European Technology Platform Networld Europe

Visions for Future Communications Summit

POST-EVENT REPORT

Organized by Networld Europe with the support of SNS IA, SNS OPS, European Commission and IEEE

Lisbon, November 07th and 08th 2023

Visions for Future Communications Summit - Event Overview

Visions for Future Communications Summit is a top-quality research workshop, with the support of 6G-IA and IEEE, oriented to identify key research areas in information and communication technologies in the mid-future of 7 to 10 years. It will follow from the previous events structure held in 2017, 2019, and 2021, considering that by 2030 6G will be reaching the market. Given the expected innovation cycle times, it is now appropriate that we start discussions on Innovations after 6G.

The Summit covered multiple research lines, roughly structured along Physical Layer, Network and Control Plane, and Applications and Services. Each research line had a keynote speaker, and a set of sessions. All sessions were organized as panels of distinguished speakers from academia, industry and High-level European Commission officials presenting their viewpoints on a subarea within each track. Panels were oriented to encourage interaction among the panelists and between the panelists and the audience. Panels were enriched with contributions from an open call to the community, and with sessions presenting long-term visions from different stakeholders.

The purpose of the Summit was not to show what each presenter knows, but to technically identify what would be promising and challenging to achieve and will need work from our sector's professionals.

Based on the public presentations and contributions of the international experts, a document on seminal research directions for the communications field will be produced. This white paper will be widely distributed to the community and will be used as input by the European Commission, ITU-T and other relevant stakeholders as a contribution to mid-term research directions.

The discussions were very fruitful, and highlighted several areas which should been placed on the R&D roadmap in The past Whitepaper, the Strategic Research and Innovation Agenda (SRIA), has been the basis for the design of the upcoming Smart Networks and Services funding calls.

Location: Hybrid (Online and Onsite Lisbon)
Date: 07-08/11/2023
Duration: 2 full days (16 hours)
Number of registrations: 65
Maximum number of simultaneous attendees: 21
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Visions for Future Communications Summit - Agenda

Visions for Future Communications Summit – Day 1

Opening Speech and introduction (*Rui L. Aguiar - Networld Europe SB Chair/ University of Aveiro)*

Prof. Rui Aguiar welcomed the speakers and the participants to the 4th Visions for Future Communications Summit. He then gave an overall perspective of the agenda and concluded his opening speech by noting the very good curricula of the event speakers and thanking them for their availability and participation.

Session 1: System and Architecture *(Chair: Artur Hecker)*

This session provided a wealth of insights covering various important aspects of advanced networking. One focal point was the evolution of network monitoring, where an emphasis on intelligence, manageability, and interoperability was underscored. AI emerged as a pivotal force driving this transformation, with specific components like NWDAF, DCCF, UDM, and orchestrators like ONAP playing crucial roles. The discussions delved into the intricacies of data availability and granularity, crucial for reliable automation in network management. Addressing fragmentation's impact on key performance indicators, the presentations shared measurement results, highlighting the need for context-based approaches. A paradigm shift beyond Service-Based Architecture in 5G networks was explored, advocating for a micro-service-led architecture connected through HTTP2-based service-based interfaces. This novel approach aimed at enhancing topological flexibility and optimizing use cases, extending its scope to self-programming, self-optimization, and self-hardening. Another dimension unfolded in the envisioning of the next-generation core network, with research directions spanning an Application-Centric Services Network, Intent Communication Network, High-End Experience Network, Network with Device-Edge-Cloud Unified Computing Technology Stack, Ultra-distributed Intelligent to Business Network, and Self-intelligent Networks Enable Intelligent Inclusiveness. Each direction encapsulated a vision, addressed pain points, and proposed research paths for creating a connected, intelligent world. Finally, a deep dive into high-performance computing shed light on the distinctive properties defining the top 10 supercomputers, centering on the critical relationship between data accessibility and compute resources for optimal computational performance.

