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#### THE MAGAZINE FROM THE GÉANT COMMUNITY | ISSUE 43

## DIGITAL GENERATIONS Tirana, Albania **5-9 JUNE 2023**

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A GÉANT SAFARI ADVENTURE OUB BIG FITT GÉANT FIT FOR 2028 IDA HOLZ, "MOTHER OF THE INTERNET" IN LATIN AMERICA SUSTAINABLE DEVELOPMENT GOALS

HOW AFRICAN RENS ARE CONTRIBUTING TO SDGS





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## Welcome from **Cathrin Stöver**

Welcome to this issue of CONNECT, and welcome to TNC23! If you are here in Tirana, TNC week promises again a packed programme of keynotes, sessions, workshops, side meetings, and just as importantly a chance to catch up with colleagues and friends from all over the world. And, for those unable to travel, we hope our online platform brings a flavour of the conference to you all. Whilst it can't offer the coffee, cake, and camaraderie of an in-person TNC, it does bring you live streaming of all sessions, on-demand video, and chat sessions with other online participants. Last year, we welcomed physical and online attendees from 80 different nations, let's hope for similar this year!

As we always do in our TNC issue, we take a look behind the curtain to bring you some background to the TNC programme.

One of my favourite parts of the conference is the awarding of the Community Award, illustrating as it does the passion and commitment of our community, shown throughout the year. This year, I hope you join me in a huge congratulations to our winners Sebastiano Buscaglione of GÉANT, and Sabine Jaume who has held numerous Board and Committee positions in our community. We also congratulate Arjan Xhelaj of RASH, who is this year's recipient of the Vietsch Foundation Medal of Honour.

At TNC we love to shine the light on the next digital generation via the Future Talent Programme and show how our community continues to expand via the Emerging NREN Programme, and you can learn more about the programmes and their participants in this issue.

Elsewhere in the magazine, we feature interviews with opening keynote speaker Mira Mezini of the Technical University of Darmstadt, Juha Oinonen of FUNET at CSC, and Quantum computing expert Kristiaan De Greve of IMEC.

Of particular note is the wonderful and heartfelt article on Ida Holz, a true female pioneer, recognised 'mother of the internet' in Latin America, and somebody I am proud to call a friend.

Finally, I would like to draw your attention to Hendrik Ike's article on the Digital Decade, and strongly encourage you to read the piece on the need for GÉANT to prepare for 2028. It is highly important for us all in Europe. The discussion has well and truly started so, if you're in Tirana, why not drop by the GÉANT booth, meet the teams, and join the conversation?

Enjoy the issue, and the conference!

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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## Getting ready for the Digital Decade

Words: Hendrik Ike, GÉANT

The Digital Decade is a European Union (EU) initiative designed to accelerate the digital transformation of Europe up until 2030. The goal of such an initiative is to ensure that all European citizens have access to secure, high-quality digital infrastructure and services, whilst also protecting their rights in the online space.

digitised.

A second impact will be an increase in demand for certain technologies - applications will need to be developed that aid researchers and educators. This could include tools available for data analytics and visualisation, cloud-based computing, more effective trust & identity/AAI management and more resilient security services. A more nuanced yet equally important aspect of the Digital Decade is the focus on improving digital skills and education. To ensure that all Europeans have the digital skills they need to participate fully in the Digital Single Market is by no means a small task, especially when you consider that 54% of the European population only has basic digital literacy (though population is not the same as workforce). NRENs could work closely with institutions in order to develop and deliver

Internet governance takes different forms across the globe; in the United States an internet friendly to business and corporate competition takes precedent, in China the emphasis is on state sovereignty, and in Europe the European Commission (EC) wishes our internet to be people centered. But why is this important to our community? On the face of it, there will be one immediate impact. One of the key goals of the Digital Decade is to ensure that all Europeans have access to high-speed, secure digital infrastructure. This means that NRENs will need to invest in upgrading their networks and services to meet the increasing demand for bandwidth and connectivity as an overall societal trend. The amount of data being both produced and consumed by individual R&E users and institutions will increase due to the continent as a whole becoming increasingly

new digital education programs and training courses, to cover this demand from an R&E perspective.

But what can NRENs do now to ready themselves for such developments? Well, one immediate benefit would be to position themselves within the cooperation cycle of the Digital Decade policy programme. This monitoring, reporting and governance mechanism will produce a yearly 'State of the Digital Decade' report, which reports back on the recommended actions to Member States and utilises the Digital Economy and Society Index (DESI) to measure progress via Key Performance Indicators (KPIs). So, aligning NREN work to the DESI index would immediately bear fruit.

An even more advantageous course of action would be for respective NRENs to be listed in each of the EU-27 national roadmaps. The national roadmaps are set to be revised and consulted within the cooperation cycle every two years, but at the moment, national ministries are drafting their recommendations. Speaking now to ministerial contacts regarding this topic would therefore be mutually beneficial for both sides. For those NRENs outside of the EU-27, the Horizon Europe Widening work programme also provides ample opportunities for digital skills training in the wider European Research Area.

To conclude, within the tangled and often confusing world of EU policy making, the Digital Decade is a relatively simpler and more straightforward programme to interact with. In doing so, NRENs and GÉANT can remain relevant and eligible for future benefits and opportunities that stem from the programme up to 2030 and beyond.

## GÉANT Fit for 2028

If you are like me, the first question you ask yourself when reading this title is, of course, why 2028? It is out of sync with both our strategy and foresight work. But still, 2028 is an important date for us: the current Multi Annual Financial Framework (MFF) of the EU will come to an end in 2027, and with it our current funding envelope. At this moment, GÉANT's main funding source is formalised by the GN5 Framework Partnership Agreement (FPA), a seven-year agreement signed in 2022, which allows for the definition of specific grant agreements, such as the current GN5-1 and GN5-IC1 projects. Funding for new programmes will commence from 2030 onwards, but as we all know the leadup to access to new funding programmes takes a good two years, at least. Hence 2028 is a key year for GÉANT.



#### Words: Cathrin Stöver, GÉANT

Predicting the future and focusing on what may happen five years ahead is of course a challenge. But we can, to a certain extent, make predictions based on what we are seeing in the current MFF and the mechanisms defined in its associated Financial Regulation, as well as the main policy goals defined by the current Commission: the twin transition of green and digital, the corresponding Digital Decade programme, and the Global Gateway programme. They affect us already today and it is predictable that they will affect us even more in the future.

### Where are we now?

Over the last two years, at GÉANT internally and in conversations with the EU NRENs and even our wider community, we have been talking about our "Big 5". We have mapped the Big 5 African mammals to our main interests as a community: with the GÉANT project itself being the Rhino, EOSC being the Elephant (what else?), EuroHPC the Lion, Quantum with as many spots as a Leopard, and the Buffalo taken by our international activities. This easy metaphor has helped us focus our activities and it has resulted in organised

community conversations, activities, and actions around EOSC and EuroHPC and has led to an increased dialogue on Quantum. Dependable as a Rhino, the GN4-3 project has wrapped up yet another outstanding project period and GN5-1 has started at full force. The international activities are shaping up in the form of the new GN5-IC1 project with the extended Network Infrastructure Advisory Committee Terms of Reference to ensure full community buy-in.

While you can imagine the Big 5 as vertical activities, we have also identified the horizontal activities which cut across all of the Big 5: these are to begin with of course the 'secure connectivity', Trust and Identity, Security, as well as Standards and Compliance and Legal aspects, including the digital/green transitions and their societal impact measured through our contribution to the Sustainable Development Goals (SDGs) in GN5-1. When looking at this picture of horizontal and vertical activities, I would say that as a community we are well prepared. We have champions across these lines and are in constant conversation. This is good.

But – and of course there must be a 'but', otherwise this would all be pointless: there is a Mosquito in this room, buzzing around and maybe even keeping some of us awake at night.



#### The Mosquito in the room

GÉANT and the NREN community have a track-record of more than 25 years of funding through the Framework Programmes for Research and Technological Development. These Framework Programmes, or abbreviated FPs, are funding programmes created by the European Union/European Commission to support and foster research in the European Research Area (ERA). Starting in 2014, the FPs were named Horizon2020 and Horizon Europe (HE) respectively. We have little experience in dealing with other funding instruments and, in the past, this has never been an issue.

However, what we see now and particularly in the advent of the Digital Decade is the growing fact that areas of our natural interest are funded outside of HE. Take EuroHPC: it is mainly funded through the Connecting Europe Facility (CEF). Or take Quantum, which is mainly funded in the Digital Europe Programme (DEP). While in the area of Trust and Identity the development of services is still being funded through HE, in the future the delivery of such services will be funded in DEP. International activities are funded in various environments from the Neighbourhood, Development, International Cooperation Instrument (NDICI) or the Instrument for pre-accession Assistance (IPA3), to elements of CEF. But all of it is coming together in the context of Global Europe, Team Europe, and into the Global Gateway policy.

So, across the Big 5, we already see a fragmentation of funding for those activities, which we have identified as priorities for GÉANT and the community.

In addition, we have the horizontal complexity of eligibility and compliance rules, which have of course always existed, but which have become more sharply defined in the wake of the war in Ukraine. The so-called security clause can be invoked in all funding instruments, with immediate and limiting effects: we suddenly may have to deal with the challenge of EU27 vs GÉANT44. For a community like ours which has been built and expanded over the last thirty years based on the premise and promise of trust, inclusion, and consensus, these criteria as a consequence of the geopolitical crises around us are challenging our core values.

And here is where the Global Gateway programme is suddenly so very interesting in its complexity and nuance: while it seems that the doors are closing and the funding is fragmenting, this programme aims to bring it all back together, casting a wide net for Europe to collaborate with our partners globally.

#### **Financial** Regulation

#### Twin **Transitions**

At GÉANT, with our stable global community of more than 115 NRENs world-wide, we are ideally placed to respond as an integral and reliable partner to the Global Gateway focus area of research and education, as well as digital. We can be the 'not-forprofit' global player at the table. The BELLA programme, as a pathfinder to the Global Gateway, has shown that we can make a difference.

#### What's next towards 2028?

Whatever we do next, this must be a community discussion. I am happy to say that this conversation started at the General Assembly in March 2023 and will continue throughout this year and maybe into the next. It will be influenced by the EC's plans for GÉANT, as well as their decisions on developments for EOSC and EuroHPC. There are three areas which we will have to keep our eyes on and deal with: positioning

GÉANT, certification, as well as being able to receive funding beyond the current and known way of an FPA.

First, to avoid more fragmentation in the next MFF, we need to be able to state clearly the GÉANT position: that GÉANT and the NRENs provide secure connectivity and hyperconnectivity, as well as access and trust and identity services to the European research and education community. There is no need to fund connectivity or trust and identity services for R&E in every other programme or project. It is taken care of, we do it. And we innovate constantly. This must include the natural next step for networking, which may

#### Funding & Eligibility

#### Digital Decade

be Quantum, as well as the need for Europe to be internationally connected around the globe.

This leads to the second element: we need to ensure that the GÉANT Association takes steps towards organisational maturity by undergoing a pillar assessment and gualifying for ISO certification.

And third: we need to be ready as the GÉANT Association, as well as the NRENs and our community, to be able to accept funding in different ways than just grants. This could mean the negotiation of a contribution agreement and a

Feature



## GÉANT Fit for 2028

common understanding of what that means for the GÉANT and NREN dynamics. Equally, we may need to transform and in the future be able to compete with our services in public procurements by the EC or its operational entities.

The conversation has started. Let us together ensure that GÉANT and the community of NRENs keeps serving research and education in Europe for the next decade.

### **WELCOME TO** AC23TIRANA, ALBANIA | 5-9 JUNE 2023

E RASH

### **TNC23 WELCOMES THE DIGITAL** GENERATIONS

This year the international R&E community comes together in the colourful capital of Albania to celebrate another year of achievements, create new connections, and devise new plans for collaborations. GÉANT and RASH, the National Research and Education Network of Albania. welcome you to Tirana!

We're delighted to be back in Southern Europe to spend the last few days of spring in the embrace of a warmer climate and make the most of the renowned Albanian hospitality. Most importantly, Tirana, awarded the European Youth Capital for 2022, with a vibrant community of students and young workers, welcomes the digital generations.

The TNC23 team has been working around the clock to deliver another memorable TNC conference. Ann Harding, Chair of the TNC23 Programme Committee says, "I would like to welcome everyone to the vibrant city of Tirana and hope that we will be inspired, challenged, and connected as we mix digital generations from all over the globe in the sessions, and of course at the social events."



Scan this QR code to view the conference programme

#### **TNC23 VENUES**

The Palace of Congresses

TNC23's main venue, the Palace of Congresses, is an impressive building that serves as a hub for political, cultural, and social events in the Albanian capital. The palace boasts a spacious hall, multiple meeting rooms, and a beautiful terrace overlooking the city. Built during the late communist era to host the Congresses of the Albanian Labour Party and other official activities, today the palace is used for conferences, festivals, exhibitions, official ceremonies, concerts and more. It currently has a capacity of 2.100 seats.

#### **Rogner Hotel**

Only a three-minute walk away from the Palace of Congresses, the Rogner Hotel will only host selected meetings and presentations in the 'one track' room.



#### **ABOUT TIRANA**

Blessed with a subtropical Mediterranean climate, the welcoming, young, and vibrant capital of Albania is also the country's cultural, entertainment and political centre. Visit its museums, monuments and parks and enjoy the view of its unique residential buildings painted in rainbow colours. You are all invited to feel and enjoy the vibe of Tirana!

#### **THE COMMUNITY HUB**



New for TNC23, the Community Hub is an informal collaborative space where conference participants can discuss, share ideas, brainstorm, and exchange information. It will be busy, buzzing, and hectic, but easy to access. The one and only rule: all participations must be open!

#### **INFORMAL DEMONSTRATIONS**

The Hub includes two stations available for spontaneous demonstrations, such as software or service demos for just one delegate or a small group. The demo station consists of one high table and power, no other AV equipment is provided: a laptop is all that presenters need.

#### **SOCIAL EVENTS**



#### **KICK OFF PARTY** TUESDAY 6 JUNE

The TNC23 Kick Off party will take place in the pedestrian street 'Murat Toptani' and the 'The Cloud' installation: it will be an open-air party! 'Murat Toptani' is the popular stone-paved and tree-lined street in the very heart of Tirana, passing many cafes, also recognised as the capital's historical gallery and museum. 'The Cloud' is a monumental art installation accessible from Murat Toptani. Murat Toptani will be closed off exclusively for the TNC23 party goers.

#### **ROUND TABLE**

The round table is available for impromptu discussions or brainstorming sessions for a small group of people to talk about or further explore an idea inspired by a talk.

Palace of Congresses

Tuesday 6 June, Wednesday 7 June, Thursday 8 June 10.30 - 11.00

- 12.30 14.00
- 15.30 16.00

#### **MESSAGE BOARD**

Anybody wishing to advertise a service, a project, a meeting, or a get-together can do so via the message board. Everybody is encouraged to bring along a flyer, a leaflet, even a small poster, or post a note or add an idea to the board.

For confidential meetings, an ad-hoc meeting room seating up to 10 people is available at the Rogner Hotel until the afternoon of Thursday 8 June. Visit the GÉANT booth to register.





#### **CONFERENCE DINNER** WEDNESDAY 7 JUNE

Ferma 100 is a farm restaurant located in the village of Vishnja in a small oasis in the middle of the Erzen River valley, just a few kilometres from Tirana city centre. Al fresco dining, tasting fresh local produce and traditional Albanian cuisine, with a stunning view of the valley will make it a summer night to remember. Please, remember to take the conference badge to the above social events with you as it will be your entry pass for the event.



