| SANET | Slovakia | www.sanet.sk |
| SigmaNet | Latvia | www.sigmanet.lv |
| SURFnet | Netherlands | www.surfnet.nl |
| SWITCH | Switzerland | www.switch.ch |
| ULAKBIM | Turkey | www.ulakbim.gov.tr |
| UoM | Malta | www.um.edu.mt |

Associate NRENs

| | | |
|---|---|---|
| BASNET | Belarus | www.bas-net.by |
| JSCC | Russia | www.jscc.ru |
| RENAM | Moldova | www.renam.md |
| URAN | Ukraine | www.uran.net.ua |

GÉANT is fundamental to realising the vision of the European Research Area: a border-free zone for research created by the networking of institutions and the increased mobility of researchers around Europe

# Contributing to the Vision of the European Research Area

## What is Research and Education Networking?

Research and education networking allows researchers and academics, teachers and students to collaborate, sharing information and facilities via a series of interconnecting electronic networks. These networks form a separate part of the Internet, reserved for the research and education community. Using research networks, academics and researchers can collaborate across different countries and continents throughout the world.

Research networks serve two primary purposes:

- They support the work of researchers and academics by providing a high-capacity data communications infrastructure that allows the rapid transfer of large amounts of data.
- In addition, they form a research tool in their own right, by providing a platform on which researchers and innovators can develop and test new network technologies and services.

Great advances in research networking have been made possible by the revolution in the telecommunications sector. Much of today's network communications technology was developed using research networks, and much of tomorrow's consumer communications technology is already a reality in the research sector.

## GÉANT at the Heart of the European Research Area

The GÉANT network is fundamental to the European Union's (EU) vision of a European Research Area (ERA), a policy initiative for a border-free zone for research. The EU is creating the ERA by:

- Networking leading research institutions together to produce European "centres of excellence" through closer cooperation.
- Implementing research programmes in a coordinated manner across Europe.
- Encouraging greater mobility of researchers around Europe.

In a 2009 communication to the European Parliament and Member States, the European Commission stressed the major contribution that the GÉANT e-Infrastructure makes to realising the vision of the European Research Area. GÉANT plays a key role in supporting the deployment of new research facilities, the development of which is articulated by policy groups from the European Strategy Forum on Research Infrastructures (ESFRI) and the e-Infrastructure Reflection Group (e-IRG) in a dialogue with Member States.

GÉANT also forms a key component of the EU's Lisbon Strategy, which aims to make Europe the world's most dynamic and competitive knowledge economy by promoting innovation. GÉANT is furthering the contribution of information and communication technologies (ICT) to the Lisbon goals by developing e-Infrastructures that help build new research environments, driving productivity and the quality of the science performed.

This infrastructure links researchers in all domains with huge bandwidth, removing geographical constraints and facilitating distributed collaboration, thus creating synergies between dispersed research groups and enhancing their potential to address more complex challenges.

GÉANT is also helping to deliver the EU's i2010: European Information Society 2010 initiative, which forms part of the Lisbon Strategy and aims to:

- Achieve a single European information area.
- Boost innovation and investment in ICT in order to support growth and employment.
- Create an inclusive European information society to improve the quality of public services as well as quality of life.

GÉANT will continue promoting the role of e-Infrastructures in a changing and global research environment.

## A Test-Bed for the Future Internet

In parallel with operating the existing network infrastructure, GÉANT conducts ongoing research into the emerging technologies, standards and equipment that will be built into the infrastructure of tomorrow. GÉANT research teams collaborate with industry, standards bodies and networks around the world to identify optimum technological solutions. Analysis of emerging future networking technologies and research into new services are essential to bring innovation to the core network infrastructure and to technological solutions for network control, management and service provisioning across the GÉANT Service Area.

As the most advanced research and education network in the world, GÉANT is at the forefront of new information and communication technologies. Essentially it acts as a test-bed for new technologies, providing an opportunity for proof of concept before commercial adoption. The latest GÉANT project is primarily focused on the development and introduction of services for its user base that will have widespread benefits and ultimately provide the blueprint for future commercial applications.

Consequently GÉANT is a key part of the EC's Future Internet initiative. Building on concepts such as grid and cloud computing, the Future Internet initiative is researching the creation of an "Internet of Services", where new, interoperable services can be quickly developed and deployed on top of the existing high-speed infrastructure.

