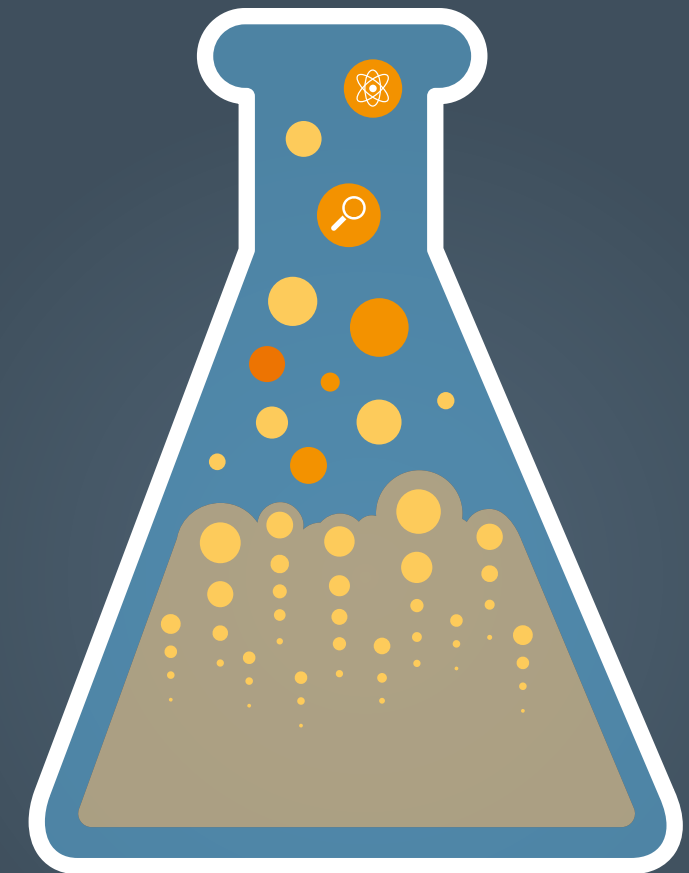


CONNECT

THE MAGAZINE FROM THE GÉANT COMMUNITY | ISSUE 44 2023

**HOW DO GÉANT AND
THE NRENS SUPPORT
OPEN SCIENCE?**



ALSO IN THIS ISSUE



CONNECT INTERVIEW:
DR. STEFAN HANSLIK



QUANTUM COMMUNICATIONS
- THE NEXT GENERATION OF
NETWORKING TECHNOLOGIES



**GÉANT AT THE EOSC
SYMPOSIUM 2023**

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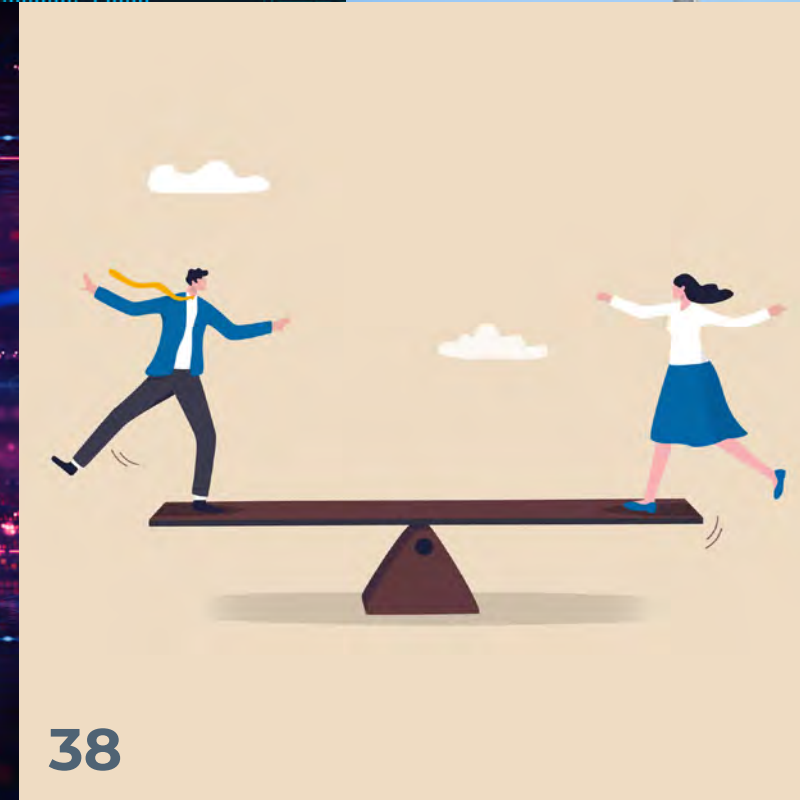
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Editor's welcome

What does Open Science look like?

You can see from our cover that it's difficult to visualise that term! However – away from magazine covers – we see it everywhere. We see it in the ongoing community collaboration and in the highly constructive discussions at the EOSC Symposium, we see it in the endless sharing of knowledge, in the management of

data to FAIR principles, in national engagement in myriad projects, and most importantly we see it being built on foundations of expertise – and here I urge you to read our interview with Dr Stefan Hanslik on the next page, and the article on page 7 on how 20 years of federated identity management has brought us to where we are now. Our special section on Open

Science covers all of this and more, and we hope you find it useful. Whatever Open Science looks like to you, it's clear this community is supporting and enabling it in so many ways.

Another hot topic gets the CONNECT special section treatment in this issue: Quantum. We look at the benefits of Quantum Key Distribution and how GÉANT is investigating its use in a

pan-European environment; a joint article from GRNET and PSNC considers how a combined system of EuroQCI, EuroQCS, and EuroQSM (you'll have to read the article!) can provide the ideal environment for development and integration of quantum technologies; and several of our commercial partners add their thoughts to round out a fascinating section pulled together by our own Karl Meyer.

Later in the issue we look at High Performance Computing, via an interview with Jan Jova Javoršek about the setting up of Vega, Slovenia's EuroHPC node; we also hear about tools developed for training neural networks on the LUMI supercomputer; and FCCN talk about Deucalion – Portugal's latest addition to the EuroHPC initiative.

Cybersecurity Month takes place every October and once again our annual community CSM campaign has delivered the goods: videos, webinars, articles, and interviews. Our regular Security section picks up on this and introduces NeMo – the DDoS solution for NRENs – whilst also shining a light on some of the people behind this increasingly important area. And, in this context, we take a close look at the latest version of eduMEET and how it offers important security features and benefits for the community.

Elsewhere, we look at energy efficiency for networks and data centres; how libraries can be enablers of scientific research; we review two important workshops held at TNC23: the second CEO Track, and the Gender Equality workshop; and finally, we look ahead to TNC24 in Rennes. On the subject of which, the Call for Proposals is open! So, if the wide range of topics covered in this issue has inspired you in your own discussions, visit the TNC24 site to help shape this conference and make your mark!

Finally, as your long-suffering CONNECT editor (alongside our production editor Silvia Fiore who does the really hard work) I'd like to highlight and thank the team behind the scenes, whose tireless work together with all our NREN and partner contributors makes this magazine what it is: a reflection of the enormously diverse activities that are enabling Open Science, Quantum, HPC, and everything else big and small that keeps the research and education community thriving. We hope you enjoy this packed issue and, as always, if there are topics you'd like to see more of, please let us know!

Paul Maurice, GÉANT

CONNECT is the magazine from the GÉANT community; highlighting the activities of Europe's leading collaboration on e-infrastructure and services for Research and Education.

The Team Behind CONNECT

Reflecting the breadth of our community, the articles you read in CONNECT are contributed by a wide range of people from the GÉANT Association, the GN5-1 project, and from our NREN and regional partners. The planning, production and editing is performed by a small team highlighted below.

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CONNECT Interview:

Dr. Stefan Hanslik

Interview by: Hendrik Ike, GÉANT

Dr. Hanslik, in your role as the national representative for Austria in both the steering and governing boards of EOSC and the EuroHPC Joint Undertaking, as well as your chairmanship of the e-IRG, you are uniquely placed at the heart of major developments supporting science in Europe. What do you think are the main challenges European science is facing?

It's a tricky question to answer. First of all, let me give you my gut feelings and my opinion on that. I'm always thinking about the whole system we have in Europe when it comes to research and research infrastructures. Here, I come to the first semantic opinion I have, because nowadays we know that when talking about infrastructures, e-infrastructures should be equal in value. It's an old tradition to separate those two, and I personally think that it's time now that the infrastructures and e-infrastructures are one group here. When I remember my work as a scientist and talk to scientists working now, there is simply no research work possible on both sides without the e-infrastructures. And on the other hand, it's not possible without the necessary larger infrastructures for experimentation. This is not domain-specific; it goes over all domains nowadays. So, I see that the main challenge in Europe at the moment for the scientific world is to cope with this new situation. All scientists are producing enormous amounts of data. The big challenge is processing and how to keep and deal with all this information. The main proportion of scientific data generated in Europe is funded publicly, so sharing and keeping it public is crucial. All of this has a prominent role. A lot has been developed in the last 20-30 years on both the infrastructural and policy levels. Open Science has become an integral part of European policy architecture, for example. The main challenge we face now is how to deal with this new situation. The role of the e-infrastructures is a big issue because it often works in the background, without much promotion or policymaking help.

That's nice to hear because it leads into my second question. As you know, EOSC and EuroHPC are driven by the Member States and policymakers in Brussels. However, infrastructures like GÉANT and the NRENs have developed from a bottom-up approach, guided by their constituents to create service offerings for researchers and educators. How do you see these top-down initiatives working with bottom-up initiatives seamlessly? Do you think it will be an easy transition, or do you see challenges?

I think this is part of one of the big European challenges we have to solve. As you said, for example, EuroHPC is top-down driven, and we had to react to it. Even in its development, there's an adaptation to pre-existing bottom-up initiatives. The concept of a federated data infrastructure in Europe and exascale computing, which is the main part of EuroHPC, also align. Major initiatives are coming together, and we see this with many initiatives from the Commission, stakeholders, and Member States, as they align their efforts. Exascale computing isn't just to help run EOSC for example; it's also for specific scientific problems. It's a European prestige project to demonstrate our strength globally - something that we should support.

In the last five years, we've seen scientists and policymakers realise that these initiatives depend on a common understanding of what needs to be done to keep ahead in scientific work compared to other continents. The Commission and Member States are making efforts to align interest groups like ESFRI, EOSC, and EuroHPC. Discussions in the joint undertaking support have shown attempts to integrate activities and avoid duplications. Fragmentation is still a problem in Europe, partly due to the funding system. We should consider larger projects involving more people, as the scientific community is well connected. Smaller projects can be more administratively burdensome without significant distinctions from larger ones. Thinking about bigger European undertakings is a favourable approach.

Your message is clear: communities in the scientific field know each other, and larger projects involving a wider base of stakeholders tend to yield better results.

Indeed, this is evident in major European initiatives like EOSC and EuroHPC, where many individuals overlap between the groups, and the community itself is interconnected. While there may be technical differences and varying domains, digital infrastructures are essential and should be used across the board. I'm convinced that this will gain traction among users.

You mentioned that researchers and policymakers are keenly aware of Europe's position compared to other continents. Initiatives from the European Commission reflect this awareness. Regarding digitalisation and the green transition in the research sector, how can the e-IRG facilitate this and how might international cooperation support it?

The e-IRG has the advantage of not being solely limited to the 27 EU Member States; it has a broader scope that includes associated countries. Moreover, looking at the groups and bodies within the e-IRG, especially its strong connections to e-infrastructure groups like others, it is more engaged with the international world. The efforts in the data sector, such as the FDO forum demonstrate this international involvement. The scientific community is inherently international, and this will further scale up due to Europe's exceptional initiatives. For example, the EOSC is an initiative unique to the European Community. Initiatives like the FDO align with the open science concept and contribute to the international aspect. Since my involvement with the EOSC model, it has always included an international perspective because it was clear from the start that this couldn't be limited to Europe alone. Building a World Wide Web of FAIR digital objects must consider the global context.

In the past, the terminology used in Europe was “sovereignty,” and it later shifted to “autonomy.” On one hand, Europe appears to be working to secure itself more than before, even in the realm of science. However, science is inherently international, and researchers collaborate across borders. Many initiatives aim to be outward-looking. I understand this might not have a straightforward answer, but how do you perceive these two aspects playing out in Europe today? Is there more enthusiasm for transcontinental research and education, or are these initiatives becoming more inward-looking?

I'm not entirely certain if I can provide a definitive answer, but I have the impression that a significant aspect, particularly when viewing Europe as part of the global scientific community, is a kind of competition over data. We recognise that scientific data holds immense value, and this has led to concerns about protecting it from external influences. This is especially relevant as scientific data is often publicly funded, and there is a responsibility to safeguard them from misuse by inappropriate institutions, for example. So, the idea of establishing something like a Schengen space for scientific data in Europe is appealing. However, a Schengen space doesn't imply complete isolation; there should be some level of transparency with other continents.

Regarding your question about international collaboration and whether it's still valued, I believe it is. In today's world, it is impossible to engage in scientific work without taking a broader perspective. The question is, how can Europe remain a competitive player in this global scientific landscape? Some argue that Europe lags behind, with the Americans as innovators and the Chinese as imitators, but I don't find this view convincing.

Let's move on, to consider gender balance. Currently, e-IRG has more men in its leadership and secretariat roles, but its events are well balanced in terms of gender. How do you view the significant skills gap between men and women, particularly in research, and what steps are e-IRG and wider European initiatives taking to address and improve this issue?

Addressing this issue is undoubtedly challenging, and it's not unique to e-IRG but prevalent at the European and even domestic levels. In my work for the Ministry, we grapple with this question almost daily, exploring ways to enhance the situation. What I've observed is a generational shift. Some Eastern European countries have demonstrated better gender balance in technical schools and universities compared to countries like Austria, Germany, or France. The newer generations pursuing scientific careers seem to have more self-confidence. This shift applies to both younger men and women who are more committed to their career paths.

Regarding the challenges faced by female participants, especially concerning managing families, societal changes are evident. In Austria, there might still be a more traditional view of family structures, but neighboring countries like the Netherlands, France, and Finland offer positive examples of creating better conditions for young women to pursue their educational goals. There's progress being made in reducing these imbalances, even within school systems. A good example is how to simply set up conditions where young women can follow this curriculum more easily. I believe this is improving over time, and I'm quite positive about it. Personally, as a father to a daughter, I hope this will be the case.

Thank you for your insights – I appreciate your positive outlook on this specific issue. Now, let's return to the European level. Earlier, you mentioned fragmentation as a challenge, particularly when numerous small projects work toward similar goals but result in limited impact. This issue is noticeable even in Horizon Europe work programmes, where efforts can overlap. What, in your opinion, should e-IRG do to remain relevant, especially when substantial investments are top-down driven and fragmentation is on the rise? For example, the Digital Europe program includes initiatives that align with GÉANT's goals but primarily target business and industry. How do you envision the development of this ecosystem in the future?

You've touched upon one of the most significant issues, and I believe it's primarily due to how research programs are designed. The responsibility for addressing this matter also lies with the Member States, as they should convey the challenges faced by the scientific community to the program committees of research infrastructures and EuroHPC. Unfortunately, what I've observed is that most Member State representatives do not discuss these issues in programme committees, which is concerning. On the other hand, the European Commission tends to emphasise that it's the Member States who make the decisions, so the onus is on them to raise these concerns.

However, there might be an opportunity within the discussions about the upcoming Horizon Europe framework programme. From our perspective, we've engaged in extensive discussions with colleagues from various domains and ministries. We've concluded that continuing with the same approach as in previous framework programs, where everything gets bigger and more fragmented, isn't the right path. Initiatives stemming from Digital Europe, the framework

program, and even EuroHPC have become increasingly fragmented. Some initiatives don't coordinate with others, resulting in suboptimal policy ideas.

For example, there's a prominent concept called 'data spaces', which is causing confusion. Different directorates within the Commission have varying ideas about it, and there's a distinction between those focused on industry and those focused on science and research. This division isn't practical, and it's perplexing why these structures within the Commission sometimes lead to suboptimal outcomes for the European Research Area.

In summary, the fragmentation issue needs to be addressed. It might be beneficial to incorporate this concern into the Horizon Europe framework program. We should aim to bring various stakeholders together, including the scientific community, to recognize the common understanding that our efforts should benefit European scientists.

I don't have a definitive solution, but I do believe it's crucial to acknowledge the role of Member States in bringing these issues to the table and discussing potential improvements within our existing system.

I understand that it's a complex issue, and your insights are valuable. It's not just a challenge for e-IRG but a broader issue in Brussels and across various sectors.

Indeed, it's a pervasive challenge, and I hope that addressing this fragmentation will lead to more effective initiatives and support for the European scientific community. It's essential to safeguard and sustain structures that are working effectively.

As you just said, GÉANT's been around for a while, and it works. It should be sustained, which is always very nice to hear. EOOSC is a relatively new invention, but GÉANT and EOOSC obviously have a good relationship. That came to the point where in an e-IRG white paper in 2022, GÉANT was mentioned as a vital trust integrator for the EOOSC ecosystem. So, GÉANT is not just about connectivity. We have our trust and identity services like eduroam, eduGAIN, and other AAI and security services. How do you think GÉANT can be of use to the wider EOOSC community, especially when we're talking about trust and associated services?

I think GÉANT could be even stronger here. There are two key aspects to consider in this context. First, the functioning infrastructure, which necessitates services like AAI, and I believe the best-case example is where we currently have this infrastructure in place, enabling Europe-wide access to the Internet. The next step involves creating a system that goes beyond just Internet access. We require access to data across various domains, similar to what we've defined with the worldwide map of objects. It's abundantly clear to me that achieving this is not possible without GÉANT and the support of stakeholders in the background, including both large and small research infrastructures. When I mention infrastructures, it's crucial to note that they come with associated costs. We should also consider the collections and resources available in this domain. Therefore, I believe there's a shared understanding among the younger generation involved in recent activities because we've witnessed the evolution of these technologies. I remember

being at university in the early '90s when we could connect computers from different continents and exchange emails without relying on external authorities like the Commission. This organic development has resulted in a highly efficient system that continues to expand, not limited to Europe but also extending to other continents like Africa and our counterparts in South America. Consequently, there's no need to reinvent the wheel; we should focus on leveraging existing structures.

Thank you very much for such comprehensive answers. Finally, we'd like to know a bit more about you. What was the last book you read, film you saw in the cinema, or summer holiday?

The most recent book I read was during my vacation in Greece on an island, and it was a beautiful experience. I thoroughly enjoyed the Mediterranean lifestyle and found more time for reading. I'd like to recommend a book to anyone interested in the political situation in Russia. It's Catherine Belton's "Putin's Friends." This book offers a well-executed analysis backed by extensive research, including interviews, covering the complex history involving the USSR and how it has led to the current geopolitical situation in Europe. It's a highly engaging read. Personally, I appreciate the depth of research in the book, particularly since I had some involvement in the developments of the early '90s and '80s. Specific cities in Europe, such as London, Vienna, Zurich, and Brussels, played pivotal roles in the political and economic changes discussed in the book. So, that's my book recommendation, and it was the last book I read! Personally, I loved it; it was even more thrilling than an Agatha Christie novel.



GÉANT at the EOSC Symposium 2023

It was so good to see so many old friends gathered together in Madrid to celebrate all things EOSC. There were a number of speakers and session leads from the community including Chris de Loof from Belnet chairing a session on Data Spaces and Emma Lazzeri from GARR who is co-ordinating the Skills4EOSC project. We heard from Jan Meijer (Sikt) on the progress of the EOSC task force for Financial Sustainability – additionally Kostas Koumantaros from GRNET on NI4OS and Roberto Sabatino from HEAnet on the monitoring of national open science activities. GÉANT's own Olaf Verschuur presented on the excellent results of the OCRE framework.

Important topics such as EOSC partnership priorities, financial models for EOSC post 2027, interoperability, and Use cases were discussed and each session during the three busy days demonstrated how far EOSC has come since its inception. A particular highlight came on the Thursday during the “Unconference”; GÉANT and NRENs co-organised, along with the EOSC Association, a 2hr interactive session on EOSC Nodes with roundtable discussions. The outputs will be used by the EOSC Association for future work. This was the culmination of work carried out during the summer by a small GÉANT community working group which put together a community position paper on the subject which has been published during the Symposium week and also been

submitted to the EOSC Association for consideration (GÉANT community position paper on the establishment of EOSC Nodes).

In the final panel on Friday morning, GÉANT CEO Erik Huizer re-iterated a number of key messages from this paper including ‘no master node to rule them all’ sharing his experience of what worked (and what didn’t!) when building the internet in the closing plenary along with a simple mantra “we’ve got you covered” (for Network and Trust and Identity).

If you want to get a better understanding on how Federated Identity Management has evolved over the last 20 years – see page 15 for “20 years of Federated Identity Management: where are we now and how did we get here?”.

Key takeaways

- 2024 will be ‘the year of the design and initial deployment of the EOSC Federation’ (it will also be the year where initial decisions will be taken on EOSC governance post 2027)
- The EOSC EU node is not a master node, but a reference node
- A minimum set of requirements will have to be defined to enable an inclusive EOSC Federation
- The EOSC Federation will include multiple nodes, each country and thematic community will discuss the best set-up
- The countries will have a key role in the post-2027 decision-making process
- EOSC does not operate in isolation: initiatives like data spaces, Destination Earth and EDICs will offer potential opportunities for synergies and joint developments with EOSC
- The EOSC Future project will continue for an extra 6 months to ensure a smooth handover to the EOSC Procurement awardees

Overall it was great to see so many colleagues in person and to see how far EOSC has come. We look forward to the next EOSC Symposium in Berlin in 2024!

Read the community's EOSC Nodes **position paper**.



EOSC Focus: Interview with Chris De Loof, Belnet

This is the first in a series of interviews conducted by the EOSC Focus project. The series aims to highlight the role of the EOSC Association's Mandated Organisations. By bringing their activities and insights to the forefront, the EOSC Focus interviews will help to reinforce the connections between each country's Mandated Organisation and its EOSC-A member and observer organisations, as well as to make visible the work going into the implementation of EOSC at the national and institutional levels. Chris De Loof spoke with EOSC Focus in his role as Innovation Manager – Advisor EOSC at Belnet.

Interview by: EOSC Focus project

What is the role of Belnet as a Mandated Organisation in the EOSC Association, and how does it enable the development of EOSC?

Belnet is, in the first place, the National Research and Education Network – NREN – for Belgium. That means that Belnet is already providing the physical connections to the EOSC ecosystem, which gives us a lot of advantages relative to facilitating the development of EOSC. As an EOSC-A Mandated Organisation we are positioned to

translate and communicate the mission of EOSC in the national context, to keep the Belgian members, observers and other stakeholders informed on the development of EOSC, and to help facilitate the national discussion around EOSC.

We are also part of GÉANT, which is delivering a number of common technical services among NRENs that are likewise linked to the EOSC ecosystem. These include connectivity services for the research community; authorisation and authentication infrastructures (AAI), such as eduGAIN; and a lot of other services that we offer to

the community – for example our service Belnet FileSender, which is used for secure data transport.

As a service provider, Belnet gets its funding from Belgium's research-funding and research-performing organisations to develop or deliver services in co-creation with and for them. Next to the R&E community, Belnet also offers connectivity and services to the public government with a main focus on the federal level in Belgium.

It is these well-established relationships that enable us to facilitate EOSC at the national level in Belgium.

What kind of engagement activities does Belnet develop?

Our engagement activities are mostly related to the technical services that we offer.

For example, we have a Community of Practice with traditional researchers, digital researchers, technicians and other professionals, all working in the research organisations connected to the Belnet network. Starting, moderating and stimulating a Community of Practice on Open Science tools is of vital importance.

We notice this even for certain solutions, like the DMPonline.be platform, which is a well-performing, but a quite static tool. As a service provider, you want to evolve and try to automate the tools as much as possible so Data Management Plans can, for example, become machine readable. We need to involve and consult our research community to gather all the necessary requirements. So, who will give us the requirements? Yes, our Community of Practice.

Belnet is also connecting people and organisations digitally. We provide solutions that are created by EOSC or GÉANT and offer those services to the research community. We organise EOSC coordination meetings where all Belgian Open Science stakeholders can have their say. We advocate that each Belgian organisation with an interest in Open Science and EOSC can become a member or an observer of the Association.

What does this role as a facilitator enable you to achieve?

We are mainly facilitating mutual and bi-directional communication between the Belgian research organisations, the ministries and EOSC-A. As facilitator we deliver technical services and guarantee interoperability between the stakeholders of EOSC.

Belnet is no policymaker but offers IT services to the Research and Education institutions and government bodies located in the different regions. As the national e-infrastructure provider, Belnet is very well positioned to connect the whole Belgian spectrum.

As an example, Belnet is able to actively contribute to all necessary technical steps of the research data lifecycle. First, we can provide research-performing organisations with the DMPonline.be tool, which is important for securing funding. Second, we can connect them to storage at Belnet, to hyperscalers via the OCRE agreements with GÉANT, and to the long-term data preservation platforms. Finally, we can ensure that they get processing time, for example, on the LUMI supercomputer, in Finland.

What can Belnet do as a Mandated Organisation to implement EOSC?

The most important way in which Belnet can contribute to EOSC's future is by offering sustainability. If we look to the global landscape of e-infrastructures for research, we need the operational capacity of the NREN and national HPC centres for data connectivity, services, processing, provisioning and storage. They are the ones that, together with some well-equipped research-performing organisations, guarantee the operability of EOSC over the long term.

We also stand as part of the support structure of EOSC-A, and the Association needs to be sustainable too as a coordination centre. Belnet is one part of what should be seen as a European sum of all national infrastructures dealing with Open Science and which are coordinated at the highest level by EOSC-A. The Association is the mechanism for Belnet to advance Open Science and the exchange of FAIR research data.

Additionally, most Belgian universities have e-infrastructures, research data repositories and knowledgeable data steward policies that we can be proud of. The infrastructure and personnel from these universities are actively connected to the EOSC ecosystem and are contributing to the EOSC-A Task Forces.

Meanwhile, there is more and more political interest in Belgium for Open Science. This interest translates into policies, legislation and funding.

What are the most relevant challenges and obstacles for the future?

Belgium was one of the first countries to sign the Berlin Declaration on Open Access, and became involved in the DRIVER project about 20 years ago. The difference with EOSC today is that we don't just talk about open access anymore but about open data.

One of the strong points, because of this long history, is that we already have a lot of legislation in place to deal with those kinds of subjects. The challenges in this respect, however, are that there is no robust technical framework yet, and the need for data scientists is very high. As a Mandated Organisation, we can help to address these.

Already there is investment in data stewards and coordination, but investment in service-offerings is weak. Technologies enabling science to be performed in an open and FAIR way costs money and human resources.

To provide a continuous funding stream, it's very important that politicians and funding organisations see the benefits of Open Science. Open Science is a digital transformation of science and creates new services and opportunities that were not there before. The budget has not always come from public funding. There are a lot of opportunities to collaborate on data and new services with commercial players that are in agreement with Open Science practices and Open Source principles.

Finally, implementing EOSC is a slow process. And the slow process may be a barrier for broader uptake, and the window of opportunity could close. It's about expectations management. For me, Open Science is the digital transformation of research. That means also that you must pay attention to the cultural shift.

Where do you see opportunities to improve the implementation of EOSC?

The future lies in an alignment with common European data spaces, European Research Infrastructures, national and European e-infrastructures for research, and European Partnerships.

Some bricks of data spaces are similar to EOSC because EOSC is supposed to become the horizontal data space for research data between the other data spaces. Data spaces such as the one for the Green Deal and Health are to a high degree based on the interoperability of domain-specific research data. For EOSC, the community of practice will be the researchers who will need access to data available in other data spaces – health, agricultural, mobility, etc. The interoperability framework of EOSC will be the technical blueprint of the EOSC data space.

We need interoperable data, but unfortunately that is just the thing we are missing: where is the data? who has the data? how do we retrieve it? where are the metadata and the persistent identifiers? That is a key area of improvement I think we need to address as soon as possible. Monitoring can help, but most of all we need some tangible results and use cases.

In closing, is there anything you would like to share with us or prioritise for the readers?

Open Science is only possible because of the positive attitude of the researchers. Researchers are doing their passionate research and they need the infrastructure to realise their dreams. So that means: happy researcher, happy society. I think it's very important that we stay focused on the basic principles of Open Science – advancing science for the benefit of society – and that we focus well on our core business, research and researchers, and minimise the bureaucracy and overhead. Open Science is just science done right!

About Belnet

As an NREN, Belnet delivers connectivity services for the research community and authorisation and authentication infrastructures (AAI) such as eduGAIN. Also, as Service Provider, Belnet offers specific services for R&E institutions like FileSender. Belnet receives funding from the research-funding and research-performing organisations in Belgium in order to develop or deliver services in co-creation for or with them, but is not a research-funding or research-performing organisation itself. Belnet's main stakeholders are thus the research-performing organisations rather than the individual researchers. Next to the R&E-community, Belnet also offers connectivity and services to the public government with a main focus on the federal level in Belgium. Belnet is part of GÉANT, it is the EOSC Association Mandated Organisation for Belgium, and is a partner in the Horizon Europe project EOSC Focus.

About Chris De Loof, Innovation Manager – Advisor EOSC at Belnet

As Senior Policy Advisor at the Belgian Science Policy Office (BELSPO), Chris De Loof works on digital strategies for scientific research and culture heritage. Chris is a long-time promoter of open and FAIR data and Open Science, and has spent the last couple of years as Innovation Manager and Advisor EOSC at Belnet. He has an interest in innovative, cross-cutting collaborations between cultural heritage professionals and researchers, chiefly in the humanities and social sciences. Chris is delegate to the Commission expert group on the common European Data Space for Cultural Heritage (CEDCHE). He is also Chair of the General Assembly of DARIAH, the European Research Infrastructures for digital humanities and arts, and Belgian representative in the European Research Infrastructure for Heritage Science (E-RIHS).



20 years of Federated Identity Management

– where are we now and how did we get here?

