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Monday Plenary Keynotes

Monday 5 June 2017, 9:00–9:45 (Parkside 1)
Meeting the Technical, Political and Economic Aims of 5G
Adrian Scrase, *ETSI, France*

Standards for the 5G Mobile Communications System are being developed by 3GPP with increased urgency, as operators accelerate their deployment ambitions. Architectural plans are maturing and technology choices are being made, based on the results of regional and national research activities. This presentation will consider the resulting characteristics of the new radio interface and core network, the timeline for standards completion and operator priorities. The substantial 5G building blocks under preparation within ETSI will also be addressed, together with the impact they will have on 5G system performance. Since the digital transformation of industry (resulting in increased GDP) remains an overall objective for 5G, this presentation will also consider the extent to which the ICT industry is engaging other industry sectors in the 5G design process, to ensure that their requirements are properly captured.

Adrian Scrase played a central role in the creation of the "3rd Generation Partnership Project" (3GPP) and is responsible for the operations of the 3GPP Project Co-ordination Group. He heads 3GPP's Mobile Competence Centre (MCC) which is an International team of 20 experts who provide comprehensive support to the Project. He was also principally involved in the formation of the recently created "oneM2M" Partnership Project and oversees ETSI's support to that initiative. He is CTO within ETSI with operational responsibility for all of ETSI's standards production activities. He has more than 30 years experience in the telecommunications field, which includes 25 years of experience in standardization.

Monday 5 June 2017, 9:45–10:30 (Parkside 1)
The Perfect Storm: IT + CT + DT
Chih-Lin I, *China Mobile, China*

The notion of ICT convergence has been around since the 1980's. However until recent years that convergence has been superficial. For the most part, IT and CT have been evolving on distinct paths with their respective nature: Soft and Agile v.s. Hard and High Performance. As we seek solutions to meet diversified scenarios and various extreme requirements in 5G era, it is clear that we must build on the deep and true convergence of IT, CT and a younger revolutionary power, the data technology (DT). This talk will share the exciting and challenging journey of the deep CT+IT+DT convergence, and CMCC's perspectives on the E2E 5G solutions threading through the core network, the access network, and the air interface.

Chih-Lin I received her Ph.D. degree in electrical engineering from Stanford University. She has led R&D in AT&T Bell Labs; as Director of AT&T HQ, Director of ITRI Taiwan, and VPGD of ASTRI Hong Kong. She received the IEEE Trans. COM Stephen Rice Best Paper Award, is a winner of the CCCP National 1000 Talent Program, and has won the 2015 Industrial Innovation Award of IEEE Communication Society for Leadership and Innovation in Next-Generation Cellular Wireless Networks.

In 2011, she joined China Mobile as its Chief Scientist of wireless technologies, established the Green Communications Research Center, and launched the 5G Key Technologies R&D. She is spearheading major initiatives including 5G, C-RAN, high energy efficiency system architectures, technologies and devices; and green energy. She was an Area Editor of IEEE/ACM Trans. NET, an elected Board Member of IEEE ComSoc, Chair of the ComSoc Meetings and Conferences Board, and Founding Chair of the IEEE WCNC Steering Committee.

She was a Professor at NCTU, an Adjunct Professor at NTU, and currently an Adjunct Professor at BUPT. She is the Chair of FuTURE 5G SIG, an Executive Board Member of GreenTouch, a NOC Founding Member of ETSI NFV, a Steering Board Member of WWRF, the Publication Chair and ComSoc Rep of IEEE 5G Initiative, a member of IEEE ComSoc SDB, SPC, and CSCN-SC, and a Scientific Advisory Board Member of Singapore NRF. Her current research interests center around "Green, Soft, and Open".

Monday Industry Track: 5G and Wireless

Monday 5 June 2017, 11:00–12:30 C3-2
Mobile Xhaul Network for 5G RAN Evolution
Huyn Kyu Chung, *ETRI, Korea*

For 5G mobile communication services, it is expected that small cells will be more densely deployed and moving network could be a key feature to accommodate various 5G service requirements. Based on these technical trends, it is necessary to study technical solutions to support network mobility and to provide wireless connectivity to functional entities within radio access network (RAN) with scalable and flexible manner. In this talk, the Mobile Xhaul Network (MXN) will be introduced which is the ongoing research project as a way to provide wireless transport connectivity to 5G RAN including moving cell via Xhaul link consisting with front-haul, mid-haul and backhaul. Currently, the MXN project is focusing on network architecture and essential radio transmission technologies such as MIMO and beamforming with millimeter wave on 28GHz frequency band. In this talk, as a preliminary study of MXN, a wireless backhaul solution for moving network, called Mobile Hotspot Network (MHN) will be introduced, which is one of candidate technologies for mobile backhaul commercial solutions in the metro environment in Seoul, Korea.

Dr. Hyun Kyu Chung is a vice president of ETRI(Electronics and Telecommunications Research Institute) and head of 5G Giga-communications Research Laboratory. In this role, he is responsible for mobile communication R&D and CPND(Contents, Platform, Network and Device) technologies for the Giga-Korea Project in ETRI. He received B.S. degree from Seoul National University in 1985 and his master degree on electrical engineering from KAIST in 1988. Then, he joined to KT(Korea Telecom) in 1988 as a researcher. After moving his career to SK Telecom in 1993, he had served as a researcher for deploying world-first CDMA commercial networks in Korea. Since then, he had served as head of SK Telecom U.S. R&D Center at Fairfield, New Jersey. In U.S. he pursued Ph.D. degree in electrical engineering in Polytechnic institute of NYU, Brooklyn, New York, where his research interest was wave propagation for mobile communications. After his doctoral degree in 2000, he joined to Lucent Technologies in New Jersey as a member of technical staff and then joined ETRI in 2001.

Monday 5 June 2017, 11:00–12:30 C3-2
Toward 5G Deployment in 2020
Takehiro Nakamura, *NTT DOCOMO, Japan*

5G is one of the hot topics in ICT industry and academia. So many deliverables have been published and reported by many 5G research activities so far. On the other hand, we are shifting to development phase toward 5G commercial deployment. Major ICT industry companies including NTT DOCOMO have already announced their aggressive time plan to launch 5G. Standardization work is on-going to specify 5G specifications in 2017-2018. NTT DOCOMO has been so active for 5G research and development to launch 5G commercial service by 2020. In this presentation, DOCOMO's views on time plan, NW deployment & migration scenarios, spectrum deployment scenarios for 5G deployment by 2020 will be provided and an update on DOCOMO's 5G trial.

Takehiro Nakamura joined NTT Laboratories in 1990. He is now VP and General Director of 5G Laboratory in NTT DOCOMO, Inc. Mr. Nakamura has been working for research and development of the W-CDMA, HSPA, LTE/LTE-Advanced, 5G and Connected Car technologies. He has been engaged in the standardization activities for the W-CDMA, HSPA, LTE/LTE-Advanced and 5G at ARIB in Japan since 1997. He is currently the leader of 2020 and Beyond Ad Hoc(20B AH) in ARIB and Acting Chairman of the Strategy & Planning Committee in 5G Mobile Communication Promotion Forum(5GMF) in Japan. He has been contributing to standardization activities in 3GPP since 1999, and to 3GPP TSG-RAN as a vice chair during March 2005 to March 2009 and chair during April 2009 to March 2013.

Monday 5 June 2017, 14:00–15:30 C3-2
The Path to 5G
David Soldani, *Nokia, Germany*

The talk introduces the most important use cases, within the three agreed usage scenarios, and spotlights on different regions. It then describes the main differences between 5G and LTE, and presents a simplified, flexible data centric architecture with generic procedures, the most important 5G enabling technologies for a new generation of latency critical services, and related experimental results. The talk concludes with an overview of global 5G plans and milestones, with special focus on the 3GPP standardization framework

David Soldani received a M.Sc. degree, Laura Vecchio Ordinamento, in Electronic Engineering with magna cum laude

from Università degli Studi di Firenze, Italy, in 1994; and a D.Sc. degree in Technology with distinction from Helsinki University of Technology (Aalto University), Finland, in 2006. In 2014 and 2016, he was appointed Visiting Professor and Industry Professor at University of Surrey, UK, and University of Technology Sydney, Australia, respectively. From 1997 to 2006 he was at Nokia in various technical and research management positions. From 2007 to 2009 he served at Nokia Siemens Networks (NSN) as Head of Customer Networks & Solutions and Solutions & Services Innovation functions, Research Technology & Platforms (RTP), Munich, Germany. Prior to joining Nokia, he was a research engineer at Rohde & Schwarz (R&S) and Sirti S.p.A., in Milan, Italy, and officer (lieutenant) at the Italian Military Navy, Livorno, Italy. From Feb 2009 to Aug 2016, he was at Huawei European Research Centre, Munich, Germany, as Head of Central Research Institute (CRI) and VP Strategic Research and Innovation, in Europe; and represented Huawei in the Board of Directors of The 5G Infrastructure Association (5G-IA) and NetWorld2020 European Technology Platform (ETP), in Europe. He is currently back at Nokia serving as the Head of 5G Technology, End to End, Global. Areas of his responsibilities and expertise include, but not limited to: future wireless, network, big data value, computing, IoT and multimedia technologies.

Monday 5 June 2017, 14:00–15:30 C3-2
5G: "From Vision to Reality"
Wonil Roh, *Samsung, Korea*

With the ever-increasing demands on mobile data traffic, stronger requirements on latency and reliability of novel mobile services, it becomes more challenging to meet those diverse needs by sheer migration of the existing cellular technologies. Consequently, 3GPP set out 5G standardization to accommodate those needs with evolutionary technologies in April 2016. Samsung's innovative and pioneering technologies are now being used in the most advanced 5G trials yet and are helping to lay the foundation of critical 5G standards. Through research partnerships spanning the industry value chain, Samsung and its global partners are now demonstrating the viability of some of the first practical use cases, including fixed wireless access. The industry is now in need of productive ecosystem spanning the entire value chain that is capable of delivering on the promises of 5G. Samsung is actively working to make that a reality, in order to kick start tangible 5G applications.

Dr. Wonil Roh is currently a Vice President and Head of Communications Research Group at Samsung Electronics Corp in Korea, responsible for research and development of next generation mobile communications technologies. He started working at Samsung Electronics in 2003 in research and development of CDMA and Mobile WiMAX base-stations with the main focus on multi-antenna algorithms and system analysis. Then he led overall WiMAX standard activities and strategy in Samsung including IEEE, the WiMAX Forum and ITU-R, and served as Chair of Technical Working Group (TWG) of the WiMAX Forum from 2006 to 2011. Since 2011, he has been leading research efforts for the next generation cellular (Beyond 4G or 5G) technologies with a focus on development of disruptive technologies and feasibility studies. Dr. Roh holds a Doctorate in Electrical Engineering at Stanford University in USA.

5G CHAMPION: 28 GHz 5G Proof-of-Concepts at 2018 Winter Olympic Games
Emilio Calvanese Strinati, *CEA, France*

5G – Next Generation Communication Networks – will be a global game changer from a technological, economic, societal and environmental perspective. The 5G CHAMPION develops, prototype and trials key enabling technologies for a proof-of-concept environment to be showcased at the 2018 Winter Olympics in PyeongChang, Korea. This will allow maximum visibility for the available technology two years ahead of 2020, i.e. the official launch of 5G. Key enabling technologies included in the 5G PoC include i) a complex 5G set-up operating inside and close to the PyeongChang Olympic venue, addressing indoor and outdoor propagation channels in mmWave & below 6GHz spectrum; ii) high-speed broadband connection via mmWave high capacity backhaul in 24-28 GHz, using novel antenna arrays for wireless back/front-hauling, enabling the provision of >2Gbps; iii) advanced evolved packet core solutions for efficient system management with virtualization through NFV/SDN as well as a novel SDN-based IPsec tunnel architecture; iv) novel accurate positioning solutions (<1m accuracy) using mmWave combined with GNSS PPP; v) direct UL/DL communication between satellites and 5G User Equipment 'as is' – a corresponding first ever proof-of-concept will set-up; vi) better mobility support through a novel small cell architecture & hybrid adaptive beamforming. The overarching objective is to achieve a highly energy-efficient system approach.

Dr. Emilio Calvanese Strinati obtained his Engineering Master degree in 2001 from the University of Rome 'La Sapienza' and his Ph.D in Engineering Science in 2005 on Radio link control for improving the QoS of wireless packet transmission. He then started working at Motorola Labs in Paris in 2002. Then in 2006 he joint CEA/LETI as a research engineer. From 2007, he becomes a PhD supervisor. From 2010 to 2012, Dr. Calvanese Strinati has been the co-chair of the wireless working group in GreenTouch Initiative which deals with design of future energy efficient communication networks. From 2011 to 2016 he was the Smart Devices & Telecommunications European collaborative strategic programs Director. Since December 2016 he is the Smart Devices & Telecommunications Scientific and Innovation Director. In December 2013 he was been elected as one of the five representative of academia and research center in the Net!Works 5G PPP ETP. He is currently one of the three moderators of the 5G future network expert group. Since 2016 he is the coordinator of the H2020 joint Europe and South Korea 5G CHAMPION project. E. Calvanese Strinati has published around 100 papers in international conferences, journals and books chapters, given more than 50 international invited talks and keynotes and is the main inventor or co-inventor of more than 60 patents. He has organized more than 50 international conferences, workshops, panels and special sessions on green communications, heterogeneous networks and cloud computing hosted in international conferences.

Understanding the Need and Application of 5G in a Ubiquitous 4G World
Ray Owen, *Nokia, Australia*

With 4G wireless services in the maturity phase, 5G wireless is on the horizon with Phase 1 standardisation end 2017. This talk will explore the different applications for 5G over and above the 4G available today. The 4G applications have evolved quickly to take advantage of broadband connectivity. Using 5G there will be a next generation of applications taking advantage of extremely low latency and even higher broadband connectivity performance. The Pacific region is expected to lead in advanced automation and advanced analytics for "connected" innovation. The presentation will focus on the needs of different applications and the business rational for going beyond 4G wireless into 5G. Finally the presentation will consider the steps to 5G including architecture changes and the air interface changes to support the 2020 commercial launch of 5G.

As the Market Unit Head Oceania, for Nokia Networks, **Ray Owen** is responsible for managing all Nokia Networks' sales and operations across the market unit. Ray brings with him an in depth experience in the telecom industry and a proven track record of more than 20 years in various customer facing sales, marketing, R&D and leadership roles. Prior to joining Nokia as the Head of Sales Development of Asia Pacific for Nokia Networks in 2011, Ray was Head of Technical Marketing & Pre-Sales for Motorola's Networks business, Asia Pacific where he had responsibility for Motorola's networks portfolio and leading the strategy, technical marketing and solution architect teams. He had also held various roles across the Asia Pacific and EMEA regions for Motorola as General Director in Vietnam, director of network products and Chief Architect for Motorola's first 3G roll out in Australia as well as R&D management positions in the UK. Ray's achievements include winning Vietnam's first 3G network rollout with VNPT for Motorola and then ensuring Vietnam's first 3G services was launched. Based in Sydney, Ray holds a BSc degree in Electrical & Electronic Engineering from the University of London and a PhD from the University of Birmingham.

Mobile Edge Computing: Paradigm Shift in End-User Computing with Service Aware Radio Access Networks
Brian Hutson, *Juniper Networks, Australia*

End-User Computing has come a long way in last few decades since its adolescent age. With smart devices and smartphones becoming our everyday companions, the ubiquitous mobile Internet and computing applications transfuse people's daily lives. With surge in demand for high-quality mobile services anytime-anywhere, to address the omnipresent user demand, and accommodate the explosive growth of mobile traffic are some of the key issues that remain to be answered by the next generation mobile networks. Mobile Edge Computing (MEC) is a natural development in the evolution of mobile base stations and the convergence of IT and Telecommunications networking; as it aims to place compute and storage resources in the Radio Access Network (RAN) to improve the delivery of content and applications to end users. MEC has the agility to empower new vertical business segments and services for consumers and enterprise customers. In this talk, we outline the main features of MEC pertinent to Service Aware RAN (SRAN) and describe its concept, architecture, and design goals. We discuss some of the future research topics from the networking perspective.

Brian Hutson joined Juniper Networks in July 2007 and is the Director of the Center of Excellence for Asia Pacific. In this role, Brian leads a team of senior consultants who are focused

on providing best practice architecture and expertise in emerging technologies for Juniper's customers in APAC. Additionally, Brian is Juniper's media spokesperson for Cloud in APAC and is responsible for driving, developing and evangelizing Juniper Networks solutions in Cloud Computing for customers throughout the Asia Pacific region. Brian has spent more than 20 years designing and implementing IP networks and security architectures and designs. He has worked as a security architect, network designer and Infrastructure manager for a variety of organisations both Service Provider and Enterprise. Prior to Juniper Networks Brian had over 12 years' experience performing a variety of functions including: IP networking design and architecture, security architecture, design, auditing and review, CoBiT auditing and compliance, web application design, forensic analysis, systems management, disaster recovery, performance measurement and capacity planning.

