Winter 2024

EURESCOM message

The magazine for telecom insiders

CELTIC News 2/2024

CELTIC-NEXT

Sustainability in 6G

The Kennedy perspective

Sustainable sustainability

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Highlights from Eurescom's Participation in 2024 Key Events

What's new?

Launch of the new Horizon Europe SUSTAIN-6G and SNS CO-OP projects

CELTIC-NEXT

eureka Cluster

Join the Industry-Driven Research Programme of next-generation communications for a secured, trusted, and sustainable digital society

CELTIC-NEXT Spring Call 2025 for Project Proposals – Deadline: 21 April 2025

Here is the opportunity to participate in CELTIC-NEXT, the industry-driven European ICT and telecommunications research programme under the umbrella of EUREKA. Do not miss the submission deadline for the next call for project proposals, on the 21 April 2025!

CELTIC-NEXT projects are collaborative private-public partnership R&D projects. All EUREKA member countries and associated countries can financially support them. More information on public funding and national contacts per country can be found on the CELTIC-NEXT Public Authorities Website. Please talk to your national contact early in the process.

Easy proposal process

Preparing and submitting a CELTIC-NEXT project proposal is easy. Just register via the CELTIC-NEXT online proposal tool, fill in the Web forms, and upload your proposal in pdf. Access to the proposal tool and to a proposal template is available via our Call Information page (https://www.celticnext.eu/call-information).

Benefits of participating in CELTIC-NEXT

- You are free to define your project proposal according to your own research interests and priorities.
- Your proposals are not bound by any call texts, as long as it is within the ICT/telecommunications area see: CELTIC-NEXT Scope and Research Areas.
- CELTIC-NEXT projects are close to the market and have a track record of exploiting their results soon after the end of the project.
- High-quality proposals have an excellent chance of receiving funding, with an average success rate higher than 50 %.
- The results of the evaluation will already be known in June 2025.

If you have any questions or need help, do not hesitate to contact us; we would be pleased to support you.

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Dear readers,

Pooja Mohnani
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As we lay the groundwork for 6G, the balance between progress and preservation is critical. While the next generation of wireless technology, promises **phygital** ie seamlessly integrate both the physical and digital worlds. This is quite exciting, but it must not come at the expense of our planet. Through collaboration, innovation, and commitment to sustainability, we can ensure that 6G becomes a beacon of responsible technological advancement.

With this vision, efforts are directed to create a unified 6G, driven by key stakeholders worldwide, evolving to global consensus. The European perspective, represented by the 6G Smart Networks and Services Industry Association (6G-IA), underlines Europe´s proactive role in 6G Research and Development (R&D) and standardisation, addressing societal, environmental, economic and market challenges.

To understand the implications of sustainability in 6G, we reached out to leading expert from Nokia, for an exclusive interview for the Eurescom message and gathered insights on the core value of sustainability for ICT industry.

This issue of Eurescom message magazine features a diverse range of articles on various ICT-related activities including learnings derived from the Sustainability Task force of the Smart Network and Services initiative,Technology board. The TB of the SNS JU oversees and supports the technical work of SNS Projects and the implementation of the SNS-Initiative. One of the most important task forces is the Sustainability Task Force, created in 2023 which monitors the project activities and advocate the need for a globally accepted framework that must have specific and measurable indicators to evaluate the success in meeting sustainability goals.

When sustainability becomes a key aspect of innovation, the results are not only impactful but also enduring. This is the aim of projects led by Eurescom, the EU funded Project PAROMA-MED aims to develop novel technologies, tools, services and architectures for patients, health professionals, data scientists and health domain businesses and share their Sustainable practices that enable Privacy Awareness and Privacy Preserving Distributed services and applications in medical sector.

In the article “How can 6G-SANDBOX as an experimental platform contribute to assess sustainability?” you get the glimpse of 6G-SANDBOX experimental facility and how it is being developed to validate concepts and ideas around sustainability.

In this edition, the KENNEDY Perspective on **“Sustainable sustainability”** reflects on the evolution of telecommunications networks and how techno-economic balancing act between the costs of providing the connectivity versus the costs of the materials and equipment is critical! And the final search to the answer: how to deliver services at a reasonable affordable price to the consumers?

With Eurescom’s active engagement, we showcased our participation at the EuCNC & 6G Summit 2024, and made a significant impact at the Summit with representation of SNS OPS & SNS ICE projects via the SNS JU booth, organization of workshop titled “Non-Terrestrial Networks and Terrestrial Networks Unification – from Vision to Reality", presentation and demonstration from projects CENTRIC and CHARITY, Moderating the SNS JU Workshop, promoting the need for inclusion and diversity and presenting at the WiTaR Working Group Session etc.

Continuing the trend, the FUSECO Forum was another Strategic telecommunications industry event where we presented, on the sustainability needs, challenges faced by 6G and Verticals, and the actions required to address these challenges.

As a part of the INPACE Support Action the workshop on the Digital Partnerships between the EU and the Republic of Korea, Japan, and Singapore, was organized. At the exhibition space, project 6G-SANDBOX presented and demonstrated the latest project results. The vision for integrating Terrestrial Network(TN) and Non Terrestrial Network(NTN) for 5G-Advanced, focusing on network disaggregation, multi-connectivity, and space edge computing, was also presented.

Additionally, Eurescomians participated in several other high-profile events like Berlin 6G Conference, Digital-Gipfel, NEM Summit 2024, 5G Techritory etc. reaffirming our dedication to driving advancements in next-generation communication technologies, with a focus on 6G by engaging in collaborative workshops, panel discussions, and strategic initiatives.

We continue to shape the future of telecom, tackling key industry and leading role in 6G innovation with the launch of the new Horizon Europe SUSTAIN-6G and SNS CO-OP projects starting in January 2025.

As the digital transformation of global economies accelerates, fostering international cooperation in digital technology has become essential. To support this vision, the EU-funded INPACE project was launched in January 2024 plays an important role in supporting the implementation and advancement of the Digital Partnerships established between the European Union and key Indo-Pacific countries, including Japan, the Republic of Korea, and Singapore, and through the Trade and Technology Council with India.

My editorial colleagues and I are confident that you will find valuable insights in this edition of *Eurescom’s Message*. We warmly welcome your feedback on the current issue and invite your suggestions for topics to explore in future editions. Let us know if you are interested to join forces with us!

Happy reading!

EVENTS CALENDAR

8 – 12 December 2024
IEEE Globecom 2024
Cape Town, South Africa
https://globecom2024.ieee-globecom.org/

28 – 30 January 2025
5th IEEE International Symposium on Joint Communications & Sensing
Oulu, Finland
https://jcns-symposium.org/

3 – 6 March 2025
MWC25 Barcelona
Barcelona, Spain
https://www.mwcbarcelona.com/

12 – 16 May 2025
First IEEE/ IFIP WebAssembly, Cloud and Edge: Shaping the Future of Computing (WACE) Workshop
Honolulu, Hawaii
https://noms2025.ieee-noms.org/

19 – 22 May 2025
IEEE INFOCOM
London, United Kingdom
https://infocom2025.ieee-infocom.org/

26 – 29 May 2025
IEEE International Conference on Machine Learning for Communication and Networking
Barcelona, Spain
https://icmlcn2025.ieee-icmlcn.org/

3 – 6 June 2025
EuCNC & 6G SUMMIT 2025
Poznan, Poland
https://www.eucnc.eu/about/announcement-eucnc-6g-summit-2025/

10 – 13 June 2025
The 33 Mediterranean Conference on Control and Automation
Tangier, Morocco
https://med2025.org/

SNAPSHOT

Eurescom team presence at the EuCNC & 6G-Summit 2024 in Antwerp, Belgium

Eurescom-team-in the hall of the EuCNC 2024

Eurescom GmbH made a strong impact at the EuCNC & 6G Summit 2024 in Antwerp, showcasing its innovative telecommunications projects. The event attracted 900+ delegates and 50+ exhibitors, creating a dynamic platform for 5G and 6G developments. Eurescom co-hosted the SNS JU stand, promoting strategic 6G goals and international collaboration via the SNS OPS and SNS ICE projects. The CENTRIC project demo highlighted NVIDIA's Neural Receiver, optimized for multi-user MIMO performance through site-specific neural networks. Eurescom also featured via its now finished project CHARITY, which uses intelligent orchestration for immersive communications. Participation in the WiTaR session underscored Eurescom's commitment to diversity and inclusion in tech. Overall, Eurescom reinforced its role in driving network technology advancements and global partnerships.

Further information
EuCNC & 6G-Summit website – https://www.eucnc.eu/

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Sustainable sustainability

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The concept of sustainability is the idea that something is capable of being maintained at a steady level. For example; when I go Nordic walking, I try to sustain a speed of 6km/hr. I know that this is not very fast, but it is the speed I can keep up for 15~20km without exhausting myself. If I try to go faster, it works for a short while, but then I discover I have used my energy too fast and could end up getting the bus home.

When we consider the idea of sustainable telecommunications networks we have the same dilemma. Our networks can be made super powerful everywhere by massive over dimensioning, but then we will have to consume a lot of energy continually to keep them available. Clearly this is not acceptable or affordable.

The idea of sustainable infrastructures is where the capital investment of natural resources to create and operate such networks is kept to a low level where it does not exhaust the available resources and is reusable or at least recyclable. Similarly, on the operational side we need to ensure that running infrastructures use only the minimum energy that they need and even that should be reduced in quiet times if there is not much traffic being handled.

