GÉANT PROJECT

CONNECT

THE MAGAZINE FROM THE GÉANT COMMUNITY | ISSUE 17 2014

SKA

EXPLORING THE UNIVERSE WITH THE WORLD'S LARGEST RADIO TELESCOPE

CERN AT 60:
MUSICAL CELEBRATIONS HELP MARK ANNIVERSARY

DENGUE FEVER:
THE POWER OF NETWORKS TO EMPOWER COMMUNITIES

TRUST AND IDENTITY:
FUTURE FOCUS FOR IDENTITY FEDERATIONS

CONTENTS

CONNECT is the quarterly magazine from the GÉANT community; highlighting key areas of interest, updates on the project and its vital work supporting European research and education. We give insights into the users who depend on the network, and the community that makes GÉANT what it is. We welcome feedback at **connect@geant.net**

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Cover image © SKA Organisation

GUEST WELCOME FROM JOHN CHEVERS

John is responsible for international and business development for the GÉANT project

Welcome to the latest issue of CONNECT, which as always focuses on the diverse science community that uses the GÉANT network. For example you can read about our work with Square Kilometre Array on page 6 and an interview with Chiara Mariotti from CERN on page 13. This community is of particular interest to me as I lead the team responsible for engaging with science users.

Until relatively recently, most of our user projects came from the physical science or computing sectors. Now, the scope is much larger and we have made special efforts to understand the needs of the bio-science and earth science sectors.

This edition also looks at GÉANT's reach beyond Europe. The GÉANT project works with a great number of science initiatives, and while partnerships were once typically limited to western-European countries with established science budgets, today the scope is much wider. Now there are more European states involved and more projects with significant partners on other continents.

GÉANT is actively addressing these needs – both through account management of each science collaboration and through ensuring that the technology and infrastructure is in place to meet and stimulate demand.

On page 4 you can read about a major new partnership between the US Energy Science network (ESnet) and GÉANT to provide more than 300Gbps of capacity between European and American researchers, especially those involved in the Large Hadron Collider experiments at CERN.

Given all this progress, you might feel that the work is done and networks need no longer be a concern for scientists planning a large-scale initiative.

Certainly connectivity is no longer a limitation on data transfers in Europe, but we need to look beyond this infrastructure at how science works. GÉANT has made real strides in the way it interacts and serves the science community (our International User Advisory Committee is a good example) but the environment continues to evolve and demand ever-more integrated solutions.

A key challenge will be to develop GÉANT's relationships with global partners, to offer the same sort of seamless service provision we have worked hard to achieve in Europe. Geography is not the only boundary for science – we must also look towards service paradigms in which transport of data is integrated with other data essentials such as compute power and storage.

GÉANT is well placed to progress such integration, with tools such as eduGAIN (which enables the bringing together of trust and identity federations around the world) and we look forward to collaborating with new global initiatives to continue to serve and stimulate the science community.

CATHRIN STÖVER MAKES FINALS OF THE 2014 DIGITAL WOMAN OF THE YEAR™ AWARD

Congratulations to Cathrin Stöver, Chief International Relations and Communications Officer at DANTE and Outreach Coordinator for the GÉANT project – a finalist in the prestigious European 2014 Digital Woman of the Year Award!

One of four finalists from across Europe, the awards recognise outstanding women in digital sectors around the world. They form part of the international Ada Awards that recognise outstanding girls and women in digital sectors globally and the organisations that support them. The awards are affectionately named after the first-ever computer programmer, Ada Lovelace, Lady Augusta Ada King, Countess of Lovelace.

The annual award is open to women who distinguish themselves through leadership, creativity, entrepreneurship, social-focus and/or innovative discoveries, and who are positively impacting the number of girls and women participating in digitally-driven or digitally-enabled areas of study or work.

Cathrin was nominated by her team for her role in closing the digital divide for potentially hundreds of millions of people. Her work was highlighted as having a massive impact on society as a whole, unlocking a vast sea of human potential and offering unprecedented possibilities for entire countries.

The abundant support received from the R&E networking community for Cathrin's participation was overwhelmingly positive. Warm messages and quotes were received from around the world in support of her nomination – and went a long way towards Cathrin's accolade. A big thank you again to everybody for their enthusiasm and insight.

The winner of the award, Esther Roure Vila from Cisco, Spain, was announced in Rome on 30th October.

Cathrin said: "It was fantastic to be part of an award that encourages more women in to technology. I feel honoured to be a finalist beside such inspirational women and I would like to offer my sincere congratulations to Esther Roure Vila. Also another big thank you to everybody who contributed their time and heart-warming words in support of my nomination."

To find out more about the awards visit: **www.adaawards.com**

"Before you light a fibre, or set down a single line of code, you have to network people. This is what Cathrin does."
Ann Harding, SWITCH – The Swiss NREN.

"Cathrin inspired me to set up the telemedicine project here in Latin America, which today contributes so much to the health of our region."
Luiz Ary Messina, Rede Universitária de Telemedicina

"Cathrin Stöver is a smart, savvy, empowering and amazing woman."
Margaret Ngwira, UbuntuNet Alliance, Malawi.

"Cathrin has indeed contributed a lot to the success of the global interconnection of the Research and Education Networks around the world."
Sabine Jaume-Rajaonia, RENATER (French Research and Education Network)

DANTE AND TERENA JOIN FORCES TO BECOME THE GÉANT ASSOCIATION

TERENA and DANTE have become the GÉANT Association. The new organisation was established during meetings held in Berlin on 7 October. TERENA members and the shareholders of DANTE voted unanimously for the restructuring, which marks a new phase in almost thirty years of collaborative research and education networking in Europe.

The restructuring comes in response to wishes from the community of Europe's national research and education networking organisations (NRENs). The main benefits of the new association will be simplified governance, more efficient management, more flexible use of resources and a more inclusive membership.

Pierre Bruyère, Director of Belnet, the Belgian NREN, was appointed as Chair of the interim board of the GÉANT Association following three years as president of TERENA. He said: "The GÉANT Association is the leading collaboration on network and related infrastructure and services for the benefit of research and education, contributing to Europe's economic growth and competitiveness."

The new Interim CEO of the GÉANT Association has been named as Bob Day, Executive Director of Janet, the United Kingdom's NREN. The association's board asked him, as he steps down as chair of DANTE, to take on this new role during the period of transition and integration. He said: "The restructuring will create a vehicle to coordinate the community's approach to the European Commission's Horizon2020 Programme."

NRENS

Initial reactions from the NREN community are positive. Tomás de Miguel, director of RedIRIS, captures the typical responses well, saying "The creation of the GÉANT Association is a new milestone in the long and fruitful history of cooperation among European NRENs. It is a very positive sign of our shared commitment to provide jointly to our users world-class ICT services needed for global scientific and academic collaboration."

João Nuno Ferreira, Head of the Portuguese FCT-FCCN says "A new cycle is starting for Research and Education Networks in Europe, in line with the challenges of Horizon 2020 and building on the huge experience accumulated by the GÉANT community over the years. It's an exciting challenge!"

A NEW BEGINNING

A first website for the GÉANT Association is now available, which includes FAQs and a simple overview of the restructuring, membership, activities and governance of the association.

While a longer term web presence is being developed, your patience and understanding are requested. In the meantime, please refer to the TERENA, DANTE, TNC and GÉANT Project websites for more detailed information about all services, network, news, events and other activities.

www.geant.org
www.dante.net
www.terena.org
www.geant.net
www.tnc15.terena.org

GÉANT AND ESNET FORM TRANSATLANTIC PARTNERSHIP WITH NEW HIGH-SPEED NETWORK RING ACROSS EUROPE

INFRASTRUCTURE WILL ACCELERATE TRANSATLANTIC RESEARCH AND EDUCATION COLLABORATION

The Department of Energy's (DOE) Energy Sciences Network, otherwise known as ESnet, is extending its reach using the state-of-the-art GÉANT network and the services of GÉANT's operator, DANTE, to deploy a resilient high speed network ring across Europe.

Together with the ESnet and GÉANT infrastructure, the three 100Gbps European links, shown in the map below, and associated routing equipment will greatly improve collaboration opportunities between US and European research and education facilities, thanks to the superfast connectivity and resilience vital for such big data uses.

ESnet is connecting to GÉANT at three locations: London, Amsterdam and Geneva. GÉANT will provide the three 100Gbps links to move data between these locations, as well as the GÉANT Open service, which will enable ESnet to quickly manage multiple interconnections with international networks. DANTE is also responsible for the provision and installation of the four ESnet points-of-presence across Europe.

DANTE installed ESnet's first European network node at CERN (the major laboratory outside Geneva that houses the LHC) in mid-September, and is now deploying other equipment necessary to bring the first link online. The plan is for all links to be commissioned and in production by January 2015. The timing is important, because the LHC is undergoing upgrades and expected to resume operations next spring, at which point it will be generating significantly more scientific data every day.

"After ESnet's transatlantic extension is complete, we look forward to collaborating with GÉANT on a range of additional projects: assisting scientific collaborations to achieve faster outcomes, promoting better architectures for data mobility, and assuring that researchers in the US and Europe make optimal use of advanced networks."

Greg Bell, Director, ESnet

"The agreement between GÉANT and ESnet is a great example of international research networks collaborating to not only support the growing needs of big science, but to maximise the use of the world's most advanced networking facilities, This high-speed infrastructure will provide millions of researchers and academics at laboratories, universities and research institutions with unprecedented intercontinental bandwidth and resilience, with huge implications for collaborative research on some of the world's most important scientific challenges."

Niels Hersoug, Joint Project Manager of GÉANT

The first floor of the Tokamak complex is completed

GÉANT USER UPDATE

THE FIRST FLOOR UPON WHICH THE ITER MACHINE WILL REST IS READY!

14,000 m3 of concrete, 3,600 tonnes of steel, 2,500 embedded plates: the B2 Slab is completed!

Hundreds of workers have been involved in the construction of the B2 Slab

ITER is the biggest international energy collaboration aiming to demonstrate the viability of fusion power as a sustainable energy source.

This one-of a-kind fusion reactor is bringing together seven parties that represent 50% of the world's population and 80% of the global GDP.

The project is being constructed in Cadarache, in the south of France, where a 42-hectare platform—the approximate size of 60 soccer fields—will house the scientific buildings and facilities.

Words
Aris Apollonatos, F4E Communications

Pictures
© F4E Communications

The project has turned a new page with the completion of the first floor of the Tokamak Complex, the main building that will host the reactor. This is an important achievement for F4E as the Tokamak slab marks the conclusion of the preparatory phase of the construction site which started in August 2010.

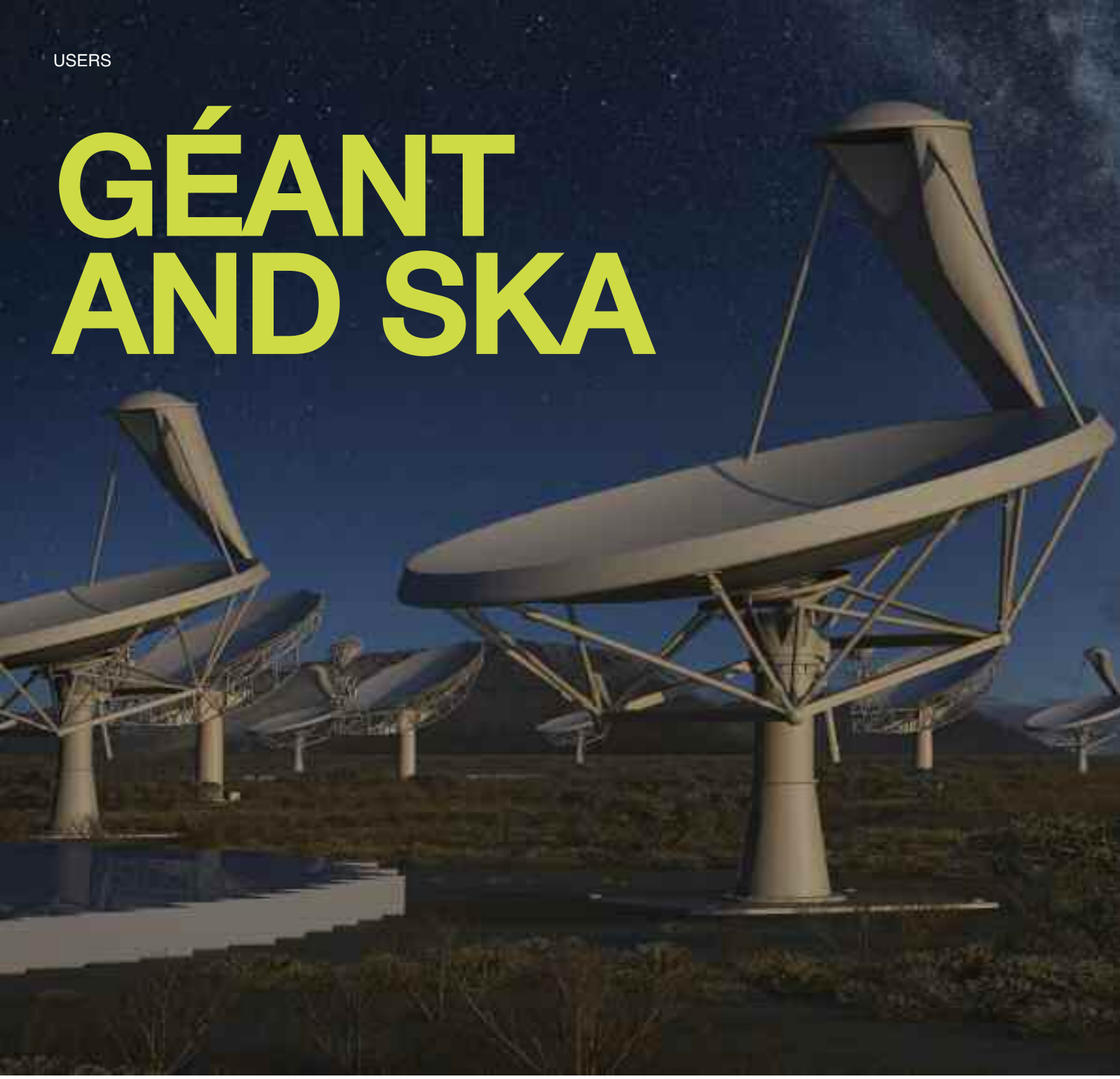
Those four years of hard work have been challenging for all parties involved in the ITER project: ITER International Organization, F4E, the companies collaborating under the Architect Engineer contract and all F4E contractors involved in this domain.

The concrete pouring of this huge slab, covering an area of 9,600m2, started in December 2013.

The hold point was released by the French Nuclear Authority on July 10, and the central 9 sections of the slab were poured within 7 weeks.

This was made possible thanks to the personal commitment of all the people involved, working during the holiday period, night shifts and weekends when necessary. The 150 workers used 14,000m3 of concrete, 3,600 tonnes of steel and 2,500 embedded plates in total.

GÉANT AND SKA



EXPLORING THE UNIVERSE, WITH THE WORLD'S LARGEST RADIO TELESCOPE

THE SKA PROJECT

The SKA Organisation is co-ordinating the global science and engineering activities for the world's largest radio telescope. The entire project is led by the SKA Organisation, which is based at the world famous University of Manchester's Jodrell Bank Observatory, in the UK, in the shadow of the 76m Lovell radio telescope, which played an important part in the dawn of the space age. The SKA Organisation formalises relationships between the international partners and centralises the leadership of the project. Eleven countries are currently members of the SKA Organisation and further countries have expressed their interest in joining the SKA Organisation in the coming months and years.

THE SKA WILL:

- Be the largest and most sensitive radio telescope in the world.
- Revolutionise our understanding of the Universe and the laws of fundamental physics.
- Be built in radio-quiet locations in Australia and Africa, in some of the most sparsely populated regions on earth.
- Have 50 times the sensitivity and thousands of times the survey speed of current imaging instruments.
- Be able to detect an airport radar at tens of light years.
- Have a life span of at least 50 years.
- Be continuously upgradable as computing power increases.
- Use revolutionary new receiver technology, signal transport mechanisms, signal processing techniques and computer processing power on a larger scale than any in existence.
- As the SKA will be an aperture synthesis instrument, comprising many independent receiving elements, exciting science will be achievable before the full array is complete.
- Initial science results are expected in 2020.

Our Universe contains many unknowns. Humanity, throughout all of recorded history has wanted to unlock the secrets of the Universe. Now at the start of the 21st century, a new global scientific undertaking will help uncover the mysteries of the Universe, in a way never before achieved.

The Square Kilometre Array (SKA) project is an international effort to build the world's largest radio telescope, with a square kilometre (one million square metres) of collecting area. The scale of the SKA represents a huge leap forward in engineering, telescope design and research & development towards building and delivering a unique instrument. With detailed design and preparation well under way, the SKA Organisation is moving towards starting early science operations with a portion of the telescope in 2020.

As one of the largest scientific endeavours in history, the SKA has been bringing together a wealth of the world's finest scientists, engineers and policy makers to bring the project to fruition. The SKA will not be one large single radio telescope, but will use vast numbers of "smaller" radio telescopes, built with three unique antenna designs. These will in turn form four instrument configurations, enabling astronomers to monitor the sky in unprecedented detail, and survey the entire sky thousands of times faster than any system currently in existence.

The SKA telescope will be co-located in Africa and in Australia. South Africa's Karoo desert will cover the core of the high and mid frequencies of the radio spectrum and will see telescopes spread all over the continent, whilst Australia's Murchison region, with hundreds of thousands of dipole antennas will cover the low frequency range, as well as play host to the SKA survey instrument.

Picture
Artist's impression of the SKA Dish arrays in operation at night time. Credit SKA Organisation

TRANSFORMATIONAL SCIENCE

The SKA will revolutionise our understanding of the Universe and the laws of fundamental physics.

