

CONNECT

THE MAGAZINE FROM THE GÉANT COMMUNITY | **ISSUE 42 2023**

A new era for digital innovation

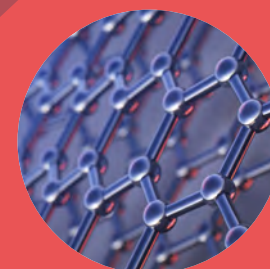
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**TNC23 AND THE
DIGITAL GENERATIONS**

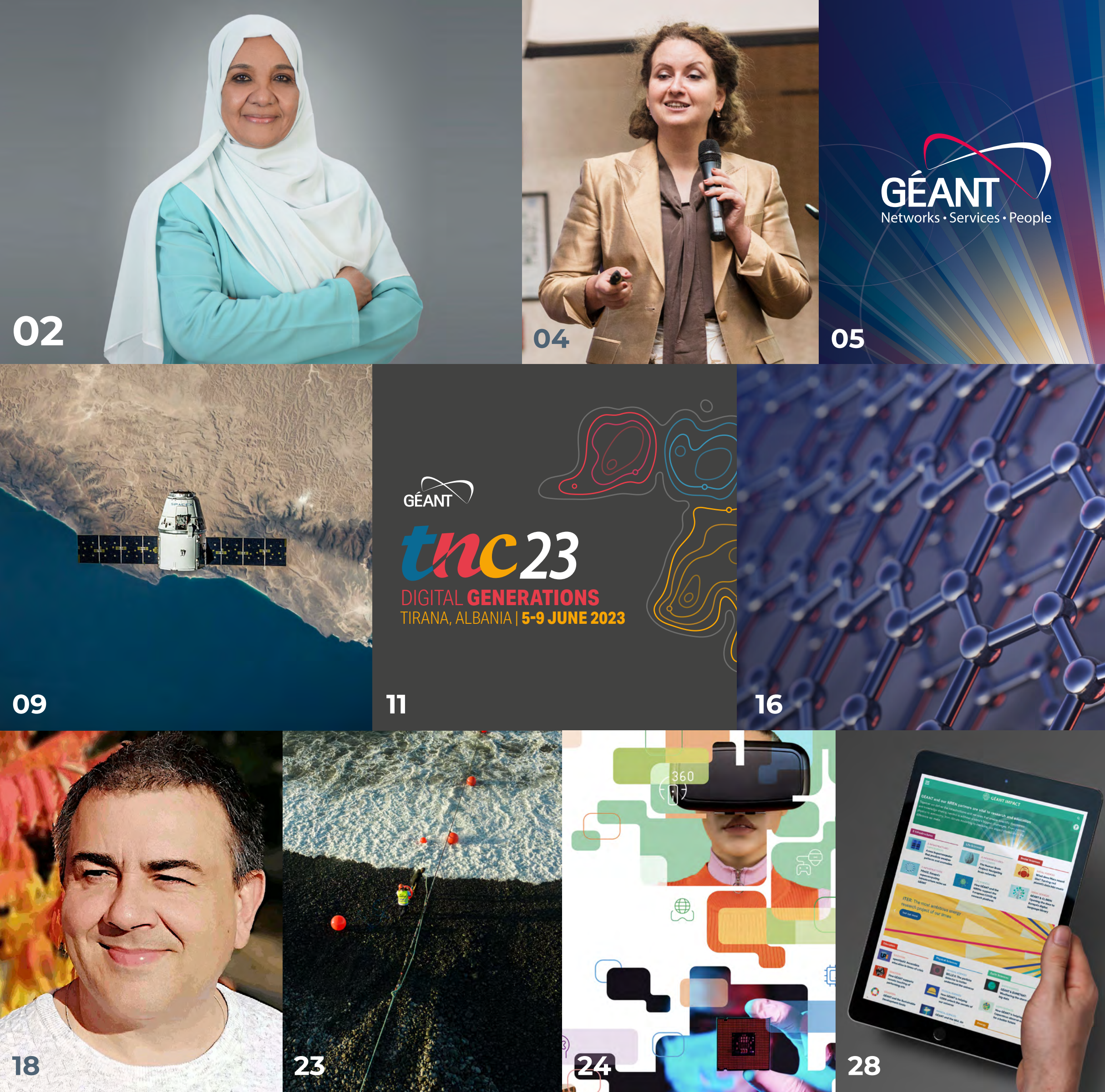


**A NEW ERA FOR THE
GÉANT PROJECT**



THE IMPACT OF OCRE

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Welcome from Cathrin Stöver

GÉANT's Women in STEM campaign is a regular event in our community calendar and it's good to see how every year in March more NRENs around the world engage in this campaign. The interview with Dr. Bilge Demirköz, Professor of Astro-Particle Physics at Middle East Technical University in Turkey (page 4) is again a testimonial on how hard-working, creative, and ambitious women have to be in order to succeed in the

field. And her description of how bullying and harassment on social media make life even more difficult than ever for girls who stand out is very sobering indeed. It is a pity that so many of us need so much strength to focus on what Bilge calls "nature's delights" and shut out the toxic noise. I am glad that with Dr. Bilge Demirköz we have a model of strength and determination to follow.

Another strong woman in STEM and a female pioneer of our community is Dr. Iman Abdelrahman. Iman looks back at her career in Sudan, as Head of the ICT Directorate at the Sudanese Ministry of Higher Education, Founder and CEO of Sudan's national REN, SudREN, Deputy Chair of the UbuntuNet Alliance, and Sudan's Country Coordinator at the Electronic Information for Libraries (page 2). I have always been in awe of

Iman's energy, will to achieve, and readiness to overcome obstacles. It is inspiring to read her words of encouragement.

For more on our #WomeninSTEM campaign, please make sure to follow us on social media throughout March - Women's History Month. We bring together outstanding female representatives from the international GÉANT community to celebrate their contributions and to empower future generations.

This issue of CONNECT features another really interesting thought piece from the Italian NREN, GARR. On pages 20 and 21, GARR's Director Claudia Batista explores the question whether we really know what

we are buying when we turn to public clouds. She offers a handbook to help research network users make an informed choice of public cloud services and avoid nasty surprises.

And it's always great to see when an NREN shares their success stories with us: CESNET, the NREN in the Czech Republic, received the Industry award from IDEA StatiCa, awarded for company innovation as part of the Czech Head award, the country's highest scientific acknowledgement. The team was awarded for their solution for video and audio transmission via a computer network across large distances with exceptionally low time latency, named Modular Video Transmission Platform (MVTP). Congratulations! Make sure to read the interview with Dr. Sven Ubik on page 25.

Last not least – TNC23 in Tirana, Albania and hosted by our partner RASH is coming up! Make best use of Early Bird registration until 26 March 2023 and join us in Tirana from 5 to 9 June 2023! As the Chair of this year's programme committee, Ann Harding, from SWITCH, says: "This year we have some excellent content for everyone. My inner nerd is very happy with deep technical sessions in T&I, networking, and security. There's some impressive innovation to be seen. We also were overwhelmed by the choice of papers highlighting how the community is working to support research and education!" It will be yet another great event!

Until Tirana! And thanks for reading!

Cathrin Stöver, 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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This magazine is published by GÉANT, as part of GÉANT projects GN5-1 and GN5-IC1, which have received funding from the European Union.

The following projects that may be mentioned in the newsletter also receive funding from the European Union: AfricaConnect3 (DG INTPA) and EaPConnect (EU4Digital).

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CONNECT Interview:

Dr Iman Abdelrahman,

founder of SudREN

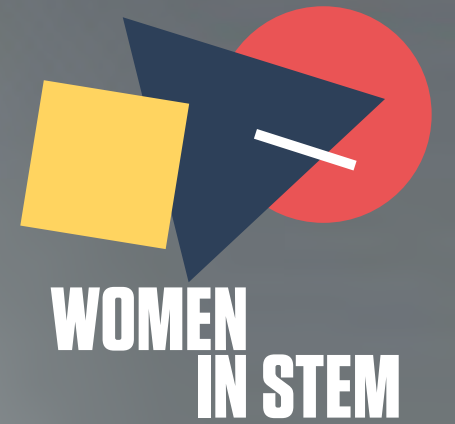
Interview by: Silvia Fiore, GÉANT

Iman, you have a long list of achievements: Head of the ICT Directorate at the Sudanese Ministry of Higher Education, Founder and CEO of Sudan's national REN, SudREN, Deputy Chair of the UbuntuNet Alliance, and Sudan's Country Coordinator at the Electronic Information for Libraries (EIFL), among many others. You have also been awarded the 2015 Sudanese "Distinguished Arab Woman Engineer" award. How did you make all of this happen?

My work has always been my baby and I have always given it my time, care, and love. Balancing between my career, my family, and my social responsibilities was an objective which I managed to accomplish. I certainly got support from my parents, my husband, and my kids.

A moment that had a great impact on my career was joining the UbuntuNet Alliance and the AfricaConnect project. I was inspired by wonderful ladies, such as Mrs Margaret Ngwira, the co-founder of UbuntuNet Alliance, who was always full of hope and love for Africa. I was also lucky to work with and learn from Mrs Cathrin Stöver, Chief Communications Officer at GÉANT, who was always energetic, well organised, and a successful leader with her nice character. They both were role models for me. I got real support and encouragement from Dr Francis Tusubira, the former CEO of UbuntuNet Alliance with his optimistic character. I learnt from him that being strong and self-confident is the key to success. I also got support and learned a lot from Dr Duncan Martin, the former CEO of TENET and Prof Meoli Kashorda, the CEO of KENET. All these people generously shared with me all the knowledge and experiences they had to help me build a successful NREN for Sudan.

And I could not forget the young ambitious staff at the UbuntuNet Alliance, Beatrice Ng'ambi, Tiwonge Banda, and Hastings Ndebvu. They have worked there from the very early stages of the network and contributed greatly to its success.





Can you tell us more about your role in establishing SudREN?

In 2007, Prof Abdelrahim from the Faculty of Medicine at the University of Khartoum invited me to participate in a meeting of the UbuntuNet Alliance, where I saw for the first time the UbuntuNet map with the network connections between NRENs in East and Southern Africa. It was also the first time for me to hear about the AfricaConnect project and to see how it connects the continent's networks to the global research and education community via GÉANT. There I gave a presentation about the Sudanese Universities Information Network (SUIN) and everyone was surprised to hear that the network connected 27 public universities via an old copper technology served with a very poor Internet speed in kbps, with a technical staff of only two engineers!

Prof Bjorn Pehrson of the Swedish Royal Institute of Technology, who was working in the first feasibility study for the AfricaConnect project, gave me a

list of requirements for SUIN to join the project. I realised at that time that SUIN was not a real NREN, and a lot of work would be needed for it to become one. So, I returned to my country with a dream and a vision for SUIN to be at the level of TENET in South Africa or KENET in Kenya and to join the project. I took that list of requirements, and I submitted a proposal to the head of the Universal Fund Department to get a governmental fund for establishing the last mile connections for all Sudanese Universities in an optical fiber network. The request for that fund was approved immediately! Then, I went into a series of negotiations with the Telecom companies and got an offer for a fifth of the commercial price for the Mbps/month, which was affordable for the universities. Thanks to the AfricaConnect project, my staff joined a series of training sessions, and eventually contributed to the improvement of the network. At the end of 2009, SudREN was born and registered as a NGO under the Association of Sudanese Universities!

For the next eight years, SudREN was a membership-based organisation, with a board elected by its member institutions, with 13 qualified members of staff and a sustainable business plan. Its membership reached 102 member institutions comprising all the Sudanese public and private universities, research institutions, colleges, and academies. In 2015, SudREN was classified as an operational NREN in the maturity model in the World Bank report by Michael Foley.

Then in 2017, it was taken over by the Sudanese government and eventually lost its success factors, such as its governance model and highly capable technical staff. SudREN is now a governmental organisation that adheres to restrictive regulations and laws. In my opinion, it is not an easy task for SudREN to be revived successfully, as it requires the dedication of significant resources and project management, and certainly the goodwill and support from its member institutions and the government.

Picture
Staff of the
University of
Khartoum
celebrating
International
Women's day

As Sudan's Country Coordinator at EIFL, you have been advocating for a collaborative relationship between NRENs and library consortia. How have libraries become so crucial for the African research and education community and what is their role nowadays?

NRENs and their member institutions in Africa and across the globe work to address their end users' needs and provide them with the necessary services they require. Librarians can help with this because they already have direct contact with the very users NRENs want to reach – students, researchers, and academic staff - and already work to build a strong and vibrant community. So, there is no doubt that libraries are crucial for the African R&E communities, and they should build a strong partnership with them.

SudREN joined EIFL in 2007 and since then its member institutions have been able to access various commercial e-resources for free via the IP addresses deployed by SudREN, and that was one of the most important services provided to the members. The libraries in Sudan also benefited a lot from EIFL's Open Access program and training workshops.

Given my experience with the librarians' community and as former CEO of SudREN, I was invited by Omo Oaiya to join LIBSENSE. Libraries are crucial for NRENs, and the LIBSENSE initiative advocates for a great model. It aims at building a community of practice for Open Science and to provide free access to scholarly content. I believe that

this great project is a good example of collaboration between libraries and NRENs and that it is making very fast steps towards achieving its goals through its working groups focusing on policies, infrastructure and capacity building.

In a previous interview published in CONNECT20, you say that the community needed “a human network with the same goal, the same ambition, the same dream” and that AfricaConnect2 would have provided that. Now that the EU co-funded project has reached its third phase, what progress do you see?

Today, after 12 years from the first project phase of AfricaConnect, I can say that most of our dreams came true! The connectivity map shows the amazing progress in covering most regions in Africa and the Arab world, and the project is providing shared services with high speed and reliable internet connectivity. It is also wonderful to read about the continuous successes in strengthening the human resources capacities at different levels across the NREN community even during the COVID-19 pandemic.

All these achievements are evidence of the successful collaboration between the project partners: the European Commission, GÉANT, and the three regional partners in the continent – the UbuntuNet Alliance, WACREN, and ASREN - with the collaboration of regional and national support bodies. Although the partners come from different corners of the world and therefore have cultural

differences, they share the same goal, ambition, and the same dream which led to building one big family that works together with dedication to achieve the goals of the project. That would not have happened without good leadership. I believe that the pioneers of the AfricaConnect project - Cathrin Stöver and Francis Tusubira - and the CEOs of the three RRENs - Prof. Madara Ogot of the UbuntuNet Alliance, Boubakar Barry of WACREN, and Yousef Torman of ASREN - played a vital role in these achievements.

You are a true female role model in STEM. Tell us, what is your secret?

In Africa and other regions in the world, women undertaking a career in STEM are facing significant societal challenges. Studying to become an engineer, for example, is considered a threat to the stereotypes of women being at home handling household tasks. However, I believe that any woman in STEM is responsible for changing that misconception and can build an image for herself and plan for her life accordingly! I also believe that the image you build for yourself in your own mirror is the image that others will come to see!

So, I advise young women in STEM to always think of themselves as a successful, powerful, self-confident, hard-working, and well-organised woman and work to make it become a reality. Then, success will certainly follow.

To learn more about the current phase of the AfricaConnect project, visit <https://africaconnect3.net>

CONNECT Interview:

Bilge Demirköz,

Professor of Astro-Particle Physics at Middle East Technical University (METU), Turkey

Interview by: Rosanna Norman, GÉANT

Professor Demirköz, could you share some highlights of your EaPEC 2022 closing keynote: ‘A prelude to a long journey: from Big Data to Scientific Wisdom’?

For this talk I joined physics and philosophy in a public space for the first time. I was aware that I was taking a risk because I didn't know how it would resonate with the audience, but after the positive feedback received I am pleased I took this chance. The EaPEC 2022 keynote experience encouraged me to hold a very similar talk, this time in Turkish and in front of a local audience, at the Turkish Academy of Science in December 2022.

This talk stems from the observation that data becomes knowledge, but at some point it must also become wisdom. So, how do we humanise or understand the human level of all this vast knowledge? For instance, CERN produces an incredible amount of data to the tune of petabytes per year, this data is then turned into physical knowledge, but there is also a lot of learning that goes into the process of doing physics.

