VIRTUAL CONFERENCE
FINAL PROGRAMME
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Message from the General Co-Chairs

It is a great pleasure to welcome you to this joint edition of the 30th European Conference on Networks and Communications (EuCNC2021) and of the 3rd 6G Summit. We are extremely happy to join forces with the 6G Summit held in Finland in 2019 and 2020 to boost the 6G dimension of European Research and Innovation. Due to COVID-19 pandemic restrictions, this conference, initially planned to be held in Porto, Portugal, will now be run totally virtually.

This edition represents a landmark in the history of the conference. When its predecessor, the “Mobile Summit” conference, was launched 30 years ago, the first European GSM network was not even deployed and most optimistic market studies predicted about 40 million users in Europe. Three decades later, we have more active mobile devices in the world than the number of inhabitants on the planet. The mobile revolution has penetrated each and every domain of economic and social activities and each generation has brought new innovation: data with 3G, broadband internet with 4G, and now the object connectivity with 5G, with important prospects to accelerate the digitisation of multiple business processes in vertical industry.

For each of these innovations, Europe has been able to count on world-class R&D actors from industry, universities and research centres. But there is no room for complacency! With a multiplicity of 6G initiatives being now launched around the world, Europe needs to be ready to tackle the new challenge, to seize the opportunity to consolidate its leadership with a competitive, green and sovereign capability in this strategic sector and to answer the call of the ambitious digital and green policy agenda of this Commission.

In the context of the 2021-27 Framework programme, the priority is hence to reinforce Europe’s competitiveness and strategic autonomy through excellence in R&D&I and strategic investments addressing identified market failures, whilst continuing to promote 5G lead markets across vertical sectors, aiming at creating a digital ecosystem in Europe. The focus extends beyond networking and spans the whole value chain from components and devices to the Cloud, AI and Cybersecurity. In the same way, it extends beyond technology into applications and user experience, aiming at economic and societal impact.

In order to achieve this priority, the Commission adopted a two-pronged approach: launching a 6G flagship whilst promoting 5G deployment, towards the goal of 5G everywhere. This will be done through a strategic European partnership on Smart Networks and Services (SNS) supported by 900 million € from the Horizon Europe programme and leveraging a similar investment from the private side. SNS will build upon the 700 million € of 5G PPP in Horizon 2020, including over 60 million € on beyond 5G, in eight projects addressing specific technologies and a 6G flagship project.

Besides implementing 6G research, the SNS partnership is planned to coordinate over 1 billion € of deployment actions under the CEF2-Digital programme, in particular on the cross-border 5G Corridors. This will be complemented by 5G national investments at Member States level under the umbrella of the Resilience and Recovery Fund, where about 150 billion € have been reserved for Digital investments.

By spanning the broad scope from 5G (moving towards deployment) to 6G (moving from vision to concepts and to technology enablers), this year’s joint EuCNC & 6G Summit will already reflect their duality.

This conference is finally an opportunity for EU-funded projects to showcase their substantive achievements, through compelling demonstrations, at the end of the Horizon 2020 programme, with a continued focus on 5G trials and on Beyond 5G, and to confirm the excellence of European research and innovation in communication technologies.

We wish you a very fruitful and enjoyable online conference.

Pearse O’Donohue & Miguel Almeida
Conference General Co-Chairs
The 2021 Joint EuCNC & 6G Summit, initiated this year, builds on putting together two successful conferences in the area of telecommunications: EuCNC, in its 30th edition of a series, supported by the European Commission, and the 6G Summit, in its 3rd edition, originated from the 6G Flagship programme in Finland, one of the very first in its area.

This conference was expected to take place in the beautiful city of Porto but, due to the pandemic situation which is largely affecting international travels, we decided to realize it virtually.

The conference focuses on aspects of telecommunications ranging from 5G deployment and mobile IoT to 6G exploration and future communications systems and networks, including experimentation and testbeds, applications and services. It is carried out under the motto On the Road to 6G.

We received 215 paper submissions from 33 countries, not only from Europe, but also as from other regions, namely Asia/Pacific, USA, Middle East, Africa, Canada and Latin America. Each paper was reviewed by at least three qualified reviewers, with an overall acceptance rate of 50%. We also received proposals for organizing 22 Workshops, 10 Special Sessions and 9 Tutorials.

The conference occurs from 8th to 11th of June 2021. The first day is dedicated to Workshops and Tutorials. Starting formally on the 9th of June, the conference will consist of plenary sessions and parallel sessions. Plenary sessions will include keynote speeches by Michael Peeters, Manuel Ramalho Eanes, Roberto Verdone, and Petter Vetter, as well as discussion panels dedicated to the following themes: “6G and B5G prospects for vertical industry”, “Components and hardware on the road to 6G”, and “6G – from visions to system requirements”. The parallel sessions will be dedicated to paper presentations, special sessions and posters. The conference will offer also to participants a virtual exhibition, consisting of virtual booths and facilities for enabling also the real-time interaction with participants.

We thank all authors for submitting their manuscripts, as well as the track chairs and reviewers for their devotion to selecting high quality contributions. A special thanks goes to the European Commission, the conference supporter, IEEE, and the Portuguese Presidency of the Council of the EU 2021. We also thank our patrons: NOS – Diamond Patron, Huawei – Platinum Patron, Nokia – Gold Patron, and Ericsson – Bronze Patron.

Finally, we would like to emphasize the hard work of the Local Organising Committee, and thank them for their enthusiasm even when we realized that this event could not be organized the way we all planned and expected.

We hope that you enjoy the 2021 Joint EuCNC & 6G Summit program and consider contributing to the next year’s edition of the conference.

Manuel Ricardo, Ari Pouttu and Rui Campos
Technical Program Committee Chairs
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Keynote Speakers
Instructions to Antennas: 6G on the back of an envelope (or napkin)

Wednesday, June 9, 9:30 – 10:15

Michael Peeters
VP R&D Connectivity/Imec,
Belgium
Professor Advanced Wireless
& 5G Networks/Universiteit Antwerpen, Belgium

5G deployments are still in their infancy and yet here we are debating the multiple dimensions that will characterize 6G. Some may claim that this is just the result of an overheated hype engine but there is more to this: our gut is telling us that we have reached the edge of what current microelectronic technologies can enable. This is not unique to our domain. With Moore's law under pressure, a rethinking of what the semiconductor industry calls scaling is also underway. Blending of different technologies together to achieve benefits at the system level using System-Technology Co-Optimization (STCO) is taking central stage. The current vision of 6G requires the support of the THz band, novel antenna technologies, evolution of network topology, spectrum sharing, edge AI, split computing, high-precision time-sensitive networks, and so on. Let's ground ourselves with some key zeroth-order approximations that can guide us in analyzing the constraints of such systems and show where these lead us.

Michael Peeters is VP of R&D for Connectivity at imec. His previous experience as CTO for both the Wireline and Wireless business lines at (what is now) Nokia was built on the culture, enthusiasm, and love for technology and science that he got from his time at Bell Labs—and the principles of Free Inquiry bestowed on him by his Alma Mater, the Vrije Universiteit Brussel (VUB). Next to this, he has served as the President of the CBRNS Alliance, on the Board of 5G Americas, and on the Board of ATIS. Passionate about inspiring the next generation of engineers with the challenges of communications, he currently also lectures in Advanced Wireless and 5G Networks at the University of Antwerp. During his research career starting with a Ph.D. in Applied Physics and Photonics from the Vrije Universiteit Brussel (VUB), he has authored more than 100 peer-reviewed publications, many white papers and holds patents in the access and photonics domains. An electrotechnical engineer by training, he is a senior member of IEEE and a Fellow of the VUB. Outside of work, his quest to discover the recipe for a perfect lasagna is balanced by bouts of long-distance running to offset the inherent caloric intake. See also: https://www.linkedin.com/in/multiplex/

NOS is the largest communications and entertainment group in Portugal. It offers state-of-the-art fixed and mobile solutions to all market segments, supported by the most advanced technologies. In 2020, NOS was the largest private Portuguese R&D investor, reflecting a strong commitment to innovation and technological development, which is part of NOS DNA since the first day.

In this context, we look at 5G not only as our main strategic pillar but as an important catalyst for the upcoming industrial revolution, which promises to change the way we live, how companies work and how societies govern themselves. The disruption that 5G contains, more than the direct extrapolation of its characteristics, involves all the adjacent technologies that it drives. Without the latency, reliability, resilience, speed and performance of 5G, these technologies would never be scalable. In this sense, 5G is the accelerator of a digital society marked by immersive experiences, autonomous and collaborative mechanisms, massive exchanges of information, artificial intelligence and sensing of the physical world.

To seize this opportunity, it is therefore necessary to work in a network, fostering comprehensive and complementary ecosystems, with a great focus on experimentation, but also on the real value for the economy. That’s how we started our path to 5G at NOS. By creating agile teams, with employees from multiple departments, but working close to various partners, ensuring the adaptation of technology to each business, in different contexts. In this sense, we believe that we are at the forefront of technology implementation, actively contributing to the construction of smart cities and the development of society 5.0.

As an engine of transformation in Portugal and always embracing the future, NOS wants to inspire and mobilize everyone to conquer new possibilities, in a country and culture that has the fundamental requirements to incubate the ideas and initiatives that will transform the world.

Manuel Ramalho Eanes is an Executive Board Member of NOS SGPS. Manuel is responsible for the B2B segment and leads the strategy for ICT, IoT and Cloud services, positioning NOS at the forefront of innovation and business transformation. Manuel is also leading the mission of helping Portuguese enterprises to embrace the digital revolution, mainly through the adoption of 5G, Artificial Intelligence, Internet of Things or Big Data. Before joining NOS, Manuel was an Executive Board Member of Optimus – Comunicações, SA with responsibility over the areas of Corporates and Operators, and before that he was head of the Residential Fixed Business, Central Marketing and Data Services, Personal Sales, Small Businesses and Business Development. Manuel Ramalho Eanes started his career at McKinsey & Co and holds a Degree in Business Management by the Universidade Católica Portuguesa (Lisboa) and an MBA by INSEAD.

How 5G will enable a Digital Society

Wednesday, June 9, 10:15 – 11:00

Manuel R. Eanes
Executive Board Member,
NOS SGPS, Portugal
The Internet of Things (IoT) paradigm, after two decades of development based on non-3GPP short and long range radio technologies, is entering a new phase with the deployment of 5G networks, which aim at integrating it into the 3GPP systems. This will open the door to new IoT applications like for instance the Industrial IoT for predictive maintenance. However, 5G will not be able to cover all requirements posed by the most advanced applications. With the advent of 6G, a new phase will be initiated: new IoT domains will be addressed, and more ambitious key performance indicators will be set. This talk discusses some of the new IoT scenarios envisaged for the 6G era. From the technological side, 6G might introduce several disruptive new enabling technologies. Some of them will appear already in the current decade in the context of 5G, and will express their full potential with 6G; some others require a level of maturity that will make them available only in the next decade and so will be implemented only with 6G. To mention some: AI-based networking, the use of meta-surfaces, drone base stations, joint communication and radio detection, high-precision localisation, THz communications. In this talk we also discuss which ones promise to boost the IoT towards more advanced paradigms and applications.

Roberto Verdone is Full Professor in Telecommunications at the Univ. of Bologna, where he heads the a research group performing research on i) Radio Resource Management for mobile systems, ii) MAC, routing and topology aspects of the IoT, iii) architectures and technologies for the IoT. In particular, he is active in the field of the intelligent IoT in 5G and 6G networks, THz communications, and UAV-aided networks. Since 2020 he is Director of the National Laboratory of Wireless Communications, WiLab, participated by about fifty researchers. He is also co-Director of the WiLab-Huawei Joint Innovation Center on “Intelligent IoT for 6G” established in 2020 for the decade 2020-2030. He published about 200 research papers, on IEEE journals / conferences. He has been involved / has coordinated more than ten European projects, and many industrial contracts in the past 15 years. He contributed in various roles to the Organising Committee of several IEEE conferences like ICC, VTC, PIMRC. In 2014, he was the organiser and General Co-Chair of the first edition of EuCNC, held in Bologna.

The 6G era will be defined by the symbiosis of digital, physical, and biological worlds with the goal to augment human productivity and wellbeing. While in the 5G era, with thanks to the massive scale deployment of sensors, the digital world perfectly captures past and current states of the physical world, the connection of these two worlds with the biological or cognitive world remain largely unaddressed. We believe that in the 6G era cognitive systems will anticipate individual and collective intents to plan for actions in the worlds that optimally serve human needs. For that to happen we will need to witness significant advances in artificial intelligence, computing and sensing technologies. The 6G network will be the essential infrastructure for the integration of these future capabilities.

Peter Vetter is Head of A-Lab (Access & Devices Research Lab) at Nokia Bell Labs and Bell Labs Fellow. He is leading an eminent global team with the mission to invent game changing innovations that define the future of mobile and fixed access. Under his leadership, he and his teams have realized several world-first system demonstrations in access and successfully transferred industry leading concepts into product. After a PhD at Gent University (Belgium) and post-doc at Tohoku University (Japan), he joined Alcatel (now Nokia) in Antwerp in 1993 and has been based in Murray Hill, New Jersey since 2009.
**6G – from visions to system requirements**

**Motivation and Background**
Mobile wireless research community is shifting the focus towards 2030 era, i.e., 6G technologies. Evolutionary ideas from 5G as well as radically new ones are being studied in various international initiatives. Most recently also industry has shown increasing interest to start envisioning what 6G could entail from societal, technology and business perspectives. At this early stage it is a bit difficult to have a debate on these aspects, but rather hear out visions, goals and priorities related to 6G.

**Questions**
- What are currently the views on major drivers necessitating establishing 6G technology from societal, technology and business perspectives?
- What are foreseen major regulative hurdles on the way?
- Looking back, is the expected standards process going to be similar to earlier ones?
- Is there anything particular to be done in global research arena to ease the situation in currently polarized world related to 5G?

**Participants**
- **Chair:** Matti Latva-aho (Moderator) (Prof., Director for 6G Flagship, Univ. of Oulu, Finland)
- Mikko Uusitalo (Co-ordinator for Hexa-Project, Nokia Bell-Labs, Finland)
- Peiying Zhu (Senior Vice-President of Wireless Research, Huawei, Canada)
- Alan Carlton (Senior Director for Innovation Labs, InterDigital, United Kingdom)
- Akihiro Nakao (Prof., Beyond 5G Programme / Univ. of Tokyo, Japan)
- Jan Söderström (Vice President and Head of Technology Office Silicon Valley, Ericsson, USA)

**Matti Latva-aho**
Matti Latva-aho received the M.Sc., Lic.Tech. and Dr. Tech (Hons.) degrees in Electrical Engineering from the University of Oulu, Finland in 1992, 1996 and 1998, respectively. From 1992 to 1993, he was a Research Engineer at Nokia Mobile Phones, Oulu, Finland after which he joined Centre for Wireless Communications (CWC) at the University of Oulu. Prof. Latva-aho was Director of CWC during the years 1998-2006 and Head of Department for Communication Engineering until August 2014. Currently he serves as Academy of Finland Professor in 2017 – 2022 and is Director for National 6G Flagship Programme for 2018 – 2026. His research interests are related to mobile broadband communication systems and currently his group focuses on beyond 5G systems research. Prof. Latva-aho has published close to 500 conference or journal papers in the field of wireless communications. He received Nokia Foundation Award in 2015 for his achievements in mobile communications research.

**Mikko Uusitalo**
Mikko Uusitalo is Head of Research Department Wireless Advanced Technologies at Nokia Bell Labs Finland. Mikko is leading the European 6G Flagship Hexa-X. He obtained a M.Sc. (Eng.) and Dr.Tech. in 1993 and 1997 and a B.Sc. (Economics) in 2003, all from predecessors of Aalto University. Mikko has been at Nokia since 2000 with various roles, including Principal Researcher and Head of International Cooperation at Nokia Research.

**Peiying Zhu**
Dr. Peiying Zhu, Senior Vice President of Wireless Research, is a Huawei Fellow and IEEE Fellow. She is currently leading 5G and beyond wireless research in Huawei. The focus of her research is advanced wireless access technologies with more than 200 granted patents. She has been regularly giving talks and panel discussions on 5G vision, enabling technologies and standards. She served as the guest editor for IEEE Signal processing magazine special issue on the 5G revolution and IEEE JSAC on Deployment Issues and Performance Challenges for 5G. She co-chaired various 5G workshops in IEEE GLOBECOM. She is actively involved in 3GPP and IEEE 802 standards development. She is currently a WiFi Alliance Board member. Prior to joining Huawei in 2009, Peiying was a Nortel Fellow and Director of Advanced Wireless Access Technology in the Nortel Wireless Technology Lab. She led the team and pioneered research and prototyping on MIMO-OFDM and Multi-hop relay. Many of these technologies developed by the team have been adopted into LTE standards and 4G products.
Alan Carlton

Alan Carlton is Vice President, InterDigital Wireless Labs Organization in Europe. Alan is responsible for R&D activities in the areas of 5G and IoT. Alan has led his organization to over twenty major collaborative project and testbed wins in these areas. He founded and led the UK oneTRANSPORT initiative, one of the largest Smart City projects in the UK to full commercial launch. In 5G, Alan’s research & standardization interests include radio access network, next generation internet and advanced applications of NFV/SDN and Edge technologies. Alan has over 25 years wireless industry experience spanning every generation of wireless. Prior to InterDigital, he held senior positions at Nortel, Siemens and several wireless startups both in Europe and United States. Alan is an EEE graduate of the University of Strathclyde, Glasgow and also holds a MSc. in Communications & Signal Processing from Imperial College, London. Alan holds many patents covering a diverse range of wireless technology areas. He is a regular invited speaker at major wireless industry events including Mobile World Congress in 2017, 2018 and 2019, and a frequent blogger on wireless futures on various platforms including Computerworld.

Akihiro Nakao

Akihiro Nakao received the B.S. (1991) in Physics, M.E. (1994) in Information Engineering from the University of Tokyo. He was at IBM Yamato Laboratory, Tokyo Research Laboratory, and IBM Texas Austin from 1994 till 2005. He received M.S. (2001) and Ph.D. (2005) in Computer Science from Princeton University. He has been teaching as an associate professor (2005-2014) and as a professor (2014-present) in Applied Computer Science, at Interfaculty Initiative in Information Studies, Graduate School of Interdisciplinary Information Studies, the University of Tokyo. From 2019 to present, he has served as Vice Dean of the University of Tokyo’s Interfaculty Initiative in Information Studies (2019-present). He was appointed as an adviser to the President of the University of Tokyo in 2019 and as a special adviser to the President of the University of Tokyo in 2020.

Jan Söderström

Jan Söderström is Vice President and Head of Technology Office Silicon Valley at Ericsson reporting to Ericsson Group CTO. In this capacity he drives the technology leadership work in 5G, Cloud and IoT including co-creation with ecosystem partners. He has built up the Ericsson D-fifteen Lab network platform for use case innovation and testing. Jan is also engaged in the quest for American leadership in 5G and 6G – he serves as the Vice chair of the NextG Alliance and as a board member of ATIS. From 2013 to 2017 Jan was driving the NFV and cloud transformation program at Ericsson. Prior to this Jan had a decade long engagement at Ericsson Research heading the research in IP and Cloud, including three years in San Jose building up the Ericsson lab there. Jan has a PhD in Applied Physics from Chalmers University of Technology and spent his early career working with optoelectronic devices and optical networking.
Components and Hardware on the Road to 6G

Motivation and Background

Today, Europe is strongly dependent on the supply of integrated circuits for various subsystems (e.g., CPU, optical module, …) by chipset vendors from other continents. From an economic and a robustness of supply chain perspective, this is an urgent matter for Europe to address on the road to 6G.

This entails, a) in the short term, Europe shall leverage and combine its strengths in telecommunications, microelectronics and vertical industries, and coordinate its actions with a strategic value chain approach; b) in the medium term, Europe shall secure its design and manufacturing capability of microelectronics chip, firstly by strengthening Europe’s current position and leveraging the existing ecosystems (for example IoT and automotive), and secondly by supporting the emergence of new champions, focusing on strategic parts of the value chain. Such actions will enable Europe to play a significant role in the global semiconductor supply chain, and consequently secure its competence towards the evolved 5G and 6G.

European Core Technologies for future connectivity systems and components (COREnect) is a coordination and support action (CSA) project that brings major European stakeholders from both the telecommunication and microelectronics industries together, along with connectivity-enabled vertical industries. It is part of the 5G Public-Private Partnership. COREnect is developing a cross-industry technology roadmap of core component and subsystem technologies for the evolution of 5G towards 6G. The strategic goal of the project is to help diversify and reduce European dependence on other continents when building up future connectivity systems.

This pane will elaborate on the first COREnect’s findings and results related to the expected role of microelectronics in 6G. Ideas and recommendations on strategic measures to address these challenges, as well as the potential roles of the various stakeholders in such future 6G ecosystems (e.g., industry, SMEs, academia, associations, public authorities, etc.), will also be discussed.

Questions

- What are the major technological and business challenges & opportunities for Europe on the road to 6G?
- How will Europe's attractiveness (innovation, investments, talents) across business segments be affected by evolved 5G and 6G?
- Why is it important for Europe to have a strong ecosystem in hardware/components for connectivity?
- What are the potential roles of various stakeholders in a future 6G ecosystems?
- What's kind of strategic initiatives does Europe need? – Now, 5 years out, 10 years out? By whom?
Björn Ekelund

Björn Ekelund received his MSc and PHL in Telecommunications Microelectronics from Lund University in 1985 and 1987, respectively. He joined Ericsson in 1987 and was over almost two decades responsible for microelectronics and software development for Ericsson’s mobile phone products. In 2004 he moved into product planning and marketing, and later into strategy, working for the ST-Ericsson joint venture. Since 2015 he is with Ericsson Research, leading electronics, antenna, and IOT research. Mr. Ekelund serves on the board of several publicly funded research and innovation programs, then further moved into collaborative projects and partnership management. She held different managerial positions in France and Belgium, enlarging her responsibilities to Public Relations and External Affairs. In her current position as the Director General of AENEAS, she supports the European electronic components and systems industry in dealing with the European Commission and national Public Authorities. AENEAS has a special focus on strategic investment and Research & Innovation funding programmes, at a time when European leadership is being challenged in a global environment. In particular, AENEAS plays an active role as part of the Private Members Board of the ECSEL Joint Undertaking under Horizon 2020. In addition, AENEAS is active in the operation of EUREKA funding instruments through managing the PENTA Cluster programme. PENTA was created to catalyse collaborative R&D in micro and nanoelectronics enabled system and applications, in close partnership with national funding authorities.

Caroline Bedran

Caroline Bedran has been active in the electronics and semiconductors industry for most of her career, primarily at Philips and NXP. She also has experience in the telecommunications and 5G industry, both at European and global level. After graduating as an engineer in Electronics, she was involved in RD&I activities, then further moved into collaborative projects and partnership management. She held different managerial positions in France and Belgium, enlarging her responsibilities to Public Relations and External Affairs. In her current position as the Director General of AENEAS industrial association, she supports the European electronic components and systems industry in dealing with the European Commission and national Public Authorities. AENEAS has a special focus on strategic investment and Research & Innovation funding programmes, at a time when European leadership is being challenged in a global environment. In particular, AENEAS plays an active role as part of the Private Members Board of the ECSEL Joint Undertaking under Horizon 2020. In addition, AENEAS is active in the operation of EUREKA funding instruments through managing the PENTA Cluster programme. PENTA was created to catalyse collaborative R&D in micro and nanoelectronics enabled system and applications, in close partnership with national funding authorities.

