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CONNECT

THE MAGAZINE FROM THE GÉANT COMMUNITY | ISSUE 27 2017

DIGITAL INFRASTRUCTURES for RESEARCH 2017

DI4R2017: CONNECTING THE BUILDING BLOCKS FOR OPEN SCIENCE

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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 TO OUR AUTUMN EDITION OF THE CONNECT MAGAZINE AND ALSO WELCOME TO DI4R!

Our highlight in this edition is, of course, the second DI4R conference, bringing together all European e-infrastructures and our users during a two day conference in Brussels. We are proud to have Dr. Katrin Amunts of the Human Brain Project as a key note speaker at the conference and follow this up with a CONNECT Q&A with her, and with a more in-depth article on the Human Brain Project later on in the magazine.

NRENs are often seen as supporting research, but education increasingly receives focused attention, which you can read about in the articles which have been contributed by our NREN partners in Croatia, Portugal and Serbia. In line with this, eduKEEP is being discussed in an article about life-long learning and the need for life-long identities.

There are around 110 NRENs around the world, many well established. I attended the 15th anniversary of the Ecuadorian NREN in September and we followed up with an interview with CEDIA´s CEO, Juan Pablo Carvallo. This is a must read for emerging NRENs, I was completely inspired by the way CEDIA impacted the Ecuadorian academic landscape.

And last but not least, the GÉANT (GN4-2) Project was reviewed at the beginning of November by European Commission appointed external reviewers. We are taking the opportunity of yet another successful review to remind our readers of this amazing European success story: the constructive collaboration of over 40 partners, delivering real results for the global research and education community.

Enjoy the issue!

Cathrin Stöver, GÉANT

DI4R 2017: CONNECTING THE BUILDING BLOCKS FOR OPEN SCIENCE

Researchers, developers and service providers are joining Europe's leading e-infrastructures in Brussels for the second edition of the Digital Infrastructures for Research (DI4R) conference. Held this year at the SQUARE meeting centre from 30 November to 1 December, the event is jointly organised by EGI, EUDAT, GÉANT, OpenAIRE, PRACE and RDA Europe. DI4R 2017 builds on the success of the inaugural DI4R event in 2016, a joint booth presence at TNC17 in Linz earlier this year, and an ever-closer working relationship that will benefit research communities.

Under the theme of "Connecting the building blocks for Open Science", DI4R 2017 will showcase the policies, processes, best practices, data and services that, leveraging today's initiatives – national, regional, European and international – are the building blocks of the European Open Science Cloud (EOSC) and European Data Infrastructure (EDI).

With a packed programme of 25 sessions, 5 demonstrations, 8 lightning talks and over 40 posters, the conference will not only demonstrate how open science, higher education and innovators can benefit from these building blocks, but will drive open dialogue between user communities and the e-infrastructure partners.

Annabel Grant of GÉANT comments, "The DI4R event is gaining real traction, with significant interest from the research community in how the e-infrastructures can jointly support their needs, and work with them to improve open science and collaboration for all. GÉANT is proud to be one of the major organisers, with DI4R 2017 following on from a successful joint e-infrastructure booth at TNC17 earlier this year."

Who is behind DI4R?

The DI4R Programme Committee (PC) is responsible for defining a balanced programme based on the event objectives and targets. In addition, the PC is responsible for defining the type of sessions that will make up the programme (e.g. workshops, presentation-lead sessions, posters, demonstrations), defining the content of the Call for Abstracts, reviewing the proposals submitted, making final decisions regarding acceptance of proposals, defining the content of plenary sessions and the list of keynote speakers and defining the event's timetable.

The PC consists of 16 members representing end users and senior members of the organising partners, and this year is chaired by Franciska de Jong of CLARIN ERIC, the European Research Infrastructure for Language Resources and Technology, ensuring the programme is very much user-led.

GÉANT AT DI4R 2017

As well as a joint booth presence, GÉANT will deliver two sessions, three presentations and a lightning talk. Please see the DI4R programme for full details.

Wednesday 29th

Half day AEGIS group meeting

Thursday 30th

Full Sessions:

- AAI for Researchers
- EDI capabilities, architecture and complementarity with EOSC

Presentations:

- Monitoring of Virtual infrastructures using PerfSONAR
- Challenges for Data Loss Prevention at Research Infrastructures

Friday 1st

Presentation:

- Procurement of commercial services for research communities

Lightning talk:

- AEGIS group

DI4R is jointly organised by EGI, EUDAT, GÉANT, OpenAIRE, PRACE and RDA Europe, with the common objective to best support and facilitate science and research across Europe. CONNECT spoke with representatives from the organisers for their expectations.

Natalia Manola, Managing Director, OpenAIRE

What does DI4R mean to you?

DI4R is the perfect place to showcase OpenAIRE's existing services, to reach and connect with all potential stakeholders, and to involve user communities to gather their suggestions and feedback to extend and improve OpenAIRE's services according to their needs. Furthermore, DI4R is a highly valuable occasion to liaise with individuals and projects interested in collaborating with OpenAIRE.

What are your hopes for this year's DI4R?

This second edition of DI4R is an occasion to pursue fruitful collaboration with the other organisations and institutions involved in the conference. In addition to this, as the event brings together all the important actors associated with the EOSC, the hope is that DI4R will strengthen the partnership and help to build an effective environment for European researchers.

How does this event help to support Europe's researchers?

DI4R brings together all the participants of the research life cycle, and it gives the chance to present projects and results and to discuss future perspectives and expectations with peers. The DI4R 2017 revolves around research communities and promotes European digital infrastructure services for researchers. Because of this focus DI4R presents the unique opportunity to connect technology to the people using it and consequently to provide better, user-centred solutions and services based on community input.

"We will join efforts to support the needs of European researchers and international collaborations and EGI is proud of having been one of the main promoters of this new series of events."

Tiziana Ferrari, Technical Director, EGI Foundation

"The second edition of DI4R will consolidate collaboration between the major European e-infrastructures, highlighting the outcome of work underway, how we jointly support research communities in need of seamless access to network, data and computing resources and how we proactively contribute to the establishment of the European Open Science Cloud (EOSC). DI4R 2017 will also provide a perfect chance for researchers, developers and service providers to help shape the future of Open Science."

Damien Lecarpentier, Project Director, EUDAT and EUDAT CDI

GÉANT

"We see significant interest from the research community in how e-infrastructures can jointly support their needs and work with them to improve open science and collaboration for all. DI4R is an important event and GÉANT is proud to be one of the major organisers."

Cathrin Stöver, Chief Collaboration Officer, GÉANT

RDA RESEARCH DATA ALLIANCE

"Digital infrastructures providing services from basic network, CPU and storage up to those populating the dynamic knowledge integration will determine our ability to extract knowledge from the data floods."

Peter Wittenburg, Executive Director, RDA Europe

Serge Bogaerts, Managing Director, PRACE

PRACE

What does DI4R mean to you?

DI4R is an excellent possibility to extend the reach of PRACE to researchers not aware of the possible relevance of HPC for their research, and to further enhance collaboration with partners to improve support to research through a consistent set of services offered. We already work together with all the organising partners in other ways, and the event is an opportunity to deepen that collaboration, as well as expand it to others present.

What are your hopes for this year's DI4R?

This is the second year for DI4R and the first edition that PRACE supports as an organiser. I hope that this will be the start of a long-term cooperation with the other organising partners.

How does this event help to support Europe's researchers?

Bringing so many actors together, and allowing them to present their projects and results, will foster links between stakeholders and will hopefully lead to new partnerships and networks that would otherwise be (much) harder to achieve.

As the main HPC provider in Europe, PRACE continues to intensify its connections to the scientific and industrial communities. Collaborations with partners in the ecosystem, via initiatives such as DI4R, help improve these links.

Q&A WITH KEYNOTE SPEAKER DR. KATRIN AMUNTS OF THE HUMAN BRAIN PROJECT

Dr. Amunts leads the sub-project 2 *Human Brain Organization* of the European Flagship Project, *The Human Brain Project (HBP)*, and in 2016 was elected as the *Chair of the Scientific and Infrastructure Board (SIB)* of the HBP.

Why do you think the DI4R events are beneficial for the European research community?

Bringing together researchers from data-intensive fields with representatives of the European e-infrastructures creates an important forum for insightful discussion and new ideas for working together. Very different research communities have made the step to using these powerful infrastructures, and there is a large methodical overlap between them. While the subject matters might be different, we can definitely learn or at least draw inspiration from each other, when it comes to dealing with enormous data size and ways of leveraging e-infrastructures for it. Embracing digitalization in this way is important to encourage the community-based open science approach in neuroscience that we strive for, and I think we can learn from other fields like astronomy or particle physics who previously experienced this shift.

How does e-infrastructure/ digital infrastructure enhance or support your work?

It is absolutely instrumental for our work in the Human Brain Project (HBP). Understanding the brain through an ICT-infrastructure specifically for neuroscience is at the core of our project. Data size in neuroscience has grown to levels where the use of high-performance computing is inevitable. The brain is an enormously complex system of approximately 86 billion nerve cells, each connected to around 10,000 others. We have a wealth of data on many different levels of this system, that are gathered in different research communities. But to really understand the system as a whole, much more integration of this knowledge and linking of insights would need to happen. For this the HBP develops a new ICT-based research infrastructure that is supported by four of the most powerful supercomputing centers in Europe.

What concrete results do you hope to see after DI4R 2017?

I hope that we will all come back from it with a lot of fresh ideas and insights for our projects and maybe some contacts to consult for best practice examples, or even new partnerships.

AEGIS WORKSHOP: NEED TO KNOW

The AARC Engagement Group for Infrastructures (AEGIS) is running a workshop at DI4R2017 for those that are interested in accessing and sharing digital resources using federated identities. CONNECT spoke with Christos Kanellopoulos of GÉANT, to better understand the role of AEGIS.

What is AEGIS and why is it a relevant topic to discuss during a conference such as DI4R?

AEGIS brings together representatives from research and e-infrastructures, which are implementing authentication and authorisation services that support federated access, to enable research collaboration.

Currently, AEGIS has members from 5 e-infrastructures (EGI, EUDAT, GÉANT, PRACE and XSEDE) and from 2 domain-specific research infrastructures (ELIXIR and DARIAH).

AEGIS is an initiative of the AARC project, could you explain why this initiative was set up and how it will help AARC to achieve its goals?

AARC, the Authentication and Authorisation for Research and Collaboration project, has made the strategic choice to entrust the implementation and the operations of AARC results to existing research infrastructures and e-infrastructures. This choice is based on the consideration that existing infrastructures are better positioned to deploy and operate services and thus to implement the AARC recommendations and best practices in order to guarantee sustainability and support for the scientific communities. For this reason, the AARC project is committed to working with the research infrastructures and e-infrastructures, which will act as the delivery channel between AARC and the user communities they represent.

AEGIS establishes a bi-directional channel between AARC and the infrastructures, to advise each other on the developments and production integration aspects of the AARC results. The group is composed of representatives of e-infrastructures and well-established research infrastructures as well as the AARC work package leaders and will be supported by the AARC outreach and communication activity.

The group will ensure that:

- the AARC results are known to all research infrastructures and e-infrastructures;
- infrastructures and the AARC team can discuss sustainability models, implementation aspects and approaches to use-cases;
- all key parties share the same vision and the same information about the AARC objectives and developments in the trust and identity area – even if they may be in different deployment phases.

What advantages would the e-infrastructures community gain from participating in AEGIS?

The way researchers collaborate within scientific communities can vary significantly from community to community. On the one side of the spectrum there are large, highly structured research communities, while on the other side there can be small fragmented research communities with very loose structures. What all of them commonly share, is the need to access and share resources, which is a crucial aspect for the success of their collaborations.

AARC has delivered a blueprint architecture that champions federated access and defines technical components and policy aspects for research and e-infrastructures to build interoperable AAIs. This is a major achievement. However, the implementations of the blueprint is the responsibility of the research and e-infrastructures. AEGIS helps participating infrastructures understand the importance of adopting AARC frameworks, as well as unveiling aspects that may emerge during the deployment phase that may still be unknown.

Who should definitely not miss out and how can they get involved?

Members of research communities and digital infrastructures that are interested in accessing and sharing digital resources using federated identities should attend the AEGIS workshop on the 29th November from 13:00 to 17:00.

This workshop will offer an interactive session where researchers and research infrastructures present their use-cases and, more generally, describe how they do their daily work and which obstacles they face in accessing and sharing resources using federated identities. Some solutions will be presented in light of the benefits they bring to researchers and research infrastructures if adopted, and maturity and service models.

See also:

AARC **https://aarc-project.eu/**

AEGIS **https://aarc-project.eu/communities/aegis/**

GÉANT AND THE EUROPEAN OPEN SCIENCE CLOUD

The European Open Science Cloud (EOSC) is a programme identified by the European Commission (EC) as one of the most important projects for Research and Education across the community. On 23 March 2017 EU ministers signed a declaration to support the next generation of computing and data infrastructures. This public and private investment for the EOSC will support Europe's 1.7 million researchers and 70 million science professionals with a virtual environment to store, share and reuse their data across disciplines and borders - preparing Europe for truly Open Science.

What is Open Science?

The large amount of data produced by the use of ICT in research has been identified by the EC as having further immense value which should be unlocked. The EC's vision is that the exponential growth of data will drive societal challenges, scientific advances and productivity gains across the European economy. Unfortunately some of this data is locked away in isolated and inaccessible silos. This isolation reduces the benefits that can be achieved if this data were open. This vision is about achieving Open Science under the FAIR Principles

What is FAIR?

FAIR is a set of guiding principles to make data Findable, Accessible, Interoperable, and Re-usable.

TO BE FINDABLE:
- F1. (meta)data are assigned a globally unique and eternally persistent identifier.
- F2. data are described with rich metadata.
- F3. (meta)data are registered or indexed in a searchable resource.
- F4. metadata specify the data identifier.

TO BE ACCESSIBLE:
- A1. (meta)data are retrievable by their identifier using a standardized communications protocol.
- A1.1. the protocol is open, free, and universally implementable.
- A1.2. the protocol allows for an authentication and authorization procedure, where necessary.
- A2. metadata are accessible, even when the data are no longer available.

TO BE INTEROPERABLE:
- I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
- I2. (meta)data use vocabularies that follow FAIR principles.
- I3. (meta)data include qualified references to other (meta)data.

TO BE RE-USABLE:
- R1. meta(data) have a plurality of accurate and relevant attributes.
- R1.1. (meta)data are released with a clear and accessible data usage license.
- R1.2. (meta)data are associated with their provenance.
- R1.3. (meta)data meet domain-relevant community standards.

Source: Force11.org

A European Open Science Cloud

EOSC is the programme through which the European Commission proposes to achieve Open Science. It is proposed that the EOSC will enable the federation of existing and emerging data infrastructures, bridging the fragmentation and ad-hoc solutions which populate the e-infrastructures landscape today, so as to remove obstacles to wide access to publicly funded research publications and underlying data. It will enable sharing and re-use of research data across disciplines and borders, taking into account relevant legal, security and privacy aspects. Bringing these disparate services and data together is a huge challenge but one which is essential to ensure that Europe remains at the forefront of advanced research.

"We must create infrastructure. Europe's final transition must be one from fragmented datasets to an integrated European Open Science Cloud. By 2020, we want all European researchers to be able to deposit, access and analyse European scientific data through a European Open Science Cloud."

Commissioner Carlos Moedas, Amsterdam, 4 April 2016

GÉANT and the European Open Science Cloud

The EOSC is still in the process of being defined but the GÉANT communities' networks and services will undoubtedly play a strong supporting role in providing seamless unconstrained access to open data and services.

The EC's data infrastructure model combines processing data (HPC infrastructure), storing data (data infrastructure) and moving data (network infrastructure). GÉANT fulfils the "moving data" part of this model, although there is much more involved than simply moving data: while GÉANT and the NRENs provide the secure, high performance European and global connectivity, their federated access services are also essential for realising the potential of data storage and processing and are key for realising the EC's vision for HPC and Big Data in Europe, and for achieving the objectives of Open Science.

The ultimate aim should be to render the physical infrastructures and services invisible to the end user – just as cloud services make the physical data centres and server hardware invisible to the user.

Supporting Open Science

GÉANT and the NRENs are collaborating with other European e-infrastructures and other stakeholders to develop a common approach towards the EOSC. GÉANT is a signatory to the joint e-infrastructures statement on the EOSC, which details eight elements for the success of the EOSC: that it be open, publicly funded and governed, research-centric, comprehensive, diverse and distributed, interoperable, service-oriented and social.

Following a stakeholder summit in June 2017, at the end of October the EC announced the EOSC declaration with a comprehensive list of the goals to be achieved by 2020. The list is wide-ranging and ambitious and will require material support from the Member States. So far around 40 scientific stakeholders have endorsed the principles and further endorsement is being sought.

The organisational strength, services and expertise of GÉANT and its NREN partners all have a key contribution to make towards the successful realisation of the European Open Science Cloud.

To find out more about EOSC visit http://eoscpilot.eu/ and for information on the EC declaration visit **https://ec.europa.eu/research/openscience/pdf/eosc_declaration.pdf**

HIGHLIGHTING THE GN4-2 PROJECT

The GN4-2 Project recently completed its first period (May 2016 to August 2017) with a successful independent review. A project of this scope, ambition and size (40 partners, 500 contributors) means a wide range of achievements and significant benefits for the research and education community. Here we bring you just a snapshot of period 1 highlights, with period 2 already underway (September 2017 to December 2018).

GÉANT's vision is to ensure equal high-performance network access for all scientists across Europe to the research infrastructures and the e-infrastructure resources available to them.

The GÉANT Project is fundamental to European e-infrastructures, delivering the pan-European GÉANT network for scientific excellence, research, education and innovation. Through its connectivity, collaboration and identity services, GÉANT, together with its NREN partners, provides users with highly reliable, unconstrained access to communication, computing, analysis, storage, applications and other resources, whenever and wherever needed.

