Summer 2022

EURESCOM message

The magazine for telecom insiders

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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.

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Xavier Priem
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Dear readers,

Extended Reality, short XR, is getting real, moving from hyped prototypes to concrete applications for different vertical markets. With the growing capabilities of networks and cloud solutions, demanding XR applications are getting more and more the conditions they need to fulfil their potential. While many technological challenges still need to be addressed, the huge potential of XR has started to rapidly unfold.

As Eurescom is leading the EU-funded project CHARITY, which is at the forefront of network-related XR research in Europe, we are able to present in this issue of Eurescom message an inside view of selected European R&D activities in the XR domain. While two articles are directly related to the CHARITY project, we also present other selected EU research activities to provide an idea of the variety of R&D activities taking place.

In the first article of the cover theme, Eurescom message editors Milon Gupta and Uwe Herzog, the coordinator of the CHARITY project, give an overview on facts and trends around XR.

In the next article, a team of authors from CHARITY partner ORamaVR present their solution for XR-based medical training.

The following article by Zbyszek Ledwoń from Polish SME Orbital Knight explores the future of augmented reality gaming and shares related insights from the CHARITY project.

In our exclusive cover theme interview, Didier Stricker from DFKI, the German Research Center for Artificial Intelligence, shares his insights on current activities and future trends in the XR domain.

In the following article, a team of authors from InterDigital Europe explore the implications of XR applications for networks.

In the final article of the cover theme, Paul Muschamp from BT presents XR experimentation use cases performed on a 5G testbed of the 5G-VINNI 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 staying in control of smart digital services in his column "The Kennedy Perspective". Under “Events”, we report about the 5G-PPP participation at MWC Barcelona 2022, the world’s largest telecoms event. See also our “News in brief” section, which features an interesting study on the digital dependence of EU countries and a short report on the agreed EU Digital Markets Act. Finally, in the latest "A bit beyond" article you can learn about Russia’s cyberwarfare against Ukraine and the West.

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.

Let me close with a personal note: This is the last issue of Eurescom message under my responsibility as editor-in-chief. I decided to leave my position as Marketing and PR manager at Eurescom and pursue new professional challenges. It is with deep gratitude that I look back to 22 years of Eurescom message and the productive work with my colleagues and our external authors.

Milon Gupta
Editor-in-chief

Cover image: © Adobe Stock

EVENTS CALENDAR

20 – 23 June 2022
IoT Week
Dublin, Ireland
https://iotweek.org

6 July 2022
2nd Workshop on Accountability, Liability and Trust for 5G and Beyond (WALT5G+ 2022)
Paris, France (Hybrid Event)
https://6g-conference.dnac.org/walt5gplus-2022-workshop

5 – 8 September 2022
IEEE International Mediterranean Conference on Communications and Networking (MeditCom 2021)
Athens, Greece
https://meditcom2022.ieee-meditcom.org

6 – 8 September 2022
11th Advanced Satellite Multimedia Conference & 17th Signal Processing for Space Communications Workshop
Graz, Austria
https://asmsconference.org

12 – 15 September 2022
IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC 2022)
Virtual Conference
https://pimrc2022.ieee-pimrc.org

18 – 21 October 2022
27th Ka and Broadband Communications Conference (Ka) & 39th International Communications Satellite Systems Conference (ICSSC)
Stresa, Italy
https://www.kaconf.com

8 November 2022
Workshop on Mathematical and Optimization Techniques for Security and Resilience in Future Networks
Paris, France
https://mathsecres22.roc.cnam.fr

4 – 8 December 2021
IEEE Global Communications Conference (GLOBECOM 2022)
Rio de Janeiro, Brazil
https://globecom2022.ieee-globecom.org

SNAPSHOT

The Green Planet


Photo by Seamus Ryan

The Green Planet is an exhibition in London which provides visitors with an augmented reality experience in which they can traverse a series of plant-based biomes, guided by a David Attenborough avatar viewed through a 5G-connected smartphone. The photo shows a user in the exhibition, enjoying The Green Planet experience.

Further information

- The Green Planet website – *https://thegreenplanetexperience.co.uk*
- Cover theme article on "5G-VINNI XR use cases from the UK" in this issue of Eurescom message.

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Do you control what you own?

The subtle art of service blackmail

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I was quite excited to have a car with Apple Carplay for the first time – but then I discovered it didn't work. I checked every connection. I used a cable instead of Bluetooth. I consulted the car manual (the last resort of every engineer) to no avail. And then eventually I discovered that Apple Carplay does not work unless you activate Siri. Nobody says this in the advertisements for Carplay.

This is essentially a form of blackmail – you cannot use independent services on the devices you have paid for unless you allow us to listen to you. How did we let this slip through the system? Is this allowable in an open market?

Maybe I am naive – and maybe Siri has always been listening, even though I have switched her off – I simply can't tell. In fact, I am certain that updates of the IoS operating system on my iPhone have switched on things I had switched off. No, I don't want iCloud. No, I don't want Apply Pay. Yes, I do want to listen to the international radio in my car or the audiobooks I have bought without Siri being involved.

Our new relationship

Having conceded I had to allow Siri a little into my life, I then decided to see if she (is that personification?) could actually be useful. I asked for directions to Haag, which was not far from where I was at the time. She answered what I wanted to know about Mr. Hug. I exclaimed out loud that she was an idiot. She was still listening and reprimanded me for not being nice.

So now, not only am I forced to have the AI person in my life, but she is prepared to get touchy, if she thinks I am not being nice to her. I have enough interactions with sensitive people in my life not to need this.

Since then, we have reached an understanding, where I don't ask her anything and I don't encourage her to ask me things. However, she still finds opportunities. If an SMS comes in while I am driving, she asks me, if she should read it to me. If I accept, she then asks me, if I want to reply. I understand this may be useful, but I can't help being concerned about where this conversation is being processed and who has access to it.

The issues here

Apart from the obvious privacy concern, I am concerned about being obliged to take services I don't want so that the services I do want will work. It may not have a direct cost, but it is consuming data in my data package volume and it is most likely giving location information as part of the voice recognition service.

Searching the internet, I find sources saying that to ensure you get the most appropriate response, Apple doesn't completely anonymize your data, leaving in things like location. Then Apple could keep your recording for up to six months, after which it could be stripped of any personal identifier and kept for two additional years. Does it stop there? No. Some small selection of recordings could be stored for longer than two years to assist the ongoing improvements.

The further issue is to do with choices – I have discovered that many apps take their language setting from the phone. So, if you have the IoS in English, you are obliged to have the apps in English. This is another problem for Siri. I live in Germany and can manage a reasonable pronunciation of the town names in German, unless there is an umlaut of course – no non-German can manage umlauts correctly. But Siri, because my operating system is in English, tries to pronounce German town names phonetically using the English alphabet. Worse still, she refuses to take such names from me unless I can work out what anglicised sound she expects to hear.

We are back to the typical relationship problem of her listening to me but not being able to understand what I am saying.

Do we have a future?

Honestly, as we get older, we become less tolerant of things that cause stress in our lives. When things don't work as expected, it is a cause of frustration. Over time, frustration can turn to resentment, and once you start resenting your correspondent, the relationship is doomed.

I am forced to accept Siri, but I don't want Siri. I may be open to voice control when it is local, but not when it is somewhere in the great orchard being squeezed for every last drop of data juice by the Apple data miners.

I dream of a secure world where there is sufficient intelligence in my devices to talk to each other without involving big brother and without being forced to add relationships that I really don't want. Is that too much to ask?

Extended Reality

An Overview

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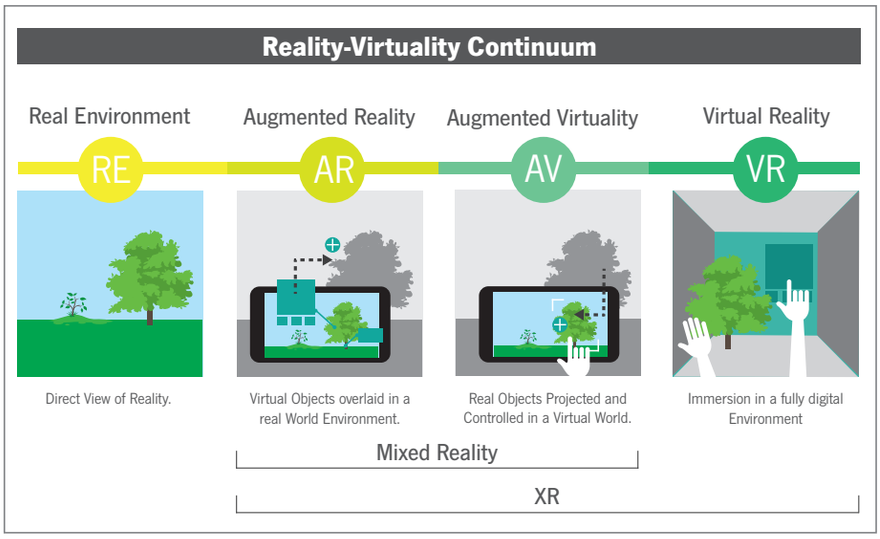

The reality–virtuality continuum

Until recently, merging the real world with the virtual world has been the subject of science fiction and advanced research, but nothing that normal citizens would experience in everyday life. This could soon change with the advent of Extended Reality, also known under its abbreviation XR.

XR is an umbrella term for immersive technologies including augmented reality (AR), augmented virtuality (AV), virtual reality (VR), and mixed reality (MR), which can be any combination of AR, AV, and VR.

The XR concept is rooted in the reality–virtuality continuum, which is a continuous scale ranging from the completely real, what we call 'reality', to the completely virtual, also called 'virtuality'. The reality–virtuality continuum encompasses all possible variations and compositions of real and virtual objects. The concept was first introduced by Canadian professor Paul Milgram and Japanese professor Fumio Kishino in 1994.

The metaverse hype

A term closely related to XR is 'metaverse', which was coined by Neal Stephenson in his 1992 science fiction novel Snow Crash. According to Wikipedia, "a metaverse is a network of 3D virtual worlds focused on social connection". In 2021, the metaverse became one of the most hyped concepts in the tech world, while most people still did not know, what it really is. The reason for the hype was the new vision proclaimed by Facebook CEO Mark Zuckerberg when he explained a set of new initiatives and the renaming of his company to Meta Platforms: "Our overarching goal across all of these initiatives is to help bring the metaverse to life." [1]

Despite the buzz around the fuzzy concept of the metaverse, there are nonetheless hard facts behind it, if we look at XR as the technological foundation for whatever the metaverse is going to be. Or in other words: there is a strong business case for XR.

Fast-growing XR market

According to a forecast by MarketsandMarkets [2], the XR market is expected to grow by 380 percent from USD 33.0 billion in 2021 to USD 125.2 billion in 2026. The main industries driving this expected growth are, according to the MarketsandMarkets report, the education sector, the automotive industry, the healthcare sector, and the entertainment and gaming industry. Market leaders in the fast-growing XR market are companies from the US and Asia, including Microsoft (US), Sony (Japan), Meta (US), HTC (Taiwan), and Google (US).

Europe's position in XR

From a European perspective, this raises two major questions: 1. What share of this fast-growing market could European companies achieve? And 2. How will the spread of XR into many sectors of business and life change society?

On the first question, there are no easy answers, as it will depend on the application areas and how successful European companies will be in identifying business opportunities, exploiting available technologies and converting research results into success product and service innovations on the market. In some areas, where Europe is traditionally strong, like the automotive sector and the healthcare sector, a relatively high market share of European products and services appears possible, while it appears to be rather unlikely in relatively weak European sectors like entertainment and gaming. In addition, tight regulations on data privacy and electronic services in general could potentially limit the speed and scale for offering XR services on the European market, compared to the much more liberal market conditions in the US.

One thing is clear, though: European industry is aware of the high potential of XR and is ready to use it. A study published in 2021 by Ecorys and the XR Association (XRA) produced the following key findings: (i) Over 93% of XR companies surveyed in Europe predict growth in their sales over the next three years, with two thirds expecting their revenues to grow by more than half. (ii) The total market value of the European XR industry is expected to increase to between €35 billion and €65 billion by 2025, which would represent a gross added value of between €20 billion and €40 billion, and directly creating employment for some 440,000 to 860,000 people. (iii) Wider supply chain impacts of the XR sector, which may include a whole new ecosystem of hardware and software suppliers as well as service providers and vertical business users, are expected to indirectly increase production value to between €35 billion and €70 billion, generating an additional 780,000 to 1.5 million jobs.[3] [4]

The European Commission is supporting this growth of the European XR sector through research and innovation, aiming to create a European XR ecosystem aligned with European values.[5] In this emerging ecosystem, the European Commission is encouraging cross-fertilisation between disciplines and domains, like 5G/6G, data, artificial intelligence, edge and cloud computing. The EC places "a special focus on industry and SMEs, which will support Europe to become a force in XR".

Social impact of XR

An open question is what impact XR could have on society as a whole, and what the social implications could be. Even though XR has been around for decades, it has not yet been widely used by the majority of citizens. The impact on users and society could to some extent be compared with social media, where people spend time in virtual ways instead of physical interactions – with social and psychological effects, which have been extensively studied. In contrast to this limited commonality with social media, XR will be much more immersive and not comparable with texting and sharing of images and videos, as done in social media today.

To what extent XR will finally impact the lives of users will also depend on how well it will engage the five senses, which means going beyond sight and hearing by including also touch, smell and taste for full immersion [6]. How immersion via XR affects physiological and psychological health is the subject of ongoing research. In a recent paper, researchers from the University of Texas warn that Virtual Reality affects depression, when social connectedness and self-esteem are low [7].

While there are potential risks, XR could also contribute to improving the quality of life. If XR would develop into providing a comprehensive immersive experience, it could enable many people to enjoy experiences they could otherwise not afford, as they wouldn't have enough time or money to get access to such experiences in the real world. Think, for example, of an immerse virtual museum visit or a concert of your favourite artist anywhere in the world. Or imagine you could attend a sports match from your sofa and experience the excitement of spectators, like you were in the stadium, without paying for an expensive ticket and being stuck in a traffic jam after the match. In this way, XR could become a significant facilitator for social inclusion.