Lars Reger

Lars Reger is executive vice president and chief technology officer of NXP Semiconductors. As CTO, Lars is responsible for managing new business activities and R&D in the focus markets of automotive, industry 4.0., internet of things (IoT), mobile, and connectivity & infrastructure. Before joining NXP, Lars gained deep insight into the microelectronics industry with a focus on the automotive sector. He began his career with Siemens Semiconductors as product engineer in 1997. His past roles at Infineon included head of the process and product engineering departments, project manager for mobile system chips, and director of IP management. Prior to joining NXP as head of automotive strategy in 2008, he was responsible for business development and product management within the connectivity business unit at Continental. In December 2018, Lars was appointed CTO and has since then been responsible for the overall technology portfolio of NXP. Since April 2019, he has been a board member of the committee for digital economy, telecommunications and media in the German Industry Association. Lars is also on the board of directors of ITS World Congress and a member of the Forbes Technology Council.

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Thomas Kropf

Professor Thomas Kropf is president of the Bosch Group's corporate sector for research and advance engineering. Headquartered in Renningen, Germany, the research sector has locations across the globe, including major research and technology centers in North America, China, and India. It covers all the systems and technologies found in Bosch products, ranging from mobility solutions, industrial technology, and energy and building technologies, to consumer goods. In addition, Kropf is also responsible for the Bosch Center for Artificial Intelligence, as well as for grow, a Bosch-internal start-up platform. Prior to his current assignment, Kropf was senior vice president with responsibility for cross-divisional automotive systems engineering in the Mobility Solutions business sector. In this role, he also defined the company's automotive technology strategy, reporting directly to the Bosch board of management. Further assignments included responsibility for the Infotainment business unit of the Bosch Car Multimedia division, product management and advanced engineering in the Chassis Systems Control division in Abstatt, Germany, software and systems engineering as well as customer project management for radar, video, and ultrasonic driver assistance systems in the Driver Assistance business unit in Leonberg, and microelectronics development in the Automotive Electronics division. Professor Kropf joined Bosch in 1999, after successfully completing an assistant professorship at the Karlsruhe Institute of Technology, Germany. He holds a master's degree in electrical engineering from the University of Darmstadt, Germany, as well as a Ph.D. and a higher doctorate (Habilitation) in computer science from Karlsruhe Institute of Technology (KIT), Germany. In addition to his position at Bosch, Thomas Kropf is adjunct professor at the University of Tuebingen, Germany, where he teaches computer science.

Björn Ekelund

Björn Ekelund received his MSc and PHL in Telecommunications Microelectronics from Lund University in 1985 and 1987, respectively. He joined Ericsson in 1987 and was over almost two decades responsible for microelectronics and software development for Ericsson's mobile phone products. In 2004 he moved into product planning and marketing, and later into strategy, working for the ST-Ericsson joint venture. Since 2015 he is with Ericsson Research, leading electronics, antenna, and IOT research. Mr. Ekelund serves on the board of several publicly funded research and innovation programs as well as on that of some corporations and government bodies.

Lars Reger

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6G and B5G prospects for vertical industry

Wednesday, June 9, 14:00 – 15:30

Organizer: Markus Dillinger, Huawei Technologies Duesseldorf GmbH, Munich, Germany

Motivation and Background

The discussions about B5G or 5G evolution and 6G have started ca. 2 years ago and the discussed concepts are vague and circle around higher order MIMO, AI and Distributed Computing. For the vertical industry it is difficult to understand potential benefits, threats, opportunities or even weaknesses of future concepts. Still, 5G is not yet fully commercially in place for vertical applications. For instance, 5G R16 is still to come for commercial cars and 5G R16 does not offer all the features the manufacturing industry requires. The vertical sectors need urgently to get involved in such discussions to avoid useless 6G strategies and insufficient solutions. New solutions should not just be an extrapolation of known 5G concepts by increasing MIMO orders and higher processing powers. Moreover, 6G must address e.g. energy saving concepts by making more intelligent use of resources and offering new use cases which were not addressed in 5G. We will naturally see new capabilities by merging sensing and communication technologies, new short range use cases like body area networks and the emerging of non-terrestrial network as integral part of the 6G story. The panellists will try to identify new 6G technical enablers and concepts and will discuss their potential benefits or concerns for automotive, ehealth, manufacturing and other verticals.

Questions

- What are the shortcomings you see in 5G networks and their known 3GPP features?
- Benefits of using much higher radio frequencies up to VLC in your industry?
- Is there a need for better short range communications and networks for your industry?
- Which benefits you expect from NTN and its potential integration into terrestrial networks?
- What are the potential threats for vertical industries?
- Which use cases can be better supported by 6G or 5G evolution networks?

Participants

- Chair: Markus Dillinger (moderator) (Head of 5G R&D for verticals, Huawei Technologies Duesseldorf GmbH, Germany)
- Nancy Alonistioti (Assoc. Prof. in Informatics and Telecommunications, Dept. of Informatics and Telecommunications, N. K. University of Athens, Greece)
- Antonio Eduardo Fernandez-Barciela (Car2X connectivity expert, Spain)
- Andreas Mueller (Head of Communication and Network Technology in the Corporate Research Department of Robert Bosch GmbH, Stuttgart, Germany)
- Frederic Thepot (Director, DOCOMO Laboratories Europe GmbH, Munich, Germany)
- Christoph Thuemmler (Physician and the Clinical Lead of the Clinic for Care of the Elderly at Leipzig Park Klinikum and Head of the Centre for Care of the Elderly of Leipzig, Germany)
- Jorge Graça (Chief Technology and Information Officer, and Executive Board Member, NOS SGPS, Portugal)

Markus Dillinger

The discussions about B5G or 5G evolution and 6G have started ca. 2 years ago and the discussed concepts are vague and circle around higher order MIMO, AI and Distributed Computing. For the vertical industry it is difficult to understand potential benefits, threats, opportunities or even weaknesses of future concepts. Still, 5G is not yet fully commercially in place for vertical applications. For instance, 5G R16 is still to come for commercial cars and 5G R16 does not offer all the features the manufacturing industry requires. The vertical sectors need urgently to get involved in such discussions to avoid useless 6G strategies and insufficient solutions. New solutions should not just be an extrapolation of known 5G concepts by increasing MIMO orders and higher processing powers. Moreover, 6G must address e.g. energy saving concepts by making more intelligent use of resources and offering new use cases which were not addressed in 5G. We will naturally see new capabilities by merging sensing and communication technologies, new short range use cases like body area networks and the emerging of non-terrestrial network as integral part of the 6G story. The panellists will try to identify new 6G technical enablers and concepts and will discuss their potential benefits or concerns for automotive, ehealth, manufacturing and other verticals.
Nancy Alonistioti is Assoc. Prof. in Informatics and Telecommunications in the Department of Informatics and Telecommunications, of which she is currently Vice-Chair, of the N. K. Uni. of Athens. She has over 20 years of experience in numerous national and European projects, including projects/technical management experience (e.g., MOBIVAS, ANWIRE, LIASON, E2R 1Mi, E3, SefInet, SACRA, CONSERN, UniverSelf, SmartAgriFood). She is currently leading the SCAN group activities. She has served as member of the Future Internet Assembly Steering Committee. Recent activities and projects are in the areas of 5G (5GCroco, 5GROWTH), 6G (RISE 6G), European Digital Innovation Hubs (coordinator of LIVINGTRAC) and Smart cities and Smart Maritime (national projects). She is member of the ETSI Experts group and the Greek standardization group ELOT (5G, smart city, and autonomic communications). She has over 150 publications in the area of mobile networks, NGI, SDN/NFV, IoT and AI, Smart City/Maritime applications, autonomic communications and reconfigurable mobile systems. She is coauthor of 4 WO Patents and has more than 2500 citations.

Antonio Fernandez Barciela is a Car2X expert at Stellantis. He graduated in Telecom Vigo with long experience in mobile oriented projects and a strong IT background in network, security and protocols. Experience as a voice and data architecture for corporate mobile environments. From 2012 working in the R&D department of PSA for connectivity projects. He is the WGS chair in SGAA for business model and go to market strategies. Project leader and contributor in national and international (AUTOPILOT, TOWARDS5G, 5GCAR, CONCORDA, SAT2CAR, 5GCROCO) innovation projects, working closely with companies from the automotive and the IT world. He is a well-known Car2X connectivity expert holding several patents.

Andreas Mueller is the Head of Communication and Network Technology in the Corporate Research Department of Robert Bosch GmbH in Stuttgart, Germany and at the same time the Bosch Chief Expert for Communication Technologies for the IoT. In addition to that, he is coordinating the Industrial 5G activities of Bosch across the different business units. He also serves as General Chair of the “5G Alliance for Connected Industries and Automation” (5G-ACIA), the globally leading initiative for driving and shaping Industrial 5G. Prior to joining Bosch, Andreas was a Research Staff Member at the Institute of Telecommunications of the University of Stuttgart, Germany, where he was contributing to the further development of the 3GPP Long Term Evolution towards LTE-Advanced. Besides, he was working as a Systems Engineer for Rohde & Schwarz, developing a novel software-defined radio based communication system for the German Armed Forces. Andreas holds a German Diploma degree as well as a Ph.D. degree in Electrical Engineering (with distinction) and a M.Sc. degree in Information Technology, all from the University of Stuttgart, Germany.

Prof. Christoph Thuemmler is a physician and the Clinical Lead of the Clinic for Care of the Elderly at Leipzig Park Klinikum and head of the Centre for Care of the Elderly of Leipzig region. He has also been a Professor of eHealth with Edinburgh Napier University since 2010. He has been working with wireless technologies and mobile radio technologies in the health domain for more than 20 years. Prof. Thuemmler was an advisor to the EC at the EU-China round table on the IoT and also served as the convener of the 5G Health vertical of 5GPP in the first years of the project campaign. Amongst many other publications he contributed to MWC conference papers and the 5GPP health vertical white paper. Lately he implemented the first 5G hospital campus network in Europe at Helios Campus Leipzig, Germany. The initiative has been funded by the state of Saxony. Testing and validation of the facility has recently commenced and the 5G campus network should be ready for testing innovative medical technology by summer 2021. He is the founder of the 5GHealth Institute, which will focus on the standards and specifications of 5G for the health domain.

Frederic THEPOT joined NTT DOCOMO in 2005 as Senior Manager, Standardization and was responsible for 3GPP SA1/SA2 activities as well ETSI and NGMN activities within NTT DOCOMO Global Standardization team. During that time, he pioneered the 4G/LTE new core architecture transformation “All-IP-Network” and started many new study and work items like M2M. He is now the Director of DOCOMO Laboratories Europe whose role is to develop the necessary 5G and NFV standards within 3GPP, ETSI, NGMN, 5G-ACIA and 5GAA in order to accelerate the deployment of 5G services to a broader ecosystem. In particular, he started tri-lateral collaboration on V2I with both Telecom vendors and Car OEM in Japan and Europe. He is currently elected Board Member of 5GAA.

Jorge Graça is an Executive Board Member at NOS SGPS. As Chief Technology and Information Officer, he leads all the technology deployment and operations including mobile and fixed networks, IT infrastructure and service platforms. In recent years, he led the transformation of NOS network, preparing for the arrival of 5G and edge computing technology. Jorge Graça started his career at Boston Consulting Group; his entire professional path has been in the telecommunications industry. Jorge has held positions in planning and control, strategic convergence and television services at Portugal Telecom and was Director of ZON TV Cabo responsible for Product and Marketing areas. He has a bachelor's in management from Universidade Católica Portuguesa and an MBA in Analytical Finance & Marketing from Northwestern University – Kellogg School of Management.
Tuesday, 8 June 2021

Tuesday, 8 June 2021, 9:30-11:00/11:30-13:00, Zoom Room

**WS1: 6G for Connecting the Unconnected in Rural and Remote Areas to Meet UN SDG’s**  
Chair: Harri Saarnisaari, University of Oulu, Centre for Wireless Communications, Finland

**WS3: Connectivity and Beyond: How the 5G Ecosystem Empowers the Port, Logistics and Automotive Industries**  
Chair: Eusebiu Catana (ERTICO)

**WS10: 5G for CCAM for Cross-Border Corridors**  
Chair: Konstantinos V. Katsaros, Institute of Communications and Computer Systems (ICCS), Greece

**WS6: 5G Private Networks**  
Chair: David Gomez-Barquero, Universitat Politecnica de Valencia, Spain

**WS8: From 5G to 6G Automated and Intelligent Security: FAST**  
Chair: Antonio Skarmeta, University of Murcia, Spain  
Pascal Bisson, Thales SIX GTS, France

Chair: Pravir Chawdhry, Joint Research Centre of the European Commission  
Doriana Guiducci, European Communications Office of CEPT

**TUT2: Reconfigurable Intelligent Surfaces: Localization and Communication Convergence.**  
Lecturers: George C. Alexandropoulos, National & Kapodistrian University of Athens, Greece  
Henk Wymeersch, Chalmers University of Technology, Sweden

**TUT4: Dynamic Spectrum Sharing and Bandwidth-Efficient Techniques in Non-Terrestrial Networks**  
Lecturers: Alessandro Vanelli-Coralli, University of Bologna, Italy

Tuesday, 8 June 2021, 14:00-15:30/16:00-17:30, Zoom Room

**WS2: Hardware Enabling Technologies for 6G Networks**  
Chair: Colin Willcock (The 5G Infrastructure Association)

**WS5: Hexa-X –The European 6G Initiative**  
Chair: Patrik Rugeland, Ericsson Research, Sweden  
Mikko Uusitalo, Nokia Bell Labs, Finland  
Mauro Boldi, Telecom Italia S.p.A., Italy

**TUT1: Terahertz Communications for 6G Systems**  
Lecturers: Chong Han, Shanghai Jiao Tong University, China  
Josep M. Jornet, Northeastern University, USA

**WS6: 5G Private Networks**  
Chair: David Gomez-Barquero, Universitat Politecnica de Valencia, Spain

**WS8: From 5G to 6G Automated and Intelligent Security: FAST**  
Chair: Antonio Skarmeta, University of Murcia, Spain  
Pascal Bisson, Thales SIX GTS, France

Chair: Pravir Chawdhry, Joint Research Centre of the European Commission  
Doriana Guiducci, European Communications Office of CEPT

**TUT3: B5G: A New Frontier for Non-Orthogonal Multiple Access**  
Lecturers: Zhiguo Ding, University of Manchester, United Kingdom  
Yuanwei Liu, Queen Mary University of London, United Kingdom

**TUT5: Hands-on Tutorial on Fed4FIRE Testbeds and Openwifi**  
Lecturers: Brecht Vermeulen, imec/Ghent University, Belgium  
Xianjun Jiao, imec/Ghent University, Belgium  
Wei Liu, imec/Ghent University, Belgium
Wednesday, 9 June 2021

Wednesday, 9 June 2021, 9:00-9:30, Webcast in the platform, LIVE

Chair: Manuel Ricardo (Univ. Porto / INESC TEC)

- Manuel Ricardo
  - Univ. Porto / INESC TEC, Portugal
  - Host and TPC Co-Chair of Joint EUCNC | 6G Summit 2021
  - Welcome, Organisational information, Technical Program overview

- Matti Latva-aho
  - Univ. Oulu, Finland
  - Steering Committee Vice-Chair
  - Joint EuCNC & 6G Summit

- Pearse O’Donohue
  - Director, Future Networks, DG CONNECT, EC
  - Conference General Co-Chair
  - Shaping Europe’s Digital Future

- Miguel Almeida
  - CEO of NOS Group, Portugal
  - Conference General Co-Chair

- Manuel Heitor
  - Portuguese Minister of Science and Technology, Portugal

Wednesday, 9 June 2021, 9:30-11:00, Virtual Platform

Keynote 1
Instructions to Antennas: 6G on the back of an envelope (or napkin)
Michael Peeters, VP R&D Connectivity/imec, Professor Advanced Wireless & 5G Networks/Universiteit Antwerpen, Belgium

Keynote 2
How 5G will enable a Digital Society
Manuel R. Eanes, Executive Board Member, NOS SGPS, Portugal

Coffee Break  11:00-11:30

Wednesday, 9 June 2021, 11:30-13:00, Zoom Room

PHY1 - Antenna Phased Arrays and Beamforming
Chair: Luís Pessoa, INESC TEC, Portugal

- Performance Comparison of Near-Field Focused and Conventional Phased Antenna Arrays at 140 GHZ
  - Dinesh Acharya, Joonas Kokkoniemi and Aarno Pärssinen (University of Oulu, Finland); Markus Berg (University of Oulu & Excellent LTd., Finland)

- A Systematic Beam Broadening Method for Large Phased Arrays
  - Corentin Fonteneau (Orange Labs, France); Matthieu Crussière (Univ Rennes, INSA Rennes, CNRS, IETR, France); Bruno Jahan (France Telecom, France)

- Analysis and Optimization of Reconfigurable Intelligent Surfaces Assisted MIMO Systems
  - Le Hao (Technische Universität Wien, Austria); Stefan Schwarz (TU Wien & CD-Lab Society in Motion, Austria); Markus Rupp (TU Wien, Austria)

- Hybrid Beamforming with Fixed Phase Shifters for Uplink Cell-Free Millimetre-Wave Massive MIMO System
  - Abdulrahman Saeed Al Ayidh (University of Glasgow, United Kingdom (Great Britain)); Yusuf A. Sambo (University of Glasgow & School of Engineering, United Kingdom (Great Britain)); Shuja Ansari and Muhammad Ali Imran (University of Glasgow, United Kingdom (Great Britain))

Towards Power Efficient 6G Sub-THz Transmission
Hardy Halbauer and Thorsten Wild (Nokia Bell Labs, Germany)
VAP1 – IoT Services and 5G Technologies
Chair: Nandana Rajatheva, University of Oulu, Finland

Cell Association for MTC Devices in 5G Networks: Schemes and Performance Evaluation
Dinithi Vithanage and Indika Anuradha Mendis Balapuwaduge (University of Ruhuna, Sri Lanka); Frank Y. Li (University of Agder, Norway); Vicente Casares-Giner (Universitat Politècnica de València, Spain)

Enhanced Teleoperative Transport and Logistics: A 5G Cross-Border Use Case
Johann M. Marquez-Barja (University of Antwerpen & imec, Belgium); Selendria A. Hadwardoyo (University of Antwerp & IMEC, Belgium); Bart Lannoo (University of Antwerp - imec, Belgium); Wim Vandenberghe (Ministerie van Infrastructuur en Waterstaat, The Netherlands); Eric Kenis (Ministerie van Mobiliteit en Openbare Werken, Belgium); Lauren Deckers (H2 University of Applied Sciences, The Netherlands); Maria Chiara Campodonico and Claudia Dos Santos (Martel Innovate, Switzerland); Rakshithe Kusumakar (V-TRON, The Netherlands); Matthij Kleepper (KPN, Mobile Innovation Radio, The Netherlands); Joost Vandenbergbosch (Be-Mobile, Belgium)

Cloud-Native 5G Infrastructure and Network Applications (NetApps) for Public Protection and Disaster Relief: The 5G-EPICENTRE Project
Konstantinos Apostolakis, George Margetis and Constantine Stephanidis (Institute of Computer Science, Foundation for Research and Technology Hellas, Heraklion, Greece); Jean-Michel Duquerrois, Laurent Drouglet, Arthur Lallet and Serge Delmas (Airbus DS Secure Land Communications, Elancourt, France); Luis Cordeiro and Andre S. Gomes (OneSource, Coimbra, Portugal); Marta Amor (Nemergent Solutions SL, Bilbao, Spain); Almudena Diaz Zayas (ITIS Software, Universidad de Málaga, Málaga, Spain); Christos Verikoukis (Telecommunications Technological Centre of Catalonia (CTTC/CERCA), Castelldefels, Spain); Kostas Ramantas (Quadrate Informatica S.L., Barcelona, Spain); Ioannis Markopoulos (Innovation &amp; Project Management Department, Forthnet S.A., Athens, Greece)

Performance and Service Continuity of HD Map Downloads in MEC-Enabled Cross-Border Mobile Radio Networks
Maciej Muehleisen (Ericsson GmbH, Germany); Mazen Abdel Latif (Ericsson, Germany); Mikael Nilsson (Lund University & Volvo Car Corporation, Sweden); Roland Gustafsson (Ericsson AB, Sweden); Hongxia Zhao (Volvo Car Corporation, Sweden); Daniel McGillivray and Magnus Castell (Ericsson AB, Sweden); Henrik Segesten, Johan Löfhe and Ulf Larson (Volvo Car Corporation, Sweden)

RAS1 – Wireless Access
Chair: TBD

Minimizing the Exposure Dose of Multi-Antenna Multi-Carrier System Users
Fabien Héliot and Tim Brown (University of Surrey, United Kingdom (Great Britain))

Power Optimization and Throughput Enhancement in 6G Networks by Delay-Aware Resource Leverage
Silvio Mandelli, Alessandro Litto, Andreas Weber and Thorsten Wild (Nokia Bell Labs, Germany)

Impact of Effective Antenna Pattern on Estimation of Interference in Citizens Broadband Radio Service
Kamil Bechta (Nokia Networks, Poland); Jinfeng Du (Nokia Bell Labs, USA); Marcin Rybakowski (Nokia, Poland)

Optimal Split Bearer Control and Resource Allocation for Multi-Connectivity in 5G New Radio
Jocelyne Elias (University of Bologna, Italy); Fabio Martignon (University of Bergamo, Italy); Stefano Paris (Nokia Bell Labs & Université Paris Descartes, France)

NET1 – Network Softwarisation I
Chair: Ana Aguiar, Univ. Porto and IT, Portugal

Monitoring as a Service over a 5G Network Slice
Dimitris Gianopoulos, Panagiota Papaioannou, Christos Tranoris and Spyros Denazis (University of Patras, Greece)

PiEdge: An Edge-Driven PaaS Model for Network Slicing Automation
Alexios Lekidis (Intracom Telecom, Greece); Vasileios Theodorou (Intracom S.A. Telecom Solutions, Greece); Nikolaos Psaromanolakis (Intracom Telecom, Greece); Carmen Guerrero (University Carlos III of Madrid, Spain); Diego Lopez (Telefonica I+D, Spain)
Empirical Design, Prototyping and Evaluation of a New Hardware-Based Network Slicing Approach for 6G Backbone Networks
Ruben Ricart-Sanchez (University of the West of Scotland, United Kingdom (Great Britain)); Pablo Salva-Garcia (University West Of Scotland, United Kingdom (Great Britain)); Enrique Chirivella-Perez (University of the West of Scotland, United Kingdom (Great Britain)); Jose Maria Alcaraz Calero (University of the West of Scotland & School of Engineering and Computing, United Kingdom (Great Britain)); Qi Wang (University of the West of Scotland, United Kingdom (Great Britain))

5Growth: Secure and Reliable Network Slicing for Verticals
Vitor A Cunha (Instituto de Telecomunicações, Portugal); Nikolaos Maroulis (National and Kapodistrian University of Athens, Greece); Chrysa Papagianni (University of Amsterdam, The Netherlands); Javier Sacido and Manuel Angel Jimenez (Tercaria Ideas, Spain); FabioUbaldi (Ericsson, Italy); Molka Gharbaoui (CNIT, Italy); Chia-Yu Chang (Nokia Bell Labs, Belgium); Nikolaos Kourioumpas (National and Kapodistrian University of Athens, Greece); Konstantin Tomakh (Mirantis, Ukraine); Daniel Corujo (Instituto de Telecomunicações Aveiro & Universidade de Aveiro, Portugal); João Paulo Barraca (University of Aveiro & Instituto de Telecomunicações, Portugal); Sokratis Barmpongakis (University of Athens, Greece); Denys Kucherenko (Mirantis, Ukraine); Alessio Giorgetti (National Research Council of Italy, Italy); Andrea Bodi (Ericsson, Italy); Luca Valcarenghi (Scuola Superiore Sant’Anna, Italy); Oleksii Kolodlazhnyi (Mirantis, Ukraine); Aitor Zabala (Telcaria Ideas S. L., Spain); Josep Xavier Salvat and Andres Garcia-Saavedra (NEC Labs Europe, Germany)