COLLABORATION WITH NRENS, INDUSTRY, E-INFRASTRUCTURES AND USERS

By interconnecting Europe's NRENs and facilitating high-speed links with other global regions, GÉANT connects schools, universities and the world's largest research projects, helping deliver real societal benefit. Through close consultation and collaboration with NRENs, large user projects, international networks and e-infrastructures, efforts are being further aligned, relationships continue to be strengthened, NREN satisfaction levels further improved, and communications channels successfully increased.

Increased NREN engagement and satisfaction: unprecedented levels of support with 38 NREN service reviews completed; largest ever response to annual satisfaction survey, with results showing strong confidence in GÉANT with 98% confirming GÉANT's ability to serve its members in the best possible way and 93% that GÉANT's service portfolio meets their NREN's current needs and no NREN disagreeing to this statement.

Wider consultation: 29 NREN partners, 10 international NREN partners, 7 international research projects, 30 GÉANT project and organisation personnel, as well as numerous vendors and e-infrastructures consulted on GÉANT network and service evolution.

Improving access to data: a redesigned and interactive Compendium contributed to by 42 NRENs; now provides better access to data and trends; interactive topology map launched with over 1,300 unique visitors.

Closer alignment with e-infrastructures: significant focus on relationship building; new DI4R joint event successfully launched in 2016, repeated in 2017; numerous alignment meetings held.

Growing the community: over 1,000 attendees at TF/SIG meetings; record attendance and excellent feedback from TNC16 and TNC17.

Building skills: 8 training events held benefiting over 120 participants from 25 partners; GÉANT e-Academy launched to provide 24/7 learning and development.

Increasing communication: flagship CONNECT magazine produced 250 articles covering thought leadership, services, users, partners and sponsors; distributed at worldwide events. Contributions made to global success stories; development of community blog site; new websites launched to support services and community.

Key infrastructure: coordinated deployment of new topology for PRACE, resulting in cost savings and the first large-scale deployment of GÉANT MD-VPN technology.

Serving big-science: expansion of the LHCONE multi-domain service to new world regions; providing unprecedented 2 x 100G capacity to CERN for distribution of the LHC computation.

Global users: the EUMETSAT data dissemination service was successfully expanded to Australia and China.

40
partners
500 contributors

50M
users

700+
attendees

2115
petabytes
TOTAL TRAFFIC VOLUME

60%
growth
IN GLOBAL TRAFFIC

700K
re-procurement savings

23 cloud services

eduroam

3.6 BILLION NATIONAL AUTHENTICATIONS

SERVICE REQUESTS UP BY MORE THAN
250%

DELIVERING OPERATIONAL EXCELLENCE; REALISING THE FUTURE

The GÉANT network continues to deliver cost-effective and extremely high performance for all users, whilst planning for the next generation network is finalised. With a new European partner in Albania and further expansion of global connectivity, particularly as part of the Advanced North Atlantic (ANA) collaboration, GÉANT continues to support Europe's position at the forefront of research.

Cost savings: re-procured 17 private circuits with direct savings of nearly €700k, whilst increasing the capacity on most of the services.

GÉANT Testbeds Service: GÉANT's network for innovation completed its expansion, including the creation of a Virtual Private LAN Service for GTS use.

Security: securing the project environment and its devices continues to be a high priority; a DDoS solution for the GÉANT Network was successfully implemented.

Planning for the future: with traffic growth greatly outpacing internet growth, it is vital to ensure the delivery of a cost-efficient and high performance network that continues to meet and exceed the rapidly growing requirements of research and education. The network evolution plan published in GN4-2 outlines the vision and strategy for the next generation of the GÉANT network.

Standards development: GN4-2 plays an active role in standards development, with continued leadership roles in standards organisations such as Open Grid Forum, Internet Engineering Task Force and W3C; actively involved in many more.

EXPANDING A PROFESSIONALLY MANAGED USER-DRIVEN SERVICE PORTFOLIO

GÉANT follows a Product Lifecycle Management process to ensure services are developed to user requirements and then transitioned to fully supported production services, within a portfolio covering networking, trust and identity, mobility, security and clouds.

Building the cloud: following a successful pan-European IaaS tender, GÉANT has created an innovative digital single market for cloud services, with 23 services currently available for NRENs to offer their communities. The overall aim is to make cloud and application services safe and easy to use for the European research and education community.

Growing eduGAIN: added 9 new federation members, a 23% increase in the number of IdPs, and significant increase in adoption of features to support research.

Growing eduroam: the roaming Wi-Fi service for research and education saw national authentications grow by 21% to 3,642,300,756; international by 18% to 834,487,457.

Transitioning services: 7 Trust and Identity service developments moved to design stage, 7 moved to pilot stage, 2 moved to production implementation.

Innovative services: filling the services pipeline with innovative new services, such as InAcademia; eduTEAMS; eduroam managed IdP; Campus IdP; StepUp Assurance & MFA; and Discovery.

Improving software development: ongoing training and software management support to ensure continuous improvements in software development.

Support and response: continuation of highest level support and response saw over 630 service requests (an increase of over 250%) successfully addressed; and 8,800 tickets processed by the GÉANT Operations Centre.

See also:
www.geant.org/geantproject

VOICE OF THE GÉANT BOARD

Continuing our series of Board member interviews, CONNECT spoke to Valter Nordh, Chief Technology Officer at SUNET and GÉANT Board member since 2015, about the GÉANT Community Committee and his hopes for the Board.

Valter Nordh has been CTO of the Swedish NREN SUNET since 2013 where his responsibilities focus mainly on the field of identity access management. Valter's work commitments also include NORDUnet and the University of Gothenburg. He played numerous important roles in the GÉANT GN3 and GN4 projects, where his work has helped to influence several key areas including Trust and Identity. He currently chairs the GÉANT Community Committee.

Valter, what is the main purpose of the GÉANT Community Committee?

The GÉANT Community Committee's (GCC) main purpose is to oversee the GÉANT Community Programme (GCP), formerly known as the TERENA Technical Programme. Its main objectives are to help NRENs better support the needs of their research and education communities and to provide key support in the areas most important to NRENs. Another aspect of the GCC is to assist GÉANT in community-driven collaborative initiatives and mutually assist NRENs in providing students, lecturers and scientists the best possible internet and ICT facilities, by sharing ideas, best practices, harmonising procedures and picking the best technologies.

Can you tell us about some of its achievements and how they are helping the community?

The most widely known service is undoubtedly eduroam; a less known fact is perhaps that the idea of eduGAIN was also nurtured and developed during discussions within some of the Task Forces (TF). Another example is ownCloud, a filesync and collaboration service used by many NRENs, which emerged from a discussion in the TF Storage, now known as the Special Interest Group-Cloudy Interoperable Software Stacks (SIG-CISS).

How would you like to see the GCC develop in the future?

As the GCC mostly plays an overseeing role for the GCP, I think that the answer should focus on the future development of the latter. The GCP draws from the experience and expertise within the community, GÉANT and the GÉANT Project, it supports ideas generated by TFs and SIGs: it is a very agile system as it enables NRENs to cooperate freely on any chosen topic.

One of the areas we are currently working on is how ideas from the GCP, when linked with the right tasks, programmes or funding streams, can be further developed and adopted by the GÉANT Project. It's important that the GCP retains its agility whilst making the best use of the GÉANT Project's stability and long term goals. The connections with the Project will certainly develop further and this is based on the demonstrated evidence of the transfer of knowledge and innovative ideas between the GCP, the GÉANT Project and other areas. In relation to the subject of idea generation, it should be noted that many of the ideas that emerge at TF and SIG level often do not pass the final scrutiny and are never implemented. This is a foreseeable and expected consequence of the involvement of many very skilled individuals from different backgrounds operating in a very fertile and stimulating environment.

What is your main area of responsibility on the GÉANT Board?

The GCC and the GÉANT Board, both elected by the General Assembly, have two distinct functions. I have now been serving as part of the combined GÉANT Board role for two years – I was previously in the TERENA TEC as well as in the interim GÉANT Board. My responsibility is to report back on progress in the area of the GCC and I am currently co-chairing the GÉANT CEO Recruitment Committee with Sabine Jaume-Rajaonia.

How do you think the GÉANT Board can best support the community?

The GÉANT Board is made up of individuals who are endorsed and trusted by the wider community and needs constant input from GÉANT's many stakeholders: the communication flow needs to be continuous and transparent at all times as I believe that the decisions made by the Board should (generally) not come as a surprise, but rather should be logical and expected. The Board not only has a clear legal function, but also a nurturing role, it is responsible for looking after GÉANT whilst also keeping up to date with the NRENs' and the European Commission's agenda; a great deal of work goes into identifying challenges and working out compromises.

As a Board member, one of the particular challenges that I face is the shift of mental focus required between my day-to-day problem-solving job at SUNET, to the broader mindset required of a Board member. We need to ask GÉANT the right questions, understand the full picture and also challenge GÉANT to enable it to find the best solutions to its challenges; the Board shall not and cannot provide all the solutions.

The best way to support the community is by making sure that GÉANT keeps doing things that are valued by the NRENs and fully in line with their objectives; this way GÉANT will remain relevant and interesting in the eyes of the community thereby ensuring mutual interest and continuous engagement.

EDUKEEP - LIFE-LONG IDENTITIES FOR LIFE-LONG EDUCATION

eduKEEP is a project within GÉANT to help develop the framework for life-long persistent identities within research and education. Maarten Kremers (SURFnet) explains why this is important and how GÉANT is working to support life-long education.

R&E is borderless

People today are more mobile than ever. We are willing to move around countries, across borders and even across continents to find the best education or careers. Research and Education are truly global and we are all equally global. We are also embracing life-long learning. No longer is the path through higher education linear with everyone starting at 18, progressing for 3, 5, 7 years at the same institute and then leaving for a life in the "real-world" (whatever that means).

We are starting at different times, taking breaks from education or research, moving from education to industry then into research and maybe back into education. Many of us combine different roles simultaneously and we may be working in these different roles under different institutions all at the same time.

Around the world the "gig economy" has taken over all our lives. We can have one role on Monday morning, another that evening and a third on Thursday and all with different institutions.

How do we support this mobility and flexibility?

With this increase in mobility comes an increase in complexity. The rise in distributed and cloud services means that users expect easy seamless access to all their services, but the current identity structures don't recognise or support this new paradigm of work, research and education.

Identities are still created and managed in institutional silos which weren't developed with the concepts of mobility or parallelism in mind. This creates cost and complexity for both users and identity managers alike.

- Users have to manage their multiple identities remembering which identity is used for which services (or having to switch between identities within a single service).
- Managers have to work out how to migrate and support staff, they may need to inherit information in different structures and formats.
- Users may have multiple subscriptions to the same service - dramatically increasing costs and wasting time and money.
- Service providers may also face costs and complexity as users move from one institution to another. How can services and data be migrated across?

We don't change our name or tax ID when we change jobs – tax systems manage to cope with multiple careers (and sometimes even manage multiple simultaneous careers) so why do we have to change our identity just because we have moved university?

The Solution – Life-long identities

These are the problems that eduKEEP is hoping to solve. The aim is to develop strategies and architectures to support the more flexible world of Research and Education in which we live.

Just as federated Identity broke down the barriers caused by silos of information, systems and data, eduKEEP will create systems that break down silos of identity, allowing personal mobility throughout R&E. eduKEEP will investigate current services within NRENs and projects to understand the requirements of users and managers and look for opportunities to share ideas and best practice.

One of the key issues to address is funding a life-long identity system. Managing a life-long identity implies a life-long cost and as more and more people begin to use persistent identities then so these costs will grow. Who then pays for these facilities – how do we equate the long term savings from these identities with the costs of developing and providing them? How can the investments and developments be funded? Another issue is the soon to be implemented GDPR regulations. This will place large burdens not only on life-long identity provision, but also the current federated and inter-federated identity services that R&E relies upon.

eduKEEP needs to assess all opportunities and issues because unless they are addressed, then the current linear, sequential identity paradigm will diverge from our complex, parallel, intermittent reality.

To find out more about eduKEEP and the range of research activities taking place in GÉANT visit: **https://www.geant.org/Innovation/Research_programmes/**

InAcademia
ONLINE STUDENT VALIDATION

INACADEMIA IS RECRUITING!

Following the release of version 2.0, InAcademia is working hard to recruit both Service Providers and Educational Institutions.

Why should Institutions offer InAcademia?

Benefits to Staff and Students - Your staff and students deserve the best services. Using your buying power and the power of the European student population, suppliers want to offer your members great deals. From digital subscriptions through to reduced price software and IT services, your staff and students can benefit from being able to access special deals.

InAcademia can offer significant bargaining power to the members of your university. By making it easier for suppliers to identify students then they are more likely to provide special offers. By using their eduGAIN interfederated identities staff and students will be able to take advantage of these online offers safely and securely.

Benefits to IT and IdP support staff – Your organisation will be asked to make deals with many local, national and international organisations. This probably has been done a lot in the past already. Without InAcademia your IT department and IdP support team would need to make separate arrangements with each of these suppliers and have a lot of work with each and every one. By enabling InAcademia this task can be done once. Any new suppliers can then be simply redirected to InAcademia to support their needs. The main advantage of this is that no privacy sensitive data needs to be exchanged with local businesses or international business with head offices on the other side of the world.

Benefits to Administration staff – Every day the administration team will field many queries about student and staff status with suppliers asking to confirm partial or inaccurate details. InAcademia will reduce the number of status queries from these suppliers wanting to check credentials. By removing this overhead your staff can focus on more important tasks.

How does it work?

InAcademia uses the federated identity services provided by eduGAIN to securely authenticate student identities without exposing user IDs or passwords to third parties. It provides a lightweight, secure ID service to third party suppliers without the cost and complexity of developing individual facilities for your institution.

Is it Safe?

Because the student's username and password are validated by the InAcademia endpoint (the Identity Provider) using eduGAIN interfederation, no username or password information is requested, or stored by the supplier website, nor by InAcademia. This means the information is kept secure.

But don't just take our word for it!

"We started using InAcademia as one of the first users in Europe and had to be waiting for institutions to join. But we are very happy with this easy and simple service that guarantees us the legitimacy of buyers being students. Chapeau for InAcademia!"

Hans-Peter Ligthart, SURFmarket

Why Service Providers should offer InAcademia

Currently most discount services online require students to photograph their ID and email or upload the image to the seller. These then either need to be manually checked or often assumed to be correct. This process is both expensive in manpower to authenticate these details and time-consuming. If these details can't be checked in real time then the risk is that the potential customer will (electronically) walk away. Equally the risk of someone "borrowing" a friend's ID is potentially quite high.

In addition, if student ID cards are stored as machine readable images this may have ongoing GDPR issues for suppliers as the ID card contains large amounts of personally identifiable information. We know for sure that students don't like uploading their personal details and will avoid this, resulting in not buying online at the specific Service Provider's webshop.

Other organisations may assume a student identity through the checking of an academic email address but of course not all students have a recognisable academic email address or may have retained one after they have left full-time education. Again, this may require costly manual intervention.

For both of these sets of problems InAcademia provides a simple, real-time and secure online authentication process. With a structure that provides authentication with institutions across Europe it is highly scalable and cost-effective.

Just as institutions using InAcademia only need to implement the InAcademia service once to support multiple suppliers, then suppliers only need to implement InAcademia to reach many institutions. This reduces dramatically the workload in implementing the authentication process and also the ongoing support load. Implement once, use many, many times.

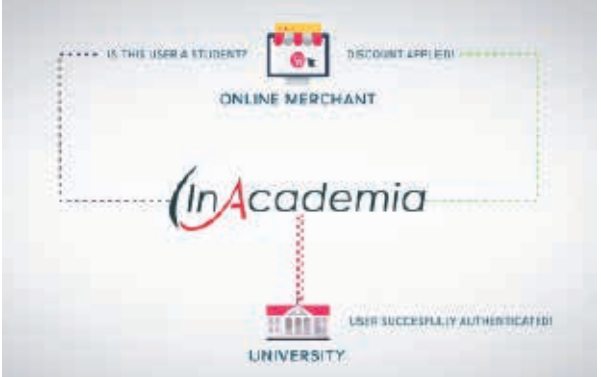
For institutions and suppliers interested in implementing InAcademia please visit **InAcademia.org**

InAcademia 2.0 release

Based on feedback from our pilot partners we have improved the features of the InAcademia service. The improvements included

- Consolidated SAML backend for better interaction with institutions.
- Support for discovery hinting.
- Support of a custom error page when the IdP doesn't release necessary attributes.
- Improved support for affiliation attribute handling.
- Improved support for getting the domain claim.
- Support of Identity Provider blacklisting
- Offloading audit logs to a log server for statistics
- New UI for the consent screen
- Improved error messages and handling

To find out more about the new features and functions visit **InAcademia.org**



GÉANT PROCUREMENT – STREAMLINING PURCHASING ACROSS THE R&E COMMUNITY

As a large multi-national organisation handling large amounts of EU funding, GÉANT has a small but growing Procurement Team who are developing solutions allowing GÉANT and the NRENs to meet their purchasing needs, ensuring both value for money and compliance with EU funding rules. One of the key tools at their disposal is the Framework Agreement.

What is a Framework Agreement?

A Framework Agreement is an agreement concluded between a public contracting authority and one or more suppliers, to establish terms governing contracts that may be awarded during the life of the agreement. It is a general term for agreements that set out terms and conditions, including pricing, for making specific purchases (call-offs). They are typically established when an organisation requires a simplified route to market with a pre-agreed 'list' of preferred suppliers, and are ideal where its projected spending forecast dictates requirements and determines a longer term need for multiple transactions, whose aggregate value is likely to exceed the European Union spending threshold of €209,000.

