GÉANT

# CONNECT

THE MAGAZINE FROM THE GÉANT COMMUNITY | ISSUE 8 AUGUST 2012

## DATA NEEDS ARE GROWING EVERY DAY, EVERYWHERE. HOW IS GÉANT RESPONDING?

READ OUR FEATURES ON TERABIT NETWORKING AND GLOBAL EXPANSION

**MORE THAN A NETWORK**
GÉANT services are empowering users

**WHAT DOES THE HIGGS BOSON SOUND LIKE?**
Sonification has turned the particle into a (great) melody

**CENTRAL TO EUROPEAN E-INFRASTRUCTURE**
Contributions from our research partners

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# TEAMWORK BREEDS GÉANT SUCCESS!

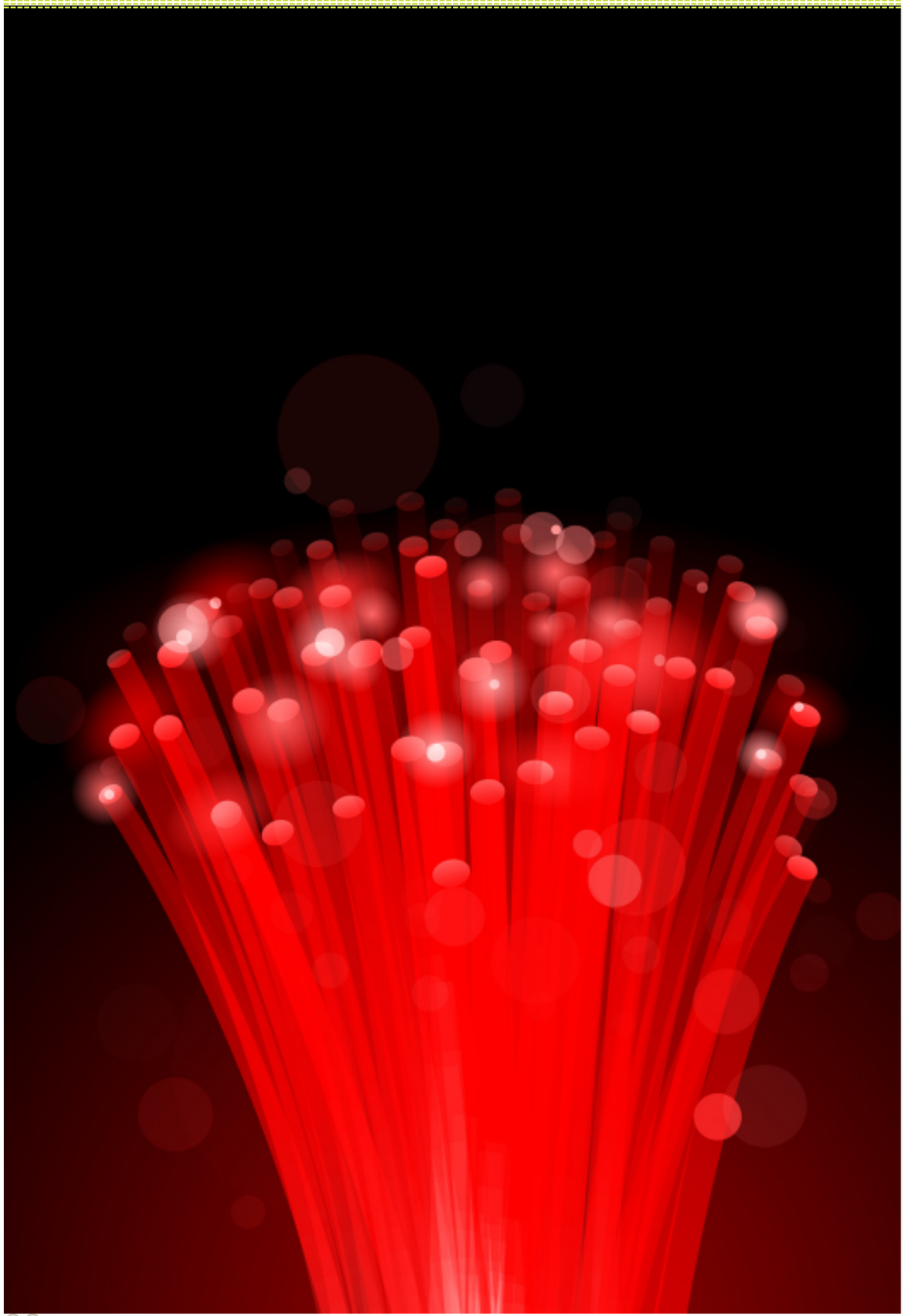
By Milos Karapandzic, Head of GÉANT Project Management Office

Teamwork and professionalism played a large part in achieving a successful third year for GÉANT.

At the EC Year 3 Review meeting, hosted by Belnet in Brussels, 19 – 21 June, the preliminary verbal report of the EC's review team was very favourable, but we'll have to wait for the official report to come in until we can put it on the record! What we can say is that the Reviewers were very impressed with the body of work the project had achieved in the third year; and with the quality and content of the presentations and in particular, the team spirit displayed by the project management team during the three-day meeting.

Contributing to the success, two major change programmes, introduced during Year 3, are now at the heart of how the project manages and coordinates the work. A product management structure has been put in place, with dedicated product managers trained and allocated to the services. In addition, GÉANT has developed its own Project Management Framework based on established industry best practises, such as Prince2 and P3O, designed to balance light-touch structure and discipline with flexibility. These changes are having a huge impact on efficiency and facilitating the cooperation between Activity teams, with the ultimate goal of continuing to ensure we deliver services and the network that the NRENs and users need.

What the work and achievements throughout Year 3 have demonstrated, is that from the developments and delivery of the network itself, to the progress of the services and innovations and discoveries of the research teams, and with two new coordinating frameworks in place, GÉANT is even better able to plan for and provide for our user communities, by giving flexibility in the way they achieve their networking needs, now and into the future. You can read about the plans for the terabit network, as well as the progress of some of our key services, in this issue of CONNECT.



# GÉANT ANNOUNCES MOVE TO TERABIT NETWORK

Delivering innovation and meeting user needs have always been two guiding principles at the heart of the GÉANT project. As part of this innovation in May 2012 GÉANT announced a major investment designed to support capacity of to up to 2Tbps (terabits per second) across itscore network.

Aiming to future proof the network until 2020, the migration will enable faster collaboration on critical projects and meet the rapidly increasing demand for data transfer from the 40 million researchers and millions of students across Europe that rely on GÉANT.

## THE NEED FOR SPEED

The creation and sharing of research data is increasing at an enormous rate, impacting research networks, high performance computing (HPC) and grids – collectively known as e-infrastructures. Major projects involving global partners, such as CERN's Large Hadron Collider and the forthcoming Square Kilometre Array, generate enormous amounts of data that needs to be distributed, analysed, stored and accessed for research. This need for fast, stable transfer of data depends heavily on the high speed and dedicated bandwidth offered by research networks, such as GÉANT.

In the new network, 500Gbps capacity will be available across the core from first implementation, delivering circuits across Europe that will allow individual users to transfer data at speeds of up to 100Gbps. This will also have the added benefit of making it easier for users to dynamically access the bandwidth they need, speeding up the sending of data, collaboration and consequently achieving research results.

## A TESTBED FOR INNOVATION

To achieve this major step forward four-year contracts have been awarded to Infinera and Imtech, to respectively provide the transmission equipment and switching platform to comprehensively upgrade the 50,000km GÉANT backbone network.

GÉANT has always acted as a testbed for the latest innovation, deploying emerging technology and new protocols (such as IPv6) ahead of commercial networks. GÉANT's hybrid architecture is a good example of this as it is based on two types of equipment – optical transmission and data packet switching. The procurement was therefore split into two groups. Infinera was selected to provide optical transmission equipment lighting all the dark fibre in the GÉANT backbone network, whilst Imtech will provide the data packet switching platform using Juniper equipment.

The new network migration will therefore continue GÉANT's role as a testbed for new technology, while delivering the capacity, speed and services that Europe needs in order to keep the region at the forefront of world research.

When the investment was announced, Ivan Maric, chair of the GÉANT Executive Committee commented, "e-infrastructures in Europe are vital to foster research and innovation for the benefit of society. I'm thrilled by this milestone, which allows the GÉANT network to continue to serve the research and education community, with ever increasing speed and efficiency. It has been a pleasure to participate in this impressive achievement, reached by deep commitment of DANTE and all the European NRENs. I look forward to the full deployment of Terabit networking in the years to come."

# Q&A
# ROLLING OUT THE TERABIT NETWORK

XAVIER MARTINS-RIVAS,
IP MANAGER, DANTE

The new GÉANT terabit network is a major investment and rolling it out is a large scale project. Xavier Martins-Rivas, IP Manager, heads the team responsible for building the new network and explains how it will be done.

## WHAT IS THE TIMESCALE FOR THE ROLLOUT OF THE TERABIT NETWORK?

Work begins in July 2012 and is scheduled to be completed in April 2013. While ten months is not a long time we've liaised closely with our NREN partners and the equipment suppliers Imtech/Juniper and Infinera to put in place a structured plan that will ensure all our users across Europe receive the benefit of the new networks within that timeframe.

## CAN YOU GIVE US AN IDEA OF THE SCALE – WHAT DOES THIS INVOLVE?

This is an enormous project. Essentially we're completely refreshing our 50,000 km backbone network infrastructure – replacing all existing equipment with the latest transmission and switching technology and installing over 150 new pieces of equipment in ten months. We need to visit 170 sites across Europe, from Tallinn and Riga in the North and Dublin in the West to Moscow in the East and Athens in the South. And as it is a phased route by route migration we'll be visiting some sites several times if they are part of multiple routes.

We obviously don't undertake a project of this size lightly but this is a long term investment. The rollout is designed to support up to 2Tbps (terabits per second) capacity across the core network, meaning we are essentially future proofing GÉANT until 2020.

## HOW WILL THE MIGRATION BE CARRIED OUT?

To minimise disruption we're splitting the project, replacing our existing equipment in two phases, beginning with switching and then transmission technology. Within each phase we'll be rolling out the migration in geographical stages to further lessen any downtime. In each case members of our network engineering team will visit the Point of Presence in order to manage the upgrade at first hand and deal with any unexpected issues.

