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EU advances research collaboration with GEANT's high-speed ICT infrastructure

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GÉANT, the pan-European research and education network infrastructure, is evolving fast. Long considered the most advanced research network in the world thanks to its 99.999 % availability, continual development and an expanding range of multi-domain services to enhance performance and access, GÉANT is building on that reputation with a comprehensive upgrade to its transmission and switching technology — and effectively future-proofing the network to 2020. Europe's critical network will continue to enable research and innovation that is seen as a driver of European growth by supporting some of the world's largest and most data-intensive research projects.

Set up more than a decade ago to enable research collaboration and knowledge sharing among European researchers and beyond, GÉANT has played a pivotal role in facilitating research projects that help maintain European competitiveness and provide insight into solving some of humanity's biggest challenges. GÉANT's advanced network and services enable research projects across fields as varied as climate change and environmental monitoring, food and energy supply, particle physics and radio astronomy, medicine and bioinformatics.

Together with Europe's National Research and Education Networks (NRENs), GÉANT connects over 40 million users in more than 8000 universities, higher education institutes, research institutes, libraries, museums, national archives and hospitals, as well as a further 22 000 primary and secondary schools.

GÉANT is coordinated by DANTE, which plans, builds and operates advanced networks for research and education (including TEIN, CAREN and AfricaConnect as well as GÉANT). The GÉANT consortium consists of a federated community of 31 European national research and education networks (NRENs); Nordunet (representing five Nordic NRENs); the Trans-European Research and Education Networking

Association (Terena); and four associate NRENs as well as DANTE. The current iteration of the GÉANT project (known as GN3) is also supported by EUR 93 million in funding from the European Commission. It is the NREN partners that deliver the pan-European connectivity and services to users at local level.

The 500 Gbps roll-out

GÉANT is currently implementing a major infrastructure upgrade, including the latest transmission and switching technology to support up to 2 terabits per second (Tbps) capacity across the core network, effectively future-proofing Europe's critical network infrastructure through 2020. 500 Gigabits per second (Gbps) capacity will be available across the core network from first implementation, delivering circuits across Europe that will allow individual users to transfer data at speeds of up to 100 Gbps, or multiples thereof, thereby enabling faster collaboration on critical projects and meeting the rapidly increasing demand for data transfer.

CERN has been the first 100 Gbps customer, linking Geneva to its new data centre in Hungary, to process and store vast amounts of data from the Large Hadron Collider (LHC).

'This is an enormous project, to completely refresh the 50 000-kilometre GÉANT backbone network, replacing all existing equipment with the latest transmission and switching technology and installing over 150 new pieces of equipment in 10 months,' says Michael Enrico, chief technology officer for DANTE. 'Major projects involving global partners, such as CERN's LHC and the forthcoming Square Kilometre Array (the world's largest radio telescope), generate high volumes of data that need to be distributed, analysed, stored and accessed. This need for fast, stable transfer of data depends heavily on the high speed and dedicated bandwidth offered by research networks such as GÉANT and the need for a terabit network is growing every day.'

The previous iteration of the GÉANT project (known as GN2) focused on delivering the hybrid network, using the most innovative switching and routing technology. The focus then changed to develop and deliver an expanded service portfolio to enable users to get the best out of the network through their local NREN.

Through its range of connectivity services, researchers (and other users) can select the bandwidth and performance that best matches their needs, with options ranging from high-capacity internet-protocol (IP) connections to ultra-high-speed dedicated point-to-point circuits, including innovative 'on-demand' point-to-point services. These in turn are supported by a comprehensive range of network monitoring and management services to enable consistent, secure, end-to-end performance irrespective of the users' location. Along with its NREN partners, GÉANT's goal is to ensure 99.999 % availability through the rapid identification and resolution of network errors and powerful security features to detect and prevent malicious attacks.

Applications that address authorisation and authentication issues, verifying users' identities and rights in order to grant them access to resources as appropriate, are also being developed and rolled out through the NREN project partners. This enables researchers, academics and others to freely move across network boundaries while maintaining access to their home network and the resources of other NRENs and institutions.

Accelerating scientific research

Already more than 1000 terabytes of data passes through GÉANT's IP backbone each day, much of it linked to some of the most advanced and far-reaching research being carried out anywhere in the

world.

CERN's LHC, the world's largest scientific experiment, for example, produces over 22 petabytes of data annually and research networks, including GÉANT, are critical components in delivering this data to scientists around the world.

'We have used the GÉANT infrastructure very extensively... providing us with direct connections between CERN and the major institutes as well as a high-performance IP service that allows us to get the data to and from the smaller institutes around Europe,' says Dr David Foster at CERN.

Similarly, GÉANT and other networks will be crucial for the scientific community to be able to work with the massive amounts of data due to be produced by the Square Kilometre Array, the world's largest telescope - scheduled to be operational in 2020.

Whereas previously scientific data would have had to be physically sent on disks to researchers, with GÉANT the data can be accessed from anywhere at any time, making real-time observation of highly detailed information on the universe possible.

And in the bioinformatics arena, high-speed networks have made possible research breakthroughs, such as DNA sequencing, that have transformed life sciences. With the volume of data generated by biological experiments now doubling every five months, making it available to the global user community has been a major challenge for the GÉANT partners.

Professor Janet Thornton, the director of European Molecular Biology Laboratory-European Bioinformatics Institute (EMBL-EBI), says that without GÉANT, the EBI simply would not exist. 'Because our primary goal is to collect and distribute biological data... without GÉANT we could not do that,' she notes.

Many other scientific disciplines, from earth observation and weather forecasting to chemistry and neuroscience, continue to benefit from the GÉANT network.

GÉANT also has extensive links to networks in North America (via Internet2, ESNET, NLR, NISN and CANARIE), Latin America, North Africa and the Middle East, South Africa and Kenya, the South Caucasus, Central Asia and the Asia-Pacific Region - reaching over 65 countries outside Europe.

Supporting education

In addition, the GÉANT network is supporting the educational community, with many project partners serving universities, high schools, libraries and primary schools.

In higher education, digital learning and lifelong learning are defining trends. As a result, university campuses are becoming increasingly virtual, creating a need for new collaborative tools and services. Academics and students alike expect end-to-end connectivity and limitless bandwidth, including in the wireless domain.

Similar changes are evident in schools. New, more learner-centric approaches to teaching are being employed, digital tools and resources are being used across the curriculum, while gaming and infotainment are widely seen as an important part of future learning. These and emerging applications will all make increasing demands on the network, with the education sector becoming an increasingly important user group to GÉANT and its NREN partners.