Click [here](#), to watch Bilge Demirköz's closing keynote presentation at EaPEC 2022 on 29 September 2022.

EaPEC 2022's theme was Building Connections. What is your take on this theme and how does it relate to your experience as a scientist involved in large-scale international collaborations?

In my view building connections comes in three flavours: the simple act of going somewhere and having one-to-one physical connections; then connecting as scientists to discuss and explore new ideas and projects together; and the cultural connection, as we live the culture and share the value system that affects and shapes our society. I loved my time in Baku and I enjoyed attending EaPEC 2022, not only for the many stimulating discussions and conversations, but also for the exposure to the local culture.

During my years at CERN I experienced not only a deep cultural connection with my colleagues and friends but, most importantly, strong kinship, solidarity, and lasting friendship. Together we lived and breathed science almost 24x7 and through mutual support and collaboration we were able to achieve heights that none of us could have reached working independently.

You are considered a role model for the next generation of scientists in Turkey. What motivated you to become such a committed science outreach activist and educator in your country?

I know my limitations as a role model: I graduated in the USA from MIT and my PhD is from Oxford, so I realise that I have been privileged in my career. I believe that the next generation of scientists in Turkey should find in our country a similar quality of education as offered by MIT and Oxbridge.

Only then I believe that 'we will have won the fight for enlightenment'. We cannot continue to be dependent on international education, we need our own home education system to be more competitive, we need to produce – here at home – science and education that can have international impact.

International collaborations which follow the motto "science for peace" are fundamental in developing the understanding between humans. In 1997 I left Turkey for MIT and I believe we have come a long way in 26 years: the number of research opportunities in Turkey has increased at least tenfold, we are on the right track, but we still have a long way to go.

My dream is to break into the top 100 universities, and many things need to change before we achieve that, hence I am working to increase research opportunities and build more connections between my students and the international research communities. Providing good education opportunities to everyone around the world locally is vital for social justice and we are ever so closer to it with increasing internet connectivity.

As a female scientist in a highly technical field, what advice would you give to girls who aspire to work in science?

This is the era of digital generations with 24x7 digital access but imagine that my school had its first internet connection in 1995 and I was one of the first students to send an email! I am appalled by the amount of online harassment, mobbing, trolling, and bullying that especially girls, but young people in general, experience online on a daily basis. It never stops. In my days I stood out, I was a nerd, I was different, but the bullying I experienced was verbal and direct, it was not anonymous and inevitably stopped when I went back home. I also believe that this constant online exposure and digital bombardment is severely affecting the capacity to concentrate for young people and adults alike.

My role model was a maths teacher, Mr Selim Tezel, he was very encouraging and sympathetic, he believed in me and enabled me to explore complex problem solving and additional challenges to meet my learning needs.

I truly believe that girls are as capable as boys, as long as they set their mind to achieve what they want. Ignoring the bullying and the

harassment is easier said than done. The key to resilience is understanding that bullying does not stem from one's identity or unique behaviour but the other's wish to intimidate, scare, and ultimately weaken the competition. So, I would say keep your mind busy with maths, science, and arts, what I would call nature's delights, so much that all the bullying sounds only like a distant mosquito nest.

What's around the corner for Professor Demirköz?

The recent geopolitical events and their global repercussions in every sphere of our lives have shaken us all to the core and affected us deeply. I have also felt the impact of this and have been reflecting on the future direction of my research projects and collaborations. Although I plan to take a moment to reflect and regroup, I definitely intend to continue trying to be a source of inspiration for my students and focus on the needs of science in Turkey. On a more personal level I have started studying French again and hope to deepen my knowledge of a language and culture that has always fascinated me.

Visit <https://eapconnect.eu/>



Writer's note: "I had the privilege to meet Professor Demirköz in Baku and attend her closing keynote at the EaPEC conference in September 2022. Bilge is a true scientist at heart, she's very inspiring, and has the ability to connect with her audience with great natural charisma."

A new era for the GÉANT Project

GN5-1 and its sister project GN5-IC1 (see page 7) are the first two projects under GN5-FPA, the 7-year strategic framework under Horizon Europe – the EU's key funding programme for research and innovation.

Words by: Paul Maurice, GÉANT



The 24-month GN5-1 project is the latest phase of the long-running and highly successful GÉANT Project that, in close collaboration with the European Commission, has supported Europe's research and education communities for over 20 years.

The project's mission is to provide scientists, researchers, and students secure access to the world's most advanced connectivity and collaboration services, enabling effective and secure collaboration within virtual research communities around the world.

Vast research initiatives often involving hundreds of participants across multiple countries utilising advanced computing facilities, continue to rely on the infrastructure provided by GÉANT and its NREN partners, in areas as diverse as climate change, medicine, and energy research.

“Europe’s research environment is becoming increasingly diverse, with multiple disciplines and data types brought about by the new data spaces and applications. GN5-1 is fundamental to this environment and the evolution of Open Science, linking researchers in vast projects such as the LHC, eVLBI, the Square Kilometre Array, the Human Brain Project, and Destination Earth to advanced High-Performance Computing resources, so they can focus on the ground-breaking innovation that brings socio-economic benefits for all of Europe.”

GÉANT's Chief Programme Officer, Matthew Scott

The GÉANT Project: a history of success

Benefiting from the continued support and commitment of the EC, the GÉANT Project has grown during its many iterations (GN1, GN2, GN3, GN3plus, GN4-1, GN4-2, and GN4-3/N) to incorporate not just the award-winning pan-European network, but also a catalogue of advanced, user-focused services, and a successful programme of innovation that is pushing the boundaries of networking technology to deliver real impact to over 50 million users.

What does GN5-1 look like?

GN5-1 is arranged around nine Work Packages covering 42 Tasks:

1. WP1 Project Management
2. WP2 Marketing Communications, Events, and Policy Engagement
3. WP3 User and Stakeholder Engagement
4. WP4 Above the Net Services
5. WP5 Trust & Identity Services Evolution and Delivery
6. WP6 Network Development
7. WP7 Network Core Infrastructure, Core Service Evolution, and Operations
8. WP8 Security
9. WP9 Operations Support

Interconnecting with GN5-1 are sister projects GN5-IC1 and GN4-3N (which continues until the end of 2023).



Learn more about the GÉANT Project's history of success

37 Partners
(including GÉANT Association),
2 Associated Partners
(SWITCH, Jisc),
43 countries

€ Total Costs:
€82.64M,
of which EC funding:
€55M

Behind the facts and figures are hundreds of people representing over 200 FTEs (full time equivalents) from 43 countries, and it is these people who will strive to deliver against GN5-1's objectives. Together, we are proud to be part of the GÉANT project!

What is the GN5 Framework Partnership Agreement (FPA)?

The GN5-FPA is a seven-year programme agreed with the EC and the NRENs under Horizon Europe. It includes six core action areas, to be delivered over a series of projects starting with GN5-1 and GN5-IC1.

- Action A: Understand and respond to the requirements of R&E communities.
- Action B: Evolve the Communications Commons towards data-driven research and education.
- Action C: Deliver state-of-the-art network connectivity and operational excellence.
- Action D: Deliver interoperable and distributed trust and identity infrastructure, security, and above-the-net services, and procurement.
- Action E: Ensure innovation of key infrastructures and service development as an indispensable part of the GÉANT partnership.
- Action F: Strengthen the collaborative ecosystem of GÉANT and the NRENs and develop the human capital of the GÉANT partnership.



The GN5-IC1 project aims to extend and secure the global reach of the GÉANT network. Leonardo Marino, Task Leader for Communications and Dissemination, speaks with project members about various aspects of the project.

Interviewees (all from GÉANT): Veronika Di Luna, GN5-IC1 Project Manager; Sebastiano Buscaglione, GN5-IC1 TL Planning and Method Development; Tom Fryer, GN5-IC1 TL Intercontinental Partner Engagement and User Need Assessment; Fedor Bruinewoud, GN5-IC1 TL Procurement.

Can you explain briefly what the GN5-IC1 project is and what it plans to achieve?

Veronika Di Luna: GN5-IC1 is a new project in GÉANT's portfolio. It's part of the GN5 Framework Partnership Agreement in Horizon Europe, and sister project to GN5-1. Its ambition is to plan and implement a first set of intercontinental connectivity investments, as well as to put in place a mid- to long-term investment plan for GÉANT.

So, why is GÉANT upgrading its intercontinental connectivity? And why do we need GN5-IC1?

Tom Fryer: With 25% of traffic across the GÉANT backbone either being destined for, or having an origin outside of the GÉANT membership, intercontinental connectivity is an important part of our strategy.

Historically, we worked on a regional basis, collaborating with individual organisations on their needs for connectivity with GÉANT and then gradually establishing additional arrangements for backup. What we have been missing however is a close and complete analysis of the overall intercontinental connectivity we have in place, of backup arrangements, of potential risks, of the contracts' duration, and finally of the gaps that we need to fill. That's where GN5-IC1 comes in: this project will produce a reference topology to help us have a clear view of how our connectivity should be developed and what should be prioritised.

Sebastiano Buscaglione: GN5-IC1 offers us a good opportunity to improve the state of our network. Currently, GÉANT is paying directly only for a small amount of the connectivity that finally lands on the GÉANT network. We now want to participate more actively and have more control on how connectivity between GÉANT and the other world regions is achieved.

Veronika: Ultimately, we need the GN5-IC1 project in the same way we as citizens always require better infrastructure of any type: to enhance collaboration, foster mobility, and improve the exchange of ideas. Specifically, GN5-IC1 will help to progress research and education on a global scale.

The project only started a few months ago, but you have already been quite busy. Can you explain what has been done so far and what we can expect in the next few months?

Fedor Bruinewoud: Well, our preparatory work actually started earlier. Due to expiring contracts, we had an urgency to renew connectivity to the Asia-Pacific region, which is one of the regions we exchange the most traffic with, together with North America. In order to do that, before summer 2022 we engaged with the market and had conference calls with providers to explain what we do, our intentions and objectives, and finally to collaborate in preparation for our upcoming tender.

As a result, we are now establishing new connectivity between our backbone network in Marseille and Singapore, with a 100G leased line, based on a seven-year IRU (Indefeasible Right of Use) with the option of a three-year extension. This will also allow us to renew connectivity with our Chinese partner CSTNET, who will provide an equivalent link from Beijing to Singapore, with the resulting interconnection replacing the existing 10Gbps GÉANT-CSTNET link.

The second major part of our work will be transatlantic, and specifically an upgrade of connectivity between North America and our European backbone network. In the first quarter of 2023, we are engaging with infrastructure providers to discuss obtaining terabit capacity, preferably via a spectrum solution.

Sebastiano: I believe that what we are setting up under GN5-IC1 with North America is going to be a game-changer for the connectivity between the two continents. Obtaining spectrum will mean having terabit capacity, and potentially controlled costs over a term of at least 15 years. That is quite a big change from where we are today.

Picture

From left to right: Munyaradzi Shahwe, GN5-IC1 TL Finance; Tom Fryer, GN5-IC1 TL Intercontinental Partner Engagement and User Need Assessment; Veronika Di Luna, GN5-IC1 Project Manager; Fedor Bruinewoud, GN5-IC1 TL Procurement; Leonardo Marino, GN5-1 TL Communications and Dissemination; Sebastiano Buscaglione, GN5-IC1 TL Planning and Method Development. Not in the picture: Michael Sharp, GN5-IC1 TL Implementation.

Why did you decide to target the regions of the Asia-Pacific and of North America in this first phase? What is the rationale behind your decisions?

Sebastiano: It's natural for us to start from those two regions if we consider that 75% of GÉANT's intercontinental traffic goes toward North America and 19% goes to the Asia-Pacific region, and that we already have in place a big investment towards Latin America via the BELLA programme.

Tom: Our long-term planning will result instead from the reference topology that we're aiming to produce. Of course, this work will require continuous revisions and updates, as it will be laying the groundwork for a future beyond the end of the project.

The key will be understanding the user needs. That requires our own understanding of big science projects, of where the infrastructure is, where the collaborations are, and what we predict the data flows are going to be. And this goes above and beyond our forecast of around 30-35% average growth in our intercontinental traffic year on year. In particular, we will need to cater for new projects on which we are expecting larger steps in growth, in fields like astronomy, fusion science research, or with the High Luminosity LHC coming online, which will significantly increase traffic.

We will also speak to the European NRENs to find out about specific collaborations that will need support, and at the same time we will work with our research engagement, partner relations, and international relations teams to get the full picture from our international partners. Finally, the NIAC (Network Infrastructure Advisory Committee)

will support us in our decisions, advising on our priorities and longer-term planning.

What would you say is the key strength of this project?

Fedor: Building on the supplier relationships obtained during the GN4-3N project. That makes it easier to engage with them and to explain our objectives and how we would like to achieve them.

Veronika: For me the real strength of GN5-IC1 lies in this team. Task leads have been either an integral part of GN4-3N or BELLA, and GN5-IC1 will build on that experience.

Tom: I agree with Veronika, I'm already enjoying very much the collaboration with this team. We're a relatively small group, but we complement each other very well and we have lots of support from our respective teams within GÉANT.

Why is this project a paradigm shift for GÉANT's Intercontinental Connectivity?

Sebastiano: I think that the biggest shift with GN5-IC1 is on the long-term perspective with regards to acquiring connectivity infrastructure to other world regions. Historically we have had a pay-as-you-grow model, acquiring connectivity from the market as we needed it, based on shorter-term contracts.

In our environment however, we can have the privilege to look at the long-term perspective, because we support big science projects that are generally long-term endeavours. As we saw in GN4-3N, looking at the longer-term perspective enables us to optimise our infrastructure differently, better, and with less constraints.

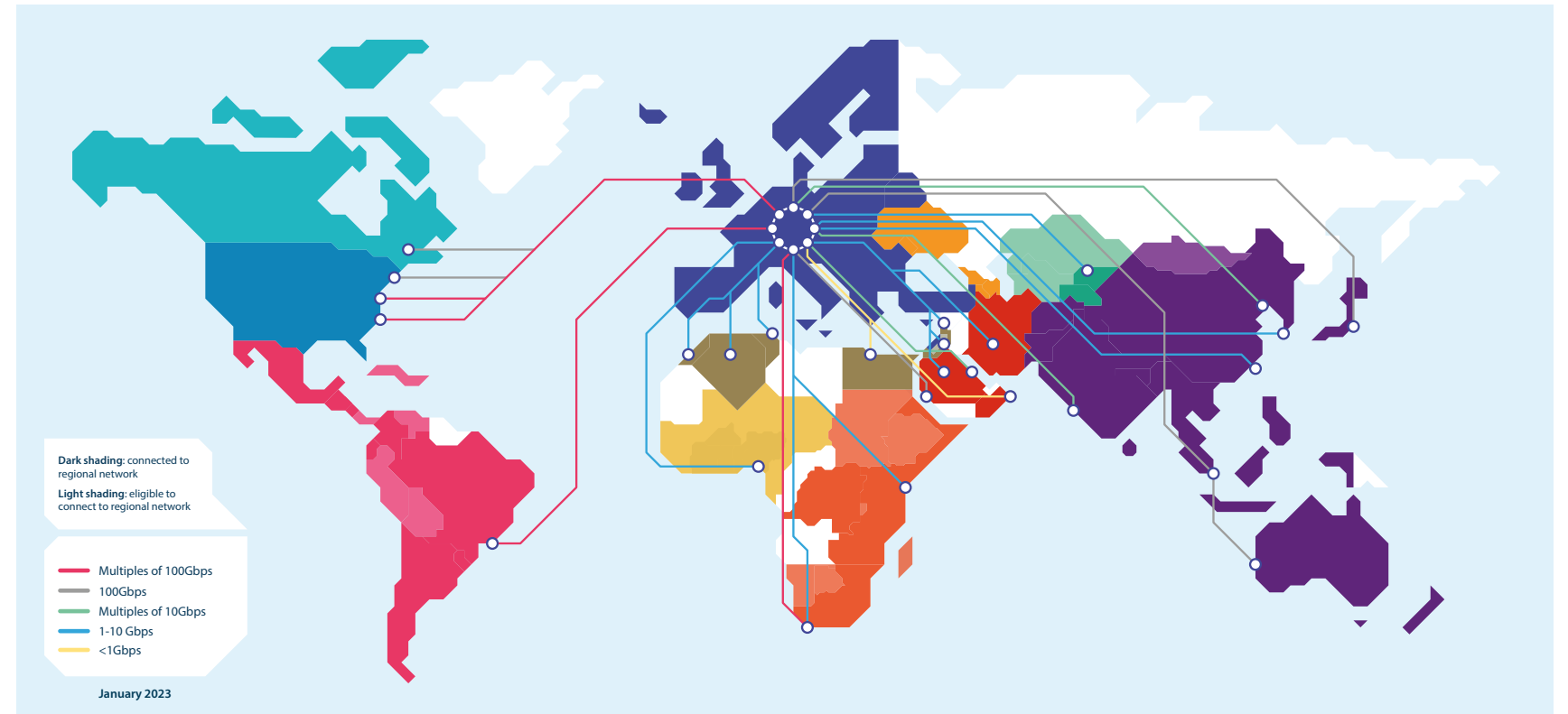
Tom: Additionally, understanding the connectivity needs for the next 10-15 years – or potentially even longer – will help us guide conversations towards future funding, be it via GN5, or through separate programmes such as Global Digital Gateway programmes, which are also looking at longer-term connectivity and at European ownership of that connectivity.