The unprecedented sensitivity of the thousands of individual radio receivers, combining to create the world's largest radio telescope will give astronomers insight into the formation and evolution of the first stars and galaxies after the Big Bang, the role of cosmic magnetism, the nature of gravity, and possibly even life beyond Earth.

If history is any guide, the SKA will make many more discoveries than we can imagine today.

The science key drivers for the SKA have been broken down in to key categories, each of which has its own working group to facilitate and manage the scientific goals.

KEY SCIENCE DRIVERS INCLUDE:

- Probing the cosmic dawn – how were the first black holes and stars formed?
- Galaxy evolution, cosmology and dark energy – how do galaxies form and what is the mysterious 'dark energy'?
- The origin and evolution of cosmic magnetism – what generates the giant magnetic fields in space?
- The cradle of life – are we alone in the Universe?
- Challenging Einstein – are gravity waves real? Was Einstein right?

SUPER SCALED TECHNOLOGY

The SKA is a technological and engineering challenge. It demands new approaches not only to radio telescope design, but also signal transport, data reduction, data management and sheer computer processing power. Development of the SKA, which in 2013 was broken down in to a number of elements known as work packages, is now progressing at speed.

Assigned to 11 vast global consortia, consisting of hundreds of the world's finest scientists and engineers, the SKA Project involves mass producing low cost, but highly accurate and sophisticated telescope receivers and the computing and infrastructure to support it. On top of this, the development of signal processing engines that can work in real time, with data on a scale never before seen, filtering out the unwanted signals and passing on the useful data.

Using high speed computer based beam forming techniques, where the telescopes will "point" electronically at regions of the sky, as well as with state of the art "Phased Array Feed" technology, the SKA will be able to scan the skies thousands of times faster than ever before. This will give engineers and scientists the challenge of transporting, at phenomenally high rates, the vast amounts of scientifically valuable radio astronomy data, firstly from the vast array of telescopes to local base stations, and then across the entire planet.

Data transport from the dishes alone will produce ten times the current global internet traffic as of 2013. The use of wide field of view technologies could increase total data rates for the SKA in to the hundreds of petabits/second domain, or around 100 times the global internet traffic every day.

Processing and post-processing will require exascale central computing engines (orders of 10^18 floating point operations per second, faster than any computer currently in existence). The SKA will also stretch algorithm development in the vital areas of intelligently filtering out unwanted noise and data, and working with data that has a very high dynamic range.

New technologies and progress in fundamental engineering and science are both required. This is why the SKA compares with some of the greatest scientific projects in history, like the Large Hadron Collider or interplanetary space probes.

The SKA's power will come from it being in many respects, a software controlled and software dependent telescope. This will allows the SKA's designers to take advantage of advances in computer power, algorithm design and data transport capability, making sure that over its entire lifespan, the SKA never becomes obsolete.

The SKA will require a fundamental shift forward in technological and scientific collaboration that will have huge and far reaching benefits for local and global scale projects.

CONNECT spoke to Dr Keith Grainge of the University of Manchester's SKA Group to understand more about the project, and how GÉANT is planning to support the challenging data needs.

Words
Paul Maurice interviewed Keith Grainge

Picture
Keith Grainge, University of Manchester

WHAT IS YOUR ROLE IN THE SKA PROJECT?

I am an academic at the University of Manchester and am the Lead of the International Signal and Data Transport (SADT) Consortium, which is designing the data transport networks between the elements of SKA. SADT is made up of 15 institutes from 8 different countries, including the GÉANT Association.

THE AMOUNTS OF DATA WE ARE TALKING ABOUT ARE IMMENSE. WHAT WILL BE THE MAIN CHALLENGES?

The sheer volume of data is staggering, but there are really 3 different challenges, each corresponding to a separate area of the telescope. First, there is the problem of transporting the data from the individual antennas to the central signal processor (CSP). This requires the provision of links from the CSP building to hundreds of different points scattered over a 100km radius area in the South African or Australian deserts. Finding an optimum combination of topology, transmission technology and data aggregation is a difficult multi-dimensional problem. Second, there is the problem of transporting the data from the CSP to the High Performance Computing centre, approximately 800km away. Here the data all travel down the same set of fibres, but in order to accommodate the volume we will be obliged to make use of the very latest, cutting edge transceivers. The third and final problem is one of providing the processed data to the astronomer. The data rate for this is small by comparison to the other two instances, but the distances are literally transcontinental, requiring transport over submarine optical cable systems.

HOW MIGHT GÉANT HELP? WHAT SORT OF SOLUTION?

GÉANT are contributing their considerable expertise into the design phase of the separate networks, including: choice of hardware and protocols; definition of standards; devising test and commissioning strategies; advice on the practicalities of operation and maintenance of the networks; liaison with NRENs on the issues associated with distribution of the final data sets to the SKA member countries.

WHY IS GÉANT OF INTEREST?

GÉANT has huge experience with providing data transport for different research communities and is heavily involved with world-leading experiments. It is a natural partner in the SKA SADT endeavour.

WHAT IS THE TIMELINE?

In addition to transporting the huge data volumes we must also provide extremely accurate time to all the individual antennas. This is required because the SKA will work as an interferometer and this requires that the signals received can be combined together in a coherent fashion. This translates to a requirement that we provide time accurate to 1ps (10^(-12) s) over the 100s km distances to the antennas. There is also a requirement for long term clock stability in order to do the most interesting experiments associated with timing pulsars. For these we must ensure the clock is accurate to 10 ns (10^(-8)s) over 10 year timescales.

On the processing and analysis side, the SKA represents a huge step in both sensitivity and data complexity for radio astronomy. As a result the standard data reduction pipelines that we have been accustomed to using will no longer be adequate to process the data and a novel and scalable approach will be required.

WHAT WOULD YOU LIKE TO SEE FROM THE GLOBAL RESEARCH COMMUNITY?

There is a lot to be learnt from existing Big Data projects – CERN being an obvious example. The next generations of optical transceivers are being developed by industry to deliver 400 Gbps or even 1 Tbps transport on one laser carrier frequency.

On the radio astronomy side, there are many essential lessons to be learnt from various pathfinder experiments such as LOFAR and eMERLIN and the precursor instruments on the South African and Australian sites: MeerKAT, MWA and ASKAP.

HOW CAN SKA BENEFIT OTHER SIMILAR – BUT SMALLER – PROJECTS?

The SKA is an exemplar Big Data problem and the challenges that we will have to overcome will be mirrored in other areas beyond radio astronomy and even academic research. The solutions that we develop for SKA will be translated into other fields and will allow a huge range of novel problems to be tackled.

ASKAP (AUSTRALIA)

CSIRO's Australian SKA Pathfinder (ASKAP) telescope is an innovative project to deliver a world-class radio telescope and associated infrastructure at the Murchison Radio-astronomy Observatory (MRO) in Western Australia.

ASKAP is an array of 36 antennas, working together as a single instrument and connected by a high speed optical fibre and linked to the iVEC Pawsey Centre supercomputer in Perth. Construction of the antennas and major site infrastructure – including roads, fibre and a central MRO Control Building – was completed in 2012, and the telescope is currently undergoing commissioning activities.

Data from ASKAP is transmitted from the MRO to the ASKAP Central Processor supercomputer, and converted to images of the sky in near-real-time by a pipeline processor running the purpose-built ASKAPsoft package. The supercomputer is already being used by the ASKAP team for calibration and imaging of data being collected by the ASKAP test array as part of commissioning and early science activities.

Once fully operational, the ASKAP telescope will offer astronomers an unparalleled view of the sky using pioneering radio receiver technology to capture signals from the radio sky with unprecedented speed and sensitivity.

ASKAP is a world-leading telescope in its own right, and will also be incorporated into the future international SKA project – to be built in Australia and Southern Africa.

For more information, visit **www.atnf.csiro.au/projects/askap**

MEERKAT (SOUTH AFRICA)

South Africa's MeerKAT telescope, currently being built some 90km north-west of the small Northern Cape town of Carnarvon, is an SKA precursor or 'pathfinder' telescope, and together with ASKAP will become part of SKA Phase 1. MeerKAT will consist of 64 dish-shaped antennas and will be the most powerful telescope in the southern hemisphere.

Each receptor (a receptor is the complete antenna structure, with the main reflector, sub-reflector and all receivers, digitisers and other electronics installed) is interlinked, and the configuration (placement) of the receptors is determined by the science objectives of the telescope. 48 of the receptors are concentrated in the core area which is approximately 1 km in diameter. The longest distance between any two receptors (the so-called maximum baseline) is 8 km.

Each MeerKAT receptor consists of three main components:

1. The antenna positioner, which is a steerable dish on a pedestal
2. A set of radio receivers
3. A set of associated digitisers.

The SKA SA Project highlights the wider benefits of such 'big science'. South Africa's SKA Project invests in developing skills for MeerKAT and the SKA through its dedicated Human Capacity Development Programme. Around 600 people, ranging from artisans to postgraduate students and postdoctoral fellows, have already received bursaries and grants. The project is also causing a surge of interest in studying mathematics, engineering and astrophysics at local universities, and attracting top students and academics from around the world to South Africa.

For more information, visit **www.ska.ac.za**

Pictures
Antennas of CSIRO's ASKAP telescope at the Murchison Radio-astronomy Observatory in Western Australia - credit CSIRO (left); MeerKAT antenna construction and launch - credit SKA South Africa (right).

CELEBRATING 60 YEARS OF CERN

GÉANT CREATES INNOVATIVE MUSICAL COMPOSITION TO SUPPORT CERN'S 60 YEAR ANNIVERSARY

On 29th September 2014, CERN opened its 60th anniversary celebrations to the premiere of a rather special piece of music, played by the European Union Youth Orchestra and conducted by world famous composer Maestro Ashkenazy.

An audience of high profile VIPs, scientists and media travelled from across Europe to the event at CERN near Geneva and were the first people to hear the ingenious composition. The music is based on the sonification of the "CERN Convention For The Establishment Of A European Organization For Nuclear Research".

Composed by Domenico Vicinanza, Arts and Humanities Manager at GÉANT, the text of the Convention was translated into a long melody by associating each character of the text with a musical note, according to its position within the English alphabet.

The CERN Convention was sanctioned on 29 September 1954 by 12 countries in Western Europe – a poignant moment for science and high-energy physics. At its core was an agreement that participating countries would collaborate harmoniously regardless of geographical, political or cultural divides, ensuring the free flow of knowledge for the greater good.

Domenico said:

"What better way to celebrate the incredible achievements of the last 60 years, than to highlight CERN's very first collaboration – the Convention agreement.

I wanted the music to celebrate the thousands of physicists and engineers who have contributed towards the game-changing scientific research we have seen coming from CERN. From the beginnings of the World Wide Web to the discovery of the Higgs Boson particle.

Picture
The European Union Youth Orchestra perform at the ceremony.
© Domenico Vicinanza

Using the EUYO, whose members are located all over Europe – the orchestra becomes a physical representation of the many people at CERN who successfully collaborate across geographical boundaries.

This is the first time an orchestra has played a classical piece made entirely from data sonification. In fact, it was recorded live and listed on the Decca Classics website. I hope this is a fitting tribute to CERN and the scientific excellence for which it has become synonymous."

WHY GÉANT?

GÉANT plays a vital role in supporting CERN by providing the high speed links to carry data from the Large Hadron Collider to many thousands of researchers located all over the world. Grid computing is one of the "power tools" behind the discovery of Higgs boson. It 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.

Vicinanza continued:

"And because data sonification is such an intensive process, we created the melody from the text of CERN convention relying on the pan-European GÉANT network, which operates at speed of up to 500Gbps and the EGI grid computing infrastructure.

The same infrastructure used by CERN researchers every day to communicate, exchange and process experimental data (the GÉANT network and the Grid) has been used to create music, converting into sound the 34,000+ characters of the founding Convention."

WHAT HAPPENS WHEN 7 PHYSICISTS PLAY MUSICAL INSTRUMENTS INSIDE THE WORLD'S MOST POWERFUL PARTICLE ACCELERATOR?

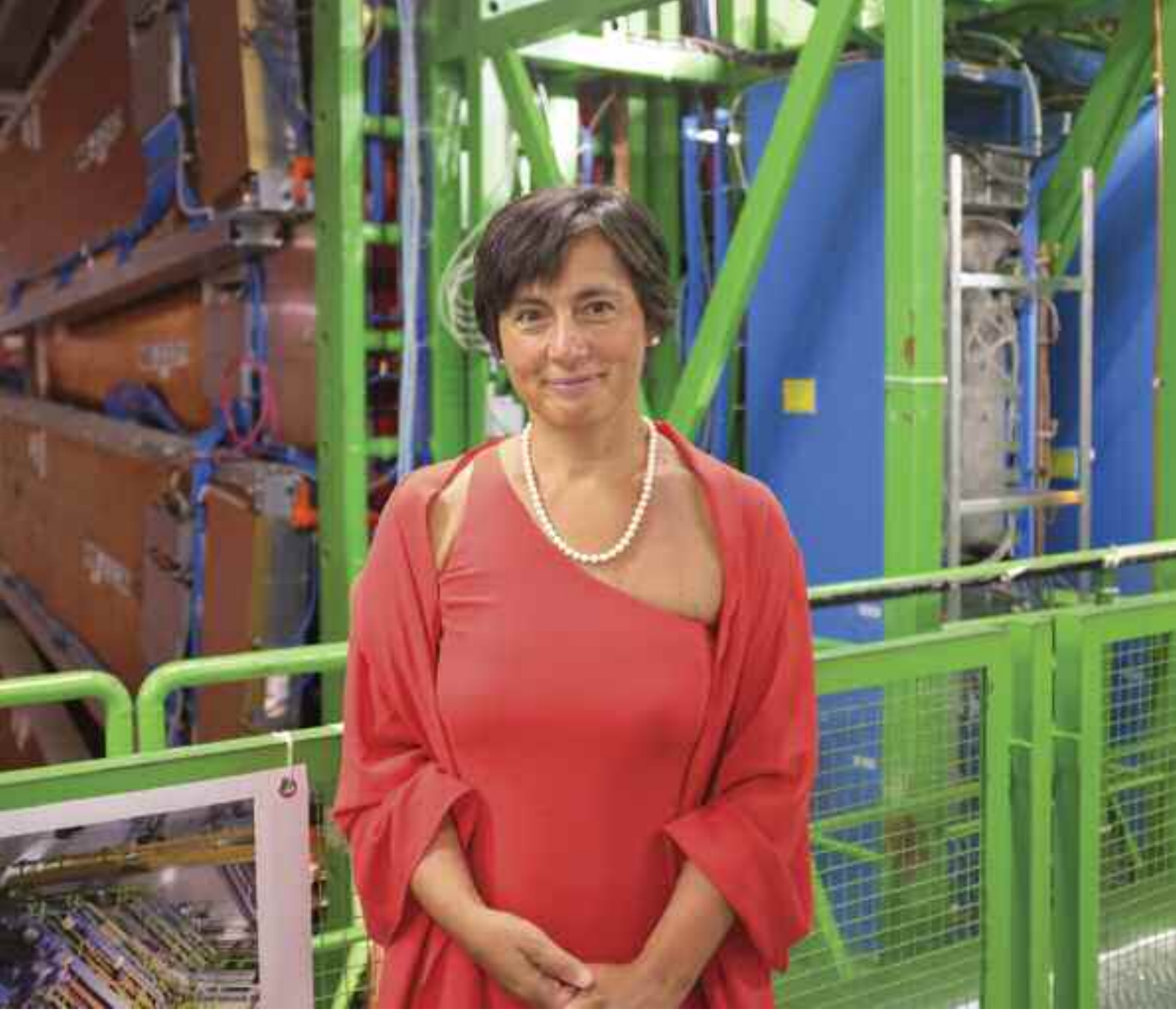
This incredible and evocative video, commissioned for CERN's 60th anniversary celebration shows seven scientist musicians playing "data" from the four LHC experiment collaborations, each standing at their experimental site, playing music from their own experiment data.

The music is based on the translation into melody (sonification) of scientific data collected by the four main Large Hadron Collider experiments (ATLAS, ALICE, CMS and LHCb).

Using data that CERN researchers use to study the deepest secrets of our world, Domenico Vicinanza, Arts and Humanities Manager at GÉANT, created the pieces by associating each measurement with a musical note from a certain musical scale.

The same infrastructure used by CERN researchers every day to communicate, exchange and processs experimental data was used to create the music. Data sonification is an intensive process and creating melodies from data relies on the GÉANT network, which operates at speeds of us to 500Gbps, as well as the EGI grid computing infrastructure.

Type 'LHChamber' and 'YouTube' into a search engine or go to: **https://www.youtube.com/watch?v=gPmQcviT-R4**



Q&A WITH CHIARA MARIOTTI, CERN

As part of CERN's 60th Anniversary celebrations, CONNECT was fortunate to attend the ceremony and enjoy the live performance (see p 11) as well as the pre-recorded LHChamber Music performance. Keen to learn more about how GÉANT supports CERN's research, we spoke with LHChamber flutist and renowned LHC physicist Chiara Mariotti.

Words
Paul Maurice interviewed Chiara Mariotti

WHAT IS YOUR ROLE AT CERN?

Right now I am the CMS (Compact Muon Solenoid) contact for the LHC Higgs Cross Section Working Group. It is a group founded by a colleague from Torino and myself. It comprises people from Atlas, CMS, LHCB and theory; its aim is to provide the experiments with state of the art calculations and analyses tools for the Higgs search and studies.

Before within CMS I have been the leader of the Higgs physics group, have been responsible of the H to ZZ to 4l analysis (one of the channels that allowed the discovery of the Higgs boson) and then of the group that takes care of the combination of the results and the measurement of the properties of the Higgs boson.

WHAT DO YOUR EXPERIMENTS FOCUS ON, AND WHAT ARE THE EXPECTED OUTCOMES?

