Winter 2021

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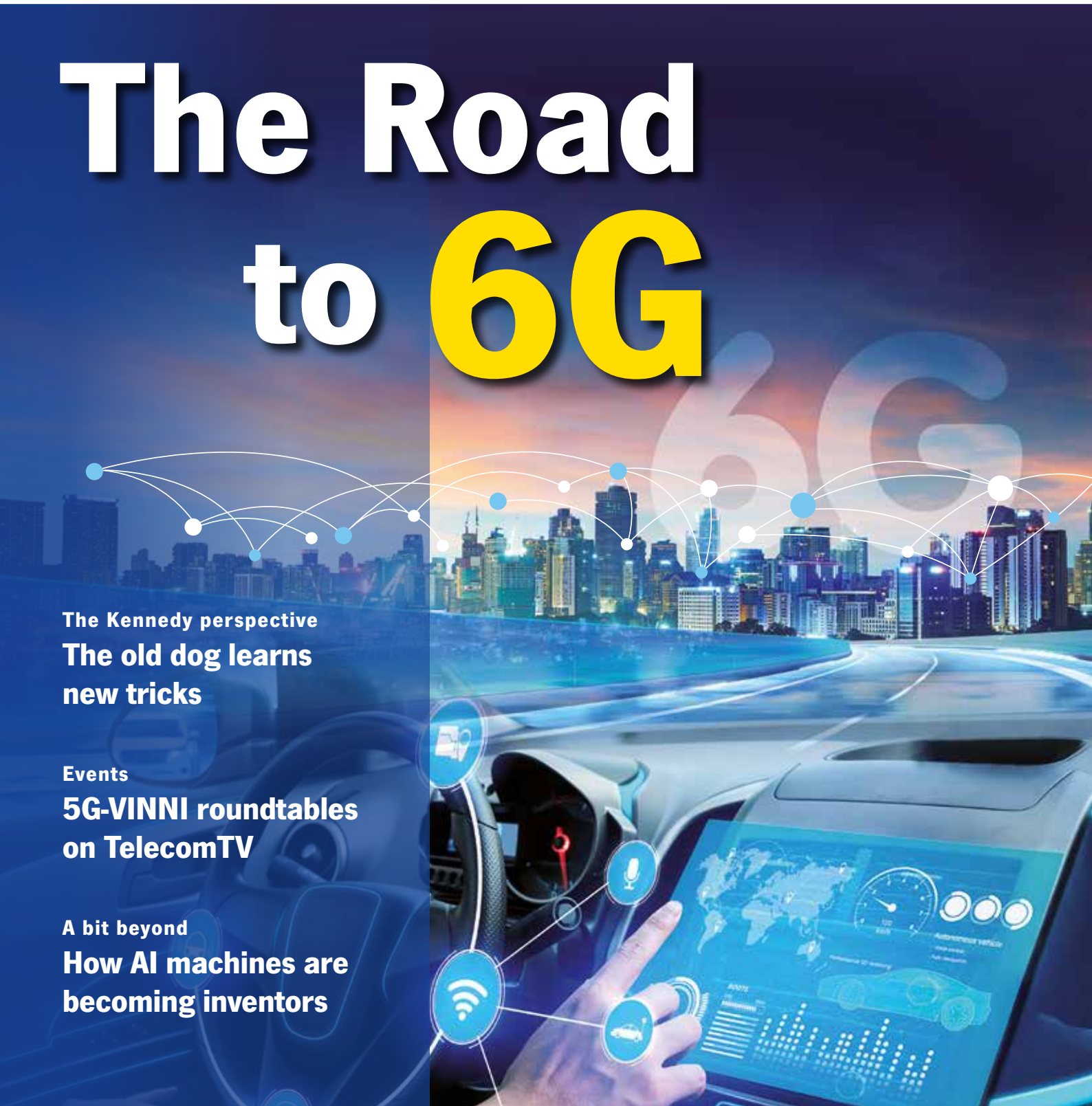
The Road to 6G



The Kennedy perspective
The old dog learns new tricks

Events
5G-VINNI roundtables on TelecomTV

A bit beyond
How AI machines are becoming inventors

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

Contact

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Xavier Priem
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Website: www.celticnext.eu

Dear readers,

While 5G networks are still being deployed, work on 6G, the sixth generation of mobile communication technologies, has already begun. Will 6G just be an evolutionary update of 5G? Or will it achieve a new innovation level in connecting people, robots and things? Researchers all over the world have started to explore these and more questions along the road towards 6G.

In this issue of Eurescom message, we provide a glimpse on what is done in Europe to move towards 6G. We present selected research and innovation projects that are already working on different technological aspects that may later become parts of the 6G standard.

In the first article of the cover theme, Eurescom message editor Uwe Herzog gives an overview on activities and concepts currently being explored on the road to 6G. The next article by the Head of Nokia Standards, Peter Merz, presents the EU flagship project on 6G, Hexa-X. Peter Merz is also the interview partner in our exclusive cover theme interview, which follows an article by Eurescom message editor Anastasius Gavras on global initiatives towards 6G. In the next article, an author team from the ARIADNE project share their insights on Reconfigurable Intelligent Surfaces for 6G. In the final article of the cover theme, Yue Zhang from the University of Leicester presents the technological vision of the 6G BRAINS project.

This edition of Eurescom message also includes a variety of further articles on different, ICT-related topics. See, for example, the new opinion article by Eurescom director David Kennedy on the challenges of personally dealing with ubiquitous data collection in his column "The Kennedy Perspective". Under "Events", we report about two interesting virtual events – the IEEE International Symposium on Broadband Multimedia Systems and Broadcasting and the roundtables of the 5G-VINNI project on TelecomTV. See also our "News in brief" section, which features the latest release of the 5G PPP white paper on 5G architecture and the new ENISA threat landscape report. Finally, in the latest "A bit beyond" article you can learn about AI machines becoming inventors.

One comment on our own behalf: the print edition of this issue of Eurescom message is printed on recycled paper certified by the Forest Stewardship Council (FSC). This reflects our commitment to the sustainable use of natural resources.

My editorial colleagues and I hope you will find value in this edition of Eurescom message, and we would appreciate your comments on the current issue as well as suggestions for future issues. Enjoy reading our magazine.

Milon Gupta
Editor-in-chief

Cover image: © Adobe Stock

EVENTS CALENDAR

7 – 11 December 2021
IEEE Global Communications Conference (GLOBECOM 2021)
Madrid, Spain
https://globecom2021.ieee-globecom.org

8 – 11 January 2022
IEEE Consumer Communications & Networking Conference (CCNC 2022)
Virtual Conference
https://ccnc2022.ieee-ccnc.org

28 February – 3 March 2022
MWC Barcelona 2022
Barcelona, Spain
https://www.mwcbarcelona.com

7 – 10 March 2022
25th Conference on Innovation in Clouds, Internet and Networks (ICIN 2022)
Paris, France (Hybrid Conference)
https://www.icin-conference.org

6 – 10 June 2022
2022 EuCNC & 6G Summit
Grenoble, France
https://www.eucnc.eu

SNAPSHOT

CHARITY project meeting in Heidelberg

The CHARITY project meeting in Heidelberg, Germany on 14-15 October 2021 was the first in-person project meeting organised by Eurescom since the Corona pandemic spread across Europe more than 1.5 years earlier. It was also the first in-person encounter of the CHARITY partners, 9 months after the project had started. The photo shows Antonis Protopsaltis from ORamaVR demonstrating CHARITY's virtual-reality based medical training use case.

Further information
Further information about the CHARITY project is available at *https://charity-project.eu*

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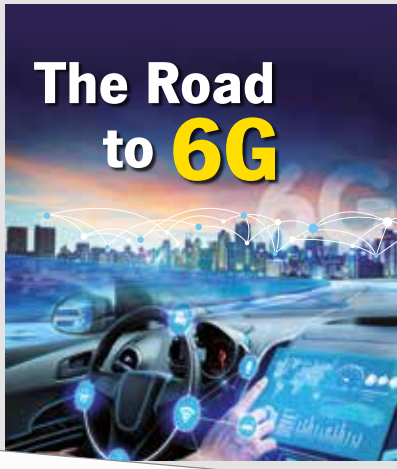

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The old dog learns new tricks

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There is a common saying that "you can't teach an old dog new tricks", based on the idea that many people are unable or unwilling to do things differently, if they have been doing them one way for a long time.

Big Brother is watching you

As I get older, I find it easier to have an overview perspective of many of the changes proposed to us and can see them in the context of the impact they will have on our lives. I know I am resisting being fully integrated by refusing to have a smart watch to monitor me as I talk, move and even sleep. However, I recognised that these capabilities are interesting – even desirable – for others.

As I think about it, the question is not black and white – it is more complex in terms of trying to understand, where it is of benefit to me to share data and where is it an invasion of my privacy. For example, I have noticed that there is a direct correlation between the auctions I look at on eBay and the ads that get offered to me on Facebook. Clearly these guys are sharing information. But is this so bad? I was looking for something specific on eBay, and if this is available through Facebook, this is actually helping me find what I want.

However, I can't tell these systems when I have actually bought something. This means they keep offering me ads for something I have already paid for, which is only going to annoy me – particularly if they offer it for a cheaper price than I paid.

You can also distort your profile by making a purchase for others. I am not sure how my online profile changed after I bought a leg waxing kit for my wife, but I did notice a significant difference in the ads I was offered after that. The level of this profiling is such that when you load a web page, there can actually be an online auction of the ad space on the page to product advertisers, based on your profile, within the time it takes you to load the page.

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Fight or flight

Having learned that systems are profiling me regardless of the permissions I gave, the question is if you can counteract this or even if you want to. I have to admit, I am not totally anti such targeting, but I have limits. I do not allow Siri to be active on my phone, because she will listen all the time to see if I need her help. I have been very annoyed to find occasionally in conversation with someone that she was active and listening from their smart watch or phone and actually tried to join in the conversation. This is too intrusive.

However, if I was alone in the house, maybe recovering from illness or injury, I probably would really appreciate being able to shout at a box to do jobs or contact people for me. Again, it comes down to context and trust. I am obviously prepared to allow some intrusion for a visible benefit. The real problem is that it is very difficult to feel you are in control and can make the right choices to choose this.

Cookies are not always sweet

The recent laws on data protection and the use of cookies to capture the permissions has not helped as much as I would like. First many web pages make it very difficult to have a clear idea about their policies as they ask first a general question where you either give full permission or open a long set of specific questions. The nasty trick is that if you reject all cookies, they use this as the basis for not holding that decision, so the next time you visit their page, you are forced to go through the whole charade again. In this way you get frustrated and you eventually accept all cookies to avoid being asked again.