This spend may be from the organisation on its own, or through combining spend with partners or similar bodies. The Framework can then be used to reduce the need for separate tendering for each purchase and so reduces the costs for both purchaser and suppliers. By working together, the R&E community can reduce the costs not only of the services but also the costs associated with contracting for those services.

What are the Key Elements of a Framework?

- They can last a maximum of 4 years duration.
- There is no guarantee of business for suppliers on the Framework Agreement.
- They can range from single to multiple suppliers (however, multi vendor Frameworks must have at least 3 suppliers under the regulations).
- Contracts are placed by "calling off" the solution, or offer, which best meets your requirements by "applying the terms of the Framework" and offers best value or you can undertake a further competition, where not all of your specific requirements are covered in the "catalogue" of products or services.

Who can use them?

A key factor is that in order to be able to use a Framework Agreement your organisation must be specified in the Official Journal of the European Union (OJEU) advertisement intended to attract potential suppliers.

The advert must also define precisely what the contracts will be for, for example you cannot buy software if the Framework is for hardware! It must also predict a maximum spend over the lifetime of the agreement. Technically this should not be exceeded as it could have prevented potential bidders if the original total was set too low.

What are the benefits of using a Framework?

There are a number of significant benefits for all parties from using Framework Agreements:

- It is EU Compliant having been through a full EU Process and complies with all Procurement Regulations, therefore subsequent procurements do not have to be advertised in the EU Tenders Daily web site.
- Achieving economies of scale (aggregated procurement = lower prices, enhanced warranties, fixed prices).
- Trading with suppliers who have been fully vetted and evaluated.
- Both the buyer and supplier save time and money from not having to create and respond to individual, low value, tenders for each purchase.
- GÉANT dictated Terms and Conditions, not the Supplier's own.

At present the procurement team have agreed five separate Framework Agreements covering a wide range of products and services for GÉANT, the NRENs and R&E institutions across Europe.

IaaS – GÉANT Infrastructure as a Service

This Framework Agreement is possibly one of the most complicated and comprehensive within the R&E community, covering nearly 20 countries and more than 20 suppliers (including in-country and pan-European resellers). This focuses on the delivery of virtualised cloud computing services, to help organisations to build their own IT platforms. They can buy their computing infrastructure not as physical servers and hardware but as a pay-as-you-need service.

The computing resource provided is specifically that of virtualised hardware, in other words, computing infrastructure. The definition includes such offerings as virtual server space, network connections, bandwidth, IP addresses and load balancers.

The Framework runs to 31 December 2020 and the range of suppliers and applicable countries are available at **https://clouds.geant.org/geant-cloud-catalogue/geant-cloud-catalogue-iaas/**

GWS

GÉANT World Service (GWS) provides commodity IP access, offering NRENs access to the wider, commercial Internet. It is ideal for NRENs who wish to take advantage of the competitive costs, those who do not wish to organise an individual connection to an ISP or those

who are keen to add diversity to their existing commodity IP access. There are seven suppliers taking part in this agreement

- Cogent
- GTT
- Interoute
- Level 3
- Telia
- Telxius
- TI Sparkle

NRENs can make their own provision through the agreement directly with suppliers, alternatively they can use GÉANT to broker a deal for them. The agreement runs to 31 July 2021, with contracts awarded under them typically being for a one year term in order to encourage Framework vendors to keep pace with the IP Transit market rates.

SDN - WAN Optimised and OpenFlow 1.3 Compliant Ethernet Switches

This agreement with Xantaro supports the sourcing of products and services required to investigate programmable and virtualisation technologies. To deal with exponential bandwidth increases and highly unpredictable traffic in an economical way. The intent is to:

- Mitigate the need to over provision at multiple network layers, delivering application awareness in the network for application-based path selection.
- Integrate with other infrastructures.
- Add programmability to offer the ability to use APIs to link applications to the network.
- Remove dependence on vendor software and provide the ability to outsource / crowdsource service development, enabling greater agility as well as increasing the speed of service development.

To use this deal you need to confirm that your solution is covered by the Framework and place an order using the relevant Statement of Works form which is an Appendix to the Framework Agreement and available from GÉANT. The agreement runs for 4 years to 6 June 2021.

Prism Provision of Equipment and Related Services for Optical Transmission Equipment

This is a four supplier Framework for OTE (Optical Transmission Equipment) and support thereof, with Alcatel Lucent, Ciena, Coriant and Infinera and runs to 5 November 2021. If an NREN can determine their best value option they can call off directly to their chosen supplier. If the NREN cannot precisely define their requirement from the catalogue pricing available, then they should conduct a further competition among all the suppliers on the agreement.

Video and Web Conferencing Solutions

One of the benefits of a Video and Web Conferencing Framework is the ability to ensure compatibility and function even if systems are purchased on an individual (or group) basis. Buyers can either select a solution that meets their requirements direct from a provider or hold a mini competition. Providers in this Framework are: Zoom; MVC (offering CISCO services); and Visions Connected (PEXIP). The Framework concludes on 20 June 2021.

Trusted Certificate Service (TCS) With Digicert

TCS takes advantage of a bulk purchasing arrangement whereby participating NRENs may issue close to unlimited numbers of certificates provided by a commercial CA at a significantly reduced price. The five main types of certificates available are:

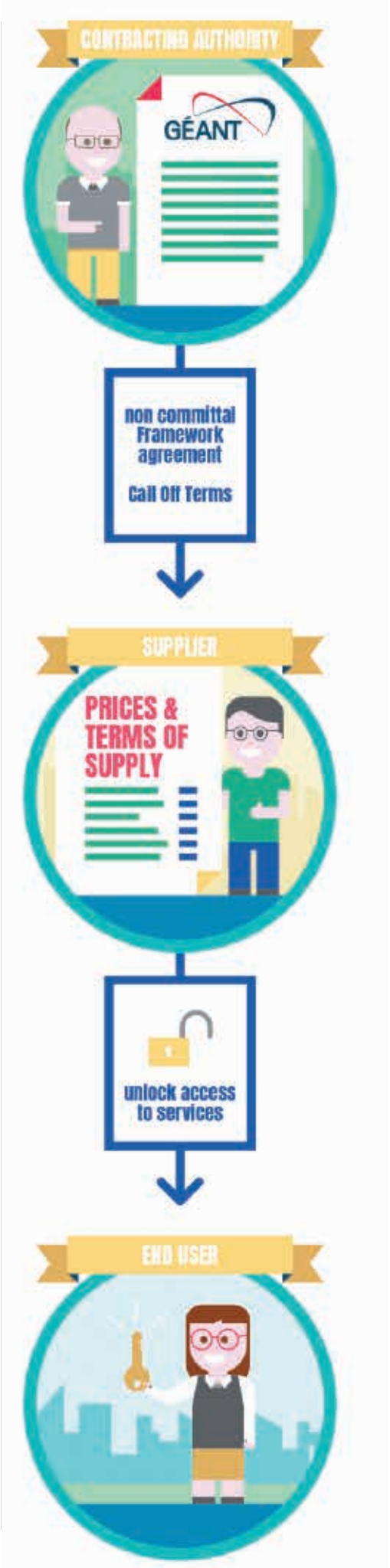
- SSL certificates – for authenticating servers and establishing secure sessions with end clients.
- Grid certificates – for authenticating Grid hosts and services (IGTF compliant).
- Client certificates – for identifying individual users and securing email communications.
- Code signing certificates – for authenticating software distributed over the internet.
- Document signing certificates – for authenticating documents from Adobe PDF, Microsoft Office, OpenOffice, and LibreOffice.

For more information visit **https://www.geant.org/TCS**

The Future

In the future the procurement team will be looking at setting up Frameworks for a wide range of products and services including IT Hardware, software and maintenance, consultancy, legal and travel services, training and temporary staff.

If you are interested in any of these topics please contact **procurement@geant.org.**



THE CONNECT INTERVIEW

ANNABEL GRANT, GÉANT

GÉANT's Annabel Grant heads up the Partner, User and Stakeholder Relations Activity in the GÉANT (GN4-2) Project, and leads GÉANT's involvement in the e-infrastructure landscape. Annabel also ran GÉANT's successful Open Calls programme (2014-2015). CONNECT caught up with her to talk about innovation, collaboration and complementarity.

What is DI4R to you?

It's the best opportunity for researchers to interact freely with all e-infrastructures (EGI, EUDAT, GÉANT, OpenAIRE, PRACE, RDA Europe) and for us to gather requirements and feedback on what they really need. In fact to quote Damien [Lecarpentier] from EUDAT, after last year's successful DI4R: "This event represents an important step towards greater collaboration between e-infrastructures, which is very much required by research communities who want to be able to access network, data and computing resources in a seamless way". This year it's fantastic to have a user-led Programme Committee with Franciska de Jong from the CLARIN community as the Chair, and we have a really exciting and interactive programme for the attendees.

Where do you see the e-infrastructure collaboration going?

The key words for me are collaboration and complementarity. We need to work together to ensure that the joint service portfolio for the user is what they need to effectively and efficiently do their day to day work; be that providing a lightning fast network, access to resources via federated access, storage and data services or computing resources. DI4R is a great example of this co-operation and interworking – a joint booth for all e-infrastructures demonstrates our shared commitment to collaborate fully.

A number of cross e-infrastructure groups are now in place to address the challenges of interworking in specific domain areas; including the WISE community working together on security matters and the AEGIS group which provides a forum for greater collaboration in the important area of Trust and Identity. These types of groups will be fundamental to assuring alignment and complementarity in all that we do.

We will also continue to work together on a number of joint initiatives including eInfraCentral, EOSCpilot (which will support the first phase in the development of the European Open Science Cloud [EOSC]) and in the future the EOSC-hub and OpenAIRE Advanced projects and others to ensure that collaboration and complementarity continue to be a strong focus.

What has excited you most in your GÉANT career so far?

Without a doubt it has to be managing the Open Call Programme which brought 30 new partners into the GÉANT consortium for the first time. The legacy of these projects can be felt across the GÉANT (GN4-2) Project today. In the Trust and Identity area – the eduroam CAT tool and components of eduTEAMS would simply not have been possible without the Open Call Programme. Equally in our Joint Research Activities many of the ideas and components underpinning GÉANT's new network design can be directly traced to specific Open Call projects. Bringing 21 projects, innovative ideas and new people into

GÉANT was really challenging… but definitely worth it when the lasting benefits are clear for all to see.

However it's really exciting at the moment too, working with the other e-infrastructures on projects such as EOSCpilot and eInfraCentral. The same set of organisations are working together for their R&E communities to cut down fragmentation and fix important issues such as interoperability. These communities will be seeing major improvements across the board and be able to access services in a way they haven't been able to previously. At TNC2017 it was fantastic to be able to host a joint e-infrastructure booth – right next to the main GÉANT booth – and this was very well received by the community. Presenting e-infrastructures to the users in a more unified manner is really important.

What concerns you today?

Before working in the GÉANT community I spent 10 years funding innovative ideas from individuals, small companies and universities. This experience, along with seeing the highly successful legacy of technologies and products from GÉANT's Open Call Programme, leads to a strong personal conviction that finding new ways of bringing innovation into the GÉANT (GN4-2) Project and sharing this with the GÉANT community is absolutely critical; especially as we move forward towards supporting important initiatives such as the EOSC and becoming a fundamental part of the European Data infrastructure (EDI).

You manage the Partner, User and Stakeholder Relations Activity in the GÉANT (GN4-2) Project. Why is this activity so important?

I really believe this work is fundamental to GÉANT's success, particularly in such a dynamic environment. By working closely with NRENs, large user projects, international networks and e-infrastructures, we can not only help to ensure efforts are aligned and relationships strengthened, but also help increase uptake of GÉANT and NREN services. Additionally, we can help to strengthen the GÉANT community through the coordination of Task Forces (TFs) and Special Interest Groups (SIGs) and one-off workshops. It's great to be able to lead an activity that brings the GÉANT community closer together and makes a real impact.

Where is your next holiday to?

It will be to northern Finland to see the Northern Lights for the first time. I'm really looking forward to the challenge of learning to walk in snow shoes and attempting to control a dog sled!

To read more about the GÉANT Open Call Programme, see CONNECT Issue 18

LIGO AND VIRGO – ANOTHER SUCCESS FOR GLOBAL R&E COLLABORATION

The recent exciting announcements from the teams from LIGO (with two interferometers in the states of Louisiana and Washington) and Virgo (with the Italian interferometer in Cascina connected to the Italian R&E network GARR) of the first observations of a "Kilonova" (the merging of two neutron stars generating both gravitational waves and a range of electromagnetic waves) on 17 August 2017 demonstrates the power and value of international collaborations.

We live in an era of big science. For the past two decades, collaborations involving hundreds of scientists have been commonplace and there are even some involving thousands. These big projects have achieved great things that wouldn't have been possible without the ability of large groups to communicate and share data, from decoding the human genome to revealing the Higgs boson. Even by these standards, however, what happened on 17 August and the days that followed was special.

The LIGO and Virgo projects comprise more than 1,500 scientists, all of whom are working towards a single goal: to capture signs of gravitational waves and decode their meaning. The data gathering happens at massive observatories in the USA and Italy, but the analysis is done in countries all over the world. This distribution and analysis of Terabytes of data can only take place through the work done by GÉANT and dozens of NRENs building high performance research and education networks to allow huge volumes of data to be rapidly and securely shared around the world.

For the first time, gravitational waves, gamma-ray busts and light have been observed simultaneously from the same source. The European Southern Observatory (ESO) working in collaboration with scientists around the world, were able to pick up the infrared and optical signals from a gravitational wave and gamma source in the southern sky, within minutes of the announcement.

As a result, data from the ESO and their partner telescopes was passed back from Chile to the ESO science data archive at Garching in Germany. This data was transmitted through the R&E infrastructure of REUNA, RedCLARA, GÉANT and DFN. Not only have ESO been utilising the NREN networks to enhance the science that they do but they have also utilised the eduGAIN trust and identity infrastructure to inter-federate their logins, thereby allowing researchers to collaborate seamlessly across institutions. ESO currently have a 1 Gbps connection to DFN and have

Words
Interview by Maddalena Vario

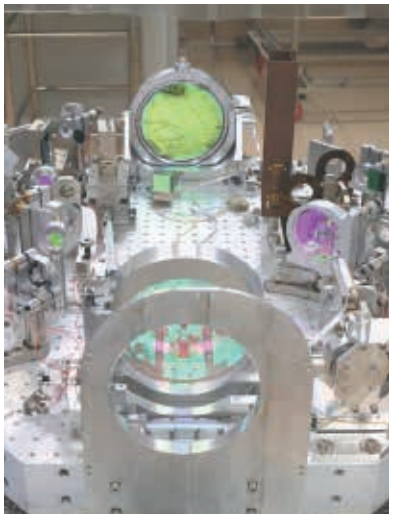
Picture
Above: Virgo detector

been actively participating in eduGAIN to enable the federation of single-sign-on identities for researchers and staff.

Across the whole period, some 3,500 scientists and astronomers, many of whom have never worked together at such a scale, had to all of a sudden figure out how to access and share data. The growth of Authentication, Authorisation and Identification (AAI) technologies and the expansion of interfederation between organisations and identity federations using eduGAIN has allowed these rapid collaborations to take place by allowing researchers to use their existing institutional identities to access data on remote systems and securely share results.

"LIGO and Virgo have been preparing to participate in multi-messenger observations, such as those from the kilonova event, for years - before we had even detected gravitational waves. The coordination between LIGO and Virgo scientists and astronomers from over 90 other observatories was facilitated through the use of federated identities, made possible by SAML identity providers at universities and research institutes around the world, by national identity federations and by eduGAIN. The foresight of these technologies and organizations really lowers the bar to creating ad-hoc research collaborations and it was crucial to the type of interdisciplinary effort that went into the kilonova announcement and papers. We hope that this is the first of many groundbreaking discoveries that these technologies will enable in gravitational wave astronomy!"

Warren Anderson, Identity and Access Management Lead for LIGO



What is a Kilonova?

The drama of a neutron-star merger is due to the fact that it involves one of the most extreme objects in the universe. Neutron stars are some of the smallest, densest stars we know. They do not have much more mass than our Sun, but all of it is compressed into a ball no bigger than the width of a mid-sized city (about 15 km, or 9 miles). That's a lot of compression. A teaspoon of neutron star would weigh 10 billion kg (or 22 billion lbs)—about the same as 1 million very large elephants. The merging of two of these stars has sufficient energy to literally shake the entire universe.

The event didn't just emit gravitational waves. It put out electromagnetic radiation in every spectrum: X-rays, gamma rays, ultraviolet, visible, and radio waves and this combination of gravitational waves and electromagnetic energy is what makes these events so exciting as it gives us multiple "views" of the same event.

Virgo and GARR – working together to support advanced research

Antonella Bozzi, Head of the IT Department at EGO (the European Gravitational Observatory, consortium founded by the National Institute for Nuclear Physics and the National Center for Scientific Research to build and manage the site of the Virgo interferometer), explained how this important international collaboration works and the role that the Italian research network plays in the data exchange between the involved sites.

When it comes to data analysis, LIGO and Virgo are a unique collaboration that shares analysis algorithms, software development, data management, analysis and computing resources. It is physics that requires a global approach because in order to locate the source of gravitational waves and to analyse their signal, it is crucial to have at least 3 detectors at a certain distance from each other.

Also, in order to reduce the rate of false alarms, it is crucial to work in multiple coincidence. For this reason, Virgo puts together the computing centres of CNAF in Bologna, CCIN2P3 in Lyon, Nikhef in Amsterdam and other resources in Poland. Thus, the computing and storage facility is shared through the GRID infrastructure, functioning on top of GÉANT and the European NRENs, which is available to both LIGO and Virgo researchers. CNAF and CCIN2P3 also act as final repositories of our raw data. Analysis is therefore a global activity, which means that there is a continuous transfer of data between Virgo and LIGO and vice versa.