## ARE THERE ANY NEW ROUTES?

Yes, as part of the new topology we'll be introducing two new routes, from Milan to Marseille and Marseille to Geneva. This route allows us to increase the route diversity outside of Geneva, and give us a presence in Marseille where many undersea cables land. Additionally we're creating five parallel routes alongside existing links to increase capacity on key backbone routes, solely during the migration phase. These will cover London-Paris, London-Brussels-Amsterdam, Amsterdam-Frankfurt, Frankfurt-Geneva and Milan-Finkenstein-Vienna.

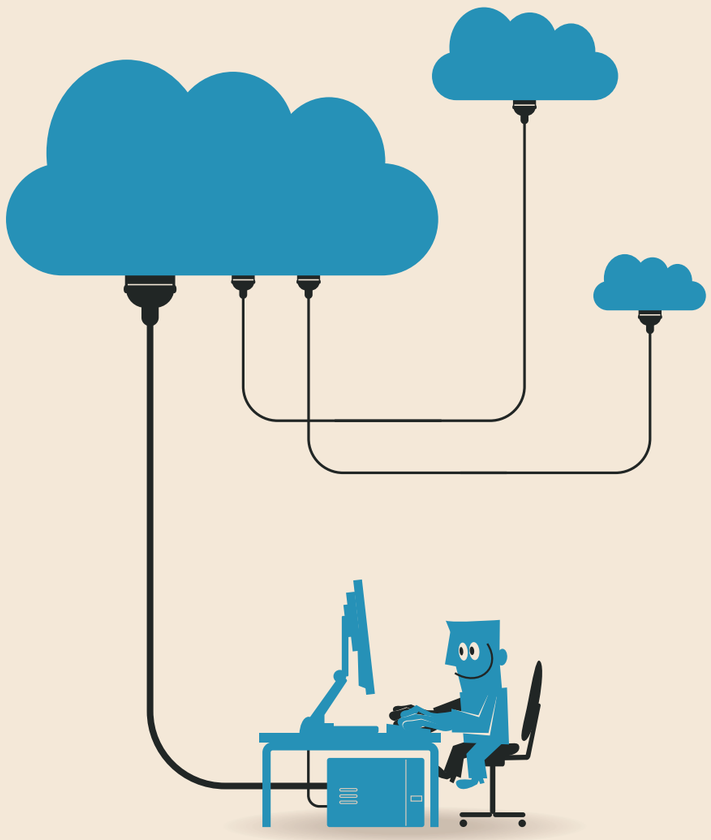
## HOW WILL GÉANT GUARANTEE CONTINUED SERVICE DURING THE ROLLOUT?

We've planned very closely to ensure that service disruptions will be minimised. As well as rolling out the new equipment in phases the majority of upgrades will occur out of peak hours to ensure minimal impact on services and users. In some cases we're installing on a parallel route, which means that we can test the new equipment and link before switchover, which will minimise downtime. Wherever possible roll back scenarios are in place to make sure that any service interruptions are minimised, even in the case of dramatic events.

## WHICH ROUTES WILL BE UPGRADED FIRST?

As I mentioned the migration will be in two phases, the first for the Juniper switching equipment and the second for the Infinera optical transmission technology. Stage one of the Juniper migration will cover our routes in the Baltic States and Poland and will be followed by South East Europe, with our sites in Prague, Vienna, Bratislava, Budapest, Zagreb, Ljubljana, Athens and Milan then upgraded. Stage three will cover the Western area, including London, Dublin, Paris, Madrid and Geneva. Finally the remaining sites – from Brussels and Amsterdam east to Moscow will be migrated.

The Infinera installation will follow a slightly different four stage rollout pattern – starting in central Europe, which will be followed by Southern routes then the North and finally the West end of the GÉANT backbone.



# GÉANT 2020 – FUTURE PROOFING EUROPEAN RESEARCH NETWORKING

The vital importance of research to European competitiveness and innovation is well-recognised by governments across the region and the European Commission itself.

Research networking is a central factor in a creating and sustaining a strong, collaborative, cross-border research community, providing the tools and connectivity needed for Europe to remain a world-leader. GÉANT is seen as a key part of the Digital Agenda for Europe, one of the EC's flagship initiatives driving Europe 2020.

To ensure European research networking continues to innovate and support the community's needs, the EC commissioned a major report to provide a vision and action plan for how European research networks should look in 2020. Written by the GÉANT Expert Group (GEG), an independent group of experts, it was delivered in October 2011.

The report outlined the fundamental changes occurring across the research world, as work becomes ever more data intensive and multi-disciplinary. This will drive a 'data deluge' with enormous volumes of information being shared and accessed across research networks, by users who demand the ability to work anywhere, rather than needing to cluster around specific locations or physical centres.

## GÉANT 2020 – THE VISION

The vision outlined in the report sees GÉANT 2020 as the European communications commons, enabling talented people to collaborate with their peers around the world and to have instantaneous and unlimited access to any resource for knowledge creation, innovation and learning, unconstrained by the barriers of the pre-digital world.

Specifically, the goals that fulfil the GÉANT 2020 vision are:

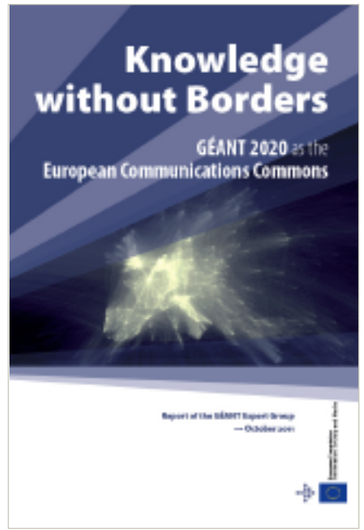
- Support knowledge communities by providing world-class connectivity and services.
- Support the growth of these communities, in both breadth and depth within Europe, and opening up to talent beyond Europe's borders
- Push the state-of-the-art of the communications commons by constant innovation and by translating this innovation into a competitive Europe
- Reorganise to cope with the constantly changing environment.

## DELIVERING THE NETWORK FOR GÉANT 2020

The migration of GÉANT to a terabit network provides a vital first step to achieving the vision set out in the report. It will deliver world-class, high capacity connectivity that provides individual connections at up to 100Gbps, future proofing research by providing the bandwidth needed for even the most data-intensive projects.

The network will underpin a range of end-to-end services, such as eduroam, that allow researchers to work fully wherever they are located within the GÉANT Service Area, accessing the same information and tools as if they were at their home institution. This supports ever more mobile researchers who are no longer tied to physical locations in order to carry out their work.

Innovation and flexibility are at the heart of the new terabit infrastructure – providing a platform for closer collaboration by user communities across Europe and linking them to the world through a future-proofed network that will evolve to meet their changing needs. The updated GÉANT network is therefore a crucial move towards achieving the goals of Europe 2020 and the GEG report.



# SERVICES FOCUS

Since the last issue of CONNECT there have been major updates across the entire GÉANT services portfolio, including user expansion in Europe and across the world and the launch of new services to the wider community. Here's a round-up of recent activity:

## BANDWIDTH ON DEMAND LAUNCHED AS PRODUCTION SERVICE

After an extensive pan-European pilot, GÉANT Bandwidth on Demand (BoD) was launched as a production service at the Terena Networking Conference (TNC) in May 2012.

The service enables NRENs to deliver customised connectivity to campus and international user projects in minutes through dynamic bandwidth provisioning.

Until now projects that needed to reliably transfer large amounts of data between two end points for short periods had to rely on static international connections. These could take weeks to create and consequently could only reasonably be available on a long term basis. BoD removes the drawbacks of static circuits, reducing administration and setup by allowing NRENs to quickly and cost-effectively provide guaranteed bandwidth to their users, exactly when they need it.

The production service will initially be offered to campus and international user projects by CARNet, Forskningsnettet, GRNet, HEAnet, PIONIER and SURFnet, working collaboratively with the GÉANT backbone. Further NRENs are expected to join over the course of 2012.

To find out more read the full release **here**.

## PERFSONAR MDM

With an ever growing number of monitoring points perfSONAR MDM is helping more and more network engineers to work together to ensure high performance on multi-domain networks.

One of the most advanced of these is Spanish NREN RedIRIS, which has deployed perfSONAR monitoring points across its backbone network and is using the tool as its main monitoring platform. From ensuring high capacity data flows to and from CERN and Spanish sites involved in the Large Hadron Collider project to linking dancers in Barcelona with their counterparts in Brazil to allow real-time performances, RedIRIS relies on perfSONAR MDM to deliver the highest levels of service to users. To find out more about how RedIRIS is benefiting, read the full case study in English **here** and in Spanish **here**.

## eduGAIN

The eduGAIN 'digital passport' service has been rapidly expanding, and now covers 14 countries in three continents. In June Canadian NREN CANARIE became the latest network to join eduGAIN, meaning that collaboration between students and researchers in Canada and Europe will be simpler, with seamless, secure access to resources at institutions on both sides of the Atlantic.

eduGAIN enables users to access vital resources such as research databases and tools at institutions in participating countries, without needing to re-register or apply for additional permission. By removing geographical and technical barriers to sharing information, eduGAIN makes it as simple to access remote resources as if they were in a user's home institution.

