



### WIRELESS WORLD RESEARCH FORUM



## PROCEEDINGS

36<sup>th</sup> Virtual GISFI Workshop of the CTIF Global Capsule (CGC)

Jointly on

## **6G KNOWLEDGE LAB OPENING**

DATE: December 21<sup>st</sup> -22<sup>nd</sup>, 2020 VENUE: CGC, AU, Birk Centerpark 40 7400, Herning, Denmark







*The current pandemic COVID-19 situation has shown the importance of digital* technologies to continue the successful operation of all spheres of life, educational, business, and social. It also gives a special flare to the 6G system. It *is envisioned that it will support further-enhanced to full-broadband (FeMBB)* services to all types of end-users and is envisioned as universal technology and infrastructure. The current trends of digitalization, user requirements for access and transmission of high-definition data while on the move, and networking and intelligence in all spheres of life demand 6G as the accelerator of transformation and innovation on a global scale and with deep penetration. *Current application trends that can be observed are the emergence of services* based on Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), wireless brain-computer interaction, smart city, tactile communications, and holographic communications. These developments challenge the current capabilities of the enabling wireless communication systems from various aspects, such as delay, rate, degree of intelligence, coverage, reliability, capacity, and cannot be achieved by evolutionary research. The research will seek breakthroughs from the current network architecture and communication theory to provide novel concepts that can be key for designing a radically new system such as 6G. At the same time, it is important to enabling such revolutionary technology developments to stay 'green' and take into account major environmental concerns, such as climate change, which can be achieved by novel, 'green' digitalized business models.

This workshop is held jointly with the CTIF Global Capsule (CGChttps://ctifglobalcapsule.org/), the Global ICT Standardization Forum for India (GISFI- gisfi.org), and is technically sponsored by IEEE (ieee.org) and by Wireless World Research Forum (WWRF-wwrf.ch). The event will span over two days and feature invited talks by external and CGC experts on various research challenges related to 6G and enabling technologies.

<i>Time</i> 09:00-10:00	Program         Session: 1 Opening         Welcome and Introduction-Ramjee Prasad, CGC, BTECH, Aarhus University, Denmark         Opening Speech- Anders Frederiksen, BTECH, Aarhus University, Denmark         Introduction to CGC-Peter Lindgren, CGC, BTECH, Aarhus University, Denmar
09:00-10:00	Welcome and Introduction-Ramjee Prasad, CGC, BTECH, Aarhus University, Denmark Opening Speech- Anders Frederiksen, BTECH, Aarhus University, Denmark Introduction to CGC-Peter Lindgren, CGC, BTECH, Aarhus University, Denmar
	Denmark Opening Speech- Anders Frederiksen, BTECH, Aarhus University, Denmark Introduction to CGC-Peter Lindgren, CGC, BTECH, Aarhus University, Denmar
	Introduction to CGC-Peter Lindgren, CGC, BTECH, Aarhus University, Denmar
	Introduction to 6G Knowledge Lab-Albena Mihovska, CGC, BTECH, Aarhus University, Denmark
	Joint Collaboration Speech- Ambassador of India to Denmark-Ajit Gupte
	Joint Collaboration Speech- Ambassador of Denmark to India-Freddy Svane
10.00-10.15	Coffee Break
10:15-11:45	Session 2: CGC
_	Session Chair: Peter Lindgren, CGC, BTECH, Aarhus University, Denmark
	Speakers:
	Per Valter, CGC, BTECH, Aarhus University, Denmark, "The potential of green business models with future 6G network and artificial intelligence based cross organisational analytical transport management systems"
	Vladimir Poulkov, CGC, Technical University of Sofia, Bulgaria, "Enhancing Capacity and Research Excellence in Holographic Telepresence Systems as a Catalyst of Digitalization: The Project HOLOTWIN"
	Octavian Fratu, CGC, UPB, Romania, "Low Latency in Future Generations of Mobile and Wireless Communications"
	Sanjay Kumar, CGC, Birla Institute of Technology Mesra, India "NOMA for Next Generation Cellular Communication Systems"
	Sandeep Inamdar, CGC Vishwaniketan, India "CGC and expectations of south east Asian universities"
11.45-13:15	Session 3: GISFI (Virtual)
	Session Chair: Albena Mihovska, CGC, BTECH, Aarhus University, Denmark
	Speakers:
	Tilak R. Dua, GISFI, India, "THz band for 6G unfolds opportunities and
	challenges"
	Kiritkumar Lathia, GISFI, Belgium, "The dawn of digital Age, Mantal Pasilianaa Managamant"
	Mental Resilience Management" T. Pama Pao, SPM Institute of Science & Technology, Chennei, India "TeraHort
	T. Rama Rao, SRM Institute of Science & Technology, Chennai, India "TeraHert Wireless Communications"
	Krishna Sirohi, i2TB Research Foundation, India "Successful O-RAN is heading
	to create a democratised opportunity to developers of Small Telecom
	OEMs/Software Solution Companies "
	Vandana Rohokale, SIT, India, "Artificial Intelligence: The Heart of Modern Medicine and Healthcare Industry"

13:15-14:00	Lunch Break
14.00-15.30	Session 4: Invited Talks 1 (Virtual)
	Session Chair: Bhawani S. Chowdhry, MUET, Pakistan
	Speakers:
	Debu Nayak, Huawei, India, "Artificial Intelligence the future of technology revolution will improve human mankind"
	Walter Weigel, Huawei Technologies, Belgium, "A Vision about 6G – for the Aarhus University 6G Knowledge Lab Opening"
	Md. Farhad Hossain, BUET, Bangladesh, "6G: Performance Enhancement from 5G and Enabling Technologies?"
	Muhammad Aamir, SSUET, Pakistan, "Role of Universities in Implementing Green ICT for achieving Sustainable Development Goals (SDGs)"
	Bharat Gupta, NIT Patna, Bihar, India, "6G Knowledge Lab Opening and 36th Virtual GISFI Workshop"
15:30-16:00	Coffee Break
16.30-17:00	CGC 6G Knowledge Lab Opening
	Ramjee Prasad, Anders Frederiksen, Ambuj Kumar, Peter Lindgren
17:00-19.00	Session 5: Keynote Session 1 (Virtual)
	Session Chair: Ramjee Prasad, CGC, Aarhus University, Denmark
	Speakers:
	H. Vincent Poor, Princeton University, USA, "Physical Layer Security: Security for 6G"
	Walter Konhäuser, Oktett64 GmbH, Germany, "From 5G technology to 6G Green Deals"
	Sudhir Dixit, Skydoot, Inc , USA "Omnipresent Knowledge Creating a New World Order: The Power of Internet, the Web and the Mobile!"
	Mahbubul Alam, DIMAAG-AI, Inc. USA, "6G will Unlock the Power of "AI-for- Everything"
	End of The First Day

Time	Program
09:00-10:30	Session 6: Keynote Session 2 (Virtual)
	Session Chair: Pawan Garg, GISFI, India
	Speakers:
	Kwang Cheng Chen, University of South Florida, USA, "Wireless Multi- Robot Systems in Smart Factories."
	Anand R. Prasad, Wenovator, Japan, "Crystal Ball: What will be 6G? How about security?"
	Steve Kim, Huawei, India, "Huawei Artificial intelligence collaboration helping technology ecosystem"
10.30-10:45	Coffee Break
10:45-12:00	Session 7 (a): GISFI (Virtual)
	Session Chair: Kishore Kumar Thakur, IETE University Ranchi, India
	Aaloka Anant, CGC and SAP Ireland, "Privacy preservation of data in a multi-party exchange"
	Sriganesh Rao, Calligo Technologies, India "Data-driven Business Model Innovation for 6G"
	Satya N. Gupta, BLUETOWN, India, "FRUGAL 5G – Bringing Broadband Faster to Rural Areas"
	Dnyaneshwar Mantri, SIT, Lonavala, India "Ubiquitous Networks: A Futur World of Things"
	Swati Prasad, BIT Mesra, India "Role of Speaker Identification towards 6
12:00-13:30	Session 7 (b): GISFI ctd (Virtual)
	Session Chair: Satya Prasad Majumder, Bangladesh University of Engineering and Technology, Bangladesh
	Speakers:
	Dinesh Chand Sharma, Standards & Public Policy (SESEI), India, "Standards 5G building blocks, Emerging Technologies & ETSI long term strategy"
	Preetam Kumar, IIT PATNA, India, "5G: Chalenges and Enabling Technologies"
	Knud Erik Skouby, Aalborg University, Denmark, "Beyond 5G and Rural Communication"
	Punnarumol Temdee and Chayapol Kamyod, Mae Fah Luang University, Thailand, "Smart Farming: Challenges and Applications for Young Smart Farmers in Thailand"
	Navin Kumar, Amrita School of Engineering, India, "Aerial Infrastructure Sharing in 6G using LAP (Low Altitute Platform)"
13:30-14:30	Lunch Break
14.30-16.00	Session 8 (a): Invited Talks 2 (Virtual)
	Session Chair: Henrik Knudsen, CGC, BTECH, Aarhus University, Denmar

	Speakers:
	Ashok Chandra and Purnendu Tripathi, GISFI, India, "Radio Frequency Spectrum for 5 G and Beyond Applications- ITU's Perspective"
	Vinod Kumar, France, "5G to 6G Evolution and Revolution"
	Ashutosh Dutta, Johns Hopkins University Applied Physics Laboratory , USA, "5G Security – Opportunities and Challenges
	Paulo Sergio Rufino Henrique, Spideo, France, "6G Networks Infrastructure for Future Multimedia Communications"
	Purnima Lala, IILM, India "Aerial Radio Architecture, a future roadmap"
16:00-16:30	Coffee Break
16:30-18:00	Session 8 (b): Invited Talks 3 (Virtual)
	Session Chair: Chandrika Prasad, PCNS, Rail Metro, India
	Speakers:
	Kapal Dev, Trinity College Dublin, Ireland, "Reinventing the Future: A Perspective from 6G Applications"
	Seshadri Mohan, University of Arkansas at Little Rock, USA, "The Evolution of Connected Vehicles: The Role of Emerging Standards, 5G and Beyond, and AI/Machine Learning"
	fred harris, UCSD, USA, "Polyphase Channelizer Separates and Demodulates Multiple FM Channel Bands"
	Neeli R. Prasad, Smart Avatar, The Netherlands, "6G: The Age of The Empathetic Intelligence"
18:00	End of Second Day and Workshop

Acard in the P

A CONTRACTOR OF A CONTRACTOR

0

# First Day

1



SESSION 1: Opening and Introduction

### **Ramjee Prasad**

Founder President, GISFI Founder President, CTIF Global Capsule Professor, Department of Business Development and Technology, Aarhus University, Herning, Denmark



Dr. Ramjee Prasad is a Professor of Future Technologies for Business Ecosystem Innovation in the Department of Business Development and Technology, Aarhus University, Denmark. He is the Founder President of the CTIF Global Capsule (CGC). He is also the Founder Chairman of the Global ICT Standardisation Forum for India, established in 2009. GISFI has the purpose of increasing of the collaboration between European, Indian, Japanese, North-American and other worldwide standardization activities in the area of Information and Communication Technology (ICT) and related application areas.

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 Honorary Professor of University of Cape Town, South Africa, and University of KwaZulu-Natal, South Africa.

He has received Ridderkorset af 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 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 Project Coordinator of several EC projects namely, MAGNET, MAGNET Beyond, eWALL and so on.

He has published more than 30 books, 1000 plus journal and conference publications, more than 15 patents, over 100 PhD Graduates and larger number of Masters (over 250). Several of his students are today worldwide telecommunication leaders themselves.

### Welcome and Introduction Speech

### **Andres Frederiksen**

*Head of the Department of Business Development and Technology, Aarhus University, Herning, Denmark* 



Andres Fredriksen is a professor in Econometrics and Business Economics and He is the Head of Department at Aahus University, Denmark. His professional experience includes: 2015 EU expert (Evaluator), FP7 & Horizon2020 2013 EU expert (Rapporteur), FP7-PEOPLE-2013-IEF-IIF- IOF 2009 - 2012 Associate Professor in Business Performance Management (tenured) 2011 EU expert (Rapporteur), FP7-PEOPLE-2011-IEF-IIF-IOF 2006 – 2009 Marie Curie Postdoctoral Researcher, Aarhus and Stanford University 2002 – 2005 Graduate Student, Aarhus University.

He has a remarkable teaching experience in Statistics/Econometrics; Undergraduate/Master's Program HR analytics, Master's Program; Personnel Economics, Master's Program; Human Resource Management, Master's; Program Leadership, Master's Program; Labour Economics, Undergraduate/Master's Program Applied Economic Consulting; Master's Program Supervision: Phd, Master's and Bachelor's levels.

His flourishing achievements includes, 2008 Tietgenprisen; 2005 – 2007 W. Glen Campbell & Rita Ricardo Campbell National Fellow, Hoover Institution, Stanford University; 2003 – 2004 Leschly Fellowship, Princeton University 2001 Tuborgprisen.

**Opening Speech** 

## Peter Lindgren

Professor, Multi-Business model and Technology Innovation Aarhus University, Herning, Denmark



Professor Peter Lindgren holds a full Professorship in Multi-business model and Technology innovation at Aarhus University – Business development and technology innovation and has researched and worked with network-based high-speed innovation since 2000.

He is an author of several articles and books about business model innovation in networks and Emerging Business Models. He has been a researcher at Politecnico di Milano in Italy (2002/03) and Stanford University, USA (2010/11). In 2007 – 2010 been the founder and Center Manager of the International Center for Innovation <u>www.ici.aau.dk</u> at Aalborg University. He works today as a researcher in many different multi-business model and technology innovations projects and knowledge networks among others E100 -<u>http://www.entovation.com/kleadmap/</u>, Stanford University project Peace Innovation Lab <u>http://captology.stanford.edu/projects/peace-</u> innovation.html, The Nordic Women in the business project - <u>www.womeninbusiness.dk/</u>, The Center for TeleInFrastruktur (CTIF) at Aalborg University <u>www.ctif.aau.dk</u>, EU FP7 project about "multi-business model innovation in the clouds" - <u>www.Neffics.eu</u>. He is co-author of several books. He has an entrepreneurial and interdisciplinary approach to research and has initiated several Danish and international research programs.

*His research interests are the multi-business model and technology innovation in networks, multi-business model typologies, and new global business models.* 

Introduction to CGC

## Albena Mihovska

CGC, Department of Business Development and Technology, Aarhus University, Herning, Denmark



Dr. Albena Mihovska is a Senior Research Academic professional. She obtained her Ph.D. in the area of mobile communications from Aalborg University, Aalborg, Denmark in 2009. She is currently an Associate Professor at Aarhus University, Department of Business Development and Technologies (since 2017), where she is with the CTIF Global Capsule (CGC) research group. Her main current activities related to research in the area of 6G enabling technologies and related applications; smart dense connectivity, digitalisation through use of artificial intelligence and Internet of Things technologies in various sectors, such as healthcare, manufacturing, etc.

In addition to her research, Albena Mihovska has active teaching and supervision activities of Bachelors, Masters, and Ph.D. students. She is a Steering Committee Member of IEEE BlackSeaCom and INFORMS Telecommunication Cluster (Vice-President). She has been Workshop Chair of IEEE GLOBECOM 2015 and Tutorial Co-Chair of IEEE GLOBECOM 2019. Associate editor of Int. J. of Mobile Network Design and Innovation (IJMDNI), and Springer International Journal of Wireless Personal Communications. A Member of IEEE (the leading international association for electronic and electrical engineers, www.ieee.org) and INFORMS (the leading international association for Operations Research & Analytics professionals, <u>www.informs.org</u>.)