GÉANT's contribution to this research is concentrated in three key areas.

### *Interoperability*

Given that research infrastructures encompass multiple networks at campus, national and international level, each with potentially different architectures, policies and technologies - ensuring they can work together is vital. In cooperation with the NRENs, GÉANT aims to provide a Federated Network Architecture that harmonises this multi-domain environment to ensure users receive seamless, end-to-end provision of services, wherever they are located.

### *Virtualisation*

There is a trend towards the use of virtualisation technology to make it easier for users to create their own networks on demand to support collaboration. GÉANT has been built to deliver this capability from the outset, enabling virtual "private" network paths with dedicated bandwidth to be deployed quickly for individual user projects. Service provisioning in this way enhances the flexibility of connectivity options.

### *Internet of Services*

To achieve an Internet of Services, it must be easy and secure to develop, deploy and access new services. The idea of composable network services, that is, being able to quickly create and install new services on the network from existing components, relies on the creation of a common software framework that services can plug into.

The power of these developments from GÉANT in pursuit of the future Internet promises that for both researchers and, eventually, the general public, it will provide the high-capacity, service-based framework needed to underpin users' requirements well into the future.

GÉANT was the first production network deployed on an international scale that uses an innovative combination of transmission and switching methods to open up new service possibilities.

# Lighting Dark Fibre for Greater Network Performance

## A Collaborative Network for the Research and Education Community

Never has international collaboration been more important in all disciplines, meaning that researchers now need to collect, share and analyse information in real time in areas as disparate as physics and e-learning, health and earth observation. The scale and bandwidth needs of this traffic mean it can only be handled by a network designed specifically for this purpose and not by commercial operators.

Research and education networks are therefore essential for international collaboration, enabling the creation of virtual teams that bring the best minds together, irrespective of location. Designed specifically to meet the needs of the research and education community, GÉANT provides a seamless, high-capacity network with unrivalled geographic reach.

To provide the capacity and services that users need and expect, European research networking itself requires a truly collaborative approach. Local campus networks link to national research networks that span specific countries and these then interconnect via the GÉANT backbone. This seamless connectivity is only possible through collaboration with the NRENs.

## Innovative Topology for Flexibility, Reliability and Speed

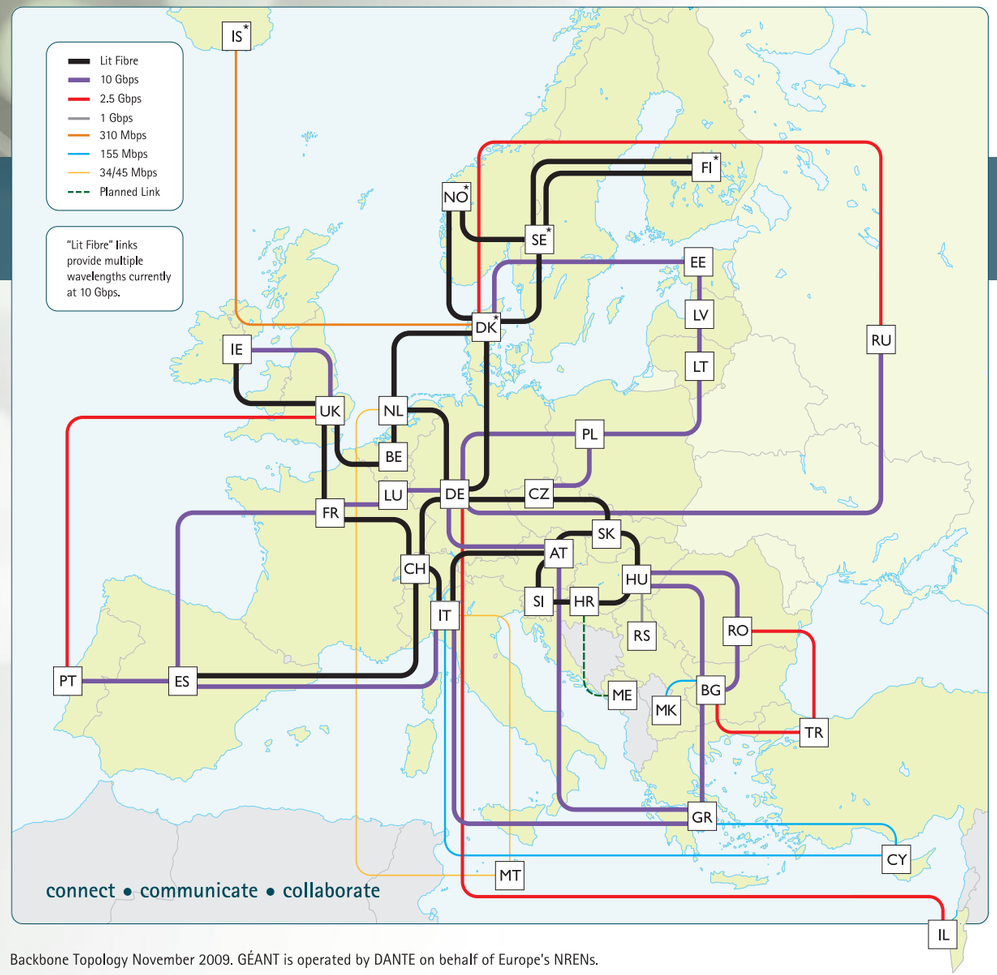
GÉANT was the first production network deployed on an international scale that uses an innovative combination of transmission and switching methods – hybrid technology that opens up new service possibilities. Delivering world-leading levels of performance, reliability and innovation, the network design for GÉANT has focused on maximising operational and service flexibility.