Sustainable for the future

The United Nations have a list of 17 sustainable goals with many clear ambitions to support people in their lives and to reduce our impact on the environment. Clearly there are interdependencies between these goals and, while the priorities obviously start with addressing poverty, food shortages and health, they quickly identify aspects of education and equality which are key concepts that require access to and sharing of information on a large scale. The communication infrastructures are facilitators of education.

The ICT challenge

The evolution of telecommunications networks is always a techno-economic balancing act between the costs of providing the connectivity versus the costs of the materials and equipment needed to deliver those services at a reasonable affordable price to the consumers. When I started working in Telecoms, we had only to balance the cost of copper cables to the houses and local exchanges. When Copper was expensive, we used more local exchanges, as copper became cheaper we concentrated the exchanges in one location with longer copper lines. One of the biggest costs was where you put the cables – underground was the most expensive solution!!

Today we have totally new infrastructures that resemble computer networks more than the traditional telephone networks. However, we are still doing a balancing act between the transmission, storage and processing of the data in transit. Today's network must know what type of communication it is supporting and, if it is voice or real-time communications then it must be delivered quickly. If the consumer is streaming content and looking at it, or listening to it, they can be very sensitive to interruptions. If the communication is the download of a large data file (maybe a movie for watching later) it is not so time critical and can be stored and forwarded. This type of traffic management allows some averaging of loads and traffic in the networks; however, it is not the full answer to the sustainability challenge.

Sustainable operations

We are now entering the era of "intelligent" equipment in the infrastructures. This means different elements of the infrastructure will have capabilities to optimise their own configuration to deliver the best service while consuming the least energy. In principle this is wonderful as it allows us to have the best of both worlds, but in practice it greatly increases the complexity of the infrastructure, and dramatically increases the signalling and connectivity traffic that must be exchanged within the network - between network elements – to ensure they do not interfere with each other and actually reduce service quality. We are only learning now if the total improvements from these incredibly capable infrastructures compensate for the additional cost of resources and energy to maintain them. Eventually they will but we may need to learn a lot more about how intelligent systems behave and interact to be sure.

Quo vadis?

The challenge when addressing any large-scale task is always where to start – you cannot resolve everything at the same time so you have to pick some priorities. In the telecommunications industry we are going through a period of unbelievable development and growth. Since the late 1990s the capabilities of the networks and the personal devices have exploded and people today are now expected to be carrying a device that allows them to communicate, entertain and even monitor their health.

We are continually chipping away at providing better, cheaper, simpler ways of ensuring everyone gets the services they need, and can be digitally "included" in society, while making sure we are minimising the energy and resources consumed. You can help by buying devices that can be fixed so we can keep our mobile phones for at least three years.

The 6G Industry Association updates its vision for 6G

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The 6G Industry Association has been working at the forefront of research and innovation as part of the global efforts to define the 6th generation of mobile communications. As the private partner in the Smart Networks and Service Joint Undertaking, it works together with EU funding authorities through a large number of projects (to date around 100 projects) to research and develop innovative solutions and bring Europe to the spotlight for 6G. A vision white paper has been guiding the efforts since 2021. The rapid evolution of technology called for an update of the 6G-IA vision on 6G. Version 2 of the 6G Vision has been published in November 2024 and is available online.

Global context

Ongoing global efforts are underway to develop and standardise 6G networks, aiming for a commercial launch around 2030. Therefore, it is important to create a unified 6G vision, driven by key stakeholders worldwide, towards a single global consensus. The European perspective, represented by the 6G Smart Networks and Services Industry Association (6G-IA), underlines Europe's proactive role in 6G Research and Development (R&D) and standardisation, also addressing societal, environmental, economic and market challenges.

Technological advancements

Technological advancements, such as native artificial intelligence (AI) support, integrated sensing and communications (ISAC), and advanced cybersecurity drive the evolution. At the same time the focus is on sustainability, both in making 6G systems themselves sustainable and in using 6G to enhance sustainability across various industries, including media, transportation, and healthcare.

Globally, 6G development is driven by key priorities like security, AI, energy efficiency, and ubiquitous coverage. Europe, especially through the Smart Networks and Services Joint Undertaking (SNS-JU) and its R&D projects like the flagship Hexa-X-II project, has been active in aligning its priorities with global standards and contributing to the 6G vision.

Integrating sustainability metrics, such as Key Value Indicators (KVIs), into the R&D process is essential to ensure that 6G not only meets technical performance targets but also contributes positively to societal, economic, and environmental goals. The use cases and key performance indicators (KPIs) for 6G reflect the European consolidated Research and Innovation (R&I) perspective. These use cases are based on inputs from various SNS JU projects and are categorized into six families, each with a representative use case and corresponding KPIs. In summary, the use case families are: (i) Immersive Experience; (ii) Collaborative Robots; (iii) Physical Awareness; (iv) Digital Twins (DTs); (v) Fully Connected World; and (vi) Trusted Environments.

KPIs are provided for each use case, including data rates, latency, reliability, and positioning accuracy, tailored to the specific needs of each use case family. Furthermore, operational aspects are considered, with a focus on the efficient operation of 6G networks, including spectrum use, unified interfaces, deployment strategies, and seamless migration from 5G.

The anticipated services of 6G technology from an "outside-in" perspective focus on services integrated with or enabled by the 6G system, emphasizing the need to sustain and build on the innovations of 5G during the transition to 6G. A "6G-enabled Services Vision" is introduced, highlighting the importance of interconnected and interoperable smart networks and services, and suggesting a new ecosystem-level approach to business for sustainable 6G. The key points of this Vision are:

- **Foster transition** from 5G to 6G to sustain and enhance 5G innovations.
- Address **potential shortcomings of 5G** in areas that may have been underdeveloped, e.g., with respect to support of vertical industries.
- **Integrate new service capabilities** with an emphasis on interoperability and service continuity.
- **Propose interconnected and interoperable smart networks** ensuring seamless interconnection and interoperability among network providers beyond just connectivity.
- **Define sustainable 6G ecosystems** prioritising sustainability and encompassing environmental, social, and economic aspects through a new business ecosystem approach.

Technological enablers

The R&D of technological enablers for 6G has been underway for some years, building on the features and enhancements of previous generations while also exploring breakthroughs that could revolutionise mobile connectivity in the near future. The most relevant topics related to the upcoming 6G system include advancements in hardware (HW) and radio technology, flexible network topologies, deterministic networking, network softwarisation, and digital twinning, as well as the widespread adoption of AI and ISAC.

The enablers are categorised in a set of concrete areas such as energy efficient technologies, network and service security, deterministic networking, radio and signal processing, new access and flexible topologies, edge-cloud continuum,

network softwarisation, network intelligence (NI), optical networks/photonics, digital twins, and HW technologies.

6G Architecture

An updated vision on the forthcoming 6G architecture focuses on potential innovations and addressing current 5G limitations. Fundamental challenges in 5G that hinder efficient global operations are identified, and potential architectural innovations for 6G to overcome these challenges are outlined. Key areas of focus include interoperability, resource awareness, service-awareness, multi-tenant federation, deeper integration of user equipment (UE), AI/Machine Learning (ML) support, dependable communications, ISAC, seamless integration between terrestrial and non-terrestrial networks (TN and NTN), enhanced security and privacy, network simplification, and sustainability.

6G builds on 5G usage scenarios (eMBB, URLLC, and mMTC) and introduces new ones, such as immersive communication, hyper-reliable low-latency communication, and ISAC. The KPIs for 6G are significantly more demanding, with higher data rates, lower latency, and enhanced reliability. In contrast to 5G, 6G considerably emphasizes sustainability, trustworthiness, and inclusion, aiming to transform technology interactions and support global sustainability goals. To realise 6G by 2030, several key non-technical steps must be addressed, including standardisation, regulation, business strategy, and sustainability.

Standardisation: The International Telecommunication Union (ITU) has named the next generation of mobile technology "IMT-2030" or 6G. By 2025, ITU will outline technical requirements that will guide standardisation bodies like 3GPP in defining what constitutes a 6G-compliant system. 6G will build on 5G foundations but also introduce new concepts such as Ubiquitous Connectivity, AI-driven Communications, and Integrated Sensing. A unified global standard is crucial for a resilient telecommunications ecosystem, supported by contributions from industry groups, associations, and open-source communities.

Regulation: 6G must comply with various regulations to be commercially viable. Key regulations include the Radio Equipment Directive (RED), which covers safety and spectrum use; the Data Act, which addresses data management; the AI Act, which governs AI system use; and the Cybersecurity Act, which establishes security certification frameworks. Compliance with these regulations is essential as 6G becomes deeply integrated into societal infrastructure.

Business Strategy: Europe, home to two of the top three telecom vendors, holds a strong position in the 6G landscape. However, it faces challenges from non-European Over the top (OTT) providers and hyper-scalers. Opportunities for Europe include leading in industrial applications of 6G and adapting to new business models and regulatory policies that support open networks and AI integration. Robust data management and a holistic approach to network security are vital for maintaining European technological sovereignty and ensuring secure, trustworthy 6G systems.

Sustainability: 6G is set to be a model of sustainability, guided by global and regional goals such as the UN's Sustainable Development Goals and the European Green Deal. This involves assessing environmental, social, and economic impacts, optimizing material use, and reducing waste. The 6G industry must innovate in both technology and business models to ensure that 6G benefits are realised sustainably and equitably, balancing connectivity advancements with environmental considerations.

The 6G industry in Europe must innovate in technology, business models and investment strategies. The focus will be on optimizing the use of resources, reducing environmental impact, and ensuring that the benefits of 6G are realised in a sustainable and equitable manner for society and business.