Veronika: I also think that GÉANT has now matured to a stage in which we are able to make big long-term investments on intercontinental links. Through GN5-IC1, GN4-3N, international projects as BELLA, EaPConnect, and AfricaConnect, and potentially in EC Global Gateway endeavours, such as the Medusa submarine cable system in the Mediterranean, we are gaining expertise, knowledge, and exposure. It's thanks to this know-how that GÉANT is increasingly a trusted partner of the EC for R&E connectivity.

How will you ensure long term-sustainability of the new routes?

Sebastiano: We will invest in places where we have many opportunities to leverage investments. There is not just one reason for getting to a place: we will choose locations where we expect to have a need in connectivity and favour big international hubs so that over time, we will have the opportunity to leverage connectivity through different projects and we will have different means to connect various regional networks.

Moving to IRU is another key point for long-term sustainability: with a substantial CapEx (Capital Expenditure) investment at the start, the OpEx cost (Operating Expenditure) will then become significantly lower than when buying



Picture
GÉANT global connectivity map. For a bigger version, go to [page 28](#)

short-term. Fixing the contract costs for 15 years will allow us to plan accordingly, provide us with security in term of costs, and protect us from market fluctuations.

Fedor: Another fundamental aspect is securing spectral bandwidth and making use of the advantages of future technology, by increasing capacity over time over the same bandwidth.

Sebastiano: We're trying to make investments that are as technology-agnostic as possible. That's why we are acquiring spectrum: because by allowing to run different types of technologies on top of it, it has the potential to remain valid over time.

Is there anything that you're particularly looking forward to in this project?

Fedor: I'm personally really looking forward to engaging with

the providers on our transatlantic connectivity. We have now provided them with a high-level overview of what we would like to achieve, but the solutions they will propose will need further discussions and iterations before we can go to tender. Ultimately through this project, I would like us to be able to shortlist a number of providers to work in close cooperation with, all offering different types of solutions that can fit us.

Sebastiano: For me a very interesting aspect is that, following from our work in projects as GN4-3N, BELLA, EaPConnect, this project will continue to raise our profile as an investor in connectivity. We inevitably spend a lot of money in connectivity already. But with GN5-IC1 rather than being only a pay-as-you-grow customer, GÉANT is increasingly becoming a player within the environment. By being able to sit at the right tables, with the people and companies

designing the infrastructure, and of course thanks to the generous funding provided by the EC, we get the opportunity to effectively make investments that we would never be able to make otherwise. Having this position within the environment is very important and will provide us with interesting opportunities in the future.

Veronika: And for me, well... you know how sometimes you can get to a moment of sudden realisation that you have discovered something new and interesting and unexpected? I think this project has a great potential to make that happen. We're venturing into uncharted territories, and I'm pretty excited about what we could discover through this project.

Check out GÉANT global connectivity map on [page 28](#)



Space technology in the Arab world: The need for cross-country collaboration to achieve SDGs

With 22 states, the Arab region stretches from the Atlantic Ocean in the far west through the Mediterranean Sea and the Red Sea all the way to the Arabian Gulf and Indian Ocean in the far east. Yet, despite the geographical vastness of the region, Arab countries share the same environmental and climate challenges.

Space technology can play a crucial role in informing decision- and policy-makers to address these challenges and contribute to the achievement and progress of the United Nations Sustainable Development Goals (SDGs). More and more Arab states have been taking progressive steps towards the advancement of their national space technology and have launched earth observation satellites. Cost predictions for space technology have recently moved to the top of government budgets and more space agencies are being established across the region.

Words by: Silvia Fiore, GÉANT and Yasmeen Al-Kouz, ASREN



Space technology and remote sensing applications can help predict and solve our environmental and climate challenges

The current climate crisis and the complexity of our planet's ecosystems need real-time data to efficiently target problems and prevent environmental disasters in a timely manner. Here is where space technology can help: by monitoring, mitigating, and providing critical advice for decision-making processes.

For example, remote sensing satellites can monitor marine resources and pollution levels. Satellite sensors can also provide real-time data on the quality of the air, with critical information to improve the population's well-being. Simulations of dust movement show how, and by how much, sand moves in the atmosphere, worsening the conditions of those suffering from respiratory and cardiovascular diseases and putting pressure on the health of the youngest (SDG 3). With sand dunes being a big part of the geography of Arab countries, their movement also poses a serious threat to the safety on the roads, agricultural cultivation, and new development plans. Satellite data allows users to recognise the movement of the sand with a precision range of 2 mm per second and to facilitate the suggestion of alternative routes to travellers, and to increase agricultural productivity and profitability through informed management processes (SDG 2).

Over the course of two years, from 2016 to 2018, a regional study using satellite data recorded nearly 127 oil spills alongside the Moroccan Atlantic Coast polluting the waters and the coastlines of the country and nearly 279 oil spill cases in the Egyptian coastline of the Mediterranean and Red Sea. But oil spills never affect just one country. They quickly become a regional problem and could lead to natural disasters. Satellites can also monitor the cross-border impact of oil spills, providing detailed information about the source of the pollution, such as determining from which oil platform it came and the kind of production (SDG 14).

Space technology can also monitor rising sea levels and their impact on the coastal cultural heritage of Arab countries. For example, in Alexandria simulations were run to test how

different scenarios could impact the city's coastline. The same is true for inland cultural heritage impacted by temperature increases and decreases, flash floods, and droughts. By collecting data even over a small period of time (15-30 days), satellite technology allows users to predict scenarios and inform preventative actions (SDG 15).

Satellites have also helped monitor, in an emergency crisis, the incident of the Ever Given ship stuck in the Suez Canal in 2021, controlling the risk on an hourly basis and suggesting solutions.

These are only a few examples of the many applications of space technology, but the link between using real-time satellite data to improve regional environmental conditions even in the most remote areas, fight the spread of diseases, and overall improve global health is evident. They are key in understanding climate change, preventing natural disasters, and equipping the population with the right tools to make better health decisions. Thanks to the information derived from earth observation and meteorological satellites, space technologies hold the potential to help achieve the SDGs.

Why is regional collaboration important?

All of the challenges and threats mentioned above are shared among the Arab states. They do not affect just one country but the region as a whole, at times also having spill-over effects from one country to another.

To ensure that these challenges are addressed in a timely and efficient way, the Arab Space community needs dedicated training and strategic support to improve industry and research development. With the space industry expected to contribute to Egypt's GDP in the next 10 years, collaboration is needed now more than ever.

There are already a lot of satellites in Egypt, Algeria, UAE, Saudi Arabia, Tunisia, Oman, and Morocco, with many more being launched in the near future. There are also several ongoing projects that are collaborating with some sub-Saharan African countries. For example, the African Development Satellite Initiative (AfDev-Sat) – led by the Egyptian Space Agency (EgSA) with Sudan, Kenya, Uganda, Ghana, and Nigeria – aims at cooperating to detect climate change and enable African countries to build their own space system.

As for every SDG, a country alone cannot dream of fully achieving a target by itself. It is essential to use its individual competitive advantages while joining forces with other countries to share resources and efforts.

How can collaboration happen?

The development of a more united front in the Arab space industry is challenged by bottlenecks such as the lack of awareness of the benefits of space technologies, limited financial support, and technology and skills gaps.

A regional strategy to support this development and regional cooperation has to be developed and should include an improved policy for sharing space infrastructure to run tests, to process and archive data, and overall to promote the region's satellite and rocket launching capabilities. Egypt already has a physical infrastructure in place, for example the Satellite Assembly, Integration and Test Centre (AITC). Human capital development is also a potential collaboration area. Exchanging expertise and organising joint training programmes will allow the building of a solid talent pool of space scientists and engineers in the Arab countries and, eventually, reinforce the region's role in the field. Similarly, sharing space resources and data for regional applications for service development, and establishing regional funding for joint research and innovation programmes are all key to foster economic growth and create new job opportunities (SDG 8).

But for all of this to happen, an enabling environment is needed to find synergies and leverage public-private collaboration and mobilise financial resources as an investment rather than a cost.

At eAGE22 in Cairo, Egypt, Prof Dr Islam Abou El-Magd delivered a keynote on the topic and concluded his presentation with the proposal to initiate regional coordination between the Arab states by developing an earth observation platform to analyse remote sensing data and provide solution to critical issues. Cross-border cooperation in the development of a satellite constellation would be the perfect opportunity to strengthen the space technology in the Arab world and enable flow of data that target the region's needs.

“The advancement of space technology is at maximum and whoever delay will not be able to be in the race. Recently, the total space budget in the Arab region exceeds \$1.5 bn and the region has demonstrated remarkable dynamicity in this technology. Hence, it is the right time for Arab states to coordinate and cooperate in space technology and its applications to meet our regional challenges and improve our socio-economic growth aiming at increasing the revenue from space industry. Egypt is hosting the African Space Agency that will implement the African Space Policy and Strategy to achieve the African Agenda 2063 and the UN SDGs. It is an inspiration to Arab states to follow the steps.”

Prof Dr Islam Abou El-Magd, Executive Vice President of the Egyptian Space Agency and Counsellor for the Minister of Higher Education and Scientific Research for African Affairs and Space Technology

Potential impact of Arab NRENs in space technology

Space technology collects vast amounts of data from satellites and other systems which it stores, analyses and distributes for a wide range of applications including environment protection, agriculture, health, transport, climate change, sustainable development, and emergency response and crisis management.

To ensure the continued distribution of these datasets regionally, the Arab States Research and Education Network (ASREN) and the Arab NRENs can operate as an essential partner, delivering the scalable, robust capacity required to meet the space technology critical parameters, including bandwidth and latency, reliability, and geographical scope.

The Egyptian Space Agency (EgSA) is directly connected via the Ministry of Communications and Information Technology via a 70Gbps link (gigabits per second), connecting researchers and decision makers through the connectivity and data services.

The Egyptian National Scientific and Technical Information Network (ENSTINET) plays a significant role in the connectivity of 12 research centres. Last year, ENSTINET became the official beneficiary partner in Egypt for the European Union's co-funded project AfricaConnect3, which is delivered locally by ASREN. Through the AfricaConnect3 project, ENSTINET will be provided with a high-capacity international internet connectivity for academic and scientific collaborations connecting the research and education communities in Egypt with the pan-European GÉANT network and the rest of the world. This important partnership can significantly enhance space technology field activities in Egypt and help researchers and policy makers improve their decision-making, which could have dramatic benefits for society.



Picture Credits to ts: Kehinde Temitope Odutayo, iStock

About the Egyptian Space Agency (EgSA)

EgSA is a Governmental Organization that's aiming at acquiring Space Technology and Satellite Launching capabilities towards the accomplishment of The National Sustainable Development Strategy "Egypt-SDS 2030" objectives. The agency is targeting the promotion of the peaceful use of space, develop space systems at the national level through investment in human capital development, leveraging the space industry for a sustainable future, supporting research and development, drive innovations, and enhancing space outreach developing of reliable, responsive and viable economical solutions to serve the national objectives.

About the Egyptian National Scientific and Technical Information Network (ENSTINET)

ENSTINET is a public information services organization which manage, operate, monitor and further develop the Egyptian National Research and Education Network. Its objective is to assist Egyptian problem solvers and decision makers to access and apply quality data and relevant current information to development. ENSTINET is operated by the Academy of Scientific Research and Technology (ASRT), which is the national umbrella for the planning of scientific research activities in Egypt.

**tnc23**

TNC23 and the Digital Generations

TNC23 will take place in Albania's capital, Tirana, from 5-9 June and will be hosted by RASH, the National Research and Education Network of Albania. Early Bird Registration opened on 23 January and the preliminary programme is already live.

Ann Harding, Team Lead from SWITCH and Chair of the TNC23 Programme Committee told us: "It's a tough two days putting together the TNC23 programme and always bittersweet as we have to decline some things we've loved. This year we have some excellent content for everyone. My inner nerd is very happy with deep technical sessions in T&I, networking, and security. There's some impressive innovation to be seen. We also were overwhelmed by the choice of papers highlighting how the community is working to support research and education and managed to squeeze in one or two additional sessions to reflect this. And, last but not least, the keynotes have a particularly strong link to the main programme themes this year. Well known community partners and some new faces will give us plenty to think about."

Words by: Rosanna Norman, GÉANT



What's on at TNC23

This year's programme provides a comprehensive snapshot of the activities, projects, interests, and trends of the global R&E networking community. To give you a taste of the content that TNC23 has in store for us, here are some of the most intriguing session titles: 'All data big and small', 'Robots rule the world', 'If it was easy we would have done it by now', 'Dreaming of electric sheep' and a favourite of mine: 'You wanted the bike, now you need to pedal'. If these titles have left you intrigued and curious to find out more, remember that you can still take advantage of the Early Bird Registration until 26 March.

Check the four key speakers who will step on the TNC23 stage in Tirana on the top right banner.

Digital Generations

We often hear the term 'digital natives' to describe a person who has grown up in the information age, but we are all living in that age – we are all the digital generations. Serving all digital generations is a challenge that NRENs must face, from building innovative educational experiences to supporting advanced research projects that have spanned decades. TNC23 will be the perfect opportunity to reflect on how we engage digital generations and to reflect on how we are integrating future generations into our own organisations and infrastructure.

"RASH's involvement in TNC23 marks a pivotal moment in our history, as it demonstrates the commitment to progress and the willingness to embrace new ideas and innovations. By hosting such a conference for the first time, we are sending a message to the world that we are open, dynamic, and ready to take on the challenges of the future. This event will provide a platform for individuals and organisations to come together, exchange ideas, and make meaningful connections that will drive growth and development in our Albania for years to come."

