6G Workshop

Defining the future of CGC 6G Research

October 12, 2021 09:00 – 16:00 CET

Hybrid workshop

Venue: *Innovatorium, room 209,Birk Centerpark 40, Herning, Denmark*

CTIF Global Capsule (CGC), Department of Business Development and Technology (BTECH), Aarhus University, Herning, Denmark.

https://btech.au.dk/en/research/research-sections-and-centres/cgc-au/cgc-members/

Welcome Message

Dear Colleagues,

On behalf of CGC and BTECH, it is my great pleasure to welcome you to attend the 6G WORKSHOP on Tuesday, October 12 at 09.00-16.00 hrs Central European Time (CET) at the CGC LABORATORY, Department of Business Development and Technology, Aarhus University, Herning, Denmark (Innovatorium, room 209,Birk Centerpark 40, DK-7400).

Considering strategically about initiating 6G global leadership during the CGC meeting held at the Naturkraft Center on Thursday August 26 – Friday August 27 in Ringkøbing, Denmark, it has been proposed to have brainstorming discussions during the workshop.

It will be highly appreciated if you all attend this future CGC challenging event. Please find below the program and the abstract of the talks and bio of the speakers. You may attend virtually as well using the following zoom link for the 6G Workshop:

Join Zoom Meeting
https://aarhusuniversity.zoom.us/j/62404483007

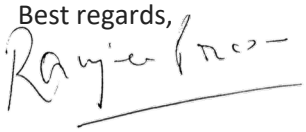
Meeting ID: 624 0448 3007

Join by SIP
62404483007@109.105.112.236
62404483007@109.105.112.235

Join by H.323
109.105.112.236
109.105.112.235
Meeting ID: 624 0448 3007

Looking forward to meeting you physically, as well as, virtually.

Best regards,



Ramjee Prasad

6G Workshop Programme

- October 12, 2021 -

Time (CET)	Topic
09:00hrs	**Welcome and Introduction to CGC 6G Research** Ramjee Prasad, CGC International
09:30hrs	**Enabling Technologies for Next Generation Telepresence Systems** Albena Mihovska, CGC Denmark
10:15hrs	*Coffee Break*
10:30hrs	**6G: A Gateway to the Pervasive Intelligence Applications** Ambuj Kumar, CGC Denmark
11:15hrs	**6G - The Last Generation** Martijn Kuipers, CGC Portugal
12:00hrs	*Lunch break*
12:45hrs	**6G a Key Enabler for Large-scale Drone Services- Opportunities and Challenges** Muhammad Bilal, CGC Denmark
13:30hrs	**Quantum Physics applied for engineering the future architecture of the 6G Networks** Paulo Sergio Rufino Henrique, CGC France (Spideo)
14:15hrs	*Coffee break*
14:30hrs	**Why 6G? Impact on our life and beyond** Neeli Rashami Prasad, CGC USA
15:15hrs	**Brainstorming session** Chair: Peter Lindgren, CGC International
16:00hrs	**Closing remarks** Ramjee Prasad, CGC International

CTIF GLOBAL CAPSULE

Vision 2025

Venue: Innovatorium, room 209,Birk Centerpark 40, Herning, Denmark

Organizing committee: Prof. Ramjee Prasad (CGC International), Prof. Peter Lindgren (CGC International) and Dr. Martijn Kuipers (CGC Portugal)

AARHUS UNIVERSITET

Bios and Talks

Welcome and Introduction to CGC 6G Research

Ramjee Prasad, *President CTIF Global Capsule , CGC International*

Dr. Ramjee Prasad, Fellow IEEE, IET, IETE, and WWRF, is a Professor of Future Technologies for Business Ecosystem Innovation (FT4BI) in the Department of Business Development and Technology Aarhus University, Herning, Denmark. He is the Founder President of the CTIF Global Capsule (CGC). He is also the Founder Chairman of the Global ICT Standardization Forum for India, established in 2009. He has been honored by the University of Rome "Tor Vergata", Italy as a Distinguished Professor of the Department of Clinical Sciences and Translational Medicine on March 15, 2016. He is an Honorary Professor of the University of Cape Town, South Africa, and the University of KwaZulu-Natal, South Africa. He has received the Ridderkorset of Dannebrogordenen (Knight of the Dannebrog) in 2010 from the Danish Queen for the internationalization of top-class telecommunication research and education. He has received several international awards such as IEEE Communications Society Wireless Communications Technical Committee Recognition Award in 2003 for making a contribution in the field of "Personal, Wireless and Mobile Systems and Networks", Telenor's Research Award in 2005 for impressive merits, both academic and organizational within the field of wireless and personal communication, 2014 IEEE AESS Outstanding Organizational Leadership Award for: "Organizational Leadership in developing and globalizing the CTIF (Center for TeleInFrastruktur) Research Network", and so on. He has been the Project Coordinator of several EC projects, namely, MAGNET, MAGNET Beyond, eWALL. He has published more than 50 books, 1000 plus journal and conference publications, more than 15 patents, over 140 Ph.D. Graduates and a larger number of Masters (over 250). Several of his students are today worldwide telecommunication leaders themselves.

