

THE IEEE SUMMIT - 5G IN FUTURE AFRICA

The role of IoT, cognitive radio and cybersecurity in networking the next billion

Date: Wednesday, 3 May 2017

Venue: Engineering I Exhibition Space, UP main campus

Time: 7.30 AM

07:30-08:00 ---- Registration and refreshments

08:00-08:15 ---- **Introduction** by Professor Sunil Maharaj, Dean, EBIT Faculty, UP

08:15-08:30 ---- **Welcome, by Professor N. Duncan**, Vice-Principal Academic, UP

Session Chair: Professor Sunil Maharaj

08:30-09:15 ---- **A Practical Network Evolution to 5G**, Hugo van Zyl, CTSO

09:15-10:00 ---- **Heterogeneous V2X Networks for Connected and Automated Vehicles**, Dr. Javier Gozalvez, Associate Professor Universidad Miguel Hernandez de Elche, Spain

10:00-10:30 ---- Break for refreshments

Session Chair: Professor A. S. Alfa

10:30-11:15 ---- **Advanced Radio Access Solutions for the New 5G Requirements**, Dr. Sami Tabbane and Dr. Soumaya Hamouda, Sup'Com and University of Carthage, Tunis, Tunisia

11:15-12:00 ---- **The Internet of People and Things (IoPT): What will 5G-Enabled Applications Look Like?**, Dr. Ed Coyle, John B. Peatman Distinguished Professor and GRA Eminent Scholar, Georgia Institute of Technology, USA

12:00-13:30 ---- Lunch

Session Chair: Dr. Soumaya Hamouda

13:30-14:00 --- **Current Research and Standardization Activities on TCP in 5G Type Networks**, Dumisa Ngwenya, CTO, Sentech Pty Ltd, South Africa

14:00-14:30 --- **Is Affordable Broadband in 5G a Challenge or an opportunity?**
Dr. F. Mekuria, Chief Scientist, CSIR

14:30-15:00 --- Break for refreshments

Session Chair: Professor Albert Helberg

15:00-15:30 --- **Mathematical Modelling; its Role in "Squeezing" the Most Out of 5G for the IoT**, Dr. A. S. Alfa, SARChI Chair, University of Pretoria and Professor, University of Manitoba, Canada

15:30-16:00 --- **Cognitive radio and spectrum in SA**, Dr. Albert Helberg, Professor, Northwest University, SA

16:00-16:30 --- **From TVWS experimentation towards 5G**, Dr. Albert Lysko, CSIR

16:30-17:00 --- **Plenary Discussion and closing**

17:00-18:30 – **Cocktail, Snacks and Networking**

SUMMIT SPEAKERS, TALK TITLES AND ABSTRACTS

1. Title: Is Affordable Broadband in 5G a Challenge or an Opportunity?

Abstract:

The 5th generation mobile standard is under construction through several standards organizations, research and industry forums. However, several IEEE COMSOC technology papers criticised the existing version (Rel. 14/15) of the 5G standard for being an urban standard and lacking features such as affordable broadband network and RAN technologies, to support the broadband connectivity of rural communities in emerging economies. Dynamic spectrum access networks (DSAN) are one such network technologies that is being tested and expected to extend the reach of broadband and 5G standards based services such as Smart_communities and IoT for rural applications. The presentation will highlight research based contributions based on emerging technologies such as spectrum database assisted networks and spectrum sharing techniques being proposed for 5G standards. Furthermore the session will provide the outcomes of the recent IEEE DySPAN2017 Symposium and panel discussion on DSA and Affordable broadband in 5G, with proposed technological and regulatory innovations to enable affordable broadband for underserved communities in Africa.

Speaker Profile:

Dr. F. Mekuria, Chief Research Scientist, CSIR, South Africa. (fmekuria@csir.co.za). He leads the 5G and Affordable Broadband Networks research at the CSIR. He is the proponent of a 4th leg for the 5G standards aimed at technologies for addressing the next billion underserved population in emerging economies. He has a PhD from Linköping University, in Sweden, and has a past as senior research Engineer at Ericsson Mobile Communications R&D lab in Sweden.