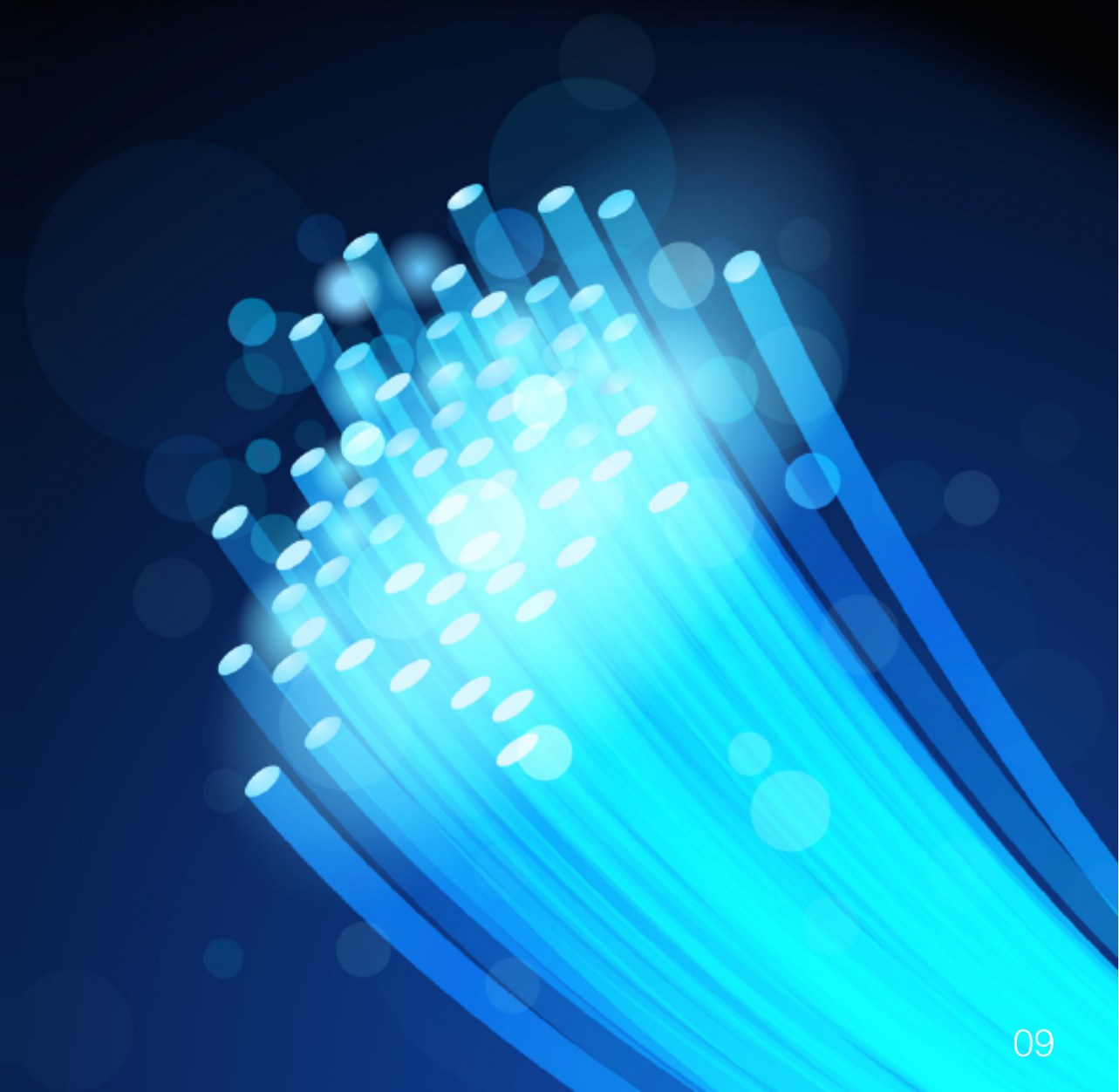
Find out more about eduGAIN's growth **here**.

## HAPPY BIRTHDAY TO eduroam®!

The eduroam secure roaming connectivity service recently celebrated a major milestone, having now been in operation for more than a decade. It has now spread to over 50 countries globally, with more than 5,000 locations in Europe alone where researchers, students and teachers with eduroam credentials can securely access the internet while away from their home institution.

Today's research and education community is increasingly mobile, and depends on technology and the internet to collaborate and communicate. eduroam was created to meet these needs. Without the need to register for guest accounts or remember extra passwords, users can simply open their laptops or activate their mobile devices, and eduroam automatically authenticates them with their home institution and handles authorisation via the institution they are visiting. This not only benefits researchers, teachers and students, but reduces the support burden for institutions themselves, making it simple to provide access for visiting users without adding to their administrative workload.

eduroam's first ten years was marked by celebrations at this year's TNC, including special recognition for Klaas Wierenga, who had the original idea for the service when working at Dutch NREN SURFnet. Read more on eduroam **here**.



# CREATING THE GLOBAL RESEARCH VILLAGE

The recent announcement that the Square Kilometre Array (SKA) telescope will be co-located in Australia and South Africa moves forward another exciting international 'big science' initiative. The SKA is a ground breaking €1.5 billion project that aims to transform our view of the universe. The world's largest and most sensitive radio telescope, it will enable astronomers to glimpse the formation and evolution of the very first stars and galaxies after the Big Bang, investigate the nature of gravity, and possibly even discover life beyond Earth.

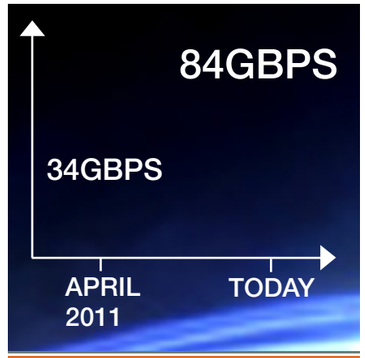
It achieves this level of detail by combining the signals from 3,000 separate dish antennas, along with other radio wave receptors. The antennas will be arranged in five spiral arms extending to distances of at least 3,000 km from the centre of the array. This gives a total collecting area of one square kilometre – the size of 200 football pitches.

Once operational in 2020 the SKA will generate enough raw data to fill 15 million 64 Gb iPods every day. This will be transmitted using optical fibre networks to a central super computer capable of performin 1018 operations per second. It is expected that data rates will be multiple petabits per second – representing over 100 times current global internet traffic.

## GROWING NEED FOR CONNECTIVITY

The SKA is a further demonstration of the exponentially growing need for connectivity between researchers in Europe and their colleagues across the world, both through large scale projects and a myriad of smaller, but no less vital collaborations.  As well as the heavy investment in GÉANT's new, terabit pan-European network, parallel work is continuing to expand the bandwidth between GÉANT and partner networks in regions across the world.

Without these high speed links, researchers simply won't be able to work together, meaning that the benefits of global projects such as the SKA and the Large Hadron Collider would not be fully delivered. High bandwidth, robust connections between GÉANT and other world regions have multiple benefits – not just allowing researchers to work together, but enabling vital projects that span e-learning, telemedicine and disaster warning systems that directly help populations across the globe. By allowing researchers to remain in their home country high speed networks help reverse the brain drain and enable local academic institutions to develop, creating knowledge economies that improve the lives of millions.




## GÉANT GLOBAL CONNECTIVITY DOUBLED

GÉANT's global connectivity is growing rapidly – it doubled from 34Gbps to 73Gbps in the twelve months to April 2012. What is even more impressive is that this growth is accelerating – in the last three months it has risen by a further 15% to 84Gbps.

These are just some of the latest additions to GÉANT's global links:

- North America: IP capacity has more than doubled, increasing from 25Gbps to 55Gbps
- Latin America: A four fold increase in IP capacity from 622Mbps to 2.5Gbps to
- Caribbean: A completely new link of 155Mbps to the recently established C@ribNET
- Sub-Saharan Africa: Anincrease from 1Gbps IP to 10Gbps IP, along with an additional 10Gbps point-to-point circuit
- South Caucasus: New 45Mbps links to both Azerbaijan and Armenia).
- CAREN: A high speed 155Mbps link to Kazakhstan
- Asia-Pacific: A new 10Gbps IP link to ASGC, the Taiwanese NREN

By increasing the range and capacity of GÉANT's links to other world regions, the aim is to create a global research village that brings together scientists, researchers and students to enable the free flow of information and faster collaboration, benefiting not just education projects, but people across the world.

# Q&A WITH CATHRIN STÖVER

CATHRIN STÖVER,
CHIEF INTERNATIONAL RELATIONS AND COMMUNICATIONS OFFICER, DANTE

Cathrin Stöver is Chief International Relations and Communications Officer in DANTE, responsible for the management of relationships with NREN organisations and regional bodies in other world regions.

As part of her role within the GÉANT project, Cathrin is responsible for the Activity on liaison and support covering international and internal relations. Additionally she is project manager of the AfricaConnect project working towards the creation of an R&E networking infrastructure in sub Saharan Africa.

Connect caught up with Cathrin to discuss what is driving the increasingly worldwide demand for greater research network capacity.

## WHAT CHANGES HAVE YOU SEEN OVER THE LAST YEAR IN GLOBAL R&E CONNECTIVITY?

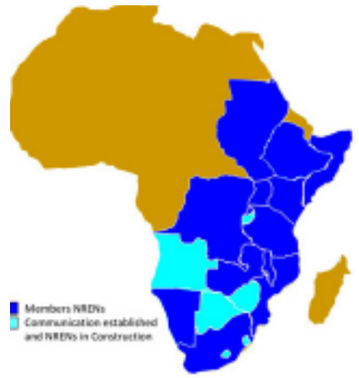
We've seen an unprecedented increase in demand for bandwidth between GÉANT and other world regions, as researchers and students across the world want to collaborate and share ever greater volumes of data. Inside GÉANT this is obviously one of the key drivers behind moving to our new terabit network, but this massive increase in data volumes is replicated globally.

## HOW ARE YOU MEETING THESE CHALLENGES?

We're working closely with research networks across the world to ensure our links deliver a seamless end-to-end user experience. This means upgrading and adding connections in line with predicted traffic increases. Working with the America Connects to Europe (ACE) project we have doubled the capacity of links between Europe and the United States, bringing it up to 70Gbps, with plans to further upgrade at the rate of at least 10Gbps per year. Additionally we have just launched a tender to quadruple bandwidth between GÉANT and China, potentially increasing it to 10Gbps. Looking at new regions, GÉANT has also just connected to the Caribbean network C@ribnet, making it our newest global peering partner.

## ARE THERE PARTICULAR WORLD REGIONS WHERE THE INCREASE IN DEMAND IS MOST VISIBLE?

From an R&E networking point of view, the African continent is very interesting these days. Here, the new undersea cable systems both to the East and West of the African continent have opened the doors to increased terrestrial capacity across sub Saharan Africa. As a result, the African UbuntuNet Alliance now has more than 20Gbps capacity to the GÉANT PoP in London. The AfricaConnect project is looking to provide an inter-African R&E backbone, keeping local African traffic local. Considering that until very recently a lot of African connectivity was very limited and satellite provided, such developments can only be explained by an enormous amount of latent demand and the fact that today research and science is truly a global activity. For example, we have also now implemented the first P2P link between Europe and Africa, linking GÉANT and UbuntuNet. This high speed 15,000 km dedicated connection will allow African radio astronomers at the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in South Africa to stream observational data to the Joint Institute for VLBI in Europe (JIVE) in the Netherlands for processing and correlation, as part of joint observations involving telescopes across the world.