#### **FUTURE TALENT** PROGRAMME 2023: **A NEW** GENERATION **OF TALENTS TO LEAD THE R&E** COMMUNITY **INTO THE FUTURE**

Words: Grace Cooper, GÉANT

The GÉANT Future Talent Programme (FTP) is back! This year, sixteen talented students and young professionals were sponsored by eight NRENs from across Europe to take part in the programme and receive expert presentation training, which will enable them to share their ideas to a wide audience at TNC (and beyond, with FTP Lightning Talks published on the GEANTty YouTube channel).

"The aim of the Future Talent Programme is to attract the next generation to our community. It has been great to see the students' energy and ideas emerging during their training sessions. One FTP22 alumnus is now a GÉANT employee, which is exactly what the programme envisaged. We look forward to welcoming more FTP students into our community in future."

Sarah Hughes, Senior Learning and Development Manager, GÉANT

GÉANT is extremely proud to see the programme continuing to thrive, building a talent "pipeline" for NRENs and creating a platform for younger generations to boost their experience, share their innovative research, and make contacts within the international Research and Education networking community.

#### **MASTERING THE ART OF IMPACTFUL PRESENTATIONS**

Supported by the GÉANT Learning and Development (GLAD) team, the programme is designed to help all participants shape their ideas and vision into captivating and engaging presentations, by providing them with the necessary skills via expert training and 1:1 coaching.

Building on the successful experiences of previous years, FTP23 participants joined Coach Michael Koenka, of Koenka & Partners, for a series of Masterclasses which took place between March and May 2023.

#### LIGHTNING TALKS, FIRST STRIKE Tuesday 6 June, 16:00-17:30



**Renata Castelo-Branco INESC-ID/Instituto Superior** Técnico, University of Lisbon Supporting NREN: FCT | FCCN, Portugal LIGHTNING TALK: THE ALGORITHMIC **DESIGN SKETCHBOOK** 



**Javier Crespo Guerrero** Universidad de Valladolid Supporting NREN: RedIRIS, Spain LIGHTNING TALK: APK FALCON: **EMPOWERING USER'S PRIVACY** 



**Felix Gaudin** UC Louvain Supporting NREN: Belnet, Belgium LIGHTNING TALK: WHY YOUR **INTERNET IS BAD!** 



**Karel Hynek** FIT CTU- Czech Technical University in Prague Supporting NREN: CESNET,

Czech Republic LIGHTNING TALK: BREAKING DOWN AI TO GET EXPLANATIONS

LIGHTNING TALKS, SECOND STRIKE Wednesday 7 June, 11:00-12:30



Brno University of

Supporting NREN: CESNET,

LIGHTNING TALK: JETSTREAM 2.0: A

**MULTI-FPGA PCIE INFRASTRUCTURE** 

SUPPORTING FPGA-TO-FPGA LINKS

Technology

Czech Republic



**Fabio Greiner** University of Zurich Supporting NREN: SWITCH, Switzerland

LIGHTNING TALK: IT'S PEOPLE - OR WHY WE NEED AN INTERDISCIPLINARY APPROACH **TO CYBERSECURITY** 

#### **ALL THE STUDENTS** PARTICIPATING **IN FTP23**

**Ana Le Chevillier** University College Dublin (UCD), HÉAnet



**Belen Fernandez de Toro Espejel** Universidad Nacional de Educación a Distancia (UNED), RED.ES



Magherita Soldaini Università degli Studi di Firenze Dip.to di Architettura (DIDA), GARR



**Martina Palmucci** Università degli Studi di Perugia, GARŘ



Thalita Nazaré Maynooth University, HEAnet



Valeria Repetto CNR - IIT Pisa, GARR



**Jenna Barrv** Technical University of the Shannon (TUS), HEAnet

#### **IDEAS AS BRIGHT AS LIGHTNING** (TALKS)

Out of this year's group of participants, eight Future Talents made it to the next step and were selected to join the prestigious TNC23 conference. They will share their work live on stage in front of an international audience of peers and specialists, in a 5-minute Lightning Talk format. These young talents reflect the spirit of TNC23's main theme of "Digital Generations" in lively and vibrant Tirana. Last year's engaging and impactful presentations were widely praised, and this year's Lightning Talk sessions are not to be missed!

More information on the 2023 Future Talent Programme is available on the GLAD wiki: https://wiki.geant.org/x/foBulg



#### **João Daniel Correia Brandão**

Universidade do Porto -Faculdade de Engenharia Supporting NREN: FCT | FCCN, Portugal

LIGHTNING TALK: **POWERING THE FUTURE: THE VALUE OF RENEWABLE ENERGY COMMUNITIES IN A DECARBONIZED WORLD** 



**Richard Plný** (FIT CTU) Czech Technical University in Praque

Supporting NREN: CESNET, Czech Republic

LIGHTNING TALK: DATA FUSION: THE KEY TO RELIABLE THREAT DETECTION





**Stefan Marinchesk** FCSE, UKIM, MARNET



### THE EMERGING NREN PROGRAMME PRESENT **CONNECTIONS AND FUTURE COLLABORATIONS**

The GÉANT Emerging NREN Programme (ENP) is a recent, but significant, addition and integral part of TNC. The programme aims to enable the integration of representatives from emerging NRENs from around the world into the TNC community, to create connections at different organisational levels between NRENs, and foster future collaborations.

#### Words: Rosanna Norman, GÉANT

Since TNC18 the programme has been bringing to TNC employees from NRENs that would not be able to participate otherwise, focusing particularly on engineering and technical personnel. In four editions the programme has reached 56 participants from 37 different countries and territories. This year, the GÉANT ENP will be held physically alongside TNC23 from Monday 5 to Friday 9 June in Tirana and supported by RASH, host of TNC23,

#### **ENP PLANNING**

At the start of the year, all Regional and National R&E Networks are encouraged to nominate representatives to take part in the programme, in particular young engineers, NREN staff members, or researchers who are part of the community but are not usually able to attend conferences, and who would

benefit from the knowledge exchange. Diversity is also strongly supported by encouraging female applications wherever possible.

**This year TNC** welcomes 13 ENP participants from **10 countries:** 

Albania **Bosnia and** Herzegovina **Ethiopia** Jordan Malawi **Palestine** Peru Serbia Sri Lanka Tunisia

Picture ENP participants at TNC22 (13-17 June 2022, Trieste, Italy)



Most importantly, three ENP candidates have been selected to present a Lightning Talk on TNC23's plenary stage. Lensa Abera from EthERNet, the Ethiopian Education and Research Network, will talk about their Higher Education Management Information System (HEMIS); Katarina Simonović from AMRES, the Serbian NREN, will present her talk 'Log management and visualisation of AMRES statistics using open-source tools': and Alexius Chipalamwazani. from MAREN, the Research and Education Network from Malawi, will present the following Lightning Talk, 'Move our Content to IPv6, please!'.

Each participant will attend TNC23 and take advantage of a tailor-made programme that includes dedicated sessions with RASH. Participants will be 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 pairing 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.

Leila Dekkar, International Relations Project Manager for GÉANT, commented: "I am really pleased with this year's programme, and I am grateful to RASH for their support and collaboration in pulling it together. With only four women taking part in ENP 2023, female participation is not as high as I as I would have hoped, but I view this as an opportunity to focus on the gender gap challenge for the ENP 2024 programme."

For further information about the GÉANT Emerging NREN Programme, contact Leila Dekkar at leila.dekkar@geant.org

### **CONNECT INTERVIEW:** MIRA MEZINI, **TNC23 OPENING KEYNOTE**

#### **SAFE AND SECURE PROGRAMMING ON THE EDGE**

Interview by: Rosanna Norman, GÉANT



We met with Professor Mira Mezini, the TNC23 opening keynote speaker presenting on 6 June 2023.

Mira Mezini is Professor of Computer Science at the Technical University of Darmstadt in Germany, and her research focuses on software development paradigms and tools. Her current research comprises two main themes: the development of programming methods to facilitate the development of correct-by-design and secure-by-design decentralised and interactive software, and the development of learning-based software-development environments to increase development productivity and software quality.

Her keynote Safe and Secure Programming on the Edge presents the goals and current results of an ongoing project, which advances the state of scientific knowledge in the area of programming foundations for distributed applications.

#### **MIRA, THANK YOU FOR KICKING OFF TNC23 WITH** YOUR KEYNOTE. WHAT IS THE **PROJECT YOU PRESENTED IN YOUR KEYNOTE IN A NUTSHELL? WHAT ARE THE BENEFITS OF SOFTWARE DECENTRALISATION?**

Today's computing infrastructure is globally distributed. The back-end of our computing infrastructure consists of geo-replicated cloud facilities: these have extensive computational power and storage, are connected with each other via mostly stable connections, and are managed by engineers of tech companies; computations are distributed and replicated across machines for scalability and availability. The back-end is the traditionally distributed computing. On the edge of the internet, there are millions of increasingly powerful devices - mobile phones, autonomous vehicles, drones, sensor networks, satellites, etc. The edge is woven with the physical and social worlds, it is out of control of skilled engineering teams; distribution is here inherent (people, devices, data sources are inherently distributed); likewise, concurrency is inherent due to people and devices acting autonomously in time and space. Not only end-to-end connections, but also local connections are often disrupted; partitions are the norm, connectivity the exception.

Instead of featuring batch processing on top of (geo-replicated) data stores, today's applications social apps, collaborative workflows, real-time businesses, software for autonomous vehicles, environmental monitoring, production 4.0 and more - are interactive and learning-based. They interact with the outside world the order of their computations is not determined by their code but driven by the flow of events/data; their behaviour is (partly) learned from data via learning algorithms. Learning is becoming interactive too, moving away from static learning from stationary datasets towards active, continuous learning in interaction with the outside world.

Currently, computing is mostly centralised (data is collected, managed, processed in the cloud and edge devices serve basically as interfaces to the outside world). The centralisation has a lot of advantages as it enables the described complexity to be handled by highly skilled engineering teams at big tech companies. But there are issues with it: lost control over ownership and privacy of data, lack of offline availability, poor latency, inefficient use of communication infrastructure, waste of computing resources on the edge. Crucially, centralisation is not viable for computing infrastructures where being off-line or having limited bandwidth is a widespread phenomenon (e.g., autonomous vehicles operating in rural areas); at the same time decentralisation is becoming viable due to increased resources of edge devices - the "data centres" of the 21st century.

Existing programming methods are not up to the challenges resulting from the above shifts - hence, as of today, decentralisation is not really viable. My research aims to fill the gap by establishing foundations and developing corresponding tools for programming safe and secure interactive and learning applications running on globally distributed computing infrastructures with decentralised control.

#### **COULD YOU HIGHLIGHT YOUR EXPERIENCE AS A** SUCCESSFUL ALBANIAN SCIENTIST, AND THE IMPACT **OF YOUR RESEARCH AND ROLE AS AN AMBASSADOR** FOR ALBANIAN RESEARCH **EXCELLENCE IN EUROPE AND** THE REST OF THE WORLD?

This is a difficult question, in the sense that I can't really highlight my experience as an Albanian scientist, as I am actually a German scientist - my whole scientific career, after completing my studies in Albania, developed in Germany (and partly the US). Needless to say, I am happy to be seen as an ambassador for my home country, as I hope it demonstrates that Albanians are capable of becoming world leaders in their areas of expertise.

#### **AS A SUCCESSFUL FEMALE ACADEMICIAN IN STEM,** WHICH CHALLENGES DID **YOU ENCOUNTER OVER THE COURSE OF YOUR CAREER?**

Personally, I can't say that I encountered specific challenges as a female academician in STEM, beyond the recurring experience of often being the only female in the room. I believe that being in the minority gender in any field, makes it more difficult to achieve one's goals and convey one's views. This is why we need to urgently change the picture and try to get more female students interested in studying STEM subjects. Unfortunately, this is a complex problem as it requires deep societal changes.

#### **WERE YOU FAMILIAR WITH TNC? WHEN DID YOU FIRST HEAR ABOUT OUR ANNUAL CONFERENCE?**

I was not familiar with TNC before being invited to give the keynote, but after reading about the conference and its impressive history, I am really delighted to meet and present to the international research and education community.

#### WHAT'S AROUND THE **CORNER FOR MIRA MEZINI?**

Together with few members of my team. I recently founded a startup company in the area of software security and I am in the first stages of the preparation to the next transition of our research results and we are ready to present them to the realworld – the topic of my TNC23 kevnote focusses in fact on such results. So, I am really looking forward to some very exciting times ahead, and I am ready to face the challenges that my profession and my research will present along the way.

## **Proud of our** female pioneers: Ida Holz, "mother of the Internet" in Latin America

Vint Cerf calls her the "mother of the internet". A key figure in the establishment of the first node of the Internet in Uruguay, an advocate and a leader in the development of an independent Latin American networking industry. This is Ida Holz.



#### Words: Silvia Fiore, GÉANT

From a Jewish family of Polish origin, Ida is of the first generation of computer engineers in Uruguay. After spending a few years in the Israeli army and working on a kibbutz, she returned home for her university studies.

In 1964, she married the love of her life, Anhelo Hernández (1922 – 2010), a Uruguayan contemporary painter whose work earned world-wide recognition and is exhibited in several museums in Uruguay, Cuba, and Russia. In 1973, after graduating, she left with her family to live in Mexico

in exile, seeking refuge from the military dictatorship in her home country. In Mexico, she established herself as an expert in the informatic networking community.

After 12 years in exile, she returned to Uruguay in 1987 with a vision and determination that access to information is key for the development of a society. Uruguay is the country with the smallest population in Latin America, but with a high level of education, especially public education which has been secular and free of charge for over a

century now. However, with such a scarce population, researchers were isolated and struggled to communicate and collaborate in the region as well as globally.

That same year, she became Director of the Central Information Service (SECIU) at Universidad de la República and, while there, she led the team that created the Uruguayan Academic Network (RAU) which got to register the .uv domain in 1991.

Up until then, emails were only exchanged between engineers at the Computer Institute of the

Picture From the left: Salma Jalife (Centro México Digital), Ida Holz, Carlos Casasús (CUDI México)

Uruguayan School of Engineering and the Universidad de Buenos Aires. They would have to make a couple of telephone calls per day to send out the emails stored in their servers and receive incoming ones - a time consuming process, yet a powerful and promising tool. In fact, it did not take long for teachers at the universities to want to be connected and receive emails as well, but as the number of users increased significantly, the Institute's servers started to get too crowded. So, Ida and her team were asked to find a solution and so created RAU and started working directly with UUNET, the biggest ISP at the time. It took a few years, as a direct link to the USA was required, but in 1995 the Internet was officially introduced in Uruguay, opening the doors to endless collaboration opportunities for local students and researchers with their global counterparts.

Ida's contributions do not stop at national level. In 1991, the "First Inter-American Networking Workshop" was held in Rio de Janeiro. There, American and European personalities introduced

for the first time the idea to build a Latin American organisation, which would, however, be led by a foreign authority. Ida did not agree: "If we could not govern ourselves and choose our own leaders, there was no point in creating anything". After a long sleepless night, her Latin American colleagues and Ida had created the Latin America and Caribbean Network Forum. Although it started with nothing - there was still no Internet at the time – the forum believed in the power of collaboration, and it worked to lay down the



fundamentals for the development of today's Internet in the region.