Especially in view of the societal impacts of XR, it will be important that Europe plays an important role in shaping XR technologies and their application, in order to ensure that society will benefit from XR without suffering from its risks. These risks could be manifold, from new forms of data privacy violations to health hazards through extended immersion in virtual or mixed-reality worlds.

Outlook

It remains to be seen, if Europe will be a leading force in XR. The efforts in research, development and innovation from the public funding side and from industry are clearly there. That said, Europe does not have an industry champion driving XR, but rather many innovative SMEs and vertical sector companies utilising XR. This entails the opportunity of vertical sector specific growth of XR and at the same time the risk that the European XR market will be dominated by big XR players from the US and Asia.

In order to enable strong growth of the European XR sector and to ensure that XR applications and services are created and operated in line with European values, industry and public funding bodies need to ensure substantial investment in this sector beyond research and development.

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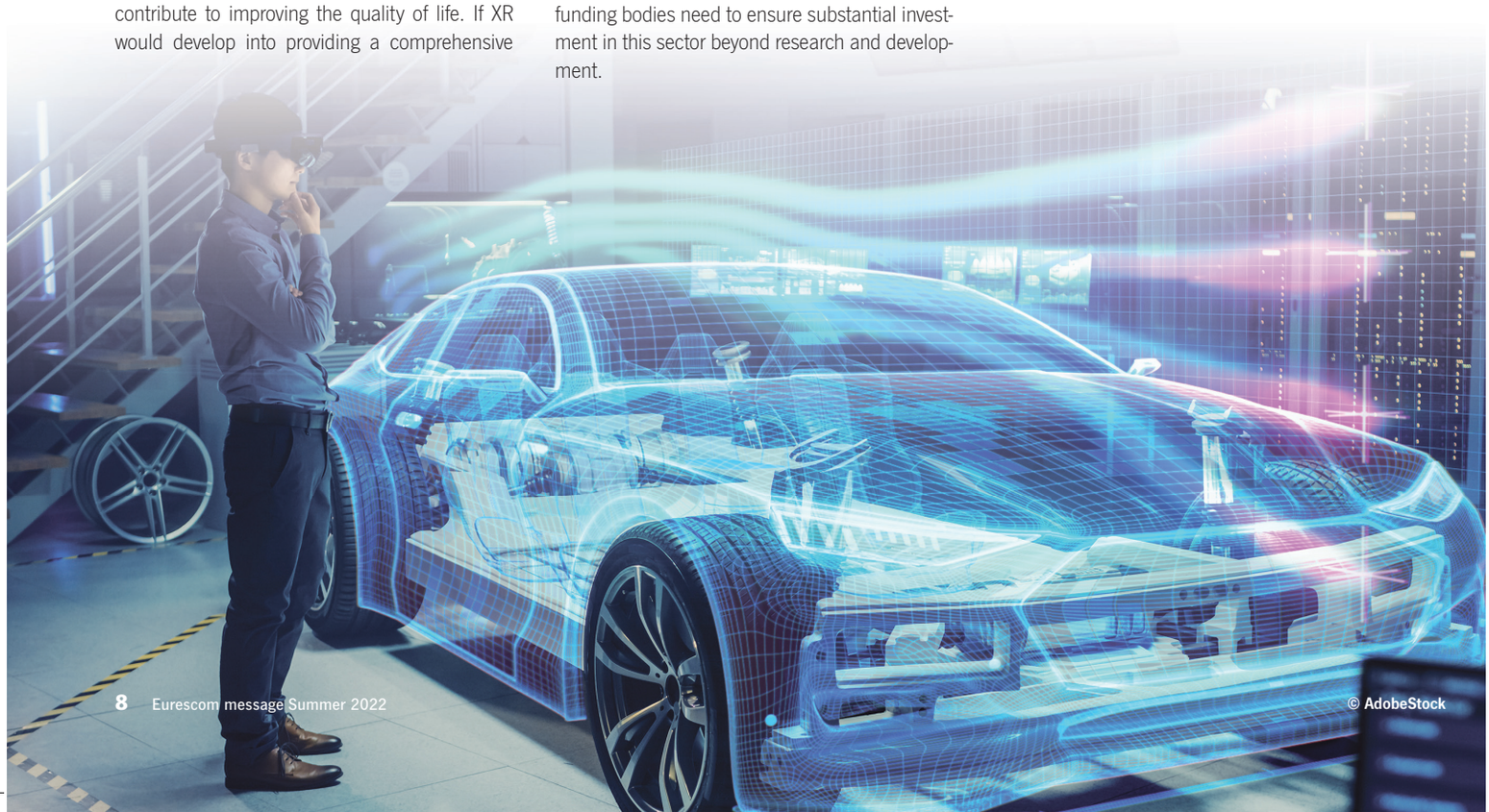

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5G-enabled XR medical training 4.0

Using XR to effectively educate healthcare personnel

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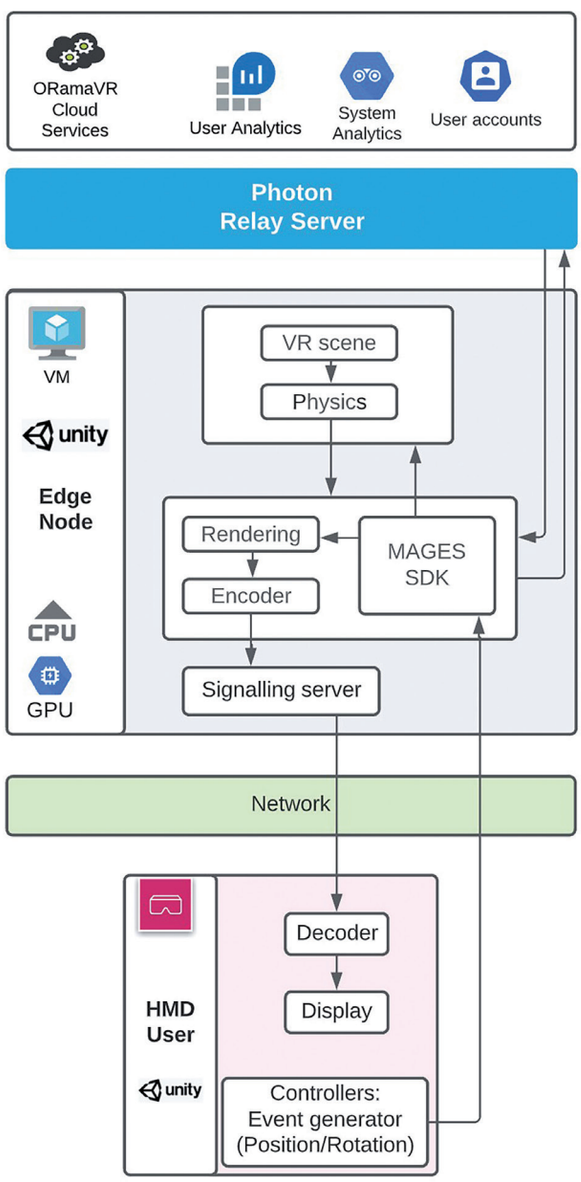

Figure 1: Realistic VR medical surgery environment, created by MAGES

As the need for efficient upskilling and reskilling of healthcare personnel is further dictated by the extended pandemic, eXtended Reality (XR) can be utilised to improve and extend traditional educational tools and approaches [1,2,3]. To this end, it is essential to identify both the opportunities and the challenges posed to achieve a major evolutionary step and effectively impact the landscape of medical training.

Virtual Reality (VR) and Augmented Reality (AR) training applications must provide high-fidelity, immersive experiences within shared, collaborative, virtual environments. In this context, real-time rigged and soft-body 3D object transformations, deformations and rendering require a significant amount of local processing power. Furthermore, the synchronised data transmission to all users in the same session demands effective use of the network capabilities, especially in 5G infrastructures. Low latency is essential to maintain a high quality of experience (QoE) and immersion, and achieving it is not straightforward, especially when the users are placed in diverse geolocations. Mobility restrictions posed by the state-of-the-art methods, which involve a tethered head-mounted display (HMD) and a local high-spec computer, can be overcome by employing standalone, untethered HMDs. However, despite recent breakthroughs in the respective hardware, the need for high-end GPUs and long-lasting battery autonomy still remains one of the main bottlenecks in realising untethered, highly immersive, real-time applications.

MAGES – A novel approach

Aiming to revolutionise existing medical approaches, ORamaVR introduced MAGES [4,5], the world's first hyper-realistic VR-based software platform for enhanced surgical training and assessment (see Figure 1).

With MAGES, trainees can perform immersive surgery simulations in a risk-free environment to improve their performances. Built on top of modern game engines (Unity3D & Unreal Engine), its novel Geometric Algebra based, inTerpolation Engine (GATE) may perform virtual character animation by sharing fewer key-frames across the network [6], thus minimising broadcasted data. Its multi-player engine allows a large number of remote concurrent users by adopting a network-

Figure 2: Use case conceptual architecture – Exploiting the available, open-source, render streaming implementation based on WebRTC signalling server

ing functionality beyond the standard client-server model, where a relay server transfers the current state of deformable objects.

Embracing 5G – The CHARITY project

To alleviate the imposed constraints on the untethered HMDs, namely GPU processing power, battery life, and mobility, ORamaVR is currently scaling up its product to edge/cloud resources, to reduce the dependency on local resource-demanding HMD technology assets. This approach, along with a proper 5G network utilisation for minimal latency and maximal bandwidth image streaming, will ensure optimal QoE, even for users using low-spec HMDs.

ORamaVR is participating as a use case partner in Horizon 2020 project CHARITY [7] and aims to exploit different data services and resources provided within the project's cloud-edge compute continuum. The main objective of this use case is to enhance MAGES edge-based components within 5G networks, while impacting CHARITY's architecture design [8] to accommodate similar applications. The use case design involves three main aspects: i) computation offloading to nearby edge resources, leaving the mobile device responsible for UI, input/output, thus streaming only necessary content to client HMDs; ii) provide a relay server functionality based on an open-source networking API, hosted in the cloud to broadcast messages to remote clients, thus ensuring low latency; and iii) runtime adaptation and dynamic optimization of GATE, based on the network characteristics.

Current research activities focus on altering the Unity3D workflow by dissecting the physics engine from the main application. ORamaVR aims to influence and adopt CHARITY's service-oriented architecture with two loosely coupled microservices, deployed in nearby edge resources, responsible for i) maintaining the game logic, rendering, encoding and managing the image transfer to the HMD (see Figure 2), and ii) conducting physics engine calculations of soft-body deformations.

Conclusion

MAGES, an XR medical training cloud-native application, aims to revolutionise the medical training landscape. To this end, and in order to effectively accommodate a large number of concurrent users from diverse geolocations, a proper exploitation of 5G networking capabilities is required. To achieve this and ultimately deliver optimal QoE for its end users, ORamaVR develops the necessary microservices, which will be used to both assess and influence the design of CHARITY's architecture, to properly accommodate XR applications of this magnitude.

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The future of augmented reality gaming

Insights from the CHARITY project

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Augmented reality gaming (AR gaming) had its moment of greatness in 2016, when Nintendo and The Pokémon Company released Pokémon GO. The game turned out to be a huge success. Hundreds of millions of people have played it every year since its premiere, and its popularity has never waned. One could draw the conclusion that the potential of AR games is large and within easy reach. Is it really the case?

It turns out that in fact the AR gaming market is very difficult to conquer. Despite strenuous attempts by many developers, it has not been possible to even get close to the success of Pokémon GO. Only some productions with an idea similar to the original, differing mainly in the setting (type of world, graphics, sound effects and music) in which very similar game mechanics are embedded, were able to get a small piece of this pie.

The next Pokémon GO

The main problem seems to be finding an equally attractive but new formula for the game. It is by no means an easy task. Rapid development of AR technology and devices supporting it seem to be the developers' ally. The use of modern features of AR technology is a direction that may have a chance of success. Games like Pokémon GO make little use of the potential that AR offers in multiplayer games. Modern mobile devices supported by software (ARCore and ARKit) allow developers to build applications that are able to provide much more advanced interactions with the environment and with other participants.

Mixing real with virtual environments

What may cause a significant comeback of AR games is the game's "understanding" of the environment in which the game takes place. A convincing, seamless mix of real-world environments with the virtual ones is the ultimate bait for players' interest. Direct interaction of the virtual game objects with the environment – like the ability to hide behind real-world obstacles, drawing a virtual graffiti on a real building, or bouncing a virtual ball among physical players - shows directions which may lead AR games to success. However, in order to achieve this goal, non-trivial technical difficulties must be overcome.

One of the use cases in the EC-funded Horizon 2020 project CHARITY aims to overcome these technical issues and provide a solid foundation for advanced AR games. The EC funded project CHARITY aspires to leverage the benefits of intelligent, autonomous orchestration of cloud, edge, and network resources, to create a symbiotic relationship between low and high latency infrastructures that will serve the needs of emerging applications.

Main technical challenges

User location discovery and synchronisation. Modern mobile devices are equipped with both GPS receivers and very precise accelerometers – this makes the device localisation much easier. Both ARCore and ARKit provide an API that allows for motion tracking. Our goal is to verify whether the provided solutions will work in the context of a multiplayer game and will be sufficiently precise throughout the whole game session.

Environment scanning and digitisation. Before virtual objects will be able to interact with the real-world environment, their shape and features must be digitised. While working on this aspect of the game, we explored LiDAR, a method for determining ranges (variable distance) by targeting an object with a laser and measuring the time for the reflected light to return to the receiver. We found that the use of LiDAR technology gives incomparably more precise results, and also much quicker.

Therefore, we have decided that further work in the project will be continued on iOS devices where ARKit and LiDAR are available. An extremely important functionality that we must test is the dynamic building and synchronisation of the mesh-collider based on the data received from several simultaneously operating devices connected to the game session. Figure 1 shows the steps of building a collision mask based on the surrounding environment.

