GÉANT
Networks • Services • People

CONNECT

THE MAGAZINE FROM THE GÉANT COMMUNITY | ISSUE 25 2017

SPECIAL ISSUE
TNC17 - THE ART OF CREATIVE NETWORKING

ALSO IN THIS ISSUE

INACADEMIA: ONLINE STUDENT VALIDATION FOR RETAIL AND COMMERCIAL SERVICES

TRANSNATIONAL EDUCATION: BRINGING BORDERLESS EDUCATION OUT OF BETA

AENEAS PROJECT: SKY-HIGH INTERNATIONAL COLLABORATION

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CONNECT is the quarterly magazine from the GÉANT community; highlighting the activities of Europe's leading collaboration on e-infrastructure and services for 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 **paul.maurice@geant.org**

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WELCOME FROM CATHRIN STÖVER

Welcome again to CONNECT and, if you are attending, welcome to TNC17! As the main opportunity for our community to get together and innovate, collaborate and celebrate, TNC is an annual highlight for GÉANT. Hosted by our Austrian partner ACOnet, this year's event offers more than ever with keynote speakers, parallel sessions, lightning talks, demonstrations and a new-for-this-year student outreach programme which had an enormous response. All this located in the beautiful UNESCO City of Linz! You can read more in the following pages (2-11), including a fascinating interview with our Opening Keynote speaker, Gerfried Stocker of Ars Electronica.

Also in this issue (pages 12-13) we hear from GÉANT Board member Sabine Jaume-Rajaonia, who speaks passionately about not only the Big Data Revolution, but the importance of our collaborations with Africa and how knowledge transfer really flows both ways. With eduGAIN welcoming its first fully participating member from the African continent (pages 28-29), a highly successful WACREN conference (pages 40-41) and significant progress in the AfricaConnect2, TANDEM and MAGIC projects, we agree with Sabine that the African continent is of strategic importance to GÉANT.

Otherwise you can learn more about the GÉANT network (pages 18-21), the InAcademia service (pages 26-27) and the Horizon 2020 project AENEAS (pages 32-33) that is working towards a federated European Science Data Centre.

Finally, I would particularly like to welcome and thank our sponsors for their support at TNC17. This year marks the beginning of our new sponsorship programme that will see GÉANT and the sponsors working together throughout the year to help foster greater collaboration and cooperation between industry and the R&E networking community. You can see on pages 56-63 contributed articles from several of our sponsors, and if you are at TNC17 please make a point to visit their exhibition booths and learn more about them.

Cathrin Stöver, GÉANT

WELCOME TO TNC17 – THE ART OF CREATIVE NETWORKING

TNC (The Networking Conference) is the largest and most prestigious European research networking conference with a regular attendance of over 650 participants. TNC brings together decision makers, managers, networking and collaboration specialists, and identity and access management experts from all major European networking and research organisations, universities, worldwide sister institutions, as well as industry representatives.

GÉANT TNC17 THE ART OF CREATIVE NETWORKING

Through keynote speeches by renowned specialists, varying parallel sessions, demonstrations and presentations, the conference presents participants with a unique overview of the latest developments in research networking, both in the technical field and in the area of application and management.

TNC17, its 33rd edition, is hosted by the Austrian Academic Computer Network (ACOnet), the Austrian National Research and Education Network for science, research, education, and culture. The conference is being held in the picturesque UNESCO City of Media Arts of Linz, Austria.

This year's keynote speakers are:

- Gerfried Stocker, Artistic and Managing Director at Ars Electronica Linz, Austria
- Bikash Koley, Director of Network Architecture, Engineering and Planning at Google
- Hannes Gredler, Chief Technical Officer at RtBrick, Inc.
- Cole Nussbaumer Knaflic, author of Storytelling with data: a data visualization guide for business professionals
- Artur Serra Hurtado, Deputy Director of the i2cat Foundation and Research Director of Citilab in Catalonia, Spain.
- Laurie Goodman, Editor-in-Chief of GigaScience
- Martin Brynskov, Associate Professor in Interaction Technologies at Aarhus University, Denmark
- Sebastian Chan, Chief Experience Officer at ACMI, the Australian Centre for the Moving Image.

ABOUT ACONET

ACOnet provides a powerful and resilient backbone network infrastructure, mainly based on Gigabit and 10Gigabit Ethernet technology. Its major points of presence are co-located at Universities in Graz, Innsbruck, Klagenfurt, Linz, Salzburg and Wien (Vienna).

ACOnet supplies its customers with multi-gigabit Internet access with a special focus on good national and regional connectivity through public and private peerings (Vienna Internet eXchange) and excellent connectivity to the European and global science, research and education community via GÉANT.

THE GÉANT (GN4-2) PROJECT AT TNC17

This year's programme features twelve GÉANT (GN4-2) Project-related speakers and two BoF (Birds of a Feather) sessions.

Tuesday, 30 May from 14:00 to 15:30
Location: D Room
Steve Cotter, GÉANT
Sparks of Innovation: GÉANT

Tuesday, 30 May from 16:00 to 17:30
Location: A Plenary
Afrodite Sevasti, GRNET
Connecting to cloud

Tuesday, 30 May from 16:00 to 17:30
Location: D Room
Frans Ward, SURFNET
Badges?!? We ain't got no stinkin badges!

Tuesday, 30 May from 16:00 to 17:30
Location: C Room
Maarten Kremers, SURFnet bv
OpenID Connect Identity Federations at lightning speed

Tuesday, 30 May from 16:00 to 17:30
Location: B Room
Kostas Stamos, GRNET
SDN in GÉANT: Pilots and operational considerations

Tuesday, 30 May from 16:00 to 17:30
Location: B Room
Luca Prete, Open Networking Lab
Empowering GÉANT deployments with ONOS brigades

Wednesday, 31 May from 9:00 to 10:30
Location: B Room
Antoine Delvaux PSNC
Good Things Come In Small Packages — Creative perfSONAR

Wednesday, 31 May from 14:00 to 15:30
Location: B Room
Afrodite Sevasti, GRNET
Software Defined Multilayer Networks

Wednesday, 31 May from 16:00 to 17:30
Location: B Room
Guy Roberts, GÉANT
Quantum Key Distribution in the GÉANT network

Wednesday, 31 May from 16:00 to 17:30
Location: A Plenary
Lars Fuglevaag, UNINETT
Clouds on the ground - ready for adoption

Thursday, 1 June from 9:00 to 10:30
Location: D Room
Rogier Spoor, SURFnet B.V.
The Commons Conservancy

Thursday, 1 June from 9:00 to 10:30
Location: B Room
Eduardo Jacob, University of the Basque Country
Fostering Creativity in Network Space: Open Orchestration for...

Other Events

Tuesday, 30 May from 18:00-19:00
Location: D Room
BoF: GÉANT Legal Task Force

Wednesday, 31 May from 18:00-20:00
Location: D Room
BoF: Cloud Café

OPENING KEYNOTE Q&A

GERFRIED STOCKER

TNC17's Opening Keynote speaker Gerfried Stocker certainly understands the challenges and opportunities offered by technology. Artistic director of Ars Electronica since 1995, Gerfried is a media artist and telecommunications engineer. From his early experiences as an electronic composer in the 1980s to his interdisciplinary research projects involving robotics, telecommunications and other interactive technologies, he has used his dual background to build the link between humans and machines so we become empowered actors of our lives.

Described as a visionary person, he has more than a story to tell about the role of creativity in the success of technological developments.

Gerfried, what is Ars Electronica?

What we have built at Ars Electronics is an ecosystem for innovation. This ecosystem allows for pioneering technological developments because it replicates the artistic thinking process from inspiration to experiments on to creation, involving a wide range of disciplines and skills. This ecosystem revolves around three pillars:

- At the Ars Festival in September of each year we bring together artists from all over the globe to present their work and visions of the future. It's a great feast of eclectic, enchanting, intriguing and catching creations.
- The Ars Electronica Center focuses on educating people about technologies and how they can change their lives as well as making them take part in the process through interactive displays and experiences.
- The obvious third pillar of the ecosystem is the Future Lab, a place where we take inspiration and needs and create answers together, with artists, engineers, developers, all working as a team from the very early stages of commissioned research projects.

Any examples of these research projects?

We worked on a new car navigation system commissioned by Siemens in the early 2000s. Up until then car navigation systems were based on maps, our input was to bring in a more instinctual way of seeing the world, i.e. in three dimensions! Using a camera at the front of the car and video-augmented reality we designed a display which showed the road ahead, with a personal yellow guiding line projected onto the road and integrating future directions and adjusting in real time as the car moved.

Now this feature has been adopted by several car manufacturers but it took the combined efforts of artists and engineers to imagine and develop a solution that is not just technologically advanced but also easy to adopt by the end user.

The Ars Electronica Future Lab also collaborated on research around a self-driving car, specifically on how to enable the interaction of the car with pedestrians. How to recognise that the car is communicating with surrounding human beings, for example how to know that the car is stopping to let you cross the road? Working with developers, artists and technicians again we have come up with ideas such as laser projected zebra crossings, which start moving like a conveyor belt then more quickly before disappearing. Our work was to recreate a language, using technology for what it is, that is a means to tell a story. The story itself has to come from our minds and our experience of the world as human beings in the first place.

Why is art so important in creating technology?

Art is not about pretty things gathered in a museum, nor is it a cool design. Art is a way of dealing with the world and the environment we live in, by critiquing it with an inquisitive eye but also by unlocking its possibilities through projections and experiments.

The problem is when you work in a technological field, especially at the speed technology can be developed these days, you need people to be highly specialised. However the more specialised you are, the less able you are to see the wider world with all its possibilities. It becomes difficult to see the world outside of your research and development focus and see opportunities for commercial applications for example.

A lot of the technology we use today was invented over a decade ago but it was only used by a few for limited applications. Until someone could see other ways in which the technology could be used in everyday life, calling for adaptations and developments for possible business opportunities. This is what artistic thinking allows you to do, to see and size the possibilities of everyday life.

What is your interest in contributing to TNC17?

Two reasons:

Advocating for a more creative approach to develop technology. The product of the future won't just need to be technologically innovative but it will need to be accepted by people and integrated into society. This is where artists can help because their core work is about people and how society work.

Ultimately it is about empowering individuals to create the products that they actually need rather than be passive consumers of ready-made technology which won't last and will be expensive to renew… This is also important from an economic point of view because technology is an investment and has a cost.

The other reason is to showcase the potential of collaboration between art and technology. Until recently in history we had always operated machines, i.e. used them as tools. But we have now entered times where we live with technologies, which brings new challenges on the table; it's not just about designing the shape of an object, it's also about creating adaptive technology, designing behaviours, a character, maybe even the soul of a machine.

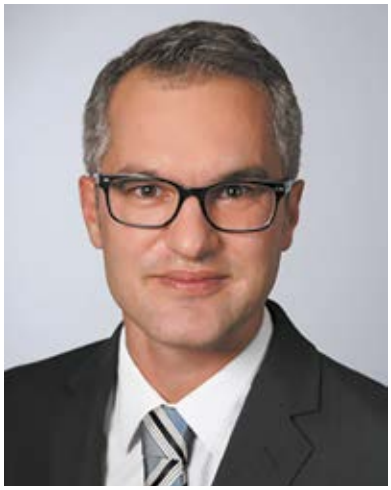
Technologies will continue to develop exponentially in the coming years. However to avoid pitfalls such as privacy breaches or health and safety risks we need to take political responsibility. This is why it is important to raise people's awareness of what technology can do so they make the most of them and see them as opportunities, not challenges.

How can art influence research and education networking?

In many ways but mostly in creating awareness among communities of people of what they can do with and demand from technologies, as well as developing this "out of the box" or "look beyond the fence" way of thinking which is the artistic way of thinking.

My goal is to empower people to better understand and use technology to create a more harmonious and appropriate cohabitation between humans and technology. I believe the goal of research and education networks is the same in the fact that you want to provide a technology that empowers researchers and students to size the opportunities ahead of them, for their benefits and ours combined.

The TNC17 Opening Keynote is on Tuesday 30 May – see **tnc17.geant.org** for more details or for archived streams after the event.



WHAT IS OPEN SOURCE?

SWITCH

Most of us will use Open Source Software without being aware of it – whether in supporting code like Apache or MySQL or through fully developed tools such as Firefox or Wordpress. On Thursday 1st June 2017 at TNC17 we will host a session looking at both Open Source Software and Hardware – but why is it so important to our community?

THE EXAMPLE OF OPEN SOURCE SOFTWARE

Open Source Software (OSS) is software for which the original source code is made freely available and may be redistributed and modified by other parties. At first, the incentive for investing a lot of time and money in developing a product that you just give away may seem crazy, but there are many benefits for organisations such as NRENs when it comes to developing OSS.

One of the most important factors for our community is that open source development can lower the total cost of ownership. Instead of several development teams creating competing products in silos or organisations buying the same product every year we can achieve great economies of scale by joining together and creating a shared codebase.

Open Source projects often work as virtual groups of people, drawn together by a shared interest. Tools such as Github allow developers from all over the world to contribute ideas, codes and issues to the software as “Committers”. This means you can attract a variety of different talents to a project, creating diversity and effectively creating a more diverse hiring pool. This also allows us to build communities of developers, which is a critical need within the NREN environment.

Security and trust in open source projects is critical - deciding to use code developed by other people can be a scary decision to make. OSS developers argue that their way of working can actually improve the quality of the project – Linus's Law tells us that "many eyes make all bugs shallow": according to the theory larger groups of people are able to see and contribute bug fixes and patches to a software, reducing the risk of security threats and improving the functionality of the software.

Finally the OSS market allows us to build on what is there. Rather than starting from scratch with any development, projects can take snippets of code or well developed modules and incorporate them into a new project... meaning the project can focus on the new developments that are needed.

THE NREN VIEW

Sven Stauber, Christoph Herzog, SWITCH

Would you invest a lot in a commercial software product and donate the results back to the vendor?

In the world of OSS, your answer might be different. And – even more important – others' answers might be different too. Our shared vision to provide top-notch IT services to the international research and education community allows us to unite our forces. Taking advantage of this opportunity requires a suitable platform, allowing all participants to access, modify and distribute the source code without a lot of paperwork.

But it is not just you making results available to others. You also might benefit from the investments of others. So from an economical perspective, the words "collaborating" and "contributing" translate into sharing costs and ensuring sustainability.

At SWITCH we consider OSS as one important framework perfectly suited for collaborative work in the world of research and higher education. And of course we are delighted about every NREN sharing this view and we are looking forward to meeting you in the world of OSS!

THE CHALLENGES

The opportunities of Open Source are great, but it is not without its challenges. One of the main challenges of Open Source is sustainability – if people can use your product for free, why would they pay you for it? Open Source projects also often find themselves in the position of being very successful but not knowing how to manage this: how can a group of developers deal with the needs of supporting everyday users? The GÉANT Greenhouse SIG identified a list of critical Open Source projects that our organisations are relying on everyday as part of their infrastructure that do not necessarily have a clear sustainability plan: https://wiki.geant.org/display/GREEN/Open+Source+Software+in+NRENs .

This is why we chose to champion the Commons Conservancy.

THE COMMONS CONSERVANCY

INCUBATING OPEN SOURCE PROGRAMMES THROUGH THE COMMONS CONSERVANCY

The GÉANT Greenhouse Special Interest Group (SIG) in partnership with the NLnet foundation initiated the creation of a support instrument called The Commons Conservancy dedicated to facilitating healthy and self-supporting ecosystems for open technologies to be sustainable in the long term.

By providing an infrastructure for coordination and a legal framework at no costs, it allows every project to grow as a virtual organisation without any lock-in. The Commons Conservancy offers guidance on licensing and legal agreements and provides a shared mechanism for managing domain names, trademark and copyrights.

Having hosted programmes such as FileSender, Internet of Coins or EduVPN, the Commons Conservancy turns Open Collaboration into benefits for the whole community. Learn how the Commons Conservancy can be a home for your open source projects on Thursday 1st June at TNC17.

Visit the Commons Conservancy for more information: **https://commonsconservancy.org/**

Open Source Collaboration Session at TNC17 Linz, Austria

Chaired by Nicole Harris, GÉANT

Thursday 1st June 2017 – 9:00 to 10:30

- Open Source Projects, Collaborating with Strangers (Christoph Herzog, Sven Stauber)
- The Commons Conservancy (Michiel Leenaars, Rogier Spoor)
- Sustainable Open Source Hardware: Business Models and Use Cases (Karen O'Donoghue)

Pictures
Left to right: Sven Stauber, SWITCH. Christoph Herzog, SWITCH. Rogier Spoor, SURFnet. Michiel Leenaars, NLnet – © Josje Deekens. Karen Donoghue, Internet Society.

THREE AWARDS, FOUR WINNERS, SEVERAL FIRSTS: THE 2017 GÉANT COMMUNITY AWARDS

The 2017 GÉANT Community Awards were the first time a prize has been awarded jointly to more than one person; the first time one has been awarded in the category 'significant contributions within the past 12 months'; the first time that 3 prizes have been awarded all in different categories; and the first time that a winner has been a woman – in fact there were two!

Hannah Short (CERN), Maja Górecka-Wolniewicz together with her husband Tomasz Wolniewicz (PSNC & Nicolaus Copernicus University), and Massimo Parovel (Music Conservatory G. Tartini, Trieste) were honoured for their contributions to research and education networking. Their awards were presented on behalf of the panel of judges by Valter Nordh, chair of the GÉANT Community Committee, during the opening plenary session of this year's networking conference, TNC17, in Linz, Austria.

MASSIMO PAROVEL

Massimo won in the category 'shared an idea with the community that led to a significant development over time'. His idea was to allow performing artists to interact in a natural way even if they are located thousands of kilometres apart. The result was a low latency audio-visual system known as LOLA, which exploits the high-quality and very large bandwidth connectivity offered by research and education networks to almost obliterate network-related delay and variations. With the LOLA project supported by the Tartini Conservatory of Trieste and Consortium GARR in Italy, LOLA became available worldwide and has now been used for educational purposes, masterclasses and performances of musicians, dancers and actors at various events including our own annual networking conference, TNC. "They made a series of spectacular demos," said the panel of judges: "If Massimo is the mastermind behind LOLA he definitely deserves an award!"

"It was a wonderful surprise to know that I was selected," Massimo said. "LOLA came from an inspired idea that I shared with a great group of people, each one a top-level expert in the fields of science, technology and professional music. I am grateful to those who proposed my nomination."

TOMASZ WOLNIEWICZ AND MAJA GÓRECKA-WOLNIEWICZ

Tomasz and Maja shared an award in the category 'has significantly contributed to many collaborative activities throughout several years" for their work on the eduGAIN service infrastructure, the eduroam CAT tool and other activities. The judges agreed that a joint prize in this category was appropriate because although Tomasz is the better-known 'front man', Maja is known to be doing a lot of the technical work in the background. "They are a strong team working very productively together," Valter Nordh said. "They really have great qualities in that they are relentless in trying to find solutions for things while keeping a low profile." Their work for the GÉANT community is supported by an agreement between their principal employer, Nicolaus Copernicus University in Toruń, Poland, and PSNC, the Polish NREN. Even though Tomasz was promoted within the university to become the CIO, he has kept up all his contributions to the community work at his previous pace. "Others might have just taken the career step and abandoned the work previously committed to others," Valter says. "It is a good time for us to say thank you for this commitment from them both."

"We were totally surprised and obviously very pleased to receive this award," Maja and Tomasz agree. "The surprise is magnified by the fact that we realise there are many brilliant and deserving people in the NREN community. The work that we have been doing was always huge pleasure and seeing that it is appreciated makes it even more so."

HANNAH SHORT

Hanna works in CERN's IT Department, and is a relative newcomer to the research and education networking community. Nevertheless, she has proved "a very valuable addition", according to the judges. The judges commended Hannah for making 'significant contributions to important developments within the past 12 months' through her leadership of work in the REFEDS and AARC project communities on 'Sirtfi' - the Security Incident Response Trust Framework for Federated Identity. This is a significant security development because Sirtfi enables the coordination of incident response across federated organisations. Acknowledging that Hannah had received three nominations, the judges said that she had succeeded in coordinating across these various groups and had pushed for the work to be done well.

Hannah said: "Joining this community has not only been a challenge and an opportunity, but it's been great fun! Thanks in particular to all those I've had the pleasure of working with through Sirtfi. As a new face in a well-established field, I've felt that both my participation and ideas have been very welcome. When I'm part of the furniture in years to come, I hope I'll be a part of keeping this attitude alive."

FURTHER INFORMATION

With the Community Awards GÉANT honours people who have contributed significant ideas, time and expertise to the development of the research and education networking community's collaborative achievements, and recognises that these contributions are often provided voluntarily and through the good will of employer organisations.

In addition to Valter Nordh, this year's judges were Christian Grimm – chair of the GÉANT Board of Directors – and Christian Panigl – host of TNC17 and chair of the Programme Committee.

See the overview of all winners at: **https://www.geant.org/People/Community_Awards/Pages/Overview_of_winners.aspx**

STUDENTS ENLIGHTEN TNC17!

What better place than TNC to introduce future innovators to our community? This year GÉANT has launched a joint programme with research and education networks to bring students to TNC to deliver a lightning talk.

Bright IT students from across Europe were nominated to submit their best idea and follow a training course provided by GÉANT to prepare for the occasion.

Picture
Rafay Iqbal Ansari, Frederick University/CYNET, Cyprus

NRENS NOMINATE STAR STUDENTS FOR TNC LIGHTNING TALK CHALLENGE

The IT Students' Lightning Talk Challenge is one of the first GÉANT Future Talent Fund (FTF) initiatives. FTF is a community initiative led by Nadia Sluer, Learning and Development coordinator at GÉANT: "We aim to attract and support the young talents our community needs to grow and achieve our long-term objectives by providing them with engaging activities and programmes adding up to their academic studies."

NRENs rose to the occasion by facilitating 13 registrations in just one month. Although a few NRENs could not take part due to clashing national Spring holidays, the idea was well received: ''Even if no candidate was proposed by RENATER this time, we look forward to contributing next year", says Sabine Jaume-Rajaonia, strategy director of RENATER, France.

The lightning talk topics received – from students via ACOnet, Austria, ASNET, Armenia, CYNET, Cyprus, FCCN, Portugal, LITNET, Lithuania, SURFnet, Netherlands and Uninett, Norway – were all extremely inspiring and we are looking forward to hearing many on the TNC17 stage.