Albena Mihovska has authored and co-authored more than 170 publications, including peer-reviewed international books, journal and conference publications. She has also co-edited four books on Mobile and Wireless Communications, published by Artech House.

Introduction to 6G Knowledge Lab

## Ajit Gupte

Ambassador of India to Denmark



Shri Ajit Gupte joined the Indian Foreign Service in 1991. He has studied Chinese (Mandarin) and has specialised in China with postings in New Delhi as Under Secretary (China) [1995-98] and in Hong Kong [1998-2000 and Beijing [2000-2004]. He has extensive exposure to India's neighbourhood and has served in Dhaka from September 2004 to May 2008 as First Secretary/Counsellor. Shri Gupte had also served in ICCR as Deputy Director General to promote India's cultural diplomacy and 'soft power' from 2008 to 2010.

Thereafter, he was Deputy Chief of Mission in Embassy of India Berlin from December 2010 to September 2014. During this period, he was also Charge d' Affaires for 9 months. He held the post of Joint Secretary (Development Partnership Administration-I), dealing with Lines of Credit for all developing countries and grants to Africa and some neighbouring countries. He assumed charge as Ambassador of India to Denmark on 2nd September 2017.

Joint Collaboration Speech

## **Freddy Svane**

Ambassador of Denmark to India



*H. E. Freddy Svane is the current Ambassador at the Royal Danish Embassy in New Delhi.* 

### **Professional Career:**

1982 Entered the Danish Foreign Service
1988-1991 Secretary of Embassy, Permanent Mission to the EC, Brussels
1991-1993 Head of section, Ministry of Foreign Affairs
1993-1997 Counsellor (Economic Affairs) Paris
1997-1999 Head of North Group's 3rd department
1999-2000 Head of North's Group's 1st department
2000-2003 General manager, A.P. Møller
2004 Under-Secretary of the Trade Council, Ambassador, Ministry of Foreign Affairs
(Trade Policy and Globalization)
2005-2008 Ambassador to Japan
2008-2010 CEO of the Danish Agricultural Council
2010 Ambassador, Ministry of Foreign Affairs (EU/EPA)
2010-2015 Ambassador to India, Bhutan, Sri Lanka and the Maldives
2015 Ambassador to Japan

Ambassador Freddy Svane become Denmark's ambassador to India on September, 2019.

Joint Collaboration Speech



# Coffee Break

## SESSION 2: CGC

## Peter Lindgren

Professor, Multi-Business model and Technology Innovation Aarhus University, Herning, Denmark



Professor Peter Lindgren holds a full Professorship in Multi-business model and Technology innovation at Aarhus University – Business development and technology innovation and has researched and worked with network-based high-speed innovation since 2000.

He is an author of several articles and books about business model innovation in networks and Emerging Business Models. He has been a researcher at Politecnico di Milano in Italy (2002/03) and Stanford University, USA (2010/11). In 2007 – 2010 been the founder and Center Manager of the International Center for Innovation<u>www.ici.aau.dk</u> at Aalborg University. He works today as a researcher in many different multi-business model and technology innovations projects and knowledge networks among others E100 -<u>http://www.entovation.com/kleadmap/</u>, Stanford University project Peace Innovation Lab <u>http://captology.stanford.edu/projects/peace-</u> innovation.html, The Nordic Women in the business project - <u>www.womeninbusiness.dk/</u>, The Center for TeleInFrastruktur (CTIF) at Aalborg University <u>www.ctif.aau.dk</u>, EU FP7 project about "multi-business model innovation in the clouds" - <u>www.Neffics.eu</u>. He is co-author of several books. He has an entrepreneurial and interdisciplinary approach to research and has initiated several Danish and international research programs.

*His research interests are the multi-business model and technology innovation in networks, multi-business model typologies, and new global business models.* 

Session chair

## Per Valter

Global Director of Multi Business Model Innovation Technology at CTIF Global Capsule (CGC), Assistant Professor at Aarhus University



Per Valter is the Global Director of the multi-business model Innovation and Technology at CTIF Global Capsule (CGC) and Assistant Professor at Aarhus University. He obtained his Ph.D. in the area of Business Development and Technology at Aarhus University in 2019. His remarkable activities related to research and Scientific Projects includes: 2020 – 2023: Greenbizz. EU / Interreg project

2018 – 2019: Exploring the boundaries of human-computer interaction in a real-world setting of globally connected entrepreneurial business model environments 2017 – 2018: B-LAB environment attribute monitoring and control 2017 – 2018: Experimental exploration of business model digitization 2017 – 2018: Biogas 2020 – A Scandinavian Biogas Network. EU / Interreg project

Per Valter has successfully created several companies and grown them to exit's stage and was awarded "Børsen Gazelle" in 2013, 2014, and 2019 for creating and leading one among the fastest growing companies in Denmark. He has authored and co-authored many publications, including peer-reviewed international books, journal and conference publications.

## *Title: The potential of green business models with future 6G network and artificial intelligence based cross organisational analytical transport management systems*

Today's freight management systems can broadly be categorised to only have organisational scope and don't use technologies like AI and high-resolution live feed data like 360 degrees video feed, etc. Consequently, there is a potential for infusing green business models that enable optimisation opportunities using cross-organisational analytical transport management systems based on future 6G networks and artificial intelligence. By integrating an AI-based algorithm into the transportation dispatching system with machine learning algorithms using reinforcement learning to make cross-organisational order acceptance decisions based on high-resolution live feed data like 360 degrees video feed showing available cargo capacity on vehicles and their geospatial data, to re-analyse the estimated outcome vs realised outcome and improve decision making. This capability will have several positive impacts, both economical and environmental, for the transportation companies: it solves the lack of skilled personnel in the market, improves the speed of decision-making process, enables fully integrated instant order acceptance, enables data-driven fast decision making and instant real-time status and makes near future forecast possible. The environment will also benefit from this new green business model by reducing today's 8 billion tonnes CO2 emissions from transport, which accounts for 24% of the whole world's CO2 emissions from energy. Furthermore, 74,5% of CO2 emissions from transport comes from road vehicles, where 29.4% is road freight. In the case of a 10% optimisation efficiency, this green business model's yearly total saving would be 235.2 million tonnes of CO2 emissions, equivalent to more than 6.5 times the total annual CO2 emissions from Denmark's entire country.

## Vladimir Poulkov

CGC, Technical University of Sofia, Bulgaria



Professor Vladimir Poulkov has more than 35 years of teaching, research and industrial experience in the field of Telecommunications. He has successfully led and realized many R&D and educational projects and managed numerous industrial and engineering projects related to the development of the telecommunication transmission and access network infrastructure in Bulgaria, working with companies such as Ericsson, German Telecom and the major Bulgarian fixed and mobile operators.

Currently he is head of the "Teleinfrastructure R&D" Laboratory at the Technical University of Sofia, Chairman of the Bulgarian Cluster of Digital Transformation and Innovation and Vice-Chairman of the European Telecommunications Standardization Institute (ETSI) General Assembly.

### *Title: Enhancing Capacity and Research Excellence in Holographic Telepresence Systems as a Catalyst of Digitalization: The Project HOLOTWIN*

This talk will introduce the HOLOTWIN project and the related planned research activities in the area of context aware holographic communications. The project is a result of the collaboration between the Technical University of Sofia (TUS), AU (Denmark), University of Surrey (UK) and Hellenic American University (Greece) and is aiming to strengthen and stimulate the research excellence and innovation capacity of the project partners in technologies for holographic telepresence systems (HTPS). The goals and some of the challenges of the project will be presented, as: how to overcome the limitations of the communication channel when huge amounts of data need to be transmitted in real time; how to incorporate artificial intelligence, 6G technologies, big data, advanced signal processing and human perceptions related to high-level semantic knowledge in HTPS. By maximizing joint and individual scientific success, developing, and assessing good and transitional practices in the area of context aware holographic communication the consortium organizations aim to foster one of the areas of 6G applications.

### **Octavian Fratu**

CGC, UPB, Romania



Octavian Fratu received the M.S. degree in electronics and telecommunications in 1986 and the PhD degree in Electronics and Telecommunications from the University "Politehnica" of Bucharest, Romania in 1997. He achieved postdoctoral stage as senior researcher in 3rd generation mobile communication systems, based on a research contract between CNET-France, ENS de Cachan - France and Universite Marne la Vallee – France.

He is currently professor in Electronics, Telecommunications and Information Theory Faculty. His research interests include Digital Mobile Communications, Radio Data Transmissions, Mobile Communications and Wireless Sensor Networks. His publications include more than 200 papers published in national or international scientific journals or presented at international conferences. He participated as director or collaborator in many international research projects such as "Optimization and rational use of Wireless Communication Bands (ORCA)" (NATO Science for Peace research project, 2013-2016), "Reconfigurable Interoperability of Wireless Communications Systems (RIWCoS)" (NATO Science for Peace research project, 2007-2010), "REDICT—Regional Economic Development by ICT/New media clusters" (FP7 CSA project, 2008-2009), "ATHENA - Digital Switchover: Developing Infrastructures for Broadband Access", (FP6 STREP project, 2004-2006), "eWALL for Active Long Living - eWALL" (FP7 IP project, 2013-2016) and other. Currently he is leading the national funded "Integrated Software Platform for Mobile Malware Analysis (ToR-SIM)" no. 5Sol/so17 project and the communication subproject of MultiMonD2 complex project no. 33PCCDI/2018 and is participating in the MSCA projects Motor-5G (MObility and Training fOR beyond 5G ecosystems – H2020-MSCA-ITN no. 861219, 2019-2023) and RECOMBINE (REsearch COllaboration and Mobility for Beyond 5G future wIreless NEtworks – H2020-MSCA-RISE nr. 872857, 2019-2023).

### Title: Low Latency in Future Generations of Mobile and Wireless Communications

The transition to the 5th Generation of communication systems promotes the automatic devices and different machines as "end-users" of such communication systems and offers new capabilities in building IoT systems on large areas and this trend is expected to continue in the future developments beyond 5G. But this development is not only a quantitative one, covering more devices and larger areas, but due the new applications we may consider (telemedicine and telesurgery, vehicular and transportation systems, worker's mobility, work from home, ambient assisted living, critical infrastructure security, industrial automation, Augmented/Virtual Reality, etc.) we need also a qualitative development bringing new requirements for the communication systems, especially in the mobile environment. As a consequence, the URLLC (Ultra Reliable and Low Latency Communication) concept has been developed and 3GPP introduced it in the new 5G standards (Release 15 and 16). Moreover, the IEEE Communications Society is sponsoring the Tactile Internet Standardization Group intending to build a standard centered on procedures able to ensure these new requirements for the reliability and the latency of the end-to-end communications. The present talk is intending to bring in attention all these new developments and trends.

## Sanjay Kumar

CGC, Birla Institute of Technology, Mesra, India



Dr. Sanjay Kumar is an Associate Professor and presently working as in-charge of the Department of Electronics and Communications Engineering at Birla Institute of Technology Mesra, Deoghar Campus.

Before joining teaching and research, he served the Indian Air Force from 1985 to 2000 in various technical capacities. He has nearly 35 years of teaching, research, and work experience in Wireless Communication. He received MBA from Pune University in 1994, M. Tech. in Electronics and Communication Engineering from Guru Nanak Dev Engineering College, Ludhiana in 2000, and Ph.D. in Wireless Communication from Aalborg University, Denmark in 2009.

His teaching and research interests lie in the field of Wireless Communication Technology. He has contributed above 90 research papers in various National and International journals and conferences in Wireless Communication. He has been closely associated with organizing and contributing to several conferences and workshops. He is an Editorial Board Member of the International Journal, "Wireless Personal Communications" published by Springer. He has delivered a large number of keynote speeches and expert talks in various National and International workshops. He is the author of several books. He is a Fellow of the Institution of Electronics and Telecommunication Engineers, India, and a Senior Member of the Institution of Communication Engineers and Information Technologists. He is a Member of the Institution of Engineers, India, a Life Member of the Indian Society for Technical Education, and a Life member of GENCO Alumni Association, Guru Nanak Dev Engineering College, Ludhiana, India. A member of the Global ICT Standardization Forum for India (GISFI).

#### Title: NOMA for Next Generation Cellular Communication Systems

Different generations of mobile cellular communication systems have adopted radically different multiple access schemes. These multiple access schemes are known as Orthogonal Multiple Access (OMA) schemes, as the individual users are assigned resources exclusively. In interference management is automatically accomplished. OMA This leads to implementation simplicity, but results in limiting the number of users. Next generation cellular communication system will support an extremely large number of users. Therefore, in place of OMA, Non-Orthogonal Multiple Access (NOMA) scheme is being considered. NOMA allows non orthogonal access i.e., it permits the same resource bock to be used by multiple users simultaneously. This results in mutual interference. NOMA allows the mutual interference to exist and applies interference cancellation techniques, which finally brings a significant increase in system capacity and throughput performance. NOMA ensures massive connectivity, low latency, high spectral efficiency, and high energy efficiency, which are the prime requirements of the next generation cellular systems. NOMA has inspired a new wave or research. This paper discusses various aspects of NOMA implementation and open research issues to be addressed to harness the full potential benefits of NOMA.

## Sandeep Inamdar

CGC Vishwaniketan, India



Dr. Sandeep S. Inamdar is a bachelor in Electrical Engineering, obtained a Master's degree in Electrical control systems. He completed his Doctoral program from the National Institute of Industrial Engineering (NITIE) in Electrical Distribution System Efficiency Improvement. He has total 32 years of experience in education, out of which 20+ years he has been leading different academic campuses in the capacity of Director / Principal & has worked with more than 40,000 students. He was Senate Member of the University of Pune, member of the board of management, the board of Research of Guru Gobind Singh Indraprastha University, New Delhi. He was an expert member of the Department of Science & Technology Committee of the Government of India for the scheme of 'Rajat Jayanti Vigyan Sancharak Fellowship'. He is a trustee of the first Indian Standardization Body of India titled 'Global ICT Standardization Forum for India "GISFI" (www.gisfi.org.in). He has organized more than 30 International Workshops and conferences including Kadiloscope, an International Telecom Union event. He has worked on a number of Industry collaborations successfully.

He is currently Trustee and Vice-President of Vishwaniketan, (www.vishwaniketan.edu.in). Vishwaniketan runs an Engineering College, Architecture College affiliated to Mumbai University, and design school with Teesside University UK.

### Title: CGC and expectations of south east Asian universities

"The relevance and importance of CGC vision and activities in south-east Asia will be discussed with examples.

The current scenario of educational and research status in academic institutes, industry especially in India will be elaborated and need of focused CGC effort to transform education from conventional teaching based method to project-based learning and using the same for commercialization of research, startups will be demonstrated.

Policy changes required for improved usefulness of CGC in this region and strategy to work more effectively for expansion will be elaborated".

## SESSION 3: GISFI (Virtual)

## Albena Mihovska

CGC, Department of Business Development and Technology, Aarhus University, Herning, Denmark



Dr. Albena Mihovska is a Senior Research Academic professional. She obtained her Ph.D. in the area of mobile communications from Aalborg University, Aalborg, Denmark in 2009. She is currently an Associate Professor at Aarhus University, Department of Business Development and Technologies (since 2017), where she is with the CTIF Global Capsule (CGC) research group. Her main current activities related to research in the area of 6G enabling technologies and related applications; smart dense connectivity, digitalisation through use of artificial intelligence and Internet of Things technologies in various sectors, such as healthcare, manufacturing, etc.