Intent-Based E2E Network Slice Management for Industry 4.0
Enrique Chirivella-Perez (University of the West of Scotland, United Kingdom (Great Britain)); Pablo Salva-Garcia (University West Of Scotland, United Kingdom (Great Britain)); Ruben Ricart-Sanchez (University of the West of Scotland, United Kingdom (Great Britain)); Jose Maria Alcaraz Calero (University of the West of Scotland & School of Engineering and Computing, United Kingdom (Great Britain)); Qi Wang (University of the West of Scotland, United Kingdom (Great Britain))

6ET1 – 6G Enabling Technologies I
Chair: Yaning Zou, Technical University of Dresden, Germany

Analysis of Downlink Connectivity in NB-IoT Networks Employing NOMA with Imperfect SIC
Shashwat Mishra (Indian Institute of Technology, Madras, India & Nokia Bell Labs Paris-Saclay, France); Lou Salaun and Chung Shue Chen (Nokia Bell Labs, France); K Giridhar (Indian Institute of Technology, Madras, India)

Study of Reflection-Loss-Based Material Identification from Common Building Surfaces
Yi Geng (Ericsson, China); Vijaya Parampalli Yajnanarayana (Ericsson Research, India); AliBehravan (Ericsson, Sweden); Erik Dahlman and Deep Shrestha (Ericsson Research, Sweden)

Best Beam Prediction in Non-Standalone mmWave Systems
Tushara Ponnada, Parham Kazemi and Hanan Al-Tous (Aalto University, Finland); Ying-Chang Liang (University of Electronic Science and Technology of China, China); Olav Tirkkonen (Aalto University, Finland)

Above-100 GHz Wave Propagation Studies in the European Project Hexa-X for 6G Channel Modelling
Pekka Kyosti (Keysight Technologies & University of Oulu, Finland); Katsuyuki Haneda (Aalto University, Finland); Jean-Marc Conrat (Orange Labs, France); Aarno Pärssinen (University of Oulu, Finland)

Integrated Sensing and Communication in 6G: A Prototype of High Resolution THz Sensing on Portable Device
Oupeng Li (Huawei Technologies Co. Ltd, China); Jia He (Huawei Technologies Co., Ltd., China); Kun Zeng (Huawei Technologies Co. Ltd., China); Ziming Yu (Huawei Technologies CO., LTD, China); Xianfeng Du, Yuan Liang and Guangjian Wang (Huawei Technologies Co., Ltd., China); Yan Chen and Peying Zhu (Huawei Technologies, Canada); Wen Tong (Huawei Technologies Canada Co., Ltd., Canada); David R Lister (Vodafone Group R&D, United Kingdom (Great Britain)); Luke Ibbetson (Vodafone, United Kingdom (Great Britain))

SPS1: One6G – An Open Accelerator for 6G Research in Europe
Chair: Egon Schulz, Huawei Technologies Duesseldorf GmbH, Munich Research Center, Germany

SPS4: Edge-Side and Device-Level Innovation for 6G Wireless Networks
Chair: Prof. Mohammad N. Patwary, University of Wolverhampton, United Kingdom

Lunch 13:00- 14:00
Wednesday, 9 June 2021, 14:00-15:30, Virtual Platform

Panel 1

6G – from visions to system requirements
Organizer/Moderator: Matti Latva-aho, Director for 6G Flagship, Univ. of Oulu, Finland

Wednesday, 9 June 2021, 16:00-17:30, Zoom Room

PHY2 – Access Networks Optimisation
Chair: Hirley Alves, University of Oulu, Finland

Forecasting Wireless Network Traffic and Channel Utilization Using Real Network/Physical Layer Data
Su Pyae Sone, Janne Lehtomäki and Zaheer Khan (University of Oulu, Finland); Kenta Umebayashi (Tokyo University of Agriculture and Technology, Japan)

On the Design of Content Transmissions with Recommendation in Wireless Caching Networks
Wei Hong (Beijing Xiaomi Mobile Software, China); Xiaoyu Duan, Huihui Gao and Zhongyuan Zhao (Beijing University of Posts and Telecommunications, China)

Max-Min Fairness with Selection Combining Strategy on Cooperative NOMA: A Finite Blocklength Analysis
Fateme Salehi, Naaser Neda and Mohammad-Hassan Majidi (University of Birjand, Iran); Hamed Ahmadi (University of York, United Kingdom (Great Britain))

End-To-End Rate Enhancement in C-RAN Using Multi-Pair Two-Way Computation
Mahmoud Hasabelnaby (The University of British Columbia, Canada); Anas Chaaban (University of British Columbia, Canada)

Toward the First D-Band Point to Multipoint Wireless System Field Test
Claudio Paoloni and Rupa Basu (Lancaster University, United Kingdom (Great Britain)); Marcel Burhenn (HUBNER GmbH & Co., Germany); Maruf Hossain (Ferdinand-Braun-Institut, Germany); Daniel Huesch (HUBNER GmbH & Co., Germany); Viktor Krozer (Goethe University of Frankfurt am Main, Germany); Quang Trung Le (HF Systems Engineering GmbH & Co. KG, Germany); Rosa Letizia (Lancaster University, United Kingdom (Great Britain)); Ernesto Limiti (University of Rome Tor Vergata, Italy); François Magne (WHEN-AB & SARL, France); Marc Marilier (OMMIC, France); Antonio Ramirez (Fibernova Systems, Spain); Jeevan Rao (Lancaster University, United Kingdom (Great Britain)); Giacomo Ulisse (Johann Wolfgang Goethe-Universität, Germany); Borja Vidal (Universidad Politécnica de Valencia, Spain); Hadi Yacob (Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Germany)

VAP2 – IoT and V2X Technologies
Chair: Frank Y. Li, University of Agder, Norway

On the Role of Sensor Fusion for Object Detection in Future Vehicular Networks
Valentina Rossi, Paolo Testolina, Marco Giordani and Michele Zorzi (University of Padova, Italy)

Co-Existence of ITS-G5 and C-V2X at an Urban Road Intersection
Sandaruwan Gayantha Jayaweera, Nandana Rajatheva and Matti Latva-aho (University of Oulu, Finland); Kapuruhamy Badalge Shashika Manosha (Keysight Technologies, Finland)

Evaluating a Novel Bluetooth 5.1 AoA Approach for Low-Cost Indoor Vehicle Tracking via Simulation
Nuno M. Paulino and Luis M. Pessoa (INESC TEC & Faculty of Engineering, University of Porto, Portugal); André Branquinho and Edgar Gonçalves (Wavecom, Portugal)

Empowering Industry 4.0 and Autonomous Drone Scouting Use Cases Through 5G-DIVE Solution
Filipe Conceição (InterDigital Europe, United Kingdom (Great Britain)); Carlos Guimaraes (Universidade Carlos III de Madrid, Spain); Luca Cominardi (ADLINK Technology, France); Samer T. Talat (Industrial Technology Research Institute, Taiwan); Muhammad Febrian Ardiannsah (National Chiao Tung University, Taiwan); Chao Zhang (Ericsson, United Kingdom (Great Britain)); Milan Groshev (Universidad Carlos III de Madrid, Spain); Timothy William (National Chiao Tung University, Taiwan); Gyanesh Patra (Ericsson Research, Sweden); Ibrahim Hemadeh (InterDigital, United Kingdom (Great Britain)); Chenguang Lu (Ericsson Research, Sweden); Alain Abdel-Majid Mourad (InterDigital, United Kingdom (Great Britain))

WOS1 – Wireless, Optical and Satellite Networks I
Chair: Ronald Raurieles, DLR, Germany
Satellite and Cellular Networks Integration - A System Overview
Gilles Charbit (MediaTek Inc, United Kingdom (Great Britain)); Kader Medies (MediaTek Inc., United Kingdom (Great Britain)); Pradeep Jose (MediaTek, United Kingdom (Great Britain)); Debby Lin (MediaTek Inc., Taiwan); Xc Zhu (MediaTek, United Kingdom (Great Britain)); I-Kang Fu (MediaTek Inc., Taiwan)

Weighted Secrecy Coverage Analysis and the Impact of Friendly Jamming over UAV-Enabled Networks
Xavier Alejandro Flores Cabezas, Diana Pamela Moya Osorio and Matti Latva-aho (University of Oulu, Finland)

Asynchronous Time-Sensitive Networking for Industrial Networks
Jonathan Prados-Garzon, Lorena Chinchilla-Romero, Pablo Ameigeiras, Pablo Muñoz and Juan M. Lopez-Soler (University of Granada, Spain)

Mobility for Cellular-Connected UAVs: Challenges for the Network Provider
Erika Fonseca (CONNECT Research Centre, Trinity College Dublin, Ireland); Boris Galkin (Trinity College Dublin, Ireland); Marvin Kelly (Dense Air Ltd., Ireland); Luiz DaSilva (Virginia Tech, USA & Trinity College Dublin, Ireland); Ivana Dusparic (Trinity College Dublin, Ireland)

Hierarchical Multi-Objective Deep Reinforcement Learning for Packet Duplication in Multi-Connectivity for URLLC
Qiyang Zhao (Nokia Bell Labs, France); Stefano Paris (Nokia Bell Labs & Université Paris Descartes, France); Teemu Veijalainen (Nokia Bell Labs, Finland); Samad Ali (University of Oulu, Finland)

Information Security in a 5G Facility: An Implementation Experience
Andres J Gonzalez (Telenor Research, Norway); Pål R. Gransund (Telenor & University of Oslo, Norway); Antonios Dimitriadis (Nokia, United Kingdom (Great Britain)); Dzmitry Reshytnik (Palo Alto Networks, Norway)

Evaluation of Live Video Streaming Performance for Low Latency Use Cases in 5G
Mikko Uitto (VTT Technical Research Centre of Finland Ltd, Finland); Antti Heikkinen (VTT Technical Research Centre of Finland, Finland)

VITAL-5G: Innovative Network Applications (NetApps) Support over 5G Connectivity for the Transport & Logistics Vertical
Konstantinos Trichias (WINGS ICT Solutions, Greece); Giada Landi and Erin E Seder (Nextworks, Italy); Johann M. Marquez-Barja (University of Antwerpen & imec, Belgium); Ronan Frizzell (INLECOM SYSTEMS, Ireland); Marius Iordache (Orange, Romania); Panagiotis Demestichas (WINGS ICT SOLUTIONS)

OPE1 – Operational Experiences and Use Cases Enabled by 5G
Chair: Abhimanyu Gosain, Northeastern University, USA

An Exposed Closed-Loop Model for Customer-Driven Service Assurance Automation
Min Xie (Telenor Research & Telenor Group, Norway); Foivos Michelinakis (Simula Metropolitan, Norway); Thomas Dreiholz (Simula Metropolitan Centre for Digital Engineering, Norway); Joan Pujol-Roig (Samsung Electronics, United Kingdom (Great Britain)); Sara Malacarne (Telenor ASA, Norway); Sayantini Majumdar (Huawei Munich Research Center & Technical University of Munich, Germany); Wint Yi Poe (Huawei Technologies - European Research Center, Germany); Ahmed Elmokashfi (SimulaMet, Norway)

How to Make 6G a General Purpose Technology
Volker Ziegler (Nokia Bell Labs & CTO, Germany); Yaning Zou (Technische Universität Dresden, Germany)

6GV1 – 6G Vision, Value and Impact
Chair: Diego Lopez, Telefonica, Spain

Hexa-X the European 6G Flagship Project
Mikko Uusitalo (Nokia Bell Labs, Finland); Patrik Rugeland (Ericsson Research, Sweden); Mauro Boldi (Telecom Italia, Italy); Emilio Calvanese Strinati (CEA-LETI, France); Gino Carrozzo (Nextworks, Italy); Panagiotis Demestichas (University of Piraeus, Greece); Mårten Ericson (Ericsson Research, Sweden); Gerhard P. Fettweis (Technische Universität Dresden, Germany); Marie-Helene Hamon (Orange Labs, France); Matti Latva-aho (University of Oulu, Finland); Josep Martrat (Atos, Spain); Aarno Pärsinen (University of Oulu, Finland); Björn Richerzhagen (Siemens AG, Germany); Dario Sabela (Intel (Germany)); Hans D. Schotten (University of Kaiserslautern, Germany); Pablo Serrano (Universidad Carlos III de Madrid, Spain); Giovanni Stia (University of Pisa, Italy); Tommy Svensson (Chalmers University of Technology, Sweden); Elf Ustundag Soykan (Ericsson Research, Turkey); Gustav Wikström (Ericsson Research, Sweden); Volker Ziegler (Nokia Bell Labs & CTO, Germany); Thomas Ziegler (Technische Universität Dresden, Germany)
6G Network Architecture Vision
Xueli An (Huawei Technologies, Germany); Jianjun Wu (Huawei Technologies Co., Ltd., China); Wen Tong (Huawei Technologies Canada Co., Ltd., Canada); Peiying Zhu and Yan Chen (Huawei Technologies, Canada)

Subsidiarity and Weak Coupling in Wireless Networks
Aarne Mämmelä (VTT Technical Research Centre of Finland, Finland); Jukka Riekki (University of Oulu, Finland)

SPS3: Recent Progress in Antennas and Metasurfaces for 6G, Zoom Room
Chairs: Qi Luo, University of Hertfordshire, United Kingdom
Luis Pessoa, INESC TEC, Portugal

Poster Session A, Zoom Room
Chair: Rui Campos (INESC TEC)

Anomaly Detection in Optical Links Using State of Polarization Monitoring
Aamir Gulistan (Simula Research Laboratory, Norway); Steinar Bjørnstad (Norwegian University of Science and Technology, Norway)

On the Feasibility of Cost-Effective Emergency Flying Communications Networks
Ruben M Queirós (INESC TEC and FEUP, Portugal); Rui Campos (INESC TEC and Faculty of Engineering, University of Porto, Portugal); Helder Fontes (INESC TEC and FEUP, Portugal)

RESPOND-A: An Initiative for Innovative Equipment, Tools and Mission-Critical Strategies for First Responders
Nicholas Sgouros (Eight Bells Ltd, Greece); Emmanouil Kafetzakis (Eight Bells Ltd., Cyprus); Ioannis Giannoulakis (Eight Bells Ltd, Cyprus); Dimitrios Nodaros and Alexandros Karatzos (Eight Bells Ltd, Greece); Georgios Kioumourtzis (Ianus Consulting Ltd, Cyprus); George Boustras (European University Cyprus, Cyprus); Anastasios Kourtis (NCSR Demokritos, Greece); Charilaos Zarakovitis (National Centre for Scientific Research Demokritos, Greece); Harbil Arregui (Vicomtech - Basque Research and Technology Alliance, Spain)

Underwater High Definition Wireless Video Streaming Using Data Muling
João Pedro Loureiro (University of Porto & INESC TEC, Portugal); Filipe Borges Teixeira (INESC TEC, Faculdade de Engenharia, Universidade do Porto, Portugal); Rui Campos (INESC TEC and Faculty of Engineering, University of Porto, Portugal)

IoT System to Monitor the Well-Being of Senior Citizens Who Self-Isolate During the Pandemic
Fabio Gonzalves, Cassandra Jesus, Francisco Fernandes and Ana R. Rosa (Instituto Politécnico de Castelo Branco, Portugal); Rogerio Dionisio (Instituto Politécnico de Castelo Branco & DIïSAC R&D Unit, Portugal)

Emergence of Blockchain Based IoT Marketplaces
Amila Prasanna Saputhanthri (University of Sri Jayewardenepura & Dialog Axiata PLC, Sri Lanka); Chamitha De Alwis (University of Sri Jayawardenepura, Sri Lanka); Madhusanka Liyanage (University College Dublin, Ireland & University of Oulu, Finland)

Design Framework of A NB-IoT Based Smart Asset Monitoring System for Logistics Solutions
Fathima Minza Ifrath, Rimzy Ahmed Zayeem and Amila Prasanna Saputhanthri (Sri Lanka Technological Campus, Sri Lanka)

SFSBroker: Secure and Federated Network Slice Broker for 5G and Beyond
Tharaka Mawanane Hewa, Nisita Weerasinghe and Pawani Porambage (University of Oulu, Finland); Anshuman Kalla (CWC, University of Oulu, Finland); George K Xilouris and Maria Christopoulou (NCSR Demokritos, Greece); Madhusanka Liyanage (University College Dublin, Ireland & University of Oulu, Finland); Miika E Ylianttila (University of Oulu, Finland)

iNGENIOUS: Next-Generation IoT Solutions for the Universal Supply Chain
Nuria Moliner (ITEAM - Instituto de Telecomunicaciones y Aplicaciones Multimedia & Universitat Politècnica de València, Spain); Carsten Weinhold (Barkhausen Institut, Germany); Erin E Seder (Nextworks, Italy); David Gomez-Barquero (Universitat Politècnica de València, Spain)

A Human Behavioral Pattern-Based Sampling Period Control in IoT-Digital Healthcare
Jaeseob Han and Gyeong Ho Lee (KAIST, Korea (South)); Jun Kyun Choi (Korea Advanced Institute of Science and Technology (KAIST), Korea (South)); Chang Jinsung (KULS, Korea (South)); Inês Cunha (Ubiwhere, Portugal); Ricardo Gonçalves (PROEF, Portugal)
FUDGE-5G: Fully Disintegrated Private Networks for 5G Verticals
David Gomez-Barquero (Universitat Politecnica de Valencia, Spain); Antonio Borges, Andre S. Gomes, Luis Cordeiro and Joao Henriques (OneSource, Portugal); Kashif Mahmood (Telenor, Norway); Sebastian Robitzsch (InterDigital Europe, United Kingdom (Great Britain))

End-To-End Data Protection Through the Computing Continuum in Smart Environments
Klaas Baert (VRT, Belgium); Joao Garcia (Ubiwhere, Portugal); Jens Kuhr (Nokia, Germany); Eliot Salant (IBM Haifa Labs, Israel); Robert Seidl (Nokia Bell Labs, Germany); Ricardo Vitorino (Ubiwhere, Portugal)

5G-RECORDS 5G Key Technology Enablers for Emerging Media Content Production Services
David Gomez-Barquero and Irene Alepuz (Universitat Politecnica de Valencia, Spain); Cristina Avellan, Salvador García and Adrian Rodrigo (Universitat Politècnica de Valencia, Spain); Esther Madejón and Narciso García (Universidad Politécnica de Madrid, Spain)

5G Project, an Overview and Follow-Up Products
Luís Conceição (Ubiwhere, Portugal)

5G Based Fault Detection, Isolation, and Service Restoration System
Mohand Ouamer Nait Belaid (University of Gustave Eiffel & EDF SA, France); Vincent Audebert (EDF R&D, France); Boris Deneuville (EDF R&D, France); Frederic Faucheux (Nokia Bell Labs, France)

Wednesday, 9 June 2021, 17:30-18:30, Virtual Platform

Welcome Reception - 30th EuCNC Anniversary
Organiser: Luís M. Correia, (IST/INESC-ID, University of Lisbon, Portugal)

Thursday, 10 June 2021, 9:30-11:00/11:30-13:00, Zoom Room

PHY3 – Channel Estimation
Chair: Jaap Van de Beek, Luleå University of Technology, Sweden

Channel Estimation and Hybrid Architectures for RIS-Assisted Communications
Jiguang He, Nhan Thanh Nguyen, Rafaela Schroeder, Visa Tapiro, Joonas Kokkonen and Markku Juntti (University of Oulu, Finland)

On the Position of Intelligent Reflecting Surfaces
Emad Ibrahim, Rickard Nilsson and Jaap van de Beek (Luleå University of Technology, Sweden)

Channel Charting Based Beam SNR Prediction
Parham Kazemi, Tushara Ponnada and Hanan Al-Tous (Aalto University, Finland); Ying-Chang Liang (University of Electronic Science and Technology of China, China); Olav Tirkkonen (Aalto University, Finland)

A Deep Learning-Based Approach to 5G-New Radio Channel Estimation
Elisa Zimaglia (Tim S.p.A., Italy); Daniel G. Rivieiro and Roberto Garello (Politecnico di Torino, Italy); Roberto Fantini (Telecom Italia SpA, Italy)

Enabling Energy-Efficient Tbit/s Communications by 1-Bit Quantization and Oversampling
Peter Neuhaus (Technische Universität Dresden, Germany); Martin Schlüter (Dresden University of Technology, Germany); Christoph Jans (Technische Universität Dresden, Germany); Meik Dörpinghaus (TU Dresden, Germany); Gerhard P. Fettweis (Technische Universität Dresden, Germany)

VAP3 – IoT Localization and Coverage Assessment
Chair: Carlos T. Calafate, UPV, Spain

Coherent Multi-Channel Ranging for Precise Localization in Narrowband LPWA Networks: Performance Trials in an Indoor Environment
Vincent Berg (CEA LETI, France); Francois Dehmas (CEA-Leti Minatec, France); Florian Wolf (CEA Grenoble & University of Limoges, France)
Improving CSI-Based Massive MIMO Indoor Positioning Using Convolutional Neural Network
Gregor Cerar (Jožef Stefan Institute & Jožef Stefan International Postgraduate School, Slovenia); Ales Svigelj (Jožef Stefan Institute, Slovenia); Mihael Mohorcic (Jožef Stefan Institute & Jožef Stefan International Postgraduate School, Slovenia); Carolina Fortuna and Tomaz Javornik (Jožef Stefan Institute, Slovenia)

Dissemination of GNSS RTK Using MQTT
Ashwin Rao (University of Helsinki, Finland); Martti Kirkko-Jaakkola (Finnish Geospatial Research Institute FGI, Finland); Laura Ruotsalainen (University of Helsinki, Finland)

Coverage of LoRa Links with α-Stable Modeled Interfering Underlying IoT Networks
Romain Chevillon (Université de Nantes, France); Guillaume Andrieux (University of Nantes & IETR Laboratory, France); Jean Francois Diorius (University of Nantes, France)

Autoencoder-Based Characterisation of Passive IEEE 802.11 Link Level Measurements
Priyanka Neuhaus (Fraunhofer Institute for Integrated Circuits, Germany); Marcus Henninger (University of Stuttgart & Nokia Bell Labs, Germany); Andreas Frotszcher (Fraunhofer Institute for Integrated Circuits IIS & Design Automation Division EAS, Germany); Ulf Wetzker (Fraunhofer Institute for Integrated Circuits IIS, Germany)

WOS2 – Wireless, Optical, and Satellite Networks II
Chair: Morio Toyoshima, NICT, Japan

ELIoT: New Features in LiFi for Next-Generation IoT
Jean-Paul Linnartz (Technische Universiteit Eindhoven, The Netherlands); Carina Ribeiro Barbio Corrêa and Thiago Elias B Cunha (Eindhoven University of Technology, The Netherlands); Eduward Tangdiongga (Eindhoven University of Technology & Institute for Photonic Integration, The Netherlands); Ton Koonen (Eindhoven University of Technology, The Netherlands); Xiong Deng (TU Eindhoven, The Netherlands); Mathias Wendt (Signify, The Netherlands); Pieter J Stobbeelaar (Signify, The Netherlands); Marcel Müller and Daniel Behnke (Weidmüller Group, Germany); Marcos Vazquez and Santi Vicent Colouques (MaxLinear, Spain); Martijn Bech (KPN, The Netherlands); Taner Metin (Fraunhofer FOKUS Institute, Germany); Marc Emmelmann (Fraunhofer FOKUS, Germany); Sepideh Mohammadi Kouhini (Fraunhofer Heinrich Hertz Institute, Germany); Kai Lennert Bober and Christoph Kottke (Fraunhofer Heinrich Hertz Institute, Germany); Volker Jungnickel (Fraunhofer Heinrich Hertz Institute & Technische Universität Berlin, Germany)