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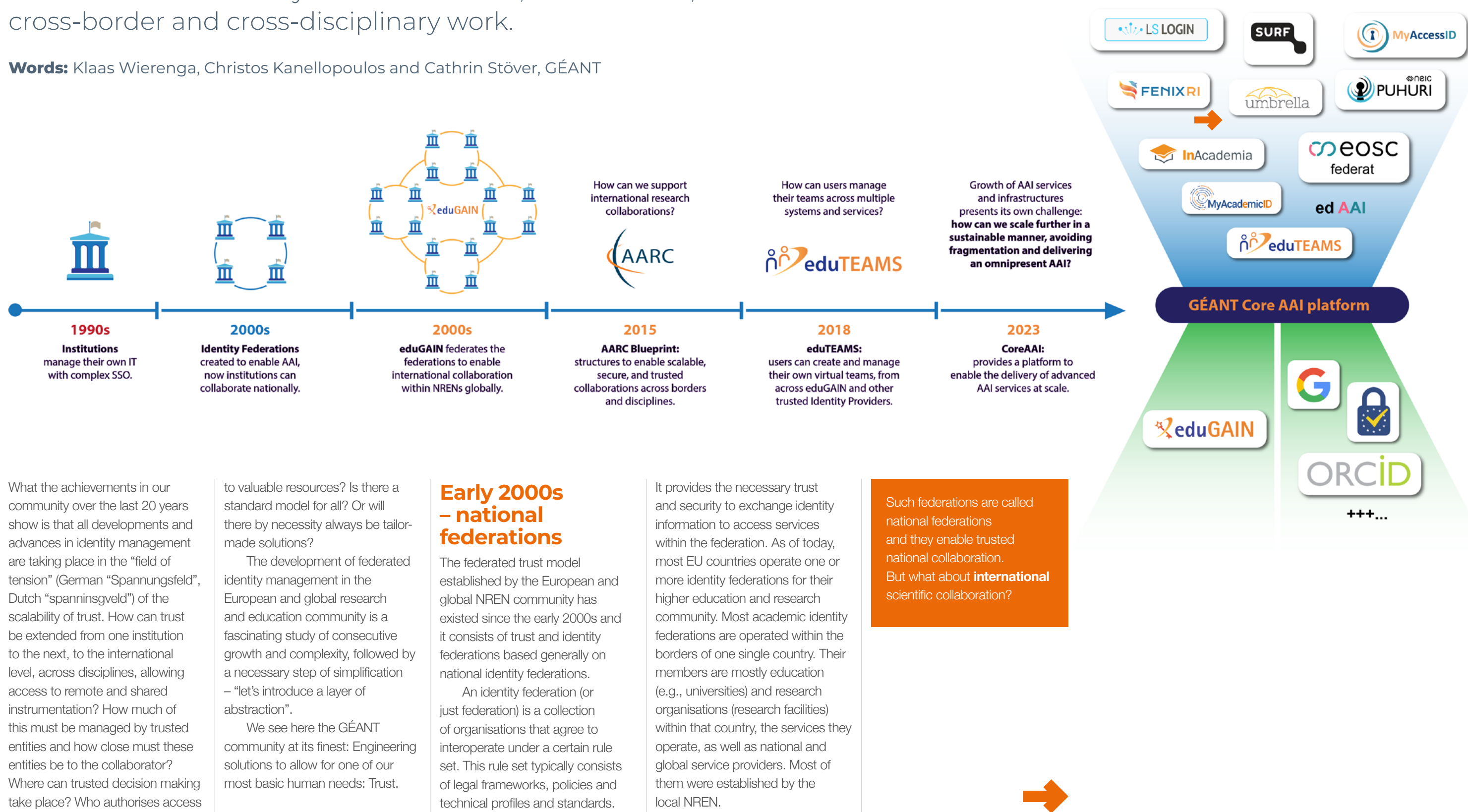
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It is repeatedly stated in meetings within the EOSC environment, that one of the main elements is the identity management infrastructure. The GÉANT community has been significantly contributing already based on over 20 years of experience in building the trust and identity structures required by scientists and researchers to carry out collaborative, international, cross-border and cross-disciplinary work.

Words: Klaas Wierenga, Christos Kanellopoulos and Cathrin Stöver, GÉANT



What the achievements in our community over the last 20 years show is that all developments and advances in identity management are taking place in the “field of tension” (German “Spannungsfeld”, Dutch “spanningsveld”) of the scalability of trust. How can trust be extended from one institution to the next, to the international level, across disciplines, allowing access to remote and shared instrumentation? How much of this must be managed by trusted entities and how close must these entities be to the collaborator? Where can trusted decision making take place? Who authorises access

to valuable resources? Is there a standard model for all? Or will there by necessity always be tailor-made solutions?

The development of federated identity management in the European and global research and education community is a fascinating study of consecutive growth and complexity, followed by a necessary step of simplification – “let’s introduce a layer of abstraction”.

We see here the GÉANT community at its finest: Engineering solutions to allow for one of our most basic human needs: Trust.

Early 2000s – national federations

The federated trust model established by the European and global NREN community has existed since the early 2000s and it consists of trust and identity federations based generally on national identity federations.

An identity federation (or just federation) is a collection of organisations that agree to interoperate under a certain rule set. This rule set typically consists of legal frameworks, policies and technical profiles and standards.

It provides the necessary trust and security to exchange identity information to access services within the federation. As of today, most EU countries operate one or more identity federations for their higher education and research community. Most academic identity federations are operated within the borders of one single country. Their members are mostly education (e.g., universities) and research organisations (research facilities) within that country, the services they operate, as well as national and global service providers. Most of them were established by the local NREN.

Such federations are called national federations and they enable trusted national collaboration. But what about **international** scientific collaboration?





From national federations to interederation: eduGAIN

The eduGAIN interederation (a federation of federations) initiative started as a research activity in the GN2 project (2004-2009). The eduGAIN service activity commenced in the successor GN3 project (2009-2013). Both GN2 and GN3 received generous support from the EU. On 1 April 2011, eduGAIN became an operational service.

As an interederation service, eduGAIN interconnects identity federations around the world, simplifying access to content, services and resources for the global research and education community – thus exporting the trust model from the national to the international level and allowing for seamless and trusted collaboration across borders.

eduGAIN enables international scientific collaboration within the eduGAIN community of NRENs around the world. But what about **very specific scientific** collaborations, where identity management is required to enable – for example – **access to distributed instruments or databases**? And how can we deal with scientific collaborators from outside the eduGAIN interederation?

Today, eduGAIN

- comprises over 80 participant federations connecting more than 8,000 Identity and Service Providers.
- eduGAIN helps nearly 27,000,000 students, researchers and educators access online services while minimising the number of accounts users have to manage – reducing costs, complexity and security risks.
- With eduGAIN participants from over 4,500 identity providers, service managers can simplify their account management and control processes – allowing greater access at reduced cost.
- eduGAIN enables institutions to easily and scalably support access to services globally – allowing control over user management.

More about eduGAIN at <https://edugain.org/>



The AARC Blueprint Architecture and FIM4R

The Authentication and Authorisation for Research and Collaboration (AARC) initiative was funded by the EC and first launched in May 2015 to address the increased need for federated access and for authentication and authorisation mechanisms by research and e-infrastructures. The AARC Blueprint Architecture (BPA) defines a set of architectural building blocks that can be used to implement federated access management solutions for international research collaborations. The Blueprint Architecture allows software architects and technical decision makers to mix and match tried and tested components and build customised solutions for their requirements.

- AARC builds on top of eduGAIN and provides a layer that is fully adaptable to the requirements of research and educational collaboration and allows for scaling trust across borders, across scientific disciplines and sectors.
- The increasingly complex identity management needs of such large research communities seem like a perfect minefield. AARC has therefore taken a modular approach and developed extensive guidelines.

- And it has become clear that identity management expertise is consistently needed.
 - The legacy of AARC work continues in the AARC Engagement Group for Infrastructures (AEGIS). AEGIS brings together representatives from research and e-infrastructures, operators of AAI services and the AARC team to bridge communication gaps and explore synergies.
 - Federated Identity Management for Research (FIM4R) is a collection of research communities and infrastructures with a shared interest in enabling Federated Identity Management for their research infrastructures.
- AARC has revolutionised the approach to identity management and today all activities are based on the AARC Blueprint Architecture.

With the AARC Blueprint architecture being developed, we return as ever so often again to the question of scalability: Federated Identity Management is only as scalable as it is offers simplicity from the complexity. A step is needed that brings the user back into the driver's seat: how to **simplify the management of virtual teams**?



eduTEAMS

eduTEAMS was developed by GÉANT to enable members of the research and education community to create and manage their own virtual teams and securely access and share common resources and services using federated identities from eduGAIN and trusted Identity Providers. With that, eduTEAMS gives the power back to the users – it allows for self-management of virtual teams and the decision who gets to be in the team and with what level of access is left entirely to the self-defining team.

eduTEAMS is already used to deliver the AAls for large scale infrastructures, such as the FENIX AAI, PUHURI, LifeSciences AAI, UmbrellaID AAI and MyAccessID in the scientific space, and InAcademia and MyAcademicID in the educational space.

Unfortunately, it is not always easy. Already AEGIS has identified the ongoing need to help user groups. It is a simple fact that a typical scientific user group does not automatically have a specialist on trust and identity in their fold. At GÉANT and the NRENs, we have realised that we need to support the set-up of almost each individual group - which is not scalable.

At the same time, we observe that the solutions implemented for the different 'verticals' have a lot in common.

Which is the moment when the need for another layer appears. At the end of GN4-3 GÉANT introduced a new layer in the FIM model: **GÉANT Core AAI**.

GÉANT Core AAI – a new layer to improve scalability

Today, the GÉANT Core AAI platform allows to deal with those user group requirements that are shared among all 'verticals': group management, third party IDs and protocol translation. It brings back a level of scalability necessary to operate a growing service such as FIM.

In 2023, the GÉANT community and NRENs across the globe look back to a history of success and learning about Federated Identity Management over the last 20 years. The absolute beauty here is that we have dealt in the environment of (human) trust infrastructure over 20 years. This is the time it took to build it, but more importantly, we have proven that we can extend it and maintain it.

Trust is here. Trust is GÉANT. Trust is federations and NRENs.

Trust has never been broken and we have the expertise to ensure it keeps fully intact. There are still those around that do not believe that Trust will scale, but we believe we have understood the scalability of Trust and the simple fact that the trust based FIM infrastructure serves millions of users with BILLIONS of requests each month speaks for itself.

Moreover, the trust environment we make available is integrated with (educational and research) business processes. It is capable of responding to emerging new requirements – as we have shown over the past 20 years with consistent and consecutive adaptations and improvements.

In short: GÉANT's Core AAI platform allows for seamless integration across domains, scaling where scalability is needed, while at the same time preserving the autonomy of communities to select their own (AARC BPA compliant) AAI, thereby ensuring that the specific needs are met and the trust based decision-making stays within the community.

Trust and scalability. We got you.

New Constitution further strengthens eduGAIN

On 15 September the new eduGAIN Constitution was approved by the eduGAIN member Identity Federations; a milestone for the service that within 12 years grew from taking its first steps into interfederation to what is now the foundation of many services in the T&I space.

Words: Casper Dreef, GÉANT

As the membership of eduGAIN and the number of entities within the service continues to grow, it was time to run a check if this foundation was still strong enough.

Using the **REFEDS Baseline Expectations** whitepaper as a starting point, the eduGAIN Futures Working Group set out to identify room for improvement and created a **set of recommendations** for the service.

One aspect that was identified for improvement was that eduGAIN itself is slow to make decisions and necessary changes to its service model. With the number of Identity Federations in eduGAIN increasing and the number of Federation representatives growing, the administrative strength of the service actually decreased. This called for a revision of the governance structure and to make that possible the eduGAIN Constitution needed to be addressed.

After consulting the broader community, including members of eduGAIN, REFEDS, and the FIM4R and FIM4L communities the proposal was made to move from a Steering Group including 150 Federation representatives to a model with a small, elected Steering Committee and an Assembly.

The Assembly, consisting of the eduGAIN Delegates and Deputies, will have an oversight role within the service. It is responsible for voting in new Member Federations, voting on changes to the eduGAIN Declaration and Constitution, and voting for membership of the eduGAIN Steering Committee, which in turn will be responsible for developing and maintaining the strategic direction of the service.

Six individuals will be elected to the new eduGAIN Steering Committee of which four must be eduGAIN Delegates or Deputies, whilst up to two of the Steering Committee members can be from the broader eduGAIN community. The Steering Committee Chair will be appointed by the Steering Committee from its membership. The eduGAIN Service Owner, who will act as vice-chair, has an ex-officio role on the Steering Committee.

The benefits of this new governance structure are that decision-making becomes more efficient and the influence of stakeholders increases. With one position on the committee reserved for the Service Owner, results of the eduGAIN task in the GN-projects can be disseminated and the needs of the eduGAIN membership can be more easily adopted by the project in return.

The first task of the Steering Committee is to prioritise the other recommendations of the eduGAIN Futures Working Group, such as updating the service model, implementing a baseline for Federation Operators and monitoring emerging technologies and their interaction with eduGAIN.

With a revised Constitution, eduGAIN continues to be the foundation on which the T&I space is built.



What is the True Value of Trust?

Trust is an important part of the GÉANT strategy and has been identified as one of our core values as an Association. Our services use a variety of technical and policy-based trust structures to ensure that our federated services are safe, secure, and appropriate for our users. Trust is also an important part of my job and my job title – my team takes responsibility for helping to define and shape this trust, whether through compliance statements (eduroam), policy frameworks (eduGAIN), policy management authorities (TCS) or specifications (REFEDS).

Words: Nicole Harris, GÉANT

Trust is a very nebulous concept – it is the belief that you can rely on something. In our community we build this trust through our interactions and engagements. Sometimes, getting to this shared understanding can be a long process: endless working group discussions, many drafts of documents, and extensive consultations are needed to make sure we have that shared belief. There are, however, many environments we work in that have pre-existing trust models and the battle for who should regulate this trust is heating up.

The internet grew out of a trust building approach that is very similar to GÉANT's: for decades, organisations like the IETF have brought together the brightest technical and policy minds to discuss, debate, draft, and define standards that can be used to shape

the internet. IETF have always been clear that they in no way govern the internet... it's a trust model. Proponents of these approaches are robust in their defence of tech neutrality and believe that governments and politics should be kept away from internet governance.

But how neutral are the defenders of this space? Our access to the internet is increasingly being filtered through very specific windows, in the form of a small set of browser options and the prevalence of apps. These systems are normally owned and therefore governed by the five big tech companies, who all have very specific agendas and cannot necessarily be trusted to make neutral decisions but are heavily influential in the spaces where internet specifications are being defined.

A recent example of this can be found in the world of browser certificates which are, on paper, governed by the CA/B Forum. Despite a ballot to reduce the maximum lifetime of a certificate failing, the major browsers went ahead and implemented the reduced timeframe. This is not the only way in which browser decisions are causing issues for everyday users of the internet, **as Hank Nussbacher has previously written about in CONNECT**. Recent changes to S/MIME certificates are also causing significant issues due to a Western-centric approach to the process (for example, requiring organisations to have a unique identifier, lack of support for different approaches to human name structure, poor understanding of address constructs

in different part of the world etc.). GÉANT has previously expressed its concern about governance of digital certificates and the lack of European representation in decision making.

Browsers are also making a show of getting rid of third-party cookies. This is seemingly a good thing; the backlash against mass tracking activities by digital platforms and the fines levied against the big tech companies are understandable. However, tracking a user across sites is not inherently a bad thing - there are many workflows in which it is useful and positive to maintain the state of a user, such as single sign-on (SSO) processes. The decisions being made by browsers around these changes may significantly impact services such as eduGAIN, and the FEDCM working group within REFEDS is trying to have a voice and influence those decisions, but we are a small voice.

Maintaining any influence over the direction of internet governance decisions has become significantly harder.

Many people think that internet regulation can and should solve this problem. A recent UNESCO conference asked for a global dialogue on internet regulation and looked at a variety of important topics, such as building an internet of trust, regulating digital platforms, supporting content moderation, transparency, and supporting freedom of expression. These are important discussions, but the moves towards regulation have not achieved the desired goals. Examples include:

- The ePrivacy Directive resulted in a poor user experience, with badly implemented and confusing pop-up boxes about cookies that did not help or better inform the user.

- Many elements of the GDPR do not translate well to the very transactional nature of the internet and technologists are struggling to implement safeguards to meet these requirements, meaning that in many places the requirements are being ignored.
- The eIDAS regulation has not made good progress in aligning implementations across member states, with certificates issued in one state not being accepted into the scheme in different states... invalidating the stated purpose of the approach.
- The introduction of QWACs (Qualified Web Authentication Certificates) is a very specific attempt by legislators to fill a gap they felt was missing since the move away from EV certificates, but the approach has been dismissed as unworkable by many involved in the space.

So, what is the solution? Big tech companies can no longer be seen as trusted partners in tech neutrality approaches, but attempts at regulation have shown poor understanding of technical implementations and the non-geographically bound nature of the internet.

It seems that organisations such as GÉANT, that already have a strong trust framework and trust culture in place with their communities, could have a role to play here. Finding the right trust brokers and giving them a voice is paramount. We are already trying to influence and be heard in many of the fora I have mentioned in this article, but there is more work to be done if we want to preserve the service ecosystem we have built for our users.



Fostering visibility of scholarly works to raise the African voice

Much has been said and published worldwide about Africa's contribution to the global knowledge ecosystem. Africa is said to have contributed to only 2.2% of the world's scholarly articles, according to the UNESCO Science Report in 2020. On the flip side, public knowledge has also revealed that Africa has been largely underrepresented in the parade of science scholarly outputs because of lopsided rules of engagement in the publishing ecosystem, disfavoured African scholars and culminating in less visibility for African scholarship.

Words: Effah Amponsah (WACREN)

Admittedly, visibility for scholarly works is a complex and multifaceted issue. On the one hand, there is a growing recognition of the importance and value of African scholarship, as evidenced by the, albeit slow, increasing number of African scholars publishing in international journals and books. On the other hand, African scholars still need help getting their work published and disseminated.

Several factors contribute to the low visibility of African scholarly works. One is the need

for adequate funding for research in Africa. Inadequate financing makes it difficult for African scholars to research and publish their findings. Another factor is the need for more infrastructure for scholarly communication in Africa, including a lack of access to libraries, journals, books and training in current trends in academic publishing.

Recognising these challenges, activities in the AfricaConnect3 project have focused on developing open science capacity-building activities and establishing a framework for sustainable open

access (OA) repository and journal development in Africa. The resulting LIBSENSE initiative is critical in fostering the visibility of African scholarship through its pillars of policy, capacity building, and community-owned infrastructure for shared institutional and national scholarly communication platforms. WACREN has also partnered with the Directory of Open Access Journals (DOAJ) and the Directory of Open Access Books (DOAB) to create avenues for more journals and books to be indexed in these schemes to raise the profile, visibility

Picture
Photo from a recent LIBSENSE Open Science Symposium in Nigeria. A collaboration between WACREN, Commission of Vice Chancellors in Nigeria, DOAJ, DOAB, Nigerian Librarians, Committee of ICT Heads and NRENs in Nigeria.



and impact of scholarly works from Africa in a structured, sustainable way. Fully guided by the peculiarity of the African context, LIBSENSE is working with these indexing platforms to remove barriers and raise the African 'voice' in global scholarship.

A recent study revealed DOAJ to be an excellent choice for diversity and inclusivity, with the number of OA journals from Africa doubling those found in Web of Science. The study also reported a five-fold increase in OA journals from Global South countries compared to equivalent services and other scholarly discovery platforms.

Furthermore, WACREN, in collaboration with the Electronic Information for Libraries (EIFL) and African Journal Online (AJOL), is embarking on a three-year

project to support diamond open access (OA) publishing in Africa. The initiative aims to empower the African diamond OA community and provide cost-efficient, open, shared publishing infrastructure. AJOL, renowned as the world's most extensive online collection of African-published, peer-reviewed scholarly journals, will help to model options to liberate African authors and readers from the financial burdens of Article Processing Charges (APCs) and subscription fees.

For those unfamiliar with diamond open access, it represents a compelling option for researchers who prioritise open access, face budget constraints, work in emerging or interdisciplinary fields, or aspire to drive positive societal change through their research. The diamond OA model enhances the

accessibility of scholarly research, particularly benefiting researchers and readers in economically challenged regions where resources for accessing research publications are limited. This approach bridges disparities and promotes increased knowledge dissemination, potentially catalysing innovation and progress across diverse domains.

In tandem with the national open science symposiums it hosts across Africa, the dedication in LIBSENSE to fostering OA repository and publishing initiatives underscores a pivotal and far-reaching contribution to amplifying the African voice in global research. These efforts will address the challenges many African scholars face and contribute to enriching and diversifying the global knowledge landscape.



Libraries: central nodes for scientific collaboration and research

Interview with Viorica Lupu, Director of the Scientific Library, Technical University of Moldova

Viorica was one of the invited speakers at the 'Libraries as enablers of scientific research' two-day workshop, organised under the auspices of the EaPConnect Project, that gathered speakers and participants from 11 countries in Tbilisi at the National Science Library of Georgia earlier this year.

Words: Olga Popcova, RENAM

Viorica, what was the topic and the main message of your talk?

My presentation 'The Role of Academic Libraries in the Open Science Landscape in the Republic of Moldova' (co-authored with Ina Nicuță of the Scientific Library of the Academy of Economic Studies of Moldova) gave an overview of how the Moldovan university libraries contribute to the implementation of the Open Science paradigm. In order to remain competitive in the diverse and complex research landscape, academic libraries first started to develop demand-oriented services and try to support researchers throughout the whole research cycle. Serving as central nodes for scientific collaboration and research, the Moldovan academic libraries are involved as key players in the Open Science movement through awareness activities, advocacy, development of institutional repositories, open educational resources, research data management, assistance and training.

How do you see the role of libraries in the context and support of scientific research and Open Science?

Libraries are integral to the support and advancement of scientific research and Open Science. They serve as hubs of knowledge, information sharing, and collaboration, helping researchers to navigate the complexities of the modern research landscape while promoting the principles of openness, accessibility, and transparency which are central to Open Science.

Libraries can assist researchers in managing their scientific data effectively. They can provide guidance on data management plans, storage solutions, metadata standards, and data sharing practices. This is crucial because sharing research data is a fundamental necessity in Open Science.

In your view, what are the benefits and challenges of international collaborations?

International collaboration in Open Science offers a great deal of opportunities for the advancement of science and for society as a whole. However, it comes with communication, data security, regulations, and resource management challenges. With proper planning and efforts in the management of these challenges, international collaboration can bring significant benefits to the scientific community, such as access to diverse expertise and resources, research facilities and funding, increased research impact, etc.

Does your university collaborate with RENAM, the NREN of Moldova? How does this collaboration benefit your work?

I participated in different training and dissemination events organised by RENAM in the framework of the NI4OS-Europe project that aimed to support the Moldovan academic and research community in the adoption and use of the services and tools offered by the European

Open Science Cloud (EOSC) infrastructure. These activities expanded my knowledge of EOSC benefits, EOSC resources and tools, as well as of Research Data Management. These events provide valuable opportunities for training, collaboration and professional development for members of the scientific community.

Can you tell us about your current and future projects and your main areas of interest?

As Open Science gains momentum, libraries are expected to play an increasingly important role in supporting open, transparent and collaborative research practices.

Being a beneficiary of the Research Data Alliance (RDA) Open Call for RDA Communities of Practice, funded through the EOSC Future project brought new opportunities for me. Since January 2023 when I joined RDA as an individual member, I have been able to gain access to exclusive resources, such as research data, best practices, guidelines, and publications, which can support me in my research and/or data management activities. RDA has numerous working groups focused on various aspects of research data management and sharing.

I joined two groups: the Improving Global Agricultural Data Community of Practice and the Libraries for Research Data Interest Group, which give me opportunities to contribute to specific areas of interest and to work with experts in these domains. The working groups focus on effective collaboration and organisation of joint activities which bring together experts, knowledge generation and research data skills training. This is a better alignment



with global best practices and an opportunity to form partnerships on specific projects, discuss issues with experts from other countries, and link national efforts and activities with international initiatives. My aim for my library is to strengthen its capacities and provide support to all members of the Moldovan scientific community in the Open Science domain.

What are your best memories of the Tbilisi event? Why?

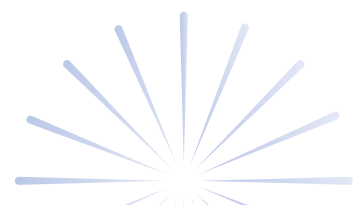
In my view, there were several important aspects of the Tbilisi event. The first was the meeting itself and the occasion to connect with like-minded individuals and

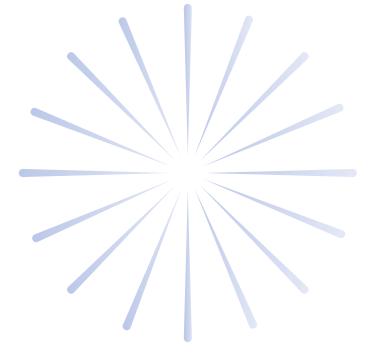
experts in the field of Open Science, which I am sure will lead to valuable collaborations and opportunities in the future. Another aspect was the chance to listen to success stories and innovative ideas in Open Science, which really inspire, motivate, and drive one's own research and projects forward.

At this event, I valued the knowledge exchange, the collaborative spirit, and commitment of all participants to advance Open Science and to be part of this movement. I was also impressed with the wonderful city of Tbilisi, the Georgian culture, and food. It's a place where ancient traditions and contemporary life coexist, creating a vibrant and unforgettable experience for visitors.

RENAM, the National Research and Education Network of Moldova, is one of the EaPConnet Project beneficiary members. EaPConnect is an EU-funded project which is establishing and operating a high-capacity broadband internet network, providing services and offering opportunities for knowledge building and cooperation for the research and education communities across the Eastern Partnership (EaP) countries: Armenia, Azerbaijan, Georgia, Moldova and Ukraine. EaPConnect is part of the European Union's EU4Digital initiative.

Picture
Viorica Lupu at the National Science Library, Tbilisi, 27 April 2023





CONNECT Interview:

Elli Papadopoulou, Athena Research Centre

Librarian and information system specialist at the Information Management System Institute (IMSI) of the Athena Research Centre, Elli is also the OpenAIRE coordinator for Greece and she is involved in several projects such as EOSC, the Greek project HELIX working on the development of the country's digital infrastructure for research and ARGOS, the OpenAIRE service for Data Management Plans. She was recently elected to be part of the OpenAIRE Executive Board as a member supporting Services. In this interview, Elli tells us more about her work and passion for Open Science and research data management for our community.

Interview by: Silvia Fiore, GÉANT



Elli, in your opinion, what are the most important elements of Open Science?

I will distill my answer to two elements that I believe are fundamental, from a sociological point of view, in the evolution of our society and, therefore, its expansion in the digital world: collaboration and inclusivity. Firstly, collaboration is integral because as humans, our development is deeply influenced by our surroundings and the individuals with whom we interact. Consequently, we become a reflection of the communities we inhabit. Secondly, inclusivity is of paramount importance. It is essential because even seemingly outlandish ideas, to some, have demonstrated their value and potential to save lives or drive innovation. True progress should embrace the non-discriminatory expression and application of diverse ideas in a participatory fashion.

In Open Science, and most prominently in EOSC that puts Open Science principles into practice, both elements are prioritised and requested at the policy, technical and operational levels. All stakeholders are engaged in realising a trusted shared ecosystem for research and innovation in their own capacity, technologies and settings. That creates the opportunity for enhanced collaboration across countries and domains promoting interdisciplinary and diversity in the process. Even more so, we see that the political leadership is considering the input of the epistemic community, expressed as data or policy briefs, for evidence policymaking, which can only have positive results, such as leading to more democratic societies rather than based on intuition or ideology.

What do you think are the challenges in Open Science and what is the community doing to overcome them?

Today, we see that the European research community collaborates in the conceptualisation and implementation of the technological aspects of Open Science, particularly through EOSC, as it is vital to create the technical framework where new technologies will be applied for FAIR data to be realised, and within the remit of which community will be able to navigate and use them. But, to establish literacy in actively practicing Open Science, I see that we still lack the dedicated policy actions and funds for the engagement and capacity building of the long tail of science. The introduction of data stewards is significant for research data management support, but we equally need to ensure that existing roles, most importantly students, professors, and librarians, are not neglected but rather are educated and up/re-skilled to feel confident and be competent in their own capacity in Open Science ecosystems. The funds and activities from/for EOSC provide a good starting point towards this direction, but still national bodies in education, digital governance, science, technology and innovation, need to promote collaboration at national level and support research careers at all levels.

Research data management needs have been rapidly changing and will continue to do so as new technologies arise. What are some of the key trends among users?

I am happy to share some insights from the perspective of Data Management Plans (DMPs) and FAIR assessments, representing both the EOSC-A FAIR Metrics and Data Quality Task Force where I actively contribute, and the forthcoming Open Science Trails project coordinated by OpenAIRE.

Open Science Trails (OSTrails) is the successful candidate project that will be funded under the topic Enabling an operational, open and FAIR EOSC ecosystem (2023) (HORIZON-INFRA-2023-EOSC-01). Open Science Trails (OSTrails) aims to advance processes and instruments for Planning, Tracking, and Assessing scientific knowledge production beyond state-of-the-art, working with various national and thematic contexts, improving existing infrastructure, and connecting key components to enable an operational, open and FAIR EOSC ecosystem. The project will start in 2024 and engages all key service providers for DMPs, FAIR Assessment Tools, Scientific Knowledge Graphs (SKGs) and their users' communities to collaboratively achieve the necessary standards and design the pathways to streamlining FAIR and machine actionable DMPs in Europe.