In addition to her research, Albena Mihovska has active teaching and supervision activities of Bachelors, Masters, and Ph.D. students. She is a Steering Committee Member of IEEE BlackSeaCom and INFORMS Telecommunication Cluster (Vice-President). She has been Workshop Chair of IEEE GLOBECOM 2015 and Tutorial Co-Chair of IEEE GLOBECOM 2019. Associate editor of Int. J. of Mobile Network Design and Innovation (IJMDNI), and Springer International Journal of Wireless Personal Communications. A Member of IEEE (the leading international association for electronic and electrical engineers, www.ieee.org) and INFORMS (the leading international association for Operations Research & Analytics professionals, <u>www.informs.org</u>.)

Albena Mihovska has authored and co-authored more than 170 publications, including peer-reviewed international books, journal and conference publications. She has also co-edited four books on Mobile and Wireless Communications, published by Artech House.

Session Chair

## Tilak R. Dua

GISFI, India



An engineering graduate of 1967 batch from Punjab Engineering College Chandigarh with diploma in Business Management and export Marketing. Have an experience of over 45 years in the telecom sector. Experience includes all facets of telecom be it Product Development, Business Development, Telecom Licensing, Regulatory issues, infrastructure sharing, Spectrum Related Issues, Efficient Utilization and Spectrum reframing, etc. Have also been involved very closely with number of Joint Ventures / Technical Collaborations. Have many first to my credit like finalization of joint ventures, technical collaboration, introduction of new product, launch of cellular services in India and finalization of license agreements / interconnect agreements. Work very closely with institutions like ITU ſUN Body)/APT/WWRF/GISFI with regards to the spectrum matters. Very actively involved with various professional institutions / associations to promote the interest of telecom sector and published many papers in telecom. Presently holding the position Vice Chairman – GISFI. In Feb 2020 was awarded "Amity National Leadership Award" For Industry Commitment Towards Green Technology. In 2010 was awarded the "Evangelist Mobile Infrastructure Award" by Hon'ble Minister of Telecommunication. Published various papers on Important aspects of Telecom sector including infrastructure. Multidisciplinary understanding of the needs of the Telecom sector in the fields live: Technology Selection, Technology Absorption, Technology Up gradation, Resolution of Regulatory issues, Telecom Licensing, Compatibility issues understanding between various technologies.

### Title: THz band for 6G unfolds opportunities and challenges

Abstract: While 5G ensured the mainstream adoption of mmWave spectrum, the need for higher data rates and consequently larger channel bandwidths will necessitate the incorporation of terahertz (THz) and sub-THz spectrum within 6G. At the same time, the opening up of new spectrum bands will also require novel radio designs that can simultaneously sense and communicate over the entire Electro Magnetic spectrum. Among emerging research and development trends in wireless communications, terahertz band (0.1-10 THz) communications have been envisioned as one of the key enabling technologies for the next decade. As of now, the THz band is available in abundance and due to the ultra-wide spectrum resources, the THz band can provide terabits per second (Tbps) links for a plethora of applications, ranging from ultra-fast massive data transfer among nearby devices in Terabit Wireless Personal and Local Area Networks to high-definition video conferencing among mobile devices in small cells.

## Kiritkumar Lathia

GISFI, Belgium



From 1992 to 2008, as Siemens/Nokia, Italy VP – Product Strategy, Standards and Regulations as well as Telecommunications Advisor of Italian Government, led Italian Government positions concerning the ETSI IPR Policy with special focus on SMEs having access to ETSI Essential IPRs.

At European level, Mr. Lathia as Chairman of ICT Standards Board assisted the European Commission to formulate its official positions for RFID, Privacy and Data Protection Principles. At international level, have participated at all management levels of ITU-T and was an active member of ETSI delegation in creation of 3GPP which is now a de-facto standards body for mobile communications. In India, I have been participating in GISFI since its formulation as advisor to Prof. Ramjee Prasad.

### Title: "The dawn of digital Age, Mental Resilience Management"

The coronavirus pandemic has opened a small window into the future digital world modus operandi of many institutions by forcing to work and play digitally with limited human to human contacts and most activities carried out digitally. This sudden lack of human warmth and contacts has led to many mental problems at all age group. With 5G and 6G providing enormous digital capabilities, how do we provide and manage our mental resilience in this new virtual world?

## T. Rama Rao

SRM Institute of Science & Technology, Chennai, India



Prof. Dr. T. Rama Rao is a Professor of Telecommunication Engineering at SRM Institute of Science & Technology, Chennai, India, and has long-standing research experience in Radio Communications. Received PhD degree on "Radio Wave Propagation studies of Fixed and Mobile Communications over Southern India" from Sri Venkateswara University, Tirupati, India.

Earlier, he worked at Aalborg University, Denmark as a Research Professor, at Universidad Carlos III de Madrid, Spain, and at the University of Sydney, Australia, as a Visiting Professor. Prof. Rama Rao received significant funding from the DST, Government of India, to develop high performance millimeter-wave antennas at 60 GHz and associated transceiver circuit for gigabit wireless applications for Defence Research Development Organization (DRDO). He is also working on inter-satellite radio link investigations at millimeter-waves with funding from the Indian Space Research Organization and developing wearable antennas for wearable device applications for DRDO. Recently received funding from DST, GoI under FIST programme to develop Photonic Wireless Communications. He is a member of IEEE, WWRF, IET, ACM, and a Fellow of IETE. So far, he has supervised 12 PhD students and has authored 80+ papers in reputed journals and 100+ in various conferences. His research interests include Antennas & its Applications; Broadband Radio Communication Networks and RF Photonic Communications.

### Title: TeraHertz Wireless Communications

With technological advancements and developments of Terahertz (THz) radiation and associated components are attracting researchers over the globe and gaining momentum due to its benefits over wireless media for various applications of identification, sensing, and tracking in wide variety of fields. Due to its variety of wide applications in areas of semiconductor devices, medical equipment, manufacturing industries, aerospace, defense industries and other public & private application uses. This research talk will provide details of THz frequency spectrum (0.1 to 10 THz) and its needed components for next generation wireless communications.

## Krishna Sirohi

i2TB Research Foundation, India



Krishna is having 32 years of experience of Research & Development in the field of Telecommunication & Defense communication products design. He has established i2TB Research foundation, a Non-for-Profit Indian Company, which is involved in Innovation enabling, Standardization, Research, and high technology competency development. I2TB Research Foundation is nurturing few Technology Startup initiatives in India in the field of ICT emerging technologies and services. As strategic advisor for product definition, engineering, development methodology and business collaborations, he is contributing to some high-technology development organizations in the field of Wireless Technology (5G/4G-LTE Access & Network), Millimeter Wave Technology based product for strategic communication and commercial network applications, Network Security and IOT based systems and solution.

His prior contribution to indigenous R&D projects includes: India's first indigenous Large Capacity Digital Switch at Indian Telephone Industries Limited (ITI); India's first indigenous Command, Control, Communication & Intelligence for Indian Navy Warfare Ship at Bharat Electronics Limited; Established and headed Mobile Technology development division in CDOT; Established (as CTO, VNL) India's first Mobile telecom R&D & Successful Manufacture; Guided complex product development initiatives in the field of network monitoring and cyber security. He is currently active in deep technical issues related to Telecom, Industry- Academia collaboration for Innovation-Research- Standardization, Issues related to high technology Startups & indigenous R&D initiatives, and associated policy interventions. Krishna has an Engineering Master's degree from IISc and B.Sc. (Hons) in Physics from Delhi University.

## *Title: Successful O-RAN is heading to create a democratised opportunity to developers of Small Telecom OEMs/Software Solution Companies*

First disruptive enhancement after Release of Global 5G Standards will be successful evolution of O-RAN. The adoption of O-RAN will disrupt mobile operations business creating an unprecedented environment of innovations and hence will create a democratised opportunity to small telecom OEM/ Software Solution providers. Open and Standardised interfaces between Radio, Baseband, Element Management System (EMS) and Control/Data Planes of DU/CU will create a fertile ground for differentiated operation practice and service offering. Disaggregated software from the hardware will demolish the wall of artificial costing. Open Software will not only create flexibility in KPI management but will boost the Open-Source community. The challenge will be best addressed by smart and thin organisations.

## Vandana Rohokale

SIT, India



Dr. Vandana Baste Rohokale received her B.E. degree in Electronics Engineering in 1997 from Pune University, Maharashtra, India. She received her Masters degree in Electronics in 2007 from Shivaji University, Kolhapur, Maharashtra, India. She received her PhD degree in Wireless Communication in 2013 from CTIF, Aalborg University, Denmark. She is pursuing her postdoctoral study under the guidance of Prof. Ramjee Prasad under Aarhus University, Denmark.

She is presently working as Professor, in Sinhgad Institute of Technology and Science, Pune, Maharashtra, India. Her teaching experience is around 23 years. She has published four books of international publication. She has published 50+ papers in various international journals and conferences. Her research interests include Cooperative Wireless Communications, AdHoc and Cognitive Networks, Physical Layer Security, Digital Signal Processing, Information Theoretic security and its Applications, Cyber Security, Artificial Intelligence, etc.

### Title: Artificial Intelligence: The Heart of Modern Medicine and Healthcare Industry

Artificial Intelligence has touched almost every aspect of human life including marketing, banking, finance, agriculture, gaming, space exploration, autonomous vehicles, chatbots, artificial creativity, mining industry, etc. But it has shown significant importance in the field of medicine and healthcare. The medicine and healthcare industry is becoming smart with machine learning algorithms that can make modern healthcare machines to predict, comprehend, learn and act. There are huge applications of AI in healthcare industries as follows. Efficient diagnosis of diseases with reduction in error rates, early and more accurate cancer diagnosis, patient's symptom checking with the help of chatbot, getting actionable insights with the help of AI deep learning, earlier cancer detection, fast detection of deadly blood diseases is becoming reality with AI. Also with AI, it is possible to develop new medicines, assistants such as radiology assistants can be trained, targeted treatment is possible with the help of deep learning. Better patient experience is observed with AI that allows hospitals to treat more patients in a day. Most repetitive processes in the healthcare industry are being automated with AI. Many operational challenges can be resolved with AI by patient flow optimization, tracking of hospital waiting times, providing fastest ambulance routes in time, increasing access to healthcare in time. Artificial Intelligence is proving to be boon to medicine and healthcare industry with lot of timely blessings.



## Lunch Break



SESSION 4: Invited Talk 1 (Virtual)

## Bhawani S. Chowdhry

MUET, Pakistan



PROF EMERITUS DR BHAWANI SHANKAR CHOWDHRY is Distinguished National Professor and the former Dean Faculty of Electrical Electronics and Computer Engineering at Mehran University of Engineering & Technology, Jamshoro, Pakistan. He did his PhD from the renowned School of Electronics and Computer Science, University of Southampton, UK in 1990.

He is having teaching, research and administration experience of more than 35 years. He has the honour of being one of the editors of several books Wireless Networks, Information Processing and Systems", CCIS 20, Emerging Trends and Applications in Information Communication Technologies", CCIS 281, Wireless Sensor Networks for Developing Countries", CCIS 366, Communication Technologies, Information Security and Sustainable Development", CCIS 414, published by Springer Verlag, Germany. He has also been serving as a Guest Editor for special issue \Wireless Personal Communications" Springer International Journal. He has produced more than 13 PhDs and supervised more than 50 MPhil/Master's Thesis in the area of ICT.

His list of research publication crosses to over 60 in national and international journals, IEEE and ACM proceedings. Also, he has Chaired Technical Sessions in USA, UK, China, UAE, Italy, Sweden, Finland, Switzerland, Pakistan, Denmark, Spain, and Belgium. He is member of various professional bodies including: Chairman IEEE Karachi Section, Region10 Asia/Pacific, Fellow IEP, Fellow IEEEP, Senior Member, IEEE Inc. (USA), SM ACM Inc. (USA). He is a Lead person for four European Commission Erasmus Mundus exchange programs \Mobility for Life", \STRoNG-TiES" (Strengthening Training and Research through Networking and Globalisation of Teaching In Engineering Studies), INTACT (It's Time for CollaboratioNTowArds Close CooperaTion), LEADERS (Leading mobility between Europe and Asia in Developing Engineering educations and ReSearch), and Steering Committee Member CENTRAL (Capacity building and ExchaNge towards attaining Technological Research and modernizing Academic Learning.

### Session Chair

## Debu Nayak

Huawei, India



Dr. Debabrata Nayak has completed his PhD in wireless security from IIT Bombay. And has been working on security domain in the last 21 years. He has been working in Huawei Telecom as Chief Security Officer. Obtained Master's degree from NIT Rourkela, specialized in Elliptic Curve Cryptography and Internet security.

Covering wide areas such as Security system Performance evaluation, Design of secure cryptographic system, Wireless Security policy design and implementation. He designed Security solution for INFINET (Indian Financial Network for RBI). IPv6 migration of INFINET.IPv6 Security for Indian financial network with C-DoT, Leading IPv6 migration and security strategies in Huawei platform development for various products, cloud security, Currently guiding Enterprise security, Consumer security and Mobile broadband security (MBB). Working on privacy of user content. Spoke more than 100 conferences in India and abroad on network security, Information security, Cyber security. He has presented 62 papers in international conferences and technical journals. He was an active member of STIG (DoD). Recently presented 10 Cloud computing security Paper in ITU, CJK Korea, China and various international conference in India. He's currently a founding member in TSDSI cyber security group. And a certified lead Auditor of ISO 27001 :2013 from British standard Institute (BSI).

## Title: Artificial Intelligence the future of technology revolution will improve human mankind

The Full-Stack AI Solution Provides a One-Stop Education & Training Platform Solution Across Device-Edge-Cloud. The Most Powerful AI computing Hardware Provides Computing Power for Academic and Scientific Research. Open Source and Easy-to-Use Hardware/Software Simplify AI Teaching and Scientific Research. Nurturing the AI Talent Ecosystem with Teaching Collaboration and a Joint Marketing System. A Full Series of Ascend Courses on Hardware/Software. Huawei Ascend AI Certification for an Intelligent Future. Incubating Multi-Scenario Teaching Demos Based on Huawei Developer Kits and Third-Party Teaching Tools. Ascend Developer Zone, a Platform to Embrace Millions of Developers in Universities. Suggestions on Teaching Collaboration: Implementation of Theoretical and Practical Courses.

## Walter Weigel

Huawei European Research Institute, Belgium



Dr. Walter Weigel graduated from the Technische Universität München, Germany, with the Diplom-Degree in electrical engineering in 1984 and with the Ph. D. degree (thesis about pattern recognition applied to speech recognition) in 1990. From 1984 to 1991 he was assistant at the Lehrstuhl für Datenverarbeitung (Institute for Data Processing) at the Technische Universität München. Dr. Weigel is since 1st April 2015 VP and CSO of the European Research Institute of Huawei in Leuven, Belgium. He was from September 2006 to July 2011 the Director General of the European Telecommunication Standards Institute ETSI. Between February 1991 and February 2015 he held several positions within Siemens AG, including VP of External Cooperations and Head of Standardization in Corporate Technology, VP of the Research & Concepts-department of the Mobile Networks business unit as well as Head of the business segment Video Processing for the semiconductor business unit (today Infineon).

He is a member of the Innovations Dialog of the German Government, of the BDVA (Big Data Value Association) Board of Directors, of the Senate of Acatech (German academy of technical sciences), of the Board of 5GAA (5G Automotive Association), of the IEEE-SA Board of Governors, of the Digital Manufacturing Executive Council of Digital Europe and of the Advisory Committee of CTIF Global Capsule (CGC) of Aarhus University. He is also lecturer and honorary professor at Technische Universität München.