TRAINED AND COACHED BY COMMUNITY EXPERTS

Of course we didn't want to let our candidates go and give their first lightning talk at TNC without accompanying them. We want them to make the most of our community. This is why we developed a 3-webinar course where they were trained, coached and mentored by community experts such as Tom Fryer, Senior International Relations Officer, GÉANT, Annabel Grant, Activity leader for Partner, User and Stakeholder Relations for the GÉANT project and many others.

The webinars took place in April and were a great success, as expressed by Rafay Ansari, a student in Computer Engineering from Frederick University, Cyprus, nominated by CYNET: "I especially liked the mentoring part. I am a PHD student and for my research I have to do a lot of presentations and talks, so this is helping me tremendously."

Ian Barker, one of the trainers and technical producer of the webinar adds: "The enormous progress we saw the students make from the first to the final presentations was amazing. They are ready to climb on stage!"

UP-SKILLING EUROPE'S IT WORKFORCE

It is not the first time that students contribute to TNC. In the past, students have had the possibility to share their work through sponsored poster presentations. But from this year onward GÉANT wants to take a more holistic approach.

Irina Mikhailava, Head of GÉANT Learning & Development explains, ''At GÉANT, we believe it is crucial for IT firms to engage with and develop future IT professionals. This belief is even stronger now as the sector undergoes times of considerable growth, creating a shortage of talent. We are committed to contributing to up-skilling Europe's future IT workforce, and bridging the gap between the supply and demand of talent - particularly in the areas of research and education networking".

The IT Students' Lightning Talk Challenge is scheduled on 30 and 31 May.

MORE ABOUT THE GÉANT FUTURE TALENT FUND (FTF)

FTF introduces students to the R&E network community through activities, conferences, meetings and other opportunities where students can find mentors, try the latest technologies and experience what the GÉANT community has to offer.

This approach enables NRENs to play a major role in developing young people's skills and inspire their fresh thinking. By participating in an FTF programme NRENs and other Research infrastructures can strengthen the relationships with their users, motivate high quality students and get them excited about their work, with opportunities to look forward to.

If you are interested in the work of Future Talent Fund, contact the L&D team through Nadia Sluer (nadia.sluer@geant.org)

IT STUDENTS' LIGHTNING TALKS CHALLENGE

TOPICS RECEIVED

Below are the titles of the lightning talks we received from our distinguished students*. We can't wait to hear more from them, at TNC17 and after.

School management information systems. *Use well what's out there, no need for more creativity*
Christoforos Christoforou, European University (Cyprus-Nicosia)/ CYNET, Cyprus

Hypervisor & Container Based Virtualization of the Data Centers. *The Key to Creative Energy Reduction*
Wahi Narsisian, National Academy of Sciences of the Republic of Armenia /ASNET, Armenia

Beyond Touch, Swipe and Tap for Smart Clothing! *Retro brings Nostalgia*
Adwait Sharma, University of Applied Sciences Upper Austria, Hagenberg/ACOnet, Austria

Security risks and ethical implications of sensitive data on the Internet of Things
Ernesta Grigaityte, University of Central Lancashire, Cyprus (UCLan Cyprus)/CYNET, Cyprus

Convert (C)reation into Rea(C)tion-The answer to Hackers' Action
Nektarios Fotiou, European University (Cyprus-Nicosia)/ CYNET, Cyprus

SmartWindow - Pablo Picasso meets Graham Bell
Rafay Iqbal Ansari, Frederick University/CYNET, Cyprus

Distributed learning based on free open educational resources?
Tiago José Castro, ESMAD - Politecnico Porto/FCT/FCCN, Portugal

EDEN - Emergency Detection for Elevator Networks
Daniel Wilfing, University of Applied Sciences Upper Austria, Hagenberg / School of Informatics, Communications and Media/ACONET, Austria

Switches - routers in disguise. *Software router acceleration using OpenFlow hardware*
Norbertas Kremeris, Kaunas University of Technology/LITNET, Lithuania

Using Raspberry Pis for cheap Wi-Fi monitoring
Fredrik Strupe, Norwegian University of Science and Technology/UNINETT, Norway

High school student's digital leap to university. Up2 University
Filipe Amaro de Sousa, ISEP - Politecnico Porto/FCT/FCCN, Portugal

**Please note that 2 students could not complete the training and thus confirm a final proposal for submission.*

GÉANT WEBINARS

Proposal Writing, Dos and Don'ts
Trainers: Tom Fryer and Annabel Grant, GÉANT
6 April 2017

Public Speaking Training
Trainer: Tara Phillips, Cause & Affect Speeches
11, 20 April 2017

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR
FCCN Computação Científica Nacional
LitNET
UNINETT

VOICE OF THE GÉANT BOARD

Continuing our series of Board member interviews, CONNECT spoke to Sabine Jaume-Rajaonia, Head of Strategy at RENATER and GÉANT Board member since 2014, about the key role of NRENs in supporting the Big Data Revolution.

Sabine, why is the role of R&E networks so critical in the current context?

NRENs have built and will continue to build roads to transport data. This data has grown exponentially over the last years and will continue to grow even more. NRENs have the crucial role to ensure that data gets from point A to B securely without being damaged and that it can be stored and shared. Data is knowledge and we need this knowledge to solve the challenges we face. The success of high performance computing and regional data infrastructures such as EUDAT depends on us for we have the networks and resources to support them and allow the data revolution, i.e. the knowledge revolution, to happen.

What is GÉANT's mission in the Big Data Revolution?

GÉANT has a key geopolitical role. We have been able to interconnect scientific and educational communities from all continents; no one else has ever done that. We need to continue to consolidate this global village, supporting new networks in Africa, Asia and all other regions of the world, offering best practice and services to enable crucial scientific collaborations, and a practical answer to school massification by expanding access to education. Research is global. GÉANT and NRENs from all over the world have a role in breaking the digital divide because we know that digital divide equals scientific divide, so our mission is to support the digital transformation on all continents for the sake of humankind.

What are GÉANT's key assets?

Its people. The reason why GÉANT stands at the heart of the global research and education network is thanks to people convinced by the need for NRENs, doing outreach, and wanting to collaborate together to expand their knowledge. We need to continue to support each other, learn from our users and from one another, create, and grow together as a global team.

The GÉANT community has outstanding technological expertise which has allowed us to be pioneers in networking and services. We need to continue to be as agile as we've been so far and again, be present and listen to be able to react quickly and seize opportunities.

Why is Africa important for GÉANT?

Africa is the second largest continent on Earth with the highest demographic growth; more than 50% of the population is below 25 years old. Africa also hosts some of the most biodiverse environments on Earth and holds the keys to a wide range of scientific discoveries, from crop security to viral diseases and climate change.

However the continent does not yet have a pan-African network for research and education. This is why as GÉANT we have been involved in AfricaConnect and now in AfricaConnect2 to make the case for NRENs in Africa and develop sustainable regional R&E networks such as the UbuntuNet network in Eastern and Southern Africa. Our mission with WACREN (West and Central African Research and Education Network), ASREN (the Arab States Research and Education Network) and the UbuntuNet Alliance (the regional Research and Education Networking organisation for Eastern and Southern Africa) is to help students and researchers everywhere win the race against climate change and other global risks. At GÉANT we are very proud to enable a key milestone in this race by connecting to Africa and supporting its R&E networking development.

Read more about Sabine Jaume-Rajaonia and RENATER's involvement in Africa on page 40.

THE VOICE OF THE COMMUNITY

2017 NREN SATISFACTION SURVEY HIGHLIGHTS

The 2017 NREN Satisfaction Survey, carried out and managed by the GÉANT Partner Relations team closed in March 2017. Here's a brief glimpse into some of this year's survey results.

The 2017 NREN Satisfaction Survey is the fifth in an initiative that began in 2012. Once a year, it provides an opportunity to step back, reconnect and hear directly from community members. The survey solicits community members' opinions on GÉANT as an organisation, as the EC-funded GN4-2 project, an operational network, a service provider and as a community facilitator. For GÉANT to continue to add value to each country or region's network and service offerings, it is vital to identify successes and areas that require improvement.

Largest survey so far

Based on positive feedback, and the belief that "the more the merrier", the 2017 survey was the second time the survey was open to any NREN employee who wished to respond. And while the questionnaire was updated slightly, for the first time a meaningfully comparative analysis was possible since the same framework and questions were used.

Objectives

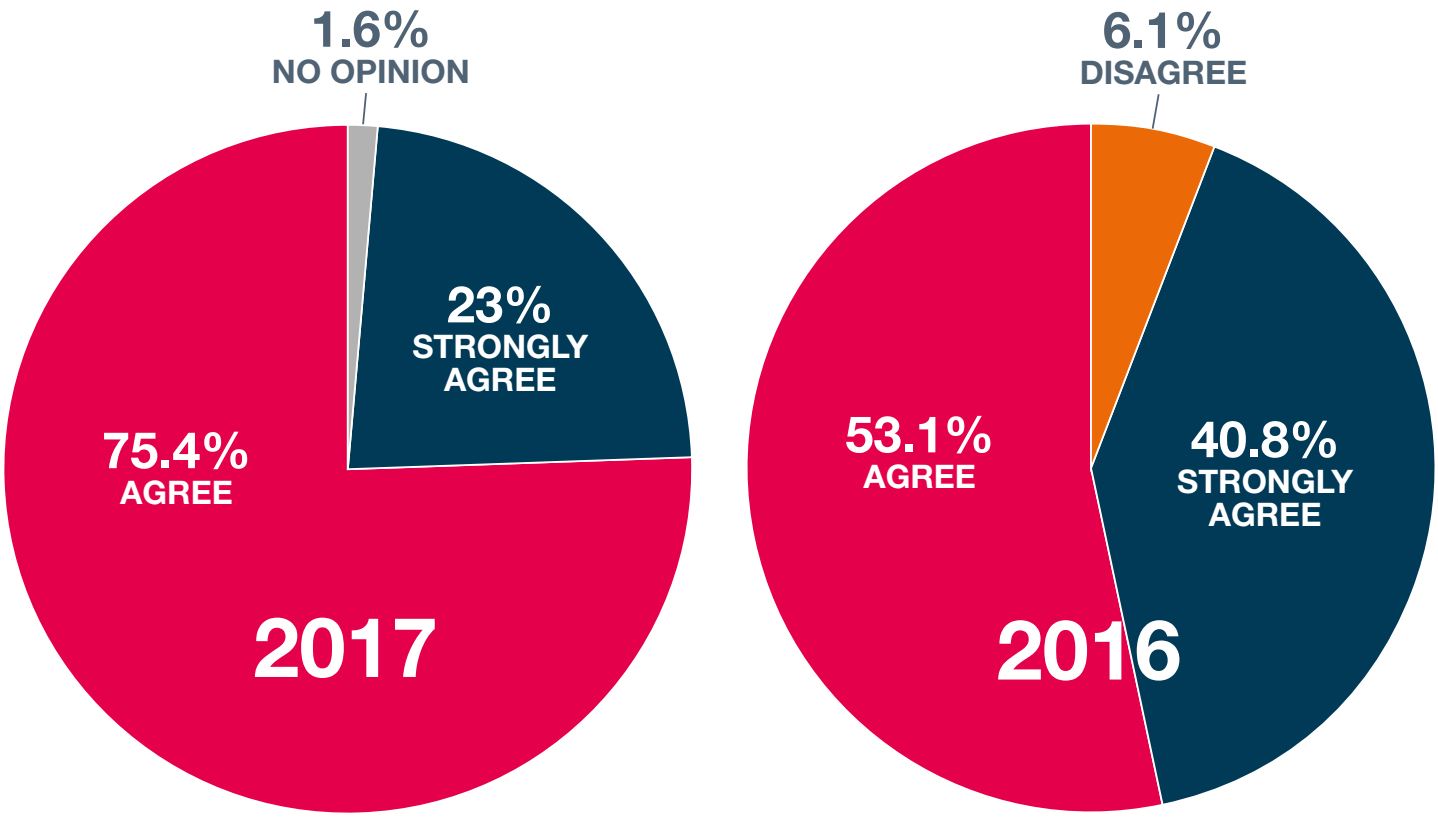
The objectives of the NREN Satisfaction Surveys are simple: to assess satisfaction with GÉANT's activities, and assess the importance of and satisfaction with specific issues, products and services. Ultimately the results help GÉANT to better understand the community's needs and determine how and where to focus efforts in the future.

As to GÉANT's call "to hear from any and all" the community clearly has something to say. The response rate this year exceeded expectations. Overall 73 (!) individuals answered the survey from 34 of 39 NRENs, compared to 49 from 33 different NRENs in 2016. This response rate illustrates strong support and appreciation for the inclusive approach, and is indicative of a strong interest in being heard. In 2017 there were up to 9 responses per NREN.

Highlights

Overall, a high level of satisfaction was expressed with the GÉANT organisation's ability to fulfil its primary roles. Strong improvements relative to 2016 (98% vs 91%), were noted in GN4-2 Project Management & Finance, in particular the improved communication via the Project Management Office (PMO) Newsletter, improved invoicing and billing and increased overall transparency are appreciated.

A significant increase in satisfaction can also be measured in Middleware & AAI services, with a satisfaction level of 96% (vs 89% in 2016) among participants. Respondents were also asked how important these activities were to their NRENs. An overwhelming majority expressed being very satisfied or satisfied in the areas that were deemed important to them.



Respondents were asked to what extent they agree with the statement, "I am confident in GÉANT's ability to serve its members in the best possible way."

High confidence

Another Key Insight from the survey is that confidence in GÉANT remains not only strong but also increased over the last year, with 98% agreement to the statement "I am confident in GÉANT's ability to serve its members in the best possible way."

While individual concern was expressed for fair and equal service for smaller, less-developed countries, the challenges of continuing to be an innovator whilst operating a world class network were at the same time recognised. Respondents also expressed a very high level of satisfaction communicating the importance of GÉANT to the European Commission, adding value to both the organisation and individual NRENs in turn.

The 2017 Survey drills further down into network operations and the GÉANT service portfolio of Network-Based Services, Real-Time Communications, Software Defined Networking, Trust, Identity & Security and Cloud Services in order to identify the community's current and anticipated needs. These results are being aligned with current initiatives to analyse users' needs across the board.

Several services and areas continued to be perceived and valued strongly, such as eduGAIN and eduroam. Others with more mixed results are carefully being analysed to pinpoint the strengths and focus on where improvements can be made.

What's next?

These findings feed into the Requirement Gathering Activity and the GN4-3 (proposed successor to the GN4-2 project) White Paper Process. The results also will serve as the foundation for improvement plans to address areas of dissatisfaction and increase excellence.

GÉANT's Partner Relations team would like to thank all of the community members who took time out of their busy schedules to respond. Partners can find the full Report on the Partner Portal: **https://partner.geant.net/sites/partner/SitePages/satisfaction.aspx**.

"The GN4-2 project is a real opportunity for GÉANT and NRENs to create and innovate. Focus should be on producing outcomes that can impact and disrupt the NREN landscape."

"I am confident in GÉANT's initiative to help new emerging NRENs..."

FOCUS ON E-INFRASTRUCTURES: PRACE

High Performance Computing and High Performance Networking have always gone together. Karl Meyer speaks to Florian Berberich, a Director of PRACE AISBL on how GÉANT and PRACE are working together to support research and education.

Florian, welcome to CONNECT. Could you tell us a little about yourself and your role at PRACE?

Thank you for the warm welcome. I got involved in PRACE from the very beginning and started to assist our Project Management Office in 2008. At that time the European Union (EU) funded the PRACE Preparatory Phase Project that prepared the establishment of the Partnership for Advanced Computing in Europe (PRACE) as a pan-European Research Infrastructure on 23 April 2010. It was very exciting to contribute to the creation of a new pan-European e-Infrastructure. In the following years the EC continued to support the implementation of PRACE. With the PRACE-2IP Project I became the project manager and since then I am the project manager of all PRACE Implementation Phase Projects. In 2015 I was appointed as member of the Board of Directors of PRACE AISBL, an international not-for-profit association with its seat in Brussels, acting as the

legal form of the PRACE-RI. There, I am responsible for all EU projects PRACE is involved in, not only the PRACE IP projects, but also EOSCpilot (the European Open Science Cloud pilot), EXDCI, eInfraCentral and ELItrans.

One of the newest and most exciting development in High Performance Computing is exascale - what do you see as the opportunities for this in research and education?

The compute power available in HPC systems is growing rapidly. In about four years we will have the first exascale supercomputers in Europe. The EU and the member states are also pushing hard for it. Already in 2012 the EU published a communication addressing this topic: HPC Europe's place in a global race. Today simulation is considered the third pillar of science beside theory and experiment, the proof being the ever-growing number of scientific domains using simulations, which are the actual beneficiaries of HPC. With the exascale supercomputers we will for example be able to discover the quantum world with a new precision we cannot imagine today. We will be able to predict weather and even more important the climate change with an unprecedented precision, too. Also industry will benefit from exascale computing with for example faster design studies or the possibility to simulate new high precision drugs which is not possible today. To help scientists and students to take full and efficient advantage of the exascale compute power, PRACE already offers a wide range of training programmes /services open to scientists and researchers from academia and industry from all over the world. Especially SMEs still have a way to go discover and leverage the new possibilities of HPC. With SHAPE, the SME HPC adoption Programme in Europe, PRACE aims at raising awareness and equipping European SMEs with the expertise necessary to take advantage of the innovation possibilities opened up by HPC, thus increasing their competitiveness. A lot of actions are already undertaken, but there is still a lot of work ahead of us.

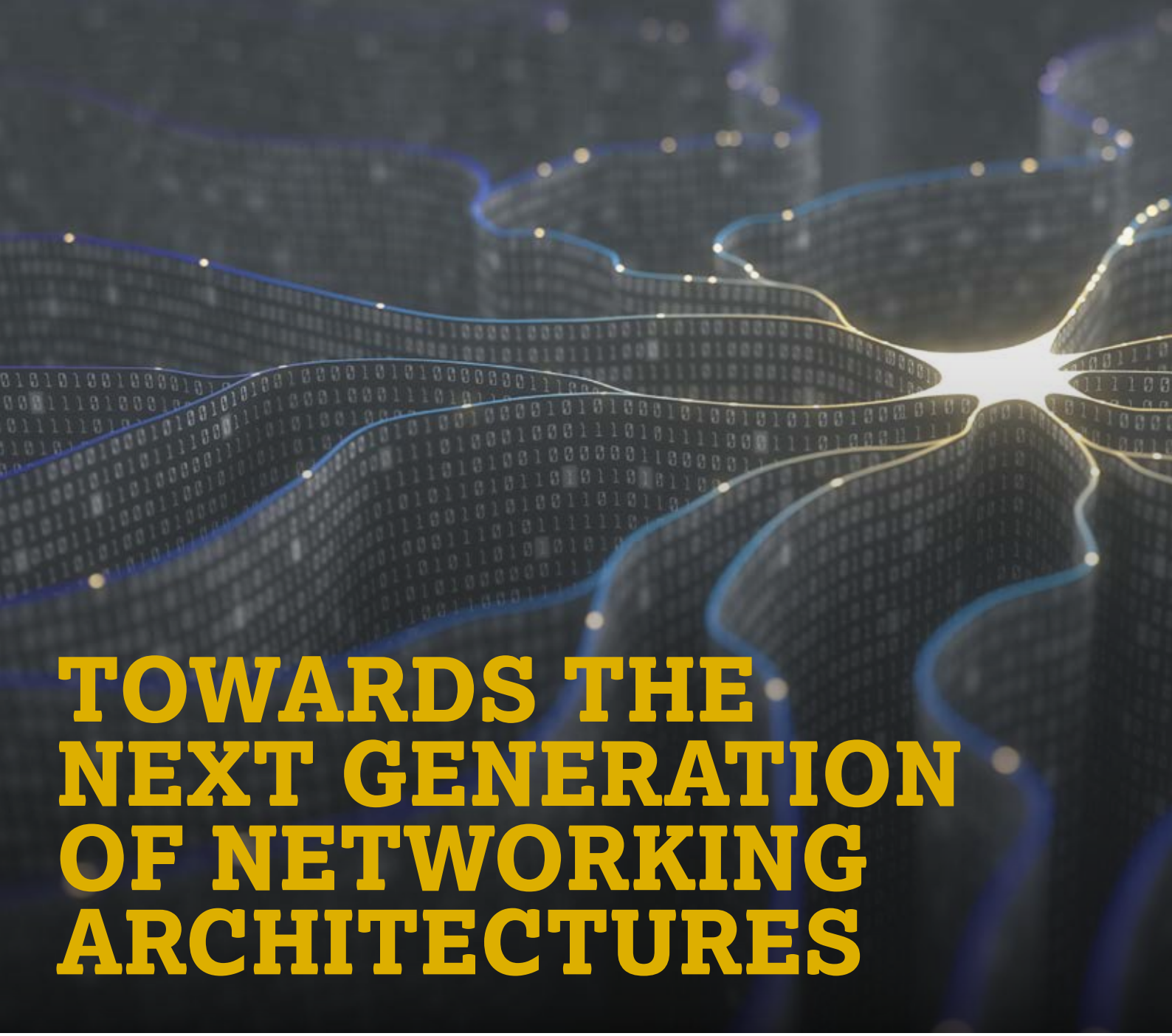
Of course networking plays a big part in PRACE - both to build services and give users access to services. How do you see PRACE working together with GÉANT helping with these needs?

High Performance Computing has always been linked to big data, either a huge amount of data is needed as input for simulations or the simulation itself creates a huge amount of data. In order to move this data to and from the supercomputer, we need high bandwidth network capacities. GÉANT provides these services in Europe and worldwide. Since many years, PRACE has used a dedicated 10 Gbit/s network, relying on dedicated NREN and GÉANT wavelengths. Recently, this has been migrated into a more flexible (allowing shorter deployment times) and cost-efficient MD-VPN solution. This is a good example of the collaboration between PRACE and GÉANT in order to improve existing networking services or to develop new services. Together with GÉANT we analyse also new services which could be beneficial for our PRACE users, for example authentication or the possibility to set up high-speed network links on demand. Another important aspect of the collaboration is the security. Since long time PRACE and GÉANT are engaged to improve the site and network security, for example in the WISE Information Security for collaborating e-Infrastructures together with for example XSEDE, EGI, EUDAT, OSG and NRENs. Last but not least, PRACE will cooperate with GÉANT in order to offer appropriate training to PRACE users and operational staff.