This whitepaper represents an update of a previous version released in June 2021. It incorporates all the advances at all levels of the 6G technology and presents a more mature vision of both the industry and academy of what 6G will be and what it can enable and mean for the society.

Further information

- European Vision for the 6G Network Ecosystem. 2024, Zenodo, https://doi.org/10.5281/zenodo.13708425

“Ask the experts: from Vision to Practice”

To understand the implications of sustainability in 6G, we reached out to leading expert from Nokia, for an exclusive interview for Eurescom message and gathered insights on the core value of sustainability for ICT industry.

Lars Christoph Schmelz, Nokia,
Coordinator Horizon Europe Sustainability Lighthouse project “SUSTAIN-6G”
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What do you think is the core value of sustainability for ICT industry?

In my opinion, sustainability is about meeting present needs without jeopardizing those of future generations. In that sense, sustainability represents a scope widening, or even scope shift for ICT industry, through introducing the "sustainable by design" paradigm, and taking a step forward from primarily looking at the network performance.

Sustainability with its different aspects (environmental, societal, economic) thereby puts on the one hand the specific needs of ICT users back to focus, driving the development of mechanisms and solutions to support the services and applications they actually ask for, and addressing their sustainability requirements such as the reduction of environmental footprint, accessibility to services, or economic viability. On the other hand, the sustainability requirements strongly push ICT industry to really deal with its own footprint, leveraging digital solutions that improve, for example, energy savings towards net zero, network accessibility and resilience, and security and privacy.

Why do we need 6G for sustainability? What are we expecting here?

As already outlined above, ICT in general, and 6G in particular, are central enablers for reducing the footprint and improving the handprint of vertical industries and the society. This includes being the driver for digital transformation and new business models, bridging the digital divide through enabling accessible, reliable and trustworthy services, and leveraging a green transformation for vertical areas such as agriculture, healthcare, smart cities or transportation.

In your opinion what learnings do we bring from 5G in order to make 6G sustainable?

From my perspective, when designing 6G in a sustainable manner, it is necessary to realistically consider what services and applications will be required by its users, society and industry, and which features 6G needs to provide, in order to serve these needs. However, this doesn’t mean to create tailored solutions for each and every use case but to design the overall system sufficiently simple and efficient. For example, with security having given a high priority already during the development of 5G, 6G must be positioned in a similar manner to ensure that the respective requirements are embedded from the early design phase, such that both consumers and businesses can benefit from Day 1 of the 6G rollout. Nonetheless, further requirements on security design, reflecting other sustainability requirements (for example, energy savings, accessibility, or even simplicity towards an economically viable solution) should be reflected as well.

How do you think sustainability should influence standardization?

Exemplary areas where sustainability goals and solutions should be influential in standardisation include energy efficiency and savings, security and privacy, data management and exposure, or the integration of Artificial Intelligence (AI). Energy efficiency – at least in mobile communications – has always been a design target, but the topic became even more urgent with the last generations - from environmental and climate as well as economic perspective. The technology migration towards software-based features together with the introduction of AI will thereby require additional focus on the respective network parts. With an increasing number of end-users that use commercial services and applications over mobile networks, security, privacy and trustworthiness play an important role. This is furthermore highly relevant for critical infrastructure services such as energy, transportation or healthcare. And to ensure that sustainability is not addressed only in silos but considers an end-to-end perspective from the device through network and services infrastructure to the application, the exchange and exposure of data to define and track sustainability values is required.

How do you think the use of AI impacts sustainability ambitions (in the positive or negative direction)

In my perspective, AI will play a key role in both, reducing footprint of 6G and increasing handprint in vertical sectors. In both cases, the AI-based analysis of large amounts of data for end-to-end optimising the infrastructure, services and applications towards joint sustainability values provides opportunities that could barely be achieved through legacy approaches. AI will certainly help improving efficiency and productivity, and its application to, for example, production processes, can have a positive impact on employee’s health and safety or the generation of waste.

On the other hand, AI implementations are expected to be quite power and potentially material consuming, and they may challenge the privacy needs of end-users or verticals, or even the trustworthiness of actions initiated by such solutions. A careful analysis of rebound effects or – in other words – "sustainability cost" vs the benefits will therefore be necessary, which may lead to use case specific decisions on the actual implementation of solutions.

In that sense, AI is exemplary for many goals, values, metrics, and technical approaches in the context of sustainability: very often there are trade-offs and rebound effects to be considered, and there is not ONE ideally sustainable solution for a problem. Finding the right balance - or compromise - might often be the biggest challenge to be solved. But maybe AI is one option for finding such balance?

Do you think diversity and inclusion has a role to play in design & development of Sustainable 6G technology? What is needed in practice to promote it?

Yes, one central goal of sustainability in the context of 6G will be to support bridging the digital divide, by enabling services that support the inclusion of people and societies, and even more basic, ensuring the accessibility of services to all. This will need to be backed by robust education programmes to help youth, seniors and ethnic minorities of all abilities learn how to access public information (healthcare, social and financial support and education services) and discover the tools and opportunities available to them. 6G will bring a set of technologies where this central goal gets closer to realisation.

In that sense: yes, from my perspective, diversity and inclusion must play a role in the sustainable design of 6G. And part of this design process should not only be to deep dive into the technical requirements and solutions, but promoting 6G as such enabler - being powerful, secure, reliable and trustworthy!

Finally, how do you envision "SUSTAIN-6G"?

With the "Sustainable 6G by Design" paradigm and the diverse goals, values, and solution approaches outlined above, it becomes clear that sustainability is not one single solution or technology that simply needs to be applied into the next generation of mobile communications. Sustainability is represented through a diverse set of technologies addressing environmental, social and economic sustainability aspects, and these aspects address requirements from a large number of use cases coming from different stakeholders.

SUSTAIN-6G therefore has the ambition to work towards a holistic approach for sustainability in the context of 6G. It will aim for the technology itself being built in a sustainable way and to reduce the ICT footprint. It will also help other industries to operate more sustainable by reducing their Scope 3 emissions and by providing ICT-powered use cases that improve the environmental and socio-economic outcomes from their businesses. This holistic approach shall thereby provide an end-to-end perspective, from device to application, and consider the full lifecycle of services, applications and assets. An important step forward will be to create the processes and methodologies on how the goals, values and metrics for such holistic approaches can be defined, and how technical solutions can be assessed accordingly. Central will be here, to consider the inherent trade-offs between different sustainability goals and create the processes and methodologies such that they support the balancing between them.

Sustainability Task Force of the SNS JU Technology Board

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The Technology Board (TB) of the Smart Networks and Services Joint Undertaking (SNS JU) oversees and supports the technical work of SNS Projects and the implementation of the SNS-Initiative. It organizes technical meetings, workshops, and the publication of reports and white papers. It can create Task Forces to address specific technical challenges. One of the most important task forces is the Sustainability Task Force, which was created in 2023.

Introduction

In the realm of technology-focused projects, there is a noticeable gap in addressing the social and economic sustainability aspects of project innovations. Most technology projects tend to equate environmental sustainability solely with energy efficiency, overlooking other important aspects. To bridge this gap, it is essential to manifest and simplify sustainability aspects for target setting, especially for projects with low Technology Readiness Levels (TRL).

Key Value Indicators

One of the significant challenges lies in developing use cases that are oriented towards sustainability values. Currently, most use cases are driven by technological advancements rather than sustainability goals. The Societal Needs and Value Creation (SNVC) sub-group of the Vision work group of the 6G Infrastructure Association (6G-IA) defined a process for the derivation of Key Value Indicators (KVIs), which aims to integrate sustainability metrics. However, this process is often perceived as complex and dependent on external experts, making it difficult for low TRL projects to follow. Additionally, these projects do not adequately cover the operational phases included in the SNVC process.

For effective outcome evaluation, it is necessary to establish consistent and comparable measurements across projects. Without this, it becomes challenging to compare KVIs across different use cases, hindering the ability to provide feedback for better design of common 6G technology enablers. Collaboration with the SNS-JU work group on Test Measurement and KPI Validation, for use case and KVI collection as well as baseline setting could enhance cross-project dissemination and ensure the longevity of KVIs.

Design 6G for Value

As we design 6G for high-end applications and use cases, it is imperative to address issues of equity, access, affordability, and empowerment in social and economic sustainability worldwide. Policy and regulation must go hand in hand with technological advancements to achieve sustainable outcomes. Unfortunately, most projects currently lack considerations for policy and regulation.

To embed sustainability into the core of research and development projects, "Sustainability by Design" needs to be established as a standard process. This approach requires a holistic systems perspective, taking into account the feedback loops among environmental, social, and economic domains. By doing so, we can ensure that 6G technology not only meets technical performance targets but also contributes positively to societal and environmental goals.

Energy savings and GHG emissions

While energy efficiency and savings are well-understood and prioritized in most projects, achieving real environmental impact requires a broader approach. One aspect is the increased use of renewable energy sources. This shift should be tracked through the carbon intensity of the energy used, ensuring that the energy powering our technologies is as clean as possible.

Additionally, it is essential to manage traffic load and capacity to prevent disproportionate increases, known as the rebound effect. Without careful management, improvements in efficiency can lead to higher overall consumption, negating the environmental benefits.

Infrastructure expansion must also be approached with a focus on reducing greenhouse gas (GHG) emissions and promoting circularity. This means designing infrastructure that not only minimizes emissions during construction and operation but also considers the entire lifecycle, including reuse and recycling of materials.

Furthermore, we must consider the feedback loops between social and economic sustainability. This holistic perspective ensures that technological advancements contribute positively to society and the economy, creating a balanced and sustainable future.