Offering data-transfer speeds of up to 10 Gbps, the network infrastructure extends across 50,000 km, including 12,000 km of lit fibre.

GÉANT is made up of a general purpose research Internet carrying multiple users' traffic, and virtual "private" network paths dedicated to carrying the traffic of individual projects that transmit huge quantities of data. In this way, GÉANT and the NRENs are able to meet the needs of different types of user with the most appropriate technology and level of service.

## Expanding Network Capacity

GÉANT will continue to evolve in order to meet the changing needs of the research and education community. Initiatives are underway that aim to increase the capacity of the core network by a factor of ten in the next three years, with speeds of up to 100 Gbps being planned to ensure speed and availability for users.




Backbone Topology November 2009. GÉANT is operated by DANTE on behalf of Europe's NRENs.

| | | | | | | | | | | | | | | | | | |
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| AT | Austria | CZ | Czech Republic | FI | Finland* | IE | Ireland | LU | Luxembourg | NL | Netherlands | RO | Romania | SI | Slovenia |
| BE | Belgium | DE | Germany | FR | France | IL | Israel | LV | Latvia | NO | Norway* | RS | Serbia | SK | Slovakia |
| BG | Bulgaria | DK | Denmark* | GR | Greece | IS | Iceland* | ME | Montenegro | PL | Poland | RU | Russia | TR | Turkey |
| CH | Switzerland | EE | Estonia | HR | Croatia | IT | Italy | MK | F.Y.R. Macedonia | PT | Portugal | SE | Sweden* | UK | United Kingdom |
| CY | Cyprus | ES | Spain | HU | Hungary | LT | Lithuania | MT | Malta | | | | | | |

*Connections between these countries are part of NORDUnet (the Nordic regional network)

With extensive links to research networks throughout the world, GÉANT is bringing multi-disciplinary user communities together for the benefit of all.