At TNC17 there is a joint e-infrastructures booth following on from the DI4R conference last year, how do you see all of the e-infrastructure projects will be working together much more in the future?

It is good to see that e-Infrastructures have started to intensify their collaboration. The main objective and overall goal of such joint efforts have to be to improve the access and the services for users. The users should be

enabled to get a unified access to the e-Infrastructure resources and services adjusted to their needs. Currently, the EOSCpilot project is working on such concepts, and both GÉANT and PRACE together with our colleagues from other European e-Infrastructures, for example EUDAT, EGI and others, are involved. Depending on the operational concept of each individual e-Infrastructure, and especially the funding model, the integration may be more challenging than anticipated. PRACE, as provider of High Performance Computing resources, offers its resources via a rigorous peer review process based only on excellence in science. Due to this peculiarity the integration needs to be analysed carefully. However, the EU prepared a promising concept of a European Data Infrastructure (EDI) which will be developed in the coming months. Together with the creation of the EOSC I believe Europe can establish a unique environment for scientists and researchers from academia and industry.



TOWARDS THE NEXT GENERATION OF NETWORKING ARCHITECTURES

The evolution of networking architectures has been a long path towards increased speed, capacity and functionality with different techniques used to support the demands of users and applications. GÉANT is working with the leading suppliers and other operators to help guide the direction of the next generation of networking services to future-proof our network and provide the services that NRENs and users need into the next decade.

The evolution of advanced networking

Until recently equipment operators have been looking to converge their platforms into unified communications equipment able to handle multiple network layers together in the same device. The key driver for convergence was a unified network management system which was used to manage layer 2/3 service and network elements. The operators benefit from convergence as it reduces the number of boxes (network elements) and simplified the management along with reducing the CAPEX/OPEX.

To support the move from Synchronous Digital Hierachy (SDH) based architectures to the more flexible MPLS structures, GÉANT converged its layer 2 and 3 equipment in 2011 on the basis that both layers could support similar functionality and a single box would make management easier and reduce OPEX.

However this trend towards equipment convergence seems to have stalled. The problem with convergence is the network operators end up with a monolithic block of hardware and software. Operators become dependent on a single vendor's innovation curve for new features in both hardware and software. In many cases the vendor's Operating System software has become so large that innovation cycles have become excessively slow. This restricts the ability of operators to offer their users new, innovative services or to leverage emerging techniques such as Alien Waves to reduce costs and pass savings onto their users.

Software Defined Networking and the benefits of disaggregation

Software Defined Networking (SDN) has reversed this convergence trend and in essence enabled providers to disaggregate not only the software from the hardware, but from vendors. This separation of hardware and software enables them to innovate independently and further disaggregation (modularisation) of functions within software and hardware allows operators to buy the only the modules that meet their requirements.

Using this approach the operators can build the network using best of breed hardware or software component instead of relying on a single vendor to deliver new features in both hardware and software. A router, switch or optical network can be built using the best modules/blocks available to deliver at scale and using the best technology available.

Efficient scaling is one of the major benefits of disaggregation in optical layer. A 'building-block' approach to the transport layer allows for low initial spend on an open line system and enables operators to grow their capacity incrementally as traffic increases. It also allows operators to exploit third party coherent optics or external transponders. This means when a new interface type or feature is needed it can be bought separately and deployed to run on top of an existing open line system.

No gain without pain

Disaggregation enables innovation but also presents some challenges especially in optical networks. The DWDM optical systems are 'analogue' with associated complexities in planning, configuration and control. An intelligent software management system for optimisation and control is needed to simplify deployment of disaggregated packet-optical solutions.

Applying the concept of disaggregation in a network means that network operators have to take responsibility to glue together different components of hardware and software. It's not just a technical change it's a cultural shift which breaks long-standing networking policy and would complicate support. For example, who do you call when there is a problem? The hardware company or the software company? It also requires an entirely new skill set in the operations team, and strong abilities in the areas of software architecture and coding are required.

Industry initiatives – GÉANT and Industry working together

There are many initiatives by web-scale companies to facilitate the development of network hardware and software in an open and collaborative environment and GÉANT is actively involved in two of the groups:

- OpenConfig.
- Telecom Infra Project (TIP).

The OpenConfig is a working group of network operators sharing the goal of moving networks towards more dynamic and programmable infrastructure by adopting SDN principles.

Telecom Infrastructure Project

The main objective of the Telecom Infra Project (TIP) is to develop an open optical transport system and disaggregate hardware and software, sustainably reduce TCO (total cost of ownership) of the transport network equipment and create open source management framework which allows for rapid adoption of new technologies. TIP has led the development of the Voyager 1U white-box switch with the objective of accelerating innovation while reducing costs.

What does this mean for GÉANT?

The aim for GÉANT is to be able to deliver a flexible, cost-effective and sustainable network architecture to support the next generation of networking requirements and support our partners and users. By working alongside vendors and network operators, GÉANT is well placed to influence and benefit from the next generation of SDN systems and infrastructure.

To find out more about the Telecom Infrastructure Project visit **https://telecominfraproject.com/**

CONNECT talks to the GÉANT Operations Team to find out more about the network, how efficiently it is run and to share their plans on how to handle the exponential growth in traffic.

How much traffic does the GÉANT network carry every day?

During 2016, GÉANT received an average of 3.9 Petabytes (that's 3.9 million Gigabytes) of data per day. That adds up to a total of more than 1.4 Exabytes of data accepted and transmitted by the GÉANT network in 2016.

What sort of traffic is this, and who are the big data producers?

GÉANT receives traffic on its two main networks: the Lambda network delivered by the Infinera DWDM system and the GÉANT MPLS/IP network delivered on Juniper MXs.

GÉANT Lambdas provide customers with 10Gbps and 100Gbps point-to-point Ethernet services and this accounts for about 40% of the total GÉANT traffic. Of this, CERN has the lion's share, amounting to approximately 80%, with other major users such as PRACE (see page 16), LOFAR (Low Frequency Array), GTS (the GÉANT Testbed Service) and others with much lower volumes.

The GÉANT MPLS/IP network provides all other services, such as GÉANT R&E IP, LHCONE, Internet access, GÉANT Plus, MDVPN and BoD, and receives the remaining 60% of the total traffic. 89% of the traffic received by this network is absorbed by three main services: GÉANT R&E IP 41%, LHCONE 23%, Internet access 25%, whilst the remaining 11% is shared among all other services. Also here CERN, with its high-energy physics community, is still the biggest data producer.

Of the NRENs, the largest users are DFN (Germany) and Jisc (UK), each accounting for over 15% of the total amount of data produced by NRENs, followed by GARR (Italy) and RENATER (France), then RedIris (Spain), with a share of 4% whilst all other NRENs' share of the traffic is lower than 3%. Data for consumption may show a different distribution, but the largest NRENs remain the main users.

What makes the network so special?

Firstly, GÉANT is a virtually lossless network, meaning that any data received by GÉANT is transmitted to its destination without dropping any packets. In order to achieve this, GÉANT actively manages capacity to accommodate for bursts and periodic changes in the traffic volume. Transmission of traffic at line rate should be possible at all times with minimal or no buffering in order to maximise throughput of host data flows. This way data is transferred unchanged and protocols running on hosts can be tuned to work on the assumption of transiting a virtually lossless environment. GÉANT also allows for elephant flows (single flows of very high rate use by HPCs) by keeping its core links running on the highest speed interfaces available on the market.

Secondly, GÉANT is a high-speed network and links are procured to ensure that delay between GÉANT PoPs in major European cities is as small as possible. This also ensures the best response time between any two entry points to the GÉANT network.

Thirdly, GÉANT strives to connect all countries with enough capacity to allow for high-speed networking. This enables the community to bridge the digital divide with the provision of adequate connectivity in countries where such resources are scarce and the market is closed.

How has the amount of traffic grown over the past few years?

From 2015 to 2016 traffic on the IP/MPLS network grew year-on-year by 64%, meaning that our traffic volume on this network is doubling every 15 months.

The growth has been driven by R&E, where the traffic volume has grown by more than 70% (LHCONE and GÉANT R&E IP), while in contrast, commercial Internet access traffic has grown by just 30%. Interestingly, this GÉANT commercial Internet traffic growth is in line with the Internet traffic growth seen by commercial providers.

The R&E community is therefore faced with a major challenge: its traffic growth rate is over twice as large as the commercial Internet's growth rate.

The growth rate for the Lambda services amounted to 12% approximately, however growth in this type of network is mainly related to new service uptake rather than to traffic growth within existing services.

What implications does this have?

Should R&E traffic growth continue at this rate, in 10 years' time GÉANT would receive 140 times the amount of traffic it receives today. By comparison, within the same time frame, a commercial provider with a growth rate of 30% would see its traffic increase 14 times. The main implication of this is that classic/standard solutions cannot work for GÉANT in the longer-term and GÉANT must look at innovative ways of delivering its network.

What is GÉANT doing to plan for this?

Classic standard solutions are based on pieces of equipment with very broad sets of features, such as a Juniper MX router. Devices like this are able to provide all services and in the past were used to aggregate services delivery into a single high feature-set box. The downside of this is that the cost-per-bit on those devices is the cost-per-bit required by the data-stream that is the most complex to deliver.

Any other data-stream whose requirements, in terms of flow handling, are much more limited, still transits through the same expensive ASICS and is handled by the same complex software.

This results in the payment of premium to transit traffic that could be delivered by a much simpler and less expensive network.

We are analysing traffic, gaining a deeper understanding of the various flows transiting our network and of the requirements from the network point of view for each flow. GÉANT is striving to understand which minimum set of features is required by the equipment that needs to service each group of flows with common requirements. We will subsequently look at groups of flows with minimum common requirements, whose aggregate traffic is large enough to justify disaggregation and find the most cost-effective way of delivering such traffic. All this will then come together in a future network architecture where the cost-per-bit is as optimised as possible and only the small amount of traffic requiring complex handling by expensive ASICS is transiting the devices providing the required capabilities.

The result is a modular layered architecture where best-in-breed for each module and layer can be selected with minimised impact on other modules/layers. A guiding principle in this architecture is ensuring that flows are handled at the lowest possible layer, which are the layers closest to the physical media.

Are there technologies that GÉANT is investigating/deploying to meet future needs?

Faced with such a high network growth-rate, GÉANT needs to look for solutions investigated and deployed by organisations with similar extreme growth levels: the datacentre world. In the past few years datacentres/cloud service providers have needed to develop their own solutions in order to be able to deal with their own growth. Primary examples include: Google, Microsoft, Amazon and Facebook. These content providers had to start optimising their networks; but as early adopters, they needed to drive the industry to produce the hardware and software they need.

These solutions have initially been tailored to the datacentre arena and consequently, in many cases, result in solutions that are of little use to ISP networks such as GÉANT. Now, content providers are expanding beyond the datacentre, into the WAN, and have started generating major disruption in the WAN market whilst driving the industry to quickly provide solutions. GÉANT is looking at this phenomenon very closely and preparing to deploy the right combination of technologies as they become available.

In line with this, GÉANT has been following trends such as open line systems, alien waves, packet optical integration, coherent optical networking, open-source hardware projects (TIP), merchant silicon evolution, SDN and white boxes.

In particular, a big trend in the industry is the move toward centralisation of control plane, multilayer orchestration and programmability: forward-looking decision making based on a more centralised and holistic view evaluating the use of a richer set of inputs. GÉANT plans to follow this approach to enable its partners to interact more directly with network resources. NRENs and other e-infrastructures will have a view and understanding of resources utilisation, they will be able to reserve capacity whilst influencing the network behaviour to fit their specific needs. Bi-directional communication between software running the network and software utilising the network as a resource should improve, and in the longer term this will improve service and customer experience as well as network utilisation and costs.

Acronyms table

LHCONE - LHC specific L3VPN network

GÉANT Plus - point to point Ethernet over MPLS service

MDVPN - Multi Domain VPN, Carrier of Carriers service

BoD - Bandwidth on Demand, dynamic point to point multidomain Ethernet service

HPC - High speed computing

SDN - Software defined networking

TIP - Telecom Infra Project, an opensource hardware initiative sponsored by Facebook, among others

NETWORK PERFORMING ARTS PRODUCTION WORKSHOPS - BRINGING THE ARTS AND TECHNOLOGY TOGETHER

Research and education go beyond science and encompass many disciplines, including the arts and humanities, social sciences, and other cultural areas.With 80 participants from 28 countries and 3 continents – the 2017 Network Performing Arts Production Workshops (NPAPWS) were the best attended event in the series so far. This year, academics, technicians and artists met at the Royal Danish Academy of Music in Copenhagen to share knowledge and experience in using research networking in supporting real-time musical, dance and artistic performances.

NPAPW – THEN AND NOW

In 2000, Internet2, the U.S. research and education networking consortium, identified the potential of using advanced networks for arts and humanities and began bringing technicians, academics and artists together for Network Performing Arts Production Workshops in 2003. Since the beginning, the annual workshops took place at the campus of the New World Symphony in Miami Beach, Florida.

The NPAPW is designed for those who want to explore the evolving role of advanced education and research networks in supporting cultural performances. Previous workshops have attracted:

- students, academics and technical staff of institutions that offer education and produce events in the performing arts (music, dance, theatre, visual arts schools and academies, etc.);
- people involved in audio/video production and education in other areas;
- staff from NRENs and regional education networks, whose constituents have a need for high-end audio visual production and transmission over those networks.

Participants of previous workshops attend to build on their prior knowledge and skills, and share their experiences, while first-time participants are encouraged to attend to bring new perspectives and to share experiences.

Since 2009, the Network Performing Arts Production Workshops (NPAPWs) have been held in Europe and the United States annually. The European workshops were held in Trieste in 2009, Paris in 2010, Barcelona in 2011, Vienna in 2013, London in 2015 and Copenhagen in 2017. In 2010, 2012, 2014 and 2016, workshops were organised at the New World Symphony in Miami.

Currently NPAPWs are a collaborative project of GÉANT, Internet2, New World Symphony, GARR (Italian NREN) and other European national research and education networks (NRENs), working together with cultural institutions around the world to organise the annual event.

The 3 day workshop's program was mainly focused on education – teaching and learning via the academic networks and using various technologies available, including those developed by the members of the R&E community such as LoLa (Low Latency video-streaming system), Utragrid (high-quality/low latency video and audio transmissions software) and others. Technical updates, research presentations, discussions and live demonstrations were complimented by 2 multi-site evening performances – 'Similarities' (Prague – Miami – Copenhagen) and 'Longing for the Impossible' (Copenhagen – London – Barcelona).

The last day of the workshop was dedicated to creative use of technology, such as the Coriolanus Online project, enabling students in the UK and Finland to rehearse part of Shakespeare's play together via the network without leaving their home institutions. Another impressive example came from the researchers of Anglia Ruskin University, who set up a live demonstration to show how one's rowing technique can be improved by creating music from their movements, which then can be evaluated by a sports therapist located thousands of kilometers away based on the musical notes produced.

At the end of the workshop, Mary Barnett from USA shared her experience in adopting LoLa in a public library in Chattanooga, one of the first Gig Cities in the world, showing how those technologies grew out of being something only used by musicians at conservatories and asking what is next? What other spaces and venues can the solutions available for collaboration over advanced networks be adopted in?

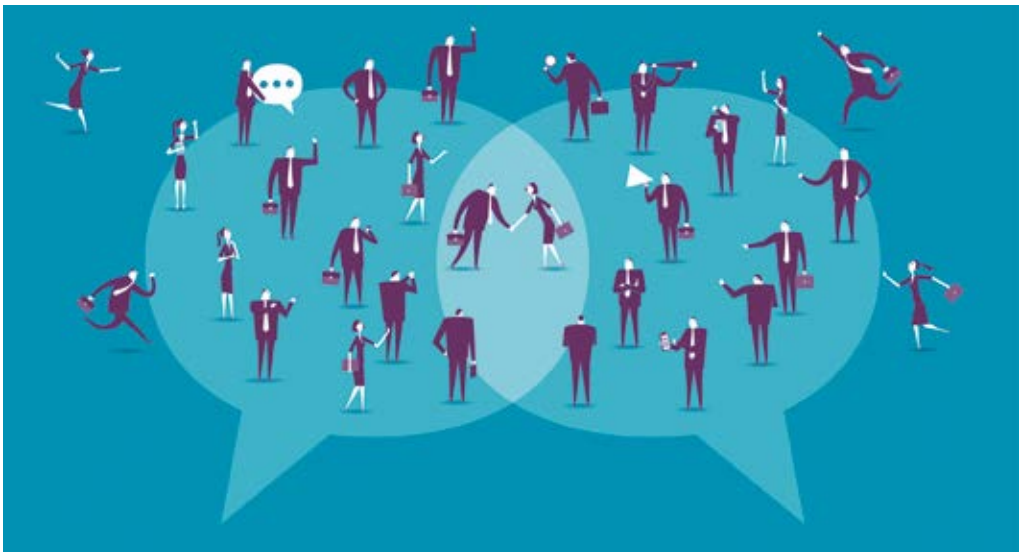
"It is thrilling to bring together the NREN performing arts community. These faculty, students and IT staff embody the essence of innovation. With intense requirements for low-latency, HD video, multi-channel and binaural audio, end-to-end performance, this community pushes invention to its limits to enable remote education, auditions, rehearsals and performances."

Ann Doyle, Internet2 Cultural Initiatives

This year's workshop was kindly sponsored by DeiC and Sennheiser. The next NPAPWS event will take place in Miami, USA in 2018. Meanwhile, find information about similar projects, other events and check continuously updated learning materials on the NPAPWS community website.

NEW TASK FORCE ON RESEARCH ENGAGEMENT DEVELOPMENT(TF-RED)

Task Force aimed at developing methods to engage with research communities



Research engagement is about working with research collaborations in every discipline to facilitate effective use of available tools and technologies for optimal research success.

The new Task Force on Research Engagement Development (TF-RED) is a collaboration of NRENs and other research infrastructures who are working together to develop methods for engaging with researchers and collaborations on a national and international scale through a series of reports, workshops, and best practices.

TF-RED focuses on working with representatives of countries who will work with local research support offices and IT departments to help researchers use networks and related tools to improve their use of computing, data, and facilities, either on a local, national or international scale.

The results of TF-RED will yield documentation for other NRENs or infrastructures to develop their own or integrated form of research engagement, which will benefit the various research domains and e-infrastructures on a global scale.

TF-RED hosted a meeting at the recent Internet2 Global Summit to discuss work items with existing and potential collaborating organisations in the United States. Sylvia Kuijpers of SURFnet, who chairs the Task Force added, "The meeting went well, there were at least three additional countries interested in participating and willing to contribute. In the meantime, we also had fruitful conversations with EGI and they will join the task force too. At TNC17 we will have an additional meeting for which we want to invite everyone interested in research engagement."

Chair:
Sylvia Kuijpers (SURFnet)

Co-chairs:
Jim Bottum (Internet2)
Kate Petersen (ESnet)
David Salmon (Jisc)
Jakob Tendel (DFN)

TF-RED is open to anyone to participate and will actively seek collaboration with other infrastructures (such as Elixir, Clarin, EPOS, ELI, ESS, EUDAT, EGI, PRACE etc.), but also other projects (European Open Science Cloud) with respect to research engagement efforts as a framework is developed within the NREN community.

TF RED will help to:

- Increase our understanding of research requirements and workflows.
- Gather and share information, which can be used to improve network/ research architecture and design.
- Understand what is important to researchers so that NRENs/research infrastructures can be more responsive to their needs.
- Build a body of knowledge about research applications as correlated to network utilisation, which can be cited in interactions with larger community and policy efforts.

Outputs of TF-RED will include:

- Supporting research collaborations that want to collaborate internationally.
- Establishing a continuous and permanent information flow between Research and Education Networks (RENs), research infrastructures and science and research communities.
- Improving the performance of network-centric and data-centric workflows.

FURTHER INFORMATION:

You can subscribe to the TF-RED mailing list here: **https://lists.geant.org/sympa/info/tf-red**

TNC kick-off meeting: 30 May 2017, 9:00-10:30, **https://tnc17.geant.org/core/event/8**

TNC session about research engagement: 31 May 2017, 9:00-10:30, **https://tnc17.geant.org/core/session/19**

CLOUD SERVICES UPDATE

The pan-European Infrastructure as a Service (IaaS) tender carried out by GÉANT and 36 NRENs during 2016 is delivering real choice to the research and education community. Common framework agreements with providers ensure research and education institutes can consume the cloud in a safe, easy and predictable way:

- Standardised conditions of use for all education and research institutes.
- Users can log in to the cloud services provider via Single Sign-On (SSO) utilising the community's identity management capabilities.
- Institutions can access cloud services via the high-performance NREN and GÉANT data networks, significantly reducing network traffic costs.

This efficient supply-chain saves education and research institutions time and money. It also delivers on the European Commission's European Cloud Initiative, and European Open Science Cloud objectives, through giving research and education institutes' immediate access to secure, flexible, and low cost cloud technologies.

The latest providers to join the GÉANT Cloud Catalogue – a growing resource providing a structured listing of service providers and cloud services – are Amazon Web Services AWS) and Dimension Data.

AMAZON WEB SERVICES

Research and education institutions in 28 countries across Europe can now access AWS cloud services via the GÉANT Cloud Catalogue, through resellers Arcus, Comparex, and Telecom Italia.

Steve Cotter, GÉANT CEO said of the announcement, "We are delighted to welcome Amazon Web Services to the GÉANT Cloud Catalogue, further expanding the range of leading cloud services that our NREN partners can bring to their customers. We expect the Cloud Catalogue to deliver real benefit to millions of users across the European research and education communities."

"We are excited to now be part of the GÉANT Cloud Catalogue and to see the possibilities that flexible, scalable, secure, and reliable cloud services bring to the education and research community of Europe," said Max Peterson, Head of EMEA Public Sector, Amazon Web Services. "Students, educators, and researchers are key drivers of technological innovation and the backbone of modern economies. We look forward to helping the European research community use AWS technologies to further invent and advance scientific discovery."

For more information, see: **www.aws.amazon.com**

DIMENSION DATA

GÉANT can now provide Dimension Data's enterprise class IaaS cloud services through 18 of its NREN partners, reaching thousands of universities, schools and research institutions.