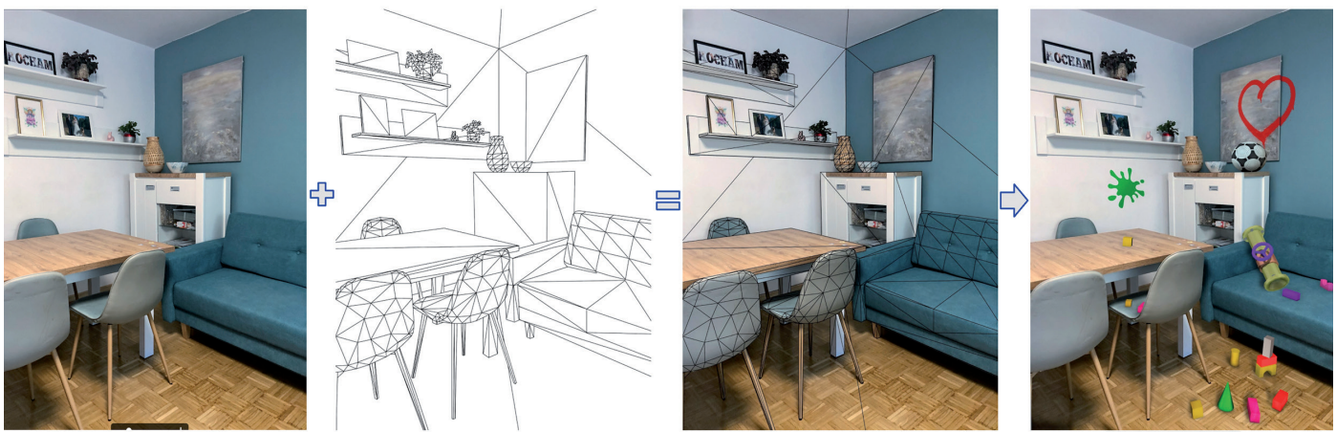

Figure 1: Steps of building a collision mask based on the surrounding environment

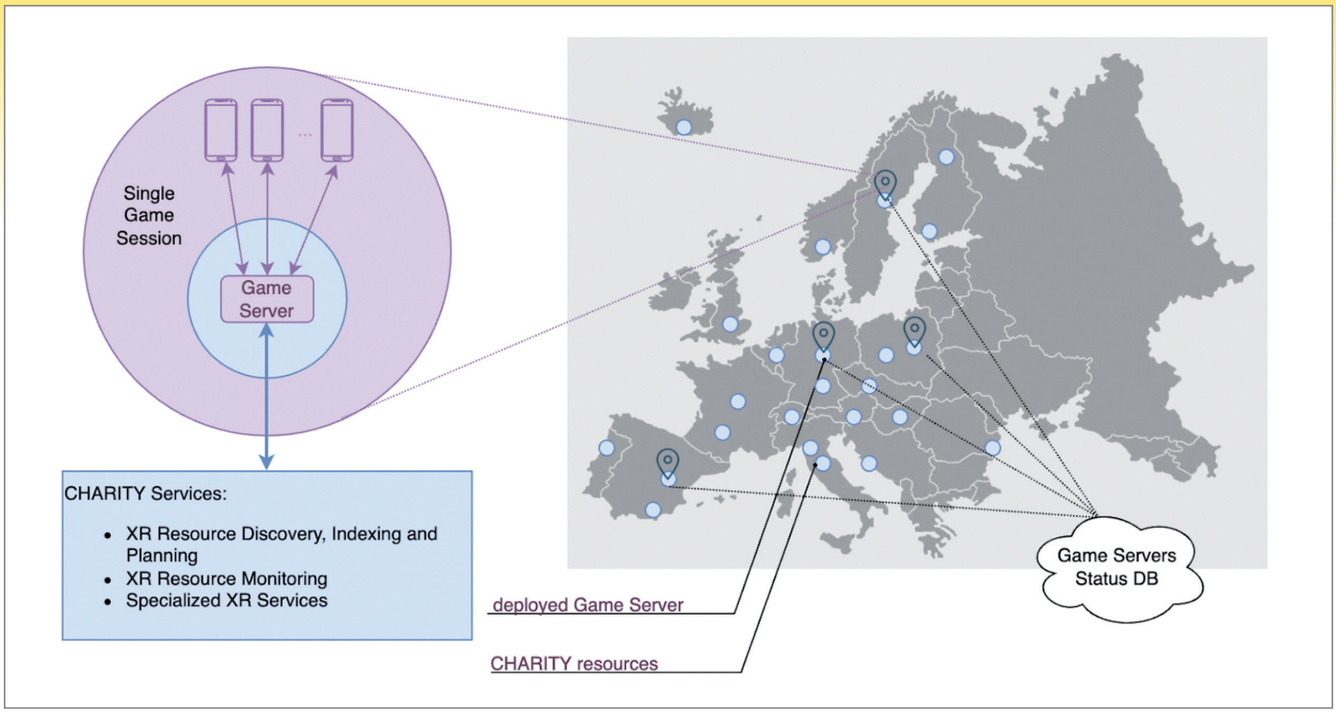

Figure 2: High-level schematic view of the AR multiplayer mobile game deployed in CHARITY

Data merging and synchronisation. Environment data can be collected by all players connected to a game session. It is necessary to build an additional online service for combining many meshes into one. This service must have the functionality for understanding the mutual position of individual meshes by recognizing common parts or other characteristic elements of the mesh. Mesh synchronisation also requires efficient transfer of large amounts of data between connected clients and the server. In addition, the optimal location of the game server needs to be identified to minimise the delays arising at the network layer.

Conclusion

I am convinced that AR games have a bright future ahead. We only need to harness the potential offered by modern technology, make it work efficiently as a uniform system and, most importantly, create games that will bring joy and satisfaction to players.

The hope is that the technology available today will turn out to be complete and mature enough to support modern, feature-reach AR multiplayer mobile games. With the AR gaming use case in the CHARITY project, we are confident to make an important step in this direction.

Further information

Horizon 2020 project CHARITY – *www.charity-project.eu*

CELTIC-NEXT
∑eureka Cluster

CELTIC News 1/2022

The newsletter of EUREKA Cluster CELTIC-NEXT

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CELTIC-NEXT
Eureka Cluster

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

CELTIC-NEXT Call for Project Proposals – Deadline: 21st of October 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 21st of October 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 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 December 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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The new improved Eureka Clusters Programme

David Kennedy
CELTIC-NEXT Chair Person
kennedy@eurescom.eu

The Eureka Clusters Programme (ECP) is coming out of a restructuring phase where there was a lot of pressure on the Clusters themselves to become more flexible and responsive, against a promise of more investment and more support for the industry and community research and collaboration needs. At this point it is useful to see how we are progressing and if we are achieving our goals.

From the Clusters side we have shown great flexibility and adaptability by running joint thematic calls for topics that were identified as common interest. However, despite this the major expectations the Clusters had from the renewal have not emerged yet. We expected that the joint calls would be new topics that would generate new budgets and increase the investment overall in the Cluster activities, but to date, we have not seen this in reality. In fact, many Eureka member public authorities admit they are funding the new joint calls from the existing Cluster budgets with no additional funding being generated.

The problem here is that we are then, in effect, just increasing the number of calls to be managed and therefore the number of reviews, assessments, funding decisions, etc., for what is effectively the same size programme. Clearly it is not a long-term strategy to keep increasing the costs of operation without seeing any increase in the volume and value of the programme. So, we do need to do a progress assessment on the New ECP model and work out which parts are working and which parts need more attention.

From the Clusters perspective, one part that has not taken off is the expected high-level meetings between industry representatives and national authorities. It was foreseen that we could have strategic discussions that would lead to common ideas on the priorities and therefore a mutual commitment of both public authorities and industry to invest in the identified priorities of the moment. We are just not there yet. We need to get this dialogue going to stimulate the anticipated increases in investments.

Bigger is better

The other point of concern is that we have an increasing trend for smaller project proposals coming from the community. We need to see why this is happening and how can we motivate more substantial actions. One possible cause is that proposers are being conditioned by warnings of limited funding opportunities – so they ask for less, so the project ambition is reduced, so the public authorities are not impressed by the limited proposals, and we are in a downward cycle. Another suggestion is that proposals are shrinking, because resources are limited. However, this is only true if the proposals are moving away from the core needs of the industry. Industry players are simple in this regard in that they decide what they need to do for their future business and, if the project proposal is in line with their business goals, then they commit the necessary resources. But maybe we are coming back to the missing strategic discussion where the business needs and the national interests need to be aligned.

The Cluster commitment to flexibility has been proven by the joint calls, but this has introduced two concerns: the first is that the public authorities seem to have difficulties being equally flexible – it was really unfortunate that one public authority refused to support a project in a joint call, as it was proposed through a Cluster they did not support – this challenges the very basis of joint calls; the second concern is that the level of budget commitment to joint calls is such that the issues may be better addressed as recommended themes within the normal bottom-up calls of the Clusters.

The way forward

Whatever way we look at it, there is a clear need to strategically invest from both the national and the industry sides – but it must be done in a coherent way. There are several challenges in the new model that we must progress on, to get the additional value from the programme. It is now emerging that it will be necessary to have multiple national level meetings with the Cluster interests rather than the one common high-level meeting – or maybe both approaches need to run in parallel.

In any case, we must preserve and promote the essence of the extremely efficient and useful Eureka Clusters instrument. This, in essence, is the structure in which the proactive Cluster core groups, as the key industry players of their respective sectors, work in partnership with the Eureka public authorities to stimulate a set of bottom-up project proposals that capture the needs of industry, aligns them with the national interests and develops products and services for the benefit of both society and industry as a whole. The EUREKA Clusters Programme matters.

Accelerating the digital transformation in Europe

Public event of CELTIC flagship project AI-NET

The public event of AI-NET in Berlin on 28 April 2022 presented the first-year results of the CELTIC flagship project. In addition, the half-day event hosted by Fraunhofer HHI provided the opportunity to discuss topics of strategic relevance related to the work of AI-NET.

The event, moderated by CELTIC-NEXT Chairman David Kennedy from Eurescom, started with high-level presentations by representatives of the four public authorities funding the project.

The attentive audience on site – A larger number of participants attended remotely

Public authorities stress digital sovereignty

Prof. Dr.-Ing. Ina Schieferdecker, Director-General for Research for Digitalization and Innovation at the German Federal Ministry of Education and Research, set the tone, when she explained the relevance of AI-NET: "AI-NET is an important step for Germany and Europe towards resilient and secure network infrastructures for technological sovereignty." She highlighted that a peaceful Europe needs to be in the driving seat of the digital transformation as progressed by AI-NET. She put this in the context of the Russian invasion of Ukraine and the COVID-19 pandemic and their impact on the economic and technological sovereignty of Europe.

Andreas Aurelius, Head of ICT department at Swedish innovation agency Vinnova, stressed the importance of resilient societies enabled by resilient digital infrastructures in Europe. He particularly highlighted AI-NET's contribution to enabling resilient networks infrastructures across Europe by making them more secure and autonomous – characteristics he considers critical for our future society and economy.

In the same vein, Heikki Uusi-Honko, Head of International Networks at Business Finland, underlined the high relevance of AI-NET, as industrial sovereignty is more topical now than ever. He added that in order to get innovations fast to the market, it requires a native digital mindset, which AI-NET has demonstrated. He highlighted the expected impact for Europe and its fast step change in the digital transformation.

Christian Dubarry, Head of European Affairs at Bpifrance, explained how France considers cloud computing as a future champion of sovereignty, and expects a doubling of the number of companies for trusted cloud computing already by 2025. He said that AI-NET ANTILLAS could contribute to these goals with its concept of edge and fog infrastructure.

All four public authority representatives acknowledged the intermediate results of the three AI-NET sub-projects.

Presentation of project results

After a demonstration tour of selected results achieved by AI-NET, the event continued with presentations of AI-NET and its sub-projects. Coordinator Achim Autenrieth, Director Advanced Technology at ADVA, started by providing an overview on AI-NET as a whole before handing over to the leaders of the three sub-projects. Azimeh Sefidcon, Research Area director for Cloud at Ericsson, presented AI-NET-ANIARA and its achievements to date. AI-NET-PROTECT was presented by Jörg-Peter Elbers, Senior VP Advanced Technology at ADVA. And finally Olivier Audouin, Director of external affairs at Nokia, gave an overview on AI-NET-ANTILLAS and its results.

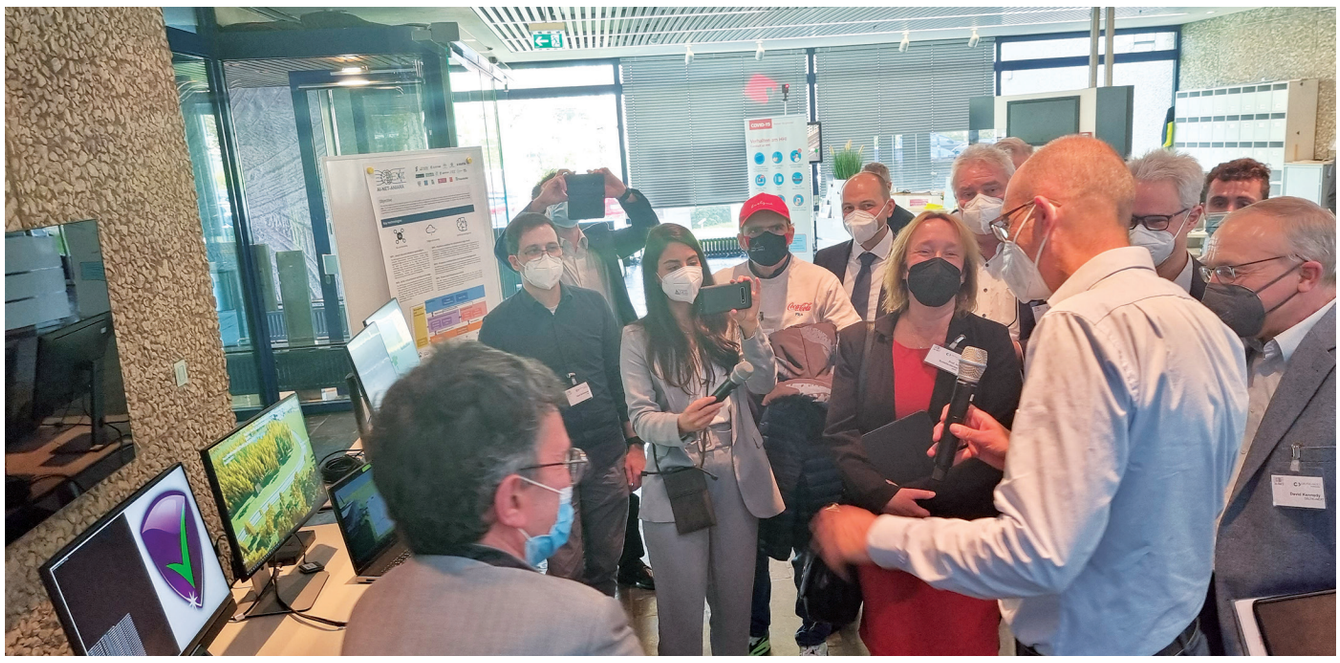
Panel discussion on digital sovereignty

The final highlight of the event was a panel discussion on the geopolitical, economic and technological challenges Europe is facing on its way digital sovereignty. The six panel participants provided a diversity of industry views on the subject. Panel participants included Johan Sandell, CTO of Waystream,

Prof. Dr.-Ing. Ina Schieferdecker from the German Federal Ministry of Education and Research

Christoph Glingener, CTO of ADVA, Timo Lehnigk-Emden, CTO of Creonic, Olivier Winzenried, CEO of WIBU systems, Jim Dowling, CEO of Logical Clocks, and Jonathan Rivalan, R&D Director of SMILE.