SDN Controlled Visible Light Communication Clusters for AGVs
Eike Lyczkowski (SEW Eurodrive, Germany); Christian Sauer (SEW EURODRIVE GmbH&Co KG, Germany); Nils Brödner and Wolfgang Kiess (University of Applied Sciences Koblenz, Germany); Marco Schmidt (University of Applied Sciences Würzburg Schweinfurt, Germany)

Flexible Multiband Signal Transmission Using a Directly Modulated Laser over Photonically Generated 40 GHz
Luis Vallejo (Universitat Politecnica de Valencia, Spain); Beatriz Ortega (ITEAM Research Institute, Spain); Vicenc Almenar (Universidad Politecnica De Valencia, Spain); Dong-Nhat Nguyen, Jan Bohata and Stanislav Zvanovec (Czech Technical University in Prague, Czech Republic)

Towards Unified Channel Equalization to Meet Transmission Requirements for Next Generation Passive Optical Networks
Hamza Hallak Elwan (Foton Lab, France); Fabienne Saliou and Gaei Simon (Orange, France); Luiz Anet Neto (IMT-Atlantique, France); Philippe Chancloz (Orange Labs, France)

OPE2 – Advanced Wireless and Network Solutions for 5G
Session Chair: Jean-Marie Gorce, INSA-Lyon, France

Trust but Verify: Crowdsourced Mobile Network Measurements and Statistical Validity Measures
Anika Seufert and Florian Wamser (University of Wuerzburg, Germany); Stefan Wunderer (Nokia Solutions and Networks, Germany); Andrew Hall (Tutela Technologies Ltd., Canada); Tobias Hoßfeld (University of Würzburg, Germany)

Performance Evaluation of MN System in Highway Environment
Sung Woo Choi, Seung Nam Choi, Dae-Soon Cho and Junhyeong Kim (ETRI, Korea (South)); Gosan Noh (Electronics and Telecommunications Research Institute, Korea (South)); Jung Pil Choi (Mobile Communications Research Lab., Electronics and Telecommunications Research Institute, Korea (South)); Hee Sang Chung (ETRI, Korea (South))
Thursday, 10 June 2021, 9:30-11:00, Zoom Room

**6GV2 – 6G Platform, Intelligence and Trust**
Session Chair: Volker Ziegler, Nokia Bell Labs, Germany

*Int5Gent: An Integrated End-To-End System Platform for Verticals and Data Plane Solutions Beyond 5G*
Dimitrios Klonidis (UBITECH, Greece); Dimitrios Apostolopoulos (National Technical University of Athens & Institute of Communication and Computer Systems, Greece); Georgios Katsikas (Ubitech, Greece); Giannis Giannoulis, Konstantinos Tokas and Konstantina Kanta (National Technical University of Athens, Greece); thanos Xirolfotos (UBITECH, Greece); Raul Muñoz (Centre Tecnològic de Telecomunicacions de Catalunya (CTTC/CERCA), Spain); Francesca Moscatelli (Nextworks, Italy); Guy Torfs (Ghent University & Imec, Belgium); Christos Vagionas (Aristotle University of Thessaloniki, Greece); David Larrabeiti (Universidad Carlos III de Madrid, Spain); Zhongxia Simon He (SINOWAVE, Sweden); Janez Sterle (INTERNET INSTITUTE Ltd, Slovenia); Dotan Levi (NVIDIA, Israel); George Lyberopoulos (COSMOTE Mobile Telecommunications S.A., Greece); Victor Lopez (Telefonica, Spain); Eleni Trouva (INTRASOFT International, Greece); Yigal Leiba (siku Communications Ltd., Israel); Xavi Vilajosana (Worldsensing, Spain); carles Terés (Ferrocarrils de la Generalitat de Catalunya, Spain); Hercules Avramopoulos (National Technical University of Athens, Greece)

*AI and 6G Security: Opportunities and Challenges*
Yushan Siriwardhana and Pawani Porambage (University of Oulu, Finland); Madhusanka Liyanage (University College Dublin, Ireland & University of Oulu, Finland); Mika E Ylianttila (University of Oulu, Finland)

*6G Security Challenges and Potential Solutions*
Pawani Porambage (University of Oulu, Finland); Gürkan Gür (Zurich University of Applied Sciences (ZHAW), Switzerland); Diana Pamela Moya Osorio (University of Oulu, Finland); Madhusanka Liyanage (University College Dublin, Ireland & University of Oulu, Finland); Mika E Ylianttila (University of Oulu, Finland)

**SPS2: EU-China Collaboration in 5G and Beyond**
Chair: Mr. Uwe Herzog, EURESCOM, Germany
Dr. Tao Chen, VTT, Finland
Ms. Kai Zhang, Martel, Switzerland

**SPSS: Advances in OpenRAN and the Neutral Host Paradigm**
Chair: Angelos Gouloumas, Satellite Applications Catapult, United Kingdom, Nikolaos Tsampieris, ERTICO ITS Europe, Belgium, Greig Paul, University of Strathclyde, United Kingdom.

Coffee Break 11:00-11:30

Thursday, 10 June 2021, 11:30-13:00, Virtual Platform

**Panel 2 Components and Hardware on the Road to 6G**
Organizer/Moderator: Gerhard Fettweis, Technische Universität Dresden, Germany

Lunch 13:00-14:00
Thursday, 10 June 2021, 14:00-15:30, Virtual Platform

Keynote 3
IoT and 6G
Roberto Verdone, Professor, University of Bologna, Director, WiLab, Italy

Keynote 4
Augmenting Human Potential in the 6G Era
Peter Vetter, Head of Access & Devices Research Lab, Nokia Bell Labs, USA

Coffee Break 15:30-16:00

Thursday, 10 June 2021, 16:00-17:30, Zoom Room

PHY4 – Modulation and coding
Chair: Marwa Chafii, ENSEA, France

Complex Deep Neural Network Based Intelligent Signal Detection Methods for OFDM-IM Systems
Xiao Chen, Miao Liu and Guan Gui (Nanjing University of Posts and Telecommunications, China); Bamidele Adebisi (Manchester Metropolitan University, United Kingdom (Great Britain)); Haris Gaćanin (RWTH Aachen University, Germany); Hikmet Sari (NJUPT & Sequans, France)

Index Modulated MIMO GFDM Systems
José Calpa Juajinoy (Pontifical Catholic University of Rio de Janeiro, Brazil); Raimundo Sampaio-Neto (Cetuc-Puc-Rio, Brazil); João Cal-Braz (National Institute of Metrology, Quality and Technology (Inmetro) & PUC-Rio, Brazil)

Orthogonal Versus Non-Orthogonal Multiplexing in Non-Coherent Massive MIMO Systems Based on DPSK
Victor Monzon Baezâ and Ana Garcia Armada (Universidad Carlos III de Madrid, Spain)

Blind Neural Belief Propagation Decoder for Linear Block Codes
Guillaume Larue (Institut Polytechnique de Paris & Orange S.A., France); Louis-Adrien Dufrêne and Quentin Lampin (Orange Labs, France); Paul Chollet, Hadi Ghauch and Ghaya Rekaya (Institut Polytechnique de Paris, France)

A Study of Barker Spreading Codes for High-Speed PSSS Wireless Systems
Lukasz Lopacinski (IHP, Germany); Nebojsa Maletic (IHP - Leibniz-Institut für Innovative Mikroelektronik, Germany); Alikea Hasani (Brandenburg University of Technology Cottbus-Senftenberg & IHP GmbH - Innovations for High Performance Microelectronics, Germany); Karthik Krishnegowda and Jesús Gutiérrez (IHP - Leibniz-Institut für Innovative Mikroelektronik, Germany); Rolf Kraemer (IHP Microelectronics, Frankfurt/Oder & BTU-Cottbus, Germany); Eckhard Grass (IHP & Humboldt-University Berlin, Germany)

VAP4 – IoT for Industrial and Business Applications
Chair: Kamran Sayrafian, NIST, USA

Scalable Storage Scheme for Blockchain-Enabled IoT Equipped Food Supply Chains
Janitha Pranath Rupasena (University of Moratuwa, Sri Lanka); Tharaka Mawananhe Hewa (University of Oulu, Finland); Kasun T. Hemachandra (University of Moratuwa, Sri Lanka); Madhusanka Liyanage (University College Dublin, Ireland & University of Oulu, Finland)

Measured Distributed Vs Co-Located Massive MIMO in Industry 4.0 Environments
Maximilian Arnold (Nokia Stuttgart, Germany); Paolo Baracca, Thorsten Wild and Frank Schach (Nokia Bell Labs, Germany); Stephan ten Brink (University of Stuttgart, Germany)

Empirical Investigation of Offloading Decision Making in Industrial Edge Computing Scenarios
Alexander Artemeniko (Robert Bosch GmbH, Germany); Ismail Methrez (University of Stuttgart, Stuttgart, Germany); Keerthana Govindaraj (Robert Bosch GmbH & COMSYS, RWTH Aachen, Germany); Andreas Kistaedter (University of Stuttgart, Germany); Mykoia Kuznetsov (Odessa National Polytechnic University, Ukraine)

Weathering the Reallocation Storm: Large-Scale Analysis of Edge Server Workload
Lauri Lovén, Ella Peltonen and Erkki Harjula (University of Oulu, Finland); Susanna Pirttilä (University of Oulu, Finland)

A 5G Health Use Case Calling for Ecosystem Strategies. Resolving Technology and Business Dependencies Necessary to Kick off the Market
Ewout Brandsma (Philips, The Netherlands); Hanne Kristine Hallingby (Telenor, Norway); Per H. Lehne (Telenor Research, Norway)
RAS2 – RAN and Network Management
Chair: Nuno Almeida, Univ. Porto and INESC TEC, Portugal

ML-Based Slice Management in 5G Networks for Emergency Scenarios
Apoorva Arora (KPN BV, The Netherlands); Toni Dimitrovski and Remco Lijens (TNO, The Netherlands); Haibin Zhang (TNO ICT, The Netherlands)

Equilibrium Analysis in Wireless Networks Walrasian Markets: A Distributed Approach
Vahid Haghighatdoost (Shahed University, Iran); Siavash Khorsandi (Amirkabir University of Technology, Iran); Zaheer Khan (University of Oulu, Finland); Hamed Ahmadi (University of York, United Kingdom (Great Britain))

Flexible Multi-Operator RAN Sharing: Experimentation and Validation Using Open Source 4G/5G Prototype
Maya Kassis (Telecom Sudparis, France); Salvatore Costanzo and Mohamad Yassin (Orange Labs, France)

SDN-Enabled THz Wireless X-Haul for 5G
Jose Costa-Requena (Aalto University, Finland); Nicola Carapellese (SIAE Microelettronica, Italy); Panteleimon-Konstantinos Chartsias, Eleni Karasoula and Dimitrios S. Kritharidis (Intracom Telecom, Greece); Eduardo. Yusta Padilla (Telefonica, Spain); Abrahaim Afriyie (Cumucore, Finland)

A KPI-Based Self-Optimization Algorithm for Inter-Frequency Handover in 4G/5G Networks
Marco Skocaj (University of Bologna & WiLab, CNIT, Italy); Andrea Orsi and Federico Franchini (TIM, Italy); Roberto Verdone (University of Bologna, Italy)

On a Deep Q-Network-Based Approach for Active Queue Management
Dhulfiqar A AAlwahab (Eötvös Loránd University, Hungary); Gergo Gombos (ELTE Eötvös Loránd University, Hungary); Sándor Laki (Eötvös Loránd University, Hungary)

Reinforcement learning has gone through an enormous evolution in the past ten years.

TeraFlow: Secured Autonomic Traffic Management for a Tera of SDN Flows
Ricard Vila, Raul Muñoz; Ramon Casellas and Ricardo Martinez (Centre Tecnològic de Telecomunicacions de Catalunya (CTTC/CERCA), Spain); Victor Lopez (Telefonica, Spain); Oscar González de Dios (Telefonica I+D, Spain); Antonio Pastor (Telefonica I+D & Universidad Politécnica de Madrid, Spain); Georgios Katsikas (Ubitech, Greece); Felix Kladek (NEC Europe Ltd., Germany); Paolo Monti (Chalmers University of Technology, Sweden); Alberto Mozio (Universidade Politécnica de Madrid, Spain); Thomas Zinner (NTNU, Norway); Harald Øverby (Norwegian University of Science and Technology, Norway); Sergio González (Atos, Spain); Håkon Lensethagen (Telenor Research, Norway); José-Miguel Pulido (Volta Networks, Spain); Daniel King (Old Dog Consulting, United Kingdom (Great Britain))

5Growth Data-Driven AI-Based Scaling
Danny De Vleeschauwer (Nokia, Belgium); Jorge Baranda (Centre Tecnològic de Telecomunicacions de Catalunya (CTTC/CERCA), Spain); Josep Mangues-Bafalluy (Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), Spain); Carla Fabiana Chiasserini, Marco Malinverno and Corrado Puligheddu (Politecnico di Torino, Italy); Lina Magoula (National and Kapodistrian University of Athens, Greece); Jorge Martin-Pérez (Universidad Carlos III de Madrid, Spain); Sokratis Barmpounakis (University of Athens, Greece); Koteswara Rao Kondepudi (Indian Institute of Technology, Dharwad, India); Luca Valcarenghi (Scuola Superiore Sant’Anna, Italy); Xi Li (NEC, Germany); Chrysa Papagianni (University of Amsterdam, The Netherlands); Andres Garcia-Saavedra (NEC Labs Europe, Germany)

NET2 – Network Softwarisation II
Chair: Thomas Henderson, Univ. Washington, USA

Anomaly Detection and Analysis Framework for Mobile Networks
Jessica Mendoza, Isabel de-la-Bandera and Jesús Burgueño (University of Málaga, Spain); César Morillas and David Palacios (Tupl Inc., Spain); Raquel Barco (University of Málaga, Spain)

Adaptive and Latency-Aware Load Balancing for Control Plane Traffic in the 4G/5G Core
Van Giang Nguyen, Karl-Johan Grinnemo, Javid Taheri and Anna Brunstrom (Karlstad University, Sweden)

6ET2 – 6G Enabling Technologies II
Chair: Albert Banchs, Universidad Carlos III de Madrid, Spain

Multi-Party Collaboration in 5G Networks via DLT-Enabled Marketplaces: A Pragmatic Approach
Adriana Fernández-Fernández (Fundació i2CAT, Internet i Innovació Digital a Catalunya, Spain); Michael De Angelis and Pietro Giardina (Nextworks, Italy); James Taylor (Bartr Group, United Kingdom (Great Britain)); Paulo Chainho (Altice Labs, Portugal); José M. Jorquera Valero (University of Murcia, Spain); Leonardo Ochoa-Aday (Fundació i2CAT, Internet i Innovació Digital a Catalunya, Spain); Diego Lopez (Telefonica I+D, Spain); Gino Carrozzo (Nextworks, Italy); Muhammad Shuaib Siddiqui (Fundació i2CAT, Internet i Innovació Digital a Catalunya, Spain)
DEDICAT 6G - Dynamic Coverage Extension and Distributed Intelligence for Human Centric Applications with Assured Security, Privacy and Trust: From 5G to 6G
Vera Stavroulaki (WINGS ICT Solutions, Greece); Emilio Calvanese Strinati (CEA-LETI, France); Francois Carrez (University of Surrey, United Kingdom (Great Britain)); Yannick Carlinet (Orange Labs, France); Mickael Maman (CEA-LETI Minatc Campus, France); Drasko Draskovic (NOKIA, France); Drazen Ribar (AIRBUS, France); Arthur Lallet (Airbus, France); Klaus Mößner (Chemnitz University of Technology, Germany); Milenko Totic (VizLore Labs Foundation, Serbia); Mikko Uitto (VTT Technical Research Centre of Finland Ltd, Finland); Seilendria A. Hadiwardoyo (University of Antwerp & IMEC, Belgium); Johann M. Marquez-Barja (University of Antwerp & imec, Belgium); Esther Garrido (Atos Spain, Spain); Makis Stamateelatos (Diakinesis, Greece); Khaled Sarayeddine (Optinvent, France); Pablo Sanchez Vivas (TTI, Spain); Aarne Männilä (VTT Technical Research Centre of Finland, Finland); Panagiotis Demestichas (University of Piraeus, Greece)

Wireless Environment as a Service Enabled by Reconfigurable Intelligent Surfaces: The RISE-6G Perspective
Emilio Calvanese Strinati (CEA-LETI, France); George C. Alexandropoulos (University of Athens, Greece); Vincenzo Sciancalepore (NEC Laboratories Europe GmbH, Germany); Marco Di Renzo (Paris-Saclay University / CNRS, France); Henk Wymeersch (Chalmers University of Technology, Sweden); Dinh-Thuy Phan-Huy (Orange-France Telecom, France); Maurizio Crozzoli (Temele Italia, Italy); Raffaele D’Errico (CEA, LETI, Minatc Campus & Univ. Grenoble-Alpes, France); Elisabeth de Carvalho and Petar Popovski (Aalborg University, Denmark); Paolo Di Lorenzo (Sapienza University of Rome, Italy); Luca Bastianelli (Università Politecnica delle Marche, Italy); Mathieu Belouar (SNCF, France); Julien Etienne Mascolo (CRF, Italy); Gabriele Gradoni and Sendy Phang (University of Nottingham, United Kingdom (Great Britain)); Geoffroy Lerosey (Greenwave, Germany); Benoît Denis (CEA-Leti Minatc, France)

Why is Application Reliability an Issue for an Ultra-Reliable 6G Network?
Malla Reddy Sama (DOCOMO Euro-labs, Germany); Riccardo Guerzoni (DOCOMO Euro-Labs, Germany); Wolfgang Kiess (University of Applied Sciences Koblenz, Germany); Srisakul Thakolsri (DoCoMo Euro-Labs, Germany); Jan Jürjens (University of Koblenz & Fraunhofer ISST (Germany))

Optimized Precoders for Massive MIMO RadCom Systems
Murat Temiz (University of Manchester, United Kingdom (Great Britain)); Emad Alsusa (Manchester University, United Kingdom (Great Britain); Mohammad W. Baidas (Kuwait University, Kuwait)

SPS7 6G Visions
Chairs: Marja Matinmikko-Blue, University of Oulu, Finland

Poster Session B
Chair: TBD

Big Communications: Connect the Unconnected
Shuping Dang and Chuangting Zhang (King Abdullah University of Science and Technology, Saudi Arabia); Basem Shihada (KAUST, Saudi Arabia); Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Mobile Edge Computing Heterogeneous Networks: Spatial Modeling and Delay Analysis
Yongqiang Zhang (KAUST & King Abdullah University of Science and Technology (KAUST), Saudi Arabia); Mustafa A Kishk (King Abdullah University of Science and Technology, Saudi Arabia); Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Performance Evaluation of UAV-Enabled Wireless Networks with Limited Capacity Charging Stations
Yujie Qin (King Abdullah University of Science and Technology (KAUST), Saudi Arabia); Mustafa A Kishk (King Abdullah University of Science and Technology, Saudi Arabia); Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Laser-Powered UAVs for Wireless Communication Coverage: A Large-Scale Deployment Strategy
Mohamed-Amine Lahmeri and Mustafa A Kishk (King Abdullah University of Science and Technology, Saudi Arabia); Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Compressive Localization with RIS in Near-Field
Omar Rinchi (University of Jordan, Jordan); Ahmed Ezzanaty and Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

AI-Enabled Slice Protection Exploiting Moving Target Defense in 6G Networks
Maria Christopoulou (NCSR Demokritos, Greece); Wissam Soussi (Zurich University of Applied Sciences (ZHAW) & University of Zurich (UZH), Switzerland); George K Xilouris (NCSR Demokritos, Greece); Gurkan Gur (Zurich University of Applied Sciences (ZHAW), Switzerland); Edgardo Montes de Oca (Montimage, France); Harilaos Kounaras (NCSR Demokritos, Greece); Burkhard Stiller (University of Zurich, Switzerland)
Piezoelectrically Adjustable Metamaterial Particles in the Role of THz Modulators
Antonios Lalas (University of Western Macedonia, Greece)

On the Capacity of Reconfigurable Intelligent Surface Assisted MIMO Systems
Jia Ye (King Abdullah University of Science and Technology, Saudi Arabia); Shuaishuai Guo (Shandong University, China); Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Dynamic Control Plane Load Balancing in Large Scale Distributed vSDN-Enabled 5G Networks
Deborsi Basu (Indian Institute of Technology, Kharagpur & IEEE Student Member, India); Sricheta Parui and Vikash Gupta (Indian Institute of Technology Kharagpur, India); Uttam Ghosh (Vanderbilt University, USA)

Security Orchestration Framework for Federated Network Slicing
Shalitha Wijethilaka (University College Dublin, Ireland); Madhusanka Liyanage (University College Dublin, Ireland & University of Oulu, Finland)

Identifying Factors Enabling the Enhancement of Service Migration of Multi-Access Edge Computing
Pasika S Ranaweera (University College Dublin, Ireland & University of Ruhuna, Sri Lanka); Anca Delia Jurcut (University College Dublin, Ireland); Madhusanka Liyanage (University College Dublin, Ireland & University of Oulu, Finland)

SANCUS - Towards Unifying the Analysis and Control of Security, Privacy and Service Reliability
Charilaos Zarakovitis (National Centre for Scientific Research Demokritos, Greece); Nikolaos Pitropakis (Eight Bells LTD, Athens, Greece); Dimitrios Klonidis (UBITECH, Greece); Hicham Khalife (Thales Communications & Security, France)

Measurement-Based Performance Evaluation of 5G NR Broadcasting
Kiril Kirev and Stefan Pratschner (TU Wien, Austria); Stefan Schwarz (TU Wien & CD-Lab Society in Motion, Austria)

Spatial Probabilistic Shaping for VLC
Amanat Kafizov (King Abdullah University of Science and Technology, Saudi Arabia); Ahmed Elzanaty and Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

A Single Detector Versus an Array of Detectors Receiver in Free-Space Optical Communications: A Performance Comparison
Ming-cheng Tsai (King Abdullah University of Science and Technology, Saudi Arabia); Salman Bashir (KAUST, Saudi Arabia); Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Beamforming Design for Full-Duplex Wireless Powered Communication Networks
Muhammad Shahid Iqbal (Koc University, Turkey); Yalcin Sadi (Kadir Has University, Turkey); Sinem Coleri (Koc University, Turkey)
Friday, 11 June 2021
Friday, 11 June 2021, 9:30-11:00/11:30-13:00, Zoom Room

**NET3 – Network Softwarisation III**
**Chair:** Franco Callegati, Univ. Bologna, Italy

A Security Monitoring Architecture Based on Data Plane Programmability
Amir Alsadi (University of Bologna, Italy); Davide Berardi (Università di Bologna, Italy); Franco Callegati (Universita’ di Bologna, Italy); Andrea Melis and Marco Prandini (University of Bologna, Italy)