# Enabling Global Virtual Research Communities

## Connecting Researchers Across the Globe

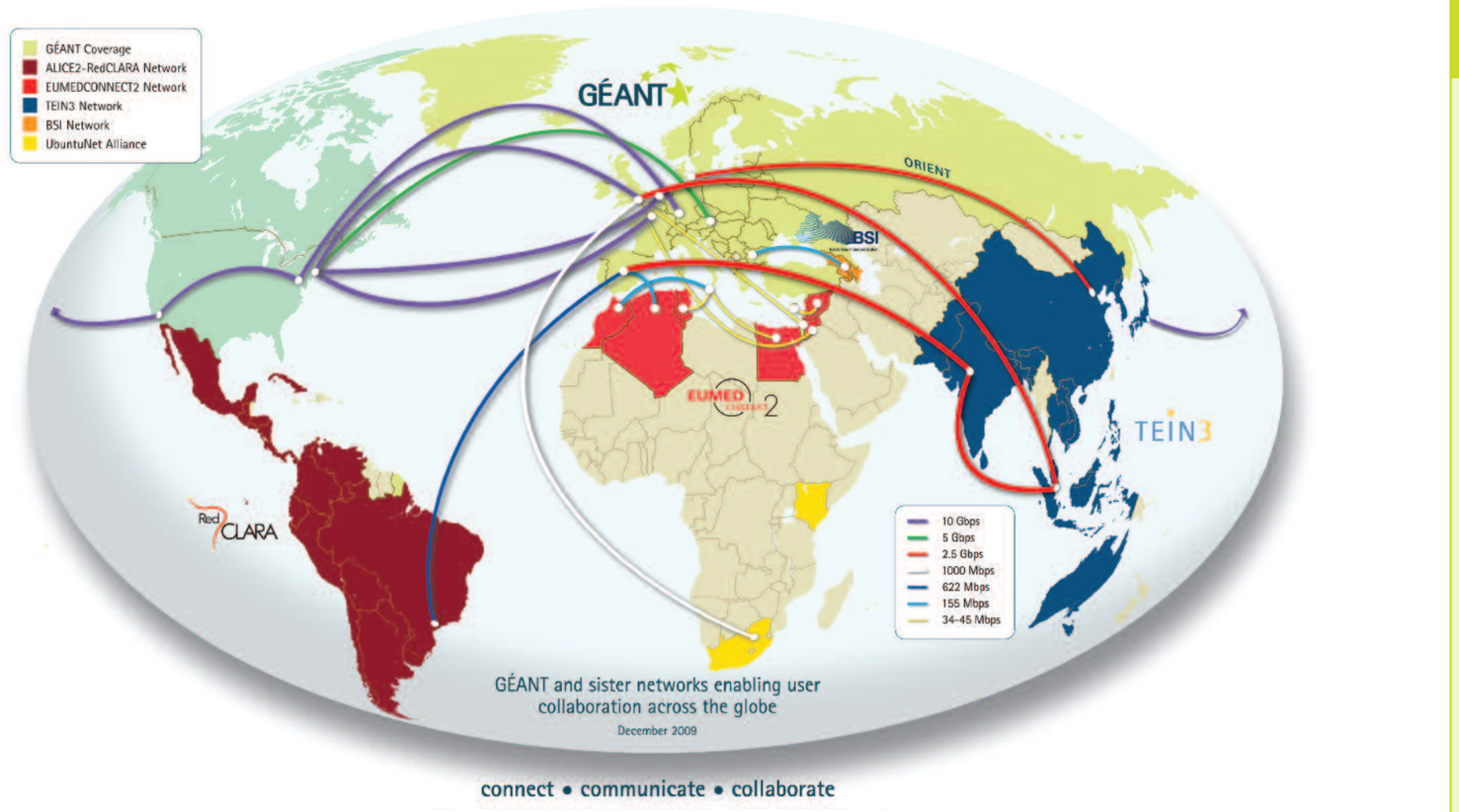
Research today is a global activity and increasingly important for seeking solutions to many of the issues currently facing the world. European researchers in fields such as health and drug discovery, seismology and astronomy, crop research and weather forecasting need to be able to work more closely than ever before with their global counterparts.

The GÉANT network has high-speed links to networks in other world regions, including:

- **Asia-Pacific** – 18 countries across the region through the TEIN3 network.
- **Caucasus** – the Black Sea Initiative (BSI) links the countries of the south Caucasus to Europe through a connection to GÉANT.
- **Central Asia** – the CAREN network will provide connectivity to the central Asian countries of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.
- **China** – reaches an estimated 15 million researchers through the ORIENT link.
- **Latin America** – 13 Latin American countries in the RedCLARA network.
- **North America** – links to Internet2, ESnet and NLR (US) and CANARIE (Canada).
- **Southern and Eastern Africa** – a link to the UbuntuNet Alliance provides connectivity to the countries of sub-Saharan Africa.
- **Southern Mediterranean** – providing a gateway to North Africa and the Middle East, the EUMEDCONNECT2 network reaches 2 million users.

Work is also underway to connect to the Caribbean.

GÉANT's extensive geographical reach, high bandwidth, reliability and data-transfer speeds enable European researchers to share huge quantities of data and collaborate effectively with their peers throughout the world, regardless of distance or location.