The CMS experiment at the LHC is focusing on Higgs physics, in other words on the understanding of the origin of the mass of the elementary particles, and on searching for physics beyond the Standard Model. In parallel the experiment is able to precisely measure many Standard Model quantities.

We expect to unravel the mystery of the origin of masses, i.e. if the Higgs boson is the only one responsible for it, or if the nature is more complex. We will discover if there is something beyond the Standard Model, something maybe already hypothesised (like Supersymmetry) or something totally unexpected and never thought of.

WHAT HAVE BEEN THE MOST SIGNIFICANT DISCOVERIES SO FAR?

Most recently at the LHC, the discovery of the Higgs boson.

However before that about 10 years ago the discovery that the neutrinos have masses was a real change in the particle physics. At LEP there was no special discovery, but LEP established the Standard Model of Particle physics, and it went deeply into the electroweak interaction. Often we said that LEP discovered the ElectroWeak radiative corrections. In 1983 Rubbia discovered the W and Z boson, this last one firstly seen in an indirect way in 1973 at Gargamelle (the discovery of the “weak currents”).

The Higgs boson discovery is of special importance, since it modifies our way of thinking, and the vision of our world.

Picture
© Domenico Vicinanza

HOW HAS THE NETWORK HELPED? WHAT WOULD TAKE ITS PLACE?

Today it would not be possible to work without the network.

The network has become an essential tool. Computing power and storage capacity at CERN are limited, so to find the Higgs Boson we had to connect the Scientific Computer Centres of all participating countries and universities. One year of running at LHC is producing up to 30 PetaBytes of data. To analyse this data, we have about 200,000 PCs running constantly around the clock.

All this data is processed via the network all around the world. When we submit a job, this will run in any accessible machine, maybe in US, maybe in China…

The network is also the essential tool for communication. There are 10,000 physicists and engineers in total contributing to the LHC and they cannot always be at CERN. So the use of the network for Videoconferencing and data exchange is a very important tool. The possibility to arrange video or Skype conferences is extremely beneficial, since we are not forced to travel and we can talk more often and proceed faster. The network allows us to be constantly "on-line", from home and from anywhere we are in the world. This is spectacular and has changed the way we live. Of course, the downside is we are always 'there' – how many of us are able to spend one day without opening our laptop, reading email or checking the status of jobs, or the running of the experiment?

WHAT IS YOUR BACKGROUND, AND HOW DID YOU REACH THIS ROLE?

I graduated in 1987 with a master thesis in Elementary Particle Physics at the E760 experiment at the Fermi Laboratory. The subject of the PhD thesis was the measurement the gluon structure function via J/psi production in deep inelastic muon scattering at the NMC experiment at CERN. I then joined the DELPHI experiment at LEP. First I measured with high precision some of the parameters of the Standard Model (of particular importance the partial width of the Z into b quarks); later, in 1996, during the LEP2 phase, I started the adventure of the search of the Higgs boson. In DELPHI I coordinated two physics groups and later became the physics coordinator of the experiment.

Since 2000 I have been working in the CMS experiment at LHC, where I participated in the construction of the muon detector and continued the search of the Higgs boson. In CMS I have been responsible of the Higgs Physic Group, and I co-founded and co-coordinated the LHC Higgs Cross Section Working Group: a collaboration between theoretical and experimental physicists for precision Higgs physics at LHC.

Many students in the Torino University graduated and got the PhD with me. In 2012 we discovered the Higgs boson, and since then I kept working in the Higgs physics, concentrating on one side to measure precisely its characteristics, and on the other side to look for eventual new physics (for example a second Higgs boson…)

I did my studies and PhD at the Torino University, then I got a postdoc in Rome (at the INFN, in the Istituto Superiore di Sanita') followed by a permanent position. Then I spent six years as Staff at CERN and when I finished the contract I went back to the INFN in Torino. And there I am, but I am spending most of my time at CERN, since my family lives here.

HOW DID YOU COME TO BE INVOLVED IN THE LHCHAMBER MUSIC COLLABORATION?

I have known Paola Catapano (Science Communicator at CERN) for a long time, maybe 20 years (before we had kids, we used to spend our weekends biking all around the region, sailing on the lake, or skiing in the winter) and she often invited me to join her adventures! This one is totally fantastic!

DESCRIBE YOUR TYPICAL DAY:

Before the Higgs discovery, my day was essentially split between work and kids.

I was bringing the kids to school at 8:30, going to work, coming back at around 5:30-6:00, staying with the kids until 9 pm when they went to bed, and then back to work (from home). After the Higgs discovery – rightly called "Higgs hunter liberation day" (!!), and with the kids being slightly easier to manage, I rediscovered other pleasures: music first of all, and sport. So I bring the kids to school, I go to work, but I come home slightly earlier and then I play the flute. On Wednesday evenings I play in the orchestra of the village where I live, and on Monday lunch times I go to the music school to take flute lessons. The rest is for the kids: we try to do things together, usually sporting activities. And of course I drive them around for their activities: music, sport…

WHAT ARE YOUR HOBBIES AND INTERESTS?

I love to play the flute, I love reading. I never spend a day without having had my dose of reading! I also restarted doing yoga. I like to do cross country ski (in winter I go up in the Jura very early in the morning, I do a 13 or 15 km ring and then go to work!), I also like to swim, to bike and to walk.

I have also been participating in the POP-Science (**www.pop-science.eu/poetry/**) initiative: in July a few physicists met poets coming to CERN to learn about us and our work. Then they had to write poems on the subjects. It was very interesting to read what they wrote. That evening, we all met the public in downtown Geneva at the FNAC, and finally in the evening together with very famous astrophysicists (Reeves and Mayor) we met the public in a theatre, answering questions long into the night.

GÉANT EXHIBITING AT SUPERCOMPUTING 2014

HPC MATTERS

Pictures
The GÉANT booth at last year's event, SC13

Between 16 and 21 November this year, the world's most respected minds in high performance computing, networking, storage and analysis will gather in New Orleans for SC14 to showcase their innovations and far reaching impact.

This year's SC14 focuses on a fresh take on HPC as a means to share the community's collective accomplishments and engage in important conversations around how we make HPC Matter to our lives, our future, our communities and our world.

GÉANT will be joining forces with the Square Kilometre Array (read all about this collaboration on page 6) and SADT, the consortium which designs the data transport networks between the elements of SKA. If you're visiting, you can find them at booth number 2525, for a series of demonstrations and pioneering collaborations – as well as a chance to speak to the experts directly. There are likely to be over 10,000 attendees at the show, who visit each year to discover the latest solutions that will keep them at the leading edge of their professions.

Visitors will discover more about the GÉANT Open Call Project CoCo via a demo and lightning talk. There'll be demos featuring gOCX, OpenFlow/NSI, GÉANT testbeds and many others. People will also get the chance to learn more about eduGAIN and federated identity, and how it can significantly simplify access to content, services and resources for the global research and education community.

Follow us on Twitter **@GEANTnews** and keep up with what's happening using **#SC14**

FUTURE FOCUS FOR IDENTITY FEDERATIONS

In 1989, Tim Berners-Lee wrote a paper called Information Management: A Proposal[1] to persuade CERN management that a global hypertext system was in CERN's interests. The paper included a section entitled "non requirements" where Berners-Lee notes that:

"Discussions on Hypertext have sometimes tackled the problem of copyright enforcement and data security. These are of secondary importance at CERN, where information exchange is still more important than secrecy. Authorisation and accounting systems for hypertext could conceivably be designed which are very sophisticated, but they are not proposed here."

Fast forward to 2014 and we see a battle between the "commodification of self" with organisations such as Facebook using personal data for profit and increasing concerns in our post-Snowden world where nothing is secret. These have brought security and authorisation issues to the forefront of our minds as we seek to shape the future of the web. Most importantly how do we manage how information is managed and shared?

Information management has become more and more focussed on people management and is being shaped increasingly in the language of anthropology as we discuss online tribes, status and memes.

The importance of this shifting emphasis is also being reflected in the laws and regulations that govern our online interactions. The EU is in the process of updating several directives that will have implications for security and personal data management, including overdue revisions for data protection and electronic identification and trust services. In doing so, these directives are becoming regulations in order to push greater consistency in the way these processes are implemented across Member States in clear recognition of the fact that web traffic is not bound by geographical boundaries. None of these issues should be new to NRENs, who have consistently led the field in developing solutions to trust and identity for many years. There are now nearly 9000 entities registered in Identity Federations worldwide, representing groups of users and the services they access. The long history of these identity federations provides a strong service base for addressing new challenges and it is clear that the next 3 years will bring plenty of changes.

Core areas of development over the course of the next few years are likely to be:

- **Demand for greater trust (assurance).** Identity federations currently provide a very effective baseline level of trust for many services but some communities wish to see organisations commit to increased levels of audit and security and user registration processes. Increased assurance brings with it spiraling costs for identity providers so a focus on cost-benefit for these approaches will be needed.
- **Demand for greater standardisation.** Federations have grown up organically in many countries and have focused on specific local use-cases. This has led to an environment of federations that have adopted slightly different approaches. As we participate in more global exchange of information through services such as eduGAIN it will be necessary for federations to commit to a more common approach to service offering.
- **Demand for metadata improvement.** Metadata is at the heart of federation operations and provides the information needed to drive access to resources. Federations are identifying more and more information that needs to be in metadata, such as processes to tag service types or how the metadata should be used in discovery services.

The problem space is large, and being tackled by many different groups such as work in the GÉANT project, REFEDS, and potential new EU projects focused specifically on identity issues. To help coordinate this work, the NREN-PC has established a Trust and Identity Committee to support strategy within the GÉANT projects and liaison with appropriate external groups.

Words
Nicole Harris, Project Development Officer, TERENA

1. http://www.w3.org/History/1989/proposal.html

PERFSONAR GOES FROM STRENGTH TO STRENGTH

With the combining of the parallel perfSONAR MDM and PS developments, the new unified perfSONAR is going from strength to strength. The latest version of perfSONAR (3.4) now incorporates core perfSONAR MDM components and demonstrates the combined power of a single development team.

The new perfSONAR 3.4 was jointly presented at TechExchange 2014 in Indianapolis (26-30 October) and the response was overwhelming with well over 100 attendees resulting in standing room only at the conference panel session. The joint presentation involved members from GÉANT, Internet2, ESnet and Indiana University.

The live demonstration provided live OWAMP measurements between hosts both across the US (in MAN LAN and WIX) and across the Atlantic and showed off the new eduGAIN based login process and the enhanced webUI.

Since its release on the 7th October the new perfSONAR 3.4 has been downloaded and installed in more than 400 nodes.

perfSONAR

"The enthusiastic response to the new perfSONAR 3.4 has been fantastic and really shows the demand within the R&E community for this service. By working together we can deliver a great service that the users need"

Domenico Vicinanza, Product Manager, GÉANT.

By tracking performance across and between domains it is now possible to identify and rectify any potential performance bottlenecks, helping research teams focus their efforts on their research and allows NRENs to identify where investments in new capacity will provide the best return. With over 400 measurement points across the globe, it is now far easier for NRENs and research teams to accurately measure the performance of the network and ensure the networks meet their research needs.

The perfSONAR web site (perfSONAR.geant.net) has been rebranded to reflect the new, integrated, service and allows the latest versions of software to be downloaded. Visit **perfSONAR.geant.net** for more information.

GÉANT CLOUD SERVICES

The opportunities for cloud services within the Research and Education community continue to grow and the Support to Clouds team have been working closely with both NRENs and key cloud providers from across the work.

"It quickly became apparent that working together in GÉANT, to aggregate demand and expertise, is welcomed and needed to become a 'cloud player'. As most NRENs are in a start-up phase for clouds, being able to exchange information with peers across the community is highly beneficial."

Andres Steijaert Activity Leader – Support to Clouds, GÉANT

THE CHALLENGE OF CLOUD SERVICES

The standard delivery of cloud services by commercial organisations is often incompatible with the requirements of higher education and research. There are significant challenges on trust, security, privacy, legislation, procurement and regulation. These issues have different implications between cloud services used in a private capacity, compared to services used within an education or research environment, where the ownership of data and the need to ensure strong custodial control are important.

The cloud is evolving rapidly. Users are making choices now. In its most basic form and from a user perspective, the cloud is about consuming ready to use online services, provided by external providers, through a pay-per-use model. There is a real danger that if NRENs and institutions do nothing, users will drift into fragmented islands of incompatible services that may not have a sustainable future.

Words
Karl Meyer, Product Marketing and Communications Officer.

"Traditional legacy IT solutions no longer meet the needs of the education sector, which is looking to collaborate and manage critical documents more easily and securely from anywhere and on any device. Our partnership with GÉANT removes the barriers to cloud adoption within the education sector by delivering a platform that supports education programmes and strategies."

David Quantrell, Box senior vice president and general manager of EMEA

One of the benefits of a community approach has been the opportunity for knowledge sharing which allows NRENs to cope with the learning curve of Cloud provision much more easily. Also those NRENs that have been working on cloud services for a number of years have benefited from a combined initiative though the economies of scale that the GÉANT community offer. The larger scale of the joint European approach (compared to national initiatives) has opened doors at large cloud providers. As part of this , the team was able to engage in conversations with senior management of a considerable number of cloud providers and to translate these contacts into concrete efforts: a first wave of providers (both commercial vendors and providers from with the Education and Research domain) is now working with the team to adapt their services to the needs of the GÉANT community.

COMMUNICATING THE CLOUD PARADIGM

Part of the role of the GÉANT clouds team is outreach both within the GÉANT community and Suppliers but also to other EC groups and communities. This work with external stakeholders provides a demonstration of the NRENs capabilities and also opens the opportunity to work with the wider EC community to maximise value.

EGI AND GÉANT WORKING TOGETHER

On the 25th/26th September EGI and GÉANT hosted a cloud symposium as part of the EGI Autumn Conference.

The Symposium was very well attended with over 150 participants including representatives from NRENs and a large number of NGIs were able to find out more about what GÉANT and EGI are working on in this fast moving field.

A great deal of commonality was found between the organisations and as a first step a paper outlining the potential areas of collaboration will be produced. This will cover areas such as;

- Interoperability
- Security
- AAI
- Promotion of Open Standards/standards adoption
- Policies e.g. national procurement policies to serve ESFRIs
- User requirements and user support

The symposium was a valuable first step in identifying areas where the two organisations could work together in the future.

For more information on how cloud services can benefit your organisation and to find out more about the cloud services team visit the new cloud services portal at **http://clouds.geant.net**.

CAMPUS BEST PRACTICE – SUPPORTING VIRTUALISATION AND LINUX SECURITY

Words
Nadia Sluer, TERENA

The Campus Best Practice team have been extremely busy and have prepared a range of new and updated best practice guides to help NRENs and Campus IT teams keep their infrastructure secure and up to date.

In particular their recent efforts have focused on helping secure Linux systems and supporting the growing field of virtualised network devices.

SECURING LINUX

Linux is an increasingly popular choice for an operating system in a server environment. The granularity and flexibility of settings, high performance, reliability and security are some of its comparative advantages over other operating systems. The vast majority of services that academic institutions provide to their users are hosted on servers running the Linux operating system. Due to infrastructure limitations, one sever often hosts several services, which adds to the challenge of protecting the Linux server. System administrators are expected to protect the server from potentially malicious activities that could jeopardise or compromise the provision of services. However, the protection of a Linux server is not a one-time effort, but a lasting process that continues as long as the server is in use. The Campus Best Practice teams, led by AMRES, have produced a simple to use guide to help campus IT teams ensure their Linux infrastructure is as secure as possible.

NETWORK VIRTUALISATION

IT infrastructures have changed significantly in the last few years, particularly in the area of virtualisation of server systems. This area is already relatively stable, but in recent times; virtualisation has also begun to penetrate into the area of network infrastructure.

Of course network infrastructure as a whole cannot be virtualised to the same extent as server systems, because it includes the physical part of the data centres themselves. Despite this, we can find applications that can be suitably virtualised as a whole or in part.

This document, produced by CESNET, describes the benefits of virtualisation, but also looks at the disadvantages – when it is better not to use virtualisation. Included here are the requirements for virtual infrastructure, since the network devices used here have slightly different requirements to classical virtual servers in terms of network integration.

The guide also considers the question of what parts of the infrastructure are suitable for virtualisation and what parts are not, and outlines the benefits of virtualisation which are in cost-reduction and increased scalability of the infrastructure deployed.

This is an invaluable resource for any team considering network device virtualisation within their infrastructure. Both these Campus Best Practice Documents and many more new and updated guides can be downloaded from the Campus Best Practice website at **cbp.geant.net**

DATACENTER INFRASTRUCTURE AS A SERVICE (IAAS) WORKSHOP 2014

With the exponential growth in networking and datacenter usage, many organisations are facing the prospect of having to upgrade their current overcrowded, old and energy consuming facilities. Before planning a costly and complex rebuild or renovation many are looking towards an outsourced solution.

Many IT teams are asking some key questions:

- Is building new space the only option or could IaaS be a better solution?
- Is it worthwhile to build your own cloud or is joint procurement a better choice?
- How do you ensure high quality of services from outsourced solutions?

To answer these questions and more, CSC/FUNET hosted the GÉANT Campus Best Practice team Datacenter IaaS workshop, on 11-12 September

NREN staff involved in datacenter and campus deployments as well as network engineers working with deployment of IT services on campuses came together to discuss a set of themes built around datacenters. In total 39 people from eight different countries attended the event. The sessions were also streamed live and recorded.

The community was invited to contribute to the event by presenting their results, experiences and success stories on the deployment and usage of datacenter and cloud solutions. Many interesting presentations and lightning talks offered participants a unique overview and insight of the latest developments in datacenters, cloud services, security and data storage covering themes such as Green datacenter technologies; cloud service provisioning; joint procurement, costs and agreements; security; and datacenter networks.