### Title: A Vision about 6G - for the Aarhus University 6G Knowledge Lab Opening

The presentation will introduce a vision how a future 6G-network may look like. It will start with applications and their requirements & challenges, which may lead to such a system. Then it will show different potential technologies which can be seen as potential corner stones for such a network. It will also cover how AI can be used in radio communications and a view on "coreless" network architectures. Finally, a view about future global standardization will be provided.

## Md. Farhad Hossain

BUET, Bangladesh



*Md.* Farhad Hossain received his Ph.D. from the School of Electrical and Information Engineering, The University of Sydney, Australia in 2014. He completed his B.Sc. and M.Sc. in Electrical and Electronic Engineering (EEE) from Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh in 2003 and 2005 respectively. Currently, he holds a position of Professor in the Department of EEE, BUET. He also works as an electrical and electronic engineering consultant.

Dr. Hossain has published over 80 peer reviewed articles in highly prestigious journals and conference proceedings. He was the recipient of the Best Paper Award in three international conferences and the Student Travel Grant in IEEE Global Communications Conference (GLOBECOM), Anaheim, CA, USA, 2012. His research interests include mobile cellular networks, IoT/M2M communications, smart grid communications, wireless sensor networks and underwater communications. He has been serving as TPC member and reviewer in many international journals and conferences.

### Title: 6G: Performance Enhancement from 5G and Enabling Technologies?

Since the inception of wireless mobile cellular communication system, it has been transforming the world and our lives in an unprecedented way. The latest 5G technology will surely continue the legacy of cellular networks and change the world at an accelerated pace over the coming decades. 5G will support the sheer flexibility of roaming freely with our communication devices, provide connectivity anywhere anytime, allow faster deployment of networks in any disaster hit area; assist mission- and time-critical operations for both civilian and military applications, facilitate the 4th industrial revolution and so forth. However, 5G will not be sufficient to support future explosive data demand and various emerging applications, some of which have already been identified by the industries and the academia. Consequently, a growing number of industry forums and researchers have initiated their activities on the development of the next generation 6G cellular networks. This talk will take a holistic approach and discuss the performance enhancement requirements to migrate from 5G to 6G. Some potential use cases as well as enabling technologies for materializing 6G cellular networks will also be focused.

## **Muhammad Aamir**

SSUET, Pakistan



Dr. Muhammad Aamir was born in Karachi Pakistan, on July 3, 1976. He received MS degree in Electronic Engineering (with specialization in Telecommunication) in 2002 and BS in Electronic Engineering in 1998. He accomplished his PhD in Electronic Engineering from Mehran University of Engineering & Technology. During his PhD studies, he accomplished his research work at the University of Malaga under Erasmus Mundus Scholarship.

He has authored and co-authored around 50 research papers and book chapters published in various journals, books and conferences of international repute. He is a life member of Pakistan Engineering Council and professional member of IEEE for last 12 Years. He was awarded with a grant by the Ministry of Education Spain to teach at the University of Malaga which he successfully availed in May 2012. He is also Member of two separate National Curriculum Revision Committees constituted by Higher Education Commission (HEC) for revision of Electronic Engineering Curriculum and Telecommunication Engineering Curriculum at the National Level. He was served as guest editor for special issue of Springer's Journal with title "Wireless Personal Communication" which had published in November 2016. He is also HEC approved supervisor for PhD candidates in Pakistan. He is currently associated with Sir Syed University of Engineering & Technology as Professor and Associate Dean in the Faculty of Electrical & Computer Engineering.

Additionally, he is also Editor-in-Chief of Sir Syed University Research Journal of Engineering & Technology which is a HEC-Recognized Research Journal published bi-annually.

## *Title: Role of Universities in Implementing Green ICT for achieving Sustainable Development Goals (SDGs)*

In this talk, a framework is introduced for implementing Green ICT for achieving Sustainable Development Goals (SDGs) with the help of Universities aiming to focus on the sustainable green environment. The SDG plan includes an extensive range of interconnected challenges which are mostly related to social, economic, and environmental factors. Therefore, the unique functions and expertise of universities are a significant avenue for overcoming all of these where special focus is the impact of Green ICT. Perhaps the SDGs will not be achieved without the education sector. The talk will highlight key roles for universities in the form of teaching and learning, research, organizational governance, culture and operations which can support the significant role of ICT in achieving SDGs.

### **Bharat Gupta**

NIT Patna, Bihar, India



Dr Bharat Gupta has been involved in the field of education and research for the last seventeen years. He is a senior member of IEEE (USA). Dr. Gupta did his graduation in 2000 and post-graduation in 2003. He did his doctorate from University of Rome, Tor Vergata, Italy in the year 2011. He got the Indian Young Research award from the Ministero dell' Istruzione, dell' Università e della Ricerca (MIUR), Italy. Presently, He is working as an Associate Professor in Department of Electronics & Communication Engineering, National Institute of Technology Patna, Bihar. Since 2016, he is the Professor-In-Charge of Incubation Centre, NIT Patna and Nodal officer for Bihar startup at NIT Patna.

Dr. Gupta is the Chief Investigator for the project "Scheme for Financial Assistance for setting up of Electronics and ICT Academies" at NIT Patna sponsored by the Ministry of Electronics and Information Technology (MeitY), Govt. of India. He has delivered many talks in International & National conferences and workshops. He has published more than 65 papers in International and National Journals and conferences. He is the reviewer of many International journals. He has organised the workshops at national and international level. His research area covers mainly Wireless Body Area Network, Routing and MAC protocol for Medical Wireless Communication, ICT for Health care, Internet of Thing (IoT), Medical IoT (MIoT), FM-UWB communication technology, Machine Learning.

#### Title: 3D Deployment in Wireless sensor network: A future perspective view

Recent advancement in terms of technology and its real world application, Wireless Sensor Network (WSN) has made a special niche for itself. Worldwide forecasts indicate that the size and population of cities will increase further. This immense growth will put a strain on resources and pose a major challenge in many aspects of everyday life in urban areas, such as the quality of services in the medical, educational, environmental, transportation, public safety, and security sectors, indicatively. WSN offers a variety of applications and solutions. To process the extracted data and transmit it to the various location, a large number of nodes must be deployed in a proper way because deployment is one of the major issues in WSNs. However, the 3D Deployment of WSN is one the prominent way to achieve the envisaged goal. To have an optimum performance a trade-off is required between the power consumption and the percentage of area covered. To have an optimum coverage node are expected to be placed in such a way that maximum area is covered with minimum number of nodes.



# Coffee Break



## CGC – 6G Knowledge Lab Opening



### **Ramjee Prasad**

Founder President, GISFI Founder President, CTIF Global Capsule Professor, Department of Business Development and Technology, Aarhus University, Herning, Denmark



Dr. Ramjee Prasad is a Professor of Future Technologies for Business Ecosystem Innovation in the Department of Business Development and Technology, Aarhus University, Denmark. He is the Founder President of the CTIF Global Capsule (CGC). He is also the Founder Chairman of the Global ICT Standardisation Forum for India, established in 2009. GISFI has the purpose of increasing of the collaboration between European, Indian, Japanese, North-American and other worldwide standardization activities in the area of Information and Communication Technology (ICT) and related application areas.

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 Honorary Professor of University of Cape Town, South Africa, and University of KwaZulu-Natal, South Africa.

He has received Ridderkorset af 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 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 Project Coordinator of several EC projects namely, MAGNET, MAGNET Beyond, eWALL and so on.

He has published more than 30 books, 1000 plus journal and conference publications, more than 15 patents, over 100 PhD Graduates and larger number of Masters (over 250). Several of his students are today worldwide telecommunication leaders themselves.

#### Lab Opening Message

### **Andres Frederiksen**

*Head of the Department of Business Development and Technology, Aarhus University, Herning, Denmark* 



Andres Fredriksen is a professor in Econometrics and Business Economics and He is the Head of Department at Aahus University, Denmark. His professional experience includes: 2015 EU expert (Evaluator), FP7 & Horizon2020 2013 EU expert (Rapporteur), FP7-PEOPLE-2013-IEF-IIF- IOF 2009 - 2012 Associate Professor in Business Performance Management (tenured) 2011 EU expert (Rapporteur), FP7-PEOPLE-2011-IEF-IIF-IOF 2006 – 2009 Marie Curie Postdoctoral Researcher, Aarhus and Stanford University 2002 – 2005 Graduate Student, Aarhus University.

He has a remarkable teaching experience in Statistics/Econometrics; Undergraduate/Master's Program HR analytics, Master's Program; Personnel Economics, Master's Program; Human Resource Management, Master's; Program Leadership, Master's Program; Labour Economics, Undergraduate/Master's Program Applied Economic Consulting; Master's Program Supervision: Phd, Master's and Bachelor's levels.

His flourishing achievements includes, 2008 Tietgenprisen; 2005 – 2007 W. Glen Campbell & Rita Ricardo Campbell National Fellow, Hoover Institution, Stanford University; 2003 – 2004 Leschly Fellowship, Princeton University 2001 Tuborgprisen.

Opening of the 6G Knowledge Lab and Commencement Speech

### Ambuj Kumar

Department of Business Development and Technology, Aarhus University, Herning, Denmark



Ambuj Kumar, is presently working in the Department of Business Development and Technology (BTECH) since February 2017. He has more than 19 years of experience in working with Industries and academia. He received the Bachelor of Engineering in Electronics & Communications from Birla Institute of Technology (BIT), Ranchi, India in the year 2000. As a part of the Bachelor programme, He carried through Internship Training in 1999 at the Institut für Hochfrequenztechnik, Technical University, (RWTH), Aachen (Germany). He worked at Lucent Technologies Hindustan Private Limited, a vendor company, during the period 200-2004. His major responsibilities were the Mobile Radio Network Design, Macro and Microcell planning, and Optimization for the GSM and the CDMA-based Mobile Communication Networks. There, he was involved in pan-India planning and optimizing the MCNs of various service providers for both the green field and the incumbent deployments. During the period 2004 to 2007, he worked with Hutchison Mobile Services Limited (now Vodafone), a service provider company, where he was involved in planning, deployment, and optimization of the Hutch's rapidly expanding GSM and Edge networks across India. Afterwards, he joined Alcatel- Lucent, New Delhi, India in 2007 and continued until 2009. He worked in Network Presales Department and contributed to network rollouts for various pan-India service providers. He worked for three months in the year 2009 as Research Associate at the Centre for TeleInFrastruktur (CTIF), Department of Electronic Systems, Aalborg University, and his research area was on 'Identification of Optimization parameters for Routing in Cognitive Radio'. Post the research associate experience, he worked as a Collaborative Researcher at the Vihaan Networks Limited (VNL), India. He utilised the Research Associate experience to conceptualized innovative ideas and methods at VNL; there he developed test-bed facilities for experimental studies on 'Advanced Alternative Networks'.

He 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 2012. During 2015 to 2016, he was working as Research Assistant in the eWall Project, funded by the European Commission, at the Faculty of Science and Engineering (Department of Electronic Systems). In December 2016, he was awarded the Ph.D. degree from the Faculty of Engineering and Science, Dept of Electronic Systems Aalborg University, Denmark.

#### Brief Description of the 6G Knowledge Lab

### Peter Lindgren

Professor, Multi-Business model and Technology Innovation Aarhus University, Herning, Denmark



Professor Peter Lindgren holds a full Professorship in Multi-business model and Technology innovation at Aarhus University – Business development and technology innovation and has researched and worked with network-based high-speed innovation since 2000.

He is an author of several articles and books about business model innovation in networks and Emerging Business Models. He has been a researcher at Politecnico di Milano in Italy (2002/03) and Stanford University, USA (2010/11). In 2007 – 2010 been the founder and Center Manager of the International Center for Innovation <u>www.ici.aau.dk</u> at Aalborg University. He works today as a researcher in many different multi-business model and technology innovations projects and knowledge networks among others E100 -<u>http://www.entovation.com/kleadmap/</u>, Stanford University project Peace Innovation Lab <u>http://captology.stanford.edu/projects/peace-</u> innovation.html, The Nordic Women in the business project - <u>www.womeninbusiness.dk/</u>, The Center for TeleInFrastruktur (CTIF) at Aalborg University <u>www.ctif.aau.dk</u>, EU FP7 project about "multi-business model innovation in the clouds" - <u>www.Neffics.eu</u>. He is co-author of several books. He has an entrepreneurial and interdisciplinary approach to research and has initiated several Danish and international research programs.

*His research interests are the multi-business model and technology innovation in networks, multi-business model typologies, and new global business models.* 

Vote of Thanks

## SESSION 5: Keynote Session 1 (Virtual)

### **Ramjee Prasad**

Founder President, GISFI Founder President, CTIF Global Capsule, Professor, Department of Business Development and Technology, Aarhus University, Herning, Denmark



Dr. Ramjee Prasad is a Professor of Future Technologies for Business Ecosystem Innovation in the Department of Business Development and Technology, Aarhus University, Denmark. He is the Founder President of the CTIF Global Capsule (CGC). He is also the Founder Chairman of the Global ICT Standardisation Forum for India, established in 2009. GISFI has the purpose of increasing of the collaboration between European, Indian, Japanese, North-American and other worldwide standardization activities in the area of Information and Communication Technology (ICT) and related application areas.

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 Honorary Professor of University of Cape Town, South Africa, and University of KwaZulu-Natal, South Africa.

He has received Ridderkorset af 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 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.

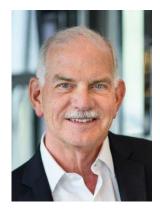
He has been Project Coordinator of several EC projects namely, MAGNET, MAGNET Beyond, eWALL and so on.

He has published more than 30 books, 1000 plus journal and conference publications, more than 15 patents, over 100 PhD Graduates and larger number of Masters (over 250). Several of his students are today worldwide telecommunication leaders themselves.

#### Session Chair

### **H. Vincent Poor**

Princeton University, USA,



H. Vincent Poor is the Michael Henry Strater University Professor of Electrical Engineering at Princeton University, where his interests include information theory, machine learning and network science, and their applications in wireless networks, energy systems and related fields.

He is a member of the U.S. National Academy of Engineering and the U.S. National Academy of Sciences, and a foreign member of the Chinese Academy of Sciences and the Royal Society. Recognition of his work includes the the 2017 IEEE Alexander Graham Medal, and honorary doctorates from universities in Asia, Europe and North America, including from Aalborg University in 2012.

#### Title: Physical Layer Security: Security for 6G

Emerging networking paradigms, such as the Internet of Things, pose security challenges due to their dynamic and decentralized nature and their composition of very large numbers of low-cost and low-complexity devices. Physical layer security can address these challenges by taking advantage of the inherent randomness of wireless communication channels and/or the unclonability of hardware fabrication processes, to harvest entropy and deliver authentication, confidentiality, message integrity, and privacy in such demanding scenarios. This talk will provide a brief overview of the motivation for this approach, and some of its information theoretic foundations.

### Walter Konhäuser

Oktett64 GmbH, Germany



Prof. Dr.-Ing. Habil. Walter Konhäuser was born in Ruhpolding, South Germany.He studied electrical engineering at the Technical University in Berlin and finalized with PhD. In 2007 he was appointed Professor for Mobile Communication Systems at Technical University Berlin. Since joining Siemens in 1982 he has been involved in a variety of assignments. For eighteen years he has worked in the mobile networks business and was CTO within the mobile infrastructure business of Siemens. In 2004 he became President for the WLAN business with worldwide business responsibility. Since 2010 he has worked as an independent professional as Executive Consultant with ITCcon GmbH, Potsdam and as Senior Consultant at Xiopia GmbH, Unterföhring. In 2013 he became Partner at Hoseit-Unternehmensberatung and 2017 associate Partner at Management Consultant Kastner GmbH & Co.KG. Since 2019 he is co-founder and General Manager of Oktett64 GmbH. The company is working on a decentralized energy management concept for digitalization in different industries based on vendor independent turnkey solutions, on standards and Open-Source frameworks including security and operation concepts.