At the individual level, we see researchers are either providing their services to EOSC or providing EOSC with knowledge and data (indirectly). Through the survey that we conducted at the EOSC-A FAIR Metrics and Data Quality Task Force, we captured the behavior of those researchers who find solutions for their FAIR assessments in the different tools that have emerged, such as the FAIR Evaluator, F-UJI or the OpenAIRE Metadata validator. However, it was observed that, although the community wants to take up and implement the FAIR concept, especially to comply with EU and national RDM policies, they are still unsure who to turn to and even which FAIR assessment tools to trust as they all present inaccuracies in the produced results.

What is ARGOS and how does it benefit the community?

Thank you for your interest in ARGOS! As the product manager, I am particularly happy to answer this question. ARGOS is the OpenAIRE service for DMPs. It is based on the open source OpenDMP software and is accessible from the OpenAIRE catalogue and the EOSC portal.

ARGOS assumes the role of an active DMP platform that goes beyond providing researchers with structured forms and instructions to write their DMPs. Through ARGOS, we enable researchers to actively prepare and manage their DMPs by connecting our platform to other scientific services, e.g. data repositories, publications,

notebooks, scientific registries, and SKGs. We view DMPs as integral components of research and treat them as FAIR outputs by, among other things, assigning DOIs and licenses to them and applying semantics to support the creation of qualified references.

To write a DMP, a lot of information seeking, writing, publishing, and cross-referencing is involved. We automate these processes in ARGOS to help researchers easily navigate their RDM activities and get a positive experience out of the rather complex and mandatory nature of data management planning. Most importantly, through our ARGOS community, we exchange knowledge, collect demands, and act as DMP liaisons in the RDM chain to ensure that DMP specifications are understood and fulfilled by everyone along the way.

How does the future of Open Science look like in Greece?

Bright and colourful, and I feel extremely lucky to be collaborating with so many amazing colleagues and professionals across Greek institutions and initiatives to collectively realise Open Science in the Greek research web. That being in my capacity as the OpenAIRE NOAD in Greece, as associate researcher in EOSC projects with regional and/or national interests, such as the NI4OS-Europe project coordinated by GRNET, as well as assisting the President of the Hellenic Open Science Initiative (HOSI).

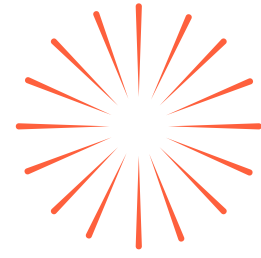
Undoubtedly, the HOSI has been an enabler towards progressing Open Science in Greece as it has led to better communication of everyone involved in Open Science, in one way or another. Together, its members, we have achieved the publication of our proposal for a National Open Science Plan (NOSP) in Greece, parts of which have been transposed to the Digital Strategy of the Ministry of Digital Governance. Currently, HOSI runs three working groups (policies-education-software) having invited more people to contribute to the second edition of the NOSP, a national library of Open Science resources and a GitHub repository for the collection of national contributions.

The role of the General Secretariat for Research and Innovation (GSRI) in national Open Science activities, also serving as the National Point of Reference (NPR) for Open Science in the EU, is encouraging. Particularly, GSRI has committed to the new ERA actions that are relevant to Open Science and we work with them to introduce Open Access and Open Science requirements in the new national funding schemes. In terms of infrastructures for Open Science, GSRI has invited EU experts to examine the situation in Greece and advise on the next funding for RIs. You may find more information in this Policy Support Facility (PSF) report.

Find out more about OpenAIRE and Elli's work at <https://www.openaire.eu/blogs/blogger/ellipapa>

NRENs at the Open Science Fair 2023

Interview with Tamara Gvenetadze, GRENA



Tamara is marketing manager at the Georgian Research and Educational Networking Association GRENA. She is actively involved in different open science initiatives.

Interview by: Leonardo Marino, GÉANT

Tamara, can you tell us more about GRENA's involvement in the area of open science?

GRENA is deeply committed to the advancement of open science in Georgia and actively contributes to the European Open Science Cloud (EOSC). The EOSC serves as a unifying platform, bringing together national and European stakeholders, initiatives, and e-infrastructures to foster an inclusive open science ecosystem across Europe. At GRENA, we recognise the paramount importance of cultivating a trusted,

virtual, and federated environment that transcends geographical boundaries, all while adhering to the core FAIR (Findable, Accessible, Interoperable, Reusable) data principles.

Does GRENA offer services or organise activities in support of Open Science?

Within the framework of the EC-funded NI4OS-Europe project, GRENA prepared and facilitated the signing of a Memorandum of Understanding (MoU) on the Georgian Open Science Cloud initiative. Signed by sixteen parties, the MoU aimed to:

- Support the development of a national strategic vision for the optimisation of data services in favour of scientific research and innovation.
- Promote the inclusion of other national institutions in the development of the Georgian Open Science Cloud Initiative.

The increased visibility, accessibility, and usability of Georgian scientific publications and research profiles within the European scientific community have been made possible through the cooperative efforts of GRENA and the National Science Library of Georgia. Over the course of NI4OS, GRENA provided

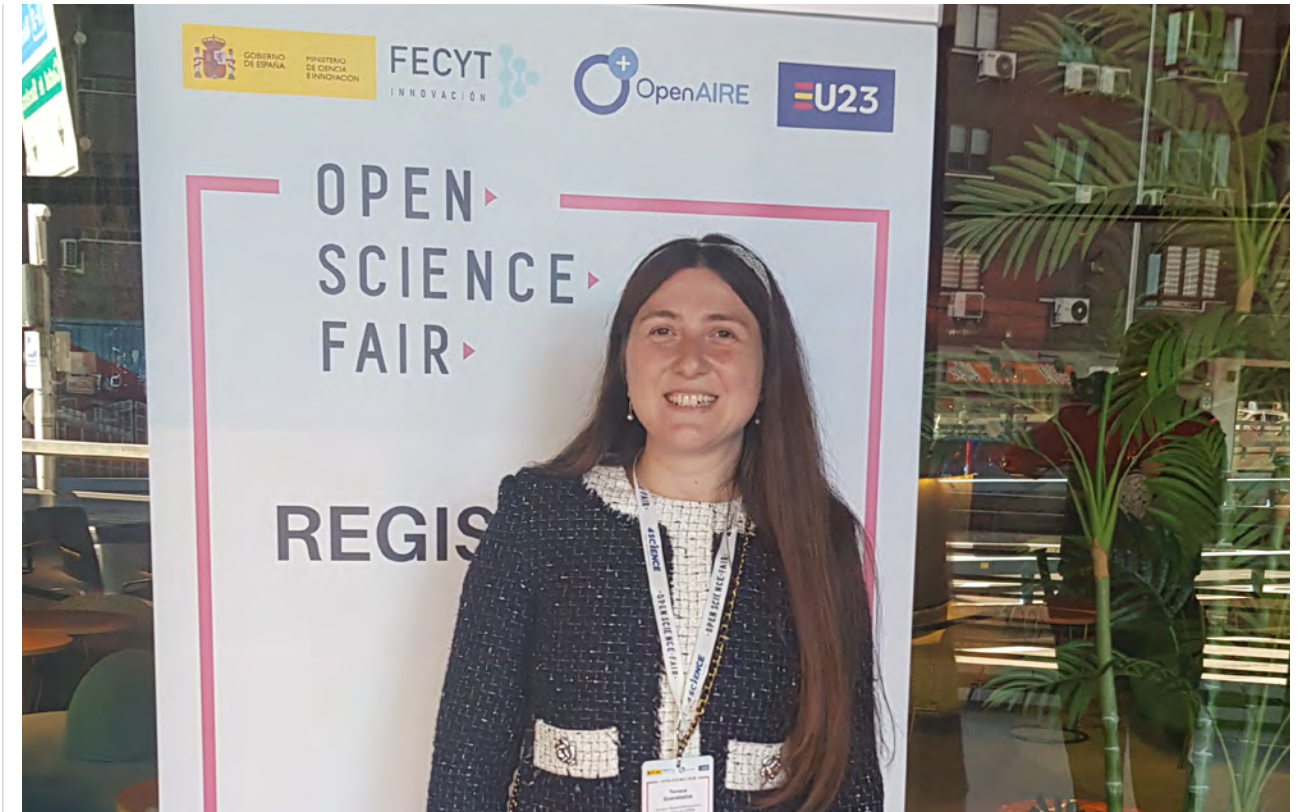
guidance and support to the library team in establishing openscience.ge, the digital repository for Georgian scientific publications that is in compliance with open science principles. The repository is now available in the EOSC catalogues and comprises electronic journals, articles and research data.

GRENA also supported research on brain disorders by providing technical assistance and computing resources for the establishment of an online EEG (electroencephalography), database portal: EEGHUB.GE. EEGHUB.GE is the first electronic EEG database in Georgia to be systematised, stored and placed in the European Data Format (EDF). Free of charge for European and local scientists and based on FAIR principles, the portal has been selected by NI4OS as a thematic service and is available in the EOSC marketplace.

Finally, GRENA is offering GCloud.ge, its own cloud service based on OpenStack and providing Infrastructure as a Service (IaaS) along with a variety of applications and integrated developer-friendly services. This cloud service - included in the EOSC marketplace - offers users full access to their virtual infrastructure, automated and quick installation of commonly used services and applications, and includes a ready-to-use GitLab service for version control and an efficient resource usage charging policy.

Why are you attending the Open Science Fair in Madrid this year? And which sessions did you enjoy the most?

I find the concept of novelty in the field of open science truly fascinating. Innovation and fresh ideas can have a profound impact on how we collaborate, share knowledge and advance research.



Personally, I am particularly intrigued by discussions around the intersection of open science and AI, open science and circular economy, as well as on the evolving landscape of research assessment, and I believe that exploring these areas can lead to exciting breakthroughs and improvements in scientific practices.

The session "AI with and for Open Science" was particularly intriguing because it delved into the latest developments in AI and how they are being applied. It featured real-world examples, which I found both informative and inspiring, and a panel discussion exploring AI's role in supporting scientific discovery from various perspectives, including ethics, algorithms, and infrastructure, with a focus on open infrastructures.

I also appreciated a workshop exploring how AI and open science can accelerate the transition to a Circular Economy, which sparked stimulating discussions on challenges such as transparency and reusability of project results. I personally believe that the transition to a Circular Economy is crucial

for environmental protection, innovation, and job creation. The workshop aimed at developing practical solutions and involved collaborative group work, including defining problems, providing context, and mapping stakeholders as a base for future research and solutions.

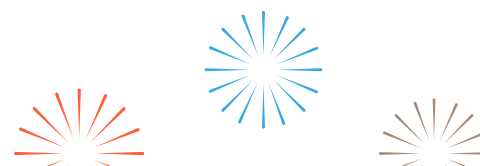
This year's Open Science Fair was titled "Charting the course: reimagining Open Science for next generations". What would you like to see in the future of open science?

I'm excited about the potential for open science to evolve and make an even greater impact. In the future of open science, I would like to see greater accessibility, interdisciplinary collaboration, ethical practices, and innovative technologies. Open science should be accessible to everyone, breaking down barriers to participation, despite geographic location or economic status, thus enhancing its global impact.

GRENA, the National Research and Education Network of Georgia, is one of the EaPConnect Project beneficiary members. EaPConnect is an EU-funded project which is establishing and operating a high-capacity broadband internet network, providing services and offering opportunities for knowledge building and cooperation for the research and education communities across the Eastern Partnership (EaP) countries: Armenia, Azerbaijan, Georgia, Moldova and Ukraine. EaPConnect is part of the European Union's EU4Digital initiative.

GRENA

GEORGIAN RESEARCH AND EDUCATIONAL NETWORKING ASSOCIATION



Interview with Emma Lazzeri, GARR

Emma Lazzeri is an Open Science expert at the Italian NREN GARR. On behalf of GARR, she is the Coordinator of the Skills4EOSC project, and she was involved in the EOSC-Pillar project as well as many other different projects and initiatives in the Open Science field. Additionally, she is the Coordinator of the ICDI Competence Centre for Open Science, FAIR and EOSC and she is sitting in different expert groups on Open Science at both national and European level. Her background is Telecommunication Engineering and she holds a PhD in Innovative Technologies from Scuola Superiore Sant'Anna, Italy.

Interview by: Leonardo Marino, GÉANT



Emma, can you tell us more about GARR's involvement in Open Science initiatives, both nationally and internationally?

GARR's main objective is to support the Italian Research and Education community by providing high-performance connectivity and developing innovative services for the daily activities of researchers, professors and students as well as for international collaboration.

GARR is also one of four founding members of the EOSC Association on behalf of ICDI, which it represents as the Italian Mandated Organization.

From 2019 to 2022 GARR coordinated the EOSC Pillar project, which was based on the idea that setting up a European infrastructure should be linked to national

activities. Through the coordination of national initiatives in Italy, France, Germany, Austria and Belgium, the project built a federation of initiatives, developed transnational access, use cases of networks working to implement FAIR data practices and a training platform.

Currently, GARR coordinates the Skills4EOSC project, "Skills for the European Open Science Commons: Creating a Training Ecosystem for Open and FAIR Science" (2022-2025).

Specifically, what is GARR doing to support the Italian research community in the implementation of Open Science?

As mentioned, GARR is representing the Italian community in the EOSC Association on behalf

of ICDI. Within ICDI, GARR is coordinating the Italian Competence Centre (ICDI-CC) on Open Science, FAIR, RDM and EOSC. Created in 2020, the ICDI-CC consists of a network of more than 60 national experts that provide training, support and other activities for the Italian community.

The ICDI Competence Centre is one of the key drivers for Open Science in Italy. By pooling the competences available within research institutions, universities and thematic and cross-discipline research infrastructures, the Competence Centre aims to act as a single national reference point for:

- providing support, consultancy and training activities on Open Science, FAIR principles and EOSC.

- fostering the integration of Open Science in the daily practice of different stakeholders, through the acquisition of skills and awareness raising on its positive effects.
- designing and promoting structured training and introducing the new professional figure of the data steward into research institutions.
- promoting the development and dissemination of good practices by making accessible guides, guidelines, standards, training and information resources.

Picture
The Skills4EOSC project team at the Open Science Fair 2023

ICDI-CC activities address a variety of stakeholders, such as those responsible for the governance of research institutions, public and private funding bodies, individual researchers and support staff, including the network of data stewards. The action targets all components of society that can contribute to and benefit from Open Science, the application of FAIR principles and the building of EOSC, such as public administrations, innovative enterprises and citizens.

In this context, the Competence Center regularly organises a series of webinars called ‘Open Science Café’ to discuss Open Science topics with renowned experts in an informal way.

Finally, GARR is also one of the key actors involved in the working group created by the Italian Ministry of University and Research to support the operational phase of the National Open Science Plan.

At this year’s Open Science FAIR you are running a workshop on digital skills for open science, as coordinator of the Skills4EOSC project. Why do we need a focus on skills and what does the project aim to achieve?

Skills4EOSC is a Horizon Europe Infra-EOSC project, co-funded by the European Union and UK Research and Innovation (UKRI), aiming to create a coordination network of Competence Centres in the field of Open Science and FAIR research output management in the EOSC context.

Consisting of 44 partners, the project brings together leading experiences of national, regional, institutional and thematic Open Science and Data Competence Centres from 18 European countries with the goal of unifying the current training landscape into a common and trusted pan-European ecosystem, in order to accelerate the upskilling of European researchers and data professionals in the field of FAIR and Open Data, intensive-data science and Scientific Data Management.

Competence Centres (CCs) are seen as centres of gravity of Open Science and EOSC activities in their countries. These entities can either be established national initiatives (as is the case of ICDI in Italy) or initiatives under establishment or organizations which have the leading or mandated contribution to Open Science activities nationally. CCs offer training and support, empowerment, lifelong learning, professionalisation and resources to a variety of stakeholders, including not only researchers and data stewards, but also funders, decision makers, civil servants, and industry.

Pictures

Left: Skills4EOSC + ICDI poster - Advancing Open Science in Italy

Right: Emma Lazzeri presenting at the Open Science Fair 2023. Credit to Alicia Fatima Gomez-Sanchez.

At this year’s Open Science FAIR in Madrid, we jointly organised a workshop with the PATTERN project and the EOSC Association Task Force on Data Stewardship curricula and career paths. Counting more than 100 attendees, this energetic and dynamic workshop showcased the recent advances in training both from the policy and methods perspective. Skills4EOSC presented its latest results in terms of competence definition and methodology, which respond to the current framework of the European Union on skills definition and career development (the European Research Competence Framework, The Council Conclusions, ERA actions and the European Year of Skills):

- the Skill4EOSC Minimum Viable Skillset (MVS) which draw on established competences frameworks and resources defining the Open Science mission, activities, or outcomes expected of relevant roles. MVS synthesise these, profiling each role as an aid to developing new curricula, career paths and courses.
- The Skills4EOSC FAIR-by-design methodology for learning materials, which describes the production of learning materials based on the backward instructional process that is extended with additional activities focusing on the implementation of the FAIR guiding principles. A general discussion on important aspects of implementation such as granularity, scope, metadata schema, interoperability and publication in relevant repositories is provided together with a step by step six stage workflow and checklists that help implement the FAIR-by-design process.



You are also just back from the EOSC Symposium in Madrid, where the GÉANT community was well represented. What is your main takeaway from the conference?

The EOSC Symposium was highly participated in its 2023 edition, in particular by NRENS which play a leading role in the co-creation of EOSC. As the EOSC is shaping more and more, also from a technical perspective, with the attention now being concentrated around the concept of EOSC-nodes, the GÉANT community is bringing its expertise in the creation of a unique federated environment to support the European and Global research community.

This year, the themes of the Open Science Fair and EOSC Symposium were respectively “Charting the course: reimagining Open Science for next generations” and “Taking EOSC into the Future”. What would you like to see in the future of open science?

Open Science is becoming the norm, and as more and more initiatives are embracing various aspects of Open Science, many researchers are still left behind. GARR’s support goes in the direction of raising awareness and building the skills needed to support the national and European community in the application of Open Science and FAIR principles. I would like to see more researchers involved in the future of open science and of its key events to effectively co-create the EOSC of the Future with and for researchers.

Skills 4 EOSC + ICDI
Advancing Open Science in Italy

- PROVIDE** Supply the ICDI Competence Centre with European-aligned resources, methodologies, and operational tools.
- EMPOWER** Equip the ICDI Competence Centre with the essential skills and competences outlined in Skills4EOSC.
- ENGAGE** Support the ICDI Competence Centre in connecting with national and international communities.
- UPSKILL** Assist the ICDI Competence Centre in enhancing and assisting Italian stakeholders in Open Science implementation.

Co-funded by the European Union, UK Research and Innovation, Supporting EOSC

Skills4EOSC has received funding from the European Union's Horizon Europe Research and Innovation Programme under GA No. 101058527 and from UK Research and Innovation (UKRI) under the UK Government's Horizon Europe funding guarantee, Grant No. 10040140



CONNECT Interview:

Connie Clare, Research Data Alliance

Connie is a former PhD researcher in Developmental Biology at the University of Nottingham in the UK. She was previously the Community Manager at 4TU.ResearchData, an international data repository for science, engineering, and design disciplines. In her current role as Community Development Manager at the RDA, Connie is responsible for managing engagement with the global RDA community and facilitating its growth and development.

Interview by: Silvia Fiore, GÉANT

How did your interest in research data management develop?

It all started in 2019, during my PhD in Developmental Biology at the University of Nottingham. As part of my doctoral studies, funded by the BBSRC, I travelled to the Netherlands to undertake an

internship working with the Data Champions at Delft University of Technology (TU Delft).

I spent three months interviewing researchers and publishing written articles about their motivations to become advocates for good research data management. Before this experience, I did not truly understand what 'research data

management' was in the context of my own research. Planning, collecting, processing, analysing, and preserving data was just a 'means to an end' for me to write my thesis and associated journal publications. I certainly hadn't considered the value of my data or how to make it openly available for reuse by anyone else.

Learning from the Data Champions and Data Stewards at TU Delft made me realise that good research data management is a prerequisite for research integrity and reproducible research, and its importance is increasingly emphasised by funding bodies, governments, and research institutions around the world.

I also realised that education and support for good research data management is not widely available to researchers in many institutions. This ignited my passion to help researchers achieve better research data management and, upon completing my PhD, I embarked on a new career path as a Community Manager with the aim to build communities and collaborations that focus on the creation and reuse of data that is Findable, Accessible, Interoperable and Reusable (FAIR).

What does it mean to build a community?

Community management is the catalyst for open and collaborative team research. It's about providing space and opportunity for multidisciplinary experts to exchange knowledge and work transparently to overcome research data challenges. I believe that community managers are the glue that binds the community, bringing people together to drive progress forward.

My first position at 4TU. ResearchData, an international data repository for science, engineering, and design, involved building an online community from scratch during the COVID-19 pandemic. Building connections and trust in a remote setting proved challenging, however with consistency, resilience, and determination, a small network of data stewards flourished to a vibrant online community of more than 170 researchers and data support professionals.

In my current position at the Research Data Alliance (RDA), I support the growth and development of a 13,000+ member strong community of international data experts. It is truly amazing to witness such a broad and diverse community of volunteers come together to build the social and technical bridges that enable open sharing and re-use of data across technologies, disciplines, and countries to address the grand challenges of society.

In both positions I have been fortunate to have the freedom to be creative and craft my role, which boosts my energy and enthusiasm for my work. From developing high-level strategic management plans to organising community events, my community building tasks and activities are highly varied; I work on many diverse projects with community members, and I love that no two days are the same! .

How is the 'FAIR' research data management landscape evolving to continue to support the increasing and ever-changing needs of researchers?

'Research Data Management', 'Open Data' and the 'FAIR Data Principles' are distinct but related concepts gaining significant traction among the global research data community. Taken together, these concepts emphasise the importance of data stewardship and data sharing, ensuring that data is made available in ways that promote its access and reuse.

In recent years, there has been rapid development and advancement of technical and social solutions to support researchers in making their data FAIR.

The research data landscape has evolved to comprise a myriad of FAIR-enabling digital tools, services, and infrastructures, including persistent identifiers, metadata schemas, standards and ontologies, repositories, registries, and open research commons.

With the ever-expanding array of technical solutions, it becomes increasingly important to provide social solutions for researchers that help to raise awareness, educate, and build capacity among researchers to achieve good research data management, and effective implementation of the FAIR Data Principles.

Aside from the deployment of actionable research data management policies and mandatory data management plans, it is positive to see a growing number of institutions invest in support staff, such as data stewards, data managers, research software engineers, and community managers, who can provide researchers with essential research data management-based skills and competencies to achieve FAIR data.

A final point to note is the hot topic of research assessment reformation which strives to recognise data, software, and other digital objects as 'first class research outputs'. I look forward to what the future holds for research evaluation since it is a key player in driving the culture change towards the adoption of FAIR research data management practice.

You recently attended the Open Science session at TNC23 where you talked about the value of RDA for the community. Can you tell us more about it?

The RDA is a grassroots, community-driven initiative with members from 150 countries that is built on guiding principles of openness, inclusivity, consensus and transparency. Membership is open to all interested individuals who subscribe to the organisation's guiding principles. All meetings are open to members and all outputs are publicly disseminated and available to all.

The RDA is unique in providing a neutral social platform where data experts meet from all corners of the globe to exchange knowledge and best practices on various research data management related topics. And, the diversity of topics is quite astounding as more than 100 community groups - Working Groups, Interest Groups and Communities of Practice - are dedicated to advancing topics related to FAIR data, software and hardware; metadata and technical infrastructure; research data policy, support and education; sustainable development and responsible research; and, disciplinary data. Research Data Alliance pathways created by the RDA's Technical Advisory Board help community members navigate all RDA activities.

Joining the RDA has value for a diversity of stakeholders, including researchers, data supporters, industry professionals, infrastructure providers, librarians, funders, publishers, research performing organisations and regions.

Members gain access to a growing network of international experts with broad experiences, perspectives, and practices relevant to data-driven discovery and innovation. They receive regular updates about the work of the RDA, can participate in groups and biannual Plenary meetings to discuss and debate research data management related topics of interest, and can contribute to the practical development of concrete solutions and deliverables. All members have a voice within the community to provide advice, express their needs, and troubleshoot solutions to data-related challenges.

What are some of the most exciting recent developments in your work with RDA?

This year is the RDA's 10th birthday! To commemorate this important milestone with our member community the RDA Secretariat has organised a year of celebratory events and activities. Each month of 2023, from February to November, is dedicated to a specific theme related to research data management of relevance to the RDA community and, so far, we have scheduled around 50 diverse activities, including webinars, workshops, podcasts, and hybrid Plenary meetings!

I am excited to attend the next RDA 21st Plenary meeting, 'A Festival of Data' as part of International Data Week 2023 which will take place in Salzburg, Austria in October.

As part of the anniversary celebrations, I have had the pleasure of organising a series of community cross-fertilisation workshops in collaboration with my colleague, Kathryn Barker. Together, we run monthly virtual workshops that bring together RDA working groups, interest groups and Communities of Practice with members of the wider research data community to discuss the future of important research data management-related topics.

I'm also proud to be facilitating new working groups supported by Oracle for Research, as part of the RDA's strategic plan to engage the private sector. After considerable planning and preparation, the first working group, 'Mapping the landscape of digital research tools', officially kicked off in April to identify, categorise, and map different types of research tools to the research data lifecycle.

Watch this space! Another facilitated working group will be launched soon and hopefully we will see more of these innovative industry collaborations in the future to support the research community with enablement of FAIR data practices and principles.

My work with the wonderful RDA members and experience of the vibrant community at TNC has highlighted many synergies and areas of collaboration that I hope we can explore together in the near future.

Read more about RDA on <https://www.rd-alliance.org/>. Connie joined an episode of FAIR Data Podcast - listen to it on **Spotify**.



About Roderick

Roderick joined GÉANT just over two years ago and, in addition to DDoS, he also focusses on Cyber Threat Intelligence (CTI). He has a foundation in computer engineering, a Master's degree plus various certifications in Information Security, and 13 years of experience in R&E networks. He enjoys being part of the community, learning and sharing experiences.

NeMo

- the DDoS solution for NRENs

Roderick Mooi is the Senior Information Security Officer at GÉANT and service owner for Distributed Denial of Service (DDoS) Cleansing and Alerting (C&A). CONNECT met with him to talk about the planning process, deployment, and migration to NeMo of the DDoS attack detection and mitigation solution for NRENs.

Interview by Rosanna Norman, GÉANT

Could you summarise NeMo's benefits and how it compares to other DDoS solutions for NRENs?

NeMo has been freely licensed for R&E use which means that NRENs don't need to pay a licence fee. It uses flow data and statistical algorithms to detect anomalies on the network and sends alerts, when anomalies are identified, backed by a powerful analysis interface. In addition, it features its own cleansing engine! NeMo is a holistic, scalable and decentralised DDoS detection and mitigation solution and its propriety mitigation technology provides multiple mitigation options when needed. In addition, ongoing GN project support makes it an appealing and cost-effective alternative to commercial solutions for NRENs.

What are the main challenges that have characterised the NeMo migration?

After 12 months of setup, adding features, tuning and meticulous testing, NeMo was finally declared fit-for-purpose and ready for production in the GÉANT network. The pilot started with three NRENs in July 2023, and to date 12 NRENs have been onboarded. In between we also decommissioned FlowMon DDoS Defender (our previous detection solution). To evaluate the roll out of NeMo we carried out a survey among the first NRENs who completed the migration, and I am pleased to say that we received high scoring and encouraging feedback on the solution's user interface, but most importantly on its detection capabilities and analysis tools as well as the support provided by our teams throughout the process.

One of our main challenges is a shortage of resources. In addition, the actual implementation of the project took longer than expected due to reduced hardware availability in 2022 (network cards in particular). These shortages delayed the real-life deployment with actual hardware even though we could perform a simulated setup and preliminary testing using virtual machines. In addition, NeMo itself wasn't completely ready for adoption outside of DFN – we initially planned a GÉANT implementation for 2023-24, but due to expanding requirements, current DDoS C&A hardware reaching end-of-life, product discontinuation (FlowMon DDoS Defender) and far too expensive commercial alternatives, we expedited our implementation. This meant that, in consultation with the WP8 DDoS project task team, activities needed to be re-prioritised and resources reallocated and carefully managed.

Who manages NeMo?

The GÉANT Security Operation Centre (SOC) is responsible for NeMo's day-to-day operations, it's in fact the first service completely run by our SOC! We can say that NeMo has brought together security and operation teams, they are now working more closely, united by a common goal.

Roderick, can you tell us about NeMo and how it became the standard DDoS software for the GÉANT Project participants?

NeMo was originally developed by DFN-CERT for DFN (the German NREN), to meet the NREN's unique network monitoring and mitigation requirements. NeMo has been deployed on the DFN network for over 12 years. In addition, the regular and continuous development of the solution through the latest iterations of the GÉANT Project, delivered considerable improvements and increased NeMo's suitability for the GN5-1 project participants, and for GÉANT and its NREN members. NeMo was selected to detect and protect, in the event of DDoS attacks, the GÉANT network, related infrastructure and especially NREN uplinks.

Brief history of NeMo

A chat with Eugene A Brin, DFN-CERT



NeMo in the NREN landscape

In recent years, the NREN landscape has experienced notable new challenges specifically on the security front. Traditional commercial analysis and monitoring solutions adopted by GÉANT were becoming prohibitively expensive, prompting GÉANT to re-evaluate its IT security suppliers. In the quest for more cost-effective and efficient alternatives, GÉANT conducted a comprehensive NREN survey, at the end of which NeMo emerged as a compelling option. Following meticulous evaluations, GÉANT made the strategic decision to transition its entire DDoS C&A service to NeMo in 2020.

NRENs within the GÉANT community are very different in their characteristics, in terms of history, organisational maturity, funding and availability of resources. In the context of DDoS prevention, some NRENs have successfully developed capabilities to monitor and mitigate attacks effectively. However, many NRENs face challenges stemming from limited visibility of what happens on their networks, making them more vulnerable to potential threats.