Monday 5 June 2017, 16:00–17:30 C3-2
Architecture & Implementation of Multi-Antenna Communication Systems for 5G Networks
Karl Nieman, *National Instruments, USA*

Multi-antenna technologies are a key enabler of 5G's ambitious goals to drastically enhance network capacity and quality of service. In sub-6 GHz bands, MIMO dimensions must considerably scale to more efficiently use limited spectrum. In above-6 GHz bands, beamforming and hybrid MIMO architectures are essential to overcome propagation losses and achieve cost-effective deployments. In both cases, it is necessary to support wide system bandwidths and a multitude of other requirements that contribute to higher system complexity versus 4G predecessors. This talk will discuss some of these challenges as they pertain to the development and implementation of real-time, multi-antenna 5G system prototypes. It will cover details of achieving real-time performance with high MIMO dimensions and bandwidths by implementing distributed, high-throughput signal processing in a unified hardware and software framework. It will also share lessons learned in system design and over-the-air results from several industry and academic partners.

Dr. Karl Nieman is a Senior Wireless Platform Architect in the Advanced Wireless Research team at National Instruments. His interests are with research and standardization of 5G technology, particularly high-channel count digital and hybrid MIMO architectures and signal processing. He has designed and implemented many FPGA-based real-time wireless communication systems, has made multiple contributions to 3GPP RAN1, and holds multiple issued and pending patents on 5G technologies.

Tuesday Plenary Keynotes

Tuesday 6 June 2017, 9:00–9:45 (Parkside 1)
No Cell Networks
Wen Tong, *Huawei Technologies Co., Inc.*

In this talk, we present the latest 5G new radio (NR) air-interface technologies and new radio access networks architecture. The migration of the wireless networks with the latest cloud-edge-computing infrastructure opens the opportunity for user-centric access networking protocol to remove the classical cellular networking principle. Furthermore, for out-door macro-cell deployment, such a cloud RAN based the architecture will enable the Ahlsewde multi-user theoretical optimal scheduling methodologies to further enhance the average cell spectral efficiency and cell edge throughput. For indoor micro-cell networks, we present a novel mmWave-pencil-beam access architecture, based on the latest multi-user channel measurement results; we show that spatial re-use factor can be increased by more than 8 times while minimizing the beam-switching and beam-searching gap time, in particular, for the use the unlicensed spectrum, this architecture can minimize the need for carrier-sensing-multiple-access protocol. The user-centric-no-cell (UCNC) architecture can also drastically reduce the access latency, access protocol signaling and increase the number of connection links.

Dr. Wen Tong is the Huawei Fellow, CTO, Huawei Wireless. Prior to joining Huawei in March 2009, Dr. Tong was the Nortel Fellow and global head of the Network Technology Labs at Nortel. He joined the Wireless Technology Labs at Bell Northern Research in 1995. He had pioneered fundamental technologies from 1G to 4G wireless with 350 granted US patents. Since 2010, Dr. Tong is the vice president of Huawei wireless research. In 2011, he was appointed the Head of Communications Technologies Labs of Huawei, where he currently leads 5G wireless research and development. Dr. Tong was elected as a Huawei Fellow and an IEEE Fellow. In 2014, he was the recipient of IEEE Communications Society Industry Innovation Award for "leadership and contributions in development of 3G and 4G wireless systems". Dr. Tong serves as Board of Director of WiFi Alliance and he is a fellow of Canadian Academy of Engineering.

Tuesday 6 June 2017, 9:45–10:30 (Parkside 1)
How Soon Can We Achieve a Fully Autonomous Transport System?
Hugh Bradlow, *Telstra Corporation, Australia*

Human drivers kill. Eliminating the human element from our transport systems will save lives and remove a significant burden from our health system (approximately 10% of hospitalisation injuries are due to road accidents). Global investment dictates that autonomous vehicle (Level 4) technology will be available within the next decade. This raises the important question as to how soon we can eliminate all human control from our road system and what regulations and infrastructure will be required to achieve this desirable goal. This presentation will examine some of the key considerations required to achieve a fully autonomous road system and how quickly we can feasibly bring this about.

Hugh S. Bradlow is President of the Australian Academy of Technology and Engineering, and Chief Scientist at Telstra Corporation. In the latter role he acts as a "forward scout" looking at the longer term technology directions and technology disruption that will impact Telstra and its customers. Prior to becoming Chief Scientist he was Chief Technology Officer and Head of Innovation at Telstra, responsible for the introduction of new technologies into Telstra's business. Before joining Telstra in September 1995, Professor Bradlow was Professor of Computer Engineering at the University of Wollongong in Australia and Professor of Electrical Engineering (Digital Systems) at the University of Cape Town. Professor Bradlow is a graduate in electrical engineering from the University of Cape Town in 1973 and received the D.Phil. degree for research in experimental nuclear physics from the University of Oxford. He is an Emeritus Professor of the University of Wollongong, a Professorial Fellow of the University of Melbourne, and a recipient of a Centenary Medal from the Commonwealth of Australia. He is globally recognised as a thought leader in telecommunications and was elected as the joint 2009 Australian Telecommunications Ambassador of the Year, named by Global Telecom Business as one of the most 100 most influential telecommunications executives in the world and Smart Company designated him as one of the 12 most influential people in Australian ICT.

Tuesday Industry Track: Smart Transport and Logistics

Tuesday 6 June 2017, 11:00–12:30 C3-2
Vehicle Detection for Intelligent Transportation Systems: Historical Evolution & Emerging Trends
Michael A. Jensen, *Brigham Young University / Wavetronix, LLC, USA*

Vehicle detection for intelligent transportation systems (ITS) has experienced significant development over the past several decades, with each new technology bringing new data modalities. To date, efforts to combine data from different detection technologies have been relatively limited, as the benefits have generally not justified the implementation and deployment costs. However, the almost certain deployment of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication systems will lead to the development of cooperative ITS architectures that will fuse data from legacy detection systems with data communicated from vehicles, providing travelers and roadway operators with an unprecedented richness of information and applications. This presentation will summarize the historical evolution of infrastructure vehicle detection systems, with an emphasis on the capabilities offered by different technologies and how these capabilities have driven the evolution of ITS. It will then focus on cooperative ITS, with a emphasis on how legacy detection might integrate with new vehicle communication data and how roadside sensing needs to evolve to complement the information provided by these vehicle communication systems.

Michael Jensen received the B.S. and M.S. degrees from Brigham Young University (BYU) in 1990 and 1991, respectively, and the Ph.D. from the University of California, Los Angeles in 1994, all in Electrical Engineering. Since 1994, he has been at BYU where he is currently a Distinguished University Professor of Electrical and Computer Engineering and Dean of the Ira A. Fulton College of Engineering and Technology. He is co-founder of Wavetronix, LLC, a leading manufacturer of vehicle detection systems, and currently functions as a Senior Scientist and member of the Management Board. He has published over 275 articles and book chapters on the topics of antennas, propagation, and signal processing for wireless communication, radar, and sensing systems. He received the Best Student Paper Award at the IEEE Antennas and Propagation Society Symposium in 1993, the H. A. Wheeler Applications Prize Paper Award in the IEEE Transactions on Antennas and Propagation in 2002, and several outstanding faculty awards at BYU. He was elevated to the grade of IEEE Fellow in 2008. He is the immediate Past-President of the IEEE Antennas and Propagation Society and has previously served as the Editor-in-Chief of the *IEEE Transactions on Antennas and Propagation*.

Tuesday 6 June 2017, 11:00–12:30 C3-2
Trials of Semi-Automated Vehicles on Eastlink
Jerome Carslake, *National Road Safety Partnership Program, Australia*

The Victorian Government is funding this project out of the Smarter Journeys – ITS Transport Technology Grant Program. One of the purposes of the Grant Program is to facilitate the introduction of innovative ways of addressing constraints and complaints about the Victorian road network and to bring customer journey experiences into the 21st century. There are two parts to this project which will use a trial section of EastLink, in eastern Melbourne, Australia. The first part is more theoretical in nature and aims to develop the technical infrastructure requirements, the certification criteria and operational requirements for autonomous vehicle operations. The second part is practical and involves trialing level 2 and level 3 vehicles equipped with C-ITS on EastLink. The Project Leader is ARRB, who are working in partnership with ConnectEast and LaTrobe University to deliver this project for the VicRoads Grant Program. A summary of findings to date will be presented.

Jerome Carslake is the Manager of the National Road Safety Partnership Program (NRSPP) and Chair of the Australian Driverless Vehicle Initiative (ADVI) Policy and Risk Group, both of which are delivered by ARRB. Jerome has an extensive background in transport including leading the development of the NRSPP and other strategic projects within the National Transport Commission and as a consultant and policy adviser within the agricultural sector on related supply chains. Jerome's origins are from the northern wheat belt of Western Australia and his background is in agricultural science, agribusiness, project management, strategic research and stakeholder engagement. His passion is in team work and collaboration which originate from his rowing at an elite level in Western Australia as both a rower and coach.

Tuesday 6 June 2017, 11:00–12:30 C3-2
Telematics Costly Disaster or Benefit—Implementation is Key
Jerome Carslake, *National Road Safety Partnership Program, Australia*

The use of telematics continues to grow throughout the Australian transportation industry as operators hope to take advantage of the operational and safety benefits of utilising these technologies. This presentation will explore how telematics should be treated as just another component in a safety management system and proper

implementation is crucial in strengthening an organisations road safety culture and ensuring the technology pays its way. To do this, the National Road Safety Partnership Program (NRSPP) will apply a case study and consultative methodology with leading figures from the transport industry – including operators, drivers, insurers, technology providers and researchers. NRSPP will explore the benefits and issues of these technologies; requirements for effective implementation; and their place within an organisation's overall operations and safety management system.

Jerome Carslake's bio appears above.

Tuesday 6 June 2017, 14:00–15:30 C3-2
Internet of Things via Low Earth Orbit
Alex Grant, *Myriota Pty Ltd, Australia*

Ubiquitous connectivity is an unspoken assumption underlying the Internet of Things. However in many remote and maritime areas, this assumption does not hold. This talk will describe an approach for providing cost effective global connectivity for Internet of Things applications such as asset tracking, logistics and sensor telemetry.

Alex Grant is Chief Executive Officer of Myriota Pty Ltd, which offers global internet of things connectivity via satellite. Dr Grant was previously a Professor, and Director of the Institute for Telecommunications Research at the University of South Australia. In 2004, he co-founded Cohda Wireless, the world's leading vendor of connected vehicle technology and services. Dr Grant was the recipient of the 2013 Pearcey Entrepreneur Award, the 2008 IREE Neville Thiele Award from Engineers Australia, and the 2004 Young Tall Poppy Science Award. Dr Grant is an internationally renowned wireless communications researcher. He has published a book and over 150 technical papers. He holds many issued patents in the area of intelligent transport and wireless communications. He has previously served as an Associate Editor for two prestigious journals, the IEEE Transactions on Information Theory and the IEEE Transactions on Wireless Communications. Dr Grant has served as a member of the Australian Research Council College of Experts.

Tuesday 6 June 2017, 14:00–15:30 C3-2
PHY Challenges for V2V/X
Robert Olesen, *InterDigital Labs, USA*

V2V and V2X will be critical technologies enabling the suite of use cases envisioned for 5G. InterDigital has a deep history of leading research in Wi-Fi and 3GPP wireless communications. The enabling physical layer technologies for the development of V2V/X will be discussed. An overview of how this will impact the future of 5G and the future of the always connected vehicle will also be presented.

Robert Olesen received the M.S. degree in electrical engineering from NYU in 1988, and an EMBA from Hofstra University in 2006. He has 36 years of experience in research and development of microwave and wireless communication systems. Since he joined InterDigital in 1999 he has be a project lead and program manager for wireless standards related projects including 802.11 WLAN, 3GPP LTE, 5G wireless, and 3GPP New Radio. He is currently a Senior Director at InterDigital Labs. His research interests include wireless communications, MIMO, microwave transmission, and next generation air interface design. He is the holder of over 70 patents and he has received the IDCC chairman's innovation award for most important developed technology.

Tuesday 6 June 2017, 14:00–15:30 C3-2
The Big Picture – Risk, Costs & Tax Implications for Operators and Users of Connected Cars
Michael Graham, *Mercurien, Australia*

In the world of the connected car it seems like many people are doing a layer of the cake but maybe not the whole cake. The connected car has been here for some time but it has hit hurdles for many reasons. Market forces, incumbency, privacy concerns – the list goes on yet the benefits are overwhelming and clear. In this presentation Michael will present his experience of the impact of smart data on road users in the workplace. From the impact of cognitive and perceptual testing of drivers to risk maps generated by telematics data, to new models for insurance and road charging. The smart data explosion from connected vehicles will challenge the thinking of governments and businesses around the world and only the end game thinkers will win.

Michael Graham is a Co-Founder and CEO of Mercurien Pty Ltd. After studying languages and politics at the University of Queensland he completed the ICS qualification to become a Company Secretary and gained experience in retail and mining both in Australia and the UK. More recently, Michael's interest has been in the area of the intersection between telematics, road risk assessment, the monetisation of data from road networks and the human factors that affect road risk. In early 2017 Mercurien will bring together an open ecosystem that is based around the needs of drivers and their managers in the workplace. The BetterDriver platform is a way to manage fleets and their drivers for better safety outcomes, lowered operating costs and optimal taxation outcomes in a pre-road charging environment. Michael has a particular interest in the risk and monetisation strategies for connected cars from insurance to road charging.

Tuesday 6 June 2017, 14:00–15:30 C3-2
Does Your Car Have Worms?
Glenn Geers, *ARRB Group Ltd, Australia*

Hardly a day goes by without some computer virus or glitch being reported in the press. As bad as they are, the damage caused has been minimal: a few photos lost, banking systems being unavailable for a time and perhaps a red face here and there. However, when the computer systems under attack control physical systems, there is clear potential for personal harm and infrastructure damage. With the advent of cooperative intelligent transport systems the number of potential attack vectors on transport networks will become very large because every vehicle will be a mobile wireless node, and the situation will only worsen when the prevalence of self-driving vehicles increases. Basic knowledge of cyber-physical security, potential attack vectors and possible outcomes should be in every transport professional's toolbox and this talk aims to provide a brief overview of this important topic from a transport perspective.

Glenn Geers is Principal Engineer, ITS at ARRB; Australia's largest, independent transport research organisation. He is an Adjunct Associate Professor in the School of Computer Science and Engineering at the University of New South Wales.. Glenn holds honours degrees in electrical engineering and theoretical physics and received his PhD in the field of computational electromagnetism. He is on the editorial board of GeoInformatica. From 1994 to 2005 Glenn worked on biometrics, image processing and distributed systems at CSIRO

and in private industry. In 2005 Glenn joined National ICT Australia (NICTA) as Systems Engineering Manager, Intelligent Transport Systems. From 2010 to 2015 he held the role of Technology Director, Infrastructure, Transport and Logistics at NICTA. During the same period he was a Director of ITS Australia.

Tuesday 6 June 2017, 16:00–17:30 C3-2
Panel: Autonomous Vehicles: What Is Needed to Make Them a Reality?

Moderator:	**Jeff Owen**	*Vodafone, Australia*
Panelists:	**Evan Walker**	*Smart Innovation Centre at Transport for NSW, Australia*
	Jerome Carslake	*National Road Safety Partnership Program, Australia*
	Robert Olesen	*InterDigital Labs, USA*
	Michael Graham	*Mercurien, Australia*
	Glenn Geers	*ARRB Group Ltd, Australia*
	Michael A. Jensen	*Brigham Young University / Wavetronix, LLC, USA*
	Brian Haratsis	*MacroPlan Dimasi, Australia*
	Wen Tong	*Huawei, China*
	Hugh S. Bradlow	*Telstra Corporation, Australia*

Jeff Owen graduated from the University of Queensland with a BSc in 1989 and then in 1990 with a B.E. (Hons) in Electronics and Communications. He commenced his industry career in the Defence Science and Technology Organisation in Research & Development for guided weapons and airborne radar whilst undertaking a BSc (Hons) in Mathematics at the University of Adelaide, graduating in 1994. He subsequently worked for GEC Marconi Systems contributing to the design of the Jindalee Operational Radar Network. He came to the cellular industry in 2000 being appointed as the National RF Engineering Manager of AAPT in 2000, and then in the same role for Hutchison Telecommunications Australia in 2001. Since the merge with Vodafone he has been in the role of Head of Access Network Strategy for Vodafone Hutchison Australia where he establishes a long-term technology roadmap with a recent focus upon 5G and beam-forming technology. He advocates a quantitative cost-benefit optimisation approach and employs a pull-through framework to establish business cases for spectrum acquisition, technology adoption, and infrastructure investment.