"Dimension Data and its ecosystem of channel partners are ideally positioned to help our clients' transformation to digital businesses through a portfolio of end-to-end services that are supported by world-class professional, consulting and managed services," said Brian Miller, Sales and Marketing Director for Europe. "Dimension Data's services-led approach will enable GÉANT to provide for agile, scalable, secure platform to institutions focused on a digital experience for their students, academics and researchers."
Steve Cotter adds, "We're excited to add Dimension Data to our Cloud Catalogue. This catalogue enables our NREN partners to select the best solution for their customers, bringing cloud services that are tailored for the research and education communities to millions of potential users across Europe."

The GÉANT Cloud Catalogue is available at: https://catalogue.clouds.geant.net/

Further information is available at: **https://clouds.geant.org/services/geant-cloud-catalogue/**

InAcademia
ONLINE STUDENT VALIDATION

INACADEMIA – ONLINE STUDENT VALIDATION FOR RETAIL AND COMMERCIAL SERVICES

Many organisations offer students and staff special discounts or deals. From student railcards, offers on everything from clothes to concert tickets, to free or discounted software and services, students get numerous benefits as long as they can prove that they are students – usually by showing a student card.

But how do you provide these discounts or offers online? Requiring students to scan and email a student card takes effort (and exposes students to the risk that they might share much more information than is necessary) and then those scans have to be manually checked and verified, making offering special deals time consuming and costly. Often it is too difficult to check IDs so either offers aren't available on-line or they can be open to abuse.

Wouldn't it be perfect to give discounts to students and be sure that the user is actually a student? Wouldn't it be great that if you're an Identity Provider you'd only have to connect once to the community of Service Providers and not be bothered again for access or discount services?

Now we have a solution to help bring Identity Providers, Students and Suppliers together. In collaboration with national research and educational networks (NRENs) GÉANT introduces InAcademia, a service for validating a user's affiliation with an academic institution.

INACADEMIA – LEVERAGING THE POWER AND REACH OF EDUGAIN

Identity federations have been well established in Higher Education. Within these frameworks, services and institutions handle authentication requests and exchange user profile information to facilitate a user getting access to a service. The whole process is highly standardised and the institutions, the services and the federation operator all allow the trusted exchange of this identity information. Interfederating with eduGAIN expands the capabilities of these services to link more and more services and Identity Providers increasing the value of the service. For large scale academic Service Providers the benefit of federating and interfederating clearly outweigh the costs but for small organisations like local concert venues or bookshops how can they justify the cost and complexity? How can we make it simpler for these types of providers?

Because of this need for a lightweight, easy-to-use service GÉANT decided to implement InAcademia. The idea was to develop an easy-to-use academic validation service. Giving the services easy access to the high quality affiliation of a user, while at the same time making sure neither the service nor the institution has to invest a lot of effort in the exchange of that information.

HOW DOES IT WORK?

InAcademia is using the eduGAIN infrastructure to make validations possible. By implementing the service via an InAcademia button in the website of the service provider InAcademia is taking care of the specific affiliation validation request. This request of course does not contain any personal data. If this specific service is allowed to use the InAcademia service and if it is eligible to receive the requested affiliation, InAcademia will make the next step. InAcademia will ask the user to prove his affiliation by authenticating using his institutional account. In the request to the home organisation, the InAcademia service will only ask for an affiliation, nothing else. Assuming the user is able to authenticate, a matching affiliation is provided and the user consents to releasing that information to the website, the InAcademia service will then confirm the affiliation in a boolean fashion. The information which is released is limited to validating that the person is a member of the institution and his/her status.

BENEFITS FOR AN IDENTITY PROVIDER

Offering users access to special services or discounts is a clear benefit to them but can Identity Providers justify the the hassle you need to go through when connecting a specific Service Provider? By using InAcademia there is no need to manage specific Service Providers anymore – the whole world of student benefits is opened to your users in one step.

BENEFITS FOR A SERVICE PROVIDER

The benefits for a Service Provider are clear. InAcademia will provide service providers a quick, easy, reliable and secure way to verify identities. Just by adding a small link to the supplier's website the student can verify themselves and the supplier is provided with an authentication code to confirm the student's status in real-time.

There is no need to request and check photographs of IDs or check email addresses against lists of valid institutions. Everything happens either during registration or checkout on your website.

This makes validation simple, quick and cost-effective – opening up the academic world as a new and exciting market.

WHICH COMES FIRST – THE IDENTITY OR THE SERVICE?

As you can understand there might be a slight chicken and egg problem arising. As long as no Identity Providers have committed to the service there will be hardly any Service Provider interested in signing up. And vice versa, if there are no Service Providers interested, why bother and signup for InAcademia?

Well, the interest is large and the potential is big! If you have an eduGAIN federated Identity service then allowing access for InAcademia is simple and quick so please sign up as soon as possible. Enlighten your work and make your affiliates happy without being involved on a daily basis. InAcademia needs your help!

THE PLAN AND THE TIMING

Currently InAcademia is in a pilot phase. InAcademia needs both chicken and eggs! So the project currently is talking to all kinds of Service Providers and would love to connect as many Identity Providers as possible. For most of the Service Providers it is an easy job to connect to the service. This can be done almost immediately. The pilot phase of the project will last up until early 2018. During that time the financial and support organisation will be shaped and put into place. There is no doubt about the potential success of this great service.

For more detailed information please have a look at **https://inacademia.org**.

THE EDUGAIN FAMILY CONTINUES TO GROW

eduGAIN – the academic identity interfederation service with 48 member federations around the world – has welcomed the South African Identity Federation (SAFIRE) as its first fully participating member from Africa. The admission follows a vote earlier this year by the eduGAIN Steering Group.

With SAFIRE joining eduGAIN there are now over 2,300 Identity Providers (IdPs) and more than 1,500 Service Providers (SPs) working together to support access to research and education resources.

Guy Halse, Project Director of SAFIRE said, "South Africa's membership of eduGAIN will provide local academics and researchers with an easy way to log into over a thousand participating services worldwide using their home organisation's username and password."

SAFIRE will make it easier for universities and research organisations in South Africa to collaborate in a wide variety of fields, from teaching and learning through to interdisciplinary research.

As it grows, SAFIRE will support the research and education sector in realising economies of scale and savings in systems integration costs (in fact, thanks to eduGAIN, many of these integrations have already been done). The federation can also provide participants with more granular mechanisms to control access to expensive electronic resources, such as those provided by university libraries.

Information for South African research and education institutions wishing to participate in SAFIRE is available at **https://safire.ac.za/participants/idp/institution.**

BENEFITS OF EDUGAIN

Today, online services are crucial to research and education. Students, teachers, researchers and institution staff rely on them for collaboration through webmail; e-learning, teaching and conferencing; for analysing and sharing data; and for accessing journals and libraries. Usually, every online service requires a separate account. But with just one trusted identity, provided by their institution as part of an Authentication and Authorisation Infrastructure (AAI), and with participation of this Identity Provider in national identity federation and international eduGAIN interfederation agreements, users can access services from other participating federations using just a Single Sign-On (SSO).

There are many different AAI systems in use, all of which control access to networks and applications and ensure the secure movement of information within networks. It is currently necessary for organisations to join one another's federation in order to establish the relationship necessary to exchange information across these systems.

Enabling easy and convenient access to end users is a key part of delivering a service. The service operator does not want the headaches associated with issuing passwords to users, and the user does not want yet another password to add to his/her collection.

The eduGAIN service interconnects identity federations around the world, simplifying access to content, services and resources for the global research and education community. Through eduGAIN, Identity Providers offer a greater range of services to their users, delivered by multiple federations in a truly collaborative environment; Service Providers offer their services to users in different federations, increasing their target market; and users seamlessly benefit from the wider range of services.

AT A GLANCE

With eduGAIN you can:

- Rapidly and cheaply expand the range of services you offer to your users.
- If you are already participating in a federation with Web Single-Sign-On set up, there is no extra administrative burden for IT staff.
- Because the institutions handle the user accounts, there's reduced Service Provider overhead, so costs per user can be lowered.
- You can choose only trusted services from the pool available, and you control the release of user data so ensuring user privacy.

NEW EDUGAIN CONSTITUTION

At the end of April the GÉANT board ratified a new version of the eduGAIN constitution, following a long and thorough consultation with the community. The eduGAIN consitution defines how the eduGAIN service is governed and what procedural and technical requirements are mandatory for federations using eduGAIN.

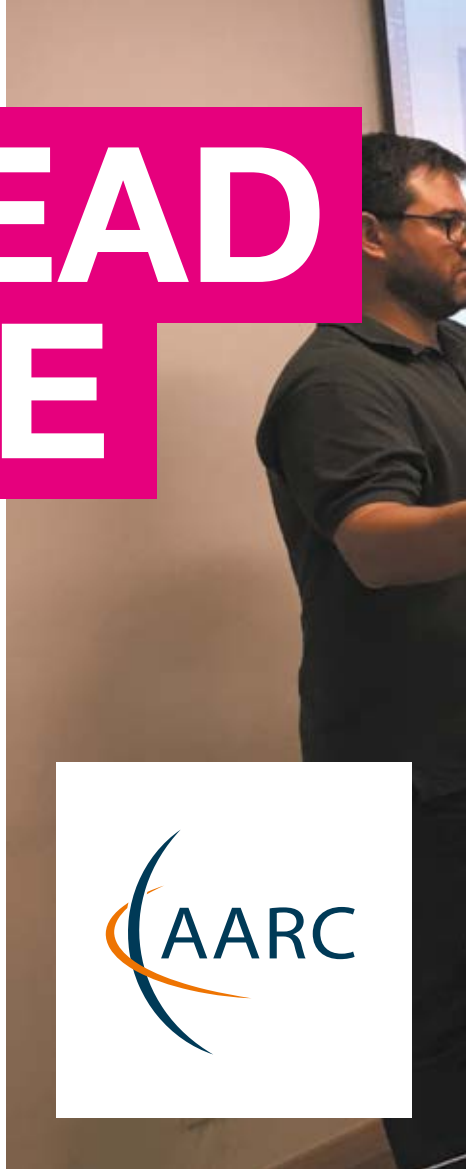
This constitutional change is the first since 2013 and has been put in place to help eduGAIN grow and support the changing requirements of our community. For the first time, eduGAIN will not be SAML-specific but will allow multiple technology profiles to take advantage of a single trust framework. This means that federations built on technologies such as OpenID Connect (OIDC) will be able to participate in eduGAIN in the future.

The new constitution also updates the governance model for eduGAIN with the GÉANT Board taking responsibility for eduGAIN governance and defining a robust governance framework for future operations.

The new constitution will take effect on 1 August 2017, giving federations and federation members a three month notification window. The changes in this version will not have operational impact on eduGAIN federations and present no new operational requirements, but the GÉANT eduGAIN team will be undertaking a full review of the SAML technology profiles over this three month period to ensure that all SAML operational requirements are fit for purpose. eduGAIN will also introduce a series of Best Current Practice (BCP) documents in this timeframe to support federations wishing to "step-up" Identity Providers and Service Providers with enhanced features.

For more information on the new constitution visit **https://edugain.geant.org**

AARC IS DEAD - LONG LIVE AARC!



The first Authentication and Authorisation for Research and Collaboration (AARC) project concluded on 30 April 2017 after two years, with many useful outputs for e-infrastructures, research infrastructures and libraries. These outputs will continue to be used and developed in the second AARC project, which, from 1 May, is building on these achievements and bringing a new focus.

WHAT IS AARC?

Until recently, each research collaboration has developed its own solution to the question of how to identify their researchers and allow them access to the online resources they need, such as data storage and computing resources. This has created barriers between groups that may want to work together.

AARC has been creating a common framework for research and collaboration communities, meaning one blueprint architecture, one set of policies, and one collection of training materials that should work for everyone and allow their authentication and authorisation solutions to work together. AARC has also been working with research collaborations to pilot and improve specific technical and policy aspects.

AARC's approach means that research collaborations can spend less time and less money reinventing the authentication and authorisation wheel, and their researchers can focus on research. Safe and more reliable access for more researchers to more services, data and software, will allow greater cooperation between research collaborations and open up the possibilities for exciting new research.

A 2-minute video summarises the AARC approach: **http://bit.ly/2pxfGNM**

WHAT HAS AARC ACHIEVED?

- Created a set of interoperable building blocks for software architects and technical decision makers who are designing and implementing access management solutions for international research collaborations - the AARC Blueprint Architecture: **https://aarc-project.eu/blueprint-architecture/**
- Created policies to complement the technical research work carried out in the architecture work package, plus recommendations and best practices to implement a scalable and cost-effective policy and operational framework for an integrated authentication and authorisation solution: **https://aarc-project.eu/workpackages/policy-harmonisation/**
- Sctfi - identifies operational and policy requirements to help establish trust between an infrastructure and identity providers. For use by personnel responsible for the management, operation and security of an infrastructure and those wishing to assess its trustworthiness. **https://aarc-project.eu/wp-content/uploads/2017/05/AARC-Deliverable-DNA3.4-final.pdf**
- Sirtfi – AARC was the main sponsor for work to create an assurance framework that allows participating organisations to cooperate effectively in the coordination of incident response, in the event of a federated security incident. **https://refeds.org/sirtfi**
- Tested pilots that expand the coverage of federated access, that test the integration of AARC results into existing infrastructures, cross-e-infrastructure pilots, and pilots addressing the needs of **libraries: https://aarc-project.eu/workpackages/pilots/**

- Worked with existing groups such as REFEDS, FIM4R and WISE, to use their well-established processes and maximise the impact of AARC results.
- Built a community among research infrastructures and e-infrastuctures that are motivated to make use of AARC results.

To make life as easy as possible for the people who will use AARC's outputs, the project has also:

- summarised the formal project 'deliverables' for a quick and easy overview: **https://aarc-project.eu/documents/deliverables/**
- produced a 'toolkit' of all materials, including leaflets, training modules, reports and FAQs, that are relevant for libraries and library service providers: **https://aarc-project.eu/libraries/, and for e- and research infrastructures: https://aarc-project.eu/infrastructures/**
- co-created a shared YouTube channel, IAM Online, for the delivery of webinars to support the spread of knowledge about how best to manage identities and federated access: **https://blog.geant.org/2017/02/18/welcome-to-iam-online/**
- spearheaded the development of an e-learning Moodle platform that was presented to project partners in March and will be launched in summer 2017.

WHAT NEXT?

While the goals and objectives of the second AARC project will largely remain the same, the project will take two main routes:

- AARC will expand efforts to engage with target communities by working closely with them to disseminate information, ensure messages are clear, deliver training, gain feedback, and implement the AARC framework. The number of partners has increased from 20 to 26, helping to make this approach easier.
- AARC will shift the technical focus from the question of how to authenticate the identity of users to the question of how to authorise permitted users to access the resources they require, across the boundaries of different infrastructures and research collaborations.

To maximise the uptake of existing materials and any that are developed in the next phase, a fresh impetus will be given to developing and delivering training, and to producing and disseminating information in more easily swallowed chunks such as 'how to…' documents, webinars and so on. This will all be supported by a change to the project website so that it becomes more of a shop window where goods AARC has to offer are clearly laid out to tempt and deliver to the people who need them.

The kick-off meeting for the second AARC project will be held on 6-8 June.

Follow AARC news on Facebook, Twitter, LinkedIn

AENEAS* - WHEN INTERNATIONAL COLLABORATION GOES SKY-HIGH

***ADVANCED EUROPEAN NETWORK OF E-INFRASTRUCTURES FOR ASTRONOMY WITH THE SKA**

ABOUT AENEAS

AENEAS, launched in January 2017, is a three year Horizon 2020 project whose primary objective is the development of a concept and design for a federated European Science Data Centre (ESDC) to support the radio astronomy community working on the Square Kilometre Array (SKA). SKA is an international project to build a radio telescope tens of times more sensitive and hundreds of times faster at mapping the sky than today's best radio astronomy facilities. Simply put: the world's largest radio telescope.

The scientific potential of the SKA radio telescope is unprecedented and represents one of the highest priorities for the international scientific community. The large scale, rate and complexity of data the SKA will generate, present extraordinary challenges in data management, computing and networking on a global scale. AENEAS brings together the 10 countries members of the SKA organisation, including the two host countries, Australia and South Africa, and a larger group of international partners. The ESDC will be a vital resource to enable the community to take advantage of the scientific potential of the SKA and will provide essential functionality, which is not currently provisioned within the SKA facilities.

One clear objective of AENEAS is to establish and maintain an active communication channel between technical developments in the wider community and the SKA design consortia coordinated by the SKA Organisation (SKAO) to facilitate sharing of results, ensure compatibility across the data boundaries, and avoid duplication of effort.

EUROPEAN SCIENCE DATA CENTRES (ESDCS)

AENEAS' core activity is international collaboration related to the development of specific science data centres including the transport and management of scientific data for SKA. These data centres are of particular importance since the extraction of scientific knowledge from the data requires the participation of the European Radio Astronomy user community as well as of scientists from the SKA member states and host countries.

This AENEAS concept design must include the functionality required by the scientific community to enable the extraction of SKA science and integrate the necessary underlying infrastructure to support that extraction. The European contribution to the SKA design and construction phase represents a large part of the total project, and the European radio astronomy community is actively involved in the full breadth of the SKA science case.

GÉANT AND AENEAS

GÉANT representatives hold key roles in the AENEAS project: they provide expertise and experience in the specification and use of high performance long distance networks and protocols and in the design of Science DMZ facilities. In addition, the procurement role of GÉANT consists in supplying information to assist the costing of a global 100Gigabit network linking the telescopes and the various regional centres.

LARGE DATA VOLUMES

Given the physically distributed nature of the SKA Observatory with the telescopes located in Australia and South Africa and the large data volumes and processing scales expected, technical issues related to networking, storage, computing, data management, access, and analysis are all key components of this ESDC design. As a Research and Innovation Action, much of the activity in the AENEAS project has been purposefully constructed to address these topics. Issues related to data movement from the SKA host countries and distribution of that data collection over large-scale storage and computing sites in Europe will be examined with an eye towards deriving an optimal topology for use by the global science community.

DATA STORAGE AND ANALYSIS

The computing and storage requirements for the foreseen post-processing and analysis needs of the European SKA community will be used to weigh different architectures and technologies. A similar analysis will be conducted to produce requirements and designs for the access interfaces and tools that the scientists will need to analyse the SKA data. Given the very large volumes of data that will be generated by SKA, AENEAS will be key in developing the new workflow procedures that will be required together with support for training the scientists on how to incorporate them in their research. These studies will be combined into a science-driven, functional design for the capabilities of the ESDC with the aim to utilise and extend the solutions rather than reinventing them.

OBJECTIVES AT A GLANCE

- Develop a concept and design for a distributed, federated European Science Data Centre (ESDC) to support the radio astronomy community in achieving the scientific goals of the SKA.
- Engage with the science community to define requirements on the analysis capabilities of the ESDC to achieve the science goals of the SKA.
- Produce design and best practice recommendations for networking, data transfer, storage, and the authentication and authorisation infrastructure required to construct an ESDC together with cost models for European and Global connectivity.
- Address the challenges of moving large volumes of data produced at the Telescopes over global distances to the Regional Centres, making this available to European researchers.
- Establish the optimal technical solution for a highly distributed SKA Science Data Centre in Europe builds on from previous experience in federating infrastructures and leverages existing investments of the European scientific and computing communities.
- Estimate the level of resources required to establish and sustain an optimal European SKA Data Centre, from a technical, funding and human resource points of view.
- Establish the policy and governance framework that allows maximal scientific exploitation of a European SKA Data Centre by the European scientific communities.
- Establish a plan for pan-European participation in the SKA science programme, beyond the current European SKA partner countries, in order to grow the astrophysics community in Europe and offer opportunities also to countries without a strong history in astrophysics.

COMMUNICATION AND COLLABORATION

One clear objective of AENEAS is to establish and maintain an active communication channel between technical developments in the wider community and the SKA design consortia coordinated by the SKA Organisation to facilitate sharing of results, ensure compatibility across the data boundaries, and avoid duplication of effort.

The AENEAS project is funded by the EC in H2020 under project no. 731016.

FULL SCIENCE PARTNERS

ASTRON (NL), University of Manchester, UCAM (UK), INAF (IT), Chalmers (SE).

E-INFRASTRUCTURE PARTNERS

Specialist organisations responsible for a particular aspect of e-infrastructure that is essential for the design of the ESDC. EGI and GÉANT are Full Partners in the AENEAS Project and are leading two of the work packages.

ASSOCIATE PARTNERS

Associate Partners include AARNET, CSIRO, Julich, RAL and SANReN who will be working with GÉANT on the proof of concepts.

ABOUT SKA

SKA is an international project to build a radio telescope tens of times more sensitive and hundreds of times faster at mapping the sky than today's best radio astronomy facilities. Simply put: the world's largest radio telescope. The SKA is not a single telescope, but a collection of various types of antennas, called an array, to be spread over long distances. The SKA is the world's largest public science data project. Once completed, it will generate data at a rate more than 10 times today's global Internet traffic. The SKA telescope will be powerful enough to detect very faint radio signals emitted by cosmic sources billions of light years away from Earth, those signals emitted in the first billion years of the Universe (more than 13 billion years ago) when the first galaxies and stars started forming. The SKA will be used to answer fundamental questions of science and about the laws of nature, such as: how did the Universe, and the stars and galaxies contained in it, form and evolve? Will Einstein's theory hold? What is the nature of 'dark matter' and 'dark energy'? What is the origin of cosmic magnetism? Is there life somewhere else in the Universe? But, perhaps, the most significant discoveries to be made by the SKA are those we cannot predict.

Organisations from ten countries are currently members of the SKA Organisation: Australia, Canada, China, India, Italy, New Zealand, South Africa, Sweden, the Netherlands and the United Kingdom.

GÉANT TURN SERVICE - RELAYING REAL-TIME TRAFFIC FOR RESEARCH AND EDUCATION

Peter Szegedi, Project Development Officer, GÉANT explains how the GÉANT TURN Service Pilot will support the reliable traversal of real time communication and other data traffic through network boundaries.

WebRTC (Web Real Time Communications) offers the Research and Education (R&E) community access to simple, open source, web based voice and video conferencing as well as real-time data streaming. With a wide range of WebRTC applications, users can select a solution that fits their infrastructure in the knowledge that they will remain compatible with any other compliant system. However, WebRTC systems often have difficulties when connecting across firewalls, Network Address Translation (NAT) devices and other network middle-boxes.