Session 2: Radio *(Chair: Ari Pouttu)*

This session explored the concept of Distributed Joint Communication and Sensing (JC&S) beyond 6G, highlighting challenges and possibilities in cell-free massive MIMO systems. The disruptive RAN beyond 6G was envisioned, addressing challenges in 5G services and advocating for autonomy in radio access network deployment, driven by AI-driven deployment and mmWave-based hardware architecture modifications. In the session, there is an emphasis on the convergence of communications and machine perception, envisioning networks with human-like awareness and introducing concepts like wireless digital twins. The significance of convergence, ongoing projects like Converge and Reconfigurable Intelligent Services, and the benefits of improved reliability through acoustic sensors are discussed. Additionally, stochastic geometry is presented as an imperative framework for designing 6G networks, exploring mathematical models for enhanced cellular networks, 3D, and non-terrestrial networks. The need for a unified approach in designing the air interface beyond 6G is addressed, focusing on emerging use cases, sustainable radio technologies, and joint communications and sensing applications in 6G-NTN signals. The session collectively aims to advance wireless communication by addressing challenges and leveraging innovative technologies.

Keynote 1: A Glimpse of the 2030s – Networks of the Future Volker Ziegler *(Chair: Rui Aguiar)*

In a comprehensive overview of the technology landscape and the considerations for 6G network development, the presentation highlights the pivotal role of AI in shaping the future of technology. It emphasizes the transformative potential of 6G, stressing the need for global collaboration, standardization, and research efforts. The network is positioned as a bridge between the physical, digital, and human worlds, with an emphasis on creating a network that "senses, thinks, and acts" through ubiquitous AI. The text identifies key network capabilities for 2030, such as ubiquity, performance, distributed service instantiation, intent-based autonomy, and sustainability. It underscores the role of AI in enhancing network functionality, from performance optimization to security and sustainability. Collaborative value ecosystems and decentralized mechanisms for trustworthy value exchange are considered essential. Distinctions are made between the requirements of consumer, enterprise, and industrial sectors in terms of network performance and security. Technical aspects of network readiness, such as traffic growth, latency, and radio capacity, are addressed, anticipating a transformative 6G that builds on existing technologies with innovative architectural changes. Network security, trust, and privacy are paramount, with quantum-safe encryption, AI-assisted monitoring, and privacy-preserving methods mentioned. Collaborative advantage, standardization, digital inclusion, trustworthiness, and sustainability are outlined as guiding

principles. Moreover, the underscores the significance of research collaborations with academia and research institutions, highlighting initiatives like the Brooklyn 6G Summit as crucial for innovation in wireless technology.

Session 3: Views Across the World on Advanced Cellular Systems *(Chair: Jorge Pereira)*

It provided insights into the current state and future trajectories of advanced cellular systems. China's successful 5G deployment was emphasized, focusing on collaborative governance, spectrum cost, and joint network construction. Addressing challenges such as negotiating frequency bands, the presentation highlighted initiatives like the Bloom Cup for fostering innovation. The vision for future mobile networks, particularly 6G in Brazil, centered on tailoring networks to meet unique vertical needs through sub-THz communications and AI. Discussions on challenges in existing networks and the importance of AI integration were followed by an emphasis on anticipating 6G advancements in the Brazilian context. Finally, 10 projects over six years aligned with Industry 4.0, Transport, Energy, and Health needs within PEPR were outlined, addressing network architectures, radio interfaces, IoT breakthroughs, and security. Collectively, these efforts aimed to propel the evolution of communication networks, incorporating cutting-edge technologies and addressing diverse application needs. In conclusion, the session highlighted achievements, challenges, and collaborative efforts in 5G and 6G deployment, emphasizing the pivotal role of collaboration, technological innovation, and strategic planning in shaping the trajectory of cellular networks worldwide.

Closing 5G-PPP Broadcasted Event *(Chair: Alexandros Kaloxylos)*

The speakers emphasized the 5G-PPP structure, highlighting the various boards, task forces, and working groups involved. Presentations highlighted the 5G-PPP 4 phases and main numbers achieved, e.g., 783 unique organizations; 24,43% SME participation; 25 MoUs and LoIs signed with global "5G" stakeholders; 3399 new skills and/or jobs created (estimate); 44% increase in annual revenue of SMEs (estimate); more than 2500 scientific papers; more than 50 white papers; more than 250 use-cases demonstrations, trials and pilots; more than 445 innovations on commission innovation radar.
A presentation giving the perspective from the CSAs (Coordination and Support Action) was also made. The speaker introduced the 4 CSAs (Euro-5G, To-Euro5G, Full5G and 6GStart), that have been supporting the activities in 5G-PPP since July 2015, and the main support activities done by these CSAs.