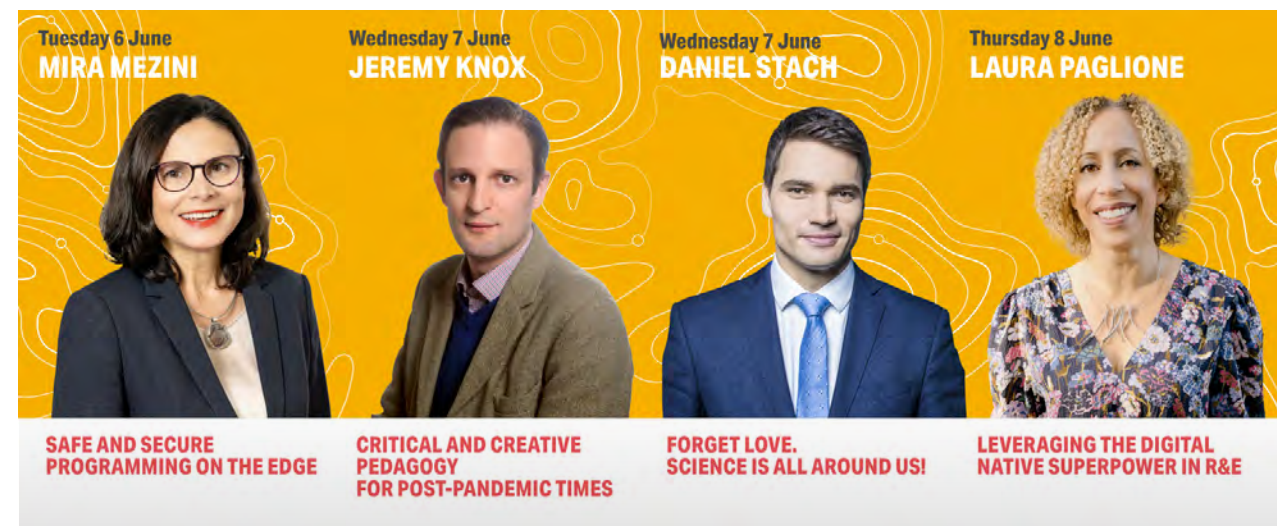
Arjan Xhelaj, General Director, RASH



About RASH

Established in 2007 following an Agreement between Albania and Italy, in 2011 RASH started operating nationally and in 2012 at international level becoming a full member of the GÉANT Association. In 2018, following an agreement between all the rectors and the Ministry of Education of Albania, RASH became an autonomous inter-institutional R&D centre for ICT.

RASH has developed in-house 10 software platforms for Higher Education and the NREN also builds and manages the academic network backbone and campus networks for public universities and research institutions in Albania. Its e-infrastructure is connected to the GÉANT network and RASH has also deployed in the country several GÉANT services supporting all scientific disciplines.



2023 Community Award

The GÉANT Community Award is a sign of recognition for the individual efforts that make up our community collaborations. It is presented every year at TNC and, according to tradition, this year's award will be presented on the opening day of TNC23.

How does the voting process work?

- Nominations closed on 28 February 2023 and were submitted via an online form on the GÉANT Community website.
- A shortlist of nominees selected by the award panel will be published on the GÉANT Community website in March 2023
- The community can then vote for their favourite nominee from the shortlist.

Visit the Community Award pages on the **GÉANT Community site** for further information on award categories and eligibility or contact the organisers at communityawards@list.geant.org.

Emerging NREN Programme – Participation and synergies

The Emerging NREN Programme aims to integrate individuals from emerging NRENs from across the world into the TNC community and create further synergies and connections at different organisational levels between European and international NRENs. Its purpose is to bring to TNC NREN staff members who would not be able to participate otherwise, focusing particularly on engineering and technical personnel.

ENP participants who attend TNC23 can take advantage of a tailor-made programme, where they are paired with GÉANT community members based on common professional backgrounds in order to facilitate informal dialogue between individuals sharing the same interests.

The objective of this experience is to make TNC participation more relevant and impactful by providing the opportunity to strengthen and enrich the NREN community and build new relationships. Representatives of the GÉANT community also benefit from the exchange as it enhances their understanding of NRENs around the world by listening to different perspectives on needs and challenges.

For further information about the ENP at TNC23, please contact **Leila Dekkar**, International Relations Project Manager for GÉANT

Future Talent Programme - Opportunities and impact

The Future Talent Programme gives students and young professionals from GÉANT-affiliated organisations the opportunity to receive expert presentation coaching and to present Lightning Talks at TNC23. Nominated by GÉANT project partners, participants receive training to help them master presentation skills and prepare for and deliver an impactful presentation.

For further information about the FTP, please contact the GÉANT Learning and Development Team glad@geant.org

TNC for the first time?

The largest and most prestigious research and education networking conference, TNC attracts a truly diverse audience of over 800 participants from more than 70 countries, representing national and regional research and education networks, schools and universities, technology providers, and many of the world's most exciting scientific projects. By bringing together decision-makers, networking and security specialists, identity and access management experts, researchers, academics, and students, TNC offers a unique collaborative experience.



GÉANT Community Code of Conduct

The GÉANT community is built on strong and consistent values, and one of those is Trust. It permeates everything we all collectively do, and the community doesn't really work without it.

Words: Paul Maurice, GÉANT

Throughout the community, dozens of events both online and face-to-face take place, mailing lists and forums provide areas for collaboration, and conversations whether formal or informal, one-to-one or within a large meeting, are a natural part of our day.

For many years this environment has been welcoming, collaborative, positive, and inclusive. And remains so. Therefore, with the introduction of the Code of Conduct, we are not addressing any particular issues but instead seeking to strengthen and protect that environment for the benefit of all members of the community.

What is the Code of Conduct?

GÉANT is dedicated to providing a positive and collaborative experience for all members of the community. Our aim is for participants to feel safe, supported, and valued for their contributions.

The Code of Conduct is a set of guidelines that apply to all online and in-person meetings and events e.g., GÉANT project meetings, TNC etc., as well as any exchanges that take place within the mailing lists of the Special Interest Groups (SIGs) and Task Forces (TFs). All members of the community, including users of a GÉANT online space or a member of a SIG or TF mailing list, have a responsibility to adhere to the Code of Conduct.

These guidelines refer to areas such as harassment, language and tone of written and verbal communications, non-sexualisation of communications, and so on. It also helps to remind many of us that what might be considered an innocent remark has the potential to cause upset and distress in others.

Importantly, the Code of Conduct also has a clear process to follow for reporting breaches, ensuring that, where needed, enforcement of the code offers protection to all members of the community.

Playing our part

It is our collective responsibility to create and maintain a safe and respectful community environment. This includes speaking out and supporting others if you witness behaviour that does not adhere to this Code of Conduct.

The GÉANT Community is a uniquely positive and collaborative environment, so let's celebrate that and protect it for the benefit of all.

View the GÉANT Community Code of Conduct [here](#)

GN4-3N Project Forecasts Busy 2023 for Next- Generation Network

As the GÉANT GN4-3N Project team celebrates the major milestone of reaching 20,000km of dark fibre or spectrum being lit, the focus remains on a busy and ambitious final year for the project that will deliver vastly increased network capacity at a lower cost than the network it's replacing.

Words: Paul Maurice, GÉANT

Built around dark fibre services using 15-year IRUs, the next-generation network is designed to support anticipated 30% annual increases in network traffic whilst utilising both new technologies and new opportunities presented by a changing landscape of network procurement.

With 26 countries now connected on fibre, the deployment status at the time of writing looks as follows:

- 42 routes fully deployed.
- 10 routes are currently in the connectivity delivery phase.
- 8 routes are in evaluation or contract finalisation stage.
- 4 routes in the active tendering phase.

Multiple route migrations are scheduled for the first half of 2023, but first let's look at recently completed routes:

- Luxembourg – Frankfurt (leased spectrum)
- Madrid – Bilbao (NREN leased spectrum)
- Hamburg – Copenhagen (NREN leased spectrum)
- Amsterdam – Brussels (NREN leased spectrum)
- Paris – Brussels (dark fibre)
- Lisbon – Sines (dark fibre – scheduled for March)

Upcoming routes

The following routes are scheduled to move into production service during the coming months:

- Amsterdam – Hamburg – Poznan
- Kaunas – Poznan
- Hamburg – Helsinki
- Tartu – Riga
- Riga – Kaunas
- Helsinki – Tartu

GN4-3N: Bridging the Network Divide

Research and education networking has unique commercial and technical requirements. The profile of this traffic – extremely high-capacity connectivity to and from smaller numbers of locations – is very different from typical commercial or domestic network traffic which is typified by many millions of relatively low-capacity users.

Commercial networks also need to return a profit, balancing user requirements against capacity cost. Typically, this is achieved by provisioning capacity with a level of contention (anticipating that not all users will be using their connections simultaneously), and this can limit the ultimate capacity they make available to users. For domestic users this can result in poorer performance at peak times, a situation that is not acceptable for the high-performance users of the R&E networks. In addition, there is a clear digital divide between European countries

(and also within them), with some highly developed areas having preferential access to the network and others that are still poorly served and often penalised by high access costs. This involves a vicious circle whereby investments in technology tend to be attracted to areas that are already developed, leading to a progressive widening of the gap between countries, both in terms of infrastructures and in terms of know-how. Without external intervention this vicious cycle will continue, further widening the digital divide.

The new network will provide improved performance, increased flexibility, and reduced expense alongside long-term platform stability. It enables fairly priced, high-capacity

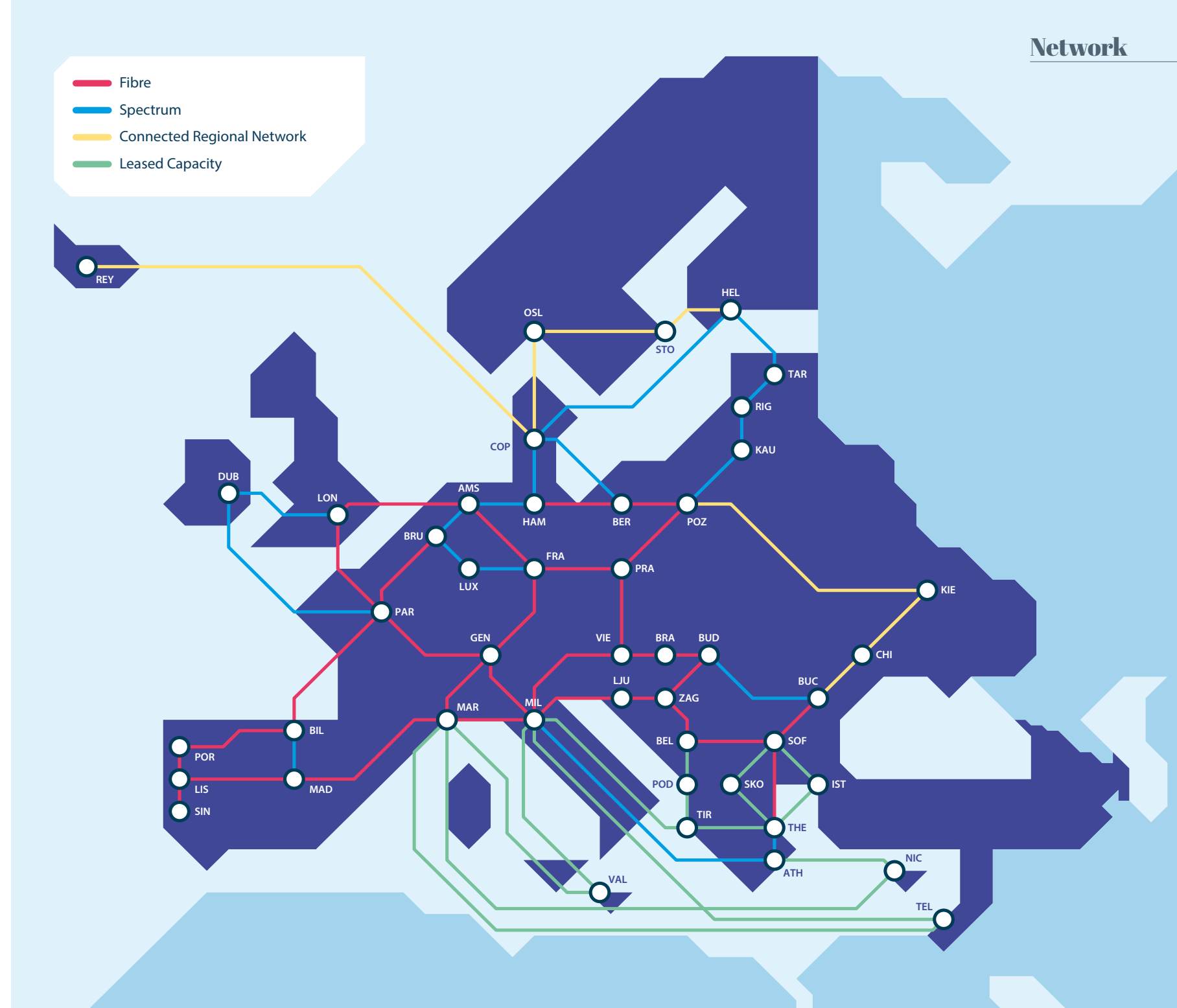
connectivity across all of Europe, where a gigabit of capacity will cost virtually the same across the network and in turn bring consistent and predictable pricing for the benefit of NRENs and their customers.

New Services to Meet the Needs of Research

The new networking technologies introduced as part of the GN4-3N Project have already resulted in the implementation of new point-to-point service offerings for NRENs, providing **managed bandwidth services up to 400Gbps across the GÉANT backbone.**

The ability of this next-generation network to support innovative services, expand to meet the new needs of high-performance networking, and simultaneously reduce running costs will provide NRENs and R&E institutions and projects across Europe with a network they can rely upon to meet their requirements long into the future.

[Click here to learn more about the GN4-3N Project](#)



New blog series from the Network Evolution Team

If you regularly visit the CONNECT website or receive the CONNECT weekly newsletter (if not, why not?) then you will have seen over the past few months a new series of blogs by members of the wider GÉANT networking team.

In-depth contributions thus far from Network Evolution Manager Mian Usman, and Senior Network Architect Guy Roberts are shining a light on exciting developments across the GÉANT network, talking about where they see new traffic demands emerging, and looking into new technologies that will benefit user communities.

The team are aiming to publish a new blog each month and are keeping the subject area open: they want to reflect subjects that are timely and encourage discussions that help to shape the network.

Extracts from the first two articles are reproduced here.

Subscribe to the CONNECT weekly newsletter and be sure not to miss future blogs from this team.



GÉANT and the NRENs ready for the demands of EuroHPC

By Mian Usman

"On 21 September 2022, Sebastiano Buscaglione, Senior Network Architect, and member of the GÉANT Network Evolution team, observed a significant traffic increase on one of GÉANT's backbone trunk links between Geneva and Milan.

Upon investigation, he discovered that the traffic was coming from ARNES, the Slovenian NREN, which is connected to a GÉANT router in Ljubljana, Slovenia. A review of their traffic graph revealed a sharp increase in traffic from 20Gbps in May 2021 to over 150Gbps in September 2022!

Most of the traffic was going over the LHCONe VRF (virtual routing and forwarding) and the increase in traffic was sudden, starting around May 2021.

We found out the reason for the sharp increase while attending the LHCONe meeting in October 2022 at CERN. During a presentation on behalf of the ATLAS experiment, David Cameron of the University of Oslo explained how the ATLAS experiment – a collaboration involving 181 institutions across 42 countries and therefore one of the largest collaborative projects in scientific history – significantly increased its use of High-Performance Computing (HPC) around the time the team observed an increase in traffic.

According to David Cameron, the experiment began using the Vega EuroHPC, a Petascale supercomputer located in Slovenia, and ATLAS was one of the first users of this facility – in this case by collaborators primarily in the Nordic region..."

Mian goes on to explain how R&E networks such as GÉANT, together with NORDUnet and the NRENs, play a critical role in enabling researchers to access and utilise advanced facilities such as the Vega EuroHPC supercomputer. And, as we see new supercomputers coming online and being built as part of the EuroHPC initiative, this scenario will become more commonplace: that of advanced supercomputers downloading data from remote locations, interconnected by Europe's NRENs, in order to feed their computation. He then explains how the roll out of GÉANT's next-generation network built under the GN4-3N project, together with the upgrading of all layers of the network, is ensuring the GÉANT community continues to meet the evolving needs of the user communities.



[Read the full blog here](#)



Are 400G ZR+ and 400G XR ready for GÉANT's IP backbone?