Brainstorming session chair

Peter Lindgren, *Vice-president CTIF Global Capsule, CGC International*

Peter Lindgren holds a full Professorship in Multi business model and Technology innovation at Aarhus University, Denmark – Business development and technology innovation and is Vice President of CTIF Global Capsule (CGC). He is Director of CTIF Global Capsule/MBIT Research Center at Aarhus University – Business Development and Technology and is member of Research Committee at Aarhus University – BSS. He has researched and worked with network based high speed innovation since 2000. He has been head of Studies for Master in Engineering – Business Development and Technology at Aarhus University from 2014–2016 and member of the management group at Aarhus University Btech 2014–2018. He has been researcher at Politechnico di Milano in Italy (2002/03), Stanford University, USA (2010/11), University Tor Vergata, Italy (2016/2017). He has been the founder and Center Manager of International Center for Innovation www.ici.aau.dk at Aalborg University, founder of the MBIT research group and lab – http://btech.au.dk/forskning/mbit/ – and is cofounder of CTIF Global Capsule – www.ctifglobalcapsule.org. He has worked as researcher in many different multi business model and technology innovations projects and knowledge networks among others E100 – http://www.entovation.com/kleadmap/, Stanford University project Peace Innovation Lab http://captology.stanford.edu/projects/peace-innovation.html, The Nordic Women in business project – www.womeninbusiness.dk/, The Center for TeleInFrastruktur (CTIF), FP7 project about “multi business model innovation in the clouds” – www.Neffics.eu, EU Kask project – www.Biogas2020.se, Central Project, Motor5G, Recombine, Greenbizz. He is cofounder of five startup businesses amongst others – www.thebeebusiness.com, www.thedigibusiness.com, www.vdmbee.com. He is author to several articles and books about business model innovation in networks and Emerging Business Models. He has an entrepreneurial and interdisciplinary approach to research. His research interests are multi business model and technology innovation in interdisciplinary networks, multi business model typologies, sensing-, persuasive- and virtual- business models.

Bios and Talks

Enabling Technologies for Next Generation Telepresence Systems

Albena Mihovska, *CGC Denmark*

Albena Mihovska (Member, IEEE) received the Ph.D. degree in mobile communications from Aalborg University, Denmark. Since 2017, she has been an Associate Professor with the Department of Business Development and Technology, Aarhus University, Denmark, where she is leading the research activities of the 6G Knowledge Laboratory, with a focus on 6G connectivity and enabling technologies, namely artificial intelligence, and advanced services and applications, such as augmented and extended reality (AR and XR), high-fidelity and real time mobile hologram, and digital twins. She is currently a Senior Research and Academic Professional. She has participated in leading roles in several EU-funded projects in the area of Beyond 5G networks, and has more than 150 scientific publications.

Abstract

The current trends of digitalization, the user requirements for access, transmission and streaming of high-definition data while on the move, and for networking and intelligence in all spheres of life, challenge the current capabilities of the enabling wireless technologies and systems in terms of latency, delay, rate, degree of intelligence, coverage, reliability, capacity. Current application trends that can be observed are the emergence of services based on augmented reality (AR), virtual reality (VR), mixed reality (MR), extended reality (XR) (e.g., high-fidelity and real time mobile holograms; digital twins), as well as applications based on advances other technologies such as sensing, imaging, artificial intelligence (AI), massive scale machine-to-machine (M2M) communications. In the light of recent pandemic, remote collaboration revealed its importance as the backbone of modern business and kept the so important human communication and interaction at a satisfactory level. With the advancement of technology, remote interactions become more and more part of our everyday living. The current methods of remote interaction between human beings are becoming obsolete, as new forms of interaction are being developed leading to a true immersion into a distant environment. Next generation communication systems will enable location and context-aware digital services, as well as sensory experiences such as truly immersive XR and high-fidelity holograms. Five dimensional (5D) communications and services, integrating all human sense information (sight, hearing, touch, smell and taste), are expected to emerge, together with holographic communications, thus providing a truly immersive experience. All these technologies and services open the door to new heights of interpersonal communication, but they also present a lot of challenges in terms of digital data gathering and transmission. This talk is focused on research and advances in technologies enabling these advanced services and applications as well as their societal impact.