## ARE THERE ANY HURDLES TO MEETING THESE CONNECTIVITY NEEDS?

With more operators having built high speed networks, generally the price of bandwidth has been falling and in some world regions keeps falling significantly. However in some markets where there are still monopoly suppliers in place and a lack of deregulation this hasn't happened yet to the same extent. In these cases it can impact our ability to deliver cost-effective high speed connections, ultimately increasing the digital divide. We are working with our global partners to ensure that R&E networks help opening markets.

## ARE THERE ANY SPECIFIC DISCIPLINES THAT ARE DRIVING THE NEED FOR INCREASED BANDWIDTH?

It is happening across the board as research of all types generates more and more digital data. Obviously big science projects such as the Large Hadron Collider and the forthcoming Square Kilometre Array create petabytes of data that needs to be shared globally, however the way that research is carried out is fundamentally changing. Rather than store information at their home institutions, researchers now access specialist data stores across the globe, combining information to aid their research projects and using grid computing infrastructures to bring together the necessary processing power to undertake complex calculations. Arts projects, such as interactive dance performances and concerts equally require stable, high bandwidth networks to enable a seamless, real-time experience, even if performers are separated by thousands of miles.

Alongside these applications, improved connectivity can have a major positive societal impact. Global research networks really can help bridge the digital divide in vital areas such as health, education and disaster warning. For example telemedicine applications allow specialist doctors to collaborate with local medical staff and treat patients using high quality video conferencing, helping to save lives. In regions such as Latin America e-learning applications mean that children can receive high quality teaching, no matter where they are located, meaning they don't have to migrate to cities to receive an education.

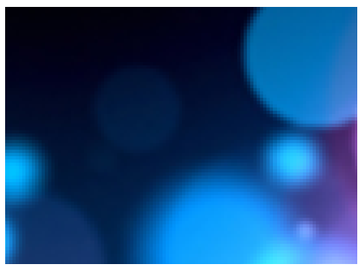
## OBVIOUSLY HIGH SPEED CONNECTIVITY IS VITAL FOR COLLABORATION, BUT USERS INCREASINGLY REQUIRE END-TO-END SERVICES THAT ARE TAILORED TO THEIR NEEDS. HOW IS GÉANT WORKING WITH OTHER NETWORKS TO DELIVER THIS?

From the outset the services that have been developed within the GÉANT project have been designed to be open and easy to deploy with those used by other networks. For example, the overall architecture of the perfSONAR monitoring tool was developed jointly by GÉANT, ESNet and Internet2 in the USA and RNP, the Brazilian NREN. These services are increasingly going global – another example is the Canadian NREN CANARIE becoming the latest organisation to sign up to the eduGAIN 'digital passport' service, allowing instant, secure access to resources on both sides of the Atlantic, while secure roaming service eduroam is now available in over 50 countries across the world.

In Latin America the ELCIRA Project run by RedCLARA aims to coordinate a series of collaboration tools and services that are being developed in Europe and Latin America in order to provide an interoperability framework that facilitates the work of European-Latin American research teams and to foster collaboration in joint research projects. The future aim is that services such as eduGAIN and eduroam will become available across the RedCLARA network.

## WHAT NEW WORLD REGIONS DO YOU SEE EMERGING IN THE NEXT FIVE YEARS FOR RESEARCH CONNECTIVITY?

Around the world, there's an increased realisation of the benefits being part of the global research community brings. This is leading to a great deal of positive activity around the world to progress national, regional and international research networks. DANTE is involved in the CAREN project in central Asia, bringing high speed networks to Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. The AfricaConnect project will bring inter-African connectivity to Southern and Eastern sub Saharan Africa and we are closely working with WACREN in West Africa to ensure that GÉANT will also be able to connect to the West African NRENs in the very near future.



# NEWS

## IPV6 MOVES INTO CENTRAL ASIA

Kazakh NREN KazRENA has become the first Central Asian research network to announce IPv6 compliance, deploying the new protocol that safeguards the future of the internet by providing access to a vastly greater pool of IP addresses. Announced on World IPv6 Day in June, KazRENA will act as a catalyst for IPv6 deployments in other Central Asian countries that are served by CAREN, the region's high performance network for research and education. CAREN facilitates communication, information exchange and collaboration between universities and research centres within Central Asia and provides access to the European and global research community. Read more at

**caren.dante.net/server/show/ConWebDoc.3416**

## TEIN3 EXCEEDS 50M USER MARK

Reaching a major milestone, TEIN3, the Asia-Pacific research network now connects over 50 million users across the region. Originally set up in 2006, the high speed network has expanded dramatically and now links 16 countries, with Cambodia the latest to join China, India, Indonesia, Japan, Korea, Malaysia, Nepal, Pakistan, the Philippines, Singapore, Sri Lanka, Thailand, Vietnam, Australia and Bangladesh. TEIN3 now serves countries representing over 60% of the world's population, delivering the ability for researchers and students to collaborate with their colleagues inside the region and also, through links to networks such as GÉANT, to work globally. Read the full story at

**www.tein3.net/server/show/ConWebDoc.3415**

# FUTURE VISION FOR GLOBAL COLLABORATION

Global research is changing rapidly, driven by increasing digitisation and information sharing between users located around the world. To meet these evolving needs the structures of international research networks themselves are changing rapidly, becoming more collaborative and seamless.

To understand the future of global research networks, DeCLARA, the RedCLARA newsletter recently ran an extensive Q&A with the leaders of 11 major research networks from around the world. The full article can be accessed **here**, whilst overleaf the interview with GÉANT's Project Managers has been reproduced

On behalf of GÉANT, DANTE general managers Niels Hersoug and Matthew Scott outlined their vision for the future of collaboration and research networks.

## WHAT COMES TO YOUR MIND WHEN YOU HEAR THAT A RESEARCHER IS TALKING ABOUT COLLABORATION?

**Niels Hersoug:** It is a major strength that there is a shared willingness among researchers around the world to work together for the benefit of mankind. The ability to collaborate is dependent on having the correct infrastructure in place, and it is out of a desire to help collaborative work around the globe that many of us are here at DANTE. RedCLARA is another good example of how well things can work when that drive to support collaboration is there.

**Matthew Scott:** Collaboration creates general benefits for society at many levels. It brings people with similar skills together to work towards a common goal, creating what we call the research village, that is to say the idea that no matter how geographically far apart people are, they can work closely together.

## WHAT WOULD YOU IDENTIFY AS THE MAIN IMPORTANCE OF RESEARCH AND EDUCATION NETWORKS?

**NH:** In addition to the support R&E networks give to research, we must also remember the important role of facilitating education. It is also essential that we continue to work to break down the digital divide, a topic which is very dear to the European Commission in contrast to commercial providers.

**MS:** Absolutely, it is crucial that we create equality of opportunity for people all around the world to access their peers and partners in the research and education community both locally and globally.ntially future proofing GÉANT until 2020.

## HOW WOULD YOU DESCRIBE THE ROLE OF YOUR NETWORK AT BOTH A REGIONAL AND A GLOBAL LEVEL?

**MS:** Within Europe, GÉANT acts as the common community for European researchers and also as a society of European NRENs in which they can collaborate on new services. Globally we see GÉANT very much as being at the heart of the Research and Education Village. An example of this is the fact that GÉANT enables the exchange of connectivity between other world regions.

**NH:** DANTE has nearly 20 years' experience of establishing regional research and education networks. This experience is something we have shared and continue to do so with other world regions.

**MS:** In addition to providing connectivity, GÉANT also provides services to meet user needs within Europe. This is again something that we can share with other world regions. The ELCIRA project led by RedCLARA, and which DANTE and GÉANT are closely involved in, is an example of how we can share experiences of services and work to create inter-regional services which benefit global collaborations.

## HOW IMPORTANT FOR YOUR NETWORK IS COLLABORATION WITH OTHER REGIONAL NETWORKS AND IN WHAT WAYS DO YOU COLLABORATE AT A GLOBAL LEVEL?

**NH:** International collaboration is key for us. DANTE has put a lot of effort into supporting other regional networks over the years, with the support of European Commission (EC) funding, meaning that connectivity costs between regions have always been shared. We have also helped other networks justify to their local funding bodies the importance of Research and Education Networks.

**MS:** For the EC-funded regional projects, DANTE has acted as the conduit between the European Commission and the regions. This has helped to create very powerful links between the regions and Europe. But as organisations such as RedCLARA in Latin America and the TEIN Cooperation Centre in the Asia-Pacific region adopt the role of managing the EC-funded projects, DANTE continues to work closely with them to support them in their work.

## HOW DO YOU THINK GLOBAL COLLABORATION AMONG REGIONAL NETWORKS WILL CHANGE IN THE COMING YEARS?

**NH:** We will see a change in the difference in the capacities provided by smaller networks and the larger ones. Gradually, connectivity will grow to the point where there is greater equality in bandwidth across world regions.

**MS:** Providing sufficient bandwidth between regions will continue to be an important part of global collaboration, but the major focus will be on the provision of inter-regional services which facilitate global collaboration.

## COULD YOU DESCRIBE YOUR VISION OF R&E NETWORKS IN THE FUTURE?

**MS:** For big projects the issue will continue to be about providing unconstrained bandwidth which commercial providers are not interested in providing, given the bursting nature of research networking. More and more, we will be working together to serve large science projects which are distributed around the globe, work which would be impossible without high bandwidth. Research projects which depend on data from the European Southern Observatory in Chile and the Pierre Auger Observatory in Argentina are good examples of this.

Beyond the issue of bandwidth, the quality of the services provided on R&E networks will be very important, be they for network monitoring, bandwidth-on-demand connectivity, eduroam, global access to services via federations, collaboration tools, etc.

**NH:** It is vital that we keep significantly ahead of the commercial providers and try out things which are not commercially attractive. We have to deliver the unthinkable.