Prof. Dr. Konhäuser was PCC chairman of the European ACTS FRAMES Project and Board Member of the Wireless World Research Forum (WWRF). He is a member of the VDE, the German Association of Electrical Engineers and is Spokesman of the regional VDE organization in Berlin and Brandenburg.

#### Title: From 5G technology to 6G Green Deals

The political policies have changed dramatically during the last years. Topics of conversations are Green Deal, Digitalization, Cyber Security, Industry 4.0 and Economic contributions to create new business and new jobs. The deployment of decentralized energy production e.g. PV-Systems on the roof or CHP's in the cellar of buildings is an important Green Deal. Another important point is to deploy communication network coverage for digitalization of the real estates for long-range, low-rate, low-power, low-cost managed services, ultra-reliable lowlatency communication for industry applications and high speed links for entertainment services. Local data generation and distribution processes from sensors, actuators and meters use suitable radio technology as e.g. Bluetooth LE, ZigBee, EnOcean, Z-Wave, KNX-RF. Data transmission to communication network Cloud Servers, where the applications can be deployed, should be managed by local transmission gateway platforms with fast links to different IoT radio technologies. For better monitoring, control and metering sensors, actuators, meters, communication technology and distributed real-time computing platforms (gateways) will be key technologies to monitor, control and meter the various electric equipment and system state parameters critical for determination of the digital applications. *This captured information will be used as input for many types of model predictive algorithms* (e.g. AI) whose output supports decisions to achieve the goals of the future. The talk will present a proposal for a gateway platform and some examples of future digital applications supported by future mobile communication systems.

### Sudhir Dixit

Skydoot, Inc , USA



Dr. Sudhir Dixit is a Co-Founder, Senior Fellow and Evangelist at the Basic Internet Foundation in Oslo, Norway, and heads its US operations. He is also associated with the Academy of Finland Flagship Programme, 6Genesis, led by the Centre for Wireless Communications, University of Oulu, Finland and the CTIF Global Capsule at Aarhus University, Denmark. From 2015 to 2017 he was the CEO and Co-Founder of a start-up, Skydoot, Inc. From 2009 to 2015, he was a Distinguished Chief Technologist and CTO of the Communications and Media Services for the Americas Region of Hewlett-Packard Enterprise Services in Palo Alto, CA, and the Director of Hewlett-Packard Labs India in Palo Alto and Bangalore. Before joining HP, he held various leadership positions at BlackBerry, Nokia, NSN and Verizon Communications.

He has been a technical editor of IEEE Communications Magazine, and is presently a Board Member, Working Group Chair and Vice Chair for America at the Wireless World Research Forum (WWRF). He was on the editorial board of IEEE Spectrum Magazine, and is presently on the editorial board of Springer's Wireless Personal Communications Journal. He is a Co-Chair of the Industry Engagement Committee of the IEEE Future Network Initiative and is on its Industry Outreach Board (IOB).

Dr. Dixit has published eight books, holds 21 U.S. patents and published extensively in numerous peer-reviewed journals and conferences. In 2018, he was appointed a Distinguished Lecturer by the IEEE Communications Society. From 2010 to 2012, he was an Adjunct Professor of Computer Science at the University of California, Davis, and, since 2010, he has been a Docent at the University of Oulu, Finland. A Life Fellow of the IEEE, Fellow of IET and IETE, Dixit holds a Ph.D. from the University of Strathclyde, Glasgow, U.K. and an M.B.A. from the Florida Institute of Technology, Melbourne, Florida.

## *Title: Omnipresent Knowledge Creating a New World Order: The Power of Internet, the Web and the Mobile!*

This talk focuses on the democratization of the world enabled by the web, access to the Internet and crowd sourcing of the content (i.e., knowledge). There are many business models in the play. presenting vast opportunities to the "would be entrepreneurs" and disrupt the current market. We present the drivers for these opportunities, what needs to happen, and what technologies would dominate its enablement. We believe Virtual CGC 6G Knowledge Laboratory offers boundless opportunities for competence development, research in business models, and development of applications and services that would potentially dominate the world order about 10 years from now.

### Mahbubul Alam

DIMAAG-AI, Inc. USA



A frequent author, speaker, and multiple patent holder, Mahbubul Alam has developed a reputation as an executive who drives quick change and achieves success. He is currently Chief Marketing and Business Development Officer of DIMAAG-AI, Inc. DIMAAG-AI provides adaptive self-healing advanced AI-platform and solutions for industries and service providers. DIMAAG-AI's mission is to democratize "AI-for-Everything". Alam is also CEO of SmartAvatar and VehicleAvatar doing business as TrustedMobi. SmartAvatar provides an intelligent trusted digital services platform for the Internet of Things (IoT) and TrustedMobi provides a trustworthy mobility service platform for the transportation industry.

He began in the mobile technology arena, later working in a variety of business development and market intelligence capacities in Cisco's Netherlands operation. Having developed a solid name in the company for far-sighted, winning strategies, he was brought to Silicon Valley to head up Cisco's Internet-of-Things (IoT) and Machine-to-Machine (M2M) platforms in 2012. After coming to California, he proceeded to create a series of now-renowned products and businesses at Cisco. The flagship 4G LTE multi-service router, the IoT edge-cloud gateway, the next-generation Integrated Services Router (ISR), Enterprise Mobility Solutions, and more. Alam grew the company's M2M business from nothing to \$350 million in four years. Along the way, he also helped initiate the company's smart connected car roadmap and created several successful internal startups, such as IoT vertical solutions for the transportation, manufacturing, and mining industries.

#### Title: 6G will Unlock the Power of "AI-for-Everything

We envision 6G to offer revolutionary transformation which will usher in an era of connected built-in intelligent applications, services, and networks that will auto-provision end-to-end systems to guaranteed quality of services for an agreed service level agreement, ultra-highspeed data rate, surpassing that of last-mile wired connectivity, perceived zero-latency & deterministic jitter for human safety and mission-critical applications, extremely high reliability for essential services, high spectrum-bands for haptic, holographic, extensive multimedia streaming and more, connected artificial intelligence for autonomous functions and future unknown use cases, etc. 6G will be a key enabler for equitable wealth distribution and a major driver for the green economy. It will unleash the full potential for Industrial Revolution IE 5.0 which will focus on the co-operation between human and machine, as human intelligence works in harmony with cognitive computing and machines perform mundane, repetitive, error-prone tasks. By putting humans back into industrial production with 6G enabled collaborative robots a.k.a Cobots, workers will be upskilled to provide valueadded tasks in production such as setting the strategy, provide oversight and add creative input, leading to massive customization & personalization for customers. In this talk, we will examine the state of AI and its potential role in 6G.



## End of the First Day



Access to the second se

# Second Day

1



## SESSION 6: Keynote Session 2 (Virtual)

### **Pawan Garg**

GISFI, India



*Mr.* Pawan Garg has more than 50 years of experience in RF spectrum management and wireless communications – terrestrial as well as satellites. He was with India's national spectrum management organization for almost 37 years and was heading the Organisation for more than 6 years. During his period as head of the organisation, Indian cellular network underwent exponential growth of subscribers – from 1 Million to 250 Million.

He has been participating in various fora of ITU, Geneva for more than 40 years and was Indian Councillor on ITU's Governing body for 6 years. He was internationally elected Member of the prestigious Radio Regulations Board of ITU for 8 years and was elected its Chairman for 2013. These have provided him extensive insight in all types of wireless services.

Session Chair

### Kwang Cheng Chen

University of South Florida, USA



Kwang-Cheng Chen has been a Professor at the Department of Electrical Engineering, University of South Florida, since 2016. From 1987 to 2016, Dr. Chen worked with SSE, Communications Satellite Corp., IBM Thomas J. Watson Research Center, National Tsing Hua University, HP Labs., and National Taiwan University in mobile communications and networks. He visited TU Delft (1998), Aalborg University (2008), Sungkyunkwan University (2013), and Massachusetts Institute of Technology (2012-2013, 2015-2016).

He founded a wireless IC design company in 2001, which was acquired by MediaTek Inc. in 2004. He has been actively involving in the organization of various IEEE conferences and serving editorships with a few IEEE journals (most recently as a series editor on Data Science and AI for Communications in the IEEE Communications Magazine), together with various IEEE volunteer services to the IEEE, Communications Society, Vehicular Technology Society, and Signal Processing Society, such as founding the Technical Committee on Social Networks in the IEEE Communications Society. Dr. Chen also has contributed essential technology to various international standards, namely IEEE 802 wireless LANs, Bluetooth, LTE and LTE-A, 5G-NR, and ITU-T FG ML5G.

He has authored and co-authored over 300 IEEE publications, 4 books published by Wiley and River (most recently, Artificial Intelligence in Wireless Robotics, River, 2020), and more than 23 granted US patents. Dr. Chen is an IEEE Fellow and has received a number of awards including 2011 IEEE COMSOC WTC Recognition Award, 2014 IEEE Jack Neubauer Memorial Award, 2014 IEEE COMSOC AP Outstanding Paper Award. Dr. Chen's current research interests include wireless networks, artificial intelligence and machine learning, IoT/CPS, social networks and data analytics, quantum photonic computing and communications, and cybersecurity.

#### Title: Wireless Multi-Robot Systems in Smart Factories

Industry 4.0 based on artificial intelligence and information communication technology emerges as a primary contributor to the digital economy and Internet of Things. In order to execute flexible production, smart manufacturing must holistically integrate 6G wireless networking, AI computing, and automatic control technologies. This talk explores the challenges of this complex system engineering scenario, from a wireless networked multirobot system perspective. Starting from enabling flexible re-configuration of a smart factory, we discuss 6G wireless technology and the trends of wireless networking evolution to facilitate multi-robot smart factories. Furthermore, the special sequential decision-making of a multi-robot manufacturing system is examined. Social learning can be used to extend the resilience of precision operation in a multi-robot system by taking network topology into consideration. This talk finally summarizes 6G technological opportunities for smart factories and Industry 4.0.

### Anand R. Prasad

Wenovator, Japan



Dr. Anand R. Prasad is a global executive for information- and cyber-security who has delivered security solutions for 5G, 4G, network function virtualization, SOC, WiFi, mobile devices, enterprise and GRC processes from scratch for secure connectivity towards a safer society. Anand has globally propagated the concept of security as the business driver with security being holistic as well as inherent to a system while considering business and architectural implications.

Anand is Founder and CEO of Wenovator LLC, a global provider of cybersecurity services and consulting with top-tier clients right across the telecommunications industry. He is also a Senior Security Advisor of NTT DOCOMO, providing advice on all aspects of cybersecurity for the company, Advisor to CTIF and Advisor to GuardRails. Prior to which Anand was Chief Information Security Officer, Board Member, of Rakuten Mobile, the world's leading MNO with the very first cloud-native 4G & 5G network implementation. As CISO of Rakuten Mobile Anand led all aspects of enterprise and mobile network security from design, deployment to operations. With over 20 years of experience, Anand has also held key roles in NEC, Genista, Lucent Technologies and Uniden. He is an innovator with over 50 patents, a recognized keynote speaker (RSA, GWS, MWC, ICT etc.) and a prolific writer with 6 books and over 50 peer reviewed publications. Anand was the Chairman of 3GPP SA3 where, among others, he led the standardisation of 5G security. He was governing council member of TSDSI, is governing body member of GISFI, Fellow of IET, Fellow of IETE and Certified Information Systems Security Professional (CISSP). Anand is Editor-in-Chief of the Journal of ICT Standardization and Co-Founder as well as Co-Editor of the Cybersecurity Magazine. He did his ir (MScEE) and PhD from Delft University of Technology, The Netherlands.

#### Title: Crystal Ball: What will be 6G? How about security?

Technology enhancements have brought us to an era of digitalization and connectivity to the credit of 5G. Resulting in further increase in the pace of technology enhancements which in turn will form the basis for 6G. In this talk we will ask the crystal ball what 6G will look like and how as well as what security considerations should be taken with regard to 6G.

### Steve Kim

Huawei, India



Mr. Kim comes with a rich experience of 20+ years of enabling business across industries through technology. He has been instrumental in enabling businesses to envision and devise their digital transformation strategy, and realize it with utmost seamlessness. Having previously served at various key management positions in Huawei, he has been the driving force behind Huawei's growth and numerous success stories.

By leveraging his vast expertise and experience in cloud computing and the new age digital technology domains, he now spearheads the Cloud & AI Business Group for Huawei India as its President. An eminent speaker holding an ocean of valuable knowledge, Mr. Kim cherishes being a part of thought-provoking discussions and sessions on modern technologies such as Cloud, AI, Machine Learning, and many more. He truly believes that empowering the youth with knowledge and information, and providing them with platforms and channels to learn and hone their technology expertise, is the key to a better future.

#### Title: Huawei Artificial intelligence collaboration helping technology ecosystem

- Huawei Global R&D Commitment and Anti-COVID-19 Partner through AI
- Huawei India' commitment for Research and National AI strategy
- Huawei AI commitment for cooperation and synergy with our AI products.
- Huawei is working towards making AI more inclusive making it affordable, effective, and reliable for all. Huawei will provide economical, yet powerful, AI computing power, enhance products and solutions, and provide Atlas series intelligent computing service, lossless networks, and storage devices for the industry.

SESSION 7 (a): GISFI (Virtual)

### **Kishore Kumar Thakur**

IETE University Ranchi, India



Kishore Kumar Thakur, FIETE (b.17.2.1960) is Hon. Director (Admin.), IETE University, Ranchi, Jharkhand, India and also the Chairman, IETE Ranchi Centre. He recently retired as the Chief General Manager Telecom, Jharkhand Circle in February 2020. He obtained his B. Tech. (Electronics and Communications Engg.) from BIT Sindri in 1983 and MBA (Marketing) from BR Ambedkar Open University, Hyderabad in 2009.

Currently pursuing PhD under the supervision of Ramjee Prasad, Professor, Future Technologies for Business Ecosystem Innovation, Aarhus University, Herning, Denmark. Possesses 35 years of work experience. Served as Assistant Computer Engineer in TISCO Jamshedpur. Worked in Bharat Sanchar Nigam Ltd, Department of Telecommunications for the last 33 Years, mostly in Hyderabad Telephones. Worked with all technologies, namely manual exchanges, strowger, cross-bar, E10B (Local/ Tax), C-DOT, System-X, EWSD, OCB, 5ESS, LG (CDMA) and GSM. Associated with development works during the periods of major technological changes. Worked for one year as DGM in Nagaland in 2002-2003. Served as GMTD, at Cuddapah and Warangal, districts and as GM (Marketing), AP Circle Hyderabad incharge of sales and distribution, franchisee management, marketing and PR activities.

Also, he worked as GM (Mobile), J&K Circle for 2 years and as GM (Projects) Hyderabad for two years. Attended workshops, seminars and training on switching, transmission, mobile and management courses. Also attended comprehensive Lucent Technology training in the USA on 5ESS switch. Leading a balanced life with Sahaj Yoga Meditation and advising others also the same.

Session Chair

### Aaloka Anant

CGC and SAP Ireland



Aaloka is an innovation pioneer. He represents the millennial generation, who do not take things as they are and believe in bringing the change. Aaloka has over 16 years of experience in Business Process Consulting and software development in roles as Development lead, Enterprise Architect, Principal Consultant, Program Manager, Project manager and Senior Business Analyst.