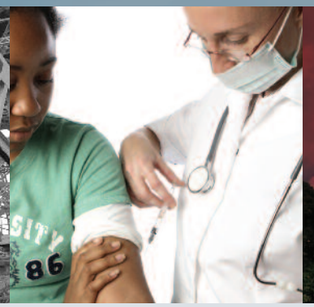



GÉANT provides connectivity to other world regions, placing Europe at the heart of global research networking.

# Connecting User Communities to Accelerate Research

The GÉANT network delivers real value and benefit to society by enabling research communities across Europe - and the rest of the world - to transform the way they collaborate on ground-breaking research.






## Bringing Benefits to Society

Users from a wide variety of disciplines can utilise GÉANT to facilitate collaboration and the sharing of data. Whether working to solve environmental issues such as predicting natural disasters and combating climate change, or pushing back the frontiers of knowledge in areas such as astronomy and physics, projects rely on a high-speed network infrastructure to link researchers together. The way research projects are conducted has been transformed by the existence of the GÉANT network; some would not be possible without it.

GÉANT users span the full range of disciplines, from Big Science projects such as the Large Hadron Collider through telemedicine and earth observation to the arts and cultural projects.

***Particle Physics at the LHC*** *–underpinning grid computing and assuring performance*

The Large Hadron Collider (LHC) is said to be the largest scientific endeavour in history. By colliding particles at extremely high energies, the LHC's experiments will generate some 15 Petabytes (15 million Gigabytes) of data annually. This huge amount of data is distributed to 11 primary processing centres around the world, from where it is accessed and analysed by thousands of scientists, engineers and support staff. GÉANT and the NREN partners have deployed a vast private network with sufficient bandwidth reserved specifically for LHC researchers to facilitate this data distribution and analysis, and linking each processing site to CERN by a dedicated connection. To support the LHC Optical Private Network (LHCOPN), GÉANT's perfSONAR multi-domain monitoring (MDM) service has been implemented to monitor network status and performance across each of these connections.

*"The LHC Optical Private Network (LHCOPN) is core to delivering physics data to the LHC scientists worldwide. To ensure the quality of the services, we need a rigorous active monitoring system that can identify real-time problems. The collaboration of the LHCOPN with the GÉANT project and the NRENs as well as the partner institutes has enabled DANTE to provide a robust and extensible system that now has a global reach."*
*Dr David Foster, European Organisation for Nuclear Research (CERN)*

***EXPReS Astronomy Project*** *– cutting data-transfer times from days to seconds*

The EXPReS project uses dedicated high-speed GÉANT links to connect remote radio telescopes across Europe to a central data processor in the Netherlands. Enormous volumes of simultaneous observation data are transmitted and then correlated to form very sharp, high-definition images of cosmic radio sources. Data was previously collected at each telescope on magnetic tapes, then the tapes transported by courier, taking several days. Now, information is sent from telescopes to the central computer in just seconds, enabling astronomers to create real-time views of the outer reaches of the universe.

*"The EXPReS project has been transformed by our connection to the GÉANT network. Whilst the advancement of telescope technology means we can now carry out years' worth of observations in days, the ability to then transfer that vast quantity of data between astronomers at such high speed means the pace of our research has accelerated beyond recognition, with real-time collaboration now a reality."*
*Professor Ralph Spencer, Jodrell Bank Observatory*

***Sichuan Earthquake –*** *providing bandwidth for disaster relief efforts*

Following the devastating 2008 earthquake in China, GÉANT played a critical role in analysing the disaster's impact and aiding reconstruction. The European Commission's Joint Research Centre (JRC) used GÉANT and the ORIENT Europe/China link to transfer high-resolution satellite images of the areas devastated by the earthquake from its Italian office directly to those leading the relief work.

*"Modern communication networks such as GÉANT and ORIENT are essential for an effective and speedy collaboration between the European Commission's researchers and local government in the wake of the Sichuan earthquake in China. In such a situation of natural and human disaster, we cannot afford to rely on conventional means of communication, such as fax and post, but need modern tools for carrying out a proper analysis within short deadlines. GÉANT and ORIENT provide the bandwidth to transport high-detail images, thereby making an important contribution to speeding up the reconstruction of infrastructure and to saving human lives."*
*Viviane Reding, EU Commissioner for Information Society and Media*

***Thalassaemia Research** – enabling collaboration to prevent disease*
Thalassaemia and its related conditions of inherited blood disorders affect over 300,000 newborn infants worldwide every year. The ITHANET project uses the GÉANT and EUMEDCONNECT2 networks to link scientists, clinicians and patients across Europe and the Mediterranean. Their collaborative research is helping to revolutionise treatment of thalassaemia and bringing significant benefits to patients.