Bios and Talks

6G: A Gateway to the Pervasive Intelligence Applications

Ambuj Kumar, *CGC Denmark*

Ambuj Kumar received Bachelor of Engineering in Electronics & Communication from Birla Institute of Technology (BIT), Ranchi, India in the year 2000. After graduation, Ambuj Kumar worked at Lucent Technologies Hindustan Private Limited, a vendor company, during the period 200-2004. During the period 2004 to 2007, he worked with Hutchison Mobile Services Limited (now Vodafone), where he was involved in planning, deployment, and optimization of the Hutch's rapidly expanding GSM and Edge networks across India. Ambuj Kumar was awarded research scholarship under European Commission -Erasmus Mundus "Mobility for Life" programme for doing PhD and joined CTIF, Department of Electronic Systems, Aalborg University, Aalborg, (Denmark), in the year 2010. Ambuj Kumar has also worked as a Collaborative Researcher at the Vihaan Networks Limited (VNL), India. The work of PhD research was conceptualized at VNL; there he developed test-bed facilities for experimental studies on 'Advanced Alternative Networks'. He was awarded Doctor of Philosophy (PhD) in 2016 by the Aalborg University (Denmark) on his thesis titled "Active Probing Feedback Based Self Configurable Intelligent Distributed Antenna System for Relative and Intuitive Coverage and Capacity Predictions for Proactive Spectrum Sensing and Management". He has been working as PostDoc in the Department of Business Development and Technology, School of Business & Social Sciences, Aarhus University (Denmark) from 2017 to 2021. Currently, he is senior researcher and assistant professor of CGC Denmark.

Abstract

It is expected that future shall be driven by Ai powered devices and machines. Users and devices are bound to collaborate on many aspects. 6G, with its immense capability in ubiquity and throughput, finds a right place as an apt technology to support the future trends. The talk shall present the definition and its application in the context of industrial applications.

Bios and Talks

6G - The last generation

Martijn Kuipers, *CGC Portugal*

Berend Willem Martijn Kuipers received a B.Sc. from the Rijswijk University of Technology, the Netherlands, in the area of computer science in 1996. In 1999, he received his M.Sc. in the area of telecommunications from the Delft University of Technology in the Netherlands. He received his Ph.D. in the area of telecommunications from Aalborg University, Denmark in 2005. During his Ph.D. he has developed a novel multicarrier access scheme for 4G systems. Currently he is employed by INOV-INESC Inovação in Lisbon, where is involved in the application of artificial intelligence algorithms for data analysis, such as clustering algorithms, seasonal ARIMA forecasting and machine learning. He has supervised more than 30 M.Sc. students and was involved with courses on telecommunications and computer networks, artificial intelligence and data structures. He has taken part in many National and European projects. He is also professor and coordinator at the bachelor's degree in Computer Science and Engineering at the Lusíada University of Lisbon.

Abstract

One of the foreseen differences with current generation is that in 6G everything will be virtualized. The use of virtualization has a big impact on the provisioning of a network. No longer do we need to make a huge overprovisioning from the beginning, but can add resources when required. Mobile Network Operators need to adapt their business model, but can also become more agile with neew features.
Another advantage of virtualization is that a virtualized network can be seamlessly upgraded. If this is true for all 6G components, then 6G could very well be the last generation.

Bios and Talks

6G a Key Enabler for Large-scale Drone Services- Opportunities and Challenges

Muhammad Bilal, *CGC Denmark*

Bilal Muhammad received his Ph.D. degree in Telecommunication Engineering from University of Rome Tor Vergata, Italy in 2015, and his master's degree in electrical engineering from Blekinge Tekniska Högskola (BTH), Sweden in 2008. Presently, he is working as an Assistant Professor at the Department of Business Development and Technology, Aarhus University. Bilal actively participates in EU projects and has been WP leader for SARA and EASY-PV H2020 Innovation Action projects. His research interests include UAV Wireless Communication for 5G and Beyond, GNSS Integrity and Accuracy for UAV, Unmanned Traffic Management (UTM) Systems and Services, and UAV business modelling.

Abstract

Unmanned Aerial Vehicle (UAV), popularly known as drone, is becoming a game-changer in automating business processes and functions at a fraction of risk, cost, and time. The European Drone Market Outlook Study 2016 forecasts the economic impact of drones to be approximately €15 billion across the value-chain of products and services by 2050. Agriculture, Urban Air Mobility, and e-commerce & delivery are among the major sectors expecting growth. The mass integration of drones into the airspace in a safe, secure, and seamless manner is unimaginable without wireless connectivity. Unlike conventional UEs, served by terrestrial infrastructure, drones require wireless connectivity provisions at altitudes of 120 m or above. This requires optimization of existing terrestrial infrastructure to extend its coverage in 3D space, without compromising QoS for terrestrial UEs, or deployment of additional infrastructure to enable UAV connectivity. This talk will discuss state-of-the art research on 6G wireless communication provision for large-scale drone services considering various opportunities and challenges in going forward.