By addressing these additional aspects, we can turn energy efficiency and savings into tangible environmental impacts, paving the way for a more sustainable world.

Conclusion

The Sustainability Task force of the SNS-JU TB has undertaken a monumental task, addressing the multifaceted challenges of integrating sustainability into our technology projects. This endeavour encompasses environmental considerations but also social and economic sustainability, requiring a comprehensive and holistic approach.

Despite the enormity of this task, there is great confidence in the task force's ability to deliver impactful results, especially as an increasing number of SNS-JU projects take a broader perspective to sustainability, like the Sustainability Lighthouse project, SUSTAIN-6G .

The task force's approach is methodical and well-structured, ensuring that every aspect of sustainability is meticulously addressed. It is actively embracing collaboration with various stakeholders, fostering a culture of shared responsibility. This collaborative spirit is essential for achieving the ambitious goals set forth.

Further information

- Key value indicators: A framework for values-driven next-generation ICT solutions, https://doi.org/10.1016/j.telpol.2024.102778
- SUSTAIN-6G Project https://sustain-6g.eu/

Sustainable practices in PAROMA-MED Project: designed for Health Applications

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With the increased pressure in industry to drive sustainability and the deployment of complex network architectures and services, to meet the expectations of customers and shareholders, are the issues that need to be tackled. Here's how EU funded and Eurescom led project PAROMA-MED is implementing sustainable practices and plans to contribute to the health vertical. The goal is to develop Sustainable technology by design and build trustworthiness for its uptake.

Sustainable architecture for health applications in 6G involves designing efficient, low latency systems, secure and reliable networks that cater to the high demands of healthcare applications in next-generation wireless networks. With 6G anticipated to provide ultra-low latency, high data rates, and massive device connectivity, its deployment in health sectors will support complex applications like telemedicine, remote monitoring, AI diagnostics, and smart hospitals. Sustainable architecture in this context emphasizes efficient resource use, reduced energy consumption, and long-term resilience.

The project PAROMA-MED develops, validates and evaluates a platform – based hybrid-cloud delivery framework for privacy- and security- assured services and applications in federative cross-border environments. To this purpose, the project develops new architectures, technologies, tools and services to support various aspects, including automatic attestation of federation partners; privacy and security by design; continuous risk assessment; privacy-preservation; and trusted data storage and processing in federative environments; AI/ML by design, managed privacy and security operations for automated policy enforcement; and cyberthreat detection and mitigation. PAROMA-MED project approached sustainable practices to handle data in the project with a holistic approach considering the potential stakeholders which are involved in related processes.

Here's how the project is addressing sustainability needs:

1. **Resource Optimization and Smart Infrastructure:** The project evolves and provides a thorough set of functional and not functional requirements classified across several dimensions. This includes the role of Fast Healthcare Interoperability Resources (FHIR) standard and positioned it at the epicenter of interworking and interoperability as an important component of smart infrastructure.
2. **Network optimization for Health Applications:** Deploying a 6G network sustainably may require a significant initial investment, especially in infrastructure. Patented (by Ericsson) a Path Computation Engine that assesses vulnerabilities and modifies the networking path for protected services and connections taking into account administrative policies and the National Institute of Standards and Technology at the U.S. Department of Commerce(NIST) vulnerability scores. This helps to prioritize different healthcare needs, optimizing resources based on application requirements like speed, bandwidth, or latency, leading to reduced infrastructure strain and power use.
3. **Federated learning Integration:** Classified Federated ML frameworks and carried out interesting experiments, this includes elaborated an extended Use Case for demonstrating the full cycle of data from creation to usage and involvement in added value applications (Federated ML).
4. **AI Model protection and controlled use:** Produced AI Models are treated as data assets and remain protected without direct exposure. PAROMA-MED deploys them temporarily close to the data for inference purposes in a volatile way.
5. **Secure and Resilient System Design:** Edge nodes representing all stakeholders are attested for integrity and adherence to foreseen principles of operation. Proofs are produced based on Hardware Root of Trust and the results are available for continuous node attestation. Collaborating nodes verify every peer's integrity and proceed to interactions only when trust is established.

6. **Data Privacy and Encryption:** Sustainable health systems must secure sensitive health data while minimizing the collection of data. The project has elaborated strategies on the utilization of Data Watermarking and Model Watermarking techniques for all assets and started implementing the relevant artifacts that continuously evolve around Privacy Awareness UI/UX solutions. Furthermore, the project enforces local usage of data and focuses on federation of data attributes to allow for sufficient data FAIRness.
7. **Resilience through Decentralization:** Decentralized network architectures, that are sending code close to health data, can reduce the central server load and support sustainable, fault-tolerant systems, minimizing downtime and energy costs.

Potential Challenges

- **Data Management:** Health applications generate vast amounts of data, and managing this sustainably requires effective data reduction techniques, compression, and efficient storage solutions. In this context the project has started working with Data Space connectors to be utilized for controlled (policy and contract enforcement) and traceable use of data.
- **Ethical and Regulatory Considerations:** Ensuring security, privacy, and equitable access to sustainable health applications in 6G is crucial, particularly given the sensitivity of health data.

By focusing on these areas, sustainable architecture in 6G could revolutionize healthcare, providing faster, more reliable services while minimizing environmental impact. Further, following the pace paved by Data Space initiatives across Europe, the project aspires to offer artifacts that will ensure the maximum exploitation of data value, within these rich and continuously evolving ecosystems, according to concrete and pervasive sovereignty principles which are elevating the role of and empowering the data owner/subject.

Further information

- https://paroma-med.eu

How can 6G-SANDBOX as an experimental platform contribute to assess sustainability?

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Introduction

Sustainability is one of the key requests for 6G. The 6G technologies shall be designed so that sustainability is guaranteed at economical, societal and environmental domains. A key principle towards sustainability in networks refers to optimizations around energy, including higher energy efficiency, increased energy savings, and use of renewable energy. Already, sustainability indicators are studied for data centers and the core network. A comprehensive overview can be found in the NextG Alliance report [1]. When it comes to the energy consumption part of sustainability, the GSMA (Global System for Mobile Communications Association) issued a report nearly a year ago (February 2024) indicating that the core network and associated data centers consume around 19% of total energy in the operation of mobile networks [2]. This is a large amount where optimization can have a large impact. However, diving into the edge part of the network and especially the radio access part the energy aspects are becoming more complex, highlighting the critical role of experimental infrastructure (such as the one of 6G-SANDBOX) that can feed the research community with reliable energy-related results.

System design decisions

Let's look at two concrete examples of how the system design impacts sustainability: Data center versus edge and the RIC in ORAN.

Data center versus edge: looking back at the early 5G concepts, we saw an industry movement to virtualize and centralize all services into the data center. This movement's rationale was cost and efficiency. Shortly after that, a counter-swing movement happened where part or full centralized functions needed to be redistributed at the edge with the intention of improving system latency, among other things. Today, the fluidity of the dynamic migration of services from the central data center to the edge is a hot topic.

Another good example of a system design decision impacting sustainability can be found in Open Radio Access Network (ORAN). The ORAN alliance has introduced a functionality called the RIC (RAN Intelligent Controller). This entity will be in charge of controlling and applying policies at the RAN level. The decision can be to shut down or start additional ORUs (ORAN Radio Units) or to optimize traffic based on needs. All these decisions can be made based on multiple factors where sustainability can be one of the parameters taken into account, but for sure, sustainability won't be the only one factor considered.

Both examples highlight technical decisions that have a large impact on the service as such and on the resources used to run the services, not just from an energy consumption perspective but also from a physical equipment perspective. Starting from these two examples, it becomes clear that experimental platforms can be critical to understanding the impact of such decisions and assessing the technology's impact and how it is deployed.

What is 6G-SANDBOX?

6G-SANDBOX aims to create a comprehensive and modular trials facility for the European experimentation ecosystem, supporting the technology and research validation processes needed for the development of 6G over the next decade. This experimentation ecosystem can be used to validate concepts and ideas around sustainability, among other things.

The 6G-SANDBOX experimental facility is a set of experimentation platforms located at distributed locations across Athens, Berlin, Malaga, and Oulu, each of which provides the necessary network and compute resources for trial networks. This setup aims to streamline the process of 6G experimentation by providing modular, automated, and easily deployable components and infrastructure.

A methodology was developed as part of the project to ensure that any experiments would be conducted in a calibrated environment. This ensured that the assessment of the technology impact could be isolated from other elements. This is valid for physical measurements as well as virtual measurements.

Running experiments as a way to assess sustainability

To accomplish this, the project defined and realized the concept of Trial Networks, which are fully configurable, manageable, and controllable networks combining virtual, physical, and emulated resources. Trial networks are automatically deployed on the infrastructure based on user configuration. The purpose of trial networks is to enable experiments to validate 6G technologies and measure key performance indicators (KPIs).

A **6G Library** contains software components that facilitate the modular and automatic deployment of Trial Networks. The 6G library follows the philosophy that each element in the library follows the "Everything as a Code" (EaC) approach, designed for easy deployment within the 6G-SANDBOX platform. The components in the 6G library include software and hardware descriptors like Mobile Core, RAN/ORAN options, UE devices, TSN infrastructure, Satellite backhaul, emulators, and traffic generators. These components are accessible through a common API framework for interaction with third-party components and applications. scenarios.