*"Over the years thalassaemia researchers in Mediterranean countries have developed considerable expertise in diagnosis and effective treatment, but these centres of excellence remained isolated, unable to undertake any really effective cooperation. Through the GÉANT and EUMEDCONNECT2 networks, ITHANET has transformed this picture, and promises great strides for the future in our ability to understand, treat and prevent this disease."*
*Dr Marina Kleanthous, ITHANET Project Coordinator*

***Typhoon Forecasting** – reliable, high-bandwidth networks for transferring life-saving data*
The potentially catastrophic impact of typhoons is well understood by PAGASA, the Philippine Weather Bureau. Following one of the deadliest tropical cyclones in Philippine history, PAGASA now relies on the TEIN3 and GÉANT networks to collaborate with Deutscher Wetterdienst (DWD) in Germany, to share accurate real-time flows of meteorological data to drive the PAGASA forecasting and life-saving early-warning systems.

*"We cooperate with the DWD and have access to the enormous power of their supercomputers to run our weather prediction models. This is an expense we would find difficult to manage on our own, and it is only a viable method because GÉANT, TEIN3 and PREGINET together provide an absolutely stable and predictable network for transferring the data we need."*
*Dr Alan Pineda, PAGASA*

***ASTRA** – resurrecting ancient musical instruments through distributed computing power*
ASTRA is a project that uses computer-intensive modelling techniques to reconstruct the sound and timbre of ancient musical instruments. ASTRA relies on the GÉANT and EUMEDCONNECT2 networks to link high-capacity computers across Europe and the Mediterranean to enable the distributed computing power necessary for the modelling process. The model and the sounds created by ASTRA can be accessed by researchers around the world, delivering a powerful tool for archaeologists, musicians and historians.

*"The combination of high-capacity research networks, such as GÉANT and EUMEDCONNECT2, with grid computing provides the computing power we need to create a window into history."*
*Professor De Mattia, Artistic Coordinator of the ASTRA project*



# Innovative Services to Enhance the User Experience

## GÉANT Service Area - empowering national networks

The GÉANT project is focused on understanding its users' requirements and offering services that meet their specific needs. In collaboration with the NRENs, GÉANT will continue to develop user-focused, multi-domain services aimed at delivering seamless network performance across borders and domains, and to roll these out at national level to institutions, projects and researchers through the GÉANT Service Area.

## GÉANT Service Portfolio - empowering users

The range of services currently offered, and those in development for introduction during the term of the project, are grouped into three types:

***Flexible Connectivity Options***
GÉANT's three levels of connectivity service – **GÉANT IP**, **GÉANT Plus** and **GÉANT Lambda** – reflect the immense flexibility that the network has been designed to offer, and together ensure the appropriate service level for the differing demands of users, be that a standard Internet connection or an Optical Private Network (OPN) linking multiple computing centres across the continent for a data-intensive research project.
**GÉANT IP** – the network's standard connectivity service provides robust, high-bandwidth access to and across the shared European Internet Protocol (IP) infrastructure.

**GÉANT Plus** – provides point-to-point connectivity across reserved, high-speed, guaranteed-bandwidth circuits on pre-provisioned infrastructure. This combines the privacy, security and availability of a private network with the cost-efficiency and robustness of a shared and managed infrastructure

**GÉANT Lambda** – a bespoke service designed to cater for longer term, extremely data-intensive network connectivity requirements. These connections provide a dedicated, full 10 Gbps wavelength (or set of wavelengths) to deliver high capacity for the most demanding of user projects.

***Network Performance Services***
Delivering consistently high performance is key to a successful user experience. Users can benefit from the range of GÉANT network support tools employed by NRENs to assure optimum performance for projects and institutions. Connectivity is supported by a comprehensive range of network monitoring and management services. These optimise network performance by providing 24x7 monitoring across the GÉANT Service Area infrastructure, enabling fast identification and remedy of any faults on the network as well as providing powerful security to prevent and detect malicious attacks.