The lively discussion, moderated by CELTIC-NEXT Chairman David Kennedy, identified numerous challenges that need to be addressed, from supply-chain risks to critical dependencies in the areas of key technologies and raw materials required for Europe's



Huge interest in the AI-NET results at the demo tour

Lively panel discussion on digital sovereignty (sitting, from left): Timo Lehnigk-Emden, CTO of Creonic, Jim Dowling, CEO of Logical Clocks, Olivier Winzenried, CEO of WIBU systems, Jonathan Rivalan, R&D Director of SMILE, Johan Sandell, CTO of Waystream, Christoph Glingener, CTO of ADVA, and moderator David Kennedy (standing)

digital infrastructure. The panel participants and the audience joining the discussion could not converge on the best path to achieving digital sovereignty, but achieved a higher level of insight on the challenges to be tackled.

About AI-NET

CELTIC flagship project AI-NET was officially launched on 1st June 2021. AI-NET aims at 'Accelerating Digital Transformation in Europe with Intelligent Network Automation'. The project is addressing the challenge that the current centralised cloud infrastructure is not adequate for serving the requirements of the digital transformation in Europe. AI-NET is built on the premise that three technologies need to be combined to shape a new secure service and application platform: 5G/6G, edge-centric computing, and artificial intelligence.

The main goal of the AI-NET project is to provide enablers and solutions for high-performance services deployed and operated at the network edge. AI-NET is using artificial intelligence for complementing traditional optimisation algorithms, in order to manage vastly increased network complexity.

› Further information

AI-NET project website – *https://ai-net.tech*

The Eureka CELTIC – ESA Space-ICT Programme

Enabling the faster convergence and development of terrestrial and non-terrestrial networks & services

On 22 November 2021, Eureka Cluster CELTIC-NEXT and the European Space Agency (ESA) signed a Memorandum of Intent (MoI) in Porto, Portugal, which aims to bring their respective communities closer together. The MoI will help to foster economic growth and jobs through coordinated R&D&I activities and the commercial exploitation of integrated space and terrestrial systems enabled by 5G and 6G. The collaboration aims to leverage the complementarity of ESA and CELTIC-NEXT and build on synergies to maximise the return on investment and to support achieving the UN Sustainable Development Goals.

In today's rapidly changing political and economic environment and its regional battlefields, Space ICT has become, more than ever, a pillar for sovereignty and resiliency.

Space ICT is currently at the centre of attention for global industry and governments. On the economic side, new non-European entrants are currently disrupting the sector with Low-Earth-Orbit (LEO) satellites and High-Altitude Pseudo-Satellites (HAPS). On the political side, satellites, with all their potential missions and services, have shown to be essential assets for countries, not only for media broadcasting and observation, but also for connectivity to individuals and objects.

European industry and countries must defend their economic and political shares in Space ICT. European industry must be able to support European countries' ICT & data sovereignty. Sovereignty cannot be achieved by purchasing and deploying equipment and services from foreign vendors that could fall under or are already under control of non-trustable governments.

Recent events in Eastern Europe have shown, how critical it is to count on both terrestrial and non-terrestrial ICT services, as together they constitute one of the critical infrastructures of a country, especially considering the digitalisation of the society and the vertical industries.

Therefore, it is mandatory to increase and leverage to its maximum the European and allied countries' funding to reach the critical mass for R&D&I and a faster time-to-market for the European countries and allies' ICT industry.

Eureka Chairman Miguel Bello Mora, Elodie Viau – Director of Telecommunications and Integrated Applications and Head of ECSAT at the European Space Agency (ESA), and CELTIC Office Director Xavier Priem

The central role of space and satellites

Space, satellites and alike play an extended and increasingly critical role in 5G, 6G and overall ICT services enabling the digital society.

Space and satellites had already an important role in the global ICT world for the economy, industry, and the people. They have already provided media broadcasting (TV), geo-positioning (GPS, GONASS, etc.), data links (backhauling and access), and telephony (satellite phones). For data links and telephony, they were mainly meant to provide those services in areas not well or at all covered by terrestrial networks, and recently also where high-data capacity was not needed. LEO fleets have somehow changed this perception by providing high-peak capacity over the coverage of one LEO satellite, with the foreseeable de-facto limitation of the maximum number of simultaneously attached users, as those share the same total LEO satellite bandwidth.

Since 5G and reinforced with 5G-Advanced, and the planned 6G, more industry verticals are getting digitalised, automated and autonomised, wireless connected instead of wired connected, or simply "connected". People will expect that services delivered by those vertical industry sectors will be ubiquitous, always on and resilient. A good example is Connected and Autonomous Vehicles (CAV), being cars, trucks, terrestrial drones but also flying objects like future flying taxis, delivery drones, and more. 3GPP has now opened wider doors for the inclusion of SatCom besides the traditional backhauling role.

Space ICT remains a complex field with specifics in terms of operational conditions for R&D&I as well as field deployment.

Entry barriers to the Space ICT sector

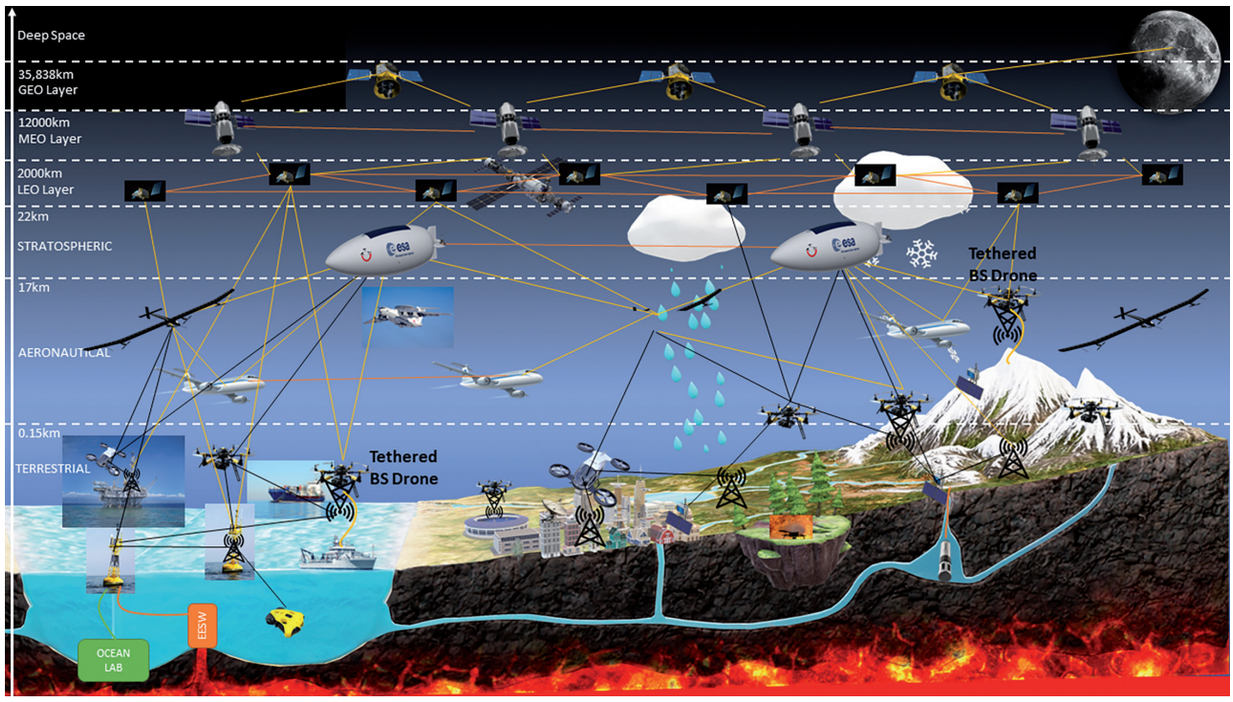
Several factors create an often too high barrier to entry for new or small players originating from the terrestrial ICT sector to move their technologies and products to the space or third dimension:

- The specific space environment for radiations, dimensions and weight, power supply limitations (level and duration) implying very costly special hardware platforms, if they even exist
- The satellites' launch costs
- The inherent inaccessibility after launch in case of outages or upgrades poses challenges not existing for terrestrial network players
- And, moreover, the space and satellite technologies (platform, payload, antennas…) knowledge itself

For the existing actors from the space sector, they seek for more competencies in 3GPP technologies and closer integration with terrestrial actors.

What CELTIC-NEXT and ESA bring to the collaboration

ESA TIA ARTES and CELTIC-NEXT provide various funding instruments: Open Calls, ITT, PPP for ESA, and bottom-up, flagship and joint ECP calls for CELTIC-NEXT. By exposing those instruments to each other's community and together, both organisations will provide a privileged forum for cross-fertilisation and collaboration of both communities, leveraging the different TRLs, funding schemes and public funding agencies across the large sum of their respective geographical coverages: the Eureka countries for CELTIC and the ESA coun-



The new Space-ICT Programme – Targeting the global 3D Internet

tries, some being common and some being different. Some stakeholders are common to ESA and CELTIC-NEXT, but most are new to the other. Both organisations see high complementarity in joining forces to leverage the association of their respective assets, forces, and communities.

As Elodie Viau said at the MoI Signature ceremony in Porto: "ESA`s strategic programme line Space for 5G & 6G demonstrates the essential nature of satellites for 5G and 6G. It sets the standards and frameworks for systems and services interoperability, as well as the base for integrating terrestrial networks with satellites. We draw technology and product roadmaps; we support and foster the development of integrated satellite terrestrial systems and value-added services."

What this collaboration will enable and what it will target

This MoI and the attached collaboration will enable the faster convergence and development of terrestrial and non-terrestrial network and service technologies in the innovative field of Space ICT, i.e., three-dimensional networking.

The MoI will focus on technology pathfinders and solutions to develop and validate research & development projects initiated by ESA and CELTIC-NEXT. In addition, the MoI includes the organisation of joint events as well as the dissemination of relevant information to terrestrial, non-terrestrial, and combined operators and vertical market stakeholders.

More specifically, the MoI will encourage terrestrial ICT and Space ICT industry collaboration with other industry verticals to facilitate the adoption of advanced Space ICT technologies in the business models and processes of all industry sectors. The focus of the cooperation is to consider the issues in a holistic way by considering the end-to-end perspective of new communications services enabled by 5G and 6G technologies, including an understanding of the economic, environmental, and societal benefits.

How it will be implemented

In a first phase, each organization will run its own funding instruments, with its own processes. This cooperation does not replace their respective funding programmes and instruments, but leverages them for identified synergies in terms of topics of interest or strategic goals for their communities.

Coordination on specific themes will be put in place. These themes, include, but are not limited to:

- Multi-layered Space ICT and Flying Objects Convergence
- Design and development of systems, subsystems and technology
- Networks and services conformance and interoperability tests
- Viable business ecosystem models
- Convergence and integration of terrestrial and non-terrestrial networks
- Frequency spectrum sharing between satellite networks and other satellite/ terrestrial networks
- Network timing and synchronisation technologies
- Edge cloud computing
- Data driven (AI enabled) management
- Data curation technologies
- Digital twins

To support the achievement of their common objectives, the two organisations intend to:

- Share knowledge, ideas and lessons learned
- Create awareness and promote opportunities for collaboration
- Utilise and leverage their relevant resources and expertise necessary to ensure the success of the common objectives, in support of the activities initiated in the context of this cooperation
- Plan and manage jointly relevant activities in areas of common interest in line with the signatories' respective legal frameworks
- Collaborate on the organisation and execution of activities with a view to reaching the common objectives identified
- Regularly attend meetings concerning the effectiveness of the collaboration, with reference to the priorities agreed
- Participate in suitable events organized by the other signatory
- Undertake joint communication, as appropriate, addressing the cooperation domains

Joint actions will be developed such as:

- Roadmapping
- Joint cross-community technology and strategy advisory boards

- Exchange on call dates and processes to anticipate best conditions for calls and participants
- Knowledge network creation and animation
- Joint working groups on specific topics across funded projects
- Joint webinars and workshops
- Promotion and provision of testbeds and trials platforms (R&D, integration, launch)
- Mutual advertisement of calls and bringing communities to jointly apply

The strategic technology calls and actions roadmaps are currently under development. CELTIC-NEXT is happy to receive your input and feedback to enrich its contribution to the joint work.

Outlook

This MoI is the first of a series of new collaborations for CELTIC-NEXT. This fulfils the objectives set by CELTIC-NEXT's Core Group to develop CELTIC-NEXT's support to and impact for the ICT community by enriching its DNA with new verticals and communities. The space community is also eager to collaborate more with the terrestrial ICT community. This collaboration offers the perfect playground for both communities to meet and work together on strategic topics and projects. CELTIC-NEXT welcomes greatly the space community's contribution to this strategic programme in terms of inputs to the roadmaps, participation to joint events and meetings, and proposals in the coming Space-ICT and 3D-NET focused calls to be announced soon.