# NEWS

## MAPPING THE LANDSCAPE, MANAGING THE FUTURE WITH EUMEDCONNECT3

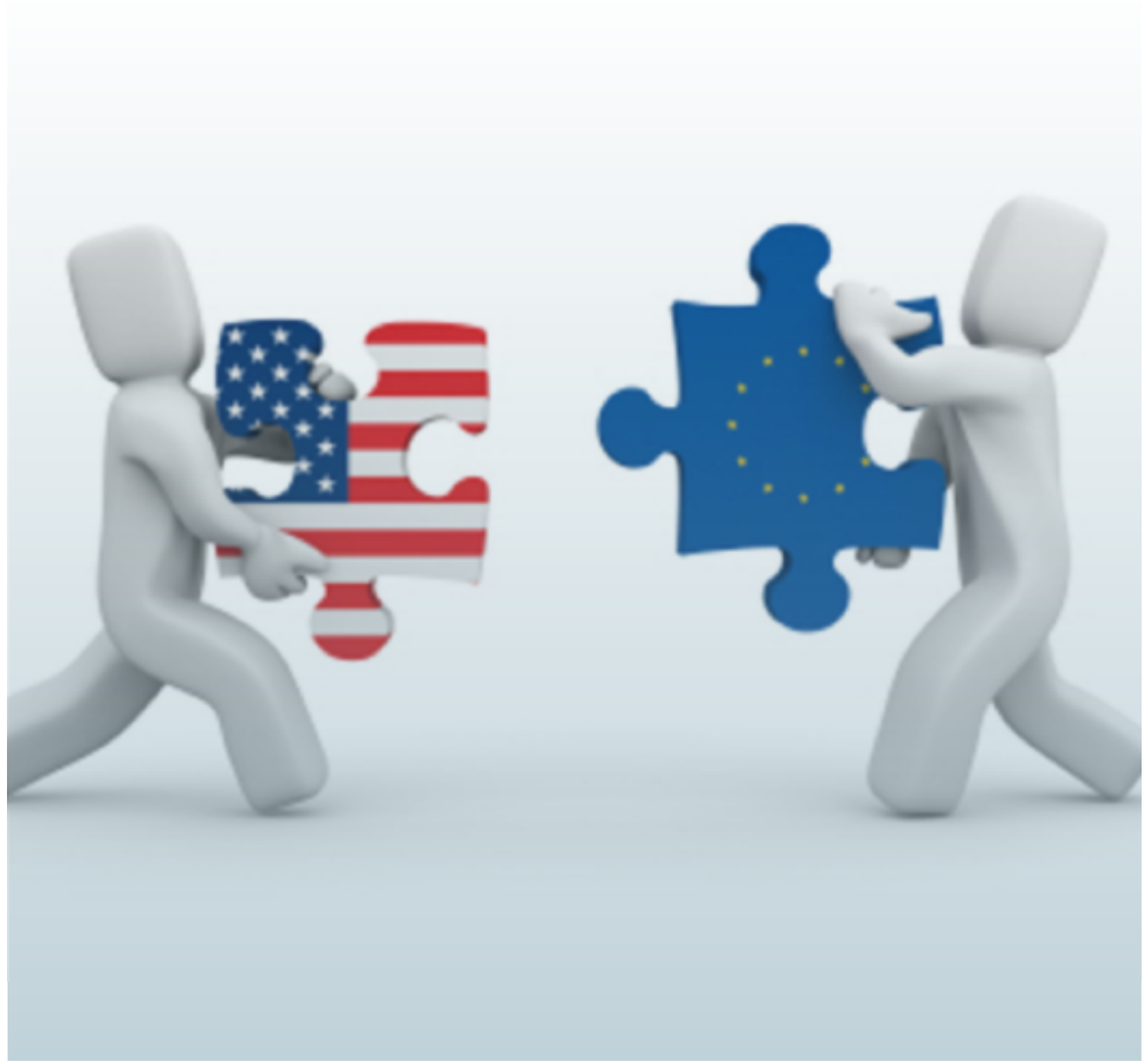
Moroccan and French researchers are using EUMEDCONNECT3 to combine their expertise in Geographic Information Systems (GIS) and remote sensing to produce new maps of the vulnerable Agadir region in Morocco. The area requires close care and monitoring as it both vitally important to the Moroccan economy and is also a protected UNESCO Biosphere Reserve. The resulting thematic maps improve policy-makers' knowledge of Agadir to help them take decisions on how to manage the territory sustainably. Download the full case study at

**www.eumedconnect3.net/upload/pdf/Agadir_FINAL.pdf**

## TEIN3 WORKSHOPS HELP NREN DEVELOPMENT

As part of an awareness-raising campaign for research and education networking amongst the South East Asian countries not yet connected to TEIN3, a very successful series of workshops has just been completed in Cambodia, Myanmar and Laos. For each workshop the project brought in experts from Asian partners and other regions to boost local efforts already underway to set up NRENs and pave the way for getting these countries connected to TEIN3/4. Over 120+ stakeholders attended each workshop, ranging from ministers, government officials, researchers and academics to NREN and prospective NREN representatives. Find out more at

**www.tein3.net/server/show/ConWebDoc.3424**



# US AND EUROPE COLLABORATE TO DELIVER 70GBPS OF TRANSATLANTIC BANDWIDTH

By James G. Williams, Indiana University/ACE project
and Cathrin Stöver, DANTE



## INTRODUCTION

Over the last 18 months the America Connects to Europe (ACE) project and DANTE have together installed 70Gbps of integrated network capacity between Europe and the US.

It is the first time that the major US research networks and GÉANT in Europe have come together to benefit from fully transparent, organised and operationally integrated transatlantic circuit procurement and implementation. This has enormous advantages for collaboration between the European and US research and education communities.

The partnership has many aspects, including the joint circuit planning, “other party aware” tendering, joint delivery of services and diverse physical circuit routing. The partners have also had joint service discussions with an emphasis on interoperable multi-domain bandwidth on demand and monitoring services, as well as on security, OpenFlow deployment and other, bilateral service discussions.

## DEVELOPING THE PARTNERSHIP ARCHITECTURE

The five year ACE Project was officially funded by the US National Science Foundation in June 2010 and aims to provide US scientists with the network connectivity and services above the network (such as end-to-end measurement and file transfer support) that they need to develop and enhance their global collaboration efforts.

## NETWORK ENGINEERING

As of 1st July 2012 the bandwidth supplied by the ACE-DANTE partnership is:

- AMS-NYC - 3x10Gbps bonded, flow-based circuit. One 10Gbps supplied by ACE and two by GÉANT.
- FFT-DC-WIX – 2x10Gbps bonded, flow-based circuit. One 10Gbps supplied by ACE and one by GÉANT.
- AMS-CHI – 1x10Gbps circuit used for point-to-point applications. Supplied by ACE
- PAR-NYC – 1x 10Gbps circuit used for point-to-point applications. Supplied by GÉANT

Based on the balanced partnership understanding for circuit deployment, the ACE project (US side) will deploy the next 10Gbps circuit. Exact origination and landing sites are yet to be determined.

## SERVICES ACROSS THE ATLANTIC

The partnership, via work done in the DICE Collaboration, has deployed the multi-domain perfSONAR measurement framework through the network. It also has deployed software developed within the DICE collaboration to provide a multidomain dynamic circuit capability between the US (the Internet2 ION infrastructure) and Europe (the GÉANT Bandwidth on Demand Service).

## BROADENING THE PARTNERSHIP

One of the difficult challenges in operating a research and education network is balancing the demands for production quality services and the necessity of developing/permitting innovative services and opportunities. The partnership understands these challenges and seeks to find the correct balance. It is also collaborating actively within the OGF towards the development of the NSI protocol and closely tracking the work of the GLIF group.

To serve global science effectively, networks must communicate closely and offer deep operational integration. This has commenced with short term staff exchanges which help the partners understand more clearly the operational character of both networks and the potential areas for in-depth collaboration such as tool development. These operational exchanges will then be broadened to include development activities in select areas.

## FUTURE PLANS

Over the course of the next 30 months the collaboration expects to:

1. Incrementally expand bandwidth of the bonded circuits in 2012 and 2013, at a rate of 10Gbps per year based on expected demand.
2. Investigate the use of 100Gbps bonded circuits in 2014 based on demand and also cost of 100G transatlantic capacity services.
3. Be well-positioned to support Big Data and new science demands such as a more powerful LHC in 2014, the development of the SKA and ITER projects and the expected significant increase in genomics related data flows.

Much has been achieved in the past 2 years due to the close partnership between ACE and DANTE. As this partnership deepens new services and links will be deployed, ensuring that researchers in Europe and the US have the vital capacity and tools that they need to collaborate effectively across the Atlantic.

# BUILDING LINKS FROM AFRICA TO GÉANT

By Rose Chisowa, Communication and Dissemination Intern, UbuntuNet Alliance

Research in Africa is being boosted by two high speed networking initiatives – AfricaConnect and new point-to-point (P2P) links between GÉANT and the UbuntuNet Alliance.

## AFRICACONNECT MOVES FORWARD

The AfricaConnect project, which began in May 2011 is now entering its procurement phase. The four year project has received €14.75M from the European Commission to create a high capacity network for research and education in sub-Saharan Africa.

The project will be strongly collaborative, so whilst DANTE is coordinating AfricaConnect, it partners with regional counterpart organisations UbuntuNet Alliance covering Eastern and Southern Africa WACREN covering Western and Central Africa – Association of African Universities Existing National Research and Education Networks (NRENs) in Africa The European NRENs of Germany, Ireland, Italy, the Netherlands, Portugal and the UK

Researchers in Africa are increasingly looking to collaborate with their colleagues both across the region and globally. Through its high speed links across the continent AfricaConnect will support data-intensive, time-critical projects involving African researchers, helping to further develop research capabilities in local institutions, assisting the region's entire economy. Millions of students and researchers served by NRENs across Africa will benefit from fast access to conventional web-based resources from all over the Southern and Eastern African region and beyond.

Additionally, AfricaConnect will provide a gateway for global collaboration, enabling users at research centres and universities to participate in joint projects with their peers in Europe and other parts of the world. This will not only help bridge the digital divide but will allow collaborative projects in areas such as health, education and climate research that directly benefit African citizens.