We use heavily both the network and the computing centres. For example, not only do we have data going from Cascina to USA and from USA to Cascina in real time, but also from Cascina to the Italian and French computing centres, with a latency of a few seconds, where offline analysis is done. From this point of view, a reliable, secure and fast network is a key asset for our collaboration. Thanks to the high performance research and education networks we can share large amount of data in real time and with high levels of security all over the world.

In 2004, we joined the community of the Italian research network, GARR, and this led to a complete change in our network. We are very happy of this collaboration and we currently use an access fibre provided by the University of Pisa (which has a collaboration agreement with GARR) that allows us to first enter GARR network and, from here, to reach the GÉANT pan-European network and the international research networks.

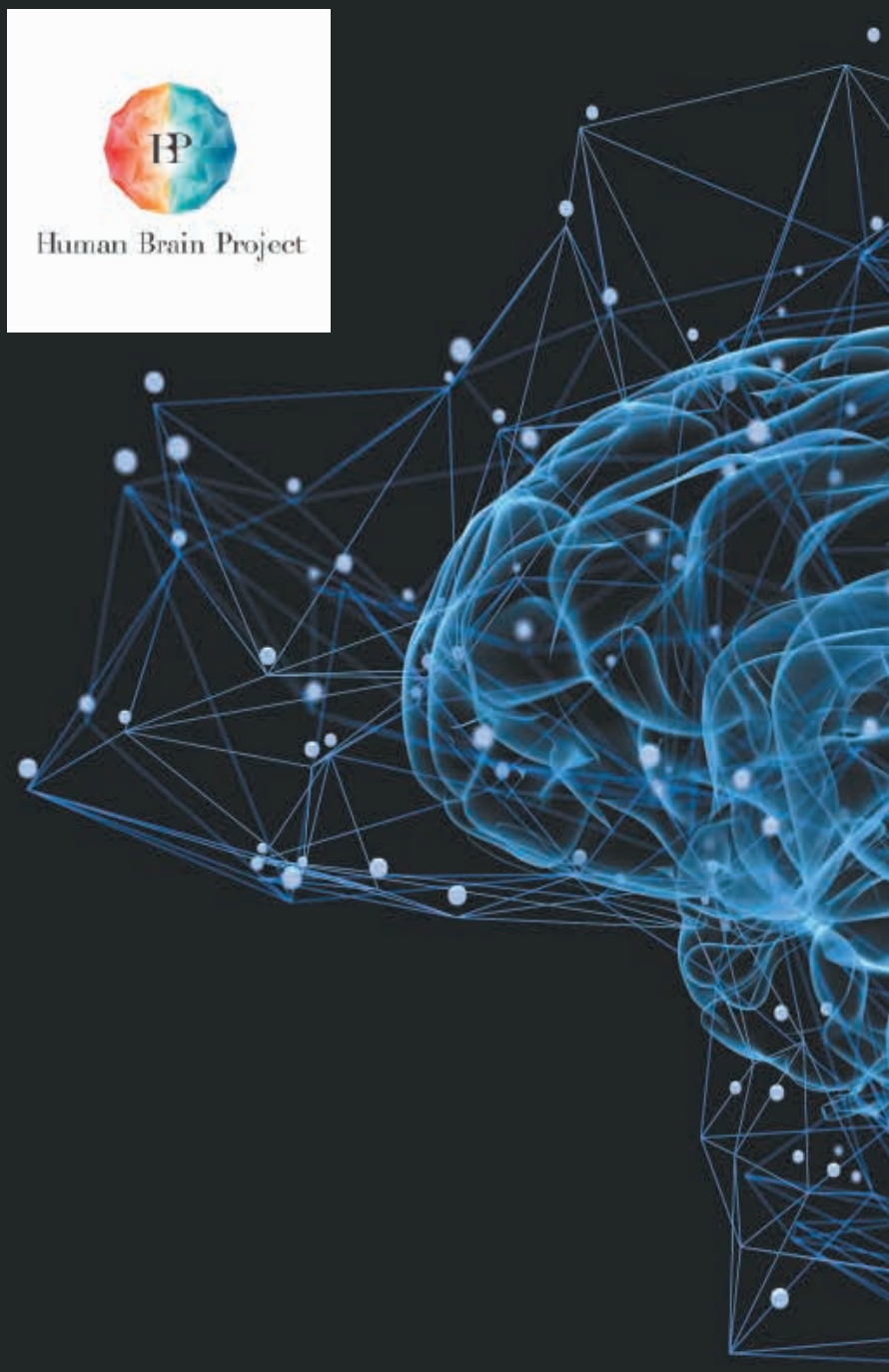
To find out more about the advanced networking and AAI technologies that helped make these collaborations possible visit **www.geant.org**, **www.edugain.org** and **www.garr.it/en/**

For more information about the ground-breaking research visit **www.ligo.org/** and **www.virgo-gw.eu/**

Credit: Simone Schiavon

THE HUMAN BRAIN PROJECT

The human brain is a truly amazing and awe-inspiring thing. It can perform feats that even the most sophisticated computers are only just starting to tackle and does so using a tiny amount of energy. The human brain consists of approximately 86 billions of nerve cells that form local and global brain networks through about ten thousand synaptic contacts per cell. These networks respond in milliseconds, but also change slowly, e.g., during the course of a day, and over the months and years in the lifespan of a person. They are shaped and re-shaped by genes as well as experience and have several hundred millions of years of evolutionary history. Understanding the multilevel organisation of the brain requires bridging the different scales in time and space, from the molecular to the level of large scale organisation and behavior.



This challenge is so extraordinary that not the even best-funded single research project could claim to provide the full picture. Therefore, a unique lasting contribution the Human Brain Project (HBP) can make is to integrate and focus precious resources to build a collaborative platform: a genuine European research infrastructure driven by innovative supercomputing and neuromorphic systems, says Dr. Katrin Amunts, the scientific research director of the HBP. On the platform, experimental and theoretical approaches are combined with models, simulation and data analytics. This provides neuroscience and brain medicine with a new path to meet the brain organisation, linking insights, methods and large datasets from many areas of brain research.

Understanding the brain takes more than brain power

Simulation and data analytics are becoming more and more valuable tools in neuroscience to approach the brain's complexity. The High Performance Analytics and Computing Platform of the HBP provides the necessary infrastructure both inside and out of the HBP. There is a network of four supercomputing centers: CSCS Lugano, the Juelich Supercomputing Center, the Barcelona Supercomputing Center and CINECA in Bologna. They host some of the most powerful computers in the world, capable of performing quadrillions of operations per second and with memory capacity measured in quadrillions of bytes. They also make this hardware available to the scientists through their Fenix platform (Federated Network for Information Exchange). I.e., they collaborate with neuroscientists to develop software, e.g. to manage and analyse their huge datasets, to simulate models most efficiently on the supercomputers (getting better results as fast as possible) or to visualize the datasets. Computer- and neuroscientists also learn together, which computer architecture is the most appropriate to solve a certain problem. It is expected that such co-design will inspire new technologies such as modular supercomputing.

This computing capacity is provided by HPC centres across Europe, which are also members of PRACE.

GÉANT worked with PRACE and the Human Brain Project to ensure that these centres were interconnected across the GÉANT and NREN networks. To enable these connections PRACE and GÉANT launched in December 2016 a pathfinder project to interconnect these sites using the MD-VPN networking service to replace the previous dedicated network infrastructure. MD-VPN provides extremely high performance virtual private networks between all the sites to enable simple, secure and manageable network capacity.

By March 2017 the pilot had been completed and was so successful that agreements were made to expand the network to include all PRACE computing centres and currently 25 systems on 18 sites in 14 countries are now connected via MD-VPN.

This use of scalable IP networking services will allow a vast range of projects such as the Human Brain Project to access and use PRACE's services much more easily in the future.

Find out More

https://www.humanbrainproject.eu

http://www.prace-ri.eu/

https://www.geant.org/Services/Connectivity_and_network

THE CONNECT INTERVIEW

JUAN PABLO CARVALLO

Juan Pablo Carvallo is the Executive Director of CEDIA, the Ecuadorian National Research and Education Network. In conjunction with the celebrations of the NREN's 15th anniversary, CONNECT caught up with him to talk about his plans for CEDIA's involvement and influence in the development of Ecuador.

Pictures
Top right (left to right); Ing. Juan Pablo Carvallo. Ing. Marcelo Jaramillo Carrera, first Executive Director of Red CEDIA. Cathrin Stöver, Chief Collaboration Officer, GÉANT. PhD. Luis Eliecer Cadenas Marin, Executive Director of Red CLARA. Dr. Nicolay Samaniego Erazo, President of Red CEDIA.

Right (left to right); Dr. Nicolay Samaniego Erazo, President of Red CEDIA. Dr. Pablo Vanegas Peralta, Rector Universidad de Cuenca. Dr. Francisco Salgado Arteaga, Rector Universidad del Azuay. Dr. Enrique Pozo Cabrera, Rector Universidad Católica de Cuenca. PhD. Luis Eliecer Cadenas Marin, Executive Director of Red CLARA, Cathrin Stöver, Chief Collaboration Officer, GÉANT.

Juan Pablo, tell us about your life at CEDIA

In the years preceding my official role at CEDIA, whilst working as a technical networking consultant for the Ecuadorian universities, I had not really been what you would call an advocate or supporter of the organisation. The network was not being used to the best of its potential, CEDIA's infrastructure was nearly non-existent, and the organisation had no visible impact within the country. I didn't expect to be associated with the NREN during my career, but then something unexpected happened: I was elected CEO of CEDIA. As you can imagine my views have now radically changed.

I started by asking myself some burning questions: what value was CEDIA bringing to our country? How could I help transform the NREN into a valuable asset for all its members? As soon as I accepted my mandate, I renegotiated all interconnection and capacity contracts with providers, and within just three weeks, the network's capacity increased threefold without added costs for our members. At the first General Assembly I presented my vision for the future of CEDIA: the academic network should be a tool to improve the quality of research in our country - in all fields, not just technology. After ensuring the underlying technology of our network was solid and reliable we developed a cloud-based system, increased the capacity of the network and created a variety of new services for the benefit of our researchers around the country.

What is CEDIA's impact in Ecuador?

The CEDIA Board enabled me to fund CEPRA, a new programme for academic research in the country. This project invites researchers to submit applications for collaborative projects within a given deadline. The most successful projects win CEDIA's funding. In order to encourage broad academic collaboration, our programme has

stringent requirements: the projects must involve three different universities from different Ecuadorian cities. Thus CEDIA spotted an opportunity and became a catalyst for academic collaboration. The following figures demonstrate the growing success of our initiative:

in 2015 we received 12 proposals, this year, in 2017, we received 45! A total of 575 researchers are currently funded by CEDIA!

As a result, the quality of academic research in our country has considerably improved, high quality research papers are being produced and published on a regular basis, the grading of our universities has improved and our researchers are better able to attend international conferences. In short, we have had an impressively positive impact on national research.

CEDIA's portfolio of services includes a research projects incubator and several programmes designed to support teachers and researchers with different levels of experience and expertise. We are deploying our new network with over 4500 km of fibre optic channels; this will be managed by our own technicians, our own NOC. We are increasing the cloud, we have also deployed several learning object servers for teachers to share materials with students and colleagues, and have also created a superior school with the support of the Brazilian network, in order to provide continuous education to professionals in our country. Our portfolio of services is continuously growing.

We have changed name to stress the importance of our goal as an NREN: we are now *Corporación Ecuatoriana para el Desarrollo de la Investigación y la Academia* with a focus on research and education in contrast with our previous name that highlighted the Internet service provider aspect. It's a strategic change aimed at making our goal more visible.

Can you talk to us about your international collaborations and your involvement with GÉANT?

We engaged thoroughly with the RedCLARA-led ELCIRA project (which aimed to expand eduroam, identity federations and collaboration tools across Latin America) and after its completion, we were one of the first NRENs in Latin America to have deployed five additional service components on top of connectivity including: eduroam, federated access integrated into eduGAIN (known as MINGA in Ecuador), videoconferencing and VoIP. All this happened within three months of my appointment.

We have been involved in many international projects such as MAGIC (a RedCLARA-led project which extended the benefits of ELCIRA and shared them with other world regions), and since then eduroam has become valuable everywhere.
With eduGAIN our researchers are now enjoying the advantages of single authentication capabilities. Our CSIRT team has become a member of FIRST, a worldwide organisation in charge of cyber security, contributing to a major decrease in cyber-attacks in the country: in 2015 we recorded 2 million cyber-attacks as opposed to just 3,000 in 2017. We have started to supply new links to those members who will be part of the South American link of the BELLA project: our part of the network is already in place! Since 2014 we have been attending TNC in Europe and the I2 Global Summit in the USA.

This year we were delighted to welcome Cathrin Stöver from GÉANT at our 15th anniversary celebrations. Cathrin's visit had such a positive impact in ways that I didn't expect and an incredible effect on my team. Cathrin's role as mentor and facilitator for RedCLARA in Latin American and CEDIA in Ecuador is widely recognised, so my team, who lives and breathes CEDIA, found Cathrin's presence and words very inspiring. Actually her visit made a lasting impression on all our guests within academia and the national authorities.

What lies ahead for CEDIA?

CEDIA's history can be segmented into three different phases. From 2002 to 2013 CEDIA was an Internet provider, serving the important purpose to lower prices and improve connectivity

nationally and internationally; from 2013 to 2016 our portfolio registered an exponential expansion with the delivery to our members of over 42 programmes focusing on different segments of the population with a focus on research collaboration. This year has seen the start of the third phase, the preparation for our biggest challenge: community engagement. How do we help researchers improve living conditions in our country and our society? How can researchers enable industry to create new technologies, products and services? How do we bridge the gap between industry and academia? CEDIA is indeed in a privileged position to play a focal role and act as a mediator for innovation between industry, academia and entrepreneurship.

I believe that the future of humanity is in the hands of NRENs. NRENS around the world have the tools to bring change and offer society a brighter future.

RIPE NCC
RIPE NETWORK COORDINATION CENTRE

TALKING IOT AT RIPE

The Internet of Things (IoT) is growing at a rapid pace, but alongside a proliferation of connected “things” comes a whole host of privacy, security and safety concerns that will need to be addressed. A group of 30 RIPE community members recently met in Leeds, UK to discuss some of these issues and to see what, if anything, RIPE and the RIPE NCC can do to help.

With many IoT problems seemingly the result of distorted market incentives (get it working and in the market now and solve the security problems later), the question of regulation features heavily in IoT discussions. This is a complicated topic. In some ways it's a public safety issue akin to fire-safety standards (particularly when we're talking about connected cars or health devices). On the other hand, any regulation will be of varying effectiveness and will take time to be developed. Regulation could also deal a serious blow to innovation and might affect new entrants or smaller players disproportionately. A "trusted IoT label" might work as an in-between, but this involves many of the same concerns.

Do service providers have an ethical obligation to protect users? Enno Rey from ERNW introduced the idea of using Customer Premise Equipment (CPE) as a shield to protect people's devices at home. By default, many IP ports are open that people will never use – maybe it's time for providers to consider closing some of these? This approach would have prevented the recent Mirai botnet attacks and likely other attacks in the future. At the same time, providers should be wary of creating an "assisted" experience that disempowers users in the name of protecting them. Do people know what's going out on their networks? One attendee was surprised at how much outbound traffic his connected TV was generating. As people's connections grow faster over time, this raises concerns about greater DDoS attack volumes and attacks against the DNS.

So what can RIPE do? There was a great deal of support among attendees for a working group (WG) on IoT. This follows two informal sessions on the topic at RIPE 73 and RIPE 74. Perhaps there is value in documenting and sharing some of the RIPE community's experiences dealing with many of the same issues that IoT manufacturers are now encountering, such as default passwords or open DNS resolvers in CPE.

The RIPE NCC is regularly asked to participate in various fora as a neutral and trusted source of technical information. An IoT WG would provide a focal point for the RIPE NCC to request community input and report back on the content of external discussions. It would also function as a clearinghouse where relevant information could be published and announced to the RIPE community. Finally, an IoT WG could help to attract participation from vendors and the security community by signalling that the RIPE community is looking at IoT issues.

The RIPE community also discussed a range of IoT topics at the RIPE 75 meeting in Dubai. Attendees at this session looked at how they can move towards becoming a fully-fledged IoT Working Group.

Get involved with RIPE and IoT

There is a dedicated mailing list for people with an interest in discussing IoT: **https://lists.ripe.net/mailman/listinfo/iot-discussion**

Reports from 21 September Meeting **https://www.ripe.net/participate/meetings/roundtable/september-2017/ripe-iot-roundtable-meeting-21-september-2017/agenda**

RIPE 75 IoT **https://ripe75.ripe.net/programme/meeting-plan/iot/**

Words
Antony Gollan of RIPE reports

FOCUS ON: GÉANT LEARNING AND DEVELOPMENT - ENABLING THE FUTURE

CONNECT catches up with Irina Mikhailava, Head of GÉANT Learning and Development (GLAD) to talk about the Future Talent Programme and other exciting initiatives recently launched by her team.

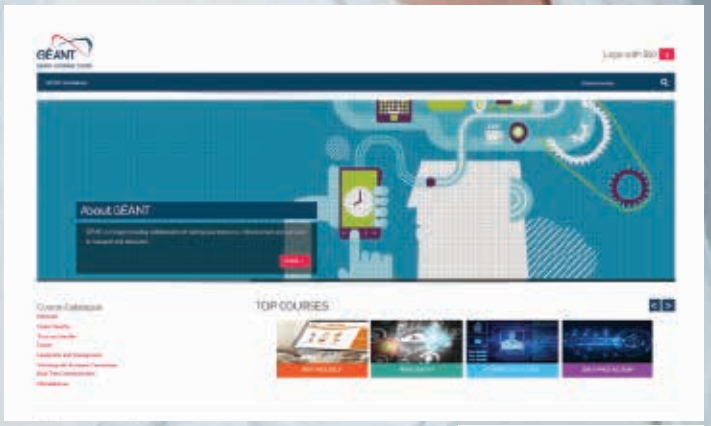
Irina, could you tell us about the principles behind these recent changes?