Memorandum of Understanding with 6G-IA signed

Collaboration for faster terrestrial and non-terrestrial convergence

On 4th April 2022, Eureka Cluster CELTIC-NEXT and the 6G Smart Networks and Services Industry Association (6G-IA) signed a Memorandum of Understanding (MoU), which aims at establishing synergies and complementary activities in collaborative ICT research. The MoU will help foster economic growth and jobs through coordinated R&D&I activities and the commercial exploitation of generated results. The collaboration aims to leverage the complementarity of 6G-IA and CELTIC-NEXT and build on synergies to maximise the return on investment and to support achieving the UN Sustainable Development Goals.

ICT has become, more than ever, a pillar of sovereignty and resiliency in the rapidly changing social, political and economic environment of today and its regional battlefields. The Russian war against Ukraine as well as the measures against the COVID-19 pandemic have shown how critical it is to count on both terrestrial and non-terrestrial ICT services, as together they constitute one of the critical infrastructures of a country, especially considering the digitalisation of the society and the vertical industries.

Therefore, it is mandatory to increase and leverage to its maximum the European and allied countries' funding to reach a critical mass of R&D&I and a faster time-to-market for the European countries and their allies' ICT industry.

This Memorandum of Understanding provides the platform for leveraging on each signatory's strengths and cooperation, to support sovereignty and resiliency for Europe and allied countries.

The purpose of this MoU is to set out a simple framework where the signatories can identify the complementary nature of their respective objectives and to identify and implement shared activities that benefit both initiatives and contribute to the achievement of their goals.

The signatories aim to leverage the diversity of 6G-IA and CELTIC-NEXT as well as the fact that their projects are somewhat sequential in terms of their Technology Readiness Levels (TLRs), to maximise the return on the respective investments and increase the impact on the Sustainable Development Goals.

The signatories will focus on encouraging cross-programme discussions and workshops on potential technology pathfinders and solutions, with a view to stimulating a pipeline of new projects for both initiatives and sharing reciprocal contributions to each other's Strategic Research and Innovation Agenda (SRIA) documents.

The focus of the cooperation is to stimulate the respective communities to consider the issues in a holistic way considering the "end-to-end" perspective of the new communications services being enabled by 5G and 6G technologies, as well as developing an understanding of the economic, environmental, and societal benefits.

How the MoU will be implemented

To support the achievement of their common objectives, the signatories intend to:

- Create awareness and promote opportunities for collaboration within and across the respective communities
- Consult mutually on their SRIAs
- Collaborate on the organisation and execution of activities with a view to reaching the common objectives identified
- Participate in and support suitable events organized by the other signatory
- Plan and manage joint activities in areas of common interest in line with the signatories' respective legal frameworks
- Undertake joint communication, as appropriate
- Leverage their relevant resources and expertise necessary to ensure the success of the common objectives
- Regularly review the effectiveness of this collaboration, with reference to the priorities agreed

Conclusion

This MoU is the second of a series of new collaborations for CELTIC-NEXT. This fulfils the objectives set by CELTIC-NEXT's Core Group to develop CELTIC-NEXT's support to and impact for the ICT community by enriching its DNA with new verticals and communities. The 6G-IA community is also eager to collaborate more with the CELTIC ICT community. This MoU offers the perfect playground for both communities to meet and work together on strategic topics and projects.

Health5G

Healthcare Transforming with 5G Wireless Tech

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The advent of advanced mobile sensing and data processing technologies is a major driver in the transformation of many verticals including the healthcare sector. This shift is further accelerated due to societal changes including ageing populations and increasing global healthcare expenditures.

The three-year CELTIC project Health5G ran from 2019 to 2021, and it successfully aimed to discover healthcare scenarios that could bank on technological advancements especially in 5G mobile technologies.

Eureka Clusters like CELTIC-NEXT traditionally support high technology readiness level (TRL) outcomes. Obtaining results with a successful technology-market fit was ensured by the diverse skillsets of the 26 partners from 6 countries.

Approach

There can be a multitude of scenarios in healthcare. The project team started out by splitting all potential scenarios into three groups:

1. **Healthcare at hospital:** Advancements in sensing, connectivity, and AI lead to improvements in existing hospital-based patient treatments, resulting in more accurate, personalised, and trackable treatments for patients. Here, we worked on several interesting hospital use case scenarios.
2. **Healthcare at home:** Technological developments and ageing populations are enabling all patients, especially the elderly and the vulnerable, to be taken care of – not only at hospitals, but also at the comfort of their homes. In Health5G, we addressed this set of scenarios under what we called 'Healthcare at home'.
3. **Emergency healthcare:** Ubiquitous connectivity and improved sensing & AI technologies were used in emergency scenarios to improve impacts of first aid and reduce fatalities. The results were studied in Health5G under emergency scenarios.

Such a discrete and upfront split provided a more systematic way by generating unique focal points to the consortium partners. Consequently, all the undertaken work would fit into one of the three categories of healthcare, whereby the pilots would also be designed accordingly.

These scenarios were considered with three different priorities in mind, the three pillars:

1. **Patient healthcare:** Medical centres and scenarios in which healthcare service is given and/or where healthcare workers are.
2. **5G wireless technology:** The combination of several technological layers that leads to a commercial 5G signal, making the services available anywhere at any time to anyone.
3. **Healthcare technologies:** All the tech companies and researchers that do not necessarily provide healthcare but are the cogs in the healthcare machine, as they provide the underlying applications, data management, and security & privacy technologies.

Achieved results

Typical CELTIC projects deliver results close to market. Hence, creating use cases with a storyline supported by partners in a meaningful value chain was considered key to success. Indeed, Health5G concluded with six country pilots and a seventh demo on the overarching topic of cybersecurity:

- Swedish Country Pilot: Patient Home Care – Integrated Swedish Demonstration
- German Country Pilot: Zero Touch Infrastructure Orchestration for Emergency Services
- Korean Country Pilot: Wireless Patient Monitoring Inside Hospitals
- Turkish Country Pilot: Healthcare at Hospital and at Home
- Spanish Country Pilot: Gait Monitoring System and Automatic Deployer by Experis
- Irish Country Pilot: Wearable Video from Paramedic to Hospital
- Cybersecurity Pilot: Sirena – Security and Cybersecurity Tool

With the addition of smaller scale PoC demonstrations, the project generated 34 public demo videos.

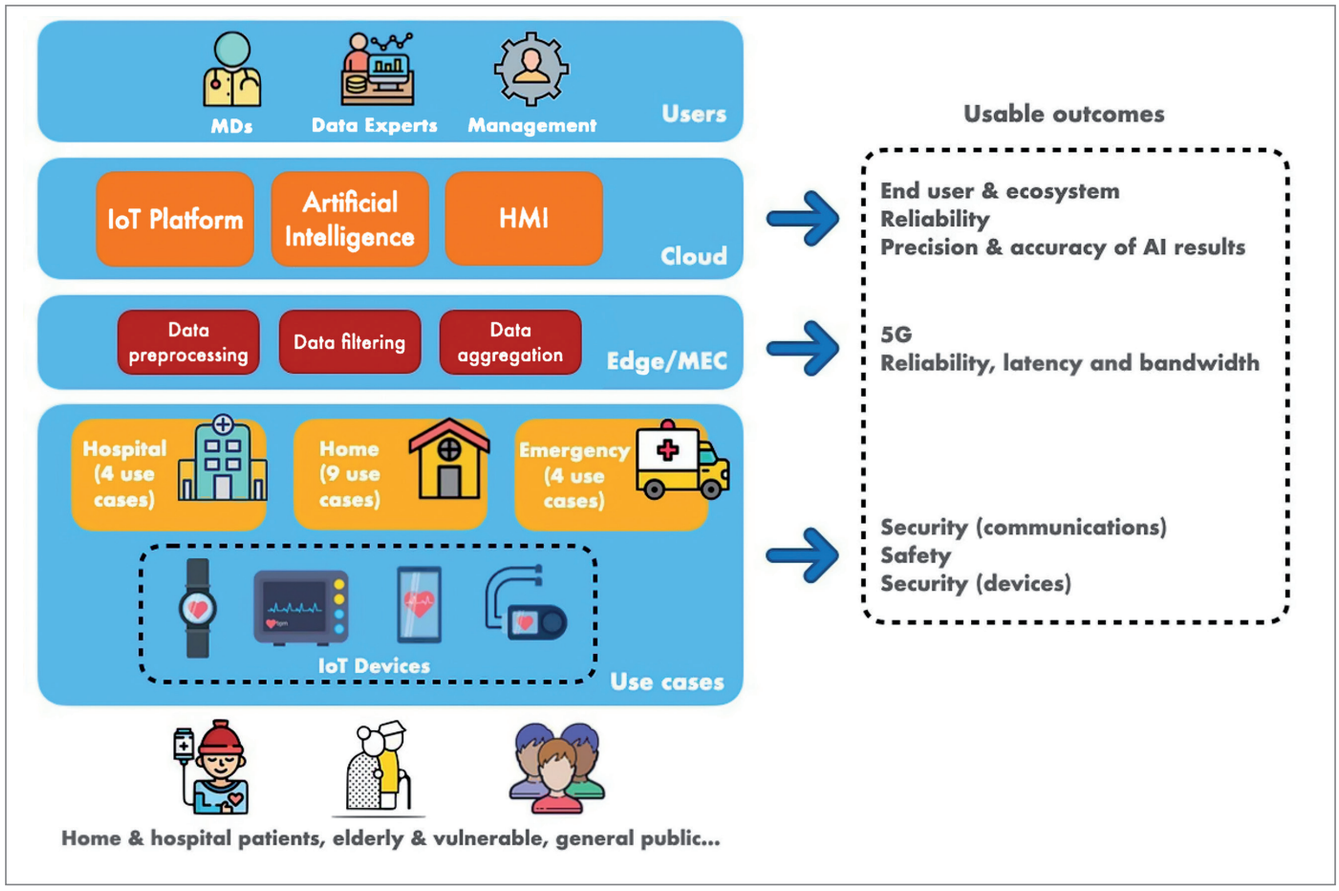

Illustration of the Health5G conceptual architecture

On the exploitation front, Health5G outcomes already started turning into further R&I projects, postgraduate subjects, field trials, or in some cases purchase orders. As for dissemination, the statistics reveal 67 journal and conference papers, 10 conference, session or track organisations, 37 stakeholder value workshops, 2 standardisation contributions, and 5 press releases. So far as standardisation goes, the main emphasis was on compliance. Standards for wireless technologies (5G), security & privacy, and medical devices were carefully studied and understood by the consortium. Of secondary priority, contribution to standards was a topic where preparations were completed for proposing changes to the O-RAN standard.

Conclusion and outlook

During Healht5G, the consortium took valuable steps to reap rewards of 5G wireless technologies and advanced medical applications that rely on ubiquitous sensing and computing. A careful analysis of the needs of patients and healthcare providers will help pave the way for healthcare services of the future.

› Further information

Healht5G project website – *https://health5g.eu*

Implementing the new roadmap

How CELTIC-NEXT is delivering on its new ambitions

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For CELTIC-NEXT, 2021 was a year of renewal and change. 2022 is a year of implementation: translating the new roadmap into partnerships and calls, designing the Space ICT flagship programme, acquiring new Core Group memberships, and implementing the first official inter-cluster joint thematic call of the Eureka Clusters Programme on accelerating industrial sustainability.

Solidarity with Ukrainian colleagues

Before going into the other topics, let me first share on behalf of the CELTIC Office our deepest compassion with our Ukrainian colleagues and their families. We are worried about the destiny of those who were not able to flee or had to stay and fight the invader. Our attempt to contact them was not successful. Our only hope is that this is because our contact attempt was their lowest priority, and they did not find the time and energy to answer.

Translating the new roadmap into partnerships and calls

In the first half of 2022, we have pursued the implementation of CELTIC's new roadmap by running several actions, and we will continue to do so in the second half. We are presenting this roadmap in our Proposers' Days, to allow consortia to propose innovative projects in the large number of fields of technologies, applications, and verticals of the roadmap. This is our traditional bottom-up approach. We will continue to run our Spring and Autumn Calls as per our successful history. This is a unique selling point of CELTIC as a Eureka Cluster compared to other international funding schemes. And it will remain so in the future.

Secondly, we are entering into new partnerships to enhance our funding impact in the global ICT community, as well as in other industries. Those partnerships will nourish further our roadmap and attractivity to Public Authorities to fund impactful innovative projects across and beyond the Eureka and European countries. This is already bearing fruits with the joining of two new CELTIC Core Group members: SES S.A. and CELLNEX Telecom.

One of the new partnerships has already been signed with ESA, the European Space Agency, in the form of a Memorandum of Intent (see the Space ICT article in this issue of CELTIC News). CELTIC and ESA will coordinate efforts and exchange on terrestrial network and non-terrestrial network convergence and cooperation. Some of those new partnerships, as for example the one with ESA, will be translated into flagship programmes and associated calls.

MoI signature (from left): Eureka Chairman Miguel Bello Mora, Elodie Viau – Director of Telecommunications and Integrated Applications and Head of ECSAT at the European Space Agency (ESA), and CELTIC Office Director Xavier Priem

Designing the Space ICT flagship programme

Space ICT has become a subject of high attention for industry and governments, and this has been strongly reinforced by the effects of the COVID-19 pandemic and the war in Ukraine. A clear sign has been also sent by 3GPP, which has now opened wider doors for the inclusion of SatCom besides the traditional backhauling role. The MoI will encourage terrestrial ICT and Space ICT industry collaboration with other industry verticals to facilitate the adoption of advanced Space ICT technologies in the business models and processes of all industry sectors.

CELTIC-NEXT and ESA are working together to define a joint roadmap of technologies, use cases and agenda of calls. ESA is a key actor in the development of all aspects and fields of space activity. Once the first roadmap and an agenda of calls are ready, CELTIC and ESA will advertise them. The joint roadmap and agenda should be defined during the first half of 2022, and the first CELTIC Space ICT flagship call should be announced for the second half of 2022.

New Core Group members

CELTIC has started to approach potential new Core Group members to enrich its DNA. And CELTIC is proud to have added two strong new members with headquarters based in Europe to its Core Group:

SES S.A. is a leading satellite operator. With over 70 satellites in two different orbits, their reach is unlike any other. They combine a vast, intelligent network of satellites and ground infrastructure with industry-leading expertise to manage and deliver high-performance video and data solutions virtually everywhere on the planet. SES S.A. already delivered a keynote in the ECP Joint Sustainability Call 2022 Webinar in Luxembourg.