Keynote 2: Quantum Technologies and Networking Yasser Omar *(Chair: Rui Aguiar)*

Quantum technologies have multiple applications. Faster computers: Quantum computers utilize superposition for parallel computations, accelerating calculations. While they match the processing speeds of traditional computers, surpassing them in specific algorithms, being able to break current encryption algorithms. Safer communications: leveraging quantum entanglement and superposition can detect eavesdropping during transmission or key distribution. Quantum key distribution allows the use of a one-time pad key. Presently, the transmission of entangled electrons is limited to 200km, or 600km under certain conditions. Trusted nodes or satellites can be used for longer distances but require reading or line of sight. Quantum repeaters are under development to relay qubits without reading them. The European Commission is funding national quantum networks for all member states and is promoting a call for international links that will interconnect all the national networks of member states. Quantum sensing and metrology: Quantum technology enables a higher level of precision than classical methods. Quantum random number generators, the size of a small chip, are already being used in mobile phones, providing superior results.

Visions for Future Communications Summit – Day 2

Keynote 3: Challenges for 2023 Peter Cochrane *(Chair: Rui Aguiar)*

Keynote 3 outlines challenges in the telecommunications sector, attributing them to outdated thinking, cumbersome infrastructures, and limited technology understanding. It criticizes the telco industry's fixation on retail models, emphasizing the importance of energy considerations. The presentation highlights the cost-effectiveness and future-proof nature of fiber-rich networks compared to wireless technology's hurdles. Concerns about the escalating energy consumption of 5G towers prompt the need for more efficient communication using fiber and picocells. Acknowledging the pivotal role of IoT in sustainable societies, the presentation advocates for efficient solutions, urging a shift to higher frequencies beyond 10 GHz. The emphasis is on adaptability, innovation, and collaborative research. The challenges in fiber technology were discussed, expressing disappointment with senior management's hesitancy to adopt new technologies. It underscores the hindrance of limited bandwidth during societal development, especially evident in the COVID-19 pandemic. Global collaboration in distributed work, insufficient broadband infrastructure, and societal preoccupations are underscored. The session addresses industry issues like outdated thinking and poor business models, proposing solutions such as overcoming

supplier reliance, adopting new technologies, and prioritizing sustainability. It envisions a more customer-focused, sustainable future for the telecommunications industry.

Session 4: Communication Technologies *(Chair: Carles Anton-Haro)*

The discussion covered various topics within the realm of optical communications, 6G integration with NTN, challenges of designing deterministic communication systems, advancements in quantum technologies, industrial use cases, and networking concepts. Optical advancements focus on hardware innovations, bandwidth enhancement, and network automation. While in wireless to fulfil demanding requirements a denser deployment using RABS for antenna coverage optimization and the utilization of drones in wireless networks are highlighted. Key points also include the need for energy-efficient networking solutions, considerations for AI implementation in network systems, and the impact of determinism on all system design aspects. The discussion emphasized the integration of non-terrestrial networks (NTN) with terrestrial networks (TN) and discussed the potential impacts of emerging technologies like satellite-enabled chipsets on the market. Additionally, it touches upon the challenges of drone deployment in different regions due to regulatory policies and referred solutions such as pre-flight command transmissions for drones' relocation, even without a continuous connection.

Session 5: Views From Other Domains *(Chair: Didier Bourse)*

The discussion delved into various aspects encompassing public safety technology, 6G, quantum technologies, cybersecurity, and XR (Extended Reality). It addressed the interoperability challenges among countries' public safety technologies due to vendor-specific solutions, and the move towards enabling public safety responder with mobile broadband for critical scenarios. The European Commission has significantly invested in public safety communications, such as the BroadMap and Broadway projects aimed at compiling requirements and evaluating industrial solutions resulting in the formation of EC Mission Critical Communication Expert Group (MCCG) to prepare policy and legislative proposals to establish an EU Critical Communication System in the 2030-35 timeframe . The European Commission also has initiatives in cybersecurity development through entities like ECSO, fostering collaboration among various stakeholders across Europe. It was emphasized that the complexities in 6G networks due to emerging technologies like IoT, AI, cloud computing, and their potential vulnerabilities, necessitate robust security measures. It was also explored the 6G-XR initiative, discussing challenges like real-time environment reconstruction, scalability, mobility, and holoportation. Touching upon the need for technological advancements to enhance the XR experience, emphasizing the role of AI, IoT, and network improvements. Finally, a discussion on the challenges of integrating holographic communication outdoors due to installation complexities and the unpredictability of wireless networks in open environments.