Most users in the Research and Education community encounter firewalls and NATs on campus, at home and on the road. Today's off-the-shelf video and web conferencing solutions offered by commercial providers usually have an in-built centralized ICE/STUN/TURN functionality, but often these are a charged-for option and lack the widely distributed nature required for global R&E. They also generally reside within the public internet requiring traffic to leave and re-enter the NREN environment adding delay and potentially congestion. The TURN service component is bandwidth-intensive so most commercial TURN services on the market typically charge for bandwidth relayed through TURN connections.

The recently developed GÉANT TURN Pilot Service addresses the need of end-user WebRTC applications to reliably transit firewalls, Network Address Translators (NATs) and other middle-boxes across multiple networks.

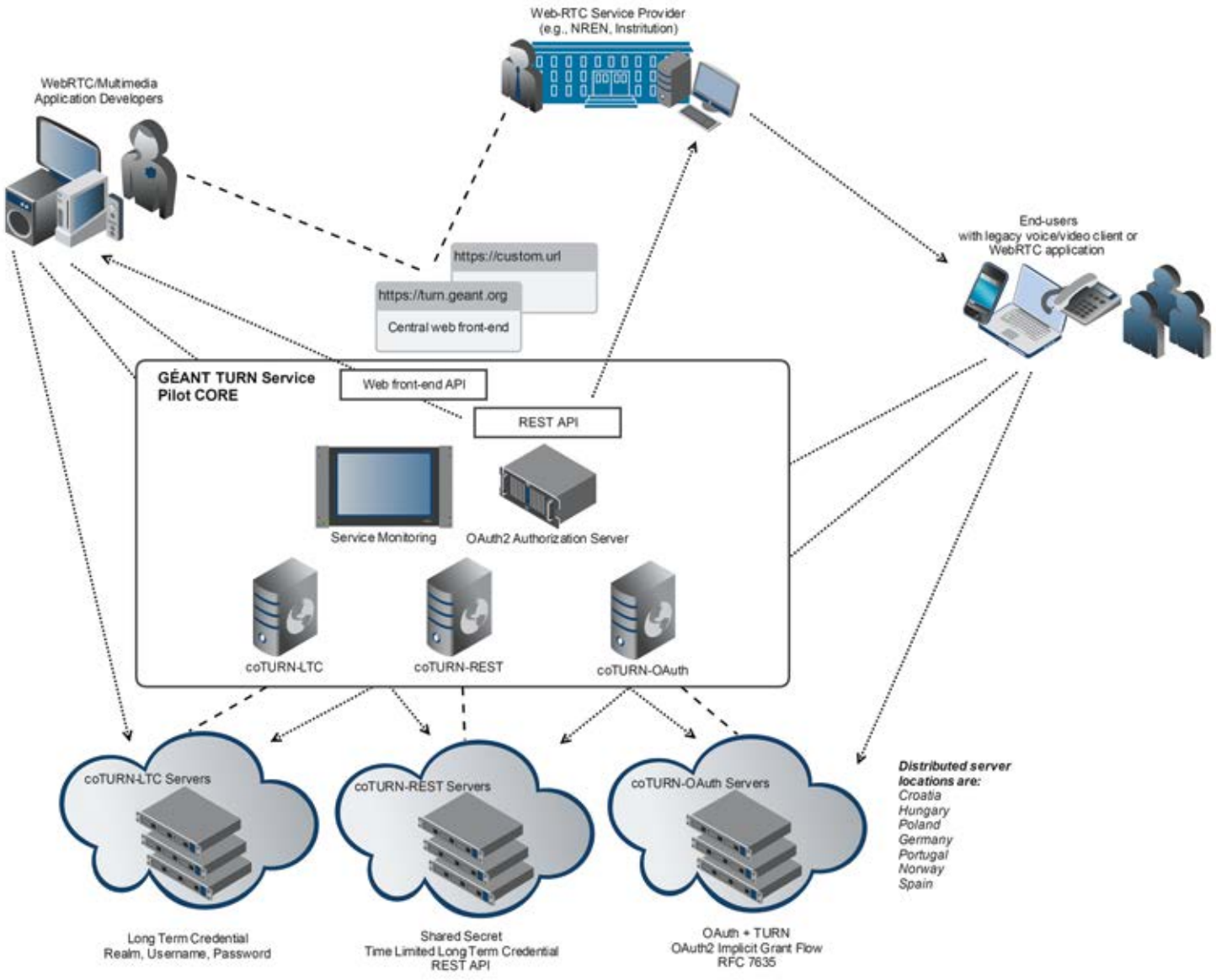
WEBRTC AND STUN/TURN SOLUTIONS

The issues caused by firewalls and Network Address Translation devices are well understood. The ICE (Interactive Connectivity Establishment), STUN (Session Traversal Utilities for NAT) and TURN (Traversal Using Relay NAT) protocols are widely accepted open standards to address and solve these complex problems with NAT/firewall traversal and IPv6 transitioning.

It is mandatory to implement such standards in WebRTC compliant end-points and often used by traditional voice and video conferencing solutions too.

By delivering a community focused solution, R&E users can benefit from access to standards-based services with the support of the GÉANT and NREN networks.

Picture
Peter Szegedi, Project Development Officer, GÉANT



FOCUSED ON RESEARCH AND EDUCATION

By using the strength of the NREN and GÉANT networks, NRENs are in the best position to facilitate such a network-demanding, highly distributed service word-wide.

Having a globally distributed, federated STUN/TURN server infrastructure keeps traffic in the trusted and secure environment of R&E networks whilst minimising the round trip time by balancing and sharing the load across the nodes.

This ensures the best end-user experience in any network conditions and reduces traffic through peering points. It is built on open source software and can easily be exploited by the community members without specific expertise in this area.

CUTTING AGE TECHNOLOGY TO SUPPORT THE COMMUNITY

Currently, the GÉANT TURN pilot is the only service that uses three authentication methods: username/password, REST API and OAuth. The OAuth credential mechanism is not yet fully standardised and GÉANT, through our lead developer, Mihály Mészáros at NIIFI/KIFU, is at the forefront of development, working alongside the big players such as Google or Microsoft on the World Wide Web Consortium (W3C) Web Real-Time Communications Working Group to converge towards this standard solution.

FIND OUT MORE

This work is being undertaken by the GEANT (GN4-2) Project's Application Services Delivery Development team (JRA4 T5) who are developing this service. The current server locations in the pilot phase include: Croatia, Germany, Hungary, Norway, Poland, Portugal and Spain. The web front-end is primarily offered for the real-time communications service providers (i.e. NRENs/institutions with web and video conferencing services) as well as the WebRTC application developers who need to access a reliable and trusted TURN service infrastructure. The involvement of more server locations globally and the development of customised front-ends are expected as the service evolves from pilot into production.

Visit **https://turn.geant.org** to experience for yourself the new GÉANT TURN service pilot.

BRINGING BORDERLESS EDUCATION OUT OF BETA AND INTO THE LIMELIGHT

Transnational Education (TNE) is an area of significant growth across the globe, providing education developed in one country and delivered in another. But with the variety of national education systems, the changing political climate, the diverse models of TNE delivery and fundamentally, the technology to support and access such education systems, there are challenges for everyone involved.

To meet these challenges, NRENs from across the globe have come together to create a Special Interest Group for TNE (SIG-TNE), and share expertise in delivering truly borderless education.

GÉANT SIGs are established under the auspices of GÉANT in order to create an open forum where experts from its community exchange information, knowledge, ideas and best practices about specific technical or other areas of business relevant to the research and education networking community.

The focus of SIG-TNE is very much on education in its entirety for the members of its steering group; with representatives from CERNET, Internet2, SURFnet, GARR and Jisc, the remit of this SIG goes beyond research collaboration.

Words
Esther Wilkinson, Head of International at Jisc

Along with GÉANT, Jisc has been working in partnership with NRENs and commercial internet providers to improve the connectivity that students depend on wherever they may be globally – and it really does improve learning experiences.

In China, for example, CERNET, the country's NREN, provides reliable, fast access to the 10Gbit/s ORIENTplus link between Beijing and London (via GÉANT). What this means beyond the technical jargon, is that TNE students and staff in China can reliably access services and learning environments hosted in the Europe, from both on or off campus.

The reasons – and the gains – for countries adopting a transnational approach are as diverse as the cultures that drive their education programmes on home turf.

In the Middle East and North Africa, partnerships are being born, in an effort to improve the quality and speed of internet connections. The region is already a hub for higher and further education partnerships with, for example the USA and Europe, TNE can be further enhanced by developing collaborative relationships with ASREN and our peer NRENs in the region.

The benefits of developing educational connectivity extend beyond the student experience. TNE can also benefit host countries, by helping support local economies; by establishing and enabling research collaboration; and, in the long term, by fostering closer links across the globe.

Aside from the economic benefits and the skills boost TNE can bring, there's a lighter side to the imperative for borderless education. TNE breaks down the barriers that previously existed, allowing for equal participation in partnerships between countries and the organisations, like Jisc, who exist to support education establishments with their digital needs.

Technology as an enabler isn't a new concept in education, from roots to shoots, our modern-day learners have become accustomed to hardware and software alike, forming part of their student experience. With transnational education, the tech isn't a nicety to facilitate blended learning, or assessments on the go, it provides the lecture hall and the space within which learning can take place.

Future challenges are also unlikely to be felt in isolation by members of the GÉANT community, so collaboration on the tools to improve TNE is of mutual benefit – one such area is learning analytics.

Self-assessment in our day to day lives is becoming normalised with ever-growing of sales of activity-tracking wearables and apps. Not only is there an expectation from students that tech will support their learning needs, but it could also boost retention rates, and save our education institutions some financial headaches.

In an online world, with less face-to-face opportunity for intervention, learning analytics could become the future-proofing tool to ensure the investment we make in our students pays off, and really delivers the outcomes they also need, in a globally competitive workforce.

Ultimately, the vision for SIG-TNE is to facilitate these learning outcomes for the education institutions we all support, but could we also aim high amongst ourselves, as a community of NRENs?

The aspiration to come to an agreement that delivers connectivity across networks for all our education establishments, with consistent/aligned policies and processes, shouldn't be seen as too lofty….TBC!

ARE THERE PRACTICAL TOOLS THE SIG CAN OFFER?

Well, yes – the UK is developing a toolkit to support universities and others delivering TNE. This will be expanded to create an NREN toolkit, giving members both a guide as their TNE is developing but also the means to better support their own education institutions. This is a fundamental part of the SIG-TNE work.

SIG-TNE gives members an opportunity to shape not only how we collaborate in Europe, but across the rest of the world, and this world really is online; a recent UK Government report pointed out, loud and clear, that 48% of crime is now orchestrated online – this group is a route to deliver borderless communications for the greater good.

To find out more about the group and to become involved, visit **https://wiki.geant.org/display/TNE/SIG-TNE+Home**

"SIG-TNE is a terrific place to share the information from different countries/NRENs - the needs, challenges, best practices, and so on. The SIG can also do the research on how to improve the services to all transnational education activities, and provide guidance to NRENs and organisations."

William Wan, Chief Technology Officer and overall program coordinator of TNE at CERNET (China Education and Research Network)

"We've seen that Transnational Education is an area of increasing importance and focus for Internet2's higher education members whose international collaborations span the globe. We are excited for this opportunity to work in support of our members' global needs, partnering more closely with the SIG-TNE NRENs to define, address and share best practices around some of the TNE challenges we all face."

Urszula Chomicka, Global Engagement Manager, Internet2

"The history of the Netherlands, when it comes to international activities, goes back centuries. So, it's not surprising that there are many partnerships between educational organisations connected to SURFnet and organisations based in other countries. In the SIG-TNE we will share ideas and work on instruments for identifying, connecting and servicing these organisations."

Alexander van den Hil, Product Management, SURFnet

GÉANT LAUNCHES NEW INTERACTIVE MAP

GÉANT is rightly proud to reach over 100 countries worldwide via extensive global partnerships and GÉANT-managed networking projects, ensuring GÉANT and our NREN partners remain at the heart of global research and education networking. For many years our European network map and our iconic global map poster (see page 64) have been displayed around the world via VC screens and partner office walls. Whilst these printed maps and PDFs will continue for now, we've worked hard to bring these to life with a fully interactive map, launching at our TNC17 GÉANT booth.

Christian Gijtenbeek, Senior Software Engineer in GÉANT's Software Development team, takes up the story. "Connecting users with data and information in an interesting way, is one of the key drivers behind great software development. So when the teams asked me to get involved with this project I was really excited to help. The brief was to give users an intuitive and informative experience, that really added value. So for example, we don't just show the network links, but the link speeds together with clickable partner and project information for each link. And the user can filter the view to see all routes with a certain speed, or zoom in and out to see more or less information."

The interactive map shows links between European countries, links to partner networks worldwide as well as the backbone links of regional networks beyond Europe. Usefully, the map can also be configured to open at particular coordinates – meaning partners can use the map on their own websites with the start view based on their own location.

Tom Fryer, Senior International Relations Officer at GÉANT adds, "This is the culmination of many months' work and we're delighted to bring it to the community. What I especially like is how it shows very clearly the extent of GÉANT connectivity and we're hopeful it presents a really useful tool for our partners worldwide."

The map will be demonstrated at the GÉANT booth at TNC17, and available online soon after. Watch for announcements!

WACREN2017

CONNECT caught up with Sabine Jaume-Rajaonia, Head of Strategy at RENATER, and member of WACREN General Assembly, at the WACREN conference in Abidjan, Cote d'Ivoire.

Sabine, RENATER is involved in TANDEM, WACREN and AfricaConnect2, what is your strategic interest in Africa?

Africa is the continent of the 21st century. It faces a lot of challenges, but also holds the keys to global challenges through its resources and biodiversity. Food security, climate change, epidemics and many other issues cannot be tackled without the input of African research. This is why as research and education networks we need to allow scientists to work together to solve these challenges. An immediate challenge is also to provide African schools and universities with the right infrastructures to tackle the youth demographics in Africa and turn it into a development opportunity for the continent.

RENATER also has a mission to help bridge the digital divide and facilitate North-South collaboration wherever possible through the global French speaking community so we naturally engaged with WACREN as early as 2011 in a partnership with CIRAD and IRD (French research institutes) to bring technical, scientific and organisational expertise towards the setup of NRENs in West and Central Africa, mostly a Francophone region.

What are the outcomes of your collaboration and what are you looking forward to?

Let me talk about the TANDEM outcomes as TANDEM is a great example of what a community can achieve together and has allowed to secure future developments in the region. RENATER was a work package leader in TANDEM project managed by IRD (Institute for Development Research) focusing on supporting the development of NRENs in West and Central Africa and allow WACREN to build the regional network through AfricaConnect2.

One of the main achievements of this collaboration is the creation of a high level think tank – the PODWAG – which has brought ministers, regulators, international funders such as the World Bank to the table to discuss the importance of R&E networks in Africa's development and facilitate their creation. I look forward to more interactions at this level during the lifetime of AfricaConnect2, with a ripple effect from West & Central Africa to the rest of the continent in creating a more inclusive pan-African information society.

The second achievement is the engagement with users, and specifically librarians in the region through the creation of Focal points by TANDEM which should allow universities and research centres to play a more central role in designing the appropriate internet services for their communities.

Last but not least RENATER has worked very closely with WACREN to provide a roadmap for WACREN development with a portfolio of services and infrastructure recommendations to support the network long term strategy, which is available on the TANDEM website.

TANDEM ENDS, WACREN RISES UP

The Horizon2020-funded TANDEM project (TransAfrican Network Development), aimed at obtaining user, political and financial engagement towards the development of the West and Central African Research and Education Network (WACREN), ended on a high note at WACRREN2017 on 29th March in Abidjan, Côte d'Ivoire.

After two days of workshops involving librarians, scientists and network engineers, the event culminated in a round table gathering policymakers, decision makers and end-users to discuss their joint vision for a connected African research and education community.

After two years of awareness-raising both at the political and the R&E community level, TANDEM's legacy offers the environment for the first first regional REN in West and Central Africa to grow, thanks to three pillars:

- The PODWAG, the ''Policy makers, Donors, regulatory authorities of West and Central Africa Group" which brought key decision makers around the table to facilitate the development and adoption of R&E networks for the region.
- The Focal Points, a task force made of academics and R&E experts first deployed in NRENS and then in universities to create engagement from end users. Now the task force is strongly led by librarians leading the way to the Libsense initiative.
- The WACREN service portfolio which will serve as a roadmap for the regional network development.

TANDEM was jointly managed by IRD, CIRAD, with the support and involvement of RENATER, GÉANT and other international partners.

AFRICACONNECT2 ATTRACTS MORE ALLIES AT WACREN2017

The third annual conference of the West and Central African Research and Education network took place on March 30-31 in Abidjan, Côte d'Ivoire and welcomed over 160 participants. AfricaConnect2 was the platinum sponsor and generated a strong engagement from the research and education community as well as from:

- the African Union Commission which endorsed the key role of AfricaConnect2 in enabling the AUC digital agenda for a booming African youth (set out in their Agenda 2063);
- the Ministry of Togo, who encouraged colleagues from partner countries to come on board;
- representatives of the Economic Community of West African States (ECOWAS) and telecommunications regulators who responded to the call for fairer connectivity prices.

The week ended up in a climax with Côte d'Ivoire signing AfricaConnect2 financing agreement, following Mali and Togo and recently joined by Burkina Faso. These national commitments are the building blocks needed to start developing the first regional research and education in West and Central Africa. Furthermore, the three regional networks involved in AfricaConnect2, the UbuntuNet Alliance, ASREN and WACREN committed to a pan-African training initiative in the framework of AfREN.

In order to achieve all this, everyone's commitment and effort is needed to ensure fair prices, more dedication and engagement at national levels from the scientific community, but WACREN2017 certainly took another promising step forward in all these arenas.

THE CONNECT INTERVIEW

HEATHER FLANAGAN

Heather Flanagan is heavily engaged in the standards development community, and actively involved in international research and education identity management discussions. Heather has run identity management tutorials around the world, including at WACREN 2016 and APAN 42. CONNECT caught up with her to talk about her role as the RFC series editor which she has now carried out for the last six years.

Heather, can you give us a bit of background on the IETF and the RFC series?

The first RFC was published on 7 April 1969 – 48 years ago. This was the first of a series on computer networking in general, and on the Internet protocols in particular. The RFC series emerged from the US government-funded research efforts that created the ARPANET and later the Internet. When the Internet Engineering Task Force (IETF) and its sister organisation the Internet Research Task Force (IRTF) were formed in the mid-1980s, RFCs became the primary publication vehicle for IETF publications, which includes technical standards, best practice documents, informational material, and descriptions of experimental efforts. Today the IETF meetings have a regular attendance of about 1500 people from all over the world, with the next IETF meeting coming up from 16 – 21 July in Prague. The amazing thing is the continuity in the community, with some attendees coming to meetings for the last 30 years.

So, what is your role?

It is important to me to support the open development process and the internationalisation of protocols. The role of the RFC Editor in making RFCs accessible to engineers and organisations from around the world is a very important part of what we do. One major pragmatic, but technically rather difficult step towards accessibility was taken just last December, when I published RFC7997 which introduces the use of non-ASCII characters in RFCs. While English remains the required language of the Series, the encoding of future RFCs will be in UTF-8, allowing for a broader range of characters than typically used in the English language. I also regularly interact with the W3C and NISO, ensuring that we are in line with the latest standards for digital publishing.

I saw the April Fools Day response to your RFC: "The Arte of ASCII: Or, An True and Accurate Representation of an Menagerie of Thynges Fabulous and Wonderful in Ye Forme of Character"

In the true spirit of the IETF community, April Fools RFCs are deeply embedded into our community´s culture! But seriously, the move away from ASCII was needed; we have to be practical!

Back to what I do. I provide the executive oversight to the RFC Series, which includes the RFC Production Center and Publisher. The RFC Editor is NOT responsible for approving Internet Drafts; that is the responsibility of the contributing stream (such as the IETF and the IRTF). I work with the editorial team and the community to ensure that an approved draft is turned into an RFC ready for comments and discussion in the relevant tracks. Over the years, the number of published RFCs has stabilised to about 350 per year. Normally, we can turn an approved draft into an RFC within 6-8 weeks, but the standards process which leads to approval can take much longer as it is fully consensus driven. Not every Internet Draft becomes and RFC, and not every RFC is a standard.

What do you think have been the major changes and challenges in the Internet technical community, including the IETF, over the years?

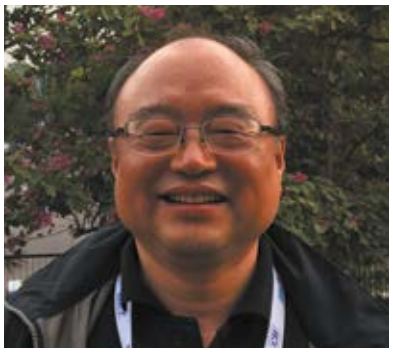
The Internet is a constantly evolving, maturing creation, and it is important that a diverse set of experiences be brought to the standards development process. Continuing with the IETF as an example for a global, open, volunteer-driven standards development organisation, new people from a variety of backgrounds are always needed to strengthen and enrich the standards development processes. Encouraging diversity is important so that the standards cover all the necessary use cases. I think that diversity comes with invitation and openness, as well as mentoring and coaching. The appointment of women to almost all of the major positions in the organisation is certainly one of the more significant changes we have seen in recent years. A real challenge for the IETF is maybe a similar challenge to what GÉANT experiences: being an inherently consensus driven community in a multi-million dollar competitive business as the Internet is today. And talking about GÉANT, NRENs have a role to play in the development of RFCs and standards! New people are always welcome, as the IETF is completely open to newcomers. There is no formal membership, no membership fee, and nothing to sign. We even have a mentoring programme to aid the integration. The July meeting in Prague is particularly well suited to GÉANT attendees!

One last question, Heather, as this is our TNC17 issue of CONNECT – what are you expecting from your week in Linz?

This is my turn to be a part of making the Internet better! I am not an engineer, but everyone—even non-technical people--has something to offer. I am looking for groups that need help organising in order to make progress on their ideas, and I am looking to learn more about what ideas are coming to light.

Q&A

ASI@CONNECT – BRIDGING THE DIGITAL DIVIDE ACROSS ASIA-PACIFIC



BYUNGKYU KIM (BK), EXECUTIVE OFFICER OF TEIN*COOPERATION CENTER (TEIN*CC)

JIE AN (JA), CHAIR OF ASI@ CONNECT STEERING COMMITTEE, CERNET, CHINA

R S MANI (RSM), CHAIR OF ASI@CONNECT GOVERNORS, NKN, INDIA

Asia@Connect marks the 4th phase of EU funding to the TEIN programme that successfully established a regional network across Asia-Pacific in 2006 and has progressively expanded its geographical footprint over the years. With a further substantial five-year EU-funding commitment of €20M until 2021, focus during this project phase will be on increased involvement of additional partners within the Asia-Pacific R&E community to deliver the project and on stepping up efforts to support, in particular, the emerging countries.