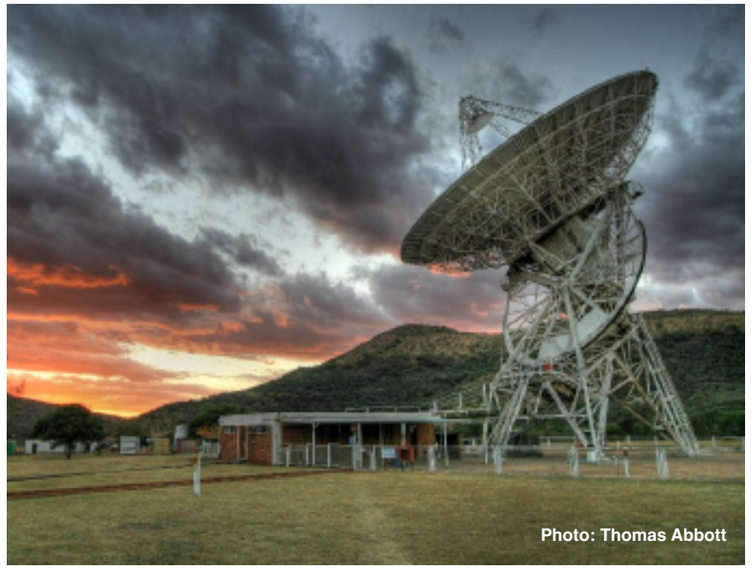


Photo: Thomas Abbott

## SEEING FURTHER INTO SPACE

Thanks to a new 15,000 km dedicated P2P link African radio astronomers are now able to collaborate and share data with colleagues in Europe and around the world.

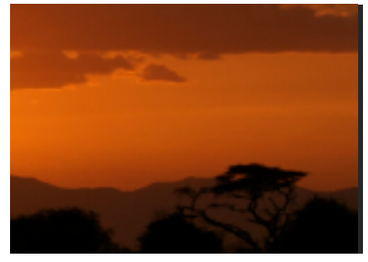
A high speed 2Gbps circuit will enable astronomers at the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in South Africa to stream observational data to the Joint Institute for VLBI in Europe (JIVE) in the Netherlands for processing and correlation, as part of joint observations involving telescopes across the world.

HartRAO, located in a valley in the Magaliesberg hills, 50 km west of Johannesburg, is the only major radio astronomy observatory in Africa. Through the technique of Very Long Baseline Interferometry (VLBI), it collaborates with radio telescopes on other continents to form a virtual telescope the size of the Earth. By combining telescopes researchers receive more detailed observations of distant astronomical objects than with any other technique.

The first P2P circuit between GÉANT and UbuntuNet, the link will deliver the guaranteed capacity needed to transmit the enormous volumes of data generated by VLBI radio astronomy in real-time. This enables observations of transient phenomena such as supernovae, using the highest resolution astronomical technique possible.

Research data gathered at HartRAO, a member institution of the South African national research and education network (NREN), TENET, flows in succession across the networks of TENET, UbuntuNet, GÉANT and Dutch NREN SURFnet.

Taken together these two projects demonstrate the accelerating pace of African research networking and the benefits that it is bringing to scientists, astronomers, students and the general population, both within the continent and across the globe.



Research today is a global activity and GÉANT continues to extend its worldwide connectivity for the benefit of the entire European research community. In this section Connect takes a closer look at some of those networks, with further information available on page 27.

# INTERNATIONAL PARTNER PROFILE: CANARIE

BY KATHRYN ANTHONISEN, VICE PRESIDENT, MARKETING, CANARIE

## CANARIE INC. IS CANADA'S ADVANCED RESEARCH AND INNOVATION NETWORK

Established in 1993, CANARIE manages an ultra-high-speed network that supports leading-edge research and big science across Canada and around the world. One million researchers, scientists and students at over 1,100 Canadian institutions, including universities, colleges, research institutes, hospitals, and government laboratories have access to the CANARIE Network. Together with 12 provincial and territorial advanced network partners, CANARIE enables researchers to share and analyze massive amounts of data, like climate models, satellite images, and DNA sequences that can lead to groundbreaking scientific discoveries. CANARIE is a non-profit corporation supported by membership fees, with the major investment in its programs and activities provided by the Government of Canada.

## ABOUT THE CANARIE NETWORK

The CANARIE Network is among the world's most advanced national research and education networks. CANARIE is a high performance hybrid network, equipped with leading-edge optical and routing equipment, that enables CANARIE to offer traditional IP network services and Lightpath services (dedicated end-to-end connections) while continuing to develop new network service offerings. Together with twelve provincial and territorial partners, CANARIE supports research, education and innovation in Canada.
In December 2011, CANARIE demonstrated full 100 Gb/s capacity using current technical infrastructure. "Data was moved back and forth at a combined rate of 186Gbps (gigabits per second), fast enough to transfer two million gigabytes of data or 100,000 full Blu-ray discs in one day. It could pave the way for networks with standard transfer rates of 100Gbps. That would speed up the sharing of scientific research, such as that at the Large Hadron Collider." "*Scientists break world record for data transfer speeds*," **BBC News | Technology**

## SERVICES

CANARIE continues to expand its support for research, education and industry by offering innovative services, such as:

- **Canadian Access Federation (CAF)** – enables collaboration among academic and research organizations across Canada and around the world. This member-based service includes support for eduroam, Shibboleth, and edugain.
- **Content Delivery Service (CDS)** – provides faster and less expensive access to Internet content around the world for connected institutions through content peering.
- **Digital Accelerator for Innovation and Research (DAIR)** – an advanced R&D environment for product design, prototyping, validation and demonstration.

## CONTACT

**Physical address:**
45 O'Connor St., Suite 500, Ottawa, ON, Canada K1P 1A4.
Phone: (613) 943-5454
e-mail: info@canarie.ca

You may also follow CANARIE through social media. Find us on **Facebook** and **LinkedIn** by searching for CANARIE Inc. On **Twitter**, search for CANARIE_Inc.



# INTERNATIONAL PARTNER PROFILE: SINET

BY SHIGEO URUSHIDANI, PROFESOR, NATIONAL INSTITUTE OF INFORMATICS (NII)

## OVERVIEW

The Science Information Network (SINET) is a Japanese academic backbone network for more than 700 universities and research institutions. It connects many research facilities in such fields as seismology, space science, high-energy physics, nuclear fusion, computing science, and so on. It is now being used by over 2 million users and supports international research collaboration through international lines. The National Institute of Informatics (NII) has operated SINET since 1992, and the current version is SINET4 launched in 2011.

## NETWORK

SINET4 positions all nodes in earthquake-resistant data centers (42 edge node and 8 core nodes) and connects them with high-speed duplexed lines of a maximum of 40 Gbps. It also has redundant routes between core nodes along with reroute functions for all transfer layer services. This design for high-availability worked effectively even for the Great East Japan Earthquake on March 11, 2011.

## INTERNATIONAL COLLABORATION

SINET4 currently has three international lines and will upgrade them to four 10-Gbps lines in April 2013 in order to strengthen international research collaboration: lines to Singapore, Los Angles, New York, and Washington D.C. It is connected to GÉANT and European academic networks via Singapore (TEIN3/4), New York (MANLAN), and Washington D.C. (WIX). Examples of collaborative research projects between European countries and Japan are ATLAS at LHC, eVLBI, ITER, GRID5000, SHV transmission, and so on.

## SERVICES

SINET4 provides a variety of multi-layer network services:

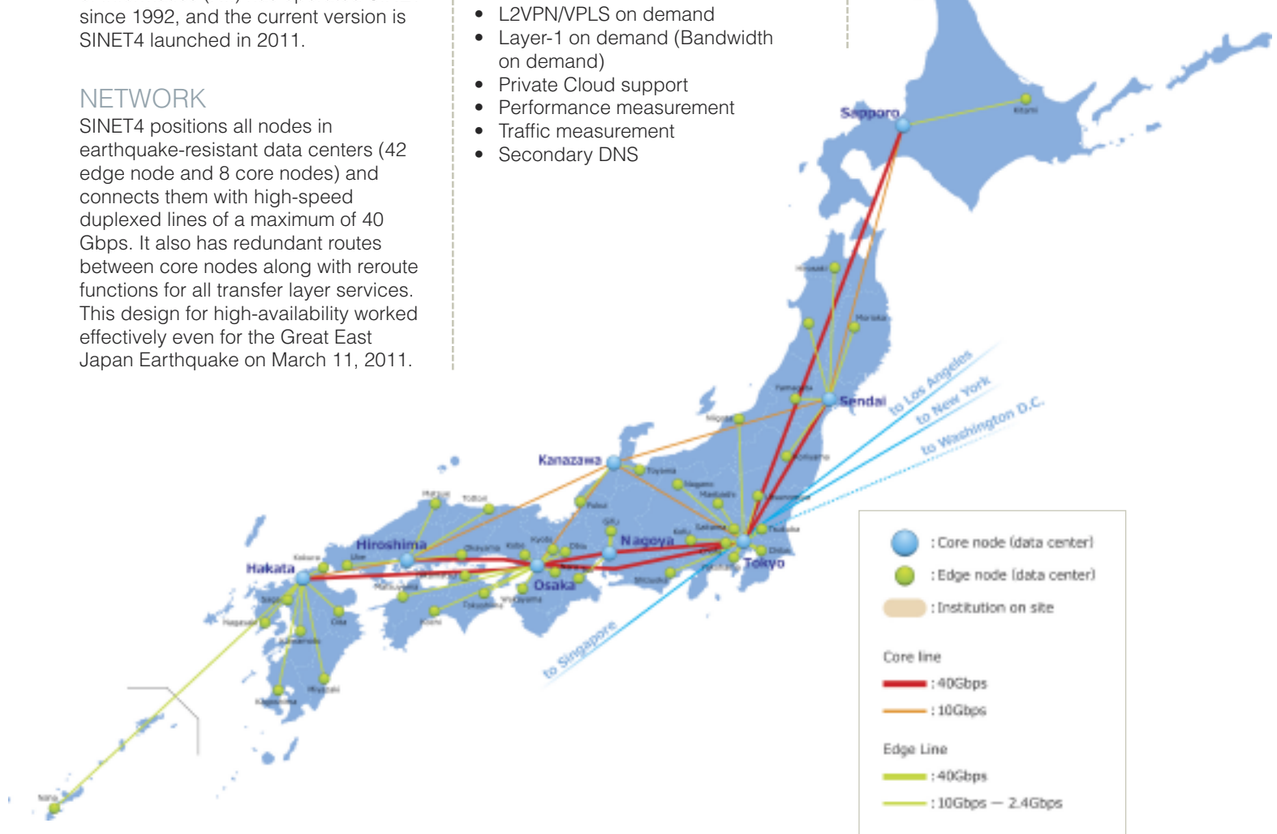
- Internet Access
- IPv6 with multicast capabilities
- L3VPN with QoS control
- L2VPN/ VPLS with QoS control
- L2VPN/VPLS on demand
- Layer-1 on demand (Bandwidth on demand)
- Private Cloud support
- Performance measurement
- Traffic measurement
- Secondary DNS