In the context of network monitoring and visibility, NRENs within GÉANT can be categorised into three groups:

- **Low Network Visibility and Limited DDoS Mitigation Abilities:** NRENs in this category grapple with both limited network visibility and a reduced capacity for DDoS mitigation.
- **Moderate Visibility or Intermediate Mitigation Abilities:** some NRENs fall into this intermediate category.
- **Robust Visibility and Effective Mitigation Ability:** NRENs in this category boast robust network visibility and effective DDoS mitigation capabilities. However, they are occasionally constrained by financial considerations, as they often rely on commercial, sometimes pay-as-you-go DDoS mitigation service providers.

Evolution of NeMo

Since its inception, NeMo's development was driven by the motivation to address the unique requirements of NRENs. The field was largely dominated by commercial solutions, but none was tailored to meet the specific needs of NRENs. The origins of NeMo trace back to over ten years ago, when under the leadership of Jochen Schönfelder, the DFN-CERT R&D team, invested several person-years on the project. As a co-lead of the security tooling within WP8 in GN5-1 Jochen currently is also advancing SOC's analytics capabilities with NeMo – which is another direction the software is evolving towards.



While NeMo's journey is marked by its creators' intrinsic motivation to cater for the unique requirements of NRENs, its academic-driven development approach is reflected in the well-researched design of algorithms, efficient software implementations, and the strategic selection of mitigation techniques suited to various situations. Due to its efficient design, NeMo is suited to NRENs and academic networks of all three maturity groups.

From Detection to Auto-Mitigation

In the past five years, particularly during GN4-3, the focus for GÉANT has been the creation of visibility and analytics capabilities. As we transitioned into GN5-1, our focus was dominated by detection, however that soon expanded to encompass the complexities of mitigation.

Mitigation, as the final phase in an effective response to DDoS attacks, bears additional complexity as it hinges on intricate hardware dependencies and demands seamless integration into the network's core. Consequently, deployment of mitigation capabilities necessitates delicate fine-tuning, tailored to the unique network configuration and deployed hardware.

Today, we're venturing into the field of auto-mitigation, reflecting our unwavering commitment to address the ever-changing requirements of NRENs.

About Eugene

Eugene, a senior software engineer with the R&D unit of DFN-CERT, has been leading NeMo project's software development in recent years. Currently, he co-leads the DDoS activity for GN5-1 in WP8, while his active involvement on Security within the GÉANT Project dates back to GN4-3. Eugene's passion is learning and sharing experiences with the community on the topics of Software Architecture & Development, IT Security and Decentralised Systems.

Quantum Communications – The Next Generation of Networking Technologies?

Quantum computing has long been considered to be the next revolution in computing. Quantum computers will, it is claimed, be able to solve complex problems that would take existing supercomputers weeks or months to complete, in a matter of seconds. Alas, up until now, the largest quantum computer has reached only 433 qubits and these computers use massively more power than “traditional” computers yet cannot solve many real-world problems as fast as, let alone faster than, existing computer systems.. The era of easy-to-use, cost-effective quantum computing is still in the future.

Words: Karl Meyer, GÉANT

However, quantum technologies are already being used in other fields and one of the most interesting and exciting opportunities is the field of quantum networking and in particular Quantum Key Distribution (QKD).

QKD actually uses one of the characteristics of quantum fields that make quantum computers so difficult to build as a core element of its design. The sensitivity of photons to interference helps give QKD its advantage.

QKD is a mechanism to send keys – usually encryption keys – across networks in a way that is both highly secure and also impossible to intercept and this is extremely important when systems are using symmetric encryption keys. In symmetric encryption the same key is used to both encrypt

and decrypt the data being sent. This is unlike asymmetric key encryption which uses one key to encrypt data and another to decrypt it.

Asymmetric keys are the bedrock of virtually every transaction across the internet. From securing WhatsApp messages so that only the receiver can view them, to encrypting your bank details as they pass from your bank to your phone, asymmetric keys are working hard to keep your data private.

However, they are working very, very hard. Asymmetric encryption and particularly decryption is very processor intensive and consumes a lot of power and takes a lot (relatively) of time. For a credit card number or text message this processing power is trivial, but

for massive files or time sensitive data (live streaming for example, or data from radio telescopes) this increased processor power and time comes at a substantial cost. Symmetric encryption (where the same key is used) is by comparison much easier, quicker and therefore cheaper. However, the problem comes from the need to share these keys.

With asymmetric keys you can send your encryption key in plain text to the other party and, as long as you keep the decryption key safe, it will be virtually impossible for an eavesdropper to view the encrypted data. But if the eavesdropper is able to intercept a symmetric key, then they will be able to view all the data you are encrypting with it with impunity.

QKD – Private and Tamperproof

This is where QKD comes into its own. QKD uses the quantum states of individual photons to transfer information about the key between the two parties. It relies on these sensitive states to be unchanged and, most importantly, un-examined between the sender and the receiver. If an eavesdropper attempts to intercept these photons, then the very process of intercepting them will change their quantum state and the two parties will be able to identify that interception has taken place. QKD is in this way similar to the ancient wax seals placed on letters to ensure no-one has opened and read them in transit. Looking at the contents damages the letter, and the receiver knows that someone has read the message.

QKD therefore provides a way to share information between two parties and they can be confident that no-one has intercepted it.

However, most fibre optic communication networks – particularly inter-city or international – rely on repeater stations between the sending and receiving nodes to take in the signal and reboost it. This is because fibre optics are never perfect, and signals are attenuated as a result of travelling through the fibre optic. These intermediate repeaters are Raman Amplifiers which take in the weakened signal and boost it back up before transmitting across the next leg of the journey. Unfortunately, these amplifiers destroy the quantum coherence of the signal and so stop QKD working. The amplifiers act exactly like eavesdroppers would and so the key transfer system breaks down.

The only way to avoid this issue is to either restrict connections to those paths which can be managed without repeater devices or to implement trusted nodes at these intermediary points. These trusted nodes essentially act like Victorian

era telegraph operators, taking in the message from one circuit, copying it down, then passing it on to the next in line. This is of course a major security issue with the use of QKD across many nodes as it would be difficult, if not prohibitively expensive, to implement. Although lab tests have demonstrated QKD transfers over up to 600km of fibre, in the real-world 10-20km has been the practical limit.

For this reason, the majority of QKD implementations so far have been within metro areas and have been implemented for government and financial institutions.

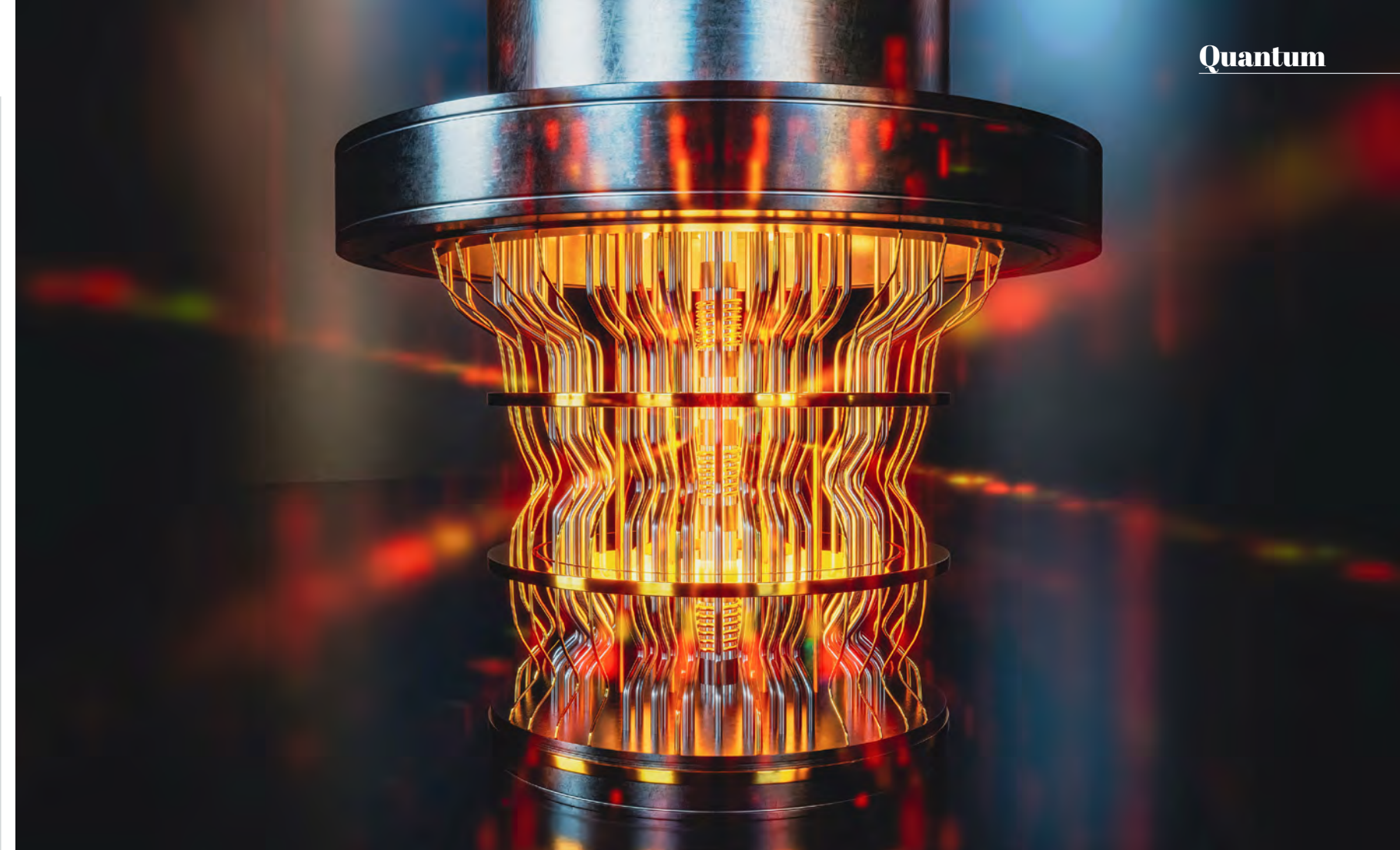
QKD and the GÉANT Community

The GN5-1 project has given the GÉANT community a unique opportunity to investigate how QKD can be used outside the metro areas and if it would be extendable to a pan-NREN and pan European environment.

The newly created dark fibre services across Europe provide GÉANT with direct access to high quality fibre optics with low noise, low attenuation, and known routing and technology end-to-end. As a result, GÉANT was able to undertake a study of the network documentation before having to undertake field tests and installing on-site equipment.

These tests have been highly successful over connections up to nearly 600km and the full results will be published shortly.

One major advantage of this work has been the ability to test the quality of the network infrastructure which will enable other technologies and techniques to be used in fields such as time and frequency services and ultra-high-performance networking.



Picture
Piotr
Rydlichowski,
PSNC,
Pioneer-Q
Coordinator



The Future of Cybersecurity:

and the Role of NRENs in building National Quantum Communication Infrastructure, enabling robust European Quantum Communications

Words: Dr. Ilias Papastamatiou, GRNET and Piotr Rydlichowski, PSNC

With the European Quantum Communication Infrastructure (EuroQCI) Initiative, the EU is creating a pan-European network of quantum communication infrastructures. The EuroQCI will safeguard sensitive data and critical infrastructures by integrating quantum-based systems and technologies into existing communication infrastructures, providing an additional security layer based on quantum physics. It will reinforce the protection of Europe's governmental institutions, their data centres, hospitals, energy grids, and more, becoming one of the main pillars of the EU's Cybersecurity Strategy for the coming decades.

The EuroQCI initiative is also linked with the European Quantum Computing & Simulation Infrastructure (EuroQCS) initiative and the European quantum sensing and metrology (EuroQSM) initiative, that focus on quantum computing and quantum simulation and measurement infrastructures. This combined system of EuroQCI, EuroQCS and EuroQSM research infrastructures will provide a comprehensive environment for quantum technologies development and integration.

This will be achieved by incorporating systems and technologies based on the principles of quantum technology, by the distribution of quantum keys (QKD) to existing communication infrastructures, which will offer an exceptionally secure form of encryption, offering an extra layer of security. Quantum encryption systems offer state-of-the-art security, as far as data protection is concerned, by using QKD technology.

EuroQCI, which will be composed of a terrestrial segment relying on fibre communication networks linking strategic sites at national and cross-border level, and a space segment based on satellites. It will be an integral part of IRIS², the new EU space-based secure communication system. EuroQCI will thus contribute to European digital sovereignty and industrial competitiveness and help to meet Europe's Digital Decade target of being at the cutting edge of quantum capabilities by 2030.

At TNC23, Dr. Ilias Papastamatiou from GRNET, Greece's NREN and coordinator of the HellasQCI project (Greece's National Quantum Communication Infrastructure (QCI) project) and Piotr Rydlichowski from PSNC,

Poland's NREN and coordinator of the PIONIER-Q project (Poland's National QCI project), participated at the "Quantum: beyond the crypto techbros session", and presented the "Quantum Internet Activities in European NRENs"

NREN Collaboration at the Heart of the EuroQCI: HellasQCI, PIONIER-Q and Beyond

The presentation and the fruitful discussions that followed demonstrated the advantages of the NRENs collaboration in this new and evolving domain of quantum communication technologies. GÉANT's NREN community through its long standing collaboration, the GN5-1 project, and the GÉANT Quantum Strategy Group concretely facilitate the cooperation and the synergies between numerous NRENs that coordinate and participate in their national efforts to build their National Quantum Communication Infrastructures (NatQCIs) such as GRNET (Greece, HellasQCI), PSNC (Poland, PIONIER-Q), HEANET (Ireland, IrelandQCI), CARNET (Croatia, CroQCI), RoEduNet (Romania, RoNaQCI), CESNET (Czechia, CZQCI), SURF (The Netherlands, QCINed), BELNET (Belgium, BE-QCI), Cyprus (CYNET, CYQCI), KIFU (Hungary, QCIHungary) and other NRENs that participate indirectly at their National QCIs as partners. The exchange of expertise and the collaboration of the NRENs are essential for creating a secure and operational EuroQCI. In the next two sections we describe examples for QCI proposals and activities from GRNET and PSNC.



HellasQCI Description.

GRNET S.A. - The National Infrastructures for Research and Technology, operating under the auspices of the Greek Ministry of Digital Governance, is the coordinator of the HellasQCI project. HellasQCI aims to deploy advanced National Quantum Communication systems and networks in Greece.

Its architecture comprises of three metropolitan test sites located at major cities of Greece namely: HellasQCI-Central (Athens), HellasQCI-North (Thessaloniki) and HellasQCI-South (Heraklion-Crete). Each test-site is divided into Governmental and Industrial testbeds, which allow the project to investigate the field deployment of QKD technologies in a plethora

of realistic scenarios and use cases addressing National Security, Public Health, Critical Infrastructures, and ICT sector. An additional Educational testbed will allow the development of new quantum technologies, enhance SME innovation, and offer Greece a futureproof pathway towards Quantum Internet. It will also serve as a comprehensive training environment for technical, research staff, and end users.

For inter-test-site links and international connection with other EuroQCI members, HellasQCI will exploit three Greek Observatories, which constitute national assets and have been selected by ESA to be upgraded as Optical Ground Stations with QKD capabilities. The HellasQCI consortium involves key research institutes and universities of Greece, which are

able to address the needs for an operational HellasQCI infrastructure. HellasQCI cooperates with other EU Member States in order to boost Europe's scientific and technological capabilities in cybersecurity and quantum technologies, and to this end, it has already partnered with several NRENs and countries such as Poland, Ireland, Austria, Luxembourg, Malta, Bulgaria, Romania and Cyprus.

HellasQCI will provide a holistic training environment for technical, research and end-user staff in order for the country to be ready for the operational phase of the EuroQCI. In addition, among the project's aims, HellasQCI will establish a national quantum ecosystem from all relevant stakeholders that can benefit and support the HellasQCI networks, gather expertise and share knowhow on quantum

communication technologies that can be applied in practical and sustainable use cases. This national quantum ecosystem will ensure the better participation of the country to the EuroQCI initiative and facilitate the future expansions of the HellasQCI networks into more end-users.

PIONIER-Q Description

The PIONIER-Q project is a QCI proposal prepared by the Polish community and is coordinated by PSNC. The partners of PIONIER-Q are all HPC centres in Poland that are also part of the PIONIER consortium of Polish National Research and Education Network. The main goal of the project is to:

- build the QCI network based on PIONIER network infrastructure and services
- implement a number of use cases and scenarios
- provide research platform for the community
- organise training and workshops
- cooperate with other QCI projects
- integrate with EuroQCS-Poland project infrastructure.

PIONIER-Q will use existing QKD infrastructure that was implemented by PSNC under the OPENQKD project and NLPQT project (National Laboratory for Photonics and Quantum Technologies) where PSNC established local, metro QKD infrastructure in POMZAN network and long-distance Poznan - Warsaw QKD link of 380km (5 trusted nodes).

PIONIER-Q aims to connect not only QCI and Quantum Computing activities but also reference time and frequency transmission system that uses optical carrier technology and are developed under the NLPQT project.

Proposed PIONIER-Q use cases connect various applications and services from the public sector to achieve synergy in terms of infrastructure security. HPC centres that are part of the PIONIER-Q consortium have a wide range of different existing services and in a natural way can provide multiple scenarios not only for EuroQCI infrastructure but also EuroQCS infrastructure. The whole EuroQc and EuroQCS infrastructure will be managed, operated and monitored by PSNC using its existing infrastructure and also by specially developed tools and services.



Picture
Top left:
Dr. Ilias
Papastamatiou,
GRNET,
HellasQCI
Coordinator

“It is a great honour that the Ministry of Digital Governance entrusted GRNET to coordinate the HellasQCI project to build the National Quantum Communication Infrastructure of Greece. This important project will pave the way for upgrading the cybersecurity of network communications both at National and European level. The creation of this quantum infrastructure, combined with other initiatives will create a secure network for ground and satellite communications, ensuring the highest possible level of security in all government and private sector communications. GRNET has a major role in all European cloud/ service infrastructures such as EOSC, EUDAT, EGI, GÉANT, PRACE and EuroHPC and we are proud to implement this new quantum communication infrastructure. The project started in January 2023, and has already demonstrated the exchange of the highest level of expertise and collaboration amongst the National Partners, European NRENs community and GÉANT, in order to create a secure and operational EuroQCI”.

GRNET's CEO Dr. Aristeidis Sotiropoulos

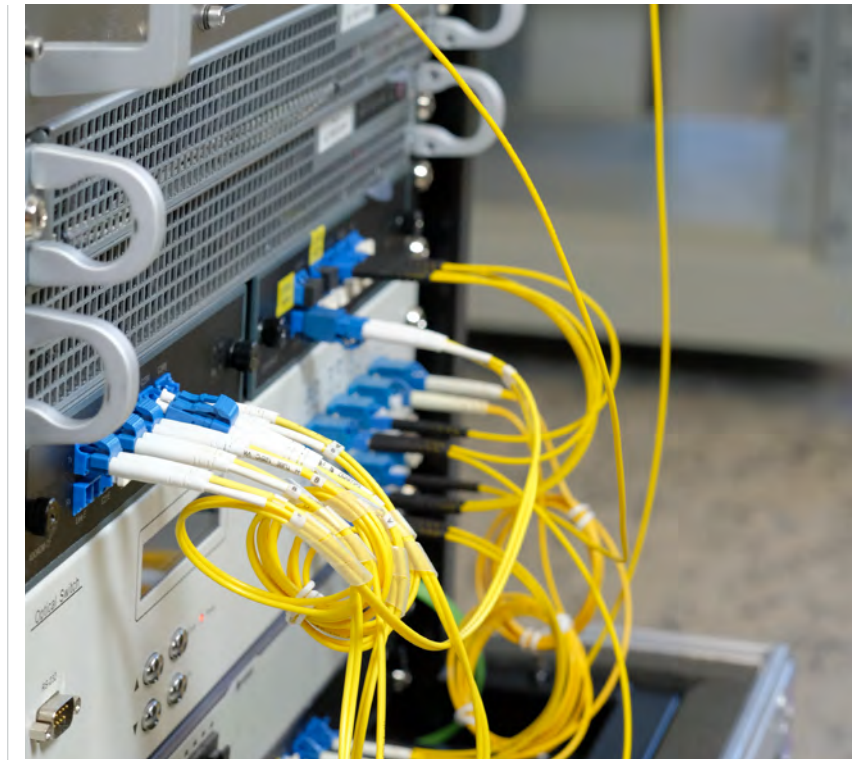
Network integration of Quantum key distribution

Quantum key distribution (QKD) has emerged as a viable and robust option for enhancing the security of optical network infrastructure. From the network-design point of view, a key distribution service has to adapt to the requirements of the network rather than impose restrictions. QKD should be operated as a communication add-on to mirror the role of security in communication and be, in this sense, seamlessly integrable in pre-existing communication environments.

Words: Hans Brunner, Principal Research Engineer, Optical & Quantum Laboratory, Munich Research Center, Huawei

The advantages of continuous-variable QKD (CV-QKD) can be exploited to ease the integration of QKD in metropolitan-area telecommunication networks. This technology provides more flexibility compared to other QKD classes and has an inherently higher tolerance to other signals on the same fibre. Flexible QKD devices should allow at least a standardised and changeable configuration of the wavelength and peer to break the inseparable/atomic QKD links (sender-receiver pairs, which are locked to each other).

The Munich Research Center of Huawei has developed compact CV-QKD prototypes with several key features for facilitating network integration. Among these features are the coverage of typical metro link losses with automatic adaptation to the channel conditions as well as in-channel synchronisation, which reduces the spectral needs to a single dense-wavelength-division-multiplexing (DWDM) channel. In many situations, this fully C-band tunable channel can simply be connected to a free multiplexer port of an existing and populated DWDM infrastructure. Any-to-any connectivity between many QKD transmitters and receivers can reduce the number of devices needed, while dynamic protocol switching allows to address different security requirements and cryptographic tasks.



These prototypes and their network features were demonstrated in operational environments in the Madrid quantum testbed. 36 different, loop-free QKD links could be established in a network with only five QKD senders and five QKD receivers by interconnecting the modules through reconfigurable optical add-drop multiplexers. The QKD modules could be connected to existing optical-transport-network links of different vendors without any downtime or disruption of the previously installed traffic. Integration with key stores and hardware encryptors was successfully tested. Specific cryptographic protocols

could be activated for tests with oblivious transfer and secure multiparty computation.

The urgency of quantum resilience and the maturity of QKD create demand for devices that adhere to the needs of network providers and simplify network integration.

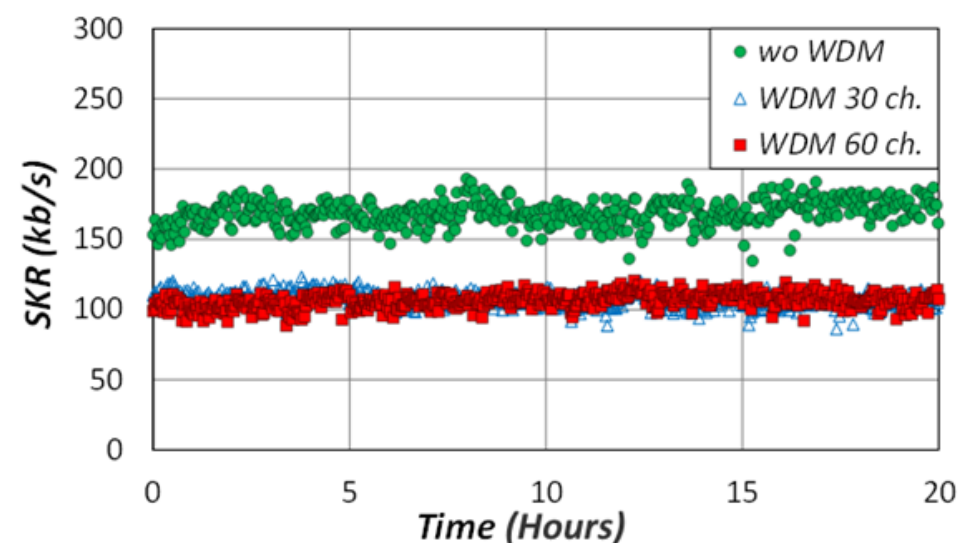


TOSHIBA

Quantum Key Distribution deployment practicalities in today's networks

Quantum Key Distribution (QKD) provides provably secure protection against attacks by quantum computers on current public key encryption protocols and infrastructures. QKD is being increasingly deployed globally and there are some important considerations for practical QKD deployment in today's fibre networks.

Words: Lee Johnson, Toshiba Lee Johnson, Business Development Manager, Toshiba Europe Limited



High optical loss budgets and high Secret Key Rates (SKR)

QKD systems should provide high optical loss budgets to enable design and deployment flexibility and to also mitigate against future potential fibre degradation. High Secret Key Rates (SKRs) are also important, to allow frequent key rotation and to service multiple users with a range of diverse use cases. Toshiba designed their QKD systems to be practically deployable in today's fibre networks, they have loss budgets (up to 30 dB) and high Secret Key Rates (300 kbit/s at 10 dB loss).

Quantum and Classical data co-existence

QKD should also integrate with existing deployed fibres and DWDM data services - it is important that the QKD service can co-exist with the large number of DWDM data channels and the high optical launch powers that exist on today's networks. Toshiba's multiplexed QKD system transmits the quantum information at 1310 nm, multiplexing this with classical C band DWDM data channels.

Researchers at Orange demonstrated effective co-propagation of classical and quantum signals with high secret bit rates using the Toshiba multiplexed QKD system. The research showed that 60 DWDM data channels in the C band co-propagated well with the QKD quantum channel in the O band and that the QKD system could accommodate high optical launch powers of ~17 dBm, (graph bottom left).

The research found that the high number of WDM channels used had a minimal impact upon SKR. Instead, it was found that the aggregated data channel optical launch power used was the most influential factor on the SKR. As a result, the researchers proposed a new metric – Co-propagation Efficiency (CE) – which can estimate the performance of the QKD system (its ability to deliver secure keys successfully with a good SKR) in a co-propagation regime while considering the total power of the classical channels and the transmission distances.

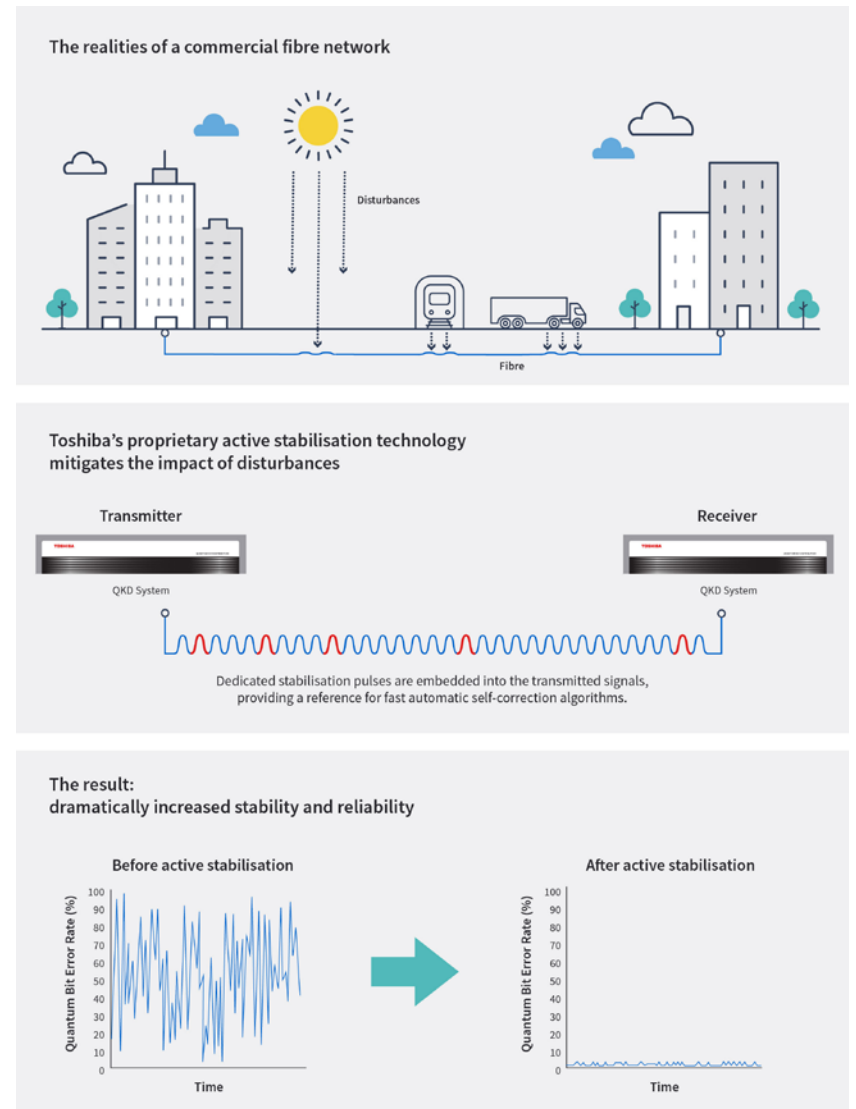
The full research paper can be read here <https://arxiv.org/abs/2305.13742>

Active stabilisation for optimal operation

Toshiba QKD systems use active stabilisation technology, whereby dedicated stabilisation pulses are embedded in the encoding pattern. These references enable continual real-time feedback algorithms to automatically correct the polarisation, timing and phase of light, minimising the error rate, (graphic top right).

Toshiba recently collaborated with the Czech Technical University in Prague and the Czech national railway operator - České dráhy to study the potential of using trackside fibre for quantum-safe communication networks.

The University procured use of a 46 km length of trackside fibre, running within 5 metres of a main railway line. The fibre experienced significant vibrations and mechanical noise due to a high volume of railway traffic on the line.



These mechanical vibrations and thermal fluctuations can affect various properties of propagating light, such as polarisation, phase and timing delays, subsequently reducing performance and increasing error rates in QKD.

Toshiba supplied a multiplexed QKD system which was first set up in the laboratory to obtain baseline performance data, then moved it to the railway sites.

Throughout the entire deployment the QKD performance was excellent. The system generated quantum keys at a secure bit rate of 112 kbps over a distance of 46 km, (quantum channel loss >15 dB) with a quantum bit error rate (QBER) of $3.90\% \pm 0.41\%$, only marginally higher than the lab results.