Since then, she has been instrumental in establishing three other keystone regional organisations – the Latin American and Caribbean Internet Address (LACNIC), the Latin American and Caribbean Association of Country Code Top-Level Domains (LACTLD), and the Latin American regional research and education network, RedCLARA.

Her selfless dedication and the time she has invested – and continues to do so – in the development and improvement of ICT networks in the region led her to be inducted to the Internet Hall of Fame in 2013, making her the first Latin American woman to be awarded.

This was not the only award she received. In 2009, she had been awarded the Lifetime

Achievement Award granted by LACNIC. In 2014, she received the Moña de Honor at the public primary school she attended, in celebration of the power of education and vocation of teachers. In 2015, the Uruguayan postal service honoured her by issuing two stamps of their "Highlighted Personalities" series in her honour.

Today, at 88, she is still very much involved in the community and is currently writing a book on the story of academic networks in Latin America together with Michael Stanton, one of the founders of the Brazilian NREN, RNP. Ida is a strong advocate for an exclusive network for research and education in Uruguay to improve the connectivity for local students and researchers. It is hard to imagine a world without that. The arrival of the Internet in

the region has changed lives for the better and it has become a significant part of everyday life for educators and researchers. A powerful tool to plan, execute, and distribute their work, it enables incredible progress in all areas of human life.

A humble and visionary leader, Ida is a true pioneer behind the existence and evolution of the Internet in Latin America and an inspiration to the next generation of computer scientists and Internet champions. She is the mother of Ayara, a ballerina who performed all over Latin America and Europe before returning to Montevideo to work as a teacher, and Arauco, an award-winning filmmaker and cinematographer. She is grandmother to three children who are her joy.

Picture From the left: Carlos Casasús (CUDI México), Nelson Simões (RNP), Ida Holz, María José López (RedCLARA), Tom Frver (GÉANT), Michael Stanton (RNP)

"When I use the metaphor "we are all standing on the shoulders of giants", it is Ida Holz that I refer to for myself. I met Ida in 2002, when the EC and GÉANT



started the conversations with Latin American NRENs on the joint formulation of the collaborative project which led to the creation of RedCLARA. This was the first time I managed an international project of such magnitude, and it was to Ida that I turned for guidance over the next five years. She showed me that true collaboration is built on a constructive and positive attitude, the need for some guite strict measures, a level of reliability and most importantly: never to leave the room before you can see the agreement in everybody's eyes. She ensured that I found the way of true collaboration which ensured the long-term success of RedCLARA. I am proud to be able to call her my friend and to have sat at her table eating the biggest plate of spaghetti ever served".

Cathrin Stöver, Chief Communications Officer at GÉANT

"Ida Holz is one of those indispensable characters that we meet once in life. What happened in **Uruguay and** Latin America



with the Latin American Network Forum and later with the creation and subsequent development of RedCLARA cannot be understood without her. In addition, with a leadership style that significantly promoted cooperation between the countries of our region. I have the honour of her friendship; she has inspired me over the many years of working together".

Luis Cadenas, Executive Director of RedCLARA

"In 2002 I met Ida personally, but it wasn't in the South. It was at the presentation meeting for the idea of the ALICE (America Latina Interconectada



Con Europa) project, in Toledo (ES). She was moving behind the scenes in Latin America towards a coordinated positioning between NREN for a regional network (now RedCLARA), a regional organization (now CLARA) and a vision of future direct interconnection (now BELLA). Visionary, impatiently courageous and very inclusive. It was exactly what we needed - love at first sight".

Nelson Simões da Silva, Executive Director of RNP

"When I started working for RedCLARA, and that is literally since it was created. I was super impressed by the figure, personality, and



capacity of Ida. Knowing her means loving and admiring her. 20 years ago, when I met her, I didn't know that she was who fought for connecting Latin America to Internet, until I saw her fighting to make the Latin American advanced network a reality. Her strength, values, the way she considers every person with respect and empathy, really touched me deep inside. I cannot tell how much I have learned from her in this networking environment, but I know I would love to be half as wise as she is and half as brilliant and sensible... that would make me a great woman. Ida is just one of a kind, and for sure she is RedCLARA's soul."

María José Lopez, Public Relations and Communications Manager at RedCLARA

## **2023 GÉANT COMMUNITY AWARD**

This year's GÉANT Community Award was presented to two winners: Sebastiano Buscaglione from GÉANT, in the category "initiators of significant new ideas or improvements which have had lasting impact on the organisation, project or community", and Sabine Jaume in the category "impactful contributors to the GÉANT project or wider community activities over a sustained period of time".

The awards were presented by Paul Rouse, co-Chair of the GÉANT Community Committee, on Tuesday 6 June, during TNC23's opening plenary, in Tirana, Albania.

#### Words: Silvia Fiore, GÉANT



#### **SEBASTIANO BUSCAGLIONE, SENIOR NETWORK ENGINEER,** GÉANT

#### About Sebastiano

Sebastiano has made an impressive contribution in planning and designing the next evolution of the GÉANT pan-European network. His technical acumen and his ability to relay complex issues are paired with his ability to engage successfully with all stakeholders (GÉANT, NRENs, European Commission reporting, as well as a wide breadth of providers in the Telco and network technology marketplace). Sebastiano's commitment to the GN4-3N project has been unwavering and he is always on top of what is a very wide scope of work to manage. In addition, he always maintains a calm disposition, he's respectful of all views, and his subject matter expertise is always assuring.



Bram Peeters, Chief Network Operations Officer at GÉANT, adds "I'm very happy to see Sebastiano receiving this welldeserved community recognition. His ability to blend technical insights with an appreciation of who we do it with and for is truly remarkable and noteworthy. Seb's dedication to ensuring that the solutions are not only technically sound, but also beneficial for the community is really admirable. We have seen that in the GN4-3N network project Seb will help to make sure we get there together, in a very positive and calm way. I'm consistently impressed by his skill in balancing multiple responsibilities, processing all the information, and generously sharing his expertise. Congratulations, and I hope we can continue to work together on good things for a long time!"

Sebastiano reacted, "It is a great honour for me to receive this award, and I want to use this occasion to thank this community for the amazing trust and support I received throughout the years. It is an incredible privilege to be able to do the work I do as I truly believe that what we do is important. Each of us working together with all our differences toward common goals; this community is a beautiful, living example of what can be achieved with trust, collaboration, and passion. There is no better place to be!"



#### **SABINE JAUME**

#### **About Sabine**

For over 28 years, Sabine has been one of the most valuable members of both the European and international community. She had a key role in setting up the French NREN, RENATER, and advocated for GÉANT and European NREN collaboration as we know it now. Over the years, she has been a member of several Boards and Committees (GÉANT Board, GÉANT Community Committee, GÉANT Community Programme, and the Programme Committee of TNC20 and TNC21). A strong advocate for NRENs around the world, she was not only involved in the BELLA and AfricaConnect projects, but she kick-started and led many initiatives for NRENs in Africa. With her welcoming and supportive disposition, she always goes the extra mile to share her expertise, help newcomers, and support innovation in the community.

Erik Huizer, Chief Executive Officer at GÉANT, says "A driving force behind AfricaConnect projects working to help establish stable NRENs in the region, a quality controller in several GÉANT committees, with a keen eye for detail and a dedicated GÉANT board member with NREN interests at heart, to name but a few examples - this is Sabine. She is a wonderful, open, and warm person who has contributed to our community on various levels with great energy and dedication, and if anyone deserves recognition for contributions that benefit all NRENs, it is Sabine."

Sabine reacted "This award is an utmost honour. I am very grateful to those I am working with for 28 years and who made it happen! It also very nicely bootstraps a new chapter of my career. Our GÉANT Community is made of amazing people continually engaging with all stakeholders: users, NRENs and RRENs, funding bodies, policy makers, and industry. Because no matter the frontiers, research and education deserve top class networks, security, and digital services. I am so proud to be part of this Community. Let's keep on innovating together for a bright future!"

Paul Rouse concludes with saying "The Community Award embodies the uniqueness of what it is to be involved with research and education networks. In this community organisations come together, bound by trust in one another to deliver the services needed for research and education on a global scale. It is the people within these organisations that enact this, and the Community Award is a chance for us to recognise those who have made such a great impact. The nominees for 2023, like previous years, allow us to showcase some of the great work being done in our community.

Having been lucky enough to work closely with the two winners this year, I am really pleased to see how our community has chosen to recognise their fantastic work. If you are inspired by their stories, remember the Community Award is there for you to nominate next year - let's keep celebrating the achievements of our colleagues."

The TNC23 stage also hosted the ceremony for the 2023 Medal of Honour by the Vietsch Foundation. The award was presented to Arjan Xhelaj Director General of RASH, the Albanian Research and Education Network, by John Dyer, member of the Board of Trustees of the Vietsch Foundation. Valentino Cavalli, Chair of the Board of Trustees of the Vietsch

Foundation comments: "Arjan Xhelaj has been responsible for establishing the RASH academic network from scratch and developing it through a decade of successful achievements to a fully functional organisation, serving the academic network and users of Albania and representing the Albanian research and education community in international fora and projects. In the spirit of the award, which recognises individuals who have proved their organisational skills and whose efforts have led to the creation of institutions or services of long-term value, Arjan Xhelaj was selected as the most deserving recipient, in a list of very valuable candidates, some of whom were nominated by various communities". Explaining the rationale for the choice, Valentino recalls that he "first met Arjan in 2011, during a meeting in Italy, where he and Karel Vietsch had been invited to advise on the consultancy project that paved the way to the creation of the research and education network of Albania. Arjan proved since then to be a very competent, strong, and motivated player, and asked very soon to become a member of TERENA. The Vietsch Foundation board unanimously recognised the value of his commitment and successful achievements throughout the years. Board members are also particularly excited that the 2023 medal of honour has been awarded to the host of TNC this year".

#### About Arjan Xhelaj

Arjan Xhelaj is the founder, and currently Director General and Chairman of the Governance Board of RASH, the Academic Network of Albania. He is an experienced institutional leader with a proven track record of working in government, public administration, industry, and International Relations. The Researcher and Innovator has strong experience in the European Commission as a Member of various governing and advisory Boards. He has studied Engineering in Applied Physics and Information Technology and worked as PhD researcher in Biophysics at Frankfurt am Main University, Germany.

#### About the Vietsch Foundation

Read the CONNECT interview with Arjan Xhelaj on the next page.

#### Arjan Xhelaj, Director General of RASH, receives the 2023 Medal of Honour by the Vietsch Foundation

The mission of the Vietsch Foundation is to promote research and development of



advanced Internet technology for scientific research and higher education. The Vietsch Foundation fulfils its goals in two ways: First, it contributes funding to specific research and development projects that demonstrate potential value to progress European and global research and education networking. And second, each year it awards a medal of honour to people who have contributed to the development of services or technologies of lasting value that are used by the networking community and its users in research, development and education. The Foundation was created through the last will and testament of Willem Karel Vietsch (1952-2014). a Dutch expert, a leader of the international Internet community, and also the Secretary-General of TERENA, a former association of European national research and education networks. For details visit: http://www.vietsch-foundation.org



## **CONNECT Interview:** Arjan Xhelaj, **Director General, RASH,** the Academic Network of Albania

Arjan Xhelaj has many reasons to celebrate this year: not only is he this year's proud recipient of the prestigious Medal of Honour awarded by the Vietsch Foundation, but he will receive this award at TNC23, which is hosted by RASH, the organisation that he founded and now leads, in his hometown of Tirana. We approached him to talk about his plans for RASH, the opportunities and challenges faced by the Academic Network of Albania, and his vision for research and education in his country.

Interview by: Rosanna Norman, GÉANT



#### Arian. what does the Medal of Honor mean to you?

I am honored and grateful to receive the Vietsch Foundation award. This recognition means a great deal to me and serves as a reminder of the importance of the work that I do. The support and encouragement provided by the Vietsch Foundation is deeply appreciated and will undoubtedly inspire me to continue striving towards excellence in my field. I am truly humbled by this award and am excited to continue making contributions to my community and beyond.

Founded by you over 10 years ago, RASH is now an established and functional organisation serving the academic network of Albania and representing the Albanian research and education community at international level. How did it all start?

RASH, the Academic Network of Albania, is the Albanian National Research and Education Network (NREN). Established via an intergovernmental agreement by Albanian Parliament between Albania and Italy, in 2011 RASH started its operations as the Albanian NREN at national level and in 2012 internationally as a member of TERENA, the Trans-European Research and Education Networking Association (which later merged with DANTE to become GÉANT Association). Everything started from scratch: I selected five internationally educated people (Germany, USA, UK), who had the wish and desire to contribute to the development of our country. With the support of an experienced partner such as CINECA-Italy, we designed the first e-services for the university and with TERENA's help we configured the first national network dedicated to education and scientific research connected to the GÉANT network. Over the years, and in collaboration with the Ministry of Education, RASH grew further, starting to offer national services for education and science. In 2018 according to an agreement between the rectors of all public universities and the Ministry for Education, RASH was reorganised

as the autonomous Inter-institutional R&D centre for ICT. In the last 10 vears we offered and developed "in house" software and e-infrastructure services for the Albanian education and researcher community promoting GÉANT services and also among others, EOSC and Open Science, EuroHPC and other European initiatives

#### In your view, what does the future of research and education look like in Albania?

Albania has made significant progress in R&E in recent years, but there is still a lot of room for improvement. The government has implemented various policies and initiatives to improve the quality of R&E, such as increasing funding for research projects and promoting collaboration between universities and research institutions, and internationalisation of the Albanian Higher Education (HE) system through bilateral agreements with European countries and American universities. In Albania we have 12 public and several non-public universities, including the University of Tirana, the Polytechnic of Tirana, and other

universities that offer a variety of programmes in various fields, including natural sciences, engineering, social sciences, medicine, and agriculture. However, the quality of education and research in Albania is still affected by several factors, including limited resources and brain drain. Many talented Albanian researchers and scholars leave the country to pursue their careers abroad, which hinders the development of the country's research and education sectors.

In conclusion, while there are several initiatives from the government and other stakeholders to improve research and education in Albania through the internalisation of our HE, a lot of work still needs to be done to reach international standards and retain talent within the country.

#### What do you hope will be the main impact for **RASH and Albania of** hosting TNC23?

Hosting TNC23, the largest and most prestigious conference in R&E networking, is a significant opportunity for RASH and Albania. The conference will provide a platform for RASH to

showcase its achievements, network with other academic networks, and strengthen its partnerships with other institutions.

Moreover, TNC23 will bring together researchers, academicians, and experts from around the world, providing an opportunity for Albanian researchers and students to learn from and collaborate with leading experts in their fields. This could potentially lead to new research collaborations and partnerships that could benefit RASH and Albania in the long term.

Hosting TNC23 will also promote Albania as a destination for international conferences, potentially leading to more conferences being held in the country in the future. This could have a positive impact on the economy by bringing in more tourism and revenue.

#### What is around the corner for Arjan?

First some holidays on the Albanian riviera to recover from the pressure of co-hosting TNC23. It has been a very long year, full of challenges and headaches, but with a beautiful result. Personally, as a doctor in engineering and as an experienced researcher, I am excited about the prospects of my career in technology and innovation. Over the years, I have gained a deep understanding of the potential of technology to drive social and economic development, and I am committed to continuing my research in this area.

I am committed to making a positive impact on the world around me by building partnerships with experts in fields such as economics, sociology, and public policy, I believe that we can drive research that is both innovative and impactful. tackling some of the most pressing social and economic challenges that communities face today.

My wish for the future is to be able to make my experience, gained in the last 30 years, more and more available to the GÉANT community and to other NREN communities outside Europe, to be able to talk about the path I followed with the creation of RASH.