Keynote 4: Challenges and Opportunities for 6G Networks Alexandros Kaloxylos *(Chair: Rui Aguiar)*

The presentation titled "The road to 6G: Lessons learned considerations for future steps" covered the following key topics “What 6G will be?”; “Lessons learned (?) from 5G”; “What can we do better” and “Closing remarks”.

A slide comparing the new 6G KPIs and 5G KPIs was presented to highlight the difference between them. However, the speaker emphasized that 6G is also driven by societal, business and policy needs; sustainability; security and privacy; AI/ML; high performance computing; ….

The discussion delved into the crucial technologies underpinning 6G networks and offered personal reflections on lessons learned during their development. The presentation questioned the sustainability of traditional business models for operators and vendors and emphasized the importance of revisiting strategies for the 6G design phase to improve its effectiveness.

Session 6: Security and Software Enablement *(Chair: Emmanuel Dotaro)*

Session 6 encompassed diverse presentations focusing on critical security aspects of technological advancements and challenges in the European Union's digital landscape. Topics ranged from the imperative need for innovative technological approaches, particularly in Data Usage Control technologies, to safeguard data within the EU, to the escalating importance of energy considerations in the realm of 6G technology and the ICT sector. Discussions delved into the necessity for foundational paradigms to address energy and carbon footprints for a sustainable 6G ecosystem. Limited Domain Interconnection emerged as a theme, emphasizing its role in driving innovation in edge networks and its historical evolution beyond IP end-to-end transfer. Additionally, the meeting highlighted the role of open experimental infrastructures in inspiring future innovation, bridging the gap between 5G/6G technologies and vertical industries, with a focus on the challenges and opportunities in creating flexible, interoperable vertical infrastructures. Discussions revolved around standardization, architecture, hardware integrations, socket interfaces, limited domains, deployment simplification, and achieving interoperability through semantic technologies.

Challenge Address - What are key values, after all? Katrina Petersen *(Chair: Rui Aguiar)*

The presentation at the Challenge Address focused on the challenge of articulating and measuring key societal values within innovation and design. It emphasized the need to not view values as external to innovation and instead view engaging societal values, such as improved public safety or energy efficiency, as a way of aligning performance to meet the prospects and possibilities for stakeholders and contexts. Three key aspects were outlined: defining value, designing for value, and delivering value, raising questions about who defines value, who is responsible for ensuring value outcomes, and how to prioritize innovation. The importance of stakeholder participation and various design approaches like Participatory Design, Design Thinking, and Researcher Intervention was also highlighted.

Keynote 5: European Perspectives and Priorities Jorge Pereira *(Chair: Rui Aguiar)*

The presentation outlines the European 6G Vision, emphasizing the importance of achieving a 2030 Digital Decade and advancing the Digital Europe agenda. The vision includes EU-wide deployment, strategic capacities, advanced digital skills, and a focus on by-design regulatory compliance, including privacy-friendly and unbiased AI. It highlights the need for capacity, uptake, and use-cases, with a lens on prosperity, people, and the planet.

Smart Networks and Services are identified as strategic areas with a focus on industrial leadership; applications; societal, sustainable development goals and sovereignty/open strategic autonomy.

Furthermore, it mentions a joint undertaking for 6G networks and services to facilitate and develop industrial leadership in Europe for 5G and 6G and services by 2030. The presentation outlines a timeline with 3 SNS phases from 2023 to 2030, including 6G research activities, 6G requirements convergence, 6G system projects, the development of 6G specifications and the implementation of early 6G trials.

Closing Words: Rui Aguiar and Ari Pouttu

Prof Rui Aguiar elaborates on the next steps forward, namely the new SRIA 2024 document with special attention to potential new areas that need to be addressed in this document. He then concluded by thanking the team involved in the organization for all their effort and work preparing this event, as well as the speakers, panelists and participants that contributed with their views and content and hoping to see everyone again in 2 years' time for the 5th Visions for Future Communications Summit.