This is a promising indicator of how QKD can practically bring quantum-security to critical infrastructure communications, while also highlighting the opportunities for using trackside fibre in future quantum communication networks.

For more information about Toshiba Quantum Technology please visit <https://www.toshiba.eu/quantum/>



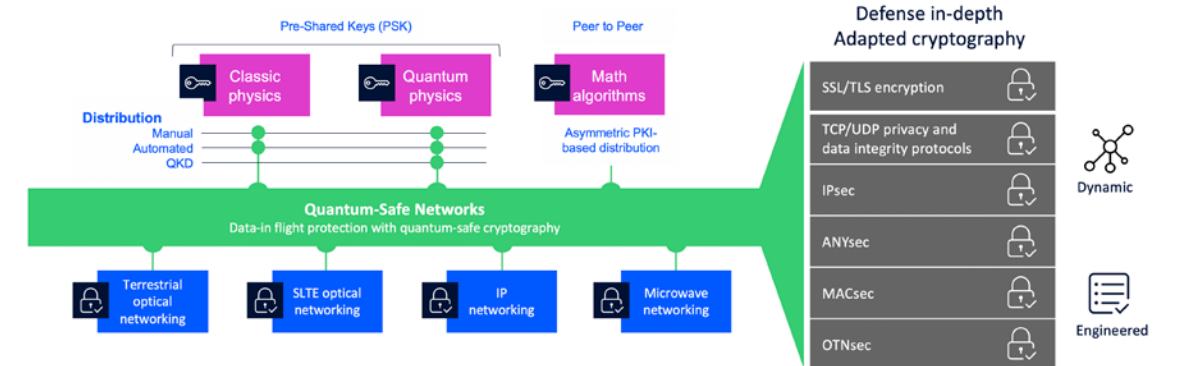
Keeping the network secure along the quantum path

Network engineers are watching the downside of quantum computer development: emergence of a cryptographically relevant quantum computer (CRQC). Theorised for years, a CRQC renders widely used asymmetric cryptography useless. Among the fears is the ability for a bad-state actor to decipher previously stored encrypted data in a harvest now-decrypt later (HNDL) attack. This realisation caused the US NIST to change recommendations for handling sensitive data and triggered the European Union to establish the EuroQCI initiative.

Words: Chris Janson, Nokia

Quantum-Safe Networks

Multi-domain transport solution for data in-flight protection



1 © 2023 Nokia

Protecting data in the quantum age is not a simple matter of installing an appliance or upgrading software. It requires a review of the total network infrastructure and planned adoption of new security technologies. Decision makers should immediately evaluate and prioritise which portions of their networks are most at risk and implement countermeasures to assure that today's data is staying secure from later unauthorised decryption while also ensuring protection into the future.

Proven ciphers like symmetric classic key distribution stand alongside novel concepts such as quantum key distribution (QKD) and post-quantum cryptography (PQC). It is easy to confuse these solutions and assume that one has a place over the other. It's best to view each as having a role to play over the coming years. QKD is a fascinating way to use quantum mechanics to ensure absolute randomness and intrusion detection. Yet there are many challenges in its implementation, and it will not cover every network situation. Similarly, PQC, using mathematics-based algorithms and asymmetric key distribution, promises to meet security needs of dynamic connections at

higher layers. But PQC also has time consuming issues to work through in standardisation, product development and certification.

Nokia believes the Quantum-Safe Network is evolutive. Utilising classic physics based pre-shared keys, distributed through manual or automated means provides quantum-safe protection against HNDL attack now. QKD and PQC are capabilities which can be added to a classic physics-based infrastructure, creating a highly resilient, flexible hybrid architecture. Connectivity at any layer can be protected today and kept safe from CRQC attack into the future.

Earlier in 2023, Greece's NREN GRNET engaged with Nokia in a proof-of-concept trial for components of the HellasQCI Project; a QKD architecture, based on the objectives of EuroQCI. GRNET operates under the Ministry of Digital Governance, providing networking, cloud computing, HPC, and e-Infrastructures. It connects more than 150 organisations across 50 cities and serves hundreds of thousands of users daily in Public Administration, Education, Research, Health and Culture. HellasQCI will ensure quantum-safe connectivity for critical infrastructures.

HellasQCI will build on three metropolitan test sites, using both terrestrial fibre links and satellite links in the QKD architecture. This terrestrial and space approach both minimises cost and mitigates fibre distance limitations of QKD. Also, HellasQCI will evaluate quantum key distribution technologies, including continuous and discrete variable (CV-QKD and DV-QKD) and single photon entanglement. These deployments will support the maturity of QKD into future applications.

In time, HellasQCI will become a global model for the evolutive quantum-safe blueprint for secure connectivity among diverse users and domains.

Learn more about Quantum-Safe Networks and Nokia's evolutive blueprints in this [white paper](#).

NOKIA



Towards an ultra-secure communication network for the EU

Secure communication over the Internet depends on the use of asymmetric cryptography. Much like multiplying two numbers ($61 \times 89 = 5,429$) is exponentially easier than prime factorisation (5,429 is the product of which two prime numbers?), asymmetric encryption is easy to perform but seems fiendishly hard to reverse without knowing the right key.

Words: Prof. André Xuereb, Merquy Cybersecurity Limited

However, this difficulty is a mirage. Sufficiently sophisticated quantum computers are known to have the capability to efficiently decrypt algorithms such as the ubiquitous RSA² or elliptic curve cryptography. Disconcertingly, the “intercept now, decrypt later”³ attack means that data transmitted today is vulnerable, even though no such computer exists yet. Quantum key distribution (QKD)⁴ was developed to counter this threat by exploiting the laws of the universe to create information theoretically secure communication links. The need to adopt this technology is apparent and urgent.

In 2019, the EU launched the European Quantum Communication Infrastructure⁵ (EuroQCI) initiative, which aims at creating a continent-

wide ultra-secure communication network built on QKD². Several EuroQCI projects⁶ are currently in progress to help demonstrate the feasibility of this vision.

The Maltese project Physical Security for Public Infrastructure in Malta⁷ (PRISM), in which we⁸ participate, is building a country wide QKD network for servicing the public sector.

PRISM is deploying technology that can retrofit QKD into existing communication networks without requiring any software updates, and which goes beyond point-to-point QKD links. This advance is key to creating a new generation of communication networks that are resilient to this unprecedented class of cybersecurity threat.

PRISM is co-funded by the European Union under the Digital Europe Programme grant agreement number 101111875. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Picture

A recent public demonstration of a quantum-encrypted video call using PRISM-developed technology.¹

¹ <https://www.um.edu.mt/newspoint/news/2023/05/public-demonstration-quantum-encrypted-video>

² <https://doi.org/10.1145/359340.359342>

³ <https://dx.doi.org/10.2760/180945>

⁴ <https://dx.doi.org/10.2760/38407>

⁵ <https://digital-strategy.ec.europa.eu/en/news/future-quantum-eu-countries-plan-ultra-secure-communication-network>

⁶ <https://petrus-euroqci.eu/national-euroqci/>

⁷ <https://prism-euroqci.eu/>

⁸ <https://merquy.eu/>

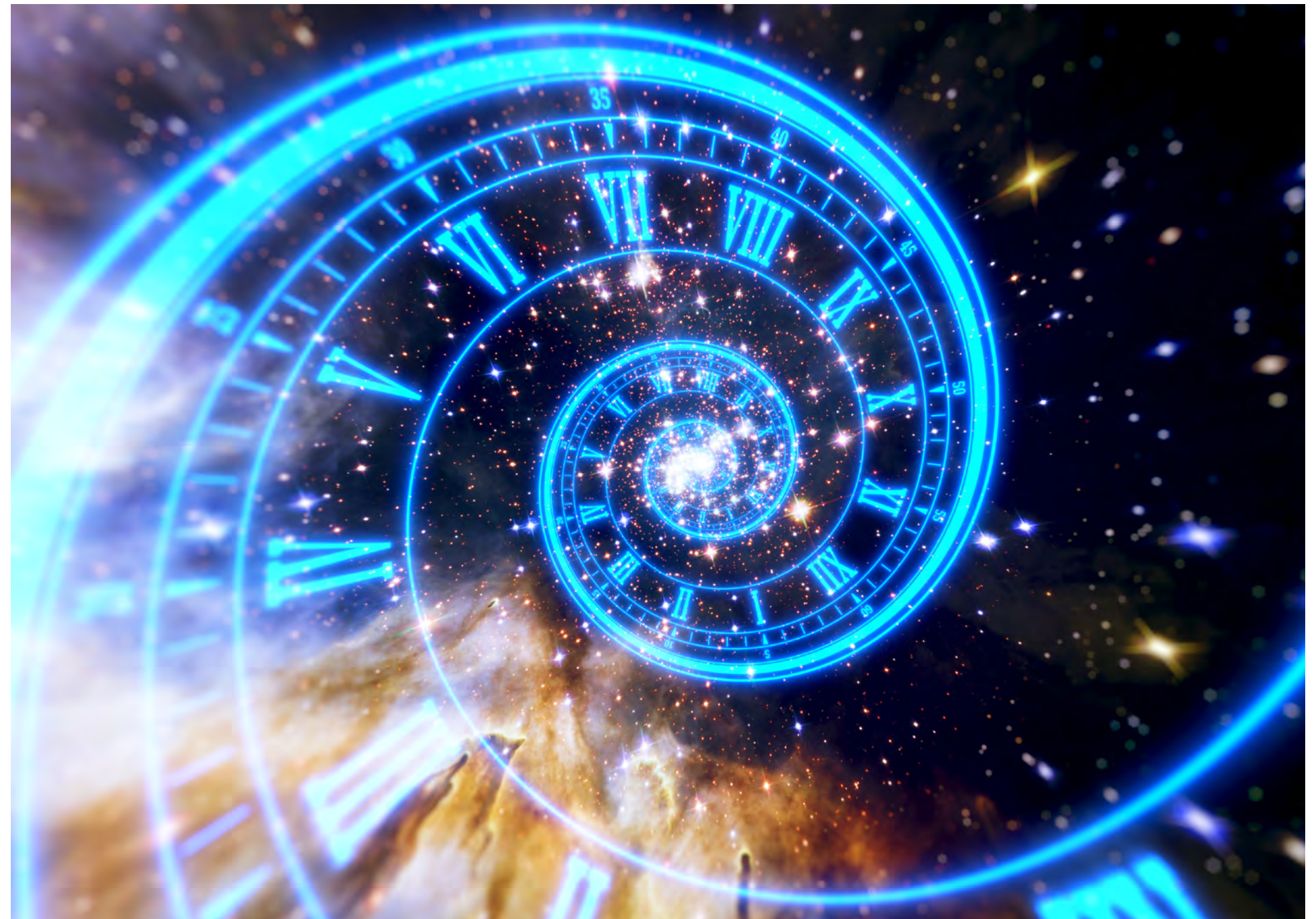
What time is it and why is it important?

One of the most consistent themes across human civilisation has been our need and ability to tell the time with increasing accuracy. Knowing the time has been crucial in our ability to organise into communities and even navigate the world. From Harrison's timepieces in the 18th century that helped sailors navigate the globe to today's GPS in our phones that help us find a coffee shop, time is what helps us know where we are and what is happening around us.

Words: Karl Meyer, GÉANT

Today, Time and Frequency (T&F) services are critical to many civil and industrial sectors, both directly and indirectly, including telecommunications, geo-positioning (including autonomous vehicles), energy, finance, and advanced scientific use cases. Access to precise time and frequency signals is, therefore, of major interest to industry, research, and the economy worldwide. For example, distributed radio telescopes and gravitational wave sensors need to be able to cross-reference their data and for this accurate timing is essential.

In the past few years, National Metrology Institutes (NMIs) have successfully developed and tested new T&F techniques using optical fibres which have shown a stability performance of at least three orders of magnitude better than the current best commercial services. Moreover, such techniques offer an alternative to Global Navigation Satellite System (GNSS) for end-users who cannot rely on broadcast signals due to, for example, security concerns such as GPS spoofing attacks or reception issues if they are located in an underground laboratory. Further, new T&F services have the potential to respond effectively to the challenges of tomorrow.



These new services generated by NMIs and based on optical fibre transfer (often referred to as metrological T&F services) have emerged in response to a worldwide challenge driven mainly by research institutes that wanted to improve their physical experiments using metrological signals. Early projects and proof of concept deployments were nationally funded, and succeeded in implementing the first optical links, with each country experimenting

with its own design but, so far, there is no common standardisation throughout Europe, and as a result many different deployment techniques remain in use.

It is also important to consider how metrological services can co-exist in standard telecommunication networks, one challenge being whether it is possible to run T&F and data services over the same fibres. Such approaches can potentially be invaluable to allow distant end-users to be more readily connected to the NMI (or institution) generating the service.

Close collaborations of NRENs have succeeded in the development of national and international testbeds and pilot services. Progress towards building an ecosystem, business modelling, regulation, standardisation and exploitation has been studied in projects such as CLONETS-DS in which GÉANT is both a coordinator and contributor.

In order to help coordinate the work that many GÉANT Community members are contributing, the GÉANT project is working on catalysing the emergence of metrological networks in Europe, and to document their experiences on the range of techniques and technologies in use.

To find out more about this work visit <https://www.clonets.eu/clonets-project.html>



Digital Research Infrastructure: Promises and Possibilities

The promises of strong research infrastructures are widely recognised, including how it can help developing nations gain equality in research and enable minority groups to connect and find a voice. While that is true and indeed wonderful, the potential of research infrastructure never exceeds the people realising that potential and the ecosystem within which it sits.

Words: Jakob Feldtfos Christensen and Lachlan Smith, DIVERSlunity



DIVERSlUNITY

Research never happens in a vacuum. Institutions are part of national cultures, and researchers are human with biases and stereotypes. Any promises and possibilities depend on human beings – and the moment you bring them into the equation, things can get messy. But we shouldn't give up; we simply need an honest narrative.

However, the abstract nature of digital research infrastructures makes it easy to buy into the naïve idea of a shared global research culture. But the moment we buy into that, we forget that LGBTQ+ people, like us, and other minority groups cannot necessarily travel all over the globe without a significant element of personal risk.



And that is a promise of digital infrastructures: that we can collaborate without going to places where we may face that risk. Minority communities can find other community members worldwide and create research collaborations. But, as social media has shown us, this is a double-edged sword as the platforms building communities are also the platforms of hate speech, shaming and persecution. What was meant to connect us – isolated us. We don't want that to be the consequence of digital research infrastructure.

And we all know that decisions are often made by those in the room, those who get to connect and network face-to-face, and those who are at the dinners and get a drink in the bar afterwards. Digitalisation risks creating an illusion of possibilities and equality on the surface, but ultimately, it becomes a tool to maintain the status quo.

And so, digital research infrastructures must be seen in a complex frame of power dynamics, incentives, values, and culture. New digital infrastructures can switch up the power dynamics at the core of the research ecosystem. And while most of us consider that a good thing, some might feel threatened and inclined to maintain the status quo.

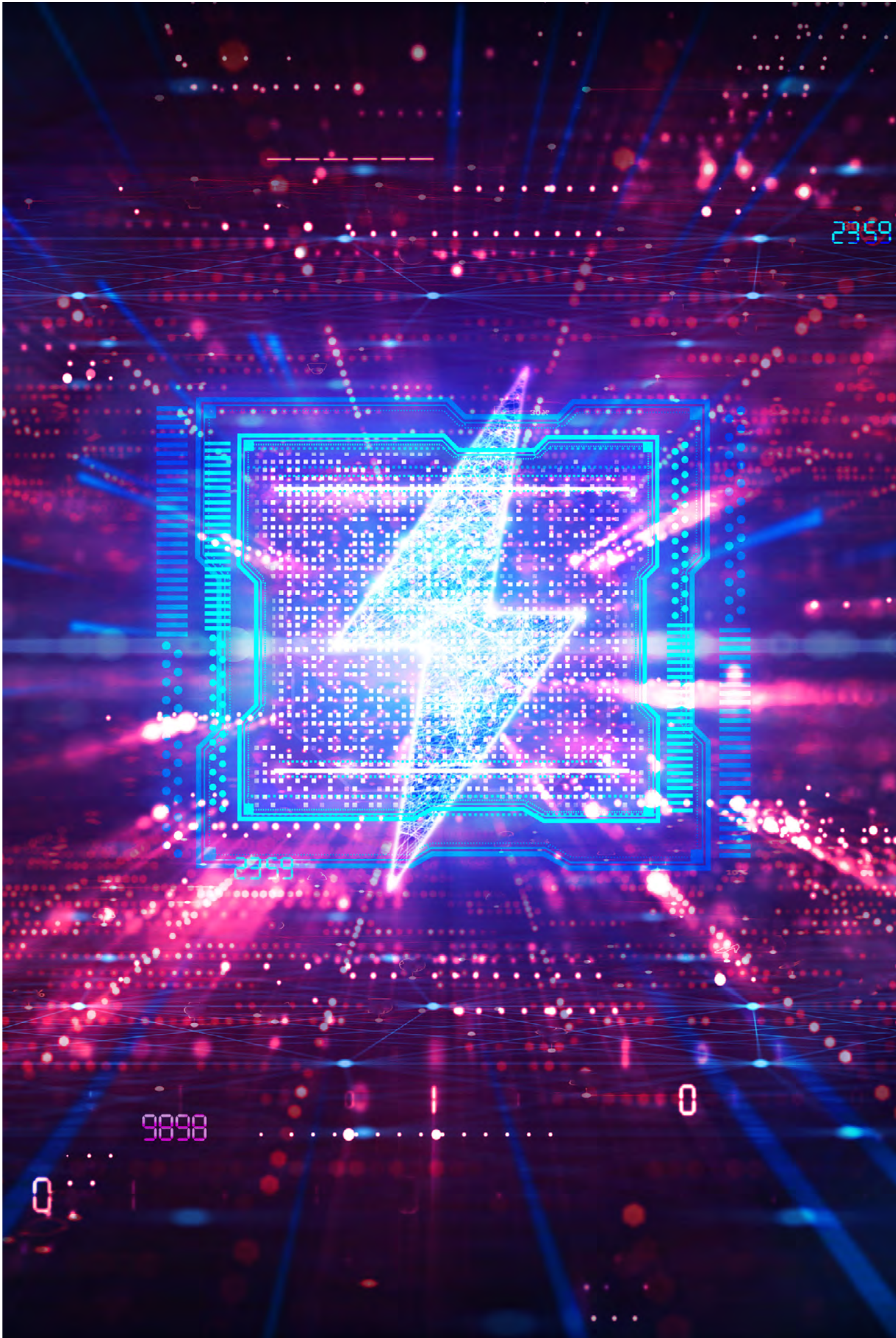


Building the infrastructure and leaving it to everybody else to fulfil the potential is like the researcher publishing an article and insisting that it has led to real-life changes. We talk about paths to impact and impact partners. We may need to do the same regarding the providers of research infrastructure. What is your responsibility? Who will help you? How will you make it work for everybody –not just for those already in power?

Not that you can do it alone. You are part of the research ecosystem, so we must solve it together. Research is more than bits, bytes, data and cables. People do research for the benefit of society. So, let's talk about power dynamics, incentives, values, and cultures for people worldwide in all our diversity.

Jakob Feldtfos Christensen is the director of DIVERSlunity. Lachlan Smith is co-director of Cloud Chamber. Together they host "The Diversity in Research Podcast". Visit their website <https://diversiunity.com/>

Pictures
Lachlan Smith (left) and Jakob Feldtfos Christensen (right)



CONNECT Interview:

Jan Jona Javoršek, Jožef Stefan Institute

Jan Jona Javoršek is head of the Network Infrastructure Centre at the Jožef Stefan Institute in Ljubljana, where he is involved in infrastructure development and advanced computing for research and academia. The Institute is connected to the Slovenian NREN, ARNES, since 1993. Jona was involved in the creation of a national supercomputing network consortium SLING and the building of the national EOSC community, took part in several AI and supercomputing endeavours, and has participated in initiatives and infrastructures such as WLCG, EGI, EuroHPC, EOSC and the establishment of the Slovenian EuroHPC node, Vega EuroHPC.

Interview by: Silvia Fiore, GÉANT

We heard you were behind the 130Gbps data increase from May to September 2022 in one of GÉANT's backbone trunk links between Geneva and Milan and ARNES access ports to GÉANT. Can you tell us what happened and what were you working on?

In April, **Vega EuroHPC**, the new Slovenian national supercomputer and also the first EuroHPC peta-scale supercomputer, was deployed at **IZUM**, the Institute for Information Science in Maribor. Our design for Vega was innovative, since we wanted our supercomputer to have a large storage system, a pool of support machines for user project management and a broad connection to the GÉANT network to support large data tasks and work with large research collaborations that use GÉANT and understand federated access. Vega may well have been the first HPC machine to offer this kind of environment right from the start.

Prof. Andrej Filipčič and colleagues from our **institute's ATLAS group** helped to convince the vendors to accept the design, but our team also helped to improve the architecture, optimise the CEPH storage and I/O subsystems and tune the system during the early test runs. So, ATLAS computing

jobs were our natural testing load and became one of the first production allocations on the system. At the time, Vega without its accelerated NVidia partition nearly doubled the total computing power available to ATLAS, and its design with ARNES and GÉANT's excellent NORDUnet connectivity allowed it to fully exploit that power. So, the 130 Gbps increase was Vega streaming the ATLAS data while also happily running our users' jobs. (See **David Cameron's slides** from the LHCOPN-LHCONE meeting #49 – CERN for details.)

And the network created by ARNES, GÉANT and NORDUNET in support of facilities like Vega EuroHPC as well as experiments like the ATLAS collaboration, has been described as a "rock-solid, highly reliable building block". What is the role of the supercomputer in the wider HPC community?

All HPC systems are at the forefront of technology, and each comes with unique challenges. For us, the large but steady and well-understood ATLAS load helped us to work through the initial issues and to fine-tune the machine, the storage, our software and the network.

But for ATLAS, it meant a fully refreshed run-2 dataset with all the associated simulations just before the restart of the LHC!

In the wider HPC community, Vega held a special place since it was not just a national system, but also the **first EuroHPC machine**. It is designed for tasks in a wide variety of domains, and it supports many workloads: computational chemistry, computer vision, language models and genomics were among our early adopters. Our colleague Barbara Krašovec, who previously set up the HPC effort at ARNES and led the grid computing team, has been instrumental in establishing high standards at Vega and ensuring that user support means that we put an effort into scaling applications and pushing to get to the results in the time allotted. In this way, we are continuing a tradition that is part of our birthright: in Slovenia, supercomputing first took off in the 1990's at the Jožef Stefan Institute, where the National Supercomputing Centre was established under direction of my predecessor Vladimir Alkalaj right next door to what later became ARNES. The same group was responsible for Slovenia's extremely **early web penetration** which promoted academic networking and computer science in schools. So, it was natural to build a **national supercomputing infrastructure** with ARNES and to involve also IZUM and our universities and research institutions.

What does the collaboration between GÉANT, NORDUnet and Arnes actually mean in practice for the users on the ground?

From the point of view of the Jožef Stefan Institute and our researchers, the close cooperation with Arnes and NORDUnet, as well as the access to initiatives and infrastructures within GÉANT, have become an indispensable part of our working environment. The ability to rely on them when working with our colleagues in large collaborations and across borders is a prerequisite for participating in key scientific challenges we face today. But the ideas of collaboration, federation and interdisciplinary research that GÉANT is built on, and that universities and research institutions understand, are a cornerstone of our ability to address such challenges. The collaboration with Arnes and NORDUnet is a prime example: building on efforts within the EGEE and EGI initiatives, as well as regional and national efforts, GÉANT enabled Arnes and NORDUnet to help us participate in a pan-Nordic effort to provide a regional Tier-2 storage facility for ATLAS. The expansion to Slovenia and other countries, made possible by this collaboration, was a great demonstration of the versatility and power of the GÉANT infrastructure. Arnes and NORDUnet worked directly with us as their users. It was not only a success, but also a proving

ground for dedicated scientific VLAN usage in the context of big data pipelining to computer centres. It opened the door to a new approach where our users can relay to use multiple 100Gbps lines for data transfer between storage and computing in multinational research collaborations or within national networks.

What's next for the Slovenian supercomputer?

Vega was built as part of our national **HPC RIVR project**. The aim was to upgrade regional and national high-performance computing capacities, and it's been a great success, not only with Vega, but also with HPC Maister at the University of Maribor, HPC RIVR project coordinator. The general interest has prompted Arnes to upgrade its HPC facility so that we have a modern system that is also available for training and education. But all this interest means that all our machines, not just Vega, are in great demand, while our staff is also busy working on projects to improve software and security, working on scalability, expanding federation support for HPC centres and large data repositories etc.

I have to mention **MAX (MAterials design at the eXascale)**, the **EuroHPC centre of excellence**, in which our group is directly involved and which allows us first-hand experience of running advanced software on different machines and architectures. We are also preparing the infrastructure for a successor to Vega, but at

the moment we are spending more time on our work within the Leonardo consortium, supporting **HPC Leonardo**, one of the most powerful machines in the world.

In the long term, however, our efforts to expand the national network computing federation are probably more important. Based on our Arnes AAI federation and the initiatives of eduGAIN, eID and AARC, we are working on building a federation with EuroHPC systems. Based on our experience with GÉANT and the Nordic federations we hope to enable a similar collaboration in supercomputing and large data repositories. But we need to address new challenges, such as advanced software support, security, hyperconnectivity and communication with user communities – and for all of these issues GÉANT is key.

Personally, I believe that GÉANT could provide us the context in which to develop better, simpler tools for researchers and students. EuroHPC aims to build 1Tbps hyper-connected supercomputers, but we also need to build the user communities that will be able to make use of these new systems. So, in the end, what we need to address is the challenge of academic networking in every sense of the word.

Learn more about Vega EuroHPC on <https://izum.si/en/hpc-en/> and the ATLAS experiment on <https://www-f9.ijs.si/en/research/atlas/>.




Big Sleep Data: LUMI Supercomputer Trains Neural Networks for Sleep Research

Two graduate students at Aarhus University in Denmark have contributed to international research by developing tools for training neural networks on LUMI.

Words: Marie Charllotte Søbye, DeiC

Andreas Larsen Engholm and Jesper Strøm can't help smiling when it's mentioned during the interview that, as students, they've already made a significant contribution to research. Nevertheless, it's true because the back-end tools these two young men have developed to train selected sleep scoring models on the LUMI supercomputer will be freely available on GitLab in a user-friendly form. These tools will make it easier for future researchers to load more sleep data. More data leads to better sleep scoring models and more accurate interpretations of sleep data because neural networks become increasingly skilled at automatically reading sleep stages correctly.

Machine Learning with Big Data in Sleep Research

In the field of sleep scoring a 'gold standard' exists, where a sleep expert, using a manual, determines the sleep stage of the individual sleeper every 30 seconds throughout a night's recording. This is a task that calls heavily for automation. Can we create an analysis model that replicates what a sleep expert would have answered? The task was to train neural networks to perform sleep scoring based on 20,000 PSG (Polysomnography) recordings to see the impact of working with such a large dataset. It was all about how well they could train the neural networks.

The Work Begins: Normalising 21 Datasets Takes Time

A significant part of the work in this project involved programming the back end to be able to load 20,000 nights' worth of data (which was the sum of the 21 datasets) in a sensible way.

“The major work of normalising all the data for our models was actually what took the longest time, and that pre-processing pipeline is now accessible to other researchers and students, making it much easier to load dataset number 22. We emphasised finding a sustainable, scalable solution that could be used by others in the future,”

Andreas Engholm says.

Without LUMI, we probably would have abandoned the project

The project utilised a total of 3500 GPU hours. If a single GPU had done the work, it would have taken 145 days, longer than the entire 4-month thesis period.

“In reality, we probably would have abandoned the project if we didn't have access to LUMI. We would have had to move data back and forth because there wasn't enough space, making it very inconvenient,”

Jesper Strøm explains.

Fact Box

When: April to June 2023

Allocation: 5000 Terabyte hours, 3500 GPU hours on LUMI via DeiC's "Sandbox"

Solution: Software designed to run on parallel GPU nodes and temporary storage of up to 50 TB of data

Student: Andreas Larsen Engholm, M.Sc. Computer Engineering, AU

Student: Jesper Strøm, M.Sc. Computer Engineering, AU

Advisor: Kaare Mikkelsen, Assistant Professor, Biomedical Technology, Department of Electrical and Computer Engineering, AU

Resources

1. LUMI supercomputer: <https://www.lumi-supercomputer.eu>
2. Apply for resources on LUMI: <https://lumi-supercomputer.eu>
3. HPC/LUMI Sandbox: <https://www.deic.dk/en/Supercomputing/Instructions-and-Guides/Access-to-HPC-Sandbox>
4. SLURM Learning: <https://www.deic.dk/en/news/2022-11-21/virtual-slurm-learning-environment-ready>
5. Cotainr for LUMI: <https://www.deic.dk/en/news/2023-9-20/cotainr-tool-should-make-it>
6. GitLab tools developed for pre-processing of sleep data on LUMI: https://gitlab.au.dk/tech_ear-eeeg/common-sleep-data-pipeline

Picture
Woman wearing a 'partial PSG' setup for sleep monitoring, including EEG and EOG electrodes. Credits to Kaare Mikkelsen

Deucalion Supercomputer Inaugurated: A Milestone for European High-Performance Computing

In a momentous ceremony, **Deucalion**, the latest Portuguese addition to the European High-Performance Computing (EuroHPC) initiative, was inaugurated at the University of Minho in Guimarães, Portugal. The event was attended by high-ranking officials, including the Portuguese Prime Minister, António Costa - marking a significant step towards enhancing Europe's prowess in supercomputing.

Words: FCCN Marketing and Communication team

The inauguration ceremony witnessed the presence of key figures such as the Portuguese Minister of Science, Technology, and Higher Education, Elvira Fortunato, Madalena Alves, President of the Portuguese Foundation for Science and Technology (FCT), Thomas Skordas, Deputy Director General for Communication Networks, Content, and Technology of the European Commission (CNECT), and Anders Dam Jensen, EuroHPC Joint Undertaking's Executive Director.