Blockchain-Based Zero Touch Service Assurance in Cross-Domain Network Slicing
Vasileios Theodorou (Intracom S.A. Telecom Solutions, Greece); Alexios Lekidis (Intracom Telecom, Greece); Theodoros Bozios (Intracom S.A. Telecom Solutions, Greece); Kalman Meth (IBM, Israel); Adriana Fernández-Fernández (Fundació i2CAT, Internet i Innovació Digital a Catalunya, Spain); James Taylor (Bartr Group, United Kingdom (Great Britain)); Pedro Diogo and Pedro Martins (Ubiwhere, Portugal); Rasoul Behravesh (Fondazione Bruno Kessler, Italy)

Distributed AI-Based Security for Massive Numbers of Network Slices in 5G & Beyond Mobile Systems
Chafika Benzaid and Tarik Taleb (Aalto University, Finland); Cao-Thanh Phan (BCOM, France); Christos Tselios (University of Patras & Citrix Inc., Greece); George Tsolis (Citrix Systems Inc., Greece)

Network Policies in Kubernetes: Performance Evaluation and Security Analysis
Gerald Budigiri (KU Leuven, Belgium); Christoph Baumann (Ericsson Research, Sweden); Jan Tobias Mühlberg, Eddy Truyen and Wouter Joosen (KU Leuven, Belgium)

**OPE3 – Experimentation and Performance Evaluation for 5G and IoT**
**Chair:** Brecht Vermeulen, IMEC Ghent Univ., Belgium

Performance Evaluation of COINS Framework for Wireless Network Automation
Ivan Bošković (Jozef Stefan Institute, Slovenia); Halil Yetgin (Jozef Stefan Institute, Slovenia & Bitlis Eren University, Turkey); Carolina Fortuna (Jozef Stefan Institute, Slovenia); Mihael Mohorcic (Jozef Stefan Institute & Jozef Stefan International Postgraduate School, Slovenia)

A Performance Comparison of Virtualization Techniques to Deploy a 5G Monitoring Platform
Ramon Perez (Telcaria Ideas, Spain); Priscilla Benedetti (University of Perugia, Italy); Matteo Pergolesi (Telcaria Ideas, Spain); Jaime Garcia-Reinoso (Universidad Carlos III de Madrid, Spain); Ator Zabala (Telcaria Ideas S. L., Spain); Pablo Serrano (Universidad Carlos III de Madrid, Spain); Mauro Femminella and Gianluca Reali (University of Perugia, Italy); Albert Banchs (Universidad Carlos III de Madrid, Spain)

A Performance Measurement Platform for C-ITS over 5G
António Serrador (Polytechnic Institute of Lisbon & ISEL, Portugal); Carlos Mendes (ISEL, Portugal); Nuno Datia (ISEL - Instituto Politécnico de Lisboa & NOVA LINCS, FCT, Universidade NOVA de Lisboa, Portugal); Nuno Cota (Instituto Superior de Engenharia de Lisboa, Portugal); Nuno Cruz (Instituto Politécnico de Lisboa & Universidade de Lisboa, Portugal); Ana Rita Beire (SOLVIT - Innovation on Telecommunications, Portugal)

Reprogramming of Embedded Devices Using Zephyr: Review and Benchmarking
João Oliveira (Fraunhofer Portugal AICOS, Portugal); Filipe Sousa (Fraunhofer Portugal, Portugal)

**CME1 – Components and Microelectronics**
**Chair:** TBD

Design and Fabrication of Sub-THz Steerable Photonic Transmitter 1×4 Array for Short-Distance Wireless Links
Luis M. Pessoa (INESC TEC & Faculty of Engineering, University of Porto, Portugal); Luís Gonzalez Guerrero and Cyril Renaud (University College London, United Kingdom (Great Britain)); Glenn George (Bay Photonics, United Kingdom (Great Britain)); Marco A. Porcel (VLC Photonics, Spain); Henrique M Salgado (University of Porto & INESC Porto, Portugal); Bilal Hussain (Faculty of Engineering of the University of Porto, Portugal); Alberto Hinojosa (VLC Photonics SL, Portugal); Chris Graham (University College London, United Kingdom (Great Britain)); James Seddon (UCL, United Kingdom (Great Britain)); Juan Fernández (VLC Photonics, Spain)
SiGe: BiCMOS Technology is Enabling D-Band Link with Active Phased Antenna Array
Andrea Pallotta (STMicroelectronics, Italy); Pascal Roux (Nokia-Bell-Labs/III-V Lab, France); David del Rio and Juan F Sevilla (CEIT and TECNUN, Spain); Mahmoud Pirbazari and Andrea Mazzanti (University of Pavia, Italy); Vladimir Ermolov, Antti E. I. Lamminen and Jussi Säily (VTT Technical Research Centre of Finland, Finland); Mario Giovanni Luigi Frecassetti (NOKIA, Italy); Maurizio Moretto (Nokia, Italy); Jesus de Cos (ERZIA, Spain)

FPGA Implementation of a Wideband Multi-Gb/s 5G BF-OFDM Transceiver
Jean-Baptiste Doré (CEA, France); Marc Laugeois (CEA-LETI, France); Nicolas Cassiau (CEA-Leti Minatec Campus, France); Xavier Popon (CEA-LETI, France)

A 336 Gbit/s Full-Parallel Window Decoder for Spatially Coupled LDPC Codes
Matthias Herrmann (TU Kaiserslautern, Germany); Norbert Wehn (University of Kaiserslautern, Germany); Max Thalmaier, Markus Fehrenz, Timo Lehngk-Emden and Matthias Alles (Creonic GmbH, Germany)

Noise Consideration of Radio Receivers Using Silicon Technologies Towards 6G Communication
Mikko Hietanen, Sumit P Singh, Timo Rahkonen and Aarno Pärssinen (University of Oulu, Finland)

SPS6: Space - the Next 6G Frontier, Zoom Room
Chair: Maria Guta, Esa, The Netherlands
Tomaso de Cola, DLR, Germany,
Adam Kapovits, Eurescom GmbH, Germany

SPS7 6G Visions, Zoom Room
Chair: Marja Matinmikko-Blue, University of Oulu, Finland

SPS8: Autonomous Network Management towards 6G, Zoom Room
Chair: Stefania Bartoletti, CNIT, Italy
Gino Carrozzo, Nextworks s.r.l., Italy

SPS9: RIS-empowered Communications and Localization for Smart Radio, Zoom Room
Chair: Emilio Calvanese Strinati, French Alternative Energies and Atomic Energy Commission - Laboratory of Electronics and Information Technology (CEA-LETI), France,
Vincenzo Sicancalepore, NEC Laboratories Europe GmbH, Germany, Marco Fiore, IMDEA Network Institute, Spain,
Benoît Denis, Ahmed Elzanaty, King Abdullah University of Science and Technology (KAUST), Saudi Arabia,
Anna Guerra, University of Bologna (UNIBO), Italy,
Francesco Guidi, National Research Council of Italy (CNR-IEIIT), Italy.

Friday, June 11, 11:30 – 13:00, Virtual Platform
Panel 3
6G and B5G prospects for vertical industry
Organizer/Moderator: Markus Dillinger, Huawei Technologies Duesseldorf GmbH, Munich, Germany

Friday, June 11, 13:00 – 13:30
Webcast in the platform, LIVE
Chair: Manuel Ricardo (Univ. Porto /INESC TEC)

Friday, June 11, 14:30 – 17:30, Zoom Room
Smart Networks and Services Info Session
Chair: Colin Willcock (The 5G Infrastructure Association)
Workshops
**WS1: 6G for Connecting the Unconnected in Rural and Remote Areas to Meet UN SDG’s**

**Workshop Chair:** Harri Saarnisaari, University of Oulu, Centre for Wireless Communications, Finland

**Tuesday, 8 June 2021, 9:30-11:00/11:30-13:00, Zoom Room**

**Organisers:**
- Harri Saarnisaari (University of Oulu, Centre for Wireless Communications)
- Seppo Yrjölä (Professor of Practice, Centre for Wireless Communications, University of Oulu; Principal Engineer, Nokia Cloud and Network Services)
- Marja Matinmikko-Blue (Adjunct Lecturer, Centre for Wireless Communications, University of Oulu, Finland)
- Adrian Kliks (Associate Professor, Centre for Wireless Communications, University of Oulu, Finland)
- Harley Walsh, UN chief of cyber crime, “Countering Cybercrime: the policy vs reality gap”
- Prof. Josef Noll, University of Oslo & Basic Internet Foundation, “Societal needs as a driver for a decentralised 6G”
- Ass. prof. Marianne Kinnula, University of Oulu, “Co-evolution of human capabilities and intelligent technologies”
- Adj. prof Marco Giordani, University of Padova, “Bridging the Digital Divide: The Potential of Non-Terrestrial Networks”

**Participating Projects:**

**Motivation and Background**
Technical, human, societal and business challenges have to be addressed during 6G development. This is emphasized in rural and remote areas where the digital divide is the most serious. Reasons for this include low population density, low incomes or even poverty, difficult terrain, missing and unreliable infrastructure and low level of education. In addition, the COVID pandemic has changed society’s priorities on many fronts, including remote education, remote working, and remote healthcare. In other words, societal resilience should be increased.

The goal of the workshop is to raise awareness about the problem, open discussions, dig deeper in challenges and share information. This is done by offering talks, via an interactive session and by sharing the results of the latter openly at least through the 6Gchannel (https://www.6gchannel.com/) to benefit all the 6G researchers, e.g., in their development projects.

The mentioned challenges cry for innovative solutions to provide affordable yet sufficient services to the people. Furthermore, it has been identified that that many United Nations’ Sustainable Development Goals (SDGs) require connectivity. In addition, recognition of human as well authorities’ needs (like public safety) and requirements and identifying use cases are extremely important, though it is hard to see to 2030s and 2040s, where 6G will be used. This workshop offers a forum to hear and discuss these things at this early stage of 6G.

For background information and initial thoughts, please look at the 6Gchannel and white papers from 2020 therein.

**Agenda**
- **9:00-9:45 Opening**
  - Prof. Harri Saarnisaari, University of Oulu
- **9:45-10:30 Presentations**
  - Neil Walsh, UN chief of cyber crime, “Countering Cybercrime: the policy vs reality gap”
  - Prof. Josef Noll, University of Oslo & Basic Internet Foundation, “Societal needs as a driver for a decentralised 6G”
  - Prof. Marianne Kinnula, University of Oulu, “Co-evolution of human capabilities and intelligent technologies”
  - Adj. prof Marco Giordani, University of Padova, “Bridging the Digital Divide: The Potential of Non-Terrestrial Networks”
- **11:30-13:00 Interactive session**
  - Discussion with audience based on presentations and questions by organizers
WS2: Hardware Enabling Technologies for 6G Networks

Tuesday, 8 June 2021, 14:00-15:30/16:00-17:30, Zoom Room

Organisers:
- Gerhard Fettweis (TU Dresden)
- Yaning Zou (TU Dresden)
- Didier Belot (CEA)
- Mohand Achouche (NOKIA)
- Björn Ekelund (Ericsson AB)
- Jochen Koszecha (Infineon)
- Jacques Magen (AUSTRALO)
- Björn Debaille (imec)
- Piet Wambacq (imec)
- Patrick Pype (NXP Semiconductors)
- Frederic Gianesello (STMicroelectronics)
- Patrick Cogez (AENEAS)
- Colin Willcock (The 5GIA)

Participating Projects:
- COREnect

Motivation and Background
The COREnect project is bringing together the most prominent European industrial and academia players as well as industry associations in the network, microelectronics and verticals domains to jointly develop a high-level strategic roadmap of core subsystem and component technologies for supporting future connectivity. The goal is to establish a sustainable European technology sovereignty in 5th Generation (5G) and beyond, promote innovation and business opportunities e.g. for small and medium-sized enterprises (SMEs), pave the way for one or more future European champions in this area, and lay a solid foundation for the long-term success of both industries.

Based on the initially identified COREnect end-to-end system view with a value chain consideration, COREnect has organised three Expert Groups (EGs) to address the three strategic focus areas within the industry roadmap:
- Expert Group #1 Computing/Storage Core Technologies for Future network
- Expert Group #2 Communications/Sensing Core Technologies for Future network
- Expert Group #3 Peripheral Core Technologies for Future network

The purpose of this workshop is to present the key findings of these EGs at a broad ICT audience. Combining insights and expertise from the communication and microelectronics domain, the three expert groups will address three key areas and share their sector-specific viewpoints on: a) Electronics for Trustworthy Communication (6G and beyond), b) Future Core Technologies and Integration and c) Energy-efficient, Green Communication Electronics.

As the EuCNC is major event that attracts all key European stakeholders, it offers a unique opportunity to disseminate these findings as the results of almost one year of activities but also allow the exchange of ideas and opinions from the participants from the telecommunications’ sector. Towards this end, the Workshop will schedule a dedicated panel that will operate as an interactive event with the participants.

Agenda
14:00-15:30 Presentations
- Colin Willcock, 5GIA, “Hardware enabling technologies to ensure EU’s digital autonomy in 6G networks: The COREnect approach”
- Patrick Pype, NXP, “Electronics for Trustworthy Communication (6G and beyond)”
- Piet Wambacq, IMEC, “Future Core Technologies and Integration”

Coffee Break

16:00-17:30 Presentations and Panel
- Gerhard Fettweis, TU Dresden, “Energy Efficient, Green Communications Electronics”
- Panel: “Opportunities and Challenges for hardware enabling technologies in the SNS Partnership
  - Moderator: Yaning Zou – TU Dresden, Technical Manager, COREnect
  - Panelists: Fredrik Tillman (Ericsson), Mohand Achouche (Nokia), Patrick Cogez (AENEAS), Ludger Verweyen (Infineon Technologies), Frank Hoffman (Bosch)
WS3: Connectivity and Beyond: How the 5G Ecosystem Empowers the Port, Logistics and Automotive Industries

Tuesday, 8 June 2021, 9:30-11:00/11:30-13:00, Zoom Room

**Organisers:**
- Jurij Mirnik (PORT OF KOPER)
- Dejan Šošter (TELEKOM SLOVENIJE)
- Janez Sterle (INTERNET INSTITUTE)
- Pavlos Basaras (ICCS)
- Ralf Willenbrock (TSYSTEM)
- Athanasios Koumarparos (VODAFONE INNOVUS)
- Oihana Otaegui (VICOMTECH)
- Fatma Raissi (AKKA)
- Pierluigi Freni (LIFTT)
- Michela Apruzzese (ICOOR)

**Participating Projects:**
- 5G-LOGINNOV
- 5GMETA

**Motivation and Background**
Jointly organised by the European H2020 projects 5GMETA and 5G-LOGINNOV, this workshop explores the various applications of 5G, with a focus on the logistics and automotive sectors. Data has become an extremely important asset, not only to cope with traffic congestion, environmental challenges and handle upcoming and future logistics capacity, but also to develop economic and innovative business opportunities for regions, industries, SMEs and high-tech start-ups. 5G-LOGINNOV will not only use data to stimulate and facilitate innovative products and services, whilst ensuring data privacy, security, interoperability and ownership, but also use new, innovative concepts, applications and devices supported by 5G technologies, IoT, data analytics, next generation traffic management and CCAM to reach the above-mentioned goals. Thanks to the expertise of both project consortiums, which gather very relevant and well-positioned European stakeholders from research and academia, telecommunications, RTOs, clusters, incubators and industry, participants to the workshop will learn about the CAD and logistics challenges, architecture, innovations and services enabled by 5G. Participants will also have the opportunity to get involved in the projects’ future SME and start-up activities. Both projects will present their concrete actions, activities and 5G roadmaps through their respective living labs and use cases, which include use cases on R&D Live Training Loop, Networking Parking and Driving Safety & Awareness, Traffic Management Applications, Video Surveillance, Precise positioning, Predictive Maintenance and Real Time Tracking.

**Agenda**
9:30-11:00: Opening
- Eusebiu Catana, ERTICO 5G-LOGINNOV Coordinator, “Deploying new CAD and Logistics tailored services in real-life port-city areas with 5G LOGINNOV”
- Oihana Otaegui, VICOMTECH, 5GMETA Coordinator, “A 5G platform to enable mobility data monetization – empowering the automotive ecosystem from industry players to new entrants”

Technical Session
- Ralf Willenbrock, TSYSTEM (5G-LOGINNOV), “5G ecosystems for sustainable port/hinterland connections”
- Djibrilla AMADOU KOUNTCHE, AKKA (5GMETA), “5GMETA Platform for automotive Domain”
- Pierluigi Freni, LIFTT (5GMETA), “5G Functions for enabling monetization of mobility data”

Coffee Break
11:30-13:00: Panel Discussion
Panel: “5G in real solutions: enabling logistics and automotive industries to safety, environmental sustainability and efficiency”
- Moderator: Zeljiko Jefic, Deputy Director of Innovation and Deployment, ERTICO
- Panelists: Port of Koper Living Lab - Janez Sterle, INTERNET INSTITUTE
- (5G-LOGINNOV), Piraeus-Athens Living Lab - Pavlos Basaras, ICCS (5GLOGINNOV), Hamburg Living Lab - Ralf Willenbrock, TSYSTEM (5GLOGINNOV), R&D Live Training Loop use case - Oihana Otaegui, VICOMTECH (5GMETA), Networking Parking use case - Djibrilla AMADOU KOUNTCHE, AKKA (5GMETA), Driving Safety & Awareness use case - Arslane HAMZA-CHERIF, ICOOR (5GMETA)

Open discussion

Presentations - Emerging 5G Business Models: how 5G can enable different services and market players
- Pierluigi Freni, LIFTT (5GMETA), “5GMETA to catalyse new business opportunities”
- Mariangela Rosano, ICOOR (5G-LOGINNOV), “5G enabled business opportunities and models for new players in the logistics domain”
WS5: Hexa-X – The European 6G Initiative

Workshop Chair:
Patrik Rugeland, Ericsson Research, Sweden,
Mikko Uusitalo, Nokia Bell Labs, Finland,
Mauro Boldi, Telecom Italia S.p.A., Italy

Motivation and Background
The EU commission recently granted the 2.5 yHexa-X project (H2020 ICT-52) on explorative research towards 6G. With 25 partners from leading academic institutions and industry players, the project stands out as the European flagship initiative in 6G, an area that will be of key importance in the technical evolution in the coming decade. The project will establish a vision for the future networks of 2030 addressing the envisioned use cases and services. The 6G networks will be designed based on the fundamental principles of trustworthiness, sustainability and digital inclusion. The project will explore a plethora of technical enablers related to e.g. enhanced radio performance and combined communication and localization/sensing; Connected intelligence with integrated AI/ML; Network evolution expansion, exploring new network architectures and novel verticals. As such, the workshop will accurately address the conference tracks ‘6G Enabling Technologies’ and ‘6G Visions’, by providing a consolidated view on the 6G research from the major European players. With this workshop we want to create awareness of the project and disseminate early results and present ongoing research and plans.

As the Hexa-X project will be the European 6G flagship project, interactions with other ICT-52 6G technical enabler projects will be crucial and the workshop presents an important venue for initiating collaboration and sharing of results. This will be achieved by inviting two presenters from related 6G enabler projects within the H2020 ICT-52 program.

Agenda
14:00-15:30 Presentations
- Mikko Uusitalo (Nokia Bell Labs), Patrik Rugeland, “Hexa-X Project Overview”
- Patrik Rugeland (Ericsson Research); Mikko Uusitalo; Björn Richerzhagen; Marco Hoffmann; Marie-Helene Hamon, “Hexa-X Use cases and Key value indicators”
- Azeddine Gati (Orange), “The Sustainability Road for 6G”
- Yaning Zou (TU Dresden), Aarno Pärssinen; Henk Wymeersch, “Radio Performance Towards 6G”
- Josep Martrat (Atos); Ignacio Labrador Pavon; Miltiadis C. Filippou, “Connecting Intelligence and Smart Orchestration for B5G/6G Networks”
- Björn Richerzhagen (Siemens); Mårten Ericson, “Advances in Network Evolution and Expansion”
- Emilio Calvanese Strinati; Vincenzo Sciancalepore; George C. Alexandropoulos, “The RISE-6G Project: Wireless Environment as a Service Enabled by Reconfigurable Intelligent Surfaces”
- Vera Stavroulaki; Panagiota Demestichas Hosts; Harri Saarnisaari, Seppo Yrjölä, Adrian Kliks (Univ. Poznan), Marianne Kimnula, Anna Suorsa (Univ. Oulu), Panos Kostakos (Univ. Oulu), Muhammad Zeeshan Asghar (Univ. Jyväskylä), “DEDICAT 6G: Dynamic Coverage Extension and Distributed Intelligence for Human Centric Applications with Assured Security, Privacy, and Trust: From 5G to 6G”

Coffee Break
16:00-17:30 Presentations
- Azeddine Gati (Orange), “The Sustainability Road for 6G”
- Yaning Zou (TU Dresden), Aarno Pärssinen; Henk Wymeersch, “Radio Performance Towards 6G”
- Josep Martrat (Atos); Ignacio Labrador Pavon; Miltiadis C. Filippou, “Connecting Intelligence and Smart Orchestration for B5G/6G Networks”
- Björn Richerzhagen (Siemens); Mårten Ericson, “Advances in Network Evolution and Expansion”
- Emilio Calvanese Strinati; Vincenzo Sciancalepore; George C. Alexandropoulos, “The RISE-6G Project: Wireless Environment as a Service Enabled by Reconfigurable Intelligent Surfaces”
- Vera Stavroulaki; Panagiota Demestichas Hosts; Harri Saarnisaari, Seppo Yrjölä, Adrian Kliks (Univ. Poznan), Marianne Kimnula, Anna Suorsa (Univ. Oulu), Panos Kostakos (Univ. Oulu), Muhammad Zeeshan Asghar (Univ. Jyväskylä), “DEDICAT 6G: Dynamic Coverage Extension and Distributed Intelligence for Human Centric Applications with Assured Security, Privacy, and Trust: From 5G to 6G”

Tuesday, 8 June 2021, 14:00-15:30/16:00-17:30, Zoom Room
Organisers:
- Mikko Uusitalo (Nokia, Project coordinator)
- Patrik Rugeland (Ericsson, Technical manager)
- Dario Sabella (Intel, Innovation Manager)
- Marco Hoffmann (Nokia, WP1 leader)
- Yaning Zou (TU Dresden, WP2 co-leader)
- Aarno Pärssinen (U OULU, WP2 co-leader)
- Henk Wymeersch (Chalmers, WP3 leader)
- Miltiadis Filippou (Intel, WP4 leader)
- Mårten Ericson (Ericsson, WP5 leader)
- Josep Martrat (Atos, WP6 co-leader)
- Ignacio Labrador (Atos, WP6 co-leader)
- Björn Richerzhagen (Siemens, WP7 leader)
- Mauro Boldi (Telecom Italia, WP8 leader)

Participating Projects:
Hexa-X
WS6: 5G Private Networks

**Workshop Chair:**
David Gomez-Barquero, Universitat Politècnica de Valencia, Spain

**Organisers:**
- David Gomez-Barquero, Universitat Politècnica de Valencia (UPV), Spain
- Kashif Mahmood, Telenor Research, Norway
- Nikolaos Tzanis, ADMIE (Greece)
- Niels König, Fraunhofer Institute for Production Technology (IPT), Germany
- Manuel Fuentes, Fivecomm, Spain
- Jordi J. Gimenez, European Broadcasting Union (EBU), Switzerland
- Kennet Nomeland, Norwegian Defense Material Agency (NDMA), Norway
- Ki Won Sung, KTH Royal Institute of Technology, Sweden
- Jose Ordonez-Lucena, Telefonica, Spain
- Daniele Munaretto, Athonet, Italy
- Simon Fletcher, Real Wireless, UK
- Håkon Lønsethagen, Telenor (Norway)
- Jose Costa-Requena, Cumucore, Finland
- Sebastian Robitzsch, InterDigital, UK
- Dirk Trossen, Huawei Technologies Duesseldorf GmbH, Germany
- Sergio Gonzalez, ATOS, Spain

Tuesday, 8 June 2021, 9:30-11:00/11:30-13:00/14:00-15:30/16:00-17:30, Zoom Room

**Motivation and Background**

A private 5G network, known as Non-Public Network (NPN) in 3GPP terminology, allows the use of 5G technologies to create a dedicated network with unified connectivity, optimised services and a secure means of communication within a specific area. A private network can be run either by the company itself or a third party, based on the same or different spectrum owned by mobile network operators.