I would like to start with an inspiring quote by P. Senge: 'A Learning organisation is an organisation that is continually expanding its capability to create its future'. It is my conviction that in order to be successful in the knowledge economy we need to work towards fostering learning organisations and learning ecosystems. Traditional learning methods will soon no longer be sufficient to prepare for the future; there is a need to become creative and experimental in the development of new learning tools and programmes. I see GLAD as a knowledge powerhouse supporting excellence in the community of networking professionals through learning, growth and sharing of knowledge. My ambition for GLAD is to become a point of reference and a future enabler for our community.

What does the Future Talent Programme entail?

The Future Talent Programme recognises the importance of the role of young professionals in our community. The community offers young talents opportunities for growth and in return they deliver ideas, energy, passion and dedication. Learning is experiential, it stimulates personal and professional growth and the ability to be innovative. This year, the Future Talent Programme provides the context for two exciting initiatives: Lightning Talk Challenge and Poster Pursuit. The Lightning Talk Challenge is a learning experience around presentation skills to prepare young professionals to get their ideas on stage at TNC. Poster Pursuit aims to encourage the development of visual presentation skills for poster presentation sessions also at TNC. To increase the chance of gaining admission, GLAD will support all registered participants with free training webinars.

We believe these initiatives offer NRENs a great opportunity to present their young professionals to an international audience of innovation enablers and to gain valuable visibility amongst their member audience as well as within the global research and education networking community. **We invite all NRENs to nominate passionate, enthusiastic and talented IT students to take part and present their ideas at TNC18 that will take place in Trondheim, Norway in June 2018. Up to three participants for each initiative can be nominated by each NREN. To secure nominations, NRENs are asked to register their participants at Lightning Talk Challenge EventR and Poster Pursuit EventR.**



e-Academy homepage

Can you give us an overview of your courses and programmes?

The learning and development activities that we enjoy implementing are geared towards supporting career growth and professional development of our community. We support training activities of GN4-2 and AARC projects and look after TRANSITS training events. In addition to the Future Talent Programme, GLAD portfolio also includes the Technical Knowledge Programme that aims to help participants to stay on top of state-of-the-art technical subjects, and the Capabilities Building Programme that facilitates organisational and managerial sustainability.

Last month we launched a brand new website and also a Moodle-based e-learning platform called GÉANT e-Academy. The e-Academy has the ambition to become a 'one stop' e-learning space for networking professionals in Europe by providing them with interactive learning experiences and knowledge anytime, anywhere. As a resource, the e-Academy will host GLAD training products and educational content designed and developed by the community.

As a team, we also offer our expertise in interactive events design, facilitation, coaching and management of professional development. We are open to opportunities to collaborate with partner organisations, the wider networking community and other like-minded institutions.

If you would like to join us in this mission or would like to learn with us, contact **glad@geant.org** or visit our website **learning.geant.org**

"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 to their academic studies."

Nadia Sluer, Technical Training Coordinator, GLAD.

The TNC17 Lightning Talks Challenge through the eyes of its participants

AT TNC17 GÉANT launched a joint programme with research and education networks to bring young professionals and students to the conference and 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's Learning and Development team to prepare for the occasion. The IT Students' Lightning Talk Challenge is one of the first GÉANT Future Talent Programme initiatives. Every single student, with their enthusiasm and the exciting topics brought to TNC17 an absolute breath of fresh air; we look forward to repeating and surpassing the experience at TNC18.

CONNECT approached one of these TNC17 Programme alumni to learn about their experience from the preparation work carried out with the support of the GLAD team, through to the delivery of their talks and their TNC17 attendance.

Fredrik Strupe, UNINETT Lightning Talk: Using Raspberry Pis for cheap Wi-Fi monitoring

How did you learn about the Student Lightning Talk Programme?

My supervisor at UNINETT suggested to put myself forward to present the project I've been working on for the past year (I am currently working at UNINETT while studying at university); it sounded very interesting and I decided to give it a go.

How did you find our webinars and our coaching?

The lessons helped me during the creation of the paper and the preparation of the talk, and the seminars gave me the opportunity to meet the other students. The feedback on the talks received from the coaches and the other participants was also useful, and enabled me to considerably improve the talk. All in all it was a very enjoyable experience, and it made the thought of presenting to a large audience so less scary than expected.

What was the most memorable moment of TNC17?

I have so many memorable moments from the event, but the most unforgettable is probably the opening reception, a great social event spent on a boat cruising the Danube River. It was a fantastic way to get to know the other students and the GÉANT staff, and to meet other participants from all over Europe.

What did TNC17 mean to you?

It gave me an insight into the networking community in Europe, and the different organisations and people involved.

What was the biggest challenge you faced at TNC17?

Probably avoiding a heat stroke! Coming from 8°C in Norway, the summer heat in Austria was quite exhausting. But on a more serious note, delivering the five minute lightning talk was probably the biggest challenge I have ever faced, as I don't have much experience in presenting to large audiences.

How do you think this experience will benefit you in the future?

It gave an incredible boost to my confidence and helped me improve my presentation skills, in addition, during TNC17 I had the opportunity to meet people I may collaborate (and encounter) with in the future. The event also gave me a great insight into the types of jobs within the European networking community, and I am sure it will inspire me to choose a career path after my studies.






VISIBLE SUCCESS FOR EAPCONNECT

2nd EaPEC conference

Research infrastructures and e-infrastructures representatives joined a large group of enthusiastic participants and high-level speakers at the 2nd Eastern Partnership E-infrastructures Conference (EaPEC) in Minsk, Belarus on 27-28 September.

Sessions on e-infrastructures for Open Science and e-infrastructure challenges were part of a varied schedule at EaPEC 2017. With lively discussions and engagement with the large audience, the conference succeeded in building community interactions as the basis for future collaborations on policy and research in the Eastern Partnership (EaP) region.

EaPEC 2017 featured lightning talks and breakout workshops as new additions to the programme. Topics ranged from social entrepreneurship, a virtual reality streaming-based learning environment, and software router acceleration using OpenFlow hardware, to research data management and artificial intelligence as Open Science.

Three keynote speeches were delivered: Severin Strohal, Deputy Head of Unit 'Georgia, Moldova & Neighbourhood Cross-Border Cooperation' at the European Commission explained 'the European Eastern Partnership'; Karlheinz Meier of Heidelberg University and of the Human Brain Project discussed 'brain-inspired computing'; and Erik Huizer, CEO of GÉANT, made the case that 'internet freedom is essential for research'.

In a panel session on e-science and innovation, participants explored how the host country, Belarus, can achieve its goal of becoming an 'IT country'. Drawing on nearly 20 years of progress in Estonia, Kristina Lillemets, the Director of the Estonian national research and education network EENet of HITSA, advised that success comes if governments have a clear vision, a strong will, and if they "invest in infrastructure, invest in people, invest in collaboration with the private sector, because the government alone cannot do this". In Belarus, according to Alexander Tuzikov – Director General of the conference host organisation UIIP NASB / BASNET – such investment is needed to improve prestige and support motivation for young people to go into research and innovation. "We are expecting some changes in the near future because there was a meeting of the president of our country with people from research this year. The president said we should change this situation with stimulation of researchers."

A high level of interest in collaboration using research and education networks and other infrastructures and services was evident during EaPEC 2017. In particular, a broad range of fields were represented by six winners of this year's Enlighten Your Research awards, which had enjoyed a record high number of applicants. Digitisation of cultural heritage, professional development for teachers, digital libraries, open government data sharing, and cloud computing are areas that will benefit from research projects in the Eastern Partnership (EaP) region supported by EYR and partners in the coming years, coordinated by SURFnet, the originator of the EYR programme.

EaPEC 2017 was organised by the EaPConnect project and hosted by UIIP-NASB BASNET.

Photos, links and video streams of the performance: **https://www.facebook.com/EaPConnectProject/**
Other information: **https://www.eapconnect.eu**

Pictures
EaPEC 2017 with Florian Berberich (PRACE), Andrea Wiktorin (Head of EU Delegation to Belarus), Kristina Lillemets (EENet of HITSA), Karlheinz Meier (Human Brain Project) and Erik Huizer (GÉANT).

Pictures
Main image; Laura Põldvere and Kirke Karja (piano) with Reso Kiknadze on screen.

Surrounding images;
- Linda Corugedo Steneberg, Director, DG CONNECT and Lawrence Meredith, Director 'Neighbourhood East', DG NEAR, enjoying 'Music Without Borders'.
- Maria Minaricova, EaPConnect project leader, and Claudio Allocchio of GARR.
- Ivari Ilja (piano) and Henry-David Varema (cello) with Katsiarina Shapochka (viola) and Oleg Iazina (violin) on screen.
- Lawrence Meredith, Director 'Neighbourhood East', DG NEAR, welcoming 'Music Without Borders' guests.
- A cake celebrates the arrival of LoLa in Estonia.

A harmonious day in Tallinn

On 5 October 2017, Eastern Partnership Connect (EaPConnect) project partners presented 'Music Without Borders' in a special concert for European Ministers and Ambassadors, then joined many of them for the second Eastern Partnership (EaP) Ministerial Meeting on Digital Economy, in Tallinn, Estonia.

During the ministerial meeting, EaPConnect was mentioned in a declaration on digital economy that EU and EaP country representatives signed. This includes a commitment to deepen cooperation in six areas: electronic communications and infrastructure; trust and security; eTrade; digital skills; ICT innovation; start-up ecosystems and eHealth. Delegates welcomed EaPConnect progress and agreed to implement further actions to promote well-structured ecosystems for ICT research, innovation and start-ups.

Preceding the meeting, the 'Music Without Borders' concert showcased how research and education networks paired with 'LoLa' low latency technology can support harmonious cross-border collaboration. With a programme of Mozart, jazz and comic opera, the event demonstrated new opportunities for artistic research, rehearsal, performance and teaching in the EaP region.

Estonian and Armenian musicians located in Tallinn played seamlessly together with Belarusian and Georgian performers who were connected in real time from Minsk, Belarus. This was the first time that LoLa had been used in Estonia and Belarus. The performance showed the capability of the national research and education networks to support its use.

Lawrence Meredith, Director 'Neighbourhood East' of the European Commission's Directorate-General for Neighbourhood and Enlargement Negotiations gave a welcome speech and provided the following statement: "The EU is pleased to support since 2015 the Eastern Partnership Connect project and its efforts to provide not only physical networks to interconnect Eastern Partnership (EaP) and other countries with high-speed broadband connections, but also its efforts to build online services for research and education, to extend its reach beyond supporting big science and research and to offer support also to the arts and humanities. Projects like this are of strategic importance to help bring EaP and European neighbours closer together."

'Music Without Borders' was hosted by the Estonian Academy of Music and Theatre with the Estonian research and education network link provided by EENet of HITSA. In Minsk, LoLa was implemented at the Academy of Sciences and the network was provided by the United Institute of Informatics Problems/BASNET (UIIP NASB).

Eugeni Efimov, Head of the International Cooperation Department at UIIP NASB said: "It's extremely important for our musicians to have the ability to make the window to Europe open wider, and to have more chances to organise online meetings with musicians of many European countries."

LoLa was developed by the Giuseppe Tartini Music Conservatory in Trieste, Italy, in collaboration with the Italian research and academic network GARR. **https://lola.conts.it**.

EC news about the declaration on digital economy: **http://bit.ly/2fNMcXO.**

Photos, links and video streams of the performance: **https://www.facebook.com/EaPConnectProject/**
Other information: **https://www.eapconnect.eu**

TNC18 - INTELLIGENT NETWORKS, COOL EDGES?

EARLY BIRD REGISTRATION OPENS ON 5TH DECEMBER 2017

Intelligent Networks, Cool Edges? is the theme of TNC18, the largest networking conference for research and education. TNC18 will be held in Trondheim, Norway between 10th and 14th June and hosted by UNINETT, the Norwegian National Research and Education Network. Trondheim, the tech capital of Norway, offers the ideal backdrop for TNC18's stimulating theme.

The conference will also focus on a variety of thought-provoking sub-themes such as the power of the Internet, the responsibility of sustainability and delivery, the power of data analytics, the creation of intelligent complexity and networking at the speed of science.

You can register from 5 December on the TNC18 website registration page at **tnc18.geant.org**

The initial call for proposals - for presentations and session topics – closes on the 30th November 2017, but there are still many opportunities to actively contribute to TNC18. Visit **https://tnc18.geant.org/submit** and follow the instructions on the page:

Meeting proposals
- Deadline 15 January 2018
To cater to a growing demand from the community, at TNC18 more opportunities will be created to organise working groups, BoFs, meetings and workshops.

Demonstrations
- Deadline 15 January 2018
Showcase your (technical) innovation at TNC18! Demonstration slots are 30 minutes long and are offered during the breaks on Monday, Tuesday and Wednesday.

Lightning talks
- Deadline 16 April 2018
The call for lightning talks will open on 1 February and will run until 16 April 2018, midnight CET. Lightning talks are 5 minute talks, in which a hot topic is quickly addressed.

Posters
- Deadline 16 April 2018
Featuring a poster at TNC will serve as an excellent advertisement for your work. The call for poster proposals will open on 1 February and will run until 16 April 2018, midnight CET.

Sponsorship

TNC18 is a great way for organisations to gain exposure and expand their business opportunities in the research and education networking community. For more information visit **https://tnc18.geant.org/sponsorship** and for additional questions please contact **tnc18@lists.geant.org**.

Registration

The TNC registration fee includes access to all conference sessions, materials and social events as well as lunches and coffee breaks. All information regarding registration and submissions can be found on the TNC18 website.

We look forward to welcoming you in Trondheim!

ALBERTO PÉREZ GÓMEZ NAMED AS NEW DIRECTOR OF REDIRIS AT RED.ES

The Red.es Board of Directors has appointed Alberto Pérez Gómez as the new Director of RedIRIS, the Spanish academic and research network.

This appointment will reinforce the organisational structure of RedIRIS, thus resulting in the achievement of the objectives of Red.es, the Ministry of Energy, Tourism and the Digital Agenda, and the Secretary of State for Information Society and Digital Agenda.

Since 2002, Dr Alberto Pérez has been working at Red.es, the public entity responsible for promoting the Information Society in Spain.

He joined the entity to work on the ".es" Domain Register, and has since collaborated in representing Red.es internationally at forums such as ICANN or CENTR (Council of European National Top-level Domain Registries).

In 2004 he took on the role of Deputy Director of RedIRIS, dealing with financial management, personnel, service portfolio and projects, which included working on the deployment of RedIRIS-NOVA. He also represents RedIRIS at the GÉANT General Assembly.

Before joining Red.es, Alberto worked at the Telecommunications Market Commission from 1999 to 2002, and, from 1994 to 1999, as a professor in Constitutional and EU Law at the University of Alcalá, where he also graduated. Alberto completed his doctoral thesis on communications regulation, has published two books and various articles on ICT sector policies, has consulted with European institutions and governments as part of his collaboration with the European Audiovisual Observatory and with the University of Oxford, as well as speaking at many sector courses and conferences. He also studied an Executive MBA at the IE Business School, and is a Sworn English and French Translator-Interpreter recognised by the Spanish Ministry of Foreign Affairs.

CONNECT congratulates Alberto on his appointment and looks forward to continued fruitful collaboration!

20 anos | FCT Fundação para a Ciência e a Tecnologia

FCT | FCCN: NAU PROJECT IS NOW SAILING THROUGH KNOWLEDGE SEAS

FCCN, a unit of FCT – the Foundation for Science and Technology, has recently launched the NAU Project, an initiative aiming to implement, develop and operate a Portuguese e-learning platform directed to massive online audiences.

Pictures
Launching the NAU Project at Pavilhão do Conhecimento, Lisbon

The NAU project goes further than the typical MOOC initiatives, as it supports open and closed courses and will be available beyond high education, reaching also promoters such as public administration and nonprofit organizations. The NAU Platform aims to aggregate all the national initiatives regarding MOOCs in order to reduce costs and reach a larger number of trainees, thus making learning contents more accessible.

The project was officially launched in a public presentation held at Pavilhão do Conhecimento, Lisbon, on September 27 2017, attended by more than 200 participants. The event garnered enthusiastic support from its attendees, receiving very positive feedback.

The Secretaries of State of Science, Technology and Higher Education, Public Administration, Education and the assistant of the Secretary of State of Health were representing the Portuguese government.

Founding institutions

In order to implement the project, a consortium was established composed of: FCCN, INA (a public institution that aims to promote the qualification and mobility among workers in public functions), IEFP (a public institution to promote the creation and quality of employment and combat unemployment), Direção Geral da Educação (a governmental body responsible for the implementation of the policies relating to the pedagogical and didactic components of pre-school education, primary and secondary education), Direção Geral de Saúde (the public institution that aims to guide and coordinate health promotion and disease prevention activities) and Secretaria-Geral da Educação e Ciência (a central service under the direct administration of the Portuguese government, providing specialized technical support to government bodies working on the education and science areas).

Such a diverse group of founding institutions reflects the objective to promote and support the e-government concept, enhancing and facilitating new means of communication with the citizens.

With the opening of this Project to the Public Administration at large, the aim is to enable all institutions to reach out, not only to their workforce, but also to their stakeholders and citizens. As an example, the Health Ministry will be able to train thousands of Doctors; the Education Ministry will be able to train Teachers.