With its immense computing power Deucalion is a petascale supercomputer capable of executing over 10 petaflops, equivalent to 10 million billion calculations per second.

As the most powerful supercomputer in Portugal, Deucalion's computational capabilities will be accessible to users not only in Portugal, through the National Network for Advanced Computing (**RNCA**), managed by the **Portuguese NREN - FCCN**, but also throughout Europe. This addition enriches the diverse set of computing architectures

offered by EuroHPC systems, promising to accelerate research and development across a wide spectrum of fields such as advanced research in meteorology, climate modeling, fluid dynamics, aerodynamics, astrophysics, cosmology, among others.

Anders Dam Jensen, EuroHPC Executive Director, expressed his enthusiasm about Deucalion's inauguration, stating, "I extend a warm welcome to Deucalion as the latest addition to our expanding family of EuroHPC supercomputers. Deucalion stands as another proof of Europe's dedication to

technological excellence and collaborative innovation. Today's inauguration is a new milestone towards our mission of making Europe a global leader in high-performance computing."

João Nuno Ferreira, the General Coordinator of the FCT's FCCN Unit, emphasised the importance of Deucalion in addressing the scarcity of computing resources in Portugal and bridging the gap in supercomputing capabilities within the European Union. He highlighted how Portugal's participation in the EuroHPC

initiative ensures not only technological advancement but also European integration and co-funding.

Madalena Alves, President of FCT, emphasised the accessibility of Deucalion's resources, stating, "The Deucalion supercomputer is capable of supporting over 200 projects annually and can multiply the national computing capacity by tenfold. High-performance computing generally comes with a high cost. By making this resource accessible to all researchers, institutions, and even companies, we aim to enhance the

competitiveness of science and technology developed in Portugal."

This HPC addition is hosted by the Minho Advanced Computing Centre (**MACC**) at the **University of Minho** and was made possible through co-funding. The project joined the Portuguese Foundation for Science and Technology (FCT), through FCCN, and the European joint company EuroHPC, representing a combined investment of €20 million, with 35% coming from EuroHPC's community funds and 65% coming from other sources through FCT.

Learn more about Deucalion at <https://www.fccn.pt/en/inovacao/projeto-deucalion/>



Cotainr tool should make it easier to use LUMI's superpowers for research

DeiC's HPC team has developed a container software tool that initially aims to make it more accessible for those running AI/ML in Python to use the LUMI supercomputer

Words: Marie Charllotte Søbye, DeiC

If you've ever tried to work on an HPC facility as a researcher, you know that it can be quite a task just to get started. Suddenly, you need to be familiar with a Linux setup, command lines, package managers, etc., to a degree you may not have experienced before. For many, this can entail a lot of extra work because it's not something most people are already well-versed in, even if they are experienced in the software development process.

In DeiC, we want to address this issue because it's important that as many people as possible can access our HPC facilities, and IT challenges shouldn't be what determines access to supercomputer resources. That's why, at DeiC, we have developed a piece of software called "Cotainr". The Cotainr tool ensures that you can run directly on the HPC facility via a single file, eliminating the need to download and install software on your laptop.

"Basically, it's about the challenges of making your software available on HPC facilities. You have to download and install software on your own computer. But there's an alternative, which involves using these containers, where you don't install the software, but instead the software you need is in a file called a 'container.' You use a special program on the HPC facility to execute the software directly from that file, without having to install all the software locally," explains Christian Schou Oxvig, Special Consultant at DeiC.

We want to help researchers get started more easily using our HPC facilities, especially the LUMI supercomputer. In simple terms, this means we want to move away from the idea that you have to acquire a lot of detailed knowledge about Linux, supercomputers, etc., just to use our facilities. The goal is that you can do something that closely resembles what you already know as a researcher.

First use case is Python environments with AI and ML on LUMI, and more to come

"Initially, we have developed a Cotainr solution for LUMI, so you can make your Python/AI/ML software easily accessible. That's where we start because we know there can be challenges here," continues Christian. "If you work in Python, for example, with AI/ML, data science, or SA analysis,

and you already use the tools called Conda and Pip to manage your Python environments, you will be able to quickly transition to LUMI and run from our Cotainr." Eske Christiansen, Chief of HPC at DeiC, adds, "We're focusing on the Cotainr for LUMI, and as we see the need more use cases will emerge. Our clear goal is to spread the idea to as many systems as possible to simplify access to our HPC facilities".

More information

Contact: Eske Christiansen,
eske.christiansen@deic.dk

Code on GitHub: <https://github.com/DeiC-HPC/cotainr>

Documentation on Read the Docs: <https://cotainr.readthedocs.io/en/latest/>



Improving Gender Equality – by Principle and Design

On 7 June this year during TNC23 in Tirana, Albania, a workshop was held regarding potential Gender Equality Principles that could be of use to our wider community. What led to this workshop coming to fruition, and what came out of it, is a subject that requires greater exposure.

Words: Hendrik Ike, GÉANT



The topic of Gender Equality is becoming both increasingly important and urgent. And, in a way not dissimilar to other challenges that face our community, it is the subject of both top-down and bottom-up influences.

Starting with the bottom-up, gender imbalances within both GÉANT and NRENs is a well-known problem that is rooted in systemic, structural, and cultural issues. Especially in our technical sphere, there is a growing realisation of the need to encourage and support non-male starters and professionals in a wide range of roles – be that in development, engineering, technical, procurement, managerial – you name it. Not only does this help the broadest range of individuals flourish in what is a unique community, but it also makes our organisations stronger and healthier.

The European Commission recognises this need also in the research realm, and as a result has brought in the requirement for Horizon Europe grant beneficiaries which are public bodies, higher education establishments, and

research organisations (GÉANT and most NRENs qualify in these classifications) to have formal Gender Equality Plans. From the plans, actions are put in place that are designed to improve gender balances. So, here the top-down approach is also starting to make a difference. Within one year we have now established a Gender Equality Committee at GÉANT that oversees the implementation of this plan and looks to bring about tangible results. Some smaller differences have already been made, such as introducing a blind marking process for TNC submissions, or in starting to collect gender data as a baseline for events run by GÉANT in our community in order to help set future targets. The Gender Equality Principles socialised at TNC23 were also a part of this.

But what are these principles? You can see them below. They're not official, they're not finalised, and they're available only for reflection and discussion. This is because, when thinking about how to best help our community on this important topic, principles are normally an effective vehicle to bring

about correct decision-making that is rooted in core values and ethics. Many NRENs globally are at the very beginning of this process, and so to have too rigid a process or blueprint with formalised actions would not land with a wider audience. Instead, a list of principles helps serve as a first guide or iteration of the process for any organisation that wishes to use them. You can see this reflected in the first principle below.

- We utilise respective stand-alone gender-inclusive policies that explicitly promote and support Gender Equality in all aspects of our work. If need be, this document can be the first iteration of that process.
- We promote Gender Equality in all aspects of leadership, governance, and decision-making.
- We promote Gender Equality in the recruitment and career development opportunities of our respective organisations.
- We promote Gender Diversity in the more technical teams of our respective organisations.
- We actively support the requirement of gender auditing in our respective organisations.
- We support a safe and collaborative culture of inclusive Gender Diversity across our respective organisations, including Gender-Aware training.
- We promote working arrangements within our respective organisations that must include flexible working arrangements and resourcing in order to not just support but encourage the career progression of women.

During the one-hour roundtable, which was well attended at the TNC23 Community Hub, these principles were discussed both with regard to their content, but also in relation to the wider feelings and observations they touched upon.

Needless to say, it was a fascinating session that will be built upon in successive years. The discussions shed light on the complexities and challenges faced by NRENs and RENS in promoting Gender Equality in technical communities. The insights shared during this event underscore the importance of collaboration, awareness, and continuous effort in advancing Gender Equality in the digital sector. There was recognition that change is needed, and by adhering to these principles, NRENs and RENS are taking significant steps toward a more inclusive and diverse future for their organisations and the broader technical community.

Regarding practical next steps, these principles are being discussed by those who attended the roundtable, and the GÉANT Gender Equality Committee. We also have the reflections made by participants per principle, and we would like to translate those into tangible recommendations that could be useful and transferable across all of our organisations in order to potentially improve working practices. For those who could not attend but are interested in the principles or would like to engage more with this subject within our community, then please do not hesitate to get in touch with myself or any member of the Gender Equality Committee.



CEO Track 2023: tuned towards new challenges

Following the success of the inaugural CEO Track at TNC22, the second CEO Track took place at TNC23 in Tirana, Albania. With an increase in attendees, a new half-day format timed to avoid TNC programme clashes, and a joint dinner with the General Assembly to further boost networking opportunities, this year's CEO Track was considered a great success and a worthy follow-up to the 2022 debut!

Words: Paul Maurice, GÉANT

Wait, what is the CEO Track?

The CEO Track is an initiative that looks to benefit from having so many CEOs in one place to build relationships, discuss common challenges and opportunities in the global community, and focus their collective efforts on how to address key topics at each meeting.

For example, last year's Track highlighted the challenges in recruiting and retaining talent in our community, which led directly to a very successful TNC23 side meeting on this exact topic.

This year's Track welcomed 58 attendees from across the globe for focused discussions on Artificial Intelligence (AI) and Sustainability.

AI session

The AI session looked at what NRENs are doing in the AI space, how it could impact Research and Education Networking (REN) business, and the potential it could have in the REN landscape.

What was clear is that it's an important and challenging topic, with some already looking to embrace the potential of AI into their organisations in areas such as cybersecurity, internal network automation, and mitigation tools, and others taking a more cautious approach, investigating vendors, considering data privacy, and even testing ChatGPT for marketing content creation.

AI certainly has the potential to significantly impact the business of NRENs, for example:

- Network optimisation – with NRENs dealing with vast amounts of data traffic, AI can help optimise network performance by analysing traffic patterns, predicting congestion points, and suggesting efficient routing strategies. This could enable NRENs to enhance network capacity, reduce latency, and improve overall network reliability.
- Security and threat detection: AI can boost NREN capability in detecting and mitigating cyber threats; analyse network traffic in real-time and identify anomalies, and alert admins to potential threats.
- Intelligent virtual assistants: AI-powered virtual assistants can be used to provide efficient customer support and streamline administrative tasks for NRENs; assist in troubleshooting network issues, provide information on available services, and offer personalised recommendations based on user preferences and historical data.

For these and several other reasons, AI will have a real impact on our community. For example, many NRENs will be expected to advise ministries and possibly end users on how to benefit from AI and where to show caution; NRENs will be expected to provide skills and training to their stakeholders; and to engage with commercial partners on AI platforms that can best utilise data.

Sustainability session

This session looked at how NRENs support and progress the Sustainable Development Goals (SDGs), in particular #4 Quality Education, #9 Industry, Innovation and Infrastructure, #13 Climate Action, and #17 Partnerships for the Goals.

Unsurprisingly, #4 Quality Education is a natural fit for NRENs who share an unwritten mission to increase and widen access to internet, content, and resources. The community's work to make eduroam available as widely as possible is entirely supportive of this goal, as is the push to make access cheaper to infrastructure in order to close the digital divide.

When discussing the #9 goal, it was agreed that infrastructure and innovation are well covered by NRENs but that closer engagement with industry could be beneficial. GÉANT's commercial partnership programme is a good indicator of how this can be successfully achieved.

On #13 Climate Action, NRENs see themselves as enablers for research and development of concepts that can positively support this goal, facilitating collaboration between R&E and industry to seek innovative solutions. The community's work in supporting the Copernicus programme is also of clear benefit. However, there are many areas in which NRENs as organisations can make their own contribution – office location, flexible working models, reduction in travel etc. – as well as looking towards the networks and services we run and investigating the greenest options.



#17 Partnerships for the Goals seemed to encapsulate the nature of the CEO Forum itself – in that NRENs worldwide support each other, rely on each other, and collaborate already to indirectly further other SDGs. And it is important to note that in times of crisis and emergency, our partnerships and collaborations have been proven to be crucial. We also aim to ensure that all NRENs benefit from each other, helping to reduce not just the digital divide for our users but inequity for our community's organisations.

Looking ahead

The group then looked at further ideas to consider for both topics and reiterated their commitment to continuing the track at next year's TNC in Rennes and finding the best way to progress topic areas between meetings. All participants felt that the CEO Track at TNC helps to build a web of trust that strengthens our global community and is therefore a successful and welcome initiative.

GÉANT CEO Erik Huizer has the final word: "Research networks worldwide need to work together as partners to provide a truly global service to research collaborations. The CEO Track helps to build the trust that is essential to enable these partnerships."



tnc24

Rennes, France | 10-14 JUNE 2024

TNC24: RENDEZVOUS À RENNES

EVERY TNC BRINGS OUR DIVERSE COMMUNITY TOGETHER – WHETHER IN PERSON OR ONLINE – TO RECONNECT, TO REVITALISE, TO REGAIN OUR BALANCE.

Words: Silvia Fiore, GÉANT

It is this coming together – this rendezvous – that gives all of us our balance: our diverse community thrives on it – only together can our different skills combine to accomplish so much. We learn together, we support each-others work, we discuss our challenges, and we celebrate our success. TNC24 invites you to rendezvous à Rennes to come together, to give back, and to look to the future together.

Capital of Brittany, Rennes has a thriving digital industry and is a true hotspot for tech enthusiasts. With its vibrant student scene, a rich cultural calendar and a diverse heritage, Rennes is only 90 minutes (by train) from Paris and offers a unique perspective on French art, architecture, and gastronomy. TNC24 is going to be hosted at the historic premises of a 14th former convent, Le Couvent des Jacobins.

CALL FOR PROPOSALS

The Call for Proposals for single presentations, demonstrations and side meetings is now open. All proposals can be submitted on the TNC24 [website](#).

SUBMISSION DEADLINES:

Single presentations and side meetings
30 November 2023

Demonstrations
5 February 2024

TNC24 PROGRAMME COMMITTEE

Alexander van der Hill, SURF (Chair)

Anass Chabli, RENATER

Brian Nisbet, HEAnet

Charlie van Genuchten, SURF

Cornelia Puhze, SWITCH

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Nick Buraglio, ESnet

Tangui Coulouarn, DEIC

Tomasz Szewczyk, PSNC

Veronika Di Luna, GÉANT

Wenche Backman, CSC



"I truly believe that NRENs make a huge difference in empowering students, teachers, and scientists. I'm really proud of that! I see TNC24 as an opportunity to share that pride and joy with everyone attending by creating a programme that gives everyone the opportunity to learn from and inspire each other. A programme that shows the great value of what we do as a community, and provides a breeding ground for incoming changes and opportunities!

For me, a perfect TNC is where people feel part of the community and its successes, where newcomers get a chance to shine, and everybody is encouraged to explore new collaborations. Above all, TNC comes with a lot of energy and fun!"

Alexander van der Hill, chair of the TNC24 Programme Committee

Don't miss any update on the upcoming conference! Subscribe to the **TNC mailing list** and visit the new TNC website at tnc24.geant.org. Follow GÉANT social media accounts to stay updated!



BECOME A CYBER HERO

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Running effective student security awareness campaigns: Insights from Brazil

Think of Brazil, and it's probably Carnival, lush rainforest, or football legends that first come to mind, rather than cybersecurity. But in Brazil, as elsewhere, cyber-attacks are on the rise – and ensuring the next generation is cybersecurity-savvy is crucial.

Emilio Nakamura is the CISO of the Rede Nacional de Ensino e Pesquisa (RNP), Brazil's national research and education network. Amongst its other services, RNP focuses on security awareness for students. Here, Emilio shares the challenges and opportunities of making cybersecurity accessible and relevant to young people in Brazil.

Words: Davina Luyten (Belnet) and Rosanna Norman (GÉANT)

RNP

RNP's security awareness programme for students

Central to RNP's approach is its recently launched Hackers do Bem ("good hackers") programme. This is aimed mainly at students aged 15 and up, plus professionals intending to change careers to cybersecurity. The RNP plans to deliver three to four sessions monthly, visiting different universities, colleges, and schools to promote the programme. A project webpage and webinars are also in the pipeline.

"Hackers do Bem is a white hat programme that mixes security awareness with capacity building," explains Emilio. "We aim to encourage students to think more about using cybersecurity in their personal lives, and also to consider cybersecurity careers. And the main goal is to provide technical training to develop cybersecurity professionals and reduce our workforce gap."

"We go and talk to students about cybersecurity risks, their impacts, common cyber-attacks, and how to assess risks. Then we talk about different areas of work within cybersecurity."

"The students are very interested in learning about cybersecurity. And they can see the opportunities to work in this field and contribute to building a more secure world."

The challenges of teaching Brazilian students about security

Explaining complex information in ways students can understand is vital. We use lots of practical examples and talk in simple language so they can understand clearly. We start with the basics and then dive deeper into some areas with students who have the interest and knowledge."

Another big challenge Emilio and his colleagues face is students' belief that cybersecurity is only about complex technical skills.

"There's a perception among students here that cybersecurity is a very difficult field to work in, very technically challenging. It seems very distant to many students," Emilio says.

"So we explain that working in cybersecurity isn't only about ethical hacking. Some jobs focus on providing security awareness, writing security policies, or talking to people. While some tasks require deep technical knowledge, others need good writing or people skills. We want to help students find the right area that suits them."

Maximising the effectiveness of security awareness training for students

Emilio identifies seven key strategies which help make RNP's security awareness campaigns for students effective:

1. Gamification

RNP uses a lot of gamifications in its security awareness campaigns to capture attention and increase participation. For example, by answering quizzes on topics like phishing and two-factor identification, people can gain points and win prizes. It's a more fun and interactive way to learn.

"In our experience, gamification is very effective for getting attention and making students participate in security awareness campaigns. That might be mainly because of the prizes involved! But the important thing is that it gets people's attention onto cybersecurity issues they need to be aware of."

RNP works with a Brazilian partner who manages the gamification platform. Together, they choose the right content for each security awareness campaign, using plenty of real-life cyber-attack examples and reflecting current issues.

2. Tailoring messages for different groups

Using appropriate language for different audiences is essential to getting your message across. Although RNP targets students as a general group, they recognise different sub-categories within this group – each with slightly different needs, interests, and existing cybersecurity knowledge.

"It's important to adjust our language for different audiences. It's one thing talking to 15-year-olds, and a very different thing talking to graduates," Emilio says.

"And speaking to computer science or engineering students is entirely different to speaking with odontology students."

3. Emphasising the personal impact of cybersecurity

Emilio and his team believe the starting point should be highlighting how cybersecurity affects people's personal lives, rather than a purely corporate or professional viewpoint.

"Presenting cases that students can relate to is crucial. Things they can see around them in their daily life or can imagine happening to them personally.

"Everybody needs to understand that cybersecurity primarily impacts our personal lives. So it's not something that only concerns cybersecurity professionals. It does also affect professional lives, but to get people engaged I think the message needs to focus on the personal impact."

4. Managing information overload

"In today's world, everyone receives a lot of messages from multiple sources, every day. There are so many ways we can share information: WhatsApp, social networks, emails, webinars, and more. But we need to take care not to overwhelm students with so many messages that they become less effective," Emilio notes.

Using different communication channels can be helpful, as long as you regulate the frequency of the messages. Short, easily digestible information is ideal.

"We're trying to use more light, visual messages that people can quickly process and understand the risks. We need to hammer home the information, but carefully."

5. Taking your message to a captive audience

RNP collaborates with various events happening across Brazil, such as during science and technology week, to raise awareness among attendees about cybersecurity. This helps broaden RNP's reach by taking advantage of audiences already gathered in one place.

"Going to talk about cybersecurity at different events is a very important strategy to get our message to more people. For example, we attend the Campus Party in Brazil, which is a big event in several cities focusing on younger people, kids and teenagers. And we talk to them in very simple language about cybersecurity."

6. Partnering with well-known personalities

Another effective approach for RNP is engaging popular influencers and experts to help share and champion cybersecurity messages.

"Using well-known personalities can mean people are more likely to listen," says Emilio. "We've already trialed bringing in YouTubers and other people who are famous in Brazil."

As well as general awareness raising, this tactic can also be used to generate interest in cybersecurity as a career.

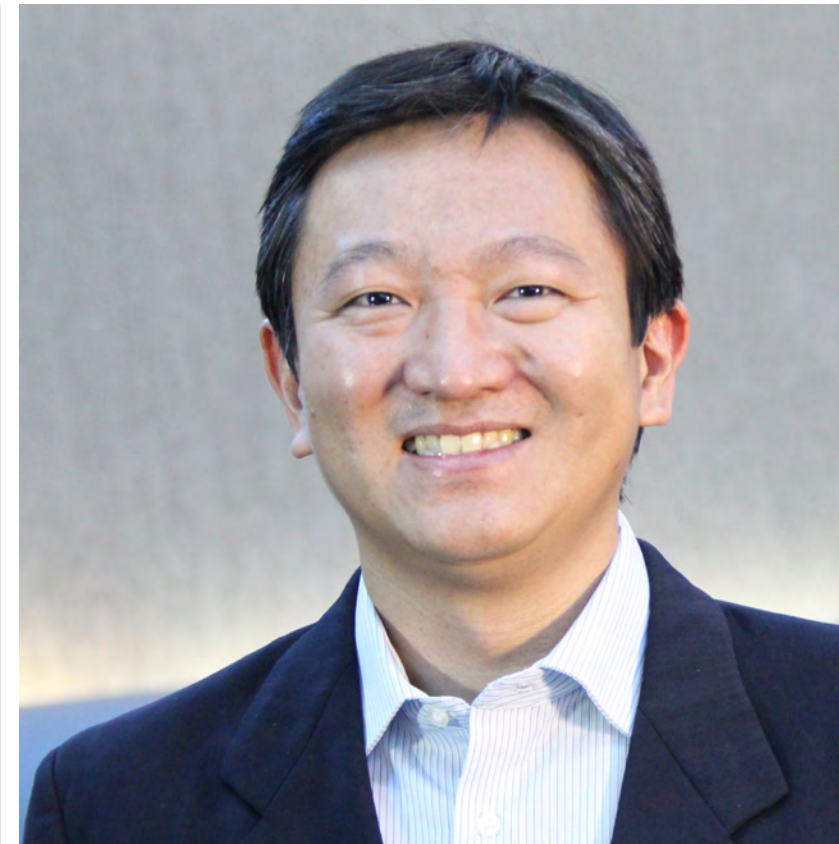
"We're also considering bringing in cybersecurity specialists who are well-known in Brazil to talk to students about working in this field. They would act as a role model or idol for younger people, to inspire and guide students about studying and working in cybersecurity."

7. Prioritising education, not just awareness

Fundamentally, Emilio believes, it's not enough just to tell students about cybersecurity risks. We need to teach them what to do if something goes wrong – and help them recognise that cyber-attacks can happen to anyone.

"I believe many people are already aware of the risks but think, 'It won't happen to me.' And many people wouldn't know how to respond to threats like ransomware," Emilio says.

"So education is vital from as early as possible in personal life. That can also help people see that cybersecurity can be a great career."



About Emilio Nakamura

Emilio Nakamura is the Associate Director and CISO of RNP, the Brazilian national research and education network. His career spans 20+ years working on national and international information security projects, and teaching information security topics.

Final thoughts: students and the future of cybersecurity

Looking ahead, Emilio feels a mixture of excitement and worry about the rapid evolution of cybersecurity, with technology, job opportunities, and threats transforming almost weekly. He believes students have a pivotal role to play in helping us shape a more secure future – but that there are many challenges ahead.

"Improving cybersecurity awareness is very important, but we have much more to do to effectively improve cybersecurity behavior in people's personal lives.

"The challenge is educational. We need to educate people from when they are young children, because cybersecurity is part of everybody's lives nowadays. It's not possible to live or work without knowing about cybersecurity.

"So, we have some very hard work to do. And students can play an important part in that."

This interview is published in conjunction with the GÉANT Cybersecurity Month 2023 campaign, Become A Cyber Hero. Cybersecurity month aims to raise cybersecurity awareness with advice, tips and best practices and to empower users in the fight against cybercrime. The campaign includes videos, interviews, animations, blog articles and a programme of webinars held by security experts from industry and the wider GÉANT community, plus security and privacy awareness materials for NRENs and guidelines on how to set up awareness programmes and more.

To find out more about GÉANT CSM23, visit: <https://connect.geant.org/csm23>

CRISIS CRISIS CRISIS CLAW

CRISIS MANAGEMENT
WORKSHOP FOR THE
GÉANT COMMUNITY

5-6 DECEMBER 2023
PSNC, POZNAN - POLAND



CLAW 2023

- the Crisis Management Workshop for the GÉANT Community

Words: Rosanna Norman, GÉANT

CLAW 2023 is nearly here and a great deal of creativity and planning has gone into the preparation of the event to make it even more relevant, challenging, educational and enjoyable. We asked Charlie van Genuchten, Security Product Manager from SURF and Leader of the Human Factor task in WP8 Security within GN5-1 to tell us more:

“CLAW’s themes this year are teamwork and creativity, both desperately needed in a crisis! In order to get participants in the right mindset from the start, we decided to make some changes to the setup of our event this year. At the start, participants will listen to a cautionary tale from the keynote speaker and then move on to the first part of the crisis exercise. Everyone will

get to know their teams, be challenged to solve some problems with creativity and take part in a working dinner that will certainly help to strengthen team spirit. On the morning of day two we will continue the exercise – but I will not add anymore as it’s meant to be a surprise for all! After lunch we will ensure everyone takes away key lessons from the event by attending one of the three training sessions where participants will be able to use their experience of the crisis exercise and hopefully translate them into new skills.”

The full programme is published on the [GÉANT Security website](#) and there is still plenty of time to register.

Keynote and Training Sessions

Keynote: The Halifax explosion of 1917 – what happens afterwards?

Anna Wilson, HEAnet

On 6th November 1917, the SS Mont Blanc sailed into Halifax, Nova Scotia containing a startling cargo of explosives and munitions destined for Allied forces in World War I. On the same morning, the SS Imo sailed out, empty and in a hurry. They collided, causing the largest man-made explosion to date. Anna’s talk will not focus on the explosion itself, but on what happened before, and what happened after. We can learn a lot by tearing apart the contributing factors to the explosion, finding what mistakes were made, and understanding why they were made. We’ll learn how to avoid and deal with accidents by looking at how other industries have responded to theirs. We’ll learn the limitations of ‘root cause’ as a concept, understand more about why mistakes are made, how to spot the signs of scapegoating and manage them. [Content note: this talk will include discussion of loss of life.]



About Anna

Anna Wilson graduated in Computer Science from University College Dublin in 1996, and straight away went next door to work for HEAnet. Anna has been with the Irish NREN in some capacity ever since. Her focus throughout has been on the IP network, and she is known for her work in various GÉANT activities and her participation in RIPE, including a recent stint as co-chair of the IPv6 working group. Anna is currently building a robot army for the Services Architecture Team in HEAnet.

Picture
Top right: CLAW
2022 in Poznan,
team photo

Parallel training sessions

a) How to Win a Crisis

Wouter Beijersbergen van Henegouwen

During this workshop we will reflect on the exercise in which participants will have already taken part, examine which success factors were based on theories and experience, and possibly identify any pitfalls too. Participants will receive practical tools to enhance their chances of success during a crisis and will also be given the opportunity to apply these straight away in a brief follow-up exercise called the Second Chance Exercise. The training is hands-on and interactive with a focus on maximising the learning outcomes from the crisis exercise.



About Wouter

For nearly a decade I dedicated myself to the realm of crisis management at Trimension, serving both government entities and private businesses. My role encompassed a wide array of critical aspects, including crisis management response, strategic planning, decision-making, and conducting crisis exercises. In 2021, I embarked on a new chapter in my career as a safety advisor for the municipality of Lansingerland. This role also saw me assume responsibilities as a crisis and project manager, overseeing various initiatives aimed at enhancing the safety and resilience of the community. On 1 Nov 2023 I became Assignment Manager for Resilience at the municipality of The Hague. This role presents a fresh set of challenges and opportunities, allowing me to further refine my skills in crisis management and resilience-building.

b) Teamwork!

Marthe Huibers

A crisis situation often demands the utmost from organisations and professionals and good collaboration can make all the difference. But a group of motivated, experienced and/or brilliant professionals does not automatically form a motivated, experienced and/or brilliant team that takes the best decisions. In the workshop Teamwork! we're going to look for those elements that can make teamwork successful and of real added value, instead of (and I quote) "just a – sometimes slightly frustrating – way to share information" or even (and I quote again) "a process that takes all the energy out". In other words: we'll be answering the question "How to turn a team of Experts into an Expert Team?" Together we investigate the four levels at which a team performs, what the success - and fail - factors of teamwork are especially in times of crises, and how to timely recognise and avoid common pitfalls in teamwork. Also, we look at individual roles in teams: what kind of team player are you during crises and what effect does this have on your teammates? Of course, we immediately apply the lessons learned to the CLAW team that you take part in during the workshop: are you able to work together as a solid team when the situation requires it..?



About Marthe

Marthe Huibers is an organisational psychologist, fascinated by (effective and ineffective) human behaviour, especially in the context of teams and organisations. It never ceases to amaze her to see what people in "effective" teams can achieve when working together (unfortunately, it also keeps surprising her how ineffective teamwork can cause brilliant people to achieve very mediocre to downright bad results...). After working as a trainer/consultant in the field of crisis management for over 10 years, she is now trainer and team coach for leaders and teams, teaching them to (re) discover and work at their fullest (crisis-) potential.

c) How to create your own exercise

Charlie van Genuchten

Since the launch of CLAW in 2017 we have been continuously improving the format of our crisis management exercises and producing material to enable NRENs across the globe to develop and recreate similar crisis simulation workshops for their organisations. We will look at the steps needed to create successful crisis exercises, how to make them work and how, through trial and error, we learnt what doesn't work. This training will help NRENs who aim to organise a small exercise for their own organisation as well as larger scale exercises for their constituencies (such as OZON in the Netherlands).