Campus Best Practice Leader Jari Miettinen opened the event saying:

"This workshop is an ideal way to share expertise across the community and finding new ideas together".

The workshop participants had a chance to visit a large, live, modern and security certified datacenter. The visit completed the workshop content in a concrete way and raised a lot of discussion.

The key conclusions of the workshop are that the community has a number of key strengths within the fields of data center development, identity federations and cloud management technologies and there is considerable scope for enhancing the skills of procurement and data center security.

NRENs have come a long way in the development of effective datacenter development and management and IaaS is another valuable tool in the R&E portfolio.

Presentation slides, recordings, agenda and more are available from **https://info.funet.fi/wiki/display/avoin/Datacenter+IaaS+workshop+2014**.

Words
Karl Meyer, Product Marketing Manager and Communications Officer

EDUGAIN UPDATES

The eduGAIN interfederation service goes from strength to strength with new members joining and interoperating with other identity federations such as InCommon allowing researchers across the globe to communicate and collaborate more effectively.

INTERFEDERATED IDENTITY GRAVITATES TO EDUGAIN

The Laser Interferometer Gravitational Wave Observatory (LIGO - **www.ligo.org**) is a dynamic group of more than 900 scientists worldwide who have joined together in the search for gravitational waves from the most violent events in the universe.

To support this distributed group of scientists and simplify the authentication of researchers around the globe, LIGO has taken the first steps to integrating with eduGAIN. This has been supported by InCommon, the Identity Federation in the USA and backed by Internet2.

Previously the collaborative tools of LIGO were only available to institutions in the USA that are members of the InCommon identity federation and via guest accounts to the world wide pool of researchers. Thanks to integration via the eduGAIN interfederation service the reach has now extended to a further 27 countries – with another 8 on the horizon. This will facilitate not only researchers accessing resources in the USA but will also support distributed collaboration tools and data sets being made available in eduGAIN connected federations around the globe.

EDUGAIN SUPPORTING INTERFEDERATION IN THE AMERICAS

Supporting the needs of the global research and education environment has always been a goal of eduGAIN. While the service started as a European project it quickly gained international members with the Japanese Identity Federation, GakuNin joining in early 2013 to become our first non-European member.

eduGAIN now includes seven identity federations in the Americas from top to tail with Argentina, Brazil, Canada, Chile, Colombia, Ecuador and the USA now members. Growth in the number of federations as well as the participation of institutions and the creation of services is expected to continue to grow with three federations in the development process and a large pool of interest due to the ELCIRA project managed by RedCLARA and supported by the European Commission.

AFIRE - OUR NEWEST FEDERATION

The Armenian Federated Identity for Research and Education (AFIRE) is the being built to support the teaching and research institutions of Armenia. This development is lead by ASNET-AM, the Armenian Research and Education Network and was supported by the GÉANT project and the European Commission's platform for the Eastern Partnership Region.

More information on AFIRE is available at **http://afire.asnet.am/**

GET INVOLVED WITH EDUGAIN

Supporting the development of identity federations around the globe and promoting federated identity solutions for research collaborations the GÉANT project has a pool of contacts, solution experts and experience in federating services available to guide you to a range of solutions to support your community.

To get connected to the global interfederation service for research and education, contact the eduGAIN team at **eduGAIN@geant.net**

More information: **http://eduGAIN.org/**

ECO2METER – HELPING NRENS GREEN THEIR IT

Rising energy consumption of the networking equipment that supports or accesses the Internet will be one of the main challenges that NRENs will have to address to promote a sustainable environment. The amount of data transported over our networks will continue to rise and energy consumption will rise with it. As the cloud and mobile devices become more important in our daily lives, the mobile, access and core networks required to support these services do too. Where energy consumption of networks currently is not regarded as a high priority, this will change in the near future in a business-as-usual scenario due to these trends related to massive increase in network activities. Lowering energy consumption is not only good for the environment, but it will make financial sense as well.

The GÉANT Green Team have been instrumental in both raising awareness amongst the NREN community and developing tools and systems to help NRENs measure, monitor and manage their CO2 emissions. We spoke to Vasiliki Giannikopoulou, Quality Manager, GRNET to discuss their eCO2meter tool.

WHAT IS ECO2METER AND HOW DOES IT HELP NRENS?

Using eCO2meter NRENS can collect data calculating their yearly energy consumption and greenhouse gas (GHG) emissions in a simple concise way. Some of the advanced functions such as the automatic creation of the final reports for verification by an external body will also help reduce the manpower involved in generating an official ISO 14064 compliant report. It also provides automatic estimation of data based on predefined values (e.g. CO2 emission factors per country, tons of emissions per mile in international flights), to help compare performance and share best practice between NRENs.

eCO2meter can be extremely helpful to NRENs since it provides a user-friendly and consistent way for completing and evaluating GHG emission reports. eCO2meter allows network managers to deduce useful conclusions regarding the more energy-hungry parts of the NRENs infrastructure. In addition, it can be used to help measure the environmental impact when applying energy efficiency techniques.

WHY DID YOU DECIDE TO DEVELOP THE TOOL?

Collection of data regarding energy consumption of the IT equipment is considered the first step towards the design and implementation of energy efficient policies. Towards this direction, measuring and monitoring GHG emissions are essential features in our strategy to reduce NRENs' overall emissions. By developing an easy to use tool, NRENs can produce these measurements in a consistent way helping us identify best practice and share ideas.

HOW HAS WORKING WITH GÉANT HELPED?

The exchange of knowledge and expertise within the "GÉANT Environmental Green team" has been invaluable. Working within a Europe-wide team means that the tools can support the needs of NRENs across the community.

- Collection of a complete set of requirements for the design of the tool taking into account the peculiarities of each NREN
- Definition of a set of parameters to be collected and a set of performance metrics to be used for statistics extraction

Words
Vasiliki Giannikopoulou Quality Manager/Project Manager, GRNET

Interview
Karl Meyer, Product Marketing Manager and Communications Officer

WHAT IS YOUR GOAL FOR THE GREENING OF IT?

The main goals are to make NRENs greener and more sustainable and also to disseminate and replicate best practices in terms of energy efficiency of the IT equipment.

Most importantly, involve all NREN members in common actions for a more environmental friendly world.

For more information on the eCO2meter tool and eCO2meter download the white paper at (**URL**) or visit (**http://eco2meter.grnet.gr/**)

HOW TO STAY ON TOP OF THE DATA TSUNAMI

Everybody is talking about it. The data tsunami is here and it's increasing exponentially, in everyday life as well as in science. The volume of data being generated in the latest research projects is many orders of magnitude greater than even five years ago. According to current predictions, by 2025 we will be collectively producing 100 zettabytes of data per year.

Words
Diana Cresti, GARR

The GÉANT network is in the thick of it, providing the essential bandwidth to support all scientific disciplines: from high-energy physics and deep space research to those addressing societal challenges such as ageing populations, disease diagnosis and climate change.

Last year, GÉANT completed a major network upgrade, scaling up to 2 Terabits per second (Tbps) and setting the Guinness world record for fastest provisioning of long haul optical transmission capacity, with 8Tbps recorded on its Amsterdam-Hamburg link.

This has dramatically increased capacity across the network but is still based on sub-optimal transmission techniques and on the same core network architecture that has existed since the start of packet networking. As the demands on the network grow and change, GÉANT and the ICT research community are already looking beyond the Terabit per second solutions.

Of the four families of Open Call projects in GÉANT's Innovation Programme, the Network Architecture and Optical Projects are closest to the physical core of the infrastructure. As such, they rely intrinsically on the OpenFlow-enabled dark fiber testbed that closely simulates GÉANT's production environment on five major routes encompassing approximately 2500 Km of high capacity dark fiber infrastructure.

The Open Call projects presented here cover a range of innovative techniques to better exploit the optical infrastructure, such as enhancing spectral efficiency in optical systems; evaluating the potential (nondisruptive) implementation of alien wavelengths; rethinking the fundamental assumptions and design decisions underlying current network architectures; extending the functionalities of OpenFlow to handle multi-domain scenarios; and setting up a state-of-the-art environment for atomic clock comparison.

COCO AT SUPERCOMPUTING 2014

For those attending the SC14 conference in New Orleans, you can catch a presentation by the CoCo project.

CoCo - On Demand Community Connection Service for eScience Collaboration - was featured in CONNECT 16.

COFFEE

ENHANCING SPECTRAL EFFICIENCY IN OPTICAL NETWORKS

The new fiber-optic networks have given rise to a huge increase in bandwidth capacity compared to traditional networks, but photonics experts know there is still room for improvement. A particularly promising technique has been developed by a team at the Italian National Inter-university Consortium for Telecommunications (CNIT). This team is now coordinating the COFFEE project, to test this method in a production-scale environment.

"We imported some techniques that have been developed for radio communication" says Luca Potì, project coordinator, "and we adapted them to optical communication. The problem that we can solve using this kind of solution is to increase the capacity of the system and demonstrate that we can enhance the connection and the data that can be sent between two different points using the already installed infrastructure."

The technique, called Time-Frequency Packing (TFP), provides the highest theoretical spectral efficiency given a fixed receiver complexity. TFP is currently being tested on the Milan-Vienna link, allowing the transmission rate of 1Tbps using a reduced bandwidth (<200 GHz and down to 100 GHz) over long-haul routes.

Compared to currently used techniques, TFP allows for lower transceiver complexity and bandwidth requirements, higher tolerance with respect to fibre propagation nonlinearities, reduced power consumption, and greater flexibility.

ICOF

FIBER-OPTICS AND THE SCIENCE OF TIME

Optical fiber has become the go-to transmission medium for atomic clock comparison. Optical fiber links allow for time and frequency comparisons to be performed at a much higher level of accuracy and stability than what is currently achievable by more conventional satellite links.

As Europe has the highest density worldwide of atomic clocks as well as the world-class optical infrastructure provided by GÉANT, putting these two elements together with a team of researchers directly setting up optical links between their clocks is a match made in heaven. This is the essence of the ICOF project.

ICOF is a collaboration of major European metrology institutes, represented by three main partners: the German Physikalisch-Technische Bundesnastalt, the Observatoire de Paris, and London's National Physical Laboratory.

"Here in Europe" says Harald Schnatz, project coordinator, "we have the unique opportunity to evaluate clocks using the optical fiber link. The fiber can provide us with such low uncertainty and such high stability, that we are able to evaluate the clocks located at two ends such as London and Paris as if they were close to each other."

Metrology has a key role in numerous scientific areas, most prominently in fundamental physics and relativistic geodesy.

IRINA

IMPLEMENTING THE NEXT GENERATION NETWORK ARCHITECTURE

Clean-slate network architecture involves rethinking the fundamental assumptions and design decisions underlying current network architectures.

The prevalent TCP/IP network architecture has been applied in a variety of situations it was never designed for. Growing problems with this system include excessive complexity, weak security, unexpected interactions between different protocols, layer violations, scalability issues and a limited interface to distributed systems.

The IRINA approach is a return to the foundational essence of networking. The project is working to implement the Recursive InterNetwork Architecture (RINA) in GÉANT's testbed environment, with the goal of building the foundation of the next generation NREN and GÉANT network architectures.

The IRINA partners are well known in the area of Future Internet research: the Belgian research institute iMinds, Ireland's Waterford Institute of Technology, the Italian research company Nextworks, and the Spanish i2CAT Foundation. Together with colleagues at Boston University, who originally proposed the RINA architecture, the partners have developed the RINA prototype which is now being tested.

An important aspect of the IRINA project is a realistic implementation of a future non-dsruptive transition: current experiments are designed to validate a smooth migration trajectory from TPC/IP to RINA.

MOMOT

TOWARDS RELIABLE DEPLOYMENT OF ALIEN WAVELENGTHS

Alien Wavelengths (AWs) are a relatively new paradigm in the optical networking world. Within the GÉANT community, the topic of deploying AWs has been around for about half a decade.

AWs have potential strong advantages in terms of cost, performance, and energy savings. The main challenge with the AW paradigm as a service is uncertainty. In the GÉANT network, both photonic services and alien wavelengths present the challenge of delivering the same predictability and security as regular transmission services. In order to assure this predictability and security, the development of a multi-domain optical modelling tool is essential.

The development of this modelling tool was taken up by the MOMoT project.

MOMoT is a collaboration between the Technical University of Denmark, CNIT and Gesellschaft fur Wissenschaftliche Datenverarbeitung Gottingen - a joint enterprise of the University of Göttingen and the Max Planck Society.

After having investigated the interests and requirements for an AW service platform within the NREN and GÉANT community, the project is now developing a multi-domain modelling tool to facilitate the deployment of Alien Wavelengths in the European network.

Project coordinator Martin Petersen remarks: "The modeling tool under development will enable all the partners and the NRENs to set up AW connections over multi-vendor environments."

MOTE

MULTI-DOMAIN OPENFLOW TOPOLOGY EXCHANGE

Circuit-based network provisioning is becoming increasingly popular, as can be seen for instance with the success of GÉANT's AutoBAHN. Extending the performance of network circuits into the campus networks is still an open problem, but one that can be addressed by OpenFlow. This technology however does not currently handle multi-domain scenarios very well.

To extend the network circuit provisioning from the circuit based networks into OpenFlow networks, some form of topology exchange is required.

The MOTE project - a collaboration between the University of Amsterdam and SURFsara - is working on a system that will bridge the intra-domain operations of OpenFlow with the inter-domain provisioning in the Network Service Interface (NSI) Framework.

"To do this" explains Paola Grosso, project coordinator "we exploit our previous work in the NML framework, and we extend that for OpenFlow, and then we can use these topologies in the NSI framework to create interdomain paths. So in some sense we take existing work, which is currently not usable for SDNs, and we leverage our expertise to build a completely new topology exchange model that is suitable for new services in GÉANT."

MOTE will provide a proof-of-concept implementation of interdomain topology exchange for OpenFlow, and an integration with the NSI Connection Service. This will allow users to seamlessly request and provision paths through OpenFlow networks, as well as NSI capable networks, such as Auto-BAHN.

Q&A WITH MARK JOHNSTON

CHIEF NETWORK OPERATIONS OFFICER, DANTE

THE ROAD TO 100G

Picture
GÉANT's new 500Gbps Transport System (capable of running at 8Tbps)

Mark Johnston joined DANTE in March 2012 to lead the GÉANT network migration to 100Gbps. Having spent over 20 years working in data communications and networking operations, he thought he pretty much knew the fundamentals; how one goes about designing, planning, building and operating large data communications networks, especially on a pan-European and international scale. However, he was about to embark on a whole new learning curve.

CONNECT caught up with Mark to find out about the road to 100G and his plans for the future.

WHAT WAS IT LIKE JOINING THE GÉANT PROJECT AT SUCH A PIVOTAL STAGE?

I spent my first 12 months at DANTE questioning why the GÉANT network was being designed the way it was – and whether it even needed to be built at all. Being new to the R&E community, I am still shocked as to how I spent 20 years in an industry doing the things I do now, yet never knowing this whole other facet of networking existed. I didn't understand the reasons and drivers for the network.

Having helped build today's GÉANT network and since taking on the role as Chief Network Operations Officer and GÉANT project network coordinator in August 2013, I have worked hard to understand those reasons, as I cannot be effective unless I do. I think I have learnt fast, but there is still lots to learn. If I were to sum up in one word why this network needs to exist and why it is built and designed the way it is, it would be 'PERFORMANCE'.

PLEASE TELL US MORE!

I think there are three critical performance factors of any R&E network, that when combined, should differentiate it from most commercial networks. The first is Bandwidth connectivity, as measured in bits per second (bps). The second is latency, delays incurred in transiting network data; and the third is throughput; the actual end-to-end data transfer rate rather than the theoretical.

R&E networks must be designed so that when these factors are combined, users are provided with a better experience than commercial networks. The biggest challenge facing the GÉANT networking community is that not every user and not every data flow across the network requires that level of performance.

Users who do not want that level of performance either cannot afford it or do not wish to pay for it. Maintaining that level of service as data volumes increase, is only going to increase cost unless new ways of designing, planning and building the network can be found.

WHAT ARE THE CHALLENGES YOU FACE RUNNING A 100G NETWORK?

As I enter my second year working on the GÉANT project, my biggest challenge is to stay ahead of multiple user demands, while leading the evolution and implementation of a network to be cost effective and deliver a user experience better than alternatives.

Work in this area has started and I believe my experience outside of R&E networking has had an influence. We are already tailoring network infrastructure design and implementation to user requirements and affordability we're starting to open people's eyes to the fact that it is the service we deliver that is important - not just the infrastructure it is delivered on.

With users connected at 100Gbps and sending large data flows across the network, understanding traffic routing and data flows to ensure data is delivered successfully is critical. With data flows greater than 10Gbps and because of the behaviour of TCP, zero tolerance of packet loss and bit errors is imperative and users of the GÉANT network like ESnet and EUMETSAT demand it. We must get there before 100Gbps connectivity matures and is widely adopted. A significant investment was made in the GÉANT network to enable users to transport data at 100Gbps, yet the investment in the tools to monitor and manage that flow of data is lagging. This will be a priority for me and my team in 2015 and beyond.

STAYING ONE STEP AHEAD - WHY IS THIS SO IMPORTANT?

Despite my early scepticism, I can say that the GÉANT network refresh in 2012 was justified, as we are starting to see 100Gbps connectivity becoming the norm. Applications migrate to cloud platforms, networks get faster, and resource slicing is becoming the norm. That means processors, systems, and storage are becoming integrated and virtualized, and more capable of using 100Gbps and greater networking bandwidth.

Today's data centre servers are connected with multiples of 1Gbps and 10Gbps, and as we are seeing with CERN, 10GbE isn't fast enough. Virtual server environments can impact the network and operations far more than a physical one, an increase in the network addressing and in performance and throughput is required as is the ability to manage virtual networked relationships. To manage this impact effectively and efficiently the data centre has to become integrated with the network and we expect SDN to solve this problem.