2. Title: Heterogeneous V2X Networks for Connected and Automated Vehicles

Abstract:

Connected vehicles will rely on V2X communications to improve traffic safety and management. V2X communications can also facilitate the development of cooperative driving and sensing applications for automated vehicles. The automotive industry is currently working to deploy connected vehicles that will initially rely on the IEEE802.11p/ITS-G5 standard. At the same time, the cellular industry has started the evolution of 4G LTE and 5G standards to integrate V2X communications, and has identified the automotive sector as one of the key verticals in the development of 5G. A massive deployment of connected and automated vehicles requires the capacity to provide reliable, scalable, and low-latency V2X communications. Providing such levels of quality of service is a challenge, and this presentation will discuss the need, opportunities and challenges for 5G and heterogeneous V2X networks to support connected and automated vehicles.

Speaker Profile:

Javier Gozalvez received an electronics engineering degree from the Engineering School ENSEIRB (Bordeaux, France), and a PhD in mobile communications from the University of Strathclyde, Glasgow, U.K. Since October 2002, he is with the Universidad Miguel Hernández de Elche (UMH), Spain, where he is currently an Associate Professor and Director of the UWICORE laboratory. At UWICORE, he leads research activities in the areas of vehicular networks, multi-hop cellular networks and D2D communications, and wireless industrial networks. He has published over 125 papers in international conferences and journals. He has received several awards at international and national conferences, the best research paper award from the Journal of Network and Computer Applications (Elsevier) in 2014, and the Runner-up prize for the "Juan López de Peñalver" award of the Royal Academy of Engineering in Spain that recognizes the most notable Spanish engineers aged below 40. He is an elected member to the Board of Governors (2011-2016) and 2016-2017 President of the IEEE Vehicular Technology Society (IEEE VTS). He was an IEEE Distinguished Lecturer for the IEEE VTS, and currently serves as Distinguished Speaker. He served as Mobile Radio Senior Editor of the IEEE Vehicular Technology Magazine, and is now on the Editorial Board of Computer Networks and Mobile Information Systems. He was the General Co-Chair for the IEEE VTC-Spring 2015 conference in Glasgow (UK), ACM VANET 2013, ACM VANET 2012 and ISWCS 2006, and TPC Co-Chair for 2011 IEEE VTC-Fall and 2009 IEEE VTC-Spring.



3. Title: Current Research and Standardization Activities on TCP in 5G type Networks

Abstract:

5G will consist of Narrowband (NB-5G), emanating from Narrowband IOT (NB-IOT), as well as Mobile Broadband. The aim in 5G Mobile Broadband is scaling up in performance and mobility, while for NB is scaling down in complexity and power. In all instances, to provide user satisfaction, the performance of transmission control protocol (TCP) needs to be enhanced. Complex interactions between 5G type networks and TCP are starting to be explored. The talk will look at expected problems associated with TCP in 5G type networks, and research and standardization activities currently underway.

Speaker Profile:

Dumisa Ngwenya, Chief Technology Officer of Sentech, has over 20 years' experience in the ICT industry. He promulgated the current form of the national radio frequency spectrum plan and the broadcasting frequency plan in South Africa and started the regulatory processes for DTT migration while at ICASA. He has been a champion of various radio frequency spectrum reforms in South Africa and initiated several research collaborations between industry and academia.

Mr Ngwenya has held various senior positions in companies such as ICASA, Alcatel, Altech, Dimension Data and PowerTech IST as well as lecturing at the University of Pretoria. He was the Research Group Leader in wireless technologies and networking at the Council for Scientific and Industrial Research (CSIR). He is a Senior Member and Council member of the South African Institute of Electrical Engineers (SAIEE) and previously a Council member of the institute. Mr Ngwenya has written and reviewed technical papers in wireless technologies and networking and served in numerous technical committees.



4. Title: The Internet of People and Things (IoPT): What will 5G-Enabled Applications Look Like?

Abstract:

Higher data rates, lower latencies, higher user densities, and full convergence of voice, data, video, M2M, V2V, etc. communications are expected with 5G systems. The question that naturally arises with forecasts such as these is what new applications will such systems enable and what research must be carried out to understand them and make them possible. We focus in this talk on a large-scale project we have underway at Georgia Tech that we call the Internet of People and Things (IoPT). Our IoPT exists for the duration of a large-scale event, a football game. It encompasses event-related data, such as the game itself; sensed data from the venue and the crowd; services provided to event attendees, vendors, and administrators; and activities leading up to and after the event. The most interesting aspects of this project from a 5G point of view is the extreme density of users (60,000+devices/km²), the wide variety of information types (data, voice, images, video), and the range of latency requirements (real-time, near real-time, non-real-time, etc). All of the above appear in three systems that we have researched, developed and deployed in the stadium: Sensor networks for monitoring RF-Spectrum usage, structural vibrations, and the game itself; and applications that fuse all of this sensed information and make it available to attendees and stadium operations. We will provide an overview of the systems themselves and the theoretical work that they have inspired in large scale WSN's and data fusion.