In order to move forward it doesn't matter how big or rich your NREN is, what matters is your vision for its development, a good plan on how to reach the final goal and persistence in the face of difficulty. Although, having a backup plan would be useful too!



# 2022 Compendium Report Published

The 2022 GÉANT Compendium of National Research and Education Networks in Europe Report has been published on 5 June and the digital version released on the GÉANT website.

Words: Jennifer Ross and Daniel Wustenberg, GÉANT

For a second year, there has been a phenomenal response rate to the Compendium Survey, with 40 European NRENs devoting time in late 2022 to complete the annual Survey. These responses, along with extra information from surveys carried out by TF-EDU, OCRE, REFEDS, and other teams within GÉANT and across the NREN community form the basis of the 2022 Compendium Report. Extra thanks is also extended to Nataša Glavor (CARNET), János Mohácsi (KIFÜ), and Hank Nussbacher (IUCC) for their work on the Compendium Advisory Board, which steers and supports the creation of the Compendium.

As usual, the Report provides insights into NREN organisations, including their budget, funding sources, and staffing – and also takes a look at the variety of governance models among NRENs and how this affects their funding structures. Further, individual NREN have answered.

the Report looks at the NRENs' end users (with a new section on the burgeoning activity in the digital health sector), their networks, security, cloud, education, and trust & identity services. In all these areas, preexisting trends continued or resumed after temporary setbacks during the COVID-19 pandemic. The latter is especially pronounced in the increase of network traffic, which is now at an all-time high. Another remarkable trend is the continuing increase in the use of cloud services, feeding into the success story of the laaS frameworks. Work is also ongoing to build a new dedicated Compendium website.

bringing together in a single site Compendium Reports dating back to 2004 and more recent Compendium Survey responses. The Data Explorer portion of the website will allow visitors to browse the individual questions asked in the survey and see how

While the Reports give a great overview of the NREN landscape, the filters within the Explorer will allow visitors to view the responses of a single NREN or make comparisons between a selection of NRENs. Visitors will also be able to compare responses from multiple years, to understand how NRENs, their networks, users, services, and more have changed and evolved over time.

A presentation of the new Compendium website will be given at the SIG-Marcomms meeting on 9 June in Tirana, and more information about the new website will be released in the coming weeks.

All GÉANT Compendia are available online at https:// resources.geant.org/geantcompendia/

### **CONNECT Interview:** Juha Oinonen, director of FUNET at CSC

Juha Oinonen is the new director of the Finnish Research and Education Network FUNET at CSC and a newly appointed member of the GÉANT General Assembly (GA). We spoke with him about his new role and about CSC's plans for the future.

#### Interview by: Leonardo Marino, GÉANT

#### FUNET by CSC

Juha. tell us more about yourself and about your career at CSC/FUNET

My history at CSC dates back to the mid 1990s, when I worked on a High-Performance Computing (HPC) project at CSC, but it's only towards the end of the decade – once I graduated in computer science – that I became employed full-time. When I started, I was supposed to be hired on the computational side, but at that time the internet bubble started to get bigger... and I ended up in FUNET.

At FUNET, I started as a network specialist working with both network and services for a couple of years. Then for a decade I held different managerial positions within FUNET, after which I temporarily shifted to various activities in the organisation. I've never been far from FUNET though, so being in my current position feels like getting back home.

It's been a very interesting environment to work in and here I have had the pleasure of working with very talented people both nationally and

internationally. I'm confident that it'll be the same also in this new role, and I'm looking forward to the future.

#### **Congratulations on** your new role as director of FUNET at CSC. How does this relate to the latest changes and developments at CSC?

Thank you! The gradual updates that have been taking place this year and in the past few years in the CSC management structure reflect the changes in our activities and the growth of the company. Obviously, these changes are necessary in a growing organisation, as they help to find possible bottlenecks and tackle them by reorganising and finding new people and new roles where needed.

It's important to mention that CSC is in a somewhat different or even unique situation if compared to many other NRENs: we have a strong role on HPC, we offer a wide spectrum of different ICT services, and we are verv active on information management and on data management, including sensitive data. And we provide services not only for universities and research organisations, but also for governmental organisations, for

example in the field of culture or in general administration. Additionally, hosting both NREN and HPC activities under the same roof makes certain things easier, for example with reaching specialists or finding the necessary decision makers and getting them at the same table.

#### CSC has a very interesting position, being at the same time an NREN and a **EuroHPC site via LUMI.** Can vou tell us more about it?

I believe that the factors that led us to host LUMI in Kajaani – other than for example the availability of green and predictably priced electricity have much to do with the strategic decisions that CSC took for national HPC services many years ago, finding new solutions and new collaborations in providing datacentre facilities. When LUMI was being planned, we were already present in Kajaani with a small number of employees, which were there to provide the services necessary for our own HPC systems.

And, as I said, CSC is more than just NREN plus HPC. CSC started on research and science computing already in the 1970s, when it was still part of the National Computing Center, operating computers for different kinds of governmental organisations, like the car registry and tax authorities. In 1971, the CSC unit obtained the first computer dedicated to science and research in Finland, but at the same time it was confronted with a great challenge: now they had the computer, but did researchers know how to use it?

It's since then that CSC has been providing user support for computational science. For instance, we help users with the software and with scientific or numerical methods, not just giving them a login prompt. We publish guides and books, provide training in the form of courses, and organise outreach towards our users in universities and research groups. I think that this solid track record contributed to our selection as a EuroHPC site and to the evolution of CSC's role.



#### How do you see your new role in the GÉANT **General Assembly** (GA) and in the GÉANT **Community?**

CSC is a member of NORDUnet and the formal representation of CSC/ FUNET and Finland in GÉANT goes via our NORDUnet membership. However, CSC is also in the GA as an observer. In that capacity we participate in meetings and contribute to the discussions, but not to the decision-making. It's of course very important that these collaboration structures are in place, that they are working, and that they manage to represent in a fair way the different ideas across NRENs and the different national situations.

In my previous FUNET life, some 20 years ago. I wasn't in the position to have this kind of participation in governance structures. Back then NRENs were running bleeding edge technologies and the challenges were different and often technical, but many things have changed since then. Numerous challenges have been tackled, thanks to network technology being much more mature and widely used in other areas. Of course, not all has been solved vet

and there are still different situations in different countries, but we have been able to move forward a good deal in many aspects.

Now that there are not so many of those early-days issues, we can focus more on our users, on their needs and requirements, and on providing value for them and for European taxpayers.

The GN4-3N project is currently upgrading connectivity between the NORDUnet and GÉANT networks, including new routes Hamburg-Helsinki and Helsinki-Tartu. How will these upgrades benefit the Finnish **Research & Education** network?

FUNET is connected to GÉANT and other NRENs via NORDUnet. These new connections, once completed, will provide more resiliency for international connectivity, bypassing parts of the current shared infrastructure. With respect to additional capacity and also their optimised topology, they will be particularly of importance for LUMI users.

Community

#### Juha, can you tell us more about CSC's and FUNET's plans for the future? What's ahead? And how is FUNET preparing to support the requirements of **EuroHPC?**

We just finished a major network upgrade, branded FUNET 2020, which was fully finalised last year. One of the aspects was adding extra resiliency to the network connectivity of Kajaani's EuroHPC site. We are now very well placed with our national fibre optic and IP networks and also in the NORDUnet model, which provides connectivity between Nordic countries via national NRENs, together with NORDUnet's coordination and infrastructure on the IP level. In that respect, we are now future-ready.

We also have plans to increase national network capacity, preparing the partial upgrade of 100Gbps connections to 400Gbps. On the service side, we will be increasing the focus on information security and related services for our users.

Finally, this year we celebrate FUNET's 40th anniversary. The initial set-up of the FUNET project took place in December 1983, and the building of the network and services started soon after that. Keep an eye on CSC's channels to join the celebration!

## The value of science fiction as a tool for stimulating innovation

Individual works of science fiction and trends within its wider development are having a growing impact, particularly through diverse and non-Western works which upend the genre's technocratic image. But it's not all spaceships and aliens, as writer and lifelong science fiction fan Ezri Carlebach explains.

Every year at the Christmas holiday period, tech guru and global philanthropist Bill Gates shares his book recommendations. In 2022, instead of mentioning new books, Gates revealed his all-time favourites. High on his list was a 1961 science fiction novel called Stranger in a Strange Land, by Robert Heinlein. There is plenty to say about Heinlein and his, at best, confused politics. But the point Gates was making relates to the way his own thinking was shaped by Stranger in a Strange Land and other works of SF (connoisseurs prefer 'SF' to 'sci-fi', although the terminology

is the subject of endless debates). Gates claims that the far-out concepts, technological focus, and future-oriented mindset of SF all contributed to his success in technology and business, from founding Microsoft to creating the Bill and Melinda Gates Foundation. Heinlein's fiction, Gates wrote, uses "an obviously fictional setting to ask profound questions about human nature".

Questioning what it means to be human has been a central feature of SF since its earliest manifestations. Mary Shelley's Frankenstein, published in

1818, has become one of the best-known and most influential English-language novels. Its premise, that technology will lead humans to acquire 'godlike' power over life, has had an impact that can be traced through countless plays, novels, movies, and other cultural forms, and, perhaps most strikingly, in deep-seated public attitudes towards technological innovation. Frankenstein is widely held to be the first great science fiction novel, all the more remarkable given that its author was just 18 years old when she wrote it.



With all the current hype about developments in artificial intelligence, such as the dramatic launch of OpenAl's chatGPT and similar natural language processing tools, there's been no shortage of commentators pointing out how various works of SF 'predicted' what's happening now, or even 'created' it, by inspiring people to copy what they'd read or watched. There are indeed some famous examples of science fiction stories leading to 'real-world' innovations.

For instance, Robert Goddard, the physicist who built the first liquid-fuelled rockets, was inspired to take up science as a teenager after reading The War of the Worlds by H.G. Wells. And Martin Cooper, the Motorola engineer responsible for creating the first mobile phone, deliberately copied the communicator devices seen in the 1960s TV show Star Trek.

But it's not the predictive power of science fiction that makes it valuable for organisations

of all kinds today. Rather, it's the ability of SF to open up new perspectives, stimulate imaginative capabilities, and fuel individual and collective innovation. After all, imagination is the single most important ingredient of innovation. Without it there'd be no science and technology, not to mention arts and culture. As we face evermore complex and technologically driven challenges, the ability to imagine how we might cope in a range of uncertain futures has



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In the early 1960s, Kingsley Amis famously described SF as "written by white British and American men for white British and American boys". But that was never the whole story. Star Trek's pioneering star Nichelle Nicholls, portraying communications officer Lieutenant Uhura, inspired individuals and communities around the world to see Black women as equal contributors at the highest levels of authority. When she felt like guitting the show after the first season, she was persuaded to continue by none other than Martin Luther King Jr. "You have opened a door that must not be allowed to close", he told her.

As there have always been diverse audiences for SF, so there have always been diverse writers of SF. There is no space here (pun intended!) to list some, let alone all of them. One of the most powerful and intriguing trends, though, is to be found in the political, cultural, and literary phenomenon of Afrofuturism. The subject of a major exhibition at Washington's Smithsonian Institute, running from March 2023 to March 2024, Afrofuturism is defined by the Smithsonian as expressing "notions of Black identity, agency and freedom through art, creative works and activism that envision liberated futures for Black life." The critical and commercial success of the Marvel franchise movies Black Panther and Wakanda Forever testify to the global appeal of, and receptiveness to, Afrofuturist ideas.

Today, if you peruse the pages of leading science fiction magazines, or the growing body of scholarly research in SF, or anthologies of the world's best

become a strategic imperative. Foresight exercises like scenario planning have delivered impressive results in the business world but are frequently considered too difficult to execute effectively, largely remaining the preserve of specialist consultants. Yet every one of us is capable of using our imagination, and any one of us might come up with the next big idea, given the right conditions.

Many business leaders are keenly aware of this, with some actively exploring new ways to enhance their ability to project into the future, as a means of escaping the limitations of the past and present. That's why some of the world's biggest companies are

referencing science fiction stories and even hiring science fiction writers. It grants them access to a mode of storytelling which is both popular and engaging and, at the same time, can stimulate the imagination when tackling strategic and operational problems. While working as a senior executive at Intel, Brian Johnson employed SF writers to develop stories in which new kinds of products and services were featured. He recognised the broader, social role of SF and encouraged the writers to "examine the dark places, the dystopia, and to come up with crazy ideas". Author Eileen Gunn has written about her experience among a group of SF writers

**Picture** Credit: Catherine Erneux

hired by Google, Apple, and other technology firms to give talks to employees and meet privately with R&D departments.

Perhaps unsurprisingly, Harvard Business Review has already published an article urging business leaders to "read more science fiction". The author, Eliot Peper, is both a published science fiction writer and a business innovation consultant. Even the UK's Defence Science and Technology Laboratory has caught the SF bug, commissioning short stories from science fiction writers. According to UK Government Chief Scientific Adviser, Dame Angela McLean, "thinking the unimaginable is simply a day in the

office for talented sci-fi [sic] writers. Who wouldn't want to hear what people like that have to say?"

But while the interest in SF in

corporate America and the British defence establishment speaks to its potential as strategic tool, for me Bill Gates is right when he highlights its role in guestioning human nature and, by implication, the social systems humans create. Despite the profound influence of women in SF, from Mary Shelley onwards, and the contribution of Black authors and fans, the structural sexism and racism within Western culture has limited the presence of diverse voices and narratives in SF.

#### **Guest Contribution**

SF writing, you will see among the authors, editors, publishers, and scholars, names that bear every cultural heritage, every form of gender identification, every sexual orientation, every kind of faith and none. Meanwhile, we face unprecedented threats to our common humanity from the new era of Al-driven communications, private-sector space exploration, and biotech advances that have brought us to the brink of artificial speciation – the creation of a human species biologically distinct from homo sapiens. It seems that the shadow of Frankenstein looms large. SF, broadly defined, has dealt with these threats for longer and in greater depth than any other literature. Ultimately, its greatest value may be to warn us of the consequences of failing to put our common humanity at the heart of our technological innovations and social reforms.

The genre unwittingly launched by 18-year-old Mary Shelley more than 200 years ago continues to have such immense impact because it captures the imagination. Aside from the obvious entertainment value, science fiction offers us alternative cognitive maps, prompting new and original perspectives on any situation or challenge. That is something to be celebrated and shared.

The editors of the CONNECT Magazine welcome guest contributions. If you would like to submit an article that you think is of interest to the GÉANT Community, please contact the editors for consideration.



## Future Campus: what will your campus look like in 2040?

What could the campus look like in 2040 to fit in well with rapidly changing education? That's what we are going to investigate at SURF. Do you have any ideas about the campus of the future? Then we would love to hear from you.

Words: Jan Michielsen, SURF





#### From chalkboard to digiboard

Surprisingly enough, the campus actually still looks the same as forty years ago: lecture halls, rooms for work seminars and so on. And with roughly the same furnishings, although of course the chalkboard has been replaced by a digiboard.

#### Education is changing fast

But education is changing fast: we increasingly need flexible, personalised teaching. Since COVID-19, distance learning has become more important, although of course we want to maintain the connection between student and teacher. New technologies such as VR and AR are being used more and more. Digitalisation in education can no longer be separated from physical space. And that is going to influence how we use the campus.

#### **Project Future Campus: how does** the campus move along?

So, the campus has to move with all these technological and social trends. In the Future Campus project, SURF investigates how the campus should change along with them. To this end, we ask questions such as: what might the campus look like in 2040? What do we do online and what do we do on location? And what will those environments look like?