For the data centre, the network and users to function effectively, identifying and removing network bottlenecks becomes critical. In this new 100Gbps world there will be a lot of legacy, such as immature network interface card drivers that slow down server throughput, firewall rules and poor routing configuration; all of which went unnoticed before 100Gbps but which will need to be updated and refined to maximize data throughput. GÉANT as a community will have to work hard to ensure end-to-end paths are optimized to support large data flows and line speeds of 100Gbps.

With the addition of 100Gbps transatlantic connectivity in 2014 and with users like ITER, BELLE II, SKA and LHC, GÉANT needs to get 100Gbps networking right as these projects will generate petabytes of data – which means traffic and data flow size will increase significantly over the next three years. I would expect us to be testing the cutting edge technologies and 400Gbps connectivity in the coming years to ensure the network is always a step ahead.

Pictures
London PoP in Harbour Exchange Docklands (left); GÉANT's new 500Gbps Transport System (right).

WHAT'S YOUR VISION FOR THE GÉANT NETWORK OVER THE NEXT FIVE YEARS?

I'd like to see the network evolve so that it is much more integrated with the NRENs networks, sharing underlying infrastructure to create a more holistic service domain between GÉANT and its partners. I hope this will mean we can also deliver the network in a much more economical way – reducing costs to NRENs. Creating a network that's even more flexible and agile – not so rigidly constrained by the physical routing of fibre. And with the ability for users to request on-demand network centric resources and services. SDN can play an important role to enable some of this.

On a global scale, we want to be more strategically aligned to the demands of our international partners. Research today is a global activity and GÉANT continues to extend its worldwide connectivity for the benefit of the entire European research community. So our role in meeting our partners' connectivity requirements to Europe is greater than ever. In doing this well we hope to influence the creation of more regional hubs to improve the cost and accessibility of connectivity to Europe.

We'll also be developing an OSS stack that provides performance management reporting and service assurance and validation information to specific users and working with other GÉANT project activities to create a service orchestration architecture that enables user provisioning of network centric services.

JUAN YACHT DESIGN TEAMS UP WITH PRACE SHAPE TO MAKE FASTER SAILBOATS

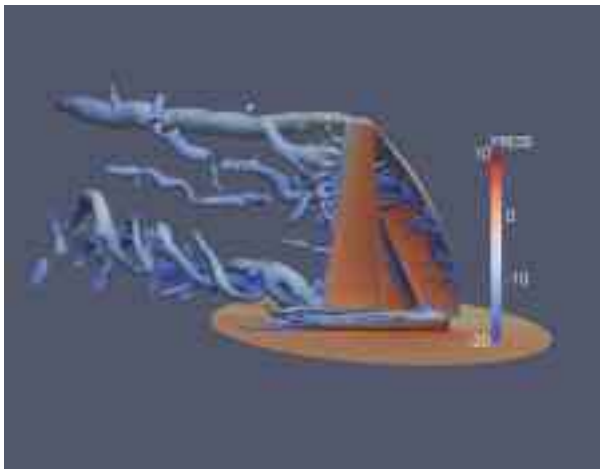
Words
Marjolein Oorsprong, PRACE Communications Officer

Juan Yacht Design (**http://www.juanyachtdesign.com/**), a Spanish SME specialised in the design of cruising yachts and racing boats especially for America's Cup and the Volvo Ocean Race, received an allocation via the PRACE SME HPC Adoption Programme for Europe (SHAPE) as part of the 15th cut-off of PRACE Preparatory Access. This will allow them to implement LES (Large Eddy Simulations) models to simulate flow around sails to replace the RANS (Reynolds Averaged Navier Stokes) models that are standard in the industry.

The use of RANS turbulence models – a pioneering adoption of Computational Fluids Dynamics (CFD) – has enabled Juan Yacht Design to put aside the need for towing tank experimental tests, a key competitive advantage in a cut-throat industry.

One of the main findings of the project is a concrete evaluation of the advantage of using LES over RANS: the latter not accurately capturing the two vortices created at the top and bottom of the Genoa sail, a problem that LES adequately resolves.

"With the support of the technical experts at the Barcelona Supercomputing Centre and the use of their in-house multi-physics simulation code, Alya, we were able to scale out our models up to 1024 cores of the MareNostrum machine and run the simulations there more efficiently than would ever be possible on our own machine," says Mr. Juan Kouyoumdjian, CEO of Juan Yacht Design. "The experience gained in this project will put us ahead of our competitors, having now a tool to simulate the aero around the sails in great detail and services our customers better with the results."



Project details

Title:
Testing LES turbulence models in race boat sail

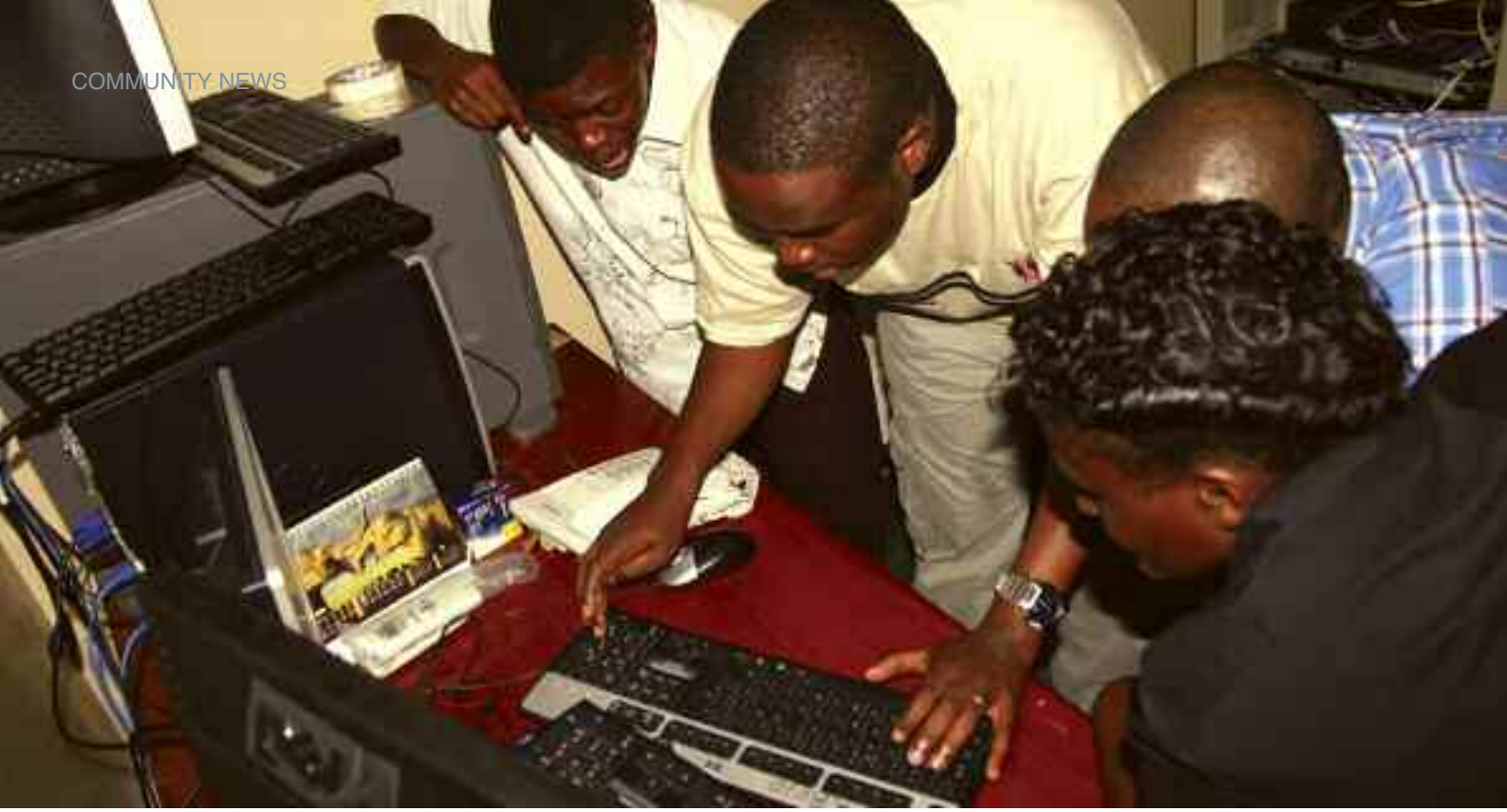
Leader:
Mr Gonzalo Kouyoumdjian of Juan Yacht Design

Collaborators:
Dr Matias Avila, Mr Hadrien Calmet, Dr Herbert Owen Coppola, Dr Mariano Vazquez of Barcelona Supercomputing Center

Research field:
Engineering and Energy

Resource awarded:
250.000 core hours on Fermi @ CINECA, Italy
100.000 core hours on MareNostrum @ BSC, Spain
250.000 core hours on JUQUEEN @ GCS@FZJ, Germany
250.000 core hours on SuperMUC @GCS@LRZ, Germany

SHAPE (**http://www.prace-ri.eu/shape**), the SME HPC Adoption Programme in Europe is a pan-European, PRACE-based programme supporting HPC adoption by SMEs. The Programme aims to raise awareness and equip European SMEs with the expertise necessary to take advantage of the innovation possibilities opened up by High Performance Computing (HPC), thus increasing their competitiveness. More detailed results of all 10 SHAPE projects are available on the PRACE website: **http://www.prace-ri.eu/SHAPE-Prototypes**



NREN INSIGHT:
TWINNING BETWEEN AFRICAN AND EUROPEAN NRENS – GERMANY AND KENYA, A SUCCESSFUL EXAMPLE

Interview with Kennedy Aseda, Lead Network Engineer, Operations, KENET

The collaboration was initiated by Prof. Meoli Kashorda of KENET and John Dyer of TERENA who pointed KENET to DFN. Planning for the twinning arrangement was then started in 2009 by Meoli Kashorda (KENET), Klaus Ullmann and Gerti Foest (DFN) which resulted in the signing of a MoU between DFN and KENET. Since then two staff members of DFN have visited the KENET headquarters in Kenya and four engineers from KENET came to Germany to learn about DFN.

Furthermore, there is a lively exchange of information between different working groups, especially the KENET NOC in Nairobi and the DFN NOC in Stuttgart. This year Kennedy Aseda, Lead Networks Operations Engineer at KENET, enjoyed two weeks of intensive training and discussion with DFN at its different sites in Berlin, Stuttgart and Hamburg (DFN-CERT).

Leonie Schäfer, DFN, talked with Kennedy about KENET, its mission and his role and objectives within his work.

How did KENET start? How is it positioned today?

KENET is one of the first NRENs founded in Africa. It started in 1999 and by June 2008 had 4 engineers as employees and 12 campuses connected. Today KENET has over 30 employees, mainly engineers, and employs 5 additional graduate trainees. The number of connected member campuses increased from 12 in 2008 to 150 today. 70% of the staff members are working in at the main offices in Nairobi, 30% outside at the NOC offices. The NOC office is situated about 25km outside of Nairobi. Main users of KENET's network are public and private universities, furthermore

some research institutes, technical colleges and governmental affiliates. Newly added to the circle of members are schools and hospitals.

What are the major projects KENET is currently involved in?

Our major project currently is to bring Kenyan schools online. The “Schools Fiber Connectivity and FREE Internet Project” runs in the city of Nairobi. 245 schools will be connected as part of this pilot. Based on the results of the pilot 2700 schools in total will be connected. Our main challenge within this project is to manage this huge amount of “customers”. For this large number of customers, individual solutions are not possible. Our approach therefore is to provide solutions to communities instead of individuals. The pilot project will run in Nairobi for one year and then the concept will be transferred to other cities.

Another important project for KENET is eduroam. Currently there are 18 eduroam campuses implemented at Kenyan universities which offer over 1Gbps connectivity. The schools connectivity project will also have a pilot installation of eduroam.

What do you see as Future Work for KENET?

The development of a concept for sharing research infrastructures would be a challenging task. Up to now infrastructure facilities are simply shut up after use or after the end of the project. Our objective is to try to get the infrastructure back online for the use of the community. The problem is that researchers tend to see research instruments and the corresponding infrastructure as “their” belonging. One of the major goals of the project would be to collect research instruments at a more centralised location which would allow continuous access by the researchers.

How is your cooperation with DFN and DANTE / GÉANT?

The cooperation with DFN is a well-established working relationship. DFN advised the initial set-up of the Kenyan NREN and offered counseling during the subsequent years. Furthermore, DFN actively supported the installation of eduroam in our country.

In recent years, several of my colleagues came to visit the DFN headquarter and its NOC to learn from the day-to-day operation of the DFN network. We always implemented something special after our return from DFN and we appreciate DFN’s support in engineering matters.

With GÉANT / DANTE we cooperate as part of the AfricaConnect project. Myself, I am a member of the Global eduroam Governance Committee (GeGC). The GeGC has the objective to ensure interoperability between eduroam regions, and to define technological and administrative improvements for the operation of eduroam at the global level.

What is your job profile at KENET?

I am the Lead Network Operations Engineer. I am supervising the operations team and ensure that Network Operations works correctly. Furthermore, I influence decisions about the selection of equipment and technical devices. My tasks include team coordination, risk management and working with our partners. In short, I have to "to put out the fire" in case of trouble.

What do you enjoy most about your work?

I enjoy most that there are new challenges every day. I enjoy the satisfaction to meet and accomplish these challenges. In Network operations, all challenges are different. I like problem solving, to meet the challenges, and to learn something new every day.

Words
Leonie Schafer, Project and Global Liaison Coordinator, DFN

Pictures
Photos courtesty of Thomas Schmid, DFN-NOC

Q&A WITH DORTE OLESEN

GÉANT is a flagship project of the European Union, key to keeping Europe at the forefront of the global research race. GÉANT is sponsored by the e-Infrastructures Unit of DG CONNECT (Directorate-General for Communications Networks, Content and Technology) of the European Commission. Dale Robertson spoke to Dorte Olesen to look closer at GÉANT in the context of EU policy and priorities.

Words
Dale Robertson interviewed Dorte Olesen

WHAT IS THE RELEVANCE OF GÉANT TO THE EU'S PRIORITIES?

The new Commission President, Jean-Claude Juncker, has announced a ten-point plan showing the priority actions he intends to take to achieve the EU's Europe 2020 vision. His two top priorities are to provide a new boost for jobs, growth and investment, and to create a connected digital single market. The European NRENs' collaboration in GÉANT has for many years helped ensure that Europe's research and education community benefits from the world's most advanced communications network. GÉANT and the NREN networks, and GÉANT's extensive international links to other world regions, provide the fundamental infrastructure required to allow Europe's researchers to collaborate and participate fully in the global research race. As well as the extensive innovation involved in developing and delivering Europe's research networks, the boost they provide to research and education in turn also gives rise to innovative commercial start-up companies and products which create employment and wealth in Europe. Broadband

infrastructure, education, research and innovation are key areas on which the EC intends to focus additional investment in pursuit of jobs and wealth creation. GÉANT is already a key initiative of the European Commission in these sectors of the economy and will continue to play a significant role in support of European Union policies through its contribution to completion of the European Research Area – a single European market for research - and its development of new internet technologies and services. As well as providing connectivity to help researchers all around Europe to participate fully in collaborative projects, the NRENs' collaboration in GÉANT develops innovative new networking services, such as the eduGAIN identity authentication and authorisation infrastructure, which support mobility and access to digital information and resources. These services have significant potential to benefit online access to public services and encourage digital "connectedness" in all sectors of the economy. The NRENs and the GÉANT Association also make a significant contribution towards the digital skillbase in Europe, developing some of the most technically advanced and sought-after network engineers in the world.

SO WHAT'S THE FUTURE VISION FOR GÉANT?

The European Commission has over a number of years been visionary and consistent in its support for pan-European research and education networking. This has led to global leadership in this field. In a context of rapidly evolving technology and heavy investment in research networks as a source of competitive advantage by other significant economies such as the US and China, the EC commissioned a group of high-level experts to advise on future actions. The mission of the so-called GÉANT Expert Group, or GEG, was to "articulate a 2020 vision for European Research and Education networking and identify an action plan for realising this vision".

The vision of the GEG and its recommendations for achieving it, were published in October 2011 in the Knowledge Without Borders report. The vision presented by the GEG is of "GÉANT 2020", the European communications commons, where talent anywhere is able 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. The GEG's recommendations for achieving this 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 European ICT sector
- Reorganise to cope with the constantly changing environment.

HOW IS THE VISION BEING IMPLEMENTED?

The European Commission has adopted the GÉANT Expert Group's vision and has implemented it in the objectives and requirements it specifies for GÉANT in the Horizon 2020 research and innovation programme.

In recognition of the long-term stable relationship developed with the NRENs' European collaboration and based on the very strong track-record of delivery in GÉANT, the EC has invited the NRENs and the GÉANT Association to conclude a Framework Partnership Agreement (FPA), a seven-year framework contract under which jointly agreed objectives are defined for realising the GÉANT 2020 vision. Future EC co-funded GÉANT projects will be implemented within the FPA. With "excellent" ratings in three successive annual EC project reviews, the GÉANT collaboration is well-placed to continue to deliver on its success and realise the European Communications Commons vision, integrating services and innovation to push the state-of-the-art and grow the breadth and depth of knowledge communities.

Another key step in achieving the vision of GÉANT as the European Communications Commons has been the recent creation of the GÉANT Association, re-organising the two collaborative organisations of the European NRENs, TERENA and DANTE, under a unified governance structure.

BUT ISN'T GÉANT JUST A NETWORK?

The GÉANT programme not only delivers a world-leading communications network, it also develops services on top of the network which, for example, make the network easier to use or enhance the ease of access to information or resources such as high-performance computers. These services are developed using a disciplined Product Lifecycle Management process which ensures they add value and meet clearly-identified user needs.