About Charlie

Charlie van Genuchten is Product Manager Privacy and Security at SURFnet. She organised the first large-scale crisis exercise for SURFnet in 2016 and has been creating exercises with and for Dutch Higher Education Institutions every year since then. Since 2017, she has been organising the CLAW Crisis Management Event for European NRENs. Charlie studied History and Arabic and learned a lot about media and politics when she was part of the Dutch National Union of Students and the European Student Union.

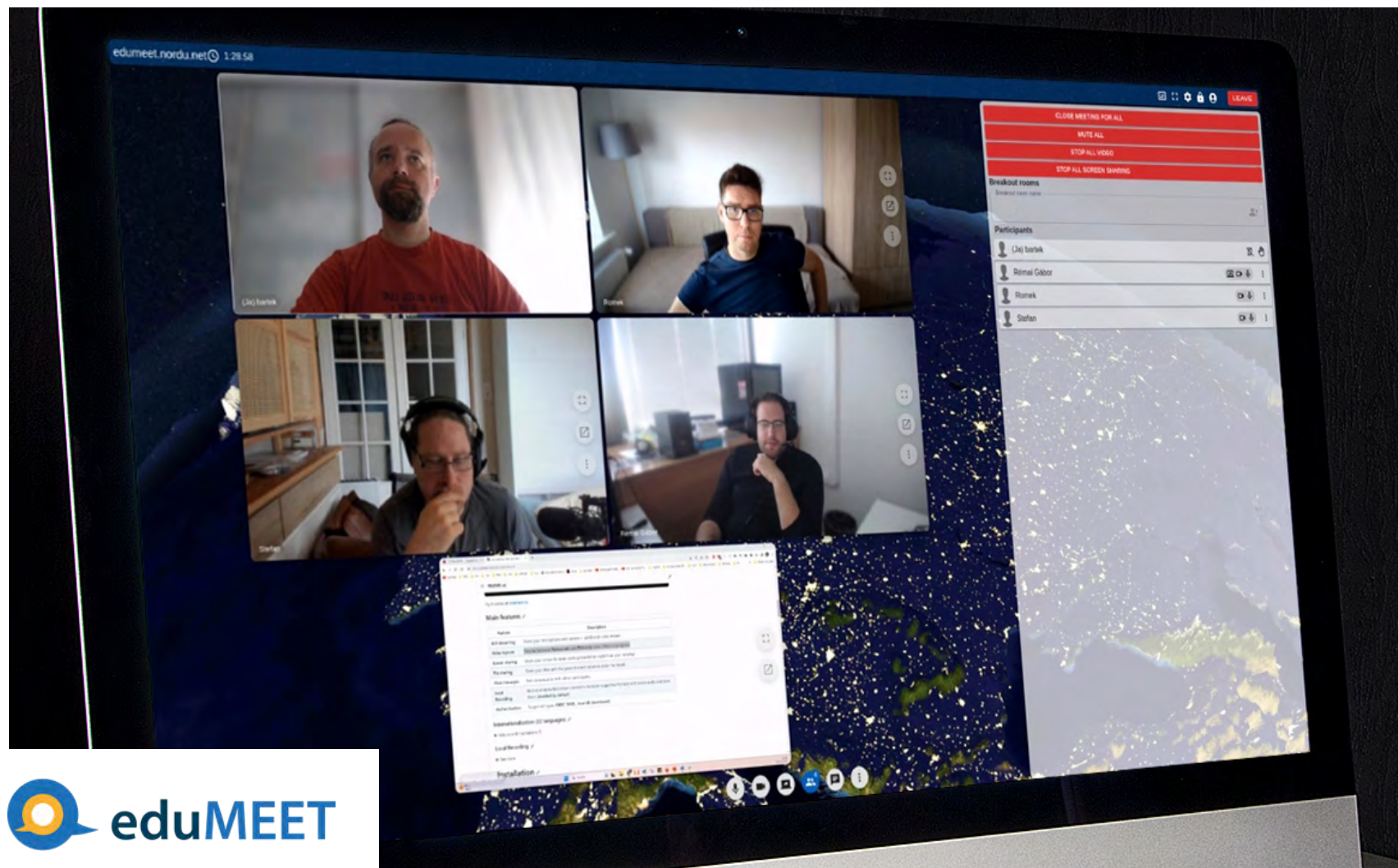
Blue Team Training

A Blue Team Training event will take place alongside CLAW 2023 on 5 December at PSNC, Poznan. The training will be led by Klaus Möller, Stefan Kelm and Tobias Dussa from DFN-CERT.

The Blue-Team Training provides a hands-on opportunity for system administrators and interested users to gain first experience in identifying and deflecting attacks in a secure sand-box environment. The simulated attacks will be detected by means of logfile analysis using Elasticsearch. The training is primarily designed for people with limited experience of IT Forensics. Although we welcome participants with more experience, we do not recommend it for highly experienced professionals.

Registration is open, but please note that places are limited.

Find out more about Blue Team Training.



Video conferencing security and privacy by design: meet eduMEET

If you haven't seen a demo, or used it in a videoconference during the pandemic, it's time to get to know more about eduMEET. On the occasion of Cybersecurity Month 2023, we zero in on many of the platform's most important security features and benefits for the R&E community.

Words: GÉANT Clouds Team

Picture
eduMEET v4.0 demo with core developers Bartłomiej (Bartek) Idzikowski and Roman Drozd, PSNC; Stefan Otto, Sikt; Gábor Rémai, KIFÜ

eduMEET is an open-source WebRTC based software platform for implementing an easy to use, secure, and affordable web conferencing service. It is quite simple to incorporate it within other more complex and integrated solutions and any modern web browser can display its end-user client interface.

Additionally, eduMEET is developed by NRENs and specifically designed for NRENs, schools, colleges, universities and research institutions to create their own on-premise Video Conferencing (VC) infrastructure and services, with a particular focus on privacy, security and digital sovereignty.

Its upcoming 4.0 version, due to be released in late 2023, adds new end-user features and further develops the platform architecture to enable increased federation and mutual resource-sharing between sovereign deployments. This paves the way for a variety of future scenarios for community federation and resilience support between community member operators.

Security and privacy as top priorities

Academic networks and the R&E community have particularly high standards when it comes to security, privacy, and data sovereignty. While commercial cloud offerings bring numerous advantages and drive innovation, their policies and priorities can sometimes diverge from the requirements and values of R&E organisations.

"Data security is mission-critical when it comes to academic research data," says Bartłomiej (Bartek) Idzikowski (PSNC), Task Leader for the ongoing transition of eduMEET from GÉANT project-developed offering into community-financed "standalone" software.

"eduMEET is the solution that best combines the benefits of being on-premise, and having full control combined with the agility, ease-of-use, and responsiveness of WebRTC," Bartek adds. "That means no tracking, audited to remove backdoor vulnerabilities, easy-to-use encrypted audio-video streams, and no analysis of stream or chat content. And it's completely powered by opensource software with full and transparent access to the code."

eduMEET 2023: State of uptake

Throughout the GÉANT community, there are currently numerous examples of installations and deployments of eduMEET. For instance, PSNC in Poland deployed a dedicated eduMEET service for the Poznań City Council, used for both local administrative purposes as well as meeting with city residents. Educational projects in PSNC and PIONIER use the platform daily, alongside the central service for the PIONIER network. In addition, there are instances in MAN (Metropolitan Area Networks) local centers throughout Poland, and in a number of universities, where they are managed by local IT staff.

In Italy, GARR manages GARR Meet: an open national infrastructure that integrates eduMEET instances together with other opensource solutions for a wide range of different applications and purposes, such as BigBlueButton opensource virtual classrooms and more.

In Nordic countries, colleagues at NORDUnet are harnessing their expertise by repurposing hardware servers from previous commercial AV solutions to deploy eduMEET.

In Albania all universities maintain their own dedicated, independent instances of eduMEET, installed and managed centrally by RASH. And in Hungary, KIFÜ offers open national instances for research and education.

However, Bartek says, the most important aspect is that R&E is part of eduMEET's DNA: "The eduMEET developers understand the needs of the R&E community because we are part of it. We listen, we hear their requests, and understand their pain points. That's how we adapt our roadmap to meet these needs and roll out new features."

A final look

When choosing a real-time video communication platform, it ultimately comes down to balancing priorities: security, privacy, and sovereignty against availability, ease of use, and cost. For one set of stakeholders with affordable hardware infrastructure and operations support capabilities, eduMEET offers a "sweet spot" between these sometimes seemingly conflicting priorities. Creating a community-wide, or local on-premise videoconference service based on eduMEET delivers it all: ease-of-use, cost-effective deployment, reliability, and data security and sovereignty in your own hands.

Visit edumeet.org to learn more.

Networks and data centres: time to talk about energy efficiency

Energy efficiency is a hot topic these days and rightfully so, due to both environmental reasons and increasing electricity prices. This is why it was the main topic of the 17th meeting of the Special Interest Group on Network Operation Centres (SIG-NOC) which took place in November 2022 in Paris hosted by the French NREN, RENATER.

Words: Gabriel Verdejo Álvarez (/rdlab); Ivana Golub (PSNC); Maria Isabel Gandia (CSUC); Sebastian Neuner (Belwü); Silvia Fiore and Tony Barber (GÉANT); and Simon Leinen (SWITCH).

Even though awareness of a strong dependency on external energy sources was known and considered before, recent global events caused high increases of energy costs that, together with a growing eco- and green-consciousness, motivated network operators to explore deeper their current modus operandi as well as existing solutions and opportunities to reduce carbon footprints.

The change is visible in several areas, and equipment vendors are providing Management Information Bases (MIBs) with power consumption data which enables network operators to monitor it on a regular basis. Using this opportunity, network operators are taking further steps by analysing existing usage and measuring energy usage per port. They are also considering alternative solutions, such as optimisation of system topology and configuration, lowering network overprovisioning for power savings, interaction with energy network, and also considering lower consumption equipment during a network equipment procurement process.

For these reasons, many NRENs in Europe and beyond are actively working on using renewable energy sources in two domains – electricity and waste heat, and being able to offer generated energy to other organisations. In this area, PSNC has evolved from fostering energy efficiency to using sustainable energy systems, through activities and collaborations with other institutions and utilities. For instance, re-using heat generated by the data centre for the office and Campus buildings and working to offer the surplus to the District Heating operator during warmer months. PSNC is also using a photovoltaic installation close to facilities with laboratories, to maximise the use of self-consumption, and locating network nodes in containers that use renewable energy.

Tony Barber, Head of the GÉANT Operations Centre, presented on how GÉANT has included energy efficiency ratings into recent network hardware procurements and how it was able to measure or closely estimate current energy usage. The challenges in measuring exact power usage and the hardware required to do this were discussed along with the differences in AC vs DC usage and why the decision may not be as clear cut as it used to be. By taking a close interest in energy utilisation, GÉANT was able to show how it has doubled the network capacity for a similar power draw achieving an effective 60% net reduction in energy usage. Reducing the carbon footprint and promoting environmental sustainability is a top priority in GÉANT's corporate responsibility program.

Unexpected consequences

Another presenter was Simon Leinen, Network Engineer at SWITCH. He shared that halfway through 2022, Swiss authorities pointed out the risk of a nationwide shortage of electrical power for the coming winter(s). Countermeasures included planned four-hour regional outages. Rightfully, many in the local community were concerned how the SWITCHlan backbone could survive such outages! SWITCH's equipment is mostly hosted at universities, and for decades they have been relying on the power provided to them. After running a survey, a few "soft spots" were identified, where unlucky combinations of regional outages could "partition" the backbone—a situation to avoid. Some of those were addressed by individual member institutions improving backup power; for others, SWITCH procured, tested, and deployed their own battery-based backup

solutions. According to Simon "This all was a significant amount of (unplanned) work that sometimes pushed us out of our comfort zone. On the other hand, our community appreciated the effort and was eager to help."

Intelligent design to reduce power

Sebastian Neuner from Belwü, the data network of the scientific institutions of the German state of Baden-Wuerttemberg, also presented their energy-efficiency initiatives at the meeting in Paris. With energy prices going up, Sebastian's team was tasked with reviewing their energy footprint and quickly noticed that they were making a lot of assumptions that were not tested or documented, nor were any scientific data available for the current hardware. "As a general rule of thumb, you always need more: space, power, battery run-time, cooling," says Sebastian. "With more efficient gear and a more efficient design, you can do more using the same resources."

His team decided to run their own lab tests with some brand new 32x 100GE router line-cards that just had arrived. They found that the actual traffic passing through the line-cards could theoretically be up to 23% of the power consumption. This is at maximum packets per second, so in practice the traffic would only make up a single digit percentage of the power. A whopping 70% of energy goes to the line-card itself, without traffic or configured services running, even with the interfaces disabled.

Disabling links between routers during times with low traffic volumes could save between 7% and 10% at the cost of losing redundancy and maybe sending traffic on longer paths. Having a network design where additional capacity is collected on a common line-card that can be powered down while



traffic levels are low could save a lot of energy. Switching line-cards on and off is currently very slow and inconvenient, but there are situations like power outages, where this sort of load shedding could be helpful.

Finally, Gabriel Verdejo Álvarez from the Research and Development Lab (/rdlab) from Universitat Politècnica de Catalunya (UPC) shared his team's institutional experience at the meeting in Paris. He highlighted that, with the increasing energy demands from HPC and cloud services, it is important to focus on energy efficiency rather than simply saving on electricity. According to the Times Higher Education (THE) Impact Rankings, UPC ranked

38th in the achievement of SDG 13 (Climate Action), climbing 33 positions from the previous edition! This is due particularly thanks to the vast educational resources on the topic, including the UPC 2030 Sustainability Campus and the IT efficiency modules that is part of the Engineering studies.

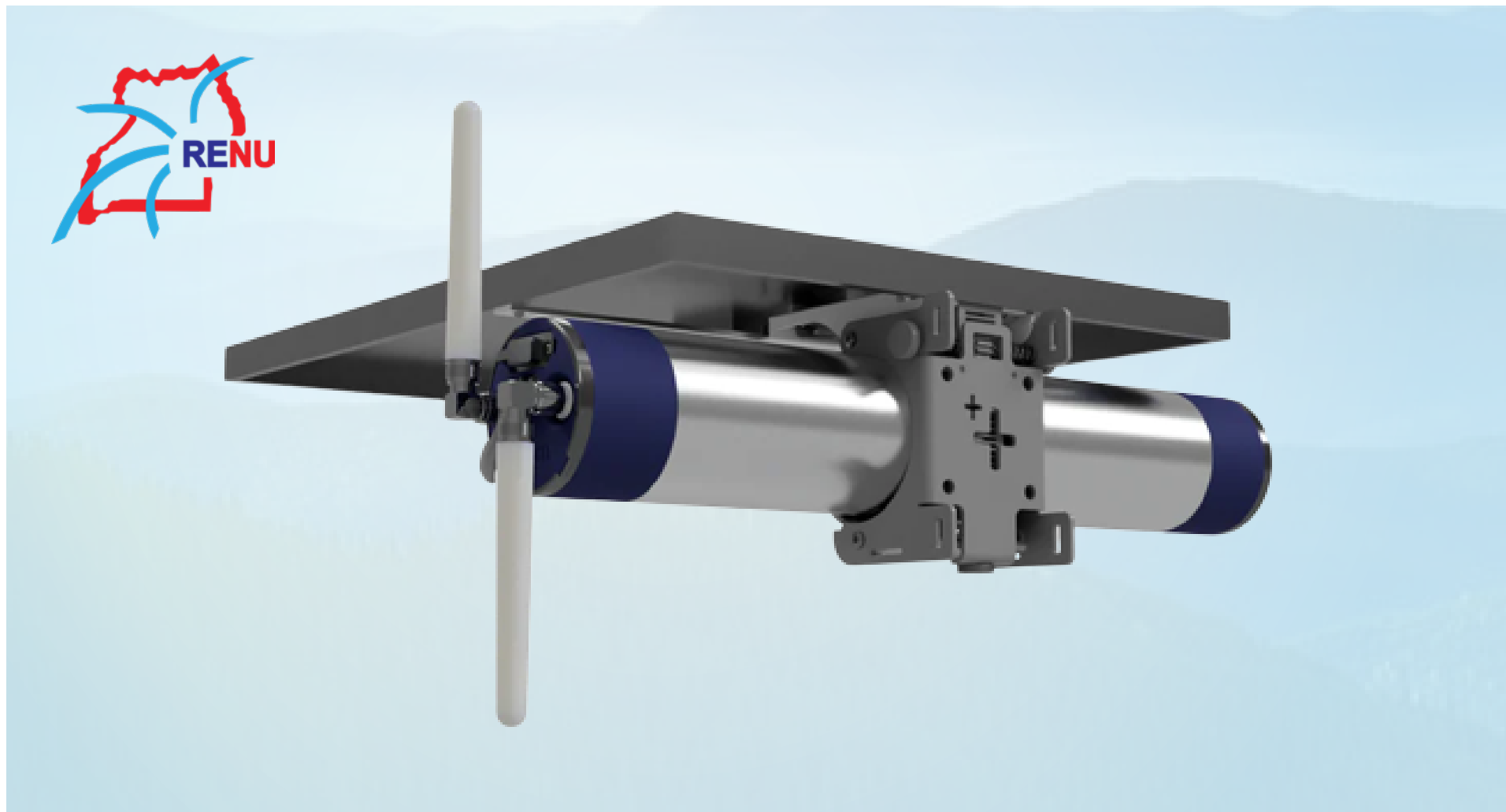
As the attendees of the SIG-NOC meeting could see, increasing costs and the green consciousness have pushed several organisations in the research and education community to investigate and work on energy-related initiatives from different angles. On the one hand, the risk of nationwide power outages and restrictions makes it mandatory to have all the right backup mechanisms in place. On

the other hand, optimising energy consumption for the computing and networking areas is becoming more relevant every day. The strategy of the organisations needs to be aligned with reduction of the carbon footprint, as investments may be needed to achieve the final goals and the architecture, the services and the physical devices are involved. From using renewable power sources or re-using the heat generated by the equipment to switching down connections while they are not in use, all the options are open and can help.

Research and education organisations can follow the path to energy efficiency from the ideas and the discussions held during the meeting. For instance:

having a set of recommendations for tenders and procurements of network equipment and services to invest in energy-efficient systems, collaborating with other organisations to re-use heat generated by the datacentres, performing measurable actions that have a real impact in power consumption. And, of course, being ready for unplanned network outages!

If you want to learn more about the topic, you can visit the [meeting wiki page](#) and download all the presentations.



RENU Partners with Mesh ++ to Manufacture Solar-powered Internet Routers in Uganda

RENU has partnered with Mesh ++, a connectivity solutions manufacturer based in Chicago, USA, to manufacture solar-powered Internet routers in Uganda, which combine renewable energy from the sun with advanced connectivity technology to deliver an Internet access solution like no other. These will be the first Internet routers to be manufactured in Uganda, and they will be accessible to all Ugandans that wish to have stable and affordable Internet access in their businesses and homes, without having to worry about cabling, unstable electricity, and the monthly power bills. Routers are pieces of equipment that when interconnected, provide the highway and backbone through which Internet communication is made possible.

Words: Caroline Tuhwezeine and Diana Asiimwe, RENU

Access to the Internet is becoming more important everyday as the world increasingly relies on it for communication, education, business, and beyond, and yet the infrastructure to access the Internet is still insufficient in most of the developing countries. In addition, the connectivity infrastructure in place currently relies on the national electricity power grids to deliver access to the Internet yet problems of poor electricity supply persist in developing countries, with most households and communities not connected to a reliable supply of electricity, or in the worst cases not connected to the national grids.

Uninterrupted access to the Internet is the foundation of the digital economies that we now live in. The above challenges mean that digitalized and Internet-based processes can hardly be performed

without disruptions. In the case of telemedicine, lives can be at stake without a reliable connection, but huge losses can also be incurred in many other processes and businesses if there are Internet connectivity disruptions. So, how can we ensure reliable access to the Internet for unconnected populations, those that do not have access to the national electricity grid, or those that have an unreliable supply of electricity?

Until now, the Research and Education Network for Uganda (RENU), in pursuit of the goal of uplifting the quality of education and research in Uganda, has been providing the research and education community with Wi-Fi connectivity solutions that are highly dependent on electricity supplied mostly through cables. The dependency on unstable electric power has been very limiting in many ways, especially to the rural communities, and as such, the digital divide in the country is still very big because rural and some urban communities do not have access to reliable and affordable electricity and hence have poor or no Internet connectivity.

No Electricity? No Problem!

Uganda faces infrastructure challenges that affect the extension of the electricity/power grid to mostly, the remote areas. RENU's joint venture with Mesh++ offers a cost-effective solution to this problem. The solar-powered Internet routers do not require a power supply from the national electricity grid, and can therefore be deployed in any part of Uganda to deliver high-speed Internet connectivity wherever it is required.

“Our deployments are quite a few in Africa and specifically in Uganda, which is why we are so excited to announce our engagement in a partnership with RENU to manufacture these nodes right here in Uganda, in fact, the first wireless routers to ever be manufactured in Uganda. We are so thrilled and so thankful to the RENU team, and so excited to start this venture.”

Danny Gardner, Director,
Mesh ++

“The products are simple and easy to deploy and they don't need any cabling; you can spin them up in a very short time, and they are very portable in a way that once you are done using them in a particular location you can shift them to any other location, and they will connect you to the Internet right away.”

Nicholas Mbonimpa,
RENU CEO

No Cables? No Problem!

The solar-powered Internet routers will provide a quick-to-deploy solution that uses a system of movable nodes to bring Wi-Fi to both indoor and outdoor spaces wherever you are, in an eco-friendly manner. Although the solution works well for indoor spaces, it works best with coverage in a large outdoor space, where trenching cable is very expensive, or a temporary event where laying cable is labor-intensive, and not cost-effective. The solution performs by utilizing multiple gateways (cellular, ethernet, satellite, and fiber), and it is portable, i.e., when one is done using it in one location, it can be moved to another location without having to worry about electricity supply and cables.

“I would like to appreciate the leadership at Mesh ++ for having agreed to work with us to enable us to set up the 1st manufacturing plant in Uganda for IT equipment specifically, Internet routers. This will be the first product of its kind manufactured in Uganda and it is firmly aligned to the industrialization drive of the country.”

Nicholas Mbonimpa,
RENU CEO

Greening the Internet

The joint venture to manufacture solar-powered routers in Uganda closely aligns with the Environmental, Social, and Governance (ESG) principles, and is set to have a positive impact in various areas. According to some estimates, the carbon footprint of our gadgets, the Internet, and the systems supporting them account for about 3.7% of global greenhouse emissions. The solar-powered routers seek to provide a solution to the issue of greenhouse emissions from the Internet, by providing routing equipment that utilizes renewable energy, which is abundantly available in Uganda.

Meshing to Cover Wide Areas

The solar-powered Wi-Fi routers work with a proprietary mesh protocol, which enables connectivity over very wide coverage through multiple interconnected solar-powered routers, while ensuring minimal loss of throughput with each hop, thus enabling massively-efficient outdoor Wi-Fi coverage. The network of interconnected solar-powered nodes makes what in technical terms is referred to as a mesh or rather a mesh network, which is currently the best way to connect large tracts of land and communities to the Internet in minutes without cabling.

Benefits of the Joint Venture to Uganda

The joint venture aligns with Uganda's National Development Plan (NDP), especially the goal of increasing ICT penetration and use of ICT services for social and economic development. For ICT, the NDP aims at “increasing ICT

penetration, reducing the cost of ICT devices and services, creating tens of thousands of direct jobs annually within the ICT sector, increasing local ICT innovation products, etc.”, and the joint venture is set to play a critical role in supporting the achievement of the results set out by Uganda's NDP.

It will improve access to reliable Internet in hard-to-reach areas, which will improve the existing education opportunities in the country by providing affordable infrastructure to support modern digital teaching and learning practices, access to e-learning platforms, and education resources, globally.

With easier access to more reliable and stable Internet connectivity, the venture will promote economic growth by supporting Internet-based economic opportunities, that will in turn create more employment opportunities for Ugandans, attract more investors and grow local businesses.

The venture will also improve Uganda's healthcare system by providing easier access to healthcare resources for individuals that are based in remote areas with limited access to healthcare, and by providing a reliable infrastructure to support remote medical healthcare through telemedicine and research.

The partnership also aligns with Sustainable Development Goal (SDG) 7 which encourages the world to ensure access to affordable, reliable, sustainable, and modern energy for all. Uganda being located at the equator, makes the country an ideal location for solar-powered technologies to thrive. The joint venture will promote more utilization of sustainable renewable energy which will reduce the effects of climate change. Additionally, the joint venture routers are interconnected in a way that requires no opening up

of the ground, unlike the older technology-based routers, making the solar-powered routers the most environmentally friendly technology of the current times.

In alignment with Uganda's industrialization drive, the joint venture is among the initiatives that seek to provide a bridge between academia and industry, particularly in the fields of engineering and computer science. By manufacturing high-tech devices and solutions in Uganda, the partnership provides a platform for higher education students to access manufacturing facilities where ideas from their lectures and classrooms are translated into products. Students will also have an opportunity to contribute to research to continuously improve the devices. This is definitely set to improve the quality of education and research in Uganda.

“The other good news is that it is going to bridge the gap between academia and industry especially for the courses of Computer Science and Engineering because most of the time our students are studying things in class but they don't have an avenue where they can see how what they study in class translates into products that are useful.”

Nicholas Mbonimpa

Key Features that Make the Device Desirable

- Use of clean and renewable energy(solar)
- Battery reserve of up to 10 days (for stable Internet access)
- Wi-Fi range of up to 350 meters
- Swift to deploy (adaptable to various environments)
- Robust, very durable, and resilient in the toughest conditions.
- Waterproof and extremely weather resistant
- Requires minimal maintenance.
- Troubleshooting can happen without disrupting connectivity for the end user

“Mesh ++ networks are deployed all over the world! We enable anybody from any background to bring Internet Access to their community - any community! Mesh ++ enables you to bring the Internet Anywhere.”

Danny Gardner

Who is Eligible to Purchase and Use the Devices?

All business entities and individuals (i.e., universities, research institutions, schools, telecommunication companies, Internet Service Providers, hotels, restaurants, cafes, resorts, homes of residences, sports facilities, etc.) that are looking for a sustainable Internet connectivity solution can buy and use the device. As we launch this venture, all interested customers can send in their orders

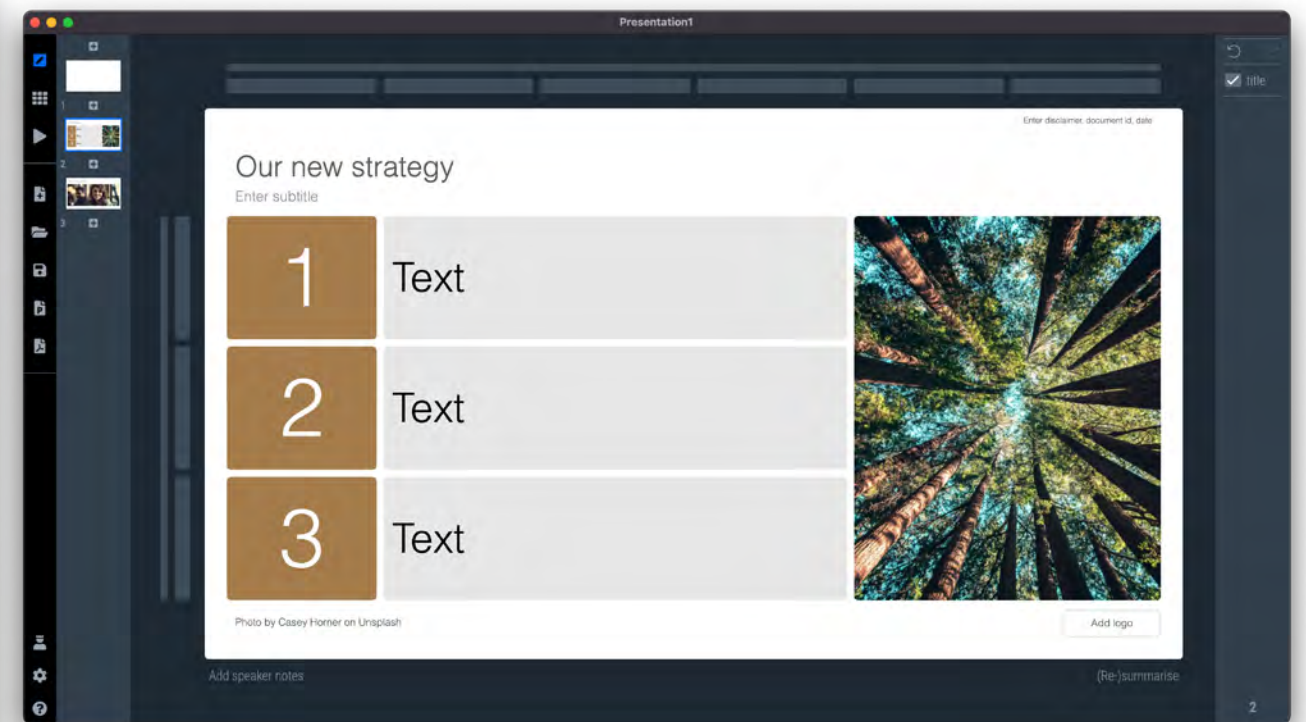
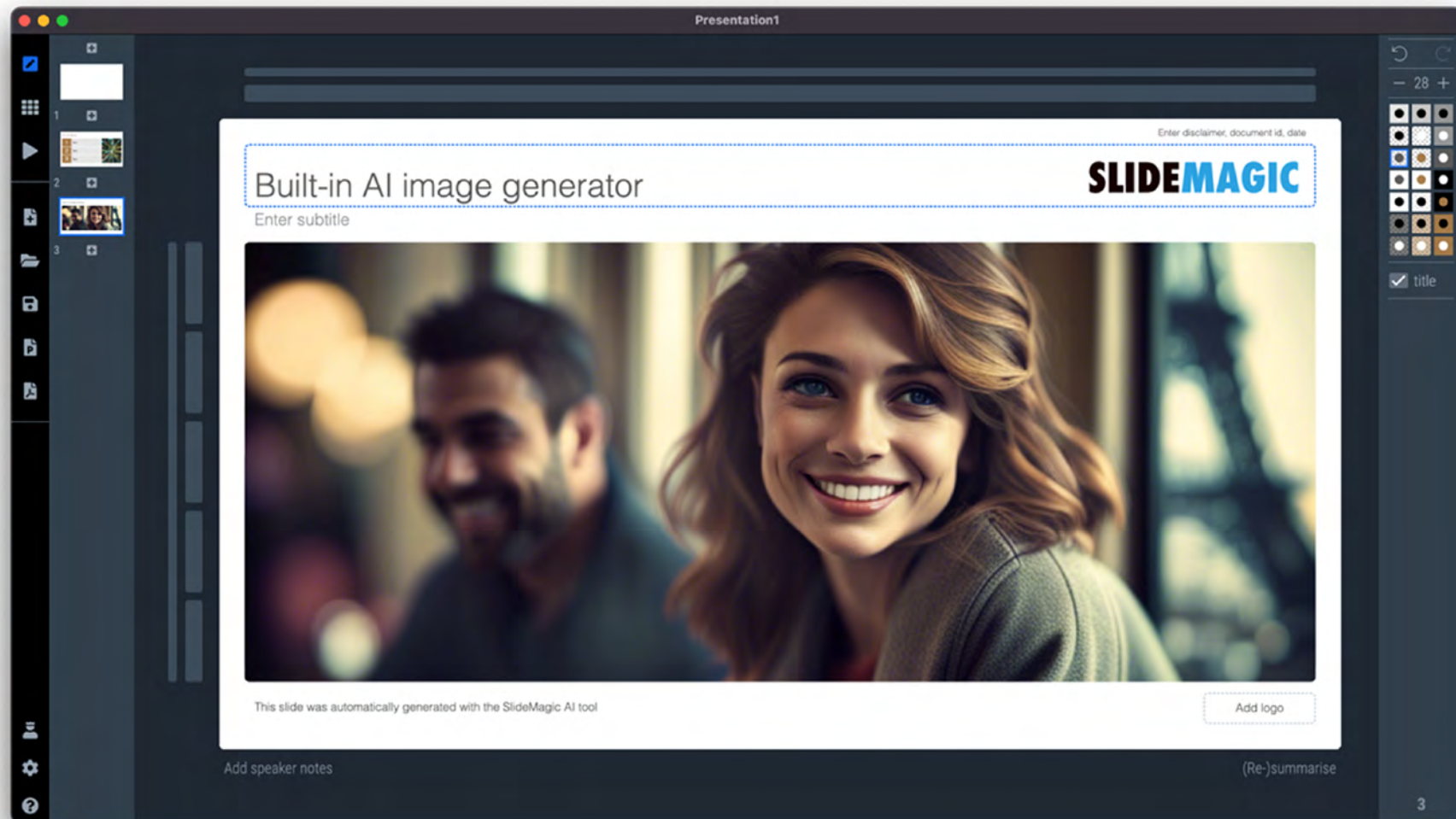
right away through sales@reu.ac.ug, to be among the first to experience this revolutionary technology that will enable them to scale their network completely wirelessly without worrying about any power connection issues.