What to do

As a confirmed old dog, I think I do have to learn new tricks to survive in this new world. I could make my life simpler by relaxing and just saying "yes to all" when asked, but I know this will increase the noise level in my life. What I want to do is customise the world to my comfortable level of sharing info, but to do this I somehow have to know enough about how systems work and where I am leaving traces and sharing elements of my profile.

Of course, if I had my personal version of Siri, Alexa or whoever that was clearly mine and not public, "she" could manage this for me. Maybe this is the answer, old dogs need personal avatars to learn the new tricks for them.

The road to 6G

An overview

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5G networks are currently being deployed around the globe. Commercial marketing towards consumers mainly emphasizes unprecedented bitrates, and vertical industries look into the potential that 5G could offer to their type of business. While there is more in 5G than that, and even though more will still be included with the 5G enhancements that are currently being standardised with 3GPP Release 17, thinking about what to address in a further generation of mobile communications has started in many regions of the world.

When I talk to people that are not in IT and I mention that I am in mobile telecommunications research, I often see them surprised: to them everything seems to be there, and maybe most noticeable to consumers are the improvements in handsets that are pushed into the market at short intervals. They do not see the huge innovation and investments that are needed in the mobile networks behind the handsets. The question of what will be in 6G as yet another generation is not answered yet. It needs careful consideration given the huge efforts and investment that can be expected from its introduction.

What 6G will add to 5G

Thinking about what 6G will be, I remember a presentation by a well-known colleague from TU Dresden, I think it was at EuCNC 2019 in Valencia, where he said – probably with a wink of the eye – that 6G will be there to fix the issues in 5G. While there is certainly some truth in that, further innovations will be part of 6G. Many initiatives have been launched in Europe, the US, China, Japan and other regions, marking the start of a 6G vision phase.

Several white papers were already published that look into promising technological advances and innovations that are potential candidates for adoption in 6G. Which of these will finally make it into the standard is difficult to forecast, but one can certainly expect that with 6G we will see the usual increments, e.g. in bitrates and latency. Given the trend to machine-centric communications, 6G will also need to be able to handle a much larger number of communication endpoints, i.e. humans and things, and to process the increasing amount of data, in absolute terms but also per area. Various technologies can contribute to that, but further expanding mm-wave technology and exploiting it, which is happening only slowly in 5G at the moment, might be an essential element to that end. From the network design view, efforts will continue to make 6G more dynamic and flexible, and, e.g., cloudification and disaggregation are ingredients for that. In addition, open APIs – think, e.g., of Open RAN – will likely play a role. A technology that is expected to receive much attention for 6G is Artificial Intelligence (AI). With further improvements of the technology, an increasing amount of available data and improved training methods, AI chipsets, and more, it could become a commodity that it is currently not yet, and can enable improvements in many aspects and elements of a 6G network, e.g., to make network management and operation more efficient and more secure.

Cost and energy consumption

A strong and overarching design principle for 6G could be to keep cost under control and to reduce energy consumption. Cost has been a recurring aspect in particular for telecom operators in a low-margin business environment, and lower cost is also important for services to be affordable for end users. Energy consumption and the ecological footprint in general have received increasing attention over the past years in which ICT has however continued to increase its share in the global carbon emissions. In view of the ongoing global warming discussions and the increasing sense of urgency that can be witnessed very strongly here in Europe and elsewhere, this topic might still get a relevance for telecom network operations that is not expected today.

Security

One theme that I see at risk of not receiving proper attention is network and service security. The theft of 50 million user data at T-Mobile US, which got known in August 2021, has underlined once more how critical it is to have proper security measures in place. The increasing number of hacking attacks that can be observed make it clear that this is not a problem that will soon fade away. Implementing proper security has a cost, but like an insurance, it does not have an immediately visible benefit nor can it create corresponding additional revenue.

From a pure cost aspect, one might argue that it is cheaper to fix an issue rather than implementing the required security mechanisms, but the potential damage might go beyond lost revenue. Possibly, strict requirements on trust and security from vertical sector users can cause a shift here. However, it will also remain a challenge for security research to come up with innovative solutions that are cost-efficient yet effective, offering a high degree of automation in line with ETSI Zero Touch Management or through the use of AI / Machine Learning technologies, that enable a low threshold for the introduction and operation of security solutions.

Hexa-X and the values of 6G

The European Union's flagship project on 6G

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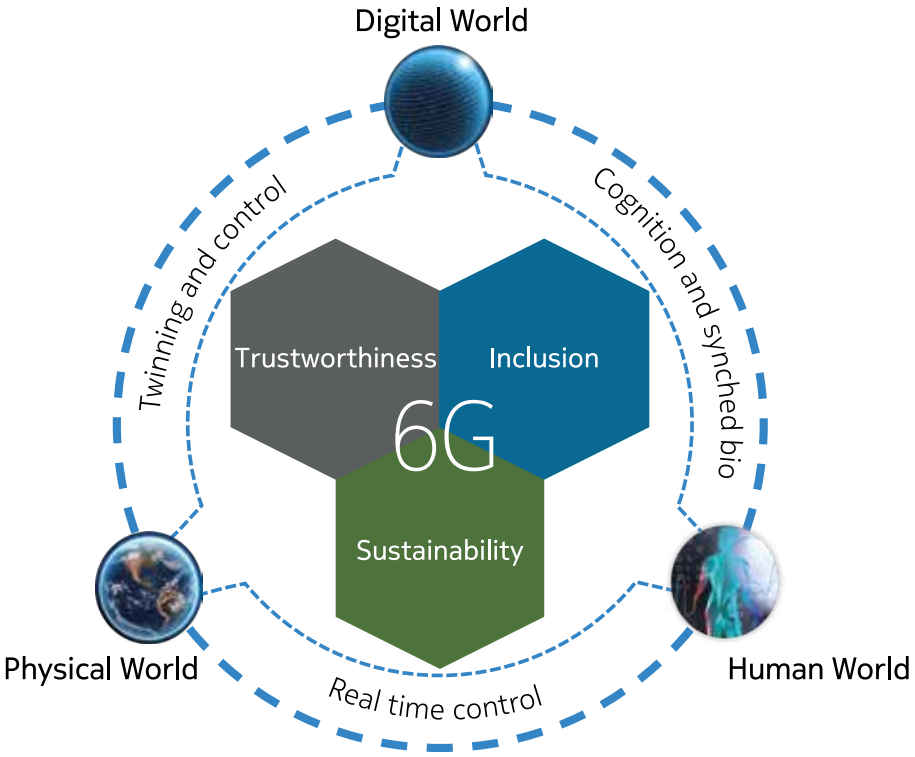
The world is just at the beginning of the 5G era, and yet researchers are already diving into the sixth generation of mobile communication technologies. The Hexa-X consortium is leading the European 6G effort with a diverse group of researchers, representing a broad cross-section of the industry and academia.

The project is being led by Nokia working closely with a strong consortium of European partners. They are preparing the foundation for future projects to come from the next big European initiative, Smart Network Services from the 5G Infrastructure Association (5G IA), while working with teams in other regions to create one 6G global standard for the world. A bit more than half a year into the two-and-a-half-year project, they have already delivered their vision, use cases and initial technical analysis for mobile networks in the 2030s.

The Hexa-X 6G vision

Hexa-X takes its name from the Greek for the number 6, with X representing the many, as-yet-unnamed capabilities of the 6G standard that may emerge. The project is part of the European Union's Horizon 2020 research and innovation program, intended to boost the technical leadership of the EU and ensure that the new standard represents the goals and values of the European community. Building an ecosystem of businesses, academia and other organizations and key talent around the new standard will ensure that Europe takes long-term leadership on both fronts.

In their vision document published earlier this year, the consortium envisions 6G as a key societal platform for building efficient and sustainable ways of living, ensuring trust, security and privacy and creating economic prosperity and growth. With climate change high on their list of priorities, the consortium is especially interested in improving the energy efficiency of networks. Since 6G will play a crucial role in improving the efficiency of other systems important to the re-



6G three worlds wheel

engineering of our carbon-based infrastructures, it must be engineered for minimal impact as well.

Consortium partners are also focused on digital inclusion, arguing that by 2030 connectivity will likely be regarded as a basic human right. They believe that the network, if designed properly, can contribute to greater trust, if built on principals of security, privacy, availability, resilience and compliance with ethical frameworks.

Trust is especially important, as 6G will be at the heart of the new age of automation and artificial intelligence. For people to accept the growing role of machines in our lives, much will have to be done to communicate the values promoted by 6G, as well as ensuring the privacy of data handling, network intelligence and the trustworthiness of AI.

Smart networks and services

In parallel, Hexa-X is also working with the 5G IA as it prepares for a broader effort to launch, in about a year's time, the Smart Networks and Services (SNS). The SNS European Partnership aims to secure European leadership for the development and deployment of next-generation mobile networks. It is focused on 5G evolution and 6G. The 5G IA recently published a paper that outlines its European vision for the 6G network ecosystem. Hexa-X made a central contribution with other current EU research to the paper.

Continuing the themes of 5G, SNS sees 6G as continuing to provide a platform for connecting even more things, humans, robots and every kind of autonomous vehicle. But it also recognizes the key role the network will play in the evolution of society, as the digital, physical and human worlds increasingly converge. They also recognize the importance of the European Green Deal and the drive to achieve climate neutrality by 2050.

The importance of a global standard

Although a European initiative, the Hexa-X consortium is clear on the importance of arriving at a global consensus on the 6G standard. It will strive for openness and collaboration among the European and global research community, standardization bodies and policy makers.

Competition with regional initiatives is healthy for driving the development of the best possible technologies. However, the days of diverging mobile standards should be behind us. The consor-

tium recognizes that we now live in a global economy with global supply chains, and the integration of our operational systems demands global standards. Achieving economies of scale is crucial for the success of today's business models. Going it alone with a European-only approach would be self-defeating in the long run.

European research projects have been at the forefront of research for many generations of mobile networks. This strong experience and track record in collaborative research will be an advantage in achieving 6G leadership. And by presenting the values informing their vision for 6G, they hope to bring the rest of the world to a clearer understanding of both the performance- and value-oriented aspects of the technology and how it can play a key role in building a more sustainable, trusting and inclusive world.