The NRENs work very closely with the research and education communities in their respective countries and understand their needs very well. This key relationship contributes strongly to keeping Europe at the forefront of innovation in e-Infrastructures. Within GÉANT, the networking community is collaborating increasingly with other European e-Infrastructures as digital technologies develop, working in a complementary manner to investigate and adapt to new service delivery approaches such as Clouds. In this way the NRENs ensure user needs for networking capacity, but also for data management solutions and data storage and processing facilities, are seamlessly met.

Europe's NRENs continue to play their role as innovators and ideas generators as digital technologies develop, which is complemented by their close relationship with academia, including many early adopters of new digital techniques.

GÉANT is so much more than just a network – it's a whole ecosystem of complementary services, technologies and innovation, working together to realise the European Communications Commons.

TECHNICAL INSIGHT

BREAKING THE TERABIT BARRIER!

infinera

A FIELD TRIAL OF THE WORLD'S FIRST SINGLE CHIP TERABIT SUPER-CHANNEL

Since the deployment of Infinera's DTN-X platform in the GÉANT network I've had the privilege of working on several trials of generally available and prototype technology with DANTE personnel and the Infinera account team. For example last year we had two successive time trial experiments using production equipment – culminating in an official Guinness World Record in August 2013.

In our most recent collaboration Infinera offered DANTE the chance to check out our next generation Terabit line card prototype on the GÉANT network between Budapest in Hungary, and Bratislava in the Slovak Republic. This prototype card creates a terabit scale "super-channel" (a set of optical wavelengths that are treated as a single unit of capacity) using one photonic integrated circuit (PIC) – think of an optical semiconductor chip.

TERABIT SCALE SUPER-CHANNELS

Figure 1 shows how this works. Using one Indium Phosphide chip (a form of compound semiconductor that is as important in the optical transmission world as silicon is in consumer electronics) we create ten parallel sets of optical transmission circuits. In fact there are over 600 optical functions integrated into these kinds of Photonic Integrated Circuits (PICs). This technology is totally unique in the optical industry, and will offer DANTE twice the line card capacity of the current 500Gb/s modules used in the Infinera DTN-X.

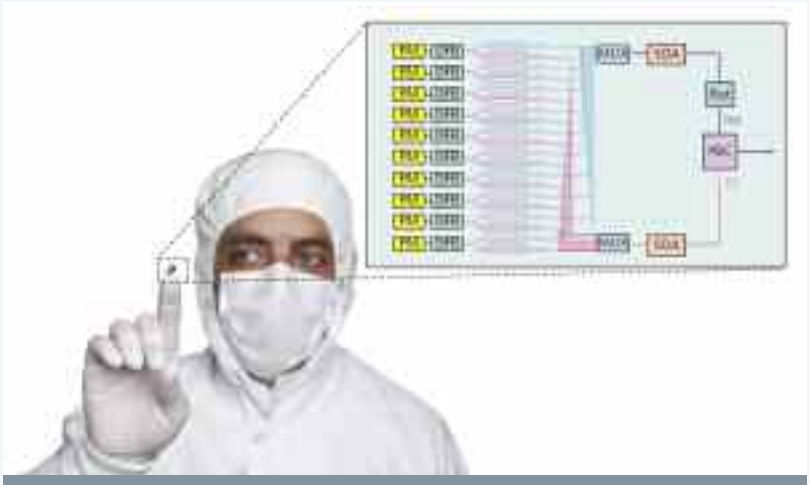


Figure 1. A fingernail-sized chip like this can deliver over 1Tb/s, and integrates around 300 optical functions. Each small box represents a discrete optical function that would otherwise be implemented in a separate module.

Figure 2 shows why this scalability is vital. Assuming a 40% growth rate over a five year period this would result in a factor of five increase in demand. If an engineer is working in units of 100Gb/s for long haul transponder provisioning at the start of this period they would have to work five times harder to meet demands after five years. There is no service provider in the world that can justify hiring five times the number of network engineers! This is why the 500Gb/s line cards already deployed in the GÉANT network are so useful in terms of keeping down operational costs while meeting the demands of NREN traffic. But the demand never ends – so it's vital to be able to offer even more capacity and operational scalability in the same form factor as these existing line cards.

FLEXCOHERENT™ SHOWCASE

Over the past five years the emergence of coherent transmission and detection technologies has effectively delivered more than a ten times increase in the combination of optical reach and fiber capacity. But there's no single coherent modulation type that will be optimal for every type of deployment. In the extreme cases, a trans-Pacific submarine link may require Binary Phase Shift Keying (BPSK) modulation, which has amazing reach but relatively low spectral efficiency. In contrast a metro deployment may be able to use 16QAM modulation, which can deliver up to 24Tb/s on a single pair of fibers, but with a reach of only about 700km. For some

Words
Geoff Bennett, Infinera

Geoff Bennett is the Director of Solutions & Technology for Infinera, a leading manufacturer of Intelligent Transport Network solutions. Geoff is a frequent conference speaker, and is the author of "Designing TCP/IP Internetworks", published by VNR.

DWDM vendors it might be necessary to order specific linecards that offer one or two modulation types, but Infinera has long been a champion of a flexible coherent (FlexCoherent) capability where the network operator (eg. DANTE) would software-select the modulation type on a single line card type.

In the terabit linecard trial we demonstrated five different modulations; BPSK, 3QAM, QPSK, 8QAM and 16QAM. Figure 3 shows a summary table of how fiber capacity and reach can be traded off, and gives constellation examples for two of the modulations we demonstrated: 8QAM and 16QAM [1].

INVESTMENT PROTECTION

One of the fundamental benefits of Infinera's DTN-X platform is its integrated, non-blocking OTN switching. To put it bluntly, if the new terabit scale line cards offer more than double the capacity, will the DTN-X's switching fabric be able to keep up? More importantly if the switching fabric has to be upgraded can this happen without taking the entire node out of service to do it?

This aspect of the demonstration was not part of the Terabit line card trial itself, but I took the chance to use Infinera's London demo lab to film exactly how it would happen. You can see the movie I made on YouTube [2].

The key points that you'll see in the movie are that the upgrade process is non-service interrupting – something I showed using an Ethernet service tester tuned to detect even a single dropped frame.

[1] Geoff Bennett, KT Wu, et al. "A Review of High Speed Coherent Transmission Technologies for Long Haul DWDM Transmission at 100G and Beyond". IEEE Communications, October 2014.

[2] Videos and White Paper on the Terabit Line Card Trial. **www.infinera.com/go/terabit_trial**

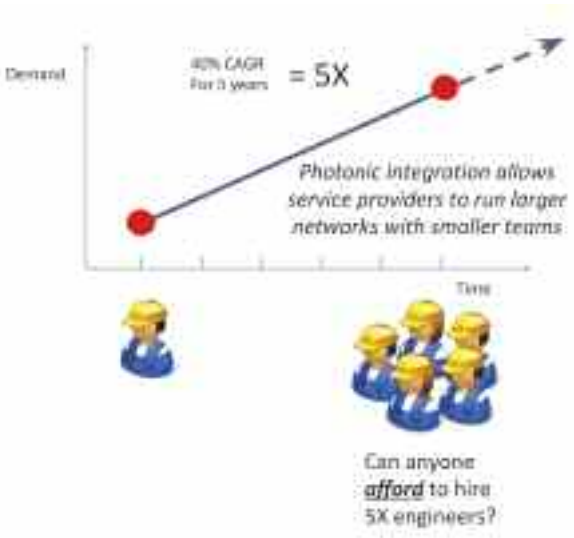
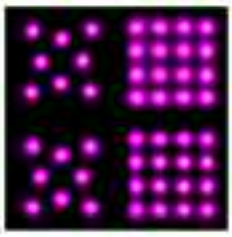


Figure 2. Increasing internet demand will either require more engineers to provision and maintain capacity, or capacity can be delivered in larger units, such as 500Gb/s super-channels.

Modulation	Bits per symbol (Net Pol)	Extended C-Band Capacity	Typical Reach
PM-BPSK	2	6Tb/s	>5,000
PM-3QAM	3	9Tb/s	6,000
PM-QPSK	4	12Tb/s	4,500
PM-8QAM	6	18Tb/s	1,600
PM-16QAM	8	24Tb/s	700



PM-8QAM PM-16QAM

Figure 3. Table summarizes the trade offs between the type of modulation, the fiber (Extended C-Band) capacity, and typical optical reach. On the right are two examples of coherent modulation constellations; PM-8QAM and PM-16QAM.

THE POWER OF NETWORKS TO EMPOWER COMMUNITIES

A network can mean many things – to many different types of people and organisations. Advanced ICT networks are the core of the GÉANT project, and the core of the local, regional and affiliate members and partners. But if we look beyond the routers, switches and fibre cables, we will find the secret to a successful network. People. With diverse needs, cultures and aspirations. By intelligently and sensitively networking these networks of people, unique and powerful communities are nurtured. These communities enable benefits that extend traditional boundaries inherently defined by network topology, and by geography and culture as well.

An outstanding example of this is the workshop programme spearheaded by the Trans-Eurasia Information Network (TEIN) and the Caribbean Knowledge and Learning Network (CKLN).

COMBATTING DENGUE FEVER

The first dedicated Dengue Fever workshop, held in January 2014 was jointly hosted by APAN (Asia-Pacific Advanced Network) and TEIN*CC (manager of the TEIN network) in Bandung, Indonesia. It brought together over 30 clinicians and researchers from within the multi-disciplinary Dengue Fever community, public health officials as well as NREN representatives from across Asia-Pacific. Under the banner “Dengue Fever- Let’s STOP it!” the workshop provided a forum to share experience and discuss best practices, mobilising a new community dedicated to helping combat the spread of this devastating disease.

All virtual participants were able to view the presentations and follow discussions in real time using the multipoint videoconference system supported by their respective national R&E networks and the regional TEIN backbone. Participants experienced videoconferencing as a time- and cost-effective collaboration tool and saw first-hand how video and web conferencing over R&E networks can save time and money for meetings and clinical case discussions.

Beyond the scope of collaboration on scientific material, participants enthusiastically agreed to follow up with virtual meetings around areas of research interest. “This was a very inspiring event. I hope it will act as a catalyst for more joint actions”, said Prof. Francis Lee Bu-Sung, President of SingAREN, Chair of Governors of TEIN*CC and driving force behind the workshop. “Everyone left with renewed energy and enthusiasm in our quest to stop the spread of Dengue Fever and to improve its treatment!”

As Prof. Lee noted, building communities is not a one-time effort. Within six months, a second workshop was held in June 2014 under the tutelage of the Caribbean Knowledge and Learning Network, CKLN, and the Caribbean Public Health Agency, CARPHA, in Trinidad & Tobago. This symposium focused on Dengue Fever and Chikungunya Virus, and welcomed clinicians, researchers and network engineers to share experiences. Representatives of the national research and education networks, TTRENT, JREN, BAHAREN, and eighty videoconference participants from Trinidad and Tobago, the Bahamas, Jamaica

Words
Audrey Gerber, Marketing & Communications, Israel Inter-University Computation Center (IUCC)

Picture
Dr. Leslie Lobel (left) oversees drawing of blood from an Ebola survivor for his study. (Courtesy of Leslie Lobel) (left).

(Kingston and Montego Bay), Puerto Rico and Malawi in South East Africa attended.

The objective of the symposium was to initiate the establishment of a medical related community with a focus on Dengue Fever and Chikungunya. Organisers sought to develop new approaches to leverage the high bandwidth research and education (R&E) networks in the region - C@ribNET and RedCLARA – to support collaborative work among health-related communities. This was the first time two CARICOM agencies worked together using the dedicated C@ribNET research and education network.

According to Dr. Karen Polson-Edwards, Senior Technical Officer, Vector borne Diseases and Neglected Tropical Diseases at CARPHA, the symposium was extremely timely as Dengue and Chikungunya are of concern for the entire Caribbean basin and many coastal and interior countries in South America. "C@ribNET and CKLN are excellent platforms for networking", she noted. "We were amazed and pleased at the extensive reach of the network, virtual streaming and the ability to share information and experiences and have vibrant discussions with clinicians, epidemiologists, environmental health officers, students and others. We recognize the endless possibilities and are looking forward to continuing to partner with C@ribNET and CKLN in future activities".

In fact, in a recent meeting of CARICOM Agency Heads, the success of the Dengue Symposium and the ability of CARPHA to share and discuss with so many in the health sector in the region was highlighted. As a result, at least six CARICOM agencies are now engaging with CKLN regarding direct connectivity to C@ribNET. These include agencies related to Meteorology and Hydrology, healthcare, disaster management, fisheries, agricultural research) and Security.

The recent Dengue Fever outbreak in Japan, where authorities have little or no experience with the disease, highlights how important this community has become. Preliminary work is being carried out to organise a series of videoconferences with Japanese healthcare and networking professionals and colleagues to share expertise. The successful implementation of this plan will prove again how the work kicked off by NRENs can become a self-sustained, ongoing effort, owned by the users themselves – a community working together to improve lives of across borders.

ON TO AFRICA

The work on Dengue Fever and Chikungunya are excellent examples of the scalable nature of efforts to build communities. As such, the tools and capabilities are easily adaptable to the plethora of infectious diseases that pose a global challenge. One of the most urgent is the need to treat and contain the spread of Ebola virus. Colleagues from around the world are lending a helping hand in formulating the programme for a special symposium on Ebola that will take place during the UbuntuNet Alliance's Annual Conference in Zambia on 13-14 November 2014.

The urgency of treating and stopping the spread of Ebola virus becomes more apparent day after day. The Ebola virus causes an extremely virulent disease that leads to death in 25 to 90 percent of cases. Outbreaks of the fast-moving virus have occurred across West Africa. The work being done in Europe, as well as the U.S., is of unprecedented scope and underscores just how much the community of cooperation fostered by R&E networking does to leverage all the resources available.

The November conference will be enhanced by the recent commissioning of UbuntuNet, the

Pictures
Participants at the "Dengue Fever- Let's STOP it!" in Bandung, Indonesia (left); C@ribNET links videoconference participants from the Bahamas, Jamaica (Kingston and Montego Bay), Puerto Rico and Malawi in South East Africa at the Dengue Fever and Chikungunya Virus workshop in Trinidad & Tobago (right).

regional high-speed Internet network in Eastern and Southern Africa in July 2014. Connecting researchers, educators and students in Eastern and Southern Africa to their peers in Europe with high-speed Internet connectivity is a great achievement in reducing the digital divide. According to Eng. Dr Tusu Tusubira, CEO of the UbuntuNet Alliance: “Today through collaboration with GÉANT as well as other regional and international partners, the UbuntuNet network is boosting African research collaboration with colleagues in Europe and elsewhere, and bringing unprecedented research and educational opportunities to the continent. The implications for socio-economic development go far beyond anything we could have dreamed of before, putting African research on the map and transforming the lives of millions. The new global threat of Ebola brings into sharp focus the need for improved collaboration”.

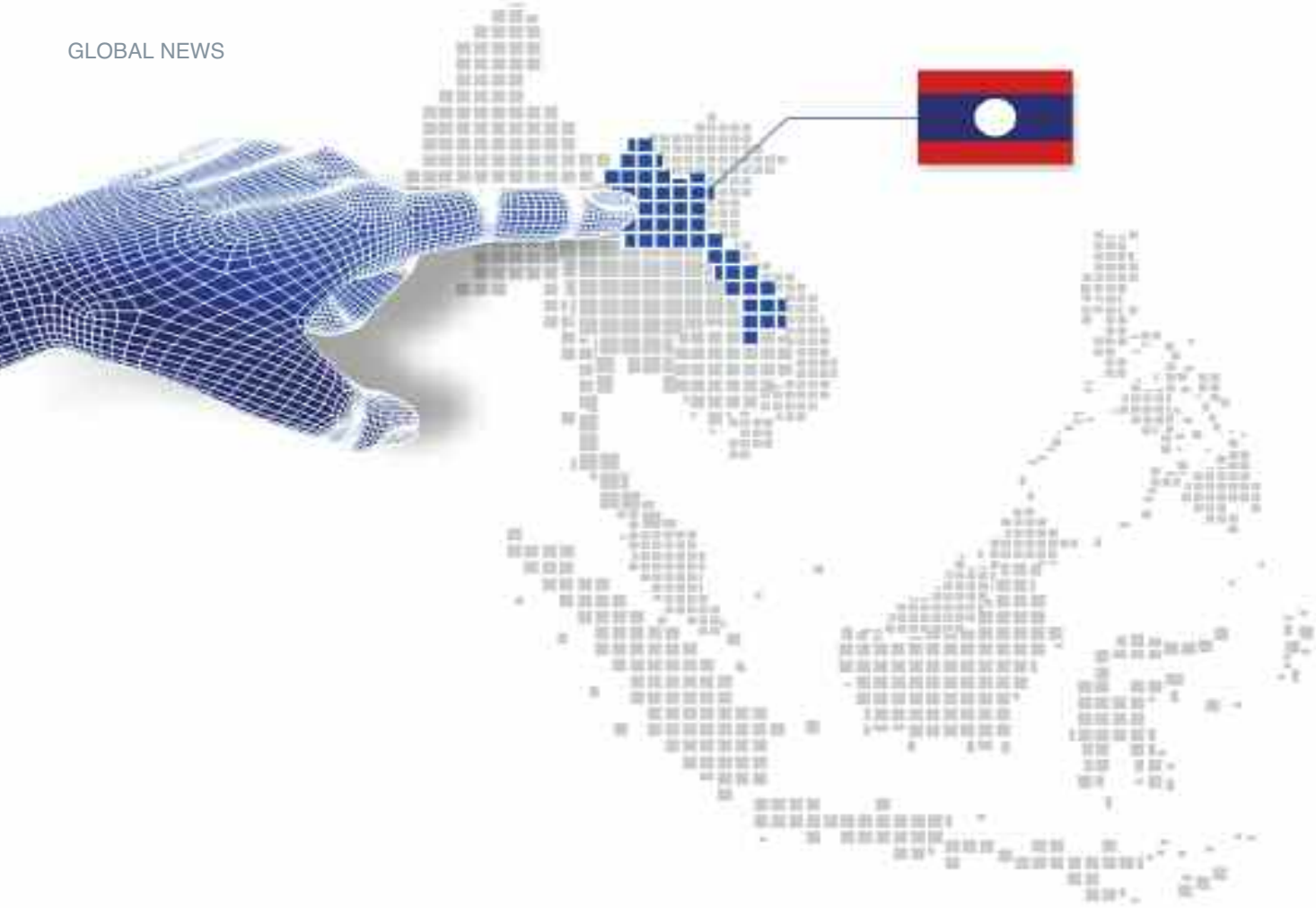
Dr. Leslie Lobel, a virologist at the Ben Gurion University of the Negev in Israel is a key player in a consortium established to find an antibody "cocktail" to fight the deadly Ebola virus, along with Dr. John Dye of USAMRIID and Dr. Julius Lutwama of the Uganda Virus Research Institute. Together, they are trying to devise a way of conferring short-term passive immunity against the disease through the use of human monoclonal antibodies. To do this, they have been following 120 Ugandan Ebola virus survivors, half of them for more than a decade.