His passion is to enable companies on making their journey to ethically adopt new technology and make their business Run Better. IIM Bangalore – Post Graduate in Enterprise Management 2010.

#### Title: Privacy preservation of data in a multi-party exchange

Quality real-world data is the foundation on which valuable information and intelligent insights can be constructed. The availability of real-world data is therefore imperative for the development of solutions which rely on intelligent insights based on historical or contemporary data. A significant development in the current times is the development of solutions based on machine learning, artificial intelligence etc. Data is generated and stored in various forms by government bodies, corporates and individuals. The data may contain either public or personal information. Sharing of information between these parties has helped the evolution of commercial business models. It has helped governments to plan better for their citizens. And it has also helped the rapid growth in our focus topic – the development of software solutions for Enterprise. This data exchange between different parties, must adhere to privacy preservation regulations, in order to respect the privacy of persons whose data is stored by the parties. The data is usually stored with consent from the persons for specified purposes only, primarily guided by terms of use in the form of a contract. The simplest way to preserve privacy is to use anonymization, but true anonymization depletes the information content of the data and compromises the utility of data. Therefore, it's a challenge to ensure that data carrying personal information is anonymized without losing its utility for a given purpose. In our research we propose a method for the exchange of anonymized data between different parties, where the shared data is fully anonymized but still has the utility for a given usage such as collaboration in clinical trials, financial fraud detection, training of machine learning software and so on.

### Sriganesh Rao

Calligo Technologies, India



Sriganesh Rao is an ICT Professional with more than 3.5 decades of global experience in leading complex technology projects with a rich background in Engineering, Business development, QA & Program Management in Telecom, Government & Defence verticals across Embedded, Engineering Services, Testing and Manufacturing horizontals. His experience spans across leading IT organizations like Tata Consultancy Services & IBM, Telecom Service Providers like OPTUS (Australia) & TATA Teleservices, Telecom OEMs like Bharat Electronics, United Telecoms & ERG (Australia) and Telecom OSS/ BSS Providers like Alopa Networks. Currently, he is the Managing Director of Calligo Technologies, a Data Science company at Bangalore. He received his M. Tech (Electronics) degree from NITK Surathkal and MBA (Technology Management with focus on International Telecommunication Management) from Deakin University in Australia. Sriganesh's current interests include 5G, M2M, IoT, Smart Cities, Industries 4.0, Business Model Innovation and Big Data Analytics.

He has served as the Chairman of 'M2M Gateway & Architecture' Workgroup setup by DoT (TEC). He is Member of the National Working Group of DoT (TEC) for IoT and its application in Smart Cities. He was also the Vice Chair of the Consultative Committee for the adoption of OneM2M Standards by TEC as National Standards. He is a Senior Member of IEEE, Senior Member and Certified Professional of Australian Computer Society, Life Member of Computer Society of India. He is also the President of Australian Alumni Association and Ambassador of Deakin University Alumni at Bangalore.

#### Title: "Data-driven Business Model Innovation for 6G"

Futuristic disruptive technologies like 6G could further transform the way we live and work, beyond what was enabled by 5G. 6G is expected to provide features beyond 5G, like furtherenhanced to full-broadband FeMBB), advanced ultra-reliability low latency of less than 1mSec, ultra-fast edge connectivity etc, which could potentially open up doors to new opportunities in various domains. Business models describe the rationale of how an organization creates, delivers, and captures value. Evolving consumption patterns, advent of social media and emerging opportunities in new sectors fuelled by 6G Technologies, would create a need to innovate new Business Models. Business leaders need to consider their potential before they begin to exert their disruptive powers in the economy and create new Business Models to fully monetize the features enabled by these technologies. The talk would include discussion on crystal gazing the new busines opportunities made possible by futuristic 6G networks; Various possible Business Models that businesses could adopt to meet their strategic objectives; Importance of harnessing 'Real-time Data" to create value.; Role of "Data-driven Business Model Innovation" in creating sustainable business.

### Satya N. Gupta

BLUETOWN, India



An International expert in NGN technologies, Regulation, Interconnection and Broadband with 40 years' experience in all aspects of Telecom, including 25 years with Govt. and Regulator, Satya N. Gupta is publicly recognized as an Analyst, Author, Advocate and Advisor on ICT related Policies, Projects and Business. After his post-graduation from IISc. In Bangalore, he joined the Ministry of Communication in 1981 and the Ministry of Railways in 1983. He is recipient of the Minister of Railways award for outstanding performance for the digitalisation project. A triple master in Electronics Design Technology, IT Management and Telecom Policy and Regulation, he is globally known as "NGNguru" he is a trainer and coach for telecommunication technologies, policy and regulation and a Regulatory advocate. Author of "Everything over IP-All you want to know about NGN". He also authored a concept called "Job Factory- Converting Unemployment into Entrepreneurship". His recent research-based work, "Long Tail - Walking the Extra Mile on Rural Broadband Business", brings out the innovative business models for rural broadband connectivity. He has also established and mentoring a consulting startup named SAAM CorpAdvisors providing Govt. Affairs as Managed Service. He is Honorary Secretary General of ITU-APT Foundation of India.

Additionally, he is Vice-President and Trustee of PTCIF and Co-chairs BIF committee on Rural Digital Infrastructure. He founded NGN Forum in India to spread awareness and capacity building in the field of emerging technologies. As a member of the Expert panel of Commonwealth Telecom Organisation, he conducts training programs in the areas of NGN Technologies, Broadband Policy and Regulation, Interconnection Costing in NGN Era, Spectrum Management, IPV6, Artificial Intelligence, Blockchain and Blue-Ocean Strategy. He is the first Indian recipient of IPv6 Hall of Fame – 2019 by Global IPv6 Forum and also the Chairman of India IPv6 Council. Presently, he is working as Chairman, BLUETOWN, India & BIMSTEC, S. Asia to forge newer partnerships and "Making It Happen" its Vision of "Connecting the Unconnected people living in Rural areas of World".

#### Title: FRUGAL 5G - Bringing Broadband Faster to Rural Areas

As part of Digital India mission of the government to make "Broadband for All " a reality in the near future, there is a great buzz about Wi-Fi everywhere especially in urban areas wherein people are expecting free Wi-Fi access in times to come. Though there is not much talk about rural Wi-Fi. Everything on Tower (EOT) concept appears to be the solution to provide broadband access to rural masses in a cost effective, timely, affordable & sustainable manner..

### **Dnyaneshwar Mantri**

SIT, Lonavala, India



**Dr. Dnyaneshwar S. Mantri** is graduated in Electronics Engineering from Walchand Institute of Technology, Solapur (MS) India in 1992 and received Masters from Shivaji University in 2006. He has awarded PhD. in Wireless Communication at Center for TeleInFrastruktur CTIF), Aalborg University, Denmark in March 2017. He has teaching experience of 25years. From 1993 to 2006 he was working as a lecturer in different institutes [MCE Nilanga, MGM Nanded, and STB College of Engg. Tuljapur (MS) India].

Since 2006 he is associated with Sinhgad Institute of Technology, Lonavala, Pune and presently working as a Professor in the Department of Electronics and Telecommunication Engineering. He is a Senior Member of IEEE, Life Member of ISTE, and IETE. He has written three books, published 15 Journal papers in indexed and reputed Journals (Springer, Elsevier, and IEEE, etc.), and 23 papers in IEEE conferences. He is a reviewer of international journals (Wireless Personal Communication, Springer, Elsevier, IEEE Transaction, Communication society, MDPI, etc.) and conferences organized by IEEE. He is a working editorial board member in STM Journals. An active member in GISFI. He worked as a TPC member for various IEEE conferences and also organized IEEE conferences GCWCN2014 and GCWCN2018. He worked on various committees at University and College. His research interests are in Adhoc Networks, Wireless Sensor Networks, Wireless Communications, VANET, Embedded Security with a specific focus on energy and bandwidth.

#### Title: "Ubiquitous Networks: A Future World of Things"

With an exponential increase in the number of applications and demand of customers, it is extremely important to respond to the queries with fast services and network use. This is possible only by use of ubiquitous networks supporting the mass media communications. The integration of advanced technologies such as CONASENSE and Human Bond Communications takes care of not only sensing and services but also Data, Speed, Cooperation, Content and Cost. The combination of Data, Technology and Media used for smart computation and communication over the internet could sever the purpose and that's the urgent demand of growing networks marching towards fusion of IoT and 5G leading to 6G. In the future generation network IoT with 5G will be the backbone of networks which adds the concept of virtualization at Anytime, Anywhere, Anything and Anybody. Ubiquitous technology is often wireless, mobile and networked, making its users more connected to the world around them and the people in it. The ubiquitous network connects the D2D, M2M, D2M and Uses the ICT and Cloud based technology to mitigate the QoS parameters. At an exponential pace, the number of machines and devices connected to the Internet has increased and will continue to expand. Ubiquitous computing's technology perspective covers a number of problems in software and hardware. Mobility, scalability, heterogeneity, privacy and trust, reliability and security, spontaneous interoperation, transparent user interaction, integration and invisibility are the most prevalent issues. The significant themes that will help in the evolution of Ubiquitous computing are- Intelligence, Cloud based Computing and Sensor Networks. Key Words: Ubiquitous Networks, ICT, Cloud Computing, Communication and Virtualization.

### Swati Prasad

BIT Mesra, India



Dr. Swati Prasad did her Ph.D. from Aarhus University, Denmark, her Master's in Electrical & Electronics Engineering from Birla Institute of Technology, Mesra, India, and her Bachelor of Engineering in Electronics & Communication Engineering from Visvesvaraya Technological University, Karnataka. She is currently serving as Assistant Professor in the department of Electronics & Communication Engineering at Birla Institute of Technology, Mesra, India.

She has authored several International Journal & Conference articles. She is a recipient of the Erasmus Mundus Scholarship for pursuing her Ph.D. in Denmark and holds a B-level certificate in the National Mathematics Olympiad. She is a member of the American Physical Society.

#### Title: Role of Speaker Identification towards 6G

When a speech utterance is given, identifying the person who spoke the utterance from a group of reference speakers, and their current emotional state is referred to as speaker and emotion identification. It is needed for human-like interaction with the machine. Research in this area has started long back, however, we have still not achieved success in building a system that can efficiently perform speaker and emotion identification under scenarios like background noise, and voice disguise. Its success may open the doors for withdrawing money from a bank using speech. I have developed some efficient and robust methods of speaker identification which has given good results over the traditional method under voice disguise scenario.

SESSION 7 (b): GISFI ctd (Virtual)

### Satya Prasad Majumdar

Bangladesh University of Engineering and Technology, Bangladesh



Satya Prasad Majumder joined the position of the Vice Chancellor of Bangladesh University of Engineering and Technology (BUET) in June 2020. He is a Professor of the Department of Electrical and Electronic Engineering (EEE), BUET.

Since joining BUET in 1981, he served in various positions in the department, faculty and university levels, including Head of the EEE department at BUET from June 2006 – May 2008. He was the Dean of the Faculty of EEE, BUET during June 2010 to June 2012. He served as a Visiting Professor in the Faculty of Engineering (FoE) of Multimedia University (MMU), Cyberjaya, Selangor, Malaysia during Jan 1999 to July 2002. He was a Visiting Research Professor in the department of Electrical Engineering of Gunma University (Japan) during Dec 2001 to Jan 2002. He was a visiting researcher in the department of Information Engineering of University of Parma (Italy) during 1996 and 997.

He worked as a consultant to the South Asian Association for Regional Co-operations (SAARC) & Dhaka Chamber of Commerce (DCC). He received the B.Sc. (1st class,4th) and M.Sc. in Electrical & Electronic Engineering from BUET, Bangladesh, in 1981 and 1985, respectively. In 1993, he obtained his Ph.D. degree in Optical Fiber Communication Engineering from the Indian Institute of Technology (IIT), Kharagpur, India.

His research interests include Opto-electronics & Photonics, Optical Fiber Communication Systems, DWDM Optical Networks, Soliton Propagation, Broadband Wireless Communications, Mobile and Infra-red Networks. He supervised more than 100 M Sc Theses and 6 Ph D Dissertations and published more than 200 research papers in Internationally reputed referred Journals and conference Proceedings.

Session Chair

### **Dinesh Chand Sharma**

Standards & Public Policy (SESEI), India



Since 2012, Mr. Dinesh Chand Sharma is associated with EUROPEAN STANDARDISATION PROJECT SESEI as Director – Standards and Public Policy. In this role and as the Seconded European Standardization Expert in India, Mr. Sharma acts as the focal point in India representing European Standards Organizations (ETSI, CEN, CENELEC), European Commission (EC) and European Free Trade Association (EFTA). The activity of the Project SESEI is focused around sectors covering Smart City, ICT, Automotive, and Electrical Equipment including Consumer Electronics.

Prior to this, Mr. Sharma worked with Ericsson for 15 years, having his last working profile as "Director – Regulatory Affairs & Industry Relation". Mr. Sharma began his career in Technical Customer Support back in 1992 and has over 26 years of industry experience covering various profiles such as Head of Regulatory Affairs, Head of Accounts & Commercial Management, Service Delivery, and Customer Support Management both in India and abroad.

Mr. Sharma also holds various Industry positions such as Chairman Advisory Committee for M2M+IoT Forum India, Chairman - Standards & Policy Working Group of IET IoT Panel, and active membership at Telecommunication Engineering Centre, Department of Telecom, Bureau of Indian Standards, etc.

Mr. Sharma holds a bachelor's degree in Electronics, the highest honors in Business Management from Stratford Institute, USA, and a SUN Solaris certification.

#### Title: Standards 5G building blocks, Emerging Technologies & ETSI long term strategy

My talk will cover Status of 5G Standardisation at 3GPP, building blocks of 5G standardization work, Emerging technology, glimpse of long-term strategy at ETSI and what's beyond 5G in Europe.

### **Preetam Kumar**

IIT PATNA, India



Preetam Kumar is currently working as an Associate Professor in the Department of Electrical Engineering, IIT Patna. He did his Ph.D. from IIT Kharagpur in the area of Wireless Cellular Communications.

He has around 20 years of teaching, research and industry experience. Physical (PHY) Layer Issues in Wireless Communications, 5G Network, Error Control Coding and Digital Communication Systems are his areas of research interest. He has published over 100 research papers in various refereed IEEE Journals, other peer reviewed journals and conferences. He is a regular reviewer of premier journals and TPC member of various conferences He was the organizing chair of First IEEE Symposium on 5G in Asia at IIT Patna. He has supervised 7 doctoral theses, and more than 30 MTech projects. He has also successfully executed high value sponsored projects from Government of India as well as consultancy projects from industry. Apart from his teaching and research activities, he is also part of many administrative/governing committees at IIT Patna and other premier institutes.

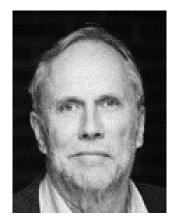
He is also serving as the Editor of Springer Wireless Networks and Wireless Personal Communication journals.

#### Title: 5G: Challenges and Enabling Technologies

As foreseen by technology front-liners, 5G is now a reality and is gaining significant expansion and roll-out plans across the globe. It is now time to look towards the associated enabling technologies that shall walk along this new paradigm shot.

### Knud Erik Skouby

Aalborg University, Denmark



Knud Erik Skouby is professor and were founding director of center for Communication, Media and Information technologies, Aalborg University-Copenhagen (2007-17) - a center providing a focal point for multi-disciplinary research and training in applications of CMI. Has a career as a university teacher and within consultancy since 1972; focus on ICT since 1987.