Further information
Hexa-X project website – *https://hexa-x.eu*

AI-driven ubiquitous networks for massive machine connections

The 6G BRAINS project vision

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Ubiquitous smart wireless connectivity is critical for future large-scale industrial tasks, services, assets and devices. Very significantly improved connectivity needs to be unlocked through novel spectrum combinations and the fully autonomous management of the underlying network resources by applying online Artificial Intelligence (AI) at multiple decision layers. Therefore, it is required to bring AI-driven Deep Reinforcement learning (DRL) to perform MAC/PHY resource allocation and configuration over the high dynamic ultra-dense D2D cell free (CF) network with new spectrum links including THz and optical wireless communications (OWC) to enhance the performance with regard to capacity, reliability and latency for next generation ubiquitous networks.

The 6G BRAINS project proposes a novel comprehensive cross-layer DRL driven resource allocation solution to support the massive connections over Device-to-Device (D2D) assisted highly dynamic cell-free network enabled by Sub-6 GHz/mmWave/THz/OWC and high-resolution 3D Simultaneous Localization and Mapping (SLAM) of up to 1 mm accuracy. The enabling technologies in 6G BRAINS focus on four major aspects, including disruptive new spectral links, highly dynamic D2D cell-free network modelling, intelligent end-to-end network architecture integrating the multi-agent DRL scheme and AI-enhanced high-resolution 3D SLAM data fusion. The proposed solution will be validated by proof-of-concept trials. The primary and secondary applications of THz and OWC technologies for a very broad spectrum of scenarios will be validated at BOSCH's self-contained smart factory.

Figure 1: 6G BRAINS Concept Vision (images: Robert Bosch GmbH)

Enabling technologies

The enabling technologies in 6G BRAINS focus on four technological areas:

- Enhanced new spectrum links: OWC and THz
- AI-driven D2D cell free network architecture for highly dynamic and ultra-dense connectivity
- AI-based end-to-end directional network slicing with guaranteed QoS over highly dynamic networks
- AI-driven data fusion for 3D indoor position mapping through heterogeneous location methods enabling 1 mm location position accuracy and 1° orientation accuracy.

Factory of the future

The factory of the future represents one of the most challenging applications of the future mobile communication systems. A large number of specific use cases representing this scenario have been described in different bodies, including 3GPP and 5G-ACIA (5G Alliance for Connected Industries and Automation). From the large list of specific use cases in the factory of the future environment, 6G BRAINS identified two use cases which require further improvement of the current 5G technology.

The first use case represents the offloading of the control logic from the industrial controller running as part of a production cell on the shop floor to a more centralized computing area called "factory edge" in a virtualized form as a virtual machine or a container. A more centralized approach, where all controllers (real or virtualized) are placed in the same area will significantly increase the flexibility of the production process and reduce the cost. Connecting the production

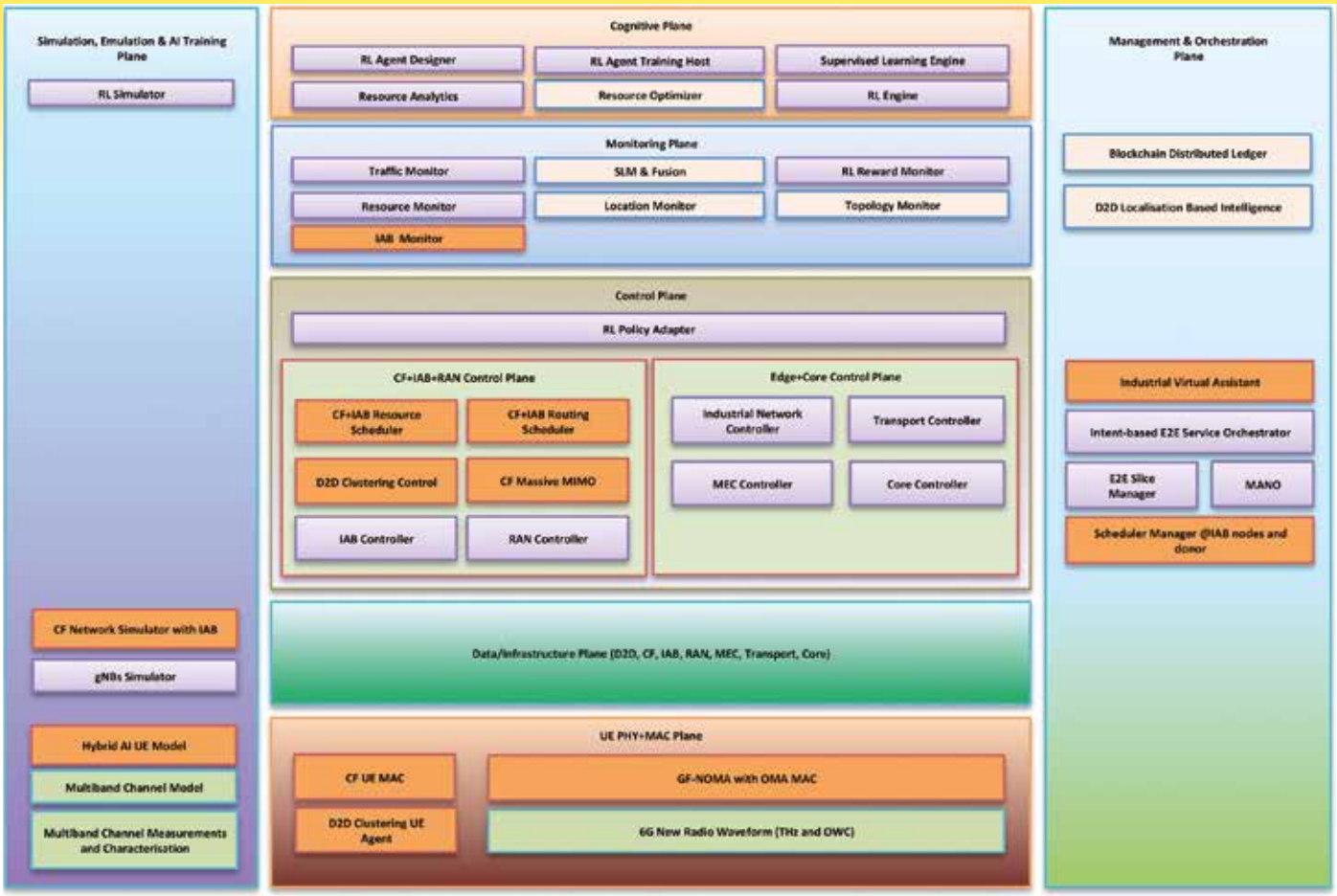

Figure 2: 6G BRAINS overall logical architecture

cells through the 6G BRAINS communication system to the "factory edge" shall enable the ease of reconfiguration of hardware and software components on demand. This use case sets very high expectations on the guaranteed latency and deterministic communication that should support low industrial application cycle times and very precise synchronicity.

Another use case is represented by wireless video cameras that are easily deployed in every factory production cell at different locations to send high-quality and high-frame-rate video to an image-analysing system located at the "factory edge". By this, a new level of production monitoring is unleashed enabling a long list of new features, such as anomaly detection, improved safety, process tracking and logging, remote control, and predictive maintenance. This use case has high requirements on the data rate, consuming up to 3 Gbps per camera in case of state-of-the-art industrial camera systems.

Finally, the combination of these two use cases represents a very challenging approach for a system that is required to provide a precise QoS differentiation by, e.g., creating individual slices for each of the required services. The 6G BRAINS concept vision is illustrated in Figure 1.

Overall logical architecture

Figure 2 presents the detailed reference logical architecture of 6G BRAINS. It highlights that the AI loops can take place at the global level or at each local level. The overall architecture includes monitoring plane, cognitive plane, control plane, management and orchestration plane, data plane, simulation/emulation/AI training plane and PHY/MAC plane of the user equipment (UE).

The monitoring plane interacts with the other planes (data plane, control plane, etc.) to collect and monitor functional and performance parameters, including KPIs. Based on the inputs from the monitoring plane, the cognitive plane analyses the system and makes decisions to offer intelligent operational strategies such as optimising resource allocation and deployment inputs to the relevant RL-driven modules such as RAN slicing and CF scheduling, maintaining the normal operation of the system in the case of faults/failures, and improving the performance in the case of suboptimal operations.

The cognitive plane outputs its intelligent decisions to other planes for actions to be applied. The control plane is called on demand, to enforce real-time actions decided by the cognitive plane via the RL policy adapter. The management and orchestration plane provides the management interface for other planes, especially the control plane and the data plane. The data (infrastructure) plane comprises the various end-to-end network segments including RAN and other wireless networks, such as CF, D2D and IAB (Integrated Access and Backhaul). The simulation/emulation/AI training plane is introduced to incorporate 6G BRAINS components that are essential for the R&D targets but are mainly required for offline or design phases, rather than online and operational phases. The UE PHY/MAC plane accommodates the functional blocks for the UE physical and MAC aspects focusing on a simulation approach.

Outlook

The technologies developed in 6G BRAINS will be widely applicable to various vertical sectors such as Industry 4.0, intelligent transportation, eHealth, and more. In particular, new business opportunities emerging in 6G BRAINS will be identified for follow-up exploitation activities. The results of 6G BRAINS are expected to create a solid basis for future projects and global standardisation for beyond 5G and 6G technologies in areas relevant to industrial environments.

Further information
6G BRAINS project website – *https://6g-brains.eu*

Global initiatives towards 6G

A review of the current status

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Not much is defined yet around 6G. It is hard to draw the line between 5G and 6G, and the nomenclature of 3GPP defining 5G enhancements and 5G advanced capabilities from Release 17 to Release 20 does not help in clarifying the borders between the generations either. Resolving this requires a consensus about the societal, market and operational needs that the 6th generation mobile network should meet and that clearly go beyond what 5G can deliver today or will deliver in the next few years.

In this context, it is worthwhile analysing the plethora of 6G white papers that have been published. The motivation for these white papers is driven by research interest, company expectations, or long-term government plans aiming to establish a long-term roadmap. However, it is very difficult at this stage to conclude on a single unified landscape of needs, requirements and expectations. In addition, several funding agencies around the world have started to fund projects and initiatives on 6G.

White papers

One of the first 6G white papers that received global attention was published in 2019 by the University of Oulu in Finland. The initiative evolved into the 6G Flagship, which is today facilitating the work of 12 expert groups on selected 6G topics with the goal of consolidating opinions and publishing them in a series of 6G white papers. According to the 6G Flagship, more than 250 experts from 100 organisations in over 30 countries contributed to the 6G Flagship white papers.

Ericsson outlines in its white papers a combination of technology push, expectations pull and new emerging use cases. Nokia defines the technological areas that will require significant advances to meet 6G requirements. Samsung provides an initial set of key performance indicators and how they compare to 5G. Many telecommunication operators like Deutsche Telekom, BT, Vodafone, Orange, China Mobile, NTT Docomo and others have published their own visions of 6G or channelled their opinions through alliances and collaborations like the NGMN Alliance (Next Generation Mobile Networks Alliance). The common denominator is that they put the technology evolution in the context of resolving societal issues.