“It took a while to gain the trust of the survivors,” says Lobel. “The culture has an inherent distrust of medical professionals. The nature of our work demands that we build long-term relationships with survivors and local researchers”.

The demanding “wet biology” requires complex logistics and arduous work in the field – not particularly computational-intensive work. But according to Lobel, computing and communications needs are incredibly dynamic – both in the field and in such a challenging locale. “We must maintain our surveillance methods and expand our understanding of the entire ecosystem, including weather conditions, animal behaviour and movement, and of course, meticulous and timely monitoring. Because travel is so difficult in rural Africa, we hope to leverage ubiquitous cellular networks to monitor outbreaks, weather conditions, animal populations and more”. This will require integration with mobile networks of enormous proportions that are likely beyond the capabilities of regular commercial cellular networks. To be done properly, this will most likely require cooperation on a global scale between outlying regions of Africa, the U.S., and the GÉANT network.

NETWORKS: COMMUNITIES OF PEOPLE

According to Cathrin Stöver, DANTE Chief International Relations and Communications Officer, connecting the dots to solve such complex puzzles starts with connecting people. “While AfricaConnect and other regional networking projects have helped to establish operational and sustainable data networks, what drives this growth is how we have connected people”, she believes. “Bringing people together in these collaborative communities, that have taken on a life of their own, will drive cooperative research programmes that exploit the talents and skills of the best and brightest from the four corners of the earth. We can only do this by building bridges between people and cultures first, alongside laying fibre optic cables and developing value added services. We are building communities because that is the best way to affect real change – in healthcare, biomedical sciences, climate, agriculture, education and environment – to help make the world a safer, healthier place”.



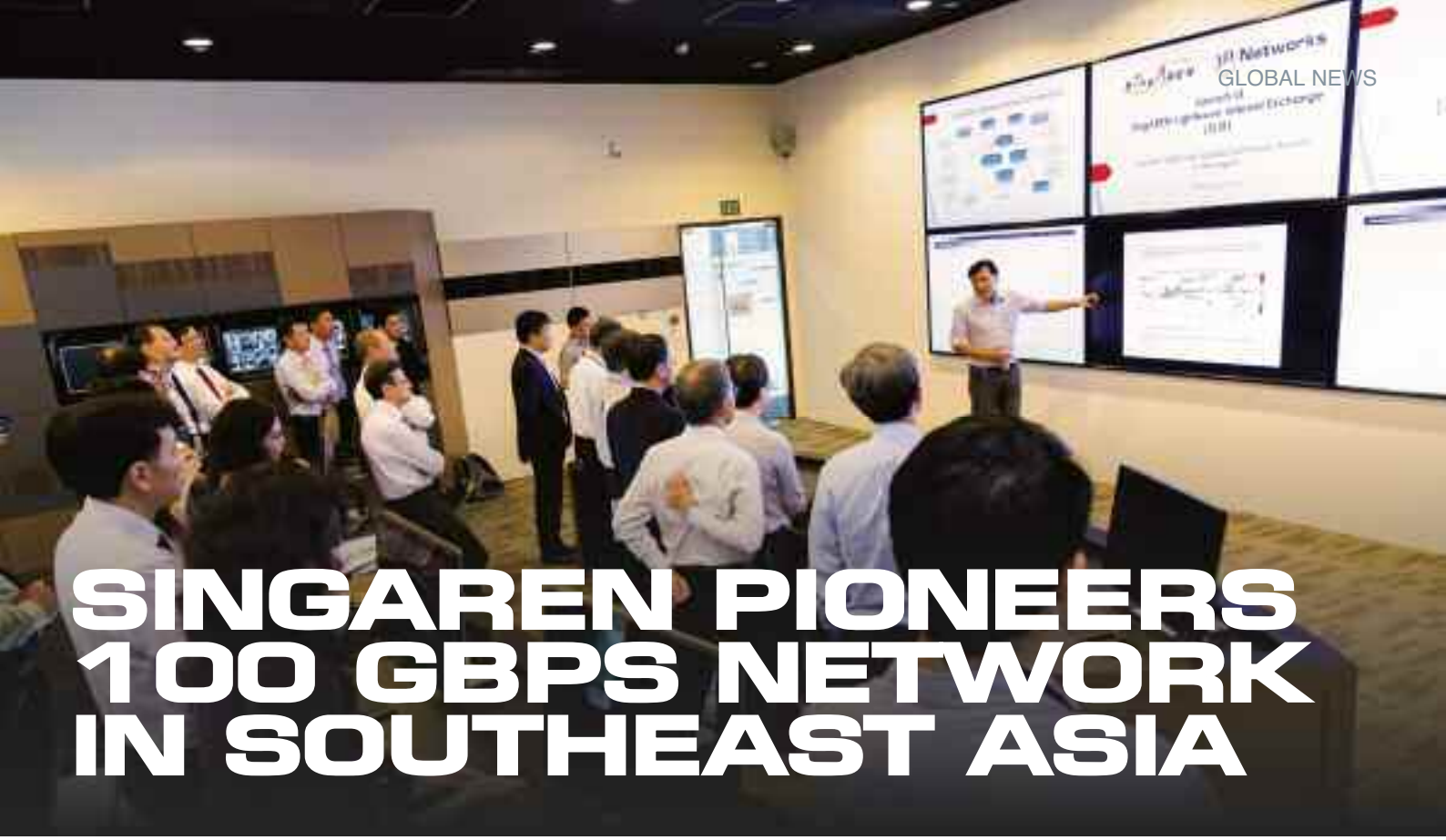
LAOS CONNECTS TO TEIN NETWORK

Words
Helga Spitaler, Senior Communications Officer, DANTE

In August, Laos became the latest country to connect to the Asia-Pacific R&E network - TEIN, bringing the number of Asian countries benefiting from the high-speed regional and international connectivity to 19. The TEIN community welcomed the news at their most recent project meetings in Nantou, Taiwan alongside the 38th APAN meeting held from 11 to 15 August 2014.

The new link initially connects National University of Laos (NUOL) in Vientiane and will catalyse the development of Laos' national education and research network, LERNET. The connection is expected to stimulate research and education activities in the country as well as participation in regional and global collaborations in areas such as telemedicine, food security and e-learning.

The physical connection of Laos would not have been possible without the assistance of the Thai NREN ThaiREN. NUOL and ThaiREN have joined forces to enable Laos to connect initially via Thailand to the TEIN network at its Singapore PoP at 10Mbps.



SINGAREN PIONEERS 100 GBPS NETWORK IN SOUTHEAST ASIA

Singapore Advanced Research and Education Network (SingAREN) has unveiled the SingAREN-Lightwave Internet Exchange (SLIX), a 100Gbps resilient backbone network connecting Singapore's key research and education sites. SLIX delivers one hundred times more capacity than SingAREN's previous generation of network infrastructure, providing stronger support for complex, data- and bandwidth-intensive research in areas such as genome and meteorological studies. In addition, the MLXe-4 core router provides a clear path for the use of Software-Defined Networking (SDN) in SLIX's network.

The new network includes a dedicated dual fibre-optic ring – capable of supporting multiple 100 Gigabit Ethernet (GigE) links. This opens up new possibilities as a testbed for advanced network technologies and experiments, extending database mirroring services, high-performance computing federations, high-volume peering with content data networks, and other value-added services.

SLIX has been developed by SingAREN in partnership with major local user partners: Agency for Science, Technology and Research (A*STAR), National University of Singapore (NUS) and Nanyang Technological University (NTU).

In addition to supporting connectivity within the local research community, SLIX connects to GÉANT via the TEIN network, as well as with Internet2 and Asian R&E networks.

The SLIX initiative is expected to lead to further collaborations with Europe over the coming months.

"SingAREN is proud to be the first to launch a 100Gbps research and education network in the region," said Professor Francis Lee Bu-Sung, President of SingAREN at the official launch event on 28 August. "SingAREN is again pushing the envelope of technology to provide high-speed connectivity and value-added services that meet the needs of the research and education communities – locally, regionally and internationally!"

For further information please visit **http://www.singaren.net.sg**

Words
Helga Spitaler, Senior Communications Officer, DANTE

Pictures
Preview of advanved network applications enabled by SLIX (top); Prof. Francis Lee Bu-Sung with SingaREN team and A*STAR/NTU staff at the SLIX launch event (bottom left); R&E networking partners around the world delivering their congratulatory messages via videoconference (bottom right).

1ST CENTRAL ASIAN R&E NETWORKING CONFERENCE - MILESTONE FOR CAREN PROJECT

Researchers, academics and students across Central Asia and Europe are set to benefit from the recent capacity upgrade of the Central Asia Research and Education Network (CAREN), celebrated at the 1st CAREN Regional Conference which took place 1-2 October 2014 in Almaty, Kazakhstan.

Themed "Innovative Internet for Researchers and Higher Education" and hosted at Turan University, the event attracted over 160 attendees from across Central Asia, including, Uzbekistan, Europe, the United States and East Asia, including representatives of the research and higher education community, policy makers, connectivity providers and ICT vendors. In line with the conference theme, the programme focussed on key areas such as cloud computing, network security, AAI and applications for science and education.

Participants heard and saw first-hand from scientists and academics how CAREN's high-speed links make a real difference in advancing collaborative research in areas such environmental studies, seismology, telemedicine and preservation of natural and cultural heritage. "We have

a dreadful history of seismic disasters. We cannot prevent earthquakes, but we can minimise their effects", commented Dr Bolot Moldobekov, Co-Director of the Central-Asian Institute for Applied Geosciences (CAIAG) and speaker at the conference. "CAREN's high-speed connectivity allows us to work together with the best people around the world to better understand and prepare for earthquakes."

The first conference day featured a telemedicine session, beaming a live liver surgery from Seoul National University Hospital (SNUH) in Korea to the audience in Almaty thousands of miles away. Conference delegates were impressed by the high quality imagery enabled by reliable research network connectivity. Excellent video and sound quality was delivered also during an e-culture demonstration which included a remote presentation by Dr Faridah Noor, Chair of MyREN and APAN e-Culture Working Groups and excerpts of previous cyber-performances.

Various presentations outlined how e-learning and remote training opportunities make education and knowledge transfer more accessible. Michael Riggs from UN-APCICT (United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development) delivered a keynote speech on ICT and engaged learning to raise awareness of the role of capacity building. He introduced UN-APCICT's flagship programme "Turning Today's Youth into Tomorrow's Leaders" to promote the inclusion of ICTD in undergraduate and graduate courses to prepare youth in the use of ICT for sustainable socio-economic development.

During the two conference days, the CAREN community also drew on the expertise of representatives from other regional networks and organisations, such a GÉANT and its Asian counterpart TEIN. In his key note presentation titled 'Fruits of regional collaboration', Dr Christian Grimm from DFN, Germany, provided sound arguments as to the necessity of collaboration with users and NRENs globally for survival and success. He illustrated his talk with examples of DFN and GÉANT practise. Wearing his TEIN hat, Prof. Francis Lee from SingaREN outlined existing collaborations between NRENs, researchers and academics in Central Asia and Asia Pacific and highlighted partnership opportunities for the future, in areas such as e-culture, disaster management and telemedicine.

Summing up the final panel session, EC Project Officer Francesco Zoia-Bolzonello concluded: "We have come a long way since 2001 when the SILK project started. CAREN has built on its achievements and will further consolidate Central Asian's role among the international R&E networking community".

"The conference stimulated lively exchanges as for many participants it was their first exposure to the potential of research and education networking in the region. I look forward to further events and further development of the CAREN project in the years to come", commented CAREN Project Manager David West.

CRNC 2014 was organised by the CAREN project and hosted by the Kazakh National Research and Education Network (KazRENA) in conjunction with Turan University in Almaty. The conference was further supported by the Ministry of Education and the President's Archives of the Republic of Kazakhstan.

Almaty also hosted the training workshop "DNS operations and network monitoring" run by an enthusiastic NSRC (Network Startup Resource Center) team who equipped current and aspiring NOC engineers in the region with hands-on advice.

For further information please visit **http://crnc2014.icaren.org/**

Words
Helga Spitaler, Senior Communications Officer, DANTE

Pictures
Live tele-surgery session from Seoul National University Hospital (SNUH) (left); NRSC team with training workshop participants (right).

REAL NETWORK – REAL BENEFITS

Upgraded in 2014, CAREN's high-speed network connectivity brings opportunities for Central Asia to participate in regional and global collaborative projects with high societal impact and direct relevance to the region, including environmental studies, seismology, telemedicine and preservation of natural and cultural heritage. In addition, e-learning and remote training opportunities make education and knowledge transfer more accessible.

MANAGING NATURAL DISASTER RISKS

The Central Asian Institute for Applied Geosciences (CAIAG) in Kyrgyzstan is collaborating closely with partner institutes in the region as well as with the German Research Centre for Geosciences (GFZ) to monitor and mitigate the impact of climate change and natural disasters, such as earthquakes floods, avalanches and mudslides. High-speed CAREN links allow geoscientists to collect and exchange monitoring data in near-real time for improved hazard assessment, risk management and effective disaster emergency response.

REVOLUTIONISING HEALTHCARE

By linking doctors, patients and hospitals via high-quality, real-time video, CAREN enables remote diagnoses and consultations and provides access to world-class, interactive medical training, thus improving patient care, reducing costs and saving lives.

DELIVERING GREEN ENERGY

CAREN underpins solar technology collaborations between European and Turkmen institutions by supporting remote training of local engineers and real-time transmission of monitoring data to optimise solar cell performance.

SAFEGUARDING WORLD HERITAGE

CAREN helps protect precious UNESCO world Heritage sites along the ancient Silk Road by enabling video links between archaeologists and historians, and by supporting UNESCO's plans for a virtual museum and remote site monitoring.

Words
Helga Spitaler, Senior Communications Officer, DANTE

ASEM SUMMIT RECOGNISES ROLE OF TEIN

Heads of State and Government from 51 Asian and European countries attending the 10th ASEM Summit held 16-17 October in Milan recognised the achievements of the Trans-Eurasia Information Network (TEIN) initiative in fostering collaboration between the two regions and endorsed its continuation under the management of the TEIN* Cooperation Center in Korea.

Park Geun-hye, President of South Korea, proposed to expand the TEIN initiative to share more information and knowledge and display creativity between research centres and education institutions across Asia and Europe. Park said: "If both continents promote connectivity in the cultural sphere and in education, if we open our hearts and build trust, it will solidify the foundation for peace on earth."

Words
Helga Spitaler, Senior Communications Officer, DANTE

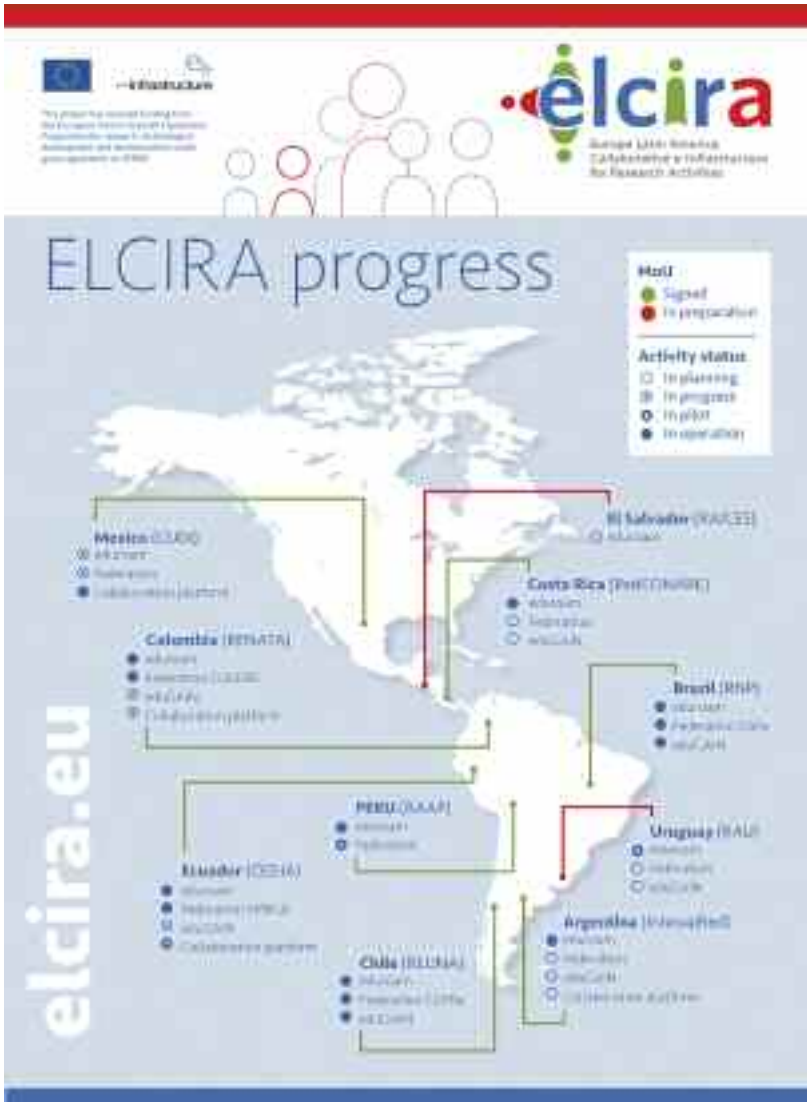
Picture
President Park Geun-hye (second from left) attends the opening ceremony of the tenth ASEM summit on October 16.