CELLNEX Telecom is a leading infrastructure operator for wireless telecommunication in Europe. Cellnex has made a firm commitment to developing its network, which currently comprises around 128,000 sites. 71,000 of them are already in the portfolio and the rest in the process of closing or planned roll-outs

up to 2030, which perfectly positions the company to develop new-generation networks. CELLNEX provides services in Spain, Italy, Netherlands, United Kingdom, France, Switzerland, Ireland, Poland, Portugal, Austria, Denmark, and Sweden thanks to the investments undertaken to boost its transformation and internationalisation. CELLNEX already delivered a keynote in CELTIC's Spring Call 2022 Proposers' Day.
Other prospective new Core Group members will be approached this year.

First inter-Cluster joint thematic call on sustainability

After having led the two pilot pre-ECP joint calls on AI, CELTIC-NEXT has contributed to the first ECP Joint Call targeting the acceleration wof industrial sustainability, with the two sub-topics chosen by the 16 participating Public Authorities:

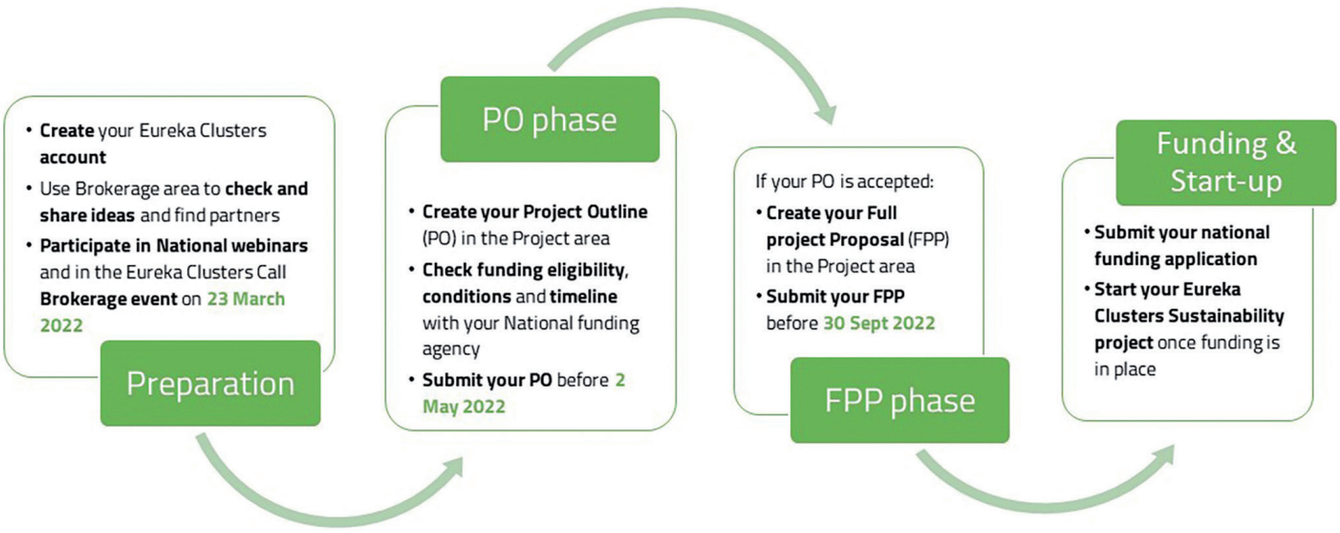
- Green ICT
- Space-Earth-ocean integrated systems for better observation and data exploitation

The timeline of this call is shown in the figure.

Information about the call, which closed on 2nd May 2022, is available on the Sustainability Call Website at https://eureka-clusters.eu/sustainability.html

Outlook

2022 is and will remain a challenging year for many topics. Joint collaborative innovation and knowledge exchange are among the best weapons against pandemics and wars. Our ICT community is one of the best positioned to understand and support this. Cybersecurity, resilience of critical infrastructures (for example with SatCom), and misuse of ICT technologies against people and nations are certainly topics to be ranked now as absolute priorities in the new world that is in front of us. CELTIC has made a collaborative proposal to its fellow Clusters within Eureka and will try to elaborate a strategic programme in that direction towards Eureka funding bodies.



Timeline of the Eureka Clusters Sustainability Call 2022

CELTIC-NEXT
eureka Cluster

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

"Remote collaboration will be the next key application of XR"

Interview with Didier Stricker from DFKI

Extended Reality, short: XR, has been a fascinating topic for experts and the interested public alike since the first XR headsets appeared. Recently, the closely linked vision of the metaverse hit the headlines, giving XR another boost. Eurescom message editor-in-chief Milon Gupta asked Prof. Dr. Didier Stricker, Head of the Augmented Vision department at the German Research Center for Artificial Intelligence (DFKI), what is behind the hype.

What is XR?

Didier Stricker: eXtended Reality can be understood as a hybrid real-virtual world at the convergence of Virtual Reality, Augmented Reality, and Wearables. The interaction of the user with the extended virtual-digital world plays a central role. The goal is to fully understand the user action and intention and, at the same time, to update the virtual representation of the real world so that it provides a consistent representation of it. eXtended Reality is the interface between the Physical World and its Digital Twin; XR fuses those two representations into one world, called eXtended reality.

How will XR technologies change the way we live and work in the future?

Didier Stricker: Our smartphones are today constantly with us. They can be considered as supercomputers equipped with many sensors which accompany us in our everyday life, at work or at home. The information they provide is, however, still represented on the display, and interaction is limited to touch and voice. XR represents the next step: the deluge of data, understanding and interpretation through artificial intelligence, advanced sensing, and new seamless display technologies, such as XR glasses, will allow modeling complex facts and behaviours. XR will be ubiquitous and provide the user with the right information at the right time at any place. This will change the way we work, learn, and communicate.

What are the social and economic opportunities of XR for Europe?

Didier Stricker: Excellent research work is achieved in Europe in XR and related technologies. However, the main XR platforms are today provided by the big US IT companies. So, the focus should be on vertical applications related to the existing European industry, like machinery, automotive, or medical devices, and key social areas, such as education and demographic change. With very advanced expertise, as it is available in Europe, new modules or building blocks encompassing software and hardware can create large markets. So, Europe is well positioned, but investments related to innovation and start-ups, together with strong partnering with large industrial groups, will be necessary to create the required critical mass.

Didier Stricker

Which XR technologies and applications are you currently exploring at DFKI?

Didier Stricker: We focus today on two main areas in XR. First, the understanding of manual workflows such as assembly work in the industry. Our system is able to recognize and localize assembly parts in 3D and at the same time identify which is the assembly step in a complete assembly workflow. The interesting aspect is that the system is trained using CAD data only. No pictures of the real object are necessary. So, those new XR applications can be automated and deployed easily. The second technology we look at consists of the visual capture of the hands of the user from the camera mounted in the XR-glasses. We would like to extract a precise hand motion and interaction with objects. The idea is to digitalize human interaction with our surroundings and in this way to capture the expertise of people, for example surgeons, and out of it create new training simulators.

What are the toughest challenges in the development of XR technologies?

Didier Stricker: Several challenges are remaining, including real-time reality capture and human motion tracking. However, enormous progress has been achieved recently thanks to artificial intelligence, more precisely thanks to deep-learning techniques. Key will be at the end excellent ergonomics of the hardware and user acceptance, which will depend directly on the way we design our application. XR apps should support users, not distract them or even lead to unwanted effects such as a lower learning rate or full dependence on this kind of XR assistance.

Which XR applications do you expect to have the highest impact in the next five to ten years?

Didier Stricker: That is a good question! I think that remote collaboration will be the next key application of XR. Such applications can be implemented efficiently today and offer a real added value compared to simple teleconferencing or audio support. The return of investment can be proven easily, and no major barriers in terms of infrastructure are existing. The creation of meaningful supporting content and the design of an appropriate user experience will be key. Then, I do think that consumer apps will play a fundamental role. Examples are virtual try-on, virtual visit of an apartment, or virtual shopping of a car. The key here will be the quality of the user experience, which assumes first a perfect quality in terms of visualization and realism.

XR applications – The implications for networks

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The term Extended Reality (XR) includes Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) applications. In this article, we explore the requirements that XR applications place on networks.

AR augments the physical world of the user by enabling interaction with the virtual world. On the other hand, VR places the user inside a virtual environment generated by a computer. MR merges the real and virtual world along a continuum that connects a completely real environment at one end to a completely virtual environment at the other end. In this continuum (see figure) all combinations of the real and virtual worlds are captured.

To run applications with XR characteristics on mobile devices, computationally intensive tasks need to be carried out in near real-time, hence corresponding computational resources are needed on the device or on an edge server in proximity. Edge computing is an emerging paradigm where computing resources and storage are made available in close proximity at the edge of the Internet to mobile devices and sensors.

In this article, we discuss the issues involved when edge computing resources are offered by network operators to operationalize the requirements of XR applications running on devices with various form factors including Head Mounted Displays (HMD) and smart phones. These devices have limited battery capacity and dissipate heat when running. Additionally, the wireless latency and bandwidth available to the devices fluctuate and the communication link itself might fail.

The XR technology landscape

The term XR includes AR, VR and MR. The domains in which XR technologies can be used include entertainment, education, industrial manufacturing, marketing, etc.

In AR, the application provides the user with information that is artificially generated and then overlaid onto the physical environment. This information can be textual, audio or visual such that in the user's perception, it becomes part of the real world.

VR involves "inducing targeted behaviour in an organism by using artificial sensory stimulation, while the organism has little or no awareness of the interference".

MR involves the "merging of real and virtual environments somewhere along the 'virtual continuum' which connects completely real environments to completely virtual ones".

The devices used to run XR applications can focus on visual, audio, or even haptic (touch-based) modalities. These devices can be placed on the head, on the body, handheld or anywhere in the physical environment.

Visual modality for XR applications can be achieved through optical see-through, video see-through or spatial projection-based approaches.

Audio modality for XR applications is typically achieved through speakers on the headsets or through headphones. More advanced techniques to generate audio involve making a moving user perceive that the sound is emanating from the user's 3D location. This involves head tracking, spatial sound synthesis and head-related transfer function.

Haptic modality can be achieved through instrumenting physical environments (example: Disney Research's AIRREAL). Alternatively, user perceptions can be augmented by on-body devices such as wearable vests, gloves, shoes, and exoskeletons.

Requirements for communication networks

The goal when delivering both streaming and interactive XR data is to provide an appropriate Quality of Experience (QoE) to the user. In the following section we focus on the application being able to provide the illusion of being present in a stable spatial space as this QoE dimension impacts the latency and bandwidth requirements for the network. This illusion of presence requires the network to provide data rates and latencies less than certain threshold values as discussed below. The illusion of presence is provided by visual, auditory and haptic inputs.

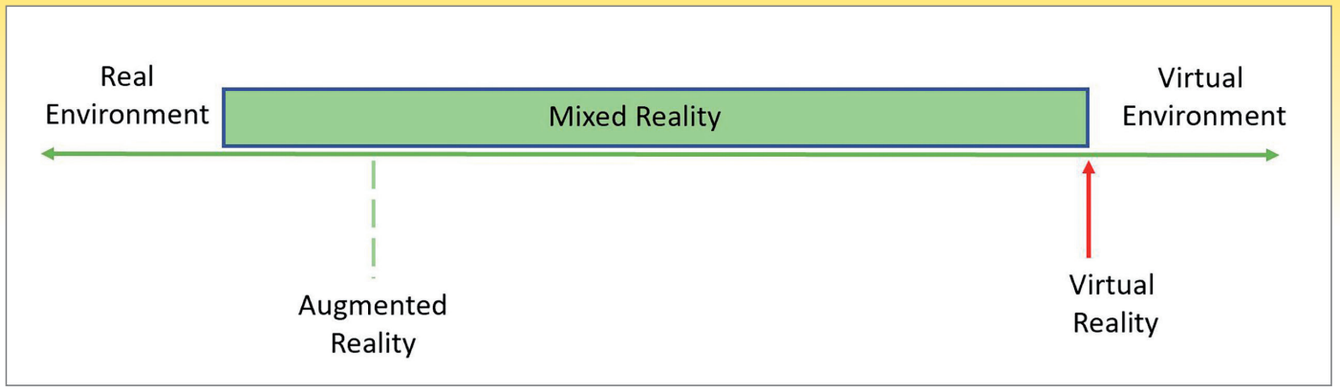
For providing visual inputs to create an illusion of presence, the display on the AR/VR device should synchronize the visual input with the way the users are moving their head. This is necessary to avoid motion sickness that results from a time-lag between when the users moving their head and when the appropriate video scene is rendered. This time lag is often called "motion-to-photon" delay. Studies have shown that this delay can be at most 20ms and preferably between 7-15ms to avoid the motion sickness problem. In addition, the data rate required could be in the order of 30 Mbps or higher for XR applications providing visual inputs to support six degrees of freedom that allow users moving in the virtual space.

For providing auditory inputs to create an illusion of presence, latencies should be below 60ms (70% probability) for VR-based isolated auditory stimuli and below 38ms (70% probability) for AR-based reference tone stimuli. Depending on the configuration of the audio system, audio bit rates of 600 kbps can be expected.

For providing haptic inputs to create an illusion of presence, latencies of up to 1ms are acceptable with a data rate of several kilobits.

Edge computing to the rescue

Edge computing represents the design consideration of network proximity. This requires that mini data centers with a small number of servers are provided closer to the location of UEs. This proximity is quantified in terms of low round-trip-



The real-virtual continuum

times and the availability of high-bandwidth connectivity between UE and an edge computing server. The edge servers use cloud technologies that enable them to support offloaded XR applications.

In particular, the edge servers deploy cloud computing implementation techniques such as disaggregation (breaking vertically integrated systems into independent components with open interfaces using SDN's data and control plane separation), virtualization (being able to run multiple independent copies of those components such as SDN Controller apps and Virtual Network Functions on a common hardware platform) and commoditization (being able to elastically scale those virtual components across commodity hardware as the workload dictates). Such techniques enable XR applications requiring low-latency and high bandwidth to offload computationally intensive tasks (that also generate heat and consume battery power) to the mini-clouds running on proximate edge servers.