Emerging commonalities in the use cases can be seen for the areas of extreme reality, holographic applications, precision sensing and actuation, human machine interfaces, and digital replicas of physical world artefacts.

Programmes and initiatives

In general, I observe that many formulated visions are positioning 6G as a tool that must address the societal needs and the sustainable development goals (SDGs) formulated by the United Nations. The 5G PPP project Hexa-X is one of the main efforts to develop so-called key value indicators (KVIs), derived from the SDGs, and finally to translate these into concrete technical requirements and performance indicators for designing the 6th generation mobile network. The same path has been established by the 6G Drivers and Visions white paper published by the NGMN Alliance, which sets the basic framework for the formulation of 6G use cases and is work in progress.

The latest batch of 5G PPP projects started in the beginning of 2021 in the scope of beyond 5G. These projects address a variety of technology topics ranging from new waveforms, channel propagation models for THz frequencies, accurate positioning, energy efficiency, extreme reliability, extreme bandwidth transport, in-network computing for artificial intelligence and machine learning, and many others.

The Horizon Europe programme puts the work on 6G under the heading Smart Networks and Services (SNS), which is planned to be launched shortly with the establishment of the SNS Joint Undertaking. The targeted public research and innovation investment is 900 million euro over the budget period 2021-2027. The German government has launched a large 6G programme with an estimated budget in excess of 600 million euro in the period 2021-2025. An initial portion of estimated 200 million euro has already been granted to several large projects called 6G hubs with the ambition of creating the basis for an innovation ecosystem for future communication technologies around 6G.

International activities

Other world regions have published their own 6G visions and partly have launched similarly ambitious programmes. Japan's NICT has released white papers on beyond 5G/6G and quantum networks. Reported plans for China state ambitions for commercialisation of 6G technologies by 2030. In the U.S., the alliance for telecommunications industry solutions (ATIS), a telecom standards body, launched the Next G Alliance in 2020 to advance North American leadership in 6G. South Korea's Ministry of Science and ICT established a 6G research and development implementation plan that calls for investing around 200 million dollars by 2025. Finally, the European Space Agency has started a study for a space-based infrastructure, which, albeit carrying 5G in its name, has a long-term ambition to embrace emerging 6G concepts.

Outlook

The list of existing initiatives, white papers, programmes and plans is much longer, and many more initiatives are underway. Global convergence on visions, requirements and roadmaps has already started in alliances and forums that will propagate in the next few years into the main standards body, namely 3GPP. We should expect exciting developments on all fronts and from all regions. Of particular importance to Europe is, whether the efforts become instrumental to meet high-level policy objectives, such as those formulated in the context of the Green New Deal, the UN Sustainable Development Goals, and the European technological sovereignty discussion.

Further information

- 6G Flagship – *https://www.oulu.fi/6gflagship/*
- Hexa-X project – *https://hexa-x.eu/*
- NGMN Alliance – *https://www.ngmn.org/*
- 5G PPP Smart connectivity beyond 5G projects – *https://5g-ppp.eu/5g-ppp-phase-3-6-projects/*
- 5G-IS 5G system infrastructure study – *https://artes.esa.int/projects/5gis*

Commercial 6G launch expected by 2030

Interview with Peter Merz from Nokia

While 5G is still being rolled out, preparations for 6G are gaining speed. That raises questions about the path towards 6G, and why we need 6G in the first place. Eurescom message editor-in-chief Milon Gupta asked Peter Merz, Head of Nokia Standards, about it. Mr. Merz is responsible for Nokia Standards including related standards research activities in areas like radio/RAN, core, network management and automation as well as network security.

Why do we need 6G?

Peter Merz: Wireless technologies are of critical relevance for our society and economy today; their importance for economic growth, wealth and sustainability will continue to steadily increase with 5G and its evolution, enabling new ecosystems and services motivated by growing traffic and trillions of devices.

Human intelligence will be augmented in the world of 2030 by being tightly coupled and seamlessly intertwined with the network and digital technologies. This will call for a shift in the way communication networks are designed. While 5G enables us to consume digital media anywhere, anytime, future technology should enable us to embed ourselves in entire virtual or digital worlds.

What are the benefits of 6G compared to 5G-Advanced?

Peter Merz: 5G-Advanced will further develop 5G to its fullest capabilities over the coming decade.

Peter Merz

Improvements in uplink capacity and handling of mobility will be combined with the inherent high data rate and low latency capabilities of 5G to create a fully immersive user experience while on the move. It will also bring innovations for improved coverage, resilient timing services that will facilitate diverse new services, enhanced low-cost massive IoT, and further support for non-terrestrial networks (NTN) and drones.

6G will go even further, calling for a change in the way communication networks are designed. Multiple key requirements must be reconciled: serve the massively growing traffic and the exploding numbers of devices and markets, while also accomplishing the highest possible standards regarding energy efficiency, strong security, and efficiency in coverage and operation, for enabling sustainable growth in a trustworthy way.

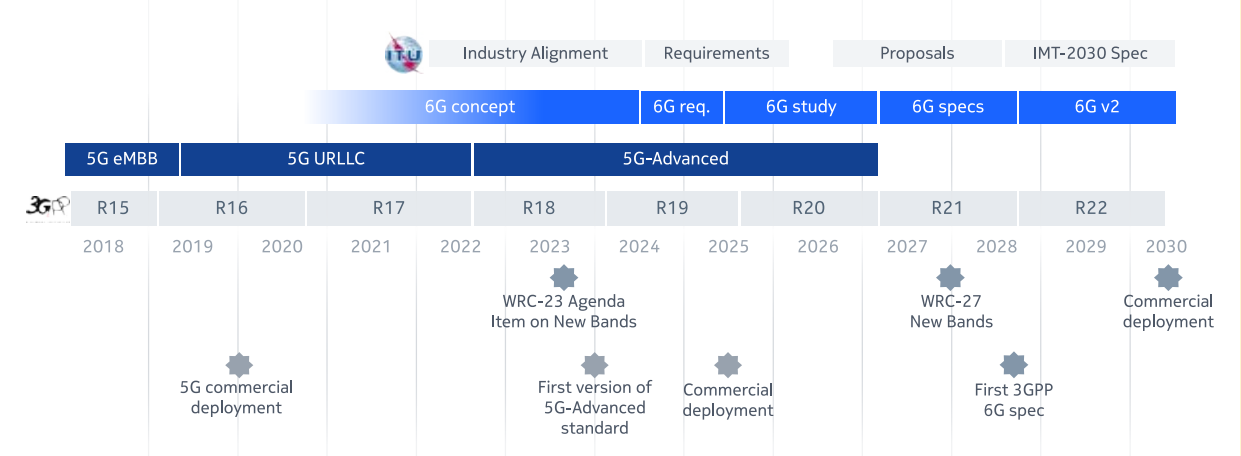
European R&D on 6G started in 2020. Where do we stand now?

Peter Merz: In general, countries and regions around the world make investments in all areas of technology and innovation. In January 2021, the European Commission 6G flagship research project Hexa-X, which is being led by Nokia, was officially kicked off. Being a 2.5-year project within the EU's Horizon 2020 ICT-52 program, Hexa-X displays European leadership in 6G, and European research projects have been at the forefront of research for many generations of mobile networks. This strong experience and track record in collaborative research will be an advantage in achieving European 6G leadership.

Horizon Europe will make 900 million euro in funding available for 6G by the end of the year. This is complemented by dedicated substantial 6G funding programs in Germany, France and Finland.

How will 6G change the ICT landscape and vertical industry sectors?

Peter Merz: 5G is the first system designed to make inroads into the industrial environment, and the transformation to Industry 4.0 featuring the first wave of wireless-enabled automation will already have happened well before 2030. 5G networks providing ultra-reliable low-latency communications (URLLC) will have facilitated real-time processing in the cloud. However, special industrial use cases relying on much more extreme requirements for wireless communication will require 6G to augment 5G.



3GPP timeline of 5G to 6G releases

CELTIC-NEXT
Eureka Cluster

CELTIC News 2/2021

The newsletter of EUREKA Cluster CELTIC-NEXT

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CELTIC-NEXT
∑eureka Cluster

Join the Industry-Driven Research Programme for a Smart Connected World

CELTIC-NEXT Call for Project Proposals – Deadline: 14th of April 2022

Do not miss the opportunity to participate in CELTIC-NEXT, the industry-driven European ICT and telecommunications research programme under the umbrella of Eureka. Submission deadline for the next call for project proposals is 14th of April 2022.

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 proposal is not bound by any call texts, as long as it is within the ICT/ telecommunications area.
- 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 May 2022.

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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What living in interesting times means for CELTIC-NEXT

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In common folklore it is often unclear, if the wish "may you live in interesting times" is intended as a curse or a blessing. Either way, it can mean that you experience a lot of change and you need to remain active and responsive to the changes to ensure that you progress positively. Well, for the CELTIC-NEXT community the recent times have been very interesting with lots of changes impacting every aspect of our domain.

CELTIC-NEXT in the new post-Covid world

One interesting aspect of the way we all restructured our lives and work in the "lockdown" period is that we have rapidly learned to do many things remotely. This creates a very significant shift from travelling and meeting to using communications to stay in contact via webinars and videoconferencing. In fact, we have learned that many meetings are no longer necessary, if the participants have reliable communications of sufficient capacities. The issue here is that we have proved the concept for remote working – even if we were forced into it without any preparation – to the extent where it is unlikely that we will ever justify the amount of travel and meetings we had in 2019 going forward.

The impact of this on business processes is that the integration of high-speed high-capacity communications infrastructures into both the production and use of many advanced products is now assured and the communications technologies must deliver.

A good example will be the advanced traffic management on the roads and the introduction of autonomous cars. In this context all road users need to be equally informed about changing circumstances on the road and, more specifically, any safety risks. And once you start supplying this information, the supply must be continuous and reliable and economical. Despite the increasing requirement for pervasive communications, we are also under pressure to ensure the sustainability of communications by lowering the power consumption of all elements of the network.

In summary, the new outlook for the ICT domain is that we have to provide incredible speed and reliability for the connections for low cost with a very low environmental profile. Clearly there are many challenges in this.

CELTIC-NEXT and the New Eureka Clusters Programme

In the past two years the CELTIC-NEXT Cluster has worked with the other Eureka Clusters to help evolve the Eureka Clusters Programme (ECP). The idea is to revitalise the instrument, as an effective and efficient international research collaboration tool and to stimulate more involvement and investments.