Bios and Talks

Quantum Physics applied for engineering the future architecture of the 6G Networks

Paulo Sergio Rufino Henrique, *CGC France (Spideo)*

Paulo S. Rufino Henrique holds more than 20 years of experience working in telecommunications. His career began as a field engineer at UNISYS in Brazil, where he was born. There, Paulo worked for almost nine years in the Service Operations, repairing and installing corporative servers and networks before joining British Telecom (BT) Brazil. Paulo worked five years at BT Brazil managing MPLS networks, satellites (V-SAT), IP-Telephony for Tier 1 network operations. He became the Global Service Operations Manager during that period overseeing BT operations in EMEA, Americas, India, South Korea, South African, and China. After a successful career in Brazil, Paulo got transferred to the BT headquarters in London, where he worked for six and a half years as a service manager for Consumers Broadband in the UK and IPTV Ops manager for BT TV Sports channel. Additionally, during his tenure as IPTV Ops manager for BT, Paulo also participated in the BT project of launching the first UHD (4K) TV channel in the UK. He then joined Vodafone UK as a Quality Manager for Consumers Broadband Services and OTT platforms, and he worked in that capacity for almost two years. During his stay in London, Paulo completed a Post-graduation Degree at Brunel London University. His thesis was entitled 'TV Everywhere and the Streaming of UHD TV over 5G Networks & Performance Analysis'. Presently, Paulo Henrique holds the Head of Delivery and Operations position at Spideo, Paris, France. He is also a Ph.D. candidate under Professor Ramjee Prasad's supervision at Global CTIF Capsule, Department of Business, Aarhus University, Denmark. His research field is 6G Networks - Performance Analysis for Mobile Multimedia Services for the Future Wireless Technologies.

Abstract

Quantum Physics is a science that describes the comportment of particles and the interactions between photons and electrons. It dates back 100 years ago with studies provided by Max Planck studying black body radiation. Later, Dirac, Schrödinger, and Heisenberg improved the theory, providing mathematical models to create the scientific foundations of quantum mechanics. Since then, discussions and challenges between Niels Bohr and Albert Einstein regarding quantum mechanics have paved the way to engineering quantum technologies. As quantum technologies studies evolve, the 6G roadmap can benefit from it to help to unlock its full potential and foster the Society 5.0

Bios and Talks

Why 6G ? Impact on our life and beyond

Neeli Rashami Prasad, *CGC USA*

Prof. Dr. Ir. Neeli R. Prasad, CTO of SmartAvatar B.V., Delft, Netherlands and TrustedMobi "VehicleAvatar Inc.", Mountain View, CA, USA, IEEE VTS Board of Governor Elected Member & VP Membership. She is also full Professor at Department of Business Development and Technology (BTech), Aarhus University. Neeli is a cybersecurity, networking and IoT strategist. She has throughout her career been driving business and technology innovation, from incubation to prototyping to validation and is currently an entrepreneur and consultant in Silicon Valley. She has made her way up the "waves of secure communication technology by contributing to the most groundbreaking and commercial inventions. She has general management, leadership and technology skills, having worked for service providers and technology companies in various key leadership roles. She is the advisory board member for the European Commission H2020 projects. She is also a vice chair and patronage chair of IEEE Communication Society Globecom/ICC Management & Strategy Committee (COMSOC GIMS) and Chair of the Marketing, Strategy and IEEE Staff Liaison Group. She is Director of CGC, USA and was assistant head of department and Professor, Electrical and Computer Engineering at International Technological University (ITU), USA.

Dr. Prasad has led global teams of researchers across multiple technical areas and projects in Japan, India, throughout Europe and USA. She has been involved in numerous research and development projects. She also led multiple EU projects such as CRUISE, LIFE 2.0, ASPIRE, etc. as project coordinator and PI. She has played key roles from concept to implementation to standardization. Her strong commitment to operational excellence, innovative approach to business and technological problems and aptitude for partnering cross-functionally across the industry have reshaped and elevated her role as project coordinator making her a preferred partner in multinational and European Commission project consortiums.

She has 4 books on IoT and WiFi, many book chapters, peer-reviewed international journal papers and over 200 international conference papers. Dr. Prasad received her Master's degree in electrical and electronics engineering from Netherland's renowned Delft University of Technology, with a focus on personal mobile and radar communications. She was awarded her Ph.D. degree from Università di Roma "Tor Vergata", Italy, on Adaptive Security for Wireless Heterogeneous Networks

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Abstract

This presentation will define 6G and discuss the need of 6G by 2030. 6G will be cross-multi/-disciplinary technology covering territorial, satellite, and space communications. Thus, it will be much more different than those of previous generations (1G, 2G, 3G, 4G, and 5G). Therefore, it is necessary to investigate in depth the impact of 6G on our daily life. It will be discussed thoroughly, considering the reality.