A **Trial Network Life-Cycle Manager (TN-LCM)** manages the deployment and life cycle of trial networks, ensuring they are accessible and

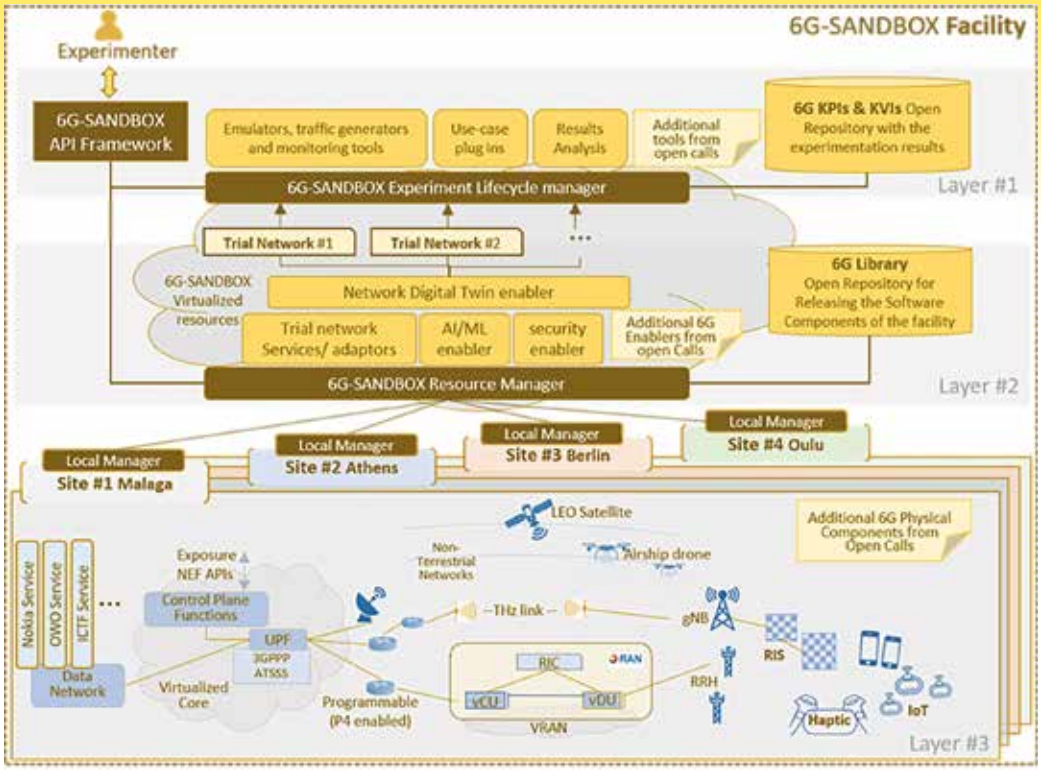

Figure 1 : 6G-SANDBOX Facility Blueprint

operational. The TNLCM orchestrates any actions needed to alter the state of a trial network. A set of predefined requirements and best practices ensures uniformity and seamless integration of components, which comply with tools like Terraform, Ansible, and Jenkins.

The concept of trial networks is realised through a blueprint, which is illustrated in Figure 1 above.

In other words, the trial Network defined by the experimenter which is composed of elements from the 6G Library is deployed by the TLNCM. This connects to the platforms infrastructure which have been highly equipped with measurement capabilities and solutions ranging from physical power measurement (from AC to DC) up to cloud measurements. And thanks to the methodology, the results can be calibrated.

Based on these technologies developed in 6G-SANDBOX, users can design experiments to validate e.g. the impact of fluid migration of cloud services from the central data centre to an edge node. Another example will be to assess the impact of RIC decisions on network optimization. More experimentation where validation of technology with a link to sustainability can be run on 6G-SANDBOX.

Conclusion

6G-SANDBOX will not solve the overall sustainability question. It can however be used to study and validate via proof of concepts technologies that do contribute to the sustainability objectives. We are open for running your experiments, please contact us via our website [3].

Acknowledgment

6G-SANDBOX has received funding from the Smart Networks and Services Joint Undertaking (SNS JU) under the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101096328.

Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission (granting authority). Neither the European Union nor the granting authority can be held responsible for them.

Further reading

[1] N. Alliance, "Evolution of Sustainable Indicatros for Data Centers and Next Generation Core Networks," no. https://nextgalliance.org/white_papers/evolution-of-sustainability-indicators-for-next-generation-radio-network-technologies/.

[2] GSMA, "Going green: measuring the energy efficiency of mobile networks," no. https://data.gsmaintelligence.com/api-web/v2/research-file-download?id=79791160&file=270224-Measuring-energy-efficiency-of-mobile-networks.pdf.

[3] 6G-SANDBOX. [Online]. Available: https://6g-sandbox.eu/experimenting/.

Eurescom's Presence at the EuCNC & 6G Summit 2024

Showcasing Innovation through Collaboration in Telecommunications

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From 3rd -6th June 2024, the 33rd edition of EuCNC & 6G Summit took place in Antwerp, Belgium. The conference addressed various aspects of Beyond 5G/6G communications systems and networks. Bringing together the State-of-the art research and global industries and businesses, attracting more than 1000 delegates from 40 countries, an exhibition with more than 50 exhibitors, were selected Eurescom projects for demonstrating the technology developed in EU R&I programmes.

SNS JU Stand via SNS OPS Project

Eurescom co-hosted the Smart Network and Services Joint Undertaking (SNS JU) stand at EuCNC 2024, through the SNS OPS project. This project serves as a collaborative platform for European and global stakeholders involved in preparing 6G smart networks and services.

At the booth, SNS OPS was joined by its sister project SNS ICE and presented SNS JU's recent achievements and promoted its strategic objectives in 6G development.

By fostering connections with international regions and standardization bodies, SNS ICE aims to ensure Europe's active participation in global 6G standardization and trend-setting. As part of the project's outreach, dedicated workshops and presentations at major events like EuCNC and Techritory will continue to shape the international discourse on 6G and inform SNS JU's community on global developments, keeping Europe's R&I at the forefront of innovation.

Eurescom GmbH Director David Kennedy (right) presenting SNS JU at the SNS OPS stand

SNS JU booth at EuCNC 2024

Team SNS ICE at EuCNC 2024

Non-Terrestrial Networks and Terrestrial Networks unification - from Vision to reality Workshop

The workshop "Non-Terrestrial Networks and Terrestrial Networks Unification – from Vision to Reality" held on June 3, 2024, aimed to advance integration between space-based and terrestrial communication networks, focusing on 5G and 6G technologies. Organized by Adam Kapovits (Eurescom) and Maria Guta (ESA) as part of the EuCNC & 6G Summit, the event explored the potential of recently available space assets for in-orbit experimentation, enabling Proof of Concept (PoC) validations, demonstrations, and standardization efforts.

Key sessions included insights into European research projects and initiatives, such as ESA's 6G precursor mission and Germany's SERANIS mission. Presenters discussed technical architectures, use cases, and enabling technologies for NTN-6G, with contributions from leading SNS JU projects like 5G-STARDUST and 6G-SANDBOX. Additionally, industry leaders and researchers highlighted projects on 3D networks, optical space backbone networks (HydRON), and combined airspace networks, underlining Europe's strong engagement in the NTN/6G domain.

Maria Guta, ESA Senior 5G/6G Satcom Solutions Architect in NTN, presenting the ESA 6G precursor mission

NTN Workshop attendees

Innovative demo for the CENTRIC Project Stand

Eurescom's CENTRIC project, led by project manager Halid Hrasnica, and demonstration set by NVIDIA and Keysight partners stood out as a prime example of innovation in receiver technology. At the CENTRIC demo, the project demonstrated NVIDIA and and Keysight's advanced Neural Receiver concept, designed to optimize receiver structures for specific deployment sites. This technology represents a step forward for multi-user MIMO receivers by utilizing neural networks that can be fine-tuned on-site for enhanced performance.

The CENTRIC demo illustrated how the neural receiver, initially trained on standard stochastic channel models, offers significant improvements over traditional MIMO receivers. When fine-tuned with data from the base station's specific deployment site, its performance outpaces that of a generically trained receiver. The hardware-based validation setup provided attendees with a tangible glimpse into the potential of neural network-based receivers within a real 5G ORAN network.

CENTRIC team at their booth

CENTRIC team with their demonstration

SNS ICE Support to the SNS JU Introduction Workshop

SNS ICE was pleased to back the Smart Networks and Services Joint Undertaking (SNS JU) Steering Board (SB), Technology Board (TB), and Working Groups (WGs) Workshop held during the first day of the EuCNC & 6G Summit 2024. This event spotlighted the collaborative efforts shaping the future of smart networks and services.

Pavlos Fournogerakis, SNS-JU's deputy head of Programme, emphasized the vital role of project collaborative bodies in advancing SNS JU's vision. SB Chairman Mikael Fallgren (Ericsson) and TB Chairman Konstantinos Trichias (6G Smart Networks and Services Industry Association) gave an update on active SNS JU projects, current technologies, and upcoming objectives for the SB and TB.

The Working Group chairs—Ömer Bulakci (Architecture WG), Michael Dieudonne (TMV WG), David Artuñedo (Software WG), and Ioannis Tomkos (Hardware WG)—shared insights into their focus areas and anticipated outcomes for the coming period, contributing to Europe's leadership in 6G innovation. The session was moderated by Eurescom Programme manager Uwe Herzog from the SNS OPS CSA project, fostering in-depth discussions on progress and goals.

Uwe Herzog, SNS OPS CSA project manager, opening the SNS JU workshop

Panel discussion on the Impact of 6G Technology

Participation in the WiTaR Working Group Session

Pooja Mohnani presenting: WiTaR collaboration opportunities with SNS JU projects and working groups

Eurescom project manager Pooja Mohnani took part in the "Women in Telecommunications and Research" (WiTaR) convened session on June 4, 2024. Representing both Eurescom and the SNS ICE project, she engaged with other leaders in a session dedicated to promoting gender equality, inclusion, and empowerment within the 6G Research & Innovation community. WiTaR, an EU-level initiative, is committed to closing gender gaps and empowering more women in R&I fields, reflecting Eurescom's own values of inclusivity and equity in tech.