About RENU

RENU is a not-for-profit membership organization owned by various Ugandan education and research institutions. RENU was established in 2006 by leaders of universities and research institutions, with the first aim of providing reliable and affordable Internet connectivity to the research and education community. Over 500 sites (universities, schools, hospitals, research sites, and other tertiary institutions) countrywide are now connected to the RENU Internet network. With the overall goal of improving the quality of research and education in Uganda, RENU now provides other various services to support the digitization of education and research.

About Mesh++

Mesh++ is a Chicago-based IoT company incorporated in 2017 in the USA as manufacturers of solar-powered Wi-Fi routers aimed at solving the last mile connectivity issues with their motto as “Wi-Fi Anywhere”. The company began as a senior design project by Danny Gardner as he finalized his studies at the University of Illinois. Mesh++ gets its namesake from the concept of Internet mesh networking, a system of devices in a geographic area working dynamically to transmit the information as efficiently as possible between one another, then ultimately to a user. Mesh ++ has its headquarters in Chicago, and an outlet in Nairobi but has its technology spread out across many countries in Europe, the USA, and Asia.



SlideMagic

– Simplifying Slide Design as if by Magic

Too often, we have all suffered death by PowerPoint with hundreds of slides presented in stuffy meeting rooms. So, we have all experienced the almost physical pain of poorly designed slides, clashing or hard to see colours, layouts that confuse and obscure the content, graphics and text crashing into the template, and images and pictures that do more to confuse than to enlighten.

Words: Karl Meyer, GÉANT

Many of these problems come from the fact that presenters are not designers and certainly not experts in PowerPoint, but they are expected to tackle designing an attractive, interesting presentation with little help.

Some of the problems come from the almost infinite customisability of PowerPoint – there are simply too many options, menus, submenus and commands available. Users have a dashboard more akin to a 747 than to the small family car that they actually need.

Jan Schultink had spent many years working at McKinsey and Company helping to develop clear visualisations for staff and clients, and ten years ago recognised that PowerPoint was, for many, simply too complex and too large and was hindering users in getting their content and their message across. So, he developed SlideMagic.

SlideMagic has been designed to simplify the process of content creation – allowing the user to focus on their message rather than having to manage style. Its easy-to-use interface with clear templates and AI generated imagery reduces styling overload. Its grid-based structure ensures consistency and quality

in the presentation, allowing the creator and the audience to see the core messages. Premium users can then export their finished product to .ppt or .pdf formats for safe distribution.

Breaking Down Barriers

Of course, the biggest problem with any application is that elephant in the corner – PowerPoint. It is so embedded in large companies that it is very hard to break into the market – which is why SlideMagic are looking at the student marketplace. These users have not yet become addicted to PowerPoint and are looking for solutions to help them focus on creating quality content quickly rather than having to spend hours learning PowerPoint. This makes SlideMagic's templates, grids and AI enabled image generation perfect.

SlideMagic uses AI to recommend and generate imagery suited to your presentation while you're writing. Non-technical audiences can generate their presentations quickly and then focus on their work again.

Reaching the student market

This desire to support the student users was the reason Jan uses InAcademia. Just like SlideMagic itself, InAcademia is designed to be simple for the students to use – by using their existing student credentials they can validate their status in less than five clicks. No need to set up accounts with third parties or to share personal data with companies.

SlideMagic benefits from a service that is integrated into their platform, making a seamless validation process which supports the whole philosophy of SlideMagic.

As InAcademia spreads more widely through the R&E communities, more and more users and companies will be able to benefit from this simple, secure and privacy preserving student validation.

To find out more about SlideMagic visit <https://get.slidemagic.com/>

To find out how InAcademia can support your organisation visit <https://inacademia.org>

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How NRENs can boost speed without compromising performance or security

The IP data fabric of national research and education networks (NRENs) provides the foundation for scientific research worldwide. But advancements in quantum computing and network applications will soon revolutionize research and create the need for NRENs to handle terabytes of data every day.

NREN operators are preparing for these changes by centralizing or distributing their data centers and adding speed and capacity. For many, this means upgrading 100G technology to 400G or 800G. Vendors are simplifying these upgrades with optical interfaces that can take NREN capacity up to 800G without disrupting research or requiring major changes to the network.

But speed and capacity aren't everything. NRENs also need to overcome traffic congestion to provide researchers with predictable performance. Sophisticated QoS mechanisms can help by differentiating traffic with fine granularity but require routers that can manage traffic from multiple 100G/400G/800G interfaces. Even with this granularity, traffic bursts can slow down applications.

Router technology has evolved to address these challenges. Vendors now offer network processors that use deep buffers to protect applications at any speed. NREN operators can use these capabilities to manage congestion inside and outside their data centers.

Cybersecurity is another growing challenge for NREN operators. NRENs are designed to enable multiple communities to collaborate using sensitive data. But highly distributed botnet attacks have made it tougher to defend this data. Traditional approaches based on firewalls and appliances can't cope with the speed and volume of these attacks.

Distributed defense approaches that combine AI-powered DDoS protection systems with high-capacity IP routers can help NREN operators block botnet attacks. These approaches enable them to identify the IP addresses behind the botnets and filter at line rate to remove bad actors.

Nokia 7750 Service Routers enable NRENs to meet new demands with speeds up to 800 Gb/s, predictable performance and multi-layer security. [Visit the Nokia 800G routing web page to find out more.](#)

How to Close the AI Skills Gap

How to help students, educators, and researchers to upskill on AI, HPC, and data science



The European Commission proclaimed 2023 as the European Year of Skills. Upskilling and reskilling has been recognised as a priority, and applying AI skills has the potential to transform every industry. Demand for AI, accelerated computing, and HPC programming skills is booming. And, as this demand grows, a notable skills gap is forming. Governments, universities and enterprises around the world are looking for ways to grow their expertise in these cutting edge technologies that are playing a tremendous role in transforming industries, improving the economy, and more.

Words: Kevin McFall, NVIDIA



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One of the companies at the forefront of AI and HPC innovations is NVIDIA. The company's invention of the GPU in 1999 sparked the growth of the PC gaming market, redefining computer graphics. It ignited the era of modern AI, whilst also fueling the creation of the metaverse. In recent years, NVIDIA has powered AI breakthroughs across all industries. From helping scientists in DNA sequencing of the human genome to creating a digital twin of our planet, Earth-2, designed to help predict climate change decades in advance. This has enabled researchers and developers to solve the world's greatest challenges as their primary mission.

To help bridge the current skills gap, NVIDIA has introduced their educational initiative, the NVIDIA Deep Learning Institute (DLI), which offers a number of diverse resources to support the full spectrum of developers.

From self-paced learning and instructor-led training to comprehensive educator programs, educators and

students can advance their knowledge in the latest skills with NVIDIA DLI. It also provides entire nations with an opportunity to build robust programmes to up-skill their populations.

Empowering Educators

Manuel Ujaldón, a Full Professor at University of Malaga, uses NVIDIA teaching kits as part of his curriculum. He's organised more than 150 NVIDIA courses as a certified instructor over the last decade.

Through NVIDIA DLI Teaching Kits, educators can get free access to lecture materials, hands-on exercises, GPU cloud resources, and more.

The kits have been co-created with academic partners, including Professor Yann LeCun and his team from New York University, University of Oxford, and the Georgia Institute of Technology. Each kit contains materials that combine the latest industry trends, GPU architectures, applications with fundamental theory, and academic approaches to teaching.

"Teaching kits are a time-saving tool for preparing classes, optimising teaching effort and maximising engagement from students," says Ujaldón. "Students look to NVIDIA as the reliable source that prepares them for the challenge of joining companies in the sector."

As well as using the teaching kits as part of his curriculum, Ujaldón has taken advantage of the benefits that come with collaborating with NVIDIA



DLI workshop participants at the Computer Science Department of the University of Cape Town. Explore all available DLI Teaching Kits [here](#).

DLI by becoming a DLI University Ambassador. Ambassadors are able to deliver the latest hands-on workshops free for university faculty, students, and researchers in the areas of GPU-accelerated computing, AI, and data science.

Nurturing National Competence Centres & Governments

National Competence Centres (NCCs) are the central points of contact for HPC and related technologies in their country. They benefit from leveraging the training content and educator programs offered.

The UK-based STFC Hartree Centre works with the NVIDIA Deep Learning Institute to upskill UK developers, researchers and students in AI, data science and HPC.

"At the Hartree Centre, we have NVIDIA Ambassadors teaching DLI courses ranging from GPU programming to Deep Learning for Computer Vision," explains Evguenia Alexandrova, Training and Events Manager at the Hartree Centre. "Collaborating with NVIDIA enhances our ongoing work to close the UK's digital skills gap by providing access to learning materials that save us time and help us to scale up our training programme."

The benefits of the NVIDIA DLI educator programmes also extend to the government departments

responsible for defining nation-wide goals for upskilling, and defining budgets and initiatives that will impact the work of NCCs, university research projects, and school curricula.

"Serbia is taking actions to tackle a skill gap for the development and use of AI," says Professor Dubravko Culibrk, Director of The Institute for Artificial Intelligence Research and Development of Serbia and a DLI Ambassador. "By working with NVIDIA DLI resources, we're able to enhance our national strategy for AI, provide support for various educational and research institutions and improve the uptake of AI across the country."

With resources like those available through NVIDIA's DLI, there are steps that can be taken at every level – grad, post-grad, workplace, or country – all of which contribute to new opportunities for individuals and the economy in general.

To get more insights and context on the state of AI skills in Europe, watch the panel discussion to hear about the most in-demand skills in the market, and the options for bridging the skills gap. **Watch the recording** of the session with DIGITALEUROPE, TechUK, EuroCC, MinnaLearn and Budapest University from NVIDIA GTC 2023.

Unlocking the digital frontier: EXA Infrastructure's mission for a connected world

In an era where data has become the pulse of progress, the urgent need for seamless, high-speed connectivity has transcended industries and reshaped the landscape of research, education, government, and finance. EXA Infrastructure stands at the forefront of this transformative wave, envisioning a future where connectivity empowers organisations across the spectrum. SVP Product and Technology, Andrew Haynes tells us more.

Words: Andrew Haynes, SVP Product and Technology

The exponential growth of data has led to a paradigm shift in how we approach and perceive our world. Gone are the days when only particle physics labs required lightning-fast 10G connections; today, data is the linchpin of progress in fields as diverse as economics, geography, climate science and beyond.

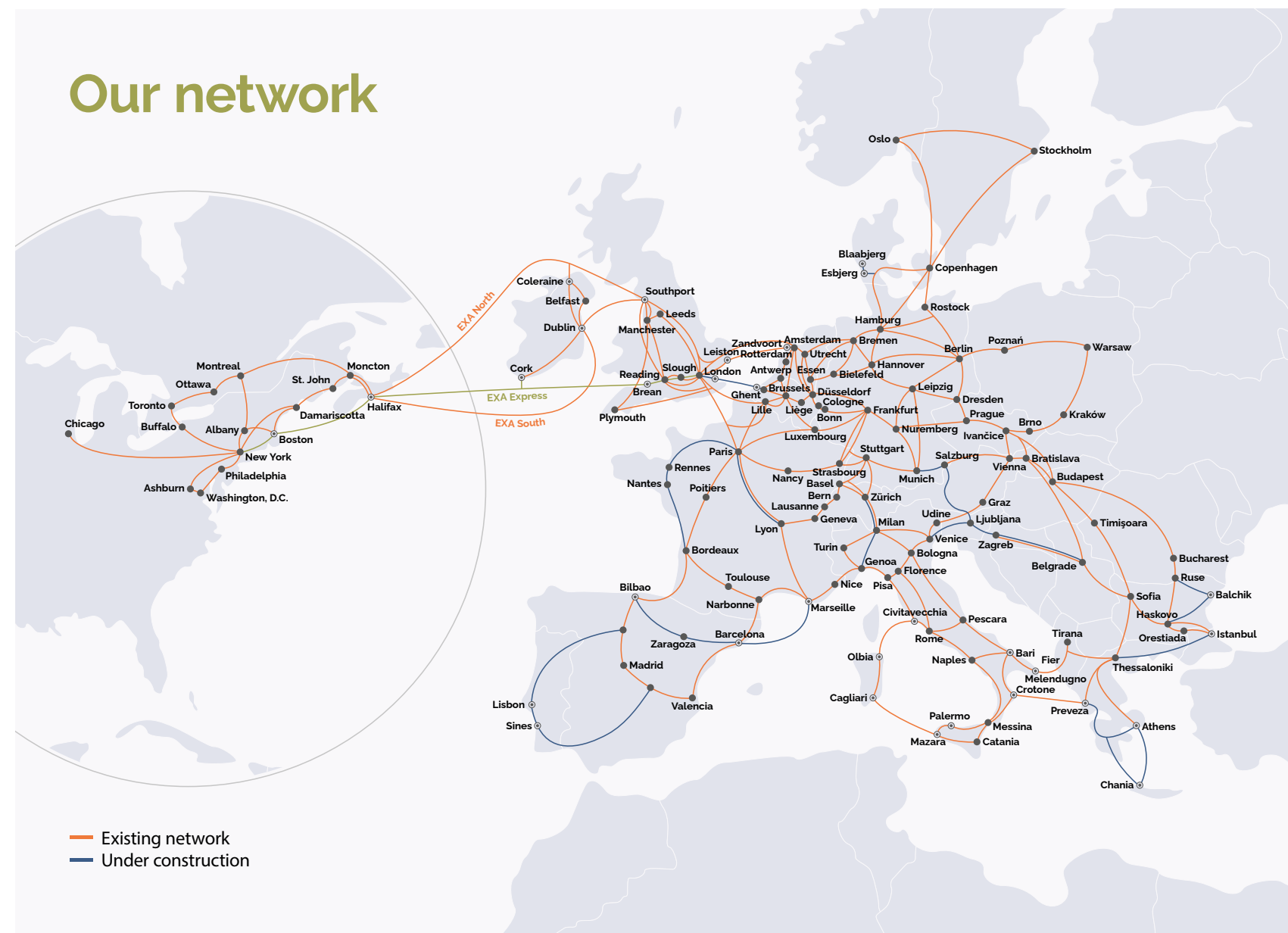
The next generation of economists rely on real-time transaction data to analyse where and how the economy is growing, while geography departments leverage mapping tools and real-

time telemetry data to decipher everything from commuting patterns to trade statistics. Simultaneously, the urgent need to address climate change is powering the reinvention of infrastructure, inundating civil engineering and climate science departments with exabytes of data.

The need for high-speed, reliable and secure connections to power research and growth is critical for sharing knowledge, which is where EXA comes in. GÉANT has been using EXA's network since 2012 for its extensive terrestrial and subsea fibre network.

Connecting the dots

From revolutionising academia to enhancing governance, to empowering financial innovation and catalysing scientific breakthroughs, EXA's vision is to become the leading pan-European and trans-Atlantic data centre to data centre connectivity provider. Growth is at the absolute core of our ambitions and plans. Our network growth plans take a strategic and long-term view about how traffic patterns will evolve as we look to service more customers and to ensure EXA is the leading connectivity provider on the market.



In this interconnected era, data has become the air that researchers and educators breathe, and the quality of connectivity—its bandwidth, availability, and latency—will define an organisation's position in the global rankings. It's not merely a matter of staying competitive; it's about attracting the brightest minds and nurturing an environment conducive to Nobel Prize-worthy discoveries. Over the years, EXA has been a chosen provider to GÉANT for its creative solutions from dark fibre, colocation, wavelength and optical spectrum requirements.

Crafting tailored solutions

However, the realities of budgets often lag behind the ambitious visions of tomorrow. Bridging this gap requires working alongside partners who can create tailored solutions that align with your unique needs and fiscal constraints. This is where EXA shines brightest—our mission is to empower data to empower us all.

At EXA, we are proud to be a dedicated fibre infrastructure provider with a focussed portfolio. We're easy to do business with, ensuring our services are accessible and competitive solutions for all of our customers.

EXA: the gateway for connectivity

EXA understands that your research partners are spread across the globe. Our network reach, availability and reliability are second to none. The future of connectivity is now and EXA is the chosen partner to harness our cutting-edge technology, scalability, expert consultation, reliability, affordability, and unwavering commitment to security.

This wave is just beginning. EXA is constantly on the lookout to add new routes to add diversity and lower latency, to upgrade capabilities to 400G and beyond,

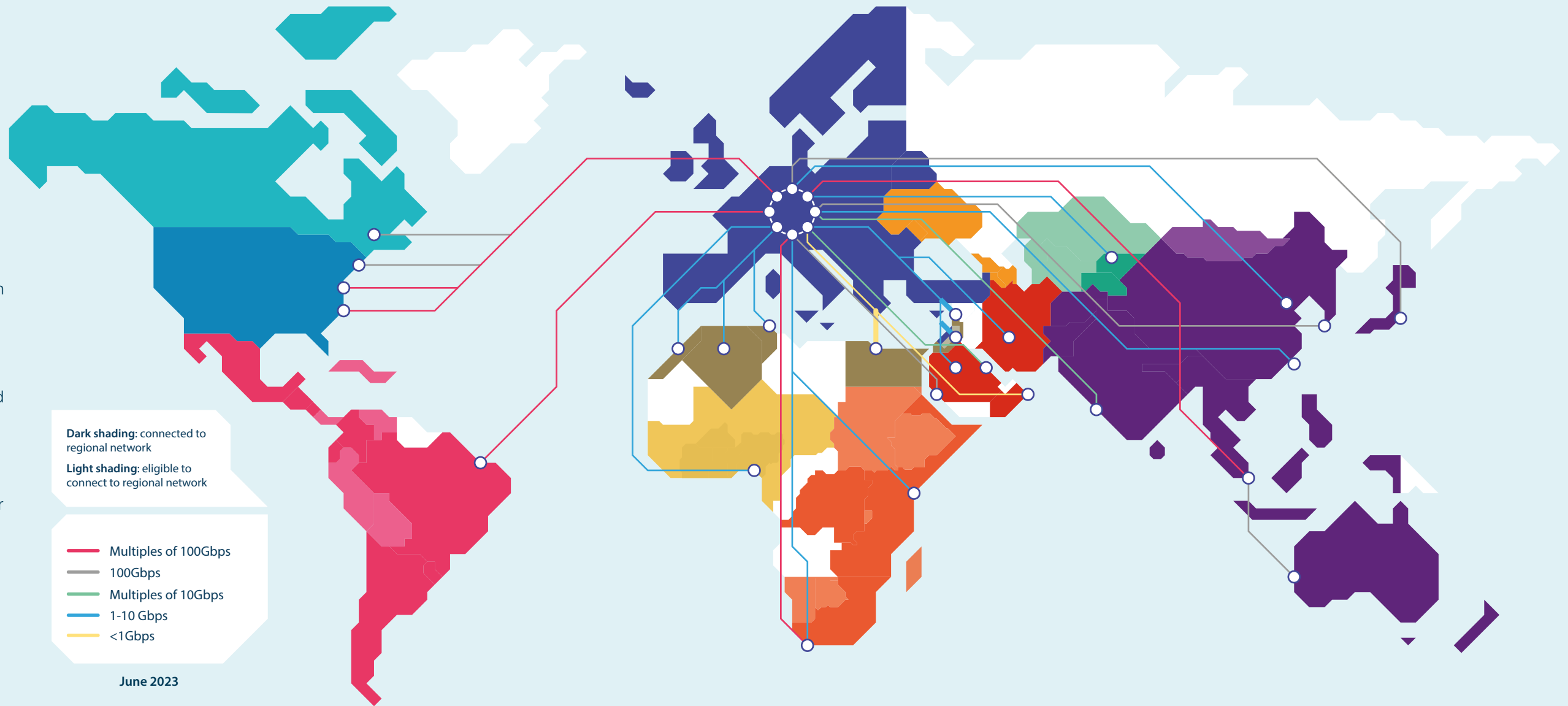
and create new, novel and scalable paradigms of connectivity like spectrum services to create solutions for the most challenging needs.

EXA is not just a provider; we're a partner dedicated to ensuring your organisation thrives in this new era of connectivity. Together, we can grow the future of connectivity and empower data to empower the globe. Let us be boring, so you can be brilliant. When you think of catalysing innovation, fostering collaboration and shaping a brighter, more connected future for your organisation and the world at large – think EXA Infrastructure.

GÉANT at a Glance

We're bringing you greater content across a wider range of channels: from our Annual Report to showcasing the amazing research projects the GÉANT community supports. And CONNECT is online (connect.geant.org) and you can sign up to our weekly newsletter. You can also get involved on social media – see you online!

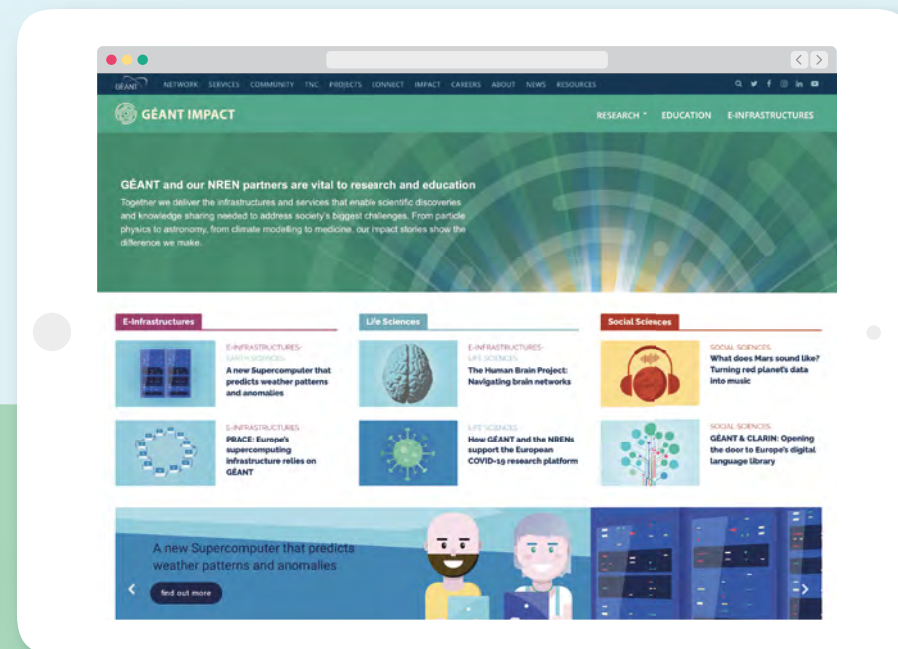
GÉANT is Europe's leading collaboration on network and related infrastructure and services for the benefit of research and education, contributing to Europe's economic growth and competitiveness. We develop, deliver and promote advanced network and associated e-infrastructure services, and support innovation and knowledge-sharing amongst our members, partners and the wider research and education networking community. Together with our NREN partners, we interconnect 50 million users at 10,000 research and education institutions; and via extensive global partnerships and GÉANT-managed networking projects, reach over 100 countries worldwide.



Dark shading: connected to regional network
Light shading: eligible to connect to regional network

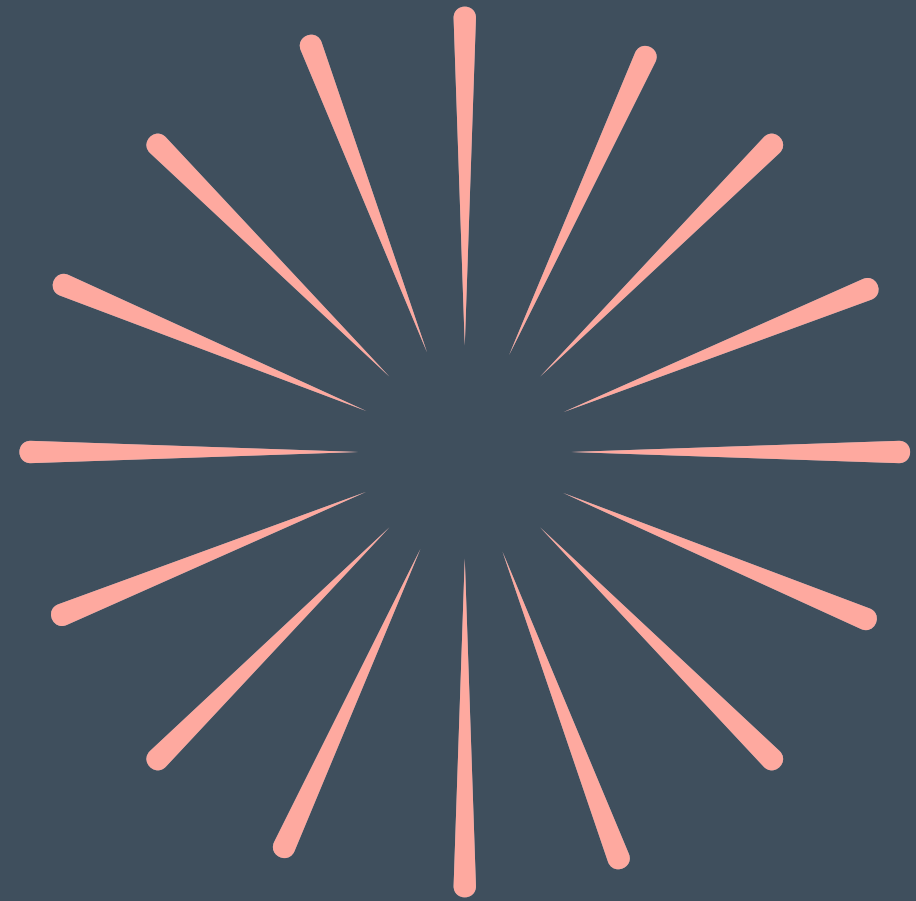
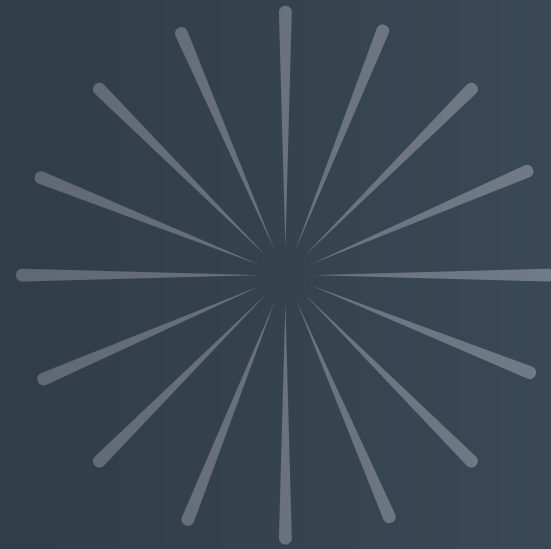
- Multiples of 100Gbps
- 100Gbps
- Multiples of 10Gbps
- 1-10 Gbps
- <1Gbps

June 2023



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Eastern & Southern Africa UbuntuNet Alliance	Central Asia CAREN	Asia-Pacific TEIN	Other R&E Networks	

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