Evan Walker is the Director of the Smart Innovation Centre at Transport for NSW. His role is to work with industry and government agencies to identify and trial future transport technologies. Before taking on this role, Evan worked as the Director of the Divisional Management Office for the Freight Strategy and Planning Division of TfNSW which provided him with a broad overview of Transport in NSW. These roles follow-on from Evan's 15 years' experience working in road Safety, where he was the Director of Safer Systems at the NSW

Centre for Road Safety for over four years. During his road safety career, Evan lead the development and implementation of new initiatives that contributed to significant improvements in road safety in NSW, including the NSW Speed Camera Strategy, the Plan B campaign and the establishment of the Community Road Safety Fund.

Jerome Carslake's bio appears on Page 18.
Robert Olesen's bio appears on Page 19.
Michael Graham's bio appears on Page 19.
Glenn Geers' bio appears on Page 19.
Michael Jensen's bio appears on Page 18.
Wen Tong's bio appears on Page 17.

Brian Haratsis is a best-selling author, futurist, thought leader and is regarded by corporate Australia as the leading economic and strategic advisor operating in the property sector locally and internationally. Brian established MacroPlan Australia (renamed MacroPlan Dimasi in 2012) in 1985 and has devoted the last 30 years to his loyal client base through the delivery of effective business and property strategy, precise forecasting of niche trends, successful facilitation of strategic outcomes and successful delivery of major projects / policies. Brian is a leader in demographic analysis and property trends and has extensive experience in forecasting demand for retirement living, aged care and is currently advising on the development of major health hubs on the Sunshine Coast and in Victoria in relation to the Sunshine Health + Wellbeing Cluster.

Hugh S. Bradlow's bio appears on Page 18.

Wednesday Plenary Keynotes

Wednesday 7 June 2017, 9:00–9:45 (Parkside 1)
New Ways of Thinking about Smart Cities
Ian Oppermann, *NSW Data Analytics Centre, Australia*

In the world of ever increasing data sources, there are new ways of thinking about smart cities. The challenges faced in future cities are complex, subtle and ultimately have people's behaviour at their heart. From rapidly increasing levels of urbanisation to the need to deliver smart services through ever more complex systems, science gives us a way of understanding these challenges. Data is a way of observing the world around us, ecosystems and behaviours. Combining data and science gives us new tools to describe, analyse and tackle these complex problems. This presentation will frame some of the major challenges we face and the opportunities within our grasp when we consider "Smart Cities". It takes a data driven view of smart cities and provides examples of how we are tackling these challenges from the NSW Data Analytics Centre working in conjunction with Infrastructure NSW.

Dr. Ian Oppermann is the Chief Data Scientist and CEO and the NSW Data Analytics Centre. Ian has 25 years' experience in the ICT sector, delivering products and outcomes that have impacted hundreds of millions of people globally. He has held senior management roles in Europe and Australia as Director for Radio Access Performance at Nokia, Global Head of Sales Partnering (network software) at Nokia Siemens Networks, and then Divisional Chief and Flagship Director at CSIRO. Ian is

considered a thought leader in the area of the Digital Economy and is a regular speaker on "Big Data", broadband enabled services and the impact of technology on society. He has contributed to 6 books and co-authored more than 120 papers which have been cited more than 3200 times. Ian has an MBA from the University of London and a PhD in Mobile Telecommunications from Sydney University. Ian is a Fellow of the Institute of Engineers Australia, a Fellow of the IEEE, a Fellow of the Australian Academy of Technological Sciences and Engineering, an incoming Vice President of the Australian Computer Society, and a graduate member of the Australian Institute of Company Directors. Ian is also president of the Australia National Committee of the IEC and the incoming president of the JTC1.

Wednesday 7 June 2017, 9:45–10:30 (Parkside 1)
Enabling IoT for a Multitude of Vertical Applications
Markus Mueck, *Intel, Germany*

The market of IoT devices is expected to be vast – including diverse target applications related to metering, medical, sports, gaming, etc. It is obvious that a large number of different modem chipset features will be required addressing various application domains, form factors and user interfaces. This environment is a serious challenge for Chipset manufacturers since it will be impossible to serve each target use case with a tailored solution. Rather, a small number of generic components need to be designed which are finally reconfigured to optimally fit their market needs. This reconfiguration will rely in particular of software component provision – affecting radio parameters as will as higher layer functionalities. This talk will explain how a recent change in European Regulation (the introduction of the Radio Equipment Directive) and related ETSI standards will address this problem and provide an agreed technical approach.

Dr. Markus Mueck oversees Intel's technology development, standardization and partnerships in the field of spectrum sharing. In this capacity, he has contributed to standardization and regulatory efforts on various topics including spectrum sharing within numerous industry standards/regulation bodies, including ETSI, 3GPP, IEEE, the Wireless Innovation Forum and CEPT. Dr. Mueck is an adjunct professor at University of Technology, Sydney and Macquarie University, he acts as ETSI Board Member supported by INTEL and as general Chairman of ETSI RRS Technical Body (Software Radio and Cognitive Radio Standardization). He has earned engineering degrees from the University of Stuttgart and the Ecole Nationale Supérieure des Télécommunications (ENST) as well as a doctorate degree in Communications.

Wednesday Industry Track: IoT/Smart Cities

Wednesday 7 June 2017, 11:00–12:30 C3-2
Multi-service and Multi-tenancy Architecture for the 5G Era
Simone Redana, *Nokia Bell Labs, Germany*

Current architectures do not provide the required flexibility to cope with the service and traffic diversity targeted by 5G mobile networks nor do they address the trends in terms of topologies. We explore novel concepts in the context of mobile network architecture for the 5G era, like cloud-based mobile architectures, functional split and placement, convergence of RAN and Core Network, multi-service and multi-tenancy architectures.

Dr. Simone Redana is Head of Mobile Network Architecture & Systems Research Group in Nokia Bell Labs and Chairman of the 5GPPP Architecture Working Group. Simone received the MSc and Ph.D. degrees from the Politecnico di Milano, Milan, Italy, in 2002 and 2005 respectively. In 2006, he joined Siemens Communication in Milan where he worked as consultant during 2005. Since 2008 he has been with Nokia in Munich, Germany. Simone contributed and leaded relay concept design in various EU research projects (WINNER II, WINNER+ and ARTIST4G). He contributed to the business case analysis of relay deployments and to the standardization of Relays for Long Term Evolution (LTE) Release 10, and coordinated the EU funded project 5G NORMA. His current research interests are on novel architecture solutions for 5G.

Wednesday 7 June 2017, 11:00–12:30 C3-2
Designing and Delivering Radio Communications Services in New South Wales
Kate Foy, *NSW Telco Authority*

The NSW Telco Authority is responsible for the overall coordination of radio services for the NSW Government. Radio is a crucial operational requirement, especially for our emergency service agencies. The Authority is working to improve the quality and efficiency of radio, to effectively manage the Government spectrum holdings and to consolidate government owned infrastructure, assets and resources to remove unnecessary costs and duplication. The Critical Communication Enhancement Program is a key plank of the NSW Government's Operational Communication Strategy. This presentation will provide an overview of the approach to the initial phases of the program to improve radio communications in a pilot region of NSW.

Kate Foy's undergraduate Degree in arts/welfare and interest in social justice saw her early career focused on working with homeless children, young people, those in the child protection system and those at risk of homelessness. Kate worked in the non-government sector in areas including western and inner Sydney as well as the Illawarra. Kate graduated to the development of social policy in central government and specialised in strategic and transformational policies and programs. Kate has held executive roles in Infrastructure, Planning and Natural Resource, and Transport, with responsibilities for programs such as Opal, Customer digital transformation, customer design and wayfinding. Kate joined the NSW Telco Authority as Managing Director in June 2016. The Telco Authority coordinates operational communications for NSW Government agencies. Kate maintains a passion for supporting our front line to provide the best possible service to the people of NSW.

Wednesday 7 June 2017, 14:00–15:30 C3-2
Wireless New Opportunity: Vertical Industry
Du Gaoke, *Huawei, China*

As the fast development of wireless industry, besides the traditional cellular MBB services, more and more new

applications in vertical and IoT industry emerge, which would result in new wireless market and technology opportunities. Mr. Du Gaoke will introduce some of the potential technology directions on wireless vertical fields, standard progress, and some considerations and research layout from Huawei point of view.

Du Gaoke, the Manger of Huawei Wireless Research Beijing Division, head of Wireless vertical industry research Lab (vLab), has much experience in mobile communications. He started to participate 3GPP standard since 2001, deeply involved in UMTS, HSPA, LTE, LTE-A standard work, even 5G standard now. Familiar with UMTS, LTE and other communication protocols, has 30+ patents. Meanwhile, he initiated new wireless application research since 2011, research project covers LTE-Trunking, Video, Internet of Things, ITS, industrial Internet of things. And the research results on IoT, ITS and Unlicensed Spectrum were taken to 3GPP and lead to several 4G features as NB-IOT, LAA, LTE-V, etc.

Wednesday 7 June 2017, 14:00–15:30 C3-2
IOT Solution for Utilities
Gavin Whyte, *Deloitte Consulting, Australia*

With the emergent of new Technologies in the IoT space, a multitude of cost effective sensors have become available. The advancements of IT infrastructure enables easy API integrations with sensors via carriers. In this talk, Gavin Whyte (Director of Data Science at KPMG) will talk about the KPMG & Huawei's collaboration on IoT solutions for utilities. This talk will go through various aspects of the solution including hardware, data, event streaming, and machine learning using robotic process automation. This talk will also introduce use cases of this solution that can help utility companies on predictive maintenance, as well as help customers to minimize spend on utility bills by reducing waste.

Gavin Whyte is currently a director at KPMG, with over 25 years' experience in the industry and specialises in machine learning and software development. Gavin has an extensive technical background and started his career as a professor in Mathematics and Computer Science. He has become a seasoned Data Scientist, executive, leader, strategist and an expert in business communications, product and process design relating to Data Science space. As a Director of Data Science for KPMG, and a machine learning specialist, he focuses on Data Science models for predictive capabilities. He has a unique ability to manage multi-disciplinary projects and navigate complex challenges. His current interests are writing machine learning code, for various data science capabilities.

Wednesday 7 June 2017, 14:00–15:30 C3-2
Smart Cities: Standards and Interoperability for the IoT
Piers Hogarth-Scott, *KPMG, Australia*

Predictions have estimated that by 2020 there will be 50 billion connected IoT devices, in a market with a potential impact of AUD 14.5 trillion by 2025. In Australia this represents up to a potential $120 billion economic uplift in the same timeframe. Recognising that IoT is by definition an ecosystem of technologies, IoT devices require a robust solution for interoperating across widely varied systems and applications. The Australian government recently launched Hypercat, a standard for secure and interoperable IoT for smart cities and industry that was originally established in the UK three years ago with backing from the British government and more recently BSI and W3C. With the Federal Government's $50M Smart Cities and Suburbs Program, there has never been a more important time for standards and interoperability of IoT.

Piers Hogarth-Scott is the National Internet of Things Practice Leader at KPMG, with a focus on Smart Cities including connected transport and infrastructure, Smart Universities, Smart Utilities and Smart Food and Fibre. Piers works with clients to tap into the $120 billion uplift in annual economic impact that is forecast to be derived from IoT to the Australian economy by 2025. Piers helps clients with IoT strategy and implementation, security, data analytics, vendor selection, programme management, local and international policy, growth plans and more. Piers is a member of the Executive Committee of the IoT Alliance Australia (IoTAA), and is a board advisor to Hypercat, a standard for secure and interoperable IoT.

Wednesday 7 June 2017, 16:00–17:30 C3-2
How Integrated Infrastructures and Processes Improve Cities' Quality of Life

Moderator:	David Soldani	*Nokia, Germany*
Panelists:	**Markus Mueck**	*Intel Germany*
	Sami Makelainen	*Telstra Corporation, Australia*
	Nevio Marinelli	*ACMA, Australia*
	Easwaren Siva	*Vodafone Hutchison Australia, Australia*

In Australia, congestion, poor access to jobs and services, reduced housing affordability and increasing pollution are the main challenges to the quality of life cities offer. The panelists will present and discuss how ICT infrastructures, spectrum utilization and services could help systems of people interacting with and using flows of energy, materials and services, and financing to catalyze sustainable economic development, resilience, and high quality of life in Australia.

David Soldani's bio appears on Page 15.
Markus Mueck's biography appears on Page 21.
Sami Makelainen has been involved in building the online and mobile worlds since mid 1990's. Having participated in design and development of one of the first full-service online banking platforms, Sami spent a number of years hands-on with various aspects of the mobile business, from developing mobile payment solutions in North America to defining network systems architectures for Nokia in Finland. Since 2009, Sami has been at Telstra Corporation in Australia, currently in charge of technology foresight at the Chief Technology Office. Sami holds an MSc degree in Computer Science from the University of Helsinki and lives with his family in Melbourne.

Nevio Marinelli is the Manager of the Spectrum Planning Section of the Australian Communications and Media Authority. The Section's primary role is to undertake the technical and frequency planning aspects of, and provide technical advice and input to, various projects related to wireless broadband and the Internet of Things. Nevio also lead Australia's involvement in WRC-15 agenda item 1.1 which

looked at the possible identification of additional spectrum for International Mobile Telephony (IMT). He is currently the chair of work stream four the Internet of Things Alliance Australia (IoTAA) dealing with radiofrequency spectrum issues. Nevio has a Bachelor of Engineering in Communications from the Royal Melbourne Institute of Technology, Melbourne Australia. He has worked as a spectrum planning engineer in the Department of Communications where he was involved in the planning of radio and television services and the replanning of spectrum to allow for the introduction of GSM services in Australia. From 1996 he worked for telecommunications operator Optus and equipment vendors Lucent and Nortel in the Middle East and Europe as a radiofrequency planning and optimisation engineer.

Easwaren Siva, General Manager, Technology Strategy & Governance at Vodafone Hutchison Australia, has more than 20 years' experience working in the Australian telecommunications industry. Mr Siva has previously held senior positions at Vodafone, Orange and 3 Mobile delivering 'first to market' digital media and mobile data services. More recently, he has led the 'transformation and growth' technology strategy for Vodafone Hutchison Australia and has played a key role in re-farming spectrum from 3G to 4G, Network Functions Virtualisation and the Hybrid Cloud Infrastructure.

Tutorials

A range of tutorials will be held on Sunday 4 June given by experts from industry and academia.

Sunday 4 June 2017 8:30–12:00 C2-5
T1: Non-orthogonal Multiple Access: Current State of the Art and Future Directions
Zhiguo Ding, Lancaster University

Multiple access in 5G mobile networks is an emerging research topic, since it is key for the next generation network to keep pace with the exponential growth of mobile data and multimedia traffic. Non-orthogonal multiple access (NOMA) has recently received considerable attention as a promising candidate for 5G multiple access. The key idea of NOMA is to exploit the power domain for multiple access, which means multiple users can be served concurrently at the same time, frequency, and spreading code. Instead of using water-filling power allocation strategies, NOMA allocates more power to the users with poorer channel conditions, with the aim to facilitate a balanced tradeoff between system throughput and user fairness. Recent industrial demonstrations show that the use of NOMA can significantly improve the spectral efficiency of mobile networks. Because of such a superior performance, NOMA has been also recently proposed for downlink scenarios in 3rd generation partnership project long-term evolution (3GPP-LTE) systems, and the considering technique was termed multiuser superposition transmission (MUST). In this tutorial, we will provide a progress review for NOMA, including an information theoretic perspective of NOMA, the interaction between cognitive radio and NOMA, the design of MIMO and cooperative NOMA, the application of NOMA in millimeter-wave (mmWave) networks, and the impact of practical constraints, such as imperfect channel state information and limited feedback, on the performance of NOMA.

Zhiguo Ding received his B.Eng in Electrical Engineering from the Beijing University of Posts and Telecommunications in 2000, and the Ph.D degree in Electrical Engineering from Imperial College London in 2005. From Jul. 2005 to Aug. 2014, he was working in Queen's University Belfast, Imperial College and Newcastle University. Since Sept. 2014, he has been with Lancaster University as a Chair Professor in Signal Processing. From 2012 to 2017, he is also an academic visitor in Princeton University working with Prof. Vincent Poor.