Following the celebrations for its official launch at APAN43 in February in New Delhi, work has now begun in earnest. Helga Spitaler from GÉANT caught up with key project representatives to find out more about this ambitious project and their plans to successfully deliver it over the next five years.

Who is behind Asi@Connect?

BK: As coordinator and beneficiary of the EC Grant Contract, TEIN*CC has overall responsibility for implementing the Asi@Connect project. In line with sustainability arguments, we were established as a non-profit organisation by the Korean government to take over project and network management from DANTE (now GÉANT) at the end of TEIN3 in 2012 and, as such, we represent and act on behalf of the 24 project partners. In actual fact, it is the Asi@Connect Governors representing the partners and the Asi@Connect Steering Committee drawn from amongst the Governors that are the real face of Asi@Connect and its objective of creating a networking environment in which R&E collaborations can flourish. And, of course, Asi@Connect continues to benefit from GÉANT's strong partnership and advisory role.

What sets Asi@Connect apart from previous project phases?

BK: Well, in the past the focus was primarily on creating a physical network, by procuring regional Asia-Pacific connectivity and internationally with Europe. The TEIN Initiative started with a single circuit between France and Korea in 2001, during subsequent EU funding rounds (TEIN2/3/4) we saw significant expansion to the point that, 16 years on, we have the world's largest regional backbone in place!

JA: Indeed. Asi@Connect will continue to upgrade capacities and extend the geographical footprint by connecting additional countries, such as Afghanistan and Myanmar. But with Asi@Connect the focus has shifted towards capacity development, application programmes to promote and increase utilisation of the TEIN network and towards new initiatives to tackle the digital divide in emerging countries. For these expanding activities we have set up new delivery procedures, based on Calls for Proposals (CFPs), with a rigorous selection process and the EC's final approval. The Steering Committee (SC) plays a vital role in ensuring that this complex process runs smoothly, is fair and transparent.

The first CFP was announced at the end of December 2016 with a closing date a month later. We received 52 proposals from 18 countries/economies – an amazing but, to be honest, also overwhelming result with a steep learning curve ahead for us. The SC members rolled up their sleeves, set up review committees and, following a rigorous evaluation process, went on to recommend 13 solid proposals to the Asi@Connect Governors.

RSM: Involving the wider community in delivering and, by extension, benefitting from Asi@Connect lies at the heart of this project phase. There is a strong drive to focus on the Least Developed Countries (LDCs) and on activities with strong societal impact. The partners have come together with a common objective to contribute towards community development by providing high-capacity, high-speed network access as well as funding outreach for proposals that have the potential of fostering development in the region. In this context, Asi@Connect aims to contribute towards a number of Sustainable Development Goals through improved access to education and research resources. Don't get me wrong, securing tangible benefits to the population at large has been obviously an objective also during previous project phases, but Asi@Connect brings this mandate to the next level through its structure, focus and delivery mechanism.

BK: Worth adding that each of the 6 work packages focuses on different aspects of development and requirements, be they technical capacity building, deployment of specialised network services or application support. The aim is to help community members develop and consolidate sustainable networks, develop skill sets and platforms for knowledge exchange and ultimately support the development of the community.

Picture
Official Asi@Connect launch during APAN43 in New Delhi

A solid backbone is there – but how will you ensure that its connectivity is actually being used?

BK: Promoting the benefits of the network is key to the success of the project, reason why an entire work package is dedicated to encouraging network-enabled R&E collaboration and application sub-projects. In parallel, we need to equip our partners, particularly in LDCs, with the necessary technical expertise to be able to support their users. Capacity building, in turn, will catalyse further R&E activities and lead to increased network usage - so a virtuous circle all round. Actually, we have seen the positive effects of this approach already during TEIN4: we held 22 application and 29 Human Resource Development (HRD) training workshops which led to the expansion of the tele-surgical TEMDEC programme, uptake of eduroam as well as to campus network design and NREN development led by the Network Startup Resource Center (NSRC). And we have 'inherited' great EU-Asia R&E collaborations, such as in the fields of high-energy physics (LHCONE), weather forecasting (EUMETSTAT) cultural cyber-performances, food security and disaster warning which we will continue to support.

JA: When talking about network usage we have to take into account that there is a difference between partners with a well-established NREN and active user engagement and those that are just building their national networks. It is important to identify target applications with societal impact which benefit in particular developing countries and are led by more advanced partners. It is equally important to support the very basic network usage and encourage collaborations in the LDCs.

RSM: A lot of R&E content is readily available to the public on the internet, via asymmetric routing. Efforts should be made in the direction of getting this content uploaded to R&E networks, where traffic can also be monitored. The delivery mechanism for content generated in small-scale experiments, for example, or for contents delivered over VC, should be cost-effective, have maximised impact and stimulate further peer collaboration. Tools which would support effective utilisation and secure access of the R&E content by people across various time zones should be developed and promoted.

At NKN I have seen utilisation of connected institutions grow from 100 Mbps to multiple 10 Gbps in a span of 2-3 years. Until 5 years ago, high-speed access was a scarse commodity for the research community in India. NKN changed that landscape, latency is a thing of the past and sharing of compute resources and data between institutes commonplace. However, I want the collaborative platform to be even stronger. Research in the future will be multi-disciplinary, for effective collaboration to happen we should build a repository of experts whose knowledge can be harnessed and shared across projects. The impact of a network can only be measured on the network of effective collaborations that it can help build.

What are the main challenges ahead?

BK: Ensuring long-term sustainability of the project and establishing a self-sufficient organisation behind it. This implies engaging in targeted lobbying activities with key stakeholders, i.e. national governments, to ensure they understand the need for R&E networking and provide the necessary funding support.

JA: The much larger EC-funding share, the scale and complexities of the project and the CFP procedure, which is new to us, certainly keep us on our toes. One of the main challenges the SC faces is to assist TEIN*CC in defining the activity plan for the next 5 years and fine-tuning the proposal section process. Another challenge is how to best coordinate 24 NREN partners and involve like-minded organisations such as APAN, ISOC, APNIC and NSRC to stimulate good proposals. And, finally, how to help TEIN*CC monitor and ensure that the awarded sub-projects are successfully carried out.

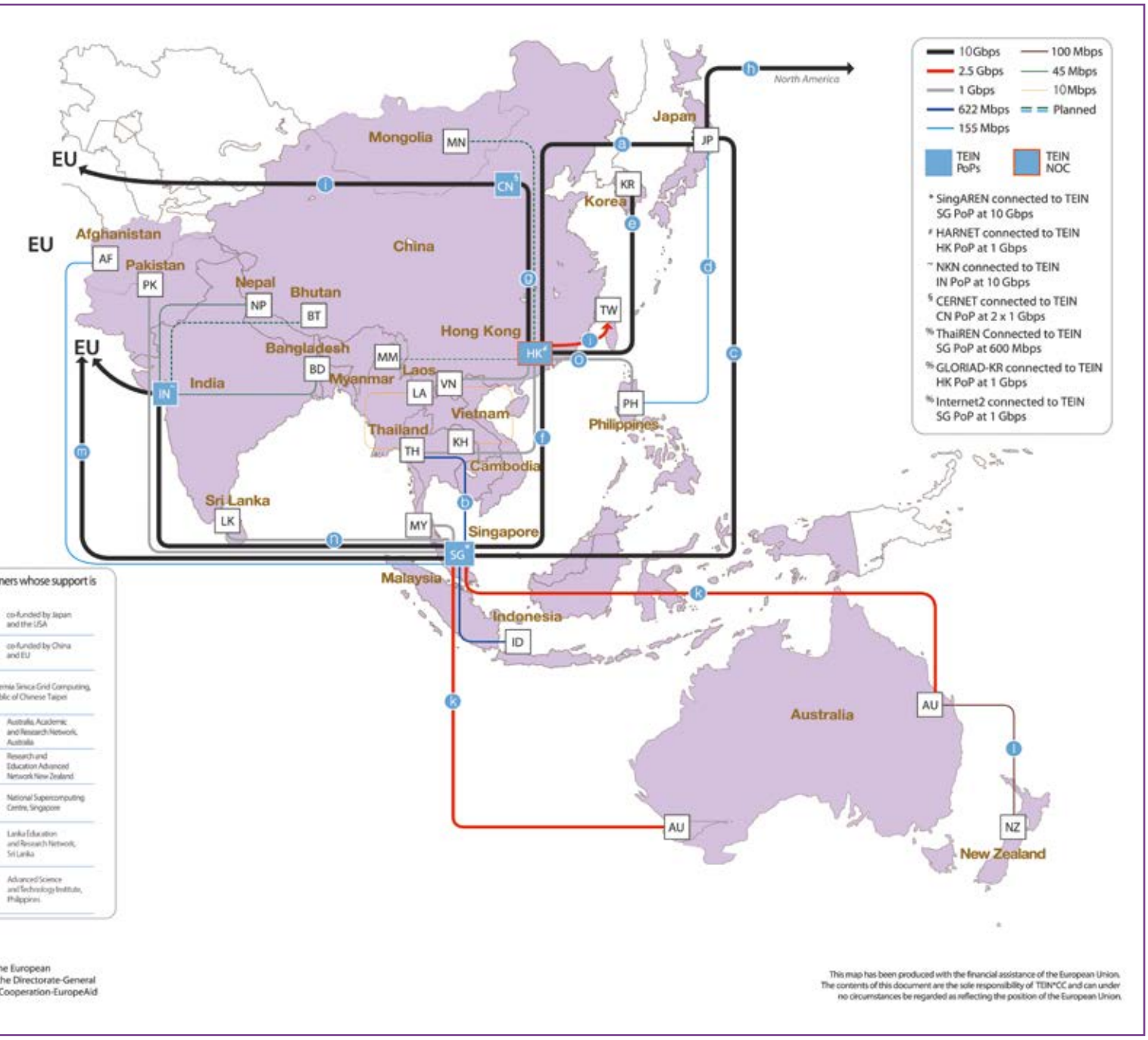
RSM: In my opinion, making this initiative sustainable without depending on resources from the networking partners and progressively making the application portion of the project self-sustained is a major challenge on the road ahead. Another challenge is how to make developing and under-developed countries part of the mainstream activities of Asi@Connect. Penetration, awareness and utilisation of the R&E network in countries which have just been connected or are yet to be connected will need to be worked on. We need to encourage more proposals from those countries. If required, we can also hand hold them and work with them to develop good proposals.

Picture
TEIN Network topology as of Dec 16

What are your expectations for the next five years?

JA: I would like to see all partners join forces and work with other local organisations to successfully implement this ambitious project. We want to live up to the expectations of the European Union and help bring the best minds together. I do think that it is within our reach to achieve the objectives, build a mature proposal evaluation procedure, devise a solid monitoring system and make Asi@Connect a real success.

RSM: As representative of India and NKN, I would like to see a mechanism put in place to calculate quantifiable



benefits to the end user and the community and regional connectivity being scaled up by supporting other countries via the Asi@Connect platform.

As Chair of Governors, my key expectation is that each Governor makes a diligent effort to maximise utilisation of R&E connectivity in their respective countries and bring it to a stage where it becomes indispensable. I expect them to create a platform where the value of the R&E network is appreciated, thereby increasing the number of collaborations in the region. I would also like to encourage tapping into the existing expertise in Asi@Connect, in the form of ISOC, NSRC etc. and use them to set up teams of experts that can help build a bridge between developed and developing countries. The knowledge that resides across the 24 Asi@Connect partner countries is immense, if we can find a mechanism of tapping this potential and building a repository of this talent, I feel we can really make a difference!

Asi@Connect is funded by the European Union under Grant Contract ACA2016/376-562.

For more information about the **Asi@Connect project visit www.tein.asia**

Asi@Connect Work Packages

WP1: Network procurement and management

WP2: Capacity development of NRENs in developing countries

WP3: R&E network design & operations and associated capacity development

WP4: Development of specialised network products, services & applications and associated capacity development

WP5: Promoting Asi@Connect-enabled R&E collaborations for societal benefit

WP6: Helping to bridge the digital divide in developing countries

NEW INTERNATIONAL CONNECTIONS IN THE MIDDLE EAST AND PERSIAN GULF

INSTITUTE FOR RESEARCH IN FUNDAMENTAL SCIENCES
IPM
پژوهشگاه دانش‌های بنیادی

IRAN

Extending its international connectivity, GÉANT has recently signed an agreement with IRANET (Iranian Research and Academic NETwork) to interconnect their backbones for the first time. The peering, initially at 1 Gbps, is provided via VLANs to GÉANT's PoPs in Amsterdam and Frankfurt.

Serving Iran's R&E community and connecting over 50 universities and research centres, IRANET is operated by the Institute for Research in Fundamental Sciences (IPM) based in Tehran.
The interconnection is set to benefit international collaborations in areas such as physics, brain engineering, cognitive sciences, particles and accelerators as well as nanotechnology.

OMREN
الشبكة العمانية للبحث العلمي والتعليم
OMAN RESEARCH AND EDUCATION NETWORK

OMAN

The GÉANT Board has also given approval to a first interconnection between GÉANT and OMREN, the NREN in Oman, which currently connects 6 major universities, with 23 additional sites in the process of being connected. The initial 155 Mbps peering is at NetherLight in Amsterdam.
OMREN has been recently launched by the Omani Research Council (TRC) to promote scientific research in the Sultanate and has established a strategic partnership with the national internet service provider OmanTel.

جامعة الملك عبدالله للعلوم والتقنية
King Abdullah University of Science and Technology

SAUDI ARABIA

GÉANT and KAUST (King Abdullah University of Science and Technology) in Saudi Arabia have renewed their existing interconnection agreement, originally set up in 2014, for a further 3 years. It continues to provide 1Gbps peering at NetherLight in Amsterdam.

FIND OUT MORE:

IRANET: **www.iranet.ir**
IPM: **www.ipm.ac.ir**
OMREN: **http://omren.om**
KAUST: **www.kaust.edu.sa**

NEW MOU EXTENDS COOPERATION BETWEEN GÉANT AND NII

Picture
SINET team

大学共同利用機関法人 情報・システム研究機構
国立情報学研究所
National Institute of Informatics

GÉANT and NII (National Institute of Informatics) in Japan have recently reaffirmed their commitment to advance integrated research and development activities in ICT-related fields by renewing their Memorandum of Understanding (MoU) for a further five-year period (2017-2021).

Building on successful collaborations under previous MoUs, the parties have identified the following areas for initial joint activities:

- Software Defined Networking (SDN) testbeds and development of production level services;
- trust and identity management services and technologies;
- cloud services adoption in academic communities;
- promotion of 100G-oriented research applications.

Prof. Shigeo Urushidani, Director of Cyber Science Infrastructure Development Department, NII welcomed the new MOU: **"International connectivity, including a direct connection to Europe, is a vital element of NII's strategy to support our user communities and to advance global scientific research. But our relationship with the GÉANT community is not just about connectivity, our relationship has always been and continues to be forged by skilled people committed to explore together how to improve our network infrastructure, roll out new services and jointly assist bandwidth-demanding research projects, such as Belle 2 and ITER/BA. Creating a network environment in support of research programmes between Japan and Europe is at the very heart of this cooperation agreement."**

MORE INFORMATION:

Signed in 2005, the first MoU between NII and GÉANT (then DANTE) stimulated cooperation in the context of the TEIN project in the Asia-Pacific and helped foster direct collaboration between Japan and Europe.

SINET5

NII operates the Japanese Science Information Network (SINET5), a 100Gbps full-mesh backbone serving 3 million users at over 800 Japanese universities and research centres and provides a 20 Gbps direct connection with the GÉANT network.

For more information on NII and SINET5 visit **http://www.nii.ac.jp/en** and **https://www.sinet.ad.jp/en/top-en** respectively

WELCOME TO LIFE AT GÉANT

GÉANT is a unique organisation that plays a pivotal role for research and education worldwide. A new initiative called Life at GÉANT is helping to attract new talent with a closer look at the people inside the organisation and what excites them about their working lives. Here we feature just two stories to give you a flavour of Life at GÉANT. See **www.geant.org** for more!

MANDEEP SAINI, PRINCIPAL SOFTWARE ENGINEER, CAMBRIDGE

Tell us about your life at GÉANT

I am currently involved in three activities within the GÉANT Project GN4-2 focussing on areas such as Application Services Delivery Development, Trust and Identity Development and Network and Service Assurance. More specifically, I am working on cloud services and on the collaboration suite to address Authentication and Authorisation Infrastructures (AAI) needs for research groups whose members are spread across different organisations in different geographical locations.

I feel particularly passionate about my work on Federated Identity Management (FIM) which is very peculiar to GÉANT as an organisation. For the benefits of those working outside our industry let me explain that FIM is an arrangement that can be made among multiple member organisations to share their resources by allowing individuals to use the same login credentials across security domains. I enabled project participants to log in to SharePoint web applications using their federated identity and also set up a central authorisation management system to handle the access rights of approximately 500 project participants from the NREN partners across Europe. Without a shadow of doubt, such changes made life for our IT department so much easier!

What do you enjoy about life at GÉANT?

Since I joined GÉANT as a full-time employee I have covered a wide variety of roles. The organisation has supported me every step of the way with career progression and keeps offering me great opportunities for professional growth. In addition, working in a Research and Education (R&E) environment drives me to learn something new every day in order to keep up to speed with technology.

GÉANT's work atmosphere is very special, its multicultural and multinational environment is very inclusive and diverse. I love my team, my colleagues are my work family, we are all very close and discuss openly and frankly on most topics. I am also very fond of my life in Cambridge, I am happy to live in such a family-friendly city.

What are the big opportunities?

We operate in a very innovative environment where new areas of research need to be explored continually. In the coming years we will need to carry on working on FIM and cloud services in order to bridge the technology gap not only between R&E and industry, but most importantly between developed and developing countries.

About Mandeep

I came from India in 2005 to complete a M.Sc. in Distributed Systems and Networks at the University of Kent. The subject of my thesis on Multi-domain Network Monitoring Systems applied to an industrial project lead to my student placement at GÉANT where, in just over one year, I was able to start my career as a fully-fledged employee and member of the Systems Team.

NADIA SLUER, PROJECT MANAGEMENT ASSISTANT, AMSTERDAM

What attracted you to GÉANT?

I joined GÉANT in 2012, the organisation's international environment and atmosphere attracted me straight away and still suit me perfectly. After spending most of my career in multinational corporations I jumped at the opportunity to join a smaller and not-for-profit company like GÉANT. It's a truly unique place to work, its set-up is ideal and I can see a clear career development path ahead of me.

Tell us about what you do at GÉANT

Since I joined GÉANT I have been learning continuously. My job as Project Management Assistant is very dynamic and never repetitive. I work with various Project Development Officers on different and exciting initiatives. I also have ownership of specific projects, mainly focussing on education.

Only a few months after starting, my manager and mentor retired and I inherited the leadership of a specific activity within the GÉANT Project GN4-1. It was reporting time and I needed to coordinate, present and also defend the activity's specific results. It was quite an intense period, but I received incredible support from my colleagues in the Project Office who helped me enormously; I was overwhelmed with their kindness, guidance and direction.

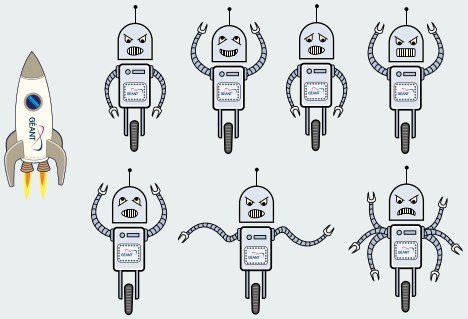
I am part of the growing Learning and Development team. The focus of a major project I am currently working on is to look for and engage with young talents and attract them to our community, specifically I refer to the NREN community to which GÉANT belongs. The exciting new programme is entitled Future Talent Fund and is currently being deployed across Europe. One of the project's initiatives is to enable all NRENs to encourage students to submit a proposal for a talk at TNC17. Hopefully the first of many new programmes and activities of this type. As a mother of three teenagers, I feel this project very close to my heart; we need to provide young people with the best tools to shape the world of tomorrow.

About Nadia

I am originally from the Dutch Caribbean island of Curaçao, but I have lived in the Netherlands since childhood. I pursued my higher education in Amsterdam where I achieved a Bachelor degree in Business Economics and Linguistics. My career prior to joining GÉANT has been very varied: I have worked for international corporations, start-up companies and have also been an entrepreneur. I enjoy the buzz of dynamic organisations and love innovative environments; it's in my genes!

To read all the interviews featured in Life at GÉANT visit: **https://www.geant.org/About/Joining_GEANT/life-at-GEANT**
Happy reading!

OCX
OPEN CLOUD EXCHANGE



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THE CONNECT INTERVIEW

PAUL HASLEHAM

CREATIVITY NEVER STOPS FLOWING

CONNECT talks to Paul Hasleham, Digital Design Manager and graphic designer extraordinaire at GÉANT. Paul is an established member of the Marketing Communications team and has been involved with the GÉANT Project via the NA2 (Communications and Outreach) Activity over the past five iterations of the project. Despite his creative nature Paul is quite reserved and prefers to avoid the limelight, so we are thrilled to finally feature him in CONNECT. With this overdue interview we take the opportunity to highlight just how much of Paul's work features in our digital and printed communications materials.

Paul, tell us about your role at GÉANT and how it has changed throughout the years.

Believe it or not I was originally employed as the DANTE webmaster in 2007 and now I oversee everything that requires design creation and input for GÉANT: from printed brochures to exhibition panels, from video editing to presentations and web design… the whole nine yards! My team is growing and in the next couple of months a new designer will join Fiona Baylis, our web editor, and myself to help share the ever growing workload.

What is the most rewarding aspect of your job and… the most challenging?

What excites me about design is communication. The way language is processed and understood. I always strive to challenge and rethink this process and enjoy taking on totally new initiatives that force me to think laterally. Like most designers, I am particularly fond of projects that give me a great deal of creative freedom, but when this doesn't happen, it's just a different type of challenge.

I strongly believe in the motto: "a designer is only as good as his/her last work", so in a way, everything is a challenge.