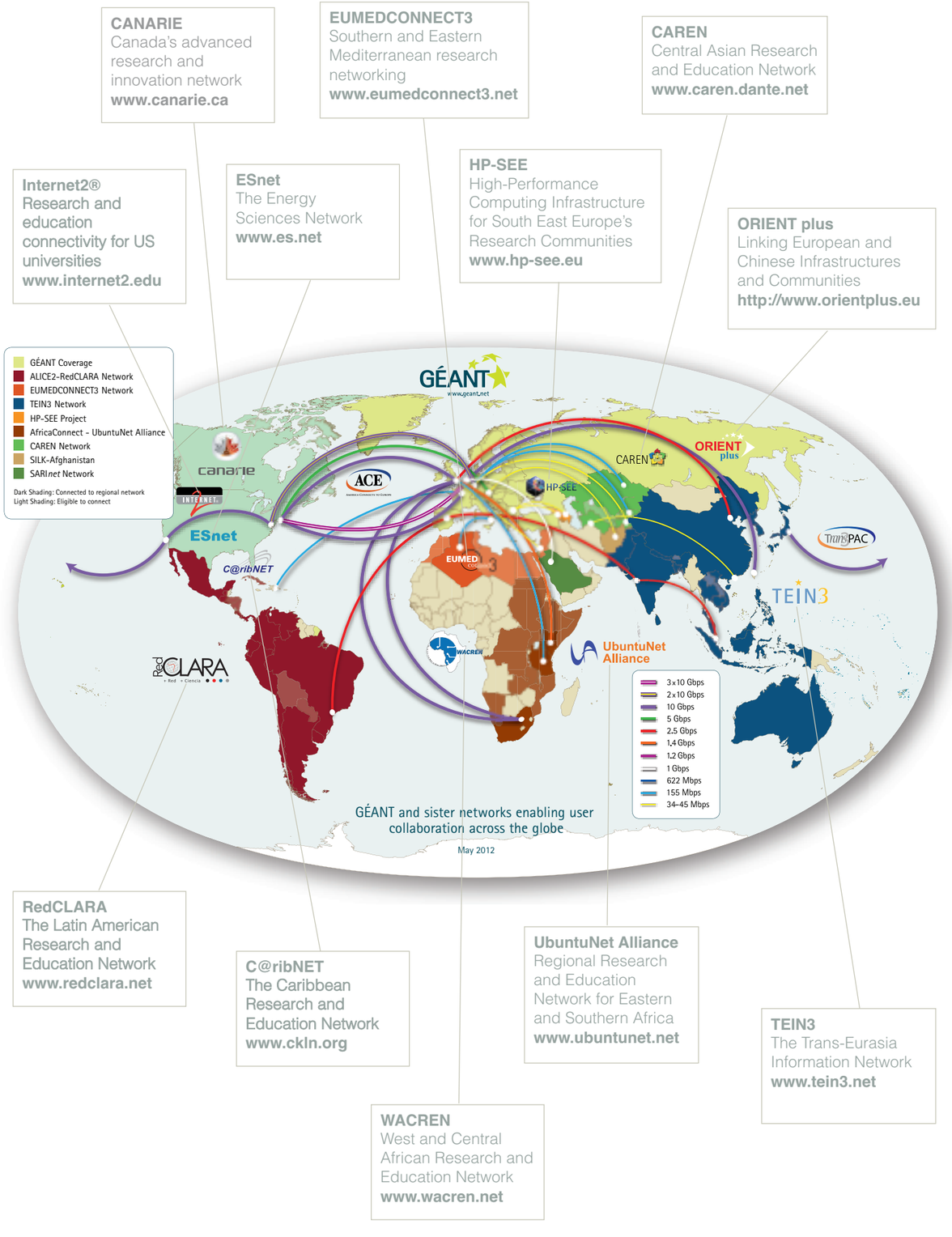
## USE CASES

For details of use cases of SINET, please visit the following website.
**http://www.sinet.ad.jp/case-examples**

## FOR MORE INFORMATION, SEE:

**http://www.sinet.ad.jp/index_en.html?lang=english**






**CANARIE**
Canada's advanced research and innovation network
**www.canarie.ca**

**EUMEDCONNECT3**
Southern and Eastern Mediterranean research networking
**www.eumedconnect3.net**

**CAREN**
Central Asian Research and Education Network
**www.caren.dante.net**

**Internet2®**
Research and education connectivity for US universities
**www.internet2.edu**

**ESnet**
The Energy Sciences Network
**www.es.net**

**HP-SEE**
High-Performance Computing Infrastructure for South East Europe's Research Communities
**www.hp-see.eu**

**ORIENT plus**
Linking European and Chinese Infrastructures and Communities
**http://www.orientplus.eu**

**RedCLARA**
The Latin American Research and Education Network
**www.redclara.net**

**C@ribNET**
The Caribbean Research and Education Network
**www.ckln.org**

**UbuntuNet Alliance**
Regional Research and Education Network for Eastern and Southern Africa
**www.ubuntunet.net**

**WACREN**
West and Central African Research and Education Network
**www.wacren.net**

**TEIN3**
The Trans-Eurasia Information Network
**www.tein3.net**



# GLOBAL CONNECTIVITY NEWS ROUND-UP

By Tom Fryer, International Relations Officer, DANTE

## THE CARIBBEAN CONNECTS TO GÉANT

C@ribNET

The Caribbean becomes the newest world region to join the global R&E networking community

In May this year the Caribbean Knowledge and Learning Network (CKLN) completed the first phase of its project to implement and operate the Caribbean Research and Education Network, C@ribNET. With EC funding made available to CKLN via the World Bank, C@ribNET today interconnects a total of 13 Caribbean countries to each other and to the European R&E community with a 155-Mbps link between Santo Domingo and Paris. The Caribbean is also connected to RedCLARA in Latin America at 45 Mbps and to the research and education community in North America at 300 Mbps. A second implementation phase will see a further eight Caribbean countries being connected to C@ribNET. For more information, visit: **www.ckln.org/home/content/cribnet**

## REDCLARA AND GÉANT TO ESTABLISH INTERREGIONAL END USER SERVICES

### EC-funded ELCIRA project will create transatlantic end user services

EC-funded ELCIRA project will create transatlantic end user services Europe-Latin America research and education collaborations will soon benefit from interregional end user services thanks to the EC-funded ELCIRA (Europe Latin America Collaborative e-Infrastructure for Research Activities) project. Led by the Latin American R&E networking organisation, RedCLARA, and partnered by DANTE, TERENA, GARR, RedIRIS in Europe and RNP (Brazil) and RENATA (Colombia) in Latin America, ELCIRA will drive the uptake of eduroam and eduGAIN by Latin American NRENs, and will work to establish a high quality videoconferencing service across the two regions. The two-year project will also identify new user groups across the two regions with the aim of supporting them with a variety of end user collaboration tools made available via a single sign-on portal. Following the start of the project, the project partners met on 4th-5th July during the summer 2012 RedCLARA meetings in Lima, Peru, to get the project underway and begin the collaborative work which will see significant benefits created for collaborations across the two regions.

## GÉANT GLOBAL CONNECTIVITY OVERVIEW AVAILABLE TO DOWNLOAD

### GÉANT publishes a summary of Global Connectivity **here**.

An overview of GÉANT's global links has been made available from the GÉANT Global Connectivity website: **http://global.geant.net**. The summary is provided in pdf format and includes information on global links (both IP and point-to-point) by region, and includes a list of the NRENs connected by each of the regional networks. The document will be updated whenever there are changes to GÉANT's global connectivity and/or the NRENs connected to the regional networks and so provides for a reliable source of the latest global connectivity information.

The overview can be downloaded directly **here**.

A version of the overview is also available in PowerPoint so that the information can be used in presentations. To receive a copy of the pptx version, please contact: **irc@dante.net**

General information about GÉANT's global connectivity and our regional partners is also available from the Global Connectivity website at: **http://global.geant.net.**

GÉANT is a vital part of the European research e-infrastructure, which includes such areas as high performance networking, distributed computing infrastructures, supercomputing and data storage. In this section, we welcome our many partners in this area to shed further light on their activities.

# THE EUROPEAN E·INFRASTRUCTURES OBSERVATORY STARTS SERVING THE E·INFRASTRUCTURES COMMUNITY

By Jorge-A. Sanchez-P., e.nventory

## E-OBSERVATORY UNVEILED DURING THE COPENHAGEN E-IRG WORKSHOP

The European eInfrastructures Observatory (www.e-observatory.eu) was officially unveiled during the e-IRG Workshop organised under the Danish EU Presidency on June 11, 2012, in Copenhagen, in front of a wide audience that included e-IRG members and other key eInfrastructures stakeholders.

The European eInfrastructures Observatory is an on-line platform, offering interactive and user-driven visualisation tools and an extensive set of benchmarking indicators to facilitate multidimensional and polymorphic monitoring and analysis, support fact-based policy and learning and disseminate achievements of electronic infrastructures in Europe and beyond. Currently, the European eInfrastructures Observatory offers 7 intuitive, interactive and user-friendly visualisation tools based on best practices in visualisation and representation techniques, features a core set of 45 benchmarking indicators that are the baseline for monitoring eInfrastructures development progress, usage, impact and investments drawn, and provides access to more than 10.000 individual figures and other related data and benchmarks.

Following the public launch of the European eInfrastructures Observatory, Dr. René Belsø, e-IRG co-chair and DeIC CTO, stated that "European countries invest heavily in e-Infrastructures; the European community supplements further, since we all believe in the strategic rationale behind e-Infrastructures. Yet, we know only little about the actual impact of these investments on European R&D. We desperately need a better overview and namely we need investment, cost and impact indicators. The European eInfrastructures Observatory is a nice initial attempt to provide such an overview and these indicators; at the very least it will stir up a needed debate on how one might get a better and more sustainable indicators production; at the very best, it will pave the way towards a sustainable structure offering the eInfrastructures community the equivalent of WorldBank, OECD-like indicators…".