Dr Ding' research interests are 5G networks, game theory, cooperative and energy harvesting networks and statistical signal processing. He is serving as an Editor for IEEE Transactions on Communications, IEEE Transactions on Vehicular Networks, IEEE Wireless Communication Letters, IEEE Communication Letters, and Journal of Wireless Communications and Mobile Computing. He was the TPC Co-Chair for the 6th IET International Conference on Wireless, Mobile & Multimedia Networks (ICWMMN2015), Symposium Chair for International Conference on Computing, Networking and Communications (ICNC 2016), and the 25th Wireless and Optical Communication Conference (WOCC), and Co-Chair of WCNC-2013 Workshop on New Advances for Physical Layer Network Coding. He received the best paper award in IET Comm. Conf. on Wireless, Mobile and Computing, 2009 and the 2015 International Conference on Wireless Communications and Signal Processing (WCSP 2015), IEEE Communication Letter Exemplary Reviewer 2012, and the EU Marie Curie Fellowship 2012-2014.

Sunday 4 June 2017 8:30–12:00 C2-6
T3: Security for 5G Wireless Network Systems
Yi Qian, University of Nebraska-Lincoln

Wireless communication technologies are ubiquitous nowadays. Most of the smart devices have Cellular, Wi-Fi, Bluetooth connections. These technologies have been developed for many years, nonetheless they are still being enhanced. More development can be expected in the next 5 years, such as faster transmission data rate, more efficient spectrum usage, lower power consumption, etc. Similarly, cellular networks have been evolved for several generations. For example, GSM as part of 2G family, UMTS as part of the 3G family, and LTE as part of 4G family. In the next few years, 5G cellular network systems will continue the evolution to keep up with the fast-growing needs of customers. Secure wireless communications will certainly be part of other advances in the industry such as multimedia streaming, data storage and sharing in clouds, mobile cloud computing services, etc. This tutorial covers the topics on security for next generation mobile wireless networks, with focusing on 4G (LTE and LTE-A) and 5G mobile wireless network systems, followed by a discussion on the challenges and open research issues in the area of 5G security.

Yi Qian is a professor at the University of Nebraska-Lincoln (UNL). Prior to joining UNL, he worked in the telecommunications industry, academia, and the government. His research interests include information assurance and network security, network design, network modeling, simulation and performance analysis for next generation wireless networks, wireless ad-hoc and sensor networks, vehicular networks, smart grid communication networks, broadband satellite networks, optical networks, high-speed networks and the Internet. He is serving on the editorial board for several international journals and magazines, including serving as the Associate Editor-in-Chief for IEEE Wireless Communications Magazine. He was the Chair of IEEE Communications Society Technical Committee for Communications and Information Security 2014-2015. He is a Distinguished Lecturer for IEEE Vehicular Technology Society.

Dr. Qian has been teaching "Network Security" every fall semester, and "Wireless Security" every spring semester after he joined University of Nebraska-Lincoln in 2009. He received two best teaching awards from the College of Engineering at UNL in the last few years. After teaching "Wireless Security" at UNL for the last six years, Dr. Qian is writing a comprehensive textbook on the topic, "Security in Wireless Communication Networks", to be published by Wiley/IEEE Press in 2017.

Sunday 4 June 2017 13:30–17:00 C2-6
T6: Sparse Code Multiple Access for 5G Air Interface
Wen Chen, Shanghai Jiao Tong University

The demands on massive connectivity, large capacity and short latency for the next generation wireless communication networks (5G) drastically push the development of new type multiple access technology over the conventional orthogonal access technology. Recently, some new type non-orthogonal multiple access techniques

such as sparse code multiple access (SCMA) proposed by Huawei, multiuser shared access (MUSA) proposed by ZTE and pattern division multiple access (PDMA) proposed by DTmobile have attracted lots of attention and have been looked as the potential 5G New Air Interface Technologies. In this tutorial, I will make an extensive introduction to the sparse code multiple access (SCMA) as a representative of non-orthogonal multiple access techniques, where I will majorly focus on the codebook and decoder design, capacity analysis, codebook assignment and power assignment. Meanwhile I will address some related problems such as grant free access, energy efficiency, and inter-cell interference mitigation for SCMA networks. By this tutorial, one can get full image of SCMA, the importance of SCMA, SCMA design and some open problems related to SCMA.

Wen Chen, a senior member of IEEE and CIE, a Professor of Electronic Engineering in Shanghai Jiao Tong University, China, where he is also the director of the Institute for Signal Processing and Systems. During 2014-2015, he was the dean of School of Electronic Engineering and Automation, Guilin University of Electronic Technology. Since 2016, he has been the chairman of Intellectual Property Corporation, Shanghai Jiao Tong University. His interests cover physical layer communications and cross layer design of communication systems, in which area, he has published 76 IEEE journal papers and more than 110 IEEE conference papers.

Professor Chen has made a tutorial in IEEE ICCC2016, keynotes in IEEE APCC2016 and IEEE ICISIS2011. He has delivered invited talks 25 times in various international conferences, workshops and universities (see wnt.sjtu.edu.cn). Prof. Chen has organized many IEEE sponsored conferences. He has been a general chair of HMWC2013, WiMob2011, ICIS2011-2009, ISISE2010-2008, WCNIS2010, and TPC chair of WiMob2012, ICCT2012, ICCSC2008, and served on many IEEE conferences as a TPC member.

Prof. Chen received the InnovateAsia 5G Competition Award for contribution in sparse code multiple access in 2015, the WCSP2015 best paper award, and Shanghai outstanding thesis supervision award in 2015. He is selected as an outstanding member of Chinese Institute of Electronics in 2013 and received 3 best papers awards of Chinese Information Theory Society in 2013 and 2014. He is also selected as a Pujiang Excellent Scholars in Shanghai in 2007, a New Century Excellent Scholars in China in 2006, and awarded the Ariyama Memorial Award in 1997. He is an editor of IEEE TWC and an associate editor of IEEE Access.

Sunday 4 June 2017 8:30–12:00 C3-4
T7: Sensing, Localization, and Interference Management in 5G Communication Networks
Guodong Zhao, Xiangwei Zhou, Wei Zhang

The fast development of smart phones and tablet devices has greatly stimulated the demand for wireless data services, leading to an impressive growth of the data traffic. Meanwhile, the networks, services, and devices will be more heterogeneous in 5G systems and the need to connect billions of devices to the networks will emerge. In this tutorial, we will first overview the main interference management techniques in 5G ultra-dense heterogeneous networks (HetNets) and discuss the major technical challenges. Then we will provide a new architecture for interference management based on interference map. The architecture is expected to meet the requirements of future 5G HetNets in terms of data rate, latency, cost, reliability, etc. In particular, the emphasis will be given to the advanced signal processing techniques, i.e., advanced sensing and localization, to build the interference map, where full-duplex radios are also considered. Finally, we will discuss the open problems and potential directions for 5G ultra-dense HetNets.

Guodong Zhao received his Ph.D. Degree from Beihang University, Beijing, China in 2011. He visited Georgia Institute of Technology, Atlanta, GA, USA, in 2007-2008 and Hong Kong University of Science and Technology (HKUST), Hong Kong, in 2012-2013. Since 2011, he has been with University of Electronic Science and Technology of China (UESTC), where he is currently an Associate Professor. His research interests are within the areas of wireless communications and signal processing. He published over 30 papers in IEEE journals and conferences. In 2012, he received the best paper award from IEEE Global Telecommunication Conference (Globecom) and the best Ph.D. thesis award from Beihang University.

Xiangwei Zhou received his Ph.D. degree in Electrical and Computer Engineering from Georgia Institute of Technology in 2011. Since August 2015, Dr. Zhou has been with the Division of Electrical

and Computer Engineering at Louisiana State University as an Assistant Professor. His general research interests include wireless communications, statistical signal processing, and cross-layer optimization. He is the ECE Outstanding Teacher of Year 2014 at Southern Illinois University Carbondale and a recipient of the best paper award at the 2014 International Conference on Wireless Communications and Signal Processing. Dr. Zhou is currently serving on the editorial board of IEEE Transactions on Wireless Communications.

Wei Zhang is a Fellow of the IEEE and an IEEE Communications Society Distinguished Lecturer. He serves as the Editor-in-Chief of the IEEE Wireless Communications Letters. He is also an Editor for the IEEE Transactions on Communications, and the IEEE Transactions on cognitive communications and networking. He is a Vice Director of the IEEE ComSoc Asia Pacific Board. He has served as the Secretary for the IEEE Wireless Communications Technical Committee. Currently, he is an Associate Professor with the University of New South Wales, Sydney, Australia.

Sunday 4 June 2017 13:30–17:00 VIP Board Room
T8: Vehicular Networking Technologies, Standards, Applications, Challenges and Future Directions
Ren Ping Liu, University of Technology Sydney

We present an overview of the state-of-the-art Vehicular Networking technologies, ranging from communications, networking, applications, to security and privacy. We will discuss technical details in the design of vehicular networking architectures and protocol suites, including LTE, IEEE 802.11p and IEEE 1609.6. The interactions and cooperation between LTE and 802.11p to support vehicular applications will also be examined.

We will investigate the performance analysis of vehicular networks with Markov chain, mobility, and channel models. We will reveal the challenges and future research directions of vehicular networks with the advent of 5G and autonomous vehicles.

Ren Ping Liu is a Professor at School of Computing and Communications in University of Technology Sydney, where he leads Network Security Lab in the Global Big Data Technologies Centre. Prior to that he was a Principal Scientist at CSIRO, where he led wireless networking research activities. He specialises in protocol design and modelling, and has delivered networking solutions to a number of government agencies and industry customers. Professor Liu was the winner of Australian Engineering Innovation Award and CSIRO Chairman's medal. His research interests include Markov analysis and QoS scheduling of wireless networks. Professor Liu has over 100 research publications, and has supervised over 30 PhD students.

Professor Liu is the founding chair of IEEE NSW VTS Chapter and a Senior Member of IEEE. He served as TPC chair for BodyNets2015, ISCIT2015, WPMC2014, as OC co-chair for VTC2017-Spring, BodyNets2014, ICUWB2013, ISCIT2012, SenSys2007, and in Technical Program Committee in a number of IEEE Conferences. Ren Ping Liu received his B.E.(Hon) and M.E. degrees from Beijing University of Posts and Telecommunications, China, and the Ph.D. degree from the University of Newcastle, Australia.

Sunday 4 June 2017 13:30–17:00 C3-4
T16: Safeguarding Future Wireless Networks with Physical Layer Security
Nan Yang, ANU; Xiangyun Zhou, ANU; Trung Duong, QUB

Wireless everything--this is the goal that the digital society is marching towards. Looking 10-20 years ahead, the ubiquitous wireless world aims at building ultra-high-quality wireless networks that connect an ultra-large number of devices and enable fully interoperable information exchange among them. Security is one of the pivotal issues that need to be carefully addressed in the design and implementation of such wireless networks, since wireless transmissions are inherently vulnerable to security breaches. This tutorial focuses on physical layer security, which has been recognized as a promising mechanism to safeguard data confidentiality by exploiting the intrinsic randomness of the communications medium. In particular, this tutorial places an emphasis on leveraging disruptive wireless technologies to secure data transmission from the physical layer. First, this tutorial provides a high-level overview of the security methods for the previous and current mobile networks. Then, this tutorial introduces the state-of-the-

art fundamental research of physical layer security, such as the evolution of secrecy performance evaluation and physical layer key generation. After this, the tutorial presents a structured and comprehensive survey of the security solutions enabled by cutting-edge wireless techniques, such as heterogeneous networking, full-duplex communication, massive multiple antennas, millimeter-wave transmission, machine-to-machine communication, energy- and spectrum-efficient communication, and software defined radio-based prototype. Finally, this tutorial identifies and discusses the outstanding barriers that future wireless designers must tackle.

Nan Yang is working as a Senior Lecturer and Future Engineering Research Leadership Fellow at the Australian National University. He is currently serving on the Editorial Board of the IEEE Transactions on Wireless Communications and the IEEE Transactions on Vehicular Technology. In 2014 he received the IEEE ComSoc Asia-Pacific Outstanding Young Researcher Award in 2014 in recognition of his contributions in wireless security. He has published 1 book chapter and over 35 journal and conference papers on physical layer security. He was the TPC Chair of the 2015 and 2016 IEEE GLOBECOM Workshop on Trusted Communications with Physical Layer Security.

Xiangyun Zhou received his Ph.D. degree in 2010 from the Australian National University where he is currently working as a Senior Lecturer. He serves on the Editorial Board of the IEEE Transactions on Wireless Communications and the IEEE Communications Letters. He has published one edited book and over 40 journal and conference papers on physical layer security, one of which received a Best Paper Award at ICC 2011. He was the co-chair of major international workshops on physical layer security at ICC 2014-2016 and GLOBECOM 2015-2016. He was a Guest Editor for the 2015 special issue on physical layer security in IEEE Communications Magazine.

Trung Q. Duong is currently an Assistant Professor at Queen's University Belfast, UK. He is the founder and co-organizer of series of the 1st, 2nd, 3rd, and 4th IEEE GLOBECOM Workshop on Trusted Communications with Physical Layer Security in 2013, 2014, 2015, and 2016. He was the Lead Guest Editor of IET Communications, Special Issue on "Secure Physical Layer Communications" in 2014. He is serving as an Editor of the IEEE Transactions on Wireless Communications, the IEEE Transactions on Communications, the IEEE Communications Letters, and the IET Communications. So far he

has published more than 220 papers, among which 31 IEEE journal articles are in the field of physical layer security.

The following tutorials have been cancelled:

T2: Millimeter Wave Communication for Connected Vehicles
Robert W. Heath Jr., University of Texas at Austin; Takayuki Shimizu, TOYOTA InfoTechnology Center

T4: Towards the Tactile Internet: Robust Low Latency Communication for Connected Cooperative Cars
Falko Dressler, University of Paderborn, Germany

T5: 5G waveforms: from terrific visions to the harsh reality
Gilberto Berardinelli, Aalborg University, Denmark

T9: Heterogeneous Network Management using SDN at the Mobile Edge for Connected Vehicle Applications
Abhimanyu Gosain, Raytheon BBN Technologies; Jim Martin, Mashrur Chowdhury, Clemson University

T10: Understanding and Tackling Non-ideal Transceivers for Future Wireless Communications
Wenyi Zhang, University of Science and Technology of China

T11: Ultra-Low Latency Heterogeneous Cellular Networking for Autonomous Vehicles
Kwang-Cheng Chen, University of South Florida

T12: Heterogeneous Ultra Dense Networks: Principles and Technologies
Haijun Zhang, USTB; Chunxiao Jiang, Tsinghua; Derrick Wing Kwan Ng, UNSW

T13: Ultra-broadband Communication Networks in the Terahertz Band (0.1-10 THz)
Chong Han, Shanghai Jiao Tong University; Josep Miquel Jornet, University at Buffalo

T14: On System-Level Analysis & Design of Cellular Networks: The Magic of Stochastic Geometry
*Marco Di Renzo, Paris-Saclay University / CNRS*

Tutorial and Workshop Program

	Meeting Room C2-1	Meeting Room C2-2	Meeting Room C2-3	Meeting Room C2-4	Meeting Room C2-5	Meeting Room C2-6	Meeting Room C3-1	Meeting Room C3-2	Meeting Room C3-4	VIP Board Room
	SUNDAY 4 June									
7:00-17:30	Registration (Parkside Prefunction)									
8:30-10:00	W4: Technology Trials and Proof-of-Concept Activities for 5G and Beyond (TPoC5G): Radio Access	W5: Wireless Access Technologies and Architectures for Internet of Things (IoT) Applications: IoT Resource Management I		W8: International Workshop on Quantum Communications for Future Networks (QCFN) 2017	T1: Non-orthogonal Multiple Access: Current State of the Art and Future Directions	T3: Security for 5G Wireless Network Systems	W2: 2nd International Workshop on Connecting All Things for Enabling Smart Cities (CONTEST)	W1: The 6th International Workshop on High Mobility Wireless Communications (HMWC) 2017	T7: Sensing, Localization, and Interference Management in 5G Comms Networks	
10:00-10:30	Coffee and Refreshments (Parkside Prefunction & Level 3 Foyer)									
10:30-12:00	W4: MU-MIMO 1	W5: Keynotes	W6: Positioning Solutions for Cooperative ITS	W8 continued	T1: Non-orthogonal Multiple Access: Current State of the Art and Future Directions	T3: Security for 5G Wireless Network Systems	W2 continued	W1 continued	T7: Sensing, Localization, and Interference Management in 5G Comms Networks	
12:00-13:30	Lunch Break (on your own)									
13:30-15:00	W4; MU-MIMO 2	W5: IoT Resource Management II	W6 continued	W8 continued	W7: Workshop on Emerging Non-Orthogonal Multiple Access Techniques for 5G	T6: Sparse Code Multiple Access for 5G Air Interface	W2 continued	W3: 2nd International Workshop on Research Advancements in Future Networking Technologies	T16: Safeguarding Future Wireless Networks with Physical Layer Security	T8: Vehicular Networking Technologies, Standards, Applications, Challenges and Future Directions
15:00-15:30	Coffee and Refreshments (Parkside Prefunction & Level 3 Foyer)									
15:30-17:00	W4: Resource Management	W5: IoT Applications	W6 Panel	W8 continued	W7 continued	T6: Sparse Code Multiple Access for 5G Air Interface	W2 continued	W3 continued	T16: Safeguarding Future Wireless Networks with Physical Layer Security	T8: Vehicular Networking Technologies, Standards, Applications, Challenges and Future Directions
18:30-20:30	VTC2017-Spring Welcome Reception (Doltone House - Jones Bay Wharf)									