New transport protocols and congestion control mechanisms in conjunction with delivery from the edge are also being investigated to support XR applications [1]. The increased volume of XR data can be delivered using multipath content delivery by Multipath Transmission Control Protocol (MPTCP). Prediction of the user's movement and network conditions using Artificial Intelligence (AI) and Machine Learning (ML) techniques can also be used.

3GPP standardization activities

A release 18 study of the SA (service and systems aspects) working group 1 within the 3rd Generation Partnership Project (3GPP) on supporting tactile and multi-modal communication services [2] identifies use cases that include immersive multi-modal VR, Immersive VR games and virtual factory.

A 3GPP SA working group 2 study on architecture enhancements for XR has recently been approved, which takes requirements specified in SA 1 study on supporting tactile and multi-modal communication services [2].

IETF standardization activities

The media operations (MOPS) working group (WG) of the IETF has finalized a draft [3] that provides an overview of operational networking issues that pertain to quality of experience when streaming video and other high-bitrate media over the Internet. Another draft [4] at the MOPS WG explores the issues involved in the use of edge computing resources to operationalize media use cases that involve XR applications.

The Audio/Video Transport Core Maintenance (AVTCORE) WG is standardising new RTP payload formats for VVC and VP9 codecs and might be expected to develop RTP payloads for MPEG Immersive Coding Standard (MIV) / Video Based Point Cloud Compression (V-PCC).

The Deterministic Networking (DetNet) WG focuses on deterministic data paths that operate over Layer 2 bridged and Layer 3 routed segments, where such paths can provide bounds on latency, loss, and packet delay variation (jitter), and high reliability. The WG has produced XR-related use cases.

The Reliable and Available Wireless (RAW) WG extends the DetNet WG concepts to provide for high reliability and availability for an IP network utilizing scheduled wireless segments and other media. This WG has also produced XR related use cases.

Conclusion

XR applications running on mobile devices with different form factors encompass AR, VR and MR applications. These applications have stringent low-latency and high-bandwidth requirements. Edge computing enhanced with new transport protocols, congestion control, multi-path delivery, AI/ML prediction of a user's movement and network conditions is emerging as a solution to mitigate the challenges of these stringent requirements.

References

[1] M. Kheirkhah, M. M. Kassem, G. Fairhurst, M. K. Marina, "XRC: An Explicit Rate Control for Future Cellular Networks", ICC 2022 - IEEE International Conference on Communications, 2022, pp. 1-7.

[2] 3GPP TR 22.847

[3] *https://datatracker.ietf.org/doc/draft-ietf-mops-streaming-opcons/*

[4] *https://datatracker.ietf.org/doc/draft-ietf-mops-ar-use-case/*

Extended reality experimentation on a 5G testbed

5G-VINNI XR use cases from the UK

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The UK facility of Horizon 2020 project 5G-VINNI provides an ideal testing ground for extended reality experimentation. From the UK facility, based at BT's Adastral Park research centre, we have been able to explore XR use cases for remote robotic control and for public exhibitions. In addition, a high-speed VPN link from the UK to the Norway facility of 5G-VINNI has enabled us to demonstrate a cross-facility, remote paramedic experiment using the 5G capabilities of both facilities.

5G-VINNI testbed in the UK

The three-year Horizon 2020 project 5G-VINNI, which ended in 2021, has provided a set of interconnected 5G testbeds across Europe. The UK facility of the project is based at BT's research centre at Adastral Park, Suffolk in the UK. Adastral Park is a large business campus comprising a number of buildings along with roads and pathways, as well as grass and wooded area – all providing an ideal testing ground for a number of XR use cases, both indoors and outdoors. The facility provides 5G radio systems at 3.6GHz and 26GHz, supported by an edge cloud compute capability (including GPU-based servers) which can host the XR applications. In addition, a high-speed VPN link from the UK to the Norway facility of 5G-VINNI allows us to explore cross-facility experiments using the 5G capabilities of both facilities.

Industry 4.0 – remote robotic control

Industry 4.0 use cases can benefit widely from the application of extended reality, particularly for industrial robotics. We conducted a remote robotic control experiment with UK company Extend Robotics running on the 5G-VINNI testbed at Adastral Park. Extend Robotics seeks to "build affordable robotic arms capable of remote operation from anywhere in the world, using cloud-based teleoperation software".

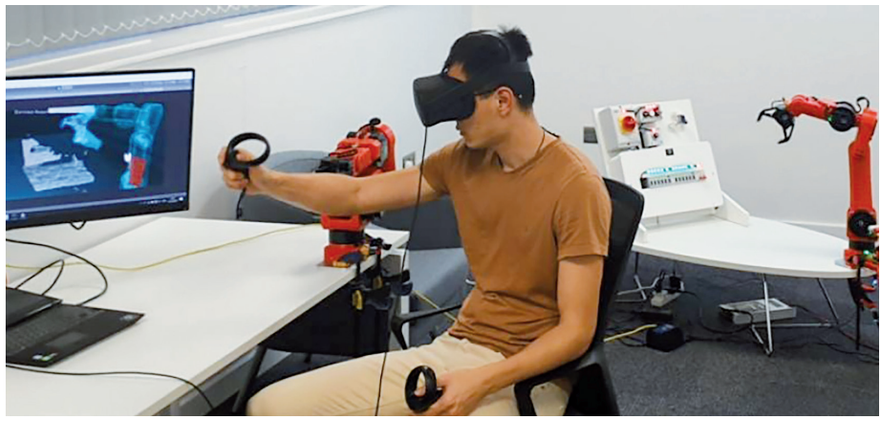


Figure 1: Remote robotic control over the 5G-VINNI network

In this experiment we have connected a robotic arm to a VR-based arm controller over the 5G-VINNI network. The arm is used to control switches and dials on an electrical panel, requiring intricate control of the arm's movement, and can be seen in figure 1.

The robotic arm houses a series of cameras that are able to stream video images of the arm to the person controlling the arm, who wears the VR headset. The high throughput capabilities of the 5G network (typically over 300 Mbps) provide more than adequate capacity for this purpose.

We have been able to show that the controller handsets, the movement of the robotic arm, and the view in the VR headsets are able to be kept in tight synchronisation. This has been possible by utilising the low latency path through the 5G-VINNI network – typically less than 10ms.

Augmented reality – The Green Planet

Exhibitions can be brought to life with the addition of an extended reality experience for their visitors. Early in 2022 the BBC launched a series of TV programmes – the Green Planet, hosted by David Attenborough – and along with the series opened an exhibition in central London. The exhibition provides visitors with an augmented reality experience in which they can traverse a series of plant-based biomes, guided by a David Attenborough avatar viewed through a 5G-connected smartphone. As part of the development, the AR application went through a series of user testing on the 5G-VINNI testbed. The application was able to take advantage of a number of testbed features including: a) high capacity – despite the users being positioned within a small indoor area, the testbed was able to support over twenty simultaneous users, each streaming the experience to their handsets at the same time. This provided valuable information for radio capacity planning at the London venue; and b) high bandwidth – download speeds in excess of 200 Mbps (single user) provided enough throughput for the video streaming and to be able to assess the user experience and thus provide valuable feedback to the application developers. Figure 2 shows a typical user in the exhibition, enjoying The Green Planet experience.

Cross testbed inter-working – remote paramedic

The use of extended reality applications can provide major benefits to the healthcare sector, improving patient outcomes in a number of innovative ways. One of these is in the support of a remote paramedic who attends an incident in the field and is able to communicate with a surgeon at the hospital. The paramedic wears a HoloLens headset and is able to view information provided by the surgeon. At the same time, the surgeon is able to view what the paramedic can see in his field of view on a computer at the hospital. The 5G-VINNI project was able to demonstrate this application between two of the project facilities, with the paramedic connecting to the 5G facility in Norway and the surgeon to the 5G facility in the UK. Figure 3 shows the set-up and imagery from the demonstration over 5G-VINNI.

The experiment was able to take advantage of a dedicated VPN established between the UK and Norway facilities of 5G-VINNI. Latency values of 38 ms were low enough to support smooth running of the HoloLens application, and end-to-end bandwidth performance of over 150 Mbps was more than enough to support the video streaming required.

Figure 2: User experiencing The Green Planet over 5G

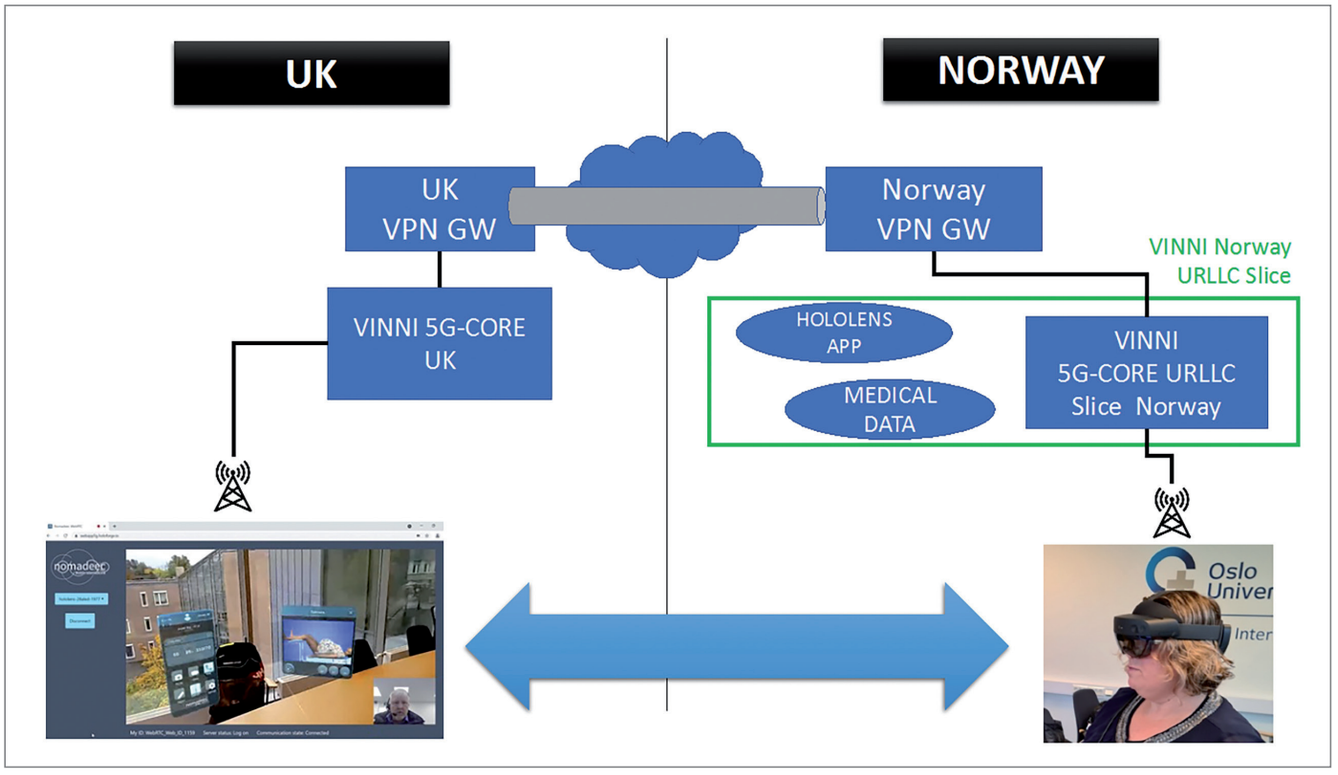


Figure 3: Remote paramedic setup over 5G-VINNI

Conclusion

Extended reality applications need a high-performance network to be able to provide the optimum experience to users. This includes high throughput to allow content streaming to XR headsets, high capacity where a number of simultaneous XR users are in operation, and low latency where the application needs tight synchronisation between the different component parts. We have been able to show that 5G is able to support these requirements. Through the use of 5G testbeds, provided through the Horizon 2020 project 5G-VINNI, we have demonstrated how the use of XR can enrich the user experience in remote robotic control, entertainment exhibition, and remote paramedic applications.

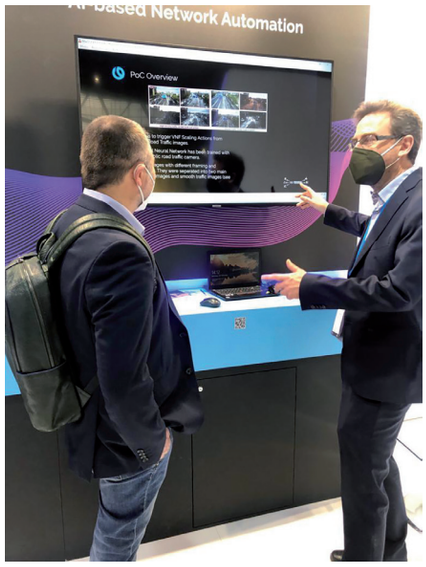
Further information

- 5G-VINNI project website – *http://www.5g-vinni.eu*
- Extend Robotics website – *http://www.extendrobotics.com*
- The Green Planet – *https://thegreenplanetexperience.co.uk*

MWC Barcelona 2022

5G-PPP participation at the world's largest telecoms event

From 28 February to 3 March, MWC Barcelona, still commonly referred to as Mobile World Congress, attracted a large crowd of 10,700 industry experts to attend in person. After two years of Covid-19 restrictions this figure was still below pre-Covid levels. Yet, the event clearly indicated a return of the industry to something closer to normality, despite the Russian invasion of Ukraine, which started four days before MWC opened its doors. Among the booths in the exhibition and the presentations in the conference programme were also a number of 5G PPP projects, which presented their latest results.



5G-TOURS results at the ATOS stand

One of the partners of the 5G-TOURS project is ATOS, who are leading the work package on use cases and requirements. As an active contributor to the network automation work within 5G-TOURS, ATOS has contributed both to the project use cases as well as external standards and open-source activities. At its own stand ATOS presented and demonstrated various research activities, including the 5G-TOURS activities around network automation based on AI.

Joint stand of 5G-TOURS, 5G-Heart and 5G-Solutions

5G-TOURS joined forces with two other 5G-PPP projects 5G-Heart and 5G-Solutions in order to have a stand in Hall 7. The experts at the stand answered the questions of numerous visitors and showed videos about the projects' use cases, including 5G-TOURS from the three nodes in Turin (Italy), Rennes (France), and Athens (Greece).