How do you think online design resources are influencing the graphic design being produced today?

I am afraid design is looking less experimental, less memorable and less unique. It's more standardised, more fashionable and less impactful. The large amount of templates populating the web is generating many improvised designers and producing less personalised solutions; I personally don't see how a design created for a specific purpose can be forced to fit a completely different brief.

How do you see GÉANT's brand evolving?

The GÉANT brand is currently in a transition phase subsequent to the changes undergone by the organisation in the last two years. I have been working closely with a variety of colleagues to create new branding elements that will be more representative of our very unique organisation. Once these are finalised, we will all need to come together and adhere to them to ensure consistency of our brand. Ensuring that both our messaging and visual branding are clearly and consistently applied across all communication channels is fundamental, as strong branding reinforces an organisation's identity and drives positive sentiment and trust. If we keep our visual identity and key messaging consistent, we will effectively develop and strengthen our brand, helping GÉANT make a far stronger and longer-lasting impression.

From where do you draw inspiration and creativity?

Everywhere and anything; creativity is not something that happens during working hours only. I find myself thinking about new design ideas at any time of the day and night. I usually find myself doodling and scribbling to ensure I do not forget by the time I am next in the office. I just love the creative process; from nothing to a concept and to a finished piece of work can sometimes take only a few minutes, whilst other times it could be days before I am fully satisfied with a concept that I have developed.

Tell us about your artistic and design influences

Definitely Hockney and Picasso – I just love their view of the world. When I was at college I was inspired by David Carson and Neville Brody because they were the 'rock stars' of the profession, Paula Scher's work still resonates with me because what she produces has the creative freedom we all aspire to achieve.

FAVOURITE FILM?

Blade Runner – I was about 18 when I saw it and it blew me away – great story, great visuals and great soundtrack.

WHAT ARE YOU READING?

John Lydon's biography – An icon from my youth - I just wanted to know a little more about him.

LAST ALBUM YOU BOUGHT?

My son is in a band so I have most recently bought his latest EP… I still have to buy them despite being their roadie!

WHERE WAS YOUR LAST HOLIDAY?

Charmouth, Dorset, UK. In a caravan, right on the beach! The walking and the weather were brilliant!

DESCRIBE YOUR PERFECT DAY OFF

Family, friends, drinking, eating and laughing.

25 YEARS OF THE INTERNET IN THE CZECH REPUBLIC

The Czech Republic, then Czechoslovakia, officially joined the Internet on Thursday, 13th February 1992. Experts from the Czech Technical University (CTU) of Prague, led by Jan Gruntorád, currently CESNET CEO, gathered to celebrate the historic occasion that enabled Czechoslovakia to become the 39th country to connect to the Internet. The very first connection was established between Prague and Linz in Austria.

Few people could have anticipated the tremendous boom of the Internet in the years to come. "Once all our calculations were completed, having taken into consideration Czechoslovakia's macro-economic situation at the time, we discovered that the cost of sending one e-mail message would amount to a thousand Czech crowns (40 EUR). Hence, we first envisaged that the Internet would be exclusively used to support scientific and research collaborations." Jan Gruntorád remembers.

Back then, the Internet was not the open environment it is today. Connections required the consent of the US National Science Foundation (NSF), which ran and fully financed the only Internet network backbone at the time. Requisite for connection was its exclusive academic use; commercial operations were not allowed.

OFFICIAL ANNIVERSARY CEREMONY

In February this year CESNET organised a ceremony on the same day and in the same location where the original event took place 25 years ago. Leading representatives from the Czech and foreign Internet and academic sectors took part; CESNET, to celebrate the momentous occasion, invited the same experts who had helped make the initial connection happen. All participants had the opportunity to listen to Steve Goldstein from NSF – who had attended the first event in 1992 - and Vint Cerf "the father of the Internet"; in addition, Oliver Popov from the Central and Eastern European Networking Association (CEENet), Pavol Horváth and Tibor Weis from the Slovakian NREN SANET also gave talks.

RESEARCH NETWORKS AS INNOVATION LEADERS

A series of lecture on Research Networks as Innovation Leaders focused on the present and future development of the Internet at academic level. Valter Nordh, a member of GÉANT's Board of Directors, spoke about the importance of cooperation on the path to innovation, highlighting the very successful eduroam project.

One of the speakers was Professor Cees de Laat, chair of the System and Network Engineering (SNE) research group in the Computer Science Institute of the Faculty of Science at the University of Amsterdam and co-founder of the Global Lambda Integrated Facility (GLIF). Professor de Laat emphasised the need for further research and development; his contribution began with a brief overview of the vast amount of research data that currently flows through the Internet. Another contributor was Joe Mambretti, director of the International Center for Advanced Internet Research at Northwestern University and director of the Metropolitan Research and Education Network (MREN) in the USA. His talk focused on research and development services for high-speed networks.

CESNET AS RESEARCH ENABLER

The closing talk was given by Jan Gruntorád who briefly recounted the key moments of the growth of the Internet and its development in the Czech Republic. He then described how CESNET has since become a leading provider of the country's e-infrastructure, managing the backbone network at speeds of up to 100 Gbps. In addition to the communications infrastructure, CESNET also provides data storage, cloud and grid infrastructure for distributed computing, infrastructure for remote collaboration (video conferencing, streaming), security services (CSIRT security team, forensic laboratory, Antispam Gateway) and network identity management (eduID.cz, eduroam, PKI services). Some of the most recent achievements of CESNET's work were displayed in the event venue's lobby: these included a COMBO card for 100Gb networks and the Photonic Services of CESNET e-infrastructure, plus traffic monitoring and analysis services.

CESNET also specialises in the transmission of high-quality video, including HD, 4K and higher resolution and minimum latency transmissions (including real-time transmissions to multiple locations). It has also been developing UltraGrid, a software solution to enable video compression through graphics adapters, and MVTP (Modular Video Transmission Platform), a hardware system which is capable of achieving extra-low latency. UltraGrid has won an international award and MVTP has been patented. It is also worth mentioning last year's TNC conference in Prague where the public enjoyed a unique distributed concert for two organs. It was an impressive example of collaboration between partners within the GÉANT community and a demonstration of the technical possibilities of today's Internet.

Pictures
Top left: Petr Konvalinka, Rector of the CTU, Jan Gruntorád CESNET CEO, Valter Nordh SUNET CTO.

Centre: Live broadcasting with Jan Gruntorád, CESNET CEO and a journalist from Czech Television.

Top right: Vint Cerf´s speech at the Auditorium 256 at the CTU Faculty of Engineering in Prague.

Bottom right: A unique distributed concert for two organs - Brno (Czech Republic) and Trondheim (Norway)

For further details about sessions and speeches, visit:
https://25let.online/en

13TH FEBRUARY 2017 IN THE MEDIA

The celebrations generated unprecedented media interest and coverage. The Director of CESNET gave extensive interviews and the Czech TV transmitted live from the event, broadcasting on ČT24 every hour throughout the day. All the major Czech TV networks reported on the anniversary celebrations in their evening news programmes. CESNET confirms that at least 76 media outlets covered the event.

OPEN PROGRAMMABLE NETWORKING

From Xantaro & Corsa Technology

10G and 100G links are becoming common in the NREN community. This is not just in the regional and backbone provider environments, but also within campus networks hosting DTNs and HPC clusters. The need for Nx100G networking is present and growing. At the same time we are looking at sharing and slicing these enormous networks. Traffic engineering, performance, and multi-tenant isolation must be addressed at the HW architectural level in order to build networks that work well.

To make this happen and to adapt to the changing network needs, open programmable (SDN) networking must lie at the heart of new network architectures. Corsa and Xantaro have a successful collaboration of carefully considering some of the key aspects of hardware design that are essential tools for building these types of networks that are the next generation (3.0!) in network innovation.

A hardware feature that best highlights the power of open, programmable networking is the Corsa Virtual Forwarding Context (VFC) capability. Network architects and operators are able to dynamically partition hardware into independent virtual SDN switches or routers (VFCs), operating at line-rate on the same shared infrastructure, via open programmable APIs. This allows them to slice their networks into virtual switching and routing instances with the same performance and throughput as if they had deployed dedicated physical infrastructure.

Each of the virtual forwarding contexts benefits from dynamically programmable advanced traffic management and QoS features which control and shape traffic within each VFC at the per-flow level to required rates as determined by the orchestration layer and network policy. Network users and operators can fine-tune traffic paths to ensure individual customers, subscribers or services receive their appropriate bandwidth and throughput. In addition, per flow statistics for all traffic is available, offering unprecedented real-time network insights at the most granular level and enabling any manner of predictive traffic management or security.

A deployed example of this open, programmable networking collaboration between Corsa, Xantaro and GÉANT is the GÉANT Packet Testbeds that can dynamically construct networks consisting of a variety of network resources – routing/switching resources, server resources, circuit and/or connection resources, storage resources, and specialised experimental hardware or software resources. The packet testbed facility is designed to be highly dynamic and virtualised, where each slice of the testbed is insulated from one another to prevent unanticipated behaviour from causing problems with other testbeds or other production services. The packet testbeds are useful for rapid prototyping and offer a realistic geographic footprint across Europe with access to external facilities and/or real traffic.

Xantaro & Corsa are silver sponsors at TNC17, please visit our teams at the Corsa stand to discuss the new developments in Open Programmable Networking.

ABOUT XANTARO & CORSA TECHNOLOGY

Xantaro a service integration partner for GEANT highly recommends Corsa Technology Openflow Ethernet Switches for implementation into the GEANT and the NREN networks. These networks are built using leading-edge technologies to create advanced, high-bandwidth infrastructure and end-to-end services that meet the needs of your partners and of their data-intensive R&E communities, facilitating collaboration and discovery by researchers around the world. Corsa's open programmable approach lends itself perfectly to addressing of today and tomorrow.

Corsa Technology are leaders in networking technologies, the solutions they build are perfect to operate as testbeds for innovation, providing the vital experience that drives successful adoption by commercial providers. Xantaro a system integrator with over 10 years experience in designing, building and maintaining carrier class networks, can now support the sourcing of Corsa products and services required for the NRENs to investigate programmable and virtualisation technologies. This will enable GEANT to deal with the exponential bandwidth increases and highly unpredictable traffic in a more flexible economical way.

For further information contact Xantaro on +44 (0)20 3857 2771 or email: enquiries@xantaro.net

Xantaro SERVICE INTEGRATION

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THE WELLCOME TRUST SANGER INSTITUTE SELECTS ARISTA FOR INNOVATIVE CLOUD-BASED INFRASTRUCTURE AS A SERVICE PLATFORM TO AID SCIENTIFIC BREAKTHROUGHS

The Wellcome Trust Sanger Institute is one of the world's pre-eminent genome research centres and was the single, largest contributor to the global Human Genome Project. As part of an ongoing strategy to enhance the agility of its information technology systems, the Institute has developed a standards based cloud using OpenStack software and Arista networking technology. With its new infrastructure as a service platform, the Institute is helping its scientists and research projects across the world gain better access to critical informatics resources.

PROJECT BACKGROUND

The Wellcome Trust Sanger Institute leads ambitious collaborations across the globe to provide the foundations for further research and transformative healthcare innovations. Since its foundation in 1993, The Sanger Institute has provided the ability to conduct research at scale and engage in long-term exploratory projects designed to influence and empower medical science.

CHALLENGE

Many of the projects rely on genome research which means the Institute is at the leading-edge of genomics technology development and implementation.

With vast quantities of scientific research data within its systems and projects generating tens of terabytes of new data daily, its IT infrastructure is a vital element of the Institute's ability to deliver new scientific breakthroughs. The Institute runs one of the largest computing resources in the UK with over 20,000 CPU cores and 40 petabytes of storage.

"A single Genomic sample can generate up to 160Gb of data," explains Dr Peter Clapham, Informatics Support Group Team Leader, "Just one of our projects is sequencing around 3000 samples and this data is then processed using various analysis techniques and made available for researchers across the world."

"One of our major requirements is the ability to scale. The sequencing process is becoming faster and our data sets are continually growing plus advances in processing technologies allows us to conduct more complex research in less time.".

SOLUTION

For the new service based architecture, the Institute chose OpenStack along with its Neutron component to deliver a set of application program interfaces (APIs) to enable interoperability and orchestration of network devices and technologies. "The network is critical in delivering a robust infrastructure-as-a-service (IaaS) environment," explains Dr Clapham, "Low latency and scalable performance were a given, but we also needed maturity on the SDN side."

Dr Clapham and his team examined a number of networking solutions. "We weren't just looking for a piece of hardware, we were looking for a partner," he explains.

Following an implementation project working closely with Arista Networks, the first iteration of the cloud architecture has been deployed. The cloud uses Arista 7060X switches throughout a design that has Layer 3 Leaf at 25GbE and Spine at 100GbE. The switch also uses a large shared packet buffer and delivers a maximum I/O rate of 6.4Tbps at a low latency of 450ns. The Institute also uses Arista's CloudVision portal software for centralized workload orchestration and automation as well as zero-touch provisioning.

CONCLUSION

"One of our scientists says that a project that would normally require queuing and months of waiting was completed in two days as the system was able to allocate and dynamically provision resources as they became available to complete the job faster." Explains Dr Clapham.

The improvements have also been felt by the ICT team. As Jon Nicholson, Networking Specialist for the Institute explains, "The major benefit is that there is relatively little to do on the networking side as CloudVision gives us a single access point for change control and management. The biggest shift for us is that we are now able to manage the infrastructure as code and this opens up more opportunities for automation."

For more information on Arista, visit **https://www.arista.com**

infinera®

GÉANT SELECTS INFINERA PACKET-AWARE OPTICAL TRANSPORT NETWORK TO SOLVE "ELEPHANT FLOW" PROBLEM

CUSTOMER: GÉANT

Challenge:

- Overcome Ethernet LAG limitations to better support "elephant flows" above 10 Gb/s
- Facilitate the upgrade path from 10 Gb/s to 100 Gb/s link speeds
- Reduce the cost of packet forwarding on backbone routers
- Flexibly upgrade GÉANT IP trunk capacity to keep up with traffic growth.

Solution:

- Use Infinera PXM in the existing DTN-X network
- Enable traffic routing across super-channel backbone based on VLAN or MPLS tags.

Results:

- Almost a 50 percent reduction in expensive router ports compared to non-packet-aware solutions
- Ability to evolve to dedicated 100 Gb/s backbone trunks as demand increases
- Forms the foundation of a packet-aware, software-
- defined network-capable Intelligent Transport Network

The GÉANT project is a European success story. For over 15 years, through the joined forces of national research and education network (NREN) organsations, the project has been a vital element of Europe's e-infrastructure strategy. GÉANT provides the high-speed connectivity needed to share, access and process massive volumes of data generated by, and essential to, diverse research and education communities working in areas such as particle physics, bioinformatics, earth observation, drug discovery, and arts and culture.

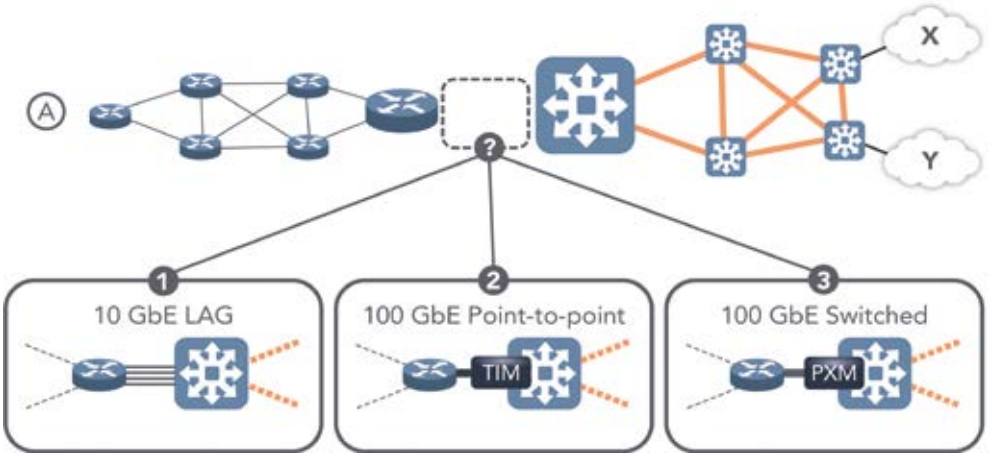

Figure 1: Three options for scalable evolution from 10Gb/s to 100Gb/s service rates

GÉANT'S CHALLENGE

The rapid growth in network traffic has challenged GÉANT's ability to grow the network beyond 10 gigabit per second (Gb/s) flows in a way that ensures network performance is both responsive and cost-effective. While Ethernet link aggregation group (LAG) works well for conventional flow sizes, there are well-documented issues with "elephant flows," which are flows with bandwidth demand that exceeds the individual link data rate of the LAG group.

Figure 1 shows the problem. Traffic flows from A, B and C to the remote location X (shown as the green dashed lines) consist of conventional, mixed flow sizes, with none of the flows exceeding about 3 Gb/s. Ethernet LAG will effectively distribute the traffic from these, and many other sub-10 Gb/s flows, across the four 10 gigabit Ethernet (GbE) links between the router and the DTN-X Intelligent Transport Network. This enables GÉANT to cost-effectively support aggregate traffic using an Nx10 GbE configuration on the router because 10 GbE router ports are relatively inexpensive.

The challenge occurs when the customer at location B, for example, generates a flow greater than 5 Gb/s (indicated by the red arrow in Figure 2). These flows are usually referred to as "elephant flows" and, because of the limitations of the Transmission Control Protocol (TCP), Ethernet LAG will try to direct this flow over a single link within the LAG. But because the flow size exceeds the capacity of individual LAG links, the only options are either to buffer the flow over a single link, or to fragment the flow over multiple links. In the case of sustained elephant flows, buffering will inevitably lead to packet loss, while fragmenting the flow may result in out-of-sequence packets arriving at the destination. Both of these conditions will cause retransmission of entire TCP windows, resulting in the sustained overloading of one or more network links [1].

The problem with the configuration shown in Figure 2 is the need to support both N x 10 GbE for conventional traffic patterns and a 100 GbE link dedicated to the elephant flows between locations B and X. GÉANT and Infinera worked together on a solution to maximise the utilisation of their existing DTN-X Intelligent Transport Network to resolve these challenges.

THE SOLUTION: ENHANCED PACKET SWITCHING

The Infinera DTN-X platform was chosen by GÉANT in 2011after a rigorous competitive bidding process. GÉANT particularly valued the ability of Infinera's multi-layer Intelligent Transport Network to provide terabit-class scalability, operational simplicity and efficiency, and high levels of flexibility and programmability. In 2012 GÉANT upgraded the transmission layer of their network using Infinera to enable multi-terabit capacity to be delivered to

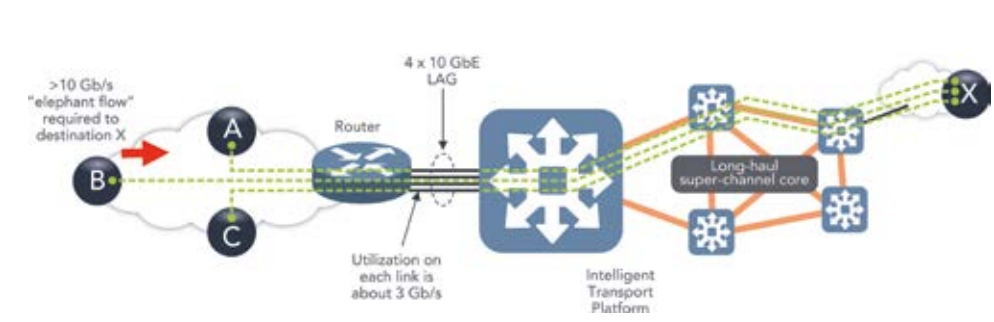

Figure 2: Using Ethernet Link

research and academic institutions in 19 European countries. Infinera recently enhanced the DTN-X Family by adding a Packet Switching Module (PXM) that provides advanced packet processing and quality of service (QoS) capabilities for Ethernet and multi-protocol label switching (MPLS) traffic flows.

Figure 3 shows how Infinera's DTN-X Platform with the PXM solves GÉANT's elephant flow problem. The PXM is a packet-aware Optical Transport Network (OTN) interface that identifies standard Ethernet virtual local area network (VLAN) tags and MPLS labels to direct traffic via the DTN-X backplane, and on to the destination across the super-channel backbone. This is achieved by the existing routers assigning aggregated flows to specific VLAN-tagged channels, upon which the PXM's role is to forward these flows onto IP trunks that have been dimensioned to suit.
The connections from A to Y, B to X and C to Z shown in Figure 3 can be individually sized using the ITU-T ODUflex protocol. Note that this single, 100 GbE link not only replaces the 100 GbE link shown in Figure 2, but it can also replace the N x 10 GbE links used for conventional traffic flows. This approach effectively "right-sizes" the OTN capacity available in the core, allowing resources to be utilised more efficiently. ODUflex resizing enables changes to be made dynamically in response to changing demands, and classic packet shaping and policing in the PXM can be matched to Metro Ethernet Forum Carrier Ethernet 2.0 bandwidth profiles. Furthermore, right-sizing in this way allows a smooth and cost-effective evolution to dedicated 100 Gb/s links as traffic flows increase by simply migrating high-demand flows onto dedicated point-to-point 100 Gb/s connections, and thereby freeing up the PXM capacity to support new sub-100 Gb/s elephant flows.

THE RESULTS: COST-EFFECTIVENESS THROUGH PACKET AGGREGATION

ÉANT has completed the initial deployment of PXM interfaces in the portion of the backbone that carries traffic to Eastern Europe. This traffic travels over fiber rings in Austria, Croatia, Czech Republic, France, Germany, Italy, Hungary, Slovakia, Slovenia and Switzerland.