*Performance measuring and monitoring*
Analysing performance in global research networks is complex since any single path might go through several domains – campus, local and national networks as well as the GÉANT backbone. Offering comprehensive multi-domain monitoring (MDM) features, GÉANT's perfSONAR MDM services allow users to access network performance metrics and perform network monitoring actions across multiple domains, ensuring that any source of congestion or outage on a point-to-point connection can be quickly and easily identified and addressed.

*Performance enhancement*
The Performance Enhancement Response Team (PERT) provides an investigation and consulting service to academic and research users on their network performance issues. The service is achieved via eduPERT, the federated structure that combines the PERTs from the local institutions, NRENs and GÉANT and fosters knowledge-sharing across the GÉANT network community. eduPERT is part of GÉANT's commitment to helping users get the best performance from their connections.

*Network provisioning*
GÉANT's network provisioning service under development takes the concept of dedicated

capacity via point-to-point connections one step further. It will provide bandwidth-on-demand to users with exacting requirements, enabling them to reserve the bandwidth they need, as and when they need it. The AutoBAHN service will calculate a route across the multi-domain environment for the required capacity at the required time, and balance the demanding users' requirements with those of traditional users so that each receives the agreed level of service.

*Security*

GÉANT takes a proactive approach to security to maintain the integrity of the network infrastructure, implementing advanced defences that offer sophisticated management of network incidents. Providing strategies for incident prevention, detection and handling, the GÉANT security systems will allow users to keep network domains secure by monitoring traffic and routing information.

***End-User Applications***

To achieve the vision of a truly open European Research Area (ERA), individual researchers and academics need to be able to log on to their institution network wherever they are working and access their resources. To these end users, the network infrastructure should appear to be one seamless resource in which the many interconnected networks are invisible but where access to confidential user-project data remains controlled.

In order to make this possible, GÉANT is building a set of interoperable systems that allow "roaming access" by verifying users' identities and rights and granting access to resources as appropriate. The systems are implemented at campus level, for use by the institution's students and researchers.

*eduGAIN*

The eduGAIN service under development aims to establish a confederation of identity providers, thereby enabling member organisations associated with different federations to seamlessly and securely exchange information as though they were part of the same national identity provider.

*eduroam® – "Open your laptop and be online"*

eduroam is a global service that provides secure, consistent network access to the individual user, with authentication handled by the home institution and authorisation by the visited institution. In this way, eduroam allows academics and researchers from eduroam-compliant institutions to go to any other participating institution and access the network without reconfiguring their laptop or requesting new passwords.

eduroam® is a registered trademark of TERENA on behalf of its member organisations.

The combination of the GÉANT Service Area and the GÉANT Service Portfolio results in a growing range of world-leading services that can be rolled out locally across the shared network infrastructure. This places the power of delivery with the national networks, and the power of collaboration with end users through solutions tailored to their individual needs.

For the latest available services, visit www.geant.net. Please note the availability and naming of services may vary by NREN. For service availability within your country, please contact your NREN.



# GÉANT – connect • communicate • collaborate

DANTE

TERENA

**DANTE** is a non-profit organisation, co-funded by the European Commission and working in partnership with European National Research and Education Networks to plan, build and operate advanced networks for research and education. Established in 1993, DANTE has been fundamental to the success of pan-European research and education networking.
DANTE has built and operates GÉANT, which provides the data communications infrastructure essential to the success of many research projects in Europe.

DANTE is involved in worldwide initiatives to interconnect countries in other regions to one another and to GÉANT. DANTE currently manages initiatives focused on the Mediterranean, Asia-Pacific, Central Asia and China regions through the EUMEDCONNECT2, TEIN3, CAREN and ORIENT projects respectively.

**Further information about DANTE and the activities in which it is involved is available from www.dante.net.**

**TERENA** is the Trans-European Research and Education Networking Association, in which Europe's research networking organisations, research institutes, equipment vendors and telecommunications operators meet, exchange information and experience, and collaborate on a range of activities. TERENA's membership includes major international research organisations, several companies and national research and education networking organisations from many countries. TERENA projects, task forces and events are open to any organisation or individual who offers appropriate expertise, manpower or other resources.

**Further information about TERENA and its activities is available from www.terena.org.**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