The approach was to consider the processes and see where the programme could be more responsive to the ever-changing set of research and innovation requirements and priorities facing industrial and national interests. A key result is the introduction of joint calls operated collectively by the relevant Clusters while presenting a consistent and seamless interface to the project proposers and the national authorities. To demonstrate the new flexibility of the Clusters, the first joint call – the AI call 2020 – was launched and run successfully. The lessons learned included greater collaboration between Clusters and more analysis of the delays and interactions in the project decisions as the Clusters combined resources. The next step in this development we hope to see now is a reduction in the overall time to decision for Eureka projects and that this experience can also be used to improve the throughput of the regular Cluster "bottom-up" calls.

The new flexibility has increased the operational costs for the Clusters, but it is anticipated that it should stimulate more national investment in the new joint topics which will increase the overall volume of the programme. This increase in research project volume should compensate for the increased costs to keep the ECP instrument efficient and practical. We in CELTIC-NEXT have heavily invested in the new structure and we are now looking forward to see how the programme volumes evolve.

Conclusion

From the CELTIC-NEXT perspective we remain committed to embracing the changes and using them to help us better serve our community. The origin of the CELTIC community was the need to bring the digital communications benefits to the world. This has evolved to the point where the vertical communities are now informed and active regarding the benefits advanced communications can bring to their domains that they are now becoming drivers of the changes in the communications infrastructures and services too.

We do live in interesting times, and CELTIC-NEXT remains committed to helping all parts of industry and society to embrace and benefit from advanced communications.

How Portugal supports CELTIC-NEXT projects

The Portuguese National Innovation Agency

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ANI – Agência Nacional de Inovação, SA, is the National Innovation Agency of Portugal. It is owned in equal shares by IAPMEI – the Portuguese Agency for Competitiveness and Innovation under the Ministry of the Economy and Digital Transition – and FCT – the Portuguese Foundation for Science and Technology under the Ministry of Science, Technology and Higher Education. ANI supports technological and business innovation in Portugal, contributing to the consolidation of the national innovation system and to strengthening the competitiveness of the national economy in global markets.

In 2020, Portugal reached a 1,6% R&D share of national GDP, an all-time high. 57% of R&D funding comes from companies' investments. There are around 4,300 R&D-performing companies investing an average of 420,000 euro per year to develop new technologies.

Portugal's innovation strategy

Along this path, an ambitious national strategy for technological and entrepreneurial innovation for the period 2018-2030 has been defined. It includes main targets such as achieving a global investment in R&D of 3% of GDP by 2030, with a relative share of two thirds coming from private expenditure, as well as becoming a European leader in digital skills by 2030. From 2021 to 2027, Portugal aims to double the Portuguese participation in European Union funding programmes, and to attract around 2 billion euros for R&I, as well as tripling the number of students in mobility in higher education, compared to 2014-2020.

ANI has a central role in the Portuguese innovation ecosystem and contributes to the achievement of the major national innovation goals. The Agency manages financial and fiscal incentives programmes to promote private investment in R&D and to foster collaborative R&D between companies and R&D institutions for an effective transfer of knowledge to the market. ANI also promotes the internationalisation of Portuguese innovative companies and R&D institutions through supporting their participation in the Horizon Europe R&DI Framework Programme as well as other international networks for R&D cooperation and business internationalisation such as the Enterprise Europe Network and the Eureka Network.

Portugal has now for the third time since becoming one of the 18 founding member states of the Eureka Network in 1985 taken over the Chairmanship of Eureka from July 2021 until June 2022. ANI is part of the Chairmanship Team, hosting the National Eureka office.

FACTS about Portuguese participation in CELTIC- NEXT projects

The EUREKA Clusters prove to be an excellent channel for the internationalisation of Portuguese companies, academia, RTOs and research centres enabling them to access to global value chains, to new knowledge and to partner with numerous countries. In fact, the opportunity offered by the Eureka Network and the Clusters projects to collaborate beyond Europe on a truly global stage is one of the major benefits identified by companies.

CELTIC-NEXT is the Eureka Cluster with the largest Portuguese participation. This is related to the fact that the technological area with the largest Portuguese participation in EUREKA projects is electronics, IT and telecoms technology (62 %).

Between 2008-2020, 31 CELTIC projects with Portuguese participation were funded. Since 2017, with the introduction of a grant-based funding instrument relying on European Structural and Investment Funds (ESIF) to support Eureka and Eurostars projects, the funding of Eureka Clusters projects has become more agile and stable in Portugal. This has raised interest and created renewed dynamics among stakeholders to apply and participate.

Under the new instrument "Projetos de I&D Industrial à Escala Europeia", 11 new CELTIC projects were recently funded, reflecting a total investment from the Portuguese entities involved of 7 million euro and corresponding to approximately 4.5 million euro of public funding.

The Portuguese entities most represented in CELTIC-NEXT projects include companies such as UBIWHERE Lda, CELFINET - CONSULTORIA EM TELECOMUNICAÇÕES, S.A., Proef Eurico Ferreira S.A., GLINTT Healthcare Solutions S.A., Wavecom – Soluções Radio S.A., and renowned research centres like Instituto de Telecomunicações, Instituto Superior de Engenharia do Porto (ISEP), or Instituto Politécnico de Castelo Branco.

CELTIC-NEXT projects with Portuguese participation focus on several ICT areas such as energy efficiency and quality of service/experience in mobile telecommunications networks, smart operations optimization and performance monitoring in mobile telecommunications networks, healthcare, smart cities, and internet of the future. Their main partner countries are Spain, France, Finland, Sweden, Turkey, Canada, Korea, and Israel.

As an added-value of participating in CELTIC-NEXT projects, Portuguese entities report an overall increase in competitiveness levels through the possibility to access new markets, to improve their positioning in global value chains, an increase in exports, improvement in R&DI capacities and gain of new expertise through the possibility to employ highly qualified human resources and lastly, the enlargement of the company's product portfolio and cross-selling of solutions.

› Further information

ANI website – https://www.ani.pt/en

ANI headquarters in Porto

Eureka – A major tool to promote research and innovation

Interview with Eureka chairman Miguel Bello Mora

On 1st July, Portugal took over the Eureka chairmanship for one year – already for the third time in the 35-year history of Eureka. The motto of the Portuguese Chairmanship is "Innovation for a greener, digital and healthier planet through a collaborative approach". CELTIC News editor Milon Gupta asked Eureka chairman Miguel Bello Mora, CEO of the Atlantic International Research Centre in Portugal, about priorities and progress of Eureka after the first quarter of the Portuguese Eureka term.

What are the main priorities of the Portuguese Eureka chairmanship?

Miguel Bello Mora: We have five main priorities for the Portuguese Eureka chairmanship: First, to increase the global outreach of the Eureka Network by promoting collaboration with international organizations with an important innovation component, like the European Space Agency, and via the organization of a series of international events.

Second, to enhance new forms of cooperation for effective RDI programmes by strengthening the relation with the European Union within the new Horizon Europe framework programme for research, development, and innovation.

Third, strengthening the Eureka Network's positioning by reinforcing the mechanisms for the generation of projects, contributing to the revitalization of the Eureka Clusters Programme.

Fourth, adding value to the Eureka label, with the organisation of Eureka's Global Innovation Summit 2022 and the Eureka Ministerial Meeting in Portugal in June 2022.

And fifth, to continue the necessary restructuring of the Eureka Secretariat and pursue a healthy financial model for the Eureka Secretariat.

Which role do you see for the Eureka Clusters Programme in the context of the Portuguese priorities?

Miguel Bello Mora: The Portuguese chairmanship is contributing to the revitalization of the Eureka Clusters Programme by implementing the new governance model, ensuring greater compromise from public authorities on the funding of projects, intensifying the participation of industrial key players at the board of Clusters' governance structures and promoting collaboration and cross-fertilisation between Clusters through the organisation of joint calls.

A joint thematic call is promoted with a topic focused on Space-Ocean-Earth Observation Systems and Space related technologies which would include the promotion of projects linked with the Green Deal in areas like Earth Observation from Space and its combination with Artificial Intelligence.

How would you describe the progress of Eureka in the first months of the Portuguese chairmanship?

Miguel Bello Mora: During the first months of the Eureka Portuguese chairmanship some of the strategic priorities have been implemented, like the collaboration with the European Space Agency, where a Memorandum of Understanding is in preparation, and the first of the international events on "Eureka meets the Atlantic through Space-Ocean-Earth collaborative innovations". In addition, the final proposal for the Eurostars 3 programme, one of the flagship projects of Eureka, has been completed in August.

What is your vision for Eureka and its programmes beyond the Portuguese chairmanship?

Miguel Bello Mora: Our vision beyond the Portuguese Chairmanship is to have Eureka as a major tool to promote research and innovation, strengthening the bottom-up, open and flexible nature of the network by building on the work done by the previous Chairmanships while following the strategic priorities of the recently approved Eureka Strategic Roadmap for 2021-2027.

Eureka shall promote the dynamism of the economy and European innovation through the recovery period from the crisis associated with the COVID-19 pandemic and should stimulate new opportunities for the development of new products and services in global markets, as well as new international collaborations towards citizens wellbeing and healthy living.

CyberWi

Cyber-security in the Wireless Industrial use case

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While the fusion of cloud, mobile and wireless technologies is one of the biggest business enablers, it is also seen as a major cyber-security challenge. The lack of security technologies that function across such different infrastructures hinders the adoption of these technologies on the global market, thus limiting the growth potential in this sector.

The three-year CELTIC project CyberWi (2016-2018) created results on security solutions integrating seamlessly over different infrastructures, like Cloud Computing, IoT networks and Embedded Systems, and showed a way towards deployment of commercially viable secure systems that can be implemented in Industrial Internet applications.

CyberWi was a joint undertaking by 13 partners from 3 European countries: Luxembourg, Finland and Sweden.

Approach

In order to ensure that the obtained results work in a production environment, demonstrators and test beds were implemented and publicly presented.

The use cases covered the following topics:

- Building automation, to protect the operation of different sensors and actuators deployed in a building
- Home automation, to protect heterogeneous consumer devices functioning as part of an automated home
- Logistics, to protect the information collected when tracking transports and goods
- Industrial systems, to secure a supervisory control and data acquisition (SCADA) system on an oil platform
- Traffic applications, to ensure the safe operation of a traffic signal pre-emption system for emergency services
- Weather services, to ensure road weather station operation as a service hotspot for multiple vehicles

In addition, the development of the OSCORE IETF standard opened the door to progress other lightweight security enablers in areas such as authorization and access control, group communication and authentication. The development of security standards has raised industry interest and led to new collaborations.