As a result of deploying Infinera's Packet Switching Module, GÉANT has the option to reduce the number

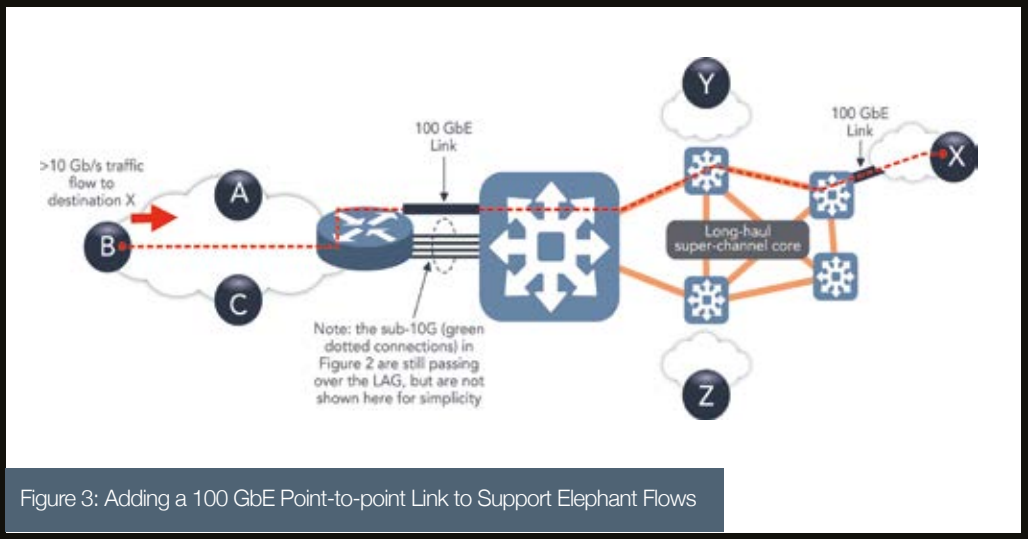

Figure 3: Adding a 100 GbE Point-to-point Link to Support Elephant Flows

of expensive router ports needed by almost 50 percent compared to non-packet-aware solutions, and as the initial pilot deployment is scaled up. In one of the design options, GÉANT would be able to reduce the number of 100 GbE router ports from eight to five by replacing eight Infinera 100 Gb/s ports with five PXM cards—a reduction factor that would continue to accumulate as GÉANT extends the roll-out to create a more meshed packet-aware topology. In addition, GÉANT has the ability to transition higher-demand connections to dedicated backbone trunks as demand increases, and the deployment of PXMs also forms the foundation of a packet-aware, Intelligent Transport Network that can be controlled at a more granular level using a Software Defined Networking (SDN) solution such as Infinera's Xceed platform.

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GÉANT has completed the initial deployment of PXM interfaces in the portion of the backbone that carries traffic to Eastern Europe. This traffic travels over fiber rings in Austria, Croatia, Czech Republic, France, Germany, Italy, Hungary, Slovakia, Slovenia and Switzerland.

As a result of deploying Infinera's Packet Switching Module, GÉANT has the option to reduce the number of expensive router ports needed by almost 50 percent compared to non-packet-aware solutions, and as the initial pilot deployment is scaled up. In one of the design options, GÉANT would be able to reduce the number of 100 GbE router ports from eight to five by replacing eight Infinera 100 Gb/s ports with five PXM cards—a reduction factor that would continue to accumulate as GÉANT extends the roll-out to create a more meshed packet-aware topology. In addition, GÉANT has the ability to transition higher-demand connections to dedicated backbone trunks as demand increases, and the deployment of PXMs also forms the foundation of a packet-aware, Intelligent Transport Network that can be controlled at a more granular level using a Software Defined Networking (SDN) solution such as Infinera's Xceed platform.

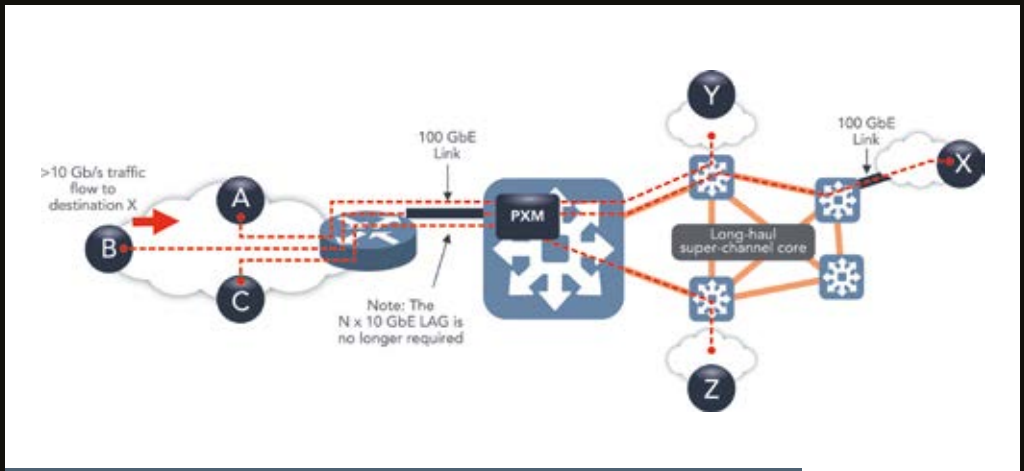


Figure 4: Using the Packet-aware PXM to Cost-effectively Support Elephant Flows

"Infinera's packet optical solution offers an effective approach to optimise the GÉANT network and efficiently and optimally handle large traffic flows," said Mark Johnston, Chief Network Operations Officer at GÉANT. "We look forward to realising the expected efficiencies and operational benefits of this solution, and continuing our excellent collaborative work with Infinera on future applications."

"One of the aspects of the Infinera solution that we really appreciate is the extensibility of the DTN-X platform," continues Mark Johnston, "Being able to add new capabilities with the Packet Switching Module enhances the services we offer our users and extends the life of the network infrastructure. It's what makes the DTN-X a genuine platform, and not just a product."

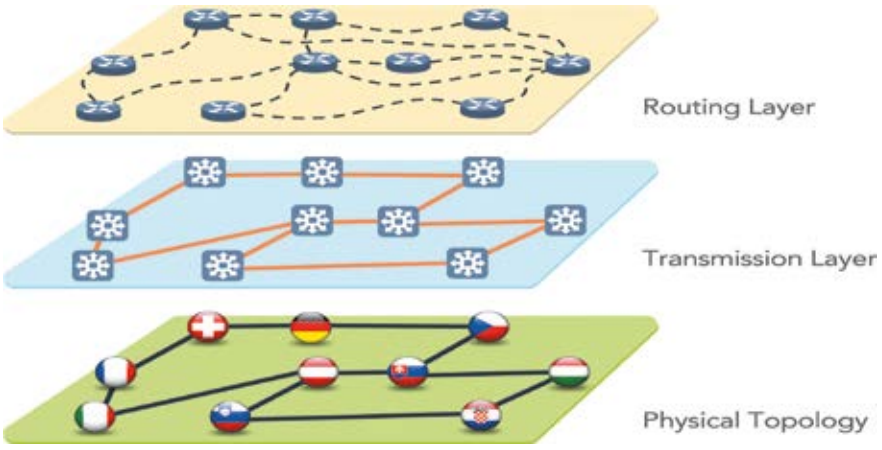


Figure 5: Physical, Transmission and Routing topologies can be common, or distinct

References

[1] Hacker, T.J. University of Michigan. "The Effects of Systemic Packet Loss on Aggregate TCP Flows". SC '02: Proceedings of the 2002 ACM/IEEE Conference on Supercomputing.

THE ELASTIC OPTICAL BACKBONE – A PERFECT FIT FOR R&E NETWORKS

All public or private telecommunications networks are supported by a high speed optical backbone. And while all optical backbones have common core requirements – there are some variations in other requirements depending on the underlying business.

National research and education network (NREN) customers, whose backbone networks provide connectivity for a diverse set of client institutions, have a unique set of needs. Their backbones must support a broad range of applications, from ultra-fast high-performance computing collaboration, to e-learning, and to special links with virtually zero latency. Here are some of their unique requirements.

One requirement worth emphasising that makes NREN backbones truly unique, is the ability to take on special tasks and to 'shine in the spotlight', as they may be called upon for "one off" demonstrations and showcases.

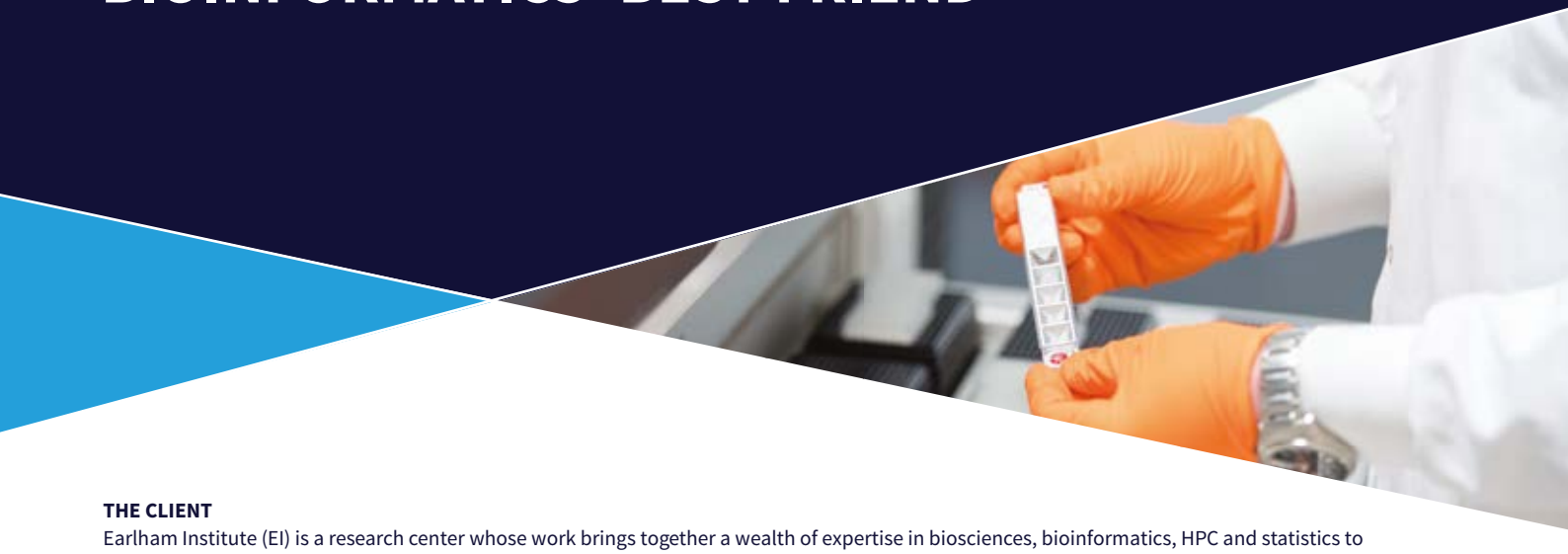
NREN backbones are also expected to support research in and around the various cutting edge technologies they are likely to incorporate, (i.e. high speed coherent transmission, SDN, and NFV). In short, NRENs need a smart and flexible optical backbone, which is dynamically adjustable to user requirements.

NREN REQUIREMENT	WHY	KEY ELEMENTS
 High bandwidth with high availability	To support high performance computing collaboration.	A standard set of client interfaces and high capacity network transport between them, as well as mechanisms for dedicated protection and dynamic service restoration.
 Platform for innovation	To support transmission and networking experimentation, and to showcase special capabilities.	A willingness and an ability to open up or customize system elements, to permit this.
 Tight integration with packet services	While optical networks need to support several types of client interfaces, they need to be particularly efficient at handling dominant packet traffic.	Optical transport packets (L2 packet services) are transported seamlessly over L1 optical or L0 wavelength facilities.
 Scalable and flexible	To economically serve a wide variety of institutional customers with different needs.	A family of platforms with interchangeable cards so that solutions can be right-sized depending on customer and demands.
 Easy to operate	To manage the network with a reduced operations staff.	A centralised and powerful network management system, with intuitive controls. Plus the ability to centrally and continuously monitor OSNR and other system performance aspects.
 Multi-vendor environment	To maximize use of current resources in an evolving environment.	Support alien wavelengths, or run as an alien wavelength on someone else's system. To support third-party equipment under a centralised NMS.
 Secure	To protect proprietary research as part of a national infrastructure.	Support L1 optical encryption for all client interface speeds.

VERNE GLOBAL

Earlham Institute
Decoding Living Systems

WHY ICELANDIC HPC IS BIOINFORMATICS' BEST FRIEND



THE CLIENT
Earlham Institute (EI) is a research center whose work brings together a wealth of expertise in biosciences, bioinformatics, HPC and statistics to understand complex biological systems in plants and animals and their interaction with the environment. Advanced genomics and computational platforms support data-intensive research and confront modern scientific challenges arising from data scale and complexity.

THE CHALLENGE
Cutting-edge, high-throughput DNA sequencing instruments generate large amounts of data, from a few hundred gigabytes to several terabytes per run. This output requires significant computing effort, making the storage, processing, analysis and sharing of the data extremely challenging.

Like any research institute that is governed by large data-driven science, EI is constantly dealing with large volumes of data arriving at very high velocity. This puts significant strain on their computing storage infrastructure, requiring increased storage space and data center hosting capability, as well as increased operational cost to cool the infrastructure.

In addition to the volume of data, EI faces challenges from a security and privacy perspective. A reluctance to put all data in the cloud and the need to know where data is at all times, meant searching for a solution elsewhere.

THE SOLUTION
As the trend for HPC in scientific research continues to rise, EI needed a strategic data center partner that could improve efficiencies by distributing large-scale genomics and computing biology data analysis.

El selected Verne Global's data center campus in Iceland based on its previous expertise providing long-term, low-cost, sustainable power for computing as well as experience working with private and public organisations.

EI also needed a provider that could directly connect customers in each country, and Verne Global's access to the National Research Education Networks allowed them to connect to EI's campus in the Norwich Research Park, England, and Verne Global's campus in Iceland.

BENEFITS
Verne Global provides flexible, scalable, secure and highly optimised data center solutions, as well as access to one of the world's most modern and reliable power grids, utilising 100% renewable energy.

Iceland's advantageous power profile offers EI long-term, low cost energy, which together provide impressive savings across the total cost of operation (TCO). In addition, due to the geothermal and hydro-electric sources of power, plus the ability for ambient air cooling due to Iceland's temperate climate, EI is able to significantly reduce the carbon footprint of its HPC workloads.

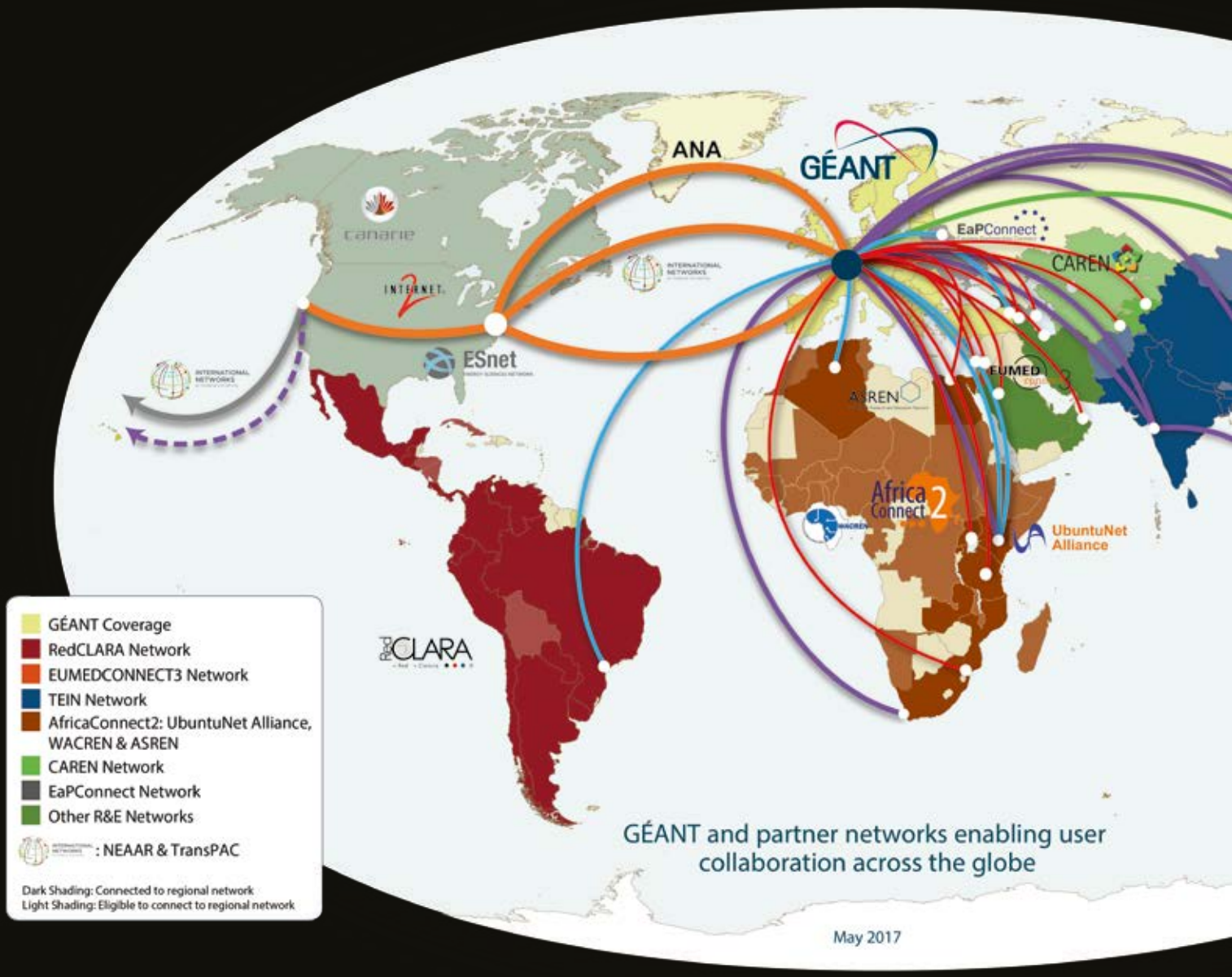
I hope the impact of our collaboration with Verne Global will be the catalyst for many more academic institutions in the UK and Europe to consider migrating their computing infrastructures to Iceland and benefit from one of the world's most reliable and cost-effective green energy resources. I'm very proud that Earlham Institute is at the forefront of this shift.

Dr Timothy Stitt, Head of Scientific Computing
Earlham Institute

GÉANT AT A GLANCE

GÉANT 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.

GÉANT has 41 member countries and is owned by its core NREN membership, and also has Associate members including commercial organisations and multi-national research infrastructures and projects.



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NETWORKS

GÉANT interconnects research, education and innovation communities worldwide, with secure, high-capacity networks. We plan, procure and build the large-scale, high-speed networks that are essential for sharing, accessing and processing the high data volumes generated by Research and Education communities, and for testing innovative technologies and applications.

GÉANT also provides network and collaboration services that facilitate international cooperation between researchers and educators, and brings people together for the human networking that drives innovation.

SERVICES

GÉANT develops the services its members need to support researchers, educators and innovators - at national, European and international levels.

Our portfolio of advanced services covers connectivity and network management, trust identity and security, real-time communications, storage and clouds and professional services.

PEOPLE

GÉANT collaborates with its members, partners and their re search, education and innovation communities to drive research and discovery, keeping Europe at the heart of global Research and Education networking.

Through our extended global partnerships we champion the role of national Research and Education networking (NREN) organisations and facilitate research networking across all world regions.

INNOVATION

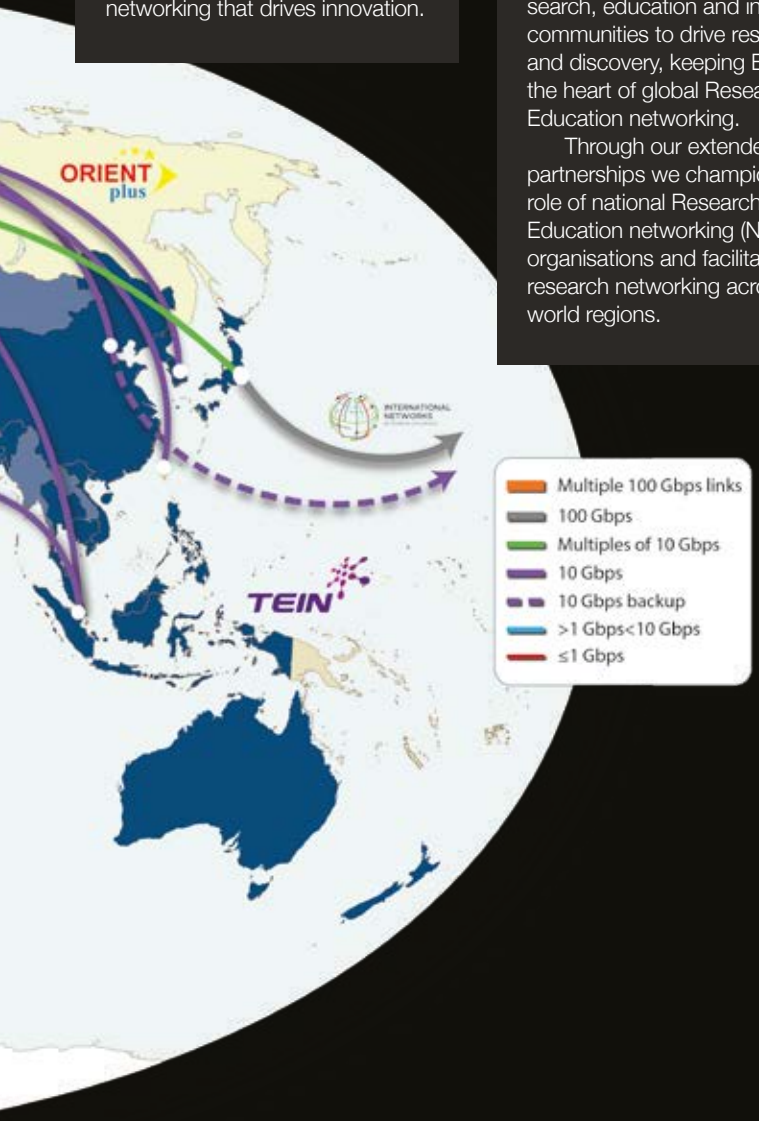
GÉANT invests in the research and development of network architectures, technologies and paradigms to develop into the services, processes, tools and network capabilities of tomorrow.

GÉANT facilitates community collaboration that pushes the boundaries of networking possibilities. Fresh ideas from task forces, special interest groups and open calls are applied through specific research activities and initiatives, informed by foresight studies and future user needs to achieve and promote innovation.

PROJECTS

GÉANT is a trusted European Commission (EC) partner in many global collaboration projects and initiatives through our special relationship with the European Union.

We have built up our depth of network expertise and leadership over two decades, and excel in managing and participating in highly successful projects, delivering Research and Education networks and services, and coordinating innovation.



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