Presentation by Diego Perino, Director of Telefónica I+D

MWC presence of the DAEMON project

The DAEMON project on Network Intelligence for Adaptive and Self-learning Mobile Networks was present at MWC through fliers and brochures available at the stands of several project partners like i2CAT and Software Radio Systems. This material provided a thorough description of the context, vision and objectives of the project and was freely available to all attendees visiting the partners' booths. The project was also featured in a looped video displayed on a monitor at the i2CAT stand.

In addition, research results from the DAEMON project were presented on stage by Diego Perino, Director of Telefónica I+D. In his talk about the impact and benefits of integrating AI in future-generation mobile networks, he explicitly acknowledged the contribution by DAEMON.

Special session of Catalonia Tourism Cluster

5G-TOURS was invited to a special session of the Catalonia ICT Tourism Cluster. In addition to other projects and local contributors from Catalonia, 5G-TOURS technical manager Belkacem Mouhouche presented the tourism node of the project and explained how the 5G-TOURS use cases developed in Turin will help tourists and citizens enjoy museums and touristic places better, especially in the COVID era.

Conclusion

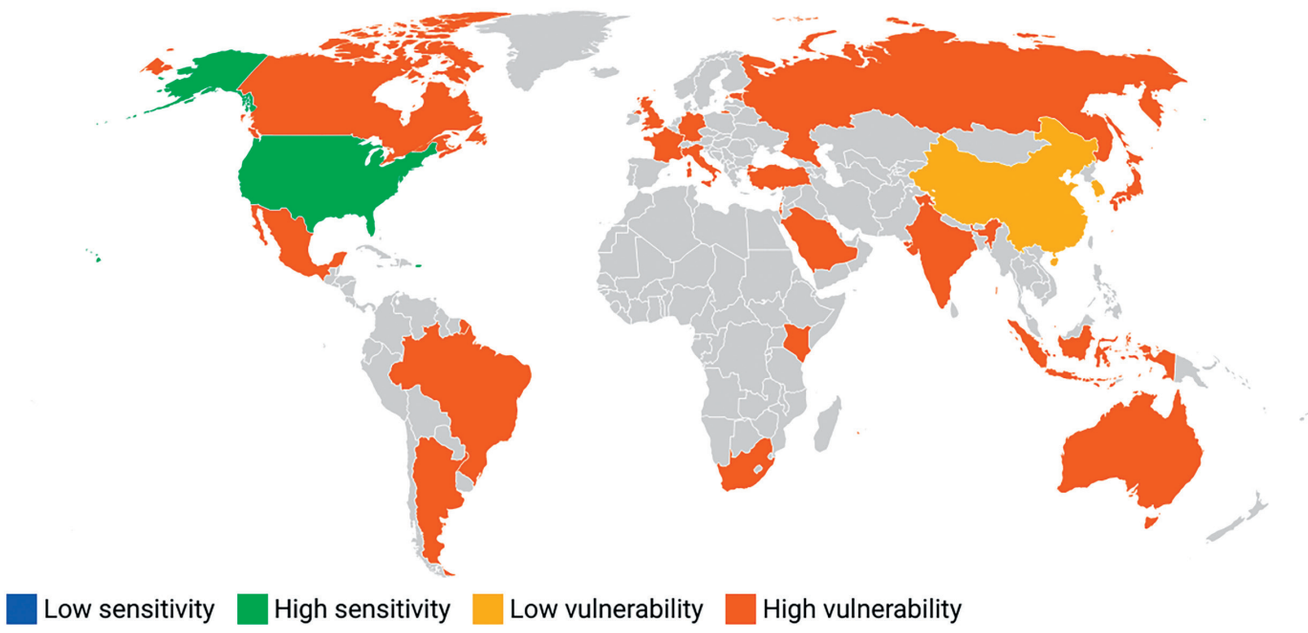
Mobile World Congress provided the opportunity for a few 5G-PPP projects to disseminate their results in person instead of online, as it had become usual in over two years of the Covid-19 pandemic. In this respect, the stands at MWC where very useful to make people aware of the 5G-PPP project activities. Presentations on stage and in special sessions added to the achieved impact.

Further information

- MWC post-event report – *https://assets.mwcbarcelona.com/Content/MWC-Barcelona-2022_Event-Report-1.pdf*
- 5G-TOURS project website – *https://5gtours.eu*
- 5G-Heart project website – *https://5gheart.org*
- *5G-Solutions project website* – *https://5gsolutionsproject.eu*
- DAEMON project website – *https://h2020daemon.eu*

News in brief

High digital dependence of EU countries



Source: © Center for Advanced Security, Strategic and Integration Studies (CASSIS), Rheinische Friedrich-Wilhelms-Universität Bonn * • Created with Datawrapper

Digital dependence of EU countries remains high. This is a central result of a research report published by the Center for Advanced Security, Strategic and Integration Studies (CASSIS) at University of Bonn in April 2022. The report summarises the key findings of the Digital Dependence Index (DDI), which measures the dependence level on different technology sectors of 23 countries.

The primary indicators of the index focus on ICT trade, communication infrastructures, and intellectual property. The level of dependence is scaled from low sensitivity to high vulnerability. The DDI compares 23 dependence indicators based on three different data sets. The digital dependence status of countries can be distinguished as follows: DDI scores between 0.5 and 1 indicate being more digital dependent; DDI scores between 0 and 0.5 indicate being less digital dependent.

In 2019, 87 percent of countries were highly vulnerable. Although the global dependence structure remained stable since then, there are substantial changes.

China, South Korea, Russia, Kenya, and the US became more autonomous in the last decade. Japan and Indonesia, on the other hand, experienced the most pronounced increases in digital dependency while the positions of the other 16 countries changed very little.

The US is by far the least digitally dependent country and has even widened the gap towards the other countries since 2019. Only China and South Korea managed to reduce the gap towards the leader. China, in particular, made the greatest gains during the last ten years.

European countries have maintained a highly vulnerable status, while their autonomy gap to the US, China, and South Korea widened, as European countries have fallen behind in every dimension compared to the three most digitally autonomous countries. According to the report, Europe's digital autonomy has eroded in the last decade. The reason is that digital interactions have become more asymmetric with China (ICT trade dependence), with the US (infrastructure and platform dependence), and the East Asian region (intellectual property dependence).

The authors of the report recommend that European countries should rethink their entire approach to digital technologies and employ a much more comprehensive and bold approach, in order to increase digital autonomy.

Further information

- Digital Dependence Index (DDI) website – *https://digitaldependence.eu/en/*
- Maximilian Mayer and Yen-Chi Lu (2022): Digital Autonomy? Measuring the Global Digital Dependence Structure. Bonn. Center for Advanced Security, Strategic and Integration Studies. *https://digitaldependence.eu/wp-content/uploads/2022/05/DDI_Paper.pdf*

EU Digital Markets Act agreed

On 24 March 2022, the European Parliament and the European Council agreed to introduce new EU rules via the Digital Markets Act (DMA) to limit the market power of big online platforms. The DMA will ban certain practices used by large platforms acting as "gatekeepers" and enable the Commission to carry out market investigations and sanction non-compliant behaviour.

The text provisionally agreed by Parliament and Council negotiators targets large companies providing so-called "core platform services" most prone to unfair business practices, such as social networks or search engines, with a market capitalisation of at least 75 billion euro or an annual turnover of 7.5 billion euro. To be designated as "gatekeepers", these companies must also provide certain services such as browsers, messengers or social media, which have at least 45 million monthly end users in the EU and 10,000 annual business users.

In three-way talks between Parliament, Council and Commission, also known as trilogue, EU lawmakers agreed that the largest messaging services, such as WhatsApp, Facebook Messenger or iMessage, will have to open up and interoperate with smaller messaging platforms upon request. Users of small or big platforms would then be able to exchange messages, send files or make video calls across messaging apps, thus giving them more choice. Regarding interoperability obligations for social networks, co-legislators agreed that such interoperability provisions will be assessed in the future.

The envisage new rules also aim to ensure that combining personal data for targeted advertising will only be allowed with explicit consent given to the gatekeeper. Furthermore, users should be allowed by gatekeepers to freely choose their browser, virtual assistants or search engines.

If a gatekeeper does not comply with the rules, the Commission can impose fines of up to 10% of the gatekeeper's total worldwide turnover in the preceding financial year, and 20% in case of repeated infringements. In case of systematic infringements, the Commission may ban them from acquiring other companies for a certain time.

The Commission had proposed the Digital Markets Act in December 2020 to address the negative consequences arising from certain behaviours by online platforms acting as digital "gatekeepers" to the EU single market.

Further information
https://www.europarl.europa.eu/news/en/press-room/20220315IPR25504/deal-on-digital-markets-act-ensuring-fair-competition-and-more-choice-for-users

The hidden battle

Russia's cyberwarfare against Ukraine and the West

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A month after Russia's invasion of Ukraine had started on 24th February 2022, some commentators were wondering why they could not see any signs of Russian cyberwarfare, which was expected to accompany the bombing of Ukrainian cities. As we know now, this first impression was completely wrong.

On 1st March, The Economist published an article under the headline: "Cyber-attacks on Ukraine are conspicuous by their absence". [1] And an article in Nature, published on 17th March 2022, asked in the headline: "Where is Russia's cyberwar?", followed by this first sentence: "Many analysts expected an unprecedented level of cyberattacks when Russia invaded Ukraine — which so far haven't materialized." [2] It is a matter of debate what you consider "unprecedented" after the already constantly high level of cyberattacks by Russia against Ukraine since the annexation of the Crimea peninsula in 2014. However, just because the massive attack was not fully visible to some Western experts does not mean that it did not take place.

Russia's cyberattack on Ukraine

At the end of March it emerged that intensive Russian cyber-attacks accompanied the Russian invasion. In a press conference on 29 March, the deputy director of the Estonian Information System Authority, Gert Auväärt, rang the alarm bell and announced that the cyber threat level in Estonia had risen following Russia's invasion of Ukraine and the cyberwarfare efforts accompanying it. He mentioned that banks, authorities, agencies, telecoms firms, companies and other significant targets in Ukraine had fallen victim to denial-of-service or malware attacks. At the same time, Ukraine's critical infrastructure had not been paralyzed despite the massive attacks.

Tom Burt, who oversees Microsoft's investigations into big complex cyberattacks, commented the Russian cyberattacks by saying: "They brought destructive efforts, they brought espionage efforts, they brought all their best actors to focus on this." He added that the Ukrainian defenders were able to thwart some of the attacks, as they had become accustomed to fending off Russian hackers after years of online intrusions in Ukraine. He praised the Ukrainian cyber defence: "They've been doing a good job, both defending against the cyberattacks and recovering from them when they are successful." [3]

The conclusion from this is that the main reason why we have not seen too many devastating effects of Russia's cyberwarfare in Ukraine seems to be that Ukrainians were defending well.

Apart from successfully defending against Russian cyber-attacks, Ukraine received effective support from Belarusian hackers.

Counter-attacks in Belarus

The first setback Russia suffered in the cyberwar against Ukraine already happened before the invasion began. A hacktivist group of exiled Belarus tech professionals called Cyber Partisans, who had been fighting against the regime of the autocratic Belarusian president Alexander Lukashenko for years, became active at the first signs of the Russian military buildup at the border to Ukraine. The Cyber Partisans attacked the Belarusian train system, which has been important for moving Russian soldiers, tanks, heavy weapons and other military equipment to the Ukrainian border. They exploited security holes in the more than two decades old Windows XP operating system on which large parts of the IT infrastructure of the Belarusian train system have been based.

In collaboration with Belarusian railroad workers and dissident Belarusian security forces, the Cyber Partisans managed to slow down Russian troop movements and supplies. This contributed to the logistical chaos of the Russian armed forces in the first weeks of the war, which left Russian troops stranded on the front lines without food, fuel and ammunition. In this way, the cyber sabotage of Russian logistics supported Ukraine's successful military resistance against the Russian armed forces in the Ukrainian capital Kyiv and other cities in the north of the country.

Russia's cyberattacks on Western countries

Ukraine is by no means the only target of Russian cyberattacks. Cyberwarfare by Russia against Western countries has a long history. [4] The most prominent event was the cyberattack on Estonia in April 2007. Although it had never been proven that the Russian government was behind it, the trail clearly led to Russia. Since the Russian annexation of Crimea in 2014, cyberattacks against Western countries like Germany, France, Poland, the UK, and the US have increased in both intensity and scope.

Cyberwarfare by Russia has included a plethora of different activities, from hacker attacks to disinformation. There are indications that Russia

interfered through disinformation and other measures with the Brexit vote in the UK and the US presidential election in 2016.

NATO's cyber defence

Since 2008, NATO has been building up its cyber defence, in response to growing cyberthreats by countries like Russia, China, and North Korea. A year after the cyberattack on Estonia, NATO founded the Cooperative Cyber defence Centre of Excellence in Tallinn. At the 2014 NATO Summit in Wales, after the Russian annexation of Crimea, NATO adopted an enhanced policy and action plan. It established cyber defence as part of the Alliance's core task of collective defense and set out to further develop NATO's cyber defence capabilities in collaboration with industry. [5]

Conclusion

At the time of writing, it is not clear, when and how the Russian war against Ukraine will end, and what types and levels of cyberwarfare will occur in within this conflict. What appears certain is that cyberwarfare has become a standard element of conflict between nations, which has expanded the arsenal of hybrid warfare. Challenges for maintaining cybersecurity will subsequently increase, making both the physical world and the virtual world a less safe place. Significant investments in cyber defence and cybersecurity will be needed on all levels, in order to ensure security and resilience of Western democratic societies.

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[2] Elizabeth Gibney, Where is Russia's cyberwar? Researchers decipher its strategy, Nature, 17 March/ 18 March 2022 – https://www.nature.com/articles/d41586-022-00753-9

[3] Preston Gralla, Russia is losing the cyberwar against Ukraine, too, Computerworld, 2 May 2022 – https://www.computerworld.com/article/3658951/russia-is-losing-the-cyberwar-against-ukraine-too.html

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[5] Cyber defence, article on NATO website, 23 March 2022 – https://www.nato.int/cps/en/natohq/topics_78170.htm

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