Time	#	(A) Meeting Room C2-1	(B) Meeting Room C2-2	(C) Meeting Room C2-3	(D) Meeting Room C2-4	(E) Meeting Room C2-5	(F) Meeting Room C2-6	(G) Meeting Room C3-1	(Industry) Meeting Room C3-2	(P) Parkside 2
SUNDAY 4 June										
7:30-17:30		Registration (Ballroom Foyer)								
8:30-17:00		Tutorials and Workshops (see program on Page 25)								
18:30-20:30		Welcome Reception (Doltone House - Jones Bay Wharf)								
MONDAY 5 June										
7:30-17:30		Registration (Parkside Foyer)								
8:30-9:00		Opening Plenary: Javier Gozalvez, VTS President; Eryk Dutkiewicz, General Chair; Xiaojing Huang, TPC Chair; Markus Mueck, Chintha Tellambura, TPC Co-chairs (Parkside 1)								
9:00-10:30		Keynote Industrial Plenary: Meeting the Technical, Political and Economic Aims of 5G, Adrian Scrase, CTO, ETSI, Germany (Parkside 1)								
9:00-10:30		Keynote Industrial Plenary: The Perfect Storm: IT+CT+DT, Chih-Lin I, Chief Scientist Wireless Technologies, China Mobile, China (Parkside 1)								
10:30-11:00		Refreshments and Exhibits (Parkside 2)								
11:00-12:30	(1)	Beamforming	Channel Measurements and Modeling I	Cognitive Radio Networks	D2D I	Full Duplex Radios	Heterogeneous Networks I	5G Networks I	Industry Sessions: 5G and Wireless	Recent Results
12:30-14:00		Lunch (Parkside 1 Ballroom)								
14:00-15:30	(2)	Cellular and Cooperative Networks	Channel Measurements and Modeling II	Communication and Sensing	D2D II	Interference Cancellation	Heterogeneous Networks II	5G Networks II	Industry Sessions: 5G and Wireless	MIMO
15:30-16:00		Refreshments and Exhibits (Parkside 2)								
16:00-17:30	(3)	Channel Estimation	Channel Measurements and Modeling III	Cooperative Communications	Modulation and Coding	Interference Modeling and Management	Heterogeneous Networks III	5G Networks III	Industry Sessions: 5G and Wireless	Transmission and Detection III
18:30-21:30		VTC2017-Spring Gala Banquet (Doltone House - Jones Bay Wharf)								
TUESDAY 6 June										
8:00-17:30		Registration (Parkside Foyer)								
9:00-9:45		Keynote Industrial Plenary: No Cell Networks, Wen Tong, CTO Huawei Wireless, Huawei Technologies Co., Inc. (Parkside 1)								
9:45-10:30		Keynote Industrial Plenary: How Soon Can We Achieve a Fully Autonomous Transport System, Hugh Bradlow, President Australian Academy of Technology, Chief Scientist Telstra Corporation, Australia (Parkside 1)								
10:30-11:00		Refreshments and Exhibits (Parkside 2)								
11:00-12:30	(4)	Relay Systems I	RF Systems and Transceiver Design	Smart Systems	Transmission and Detection I	Vehicular Networks I	Positioning and Tracking	Automated Driving and Intelligent Transportation	Industry Sessions: Transport and Logistics	Wireless Networks
12:30-14:00		Lunch (Parkside 1 Ballroom)								
14:00-15:30	(5)	Relay Systems II	SDN	Spectrum Sharing I	Transmission and Detection II	Vehicular Networks II	Localization and Navigation	Resource Allocation and Management I	Industry Sessions: Transport and Logistics	5G Innovations
15:30-16:00		Refreshments and Exhibits (Parkside 2)								
16:00-17:30	(6)	Relay Systems III	Sensor Networks	Spectrum Sharing II	Visible Light Communications	Vehicular Networks III	Localization and Tracking	Resource Allocation and Management II	Industry Panel: Autonomous Vehicles	Multiple Antenna Systems
18:30-20:30		Private reception for VTS members								
WEDNESDAY 7 June										
8:00-16:00		Registration (Parkside Foyer)								
9:00-9:45		Keynote Industrial Plenary: New Ways of Thinking About Smart Cities, Ian Oppermann, Chief Data Scientist & CEO, NSW Data Analytics Centre, Australia (Parkside 1)								
9:45-10:30		Keynote Industrial Plenary: Enabling IoT for a Multitude of Vertical Applications, Markus Mueck, Intel Germany (Parkside 1)								
10:30-11:00		Refreshments and Exhibits (Parkside 2)								
11:00-12:30	(7)	Electric Vehicles	Massive MIMO I	Millimeter Wave Communications I	Energy Efficient Transmission	Performance Analysis I	Physical Layer Security I	IoT	Industry Sessions: IoT/Smart Cities	
12:30-14:00		Lunch (Parkside 1 Ballroom)								
14:00-15:30	(8)	LTE	Massive MIMO II	Millimeter Wave Communications II	Multiple Access	Performance Analysis II	Physical Layer Security II	M2M and IoT	Industry Sessions: IoT/Smart Cities	
15:30-16:00		Refreshments and Exhibits (Parkside 2)								
16:00-17:30	(9)	Wireless Networks and Security	Massive MIMO III	Mobile Network Applications	OFDM	Radar and Remote Sensing	Radio Access Techniques	Machine Learning and Applications	Industry Panel: IoT and Smart Cities	

Level 2 Floor Plan

Level 3 Floor Plan
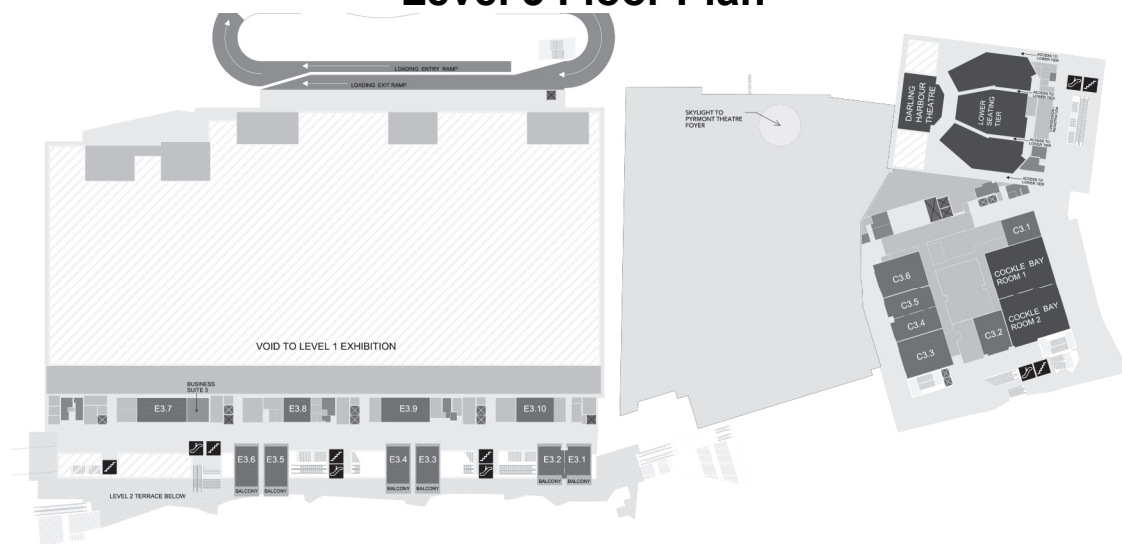
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Workshops

W1: 6th International Workshop on High Mobility Wireless Communications (HMWC) 2017

The vision of future mobile communication systems is to provide seamless high data rate wireless connections for anyone at anytime and anywhere, including the high mobility scenarios such as high speed trains and highway vehicles. High mobility results in rapidly time-varying channels, which pose significant challenges in the design of practical systems, including channel modeling, fast handover, location update, synchronization, estimation and equalization, anti-Doppler spread techniques, coding and network capacity, capacity-approaching techniques, dedicated network architectures, distributed antenna techniques and etc. To deal with these challenges, the 6th international workshop on High Mobility Wireless Communications (HMWC) aims at fostering fruitful interactions among interested communication engineers, information theorists and system designers from all over the world, building successful collaborations and bridging the gap between theory and practice.

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Shun Zhang, Xidian University
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Xiaoming Chen, Zhejiang University
xin jiang, zhejiang university
Yongming Huang, Southeast University
Yuzhen Huang, PLA University of Science and Technology
Zhicheng Dong, Tibet University

Program

Session 1

1 Analysis of Semi-Ellipsoid Scattering Channel Models for Vehicle-to-Vehicle Communication Environments
Hao, Zaichen Zhang, Jian Dang, Liang Wu, Southeast University

2 A Simple Soft-in Soft-out Equalization for Highly Mobile OFDM Systems with Block Markov Superposition Transmission
Yunhong Zhang, Sun Yat-sen University; Lei Lin, Guangdong Polytechnic Normal University; Xiao Ma, Sun Yat-sen University

3 A Wideband 3D GBSM for High Speed Railway Communication System
Liu Feng, Ping Zhi Fan, Southwest Jiaotong University

4 Genetic Algorithm-Assisted Data Detection for OFDM Systems under Rapidly Time-Varying Channels
Zhicheng Dong, Tibet University; Ping Zhi Fan, Southwest Jiaotong University; Xianfu Lei, Utah State University

5 High-Mobility OFDM Downlink Transmission with Partly Calibrated Subarray-based Massive Uniform Linear Array
Yinghao Ge, Weile Zhang, Xi'an Jiaotong University; Feifei Gao, Tsinghua University

6 Power Allocation for OFDM with Index Modulation
Qianli Ma, Ping Yang, Pengfei Wang, Xu He, Bin Fu, Yue Xiao, University of Electronic Science and Technology of China

Session 2

1 Design and Performance of Polar Codes for 5G Communication under High Mobility Scenarios
Peiyao Chen, Minzi Xu, B. Bai, Xidian University; Jiaqing Wang, State Key Laboratory of Wireless Mobile Communications

2 Dynamic Precoder for Massive MIMO in The Presence of Large Doppler Spread
Ilmiawan Shubhi, Hidekazu Murata, Kyoto University

3 Iterative Channel Estimation and Decoding of the Block Markov Superposition Transmission with Doppler Diversity
Leijun Wang, Yunhong Zhang, Xiao Ma, Sun Yat-sen University

4 Joint Doppler and Channel Estimation for High-Speed Railway Wireless Communication with Massive ULA
Dian Fan, Beijing Jiaotong University; Yuanwei Liu, King's College London; Gongpu Wang, Zhangdui Zhong, Beijing Jiaotong University; Nallanathan Arumugam, King's College London

5 Low-Complexity Detector and Performance Analysis for Enhanced Receive Spatial Modulation under High Mobility
Beixiong Zheng, Miaowen Wen, Fangjiong Chen, South China University of Technology; Peng Chen, Southeast University; Hua Yu, Fei Ji, South China University of Technology

6 Low-complexity Location-aware Multi-user Massive MIMO Beamforming for High Speed Train Communications
Chen Xuhong, Pingyi Fan, Tsinghua University

Sunday, 4 June 2017 8:30-17:00 C3-1

W2: 2nd International Workshop on Connecting All Things for Enabling Smart Cities (CONTEST)

As a key initiative for promoting the quality of living and resource efficient economy, the smart city concept has attracted much attention in both academia and industry. Information and communication technologies (ICT), particularly advanced communication techniques, play a critical role in facilitating intelligent collection and utilization of heterogeneous data from deployed equipment throughout cities. The major challenges in this area have included: low energy consumption requirement, limited radio frequency bandwidth, low-latency requirement and cost-effective requirement. This workshop aims to address these challenges and enhance international collaborations by disseminating cutting-edge research results.

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Minglei You, Durham University
Nan Zhao, Dalian University of Technology
Xiaolin Mou, Durham University
Yong Zeng, National University of Singapore
Yue Cao, Northumbria University
Zhengguo Sheng, University of Sussex

Papers

1 Achieving low carbon emission using Smart Grid technologies
Dan Li, Hongjian Sun, Durham University; Wei-Yu Chiu, Yuan Ze University

2 Choreographing Services for Smart Cities: Smart Traffic Demonstration
Lei Chen, Cristofer Englund, Research Institute of Sweden, RISE Viktoria

3 Household Level Distributed Energy Management System integrating Renewable Energy Sources and Electric Vehicles
Daniel Gosselin, Transport for London; Jing Jiang, Hongjian Sun, Durham University

4 L-index Sensitivity Based Voltage Stability Enhancement
Qitao Liu, Minglei You, Hongjian Sun, Peter Matthews, Durham University

5 Machine learning-based primary exclusive region update for database-driven spectrum sharing
Aogu Yamada, Takayuki Nishio, Masahiro Morikura, Koji Yamamoto, Kyoto University

6 Multiple Beacon Based Robust Cooperative Spectrum Sensing in MIMO Cognitive Radio Networks under CSI Uncertainty
Adarsh Patel, Indian Institute of Technology Kanpur; Afzal Ahmad, Rajeev Tripathi, Motilal Nehru National Institute of Technology Allahabad, India

7 Novel Digital Self-interference Cancellation with High Dynamic Range in Full-duplex Communications
Yang Zhutian, Harbin Institute of Technology

8 Optimal Max-min Fairness Energy-harvesting Resource Allocation in Wide band Cognitive Radio Network
Zhenzhen Hu, Zhongpei Zhang, University of Electronic Science and Technology of China

9 Private and Flexible Proximity Detection based on Geohash
Ayong Ye, Qiuling Chen, Li Xu, FuJian Normal University

10 Radio-based Traffic Flow Detection and Vehicle Classification for Future Smart Cities
Marcus Haferkamp, Manar Al-Askary, Benjamin Sliwa, Christian Wietfeld, TU Dortmund University; Lars Habel, Michael Schreckenberg, University Duisburg-Essen

11 Resource Allocation and Power Control for Power Minimization in OFDM Networks
Zhaohui Yang, Southeast University; Cunhua Pan, Queen Mary University of London; Ming Chen, Yijin Pan, Wei Xu, Southeast University

12 Total Variation Measurement Decoding (TVMD) For Reliable Wireless Transmission Of PMU Measurements In Smart Grids
Ankit Kudeshia, Varun Gupta, Neharika Valecha, Aditya K. Jagannatham, Indian Institute of Technology Kanpur

13 VLC Enabled Foglets Assisted Road Asset Reporting
Fatima Hussain, Ryerson University

Sunday, 4 June 2017 13:30-17:00 C3-2

W3: 2nd International Workshop on Research Advancements in Future Networking Technologies (RAFNET 2017)

Recently, a lot of research efforts have been made from both academia and industry side to promote various new and emerging network paradigms. The reason is straight that during the past decade, it has been realized that the current internet architecture was originally designed for end-to-end host centric communications. However, the actual focal of

communications is the content itself. Hence, we have witnessed new architectures such as an Information Centric Network (ICN) with various extensions like Content-Centric Network (CCN), Named Data Network (NDN), Data-Oriented Network Architecture, and so on.

On the other hand, enormous efforts in cellular networks have been made for improving the user experience, and in result today we are able to use LTE-A and so on. In this context, the upcoming 5G networking architectures, whose ongoing research is focused on the networking mechanisms in regards to the massive increase in the number of connected devices, bandwidth requirements, reduced latency, and the deployment of supporting operational mechanisms such as network virtualization, cloud-based deployments, mobile edge computing, and storage and new utilization scenarios. Moreover, these all new technologies are being applied in other networking domains as well, including VANETs, Smart Grid, Smart Cities, Internet of Things, Big Data, and so on. This workshop aims to bring together researchers, academics, individuals working on selected areas of future internet architectures along with 5G implications and share their new ideas, latest findings and results.