By Guy Roberts

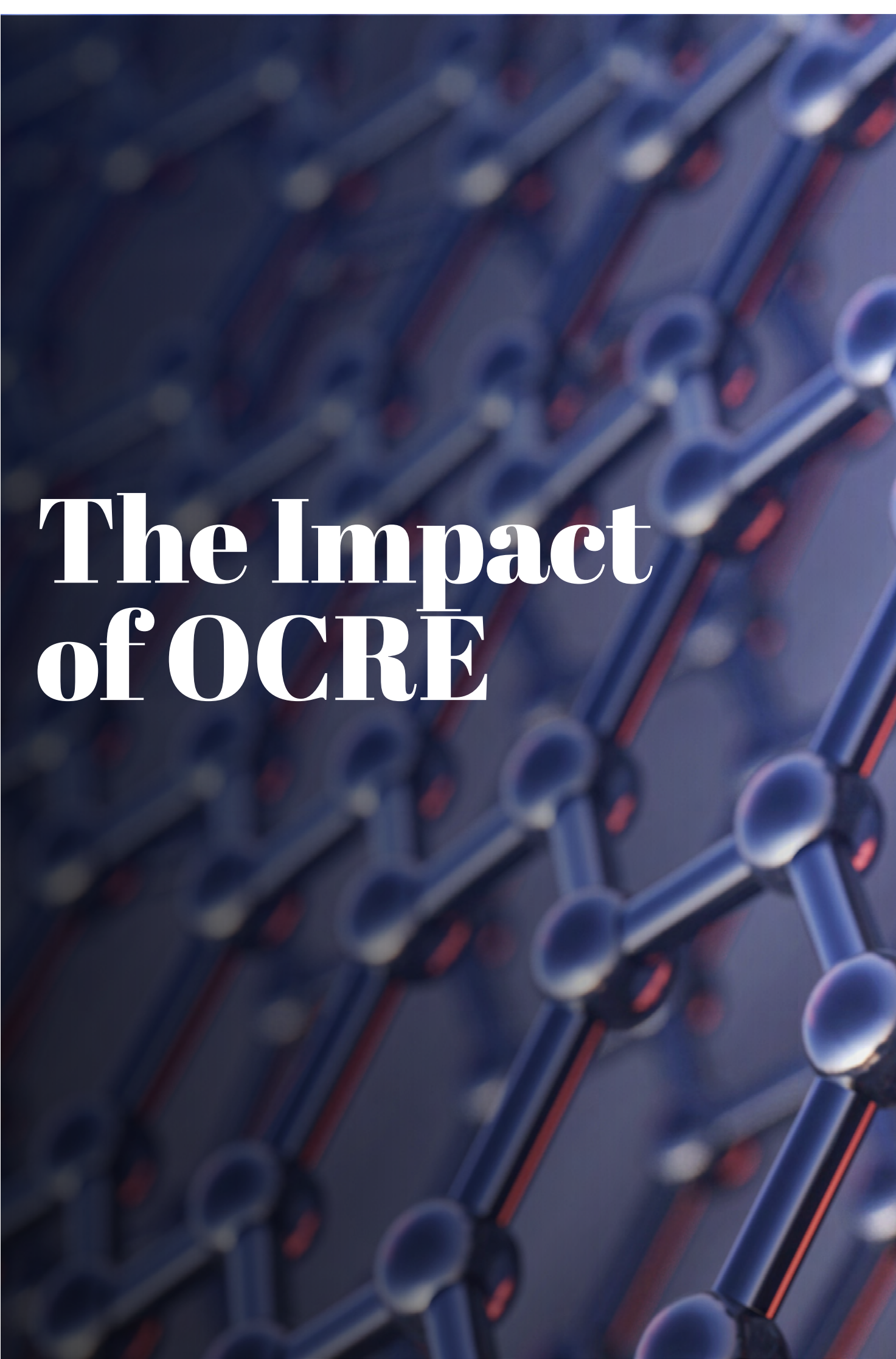
"The demand for high-capacity networking solutions is on the rise, especially for data centre interconnections that require the transfer of large amounts of traffic. In response to this demand, the development of low-power, small-form factor coherent DWDM pluggables has been a focus in the industry.



One such solution is the 400G ZR standard, which is an Ethernet-based networking interface defined by the Optical Internetworking Forum (OIF). While the form-factor of 400G ZR is not specified, it has been designed to fit into mechanical form-factors such as the Quad Small Form Factor Pluggable Double Density (QSFP-DD) and the Octal Small Form Factor Pluggable (OSFP). These form-factors are defined by Multi-Source Agreements (MSAs). To meet the requirements of the 400G ZR standard, new design techniques have been employed for the coherent Digital Signal Processor (DSP) and electro-optical devices in order to achieve the necessary low power and small size."

Guy goes on to explain the standards in more detail and, as "the adoption of ZR, ZR+, and XR optics increases, multiple component suppliers are developing hardware, which is expected to significantly drive down prices for high-capacity coherent optics in the coming years. This makes them an attractive option for use in the GÉANT IP backbone, as they could potentially allow for the removal of most transponders from some sites in the network, resulting in cost, power, and space savings."

[Read the full blog here](#)



The Impact of OCRE

The OCRE project, which came to a close in December 2022, made commercial cloud services available to accelerate research and education throughout 10,000 institutions across Europe

Driving innovation through research and driving research through innovation

The OCRE project was initiated to stimulate the use of commercial cloud and Earth Observation (EO) services by the European research community. According to Dave Heyns, OCRE Project Director, the adoption of such services was particularly low before the project commenced because researchers and research institutions struggled to find the proper service providers and reach legal and technical agreements with them.

What we did was to aggregate community demand and requirements and applied these into a pan-European call for commercial service providers to respond to," says Heyns. "These tenders provided the procurement-compliant framework agreements we needed with suitable suppliers so that institutions could more efficiently 'shop' from a list of services in the **EOSC Marketplace** to procure what they needed."

This opened the way for researchers to procure services through ready-to-use contracts and via adoption vouchers made available in funding waves for both cloud and EO services. Usage was facilitated by **NREN Cloud Service Delivery Managers** at local National Research and Education Networks (NRENs). NRENs acted as intermediaries. Since the OCRE project ended on 31 December 2022, NRENs have taken over as the primary facilitator to access the services.

"One of the most satisfying observations I've seen in the OCRE project is how proactive the commercial companies have been in engaging with researchers," he adds. "Going forward, it will be this kind of proactive approach

taken by commercial vendors that will help us identify funding opportunities, alongside harnessing the capabilities of local NRENs."

On a local level, Michel Wets, Head of Cloud Services at SURF, the Dutch NREN, believes that the role of the Cloud Service Delivery Manager is important, especially when it comes to raising awareness. "For researchers, and educators, who are so used to working with a computer under their desk, there is a learning curve."

According to Jakob Tendel, former head of stakeholder engagement for cloud services at DFN in Germany and now a co-Work Package Leader in the GÉANT GN5-1 project, usage of commercial services by public research institutions presents challenges unique to the R&E community. "These challenges can be around procurement, compliance, and third-party data handling. The OCRE framework reduces many of these pain points and uncertainties. As it progresses, via the GÉANT project, we anticipate that it will continue to accelerate growth and adoption."

Future impact

The OCRE project enabled more than 10,000 European institutions to easily access a host of relevant digital services through the OCRE Cloud Framework. The initiative provided many researchers access to on-demand high performance compute, data storage, machine learning platforms, simulation, and virtualisation tools for the first time with minimal bureaucracy. That is making the European research ecosystem more responsive, more agile, and more scalable.

The impact has been felt across 40 countries, with demand more than doubling in 2021 and even more in 2022. This trend looks likely to continue in 2023.

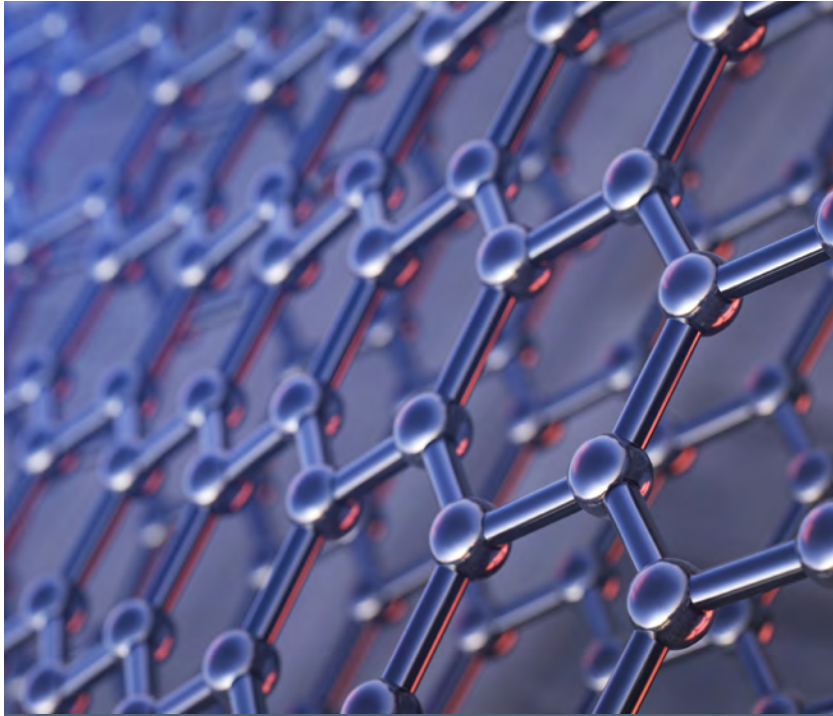
From 2023, the GÉANT GN5-1 project will support the framework implementation and will execute a new public tender for a cloud framework to succeed the current one delivered by the OCRE project in 2020.

In upcoming issues, we will bring more stories to CONNECT readers on how this model is changing the face of research in other countries and in other fields.

OCRE: Driving Innovation Through the Adoption of Commercial Cloud and EO Services

Digital Single Market strategy is one of the European Commission's (EC) 10 political priorities, intending to remove virtual borders, boost digital connectivity, and make it easier for consumers to access cross-border online content. The Open Clouds for Research Environments (OCRE) project, funded by the EC and coordinated by GÉANT, is a practical example of how this can come about, and over 48 months has successfully made it easier for consumers, in this case researchers and research institutions, to access a wide range of powerful digital tools.

Here we highlight just three of the many projects across Europe that have benefited from using the OCRE framework to accelerate their research whilst benefiting from reduced costs and easier procurement procedures – letting researchers focus on their work.



Studying 2D Materials – University of Bath

2D materials only a few atoms thick are one of the hottest topics in Physics. Since the discovery of the supermaterial graphene, for which two scientists were awarded a Nobel prize in 2010, hundreds of other 2D materials have been identified. These have either been made experimentally or identified through computational modelling. Understanding the quantum properties of these new super thin materials with promising applications in electronics, healthcare, and new energy materials requires advanced scientific facilities and techniques. Exposing 2D materials to the powerful X-rays produced at a synchrotron beam facility is one of the most effective ways of studying electron behaviour in the materials. The process generates vast amounts of data that researchers at the University of Bath have been able to analyse using sophisticated cloud computational modelling funded by OCRE.

The Microsoft cloud supercomputing resources (provided through OCRE Framework contract-holder Phoenix Software) provided by OCRE have allowed teams to carry out computational work at a range of scales with widely varying numbers of cores and compute times, optimised for the requirements of our experiments. This flexibility meant they could run calculations at the optimum core numbers for given parallelisation strategies, making calculations more efficient in terms of total core-hours used. At the same time, it has also improved turnaround time.

Undergraduate students can now receive faster and improved critical training. For example, a well-converged scientific calculation of publishable quality requires the right balance between precision and costs but doing this can be hindered by limits on computational resources. The flexibility of the OCRE cloud-funded supercomputing solution removed this limitation. It meant the work of producing scientific results and proving their reliability could be carried out by undergraduate students, allowing them to make a substantial research contribution.

“Both our experimental simulations and our training programme for undergraduates make it desirable to allocate considerable computational resources for intense bursts of activity at short notice. The OCRE-funded cloud-based resources are ideally suited to support this way of working.”

Professor Daniel Wolverson, University of Bath



Real time diagnosis to tackle aortic disease - University of Galway

Aortic disease is a leading killer worldwide, and despite perceived progress in diagnostic and therapeutic techniques the burden from aortic disease is growing. The diagnosis of aortic dissection is time sensitive and depends on cross-sectional imaging, in particular CT angiogram. Up to 50% of aortic dissection patients are initially misdiagnosed as having other conditions, and machine learning techniques have been used to successfully increase accuracy and reduce the time taken to diagnose the condition.

The aim of the project is to model the blood flow in the aorta which has been conventionally done using the finite element models. However, these methods can be computationally exhaustive and time consuming and may not be able to produce predictions in real time essential for diagnostic purposes. It is therefore required to introduce methods that will significantly reduce the complexity and time. Thanks to the OCRE cloud funding, this type of real time diagnosis is now within reach and research avenues become significantly broader than previously. Previously, similar projects would have had to have relied on locally deployed computing resources. In their experience, this has previously limited the amount of resources that can be made available for research purposes and has significantly reduced the scope of those research outputs due to cost and technical issues.

By utilising cloud solutions from AWS (provided through Rackspace Benelux B.V.), they can solve both problems by leveraging services that are designed specifically to produce solutions in these areas. The scalable nature of the services means that it is much easier to scale up availability of computational resources when specifically needed during the aortic blood flow modelling process.

“The ability to allow for real time predictions on such complex data models has previously been out of reach to us. This project challenges that notion by utilising the computational benefits of cloud services and represents an exciting example as to how it is possible to utilise these benefits for significant medical advances in the area of aortic disease diagnostics.”

Andy Donald, Research Fellow, University of Galway, Data Science Institute



Developing a new approach for the study of archaeological sites thanks to OCRE's Earth Observation vouchers - CRS4 Research Centre, Sardinia

The newborn “Digital Technologies for Aerospace” sector at CRS4 Research Centre in Sardinia, Italy, integrates a deep know-how on digital technologies (from GIS to IoT, from Machine Learning to Cloud Computing) with aerospace technologies, applying them to different application domains, including archaeology. This project focuses on defining a methodology that allows, through the pervasive use of remote sensing technologies, to assess in advance the need of excavation activities for a specific area. In order to define the methodology, the researchers will have to deal with a large amount of data resulting from the application of different detection techniques (satellites, photogrammetry, georadar, LIDAR), extracting, analysing and comparing indexes and information.

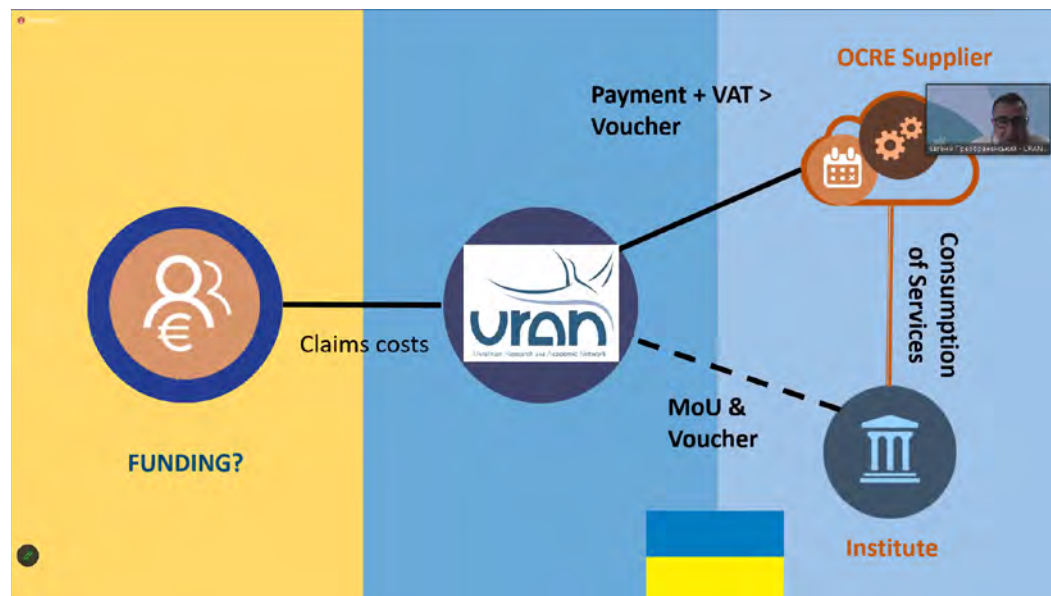
Thanks to OCRE's Earth Observation voucher for the Planetek Rheticus Platform, the CRS4 researchers are able to overcome the need for managing high data volumes and having strong data processing capacities. They can rely on a cloud-based platform that provides geo-information services. It will be a unique and useful decision support system for prioritising areas of inspection, in search of potentially new archaeological sites supporting the implementation of risk-mitigation actions. The service platform will also provide actionable information through a user-friendly and intuitive space, as well as customer support and a dedicated technical service manager.