#### Futuring: thinking about the future in a structured way

In doing so, we do not indulge in imagining futuristic futures like The Matrix or Back to the Future. We tackle this through the futuring method. Project leader Iris Huis in 't Veld explains: "In futuring, we think about the future in a structured way and look at what we need to change in the here and now to prepare for that future."

#### Developing scenarios

Specifically, SURF will work with people and with education and research organisations in order to develop scenarios for what the campus might look like in 2040. Such a scenario is not a concrete roadmap, but a palette of facilities you might need on the campus of the future.

Community

Iris: "Suppose we arrive at a high-tech scenario in which education is largely provided online in a metaverse. That will affect the layout of your campus, which you can already take into account now."

#### Will you share your thoughts on the future of the campus?

Those scenarios are not there yet. We are still in the exploratory phase, where we mainly gather information. SURF is therefore very curious whether there are already similar initiatives in Europe. Are you already reflecting on the campus of the future? Or would you like to contribute to the Future Campus project? If so, we would like to get in touch with you, as international input is very welcome.

Contact Iris Huis in 't Veld, Future Campus project leader, at iris.huisintveld@surf.nl. Or visit www.surf.nl/en/futurecampus





## Internet Brasil Program promotes digital inclusion of low-income children with free distribution of cell phone chips with internet access

The importance of digital transformation in schools across Brazil has become even more evident with the COVID-19 pandemic. In a country with so many social and regional disparities, Internet access is still a distant reality for many municipalities. With the aim of reducing this distance, the country's government created the Internet Brasil Program at the end of 2021, executed by RNP.

Words: Fabio Falcão Cazes, RNP

RNP



The initiative aims to bring connectivity and digital inclusion to students and their families through the free distribution of cell phone chips and data packages. The benefit is intended for basic education students of the public school network who are members of low-income families.

As a starting point for the Program, a Proof of Concept (PoC) was initiated in July 2022 in 15 schools in six cities in the Northeast region: Caicó and Mossoró, in the state of Rio Grande do Norte, Caruaru and Petrolina, in the state of Pernambuco, Juazeiro, in the state of Bahia and Campina Grande, in the state of Paraíba.

#### **First deliveries**

At the Dom Avelar Brandão Vilela Municipal School, in Juazeiro (BA), director Yandria Pereira translated the expectation for the official start of the program in a cordel poem she composed: "The moment of joy has arrived / And technology radiates us / Facilitating our day by day / Helping us with routine tasks / And today I bring good news / Hurray, hurray, hurray!", she declared, much applauded by the students. "It's the Internet Brasil program / Which will offer free Internet so you can enrich your knowledge".

The school's first chip went to 17-year-old Romildo Barbosa Amarante, a youth and adult education student. "It's a good feeling to be the



first, it's rewarding", celebrated the young man, who received the benefit from the hands of the local mayor.

Romildo told of the difficulties he faced in studying, especially during the pandemic. "My Internet access outside of school was very difficult. Now it's going to help a lot, it's going to be important for research and work", concluded Romildo, who intends to take the medical entrance exam after finishing high school.

RNP's customer relationship manager, Beatriz Zoss, was present at the chip delivery ceremony and highlighted RNP's role as a facilitator of teaching throughout the country. "This moment corresponds to the materialisation of the fulfillment of our great mission of helping education in Brazil. We have sought to offer new technologies, encouraging development, mobility, and the approximation of knowledge through connectivity", she commented.

At the end of the event, 12-yearold Lívia Gabriele de Souza Silva ran to the school's small garden. She sat down on one of the flowerbeds to change her cell phone chip for the new neutral chip from Internet Brasil. "It will be very good because now we will have free Internet every month", she celebrated. Lívia wants to be an astronaut and already knows what she's going to use the Internet for. "I'm going to use the chip to study about NASA, the planets, the universe, all of that", she explained.

#### Community





Currently, Internet Brasil has 17 participating schools (all in the Northeast) and 5,755 chips activated out of the 6,950 chips requested.

#### Innovative technology

Chips handed out to students are neutral. This means that RNP will be able to define, remotely, the Internet operator to be used in each cell phone. The aim is to ensure that each student is always connected to the most efficient 3G and 4G networks in each region.

**Pictures** Photos credit: Internet Brasil / Rodrigo Moura Oliveira



## HEAnet clients and Met Éireann benefit with new direct connection to Iceland via NORDUnet





A new subsea circuit from Galway, Ireland to Reykjavik, Iceland is providing a new connection for HEAnet clients to connect to the Nordic Research and Education Network, NORDUnet. While this new connection will benefit all HEAnet clients, a significant first case features Met Éireann, whose new weather forecasting modelling will be performed at a new High Performance Computing (HPC) centre for meteorology in Reykjavik.

#### Words: Sharon Moylan, HEAnet

This new partnership between HEAnet and NORDUnet provides a direct new connection at 100Gbps between our two networks. This will reduce latency and improve connectivity between Ireland and Iceland while also providing improved connectivity to Northern Europe and increasing resilience for Iceland.

Met Éireann has joined forces with the United Weather Centres - West (UWC-West) collaboration, to jointly operate the new supercomputer in a scientific and technical response to the extreme and more challenging weather forecasts expected over the next decades. The new supercomputer will provide high resolution forecasts that will be used to provide more accurate and timely weather warnings that will allow emergency services to prepare for the potential impact of severe weather. The partners in the collaboration are the meteorological services in Ireland, Iceland, Denmark, and the Netherlands.

The supercomputer is powered entirely by renewable Icelandic hydropower and geothermal energy sources and taking advantage of the local temperate climate will keep the supercomputer components cool. The running costs and CO2 footprint will be kept to a minimum, saving tonnes of CO2 in line with the four nations' commitments towards net-zero.

This is the first partnership between NORDUnet and HEAnet. Interconnecting with HEAnet in Dublin was pragmatic and straightforward, enabling NORDUnet to commission the new circuit expeditiously. Lars Bjorn of the NORDUnet Network Services and Technology Services, commented: "Coming from the research and education community there is a high level of trust, and the collaboration is very straightforward."

The new 100 Gbps connection between NORDUnet and HEAnet in Dublin will significantly improve the performance of Internet Services between the Nordic countries and Ireland.

With Europe's fastest supercomputer (LUMI) in Finland and Met Éireann's new metrology supercomputing centre in Iceland, this new connection along with our existing GÉANT connections, ensures that HEAnet clients will continue to benefit from the performance that can only be guaranteed via dedicated research and education networks.

"This new connectivity partnership between HEAnet and NORDUnet enables greater opportunity for research engagement, resource sharing, and community collaboration across Northern Europe."

Ronan Byrne, Chief Executive Officer, HEAnet.

## **Internal Policies for Effective Project Implementation and Stakeholder Engagement.** All aboard and All hands on deck.



In today's complex business environment, successful project implementation and external engagements are essential for National Research and Education Networks to achieve their objectives. These initiatives present opportunities and obstacles, necessitating a well-defined framework to guide employees and stakeholders towards a shared vision. Here, the formulation and execution of internal policies play a crucial role. This indepth article examines the significance of developing concrete internal policies and provides practical guidance on how organisations can create and implement effective policies that support stakeholder engagement and project implementation.

Words: Nicky Wako, GÉANT

#### **Internal Policies for Project Execution** and External Interactions

Internal policies serve as a compass. providing consistent guidelines and aligning employees with project objectives and strategies for external engagement. In addition, they provide a framework for making decisions, streamlining processes, and ensuring everyone is on the same page, which is essential for instilling a sense of ownership, fostering internal collaboration, and empowering employees to connect the dots

Effective policies assist organisations in identifying, evaluating, and mitigating risks associated with projects and external engagements, enabling them to address potential internal pitfalls proactively by establishing clear protocols and risk management procedures. This improves overall project success and protects the interests of stakeholders.

#### **Creating Internal Policies for External** Success

#### As Within, So Without

Effective policies should be the result of collaborative efforts involving employees, managers, and external partners. Organisations can benefit from various perspectives, ensuring buy-in and improving the policy's relevance and efficacy. NRENs should avoid perpetuating a tradition simply because "that is how it has always been done"; instead, the focus should be identifying key areas that require policy frameworks to establish internal policies.

This includes project management, communication, stakeholder engagement strategies, risk management, data security, and ethical guidelines.

Clarity is your best friend when developing internal policies. Policies must be written in clear, concise language to avoid unnecessary complexity and technical jargon because no one should be left behind. Procedures, roles, responsibilities, and expected conduct should be outlined in a format and language that facilitates consistent comprehension across all organisational levels.

#### **Establishing Trust** and Accountability

#### Trust but verify

The internal procedures for external activities lay the groundwork for establishing mutually beneficial relationships with external stakeholders such as partners, clients, funding agencies, and regulators. In turn, well-crafted and successfully implemented internal policies promote trust and accountability by encouraging transparency,



ethical behaviour, and adherence to regulatory and compliance standards.

#### **Application of Internal Policies**

#### Put the policy to work!

Once policies are formulated, effective communication and training are required to ensure that employees understand, adopt and are empowered to implement them. Guidelines should be disseminated using comprehensive strategies, including training sessions, document distribution, and visual aids. Regular reinforcement and readily available channels for addressing questions or concerns will increase policy comprehension and adherence. Resulting in strengthened stakeholder relations.

#### Monitoring and **Evaluation**

#### Run it, review it, repeat

Internal policies are not static documents; rather, they should evolve in tandem with the growth of the organisation and the changing industry dynamics. To achieve that, a robust monitoring and evaluation

mechanisms, including 360 feedback loops and suitable performance metrics, are required. This iterative process ensures that policies remain relevant, flexible, and aligned with the ever-evolving needs of projects and external engagements. Monitoring and Evaluation exercises provide the organisation with information to strengthen, eliminate, and cultivate new stakeholder relations.

#### **Ongoing Policy** Revisions

#### Efficacy of the policies

In conclusion, NRENs seeking success in a dynamic environment must develop and implement internal policies to support project implementation and external engagements.

To guarantee the efficacy of the policies, NREN leadership should provide consistent direction, manage risks, foster trust, and promote accountability. Regular reviews of the policies and lessons learned are necessary to ensure policies are consistent with emerging best practices and regulatory changes.



### Interview with **Kristiaan De** Greve (IMEC), expert in quantum computing

Kristiaan De Greve is Programme Director of quantum computing at IMEC, Associate Professor at the Faculty of Engineering Science at KU Leuven and visiting researcher at Harvard University. He obtained his engineering degree in electrical engineering from KU Leuven and earned his PhD on quantum bits and quantum repeaters at Stanford University. His scientific interests cover a broad spectrum, from advanced materials research, guantum mechanics and cryptography to artificial intelligence. Belnet spoke with him about the future of quantum computing, QKD and cryptography.

Interview by: Davina Luyten, Belnet

#### There is a lot of talk about the possibilities of quantum computers, but what are the risks?

It's important to remember that there is no operational quantum computer yet. But once these arrive - likely within the next 15 to 20 years - the current cryptographic systems we use to exchange keys with each other could be compromised. These keys are the basis for encrypting, and therefore securing, our internet traffic.

Indeed, a quantum computer will be able to crack systems such as RSA (a commonly used encryption algorithm for data transmission). This is a fundamental weakness in the cryptographic chain. Cryptographers are aware of this and have been working for some time to standardise new encryption techniques that can be implemented by standard computers, which we know a guantum computer cannot actually do anything with. This is what we call post-quantum cryptography.

What the cryptographers are doing is defining a mathematical problem that can be transformed in such a way that it is unsolvable even for a quantum computer, and then using this as the basis for encryption. Post-quantum cryptography therefore has nothing to do with quantum, but with clever mathematics. Of course, there are no guarantees that this mathematical problem could not be attacked if anything more powerful than a quantum computer ever came along.

#### This is where quantum key distribution (QKD) comes into play. What are the principles behind this and is it 100% safe?

If you want to move away from mathematics and base cryptography on the fundamental forces of nature. you end up with quantum key distribution. For more than 40 years now, the research community has been looking into how we can also use the laws of quantum mechanics for secure communications and thus for cryptography.

QKD uses certain fundamental properties of quantum mechanics, such as the fact that certain measurements cannot be combined with each other. If you apply them properly and build them into your systems, no-one can ever intercept or crack your system. Specifically, this means that you can make the chain between a sender (Alice) and a receiver (Bob) 100% secure.

In theory, this is the perfect security but in practice there are still drawbacks and limitations. To start with, QKD requires a specific network with dedicated fibres to which special systems are connected. These are currently still extremely expensive and limited in distance. To ensure secure communication over longer distances, you still need to rely on other systems such as quantum repeaters, which do not currently exist.

Conventional cryptography also does more than just transmit keys. It also checks, for example, whether the sender and receiver are indeed who they claim to be, and you can't do that with QKD. So, you only solve part of the problem - but in a way that solves it permanently, via quantum mechanics.

You can compare it to a house you want to secure against burglars. You can either secure the entire home reasonably securely or you can make the front door out of a type of reinforced steel that is 100% burglar resistant. That is exactly the difference between post-quantum cryptography and QKD. In my view, the best protection is a combination of both. To claim that QKD is the solution to protect cryptography from a quantum computer purely by itself is therefore too simplistic.

#### Are there already many use cases for QKD networks?

Not at the moment. Certain industries. such as banking, are looking at it pragmatically and taking a wait-andsee approach for the time being. They first want to know what they can gain from it, and whether it is worth the investment. For specific environments, such as governments that want to exchange highly confidential information, it is definitely worthwhile.

Once miniaturisation arrives and the price of QKD systems comes down, I expect there will be more takeup. Incidentally, that is also something we are looking at in the BeQCI project: part of the research we are conducting pertains to the integration and miniaturisation of components.

The applications of quantum are of course much broader than QKD. For research institutions, for example, quantum chemistry offers a lot of possibilities in the long run, for example for developing molecules or medication. Quantum computers will be ideal for solving specific problems that we will find difficult or impossible to solve with an 'ordinary' computer, such as quantum chemistry.

Whether R&D institutions will eventually use QKD systems I think will partly depend on what they see as the biggest threat in terms of security: are they more afraid that the information they exchange between different sites will be hacked than the information they store locally?

#### What is the focus of the BeQCI project?

On the one hand, we are building an infrastructure that is as future-proof as possible. In other words, we are not using technologies that will be incompatible in the near or distant future with a veritable quantum internet, which will connect quantum computers and quantum sensors. The latter is also the reason why we opted to partly set up a separate testbed within the project instead of fully implementing the lines on the existing, and thus shared with normal internet traffic, Belnet fibres.

In this respect, we are strongly aligned with our Dutch colleagues. Together with them, I think we are among the most cutting-edge in Europe. We are working towards a long-term vision that is already looking beyond what the EU is calling for.

At the same time, we are working with experts to build conventional solutions for cryptography. Within the European project, we are the ones who have pushed through the synergy between post-quantum cryptography and QKD the furthest, from a security perspective.

In addition, research within the project is also focusing on making chips that can make QKD systems cheaper and therefore facilitate their take-up. These discussions are not purely academic: they are also about money. Indeed, the cost of QKD is still a serious stumbling block.

#### In what areas do you expect the biggest breakthroughs in the coming years?

I expect the development of quantum computers to accelerate significantly over the coming five years or so. Researchers are now focusing on what is called a logical (stable) qubit. If we manage to produce one logical gubit, the problem becomes much more scalable than with the current unstable oubits.