Workshop Chairs
Syed Hassan Ahmed, Kyungpook National University
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Safdar Hussain Bouk, Kyungpook National University
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Sohail Jabbar, ASAS Techno
Suzan Bayhan, University of Helsinki
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Zhiwei Yan, CNNIC

Program

Sunday, 4 June 2017 14:00-15:10 C3-2
Session 1
1 **Social Networks on Wheels: A Journey from Vehicular Networks to Vehicular Social Networks (Invited Talk)**
Rasheed Hussain, Innopolis University

2 **Evaluating 5G Multihoming Services in the MobilityFirst Future Internet Architecture**
Parishad Karimi, Michael Sherman, Ivan Seskar, Dipankar Raychaudhuri, WINLAB, Rutgers University; Francesco Bronzino, Inria, MUSE Research Group; Abhimanyu Gosain, Raytheon BBN Technologies

3 **Frequency Domain Equalization of SOQPSK for Aeronautical Telemetry Networks**
Salman Fayyaz Khan, Tayyaba Azmat, Sajid Saleem, Syed Ali Hassan, National University of Sciences and Technology

Sunday, 4 June 2017 15:30-17:00 C3-2
Session 2
1 **LTE or LAA: Choosing network mode for my mobile phone in 5G network**
Rojeena Bajracharya, Rakesh Shrestha, Yousaf Bin Zikria, Sungwon Kim, Yeungnam University

2 **Broadcasting under Highway Environment in VANETs using Genetic Algorithm**
Muhamamd Jafer, M. Arif Khan, Sabih Rehman, Tanveer A. Zia, Charles Sturt University

3 **Performance of Vehicular Nomadic Node Operation in Realistic Multicellular Wireless Networks**
George Tsoulos, University of Peloponnese; Ömer Bulakci, Huawei Technologies GRC; Dimitra Zarbouti, Georgia Athanasiadou, University of Peloponnese; Alexandros Kaloxylos, Huawei Technologies GRC

4 **Study on Small World Characteristics of In-network Caching in Information-centric Networks**
Xiaogeng Xu, Tiankui Zhang, Chunyan Feng, Beijing University of Posts and Telecommunications

5 **On-demand DTN Communications in Heterogeneous Access Networks based on NDN (Poster)**
Zhiwei Yan, Guanggang Geng, CNNIC; Hidenori Nakazato, Waseda University; Yong-Jin Park, Kashif Nisar, Ag Asri Ag Ibrahim, University of Malaysia Sabah

Sunday, 4 June 2017 8:30-17:00 C2-1

W4: Technology Trials and Proof-of-Concept Activities for 5G and Beyond (TPoC5G)

The 5th generation (5G) cellular communication systems are to be launched in a couple of years. In the 5G standardization, key enabling technologies such as massive MIMO, beamforming, access technology and a new frame design are to be specified. Meanwhile, the research and development of those key technologies and their technology trials are being carried out in many research entities. On the other hand, new technology concepts for beyond 5G (B5G) have been also investigated. In these regards, this workshop is aiming to provide the opportunity to present the latest trials and trial results for 5G and the proof-of-concept activities for B5G. Through the discussion at the workshop, it is also expected to promote the exchange of new ideas among researchers.

Workshop Organisers
Gerhard Bauch and Hidekazu Murata
Technical Program Committee:

Anass Benjebbour, NTT DOCOMO
Andreas Knopp, Munich University of the Bundeswehr
Daisuke Ogawa, Fujitsu Laboratories Ltd.

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Takeshi Onizawa, NTT Corporation
Tetsuya Yamamoto, Panasonic Corporation
Tomoaki Ohtsuki, Keio University
Tomoya Tandai, Toshiba Corp.

Papers

Sunday, 4 June 2017 8:30-10:00 C2-1
Session 1: Radio Access

1 5G Field Experimental Trial on Frequency Domain Multiplexing of Mixed Numerology
Masashi Iwabuchi, Anass Benjebbour, Yoshihisa Kishiyama, NTT DOCOMO, INC.; Dan Wu, Tingjian Tian, Liang Gu, Huawei Technologies Co., LTD; Yang Cui, Tsuyoshi Kashima, Huawei Technologies Japan K. K.

2 Trial Results of 5G New Air Interface Technologies
Lei Dong, Huawei Technologies, Co. Ltd

3 A Field Trial on Opportunities for Improving the Unlicensed Spectrum Utilization of LTE
Yan Li, Shaoyi Xu, Rongtao Xu, Beijing Jiaotong University; Hantao Li, Zhenyu Li, Wenfang Tang, Huawei Technologies Co.Ltd

4 5G PoC of SCMA-Based Uplink Grant-Free Transmission in UCNC framework
Jinfang Zhang, Huawei Technologies Co. Ltd

5 Implementation of Polarization Matching Technique for Polarization Division Multiple Access
Sangheon Lee, Jong-Gwan Yook, Yonsei University; Cheol Mun, Korea National University of Transportation; Han-Shin Jo, Hanbat National University

Sunday, 4 June 2017 10:30-12:00 C2-1
Session 2: MU-MIMO I

1 DL MU-MIMO Field Trial with 5G Low SHF Band Massive MIMO Antenna
Kenichiro Yamazaki, Toshifumi Sato, Yasushi Maruta, NEC; Tatsuki Okuyama, Jun Mashino, Satoshi Suyama, Yukihiko Okumura, NTT DOCOMO, INC.

2 Field Experimental Evaluation of Low SHF 5G Radio Access System Employing Higher Rank MIMO
Yuki Inoue, Shohei Yoshioka, Yoshihisa Kishiyama, Satoshi Suyama, Yukihiko Okumura, NTT DOCOMO, INC.; Tsuneomi Haruna, Takeshi Tanaka, Armin Splett, Henrik Liljeström, Nokia

3 Field Experiment of High-Capacity Technologies for 5G Ultra High-Density Distributed Antenna Systems
Hiroyuki Seki, Fujitsu Limited; Masafumi Tsutsui, Morihiko Minowa, Kotaro Shiizaki, Chiyoshi Akiyama, Fujitsu; Tatsuki Okuyama, Jun Mashino, Satoshi Suyama, Yukihiko Okumura, NTT DOCOMO, INC.

4 Large Scale Field Experimental Trial of Downlink TDD Massive MIMO at the 4.5 GHz Band
Yuya Saito, Anass Benjebbour, Yoshihisa Kishiyama, NTT DOCOMO, INC.; Xin Wang, DOCOMO Beijing Labs; Xiaolin Hou, Huiling Jiang, DOCOMO Beijing Communications Laboratories Co., Ltd; Lei Lu, Huawei Technologies Co., LTD; Wenliang Liang, Huawei Technologies Co. Ltd; Bojie Li, Liang Gu, Huawei Technologies Co., LTD; Yang Cui, Tsuyoshi Kashima, Huawei Technologies Japan K. K.

5 Experimental Evaluation of Simple Precoding Technique for Multi-cell Coordinated MU-MIMO
Kenji Hoshino, Manabu Mikami, SoftBank Corp.

Sunday, 4 June 2017 13:30-15:00 C2-1
Session 3: MU-MIMO II

1 Keynote Presentation: Update of NTT DOCOMO Activities Toward 5G Deployment
Takehiro Nakamura, NTT DOCOMO, INC. (See bio on Page 15)

1 Performance Evaluation of Nonlinear Precoding based on 44 GHz band Experiments for 5G Ultra High Capacity Massive MIMO
Kenji Nakagawa, Shigeru Uchida, Mitsubishi Electric Corp.; Akinori Taira, Hiroshi Nishimoto, Mitsubishi Electric Corporation; Hiroki Iura, Mitsubishi Electric Corp.; Akihiro Okazaki, Atsushi Okamura, Mitsubishi Electric Corporation

2 5G Experimental Trial of 28 GHz Band Super Wideband Transmission Using Beam Tracking in Super High Mobility Environment
Jun Mashino, Kei Satoh, Satoshi Suyama, Yuki Inoue, Yukihiko Okumura, NTT DOCOMO, INC.

3 Beamforming Gain Measured on a 5G Test-bed
Arne Simonsson, Ericsson; Magnus Thurfjell, Ericsson Research; Björn Halvarsson, Ericsson AB; Johan Furuskog, Ericsson Research; Sten Wallin, Ericsson AB; Shoji Itoh, Ericsson Japan K.K.; Hideshi Murai, Ericsson Japan; Daisuke Kurita, Kiichi Tateishi, Atsushi Harada, Yoshihisa Kishiyama, NTT DOCOMO, INC.

Sunday, 4 June 2017 15:30-17:00 C2-1
Session 4: Resource Management

1 Measurement and Evaluations of Coherent Joint Transmission for 5G Networks
Yuxian Zhang, Hong Kong ASTRI; Yu-Ngok Ruyue Li, ZTE Corporation

2 Spatial Uplink Power Control for Massive MIMO
Wael Boukley Hasan, Paul Harris, Angela Doufexi, Mark Beach, University of Bristol

3 System Level Simulation of mmWave based Mobile Xhaul Networks
Kyungsik Min, Minchae Jung, Yonsei University; Seiyun Shin, Seokki Kim, Electronics and Telecommunications Research Institute; Sooyong Choi, Yonsei University

4 Performance Evaluation of Correlation Reduction Precoding with Repetition Code in Overloaded MIMO System
Kyohei Nishiyama, Keio University; Shotaro Minami, Kyoto University; Yukitoshi Sanada, Keio University; Hidekazu Murata, Yuji Hayashi, Kyoto University

Sunday, 4 June 2017 8:30-17:00 C2-2

W5: Wireless Access Technologies and Architectures for Internet of Things (IoT) Applications

The Internet-of-Things (IoT) will revolutionize industry and our lives. Future IoT networks will need to provide low latency and high reliability communications for multiple vertical industries including transport, healthcare, manufacturing, agriculture and energy. Wireless technologies will be the most cost-effective and scalable solution for enabling the intensive acquisition of information from fixed and mobile IoT devices. However, many open questions still need to be addressed to overcome fundamental constraints of radio spectrum, power, and transmission distance to support secure wide area coverage and ultra-reliable low latency communications for IoT devices. Furthermore, it is expected that each vertical industry will need to share a common IoT platform and there are formidable challenges in unifying existing networks. These include massive computational complexity and transmission latency for data processing and management of massive number of terminals from multiple vertical industries, which are not adequately addressed in the latest 5G wireless network standard. As such, there is a need to redesign wireless access technologies and architectures with reconfigurable software-defined networks to facilitate a flexible and highly-scalable common IoT platform.

This workshop is designed to bring together academic and industrial researchers in an effort to identify and discuss the major technical challenges and recent breakthroughs related to wireless IoT networks.

General Chairs:
Branka Vucetic, University of Sydney
Wibowo Hardjawana, University of Sydney
TPC Chairs:
Yonghui Li, Univ. of Sydney
Phee Lep Yeoh, Univ. of Sydney
Nan Yang, ANU
Academic Steering Committee:
Soung-Chang Liew, CUHK, HK
Jinhong Yuan, UNSW, Australia
Industry Steering Committee:
Chih-Lin I, China Mobile, China
Zhibo Pang, ABB, Sweden

Technical Program Committee:
Bruce Leow, University Teknologi Malaysia
Gayan Lasintha Amarasuriya Aruma Baduge, University of Alberta
Gunawan Wibisono, University of Indonesia

He Chen, The University of Sydney
Jing Guo, Australian National University
Junqing Zhang, Queen's University Belfast
Lifeng Wang, University College London
Maged Elkashlan, Queen Mary University of London
Mahyar Shirvanimoghaddam, University of Newcastle
Michele Luvisotto, University of Padua
Muhammad Suryanegara, University of Indonesia
Nan Yang, Australian National University
Neda Aboutorab, University of New South Wales
Nikola Zlatanov, Monash University
Peng Cheng, University of Sydney
Hairong Yan, Beijing Unviersity of Technology
Rajitha Senanayake, University of Melbourne
Shihao Yan, Australian National University
Tao Zheng, Beijing Jiaotong University
Trung Q. Duong, Queen's University Belfast
Wanchun Liu, The Australian National University
Yuanwei Liu, King's College London

Program

IoT Resource Allocation I

1 Compressive Random Access for MTC in Distributed Input Distributed Output Systems
Jinho Choi, Gwangju Institute of Science and Technology

2 A Load Balancing Algorithm for Layer 2 Routing based Wi-SUN Systems
Takuya Habara, Keiichi Mizutani, Hiroshi Harada, Kyoto University

3 A Markov-based Modelling with Dynamic Contention Window Adaptation for LAA and WiFi Coexistence
Xiaojing Yan, Tian Hui, Cheng Qin, Beijing University of Posts and Telecommunications

4 Applying Time Diversity for Improved Reliability in a Real-Time Heterogeneous MAC Protocol
Pablo Gutiérrez Peón, TTTech Computertechnik AG; Elisabeth Uhlemann, Mälardalen University; Wilfried Steiner, TTTech Computertechnik AG; Mats Björkman, Mälardalen University

5 On the Performance of Finite Machine-to-Machine Wireless Communications with the ALOHA MAC Protocol
Vahid Naghsihn, Mark C. Reed, Neda Aboutorab, University of New South Wales

Keynotes

1 Ambient Backscatter Communications for Passive Internet of Things
Ying-Chang Liang, The University of Sydney and UESTC

2 The WirelessHP: a new target of wireless communications for critical control applications
Zhibo Pang, ABB Corporate Research

3 IoT: From 2G to 5G
Chih-Lin I, China Mobile Research Institute

IoT Resource Allocation II

1 Detecting Cluster Head Attacks in Heterogeneous Wireless Sensor Networks
Chenlong Jia, Teng Joon Lim, National University of Singapore

2 Energy Minimization in Machine-to-Machine Systems with Energy Harvesting
Zhaohui Yang, Wei Xu, Yijin Pan, Rui Guan, Ming Chen, Southeast University

3 Graphic Constellations and DBN based Automatic Modulation Classification
Fen Wang, Yongchao Wang, Xi Chen, University of Xidian

4 Low-latency and High-reliability Cooperative WSN for Indoor Industrial Monitoring
Zafar Iqbal, Heung-No Lee, Gwangju Institute of Science and Technology

5 Secured Communication among IoT Devices in the Presence of Cellular Interference
Shama Naz Islam, M. A. Mahmud, A. M. T. Oo, Deakin University

IoT Applications

1 System Design and Implementation of Machine-to-Machine (M2M) for Hypertension Patients
Rizky Damiri Putra, Gunawan Wibisono, University of Indonesia

2 Usability of LoRaWAN Technology in a Central Business District
Peter Radcliffe, Karina Gomez, Paul Beckett, RMIT University; Justin Spangaro, Conrad Jakoby, Airlora Communications

3 Coverage and Capacity Analysis of Sigfox, LoRa, GPRS, and NB-IoT
Benny Vejlgaard, Mads Lauridsen, Huan Cong Nguyen, Aalborg University; István Z. Kovács, Nokia Bell Labs; Preben E. Mogensen, Aalborg University; Mads Sorensen, Telenor Denmark

4 Design and Implementation of a Low-Power Wireless Sensor Network Platform Based on XBee
Fan Wu, Chang Wei Tan, Christoph Rudiger, Mehmet Rasit Yuce, Monash University; Majid Sarvi, University of Melbourne

5 Car-To-Cloud Communication Traffic Analysis Based on the Common Vehicle Information Model
Johannes Pillmann, Benjamin Sliwa, Jens Schmutzler, Christoph Ide, Christian Wietfeld, TU Dortmund University

W6: Positioning Solutions for Cooperative Intelligent Transportation Systems

Cooperative intelligent transportation systems (CITS) have emerged in response to the major transportation challenges for society today. At the core of all CITS is the positioning and communications technologies used to connect people, vehicles, infrastructure etc. As CITS evolve and become increasingly safety-liability critical, it is essential that the required performance levels for positioning (accuracy, integrity and availability) is assured.

This workshop aims to connect CITS capabilities and requirements with the domain of positioning and navigation technologies. It focuses on the positioning technologies and infrastructure that will be necessary to deliver the fully capabilities of future CITS. It presents the current landscape for positioning based on signals from Global Satellite Navigation Systems (GNSS) such as the Global Positioning System (GPS) and describes developments over the next decade which will add satellite constellations from Europe, China, India and Japan. It will expose the weaknesses of using satellite positioning alone for CITS and propose techniques that combine both GNSS and non-GNSS signals, to meet the stringent requirements for safety critical applications. Going beyond the signals, invited presentations followed by a panel of experts will identify and critically evaluate what the core components of a positioning infrastructure for CITS should comprise.