Excerpts from the ASEM10 Chair's Statement

"Leaders underlined that digital connectivity, enabled by high-speed, high-capacity broadband connections to the Internet, is a key element of modern society's infrastructures. Leaders expressed interest to examine ways of enhancing digital connectivity between Europe and Asia. Leaders also welcomed progress in the Trans-Eurasia Information Network (TEIN) as well as the role of the TEIN Cooperation Center in the Republic of Korea and reiterated their further support for the project's implementation. Leaders also underlined the opportunity to leverage the e-infrastructure developed under TEIN for new Asia-Europe projects, in areas such as e-learning, e-science, e-health and e-government. They welcomes the opportunity for further exchanges on cyber issues at the Global Conference on Cyberspace in April 2015 in The Hague, the Netherlands."

ELCIRA REACHES ITS CONCLUSION

AT THE END OF OCTOBER 2014 THE ELCIRA PROJECT REACHED ITS CONCLUSION.



ELCIRA (Europe Latin America Collaborative e-Infrastructure for Research Activities), an EC-funded project designed to facilitate collaboration among European-Latin American research teams, reached its conclusion at the end of October this year.

Led by RedCLARA, with partners from Brazil (RNP), Colombia (RENATA), Italy (GARR), Spain (RedIRIS), as well as DANTE and TERENA, the successes of the nearly 2½-year-long project have been numerous, from significantly increasing the presence of eduroam in Latin America, to enabling the creation of new identify federations in the region, providing a suite of collaboration tools, and improving videoconferencing through a dialling system which has improved the possibilities for communication between European and Latin American researchers.

Having set out to establish eduroam in at least two Latin American countries, ELCIRA has far outstripped expectations through the deployment of eduroam in six Latin American countries (Argentina, Chile, Colombia, Costa Rica, Ecuador, Mexico and Peru). In addition, ELCIRA has supported the ongoing expansion of eduroam in Brazil, where Porto Alegre has become the first eduroam city on the continent.

Words
Tom Fryer, Senior International Relations Officer, DANTE

The objective of supporting the creation of identity federations in two countries was not only met but doubled with operational identity federations having been established in Argentina (MATE), Chile (COFRe), Colombia (COLFIRE) and Ecuador (MiNGA). Of these, the Chilean federation is a member of eduGAIN, alongside the Brazilian identity federation.

ELCIRA has also established gatekeepers for RedCLARA and the Costa Rican and Colombian NRENs. With Brazil and Mexico also integrated with the RedCLARA gatekeeper which is in turn integrated with eduCONF, users of videoconferencing facilities behind the RedCLARA gatekeeper can now dial terminals behind eduCONF in Europe, and vice versa.

An additional aim of ELCIRA was to improve collaboration for Europe-Latin American research communities. This has been done through the creation of a virtual federated platform, known as Colaboratorio V1.0. The platform makes tools and services delivered by Latin American and European NRENs available to end users in a single location and facilitates collaboration in the following ways:

- Webconferencing through the VC Espresso tool.
- Large file transfer through the eNVIO service, based on FileSender, and provided by GARR.
- The reservation of multi-point H.323 videoconferencing facilities behind SIVIC, RedCLARA's equivalent of eduCONF
- Participation in discussions and events organised by RedCLARA user groups
- A search facility for documents produced by RedCLARA and the user groups supported by RedCLARA.
- A search facility for funding opportunities, project partners and collaboration opportunities.

An active dissemination programme has ensured visibility of ELCIRA and its successes both in Europe and Latin America, including participation in leading international conferences including the International Conference on Research Infrastructures, the TERENA Networking Conference and the TICAL Conference for ICT directors of Latin American universities.

Since June 2012 the ELCIRA project has provided a significant boost to improving the ways in which academics in Europe and Latin America are able to collaborate, adding extra value and needed services above and beyond R&E connectivity in Latin American and the transatlantic connection to GÉANT.

To learn more about ELCIRA, visit: **www.elcira.eu**

GLOBAL R&E TRAFFIC INCREASES BY 11% IN 2013

An analysis of R&E traffic statistics between GÉANT and R&E Networks in other world regions has shown that from 2012 to 2013 global traffic increased by nearly 11% in comparison with 2012.

Using statistics gathered using the NetReflex tool, North America was identified as the most significant world region for the European R&E Community accounting for 79.3% of GÉANT's global traffic. The second most significant region was Asia-Pacific. Latin America and the Caribbean, and Africa and the Middle East accounted for the remaining traffic.

The results of the analysis are being used to inform dialogue with GÉANT's global partners, including discussion on interconnections, service collaboration, user support and global collaboration case studies.

COFFEE BREAK Q&A

Each quarter we invite one or two GÉANT project participants to tell us a bit about their role at GÉANT and themselves. Grab yourself a coffee and enjoy!

NAME:

Scott Edwards

JOB TITLE AND ORGANISATION:

IT Engineer – Contractor

TELL US ABOUT YOUR ROLE ON THE GÉANT PROJECT

I am a member of the IT Team, dealing with every day support and queries, and planning and building a better tomorrow.

WHAT'S THE BEST BIT ABOUT YOUR JOB?

Variety is the spice of life. DANTE is VERY spicy!

FAVOURITE FILM?

Very tricky, in terms of enjoyment and something I watch every few years. 'The Shawshank Redemption', 'Leon: The Professional' is a very close 2nd.

READING ANYTHING INTERESTING?

Nothing, I am not a big book reader, but do spend most of the day reading all sorts of things online.

GOT ANY HOBBIES? TELL US ALL!

I own 4 arcade cabinets and have a collection of 30 or so arcade game PCB's from the late 80's/early 90's. My prized possession is an original 1986 Atari Rolling Thunder cabinet, which my girlfriend bought me! When I have time I play and repair them (old PCB's have a habit of breaking!). When I have a custom games room/ arcade built in the garden of my new house (coming later this year!), I will be spending more time playing than repairing I hope!

FAVOURITE MEAL?

Pizza- no brainer! And yes Pizza IS a meal.

TOP THREE ALBUMS OF ALL TIME?

Very tricky!

1. Depeche Mode – Speak and Spell
2. Rage Against the Machine - Rage Against the Machine
3. Faith No More – Angel Dust

FAVOURITE MODE OF TRANSPORT?

Bike when it's not raining, car when it is.

A MEMORABLE EXPERIENCE YOU'LL NEVER FORGET OR SOMETHING ABOUT YOU THAT NOBODY KNOWS?

As a birthday gift my girlfriend bought me a day's experience driving a stock car! Never in my adult life have I felt so scared or totally out of my depth! The fact that my day ended by my car being written off and me being taken to hospital after spending a few minutes unconscious in the car certainly added to the lasting memory of fear!

NAME:

Bartłomiej Idzikowski

JOB TITLE AND ORGANISATION:

Senior IT specialist PSNC (Poznań Supercomputing and Networking Center)

TELL US ABOUT YOUR ROLE ON THE GÉANT PROJECT

I've been engaged in eduCONF task from its beginning (GN2, 2008). Most of design and development work was led by our team. I had also shorter episodes in perfSONAR and GEMBus.

WHAT'S THE BEST BIT ABOUT YOUR JOB?

In general, applications of cutting-edge technologies (as 4K and 8K) to create new functionalities and discover scientific solutions is extremely compelling.

In GÉANT it's about creating an attractive service together with interesting people, in order to integrate videoconferencing societies and make the e-communication more reliable and easily available.

FAVOURITE FILM?

I'm not a connoisseur of cinema, but I do appreciate niche films. I also like documentaries about tourist expeditions, as "Long Way Round" and "Long Way Down" with Ewan McGregor and Charley Boorman.

READING ANYTHING INTERESTING?

Started to read a lot of books afresh, just after getting an e-book device. Mostly crime stories, recently.

GOT ANY HOBBIES? TELL US ALL!

I'm addicted to music, which accompanies me almost all the time (very wide range of species, from metal to jazz). I'm interested in automotive technologies and sports (enduro, rallies), as well as on motorcycle tourism.

TOP THREE ALBUMS OF ALL TIME?

Hard to point just three :-))

FAVOURITE SPORT?

Off-road motorcycling, recently also mountain bike riding.

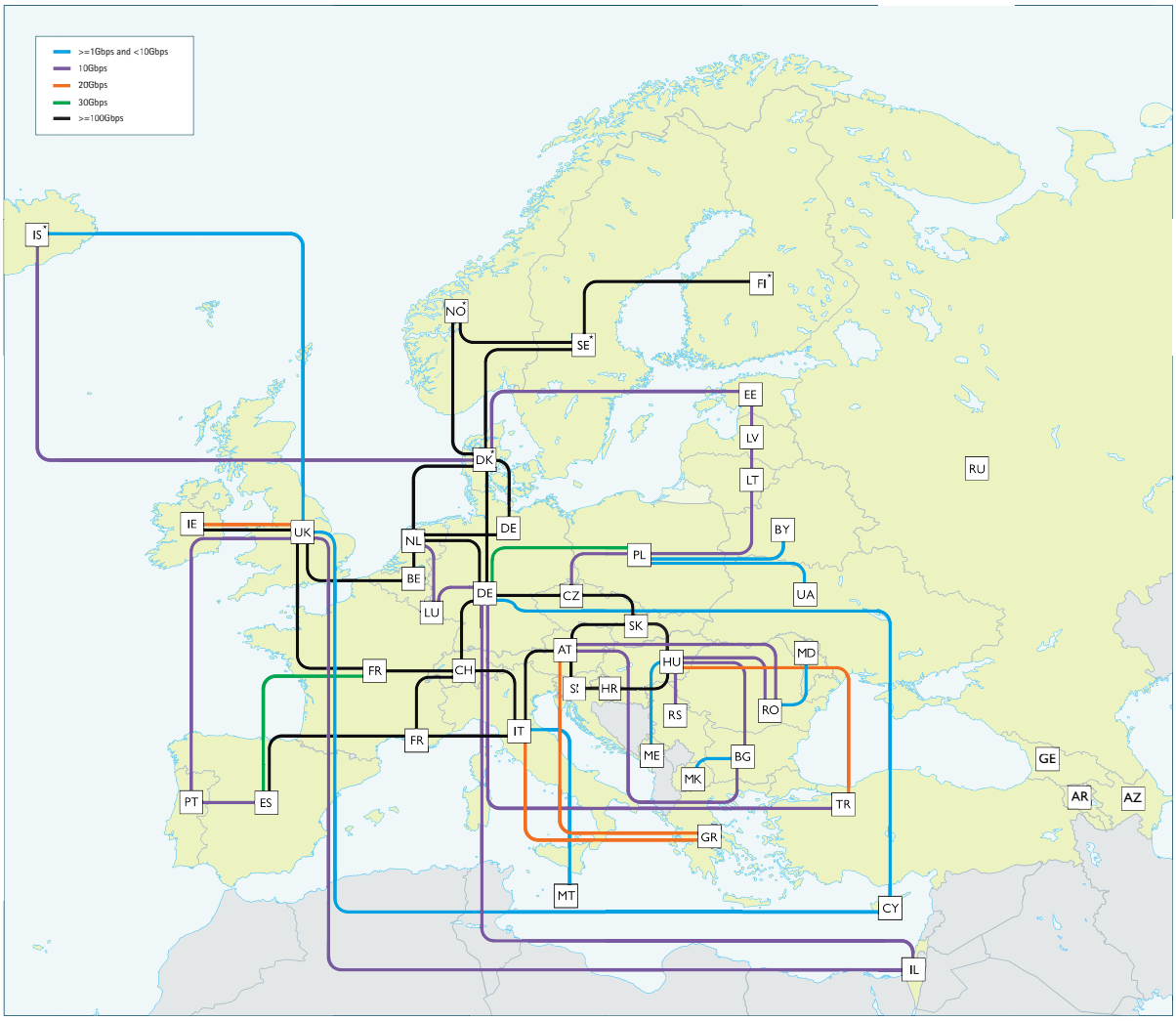
FAVOURITE MODE OF TRANSPORT?

Definitely motorbike, but car is most commonly used.

ABOUT GÉANT: AN AT-A-GLANCE GUIDE

GÉANT is the pan-European research and education network that interconnects Europe's National Research and Education Networks (NRENs). Together we connect over 50 million users at 10,000 institutions, supporting research in areas such as energy, the environment, space, health and medicine.

EUROPE'S RESEARCH AND EDUCATION DATA NETWORK



GÉANT connectivity as at January 2014. GÉANT is operated by DANTE on behalf of Europe's NRENs.

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

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

GÉANT PROJECT

AT THE HEART OF GLOBAL RESEARCH NETWORKING

The GÉANT network has extensive links to other world regions through collaboration with further networks, including those in North and Latin America, the Balkans, the Mediterranean, Black Sea, South Africa, Central and Eastern Asia.

JOIN THE CONVERSATION

www.geant.net

www.facebook.com/GEANTnetwork

www.twitter.com/GEANTnews

www.youtube.com/GEANTtv

SERVICES

ENHANCING YOUR EXPERIENCE OF THE NETWORK

The GÉANT project delivers innovative services to enhance users' experience of the network. We're here to support you with a portfolio of advanced connectivity, network support and access services, designed to meet the needs of NRENs, institutions, researchers and students. Discover more here: http://www.geant.net/Services/Pages/home.aspx

Networking Services	GÉANT IP	Core IP connectivity between NRENs. Cost effective, reliable, open and independent.
	GÉANT Plus	Layer2 point-to-point connectivity. Assured bandwidth, secure.
	GÉANT Lambda	Layer2 ultra-high capacity point-to-point connections for demanding applications
	GÉANT Peering	Layer3 IP interconnectivity with 3rd party providers.
	GÉANT Open	Flexible, open Layer2 interconnectivity between organisations
	GÉANT L3 VPN	Logical virtual IP networking – ideal for one-to-many or many-to-many connectivity.
	GÉANT Bandwidth on Demand	Flexible "on-demand" layer2 connections to provide high performance networking
	GÉANT OpenFlow Facility	A flexible testbed facility to help develop new networking services.
User Application Services	eduroam®	National and International wi-fi roaming. Secure, simple and global.
	eduCONF	An easy to use directory of VC facilities across Europe.
	eduGAIN	Federated AAI services offering assured, simple single sign-on.
Tools and Management Services	perfSONAR	Multi-domain monitoring service. Enabling NREN NOCs and PERTs to collaborate in providing seamless network performance for their users.
	eduPERT	Federated Performance Enhancement Response Teams - helping network users get the best performance from their connections.
	eduPKI	Supporting service developers by helping manage digital certificates.

THE GÉANT INNOVATION PROGRAMME

SHAPING THE INTERNET OF THE FUTURE

Part of GÉANT's role is pushing the boundaries of networking technology to shape the internet of the future. The GÉANT Innovation Programme exists to develop an advanced portfolio of technologies, to develop into services, tools and network capabilities for tomorrow's researchers.

Here are just a few ways the GÉANT Innovation Programme is driving discovery in networking technology.

RESEARCH PROGRAMMES

The research elements of the GÉANT project focus on three core areas:

- Network architectures for Horizon 2020
- Technology testing for advanced applications
- Identity and trust technologies

By being technology and supplier neutral, these research activities contribute greatly to thought leadership in networking services across Europe.

STANDARDS

The use of standards and information from standards bodies are essential to the development of GÉANT services to ensure interoperability with services of other networking organisations. Members of the GÉANT project have leadership roles in the OGF (Open Grid Forum) and IETF (Internet Engineering Task Force) standards organisations and make significant contributions to the formation of standards.

TESTBEDS

"Testbeds as a Service" provides two types of testbed capabilities to support the network research community. Dynamic Packet Network Testbed Service supports upper layer network research, and the Dark Fibre Testbed provides photonic layer long haul facilities for testing novel optical/photonic technologies in the field.

OPEN CALL

The Open Call projects bring in fresh ideas and support new uses of the network. €3.3m is being invested into 21 independent projects for research into advanced networking technologies. In support of the Horizon 2020 aims, each project is aligned to one of the GÉANT Joint Research Activities.
The four subject areas are:

- **Applications and Tools** – supporting advanced research activities and projects.
- **Authentication** – helping support secure end-to-end authentication of systems and people.
- **Network Architecture and Optical Projects** – studying future networking systems.
- **SDN** - exploring Software Defined Networking potential to meet new networking demands.

ASPIRE FORESIGHT STUDY

ASPIRE (A Study on the Prospect of the Internet for Research and Education) provides recommendations to policy and decision makers on topics likely to have a significant impact for the future of research and education (R&E) networking. For instance:

- The adoption of cloud services
- The integration of mobile services into NRENs service portfolios
- Middleware and managing data and knowledge in a data-rich world
- The future role of NRENs

The final report can be downloaded from the TERENA website:
www.terena.org/publications

GÉANT PROJECT

www.geant.net

DANTE

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The contents of this document are the sole responsibility of DANTE and can under no circumstances be regarded as reflecting the position of the European Union.

CONNECT/1014