On the communication side, quantum repeaters are still extremely difficult. These are crucial for transmitting quantum signals and increasing the distances of QKD networks. There have been a few experiments, but really getting them to scale is a challenge. I predict that by the end of the decade there will be some serious progress, at least at the lab level.

After that, all the ingredients are available to develop a veritable guantum internet and it is 'just' a question of investment.





## **Cloud Services:** An Eye on the Future

To identify and deploy above-the-net services, including those suitable for inclusion into the EOSC Exchange marketplace, continues to be a top priority for the EC, to remove geographical obstacles to innovation and bridge the digital divide.

Words: GÉANT Clouds Team

The GÉANT community has already achieved great success in doing some heavy lifting for public procurement of commercial services on behalf of the R&E community. This resulted in existing framework contracts that are used by more than 900 institutions in 26 countries and have delivered greater regulatory security for cloud consumption since 2017. Dependable renewal of these procurements is now of paramount importance to the European R&E community. Based on converging interests, the project partnership between GÉANT and the EC aims to support and accelerate efforts in these areas, and the GÉANT cloud team is focused on ensuring an optimal follow-up on the flagship joint procurement of commercial infrastructure-cloud services on behalf of the European R&E community.

These efforts recognise the need to improve the process of involving NREN stakeholders in the joint procurement, alongside the need to develop a holistic strategy for sourcing infrastructurecloud services that encompass what is commonly known as "community and commercial cloud" services that address digital sovereignty, data protection, and procurement practices.

A specialised Cloud Strategy Forum was established to address these two needs by orchestrating a collective NREN-community dialogue on sourcing strategy and how best to deploy and manage the optimal mix of community clouds and commercial cloud services. The knowledge gained in the forum will be distilled into strategy quidance to best serve the interests of the entire European R&E community.

The Cloud Strategy Forum convened this past spring to kick off these efforts, opening opportunities for NRENs to provide actionable input for the joint procurement team already preparing for the next round of the pan-European procurement tender.

Representatives of over a dozen NRENs came together with the overarching goal of developing a framework for an optimal mixture of community/commercial portfolio of services and develop best practices to manage this portfolio with appropriate and sustainable acceptance and exit criteria.

#### **Collaboration and** consensus

First and foremost, participants welcomed the initiative and the opportunity it offers to improve our collective infrastructure-cloud efforts together, over time, whether they are commercially sourced or developed by the community.

In its first meetings, the forum focussed on the upcoming reprocurement of the joint infrastructurecloud framework agreements. This offers a great opening to improve the organisation and quality of our demand aggregation required for the next iterations of joint procurement, as the stakes are rising both at institutions, NRENs and suppliers. A more transparent tender process that involves formally appointed

#### Cloud

representatives from NRENs that understand needs and potential obstacles is crucial to further develop our joint procurement capability. This means building a better understanding of the specific needs and procurement-legal requirements for each country, how to incorporate non-EU/EEA countries and ultimately ensuring as many GÉANT members as possible can benefit from the fruits of the labour: good procurementcompliant deals with commercial infrastructure cloud suppliers. The aim is to not let the strategic NREN involvement end there. Once new framework agreements are in place the involvement can be leveraged to potentially great benefit toward ongoing high-level dialogue between the NREN community, representing R&E institutions, and major cloud providers - with the aim of securing better services for users.

During the summer the focus of the forum will turn more towards a framework for sourcing strategies for infrastructure-cloud. There are good reasons why institutions work with on-premise infrastructure, and why they use public cloud services. In some countries there is a prevalence for one or the other. To get to the stage where the sum is greater than its parts it is particularly important to reach a strong understanding of these different positions in the community and to develop a common vocabulary with which to discuss the challenges surrounding the various ways for provisioning of infrastructure cloud. Only then will it become possible to identify potential collective targets on the horizon which we may want to aim for.

#### The road ahead

"We're taking the first steps on a journey through a complex landscape, to systematically investigate if, and how, to deepen our collaboration on infrastructure-cloud to begin with, and general above-the-net services as a next step," says Jan Meijer (SIKT), who heads the forum. "The objective is to identify what we as a collective can and cannot do together in this strategically important area, and that's what this forum is committed to figuring out."



## **CONNECT Interview:** Ana Alves, CISO, GÉANT

#### **Spotlight on Security**

Ana Alves, Chief Information Security Officer (CISO) and Data Protection Officer (DPO) for GÉANT, talks to CONNECT about the role and the responsibilities of a CISO, a relatively new leadership position for GÉANT, about her involvement in the organisation's security restructure, and its significance for the GÉANT community.

Interview by: Rosanna Norman, GÉANT

#### Ana, GÉANT recently announced the completion of its security restructure. Can vou tell us about this initiative and the implications for the GÉANT community?

Yes. Let me first give you the context of our security restructure. Around two years ago we were facing some challenges related to the structure of the security team and lacked a strategy that reflected GÉANT's values and objectives. When GÉANT started the IT restructure process, it became clear that we should take advantage of this opportunity and extend the restructuring initiative to include also security. I had the privilege to be part of the working group of experts involved in the restructure and with the team's passion and dedication we successfully completed this project. The mission seemed impossible,

especially considering how busy everyone was with their everyday tasks and work, but finally GÉANT's approach to security was raised to a new level. We have successfully created a focused, dedicated, and structured security team, looking to deliver secure products and services, as well as to provide the necessary support to the GN5-1 project and to the GÉANT community at large.

GÉANT has now a very different vision and posture and a far more conscious approach to security that adds significance to our role as a model for the community.

We strive for continuous improvement at all levels of the organisation. And one of the critical factors enabling our smooth transition to a higher level of security maturity has been the relentless support of the GÉANT Executive team.

#### What does a CISO do? What is the purpose and goal of this role? What are the main challenges you are tackling as a CISO and how? This answer depends on the type

of organisation, their approach to security, the team(s), and the structure. There are in fact far too many factors that can influence and define the scope of this role to be able to give a concise definition.

The CISO role at GÉANT originally emerged from the need for an independent security assessment resource, reporting directly to the organisation's management levels.

Gradually it evolved from a role dedicated mainly to compliance, audit, and assessment to a focus on GÉANT's strategy, team alignment, objectives, security risks, and especially the coordination of all security areas and projects across GÉANT.

It was particularly difficult for me during this transition to find my place. The CISO role is an independent one, meaning that it is not part of a team or a department. That for me was the main challenge. I worked hard to find my voice and my place in the security team.

Fortunately, GÉANT gave me the opportunity to work with extraordinary and generous colleagues who were absolutely crucial in this process. Working in a supportive environment, especially under the mentorship of Alf Moens (GÉANT Security Lead) has made my path so much smoother.

#### What's next for you Ana?

Well, there are so many things that I wish my days had more hours, especially as I am a mum of two young children. In the beginning of this year, I returned to work from maternity leave, and it has been quite a challenge to combine the roles of DPO, CISO and Mum. The passion for my job and the love for my kids gives me energy and inspires me every day. It is this perfect balance between home and work and the support from my colleagues that makes everything possible.

For the moment, I'm dedicated to the supportive side of the CISO role for the benefit of the community. As part of this strategy, I was appointed Security Coordinator within the GN5-1 Work Package (WP1) on Governance, Management and Coordination. This position aims to be a resource for guidelines and security best practices for the community, ensuring that all areas, tasks, and projects receive the same guidance and are able to align on the same quality standards for project deliverables.

The second part of this plan is community engagement, and to facilitate alignment among security experts from NRENs and support them in the implementation of security and legal requirements.

From the DPO (Data Protection Officer) role perspective there are also new projects that will certainly represent a challenge, but privacy probably requires a separate article.

Don't hesitate to get in touch with me via ana.alves@geant.org for any privacy or security-related matters, and if you are at TNC23, do come and find me at the GÉANT booth or at one of the security meetings.

For more information about security products, services and initiatives at GÉANT, visit security.geant.org



## Change behaviour with three clicks? Why we prefer to play with security

According to the Verizon Data **Breach Investigations Report** 2022, the human factor was involved in a full 84% of all data breaches. The technologyfocused professionalisation of the information security industry has made it much easier to hack people than IT systems. So why aren't more resources invested in sound methods and measures to address the "human factor" just as professionally?

Words: Cornelia Puhze, SWITCH

The good news is that our behaviour can be influenced. But never in the way that the behaviour of a machine can be changed. It actually makes sense to apply different teaching methods to humans. That is, not to start from the premise that the more data, the more certain the learning success. All too often, however, this approach is found in companies, for example in the assumption: if employees click through enough phishing simulations, they will eventually learn to recognise a phishing email. Unfortunately, it is not quite that simple. People cannot be trained like a text robot. People learn with experience, to which emotions such as motivation are linked. People have to understand, "grasp" why they should do something and then want to do it.

## positively

#### How does learning in play work?

Whether chess, Taboo or Fortnite games are entertaining and capture the attention. For a moment, the world of the game becomes reality and the rules become law. A game therefore has everything that is needed to successfully convey educational

#### People are not programmable

#### Shaping learning experiences

There are many different methods to make learning experiences positive and motivating. One of them is learning through play. We have developed our Security Awareness Adventures following this method. Our goal is to demystify security and make it a tangible experience. In small groups, various security challenges are explored in a playful way, curiosity and interest are aroused, the participants have fun together and a fundamental change is made: the attitude towards security. When we play with security, there are only winners!

content. Playing games is fun and increases the participants' willingness to deal with the conveyed topic (problem awareness). To play a game, the rules and the goal of the game must be learned (training) in order to be able to apply them directly (practice).

Play has the potential to convey messages in a way that sticks in the mind and positively influences employees' perception of an issue.

#### **Proven games** with security learning content: Escape Room, Scavenger Hunt. and Dungeons & Dragons

In the SWITCH Security Awareness Adventures, various playful approaches are used to teach the players how to think like a hacker. Participants playfully learn how easy it is to brute force 5-digit passwords in the "Hack the Hacker" Escape Room, follow the hacker's digital footprints in the "Track the Hacker" scavenger hunt or test their social engineering skills in the "Piece of Cake" tabletop role-playing game. Of course, these educational games do not scale. But the influence that enthusiastic employees have on their colleagues should not be underestimated! Participants share their positive experiences in the coffee corner, so the training game reaches far more than just six people.

The adventures can be carried out on a mobile basis or acquired in the form of licenses to suit different needs and situations.

Visit www.switch/securityawareness-adventures

## SURF's cyber crisis exercise **OZON: dozens** of zero-days and insider threats

At the end of March 2023, SURF organised the sector-wide cyber crisis exercise OZON for the fourth time. This edition was by far the largest, with 72 organisations and over 2,000 people taking part. Ever since 2016, SURF's members practice biennially how to respond skillfully to realistic cyber crises. "The biggest challenge this edition was to come up with a scenario that impacted all our members," says Charlie van Genuchten, project leader of OZON at SURF, the Dutch NREN.



Words: Yvonne Klaassen, SURF

#### Two main scenarios

"The exercise participants were not only from the research and education sector but were also - for example healthcare institutions. In early 2022, professionals from education, research and healthcare therefore came up with two main scenarios: an ongoing flow of zero-day exploits and an insider threat scenario, where employees from one's own organisation work for a criminal party.



We then specified these scenarios at operational, tactical, and strategic levels, taking into account the stages a real cyber crisis goes through. Based on these central scenarios, the exercise leaders of the participating institutions wrote their own scenarios that fit their organisation's learning objectives.

Furthermore, there was collaboration across the chain: parties such as the ministry and also sectoral organisations participated in the exercise."

#### Picture Credits to De Beeldredaktie

everyone on track with so many participants. Some institutions were already participating for the fourth time, but for a large part, this was the first time. From preparation to the date of the exercise, it takes an institution about 9 months to get ready. Obviously not full-time, but it does require the necessary coordination within one's own institution. SURF organises various preparatory days and buddy groups where the more experienced participants help the less experienced. And as the date of the exercise approaches, there are also consultation hours where institutions can come to us with their (technical) questions."

Organisation

"It was quite a challenge to keep

#### **Evaluation report** follows, initial feedback is positive

"We are still in the middle of the evaluation process, but the first feedback is positive. Of course, there are also points for improvement for us, SURF, it is also a learning process as organiser of the exercise. We evaluate at different levels: with the project team, with participating institutions, and the observers who observed the institutions during the exercise. We incorporate all the lessons learned, learning points and feedback into a report."

#### **CLAW: international** cyber crisis management workshop for the **NREN Community**

"For all cyber crises, practice is key. For the NREN Community, the GN5-1 project organises the international cyber crisis exercise CLAW, of which I am Task Lead. On 5 and 6 December, this workshop will take place in Poznań at PSNC in Poland."









#### **Questions?**

Please contact Charlie van Genuchten if you have any questions about the OZON exercise or about CLAW: charlie.vangenuchten@surf.nl.



## InAcademia showcases a new look

The InAcademia team is delighted to announce new branding for 2023, which has been designed to raise the profile of InAcademia in the commercial market, as well as in the academic community. The new branding features on the updated InAcademia website https://inacademia.org and will be promoted across social media as well as being included in the verification process screens.

#### Words: Karl Meyer, GÉANT

InAcademia can provide a secure, privacy-preserving verification process for students etc. to access special offers and discounts on a range of commercial online products and services. The process uses the wellestablished eduGAIN interfederation service to verify affiliation in typically less than 30 seconds.

The key benefits of InAcademia for Identity Federations are the harmonisation and simplification of on-boarding commercial Service Providers and the on-going management of them. This removes the needs for individual institutions to arrange and configure bi-lateral relationships and so reduces the manpower required at both

federation and institutional level whilst increasing the access for students and businesses alike. As commercial SPs often don't understand federated identity, federations spend a disproportionate amount of time to on-board them; referring them to InAcademia will save effort and cost for your federation.

InAcademia can also provide operational data to your federation that help to identify misconfigured IdPs, giving you an 'outside-in' perspective that is often difficult to see, particularly in the case of Mesh Federations.

The proxy relationship that InAcademia uses also means that Federation Operators and IdP Operators can be certain that the



7 7

InAcademia is a service created by Identity Federation operators under the GÉANT Project. You can have a say and can actively be involved in influencing the InAcademia future direction and roadmap.

There is no fee for NRENs to use the InAcademia service. Merchants are charged a fee to use InAcademia, and the intention is that any revenue will be used to help to sustain delivery of InAcademia service and Trust and Identity services in the future.

InAcademia has provided over 2,000,000 verifications and is now operational in 12 countries across Europe: Austria, Denmark, Finland, France, Germany, Greenland, Iceland, Italy, Spain, Sweden, The Netherlands, and Turkey. Currently over 15,000,000 students are able to use InAcademia for student verification.





## The sky's the limit: extending connectivity for learning across the campus and beyond

Heidi Fraser-Krauss explains how eduroam can increase accessibility, reduce IT workload, and help close the digital equity gap

Words: Heidi Fraser-Krauss. CEO at Jisc and member of the GÉANT board

Enabled by new technologies like 5G and the Internet of Things, progress towards truly blended learning is gathering momentum across the education and research sector.

At the same time, though, the digital equity gap leaves some learners struggling with even basic connectivity.

In addition, the need to provide secure access to Wi-Fi for learners using their own devices on campus throws up all sorts of problems for IT teams.

#### Students and staff need consistent, reliable connectivity

In an ideal world, learners should be able to connect 24/7 to their institution's resources - and stay connected.

In the real world, however, they might need to work in a public library, or at home. They might have to

travel to another campus or take a bus home every day. And every time they move locations, they have to search again for free Wi-Fi and reauthenticate

It's a long way from the ideal of 'zero touch' connectivity.