Workshop Organisers: *Allison Kealy*, The University of Melbourne
Guenther Retscher, TU Wien

Program

Positioning Solutions for Cooperative Intelligent Transportation Systems
Chair: Guenther Retscher

1 Cooperative Localisation – Challenges and Opportunities
Mark Hedley and Shenghong Li, CSIRO

2 Positioning for Public Transportation Enquiry Service and Classroom Management
Lilian S. C. Pun-Cheng and Charles M. S. Wong, The Hong Kong Polytechnic University

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3 On the Placement of UAV Docking Stations for Future Intelligent Transportation Systems
Hakim Ghazzai, Hamid Menouar, Abdullah Kadri, Qatar Mobility Innovations Center

Sunday, 4 June 2017 13:30-15:00 C2-3
Session 2
Chair: Allison Kealy

1 GNSS Vulnerabilities in Urban Environment for Vehicular Applications
Joon Wayn Cheong, UNSW

2 Interference Effects on Vehicle Positioning
Andrew Dempster, UNSW

3 Vehicle Positioning System and Performance Requirements for Different V2X Safety Applications
Yanming Feng, Queensland University of Technology

Sunday, 4 June 2017 15:30-17:00 C2-3
Panel
Positioning Solutions for Cooperative Intelligent Transportation
Moderator: Guenther Retscher, TU Wien
Panelists: Allison Kealy, The University of Melbourne
Lilian Pun, The Hong Kong Polytechnic University
Andrew Dempster, University of New South Wales
Mark Hedley, CSIRO

Sunday, 4 June 2017 13:00-17:00 C2-5

W7: Workshop on Emerging Non-Orthogonal Multiple Access Techniques for 5G

The data traffic over the cellular network is projected to continue growing explosively in the coming years in view of the proliferation of smartphones and tablets and the advent of smart terminals and emerging applications, e.g. machine-type communications (MTC). As such, an increasingly large amount of research in academia, industry, and standardization bodies such as 3GPP is now dedicated to future 5G technologies.

Future radio access networks are expected to have the capability to support: 1) massive connectivity and dramatically higher capacity; 2) diverse sets of users and applications with radically different requirements in terms of delay, bandwidth, etc.; and 3) flexible and efficient use of all available resources, such as spectrum and time. The above requirements, especially the need for massive connectivity and diverging latency, challenge the current cellular networks in many ways including the multiple access (MA) methods. As a result, significant efforts have been recently made to design more spectrally and energy efficient MA schemes for future wireless networks. A common feature of these newly designed MA schemes is the avoidance of the use of conventional orthogonal schemes, such as time division multiple access (TDMA) and frequency division multiple access (FDMA). Instead, users are encouraged to share their bandwidth resources opportunistically according to their diverse channel conditions or quality of service requirements, where the superior spectral efficiency of these non-orthogonal multiple access (NOMA) schemes has been demonstrated by recent theoretical and experimental studies.

This workshop will provide a forum for brainstorming on the emerging NOMA techniques for 5G cellular networks. We aim to bring together the leading researchers in the field, both from academia and industry, to share their recent findings and their views on what access methods best suit the diverse requirements of next generation networks.

General Chairs
H. Vincent Poor, Princeton University
Robert Schober, FAU
Program Chairs
Mojtaba Vaezi, Princeton University
Wonjae Shin, Samsung Electronics
Zhiguo Ding, Lancaster University
Jungwoo Lee, Seoul National University
Technical Program Committee:
Alireza Bayesteh, Huawei Technologies Canada Co. Ltd.
Byungju Lee, Purdue University

George Karagiannidis, Aristotle University of Thessaloniki
Hosein Nikopour, Intel Labs
Jinhong Yuan, University of New South Wales
Linglong Dai, Tsinghua University
Maged Elkashlan, Queen Mary University of London
Mahsa Derakhshani, Loughborough University
Md. Jahangir Hossain, University of British Columbia
Mojtaba Vaezi, Princeton University
Namyoon Lee, Pohang University of Science and Technology (POSTECH)
Xianfu Lei, Southwest Jiaotong University

Program

Sunday, 4 June 2017 13:00-13:50 C2-5
Keynote I
Non-Orthogonal Multiple Access in Power Domain
Zhiguo Ding, Lancaster University

Sunday, 4 June 2017 13:50-14:45 C2-5
Technical Session 1: Oral Presentations
1 Uplink Vs. Downlink NOMA in Cellular Networks: Challenges and Research Directions
Hina Tabassum, Md Shipon Ali, Ekram Hossain, University of Manitoba; Md. Jahangir Hossain, University of British Columbia; Dong In Kim, Sungkyunkwan University

2 On the Design of Preamble for Autonomous Communications with Extended Coverage
Kiran M. Rege, Nokia Bell Laboratories; M. Anil Kocak, New York University; Krishna Balachandran, Joseph H. Kang, M. Kemal Karakayali, Nokia Bell Laboratories

3 Minimum Transmit Power NOMA Beamforming for Millimeter-Wave Communications
Jinho Choi, Gwangju Institute of Science and Technology

4 Fairness Comparison of Uplink NOMA and OMA
Zhiqiang Wei, Derrick Wing Kwan Ng, Jiajia Guo, Jinhong Yuan, University of New South Wales

Sunday, 4 June 2017 15:00-16:45 C2-5
Technical Session 2: Posters
1 A novel method for improving the capacity in 5G mobile networks combining NOMA and OMA
Andrea Marcano, Henrik Christiansen, Technical University of Denmark

2 Application of Non-orthogonal Multiplexing to mmWave Multi-user Systems
Wenfang Yuan, Vaia Kalokidou, Simon Armour, Angela Doufexi, Mark Beach, University of Bristol

3 Downlink Power Allocation in SCMA with Finite-Alphabet Constraints
Jingjing Cui, Ping Zhi Fan, Xianfu Lei, Zheng Ma, Southwest Jiaotong University; Zhiguo Ding, Lancaster University

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4 Imperfect Reconstructed Filter Bank Multiple Access System Using Wide-Banded Subbands
Jian Dang, Minghao Guo, Zaichen Zhang, Liang Wu, Southeast University

5 Interference Modeling and Outage Analysis for 5G Downlink NOMA
Asim Anwar, Boon Chong Seet, Xue Jun Li, Auckland University of Technology

6 Interleaved Domain Interference Canceller for Low Latency IDMA System and Its VLSI Implementation
Tran Thi Thao Nguyen, Leonardo Lanante Jr., Yuhei Nagao, Masayuki Kurosaki, Kyushu Institute of Technology; Shingo Yoshizawa, Kitami Institute of Technology; Hiroshi Ochi, Kyushu Institute of Technology

7 Multi-cell Performance of Grant-free & Non-orthogonal Multiple Access
Ameha Tsegaye Abebe, Chung Gu Kang, Korea University; Joonsung Lee, Advanced Technology Center Nokia-Bell Lab; Minjoong Rim, Dongguk University

8 Multiuser Bandwidth Minimization with Individual Rate Requirements for Non-Orthogonal Multiple Access
Krishna Chitti, Fredrik Rusek, Lund University

9 Non-Orthogonal Multiple Access for Dual-Hop Decode-and-Forward Relay-Aided X Channel
Dehuan Wan, Miaowen Wen, Fei Ji, South China University of Technology; Ronglan Huang, Wuzhou University

10 On the Sparsity of Spreading Sequences for NOMA with Reliability Guarantee and Detection Complexity Limitation
Ting Qi, Wei Feng, Wang Youzheng, Tsinghua University

11 PHY Abstraction and System Evaluation for SCMA with UL Grant-free Transmission
Meng Cheng, Yiqun Wu, You Li, Yan Chen, Liqing Zhang, Huawei Technologies. Co., Ltd.

12 User Fairness and Performance Enhancement for Cell Edge User in NOMA-HCN with Offloading
Pragya Swami, Vimal Bhatia, Indian Institute of Technology Indore; Satyanarayana Vuppala, T. Ratnarajah, University of Edinburgh

Sunday, 15 May 2016 16:15-16:40 C2-5
Keynote 2
Non-Orthogonal Multiple Access: A New Multiple Access Scheme for New Radio
Jianglei Ma, Huawei Canada

Sunday, 15 May 2016 16:40-17:25 C2-5
Panel
Challenges and Requirements of 5G Multiple Access Techniques
Moderator: Zhiguo Ding, Lancaster University
Panelists: Anass Benjebbour, NTT DOCOMO
Byonghyo Shim, Seoul National University
Chih-Lin I, China Mobile Research Institute
Jinhong Yuan, University of New South Wales

Sunday, 4 June 2017 9:00-17:00 C2-4

W8: International Workshop on Quantum Communications for Future Networks (QCFN) 2017

The Quantum Communications for Future Networks (QCFN'17) workshop is dedicated to explore the new opportunities for application of communications theory and technologies to quantum technology. Over the last decade, a variety of physical quantum computing devices has been demonstrated and used for fundamental experiments in laboratories. Results confirm the feasibility of practical applications in quantum communications and quantum information processing related fields. Some specific applications, such as quantum key distribution are already close to the market. Come and join this workshop to connect with people from academia and industry to discuss and progress all the theory, technology and applications and to exchange ideas conceived for progressing the engineering and development of this exciting new field.

Workshop Organiser
Robert Malaney, University of New South Wales
Technical Program Committee:
Andrea Conti, University of Ferrara
Chuan Wang, Beijing University of Posts and Telecommunications
Gui-Lu Long, Tsinghua University
Jinhong Yuan, University of New South Wales

Lajos Hanzo, University of Southampton
Peter Mueller, IBM Zurich Research Laboratory
Robert Malaney, University of New South Wales
Soon Xin Ng, University of Southampton
Travis Humble, ORNL
Vinod Mishra, US Army Research Laboratory
Yu-Bo Sheng, Nanjing University of Posts and Telecommunications

Program

Sunday, 4 June 2017 9:00-12:30 C2-4
Session 1

1 Keynote: Quantum Secure Direct Communications
Gui Lu Long

2 Efficient entanglement distillation of solid qubits using non-reciprocal microresonators
Chuan Wang, Beijing University of Posts and Telecommunications

2 Entanglement concentration for Concatenated Greenberger-Horne-Zeilinger state assisted with single logic qubit
Yu-Bo Sheng, Nanjing University of Posts and Telecommunications

3 Multi-channel high speed quantum random number generating with DWDM and superluminescent LED
Ziyang Chen, Wang Gan, Li Zhengyu, Xiang Peng, Hong Guo, Peking University

Sunday, 4 June 2017 14:00-17:00 C2-4
Session 2

4 Keynote: Cooperative Classical and Quantum Communications
Soon Xin Ng

4 Multimode Entangled States in the Lossy Channel
Nedasadat Hosseinidehaj, Robert Malaney, University of New South Wales

5 Quantum Secure Direct Communication: principles, current status, perspectives
Gui-Lu Long, Tsinghua University

6 Realization of the algorithm for system of linear equations in duality quantum computing
Gui-Lu Long, Tsinghua University

7 Towards Automatically Construct Quantum Circuits for Quantum Programs with Quantum Control
Shusen Liu, Sun Yat-sen University; Yang He, Beijing Super Engine Co., Ltd.; Cai Zhang, South China Agricultural University

VTC2017-Spring Technical Papers

Monday 5 June 2017

1A: Beamforming
Chair: Robert Malaney, University of New South Wales

1 **Hybrid Beamforming for Large Scale Array Antenna in Wireless Ultra-wide Area Backhaul Network**
SeongWon Go, Korea Advanced Institute of Science and Technology

2 **On-off Analog Beamforming with Per-Antenna Power Constraint**
Shengli Zhang, Chongtao Guo, Taotao Wang, Shenzhen University; Wei Zhang, UNSW

3 **Low-Complexity Beamforming Schemes of SINR Balancing for the Gaussian MISO Multi-Receiver Wiretap Channel**
Tangyanqun, Zhengzhou Institute of Information Science and Technology; Yunpeng Hu, Xiaoyi Zhang, NDSC; Ou Li, National Digital Switching System Engineering & Technological Center; Hongyi Yu, PLA Information Engineering University

4 **Distributed Beamforming for the Multicell Sparsely-Spread MC-CDMA Downlink (Invited Paper)**
Navod Suraweera, Macquarie University, Australia; Stephen V. Hanly, Phil Whiting, Macquarie University

5 **Effect of beamforming on mmWave Systems in Various Realistic Environments**
Nor Fadzilah Abdullah, University of Bristol; Rosdiadee Nordin, Universiti Kebangsaan Malaysia (UKM); Angela Doufexi, Andrew Nix, University of Bristol

6 **Distributed Beamforming with Wirelessly Powered Relay Nodes**
Muhammad Ozair Iqbal, Ammar Mahmood, Muhammad Mahboob Ur Rahman, Information Technology University, Lahore

1B: Channel Measurements and Modeling I
Chair: Akram Al-Hourani, RMIT

1 **Application of mmWave Radio Channel Models in future 5G Communications Services**
David Steer, Huawei Technologies Canada Ltd.,

2 **Angular Resolved Pathloss Measurements in a US Suburban Scenario at 28 GHz**
Christina Larsson, Bengt-Erik Olsson, Martin Johansson, Henrik Asplund, Ericsson Research

3 **Modelling and Analysis of Non-Stationary Multipath Fading Channels with Time-Variant Angles of Arrival**
Matthias Pätzold, University of Agder; Carlos A. Gutierrez, Universidad Autonoma de San Luis Potosi

4 **Evaluation of Indoor Radio Deployment Options in High-Rise Building**
Huan Cong Nguyen, Aalborg University; Jeroen Wigard, István Z. Kovács, Nokia Bell Labs; Fernando Tavares, Preben E. Mogensen, Aalborg University

5 **Directional Analysis of Indoor Massive MIMO Channels at 6 GHz using SAGE**
Jianzhi Li, Bo Ai, Ruisi He, Qi Wang, Bei Zhang, Mi Yang, Ke Guan, Zhangdui Zhong, Beijing Jiaotong University

6 **Pathloss measurements and modeling for UAVs connected to cellular networks**
Rafhael Amorim, Aalborg University; Jeroen Wigard, István Z. Kovács, Nokia Bell Labs; Preben E. Mogensen, Troels B. Sørensen, Aalborg University

1C: Cognitive Radio Networks
Chair: Ahsan Ali, Macquarie University

1 **Energy-aware Adaptive Spectrum Access and Power Allocation in LAA Networks via Lyapunov Optimization (Invited Paper)**
Yu Gu, Yue Wang, Cui Qimei, Somayeh Soleimani, Beijing University of Posts and Telecommunications

2 **Automatic Standard Classification Method for the 2.4 GHz ISM Band**
Tatsuya Kikuzuki, Akihiro Wada, Makoto Hamaminato, Teruhisa Ninomiya, Fujitsu Laboratories Ltd

3 **Secure Channel Selection Using Multi-Armed Bandit Algorithm in Cognitive Radio Network**
Masahiro Endo, Tomoaki Ohtsuki, Keio University; Takeo Fujii, University of Electro-Communications; Osamu Takyu, Shinshu University

4 **MAC Protocol for Opportunistic Spectrum Access in Multi-Channel Cognitive Relay Networks**
Chu Thi My Chinh, Hans-Jürgen Zepernick, Blekinge Institute of Technology; Hoc Phan, Duy Tan University

5 **Two-stage Credit Threshold on Cooperative Spectrum Sensing to Exclude Malicious Users in Mobile Cognitive Radio Networks**
Jun Wu, Song Tiecheng, Southeast University; Zhang Lei, Jiangsu University of Technology; Liu Miao, Southeast University

6 **Cognitive Random Access for Internet-of-Things Networks**
Hyesung Kim, Yonsei University; Seung-Woo Ko, The University of Hong Kong; Seong-Lyun Kim, Yonsei University, Korea

1D: D2D I
Chair: Ming Jiang, Sun Yat-sen University

1 **Linear Precoder Design with Imperfect CSI in Underlay Device-to-Device Communication for a Vehicular Platooning Scenario**
Xin Zhang, Technische Universität Dresden; Andreas Festag, Fraunhofer IVI; Gerhard Fettweis, Technische Universität Dresden

2 **Interleaved Resource Mapping for Autonomous Device-to-Device Discovery in Public Safety LTE**
Kazushi Muraoka, Taichi Ohtsuji, Hiroaki Aminaka, Yasuhiko Matsunaga, NEC Corporation