The NAU Project is a two year project, co-funded by the European Fund of Regional Development with 689.448 euros, in a total of 1.2 million euros of investment. NAU plans to deliver at least 20 courses each year.

Supporting Universities and Public Administration

For the Universities, alongside their current activities, this new platform will provide them with a new place to present their key assets, reaching new audiences and fulfilling at a new level their main mission to provide high quality education.

For FCCN, it is a big step ahead and a great challenge to come, not only technically, but also as a means to reach a large interested public audience. Technically speaking, the NAU Platform will be instantiated on a private cloud infrastructure. The platform will be continually maintained and updated resorting to AGILE methodologies for software development.

During the implementation phase, it is also crucial to maintain a sustainable content production ecosystem, aiming to reduce production costs and create more competitive and higher quality courses.

To sum up, NAU's main goal is to provide a sustainable infrastructure combining technological, educational and communication axis altogether, with specific technical requirements and the need for independence from global MOOC platforms.

A game changer, the NAU project is now sailing through the knowledge seas and discovering new thoughts, experiences, ideas, and new ways of learning.

Origin of the name

The NAU project aims to be a reference of the Portuguese cultural identity in the digital space. In this case, the name chosen says it all: "nau", when loosely translated, means ship, with one particular twist: "nau" is the name of the Portuguese transport ships that sailed during the age of discoveries that succeeded the caravels. Its mission remains roughly the same: to disseminate Portuguese culture throughout the world and "finding new lands" in the "knowledge seas".

Key dates

October 1, 2017	**Project start**
April 1, 2018	**Test phase**
June 1, 2018	**Go-live**
October 1, 2018	**Big Bang**
October 1, 2019	**End**

AMRES
Akademska mreža Srbije

AMRES: CONNECTING SCHOOLS IN SERBIA

In 2003 the World Summit on the Information Society (WSIS) acknowledged the importance of schools connectivity, and adopted a plan of action calling governments "to connect universities, colleges, secondary schools and primary schools with ICTs". Since then, there has been an upward trend of connected schools to R&E networks. The latest GÉANT Compendium data for 2016 indicated that primary and secondary schools represent the largest segment (65%) and that, as of 2016, 33 NRENs connect schools to their network and five NRENs connect more than 90% of all primary schools in their countries.[1]

Strong growth in connected users

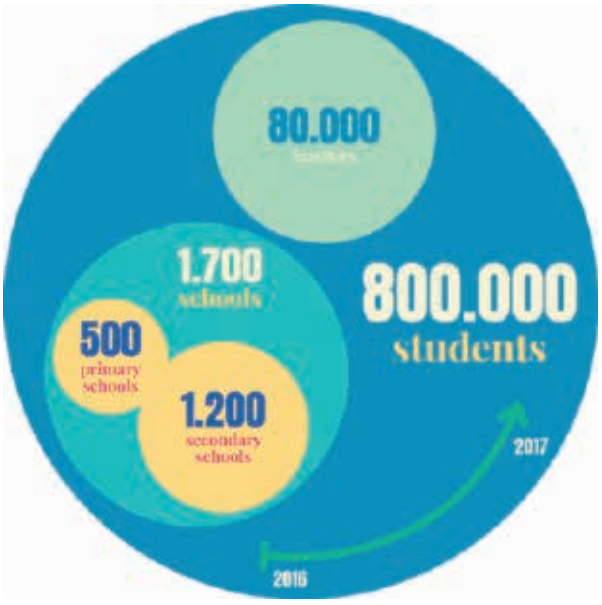
Connecting schools to the AMRES network has always been part of their founding idea and connectivity for some schools has already been provided. In 2016 this project started to connect all primary and secondary schools to AMRES. At the end of 2017, the project has been extremely successful, and at the time of writing there are 1700 schools now connected representing almost 95% of all primary and secondary schools. The rest of schools will be connected next year. The number of all users that connect to AMRES network has grown from a few hundred to 1.2 million today.

If we look at how schools are connected to the AMRES network, we see that 10% are using dark fibre (including 1G optic cables to gymnasiums) and 85% are using DSL with a speed of 20Mb. The remainder are connected via mobile network, especially schools in rural and mountainous areas of Serbia. This shows how AMRES is able to adjust to different conditions and locations of each school and provide various options.

Initially all primary and secondary schools will be connected to the AMRES network with the speed currently available and then to continually increase the speed when needed. In addition, AMRES has upgraded its connectivity to GÉANT to 20Gbs in June this year to cater for the expected increased needs of the network.

Organisational impact

Changes to the team structure and their scope of work was one of the key points in the whole process of connecting schools. AMRES operates an IT Support Centre for the schools which runs on a two shift system covering the daytime until 8pm local time and monitoring the



1. Compendium 2016 https://compendium.GEANT.org/reports/nrens_services

connectivity and the links to schools. These days the IT Support Centre is busy because of the amount of queries related to set-up and changes requested by schools. In addition, AMRES runs four main Service Centres in Belgrade, Novi Sad, Niš and Kragujevac. These service centres are located at the universities and also act as service centres for the rest of the AMRES network. To cater for the increased work load, additional staff was hired. Also a Technical Project Manager has been recruited for AMRES to oversee the entire project.

Within the schools, there is rarely any dedicated IT staff. That means that in many cases AMRES provides additional support on how to connect to the network.

The higher number of schools connected to the network also had a significant impact on the growth of the administrative work, the number of contracts to be signed and paperwork in general. Moreover, it was necessary for AMRES to adopt new policies, set up new processes and provide relevant training to the external and internal staff so that it can enable connectivity and services with the support of the government and respective ministries.

E-education and Wi-Fi for schools

Taking on the role as connectivity provider for all Serbian schools, AMRES is further participating in two pilot projects: E-education and Wi-Fi for schools. These projects are leveraging experience gained as a connectivity provider.

- *E-education*: AMRES provides the technical infrastructure for a newly tested Software for the School Information Systems (to provide information such as online class attendance, test results, reporting for parents). This pilot is run by the Ministry of Education, Science and Technological Development and currently 100 schools are participating in this pilot with plans to increase the total number to 200 schools by the end of the year.
- *Wi-Fi for schools*: this relates to rolling out wireless networks in about 40 schools. The pilot is limited to provide Wi-Fi access to teachers in the first instance. Also BYOD (Bring Your Own Device) scenarios are being tested to enable Wi-Fi access to more users and a wider community.

Both pilot projects target different schools with different technical set ups. This allows AMRES to assess the most suitable infrastructure set up providing for example insight whether symmetric links are sufficient or fibre would be required to provide such services to all schools.

eduroam is one of the services that is in the planning phase to be rolled out to schools. Currently technical feasibility is being assessed with an initial limitation to access for teachers only. In the future, there is a plan to broaden the authentication process so that not only teachers but also students will be able to connect to eduroam.

Bridging the digital divide

Thanks to connecting to the AMRES network, schools located in distant rural areas, small towns and also cities are now able to connect with users from other countries. Students and teachers connected to AMRES are able to access a high-speed and resilient network, share their knowledge and learn with other users from the community using the latest standards and services.

AMRES puts a huge amount of work into this project of connecting schools in Serbia. Within one year this NREN managed to connect almost all primary and secondary schools in their country to their network including the provision of a service desk.

The newly signed contract with Serbian Ministry of Culture and Information for connecting cultural institutions shows that AMRES is a trustworthy and valuable partner who is contributing extensively to the research and education community.

CARNet
HRVATSKA AKADEMSKA I ISTRAŽIVAČKA MREŽA
CROATIAN ACADEMIC AND RESEARCH NETWORK

e-Schools
ESTABLISHING A SYSTEM FOR DEVELOPING DIGITALLY MATURE SCHOOLS
(PILOT PROJECT)

CARNET: CROATIAN E-SCHOOLS PROJECT TO DEVELOP DIGITALLY MATURE SCHOOLS

Introduction

The Croatian pilot project "e-Schools: Establishing a System for Developing Digitally Mature Schools" had a very successful presentation during GÉANT's SIG-MSP meeting in Dublin, held on 20-21 September. The project was presented by the project's manager and CARNet deputy CEO, Ms Andrijana Prskalo Maček who pointed out that the pilot is part of a broader e-Schools program with the ambitious goal to help strengthen the elementary and secondary school education system in Croatia through more significant and appropriate use of information and communications technologies (ICT).

The e-Schools program consists of the pilot project, which is implemented in the 2015-2018 period and the major project, which will be implemented in the 2019-2022 period, based on the results of the pilot project. 10% of all schools in Croatia are part of the pilot project, and hopefully the overall program will encompass at least 60% of schools by 2022.

CARNet, as the project coordinating body, firmly believes that digitally mature schools and the appropriate use of ICT will aid in more efficient and transparent management of the schools but more importantly, develop digital competencies and prepare teachers for more innovative approaches in their work with students. Also, digitally competent students will be better equipped for further education and more competitive on the labour market.

Similar initiatives and projects do exist in other European countries, but Croatia is the first in the South-East part of Europe to carry out such an extensive project. The importance of e-Schools in Croatia was also recognized by the European Union which finances 85% of the project (total project value is over 40 million €) through its Structural Funds (European Regional Development Fund and European Social Fund). The value for the major project is estimated at 140 million €.

So how does it look in practice?

At the beginning of the pilot project, an initial evaluation of digital maturity level for 151 schools in Croatia was conducted, and the results were not great. The vast majority of schools (82%) were marked as digital beginners (level 2 of digital maturity on a scale of 5), while others fell into the category of digitally equipped schools (level 3). It was clear there's plenty of room for improvement, so on the infrastructural level, each of the 151 schools got two fully equipped classrooms for STEM courses. One of these classrooms is equipped with interactive equipment (PC computer, touchscreen monitor, camera and 30 tablets), while the other has presentation equipment (PC computer, touch screen monitor, camera). Also, STEM teachers got hybrid computers, other teachers got tablets or laptops while administrative staff received new desktop computers. Also the schools got better and faster wired and wireless local networks. At the moment, over 23.000 students are encompassed by the pilot project implementation.

Digital educational content (DEC) which accompanies the curricula is also being developed and promoted; the pilot project focuses on STEM courses for the 7th and 8th grade of primary and 1st and 2nd grade of secondary school. Created DECs will stimulate active and research learning, and will enable teachers to apply different strategies, approaches and methods. In addition, learning scenarios are another segment developed for teachers to help them integrate digital educational materials, digital tools and contemporary teaching and learning methods into their educational practices; at the moment a total of 240 of these scenarios have been created.

Through the project, already existing features such as e-Laboratory (the central place for the research, testing and selection of digital tools) and e-Lektire (a website for digital compulsory literary material) will also undergo major improvement, expansion and redesign.

Obviously, without motivated and competent teachers, infrastructure and all the equipment would fall on dead ground and would be rather pointless. However, the 7.000 teachers in this project are very motivated; even the most experienced and most competent ones among them know there is always room for the improvement of their teaching quality through the use of ICT.

Through the project implementation, a strong community of practitioners was brought up, a group of teachers who are involved in its everyday implementation. And because of their enthusiastic involvement they become more than project beneficiaries, they are partners whose feedback is needed and appreciated. Through the implementation of the project, over 900 workshops and other education forms were organized for these practitioners, and each participated on average in three different workshops.

The road ahead

There is still a lot to be done before the end of the pilot; finalisation of a centralised system for schools' business operations ("ERP for schools") which will enable integration with the other systems and services for schools as well as speedy, simple communication and data exchange between the schools, the founders, the competent ministries and other project stakeholders. Also, the Digital Content Repository will soon become active and will enable teachers, students and schools to browse and access educational materials published on various websites. The Repository will also provide teachers and publishers with a space for their digital teaching materials and will be searchable by many different criteria.

The Classroom Management System (CMS) will enable teachers to simultaneously supervise the activities of each student, interact with the students or assess their knowledge through the communication and collaboration elements of the system. Complementary to CMS is the Learning and Organisational Analytics system which will include the measuring, collection, analysis and reporting of data about learning and its contexts.

Schools included in the pilot project will also be encouraged to install sensors and smart management systems in order to monitor and optimize temperature, humidity and CO2 levels in their classrooms, thus preventing possible adverse impacts of air quality on students and teachers, such as tiredness, lack of concentration and lack of motivation.

Successful informatisation should be understood as a long-term strategic vision of the educational system. It includes ICT-supported development of curricula and of teaching and learning modes, as well as the professional training of teachers and school management personnel. This pilot is the first, but very important, step in that direction. CARNet is looking forward to sharing more information and experiences with its GÉANT partners in the time to come.

SUCCESSFUL ROEDUNET CONFERENCE ATTRACTS WIDESPREAD AUDIENCE

The 16th RoEduNet conference took place in September this year, with the theme of Networking in Education and Research. Held at the "Petru Maior" University of Târgu-Mureș in Romania, the event attracted around 80 attendees – mostly professors, young researchers and PhD students, but also University IT staff.

The conference programme covered topics such as Social Networking and Services; Network Security; Cloud Computing and Network Virtualisation; Sensor Networking; Network Management; Future Internet Technologies; Wireless and Mobile Networks; and HPC/GRID.

The event also had multiple scientific sections across these conference topics, as well as technical sections dedicated to practical aspects on some of newest technologies developed on the market, their potential implementation into networks of universities and research institutes, and interoperability with existing equipment and services provided on top of the network infrastructure.

GÉANT support

The conference was also well supported by GÉANT, with three sessions run by experts from the GN4-2 project covering Clouds, Trust and Identity (with a focus on eduroam), and the GÉANT Network. Additional outreach support was provided with the provision of GÉANT marketing materials.

The objective of GÉANT's support was to highlight to the audience how RoEduNet and their users are integrated with and can benefit from the European and globally available infrastructure and services, and also to raise awareness of, and support future adoption of services.

GÉANT speakers

- Sebastiano Buscaglione (GÉANT Senior Network Engineer): "GÉANT Network overview". Attendees were interested in GÉANT's experience and plans for implementing SDN, DCI and the GÉANT fibre strategy. Sebastiano commented, "The conference was a really open and friendly environment, at which we could all share experiences in networking."
- Slavko Gajin (Director of the Belgrade Supercomputing Centre and member of the GÉANT Clouds team): "European Cloud Collaboration through GÉANT".
- Miroslav Milinovic (Trust and Identity Activity, GN4-2): "eduroam in GÉANT Trust and Identity Services Portfolio". This session acted as a training session to support the national eduroam adoption. Miroslav commented afterwards, "I met very motivated people there, and I hope I provided them with information that will help them to improve their T&I services, in particular eduroam."

Strong impressions and a great impact

All sessions were well attended by an engaged audience sharing the national and local challenges they are facing. The overall atmosphere of the conference

was very friendly and people were willing to share their experiences openly.

The Trust and Identity sessions in particular sparked interest from attendees in joining eduGAIN, with requests for more hands-on training for deploying SP/IdP locally. Interest was also expressed in advanced network services, and the cloud services through GÉANT session was one of the most followed.

The attendees were asked to complete a survey following the event sharing their impressions and take-aways from the sessions. Responses across the board were positive, for example:

"We now have more information about the offered services, tools and means to implement one or more of the presented services."

"Good to see such presentations at our conference, to raise people's awareness."

"Better understanding of GÉANT services and their applications."

Paul Gasner of RoEduNet adds, "The next RoEduNet Conference will take place from 6-8 September 2018 and be held at the Technical University of Cluj-Napoca. As each year, the event will bring together the research and academic community of the region in the field of networking for education and research. We look further for the evolution of the papers presented in scientific sessions, and the feedback over one year on the GÉANT services deployment in the community."

JORDAN BACK ON THE GLOBAL R&E MAP THANKS TO EUMEDCONNECT3

Picture ASREN/JUNet agreement signing in Amman: Dr. Talal Abu Ghazaleh, ASREN Chairman (middle); Prof. Ali M. Qaisi, JUNet Chairman (to his left); Mr Sami Smeirat, Deputy CEO of Orange (to his right).

At the end of September the Arab States Research and Education Network (ASREN) announced the upgrade of its dedicated link from Amman, Jordan, to its PoP in London, from 155 Mbps to 1 Gbps. This step has paved the way for the Jordanian Universities Network (JUNet) to re-connect to GÉANT, thus providing Jordanian universities access to R&E resources in Europe and the rest of the world. The international capacity injection is provided through the EU-funded EUMEDCONNECT3 project which supports international R&E connectivity for the Eastern Mediterranean region, including also Lebanon and Palestine.

JUNet's agreement with ASREN was signed on 27 September in Amman in the presence of Dr. Talal Abu Ghazaleh, Chairman of ASREN, Prof. Ali M. Qaisi, Chairman of JUNet, and Mr Sami Smeirat, Deputy CEO of Orange. Connecting 11 public universities and 12 community colleges across Jordan, JUNet now has again direct access to the global NREN infrastructure. In the past, JUNet had participated in the first two phases of the EUMEDCONNECT programme, but had been without dedicated international R&E capacity since 2011.

Prof. Ali M. Qaisi, Chairman of JUNet, commented:
"This is an important step for Jordan and its research and academic communities who in the past faced many difficulties in accessing computing resources, data repositories and scientific applications and services. To complement the vital international connectivity access we are also finalising the upgrade of the capacity of our national backbone to 3.5 Gbps. In other words, our scientists are now much better equipped to collaborate and to leave their mark on the national and international scene."

Dr. Talal Abu Ghazaleh, Chairman of ASREN, added: **"This connection comes in the framework of the Euro-Mediterranean Program (EUMEDCONNECT3) co-financed by the European Union and managed by the European networking organisation GÉANT in cooperation with ASREN who endeavours to connect the Arab research and education communities to the rest of the world."**

High-speed connectivity for Middle East science hub

The reconnection was welcomed by the Jordanian R&E community, in particular by the SESAME synchrotron radiation facility, the largest scientific project in the Middle East, which was officially unveiled in May 2017.