#### Education anywhere

eduroam, on the other hand, gives students and staff a consistently positive experience, delivering seamless internet connectivity across their own institution and beyond with a single Wi-Fi profile.

Simply by opening their laptop, users gain access to any eduroamenabled site, increasing the scope of places learners can connect. Some 560 organisations across the UK offer the service from more than 2,000 eduroam hotspots.



#### **Reducing IT** department workload and costs

eduroam accommodates all the mobile connectivity requirements of an institution: it supports users and visitors connecting to the local network, and users connecting to other participating networks.

And it does all this without placing significant burdens upon an institution's IT resources. Instead, eduroam sits separately from the network, which reduces IT department workload.

It also improves the security of bring-your-own-device (BYOD) wireless infrastructures. The ability to effectively protect, monitor and audit traffic on the network is essential for safeguarding, and eduroam gives institutions "identifiable oversight" when anyone connects using their own device.

And any organisation connected to the Janet Network is eligible to use Jisc's eduroam service as part of their Jisc membership.

#### Addressing digital equity

Making eduroam available in student accommodation and transport networks and in places like libraries, community centres, and other public buildings would massively extend access to zero touch internet connectivity for students and education sector staff who, for whatever reason, are not on campus.

For example, eduroam is available at more than 500 public sector sites in Kent and Medway, delivering connectivity to council offices, community centres, fire stations, hospitals and more. It's also increasing the number of places learners at local colleges can connect. as eduroam is now also available at libraries across Kent.

Replicated across the UK, this could benefit all those learners who don't have an internet connection at home, whose broadband connection is poor, or who can't afford the data roaming costs.

#### The vision: eduroam everywhere

At Jisc, the vision is to extend connectivity even further, so that learners can access eduroam in areas where there is only cellular connectivity - on public transport, say, or at home.

We are working on a range of portable devices that use cellular connectivity to deliver eduroam to students and staff. These devices will enable learners to continue to access resources wherever they are - on the bus, in sports facilities and even in shared off-campus accommodation. The devices for home use are small enough to fit into a rucksack, while larger versions are being used in offcampus buildings to deliver eduroam to up to 100 users.

#### The sky's the limit

The potential for eduroam to extend the boundaries of connectivity is massive and far-reaching.

To prove it, we recently demonstrated that Jisc's eduroam service can successfully connect to



the Starlink satellite internet service, and we're exploring other satellite internet services too. This opens up the possibility that eduroam could be made available to UK educators and researchers anywhere on the planet with a clear view of the sky.

## Making the World a Better Place: How African RENs are **Contributing to SDGs**

In 2015, the world agreed on a common direction: create a better and more sustainable world, through the Sustainable Development Goals (SDGs). 193 countries, meeting at the UN General Assembly, agreed to make the world a better place by 2030. The SDGs have since become a benchmark for measuring the efforts of countries and organisations towards making the world a better place to live. The tick of the clock shows that the world has seven years left to attain the 17 Global Goals; and the interests of policy decision-makers and funding organisations have heightened.

Words: Harold Bowa (UbuntuNet Alliance), Effah Amponsah (WACREN), Yasmeen Alkouz (ASREN) and Silvia Fiore (GÉANT)

Though many global watchers have predicted that the world will not have ticked all the boxes by 2030, Research and Education Networks (RENs) in Africa, both national (NRENs) and regional (RRENs) have been contributing their best efforts to the achievement of the SDGs by helping to tackle urgent social issues and thereby creating value in a number of fields, including education, climate change, gender equality, economic growth, and innovation. Unfortunately, this contribution has been largely underreported.

In an effort to contribute to remedying the situation, the AfricaConnect3 Project Communications team, in partnership with the wider African research and education community, embarked on an initiative to discover and share evidence of the contributions and enhance the visibility of the work done so far by the RENs. By highlighting such contributions and showing that their activities are SDGtailored, African RENs will be more viable for funding and also wield greater advocacy power.



## **SUSTAINABLE** DEVELOPMENT **G**

#### **Steady Efforts, Great Impact**

QUALITY EDUCATION

5

For more than a decade, NRENs in Africa have increasingly fostered quality education across the continent. They have been providing muchneeded, reliable, affordable, and high-speed internet connectivity, e-infrastructure and advanced services for knowledge discovery, use and dissemination, not only within Africa but the rest of the world. This support reached a crescendo during the COVID-19 pandemic. NRENs became the lifeline for many research and education institutions across Africa, as they provided alternative options to the normal learning approach. The Ugandan NREN has been making waves in the field of off-campus Wi-Fi connection with metro eduroam and eduroam on the Go. Both allow researchers, lecturers, and students to connect to eduroam, from the comfort of their locations. ZAMREN (Zambia), TENET (South Africa), SLREN (Sierra Leone), MARWAN (Morocco), GARNET (Ghana) and CCK (Tunisia) also provided free access to video conferencing tools and platforms for Learning Management Systems to help academic continuity at the height of the pandemic. Hundreds of higher education institutions (HEIs) and research centres in over 35 countries have impacted the education of more than five million people in the R&E ecosystem in Africa.



## GENDER EOUALITY

African women are still the minority in the research field and academics of science, but the national networks in Algeria, Tunisia, Madagascar, and Zimbabwe have women at their helm. Other RENs and their member institutions in Ghana and Sierra Leone are levelling the playing field for all genders, in terms of employment, capacity building, and education. For many years now, the ICT4Girls Hackathon run by Eko-Konnect in Nigeria and the Women-in-WACREN program have given females in the sub-region the impetus to advance in their STEM ambitions. It is also worth noting that in 2022, Makerere University in Uganda, which is a member of RENU, has become the first public sector institution in the country to enrol in the United Nations Development Programme's Gender Equality Seal Initiative, designed to promote accountability for gender equality and women's empowerment in public sector institutions.

#### DECENT WORK AND ECONOMIC GROWTH



African RENs' efforts at achieving SDG 4 dovetails with efforts towards Goal 8. RENs actively offer online training and workshops to raise the capacities of their staff and that of the African community at large. The knowledge shared allows the beneficiaries to access a plethora of information from anywhere in the world. As the human capital development in African countries rises, many students and young professionals are equipped with tech-related skills and eventually have better employment opportunities.

For example, the young female participants in Eko-Konnect and WACREN's ICT hackathons and workshops have imbibed ICT-related skills for entrepreneurship and the world of work. Some final year students in Kyambogo University, taking advantage of reliable high-speed connectivity, developed a suite of management software - Zeenode. Today, this innovation has now metamorphosed into a full-fledged business employing professionals across Africa. Similarly, every year, RENU runs a hands-on Industrial Training Program for undergraduate students to immerse them into REN operations and activities.

"UbuntuNet Alliance recognises the important role that NRENs play in accelerating progress toward the UN SDGs. This initiative will not only highlight the vital contribution of NRENs, but also empower the entire community to leverage on technology to build a better future for all Africans."

Madara Ogot, UbuntuNet Alliance CEO

UbuntuNet Alliance

#### INDUSTRY, INNOVATION AND INFRASTRUCTURE



RENs are fostering the spirit of innovation in students, ICT professionals, and researchers in Africa. In Nigeria, for instance, a group of student-interns developed a campus security system to detect intruders. RENU made headlines when it powered a remote surgical operation between two hospitals on its high-speed backbone. These two are just few of the many available examples.

By leveraging on economies of scale made possible by the global network created between GÉANT and the regional networks in Africa (the UbuntuNet Alliance, WACREN, and ASREN), NRENs have been providing internet connectivity at more affordable rates, better than private sector players and hence enable a more inclusive and fair research environment. From the inception of the AfricaConnect upgrades have led to more and more countries being connected and more users benefitting from the seamless delivery of content, data, and services. In the context of open science, RENs have been joining the LIBSENSE initiative which is building a science and open access by enhancing advocacy and developing shared platforms for the library

"RENs across Africa have for many years been contributing to achieving SDGs. It is time to step up our efforts and reap the benefits of being SDGsaligned, through improved advocacy and better visibility. WACREN and its members are on this course."

Boubakar Barry, WACREN CEO



13 CLIMATE ACTION



NRENs like CCK in Tunisia have been increasingly placing emphasis on adopting greener ICT policies to reduce the carbon footprint of their networks by decreasing energy consumption through the use of solar panels and promoting sustainable practices. In addition to this, through providing increased and better internet connection to research institutes, NRENs and RRENs contribute directly to supporting research in the field of sustainability of environmental resources, crop health, farming practices, land management, and climate change.

"ASREN is proud to be collaborating with the AfricaConnect3 partners. We are taking the lead in facilitating access to scientific resources for the space and earth observation communities to enable cooperation in Africa and the achievement of the SDGs."

Yousef Torman, ASREN Managing Director



"At GÉANT we firmly believe that science and innovation knows no borders. And we partner in Africa with ASREN, UbuntuNet Alliance, and WACREN to serve research and education. As a community we proudly aim at providing steppingstones towards the world's biggest innovations and bridging the digital divide that will benefit humanity and transform our world."

Erik Huizer, GÉANT CEO



RENs are by definition associations of members and, as such, they enable the creation of partnerships. They have been developing, promoting, and benefiting from regional and international collaborations in a variety of fields, from network, services, and open science to cybersecurity and cloud engineering for almost three decades. They collaborate with development partners and likeminded international organisations, such as the European Commission, Internet Society, World Bank, the Open Researcher and Contributor ID, and Network Startup Resource Centre, among many others, to embark on projects and initiatives that support the SDGs. All cross-continental, cross-sector and multi-stakeholder collaborations aim to promote knowledge sharing and a global transfer of technical and operational expertise, to ensure the effectiveness and sustainability of African e-infrastructures and continue to contribute to SDGs.

mapping (SDG15).

**Projects** 

#### PARTNERSHIPS For the goals



#### The "multiplier effect"

Their contributions to SDGs do not end in the areas mentioned above, but their support for a more inclusive access to digital infrastructures and services across the continent has spill-over effects on many other SDGs. For example, RENs connect and provide internet services to various hospitals working on combating health diseases (SDG3) as well as research institutes addressing some of Africa's greatest sustainability challenges, like food insecurity (SDG2), water management (SDG6), and soil

NRENs and RRENs present an excellent promise for accomplishing significant progress in the achievement of some SDGs and have proved fundamental to ensure equality in access and promotion of innovation. This is true not only for African networks but for RENs all around the world. So, when are you going to make the case about SDGs for your network?

To learn more about the AfricaConnect3 project's initiative and download the full report, visit https://africaconnect3.net/sdgs-info-centre/.





## With the impulse of the FCCN Unit, IPDJ made a great technological leap

Carlos Manuel Pereira, Member of the Board of Directors of IPDJ -Portuguese Institute for Sport and Youth - explains the benefits of joining the OCRE framework agreement: "We believe that the partnership between FCCN and IPDJ illustrates well the benefits that can come from collaborative work between public bodies, with a view to improving the provision of services to citizens.

Words: FCCN Marketing and Communication team

#### How did the opportunity arise for IPDJ to use the OCRE framework agreement solutions?

The adhesion to the OCRE framework agreement resulted from a consultation carried out by the General Secretariat of the Presidency of the Council of Ministers on the occasion of the establishment of the framework agreement under GÉANT.

As the Portuguese Institute of Sports and Youth was aware of the need to modernise its technological infrastructure and that the trend was towards the adoption of public cloud solutions, we saw it from the beginning as an option with great potential compared to alternative scenarios such as, for example, the upgrade of the data center we had on our premises.

We had the clear perception that we should opt for a cloud solution and that joining a centralised procurement procedure like OCRE, with a European dimension and accompanied by experts with great technological competence, as is the case of the FCCN team, could help us on this challenging path.

#### What importance do you attribute to this possibility?

The adhesion to the OCRE framework agreement was crucial to the achievement of IPDJ's digital transformation project in terms of implementation time, quality, and overall cost. First, the improvement of the communications infrastructure resulted in a high traffic speed, essential to the migration phase of the infrastructure to the cloud and which allows the nearly 400 workers, spread across 25 different locations in the country, to access the applications and communicate effectively and quickly. It also allowed us to access a set of very useful applications such as Colibri, Educast, b-on, the NAU Platform, Filesender, eduroam and RCTS Certificates.

#### What effective difference have these solutions made to IPDJ's work?

Having as a mission the execution of public policies on sports and youth, a large part of IPDJ's target audience is part of higher education, either as students, teachers or researchers, so we consider determinant the availability of integrated digital services, safe and able to evolve in light of the accelerated and constant innovation that we are witnessing in the field of information and communication technologies.

Currently, we have the perception that the IPDJ, with the impulse of FCCN, has taken a great technological leap and is at a level of excellence in the context of Public Administration.

#### How do you evaluate the role played by **FCCN in this process?**

From the beginning, FCCN assumed the position of a Public Administration entity at the forefront of information and communication technologies, available to share its resources with other bodies and with the ability to transmit knowledge and highquality solutions in the national and international context. It is important to emphasise that, in addition to technological solutions, FCCN has always shown great openness to technically support the IPDJ's workers throughout the digital transformation process.

#### Is there anything you would like to add?

We believe that the partnership between FCCN and IPDJ illustrates well the benefits that can arise from collaborative work between public bodies, with the perspective of improving service delivery to citizens, accelerating innovation and rationalising the use of public resources, providing high quality services at a lower cost. We hope that our experience and activity may also contribute to the success of FCCN's mission.

**Innovative SUBMERSE** project to leverage existing subsea infrastructure for new fields of research

May 2023 marks the start of a new EU-funded project, SUBMERSE (SUBMarine cablEs for ReSearch and Exploration), which aims to utilise existing submarine cables already used by the research and education networking community, to monitor the Earth and its systems. By utilising existing equipment and infrastructure in a new way, the project not only avoids the need for extra hardware under the sea, but also improves the return on investment by enhancing and widening its use.

Words: Paul Maurice, GÉANT and Lars Fischer and Ieva Muraskiene, NORDUnet



multiple purposes.

to country.

The project will work closely with the diverse research communities who intend on using the data, to design and build the data generation service together, thereby creating a highly collaborative environment where data is generated by and for all parties. In this way, SUBMERSE goes beyond the traditional model of supporting and facilitating global research and education with infrastructure, to an environment where project partners and research communities together generate and share research from that infrastructure for

#### The background

Over the past five years, national seismic and oceanographic infrastructures, together with NRENs, and partners from universities, research institutes, and industry in parts of Europe have pioneered techniques to use submarine optical fibres to monitor the Earth and its systems. The methods and technologies used vary. However, two techniques show promise in the detail and scalability of their deployment: Distributed Acoustic Sensing (DAS) and State of Polarisation (SoP). The geographic locations where experiments have taken place, the length of experiments, the types of technologies used, and technological readiness levels of those technologies used also vary substantially from country

The level of technological development and cooperation between infrastructures associated with this field is now mature enough to aim for the next paradigm change: making data available from continuous observations on multiple

existing submarine optical fibre telecommunication cables, using a standardised technological configuration, at a continental scale, available to the wider scientific community, civil society, and industry.

The SUBMERSE project seeks to create and deliver a pilot activity which would serve as a blueprint for continuous monitoring upon many more cables in the future, which would lead to the opening of new market opportunities and the demonstration of methods to maximise the investments in research infrastructures, by using the by-products of their operations for the purposes of new scientific research. This would lead to the integration of established regional and national research infrastructures, thereby enabling world-class European research not possible before.