“Through this service and its geo-information platform our research project can make use of a supportive tool for environmental conditions assessment, and archaeological prospection activities supporting management, monitoring, and preservation of the ancient megalithic edifices.”

Roberto Demontis, “Digital Technologies for Aerospace” Sector, CRS4 Research Centre

To find out more about these success stories and many others visit <https://clouds.geant.org/ocre-success-stories/>

How URAN, GÉANT, and OCRE help Ukrainian universities transfer their IT infrastructure abroad



The URAN Association, the National Research and Education Network (NREN) of Ukraine, in partnership with the GÉANT Association and the OCRE project, are helping Ukrainian universities to gain access to cloud services abroad.

Words by: Tetiana Preobrazhenska, URAN

URAN and GÉANT, together with representatives from international cloud service providers, discussed this urgent topic at the round table “Digital transformation of scientific activities in universities in the context of European integration”.

A special roundtable session was devoted to cloud services. Yevhenii Preobrazhenskyi, executive director of the **URAN Association**, introduced participants to the **OCRE** (Open Clouds for Research Environments) project, which is



funded by the European Union and acts as an intermediary between commercial providers of cloud services and their users – research and education (R&E) institutions. OCRE helps both parties to create framework agreements and receive significant discounts. In particular, Yevhenii talked about the crucial role of **NRENs** in the OCRE infrastructure.

“It is through URAN that R&E institutions in Ukraine can apply to OCRE. We act as an intermediary, we help to find providers offering the necessary cloud services at a considerable discount, and even EU grants for certain projects,” Yevhenii explained.

David Heyns, OCRE Project Director, representing GÉANT and OCRE, talked about the **GÉANT Association** and the components of the pan-European R&E network

(of which the URAN network is a part), and about GÉANT services, including cloud services. David drew the participants’ attention to the long-term prospects of cloud services use by Ukrainian universities. Leading commercial providers (for example, Microsoft Azure or Amazon Web Services) which have been providing Ukrainian universities with free access to their platforms since April 2022, are available to continue this charitable support for some more months, but this means that in the not too distant future, the Ukrainian institutions will be faced with the issue of having to find funds to pay for such services.

“It is not sustainable for an institute to transition a system (e.g., Learning Management System) to a cloud platform for only six months. There should be funding to secure the hosting of such systems for at least 30 months,” David noted.

In his presentation, Dawid Dybuk, CEE Education Account Manager at Amazon Web Services (AWS), raised the same issue. He described how the cloud services provider AWS, in partnership with **EPAM**, URAN, and GÉANT have been supporting Ukrainian educators since the beginning of the full-scale Russian invasion and informed about AWS’ decision to extend their support until September 2023.

Denis Hrynyov and Mykhailo Khyzhniak from EPAM IT explained how they helped Ukrainian universities transfer distance learning servers to the AWS platform and talked about the advantages of cloud services compared to other options for the transfer of IT infrastructure abroad.

When subjected to missile attacks, shelling and frequent power outages, any IT infrastructure is at risk of destruction or breakdown, so the use of cloud services is a

reliable option to secure data and information and facilitate remote work. Ukrainian R&E institutions can get access to leading cloud platforms by contacting the URAN Association and explaining their needs and requirements. URAN specialists, together with OCRE representatives, will select a cloud service provider (such as Microsoft Azure, AWS, etc.) and help to create a framework agreement on the most beneficial terms. This achievement by the end of the project. The future is at sea, and I think we should make use of our scientific community for national and international scientific enrichment.

Further information

The event was organised by the **Scientist Support Office** with the support of the **Ministry of Education and Science of Ukraine** and was held online on 31 January 2023. Around 800 educators gathered to exchange their experience in the use of digital services, e-infrastructures, and Open Science tools at their universities, and to discuss the digitalisation of scientific and didactic activities.

The recording of the roundtable is available on the **Scientist Support Office YouTube** channel.

Pictures

Left: The intermediary role of URAN

Middle: Yevhenii Preobrazhenskyi, Executive Director of URAN

Below: Services offered by URAN

The screenshot shows the **eduMEET** website. The header includes the logo and navigation links. The main content area features the text: **eduMEET**, **Open-Source, Video Conferencing Software**, **Institutions can build their own eduMEET service quickly and easily**, **No client software – 100% web-based**, and **Ideal for remote learning**. A video player shows a person in a red shirt. Below the video, it states: **eduMEET.org**. The footer includes the logo and a small text block about the platform's development.

The screenshot shows the **OCRE (Open Clouds for Research Environments)** website. The header includes the logo and navigation links. The main content area features a list of services in Ukrainian: **Полегшує доступ до європейських хмарних послуг**, **Фінансується ЄС**, **Посередник між комерційними постачальниками хмарних послуг та споживачами**, **Бере на себе процес придбання хмарних послуг**, **шукає постачальників**, **проводить загальноєвропейський тендер**, and **укладає рамкові угоди**. A video player shows a person in a blue shirt. The footer includes the logo and a small text block about the project.



The Next Level of the European Digital Student Services Infrastructures

Enhanced solutions that make the Erasmus+ administrative processes faster, more accessible, and more secure than ever.

For the past two years, 13 higher education institutions, student organisations, student service providers, NRENs, and companies from all over Europe have been working together, under the framework of the so-called EDSSI L2 project, towards further progressing the digitalisation of the Erasmus+ and the European Student Card Initiative.

Words by: Debora Lucque, European University Foundation

The European Digital Student Service Infrastructure Level 2 (EDSSI L2), a Connecting Europe Facility (CEF)-funded project, is enhancing and expanding the interoperable infrastructure previously developed by its predecessor, the EDSSI project, by elevating it to the next level. Propelled by the ambitious vision of complementing and enhancing the Erasmus+ digital eCard core infrastructure for a seamless mobility experience, the EDSSI L2 project intends to build bridges, break barriers, and brace benefits for the entire European Higher Education Area.

Building bridges

The project partners are deploying a virtual link that connects various Student eCard systems from different nations and regions of Europe. This endeavour ushers in a new era where it will be possible for Erasmus+ students to use their local eCards in any hosting institution, regardless of their type or geographical location. Once able to access the plethora of university services available, students will benefit from a better mobility experience.

Breaking barriers

Simplified and faster administrative processes in Erasmus+ require the elimination of unnecessary obstacles within the digital workflows. Enter new CEF building blocks in the infrastructure. In particular, the EDSSI L2 project aims to integrate the e-Signature

CEF building block in the Online Learning Agreement so as to facilitate legal processes required for mobility management and support the administrative processes of student mobility.

Furthermore, the project partners are currently investigating the potential implementation of two additional building blocks, the eArchive and eTranslate, in the mobility management processes.

Bracing benefits

By further enhancing connections between the student service providers and tools of the Erasmus+ mobility environment, the EDSSI L2 project is bringing the available services, especially those of the host universities, closer to mobile students.

Upcoming events

While the official presentation of the fully-fledged enhanced infrastructure is expected to occur this summer in Berlin, the EDSSI L2 consortium is offering a sneak peek into the main developments of the project at the **EU Student eCard Stakeholders Forum** which was held on 9-10 March in Venice. Specifically, the Forum will gather management and IT staff from university departments working in the digital administration of Erasmus+ processes who will have an opportunity to have their say, share experiences and hear from experts in the field.

Who is behind EDSSI L2?

The EDSSI L2 project is led by Humboldt-Universität zu Berlin (HUB) and involves the following partners: European University Foundation, GEANT Vereniging, University of Zagreb University Computing Centre, Universitat de Barcelona, Aristotle University Of Thessaloniki, Swedish Research Council, European Council for Students Affairs, Eötvös Loránd University, Fondazione Ente Nazionale per il Diritto allo Studio e per i Servizi agli Studenti, Communauté d'Universités et Établissements Normandie Université, European Youth Card Association, and Studierendenswerk Karlsruhe.

To stay updated with the latest news, visit the official website of the project at <https://edssi.eu/>

If you are interested in knowing more about the enhancement of the digital eCard infrastructure, we recommend you save the date for the **EDSSI conference Volume 2** that will take place in Berlin on 27-28 June, 2023.



Public Clouds: Do We (Really) Know What We are Buying?

A handbook to help research network users make an informed choice of public cloud services and avoid nasty surprises

Words by: Claudia Battista, Director of GARR

In the world of research networks, the design, implementation, and management of connectivity or above-the-network services have always been planned with users. One of the main purposes of research networks is to drive technological evolution while maintaining transparency and full control of the network, and the capacity to adapt to specific user requirements.

However, the offer of ICT services by commercial providers has dramatically grown over the years and today the adoption of applications and information services on public clouds is a thing even in the scientific, academic, and cultural environment. A national research network can only acknowledge this trend and try to adopt policies to offer the best support to connected organisations that choose this option.

Yet, it is important to underline that this choice has important consequences and calls for attention to some technical, functional, and strategic aspects. Moving one or more services from the research domain to a public cloud can immediately impact performances, as well as our capacity to control our data and applications; but most importantly in the medium-long term, it can have effects on the technical and economic capacity to switch to solutions more suitable to the user's needs, and ultimately constitute a limitation to the freedom to do so.

We are talking about digital sovereignty, which for us at GARR means having full control over the tools, technologies, and conditions for carrying out scientific research, but also the knowledge of the context and the technical skills needed to choose appropriately.

GARR aims to raise awareness and spread this culture as much as possible and to provide some key elements for making conscious decisions and obtaining the best conditions when opting to use public cloud solutions. This is an even more important aspect today, with the kick-off of dozens of projects under the EU-funded National Plan for Recovery and Resilience, which will build new digital infrastructures or enhance existing ones, whose performance, portability of data and applications, and sustainability must be guaranteed.

Public cloud providers: dangerous liaisons?

In recent years, GARR, like other research networks, has received many solicitations coming, directly or indirectly, from cloud providers, aiming at the configuration of dedicated links. Often, however, the proposed solutions are not in the user's best interest. Let's see why.

Cloud providers try to “get as close as possible” to the user's work environment (universities, research

laboratories, etc.) by proposing cloud service delivery conditions that simulate a private cloud (e.g. Microsoft and AWS have “Expressroute” and “Direct Connect” in their portfolio): technical configurations are therefore proposed which allow the user to logically extend their local network domain within the provider's data centre, e.g. through a level 2 network transport service, which should necessarily be provided by the NREN on its own infrastructure.

This request would significantly involve the NREN in the provision of the end-to-end service, but without any visibility within the cloud provider's domains of competence, which are normally closed for commercial reasons. In this scenario, there is no way of setting boundaries between different management and control domains, therefore guaranteeing the service quality and end-to-end reliability from a functional and performance point of view.

Another caveat is that there are potentially hundreds of cloud providers, and satisfying the requests coming from them all would cause a scalability problem. On the other hand, choosing to follow only the big players' specifications could lead to a polarisation of the market, a scenario that is far from desirable for the research community.

Asking the “right” questions

Due to these critical issues, GARR, like other research networks, believes that interconnection solutions such as those proposed by the two big players, which envisage the extension of a user's domain on a public cloud outside their perimeter of action, should be avoided. This does not necessarily mean that users who need to turn to public cloud providers for their research activities should give them up: however, they must do so consciously and be able to correctly frame the scenario of these public or hybrid cloud proposals, by asking prospective suppliers, and internally, some key questions.

The first step is to know the architecture of the application that the user wishes to use in the cloud: is it a single-site or multi-site application? Which reliability mechanisms are foreseen? How much network capacity is required to access it, and which are the applications' functional performances? Where are the geographical sites hosting the service

located? Which routing policies towards the NREN are adopted by the specific cloud provider or their connectivity supplier, and are there possibilities and willingness to optimise or change them? Is the candidate provider willing to activate a direct peering with the NREN network?

A matter of (direct) peering

From a network point of view, direct peering represents an element that guarantees the performance and interoperability of services. There are various ways to implement it, the most natural being to establish a peering connection within a NAP (Neutral Access Point). Based on the needs and capacities involved, it is possible to either use the switching infrastructures collectively used by the different players who are present in the NAP or to create individual cross-connections. For example, for several years now GARR has established a direct 40Gbps peering with Google, given the relevance of traffic exchange between the research community and Google.

Including the presence in one or more national NAP among the mandatory requirements to qualify as a cloud provider for Research and University is therefore a good idea. If not possible, candidate providers could state their availability to activate peerings on European NAPs, where the pan-European backbone GÉANT is available with very high capacities. Also, a qualifying requirement should be, in our opinion, the bandwidth capacity the candidate provider has at the NAP.

Whichever the preferred solution and the bandwidth available, having appropriate routing policies or being available to change them accordingly should be a key requirement for any candidate provider of cloud services for the research community: it is not just a matter of ensuring performance, but also of protecting users from things that are out of our control, that can impact the services offered in a public or hybrid cloud. In particular, massive DDoS can overload the upstream providers' links towards the global Internet, from which most attacks come. In the absence of suitable routing policies and dedicated peering, DDoS can thus seriously impact this kind of service even when they are not the object of the attack, and determine a decline in performance, if not the unavailability of the service or some of its functionalities.

Picture
Claudia Battista,
Director of GARR,
presenting on the
topic of public
clouds at a
conference



Avoiding vendor and data lock-in

The second aspect on which we need to be clear about when we go for a public cloud solution is the data transfer model in case switching providers is in order. Due to contractual, economic, or technical reasons, as well as to the evolution of the organisation's requirements, the need may arise to get a new provider for a service, but without losing our data or applications. Being in a free market, cloud providers don't necessarily have interests in facilitating such switches: on the contrary, without carefully formulated agreements they may make life difficult for those users who want to leave them for another provider: it is, therefore, important to collect information beforehand about which guarantees are offered in this case.

Importing and exporting data to and from different public cloud providers is a cause of concern not only from an economic point of view. Big scientific collaborations are in the position to generate data in the order of hundreds of petabytes per year, but many providers charge a cost for migrating data outside their cloud, which could easily become an unbearable cost. Moreover, the existing links between competing public cloud providers are often insufficient to ensure optimal conditions for massive data transfers, nor it is expected that this will change

soon, and providers will upgrade them. Besides the economic aspects, a predominant concern especially in case a user wants to switch providers without losing their data assets, there are other concerns connected to the efficiency and timeliness of such data transfers, but the key one is by far interoperability.

Interoperability and collaboration

The last point we would like to draw attention to is interoperability in the framework of collaborations among organisations using different cloud infrastructures. There are several international collaborations among research infrastructures or organisations, that could adopt different commercial providers for their services: in this case, ensuring that data and services are reciprocally accessible and usable is a key priority.

Under the pay-to-move-out model, these partnerships would be paying two cloud service providers at the same time to have their own data available. There are derogations in scenarios such as OCRE that could mitigate this problem from an economic point of view, but they are not sufficient to guarantee efficiency and interoperability, plus there is a real risk that these scenarios negatively affect the FAIRness of scientific data, limiting their accessibility by researchers.

The international aspect is key, because of the very nature of scientific endeavours, but also because the ecosystem of research networks is characterised by natively interoperable solutions in a transnational and intercontinental multi-domain environment. In addition to having greater control over the infrastructure, we, the research networks, have always agreed and applied common policies for routing, access, traffic segregation, and quality of service (QoS) applied to certain types of traffic (e.g. real-time). Among NRENs, technological development is always agreed upon and managed, so as to ensure the transparency and visibility of the network, but also to implement agreed changes when needed to optimise the performance of transnational applications and accommodate user needs.