To help develop the synchrotron community in Jordan, a workshop titled "GÉANT, H2020 and European Synchrotron Sources" took place successfully in Amman in August with technical assistance and funding from the EU. Attracting over 100 scientists, the event was organised under the Technical Assistance and Information Exchange instrument (TAIEX) of the European Commission.

As part of the connectivity agreement, SESAME sees its current international capacity via ASREN doubled from 50 Mbps to 100 Mbps, with the remaining 900 Mbps being allocated to support the rest of JUNet's user constituency. Further upgrades are expected as Jordan's activities ramp up.

More information:
EUMEDCONNECT3: **www.eumedconnect3.net**
Arab States Research and Education Network (ASREN): **http://asrenorg.net/**

Image credit: SESAME

SESAME: A light for science and collaboration in the Middle East

Based in Allan, Jordan, just outside the capital Amman, SESAME is made up by physicists from several countries that rarely talk to one another - Cyprus, Egypt, Iran, Israel, Jordan, Turkey, Pakistan and Palestine - but whose scientists are determined to collaborate. And colleagues from Germany, France, Italy, UK, Sweden and Spain are supplying expertise, equipment and technical support.

Chosen for its resonance in the region's culture, the name SESAME now works as an acronym for Synchrotron-light for Experimental Science and Applications in the Middle East. The heart of the new facility is a particle accelerator, known as a synchrotron, speeding electrons around to make them emit powerful beams of radiation - so-called synchrotron light - that can be used to study the properties of materials ranging from exotic semiconductors to viruses. Applications will include: developing new materials, probing the structure of DNA, penetrating the secrets of chemical compounds, designing pharmaceuticals, performing disease infrared imaging, assessing archaeological artefacts, and measuring soil pollution.

As of May 2017, one beamline is operational, a second one is scheduled to go live in November and two more over the next two years. Among the subjects likely to be studied in early experiments is pollution in the Jordan River valley with a view to improving public health in the area, as well as studies aimed at identifying new drugs for cancer therapy, and cultural heritage studies ranging from bioarcheology to investigations of ancient manuscripts.

Opening SESAME to the world

As SESAME's particle accelerator enters production phase, it is expected to produce thousands of gigabytes every day which will be transferred to HPC centres in and outside the region for analysis, including partners in the EU-funded Virtual Research Environment Vi-SEEM project which supports research communities in Southeast Europe and the Eastern Mediterranean in need of networking and computational resources to further interdisciplinary collaboration in the fields of Life Sciences, Climatology and Digital Cultural Heritage.

As SESAME opens to the world, ASREN plays its part by providing connectivity and access to the global R&E fabric to tackle the data deluge in the years to come.

Find out more: **http://www.sesame.org.jo/sesame/**

WE MET

YOUSEF TORMAN, MANAGING DIRECTOR, ARAB STATES RESEARCH AND EDUCATION NETWORK (ASREN)

You are a passionate advocate of R&E networking across the Arab world. What fuels this passion?

In 1989, when I started as Head of the Computer Center of Jordan University of Science and Technology, we had a few centralised VMS (Virtual Memory System) servers with some scientific applications on top. We had a local area network, but no internet. All user accounts had capped storage and CPU time. Students and researchers would ask for extra capacity for their computation and analysis, and I would take great satisfaction out of helping them. I was also approached by other universities which used to access our servers via modem dial-up, but most of the time they would just come to my office to connect as the dial-up service was simply too expensive.

Well, I wanted to enable, connect, provide access! This led me in 1992 to initiate a proposal to connect all public universities in Jordan. Five universities got on board and we connected them using the optical fibre network of the Royal Air Forces of Jordan. Mind you, that was probably one of the first NRENs in the world!

In 2003, the Jordanian Government launched the National Broadband Network to serve public institutions. I was put in charge of the Universities component and we established the Jordanian Universities Network (JUNet), a dedicated fibre backbone connecting 11 public universities and over 20 other sites, including community colleges, hospitals and research centers. Via JUNet I participated in various EU-funded projects, such as EUMEDCONNECT, EUMEDGRID, LinkSCEEM and EPIKH. This was instrumental for me in shaping the vision and strategy for JUNet to provide services to the research community and encourage our scientists to get involved in national and regional collaborations. And, most importantly, these projects provided a platform to meet other Arab NREN representatives and explore common ground. Now, with ASREN, we also have an organisational framework to pursue the development of R&E networking in the Arab world.

What is ASREN's background and mission?

ASREN came about after several iterations between 2005 and 2011 to form a regional R&E network for the Arab region. Key contributions came from the EUMEDCONNECT project, which helped us incubate ASREN, and from His Excellency Dr. Talal Abu Ghazaleh, founder and leader of the TAG group and passionately interested in scientific and educational development in the Arab world. With his backing the Arab States Research and Education Network (ASREN) was established under the umbrella of the League of Arab States.

ASREN's mission is to boost scientific research and cooperation in member countries across the Arab region through the provision of world-class e-infrastructures and services and to support Arab NRENs along the way. ASREN is now an active regional partner for the North African component of the AfricaConnect2 project and for EUMEDCONNECT which continues to serve the Eastern Mediterranean countries, as well as participating in network service and science gateway initiatives across the region.

What are the main challenges and key achievements of developing R&E networking in the Arab region?

The Arab region has certainly had its share of challenges. While we have seen increased capacities and some lowering of connectivity prices, market competition is still relatively weak and this has held back the development of a proper regional R&E network. National funding support for Arab NRENs was also set back following the Arab Spring, but things are steadily recovering and I am proud about the part ASREN is playing to bring this about. I am particularly pleased that, as part of EUMEDCONNECT, ASREN has been able to re-connect JUNet to GÉANT and the wider R&E community, via ASREN's own connectivity and its PoP in London, and this includes serving the regional SESAME synchrotron facility which is based in Jordan. Lebanon is also now connected and developing well, and Palestine is also getting interested again.

In AfricaConnect2, ASREN's focus is on North Africa, but we are working closely with our African sister organisations WACREN and the UbuntuNet Alliance. With the support of GÉANT and the EU, we act as a family to bring an African R&E network into life. The ASREN community benefits vastly, as resources and expertise can be shared and solutions to shared issues can be found.

To date we have Algeria and Egypt connected to GÉANT under AfricaConnect2. Seamless continuation of the project beyond 2018 is vital to re-connect also Morocco and Tunisia and to progress towards a sustainable network in the region and an enduring place on the global R&E map.

Despite the challenges ASREN has successfully established annual conferences for the regional R&E community, under the e-AGE name. This year's event will take place in Cairo on 3 and 4 December and will be the 6th edition – it certainly has proved a very successful focus for the very diverse yet talented R&E community. All members of the GÉANT community are warmly welcome to join us!

To learn more about the e-AGE conference, visit **http://asrenorg.net/eage2017**

UbuntuNet Alliance

UbuntuNet CONNECT 2017

SUCCESSFUL UBUNTUNET-CONNECT 2017 CONFERENCE

UbuntuNet-Connect is the annual conference of the UbuntuNet Alliance that focuses on research and education networking activities in Southern and East Africa. It is organised by the UbuntuNet Alliance and was this year hosted by EthERNet, the NREN in Ethiopia.

The conference brings together practitioners in the research and education networking community, researchers, policy makers, academics, connectivity providers, and a pool of expertise from across Africa and beyond. This year's edition was held in Addis Ababa, Ethiopia on 2 and 3 November 2017 and was preceded by workshops and technical training programmes: a services deployment clinic, a workshop on advanced routing & BGP for NRENs, as well as a workshop towards an African open science infrastructure framework.

Similar to the GÉANT TNC events, the annual UbuntuNetConnect conference and pre-conference events provide opportunities for people with special and common interests to share their experiences, ideas and plans in the light of research and education networking and applications. CONNECT has had the pleasure to talk to participants, organisers as well as honourable invited guests, all praising the event and the advantages they gained by attending.

Address from the African Union Commission

The first day of the conference was kicked-off by Dr. Hadama Quedraogo, the Acting Director of the Commission for Human Resources, Science and Technology of the African Union delivered on behalf of the African Union Commissioner for Human Resources, Science and Technology, Prof. Sarah Anyang Agbor.

He started his welcoming speech by informing all attendees that the importance of ICT and innovation in the African region cannot be overemphasised. However, as Dr. Quedraogo continues, despite the enormous progress in the ICT sector in other parts of the world, he emphasises that it is not all rosy for Africa. He acknowledged that "the main reason the African continent is lagging behind in terms of ICT development and uptake is the huge costs associated with the accessibility of ICT tools and services including connectivity to the internet."

These huge financial costs therefore have a heavy impact not only on African students, researchers and engineers, but on African society as a whole, which would otherwise benefit from a faster pace of innovation.

Additionally, Dr. Quedraogo stated that the high costs of connectivity hamper international collaboration between counterparts from within the region and beyond. Continuing his energetic speech, the Acting Director showed his gratitude for the work of the UbuntuNet Alliance especially on how the organisation achieved progress for itself and its members. "Apart from price changes, I am also happy to learn of other important services the Alliance is offering to its members including engineer capacity building programmes and other value-added services."

Towards the end of his speech, Dr. Quedraogo highlighted the AUC's Agenda 2063 which seeks to accelerate the implementation of past and existing continental initiatives for growth and sustainable economic development, on the basis of exploitation of Science and Technology. The commissioner's representative spoke about his intentions to motivate African governments to support their NRENs so that they are able to operationalise their activities and in the process, strengthen and benefit fully from organisations like the UbuntuNet Alliance. He ended by reassuring all attendees that the African Union remains committed to support ICT and innovation as enabling tools of social economic development and to support organisations who are a provider of these tools.

"I have also been happy to learn that, through UbuntuNet Alliance, there now is a significant amount of collaboration and sharing of ideas and collaborative tools with other Regional Research and Education Networks from other parts of the world notably GÉANT from Europe, RedCLARA from Latin America and Internet2 from America."

Q&A with Elizabeth Kakunga (ZAMREN)

Elizabeth Kakunga participated in the 'Advanced Routing & BGP for NRENs' workshop which was held from Sunday 29 October to Wednesday 1 November. During these few days, Elizabeth gained a great amount of knowledge on routing and its protocols. We asked her about her experience.

What did you expect from the workshop and were your expectations met?
Yes, my expectations were certainly met. I came with the intention to learn more about BGP and routing and I have been able to do so. The only thing I was perhaps expecting, or rather hoping for, was that we would have more time to go even more in depth into the topics. It was a bit bulky in a short space of time. Other than that, it was very beneficial for us to maintain our network.

What key point or subject of the workshop will benefit your work and/or NREN the most?
The entire subject of the workshop will benefit my work the most. It is a subject where we are really focussing on for our network and connectivity in Zambia.

What aspect did you miss during the workshop?
As indicated before I only missed more time. It would have been great if we had more time to learn about BGP and advanced routing and get deeper into the material.

Q&A with Niry Andriambelo (iRENALA)

Niry Andriambelo is a Networking Engineer from the Madagascar NREN iRENALA. She participated in the service deployment clinic which was held from Monday 30 October to Wednesday 1 November. We asked Niry to share her findings.

What did you expect from the clinic and were your expectations met?
When I read the description, it was about deploying services your NREN wants, how to deploy it more efficiently and how to share this knowledge with the engineers in our universities. This was exactly what we learned to do and the clinic exceeded my expectations actually. The only thing lacking was time. We had many questions which were mostly answered, but if we would have more time we could have gone into more detail. Additionally, we asked the UbuntuNet Alliance team to share a little more knowledge on how we could do on-site training at our universities in Madagascar to train our engineers on this subject.

What key point or subject of the workshop will benefit your work and/or NREN the most?
We are currently working with Identity Federation (part of eduroam) and we were able to discuss this during the service deployment clinic.

What aspect did you miss during the workshop?
It would have been great to have more time to ask more questions and learn more. Luckily, we still had a few days to talk with the UbuntuNet Alliance team and ask them how to further share our knowledge with the engineers as I mentioned before. Conferences such as these are very useful to talk with other NRENs and learn from their experiences.

NEW WEBSITE GIVES EU-CHINA NREN COMMUNITY INITIATIVE A FACE

Building on a strong brand

Since the successful completion of the EU-funded ORIENTplus project in 2014, GÉANT and its Chinese partner CERNET (China Education and Research Network) have continued to provide direct internet connectivity between Europe and China. Today, they jointly fund and operate a 10Gbps link between Beijing and London, giving over 80 million researchers, academics and students across Europe and China high-capacity internet access for data-intensive scientific and academic collaborations.

During TNC16 in Prague representatives of the GÉANT and Chinese NREN communities came together to explore ways to jointly promote the link and to cooperate on technical activities. The immediate outcome of the discussions was the launch of the EU-China NREN community initiative as a forum for future collaborative efforts and the commitment to build on the strong ORIENTplus brand in their endeavours.

Website launched

To give the initiative an effective visibility tool, GÉANT, in partnership with the Chinese NRENs CERNET and CSTNET, has developed a dedicated website, outlining the background and objectives of the EU-China NREN community initiative. Key features of the site include case studies on existing ORIENTplus users, partner profiles, outlines of technical collaborations as well as an extensive resource library with useful materials to support partners in the development of R&E networking between Europe and China.

David West, Senior International Relations Officer at GÉANT, who managed the ORIENTplus project between 2011 and 2014, commented: *"The aim of the EU-China NREN community initiative is to provide a forum for our partners in Europe and China, in the absence of a project framework, to harness the potential of the ORIENTplus link through joint promotional and technical collaborations. This website is a first step on the way to make this happen. However, for it to be a valuable resource and for this initiative to produce tangible outputs, we rely on all our partners to be actively engaged."*

Jennifer An, International Relations Manager at CERNET, added: *"The legacy of the ORIENTplus project goes beyond continuing to provide connectivity. We need to get the word out, re-engage with existing users and reach out to prospective ones. We at CERNET look forward to continuing our fruitful working relationship with the GÉANT community in support of our user communities across China and Europe."*

Hong Li, Deputy Director of CSTNET, said: *"CSTNET is also pleased to be part of this initiative. Our users in the scientific and research centres across China value close collaboration with their European partners, and we welcome this opportunity to provide extra support for Europe and China to collaborate, as well as continue to meet users demand for high capacity connectivity."*

Get involved

Join the EU-China NREN community distribution list to be part of the discussions, share opportunities and ideas for promoting the connectivity among your users, provide input for user case studies and indicate interest in joining existing or initiating additional technical collaborations. Please get in touch via **info@orientplus.eu**

Enjoy exploring the new site: **www.orientplus.eu**

Background

Jointly funded and managed by GÉANT and CERNET, a 10Gbps link between Beijing and London provides direct high-capacity EU-China connectivity and seamlessly continues the EU-funded ORIENTplus circuit that was established between 2011 and 2014. The main applications running over the link include genome projects, LHC collaborations, radio-astronomy, severe-weather forecasting, agriculture, astrophysics; the ITER fusion project will also benefit.

In September 2015 GÉANT and CERNET signed a Memorandum of Understanding to reinforce their long-term partnership and to further strengthen ICT collaboration between the European and Chinese research and education networking communities.

CERNET: **www.edu.cn/english**
CSTNET: **www.cstnet.net.cn**

EUDAT CONFERENCE: PUTTING THE EOSC VISION INTO PRACTICE

On 22-25 January 2018 Porto will host the next EUDAT Conference. Entitled "Putting the EOSC vision into practice", the Conference will bring together community decision-makers and data managers, scientists & research communities, policy-makers, e-Infrastructure initiatives, research infrastructures and ESFRI projects to discuss the latest developments in the area of research data management & infrastructures.

At the heart of the event will be two plenary sessions dedicated to discussing the progress of the European Open Science Cloud (EOSC) and the European Data Infrastructure (EDI), and how EUDAT and other infrastructures can contribute to these two initiatives. Four parallel sessions will then address the following topics:

1. The future of EUDAT and the concrete opportunities offered by the newly-established EUDAT Collaborative Data Infrastructure (CDI) for service providers and research communities and the principles for engagement of these actors in the EOSC;
2. The EUDAT service roadmap, where solutions developed to address the data management needs of researchers and research communities will be demoed through concrete pilot projects, and future services in-the-pipeline;
3. The status and future plans for cross e-infrastructure collaboration, with an overview of the newly-funded H2020 initiatives;
4. The impact of the forthcoming GDPR regulation on the EOSC landscape;
5. The role of user engagement and training in the EOSC.

CO-LOCATED WORKSHOPS

The conference will also host a set of a series of co-located workshops, organised by GÉANT, EOSCPilot, AARC, SeaDataCloud ENVRI and many more!

Take a quick look at **www.eudat.eu/eudat-conference-2018/programme**

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NETWORK TRAFFIC CHALLENGES? IT'S TIME FOR A NEW PERSPECTIVE

Escalating bandwidth demands can mean only one thing…costly and complex network upgrades. But what if you could look at the challenge from a completely different perspective? Ciena's Kent Jordan explains how.

Traffic is growing. Fast. Escalating demands are straining overutilized paths between data centres, along the connections between key branch offices and their headquarters, within a campus network, or across regional and long-haul backbone routes.

The drivers behind the bandwidth may differ – it could be terabyte file size data sharing between research institutions, the shift of enterprise applications, storage and computing to the cloud, transmission of complex, high-resolution medical imaging between hospitals, evolving educational tools, or other high-bandwidth applications – but, the result is the same: costly and complex upgrades. Once a scalability issue has been identified, traditional means of overbuilding capacity typically can't solve the problem efficiently or cost-effectively.

These scalability challenges may seem insurmountable, but similar problems have been overcome in other industries by simply looking at the problem in a different way. Transportation had similar challenges with scalability. Moving bits of data from location to location is much like transporting people, and providing cost-effective ways for consumers to get from place to place via the fastest, least congested route has not been simple.