Achieved results

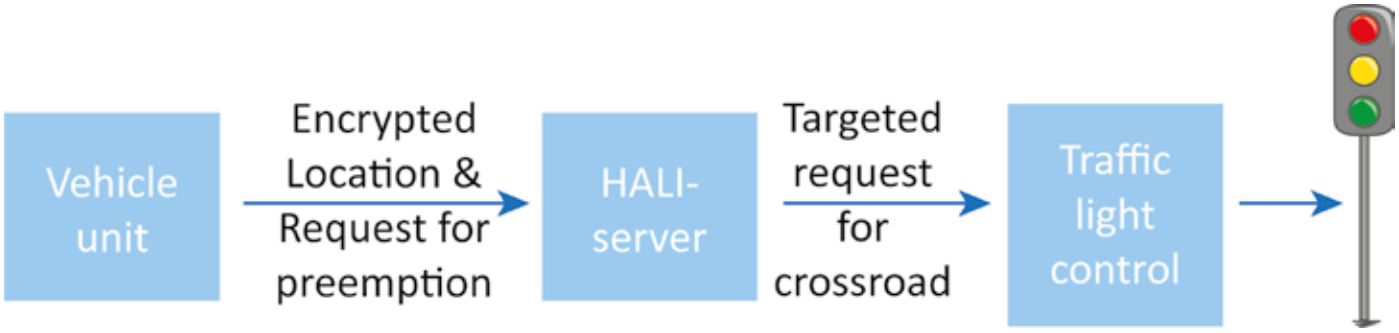
CyberWi developed new architectures and standards to improve the security in the above-mentioned use cases. The results have a high commercial impact.

These are some examples:

- The SME Applio (former Q2d Solutions) is now in a go-to-market position with a new software product family developed based on CyberWI results. There are several different commercial IoT solutions about to be implemented. A free and simple IoT service called “Applio Free” has been launched and is in use.
- Road Weather Station – By developing open interfaces the project has conducted road weather stations communication measurements and improved the cybersecurity of wireless connections between the road weather station and the server.
- Hali 2.0 – Traffic Light pre-emption system for emergency vehicles helps municipalities, fire/police departments and hospitals to reach their target faster and safer. Hali is implemented in several Finnish towns with over 700 users.

Further results in standardization and research:

- IETF standards (OSCORE and ACE) for object security and access control in constrained environments (e.g. sensor networks). These standards are integrated into several products. RISE has gained a foothold in the international standardization community at IETF and plans to exploit this in future research projects.
- Open source reference implementations of our proposed standards contributed to commercial open-source libraries implementing the OMA Lightweight M2M standard,
- CyberWi led to the implementation of the Cyber Security Laboratory named SecuLab at the Finnish research institute CENTRIA. SecuLab examines, tests and develops the security of industrial Internet and wireless systems. SecuLab provides tools for system security testing and expertise in information security management to SMEs of the region. It provides expert consulting, whether the company needs an assessment of the information security situation or support for solutions that can be used in company operations.



Hali 2.0 overview

Conclusion

The CyberWi project successfully contributed to different R&D topics in the cybersecurity area. A main result is the establishment of a security standard for IoT devices (OSCORE), which is the basis for new additional standards (e.g. Group OSCORE etc). The results of CyberWi are part of several commercial applications and laid the foundation of new services and products.

› Further information

CyberWI project on CELTIC-NEXT website – https://www.celticnext.eu/project-cyberwi/

An exciting year of transition and renewal for CELTIC-NEXT

New ambitions and new roadmap

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CELTIC-NEXT has been through several changes this year: a new Director, updated vision, mission and roadmap, and last but not least, the active role in the new Eureka Clusters Programme (ECP). Our Spring Call has been very successful, with six projects labelled and now in the funding phase, and we are curious to see the proposals from our Autumn Call, which closed on 22nd November. We are very active in preparing the future with a new Flagship series programme and closing partnerships with other funding bodies.

An enriched DNA for future growth

When I became the new CELTIC Director at the end of March this year, I discovered, from the inside, CELTIC's strong DNA, built over its 18 years of successful fostering of the ICT RDI community across Eureka countries. It has been around nine months since then – one could say, the time of a pregnancy. It has been an interesting experience, because, in a way, we have further enriched CELTIC's DNA over the last months in various manners.

First, we did this by following the long-established tradition of labelling new projects from the last bottom-up Spring Call; here I personally wish to all projects to be successful in being awarded with their national fundings.

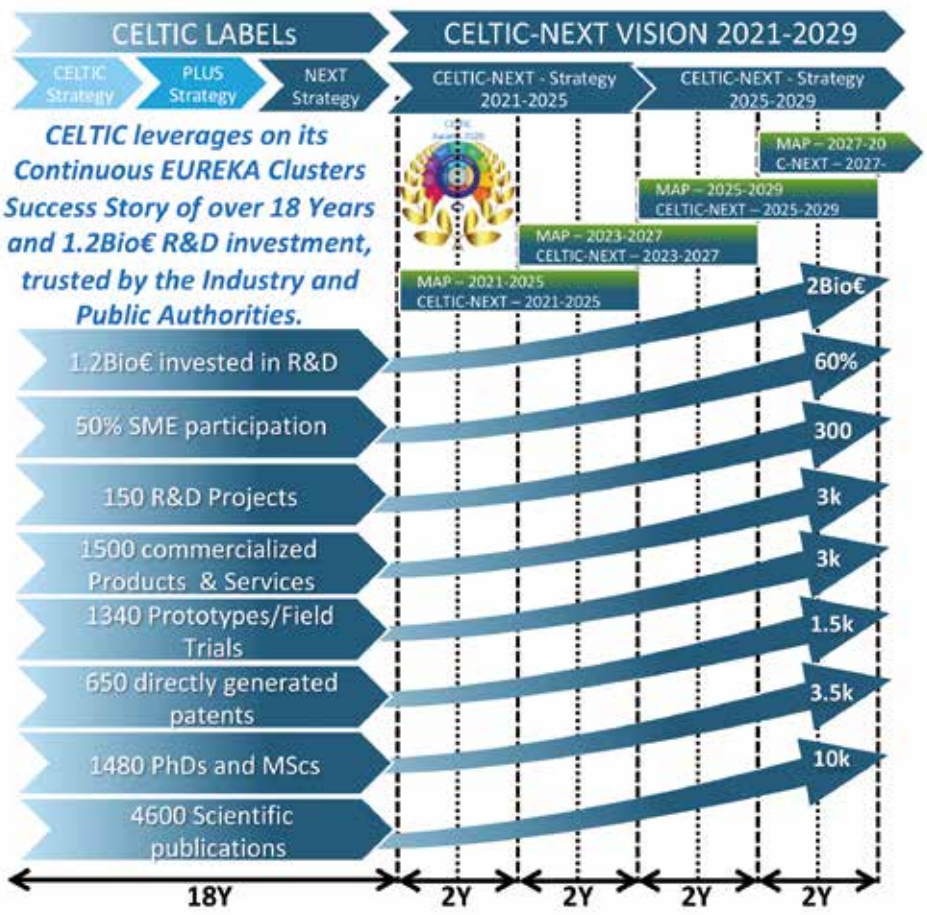
Secondly, we did this via the joint work and exchanges we had with our other Eureka Clusters friends in the context of the ECP Multi-Annual-Plan preparation and successful approval, on 17th June 2021, by Eureka and its funding Public Authorities. We will use the opportunity of the ECP MAP to address wider industrial communities and bring in additional funding countries to our ICT community. The ECP MAP application gave us also the additional opportunity to revisit the vision, mission and roadmap, last elaborated in 2018, in the light of the latest challenges and opportunities that both our ICT community and the wider world have been facing since then, like COVID-19, supply-chain challenges and the new potential role of satellites and alike in 5G, 6G and overall services.

Finally, and very much linked to the last point, CELTIC will cross its DNA with other communities in the near future, starting with the European Space sector.

This new enriched DNA will be the base for future flagship calls and projects, coming in addition to the successful series of CELTIC flagship projects like SASER, SENDATE and currently AI-NET.

Progressing implementation of Eureka Clusters Programme

After an intensive preparation and application period, which culminated in the ECP authorisation to operate as Clusters, the five Eureka Clusters CELTIC-NEXT, EUROGIA2020, ITEA4,



SMART and XECS are now implementing the first Multi-Annual-Plan (MAP) as well as the first Annual Operational Plan (AOP). CELTIC-NEXT is, as in the preparation phase, very active in the implementation phase, in order to best represent our ICT community's interests in the joint committees and actions. This period is crucial for CELTIC-NEXT to get the maximum return on investment from the new Eureka Clusters Programme, by getting the best representation in those additional funded calls. Therefore, I want to use this occasion to encourage readers from the RDI community to feed us with your needs, wishes and ideas on topics (technologies, use cases, and more) for the elaboration of future joint thematic call topics. The first thematic call will be about "Sustainable Industry" and will, among others, look at Green ICT as well as Space-Earth-Ocean Integrated Systems.

Conclusion and Outlook

As the new Director, I am proud and honoured to drive this transformation and the development of CELTIC on behalf of CELTIC's Management Group and Core Group members. Our new strategy gets already positive responses from the funding authorities of numerous Eureka countries, who want to invest in our new vision, mission and roadmap as presented in our application to ECP MAP. Our future flagship series programme is also getting very good traction, encouraging us to further pursue this new path. 2022 will be an interesting year for CELTIC!

About CELTIC-NEXT

CELTIC-NEXT is the Eureka Cluster for next-generation communications enabling the inclusive digital society. CELTIC-NEXT stimulates and orchestrates international collaborative projects in the Information and Communications Technology (ICT) domain. The CELTIC-NEXT programme includes a wide scope of ICT topics based on new high-performance communications networks supporting data-rich applications and advanced services, both in the ICT sector and across all vertical sectors.

CELTIC-NEXT is an industry-driven initiative, involving all the major ICT industry players as well as many SMEs, service providers, and research institutions. The CELTIC-NEXT activities are open to all organisations that share the CELTIC-NEXT vision of an inclusive digital society and are willing to collaborate to their own benefit, aligned with their national priorities, to advance the development and uptake of advanced ICT solutions.

www.celticnext.eu

Take, for example, holographic telepresence, which will become the norm for both work and social interaction. Another example is the massive future use of mobile robot swarms and drones in various verticals such as hospitality, hospitals, warehouses and package delivery. Think also of dynamic digital twins in the digital world with increasingly accurate, synchronous updates of the physical world.

Which are the next steps on the path towards 6G?

Peter Merz: We expect 6G systems to launch commercially by 2030, following the typical 10-year cycle between generations. Standardization phase 1 will likely start from 2025 as part of 3GPP Release 20.