WiTaR workshop attendees

CHARITY Project Stand

The CHARITY project, a Horizon 2020 project initiative lead by Eurescom and now successfully finished, showcased last advancements in immersive communication through intelligent use of network resources. Running since January 2021 and concluded in June 2024, CHARITY focused on orchestrating cloud, edge, and network resources to support emerging applications requiring both low and high latency environments. The project's open-source framework for intelligent resource orchestration captured significant interest, with visitors recognizing the project's potential to transform network resource management for immersive and interactive communication.

CHARITY team at EuCNC 2024

Joint forces at the CELTIC-NEXT & Xecs booth

Xavier Priem, CELTIC-NEXT's Director, and, Patrice Cogez, Xecs' Technical Director

The goal of the joint booth was to promote the cooperation between the CELTIC's ICT community and the Xecs' microelectronics and systems community. At the booth the EUREKA Clusters CELTIC-NEXT and Xecs presented alternative R&D&I funding schemes to the ICT community focused on 6G technology design and development. The Eureka cluster advocates Xavier Priem, CELTIC-NEXT's Director, and, Patrice Cogez, Xecs' Technical Director, provided insights on the EUREKA Clusters and information about the upcoming calls for proposals of the two clusters and the processes involved.

Conclusion

Eurescom's presence at EuCNC & 6G Summit 2024 underscored its commitment to driving technological innovation, inclusivity, and global collaboration in telecommunications. By showcasing projects like CENTRIC and CHARITY, supporting gender diversity initiatives through WiTaR, and contributing to the strategic efforts of the SNS JU through SNS OPS, Eurescom remains a key player in advancing Europe's leadership in the next generation of network technology.

EuCNC & 6G Summit 2024 offered a vibrant stage for Eurescom to demonstrate its contributions to the evolution of telecommunications and to strengthen connections within the global R&I community, and will continue by taking leading roles in beginning 2025 in two new 6G innovative SNS JU Horizon Europe SUSTAIN-6G and SNS CO-OP (see next article).

Further information

- https://6g-ia.eu/witar/
- http://6g-sandbox.eu/
- https://centric-sns.eu/
- https://charity-project.eu
- https://www.eucnc.eu/programme/workshops/workshop-12/
- https://smart-networks.europa.eu/csa-s/

12th FUSECO Forum 2024

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The FUSECO Forum is a highlight industry event around telecommunications and its applications, taking place every November in Berlin. This year the event took place for the 12th time and was under the overarching theme of "Forward to 6G", despite the fact that the industry is still in the process of deploying 5G capabilities beyond plain enhanced mobile broadband service. Activities, in which Eurescom GmbH is actively involved and partly leading have supported the event.

Anastasius Gavras, Eurescom GmbH, presenting INPACE project sustainability goals

Introduction

As we delve into the evolution of 5G, driven by advancements in Open Campus Networks, 6G RAN, Core Network Evolution, Non-terrestrial Networks, and Data-/AI-based Networking, the FUSECO Forum provided an excellent opportunity for listening to expert opinions and network with interested parties from the industry. The event reflected the lessons learned from global 5G network deployments and research. It also highlighted the growing interest in private industrial campus networks as industries gear up for the 6G era as well as the very fast emerging role of Non-Terrestrial Networks.

Sustainability

In his presentation, Anastasius Gavras from Eurescom GmbH discussed directions towards developing a sustainability framework for 6G technology, addressing environmental, societal, and economic aspects, including its applicability to key vertical sectors. The intersections between sustainability needs, challenges faced by 6G and verticals, as well as the actions required to address these challenges were discussed. Since the relevant sustainability aspects (environmental, societal, economic) cannot be fully addressed in isolation, innovative concepts and solutions are required, which consolidate a holistic view on gaps and trade-offs in technology, processes, and methodologies. Ultimately the industry needs guidelines, best practices, and roadmaps, which are validated through prototypes and proof-of-concepts. In this context.

INPACE workshop

Adam Kapovits from Eurescom GmbH, organised and chaired the workshop on the Digital Partnerships between the EU and the Republic of Korea, Japan, and Singapore, which was part of the INPACE Support Action[i] activities. Mr. Kapovits gave an overview of the INPACE activities in this context, which were followed by examples of collaboration between stakeholders from the aforementioned regions. Among others the collaboration between EU and Japan actors in the context of the SATis5 project funded by the European Space Agency was discussed. Dr. Kentaro Ishizu from NICT, Japan gave an overview of Beyond 5G/6G R&D activities at NICT especially focusing on a vision of Society 5.0 and cyber physical system (CPS). Prof. François Baccelli from INRIA Télécom / ENS (Département d'Informatique), Paris, presented the joint work with South Korean colleagues on Stochastic Geometry as a means to master complexity that results from the high number of new radio access technologies and used frequencies.

3rd Euro NTN Workshop

The workshop was co-organised by Adam Kapovits, together with Markus Breitbach from DT and Marius Corici from Fraunhofer FOKUS, and chaired by Adam Kapovits and Anastasius Gavras, and covered a wide variety of topics related to the integration of terrestrial and non-terrestrial networks (TN and NTN).
The unified 3D mobile network architecture aims to seamlessly integrate terrestrial, aerial, and satellite layers, focusing on IoT, handheld access,

Adam Kapovits, Eurescom GmbH, at the INPACE workshop

and safety-critical operations. Emphasizing the need for native NTN support in 6G, the talks reviewed 3GPP standardization efforts to eliminate mobile network coverage gaps. Ongoing and shortly upcoming experiments with 5G NTN gNodeB in space were presented and discussed, highlighting the seamless integration of terrestrial and space networks. The evolution of NTN within 5G and the need for a jointly optimized infrastructure in 6G for continuous connectivity were also highlighted.

Additionally, the challenges and optimization methods for TN-NTN spectrum sharing to avoid interference and maintain coverage were discussed. The presentation of a 6G satellite lab for real-time testing of technical challenges and new features, including satellite base stations and advanced 6G waveforms, showcased the innovative strides being made. The vision for integrating TN and NTN for 5G-Advanced, focusing on network disaggregation, multi-connectivity, and space edge computing, was also presented. Resource management challenges in integrated 5G/6G networks to maximize capacity and meet user needs, creating a dynamic 3D access network, were discussed. Lastly, approaches to modelling NTN using stochastic geometry, focusing on Low Earth Orbit satellite constellations and spectral efficiency, were presented.

Michael Dieudonne, Keysight Technologies, presenting 6G-SANDBOX latest project results

6G-SANDBOX

At the exhibition space, project 6G-SANDBOX presented and demonstrated the latest project results. Michael Dieudonne, R&D manager at Keysight Technologies Belgium and the project manager of 6G-SANDBOX staffed the booth and gave valuable insights to the visitors.

The project supports technology and research validation processes essential for the development of 6G. It introduces the concept of Trial Networks, which are fully configurable, manageable, and controlled end-to-end networks composed of both digital and physical nodes. The project focuses on defining and releasing its architecture and processes for an experimentation facility, integrating 6G technologies into a physical connectivity infrastructure, and developing a resource management framework to efficiently deploy trial networks. The goal is to create a platform for 6G technology validation and KPI measurements. Eurescom GmbH is a partner in the 6G SANDBOX project.

Conclusion

The FUSECO Forum event held in Berlin on November 7-8, 2024, was a comprehensive and forward-looking gathering that delved into the evolution of 5G and the future of 6G. This event brought together experts from around the world to discuss the latest innovations and lessons learned from global public and private 5G network deployments, as well as 5G evolution research and standardization. Overall, the FUSECO Forum provided valuable insights into the future of telecommunications, emphasizing the importance of collaboration, innovation, and sustainability in shaping the next generation of connectivity.

Further information

- INPACE Support Action
  https://inpacehub.eu/

Recent Highlights from Eurescom's Participation in 2024 Key Events

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Eurescom has recently participated in several high-impact events, underscoring its commitment to advancing next-generation communication technologies, particularly 6G. Through collaborative workshops, panels, and strategic projects, Eurescom has been contributing to the future of telecom, addressing sustainability and system architecture challenges within the industry.

"Open 6G for All" International Panel at Berlin 6G Conference 2024

Panelists from the Berlin 6G Conference 2024

At the 2024 Berlin 6G Conference, Eurescom took part in an international panel titled "Open 6G for All - Towards Open 6G Research Infrastructures and Toolkits (Open6GRIT)." This panel assembled prominent experts in telecommunications and research to discuss strategies for developing open, universally accessible 6G infrastructures that foster global collaboration and innovation. Representatives included leading voices from academia, industry, and key institutions, each contributing unique insights into the journey toward open 6G research and development. The panel featured the following distinguished experts:

- Aki (Akihiro) Nakao from Tokyo University, Japan
- Kostas Chalkiotis from Deutsche Telekom, Germany
- Maria Guta from the European Space Agency (ESA), The Netherlands
- Serge Fdida from Sorbonne Université, France
- Anastasius Gavras from Eurescom GmbH, Germany
- Sparsh Singhal from the NGMN Alliance, Germany
- Abhimanyu Gosain from Northeastern University, USA
- Thomas Magedanz from Fraunhofer FOKUS and Technische Universität Berlin, Germany

Each panelist provided insights into the technical and infrastructural requirements essential to realizing an open, adaptable 6G environment. In his remarks, Anastasius Gavras of Eurescom emphasized the importance of global cooperation and accessible research platforms to propel 6G innovation forward. He highlighted Eurescom's commitment to creating open toolkits and infrastructures that democratize 6G development, enabling wider participation and faster progress across industries.