The private networks 5G market is expected to see significant growth in the next few years. A recent study estimates the private LTE and 5G network market in $4.7 Billion in annual spending in 2020 and it is expected to grow to nearly $8 billion by the end of 2023. This study estimates that as much as 30% of that investment will be directed towards the build-out of private 5G networks, as 5G becomes the preferred wireless connectivity medium to support Industry 4.0 and other verticals. Private networks are positioned to address the increasing demand for access to communication services by vertical industries, pushing a true digital transformation across manufacturing industries and other verticals.

This workshop is organized by 12 5G-PPP projects working on 5G NPNs, recognized experts in this area. The workshop will provide a holistic view of NPNs, covering from vertical use cases, operation aspects, business models, trials and emerging technologies.

**Agenda**

9:30-11:00 **Vertical Use Cases for 5G Private Network**

**Presentations**
- 5G-ACIA: Shaping the Industrial 5G Revolution (Xueli An, Huawei, 5G-ACIA)
- 5Growth NPN Deployment Solutions & Industry 4.0 Pilot Examples (Xi Li, NEC, 5Growth)
- 5G NPNs for Process Monitoring (Nikolaos Tzanis, Fraunhofer IPT, 5G-SMART)
- Autonomous Edge 5G Private Network Requirements for Smart Factories (Nikolaos Tzanis, University of Patras, 5G-VICTORI)

11:30-13:00 **Vertical Use Cases for 5G Private Network**

**Presentations**
- 5G-enabled AGVs for NPN Production Lines in Manufacturing (Manuel Fuentes, Fivecomm, 5G-INDUCE)
- 5G for Military Use (Kennet Noland, Norwegian Defense Material Agency, 5G-VINNI+FUDGE-5G)
- On the Role of 5G NPNs for Mission Critical Services (Ki-Won Sun, KTH, PriMO-5G)
- The role of 5G Non-Public Networks for Media Production (Jordi J. Gimenez, EBU, 5G-RECORDS)
Lunch
14:00-15:30 Operation of 5G Private Networks

Presentations
- Outlook for operator adoption of 5G Private Networks (Jose Ordonez-Lucena, Telefonica, 5G-VINNI+5Growth+5G-Clarity)
- High-Tech and Affordable 5G Private Network Roll-Out to Every Corner (Sergio Gonzalez, Atos, Affordable 5G)
- Towards efficient 5G NPN Readiness and Testing, addressing the Industry 4.0 challenges of SMEs (Hakon Lonsethagen, Telenor, 5G-Solutions)
- Operation of 5G NPNs: Industry Sector Considerations for Deployment and Sustainability (Simon Fletcher, Real Wireless, 5G-TOURS)

Coffee Break
16:00-17:30 Emerging Technologies for 5G Private Networks

Presentations
- Seamless integration of TSN into 5G NPNs for Industry 4.0 (Jose Costa, Cumucore, 5G-SMART+FUDGE-5G+5G-RECORDS)
- Cloud Deployments of 5G NPNs: the Athonet Connectivity Platform (Daniele Munaretto, Athonet, FUDGE-5G)
- Cloud Native Service-Based Architecture Deployment Considerations for NPNs: An Evolution of NFV (Sebastian Robitzsch, InterDigital, FUDGE-5G)
- Making (Virtualized) Service Interactions More Flexible Within and Across 5G Private Networks (Dirk Trossen, Huawei, FUDGE-5G)
WS8: From 5G to 6G
Automated and Intelligent Security: FAST

Tuesday, 8 June 2021, 9:30-11:00/11:30-13:00/14:00-15:30/16:00-17:30, Zoom Room

Organisers:
- Jordi Ortiz, Universidad de Murcia, Spain
- Edgardo Montesdeoca, Montimage, France
- Ramon Ruiz, Universidad de Murcia, Spain
- Soon Yim Tan, Nanyang Technological University, Singapore
- Taleb Tank, Aalto University, Finland
- Diego López, Telefónica I+D, Spain
- Antonio Pastor, Telefónica I+D, Spain
- Chafika Benzaid, Aalto University, Finland
- Thanasis Giannetsos, Ubitech, Greece
- Diogo Gomes, IT-Aveiro, Portugal
- Dhruha Ayed, Thales SIX GTS, France
- Jean-Philippe Wary, Orange Labs., France
- Gérard Gobat, Zurich University of Applied Sciences, Switzerland
- Raul Muñoz, CTTC, Spain
- George Xylouris, NCSR Demokritos, Greece
- Maria Christopoulou, NCSR Demokritos, Greece
- Roman Odarchenko, Bundleslab KFT, Budapest, Hungary
- Gregorio Martínez Perez, University of Murcia, Spain
- Pedro Martins, Ubiwhere, Portugal
- Alexios Lekidis, Intracom, Greece
- Ricard Vilalta, CTTC, Spain
- João Paulo Barraca, Instituto de Telecomunicações and Universidade de Aveiro, Portugal
- Daniel Corujo, Instituto de Telecomunicações and Universidade de Aveiro, Portugal
- Jose Santa, Technical University of Cartagena, Spain
- Tanel Jarvet, CAFA Tech OU, Estonia

Participating Projects:
INSPIRE-5Gplus, 5GASP, 5GZORRO, 5GROWTH, 5GIDrones, 5GENESIS, 5GMobix, 5G-INDUCE, SPIDER, Hexa-X, Teraflow, PALANTIR and PUZZLE

Motivation and Background

5G’s capabilities and flexibility hold the promise of further facilitating the society’s digitalization by enabling new services (e.g., remote surgery, advanced industrial applications) and communication modes (e.g., gestures, facial expressions and haptics). Current wireless communication systems do not meet the performance requirements of these new services, such as bandwidth, latency and reliability. Furthermore, the current COVID-19 crisis has fundamentally changed the way the world communicates and operates, accelerating the shift towards a more digital world. Such transformation and the new requirements make the need of secure, reliable and high-quality digital services promised by 5G more crucial than ever. Moreover, these fundamental drivers are expected to amplify and become even more prominent in future 6G networks.

To address the aforementioned challenges in beyond 5G or 6G telecommunication networks, the inherent support of full automation operations in network and service management is a necessity. One of the most critical areas of application for zero touch automation is the protection of the network and system assets against potential cybersecurity risks introduced by the unprecedented evolution of the 5G threat landscape. Zero touch automation also helps on the dynamic management of trust chains running end-to-end and enabling critical workloads to traversing different tenants and stakeholders with the required level of security and trust.

FAST aims to address these cybersecurity risks by discussing innovative concepts for security management of 5G networks and beyond from a holistic high-level architecture perspective. To reach a fully-automated and secured 5G infrastructure, the adoption of a set of emerging trends and technologies is crucial, namely, Zero-touch network and Service Management (ZSM), Software-Defined Security (D-SEC) models, Artificial Intelligence/Machine Learning (AI/ML) techniques, Distributed Ledger Technologies (DLT), Zero Trust models, and Trusted Execution Environments (TEE).

The workshop will be organized around a set of key thematic areas structured in technical sessions, with the participation of 135G projects and one prominent keynote speaker, followed by related discussions on a panel of experts. Specifically FAST will provide attendees with a deep understanding of: (i) 5G infrastructure security requirements relevant to different supported verticals; (ii) security orchestration and automation along the 5Garchitecture; (iii) security mechanisms complying with expected Security Service Level Agreements (SSLA) as well as regulatory requirements; (iv) an end-to-end 5G security framework and its application in different use cases; (v) future trends and next steps to increase the security of 5G systems and design secure 6G architectures.

Agenda

9:30-11:00 Opening Session and Keynote
- Pascal Bisson and Antonio Skarmeta

Session 1: Security and Trust Architecture for Beyond 5G Networks

- Defining the Security Management Closed-Loop for INSPIRE-5Gplus, Jordi Ortiz (University of Murcia, Spain); Chafika Benzaid (Aalto University, Finland); Maria Christopoulou (NCSR Demokritos, Greece); Pol Alemany (Centre Tecnològic de Telecomunicacions de Catalunya (CTTC/CERCA), Spain); Geoffroy Chollon (Thales, France); Wissem Soussi (Zurich University of Applied Sciences (ZHAW) & University of Zurich (UZH), Switzerland)
Overview of the Security and Trust Mechanisms in the 5GZORRO Project, José M. Jorquera Valero and Pedro Miguel Sánchez Sánchez (University of Murcia, Spain); James Taylor (Bartr Group, United Kingdom [Great Britain]); Ilija Lekidis (Intracom Telecom, Greece); Javier Fernández Hidalgo (i2CAT, Spain); Adriana Fernández-Fernández (i2CAT, Internet & Innovation Digital a Catalunya, Spain); Paulo Chaimho and Bruno Santos (Altice Labs, Portugal); Jean-Marie Mifsud (Malta Communications Authority, Malta); Muhammed Shuaib Siddiqui (Fundación i2CAT, Internet & Innovation Digital a Catalunya, Spain); Manuel Gil Pérez (University of Murcia, Spain); Alberto Huertas Celdrán (Waterford Institute of Technology, Spain); Gregorio Martínez Pérez (University of Murcia, Spain); Antoine Sciberras (Malta Communications Authority, Malta)

Metrics-Based Outlier Detection for 5G Security, Athanasios Privolos, Dimitris Lioprasitis and Georgios Gardikis (Space Hellas S.A., Greece); Socrates Costicoglou (Space Hellas SA, Greece)

Coffee Break

11:30-13:00 Session 2: Automated and Intelligent (smart) Security network management

Towards a ZSM Security Orchestration for Multi-Tenant 5G Networks, Rodrigo Asenio-Garriga, Alejandro Molina Zarca, Jordi Ortiz, Jorge Bernal Bernabe and Antonio Fernando Skarmeta Gomez (University of Murcia, Spain) - 5G-enabled AGVs for NPN Production Lines in Manufacturing (Manuel Fuentes, Fivecomm, 5G-INDUCE)

5G-INDUCE - A NetApp Orchestration Platform Enabling On-Demand Deployment of Security Services, Dimitrios Klondis (UBITECH, Greece); Franco R. Davoli (University of Murcia & National Inter-University Consortium for Telecommunications [CNIT], Italy); Nicholas Sguoros (Eight Belts Ltd, Greece); George Ampounis (KSY, Bulgaria); Georgios Katsikas (Ubitech, Greece); Thanos Xirolfotos (UBITECH, Greece); Roberto Buschi (CNIT, Italy); Chiara Lombardo (University of Genoa & CNIT-Research Unit of the University of Genoa, Italy); Ioannis Giannoulakis (Eight Belts Ltd, Cyprus); Emmanouil Kafetzakis (Eight Belts Ltd., Cyprus); Panagiotis Gouvas (Ubitech, Greece)

5Growth: Hardening Interdomain Vertical Services with Moving Target Defense (MTD) - Vitor A Cunha (Instituto de Telecomunicações, Portugal); Daniel Corujo (Instituto de Telecomunicações Averio & Universidade de Aveiro, Portugal); João Paulo Barraca and Rui L Aguiar (University of Aveiro & Instituto de Telecomunicações, Portugal)

5GMobix: Security Challenges on 5G CCAM Scenarios - Luis Bernal-Escobedo (University of Murcia, Spain); Jose Santa (Technical University of Cartagena, Spain); Ramon Sanchez-Iborra and Antonio Fernando Skarmeta Gomez (University of Murcia, Spain)

Lunch

14:00–15:30 Keynote

Dr. Ashutosh Dutta. IEEE Communications Society Distinguished Lecturer and Co-Chair for IEEE Future Initiative.

Session 3: Security Beyond 5G Networks and Services

Hexa-X: Trustworthy Networking Beyond 5G, Diego Lopez (Telefónica I+D, Spain); Carlos J. Bernardo (Universidad Carlos III de Madrid, Spain); Bin Han (Technische Universität Kaiserslautern, Germany); Cédric Morin (IMT Atlantique & TéléDiffusion de France, France); Antonio de la Oliva (Universidad Carlos III de Madrid, Spain); Antonio Pastor (Telefónica I+D & Universidad Politécnica de Madrid, Spain); Cao Thanh Phan (BCOM, France); Pawani Poranghabe (University of Oulu, Finland); Peter Schneider (Nokia Bell Labs, Germany); Hans D. Schotten (University of Kaiserslautern, Germany); Elf Ustundag Soykan (Ericsson Research, Turkey); Emrah Tomur (Ericsson Research & Middle East Technical University, Turkey)

Cloud-Scale SDN Network Security in TeraFlow, Alberto Mozo (UPM, Spain); Antonio Pastor (Telefónica I+D & Universidad Politécnica de Madrid, Spain); Carlos Natalino and Marija Furdek (Chalmers University of Technology, Sweden); Rahul Bobba (NEC, Germany); Raul Muñoz, Ramon Casellas and Ricardo Martínez (Centre Tecnològic de Telecomunicacions de Catalunya [CTTC/CERCA], Spain); Juan Pedro Fernández-Palacios (Telefónica I+D, Spain); Ricard Vilalta (Centre Tecnològic de Telecomunicacions de Catalunya [CTTC/CERCA], Spain); Stanislav Vavakar (Universidad Politécnica de Madrid, Spain)

Coffee Break

16:00–17:30 Session 4: Security Enablers for Beyond 5G Networks and Services

SPIDER: ML Applied to 5G Network Cyber Range, Stanislav Vavakar (Universidad Politécnica de Madrid, Spain); Alberto Mozo (UPM, Spain); Antonio Pastor (Telefónica I+D & Universidad Politécnica de Madrid, Spain)

5GASP: Security and Trust in NetApp Deployment and Operation, Jorge Gallego-Madrid (Odin Solutions); Ana Hermosilla (Odn Solutions, Murcia, Spain); Antonio F. Skarmeta (Odn Solutions S. L, Spain)

Towards 5G Embedded Trust: Integrating Attestation Extensions in Vertical Industries, Thanassis Giannetsos and Dimitrios Papamartzivanos (Ubitech Ltd., Greece); Sofia Anna Menesidou (Ubitech Ltd, Greece); Sophia Karagiorgou (Ubitech, Greece)

PALANTIR: Practical Autonomous Cyberhealth for Resilient Micro/Small/Medium-Sized Enterprises, Dimitris Papadopoulos (Infitl: Technologies, Greece); Antonios Litke (Infitl Information Intelligence Ltd, Greece); Manuel Gil Pérez (University of Murcia, Spain); Maxime Compastie (i2CAT Foundation, Spain); Roberto Bifulco (NEC Laboratories Europe, Germany); George Xylouris (Orion Innovations PC, Greece); Michail Alexandros Kourtis (NCSR Demokritos, Greece); Vangelis Logothetis (Incites Consulting, Luxembourg); George Athanasiou (DBC Europe, Belgium)

Tuesday, 8 June 2021, 9:30-11:00/11:30-13:00/14:00-15:30/16:00-17:30, Zoom Room

Organisers:
- Jaime Afonso – European Communications Office, Denmark
- Gianmarco Baldini – EC Joint Research Centre, Italy
- Marina Barbiroli – University of Bologna, Italy
- Martin Bisig – BAKOM, Switzerland
- Oliver Holland - Advanced Wireless Technology Group Ltd and King’s College London, UK
- Ingrid Moerman – imec - Ghent University, Belgium
- Jarkko Paavola, Turku University of Applied Science, Finland
- Octavian Popescu EUROMREG, Belgium
- Kandeepan Sithamparanathan RMIT, Melbourne, Australia
- Petri Mähönen Rheinisch-Westfälische Technische Hochschule Aachen, Germany

Motivation and Background

This workshop is intended to highlight the current status and future strategic challenges of studies, techniques and regulation to enable the shared and efficient access to spectrum and further develop the spectrum sharing paradigm with appreciation of regulatory needs and technological enablers, as well as underlying research challenges.

The 5G and future 6G ecosystems blur the traditional boundaries between wired and wireless, terrestrial and satellite, as well as between the use of licensed and unlicensed frequency bands, under different authorisation regimes. As a result, the efficient use of spectrum is becoming a major regulatory challenge, which calls for future-proof strategies and rules to allow more rapid access to airwaves and to promote innovation. Spectrum sharing is the key enabler to maximise efficiency of spectrum resources, deliver digital services in the coming decades and provide more flexibility in spectrum management for verticals.

Emerging technologies such as cognitive radio, geolocation databases and the use of higher frequencies bring new opportunities for sharing, but pose new technical and regulatory challenges. Balanced access to spectrum is required, allowing new users while granting protection to incumbents. Coexistence should be assessed through simulations and measurements under proper assumptions derived from the best available information. In this context, Machine Learning and Deep Learning (Artificial Intelligence) can play a significant role to enhance the spectrum sharing efficiency. The workshop will describe some key aspects for the application of artificial intelligence to spectrum sharing. Another important aspect is the experimental evaluation of new techniques and approaches, such as cognitive radio or geolocation databases, through open testbeds and development platforms for spectrum sharing, which can be used by the research community.

The workshop will put together a visionary team of leading researchers, spectrum regulators and industry players to explore a forward-looking roadmap towards a flexible spectrum management strategy in Europe.

Agenda

9:30-11:00 Session 1: Spectrum sharing – setting the scene

Conveners: Pravir Chawdhry (Joint Research Centre of the European Commission), Doriana Guiducci, (European Communications Office, CEPT)

- Introduction: “Vision for spectrum sharing in 6G” - Pravir Chawdhry, Joint Research Centre of the European Commission
- “Spectrum challenges towards 6G” - Chris Woolford, European Communications Committee (ECC)
- “A regulatory view on Spectrum Sharing” – Mauro Martino, Radio Spectrum Policy Group (RSPG)
- “What role will spectrum access and sustainability play in 6G service provision?” Oulu 6G Flagship, Marja Matinmikko-Blue, University of Oulu, Finland
- “Why spectrum sharing is needed for 5G” – Oliver Holland, Advanced Wireless Technology Group Ltd, UK

Session 2: Machine Learning/Deep Learning in Spectrum Sharing

Conveners: Gianmarco Baldini (Joint Research Centre of the European Commission)

- “Spectrum Occupancy Prediction Using Machine Learning” – Kandeepan Sithamparanathan, RMIT, Melbourne, Australia

Coffee Break
Session 3: Techniques and tools to enable the shared access to spectrum
Convener: Doriana Guiducci (European Communications Office)
- "Spectrum sharing and compatibility studies in the European regulatory context" – Peter Faris, European Communications Office, CEPT, Copenhagen, Denmark
- "Tools and Techniques for Spectrum Sharing for Research and Regulatory Support" - Claudia Carciofi, Fondazione Ugo Bordoni, Italy

Session 4: Experiments and pilots on spectrum sharing
Convener: Isabella Cerruti (Joint Research Centre of the European Commission)
- "Spectrum sharing in 5G - Experience from 5G-Xcast Project" – Tero Jokela, Turku University of Applied Sciences, Finland
- "State of the art in spectrum sharing deployment worldwide" - Heikki Kokkinen, Fairspectrum OY, Finland
- "Frequency Sharing Topics of 5G Satellite Networks", Maria Guta, European Space Agency, Noordwijk, The Netherlands

Session 5: International perspective on spectrum sharing
Convener: Pravir Chawdhry (Joint Research Centre of the European Commission)
- "From Collaborative Spectrum Sharing in the DARPA Spectrum Collaboration Challenge to Dynamic Spectrum Allocation in Satellite Communication", Ingrid Moerman, imec - Ghent University, Belgium
- "Considerations Regarding Location-Based Spectrum Sharing Standardisation" – Octavian Popescu, Eucomreg, Belgium
- "Preparing for the future communication ecosystem – A perspective from the Satellite Industry"– Miia Mustonen, Intelsat, London, UK

Focus Talk
- "A European testbed for spectrum sharing studies based on AI/ML techniques “ Pravir Chawdhry, (Joint Research Centre of the European Commission), Doriana Guiducci, (European Communications Office, CEPT)

Session 6: Regulator’s perspective on spectrum sharing (panel)
Convener: Doriana Guiducci (European Communications Office, CEPT)
- Introduction to the spectrum regulators panel, Doriana Guiducci, European Communications Office, CEPT

Panel:
- "The path to 6G – a regulator's perspective", Richard Moore OFCOM, United Kingdom
- The PMSE Audio Frequency Blockchain for Audiovisual and Entertainment Professionals", Cédric Nozet, Yann Maigron, ANFR, France
- "Technologically Managed Environment and Self-Regulation in mm Waves", Pavel Sistek, Czech Telecommunication Office, Czech Republic
- "Sharing in the 5G mm Bands", Claudia Carciofi, FUB/MISE, Italy
- "Spectrum sharing through LSA", Miguel Capela, ANACOM, Portugal
- "Slovene Vision on Spectrum Sharing", Meta Pavšek Taškov AKOS, Slovenia
- "Spectrum Sharing Between Private Networks and Public Mobile Networks in Denmark" Jeppe Tanderup Kristensen, ENS, Denmark

Discussion and Conclusion
WS10: 5G for CCAM for Cross-Border Corridors

Tuesday, 8 June 2021, 9:30-11:00/11:30-13:00, Zoom Room

Organisers:
- Konstantinos V. Katsaros, ICCS, Greece
- Roberto Fantini, TIM, Italy
- Fofi Setaki, COSMOTE, Greece
- Joao Almeida, IT, Portugal
- Pedro J. Fernández, UMU, Spain-TBC
- Jorge Pereira, EC, Belgium
- Janie Baños, DEKRA, Spain
- Vasilis Sourlas, ICCS, Greece

Participating Projects:
- 5G-MOBIX [https://5g-mobix.com/] – Workshop organizer
- 5G-CARMEN [https://5gcarmen.eu/]
- 5G-CroCo [https://5gcroco.eu/]

Motivation and Background
The 5th generation of mobile networks, promises significant qualitative and quantitative advances for multiple vertical domains, including the fast evolving automotive sector. However, most studies and investigations contribute to and assess these advances under the implicit assumption of a single network service provider, with typical national coverage. A series of 5G-PPP Research Projects, notably ICT-18-2018: 5G-MOBIX, 5G-CARMEN and 5G-CroCo, has targeted this limitation, explicitly focusing on a series of challenges emerging for Cooperative Connected and Automated Mobility (CCAM) applications, in the context of the inherent (inter-)national mobility and cross-border and/or multi-operator environments. Running now for more than two years, the projects have established a deep understanding of these challenges, have developed corresponding solutions, and are now starting to produce experimental results from 5G deployments across a series of European cross-border corridors, but also, national multi-operator trial sites.

This workshop aims to bring together the experiences gained in these projects, targeting a focused discussion on the technical challenges, considered solutions and most importantly, preliminary results from the ongoing cross-border trials along 5G cross-border corridors across Europe. The event will offer the opportunity to consolidate views and promote the understanding of the various barriers and opportunities brought by 5G, for CCAM, exposing the first lessons learned from 5G network deployments and corresponding trials in these projects. Discussions, including a panel, we explore the implications for the future of 5G deployment and the prospects for the support of seamless CCAM service provisioning.