Meanwhile 5G will be enhanced by 5G-Advanced, which will be a key focus for 3GPP in Release 18 onwards and will power commercial networks starting 2025 onwards well before 6G arrives at the end of the decade.

Reconfigurable Intelligent Surfaces for 6G

Innovative wireless network solutions from the ARIADNE project

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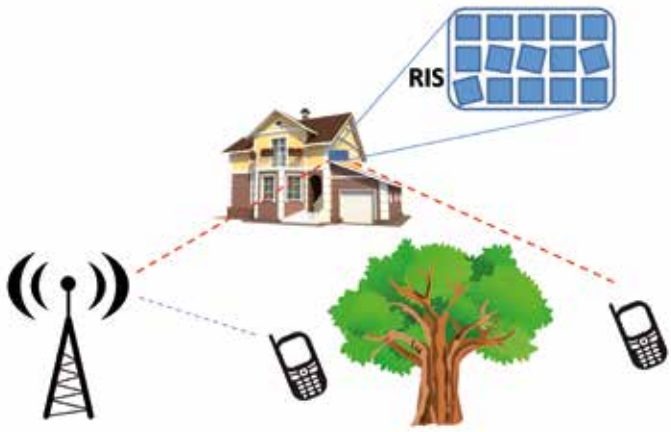

RIS attached to a house enabling communications avoiding obstacles

Reconfigurable Intelligent Surfaces (RIS), which are made of materials able to dynamically shape electro-magnetic wave fronts, are nearly passive devices that can adapt or change the radio signals between the transmitters and receivers. As explored in the ARIADNE project, one of the pioneer European actions in this area, the dynamically controlled RIS open a new dimension in designing and operating the next generation of wireless networks, 6G.

Recent research results confirm that effective deployment of RIS as controllable surfaces can enhance network capacity and coverage, but also create opportunities for future applications such as positioning and localisation. The RIS can be designed as a self-configuring part of a wireless network infrastructure, adjusting its electromagnetic characteristics in response to dynamic traffic demand and propagation characteristics.

Usage scenarios

To investigate usage of RIS in D bands, the ARIADNE project developed several static and dynamic use cases and corresponding scenarios. A typical scenario with RIS attached to a house, enabling communications and avoiding obstacles, is presented in the figure, where a user is still able to communicate with a base station via RIS, even though a tree is blocking the communication. Similar scenarios are considered also for indoor environments.

How Reconfigurable Intelligent Surfaces work

A RIS is a planar surface that consists of an array of passive scattering elements (approximate size in the range of 1 cm2), each of which can independently impose the required phase shift, and possibly an amplitude gain, on the incident electromagnetic waves. By carefully adjusting the phase shifts and the amplitudes of all the scattering elements, the reradiated electromagnetic waves can be shaped to propagate towards specified directions, with the help of an attached RIS controller. In this way, we are able to establish so-called alternative links within a cell using RIS and allow communication in non-line-of-sight (NLOS) scenarios – see the figure.

The main advantage of RIS usage is that they are almost passive elements involving very low-power electronics, representing an environment friendly and low-cost solution which can be easily deployed at walls, ceilings, billboards, lamp-posts, event vehicles, etc. On the other hand, the absence of power amplifiers and digital signal processing capabilities at RIS naturally pose some design challenges and a trade-off consideration between the coverage range of the surface, its size, and the number of RIS elements that need to be deployed on it.

Network challenges

Even though the RIS application is a promising solution to enhance the future 6G communications networks, there is still a need to perform related research on channel characterization, signal processing, physical RIS design, and more. The ARIADNE project is complementing the world-wide research activities in this field by working towards a research framework for establishing a novel network concept called Beyond Shannon smart radio environment.

Furthermore, future networks will have very high network requirements, demanding a highly dynamic control of the RIS-based wireless network infrastructure. To address this, a full optimization for dynamically controlling RIS-based networks could be achieved through accurate, but very complex mathematical models. The complexity could be handled via Artificial Intelligence (AI) technologies, which might be able to ensure that networks respond swiftly to changing data traffic situations, where the RIS structure is configured and dynamically changed in accordance with the current network demands.

Outlook

The ARIADNE project has done pioneer research work by targeting a full characterization, modelling, and performance analysis of the networks applying RIS. Towards the project end in 2022, ARIADNE will demonstrate the RIS application in one of its usage scenarios and develop a concept for managing RIS-supported wireless networks by applying AI. Finally, the ARIADNE project has been engaged in discussions on the needed standardization steps including RIS from the beginning, and is actively participating in a corresponding ETSI Industry Specification Group (ISG) on RIS, established in September 2021.

Further information
ARIADNE project website – *https://www.ict-ariadne.eu*

EVENTS

5G footprint in broadcast technology

IEEE International Symposium on Broadband Multimedia Systems and Broadcasting

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The 16th edition of the IEEE International Symposium on Broadband Multimedia Systems and Broadcasting 2021 (BMSB 2021) was planned to be held in Chengdu, China on 4–6 August 2021. Like many other events, also BMSB 2021 was turned into a fully online event due to the COVID-19 pandemic. The symposium is the premier forum for the presentation and exchange of technical advances in the rapidly converging areas of multimedia broadcasting, telecommunications, consumer electronics, and networking technologies.

Overall, the core program of the conference was held according to the published schedule, and the online format only affected the poster and best paper award sessions with a slightly adapted timing.

During the opening of the symposium, three keynote presentations addressed the audience outlining future trends and recent innovations and developments in the sector. Madeleine Noland, President of the Advanced Television Systems Committee (ATSC), USA presented her view on innovations in the Next Generation TV. Qingjun Zeng, Deputy Director General of China Broadcasting Network (CBN), China presented the recent developments in 5G broadcast in China. Finally, Dr. Yue Zhang, Associate Professor, University of Leicester, UK and Technical Manager of the EU-funded 5G PPP project 6G BRAINS presented the project.

The main programme featured 10 sessions covering a wide variety of topics, including multimedia transmission systems, artificial intelligence in next generation systems, service quality

and content, immersive image processing and applications, multimedia signal processing and last but not least multimedia networking.

Beyond 5G and 6G in broadband multimedia and broadcast systems

In his keynote Dr. Zhang presented the work of 6G BRAINS in view of the emergence of beyond 5G and 6G concepts and prototype solutions that will have a major impact on the broadband multimedia and broadcast industry. Dr. Zhang used a 6G BRAINS use case as a requirements-driving example. High-resolution, high frame-rate wireless video cameras can easily be deployed in a factory environment to unleash a long list of new features and services in an industry environment. Among others this technology contributes to anomaly detection, improved safety, process tracking and logging, remote control and predictive maintenance. State-of-the-art cameras already put a stress of up to 3 Gbps per unit on the wireless network, which along with the high reliability requirements in such a setting, illustrate the ambition.

Further information
IEEE BMSB 2021 website – *https://bmsb.scimeeting.cn/en/web/index/*

5G-VINNI project on TelecomTV

Roundtables about uses cases and network slicing

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In September and October, the 5G Verticals Innovation Infrastructure project of the 5G PPP, 5G-VINNI, which is funded under the EU's Horizon 2020 programme, presented selected results in a series of online roundtables. Topics included 5G-VINNI's use cases as well as orchestration and automation of network slicing. The roundtables were organised and produced in collaboration with TelecomTV.

Roundtable about 5G-enabled use cases

On 21st September, TelecomTV published the first of two roundtable videos about 5G innovation for industry verticals. The session sponsored by 5G-VINNI partner Nokia featured two speakers from the project: 5G-VINNI Coordinator Pål Grønsund from Telenor Research and David Kennedy, Director of Eurescom. They discussed, how 5G-VINNI has contributed to unlocking the value of 5G-enabled use cases. Pål Grønsund shared the achievements and lessons learned through the 5G-VINNI project, while David Kennedy presented Eurescom's perspective on the drivers behind the 5G PPP programme as a European, multi-vendor 5G environment for vertical industry-driven 5G use case trials.

Roundtable about orchestration and automation of network slicing

On 28th September, TelecomTV published the second roundtable video. This roundtable focused on orchestration and automation of network slicing, in particular on how 5G-VINNI has proved how zero-touch digital orchestration can simplify network slicing and lay the foundation for reliable, profitable, industry-specific 5G services.

The session featured two speakers from the project: Deepa Ramachandran, Director Product Management – Digital Operations at Nokia, shared insights into Nokia's experiences with orchestration and automated network slicing. Dr. Ilangko Balasingham, Professor of Medical Signal Processing and Communications at the Intervention Center of Oslo University Hospital, talked about some of the health-related use cases explored and what they have shown.

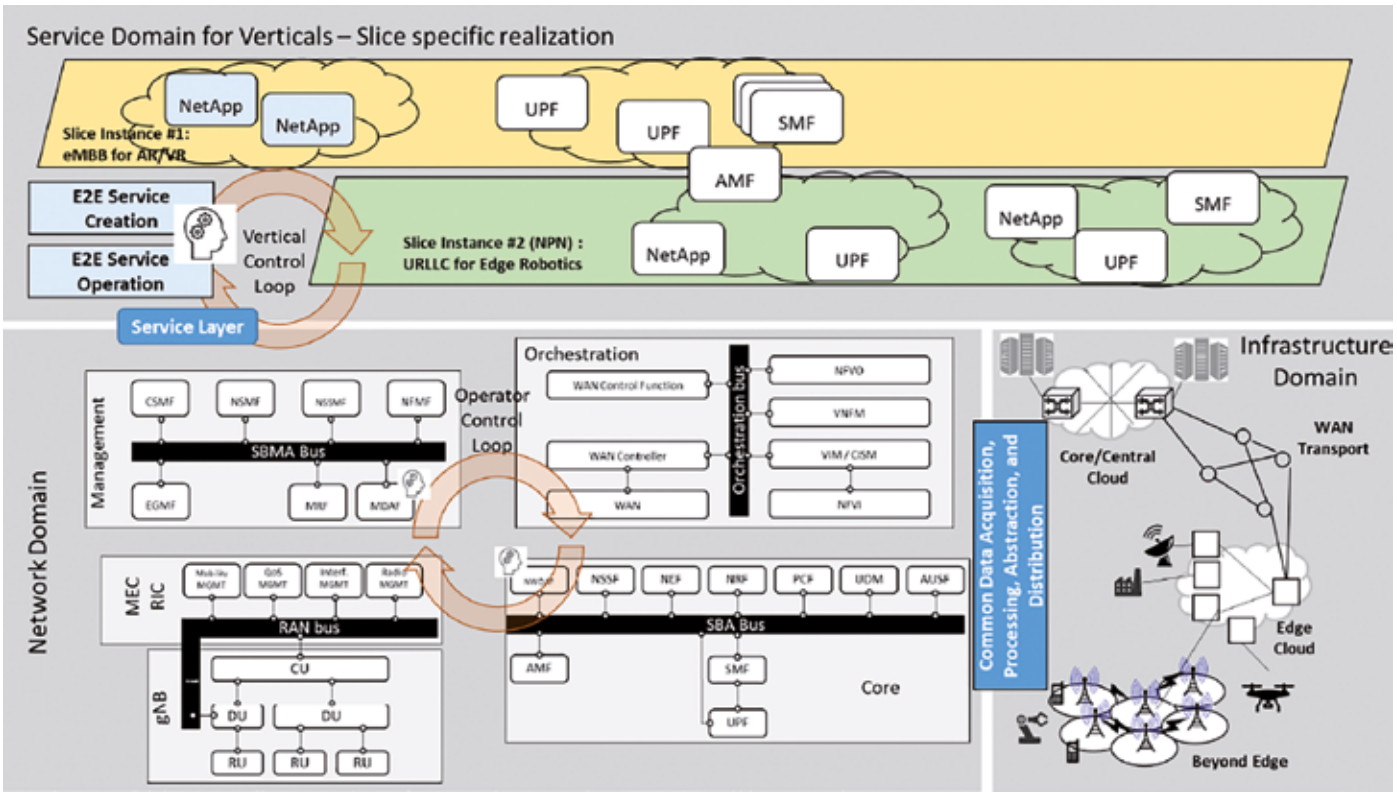
On 5th October, an online Q&A session took place, in which anyone interested had the chance to ask questions to the 5G-VINNI speakers from both sessions.