In conclusion: even though resorting to a commercial cloud provider may look like a simple solution to our needs, all that glitters is not gold. If we are planning to use these solutions for our research needs, a careful and informed assessment is needed, also from the point of view of our international scientific collaborations, and this assessment must be made “by design”, to understand if the choices we are making are interoperable and compatible with the objectives we have set ourselves in our organisation and for our collaborations.

RCTS100: Knowledge at high speed

Words by: FCCN Marketing and Communication team



In October 2017, the FCCN Unit started the construction of a new-generation national education and investigation network. The RCTS100 project, completed in 2022, expanded the optical fiber infrastructure and upgraded the technology of the Science, Technology and Society Network (RCTS), thus mitigating the existing digital divide. At the same time, it has enabled the internal networks of nine public higher education entities.

With a total investment of €17 million, 13 million of which came from the European Regional Development Fund (FEDER), the RCTS100 has taken on an ambitious goal: “Strengthening research, technological development and innovation”.

A network with nationwide impact

“RCTS guarantees a very fast Internet connection to a large universe of users, whether they belong to a higher education entity, an institution of the national scientific and technological system, an organic unit of the Ministry of Science, Technology and Higher Education or a public school under the guardianship of the Ministry of Education,” explains Ana Pinto, Director of the Network Services Area of the FCCN Unit.

The very broad coverage of the national education and research network explains the RCTS100 project's national repercussion, ensuring the availability of advanced connectivity services and a more resilient and high-capacity internet access, two essential conditions for the widespread adoption of new technologies, both in the classroom and in the research lab.

Response to the digital divide

The activation of new routes in the RCTS fibre optic infrastructure ensured the empowerment of the connections of several higher education institutions and the creation of ring topologies in the network, thus increasing the redundancy and resilience of these same connections.

The standardisation of access to fibre optics and the activation of an optical transmission system with national coverage has ensured identical conditions of access to the network, regardless of the location of the entity. “At this moment, the RCTS teaching and research entities can already access multiple services at a speed of 100Gbps, regardless of their geographical location,” explains Ana Pinto.

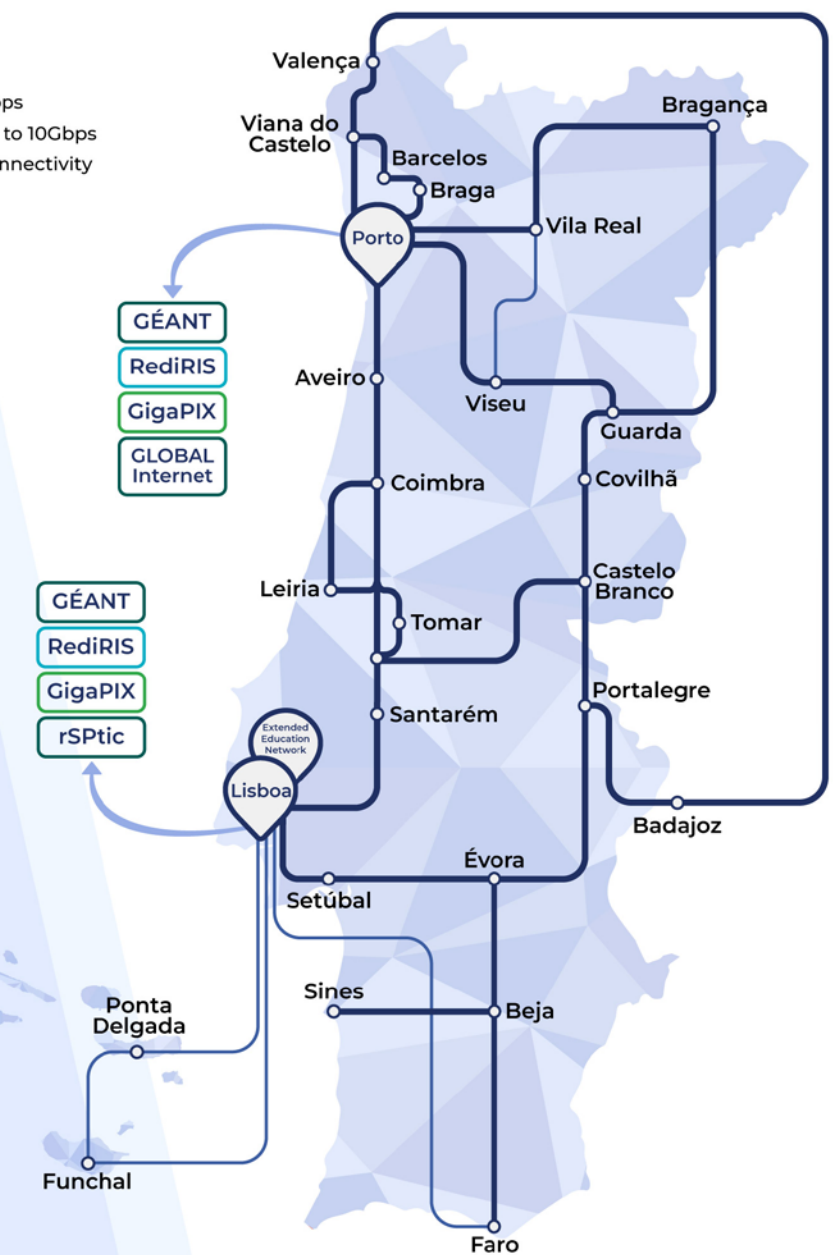
Responding to the challenge of the “digital divide” (asymmetries felt in different parts of the country, regarding the connectivity services available) is, therefore, another of the characteristics that make this project strategic for national scientific and technological development.

Over the past few months, the FCCN Unit has been sharing

RCTS

Caption:

— N x 100Gbps
— N x 1Gbps to 10Gbps
— Global Connectivity



fct Fundação para a Ciência e a Tecnologia

FCCN

Pictures
Left: RCTS100 project team

Top right: RCTS100 Network

the testimony of representatives of various RCTS entities through its blog. “The connection of the Guarda Polytechnic to the national education and research network at 100Gbps is crucial to meeting our needs”, highlights the coordinator of the Guarda Polytechnic's Center for Informatics, João Paulo Valbom.

The same idea is shared by the president of the Viseu Polytechnic, José dos Santos Costa: “The connection of the Viseu Polytechnic to the national education and research network at 100Gbps is extremely relevant”.



GeoLab: The first experiment has already started

Words by: FCCN Marketing and Communication team

In May 2022, the Portuguese Foundation for Science and Technology (FCT) and EMACOM - Madeira Telecommunications signed a protocol to promote the use of optical fibre for research purposes - the first step towards the creation of the GeoLab. Six months later, Orlando Frazão, INESC TEC's researcher, coordinated the first research project to use the EllaLink GeoLab - an infrastructure created from the EllaLink submarine cable to study the conditions of the ocean floor.

Pictures
Top left: Cable landing in Madeira

Top right: EllaLink staff member holding the EllaLink subsea cable

EllaLink GeoLab is supported by a third fibre installed in the derivation to Madeira, owned by EMACOM, which also provides the services for hosting the measuring equipment with **DAS technology** at the Amparo mooring station.

The management and operation of the EllaLink GeoLab experiments is the responsibility of FCT, through the FCCN Unit, which ensures the access of the research and education community to these resources, acting as "a glue that guarantees the communication between all the participating entities and companies", as referred by Clayton Costa, from the FCCN Unit. Clayton Costa also highlights the strategic importance of the GeoLab project as an important advance for Portugal, by enabling "regions that are not located in the mainland to be the stage for new projects".

We invited the INESC TEC researcher, Orlando Frazão, to explain how these resources have contributed to the scientific work, namely the role that the GeoLab technology can play in the protection of the oceans.

How are the GeoLab resources important for the research you have been developing?

Over the past few years, INESC TEC has developed and worked on projects in the area of distributed measurement, both in laboratory environments and in real situations. The close collaboration with the University of Alcalá has allowed obtaining knowledge about the DAS [Distributed Acoustic Sensor] technology.

The need to seek partners that can use this technology is one of the goals of the Center for Applied Photonics. The collaboration with EllaLink GeoLab will allow the application of DAS technology in a real application, namely by taking advantage of the installation of the submarine cables and their connection with the DAS equipment to study various phenomena of nature and human activities.

The main objective of this research project is monitoring submarine cables located in Madeira using DAS technology. It also aims to analyse and compare the results obtained with DAS installed in various parts of the world.

What results have been obtained from the GeoLab and how is this knowledge relevant to the ongoing research?

At the moment, the equipment is in data acquisition mode. Considering the large amount of data to be stored, its analysis is complex and will take several months to complete. However, the knowledge acquired will be very relevant for understanding the movement of tides, boats, and the detection of microseisms.

How do you evaluate the process of articulation with the infrastructure? Are all expectations being met?

The process of articulation with the infrastructure was complex, but the collaboration between the two partners has been excellent and we hope that the system in operation will present fruitful results by the end of the project.

What do you think is the relevance of GeoLab, within the national scientific system?

I think that Portugal has a very important maritime coast, which is nothing less than a living laboratory full of potential for the development of scientific activities. It is also of high importance to protect our coast, a process that ideally should be done 24 hours a day and in real time. DAS technology enables such monitoring, and we hope to demonstrate this achievement by the end of the project. The future is at sea, and I think we should make use of our scientific community for national and international scientific enrichment.

Find out more about EllaLink GeoLab at <https://ella.link/geolab/>



SURF TECH TRENDS 2023



Tech Trend report: Which technological developments are relevant for Education and Research in the Netherlands?

On 15 February, SURF published the SURF Tech Trends 2023 report with the most important technology trends for education and research in the Netherlands. The report is intended for everyone working in education and research. It contains technologies such as advanced computing, artificial intelligence (AI), edge, extended reality (XR), networking and quantum and elaborates on several trends for each technology.

With this, SURF starts a long-term collaboration with members and technical experts on technological developments. The report provides inspiration and helps to understand the trends and put observations in perspective.

Impact and public values

For each trend, the report shows the level of development, which forces influence it, and gives examples of applications for education and/or research. Moreover, it describes what impact the trend is most likely to have. The trends have also been tested against public values such as inclusiveness, freedom of education, accessibility, safety, reliability, self-determination and the professional autonomy of teachers, researchers, and institutions.

Artificial Intelligence and Edge

One of the technologies for which the trend report elaborates several trends is AI. For instance, federated learning is an application example of the trend 'New Ways to Access Data', and the trend 'Towards trustworthy AI' includes the development of ethical guidelines as an example, alongside the creation of algorithm registries. The impact of the trend 'More accessible computers and models' gives low code/no code as an application example and mentions that the impact of the trend contributes to the values of freedom and accessibility of education and research.

For Edge technology, the report elaborates on the trend Digital Twins, among others, where digital models are fed real-time reality. One application is the training and simulation of energy systems, which would be too costly or dangerous in the physical world. The impact for research is mainly cost reduction, and for education it offers opportunities for metaversities: universities having a digital twin in the metaverse.

Robotic Automation is a second trend the report elaborates on, with robots-as-a-service being an example of disruptive effects on the future of work. Although the trend is still at an early stage, the report indicates that both in education and research, people will have to learn to collaborate with robots.

Futuring

The SURF trend report is part of the future-looking activities of the SURF cooperative, which drive innovation and feed it into plans for the future. By participating in joint initiatives, with the members in their role as research institutes and SURF in its role as knowledge provider.

Go to surf.nl/en/techtrends

cesnet
"...."

CESNET:

making waves for audio and video transmission with minimal latency

Interview by: Silvia Fiore, GÉANT

2022 ended on a very good note for the Czech NREN (CESNET) Networking Application Technologies department, headed by Dr. Sven Ubik. Sven and his team received the Industry award from IDEA StatiCa, awarded for company innovation as part of the Czech Head award, the country's highest scientific acknowledgement.

The team was awarded for their solution for video and audio transmission via a computer network across large distances with exceptionally low time latency, named Modular Video Transmission Platform (MVTP).

We interviewed Sven to find out more about how the technology works and how it can help artists and musicians perform without delays and interruptions.

Sven, what does this award mean to you and your team?

Our MVTP technology won the Czech Head Award in the Industry category, which is awarded annually for the most

significant technological innovation created in our country in the last few years based on our own research and development. It is a great recognition of the work of our team and of the CESNET association. We also consider it a commitment to help make the best possible use of this technology in practice.

Can you explain in your own words what MVTP technology is and where it can be used?

It is an electronic device for network transmission of audio and video signals with very low added latency. Transmitter and receiver together need less than 3 milliseconds to send and receive audio and video signals including compression and decompression. This is achieved by implementing device functions inside a Field Programmable Gate Array (FPGA), using low-latency codecs and proper receiver buffer management.

Therefore, it can be used for applications that are latency-critical,

such as remote collaboration in the performing arts. Even with the added delay of network propagation across Europe, musicians can comfortably play together between countries over a network. The technology has already received the Creative Europe/Europa Nostra award in 2020 for its contribution to classical music collaboration across Europe.

How does this benefit GÉANT's community of artists and musicians?

Some artists and musicians are already using various tools for remote collaboration. The Network Performing Arts Production Workshop (NPAPW), organised by GÉANT and Internet2, is an annual venue for exchanging experiences in this field. We hope that MVTP technology will help to make this collaboration easier for artists and more attractive for audiences. MVTP transmissions are not only very fast, but the image quality is also suitable for HD or 4K television production.



What advice would you give to a musician who would like to start using MVTP?

You need to obtain the MVTP device, which is small and easily portable, typically through your home academy or institution. Or you can contact CESNET directly. We also help organise distributed concerts across Europe. We are particularly keen to contribute, usually free of charge, to benefit events to make them more attractive and help raise more funds for a good cause. We would be happy for artists and organisers to contact us with their questions.

What are your next projects or next steps in the development of hardware and software for audio-video communication?

We want to simplify multi-point (three or more locations) events, which are now typically implemented as a set of two-point connections. We also want to bring MVTP technology into the homes of artists and students by creating a lightweight, low-cost version that we hope will work in upcoming 5G mobile networks.

"Communication among musicians across Europe is important for sharing various interpretations and enriching experience. It is about a part of European intangible cultural heritage. This opens up a wide range of possibilities. For instance, you can organise remote admission exams, which may improve the quality of the Erasmus scheme, as it eliminates the current practice of sending audio recordings, and applicants do not need to spend money on long-distance travel."

Sven Ubik, from CESNET press release

Pictures

Above: The team behind MVTP

Bottom: The front of the MVTP device



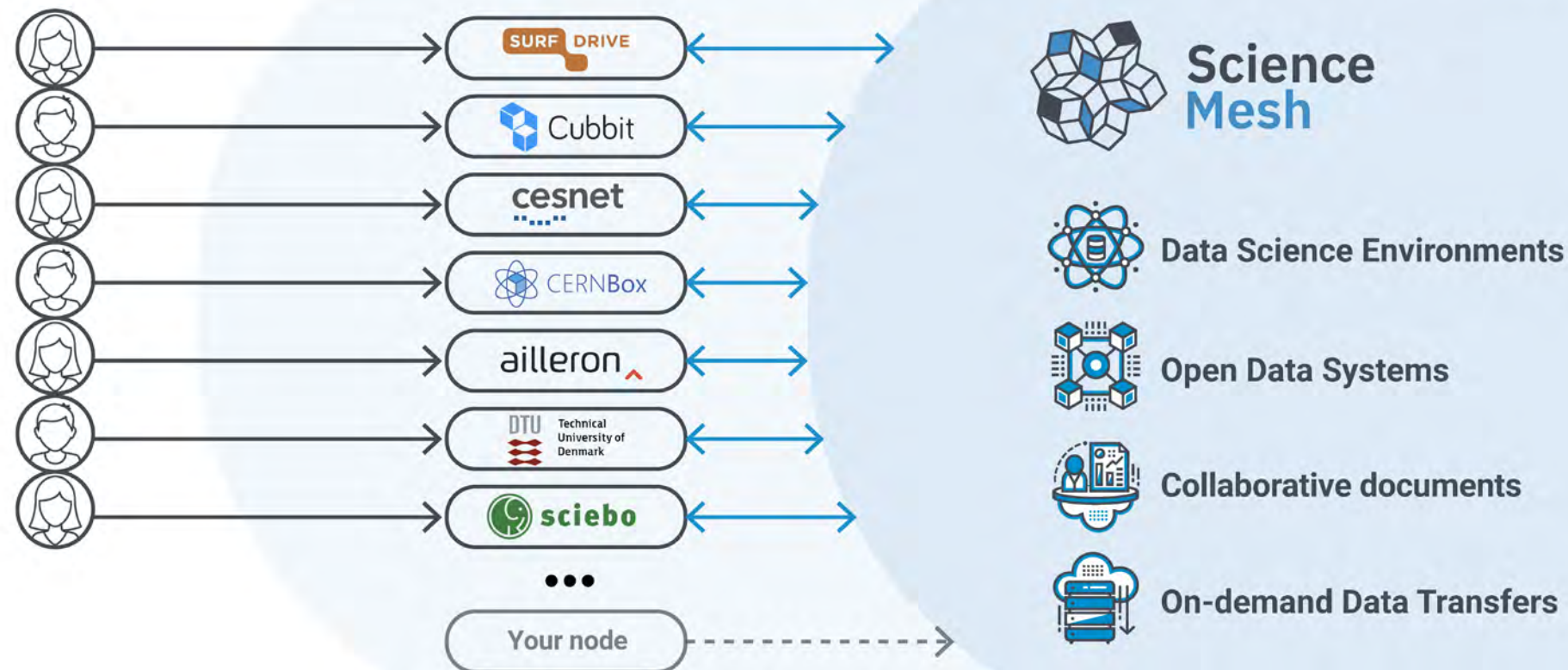
For more information about MVTP, please visit mvtp.cesnet.cz or contact CESNET Network Application Technologies department.