Agenda
9:30-11:00 Keynote
- Jorge Pereira (EC), the Project Officer of all three ICT-18-2018 / 5G-PPP Projects

Invited Presentation
- Konstantinos Trichias (WINGS, 5G-MOBIX), Konstantinos V. Katsaros, Geerd Kakes and João Almeida, “5G-MOBIX-Project Overview & Key Achievements to Date”
- Roberto Fantini, Matteo Gerosa(FBK), Filippo Visintainer, Marco Liebschand, Ana Cantarero, Edwin Fischer and Andreas Heider-Aviet, “Supporting {5G} Based Cooperative Connected and Automated Mobility Services at the Cross Border”
- Miquel Payaró (CTTC, 5GCroco) and Dirk Hetzer, “5GCroCo:Project Overview and Recent Activities”

Technical Presentations
- Geerd Kakes (KPN, 5G-MOBIX), Pieter Nooren and Maciej Muehlesheim “Seamless roaming with 5G SA deployments”

Coffee Break
11:30-13:00 Technical Presentations (cont.)
- Marco Liebsch (NEC, 5G-CARMEN), Faqir Zarrar Yousaf, Roberto Fantini, Ana Cantareroand Andreas Heider-Aviet, “No Limits -Towards a Holistic 5G Ecosystem for Cross-Border CAM Service Continuity”
- Fotini Setaki (COSMOTE, 5G-MOBIX), Nikos Kostopoulos, Konstantinos Trichias, NazliGuney, Effychia Nikolitsa, Ioanna Mesogiti, George Lyberopoulos and Afrim Berisa, “Neighboring Mobile Networks Synchronization Aspects at the Cross-Borders: The 5G-MOBIX Greece-Turkey Study”
- Oscar Castañeda and Janie Baños Polglase (DEKRA, 5G-MOBIX), “Preliminary network measurements in the context of 5G-MOBIX”
- Maciej Muehlesheim (Ericsson, 5GCroco) and Dirk Hetzer, “5GCroCoNetwork Architecture and First Trial Results”

Panel
- Panel:“Lessons learned and future outlook on 5G for CCAM”
SNS Info Session
Smart Networks and Services Info Session

Tuesday, 11 June 2021, 14:30-17:30,
Zoom Room

Organisers:
- Nicola Ciulli, NetxtWorks
- Pierre Yves Danet, Orange
- Emmanuel Dotaro, Thales
- Carles Antón-Haro-CTTC
- Alexandros Kaloxylos -5G IA
- Håkon Lønsethagen, Telenor ASA
- Jacques Magen, AUSTRALO
- Raffaele De Peppe, Telecom Italia Mobile
- Egon Schulz, Huawei
- Hugo Tullberg, Ericsson
- Colin Willcock, 5G IA

Workshop Chair: Colin Willcock
(The 5G Infrastructure Association)

Motivation and Background

This EuCNC session aims to explain the scope, objectives and structure of the European partnership on Smart Networks and Services (SNS), part of the Commission proposal for a Council regulation establishing the Joint Undertakings under Horizon Europe.

A key goal of the SNS Partnership will be to define and implement the research, innovation and deployment roadmaps that will enable Europe to lead in the creation of the next generation of smart network technologies and services. These will be designed and implemented in such a way that European values like security and privacy are safeguarded and that European technological sovereignty is further strengthened. The Partnership will also focus on the full digitization of European society including vertical industries and public administration. Thereby, the SNS Partnership targets to have a positive impact on the quality of life for European citizens and boost the European data economy.

The SNS Partnership has two main objectives, namely:
1. Fostering Europe's technological sovereignty in 6G by implementing the related research and innovation (R&I) programme leading to the conception and standardisation around 2025, as well as preparation for early market adoption of 6G technologies by the end of the decade. Mobilising a broad set of stakeholders will be key to address strategic areas of the networks and services value chain from edge- and cloud-based service provisioning to market opportunities in new components and devices beyond smartphones.
2. Boosting 5G deployment in Europe in view of developing digital lead markets and of enabling the digital and green transition of the economy and society. For this objective, the JU will coordinate strategic guidance for the relevant programmes under the Connecting Europe Facility, in particular 5G Corridors. It will also contribute to the coordination with national programmes including under the Recovery and Resilience Facility as well as other European programmes and facilities such as Digital Europe Programme (DEP) and InvestEU.

The Workshop consists of two sessions. The first one will provide information about the SNS proposal, the Strategic Research and Innovation Agenda (SRIA), as produced by NetworldEurope and key candidate areas that could be considered for the first Work Programme. The second session includes a panel discussion with key stakeholders. They will provide their views about challenges and opportunities under the SNS Partnership. The panel aims to serve as an open and interactive forum for discussion with the participants.

Agenda

14:30-16:00 CEST First Session
14:30-14:50 European Commission’s strategic objectives & preparatory actions
Peter Stuckmann
14:50-15:10 SRIA a NetworldEurope community exercise for guiding communication innovation in Europe
Rui Aguiar
15:10-15:30 Ideas for the SNS Work Programme
Didier Bourse
15:30-15:40 SNS Partnership introduction
Colin Willcock
15:40-16:00 Q&A
Colin Willcock
16:00-16:10 CEST Coffee break
16:10-17:30 CEST Second Session
Panel discussion “SNS: opportunities for the European digital Ecosystem”.
Moderator: David Kennedy - Eurescom

Panelists:
1. Andreas Mueller – 5G ACIA, Bosch
2. Carles Antón-Haro – CTTC
3. Damir Filipovic – AIOTI, Secretary General
4. David Lund – PSCE, President
5. Edwin Fischer – Deutsche Telekom
6. Egon Schulz – Huawei GRC
7. Hugo Tullberg – Ericsson
8. Jacques Magen – AUSTRALO, NetworldEurope SME WG Chair
Tutorials
Terahertz (THz) communication is envisioned as a key wireless technology of the next decade. The THz band will help overcome the spectrum scarcity problems and capacity limitations of current wireless networks, by providing an unprecedentedly large bandwidth which can enable applications including Terabit-per-second backhaul systems, ultra-high-definition content streaming among mobile devices and wireless high-bandwidth secure communications. In addition, the very small wavelength at THz frequencies enables the development of miniature radios, which can be utilized for new networking paradigms such as wireless massive-core computing architectures, wireless nanosensor networks for biomedical applications and the Internet of Nano-Things.

The objective of this course is to provide the audience with the necessary knowledge and tools to contribute to the development of wireless communication networks in the THz band, focusing on physical-layer solutions. THz technology has been identified by DARPA as “one of the four major research areas that could eventually have an impact on our society larger than that of the Internet itself”. Beyond traditional applications of wireless networks, the development of a new communication and networking technology to support systems with “billions of connected nanosystems” has been identified as “one of the four essential components of the next IT revolution” by the Semiconductor Research Consortium (SRC) and the US National Science Foundation. More recently, THz communications has been identified by IEEE COMSOC as one of the nine communication technology trends to follow. As 5G technology becomes commercial, Terahertz communication is where fundamental scientific and engineering breakthroughs will occur.

Nonetheless, the THz band, which lies in between mm-waves and the far infrared, remains still one of the least explored regions in the EM spectrum. For many decades, the lack of compact high-power signal sources and high-sensitivity detectors able to work at room temperature has hampered the use of the THz band for any application beyond sensing. However, many recent advancements with different technologies are finally closing the so-called THz gap.

THz-band communication brings many new opportunities to the wireless communication community. The THz band supports huge transmission bandwidths, which range from almost 10 THz for distances below one meter, to multiple transmission windows, each owns tens to hundreds of GHz wide, for distances in the order of a few tens of meters. Nevertheless, this very large bandwidth comes at the cost of a very high propagation loss, mainly because of molecular absorption, which also creates a unique distance dependence on the available bandwidth. All these introduce many challenges to practical THz communication systems and require the development of innovative solutions. Moreover, many of these might be helpful for broadband wireless communication systems below and above the THz band, i.e., mm-waves and optical wireless communications, respectively.

Through this tutorial, the audience will learn the necessary knowledge to work in the cutting-edge research field of THz band communications. First, as a review, THz-band devices and THz-band channel models will be surveyed, which provide fundamentals and guidelines for THz communications. As the main focus of this tutorial, novel communication mechanisms tailored to the capabilities of THz devices and the peculiarities, challenges and opportunities introduced by the THz channel will be developed, including hybrid beamforming, ultra-broadband modulations, and physical-layer security. In addition, early works at the link layer that capture the reality of ultra-directional links will be presented, including novel Medium Access Control protocols and strategies for beam discovery and tracking.

**Structure and Content**

- **Introduction and Applications of THz Communications (1/3 hour)**
  - Physical-layer for THz Communications (1.5 hour)
    - a. Hybrid beamforming
    - b. Ultra-broadband modulations
    - c. Physical-layer security
  - Link-layer for THz Networks (1 h)
    - a. Medium access control
    - b. Beam discovery, tracking and alignment
- **Summary and Open Research Directions (1/3 hour)**

**Level/Pre-requisites**

Targeted audience includes but is not limited to academic researchers in the field of 5G and beyond, millimeter waves, optical wireless communications, as well as inter-disciplinary areas of nanotechnologies, antennas and propagation, and material science. Also, this tutorial is expected to attract audiences from the funding agencies, industrial partners, and standardization group, who have strong interests in future-generation wireless systems.
TUT2: Reconfigurable Intelligent Surfaces: Localization and Communication Convergence.

Tuesday, 8 June 2021, 09:30-13:00, Zoom Room

Motivation and context:
In order to realize the gains of RISs, localization and communication must be tightly coupled and co-designed. This is in sharp contrast to 5G and earlier wireless network generations, where localization was an additional, secondary service. The underlying reason is that an RIS fundamentally provides a localized service, impacting its local environment. This implies that communication and localization professionals need to understand the properties of RISs from both perspectives, in order to realize powerful co-designs where communication and localization reinforce each other.

The goal of this tutorial is to provide attendees with an overview of the state-of-the-art in communication and localization, as well as their interaction. To do so, the latest advances in the RIS modeling and signal processing for RIS-empowered networks will be presented in conjunction with the RIS killer applications as envisioned by the recent EU projects RISE-6G and Hexa-X.

One of the main selling points of this tutorial, which sets it apart from other tutorials on RIS, is this dual perspective, taught by renowned researchers in these two fields.

Structure and Content

Part I - Fundamentals (1 hour)

Introduction
- Smart radio environments
- RIS hardware architectures
- Emerging applications and challenges

RIS Fundamentals and Modeling
- Unit cell modeling
- Received signal model
- Competing technologies (relay)

RIS killer applications
- Communication
- Localization and sensing

Part II - Communication (1 hour)

Channel Estimation
- Cascade channel estimation
- RISs with active sensing elements

RIS-enabled Communication
- Placement optimization
- Phase design optimization formulations (e.g., for security, including problem formulations)
- Capacity results
- AI/ML orchestration

Part III - Localization (1 hour)

Radio localization
- 4G, 5G, B5G and the Hexa-X and RISE-6G visions

Channel Estimation
- Parametric channel estimation
- RISs with active sensing elements

RIS-enabled Localization and Mapping
- Architectures: Passive, active RISs, Lens RISs
- Placement and phase optimization (profile design)
- Performance bounds
- Algorithms

Level/Pre-requisites

The prerequisites for this tutorial are similar to those for the general audience of EuCNC and 6G Summit: the audience needs to have basic knowledge of wireless communication and signal processing for wireless communication systems.

The tutorial will be accessible to students, academic researchers, industry affiliates, and individuals working for government, military, science, and technology institutions who are interested in studying the emerging technology of RISs and its empowered concepts: i) wireless environment as a service and ii) performance boosted areas, proposed by the recent RISE-6G project.

The tutorial targets at describing the available RIS hardware architectures and relevant algorithmic approaches for 6G wireless networks, understanding the fundamentals of passive and active metasurfaces and their reconfigurability features according to desired wireless communication objectives, investigating distributed AI methodologies for programmable wireless environments, and presenting the RISs’ potential for accurate localization and mapping.
Motivation and context:
With the current rollout of 5G, the focus of the research community is shifting towards the design of the next generation of mobile systems, e.g., 6G mobile networks. Non-orthogonal multiple access (NOMA) has been recognized as an essential enabling technology for the forthcoming 6G networks to meet the heterogeneous demands on low latency, high reliability, massive connectivity, improved fairness, and high throughput. The principle of NOMA is to encourage users for spectrum sharing, where multiple users are served in the same resource block, such as a time slot, subcarrier, or spreading code. The aim of this talk is to provide an overview of the latest research results and innovations in NOMA technologies as well as their emerging applications, including IRS-NOMA, BackCom-NOMA, NOMA-MEC, AI-empowered NOMA, etc.

Future research challenges regarding NOMA in B5G and 6G are also presented.

Structure and Content
- Basic Principles of NOMA - present the basics, challenges, recent progress, and open issues for NGMA:
  a. What will be different for 6G in terms of multiple access?
  b. Rethinking the importance of SIC
- New Requirements: Massive Connectivity for NOMA
  a. QoS-based NOMA for Downlink Transmission
  b. Semi-GF NOMA for Uplink Transmission
- New Techniques: Integration of NOMA with Emerging Physical Layer Techniques
  a. OTFS-NOMA
  b. Interplay between RIS and NOMA
  c. THz-NOMA
  d. NOMA assisted VLC
- New Scenarios: Application of NOMA to Heterogeneous Scenarios
  a. NOMA in Integrated Terrestrial and Aerial Networks
  b. NOMA in Robotic Communications
  c. NOMA assisted VR communications
  d. NOMA for E-health
- New Tools: Machine Learning Empowered NOMA-based Networks
  a. Reinforcement Learning for NOMA-based Networks
  b. Deep Learning for NOMA-based Networks
  c. Other Machine Learning for NOMA-based Networks
- Outlook and Discussion for research challenges and opportunities.

Level/Pre-requisites
Postgraduate students and telecommunication engineers in 5G/6G

Lecturers
Zhiguo Ding,
University of Manchester,
United Kingdom

Yuanwei Liu,
Queen Mary University of London, United Kingdom

Daniel B. da Costa,
National Yunlin University of Science and Technology, Taiwan
TUT4: Dynamic Spectrum Sharing and Bandwidth-Efficient Techniques in Non-Terrestrial Networks

Tuesday, 8 June 2021, 09:30-13:00, Zoom Room

Motivation and context:
Non-Terrestrial Networks (NTNs) are fundamental components in support of Europe’s ambition to deploy smart and sustainable networks and services for the success of its digital economy and to achieve the ambitious goals set forth by the Communication on “Connectivity for a Competitive Digital Single Market – Towards a Gigabit society”. The inclusion in the 5G ecosystem, foreseen in Release 17 of the 3GPP specifications, of the NTN component will improve the system flexibility, adaptability, and resilience, and will extend the 5G coverage to rural, underserved, and unserved areas. From a pure broadcast and broadband delivery instrument, NTNs are therefore becoming an essential ingredient to efficiently support the concept of wireless connectivity anywhere, anytime, at any device. B5G and 6G infrastructures will evolve towards a unified architecture with no distinction between the terrestrial and non-terrestrial components. In this framework, the efficient and dynamic use of the available spectrum resources is a fundamental element to achieve a cost and energy efficient infrastructure. Spectrum coexistence, sharing, and exploitation are keywords that shall drive the design and management of the new B5G/6G infrastructure. This tutorial aims at providing an insight in the techniques suitable for dynamic spectrum sharing and bandwidth efficient use in integrated terrestrial and non-terrestrial B5G architecture with specific emphasis on an NTN component consisting in a mega-constellation of Low Earth Orbit (LEO) satellites.

Structure and Content
- Part I – Introduction and general framework
  a. Introduction to Non-Terrestrial Networks (orbits, constellations, link budgets, propagation aspects, system elements)
  b. The NTN component in the 3GPP context (architectures and integration with the terrestrial component)
  c. Scenarios, Services and use cases
- Part II – Bandwidth efficient techniques
  a. Introduction to interference management and exploitation transmission techniques
  b. Multi-user MIMO cooperation techniques
  c. The advanced mega-constellation case
- Part III - Dynamic spectrum sharing and coexistence techniques
  a. Introduction to Dynamic spectrum sharing and coexistence techniques
  b. Satellite communications network characteristics affecting Dynamic spectrum sharing
  c. Dynamic spectrum sharing solutions for NGSO satellite communications

Level/Pre-requisites
Principles of wireless communications
Principles of propagation
Principles of cellular systems
TUT5: Hands-on Tutorial on Fed4FIRE Testbeds and Openwifi

**Motivation and context:**

The first part of the tutorial will focus on using Fed4FIRE. Fed4FIRE (www.fed4fire.eu) is the largest federation of testbeds in Europe and has also a federation with US GENI (instageni and exogeni testbeds) and US Cloudlab. With a single Fed4FIRE account and the jFed tool (https://jfed.ilabt.imec.be) you can access all those resources for experimentation. The testbeds come in different flavours, such as:

- Wired networking/SDN/NFV testbeds
- Wireless networking testbeds
- 5G testbeds
- IoT testbeds
- Cloud and bigdata testbeds

This tutorial will show you hands-on how to use these resources. More information can be found at https://doc.fed4fire.eu.

The second part of the tutorial will focus on a very specific topic: openwifi. In the H2020 Orca project (https://www.orca-project.eu), imec has developed an open source reference stack for Wi-Fi (802.11a/g/n, 802.11ax is under development) running on software defined radios (FPGA based). This will be demonstrated live using SDRs on a remote testbed, showing the different steps needed to use this openwifi on a Fed4FIRE testbeds. More information on openwifi can be found at https://github.com/open-sdr/openwifi. In the openwifi roadmap imec is developing time-sensitive and MIMO features that could offer a low cost prototyping platform for supporting (i) time-sensitive networking and (ii) advanced 6G radio architectures like cell-free distributed massive MIMO.

**Lecturers**

Brecht Vermeulen, imec/Ghent University, Belgium

Xianjun Jiao, imec/Ghent University, Belgium

Wei Liu, imec/Ghent University, Belgium

**Structure and Content**

- General introduction on Fed4FIRE testbeds
- Hands-on introduction tutorial to Fed4FIRE using the Virtual Wall testbed
- Openwifi introduction
- Openwifi demonstration on a remote testbed (w-lab.t) and instructions how to reproduce this (using the account and tools learned in step 2.)

**Level/Pre-requisites**

For the first part, knowing how to log in on a linux server with ssh is a pre-requisite for the hands-on part. The general Fed4FIRE overview requires no pre-requisites. For the second part on openwifi, knowledge about wireless/WiFi protocols is handy.

**Tuesday, 8 June 2021, 14:00-17:30, Zoom Room**
Special Sessions
SPS1: One6G – An Open Accelerator for 6G Research in Europe

Motivation and context:
As local 6G research initiatives multiply, the need for a global, open and long term 6G research accelerator emerged, clustering together verticals and academia, to develop technologies upon vertical visions, aiming at a full digitalization of society supported by one, not fragmented, 6G standard. This need fostered the creation of One6G Association, rooted in Europe and leveraging on the pivotal role of its ecosystem in 6G research. This special session unveils the new-born One6G Association, its mission and objectives; it aims at discussing Vertical visions and at presenting latest results on most promising enabling technologies.

Program
Part 1. Introduction - One6G Association Introduction
Presentation of One6G motivations, objectives, structure and members.

Part 2. 6G Vision and Enabling Technologies
Five highly qualified invited speakers will intervene to present 6G vision and cutting edge enabling technologies directions.

Part 3. Questions and Answers Session
Floor will be open to the audience to discuss One6G Association objectives and plans, as well as 6G visions and enabling technologies.

Moderator: Dr. Walter Weigel, VP, Huawei European Research Institute (ERI), Leuven
SPS2: EU-China Collaboration in 5G and Beyond

Motivation and context:
The H2020 funded 5G-DRIVE project enters its 29th month, bringing initial results to be shared with the wider 5G community. EuCNC 2021 is regarded as one of the top choices for the project to disseminate and promote the highlights of its final results, as EuCNC is not only a prominent brand in the communications and networking scene that attracts hundreds of public and private stakeholders every year, but also that its 2021 edition has a clear focus on going beyond 5G and transition into 6G.

One of the three pillars that 5G-DRIVE plans its activities around, is to twin and collaborate its research and testing activities with the China Mobile-led, Ministry of Industrial Internet Technologies (MIIT) -funded project to boost EU-China 5G collaboration at all levels, it is therefore essential for 5G-DRIVE to interact with the European and Chinese delegations.

The set-up and aim of this special session, therefore circle around showcasing the successful collaboration work between EU and China on 5G and prospects into 6G.

Program

Welcome
Kai Zhang (Martel Innovate)

Introduction to 5G-DRIVE
Uwe Herzog (EURESCOM)

Introduction to the Chinese Large-Scale Trial Project
Jianhua Liu (China Mobile)

Overall Technical Achievement of 5G-DRIVE project
Tao Chen (VTT)

Showcase and Highlights of Final Results and Cooperation between EU and China
- 5G eMBB Trial Session Highlight and Cooperation with the Chinese Twin Project (Na Yi - 5G IC, University of Surrey, Jianhua Liu, China Mobile)
- EU-China joint V2X Trial Results (Matti Kutila - VTT, Xiaoyun Zhang - Dynniq, Yinxiang Zheng - China Mobile)
- On the Need of MANO Evolution in the Context of Network Slicing (Slawomir Kuklinski, Orange)
- 5G-DRIVE’s Contribution to Standardisation
  - Contributions to Harmonised European Standard ETSI EN 302 571: Jaime Ferragut (European Commission, Joint Research Centre)
  - IPv6-Based New Internet: Latif Ladid (University of Luxembourg)
- Vision, Requirements and Technology Trends of 6G - Guangyi Liu (China Mobile)

Q&A
SPS3: Recent Progress in Antennas and Metasurfaces for 6G

Motivation and context:

The sixth-generation (6G) standard for wireless communications is currently under research and development from both industry and academia. It is anticipated that 6G wireless networks will use higher frequencies than 5G networks, which will enable much higher data rates to be achieved with much lower latency levels. Millimeter-wave and terahertz communications, ultra-massive multiple-input multiple-output (MIMO), and reconfigurable intelligent surfaces (RISs) have been envisioned as enabling technologies for 6G wireless communications. On the physical layer, antennas are critical components for 6G communications systems. It is known that transmission at such high frequencies incurs very high propagation losses, which significantly limits communications distances. To overcome this, it is required that either the antenna is designed to have a high gain or the use of an array antenna is necessary. Moreover, 6G antennas and arrays should be cost-effective; otherwise, it would limit its deployment.

Recently, there have been many reported research works on 6G antenna systems and associated technologies. The objective of this special session is to present the latest development and technical challenges in mm-wave/THz antennas and RISs for 6G applications. This special session is dedicated to bringing together researchers from relevant research areas of the 6G antennas to share their new ideas, latest accomplishments, research findings, open research problems and technical challenges within the research community.