Further information
5G-VINNI roundtables on the TelecomTV website – *https://www.telecomtv.com/content/5g-vinni/*

Discussing 5G-VINNI results (from left): moderator Guy Daniels, 5G-VINNI Coordinator Pål Grønsund from Telenor Research and David Kennedy, Director of Eurescom

News in brief

4th release of 5G PPP white paper on 5G architecture published



In October 2021, the 5G PPP Architecture Working Group published version 4.0 of the white paper "View on 5G Architecture". It provides a consolidated view of the architectural efforts developed in the projects of the 5G PPP and other research efforts, including standardization. This serves not only to review the current state of the 5G architecture, but also to identify promising trends towards the next generation of mobile and wireless communication networks, 6G.

The 4th release of the white paper is focused on the output of the 5G PPP Phase 3 projects in terms of the architecture for the integration of large infrastructures and vertical industries, the long-term evolution of the 5G technologies and the service-specific features. The white paper presents a consolidated current overview on the 5G architecture as developed by these European research efforts.

Further information
White Paper: 5G PPP Architecture Working Group - View on 5G Architecture, Version 4.0 – *https://zenodo.org/record/5155657*

ENISA threat landscape report highlights surge in cybercrime

The 2021 edition of the Threat Landscape report by the European Union Agency for Cybersecurity, ENISA, highlights a surge in cybercrime, mainly driven by ransomware and cryptojacking attacks.

Ransomware ranks as a prime threat for the reporting period April 2020 to July 2021. The cybersecurity threat landscape has grown in terms of sophistication of attacks, complexity and impact. This trend is spurred by an ever-growing online presence, the transitioning of traditional infrastructures to online solutions, advanced interconnectivity, and the exploitation of new features of emerging technologies. Supply-chain attacks rank highly among prime threats because of the significant potential they have in inducing catastrophic cascading effects.

The 9 top threats: 9 threat groups were identified due to their prominence in the reporting period. They include ransomware; malware; cryptojacking; e-mail related threats; threats against data; threats against availability and integrity; disinformation – misinformation; non-malicious threats; and supply-chain attacks.

Key trends: The COVID-19 crisis has created possibilities for attackers, who used the pandemic as a dominant lure in campaigns for email attacks for instance. Monetisation appears to be the main driver of such activities. The techniques that threat actors used are numerous. The following non-exhaustive list presents some of the most prevalent threats identified in the report: Ransomware as a Service (RaaS)-type business models; multiple extortion ransomware schemes; Business Email Compromise (BEC); Phishing-as-a-Service (PhaaS); and Disinformation-as-a-Service (DaaS) business model.

Three types of threats receive particular attention in the report: ransomware, cryptojacking infections, and misinformation and disinformation.

Ransomware has been the prime threat during the reporting period, with several high profile and highly publicised incidents. The significance and impact of the threat of ransomware is also evidenced by a series of related policy initiatives in the European Union (EU) and worldwide. Compromise through phishing e-mails and brute-forcing on Remote Desktop Protocol (RDP) services remain the two most common infection vectors. The occurrence of triple extortion schemes also increased strongly during 2021 and cryptocurrency remains the most common pay-out method for threat actors.

Cryptojacking or hidden cryptomining is a type of cybercrime where a criminal secretly uses a victim's computing power to generate cryptocurrency. With the proliferation of cryptocurrencies and their ever-increasing uptake by the wider public, an increase in corresponding cybersecurity incidents has been observed. Cryptocurrency remains the most common pay-out method for threat actors.

Misinformation and disinformation are for the first time appearing in the ENISA threat landscape report. Disinformation and misinformation campaigns are on the rise as a result of the increased online presence due to the COVID-19 pandemic, which has led to a high use of social media platforms and online media. Disinformation and misinformation campaigns are frequently used in hybrid attacks to foster doubt or create confusion, therefore reducing the overall perception of trust as a consequence and damaging this major proponent of cybersecurity in the process.

Threat actors: The report is focused on four categories of cybersecurity threat actors – state-sponsored actors, cybercriminals, hacker-for-hire actors, and hacktivists. Cyber threat actors are an integral component of the threat landscape. They are entities aiming to carry out a malicious act by taking advantage of existing vulnerabilities, with the intent to do harm to their victims. Understanding how threat actors think and act, what their motivations and goals are, is an important step towards a stronger cyber incident response. Monitoring the latest developments with respect to the tactics and techniques used by threat actors to achieve their objectives is crucial for an efficient defence in today's cybersecurity ecosystem. Such threat assessment allows us to prioritise security controls and devise an adequate strategy based on the potential impact and likelihood of threat materialisation.

The ENISA Threat Landscape 2021 report is the annual report of the EU Agency for Cybersecurity, ENISA, on the state of the cybersecurity threat landscape. The 9th edition was published in October 2021.

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Further information

ENISA Threat Landscape Report 2021 – *https://www.enisa.europa.eu/publications/enisa-threat-landscape-2021*

Invented by DABUS

How AI machines are becoming inventors

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Johannes Gutenberg invented the movable metal-type printing process, Benjamin Franklin invented the lightning rod, and DABUS invented a beverage container. While the first two claims are widely accepted, the third claim has been the cause of a fundamental controversy on who can be an inventor. That is because DABUS is not a human being, but an artificial intelligence machine. And in conventional thinking, a machine cannot be an inventor, only a tool used by a human inventor.

According to the Wikipedia entry for "Inventor", the matter is clear: "An inventor is a person who creates or discovers new methods, means, or devices for performing a task." Ryan Abbott, a law professor at University of Surrey, has been challenging this common notion since 2013. He rejects that only a person can be an inventor and claims that an AI machine could be an inventor as well. "We're moving into a new paradigm where not only do people invent, people build artificial intelligence that can invent," said Abbott, who authored in 2020 a book with the title "The Reasonable Robot: Artificial Intelligence and the Law."

The Artificial Intelligence Project

According to Abbott, corporations are unwilling to push the issue of AI inventions, if it means not being able to obtain legal protection for their products. Thus, he set up the Artificial Intelligence Project [1] and teamed up with Stephen Thaler, founder of Imagination Engines Inc., to build a machine whose main purpose is to invent. The result was DABUS, an AI machine that "invented" not only the aforementioned beverage container, but also a device for attracting enhanced attention. Abbott and a group of volunteering lawyers filed patent applications for these inventions in 17 jurisdictions listing DABUS as the inventor.

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Unsuccessful patent applications

The quest of Abbott and his team to put man and machine on an equal footing under international patent law has been overwhelmingly met by a negative response from patent offices all over the world. As of November 2021, the patent application is pending in 11 countries. In the US, Europe, Germany, the UK, and Australia, the patent application has been rejected, and appeals are pending.

The European Patent Office (EPO) and the UK Intellectual Property Office (UKIPO), for example, came to similar conclusions: they denied the patent applications on the grounds that an AI system cannot be listed as an inventor. The European Patent Convention and the UK Patents Act, which were the basis for the respective decisions, both require an inventor to be a named person. The same requirement is valid under the U.S. Patent Act.

The first patent for an AI machine

Despite the rejection by almost all patent offices, Abbott and his team finally had reason to celebrate a victory in July 2021: The Companies and Intellectual Property Commission (CIPC), an agency of the South African Department of Trade and Industry, granted a patent to the applicant Stephen L. Thaler and the inventor DABUS for a "Food Container and Devices and Methods for Attracting Enhanced Attention", with the note: "The invention was autonomously generated by an artificial intelligence" [2]. That has made South Africa the first, and, so far, the only country to grant a patent to an AI inventor. One of the reasons for this result could be that the term "inventor" is not defined in South African patent law.

The distinction between owner and inventor

In patent law, there is the distinction between the owner of an invention and the inventor. Depending on the jurisdiction in different countries, this distinction is important. The owner of the patent is usually the one who has the right to exploit it. Nonetheless, at least one name of an inventor has to be provided, otherwise the patent application gets rejected.

And this is exactly where current patent laws fall short, because Thaler did not invent the beverage container, it was DABUS, the AI machine he had built. If he had given his own name as inventor, more patent offices might have accepted his application.

Conclusion

The case of DABUS shows that current intellectual property and patent laws, which usually have been written decades ago, are getting increasingly out of sync with a fast-evolving technology landscape. The expected progress of artificial intelligence in all areas of life should sooner or later lead to a reconsideration of legal concepts regarding inventorship. Who knows, the next breakthrough invention may not be generated by an ingenious scientist of flesh and blood, but rather by an advanced AI machine.

References

[1] Artificial Intelligence Project website – https://artificialinventor.com
[2] The patent for DABUS is registered in South Africa under the patent application number 2021/03242, application date: 13/05/2021, CIPC Patent Journal, July 2021, Vol 54, No. 07, Part II of II, 28 July 2021, page 255, URL: https://iponline.cipc.co.za/Publications/PublishedJournals/E_Journal_July%202021%20Part%202.pdf

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