To find out more about CESNET, visit www.cesnet.cz and www.e-infra.cz

Each user can start from the node they already use...

and access data hosted on different nodes...

thanks to the Science Mesh Data Services.



Science Mesh

- Unlocking scientific collaboration through technology and free sharing of data in Europe

Researchers often need to access and interact with data stored in different clouds, crossing institutional and national boundaries. This requires using different tools, interfaces, and authentication methods and it stands in the way of efficient data-based collaboration. Fragmentation of research does not encourage efficient data re-use. Lack of interoperability impacts the user experiences and productivity.

Words by: Rita Meneses (Trust-IT), Gideon van den Berg (ESADE), Maciej Brzezniak (PSNC) and Jakub Moscicki (CERN)

The Science Mesh, from the CS3MESH4EOSC project, is a federation of distributed data storage and sharing services, known as Enterprise File Sync and Share (EFSS) services, where cloud platforms from different providers, known “as nodes”, are interconnected. Science Mesh users can easily share and manage data through the familiar interfaces of their institutional services and collaborate with colleagues from other organisations.

The Science Mesh services are not specific to any particular research discipline: they address the needs of a wide array of users (including academia and research industries) who are interested in scientific collaboration. They aim to serve not only well-organised user communities within existing Research infrastructures such as European Research Infrastructure Consortia (ERICs), National Research and Education Networks (NRENs) and other official clusters, but also individual researchers and smaller research groups. The Mesh aims to integrate into

Picture
“How does the Science Mesh work?” - CS3MESH4EOSC project

EOSC, allowing further expansion where EOSC users can access and produce FAIR data as well as utilise other research products provided through EOSC, all while using their own home EFSS service.

The differentiation in the Science Mesh value proposition compared to what currently exists can create a new market space and demand. Users are given the guarantee that they retain control over their remote or domestic datasets, while at the same time being supported in the transition to being FAIR-compliant.

Furthermore, the Science Mesh is an open platform with several tools distributed into 4 main groups of data services:

- 1. Data Science Environments:** access remote execution environments that provide collaborative workflows on Jupyter Notebooks in federated distributed cloud.
- 2. Open Data Systems:** organise work-data via tagging and metadata assignment and support users in depositing data into open and institutional repositories.
- 3. On-demand data transfers:** high-speed transfer of datasets from remote locations to local sites across different countries.
- 4. Collaborative Documents:** co-edit documents of various types, namely text, markdown, spreadsheets, and diagrams.

Within each category, users have at their fingertips several technologies that are integrated within the Mesh. More tools can be added to the Mesh by the technology providers themselves, enabling them a global reach and exposure to a limitless user base.

Say goodbye to problems with inefficient data sharing and access and “Mesh” yourself!

Join the Science Mesh as a researcher, developer, or service provider

- See how your cloud platform can become a Science Mesh node: **sciencemesh.io/#persona-service-provider**
- See how you can become a user of the Science Mesh: **sciencemesh.io/#persona-researcher**
- See how to add your tool into the Science Mesh: **sciencemesh.io/#persona-developer**

Visit the website to access tutorials & resources you need to get started
<https://sciencemesh.io>

Watch our Science Mesh video on how different users get benefits from the tool:
<https://www.youtube.com/watch?v=iYRB99VW3Ts>

For further information about CS3MESH4EOSC, visit **cs3mesh4eosc.eu**

And join the Science Mesh session at TNC23 in Tirana (Albania) on 9 June 2023 (09:00 - 12:30 CEST). Register & save your seat now! **cs3mesh4eosc.eu/node/328**

Moving the OSS to the cloud

Operators and CSPs are shifting platforms to the cloud – which means the OSS must follow. Your inventory system is critical for end-to-end cross-border services and connectivity, so should be targeted as the key OSS asset for service delivery. What's the latest and what does it mean for NRENs?

Why is now the right time to move your OSS to the cloud?

The cloud is now established as a secure and reliable model for hosting real-time telecoms infrastructure. It's at the heart of the next generation architecture that's behind both 5G and core networks – and most operators are looking to shift at least some of their investments in infrastructure and service enabling assets to the cloud – public or private – as research from the TMF confirms.

In a survey from 2021, the TMF reported that around 20% of Communications Service Providers (CSPs) have shifted more than 20% of their IT workload to the cloud – with some having migrated in excess of 50%. The direction of travel is clear.

For many, it's a question of “not if, but when” they will begin or, in some cases, even complete their cloud migration journey. In this context,

it's exciting to note that transport layer service orchestration has already begun to shift to the cloud. Solutions that enable complete automation and orchestration of L3 VPN services, among others, are now commercially available and deployed in a growing number of operator networks – from the cloud.

Ongoing projects are highlighting the viability of delivering a wide range of use cases, demonstrating how the cloud can accelerate operational transformation and automation for operators of all kinds. While service delivery assets are spearheading this shift, other supporting elements must also follow.

To support transport and network automation, OSS in the cloud is now essential

And that means the OSS. The OSS of the future must also be cloud-based. If we are to achieve automated service configuration and provisioning for, say, IP and MPLS services from the cloud, then we will need to be able to provide topology, resource, and asset information for use by orchestration systems.

But the TMF's research suggests CSPs are taking a step-by-step approach to cloud migration – so it

makes sense to target specific systems for early-phase migration – and one of the most likely candidates from the OSS is the network inventory system.

Why? Well, the inventory system is at the heart of OSS transformation and operational automation. Done right, network inventory is an over-arching system that interfaces to all network elements and assets, so that it can deliver a consolidated picture and record of all of them – and thus render them available to systems that consume this information, such as orchestration and automation platforms for provisioning and configuring transport services, slices and more.

Enabling automated service delivery for distributed networks

There's another compelling argument here. Most networks are by nature fragmented and distributed. A typical NREN network has the traditional access, transport, and core domains, but some, like GÉANT, also run multi-national and cross-border networks. And it's in such distributed networks that we're seeing clear signs of the need to elevate operational systems and processes into the cloud, in order to drive automation and efficiencies across the entire network footprint.

NRENs are leaders in the adoption of the latest, multi-domain network technologies and if you pursue automation strategies, then these will likely be delivered from the cloud – and so will the associated resources, such as network inventory systems. So, if you are embarking on this journey, you need a network inventory system that can move with you – like IMS from VC4.

VC4-IMS – a complete inventory management solution for NRENs

VC4-IMS is a complete, intelligent inventory management system that brings data together, eliminating silos and providing a consolidated record of your network assets – physical, virtual, logical, and service – giving you clarity and supporting operational automation and transformation.

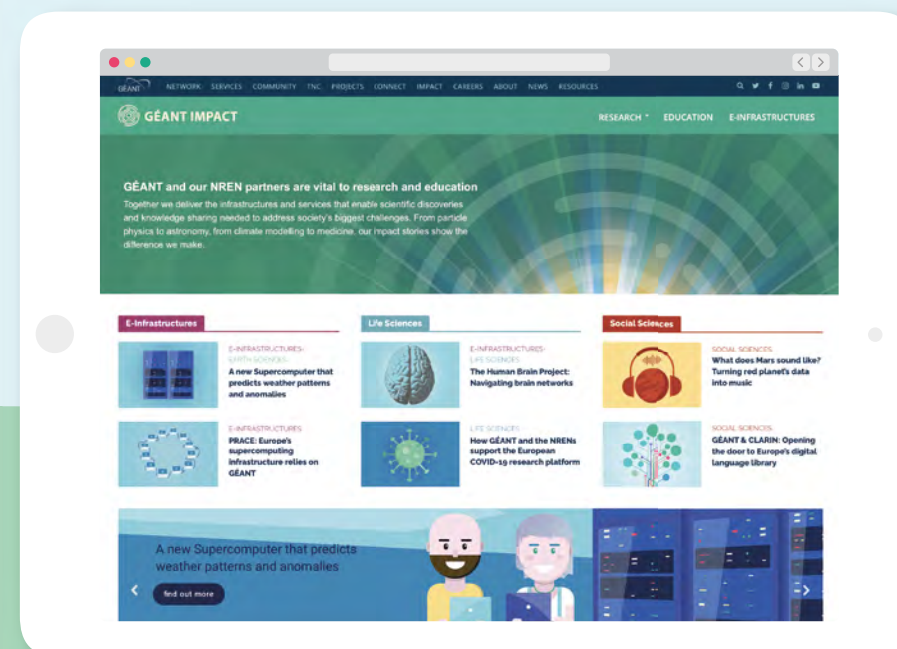
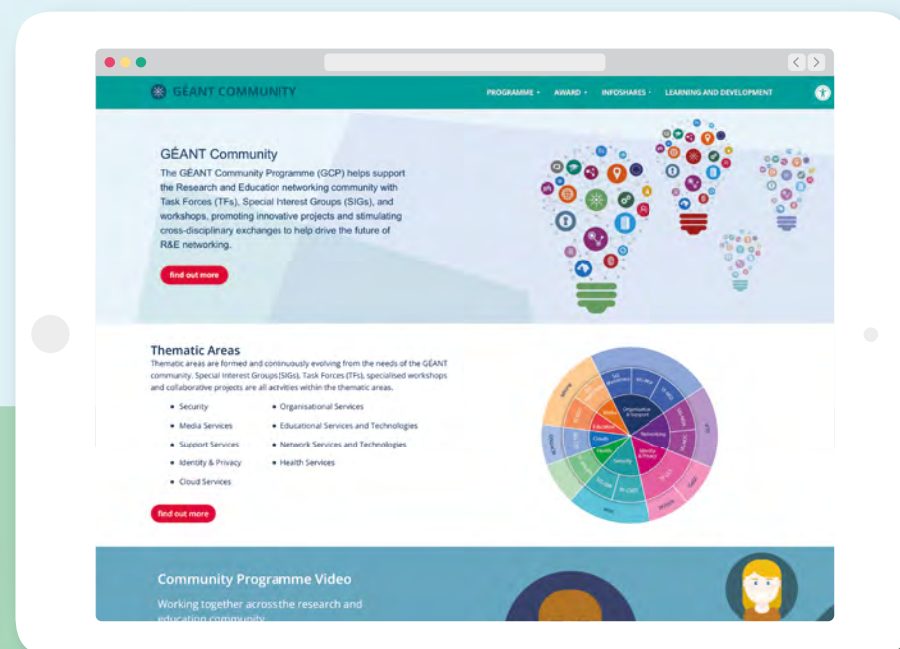
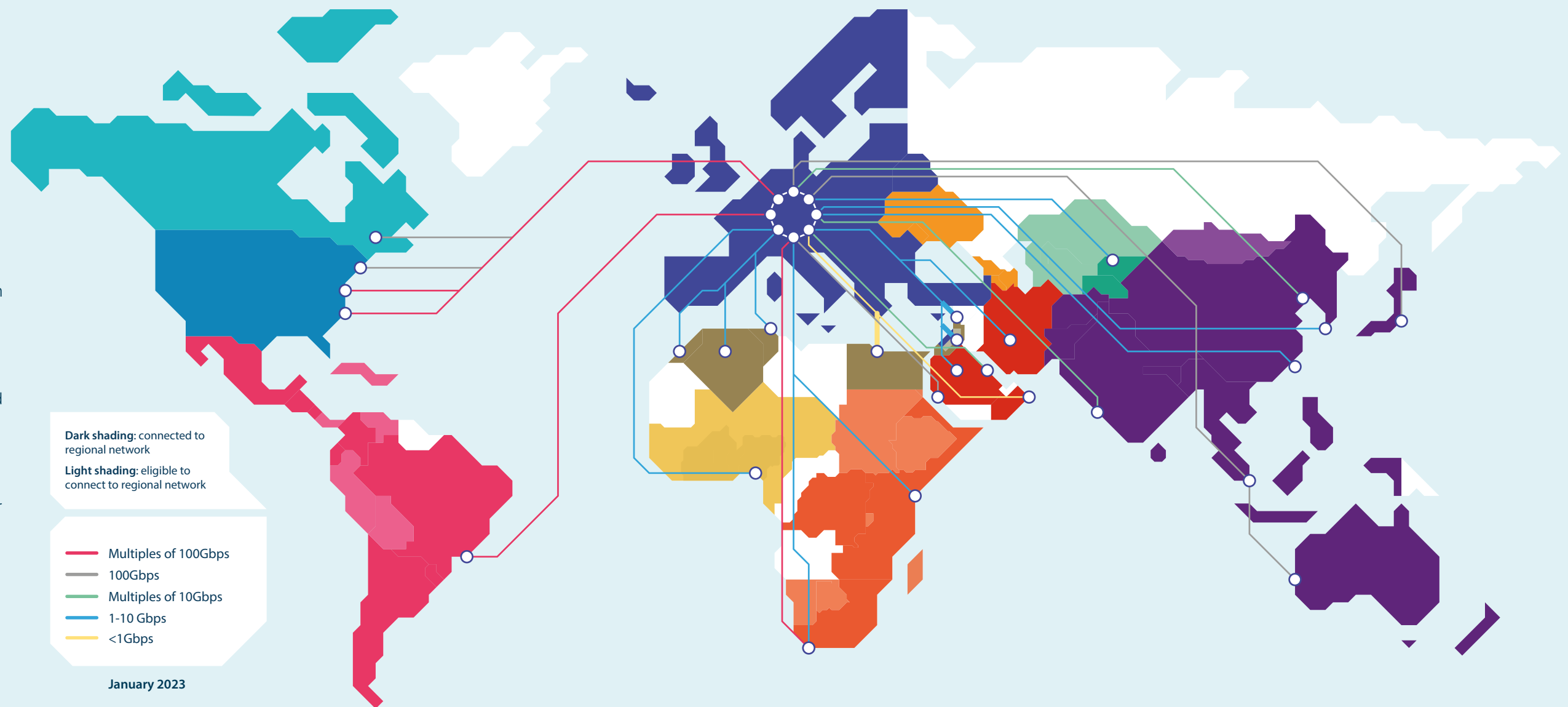
Available from the cloud, it provides the critical resource you need for your cloud journey – for distributed, multi-vendor networks and any generation of technology – and for any size of network provider.

If you have any technical or non-technical questions or would like a live demo, feel free to contact VC4 via sales@vc4.com or www.vc4.com.

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.





This magazine is published by GÉANT, as part of GÉANT projects GN5-1 and GN5-IC1, which have received funding from the European Union. The content of this magazine is the sole responsibility of GÉANT and can under no circumstances be regarded as reflecting the position of the European Union.