Speaker profile:

Edward J. Coyle is the John B. Peatman Distinguished Professor of Electrical and Computer Engineering at the Georgia Institute of Technology and a Georgia Research Alliance Eminent Scholar. He is the Founder and Director of the Vertically Integrated Projects (VIP) Program, which integrates research and education by embedding large-scale, long-term teams of undergraduates in the research efforts of faculty and their graduate students. He is also the Director of the VIP Consortium, a set of 24 universities that have VIP Programs and work together to improve and disseminate it. Dr. Coyle was a co-recipient of the U.S. National Academy of Engineering's 2005 Bernard M. Gordon Prize for Innovation in Engineering and Technology Education. In 1998, Dr. Coyle was elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for his contributions to the theory of nonlinear signal processing. He has received a number of other awards, including the 1997 Chester F. Carlson Award from the American Society for Engineering Education and the 1986 Best Paper Award from IEEE Signal Processing Society. His current research interests include signal and information processing, wireless and sensor networks, and systemic reform of higher education.



5. Title: Advanced radio access solutions for 5G

Abstract:

In the current 5G huddle, different visions are designed for what will be the next radio mobile generation. On the one hand, some are still defending the traditional “generation-defining” view which consists in developing new radio interface with specific data rate and latency targets. On the other hand, more voices are calling for a hyper-connected vision in which mobile operators would create a blend of pre-existing technologies covering 2G, 3G, 4G, WiFi and others to allow higher coverage and availability, and higher network density in terms of cells and devices. They especially appeal for a greater connectivity capable of supporting Machine-to-Machine (M2M) services and the Internet of Things (IoT). But, whatever these visions, it is now certain that the next 5G networks will have to handle a huge amount of data and connected devices. However, this reality will bring new challenges different from the previous generations. Now, it is not just a question of providing more spectrum efficiency, more bandwidth, more antennas or more small cells to face the growing data rate demands. Yet all this is essential and still attracts much attention, but more importantly, the next 5G network goal is to ensure a high energy harvesting. Currently, the percentage of the global world CO2 emissions due to Information and Communications Technology (ICT) is estimated to be 5%. If no countermeasure is taken, the energy demand to operate and serve this massive number of devices will become unmanageable, and the resulting greenhouse gas emissions and electromagnetic pollution will exceed safety thresholds. A promising answer to this issue lies in optimizing the Energy Efficiency of the system, i.e., in minimizing the amount of energy required to transmit data. This presentation will tackle the different technology enablers that help meet the new objectives of the next 5G network. It will particularly focus on the advanced radio access solutions for a better Energy Efficiency in 5G.

Speaker Profile:

Dr. Soumaya Hamouda received her engineering degree in Electrical Engineering and his DEA (Master) in Communication Systems from the National Engineering School of Tunis (ENIT, Tunisia) in 1998 and 2000 respectively. In 2007 and 2015, she completed a Doctorate (PhD) and a "Habilitation Universitaire" Degree in Technologies of Information and Communication from the Telecommunications Engineering School of Tunis (Sup'Com, Tunisia). Currently, she is an Associate Professor in Telecommunications, coordinator of the Professional Master in Telecommunication Network Technologies at the Faculty of Sciences of Bizerte (Tunisia), and also a member of the Research Laboratory in radio mobile networks and multimedia MEDIATRON, Sup'Com. Her research interests cover radio resource allocation, spectrum sharing, MAC protocols and mobility management in 4G/5G, wireless and cognitive radio networks. She is the author of several articles in IEEE conferences and journals and served as a Technical Program Conference (TPC) member of several IEEE conferences as well. She participated in several

international research projects with INRIA-Rennes (France), ETRI (Korea), UAB/CTTC (Spain) and University of Pretoria (South Africa).