This session underscored the critical role of international partnerships in 6G's success. The panel advocated for creating collaborative research ecosystems and accessible resources to help overcome current challenges in the field. The discussions reinforced the vision of an inclusive, forward-thinking 6G ecosystem that not only advances technology but also supports sustainable, equitable growth across the telecom industry.

Further information

- https://www.6g-plattform.de/berlin-6g-conference/

Contribution to the GUIDE 5G Corridors Workshop on 5G coverage along transport corridors in Brussels

David Kennedy, Director, Eurescom GmbH opening the GUIDE Workshop in Brussels

On October 16, 2024, Eurescom's Director David Kennedy participated in the third session of the GUIDE Workshop, alongside Pierre-Yves Danet, Senior Consultant at Smart Connectivity. The session focused on best practices and lessons learned from the 5G Corridors projects under Call 1 and Call 2. David Kennedy shared valuable insights into the ongoing work and developments in the 5G Corridors initiative, emphasizing the importance of uninterrupted coverage and seamless end-to-end connectivity.

Key takeaways from the session included the need for robust and stable consortia to effectively navigate the complexities of Connected and Automated Mobility (CAM) deployment and the CEF-Digital processes. The discussion also highlighted the readiness of most projects to share both passive and active network infrastructure, a crucial step in accelerating 5G corridor deployments.

The workshop, organized with the support of HaDEA, DG CNECT, and the 5GMEC4EU project, served as a platform to engage stakeholders in strategic discussions on the 5G Corridor deployment roadmap. It aimed to stimulate public-pri-

vate partnerships and foster a community around 5G-CAM implementation, ensuring continued progress in the deployment of 5G corridors.

Further information

- https://guide.5gcorridors.eu/event/5g-corridors-workshop-16-october-2024/

Sustainability and future viability of European telecommunications infrastructures Workshop at the Digital Gipfel 2024 in Frankfurt

Digital-Gipfel outdoor entrance

On October 22, 2024, David Kennedy, Director at Eurescom and Chair of the Eureka Cluster CELTIC Next, participated in the Digital Gipfel 2024 workshop in Frankfurt on "Sustainability and Future Viability of European Telecommunications Infrastructures." The session brought together experts to discuss Europe's strategy for building sustainable, inclusive telecom networks that leverage satellite technology, non-terrestrial networks (NTN), and advanced 5G/6G standards to meet Europe's connectivity and ecological goals.

The 45-minutes session began with a brief introduction, leading into a fishbowl-style discussion among panelists, including David Kennedy, Dr. Christoph Bach from Ericsson, Prof. Tim Bruysten of Charta digitale Vernetzung, and others. They explored the role of NTNs and satellite systems in complementing traditional networks, aiming to provide continuous, high-quality coverage throughout Europe and close connectivity gaps in remote regions. Panelists emphasized that integrated satellite and terrestrial communications are crucial to achieving "digital connectivity for everyone, always and everywhere."

The session included an open-chair discussion, allowing the audience to engage with the panelists and discuss the sustainability and regulatory needs of this vision. The discussion concluded with a call for actionable steps to support Europe's digital future, highlighting Kennedy's and Eurescom's commitment to collaborate for a resilient, eco-conscious telecom infrastructure across Europe.

Further information

- https://www.de.digital/DIGITAL/Navigation/DE/Service/Digital-Gipfel/Digital-Gipfel.html

NEM Summit 2024: Pillar and Pioneer in the Future of Media and Virtual Worlds

NEM Summit 2024 opening in Brussels

The 15th edition of the NEM Summit "Emerging virtual worlds for a new digital society", held on October 23-24, 2024, in Brussels, brought together leading experts from across Europe to explore the latest trends and challenges in the media and creative industries. Hosted at the VRT Headquarters, this year's summit focused on the rapidly evolving realms of extended reality (XR) and the metaverse, with discussions highlighting innovations, ethical challenges, and the integration of AI technologies.

Featured keynote presentations set the day one on topics such as interactive technologies, the future role of 6G in XR, and the ethical implications of virtual environments. Sessions examined the use of AI in creating immersive experiences, the role of digital twins, and the future of virtual productions. Discussions highlighted the increasing importance of accessibility and inclusivity in these digital landscapes.

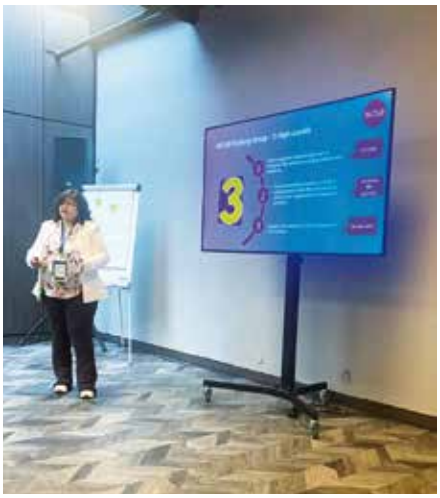
On Day 2, the focus shifted to the immersive web and making virtual worlds more inclusive and accessible. Panels emphasized strategies for enhancing accessibility, creating democratic virtual spaces, and developing adaptive web experiences for XR. The summit concluded with an open dialogue on establishing a European Virtual Worlds Initiative, outlining steps to unify efforts in technology, community building, and strategic planning.

The NEM Summit has grown since its inception in 2008 into a premier event for collaboration and innovation in media and technology. With this year's recordings available online, the discussions promise to inspire future advancements in Europe's virtual worlds ecosystem.

Further information

- https://www.de.digital/DIGITAL/Navigation/DE/Service/Digital-Gipfel/Digital-Gipfel.html
  https://nem-initiative.org/nem-summit-2024/

Eurescom Joins WiTaR, Riga TechGirls and SNS ICE at 5G Techritory to Lead "Shifting the Balance" Discussion in Riga, Latvia



Pooja Mohnani, Project Manager, Eurescom GmbH presenting WiTaR at the 5G Techritory 2024

On October 30, 2024, WiTaR, in collaboration with SNS ICE and Riga TechGirls, led an impactful discussion on gender diversity and sustainability in the telecom industry at the 5G Techritory event. The session, titled "Shifting the balance: Advancing diversity in Telecoms R&D," brought together industry and academic leaders to explore how gender balance can shape the future of 6G and drive innovation.

The event began with opening remarks on creating inclusive tech spaces, where representatives from WiTaR and Riga TechGirls stressed the importance of welcoming environments for women and under-represented groups in telecom. A key part of the event was an interactive Bar Camp, where attendees shared insights and challenges related to strengthening gender diversity in telecom R&D.

Focus areas included the need for continuous digital skills development to equip a diverse workforce for 6G, the role of sustainability in 6G networks, and the importance of diverse perspectives in cybersecurity. The discussion also covered how diversity enhances the accessibility of 6G use cases, underlining the necessity for ongoing improvements in gender equality in telecom.

Agnese Bļodniece, Riga Techgirls

The event was a great success, thanks to the contributions of speakers and attendees, including Pooja Mohnani (Eurescom), Prachi Sachdeva (TNO), Rolands Bīrons (Tet.lv), Maria Giuffrida (Trust-IT Services), Anna Olovna (Tet.lv), and others, who are collectively working to build a more diverse and sustainable telecom future.

Further information

- https://6g-ia.eu/witar/

Conclusion

These events demonstrate Eurescom's proactive role in shaping the future of telecommunications, especially through collaborative international engagements. The focus on open research infrastructures, sustainability, and cutting-edge system architecture reflects Eurescom's strategic vision to drive advancements in 6G technology while fostering global partnerships and supporting sustainable innovation across the telecom ecosystem.

Eurescom is taking a leading role in 6G innovation with the launch of the new SNS JU SUSTAIN-6G and SNS CO-OP projects.

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Eurescom leads the Horizon Europe project SNS CO-OP, which is selected to support and enhance the Smart Networks and Services initiative by coordinating the strategic activities that capture and promote the European industry's vision for 6G.

Through the lighthouse project SUSTAIN-6G, led by Nokia, Eurescom collaborates with a consortium of leading innovators and industrialists to develop a strategy for a sustainable future for ICT and the communications infrastructure at large. This includes developing technologies that prioritize environmental, economic, and societal sustainability for all future services.

Eurescom, a leading European provider of management and support services in the high-tech area, marks the launch of two pivotal collaborative research projects in January 2025. Under the umbrella of Smart Networks and Services Joint Undertaking (SNS JU), these projects aim to solidify and improve European leadership in 6G technology, fostering a sustainable, inclusive, and innovation-driven network ecosystem that supports the EU's long-term ambitions for universal next-generation technologies.

SNS CO-OP: SNS COLLABORATIVE OPERATIONS AND OUTPUT OPTIMISATION

SNS CO-OP is dedicated to coordinating strategic activities and aligning industry efforts across the currently, 78 projects of the SNS JU. In order to advance European initiatives in smart communications networks and next-generation technology, SNS CO-OP will amplify the achievements of SNS projects, highlight Europe's leadership in 6G, by building on the successes of the previous support activities in the SNS OPS and SNS ICE projects. SNS CO-OP will ensure that the impact of the SNS JU continues to evolve and expand by supporting future phases of 6G development across the EU and beyond.