Prof. Heinz-Gerd Hegering stated "The European Commission and the European Countries have started a lot of initiatives to improve IT-related infrastructures in the areas of networking, databases and supercomputing, among others. In order to gain maximum benefit out of already existing e-infrastructures as a user as well as to learn from one another as a developer or provider, an integrated and comprehensive overview of such infrastructures has been missing so far. The European eInfrastructures Observatory fills this gap in an excellent way. The system not only provides many useful information but also allows to build individual profiles and presentations in a very flexible way."

Dr. Robin G. Arak, an independent consultant and EC project reviewer also stated "The enventory project has developed an easy to use web based visualization tool which allows anyone interested in e-Infrastructures to gain an insight into the historical and current developments and parameters of important e-Infrastructures which support leading edge research throughout Europe. This will enable e-Infrastructures to be critically assessed, reviewed and planned for the future so that they can continue to improve their services and support for research and education."

The eObservatory coordinator, Dr. Jorge-A. Sanchez-P., noted: "We are very excited with the official launch of the Observatory and we are keen to follow up to any feedback from the e·Infrastructures stakeholders that will help improve it further towards a value-added tool that will serve their needs and expectations in the best manner possible!"

The eObservatory has been developed by the enventory project, co-financed by EU's 7th Framework Programme under Grant Agreement no RI-261554. The enventory project acknowledges the invaluable support and contribution of European flagship e·Infrastructures initiatives and coordinating organisations: GÉANT, DANTE, TERENA, EGI.eu, PRACE and its Advisory Board

**www.enventory.eu/advisoryboard.html**



# WORLD-CLASS SYSTEMS FOR TOP-LEVEL SCIENCE

By Marjolein Oorsprong, Communications Officer, PRACE

The Partnership for Advanced Computing in Europe (PRACE) provides persistent world-class High Performance Computing (HPC) services for researchers from academia and industry. PRACE currently has 24 member countries and provides access to 5 Tier-0 systems (June 2012).

The mission of PRACE is to enable high impact European scientific discovery, engineering and R&D across all scientific disciplines to enhance European competitiveness for the benefit of society. PRACE seeks to realise this mission through world class computing resources and services open to scientists from around the world through a peer review process. GÉANT's high speed connections underpin PRACE's HPC services, with the two projects working closely together to benefit users.

PRACE is established as an international non-profit association (aisbl) with its seat in Brussels. Concretely, PRACE aisbl has the following purposes:

- The development and provision of an Infrastructure at European level which allows the scientific communities, including those within industry, to access European large-scale computing and storage systems
- The management of the coordination between Tier-0, Tier-1 and Tier-2 resources operated and/or coordinated by the PRACE research infrastructure to deliver world-class services to the European Research Community with large-scale computing and storage resource, support and training needs
- The provision and rationalisation of access to the Infrastructure by qualified European and international scientific communities, either academic or industrial, whose projects can be evaluated for such purpose

PRACE offers two different forms of access to its resources: **Project Access** (2 calls per year) and **Preparatory Access** (open calls).

- One-Year Project Access is the standard form of access for individual researchers and research groups. It is open to researchers and their collaborators from recognised academic institutions and industry for projects deemed to have significant European and international impact.
- Multi-Year Project Access is available to major European projects that can benefit from PRACE resources and for which more than a single year of access is needed.
- Preparatory Access is a simplified form of access to limited resources for the preparation of requests in response to Project Access Calls for Proposals.

The PRACE Scientific Annual Report 2012 is available at: **http://www.prace-ri.eu/PRACE-Scientific-Annual-Report**

**Do you want more information?**
Please visit the PRACE website: **http://www.prace-ri.eu**
Or contact **Marjolein Oorsprong**, Communications Officer:
Telephone: +32 2 613 09 27
E-mail: **M.Oorsprong(at)staff.prace-ri.eu**

# STORIES FROM THE EUROPEAN GRID

By Neasan O'Neill, NGI Communications Coordinator

The European Grid Infrastructure (EGI) has just launched the latest instalment in the 'Stories from the grid' series of online videos. Previous episodes have highlighted work done by members of the DANTE team on in recreating the sounds of long-lost instruments, as well as the success structural biologists have achieved using grid technology. using high speed research networks such as GÉANT. The third episode looks at the research that uses the world's largest machine, the Large Hadron Collider (LHC), which would be impossible without the grid and the research networks that support it..

The LHC is an engineering and scientific marvel. Buried 100m below the Swiss/French border it accelerates protons around a 27km ring at close to the speed of light and then smashes them together. The result of a global collaboration of thousands, this behemoth is investigating the rules that underpin our universe by recreating the conditions present just after the Big Bang. Sharing and analysing the massive amounts of experimental data produced by the LHC's experiments relies on a high performance technology infrastructure comprising grids and research networks including GÉANT.

In the video, researchers from NIKHEF, the Dutch National Institute for Subatomic Physics, explain their work and how the grid is key to analysing and managing the massive sets of data. The star of this 'Stories from the grid' video, though, is the top quark

Discussions of the LHC are usually dominated by talk of the Higgs boson, the mysterious piece required to complete the jigsaw that is particle physics, but there is so much more going on at the LHC. The top quark is one of the other puzzles being studied. As one of the fundamental building blocks of the world around us, the top quark opens a window to the differences between theory and experimental results, while also potentially explaining dark matter or the existence of extra dimensions. Without the resources provided by the grid it would be impossible to pick out the results that could hold the clues to top quark behaviour.

"High energy physics is one of our biggest user communities, and we have always worked very closely with them," says Steven Newhouse, director of EGI. "I'm glad that we have been able to include their story in our video series as it complements the other research we have already showcased. The videos are a perfect introduction to EGI as a cornerstone of the European Research Area".

Stories from the grid, Episode 3: the Top Quark can be seen on YouTube at **http://go.egi.eu/topquark**

Previous episodes can also be seen on YouTube:
Episode 1: The cone snail and the search for powerful new anaesthetics - **http://go.egi.eu/conco**
Episode 2: Reviving the lost sounds of the epigonion -**http://go.egi.eu/epigonion**

# SONIFICATION ENABLES WORLD TO HEAR NEW HIGGS BOSON-LIKE PARTICLE

By Paul Maurice, Senior Communications Officer, DANTE

Through a combination of high speed research networks, advanced sonification techniques and grid computing the world can now 'hear' the newly discovered Higgs Boson-like particle.

DOMENICO VICINANZA, PRODUCT MANAGER, DANTE

Building on the discovery of the Higgs-like particle, the same research networks have now been a central part of turning the scientific findings into music using data sonification. Working from results supplied by the Atlas experiment at the Large Hadron Collider (LHC), researchers have created melodies that make the results easier to understand.

Sonification requires enormous amounts of networking and processing power to produce results. Creating the Higgs melody consequently relied on high-speed research networks including the pan-European GÉANT network, which operates at speed of up to 10Gbps and the EGI grid computing infrastructure. Grid computing works by linking together multiple computers in different locations via high speed networks, combining their processing power to deliver faster results when analysing enormous volumes of data.

The project was coordinated by Domenico Vicinanza of DANTE, in collaboration with Mariapaola Sorrentino of ASTRA Project, Cambridge, who contributed to the sonification process and Giuseppe La Rocca from INFN Catania, responsible for the computing framework.

In the music the peak of high notes in the second bar is the appearance of the Higgs-like particle (about 3.5 seconds into the recording). The researchers created two versions, one as a piano solo, and the second with added bass, percussion, marimba and xylophone.

"The discovery of the Higgs-like particle is a major step forward in our knowledge of the world around us," said Domenico Vicinanza, DANTE. "By using sonification we are able to make this breakthrough easier to understand by the general public, highlighting the depth and breadth of the enormous research efforts by the thousands of scientists around the world involved with the Large Hadron Collider. Neither the discovery of the particle or this sonification process would have been possible without the high speed research networks that connect scientists across the world, enabling them to collaborate, analyse data and share their results."

Previous sonification projects from the team include the creation of music from volcanic activity around the world, making it easier to spot potential eruptions by listening to changes in musical pitch.

Click on the links below to listen to the Higgs Boson-like particle:

**Piano solo**

**Piano, bass, percussion, marimba and xylophone**

**The data on which the sonification is based**

**The score of the sonification** (PDF)

For more information, see:
**Research networks help LHC unlock the mysteries of the universe**



GÉANT is the pan-European research and education network that interconnects Europe's National Research and Education Networks (NRENs). Together we connect over 40 million researchers and students across Europe, facilitating collaborative research in a diverse range of disciplines, including high-energy physics, radio astronomy, bio-medicine, climate change, earth observation and arts & culture.

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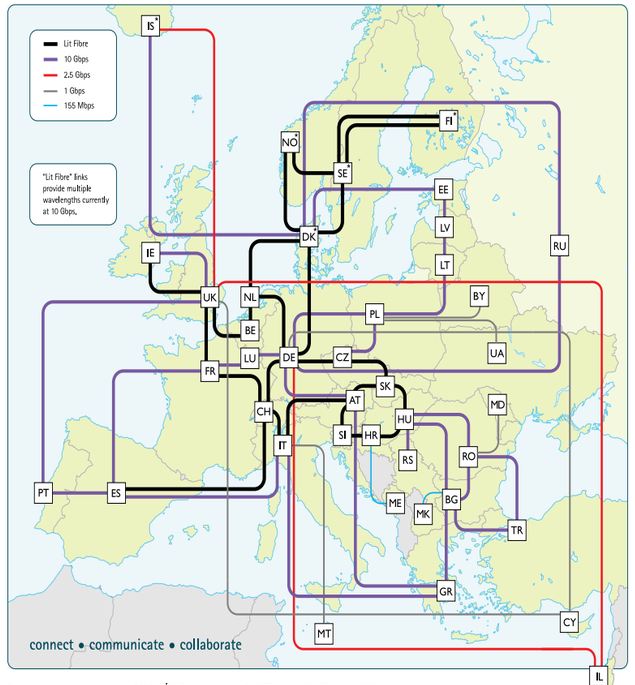


Backbone topology as at March 2012. GÉANT is operated by DANTE on behalf of Europe's NRENs.

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**NORDUnet Conference**, 18-20 September, Oslo

**4th GÉANT Project Symposium**, 15-19 October, Vienna

**SDN & Openflow World Congress**, 22-24 October, Frankfurt

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