Prof. Sami Tabbane is a professor at the engineering school of communications of Tunis Sup'Com. He is a specialist in mobile radio communication systems. He graduated from the Ecole des Mines de Paris (France) in 1998 and obtained a Doctorate from the Ecole Nationale Supérieure des Telecommunications de Paris (ENST) in 1991. He began his career at France Telecom from 1992 to 1994 and was recruited by Sup'Com in 1994. He has conducted numerous missions for the ITU in the field of mobile network planning, management and training, and spectrum management in organizations regulations. He's co-authors of several IEEE conference and journal papers. He is the co-author of "GSM Networks" (Hermes, 1995) and "Engineering Services Telecommunications" (Hermes-Lavoisier, 2005). He is the author of "Mobile Networks" (Hermes, 1997), "Manuel mobile networks" (Artech House, 2000), "Engineering of Cellular Networks" (Hermes-Lavoisier, 2002). He served as a co-chair/session chair for several IEEE conferences.



6. Title: TVWS experimentation towards 5G

Abstract:

The talk introduces the television white space (TVWS) experimental work carried at CSIR in support of introducing the dynamic spectrum access (DSA), and discusses the possibilities afforded by the DSA for 5G.

Speaker bio:

Albert Lysko has Masters in Radiophysics from St-Petersburg State Technical University and PhD in ICT from Norwegian University of Science and Technology.

Dr Lysko has over 15 years of experience in industrial research, development and testing as well as in academic work. He has lead and worked in projects on in wireless, radio wave propagation, antennas (including smart low power antennas), numerical analysis, telecommunications, real time data acquisition systems for industrial applications (incl. delay-tolerant communications and database), and software development. He was the CSIR technical leader in Cape Town television white space (TVWS) project and played advisory roles in 3 more large trials supplying Internet connectivity to over 20,000 users. He has also supervised Masters and PhD students and gave several courses.

Dr Lysko is a holder of two patents, has lead three CSIR technology demonstrators, authored or co-authored a book, two book chapters, over 60 research papers and a number of popular and news articles. He was also a contributor to two IEEE industrial standards (one already published). He was a General Chair for the conference ICACCE in 2016, organized and chaired several courses and conference sessions and is a Chair for IEEE South Africa. He was a South African representative in EU Cooperation in Science and Technology (COST) Action IC1102 "Versatile, Integrated, and Signal-aware Technologies for Antennas" (VISTA) and is the current representative in EU COST Action CA15104 "Inclusive Radio Communication Networks for 5G and beyond" (IRACON).



7. Title: Mathematical Modelling: Its Role in “Squeezing” the Most Out of 5G for the IoT

Abstract:

The IoT is well known as a technology that would allow devices to be sensed and controlled remotely. It depends strongly on the sensor networks, data collected, the ability for the devices to exchange data in the network with low latency, carry out some analysis, implement programmed decisions, and provide feedback in a timely manner. It is thus apparent that network capacity is essential in order to achieve excellent latency which is key to timely decision making. The new technology, 5G, ultimately promises high capacity in networks. Thus the technical features of the 5G, as defined and envisaged, would help achieve the high level of performance IoT expected. Given that the 5G technology will now have the required resources to order provide the promised level of IoT, one issue that needs to be addressed is how to “squeeze” the most out of the 5G enabled additional capacity to achieve the ultimate goal of IoT. One of the answers is providing excellent mathematical models and analysis that allow us to “squeeze” the most out the increased capacity, through the use of optimization and queueing theory. This presentation will elaborate how this can be achieved.

Speaker Profile:

Alfa is affiliated with the University of Manitoba, Canada and the University of Pretoria, South Africa, where he is a SARChI Chair. His interests and background are in the area of mathematical modelling of communication networks. He has published several papers in the area of queueing theory, optimization, and their applications to wireless sensor networks, cognitive radio networks, and several other areas of engineering.



8. Title: A practical Network Evolution to 5G

Abstract:

The evolution to 5G presents various practical considerations that any Network operator needs to address as this path is undertaken. Technology advancements such as SDN & NFV as well as the maintenance of the Legacy air interface are considerations that need to ensure the smoothest evolution to a 5G Network. The finite resource, Spectrum, needs to be well balances to not to displace the legacy Revenue generating subscribers. As Wireless Networks grow, their reliance on Wired Networks grow proportionally. How will the evolution of the Wired Network complement the road to 5G.

Speaker Profile:

Hugo van Zyl is the chief technology and systems officer at OpenServe, South Africa. He has a background in telecommunications, having held various leadership positions at Vodacom and Nokia Siemens before joining the Telkom team in 2008. Since then, his many management roles have insured the excellence of the company's offering.