The SNS CO-OP consortium, is composed of 22 key partners,and will be led Uwe Herzog, Programme Manager, Eurescom. This project will ensure a seamless transition of the SNS support activities for the next two years. The carefully structured work plan of SNS CO-OP is designed to support and assist delivering the global impact of the key 6G developments as envisioned in the SNS work programme. It will establish and maintain a dialogue in the wider European 6G SNS community to consolidate the European Industry view on 6G and to promote the European vision around the world.

SUSTAIN-6G: SUSTainability-Advanced and Innovative Networking with 6G

SUSTAIN-6G aims to ensure that future 6G networks contribute to sustainable growth across key sectors. This unique approach will examine sustainability impacts across the full life-cycle of 6G technology, and apply the developed insights across multiple vertical sectors. By identifying key intersections between sustainability needs and the capabilities of 6G, the project will clarify the ways in which 6G can be used to responsibly drive economic and societal benefits.

SUSTAIN-6G's mission is clear: to make sustainability integral to the design, deployment, and operation of 6G networks. SUSTAIN-6G will help shape a more sustainable, resilient, and inclusive digital future.

Together, SNS CO-OP and SUSTAIN-6G represent a significant part of the unified European SNS Initiative to advance 6G networks that are highly performant but also resilient and responsible. While SNS CO-OP will foster collaboration and strategic alignment across the large and diverse 6G SNS community, SUSTAIN-6G will bring a focused approach to sustainable technology development, considering both the immediate and long-term impacts of 6G technology on society, the environment, and the economy.

Further information

- https://smart-networks.europa.eu/eu-invests-more-than-500-million-eur-to-boost-6g-research-and-innovation/
- https://www.eurescom.eu/

How Eurescom is Paving the Way for Digital Partnerships via the Indo-Pacific collaboration: INPACE

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INPACE team after the first day of symposium workshops

INPACE symposium closing picture on Digital Technologies and policies in Seoul

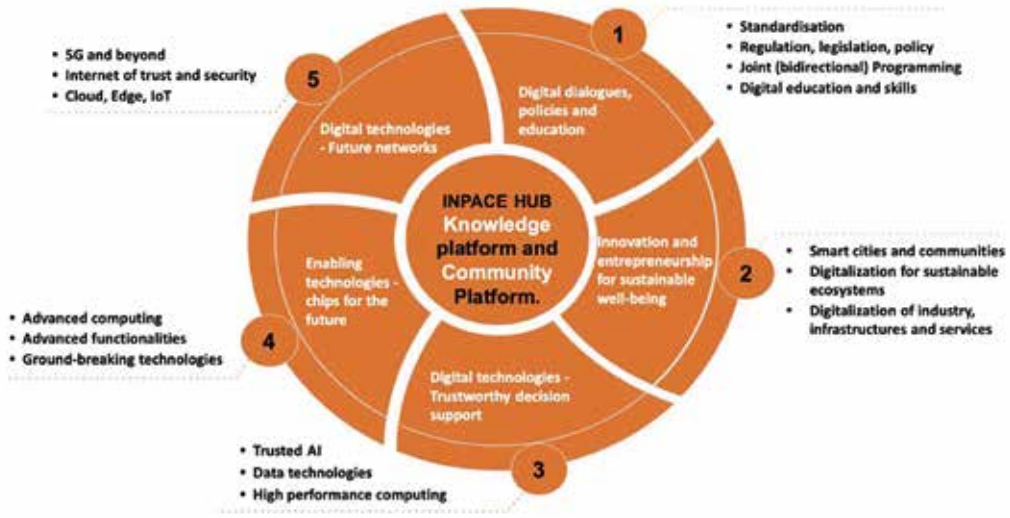
As the digital transformation of global economies accelerates, fostering international cooperation in digital technology has become essential. To support this vision, the EU-funded INPACE project was launched in January 2024. INPACE plays an important role in supporting the implementation and advancement of the Digital Partnerships established between the European Union and key Indo-Pacific countries, including Japan, the Republic of Korea, and Singapore, and through the Trade and Technology Council with India.

What is INPACE about?

The **INPACE** project, short for Indo-Pacific-European Hub for Digital Partnerships: Trusted Digital Technologies for Sustainable Well-Being, is a Coordination and Support Action designed to foster digital cooperation across the EU and the Indo-Pacific region. Running until June 2027, the project unites 21 European and Asian partners, creating a hub to support collaborative research, policy development, and industry connections. INPACE's mission is to enhance digital technology partnerships and advance cooperation in strategic areas that benefit both regions. The digital partnerships cover an extremely wide range of technologies, notably through the collaboration in 16 Thematic Working Groups (TWGs) organised under 5 clusters (see Figure below).

The Context Behind INPACE: Strengthening EU-Asia Digital Cooperation

The European Union has made strides in building robust partnerships with Asia in digital technology fields. Guided by the EU's *Digital Compass Strategy and Strategy for Cooperation in the Indo-Pacific,* **Digital Partnerships** were established with Japan and South Korea in 2022, and Singapore in 2023. Additionally, the EU initiated the *Trade and Technology Council* (TTC) with India to foster collaboration on technology and trade. These partnerships underscore a shared commitment to digital growth and emphasize the EU's strategy to enhance cooperation on emerging digital technologies and develop policies for sustainable growth and resilience.



INPACE hub working thematic and communities figure

Objectives of INPACE

INPACE aims to turn these high-level partnerships into impactful projects by:

1. **Supporting Digital Partnerships:** Facilitating the EU's Digital Partnerships and the TTC with India, translating these into tangible outcomes.
2. **Boosting International Collaboration:** Encouraging digital cooperation between Europe and Asia by connecting leading researchers, industry leaders, and policymakers.
3. **Enhancing Research and Innovation Collaboration:** Promoting joint research and industrial collaboration to drive technological advances and commercialization.
4. **Fostering Policy Convergence:** Supporting international digital policies to enhance synergies, inform policymaking, and facilitate international dialogue.
5. **Promoting Human-Centered Technologies:** Developing digital technologies that prioritize human-centric values for inclusivity, sustainability, and security.

The INPACE Symposium: Building Bridges in Digital Technology and Policy

The first INPACE Symposium on Digital Technologies and Policies took place on October 21-22, 2024, at the Daeyang AI Center, Sejong University, in Seoul, Republic of Korea. This two-day event brought together experts, policymakers, and industry leaders from Europe and the Indo-Pacific region to discuss key developments and policies in digital technology. Major topics included:

- **Trusted AI:** Leveraging the power of AI responsibly, with an emphasis on ethics and reliability.
- **Semiconductor Innovation:** Highlighting the latest advances in chip technology essential for digital infrastructures.
- **Future Networks:** Analyzing the progress in next-generation connectivity and communication.
- **Cybersecurity:** Addressing strategies to protect digital networks and data privacy.

Eurescom's Dual Role at the INPACE Symposium

Eurescom plays a pivotal role at the INPACE Symposium with two significant contributions in the Technical Thematic Sessions and Workshops on October 21, 2024:

- The first session on **"5G/6G technologies"** was moderated by Eurescom's Project Manager Adam Kapovits. Joined by speakers professor Rui Aguiar, professor Hyonwoo Lee, and professor Sunwoo Kim, the session examined the current challenges in 6G development and with a focus on how Europe and the Republic of Korea can collaboratively address these issues, it surveyed the Republic of Korea and European 6G development strategies and research programmes. The technical discussion offered valuable insights into the future of connectivity and the various approaches and highlighted the potential for collaboration in next-generation networks development.

- The second session, titled **"EU Funding Opportunities"** explored the new avenues for collaboration following the upcoming association of Republic of Korea with Horizon Europe. Moderated by Dr. Svetlana Klessova (GAC) and Adam Kapovits (Eurescom), the session outlined various funding opportunities within Horizon Europe, paying particular attention to Pillar II, which addresses global challenges and European industrial competitiveness. Dr. Klessova presented examples of Horizon Europe's opportunities, while Mr. Kapovits discussed the Eureka programme, highlighting the CELTIC-NEXT initiative in which Korea is actively engaged.
  A Q&A session followed, providing participants an opportunity to connect directly with the INPACE consortium and explore collaborative funding options in more detail.

Looking Ahead: The Future Impact of INPACE

INPACE will continue to work and align the strategies to further the goals of the Digital Partnerships and the Trade and Technology Council (TTC), fostering deeper cross-continental cooperation, advancing research and technology development, and supporting policy alignment.

In the coming months, INPACE has an exciting line-up of activities, including a series of webinars and a one-day workshop on 6G to be held at the University of Tokyo during **EU-Japan Digital Week** from 31st March 2025 to 4th April 2025. The second major symposium of INPACE is planned for the Autumn of 2025 in Singapore, building on the momentum of collaboration and innovation across regions.

This continued partnership will not only drive technological advancement but also contribute to a sustainable, inclusive, and prosperous digital future for Europe and the Indo-Pacific. The community is encouraged to stay tuned for these impactful events and initiatives that will further elevate digital cooperation and 6G innovation.

Further information

- https://inpacehub.eu/rok-symposium-october-2024/
- https://inpacehub.eu/2024/06/11/partner-interviews-eurescom/
- https://smart-networks.europa.eu/

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Innovation through Collaboration

Eurescom is the leading organisation for managing collaborative R&D in telecommunications. Our mission is to provide efficient management and support of R&D projects, programmes, and initiatives for our customers. We offer more than two decades of experience in managing large-scale, international R&D for major industry players, the European Commission, and EUREKA Cluster CELTIC-NEXT. What distinguishes Eurescom is the combination of a secure, reliable infrastructure for collaborative work, a large European network of experts, and internationally outstanding project management skills.

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