Working areas: Techno-economic Analyses; Development of mobile/ wireless applications and services: Regulation of telecommunications. Project manager and partner in a number of international, European and Danish research projects. Served on a number of public committees within telecom, IT and broadcasting where ethical issues has been a focus area incl. e.g. EUS ECOSOC; a sub-committee in the Danish 'Building Stronger Universities' initiative; the Danish Council of Independent Research and the Danish Media Committee. Further served as a member of boards of professional societies; as a member of organizing boards, evaluation committees and as invited speaker on international conferences; published a number of Danish and international articles, books and conference proceedings. Editor in chief of Nordic and Baltic Journal of Information and Communication Technologies (NBICT); Chair of WGA in Wireless World Research Forum; Past dep. chair IEEE Denmark.

#### Title: Beyond 5G and Rural Communication

Several of UNs SDGs relate to and in the reality require advanced ubiquitous communication and this is often cited as an argument for the relevance of 5G and its development beyond. However, there is a paradox: the 5G and beyond networks are developed as a very advanced and costly technology without much view to the hitherto unserved areas targeted by the SDGs.

### **Punnarumol Temdee**

Mae Fah Luang University, Thailand

Assoc. Prof. Dr. Punnarumol Temdee received B.Eng. in Electronic and Telecommunication Engineering, M. Eng. in Electrical Engineering, and Ph.D. in Electrical and Computer Engineering from King Mongkut's University of Technology Thonburi. She is currently a lecturer at School of Information Technology, Mae Fah Luang University, Chiang Rai, Thailand. Her research interests are social network analysis, artificial intelligence, software agent, context-aware computing, and ubiquitous computing.

### **Chayapol Kamyod**

Mae Fah Luang University, Thailand



Dr. Chayapol Kamyod received his Ph.D. in Wireless Communication from the Center of Tel InFrastruktur (CTIF) at Aalborg University (AAU), Denmark. He received M. Eng. in Electrical Engineering from The City College of New York, New York, USA. In addition, he received B.Eng. in Telecommunication Engineering and M. Sci. in Laser Technology and Photonics from Suranaree University of Technology, Nakhon Ratchasima, Thailand. He is currently a lecturer in the Computer Engineering program at School of Information Technology, Mae Fah Luang University, Chiang Rai, Thailand. His research interests are resilience and reliability of computer network and system, wireless sensor networks, embedded technology, and IoT applications.

## Title: Smart Farming: Challenges and Applications for Young Smart Farmers in Thailand

Applying Information Technology in traditional agriculture has many challenges in Thailand due to the diversity of agricultural factors such as environment, plants, and production types. Nevertheless, the development of wireless communication, embedded systems, and IoT technologies provide an opportunity to develop the low-cost smart solution for the performance enhancement of small and medium-size farms in Thailand. This talk will address the practical challenges and possible solutions for Young Smart Farmers in the Northern area of Thailand.



### Navin Kumar

Amrita School of Engineering, India



Dr. Navin has completed his PhD from University of Aveiro, Porto and Minho (Portugal) Europe in 2011, his M Tech from Motilal Nehru National Institute of Technology, Allahabad in 2000 and BE from Institution of Electronics and Telecommunication Engineering, New Delhi in 1996. Dr. Navin Kumar has over 24 years of working experience in Government, Industry and academia in IT and Telecommunication area. He has over 10 years of overseas experience in teaching, research and development. Currently, he is working as Assoc. Professor and chairman ECE Dept. in Amrita Vishwa Vidyapeetham (University), Bangalore campus. He has over 80 publications in peer reviewed international journals and IEEE conference proceedings.

In addition, he has also authored and edited books and book chapters. Dr. Navin has been awarded the Fraunhofer Challenge award in the academic year 2010-2011 for the best PhD thesis work. He also received a research grant from the foundation of science and technology (FCT) Govt. of Portugal towards his PhD research work. He is the recipient of Gowri Memorial award, India in 2009 for the best journal paper. Many of his papers adjudged as best paper awards at International IEEE conferences outside India. He is Sr Member of IEEE, AIENG (HK), Life member of IETE and Fellow IE(India). He is a very active IEEE volunteer. He is secretary in Bangalore Section. He served as Chair of IEEE ComSoc Bangalore Chapter (2017-18), Chair VTS Bangalore and Student Branch Counselor of Amrita School of engineering. He is also associated with IEEE Photonics, ITS, VTS, Consumer Electronics and Sensor council. Dr. Navin has been giving tutorials at IEEE flagship conferences like ICC, WCNC. He regularly speaks and delivers talks as keynote, inviting speakers in conferences and workshops.

5G His research includes, (mmWave and Massive MIMO), area Communication, Visible Light Wireless Communication, IoT and Optical Intelligent Transportation Systems, He is also the part of IEEE 5G and Future Network Initiative.

#### Title: Aerial Infrastructure Sharing in 6G using LAP (Low Altitude Platform)

Low Altitude Platform (LAP) based aerial cells offer an option for extending coverage and enhancing capacity for a terrestrial network. 6th Generation (6G) networks, considers Non-Terrestrial Network (NTN), i.e., aerial network as a key enabler for dynamic scaling of coverage and capacity. the 3rd Generation Partnership Project (3GPP) has defined the architecture and scenarios for infrastructure sharing in the terrestrial network which will not solve the scenario of dynamic deployment of aerial cells in 6G. In this talk, different architecture deployment will be discussed briefly.



## Lunch Break



SESSION 8 (a): Invited Talk 2 (Virtual)

### Henrik Knudsen

CGC, BTECH, Aarhus University, Denmark



Henrik Knudsen is currently an Associate Professor at Aarhus University, Denmark. He's mainly responsible for Innovation, Entrepreneurship, Sustainability, Marketing, Organization & Management, Business models. Apart from teaching and research, Henrik had explored the industrial culture and trends extensively. He worked as an editorial reviewer for Pearson Education Publishers U.K, Measuring Business Excellence, and Thunderbird International Business Review. He's an international gold medallist in 1992 at inventions, Geneva. He's author of several research papers. His current research projects include, JTI (Jungs typology Indicator) and Assessor – seven circles of Innovations.

His annexes include: Knudsen, H., 'Open Sesame' – knowledge processes concealed in the entrepreneurial process, IFKAD 12th International Forum on Knowledge Asset Dynamics, St. Petersburg, 2017. Knudsen, H., Open sesame - entrepreneurship hidden networks Start-up Europe Week, Feb. 2017. Knudsen H., Organisatoriske værdier: teoretisk betragtet, VIA University College som case, og focus på de ledelsesmæssige udfordringer, Paper til Center for Ledelse og Organisations Udvikling (VIA UC), April 2010. And many more.

Session Chair

## Ashok Chandra

GISFI, India



Dr. Ashok Chandra, is Ph.D. in Electronics and Doctorate of Science (D.Sc.) in Radio Mobile Communications. He joined the Ministry of Communications & Information Technology, Government of India in 1977. Dr. Ashok Chandra has Technical Experience of over 35 years in the field of Radio Communications/Radio Spectrum Management including 7 years of experience dealing with Institutes of Higher Learning in Technical Education. He has contributions of over 30 research papers at various International Conferences/Journals in the areas of EMI, Radio Propagation etc. He was instrumental in the implementation of Government of India's "Technology Development Mission" scheme. He is registered with ITU as an Expert on "Radio Spectrum Management". He superannuated from the post of Wireless Adviser to the Government of India. In his responsibility as Wireless Adviser, he was associated with spectrum management activities, including in spectrum planning and engineering, frequency assignment, frequency coordination, spectrum monitoring, policy regarding regulatory affairs for new technologies and related research & development activities, etc. He served as a Vice-Chairman, Study Group 5 of International Telecommunications Union (ITU)-Radio Sector. He has represented India to a large number of ITU meetings including World Radio Conferences (WRC). He served as Councillor from Indian Administration in the ITU Council.

### Purnendu Tripathi

GISFI, India



Dr. P.S.M. Tripathi is an Indian Engineering Services officer of the 1998 batch. He has vast technical experience in the field of Radio Communications/Radio Spectrum Management including spectrum planning and engineering and policy regarding regulatory affairs for new technologies and related research & development activities and ITU-R related matters. Dr. Tripathi is currently Deputy Wireless Adviser in Wireless Planning & Coordination (WPC) Wing of Department of Telecommunications, Ministry of Communications, Government of India. Earlier, he was associated with radio spectrum management and planning and engineering activities for telecom services in India. He has more than 20 years of experience in management, strategy in Radio Spectrum Management and Radio Spectrum Monitoring Sector including implementation of a very prestigious World Bank Assisted Project on "National Radio Spectrum Management and Monitoring System (NRSMMS)" in the WPC Wing. His areas of interest include Radio Regulatory affairs for new technologies and cognitive radio. Dr. Tripathi took lecture series at the National Institute of Technology (VNIT), Nagpur (India) in the areas of Radio Spectrum Management'.

### Title: "Radio Frequency Spectrum for 5G and Beyond Applications- ITU's Perspective"

Radio frequency spectrum (RFS), is a finite, natural, scarce but renewable resource. RFS is not consumed upon its usage and wasted, if not used efficiently, economically and efficiently. The RFS caters to the requirements of 41 radiocommunication services viz., aeronautical, maritime, radionavigation, radiolocation, radio astronomy, meteorological, broadcasting, satellite broadcasting, fixed, fixed-satellite, mobile, mobile-satellite, and space services, etc It may be mentioned that the commercial public telecommunication applications are provided under the 'Mobile service'. The applications began from 2nd Generation mobile communications. The unprecedented growth in mobile data traffic has choked network capacity of existing IMT networks. Research on next generation mobile communication system is underway. Radio spectrum is an essential element for mobile telecom service. Presently, mobile telecom service is operating between 700 MHz to 6000 MHz. Some frequency spots in millimeter (mm) frequency bands beyond 10 GHz have recently been identified by ITU for IMT services. Considering the future requirements, TIU has identified additional frequency bands for IMT services, which are under study. These additional frequency bands will be discussed and finalised during the next World Radiocommunications Conference, which is scheduled in 2023. There are considerable differences in the spectrum bands currently in use and MM waves in terms of propagation characteristics, interference management and system design etc. In this talk, frequency bands under consideration for IMT services will be discussed.

## Vinod Kumar

Former Director in Wireless Research Programme ALU Bell Labs, Paris, France



Dr. Vinod Kumar has 35+ years of experience R&D in mobile communication systems. During 27 years of his tenure in Alcatel-Lucent he has initiated and contributed to multiple research projects in 2G to 5G technologies namely GSM, GPRS, EDGE, UMTS, HSPA, LTE, LTE A systems and in wireless ad-hoc networking. Additionally, he has been involved in standardisation and marketing support activities and in Patent Management related to above technologies. He has participated in multiple international collaborative projects (EC FP6, FP7) and has been Technical Auditor of CELTIC and ANR projects. He represented ALU in Wireless World Research Forum (WWRF) till 2015 and now is an Individual Member of this Forum. Additionally, he has held WWRF Secretary's position (since its foundation in 2001) and WWRF Treasurer position since 2013.

Academic activities of Dr Kumar include teaching graduate courses in mobile communications in ENST (IMT Paris-Tech), CENTRALESUPELEC, ISEP, EURECOM in France and in MNIT in India. He was Associate Professor at the Université de Marne la Vallée in France for six years. He has acted as member of Industrial Advisory Board of CTIF Denmark, of Conseil Technique of SUPELEC-France and also of the joint INRIA-Bell Labs research lab. Other activities include being guest lecturer at IEEE events (on 5G and IoT), guest editor and referee for IEEE publications; PhD guide and examiner with CentraleSupelec and INRIA. He has 80 + technical publications and 30+ patents. Dr. Kumar is Director (retd) in Wireless Research programme in ALU Bell Labs, France.

### Title: "5G to 6G Evolution and Revolution"

5G is now no more a vision but a reality. It is the first of among the mobile wireless communication generations, which specifically considers beyond human dimensions that is M2M communications. Just as a milestone sets a pathway for future milestones, 5G is an onset for a next revolution, the 6G.

## Ashutosh Dutta

Johns Hopkins University Applied Physics Laboratory, USA



Ashutosh Dutta is currently senior scientist and 5G Chief Strategist at the Johns Hopkins University Applied Physics Laboratory (JHU/APL). He is also a JHU/APL Sabbatical Fellow and adjunct faculty at The Johns Hopkins University. Ashutosh also serves as the chair for Electrical and Computer Engineering Department of Engineering for Professional Program at Johns Hopkins University.

His career, spanning more than 30 years, includes Director of Technology Security and Lead Member of Technical Staff at AT&T, CTO of Wireless for NIKSUN, Inc., Senior Scientist and Project Manager in Telcordia Research, Director of the Central Research Facility at Columbia University, adjunct faculty at NJIT, and Computer Engineer with TATA Motors. He has more than 100 conference, journal publications, and standards specifications, three book chapters, and 31 issued patents. Ashutosh is co-author of the book, titled, "Mobility Protocols and Handover Optimization: Design, Evaluation and Application" published by IEEE and John & Wiley. As a Technical Leader in 5G and security, Ashutosh has been serving as the founding Co-Chair for the IEEE Future Networks Initiative that focuses on 5G standardization, education, publications, testbed, and roadmap activities. Ashutosh serves as IEEE Communications Society's Distinguished Lecturer for 2017-2020 and as an ACM Distinguished Speaker (2020-2022) Ashutosh has served as the general Co-Chair for the premier IEEE 5G World Forums and has organized 70 5G World Summits around the world.

### Title: 5G Security - Opportunities and Challenges

Software Defined Networking (SDN) and Network Function Virtualization (NFV) are the key pillars of future networks, including 5G and beyond that promise to support emerging applications such as massive sensing type applications while providing the resiliency in the network. Service providers and other vertical industries can leverage SDN/NFV to provide flexible and cost-effective service without compromising the end user quality of service (QoS). While NFV and SDN open up the door for flexible networks and rapid service creation, these also offer both security opportunities while also introducing additional challenges and complexities, in some cases. While several standardization bodies have started looking into the many security issues introduced by SDN/NFV, additional work is needed with larger security communities including vendors, operators, universities, and regulators. This talk will address evolution of cellular technologies towards 5G but will largely focus on various security challenges and opportunities introduced by SDN/NFV and 5G networks such as Hypervisor, Virtual Network Functions (VNFs), SDN controller, orchestrator, network slicing, cloud RAN, edge cloud, and security function virtualization. This talk will introduce a threat taxonomy for 5G security from an end-to-end system perspective, potential threats introduced by these enablers, and associated mitigation techniques. At the same time, some of the opportunities introduced by these pillars will also be discussed. This talk will also highlight some of the ongoing activities within various standards communities and will illustrate a few deployment use case scenarios for security including threat taxonomy for both operator and enterprise networks.

### **Paulo Sergio Rufino Henrique**

Spideo, France



Paulo Sergio Rufino Henrique post-graduated in Wireless Communications Systems from Brunel London University. Presently he is a Ph.D. student under the supervision of Professor Ramjee Prasad at Aarhus University and the Global CTIF Capsule in Denmark.

His research field is 6G Networks - Performance Analysis for Mobile Multimedia Services for Future Wireless Technologies. Paulo holds more than 20 years of experience working in telecommunications. His career began as a field network and support engineer at UNISYS in Brazil. Later, he joined British Telecom (BT) Brazil. Paulo worked at BT Brazil for five years managing MPLS networks, satellites (V-SAT), IP-Telephony for Tier 1 network operations. During that period, he became the Global Service Operations Manager overseeing BT business network services in EMEA, Americas, India, South Korea, 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 manager for BT TV Sports channel. At BT Sports TV, Paulo participated in the launch of the first UHD (4K) TV in the UK. Later he joined Vodafone UK as a quality manager for Home Broadband Services and OTT platforms for almost two years. Presently, Paulo Henrique holds the Integration Engineer and Pre-Sales Engineer position in Spideo, Paris, being responsible for integrating the Spideo recommendation platform on the OTT and IPTV providers.