#### New beginnings

The project held its kick-off meeting in early May, welcoming all partners to meet, discuss objectives and approaches, and plan work areas. Follow up meetings for each work package will closely follow TNC23, where the SUBMERSE project and related technologies will be discussed at the SENSEational Networking session on Thursday 8 June, 14:00-15:30.

SUBMERSE Project Coordinator, Carmela Asero of EFIS, adds, "All partners are pleased to begin work on this exciting project. We have an opportunity here to do something really quite amazing, making use of existing infrastructure to provide a world of new data and, together with the research communities making use of this data, potentially new discoveries!"



## **GÉANT Partnership** Programme

#### Working together to support Research and Education

#### Words: Karl Meyer, GÉANT Partnership Programme Manager

Across the spectrum of services delivered by the GÉANT project and the European Research and Education networking community, the skills and technologies provided by commercial partners play a key role in helping us all deliver high performance, secure, reliable, and cost-effective services to our users.

The GÉANT Partnership Programme brings together these organisations not just for TNC but throughout the year to take part in Task Forces, Special Interest Groups, and to provide training and awareness on new and emerging products and technologies to help us all. It provides a forum for collaboration, innovation, and knowledge-sharing to foster the development of internet technology and associated services for research and education.

TNC could not happen without the support of the commercial partners within the GÉANT Partnership Programme and we would like to thank all the commercial partners here at TNC23 in Tirana for their generous contributions to this event.



#### **Over 14,000 educational institutions** of all sizes use the Amazon Web Services (AWS) Cloud to:

- Modernise and secure their institutions
- Improve the student experience
- Turn data into wisdom
- Empower researchers and accelerate research

The AWS Cloud can be procured through the Open Clouds for Research Environments (OCRE) framework using our Partners:

In the UK

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rackspace technology



**Commercial Partners** 

#### SPARKLE OCRE

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### Discover Google Cloud and Google Workspace for Research & Education with Sparkle

## Accelerating digitalisation and cloud adoption in the **European Research and Education community**

Cloud offers powerful tools to researchers and students, improving data processing speed and collaboration, through shared tools and data storage.

The scalability, flexibility and costeffectiveness offered by public cloud services relieve universities and research institutes of the operational and economic burden of managing self-hosted hardware and infrastructure, thus allowing them to focus on their core activities: high quality research and education.

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In Europe, R&E institutions can benefit from OCRE, a European project created to facilitate cloud adoption in the research community. Through ready-to-use service agreements with qualified cloud service providers, the OCRE Cloud Framework offers a standardised contractual vehicle to ease the purchase of these solutions and assure the best value for money.

Sparkle - OCRE Cloud Framework provider and Google Cloud integrator in 27 countries since 2020 - provides the R&E community with Googlebased solutions ranging from High-Performance Computing (HPC), Artificial Intelligence and Machine Learning, infrastructure modernisation. collaboration and productivity tools, genomic and clinical research, healthcare, and medical imaging. In this cloud journey, interaction with end users (researchers, professors, and students) is crucial to understand the needs of the organisation and then design the cloud solution that best supports its goals.

An example of this kind of collaboration is the one with the University of Foggia, one of the youngest and most dynamic universities of South Italy, that selected Sparkle to provide a cloud solution based on Google Cloud and Google Workspace for Education technologies to equip its 12,000 students and 3.000 staff with an enhanced set of distance learning and collaboration tools, as well as further developments and integrations. As for the timing: the agreement between the University and the company was signed in December 2021 and the service was already up and running in February 2022.

And when it comes to collaborations in the research field Sparkle, thanks to its team of experts and an ecosystem of specialised local partners, can converse with customers on their respective fields, a decisive added value that results in more effective design and faster deployment of the cloud infrastructure to support their specific needs and goals. It is in this framework that Sparkle is implementing several projects with different European institutions.

#### **Commercial Partners**

In France, for example, they include a project by the University of Burgundy to build a training solution for health professionals and students in the Metaverse, as well as a project "Deep Learning for GRAPHS" by the Computer Laboratory of Burgundy, which aims to automate the use of semantic content to make it accessible without further processing.

In the Netherlands, one noteworthy project is that by Princess Máxima Center for Pediatric Oncology to create a Comprehensive Childhood Cancer Commons, harmonise data collection of childhood cancer genomes and perform state-of-the-art data analysis to support innovations in childhood cancer research, diagnostics, and treatment.

In Belgium, the iCANDID project from the Katholieke Universiteit Leuven is developing a FAIR (Findable, Accessible, Interoperable Reusable) data hub for the Social Sciences and Humanities to speed-up the data collection and preprocessing.

In Italy, the Università di Padova along with the Università Svizzera Italiana are working on a project to study federated machine learning cloud systems for precision medicine as well as on a second project focusing on a Machine Learning paradigm called Incremental Learning.

The awarding of these projects to Sparkle is a testimony of the strength of its offer to the European education and research sector and is part of the company's broader commitment to reducing the costs and complexity of the transition to the cloud.

For more information visit Sparkle for Research and Education website: https://www.ocre.cloud. tisparkle.com/

Meet us at booth #5 to meet Sparkle's and Google delegates!



## Oracle for Research simplifies and accelerates discovery

Oracle for Research is the organisation within Oracle focused exclusively on supporting the global research community through programs, resources, and technology purpose-built for researchers.

At our core, we believe researchers shouldn't be held back by technology, which is why we've made it simple for them to host, store and analyse their data with our cloud infrastructure solutions.

Below are the free products and programs we offer, and a few of our customers making strides in their domains of research.

#### Words: Andrew Bell, Oracle for Research

#### Our programs

Researchers can apply for a Cloud Starter Award, which provides \$1,000 worth of Oracle Cloud Infrastructure (OCI) credits to enable small or shortscale computational operations. Users can gain valuable experience with the cloud and boost their analytic and storage power. With Oracle for Research Project Awards, researchers gain access to a greater amount of cloud credits and more expansive compute power. Our dedicated Oracle Cloud solutions architects help set up users' tenancies, providing technical collaboration every step of the way.

The Oracle for Research Fellows Program provides \$100,000 in cash, cloud credits and technical collaboration to three research luminaries in each biannual cohort. After several rounds of reviews, three projects are selected for the quality of their proposals, potential impact, and intended use of Oracle Cloud.

With these programs, Oracle for Research strives to support bold research projects that aim to disrupt their field of study and drive positive change on a global scale.

#### Our products

We've made it easier for researchers to find and consume the data they need. Oracle Open Data is a data set repository made for the people that create, use and manipulate data sets each day. Data sets are freely available, with no need for login nor payment.

We designed Oracle Workstation Service to make users' path to the cloud more straightforward, regardless of their technical skill. Oracle Workstation Service is a purpose-built platform that simplifies the management of cloud resources. Users can select a pre-configured compute environment and storage type to suit their domain of research.

Researchers also have access to Oracle's full stack of infrastructure and platform-as-a-service (PaaS) offerings like Al/ML, Autonomous Database, and containerised solutions.

#### **Our customers**

#### University of Adelaide researchers use Oracle Cloud to screen billions of drug candidates virtually

In silico drug screening involves simulating the interactions of small molecules with target proteins to understand how drug candidates might work. Dr. John Bruning and the University of Adelaide have worked with Oracle for Research to develop new computational tools for structural biology and in silico drug screening. These are specifically designed to use Oracle Cloud and offer drastically improved computational efficiency and scalability, while also being cost effective and globally accessible.

#### University of Reading relaunches Fruitwatch.org to continue monitoring UK climate change

Oracle for Research teamed up with University of Reading researchers to launch FruitWatch.org in early 2022. Hosted on Oracle Cloud, this website is an APEX autonomous database application that enables UK citizens to report when and how their fruit trees are flowering. The website captured over 6,000 records in 2022 alone, and the team continues to monitor changes and trends in fruit tree flowering dates. This data will be essential in helping scientists develop an understanding of the role climate change has on flowering fruit trees and the ecosystem they help sustain.

#### UCLA and Oracle use breakthrough AI to improve bone fracture recovery

While fractures of the hip and long bones are among the most common fracture types, medical professionals still struggle to accurately assess the complication profile of these patients after surgery.

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Akash Shah, MD at the University of California, Los Angeles (UCLA) is building machine learning (ML) models for prediction of adverse outcomes after hip and long bone fractures. The team is using Oracle Cloud Infrastructure (OCI) Data Science, an end-to-end ML service that offers JupyterLab notebook environments and access to hundreds of popular open source tools and frameworks.

#### Are you ready to get started or learn more?

Visit **oracle.com/research** to learn more.

Apply for a Project Award directly on our website.

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## Unlocking agility to support integrated research and collaboration for multi-site projects and networks

Researchers increasingly demand agile service orchestration to support their activities. Enabling this requires instant understanding of the assets required for any given service - without accurate, updated inventory management, NRENs won't be able to deliver.

#### New network capabilities are driving new research possibilities for NREN users

The needs of multi-party and distributed research teams are evolving. They want to capitalise on dynamic, elastic service orchestration capabilities to support complex

scenarios, with agile reconfiguration to manage change and evolving scenarios

Researchers need to be able to leverage those capabilities across NREN networks, for different labs and locations, so they can investigate new problems, simulate demanding situations, view and share results, and unlock new data processing techniques for experimental purposes.

#### Agile, dynamic network performance is essential

Suppose a team wants to establish connectivity - optimised for specific performance requirements - between different sites in which collaborators are based. They may need different L3 VPNs, dedicated IP / MPLS bandwidth and connections, and



potentially much more – all of which it should be possible to request and obtain via instant activation and automated processes.

They may also have specialised local conditions to consider, too - for example, for labs in different sites. They may want dedicated network slices that span their respective labs. What's more, the resources for one project or team must be managed alongside those demanded by others in the same locations.

This is a challenge for the networks that connect research establishments and teams. As an NREN operator, you must be able to orchestrate necessary resources and deliver the service for the required period, when requested - after all, researchers don't want to submit service requests weeks in advance.

#### **Real-time orchestration** must be supported by inventory management

To deliver this, while NRENs need orchestration and automation platforms, these must also be able to access records of the resources involved in the desired service - the inventory.

To deliver a service, you need to know what assets are available, their current status (other groups in the same facilities use the same networks and infrastructure), and where they are. And, you need to know all of this (and more) in real-time, so that

orchestration systems can request, obtain and connect them to deliver the requisite service chain

However, while the service layer has evolved to support agile procedures, the operational domain - the OSS - needs to be enhanced to support new levels of agility. What's needed in the OSS is a global understanding of the resources needed by orchestration platforms. Unfortunately, many network operators, NREN or otherwise, do not have this fully integrated view of all their assets and resources.

#### The critical role of inventory management

This essential view of resources can only be enabled with an accurate inventory management solution. Such a system should maintain its accuracy by ensuring that it is automatically updated, capturing and discovering changes in the network resource base that impact the orchestration and delivery of services in the catalogue.

In addition, since new orchestration systems may be deployed in the cloud – particularly for services that span multiple borders, inventory systems should also be capable of cloud deployments.

Researchers pushing the boundaries of innovation need networks that can support their goals. As the key provider of academic and research networks, NRENs are critical to the successful

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realisation of collaborative research but transformation to support new dynamic, agile service orchestration and delivery is essential to be able to meet challenging new performance and configuration requirements. And, without an effective network inventory management platform NRENs cannot deliver the dynamic performance required.

#### VC4-IMS – a complete inventory management solution for NRENs

VC4-IMS enables you to support these new performance demands. It's 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 - enabling dynamic, agile service orchestration and the delivery of complex new services, across your network.

Backed by unique, automated reconciliation procedures, and available from the cloud, it provides the accuracy you need to support dynamic, demanding research projects - for distributed, multi-vendor networks and any generation of technology.

For more information visit www.vc4.com or visit us at Booth 14 at TNC23.

## Making IPoDWDM a Reality with Advanced Coherent **Pluggable Optics**

IP over DWDM (IPoDWDM) has been discussed within the industry for many years without ever really delivering on the promise of its vision. New 400G intelligent coherent pluggable optics, based on the QSFP-DD form factor, have finally closed the gap between the IP and DWDM worlds to make the IPoDWDM architecture viable. However, as with most technological advances, the details matter. Seemingly small differences in specifications or features within these pluggable optics can have a big impact on the overall performance and operation of IPoDWDM networks.

Words: Jon Baldry, Metro Marketing Director, Infinera



The economic benefits of the IPoDWDM architecture are clear. The removal of DWDM transponders delivers initial CapEx advantages and provides ongoing OpEx advantages through reduced space and power requirements. The architecture can also simplify overall network design and operation if it is done right!

While DWDM-capable 400G coherent QSFP-DD optics adhere to various standardisation programs, such as the 400G ZR, Open ROADM, and ZR+ specifications, there are considerable optical performance and operational differences between commercially available coherent pluggables.

Optical performance is typically measured in terms of the maximum distance that a particular optic can support at its highest line rate. As examples, Infinera recently announced record-breaking performance for IPoDWDM deployments, achieving 2,400km in a lab environment with ultra-low loss fiber and 1.800km



in a live network deployment with Arelion. There are a number of factors that contribute to this high level of performance. First is highly programmable launch power, where the underlying optical technology is critical. These distance records were achieved with Infinera's ICE-X pluggables that are built on indium phosphide (InP) technology within the transmit-receive optical subassembly (TROSA).

InP enables higher launch power at 0 dBm than the -10 dBm typically achieved by silicon photonics-based optics. In addition, InP gives lower out-of-band noise and a higher optical signal-to-noise ratio than silicon photonics-based optics. Silicon photonics-based optics sometimes contain additional micro-optical amplifiers within the pluggable to boost the signal power to the higher 0 dBm level, but this adds complexity and amplifies the out-of-band noise too, requiring a further tuneable optical filter to remove it again.

Overall, InP gives the best optical performance, as demonstrated in those recent trials and deployments. Not only does this higher performance enable IPoDWDM to support long routes, but it also helps with shorter metro routes that might have many reconfigurable optical add/drop multiplexer (ROADM) nodes, as

the number of "ROADM hops" can often be the limiting factor in these networks. Higher optical performance enables a higher number of ROADM hops in these metro networks too.

But it isn't just optical performance that needs to be considered in these new network architectures. IPoDWDM brings great advantages as it removes the need for DWDM transponders: however, transponders do a lot more than just physically host pluggable or embedded coherent optics. They provide many system-level functions that are required for the operation of the overall optical network and provide a demarcation point between the optical domain and the IP domain. When this demarcation point is moved to be within a coherent pluggable mounted directly in the router, the pluggables themselves need to ensure that system-level functions required by the optical network are still maintained. Examples include an embedded control plane, management of remote optics, optical spectrum analyser capabilities, and optical power control. These additional system-level functions therefore need to be designed into the digital signal processor (DSP) inside the intelligent coherent pluggable. A powerful DSP also enables network optimisation through a high degree of programmability.

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management needs to be maintained, or possibly enhanced, by the move to IPoDWDM. No two networks are the same, and management strategies differ from operator to operator and application to application. Today's intelligent coherent pluggables can offer a range of management approaches, including simple management via the host platform using the existing CMIS interface or an optional dual-management approach that enables a host-independent management scheme and can leverage the sophisticated optical

Finally, overall network

networking capabilities supported in the intelligent coherent pluggables. For those readers who are attending TNC23 in Tirana, Albania from June 5 to 9, make sure you stop by the Infinera booth to see how Infinera's ICE-X advanced coherent pluggables are changing the way

optical and IP networks are built. Simply put, it's a game-changing technology that has the potential to significantly impact your network, in a good way!



## **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.

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