To solve the problem, new private transit and ride-sharing companies decided to approach transportation from a different angle. They took the concept of private car service and modified that model to scale and be available to everyone. They built new tools, processes, and vast networks of drivers, giving all riders a new, more efficient way to get from point A to point B.

Words
Kent Jordan
Advisor, Product and Technology Marketing at Ciena

Now, rather than needing to struggle with bus routes, GPS directions, or finding a taxi off the beaten path, travellers can open an app, request a ride, and get picked up by a highly rated driver, often within minutes. It couldn't be simpler. The entire process for securing transportation from location to location has changed forever. And, with any driver on the road potentially offering their services, it offers scalability beyond existing public transit offerings.

What if network operators could approach the problem of scaling network traffic from a different angle, and like the transportation industry, leverage a new way to easily scale capacity to meet growing traffic demand?

Unlike moving people, moving data is highly reliant on a massive network of existing infrastructure. However, rather than expanding and overbuilding costly,

inflexible network infrastructure, what if there was a way to simply integrate a solution that optimised existing fibre facilities without impacting the existing infrastructure – an easy button for bandwidth scale. In fact, there is.

Looking at the problem of bandwidth scale in a different way, we see it isn't so dissimilar to the exponential bandwidth growth data centre operators experience across interconnects. Data centre interconnects require efficient space, low power, massive bandwidth devices that can be set up as quickly and simply as a server, enable endless integration possibilities, and can be up and running in hours, not days.

New platforms built specifically for high-capacity interconnects offer incredible speed and massive density with never-before seen simplicity. These platforms offer high-speed transmission from 100G up to 400G per wavelength with a simple server-like operational model, giving operators a new, easy-to-use tool for increasing capacity. In addition, open APIs enable seamless integration into existing infrastructure. Enterprise, Government and R&E customers are applying these platforms designed for the data centre and leveraging them in capacity-exhausted connections all across the network, increasing bandwidth across congested links in hours while saving tens of thousands of dollars.

Sometimes the best solution simply requires a fresh perspective on the problem.

For more information visit:
http://www.ciena.com/

MAKING EVERGREEN CHOICES FOR YOUR RESEARCH COMPUTING

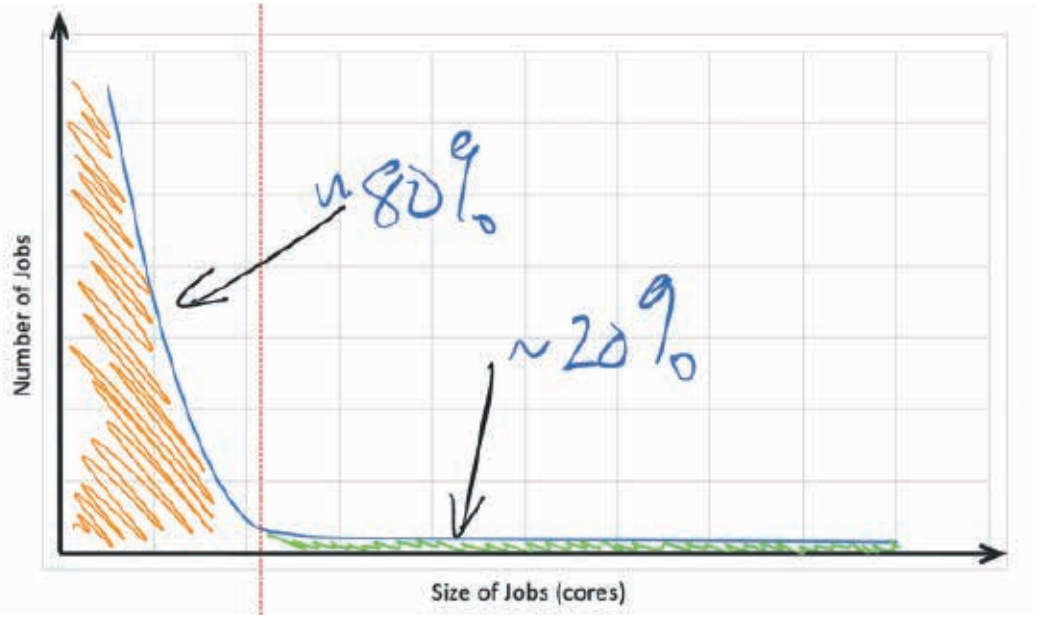
In any research computing environment, there is a diverse mix of infrastructure options. This includes on-site servers and clusters, as well as offsite resources, such as national high-performance computing (HPC) facilities, commercial cloud providers and shared resources owned by collaborators around the world. This presents continuous challenges to identify the right venue for researchers' varied compute problems.

To determine the most suitable platform, we suggest using the simple guiding principles below. This data-backed methodology should help you uncover how your researchers work and what type of infrastructure will meet their needs.

"High Performance" means different things to different people

When we look at general purpose HPC facilities, we often find that the bulk of users are running a lot of small- to-medium-sized jobs (a few cores to a few dozen cores). A smaller subset is running large jobs (hundreds of cores). These two workloads have very different design points, and with a wide variety of different job types in the 10s-of-cores category, clusters that are designed for large jobs will almost always be sub-optimal for nearly everyone else.

To be able to address the needs of the vast majority of research users, the use of bulk statistics such as TFLOPS or Gbits/second aren't helpful. They're more descriptive of a technology rather than a solution. Understanding that different applications have different needs and will evolve differently over time, is critical.



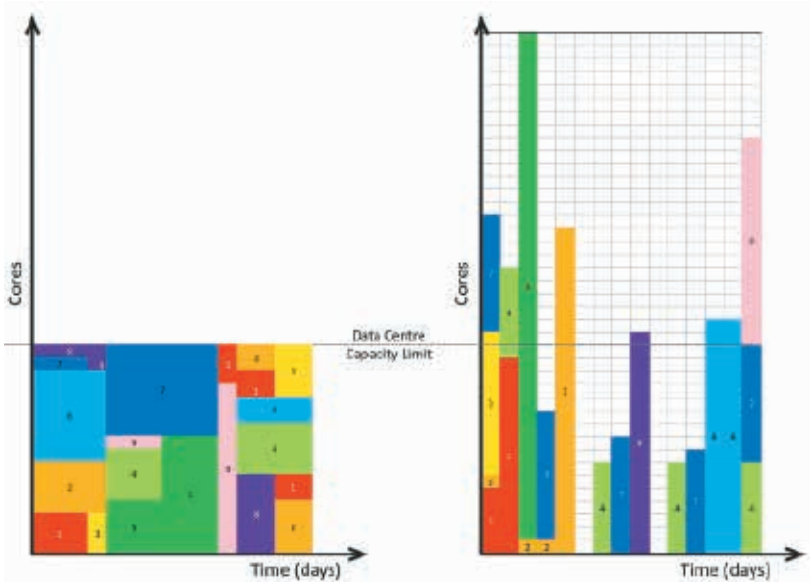
Time matters more than GHz

Many researchers report "feast or famine" periods of computing productivity. Usage spikes are often cyclical (e.g.: an end-of-semester boom in activity) and can massively oversubscribe a finite, shared facility. Other times it's spontaneous and unpredictable. In either case, researchers can waste precious time in job queues to access limited computational resources. How efficient is an "interactive node" if you have to wait 6 hours to use it?

Consider a simple thought experiment: Will your research output materially benefit from improving the speed of a given CPU by 10%? How about by 20%? What if you had access to all the resources you needed, whenever you needed them? (or example: an interactive node that's available right now, or a cluster that's ready to compute for you immediately).

Whilst we're discussing immediacy, some researchers need "instant on" access to compute resources to align with flows of data arriving from instruments or collaborators (or stock markets, industry partners, or other sources). It's almost impossible for fixed infrastructure providers to meet these kinds of demands.

In 2, we depict a traditional in-house facility's allocation for a two-week period. The left-hand side reflects the centre director's best effort to ration the fixed resources (essentially a finite number of core hours) among the competing needs of various researchers. It's highly idealised, since this is essentially a



box-packing problem with unequal block sizes that is unlikely to ever yield a perfect, singular solution. Most centres solve for this problem by over-subscribing their computing capacity and assuming a particular fall-off rate in users or jobs.

The right-hand side shows what happens when researchers are free to organise themselves, such as in a cloud environment that doesn't have these limits[1]. In this example, user #7 (dark blue) needs access to compute resources twice per week to analyse data from an offshore instrument, such as a radio telescope. Receiving a single allocation per month in the traditional model with no predictability means the user's compute capacity arrives too early or too late for certain data.

Any guess you make will be wrong, but that's ok

Research needs change quickly depending on varying profiles and needs. On a given day, the task might be to perform a massively parallel computation. Tomorrow might require machine learning algorithms. You may also find yourself needing more or less memory per core.

Science is about iterating constantly improving theories of nature. Scientific computing should also be about constantly iterating a model to ensure it keeps chasing and fitting the requirements of the science.

Data has gravity – and with big data comes big gravity

Data has never been cheaper to create or store. However, the cost of moving data over wide area networks has not decreased at the same rate. Data should be moved sparingly, and thus located where it's most accessible to everyone using it. It should also be surrounded by flexible computing and analytic resources that can be deployed upon it at will.

Our entire scientific community can benefit when we all adopt an approach that enables existing and future workloads to move to the data – not the other way around.

This means less time and money is spent moving data (or copying it), and more is invested in actually computing the data. And remember – computing data can help us all gain insights and make discoveries. Simply owning a copy of the data won't.

Researchers collaborate with other researchers

It's rare to find a researcher who works alone without international collaborations. Traditional collaborations between research teams which each have their own on-site infrastructure typically means shipping data in boxes of hard drives. Sharing methods means getting a collaborator's code, built on their cluster to compile on yours. There's also the issue that funding agencies aren't fond of paying for infrastructure used by another nation's researchers.

In the cloud, sharing a machine image or a whole data set takes a click and happens in minutes. It's an exact replica of the original too, which means you're up and running immediately. And it happens in a researcher's own cloud account, which makes for an easier segregation of expenses.

Understanding how these global pacts collect and process data and use computing resources will help you understand how much scope you have to minimise data movement, eliminate duplication and enable sharing of methods and results quickly.

Research domains don't commonly mix

This is particularly great news, because a platform for bioinformaticians need not be in the same physical place as that of the remote sensing team or fluid dynamics group. In any case, they all have different needs and what's optimal for one could be suboptimal for another.

This gives you a large degree of freedom when choosing the right place for a workload or for a team, and removes the restriction of designing one rigid platform that must serve everyone.

Conclusion

AWS has invested significant resources into building a cloud that serves the needs of millions of different customers and their unique needs. The act of federating or crowd-sourcing your computing by choosing the cloud for your workloads helps us design and build an even more flexible cloud, constantly engineering new servers and services and relentlessly lowering prices.

In the field of research, which is underpinned by serendipity, imagination and experimentation, we see this near-instant access to expansive resources as being a huge lever for reducing the friction to try out new ideas quickly and so reducing up the time to discovery.

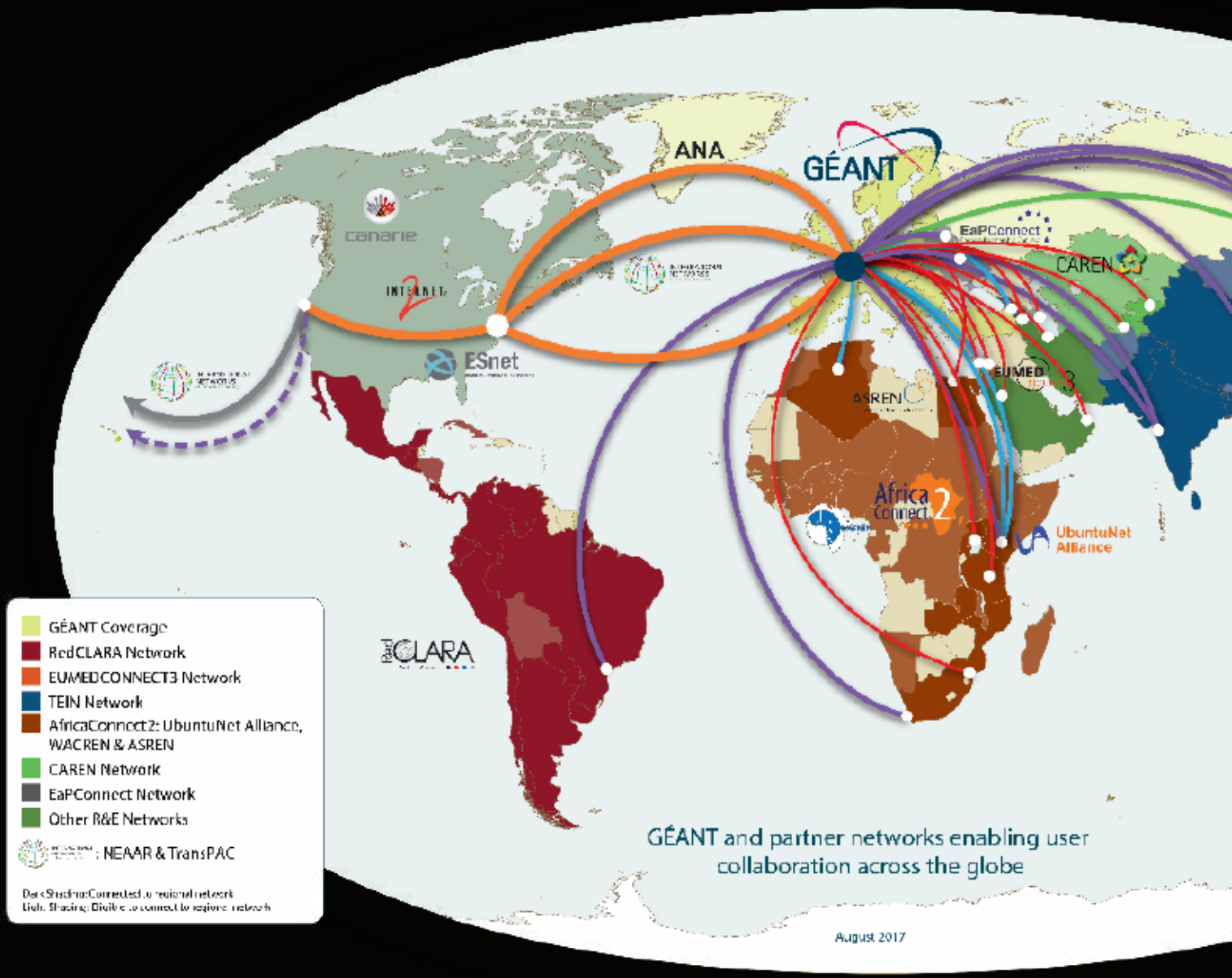
For more information visit:
https://clouds.geant.org/amazon-web-services/

1.This is not to say that cloud resources are infinite. They're merely orders of magnitude larger, which makes them effectively so.

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

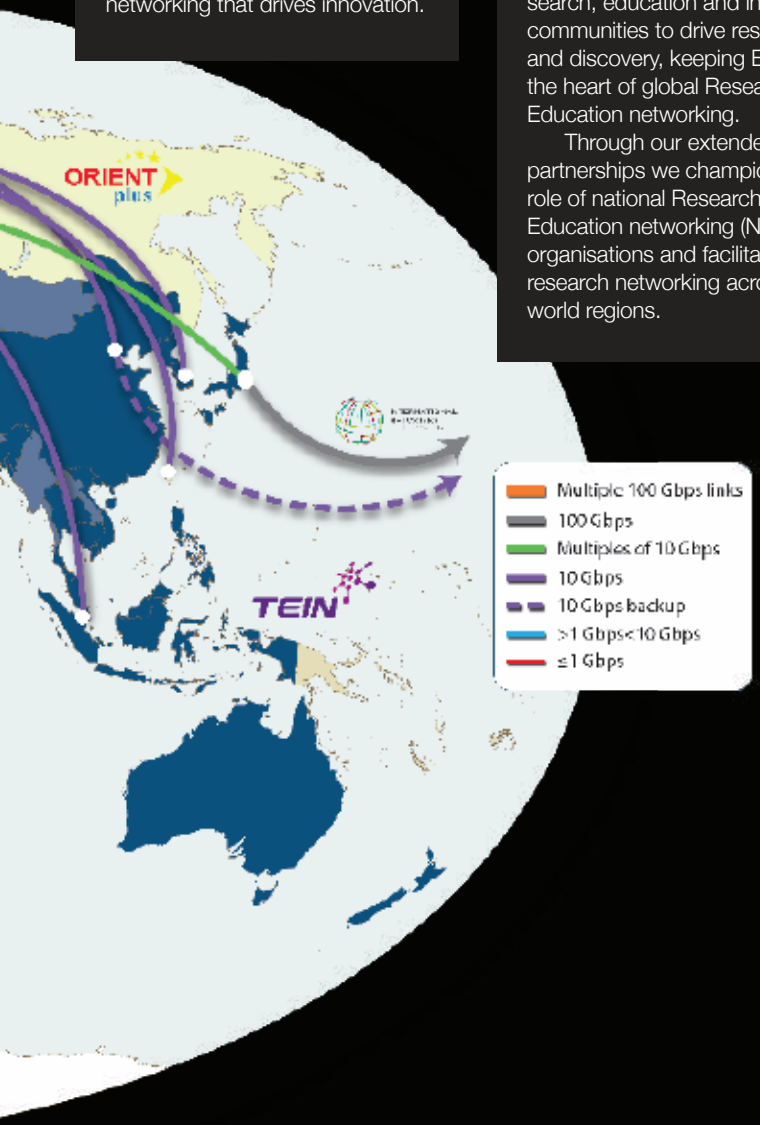
GÉANT invests in the research and development of network architectures, technologies and paradigms to develop into the services, processes, tools and network capabilities of tomorrow.

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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