### Title: 6G Networks Infrastructure for Future Multimedia Communications

Since the beginning of the 3<sup>rd</sup> Generation of Mobile Communications, 3G, mobile subscribers have enjoyed the mobile Internet. Universal Mobile Telecommunications Systems (UMTS), also known as 3G, paved the way for subscribers to access the Internet wirelessly at anytime and anywhere which the mobile signal could reach. The Long-Term Evolution (LTE) was pivotal to enable such a digital economy to create millions of new jobs in a novel economy that offers services from food delivery to carsharing, e-commerce, and Fintech, to name just a few. 4G in its latter version, the Long-Term Evolution-Broadcasting (LTE-B) pushed for a better quality of video conferencing calls, including the ultra-high quality of Video on Demand (VoD) such as UHD TV and 4K. However, an ubiquitous network was required to overcome the network's blind spots. For this, 5G was architected and developed to offer a faster and cognitive network. As 5G New Radio (NR) release 17 is approaching, the existing technologies will offer a better quality of services 5G QoS control for multimedia services, including the XR (Cross Reality) NR. However, it is time to think ahead and beyond 5G (B5G) to allow more power-hungry bandwidth consumption multimedia communications to flourish, such as holographic communications, Digital Live TV, and 8K Video Streaming, but at this time with not only QoS but with advanced Quality of Experience (QoE) for consumers. In this case, 6G is envisioned as a solution as a human-centric network to unlock new multimedia communications' full potential. 6G will need to offer an intelligent network powered by AI, ML in a distributed architecture to granted higher QoS and QoE controls as an enabler for superior advanced image processing and protocols for video applications. Keywords: VoD, 4K, Holographic Communications, 8K, B5G, 6G, QoS, QoE.

## Purnima Lala

IILM, India



Dr. Purnima Lala Mehta received a Doctor of Philosophy (Ph.D.) degree in the field o "Wireless Cellular Communications through Aerial Drones" from one of the ranked universities in the world - Aarhus University, Denmark. She received her bachelor's degree and master's degree in the field of Electronics and Communications Engineering (ECE) from Bharati Vidyapeeth's College of Engineering for Women (BVCOEW), University of Pune, India, and NorthCap University (formerly ITM University), Gurgaon, India respectively.

She has over 8 years of teaching and research experience, including international exposure in countries like Denmark, Germany, China, Portugal, etc. She has published several peer-reviewed journal/conference papers and book chapters, and edited books. Concerning one of her research papers, she has been recognized under "Quarterly Franklin Membership' from London Journals Press.

She has contributed as a Resource Person/Session-Chair in International/National conferences and workshops. She has been invited as a speaker to talk about her research work on drone-based communications at national/international conferences, FDPs, and other college events. She is an official Reviewer at Wireless Personal Communications (WPC), Springer. She has also reviewed papers for IEEE Vehicular Technology Magazine and conducted some peer book reviews as well. She is a Member of IEEE and a Life Member of IETE. Her research interests include the areas of Mobile Computing, Aerial Drone-based Wireless Communications, Wireless Ad-Hoc Networks, Millimeter-Wave Communications, Future Generations of Communications, and Business Modelling.

### Title: Aerial Radio Architecture, a future roadmap

Drone base stations as segments of aerial radio architecture is relatively a novel concept and presently a topic of current research and execution. Urban cellular networks face challenges that existing network infrastructure becomes insufficient to cater to. Swarm of Drone Base Stations as an assistive solution can be deployed and provide services to congested areas and during need-based deployments. Such a deployment is challenging as it is a shift in the provisioning of network services through an alternate layer of the spatial infrastructure. The talk will elaborate upon how aerial radio architecture can upscale and mitigate urban cellular traffic congestions.



# Coffee Break

SESSION 8 (b): Invited Talk 3 (Virtual)

## Chandrika Prasad

PCNS, Rail Metro, India



Mr Chandrika Prasad is Managing Director PNCS Rail Metro Consultancy India .He has over 4 decades of experience in providing Knowledge Consultancy, Strategy Planning, Business Development, Study, Tender & Bid preparation, Design, Construction and Maintenance of state of art Signalling & Train Control systems for Developing Railways & Metros.

As 1<sup>st</sup> Adl Member Signal of Indian Railway Board, he introduced modern Signal & Telecom technologies of ETCS, GSMR, SSI, Digital Axle Counter; SMPS, AFTC, LED Signals, Dataloggers and created islands of Signalling excellence on Indian Railways.

He was UIC Task Force Member for introduction of ETCS Pilot project on Indian Railways . He has provided /is providing Consultancy services for Indian Railways, DFCC, RITES, IRCON, MNC s, Jordan Railway Corporation, South Africa -Transnet Freight Rail and for railway projects in Myanmar, Bangladesh, Sri Lanka, United Kingdom, Iraq.

Mr. Prasad has presented papers at UIC, IEEE, AREMA, IRSTE & I. Rly, INAE, IREE Conferences in India and abroad. Over 33 of his Papers have been published in International & National journals IEEE, IRSE, UIC, IRJ, RGI, IRSTE, IRT journals, Urban Rail & Rail Business.

Session Chair

## Kapal Dev

Trinity College Dublin, Ireland



Dr. Kapal Dev is a Research Fellow with the CONNECT Centre, School of Computer Science and Statistics, Trinity College Dublin (TCD). His education Profile revolves over ICT background i.e. Electronics (B.E and M.E), Telecommunication Engineering (PhD) and Postdoc (Fusion of 5G and Blockchain). He is also working for OCEANS Network as "Head of Projects" to manage OCEANS project processes and functions to improve efficiency, consistency and best practice integration. He was awarded the PhD degree by Politecnico di Milano, Italy in July 2019.

His research interests include Blockchain, 5G Beyond Networks and Artificial Intelligence. Previously, he worked as 5G Junior Consultant and Engineer at Altran Italia S.p.A, Milan on 5G use cases. He is PI of two Erasmus + International Credit Mobility projects. He is evaluator of MSCA Co-Fund schemes, Elsevier Book proposals and top scientific journals and conferences including IEEE TII, IEEE TITS, IEEE TNSE, IEEE IoT,IEEE JBHI, FGCS, COMNET, TETT, IEEE VTC, WF-IoT. TPC member of IEEE BCA 2020 in conjunction with AICCSA 2020, ICBC 2021, DICG Colocated with Middleware 2020 and FTNCT 2020. He is also serving as GE in COMNET (I.F 3.11), Associate Editor in IET Quantum Communication, Review Editor in Frontiers in Communications and Networks, GE in COMCOM (I.F: 2.8), Lead chair in one of CCNC 2021 workshops, and editing a CRC press.

### Title: Reinventing the Future: A Perspective from 6G Applications

Fifth generation (5G) technology is already in its final deployment phase, researchers have already begun to envisage the development of the next generation of mobile communication networks, which is currently known as the sixth generation (6G). The sixth generation (6G) of mobile networks are expected to be deployed in the coming decade. It is envisaged that 6G will be extremely intelligent and will open a new range of applications and vistas in different verticals but will come up with some major challenges such as support for new frequency bands, integration of Artificial Intelligence (AI), Extremely Ultra- reliable, extremely lowlatency communications (ERLLC) etc. Challenges will bring new foundations and integration of enabling technologies for 6G such as Edge AI, Distributed Ledger Technology, Federated Learning, Quantum Communication etc will direct us into the diverse range of applications areas which will shape up the human society of the 2030s. In this talk, I will discuss the applications of 6G in different areas such as Intelligent Healthcare, Industry 5.0, UAV based Mobility etc.

## Seshadri Mohan

University of Arkansas at Little Rock, USA



Dr. Seshadri Mohan is currently a professor in the Systems Engineering Department at University of Arkansas at Little Rock, where, from August 2004 to June 2013, he served as the Chair of the Department of Systems Engineering. Prior to the current position he served as the Chief Technology Officer (CTO) and Acting CEO of IP SerVoniX, where he consulted for several telecommunication firms and venture firms and served as the CTO of Telsima (formerly known as Kinera).

Dr. Mohan has authored/co-authored over 125 publications in the form of books, patents, and papers in refereed journals and conference proceedings with citations to his publications in excess of 5880. He holds 14 patents in the area of wireless location management and authentication strategies. He is the recipient of the SAIC Publication Prize for Information and Communications Technology. He has served or is serving on the Editorial Boards of IEEE Personal Communications, IEEE Surveys, IEEE Communications Magazine, Journal of Mobility and Cyber Security and International Journal on Wireless Personal Communications (Springer) and has chaired sessions in many international conferences and workshops. He has also served as a Guest Editor for several Special issues of IEEE Network, IEEE Communications Magazine, and ACM MONET. He served as a co-guest editor of the Feature Topic "Human Bond Communications," that appeared in the February 2019 issue of IEEE Communications Magazine. He served as a guest editor of 2015 October IEEE Communications Feature Topic titled "Social Networks Meet Next Generation Mobile Multimedia Internet," March 2012 IEEE Communications Feature Topic titled "Convergence of Applications Services in Next Generation Networks" as well as the June 2012 Feature Topic titled "Social Networks Meet Wireless Networks. Dr. Mohan is a co-founder of the startup IntelliNexus, LLC, the objective of which are the development of innovative ad hoc vehicular networking to advance the notion of connected cars and the development of IoT and IoV applications to improve traffic safety and reduce accidents and congestion.

## *Title: The Evolution of Connected Vehicles: The Role of Emerging Standards, 5G and Beyond, and AI/Machine Learning*

This talk explores the status of the rapidly evolving field of connected vehicles and provides an understanding of the standards development taking place in various standards organizations such as Third Generation Partnership Project Cellular Vehicle to Everything (3GPP C-V2X), Institute of Electrical and Electronics Engineers (IEEE), and Internet Engineering Task Force (IETF) They are aimed at ensuring communication takes place between various entities in a connected vehicles network - Communications Technologies – vehicle-to- vehicle (V2V), vehicle-to-infrastructure (V21), infrastructure-to-vehicle (I2V), vehicle-to-pedestrian (V2P), and vehicle-to-nomadic devices (V2ND). Besides exploring the standards activities related to connected vehicles, this talk also explores ongoing development of security standards and machine learning as related to connected vehicles.

## fred Harris

UCSD, USA



Fred Harris holds 40 patents on digital receiver and DSP technology and lectures and consults throughout the world on DSP applications and high performance, cost effective DSP solutions. Has written some 260 journal and conference papers, the most well-known being his 1978 paper "On the use of Windows for Harmonic Analysis with the Discrete Fourier Transform" (8500 citations). Author of the book Multirate Signal Processing for Communication Systems, is co-author with Bernard Sklar of 3rd edition Digital Communications, and has contributed to several other DSP books.

Special areas include Polyphase Filter Banks, Physical Layer Modem design, Synchronizing Digital Modems and Spectral Estimation. Editor in Chief of Elsevier's DSP Journal. Became a Fellow of the IEEE in 2003, cited for contributions of DSP to communications systems. Technical and General Chair respectively of the 1990 and 1991 Asilomar Conference on Signals, Systems, and Computers, Technical Chair of the 2003 Software Defined Radio Conference, of the 2006 Wireless Personal Multimedia Conference, of the DSP-2009, DSP-2013 Conferences and of the SDR-Winn-Comm 2015 Conference. Received in 2006 the Software Defined Radio Forum's "Industry Achievement Award". Received the DSP-2018 conference's commemorative plaque with the citation: We wish to recognize and pay tribute to Fred Harris for his pioneering contributions to digital signal processing algorithmic design and implementation, and his visionary and distinguished service to the Signal Processing Community. The spelling of his name with all lower-case letters is a source of distress for typists and spell checkers. A child at heart, he collects toy trains and old slide-rules.

### Title: Polyphase Channelizer Separates and Demodulates Multiple FM Channel Bands

We have been designing and implementing DSP based radio receivers for nearly three decades now. One of the most common capabilities we have embedded in modern DSP radios is the ability to perform multiple channel receivers using poly-phase filter banks. We have recently been designing broadband receivers reminiscent of earlier designs as well as totally new designs with enhanced and interesting capabilities. We thought it would be interesting to review and compare earlier designs with modern designs to help us see how the flow of software and hard-ware technology has changed and perhaps guide us to new techniques and applications. One multi-channel receiver structure we examine separates and demodulates the 100-channel commercial FM band. We have found it useful to see how new approaches to a mature modulation scheme have evolved and continue to do so.

## Neeli R. Prasad

SmartAvatar, The Netherlands



Dr. Ir. Neeli R. Prasad, CTO of SmartAvatar B.V. Netherlands and VehicleAvatar Inc. USA, IEEE VTS Board of Governor Elected Member & VP Membership. She is also full Professor at 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 ground-breaking 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 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 has 4 books on IoT and WiFi, many book chapters, peer-reviewed international journal papers and over 200 international conference papers.

### Title: 6G: The Age of The Empathetic Intelligence

Globally 5G services are being lit up in several metro cities and it is expected to ubiquitously deployed over the next few years. Researchers are already trying to identify the factors that will define the development of the 6G of mobile technology. How will 6G differ from 5G, and what kinds of interactions and activity will allow that won't be possible with 5G? It is obvious 5G offers significant advances over 4G in terms of the followings:

- 20x better upload/download speed,
- 25x more device density per cellular base station,
- 10x lower latency,
- 10x more battery life,
- network slicing with guaranteed quality of services.

So how could 6G be better than 5G? Of course, 6G will enhance performance on every aspect of 5G and more for e.g. target download speed of 1 terabit per second, deterministic network with guaranteed jitter and latency for human safety control systems, etc. But what kind of transformative improvement could it offer? In my opinion, 6G networks must empathize with human emotions. There are many use cases in business that require at least some demonstration of empathy.

6G = Beyond 5G Connectivity + Empathetic Intelligence

6G networks must be developed with the fifth industrial revolution (IE 5.0) in mind "the age of intelligence" by incorporating human emotional intelligence with network intelligence.



## End of the Second Day and Workshop



The current pandemic COVID-19 situation has shown the importance of digital technologies to continue the successful operation of all spheres of life, educational, business, and social. It also gives a special flare to the 6G system. It is envisioned that it will support further-enhanced to full-broadband (FeMBB) services to all types of endusers and is envisioned as universal technology and infrastructure. The current trends of digitalization, user requirements for access and transmission of high-definition data while on the move, and networking and intelligence in all spheres of life demand 6G as the accelerator of transformation and innovation on a global scale and with deep penetration. Current application trends that can be observed are the emergence of services based on Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), wireless brain-computer interaction, smart city, tactile communications, and holographic communications. These developments challenge the current capabilities of the enabling wireless communication systems from various aspects, such as delay, rate, degree of intelligence, coverage, reliability, capacity, and cannot be achieved by evolutionary research. The research will seek breakthroughs from the current network architecture and communication theory to provide novel concepts that can be key for designing a radically new system such as 6G. At the same time, it is important to enabling such revolutionary technology developments to stay 'green' and take into account major environmental concerns, such as climate change, which can be achieved by novel, 'green' digitalized business models.

This workshop is held jointly with the CTIF Global Capsule (CGChttps://ctifglobalcapsule.org/), the Global ICT Standardization Forum for India (GISFIgisfi.org), and is technically sponsored by IEEE (ieee.org) and by Wireless World Research Forum (WWRF-wwrf.ch). The event will span over two days and feature invited talks by external and CGC experts on various research challenges related to 6G and enabling technologies.