Program

Presentations

- Prof. George C. Alexandropoulos (SMIEEE), National and Kapodistrian University of Athens, Greece, “Simultaneous Reflecting and Sensing Metasurfaces for 6G Wireless Communications”
- Dr. Sérgio Matos, ISCTE-IUL/Instituto de Telecomunicações, Portugal, “Mechanical Beam-Steering Using Millimeter-Wave Transmit-Array Antennas”
- Prof. Wei Hu, Xidian University, China, “Compact Antenna Designs and SAR Reduction Methods for Mobile Terminal Applications”
- Prof. Rafael Caldeirinha, Polytechnic of Leiria/Instituto de Telecomunicações, Portugal, “Smart Radio Environments for 6G”
- Prof. Sami Myllymäki, University of Oulu, Finland. “Ultra-Low Permittivity Antenna Lenses for 6G Applications”
- Prof. João Matos, University of Aveiro/Instituto de Telecomunicações, Portugal, “SDA - Software Defined Antenna for 6G”
- Dr Qingling Yang, University of Birmingham, UK, “Dual-Polarized Sub-Millimeter-Wave and Millimeter-Wave Antenna Arrays for 5G and Satellite Communications”
**SPS4: Edge-Side and Device-Level Innovation for 6G Wireless Networks**

Special Session Chairs
Prof. Mohammad N. Patwary,
University of Wolverhampton,
United Kingdom

Wednesday, 09 June 2021, 11:30-13:00,
Zoom Room

**Motivation and context:**

Future Beyond 5G/6G networks are expected to support the massive number of connected devices/sensors/machines with enhanced Ultra-Reliable and Low-Latency (e-URLLC) to realize the end-to-end latency of about 0.01 ms with 99.9999% reliability. Towards supporting the e-URLLC, ultra-low energy-consumption and high capacity links targeted by 5G/6G networks, it is crucial to introduce innovation at the edge-and device-level by addressing several constraints such as power limitations, low computational capacity and limited storage capacity over a range of radio frequencies including millimetre wave (mmWave), TeraHertz (THz) and optical bands. The recent advances in edge computing architecture and technologies with the notion of “edge processing as a service” are expected to enable e-URLLC in future networks, by bringing the computing and storage capabilities near to the end-users. Furthermore, potential device-level innovations include the design of efficient power amplifiers, receiver filters capable of operating in higher frequencies, efficient multi-antenna arrays for end-users, inter-chip communications via THz line-of-sight links, lightweight modulation and coding for high-speed communications, near-field communications and backscatter communications for zero-energy devices.

**Project**

5G Connected Forest https://uk5g.org/discover/testbeds-and-trials/5g-connected-forest/

**Program**

- Samiya Khan, Mohammad N. Patwary, Paul Wilson, and Prashant Pillai, “Edge-As-A-Service Architecture for Highly Mobile Emergency Services in 6G Wireless Networks”
- Muhammad Kamran Naeeem, Liam Naughton, and Mohammad Patwary, “AI-Enabled Light-Weight Channel Encoding for Device-To-Edge Communication in 6G Networks”
- Tooba Masood, Sardar Muhammad Gulfam, Syed Junaid Nawaz, Shree Krishna Sharma, Md Asaduzzaman, Mohammad N. Patwary, “User Scheduling for Cell-Free Wireless Networks”
- Yasir I. A. Al-Yasir, Naser Ojaroudi Parchin, Ahmed M. Abdulkhaleq, Raed A. Abd-Alhameed, and Mohammad N. Patwary, “Design of mmWave Hairpin Planar Filters for 5G and Beyond”
Motivation and context:
Empowered by principles of intelligence and openness, the O-RAN architecture is the foundation for building the virtualized RAN on open hardware and cloud, with embedded AI-powered radio control. Inspired by the O-RAN alliance, the OpenRAN infrastructure combined with increasing RAN virtualization and data-driven intelligence, will allow complexity reduction, faster innovation and significant reduction on deployment and operational cost. A major benefit of OpenRAN infrastructure is the capability of serving multiple operators using multiple VNFs sitting side-by-side on the same platform to have segregated networks. The other benefit is network function sharing through software developments. The so-called Neutral Hosting (NH) platforms can significantly reduce operational and capital expenses, as well as increase coverage and capacity in dense urban and rural environments. However, such solutions come with challenges and practicalities that require resolution before they can widely be adopted.

This session brings together experts from the industry and academia, highlighting real-world use cases and deployments, along with the operational and business challenges, as well as the steps to be taken towards the wider adoption of OpenRAN and NH platforms. More specifically, this special session will:
• Provide information on the numerous opportunities and use cases embraced by the OpenRAN framework
• Update on the status of O-RAN alliance status, standardization activities vision
• Highlight the experiences, results and lessons learnt from successful OpenRAN deployments
• AI artifacts and AI trust in OpenRAN
• Promote the 5G Neutral host services, focusing on relevant deployment strategies and challenges.
• Provide techno-economic analysis and specturm management strategies for Neutral Host deployments.
• Practicalities SatCom integration into OpenRAN
SPS6: Space - the Next 6G Frontier

Motivation and context:

Now that 5G deployments are taking place on a global scale, satellite contribution is being proven on the basis of its benefits and its integration in the overall 5G network. Major satellite contributions relate with global connectivity, easy and cost efficient deployment of secure, reliable, dedicated private 5G networks with increased reliability; serving, with ultra-low delay within the edge both civilian and governmental users as well as offering direct access connectivity for remote undeserved areas and thus reducing digital divide. Besides, COVID-19 pandemic emphasised the importance of secure and reliable satellite connectivity solutions and services supporting societal needs and the economy globally.

Recent developments enable the operation of High Throughput Geostationary (GSO) and non-Geostationary (non-GSO) satellite networks based on hundreds to thousands of satellites contributing to 5G global deployments. Initiatives spawned lately range from High Altitude Platforms (HAPs) through micro- and nano-satellite systems dedicated to M2M/IoT to mega-constellations, e.g. OneWeb and Telesat to mention but few. Stakeholders include established satellite industry players and newcomers with increasing presence of entrepreneurs. It has to be acknowledged that the new space economy is largely driven by private companies and entrepreneurs, such as Elon Musk with his Starlink constellation that managed to shake up the industry. The new space economy is both rapidly growing and very competitive due to the large number of players. Recent examples of new space applications include CubeSats, high-end private imaging satellites using e.g. hyperspectral cameras and synthetic-aperture radars, and the creation of very low orbiting (vLEO) constellations for reduced latency high throughput communications.

Research on autonomous satellites as part of a 6G vision aims to enable satellite payloads to act as mobile edge hosts to facilitate the provision of cloud functionalities on demand. The vision of a 3D space infrastructure emerges, consisting of unmanned aerial vehicles, HAPs and constellations of satellites in very Low Earth Orbit / Low Earth Orbit / Medium Earth Orbit and Geo-stationary Earth Orbit collectively contributing to the provision of connectivity and advanced integrated services on demand with controlled delay constraints. This encompasses also the integration of functionalities, such as connectivity, time synchronisation and positioning and Earth Observation data.

Last but not least, the new emerging 6G space infrastructure will contribute to meeting the new security requirements and support the European Quantum Communication Infrastructure by providing the needed Quantum Key Distribution. This Special Session builds upon the success of a series of past events and will showcase the integration of satellites in 5G and outline new paths that are being investigated. In particular, this Special Session will:

- Highlight experiences, results and lessons learnt from successful over-the-air validations with seamless satellite integration into 5G;
- Update on the status of 5G experimentation facilities exploiting new capabilities of global connectivity, edge networking, automated management, frequency sharing and Non-Terrestrial Networks (NTN) with New Radio also supporting IoT;
- Highlight the emergence of 5G services relying on the use of integrated 5G and satellite communication;
- Present 3D space NTN infrastructure concepts and discuss emerging research areas;
- Foster cross-industry cooperation opportunities between terrestrial mobile and satellite industry when shaping 6G.

Project

H2020 5G VNNI and DYNASAT
ESA ARTES programme projects SATis5, 5G METEORS, DAWN and ANCHOR

Program

The session will consists of six contributions as follows:

- Keynote opening by Mr Miguel Bello Mora, CEO, AIRCENTRE Portugal, incoming chair of EUREKA
- Keynote opening by Ms Elodie Vlau, ESA Director for Telecommunications, and Head of ECSAT
- Tomaso de Cola (DLR, Germany)/Alessandro Vanelli-Coralli (University of Bologna/Italy): From 5G to 6G: Research and Innovation Roadmap for Non-Terrestrial Networks (NTN)
- Harri Saarnisaari (University of Oulu, Finland): 6G Flagship and Innovation Roadmap for Non-Terrestrial Networks (NTN)
- Marius Corici (Fraunhofer FOKUS, Germany): Global testbeds for 6G evolution to 6G using NTN
- Florian Kaltenberger (Eurecom, France) and Thomas Heyn (Fraunhofer IIS, Germany): OA as a platform for NTN realisation of 5G direct satellite access
- Nicola Ciulli, Giada Landi and Gino Carozzo (Nextworks, Italy): Data-driven, real-time automation of network slice management in 5G infrastructures integrating satellite networks
- Klaus Schönher and Helmut Zaglauer (Airbus, Germany): Next generation space infrastructure evolving to 6G – industry perspective
SPS7: 6G Visions:

Motivation and context:
6G Flagship organized 6G Wireless Summits in 2019 and 2020 with approximately 40 invited presentations on visions of 6G. These 6G vision presentations, some of which were also accompanied with invited papers, attracted a lot of global interest. Following the success of these two prior editions of invited 6G vision presentations at 6G Wireless Summit, the same is proposed for this year's event in a smaller scale with up to 10 invited presentations on 6G visions, potentially accompanied with papers.

Project
6G Flagship

Program
Session on Thursday 10th of June at 16:00-17:30 CET:
- “Evolution vs. Revolution in 6G: A Design and Measurement Perspective”, Roger Nichols, Keysight Technologies, USA
- “Communications in the 6G Era”, Preben Mogensen, Nokia, Denmark
- “Talk by Frederico Boccardi on 6G Visions”, Federico Boccardi, Ofcom, UK
- “Talk by Mark Rodwell on 6G Visions”, Mark Rodwell, UC Santa Barbara, USA
- “6G: Blending the Real with the Virtual”, Luiz Da Silva, Virginia Tech, USA

Session on Friday 11th of June at 9:30-11:00 CET:
- “NTT DOCOMO’s Views and Activities on 5G Evolution and 6G”, Takehiro Nakamura, NTT DoCoMo, Japan
- “Beyond IMT-2020”, Bilel Jamoussi & Uwe Löwenstein, ITU, Switzerland
- “Connected and Smart Beyond 2021: Data Sharing, Privacy and Consent in the World of 6G”, Ian Oppermann, NSW Government, Australia
- “What is 6G and What is not”, Rahim Tafazolli, University of Surrey, UK
- “Talk by Tarik Taleb on 6G Visions”, Tarik Taleb, Aalto University/University of Oulu, Finland
Motivation and context:
The very nature of 5G/6G requires deep transformations of mobile and fixed networks towards truly massive and pervasive connectivity fabrics, capable of end-to-end security, high flexibility and very dynamic service lifecycle. Despite the huge progress of the last few years, 5G networks today have not completely achieved all these challenges. Network automation, NFV and cloud-native technologies are widely adopted to transform the way 5G networks and their services are built and managed today, but their entire potential is still not fully exploited. There is an urgent demand for truly autonomous network management solutions for supporting efficient and intelligent networks at scale, beyond the current 5G. A clear vision on requirements and challenges for Autonomous Network Management to be addressed towards 6G is missing. It is observed that networks will require a more efficient use of heterogeneous virtualisation technologies from multiple radio, edge and core domains, also from multiple operators; moreover, highly automated management and orchestration solutions will be needed to implement data-driven network management to exploit advanced analytics techniques; zero-touch solutions and intent-based approaches to network slicing will take critical role to manage the huge scale of software-defined network functions; heterogeneous resource trading and sharing (extended to spectrum) will need to be used to implement networks and service pervasiveness, at acceptable CAPEX for Operators and fully integrated with end-to-end trust and security. This session originates from preliminary results on autonomous network management from some5G PPP research projects (namely LOCUS, 5GZORRO, TERAFLOW, HEXA-X, ARIADNE, 5G-CLARITY, 5G-COMPLETE, INSPIRE-5Gplus, MONB5G, TERAWAY, SGROWTH, SG-TOURS, SG-CARMEN). The event aims at generating an opportunity for experts from industry, standard organizations, and the research community to share research findings, to identify gaps and prioritise the challenges of a strategic research agenda on Autonomous Network Management on the path to 6G.
Motivation and context:
The next 6G cellular networks will be a rendez-vous between localization, sensing, and communication. Indeed, through their codesign, new applications, such as cross/augmented reality, radio holography, and autonomous vehicle navigation, will be enabled at an unprecedented accuracy and reliability. Towards this vision, large intelligent surfaces (LISs) have already been identified as a potential technology thanks to the possibility to shape the electromagnetic environment intelligently, enhancing ambient awareness.

For example, the high mobility of users (e.g., drones and vehicles) might be assisted by LIS for easing the handover failures or supporting autonomous navigation and localization-based applications. Nevertheless, LISs are expected to be beneficial not only in terms of achievable spatial accuracy or system scalability but also continuity, e.g., for overcoming most pathological non-line-of-sight conditions. They shall indeed enable a timely/localized adaptation to various location-based application requirements and on-demand service provision in complex multi-user multi-operator contexts, e.g., in terms of both localization and sensing accuracy and/or addressed/preferred spatial dimensions.

All these capabilities raise open research questions related to, e.g., multi-objective multi-constraint optimization, localization-oriented RIS control and cooperative mechanisms, and suitable estimation algorithms at both single-link and multi-link levels. In addition, localization and sensing will coexist with communication in the same radio spectrum by sharing the same hardware. Hence, their codesign will be essential, as well as the capability to minimize overhead, power consumption and re-deployment cost, i.e., in comparison with ad-hoc conventional localization and sensing approaches.

In the next joint EuCNC & 6G summit, this special session aims to host innovative scientific contributions on these topics, capable of orienting the discussion on the latest localization and sensing solutions.
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The European Commission is a Financial Supporter of the conference. 2021 Joint EuCNC & 6G Summit has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 856641 (EuConNeCts4 Project)
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At the forefront of the implementation of 5G technology, NOS leads in innovation associated with smart cities and the development of 5.0 societies. By being the first company to deliver 5G technology in a city of Portugal, the company showed the potential of the fifth mobile generation in the development of society.

Committed to align its emissions with the decarbonization trajectories needed to limit global warming, NOS has signed up to the United Nations “Business Ambition for 1.5°C” Letter of Commitment. Additionally, NOS is ranked the 5th best Telecommunications Company in Europe in terms of Sustainability.

Also, at European level, NOS is a founding member of the European Green Digital Coalition, by signing the EGD Coalition Declaration to promote a green digital transformation with a view towards social, economic, and environmental sustainability.

NOS is also the leader in cinema distribution and exhibition, owning the largest number of cinema complexes and cinemas in Portugal.

NOS is on the main national stock market index (PSI-20), has 4.9 million mobile customers, 1.6 million television customers, 1.8 million fixed telephone customers and 1.4 million fixed broadband internet customers.

More information at http://www.nos.pt/institucional
Do what no one has done

What is coming is a blank page. It is being able to do faster, at the speed of thought and at the speed of feeling. It's the power of intelligence and science. It's the total absence of space between thinking and doing, between dreaming and making things happen. Today, more than ever, we are eager for the future and the turning of the page. To strive, for the first time, to do what no one has done before.

NOS 5G

nos.pt/5G
Founded in 1987, Huawei is a leading global provider of information and communications technology (ICT) infrastructure and smart devices. We have more than 194,000 employees, and we operate in more than 170 countries and regions, serving more than three billion people around the world.

Our vision and mission is to bring digital to every person, home and organization for a fully connected, intelligent world. To this end, we will drive ubiquitous connectivity and promote equal access to networks; bring cloud and artificial intelligence to all four corners of the earth to provide superior computing power where you need it, when you need it; build digital platforms to help all industries and organizations become more agile, efficient, and dynamic; redefine user experience with AI, making it more personalized for people in all aspects of their life, whether they’re at home, in the office, or on the go.

35 carriers around the world that launched commercial 5G services implemented Huawei’s B.E.S.T. Network solution for 5G. Huawei and Honor smartphones together occupied 17.6% of the global market share, meaning we maintained our position as the world’s second-biggest smartphone brand (data from IDC). We also held the largest market share in 5G smartphones (data from Strategy Analytics). Over 700 cities and 228 Fortune Global 500 companies – 58 of which are Fortune 100 companies – partnered with Huawei on digital transformation. HUAWEI CLOUD offered more than 200 cloud services and 190 solutions, while over 3 million enterprise users and developers were developing products and solutions with HUAWEI CLOUD.
Exploration lights the way forward

Exploration begins with sharing minds
We create technology that helps the world act together.

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Ericsson is a world leader in the rapidly changing environment of communications technology – by providing hardware, software, and services to enable the full value of connectivity. About 40% of the world’s mobile traffic carried through our networks. For more than 140 years, our ideas, technology and people have changed the world: real turning points that have transformed lives, industries and society as a whole. From 5G standardization to today's commercialization, Ericsson has been a key player in making 5G networks a commercial reality. With pioneering research and early collaborations with academia and other industries, Ericsson have developed and contributed to a standard that meets the needs of different industries and the society.

5G evolution will pave the way for highly intelligent haptic IoT technologies at hyperscale, leveraging new forms of vehicle-to-infrastructure, vehicle-to-vehicle, vehicle-to-pedestrian, and person-to-person connectivity. The era of 5G will be shaped by many evolutionary leaps within the standard, before we can even begin to look to the next generation.

For more information, please visit www.ericsson.com/en/future-technologies
EURASIP Journal on Wireless Communications and Networking will publish a Special Issue with papers submitted to the Thematic Series on “Wireless Technologies Towards 6G”. This Special Issue originates from the international conference 2021 Joint EuCNC & 6G Summit (Joint European Conference on Networks and Communications and 6G Summit), which will be held in June 2021 in Virtual format. The Chairs of the conference will select the best papers and will subsequently invite authors to submit an extended version of their paper by at least one third of their length, for possible consideration in the Special Issue. Only the top ranked papers will be invited to this Special Issue, in order to fulfil its purpose. The Call for Papers for the conference has already been disseminated through the 2021 Joint EuCNC & 6G Summit website, as well as through social media platforms, newsletters, and several e-mails reflectors, reaching a wide international global audience. The main target is to collect and present quality research contributions in the most recent activities related to technologies, systems and networks beyond 5G. Through this Special Issue, the state-of-the-art will be presented, and the new challenges will be highlighted, regarding the latest advances on systems and network perspectives that are already being positioned beyond 5G, bridging as well with the evolution of 5G, including applications and trials. Therefore, the motivation for this Special Issue is to present the latest and finest results on the evolution of research of mobile and wireless communications, coming, but not exclusively (since 2021 Joint EuCNC & 6G Summit is a conference open to the whole research community), from projects co-financed by the European Commission within its R&D programmes.

The authors of the best papers of the conference 2021 Joint EuCNC & 6G Summit will be invited to submit an extended version of their paper, sufficiently different than the conference counterpart with at least 1/3 of additional original material, and the common part to be rewritten from the EuCNC paper.

Submission instructions:
Before submitting your manuscript, please ensure you have carefully read the Instructions for Authors in EURASIP Journal on Wireless Communications and Networking. The complete manuscript should be submitted through the EURASIP Journal on Wireless Communications and Networking submission system. To ensure that you submit to the correct Thematic Series please select the appropriate section in the dropdown menu upon submission. In addition, indicate within your cover letter that you wish your manuscript to be considered as part of the Thematic Series on “Wireless Technologies Towards 6G”. All submissions will undergo peer review and accepted articles will be published in the journal as a collection in a single issue.

MANUSCRIPT SUBMISSION DUE: 15th OCTOBER 2021
NOTIFICATION OF ACCEPTANCE: 14th DECEMBER 2021
FINAL PAPERS SUBMISSION: 31st JANUARY 2022

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- For editorial enquiries please contact the guest editors.
Discover the Best of Porto
Discover the Best of Porto

São Bento Train Station (Estação de São Bento)
Besides being the perfect spot to start your visit, as the destination point whether you arrive from plane, train or subway, it is also one of the world's most beautiful stations. Appreciate the entrance hall, with 20,000 decorative tiles covering the walls, wonderfully representing Portuguese history and daily lifestyle. From there off, you can go almost everywhere.

Aliados Avenue (Avenida dos Aliados)
While walking around the city center streets, you can enjoy all the typical buildings and make quick stops to taste all the traditional delicacies. Moving along, you reach the Aliados Avenue, a central city point considered the heart of Porto, where you can observe the beautiful building that hosts the City Hall. Besides its magnificent architecture, this avenue is also a common stage for cultural presentations, music concerts and traditional street celebrations, such as S. João.

Clérigos Tower (Torre dos Clérigos)
As you get back on course, going up Clérigos Street, you will find Clérigos Tower, standing 76 meters tall, with a unique 360º panoramic view over the city of Porto. To enjoy this experience you just need to go up its 240 steps.

Lello Bookstore (Livraria Lello)
Going forward, you should stop at Lello Bookstore, recognized as one of the most stunning bookstores in the world. More than a century old, with an amazing inside atmosphere, namely a majestic staircase, it is said to have inspired the Hogwarts scenarios, from Harry Potter's saga, created by JK Rowling when she lived in Porto.

Ribeira (Ribeira)
Now make sure you go down the road and enter Flores Street, having a pleasant walk until you get to Ribeira, the Douro river's shore, classified as a UNESCO World Heritage Site. In Ribeira's Pier, you observe the bridges of D. Maria II, Arrábida and D. Luís I, and take the opportunity to go on a tour in the boats used to transport wine from the villa up the river. Afterwards, if you seek a different experience, or if you are feeling tired, you should take a tour in the Guindais Funicular Railway, a singular lift that will take you up the stairs to the next spot.

As you can probably imagine, it is impossible to point out everything that is worth visiting in Porto by just filling out these scarce pages. Despite so many other points of interest deserving the spotlight, we selected just a few to work up your appetite. The rest is up to you. Enjoy your visit!

Porto's Cathedral (Sé do Porto)
When you exit the funicular – or reach the end of the stairs, if you decide to go by foot - you arrive at Porto’s Cathedral, the most important church in Porto. This beautiful national monument, built between the 12th and 13th centuries, provides a privileged panoramic view over the city and the river.

Port Wine Cellars (Caves do Vinho do Porto)
http://www.cavesvinhodoporto.com/eng_index.html
Moving down and crossing over the top deck of the D. Luís I Bridge (you can do it by foot), you are officially in Porto's sister city, Vila Nova de Gaia. Continuing on the riverside, you can enjoy the sidewalk until you find the famous Port Wine Cellars. Along this avenue, there are many different wine cellars, normally providing guided tours: Burmester, Cálem, Ferreira, Graham’s, Ramos Pinto, Sandeman and Taylor's. The best thing about them is the fact that you can enjoy a Port tasting at the end of the tours!!

Afurada (Afurada)
If you have the time, a nice option could be continuing your tour, since the next recommendation is quite pleasant. However, if you feel tired, you can always rent a tuk tuk or a cab, in order to get to Afurada, a typical fishermen village, where you can stroll in the beach or eat an amazing fresh fish in one of the many traditional riverside restaurants. Then comes the time to return to Porto and you can do it right there, by picking up the taxi boat to get to Foz.

Foz (Foz)
Foz is where the Douro River and the Atlantic Ocean meet. It is famous for its beaches (several of them with blue flag) and seaside outdoor cafés. It’s a nice place to take a walk, enjoying the warmth of the sun and the exceptional view over the Atlantic sea. After wandering along, you can enjoy another great experience, which is taking an historical tram to the city center.

Virtudes Garden (Jardim das Virtudes)
Jardim das Virtudes is the perfect spot to watch an idyllic sunset with a striking view over the Douro river. Restored in 1998, this peculiar historical garden is simply a privileged location to hang out with friends, relax after work or share a special moment with your better half. Is there a greater way to finish your tour?