3 **Content Offloading via D2D Communications with the Impact of User Preferences and Selfishness**
Yijin Pan, Southeast University; Cunhua Pan, H. Zhu, University of Kent; Qasim Ahmed, University of Huddersfield; Ming Chen, Southeast University; Jiangzhou Wang, University of Kent

4 **Fast Spectrum Reuse and Power Control for Device-to-Device Communication**
Jung-Chun Kao, National Tsing Hua University

5 **Distance-based Radio Resource Allocation for Device to Device Communications (Invited Paper)**
Mª Carmen Lucas Estañ, Javier Gozálvez, Universidad Miguel Hernandez de Elche

6 **Load Balancing for Cellular Networks using Device-to-Device Communications (Invited Paper)**
Hongliang Zhang, Ling Yang Song, Peking University; Yingjun Zhang, Chinese University of Hong Kong

1E: Full Duplex Radios
Chair: Yun Ai, Norwegian University of Science and Technology

1 **Full-Duplex Decode-and-Forward Relaying: Secrecy Rates and Optimal Power Allocation**
Lubna Elsaid, Mohammad Ranjbar, Nathaniel Raymondi, University of Akron; Duy Nguyen, San Diego State University; Nghi Tran, Abdelrhman A Mahamadi, University of Akron

2 **On Partial Interference Cancellation with Partial Interference Forwarding**
Rajendra Prasad Sirigina, A.S. Madhukumar, Nanyang Technological University

3 **A New Hybrid Half-Duplex/Full-Duplex Relaying System with Antenna Diversity**
Cheng Li, Bin Xia, Zhiyong Chen, Shanghai Jiao Tong University

4 **A Tomography of Full-Duplex Cellular Networks**
Rongpeng Li, Zhejiang University; Wei Quan, Huawei Technologoies Co., Ltd; Yan Chen, Yiqun Wu, Huawei

5 **Joint Transmit Beamforming and Power Control for Full-Duplex Cellular Systems**
Pei-Rong Li, National Taiwan University; Meng-Lin Ku, National Central University; Char-Dir Chung, National Taiwan University; Sen-Hung Wang, National Sun Yat-Sen University

6 **On Performance of Analog Least Mean Square Loop for Self-Interference Cancellation in In-band Full-Duplex OFDM Systems**
Anh Tuyen Le, University of Technology Sydney; Le Chung Tran, University of Wollongong; Xiaojing Huang, University of Technology Sydney

1F: Heterogeneous Networks I
Chair: Nan (Jonas) Yang, The Australian National University

1 **Low Complexity Throughput Optimisation in OFDMA Hetnets with Heterogeneous Services**
Tran Nam Le, Dhammika Jayalath, Jacob Coetzee, Queensland University of Technology

2 **Energy Efficiency Optimization for Heterogeneous Cellular Networks**
Jie Tang, South China University of Technology; Daniel K C So, Emad Alsusa, Khairi Hamdi, University of Manchester; Arman Shojaeifard, Kai-Kit Wong, University College London

3 **User-Oriented Graph-Based Dynamic Frequency Reuse Scheme in Heterogeneous Networks**
Liang Chen, Lin Ma, Yubin Xu, Harbin Institute of Technology; Victor C. M. Leung, The University of British Columbia

4 **Experimental Evaluation on Doppler Spread Based Mobility State Decision Considering Moving Scatterers Using Actual Radio Propagation Data**
Sourabh Maiti, Manabu Mikami, Kenji Hoshino, Softbank Corp.

5 **C/U Split Multi-connectivity in the Next Generation New Radio System**
Lei Du, Naizheng Zheng, Hong Zhou, Yang Liu; Zhuyan Zhao, Nokia Bell Labs; Jiankai Chen, Tao Yu, Nokia MBB; Liu Guangyi, Xiaoman Liu, Zhuo Chen, Research Institute of China Mobile

6 **Coverage Analysis for Dense Heterogeneous Networks with Cooperative NOMA (Invited Paper)**
Chun-Hung Liu, Di-Chun Liang, Po-Chia Chen, Jie-Ru Yang, National Chiao Tung University

1G: 5G Networks I
Chair: Xing Zhang, BUPT

1 **5G Multi-RAT integration evaluations using a common PDCP layer**
Caner Kilinc, Mårten Ericson, Patrik Rugeland, Ericsson Research; Icaro Da Silva, Ericsson AB; Ali Zaidi, Ericsson Research; Osman Aydin, Venkatkumar Venkatasubramanian, Nokia Bell Labs; Miltiades C. Filippou, Intel; Marco Mezzavilla, University of Padova; Nandish P. Kuruvatti, Univ of Kaiserslautern; Jose F. Monserrat, Polytechnic University of Valencia

2 **An Evaluation of Channel Models, Frequency Bands and Antenna Topologies for 5G**
Callum Neil, Victoria University of Wellington; Mansoor Shafi, Spark, New Zealand; Peter Smith, Pawel A. Dmochowski, Victoria University of Wellington; Zhang Jianhua, Beijing University of Posts and Telecommunications

3 **Evaluation of 5G Waveform Candidates Considering Hardware Impairments and Above 6 GHz Operation**
Hua Wang, Keysight Technologies; Ali Zaidi, Ericsson Research; Xiaoming Chen, Qamcom Research & Technology AB; Jian Luo, Huawei Technologies Duesseldorf GmbH; Michael Dieudonne, Keysight Technologies

4 **Adaptive Hybrid ARQ (A-HARQ) for Ultra-Reliable Communication in 5G**
Emerson Cabrera, Macquarie University; Gengfa Fang, University of Technology Sydney; Rein Vesilo, Macquarie University

5 **Flexible Network Deployment in 5G**
Taylan Sahin, Technical University of Munich; Ömer Bulakci, Huawei European Research Center; Panagiotis Spapis, Huawei European Research Centre; Alexandros Kaloxylos, Huawei ERC

6 **Hysteretic Base Station Sleeping Control for Energy Saving in 5G Cellular Network (Invited Paper)**
Juwo Yang, Wenbo Wang, Xing Zhang, Beijing University of Posts and Telecommunications

1P: Recent Results

1 **Energy-efficient multicasting in IEEE 802.11 WLANs for Scalable Video Streaming**
Wan-Seon Lim, YongGeun Hong, ETRI

2 **A Simple Scheme for Distributed Passive Load Balancing in Mobile Ad-hoc Networks**
Benjamin Sliwa, Robert Falkenberg, Christian Wietfeld, TU Dortmund University

3 **Mobility-Aware User Caching Strategy with QoE Maximization**
Yinglei Teng, Guofeng Lu, Weiqi Sun, Yue Ma, Beijing University of Posts and Telecommunications

4 **A Mobility-Aware Channel Allocation Strategy for Clustered Ad hoc Network**
Roni F. Shigueta, Pontifical Catholic University of Parana; Mauro Fonseca, Federal Technological University of Parana; Aline Carneiro Viana, INRIA

5 **A Bi-conical Log-Periodic Antenna for Vehicular Communications**
Jean L. Kubwimana, Nicholas J. Kirsch, University of New Hampshire; Bessam Z. Al-Jewad, Cihan University

6 **Hybrid Compressive Sensing for Delay-Efficient Sustainable Data Gathering**
Jiajia Huang, Soong Boon Hee, Nanyang Technological University

7 **ThinGs In a Fog: System Illustration with Connected Vehicles**
Jim Martin, Anjan Rayamajhi, Manveen Kaur, Jianwei Liu, Mizanur Rahman, Clemson University

8 **Toeplitz Matrix Reconstruction of Interpolated Coprime Virtual Array for DOA Estimation**
Xing Fan, Chengwei Zhou, Zhejiang University; Yujie Gu, Bar-Ilan University; Zhiguo Shi, Zhejiang University

9 **Is It Cost-Effective to Share Roadside Infrastructure for Non-Safety Use?**
Alexandre K. Ligo, Jon M. Peha, Carnegie Mellon University

10 **Automating WiFi Fingerprinting Based on Nano-scale Unmanned Aerial Vehicles**
Appala Chekuri, Myounggyu Won, South Dakota State University

2A: Cellular and Cooperative Networks
Chair: Wei Ni, CSIRO Data61

1 Towards Zero Data Interruption Time with Enhanced Synchronous Handover
Lucas Chavarria Gimenez, Aalborg University; Per Henrik Michaelsen, Nokia Networks; Klaus I. Pedersen, Troels E. Kolding, Nokia Bell Labs

2 On the Emerging of Scaling Law , Fractality and Small-World in Cellular Networks
Chao Yuan, Zhifeng Zhao, Rongpeng Li, Meng Li, Honggang Zhang, Zhejiang University

3 Secrecy Outage and Diversity Analysis in D2D-Enabled Cellular Networks
Yajun Chen, Xinsheng Ji, Kaizhi Huang, Xiao-lei Kang, National Digital Switching System Engineering & Technological R&D Center

4 On a User-Centric Base Station Cooperation Scheme for Reliable Communications (Invited Paper)
Dong Min Kim, Henning Thomsen, Petar Popovski, Aalborg University

5 Cooperative Distributed Antenna Transmissions (Invited Paper)
Fumiyuki Adachi, Amnart Boonkajay, Yuta Seki, Tomoyuki Saito, Tohoku University

6 BS Switching for Green Cellular Networks Using Energy-Aware Dynamic Traffic Offloading Schemes (Invited Paper)
Md. Farhad Hossain, University of Sydney; Kumudu Munasinghe, University of Canberra; Abbas Jamalipour, University of Sydney

2B: Channel Measurements and Modeling II
Chair: Hongjie Hu, Huawei Technologies

1 Comparison of Propagation Channel Characteristics for Multiple Millimeter Wave Bands
Jie Huang, Rui Feng, Jian Sun, Shandong Unviersity; Cheng-Xiang Wang, Heriot-Watt University; Wensheng Zhang, Shandong University; Yang Yang, Shanghai Research Center for Wireless Communications (WiCO)

2 Virtual SIMO Measurement-Based Angular Characterization in High-Speed Railway Scenarios
Tao Zhou, Cheng Tao, Liu Liu, Hui Wen, Nan Zhang, Beijing Jiaotong University

3 Measurement-Based Characterizations of On-body Channel in the Human Walking Scenario
Hongyun Zhang, F. Safaei, Le Chung Tran, University of Wollongong

4 27.1 GHz Millimetre Wave Propagation Measurements for 5G Urban Macro Areas
Saurav Dahal, Mike Faulkner, Horace King, Shabbir Ahmed, Victoria University

5 Direction-of-Arrival Channel Measurements with Real MIMO Prototype at 4.6 GHz
Zhenyu Shi, Yi Wang, Huawei Technologies, Co., Ltd.

6 Impact of Different Parameters on Channel Characteristics in a High-Speed Train Ray Tracing Tunnel Channel Model
Yapei Zhang, Yu Liu, Shandong University; Jian Sun, University of Shandong; Cheng-Xiang Wang, Heriot-Watt University; Xiaohu Ge, Huazhong University of Science and Technology

2C: Communication and Sensing
Chair: Ahsan Ali, Macquarie University

1 Dual-Level Sensing Based Multiple Access Protocol for Cognitive Radio Networks
Ratan Kumar Mondal, Bouchra Senadji, Dhammika Jayalath, Queensland University of Technology

2 A Modified Waveform Design for Radar-Communication Integration Based on LFM-CPM
Yu Zhang, Qingyu Li, Ling Huang, Changyong Pan, Jian Song, Tsinghua University

3 Framework for an Innovative Perceptive Mobile Network Using Joint Communication and Sensing
Andrew Zhang, UTS; Antonio Cantoni, University of Western Australia; Xiaojing Huang, Y. Jay Guo, University of Technology Sydney; Robert Heath, The University of Texas at Austin

4 Joint Communications and Sensing Using Two Steerable Analog Antenna Arrays
Andrew Zhang, UTS; Antonio Cantoni, University of Western Australia; Xiaojing Huang, Y. Jay Guo, University of Technology Sydney; Robert W. Heath Jr., The University of Texas at Austin

5 Test Methodology for Fog Influence on Automotive Surround Sensors
Hasirlioglu Sinan, Igor Doric, Alexander Kamann, Andreas Riener, Thomas Brandmeier, Technische Hochschule Ingolstadt

6 Performance of CPSC Spectrum Sensing over Fast Frequency-Selective Fading Channels
Guilherme de Souza Lima Moreira, Rausley Adriano Amaral de Souza, Roberto César Dias Vilela Bomfin, National Institute of Telecommunications (Inatel)

2D: D2D II
Chair: Daniel K. C. So, University of Manchester

1 Energy Efficient Device to Device Communication by Resource Efficiency Optimization
Fakrulradzi Idris, University of Manchester; Jie Tang, South China University of Technology; Daniel K C So, University of Manchester

2 A Survey and Comparison Of Device-To-Device Architecture Using LTE unlicensed Band
Bushra Ismaiel, Mehran Abolhasan, University of Technology Sydney; David Smith, Wei Ni, CSIRO; Daniel Franklin, University of Technology Sydney

3 Sum-rate optimization for Device-to-Device communications over Rayleigh fading channel
Shijun Lin, Liqun Fu, Kewei Li, Xiamen University; Yong Li, Tsinghua University

4 Joint Resource Efficiency Optimisation for Overlay Device-to-Device Retransmissions
Kuan Wu, Ming Jiang, Sun Yat-sen University

5 D2D Networks for Information Diffusion and Bus Location Gaining with Local Community Buses (Invited Paper)
Huan-Bang Li, Lin Shan, Ryu Miura, Fumihide Kojima, National Institute of Information and Communications Technology (NICT)

6 Radio Link Enabler for Context-aware D2D Communication in Reuse Mode
Lianghai Ji, Andreas Weinand, Michael Karrenbauer, Hans Schotten, University of Kaiserslautern

2E: Interference Cancellation
Chair: Diep Nguyen, University of Technology Sydney

1 Subspace Based Interference Cancellation in Cooperative Multicell Transmission
Swagato Barman Roy, A.S. Madhukumar, Nanyang Technological University; Francois Chin, Institute for Infocomm Research (I2R)

2 A Joint MMSE Interference Suppression and Multiuser Detection Scheme for Multi-Cell Wireless Relay Communications
Ahmet Ihsan Canbolat, Kazuhiko Fukawa, Tokyo Institute of Technology

3 Self-Interference Cancellation of Full-Duplex Massive MIMO Relay Systems over Rician Fading Channels
Siyuan Wang, State Key Laboratory of Integrated Service Network, Xidian University; Yi Liu, Hailin Zhang, Xidian University

4 Phase Noise Self-Cancellation Scheme with Orthogonal Polarization in the Polarization Dependent Loss Channel for OFDM system
Yao Nie, Chunyan Feng, Fangfang Liu, Caili Guo, Wen Zhao, Beijing University of Posts and Telecommunications

5 Interference Analysis of Ambient Backscatter on Existing Wireless Communication Systems
ChenChen, Gongpu Wang, Beijing Jiaotong University; Yanwen Wang, ZTE Corporation; Quan Miao, National Computer Network Emergency Response Technical Team

6 Successive Interference Cancellation of ICA Based SDMA Differential Detector for BLE Systems
Masahiro Takigawa, Shinsuke Ibi, Seiichi Sampei, Osaka University

Monday, 5 June 2017 14:00-15:30 Meeting Room C2-6
2F: Heterogeneous Networks II
Chair: Nan (Jonas) Yang, The Australian National University

1 Proactive Content Push in Heterogeneous Networks with Multiple Energy Harvesting Small Cells (Invited Paper)
Xi Zheng, Sheng Zhou, Zhiyuan Jiang, Zhisheng Niu, Tsinghua University

2 Coverage and Rate Analysis for Massive MIMO enabled Heterogeneous Networks with Millimeter wave Small Cells
Anum Umer, Syed Ali Hassan, National University of Sciences and Technology; Haris Bin Pervaiz, Qiang Ni, Lancaster University; Leila Musavian, University of Essex

3 A novel utility-based handover decision policy for a two-tier HetNets
Edenalisoa Rakotomanana, Francois Gagnon, École de Technologie Supérieure

4 Base Station Preference Association with Network Dynamics
Yifei Huang, Salman Durrani, Xiangyun Zhou, The Australian National University

5 Distributed Adaptive Range Extension Setting for Small Cells in Heterogeneous Cellular Network
Lu Zhang, Nokia; Shengjie Zhao, Tongji University; Peng Shang, Jimin Liu, Nokia; Fengxia Han, Tongji University

6 Energy-Efficient Base Station Deployment in HetNet Based on Traffic Load Distribution
Congshan Fan, Tiankui Zhang, Zhimin Zeng, Beijing University of Posts and Telecommunications

Monday, 5 June 2017 14:00-15:30 Meeting Room C3-1
2G: 5G Networks II
Chair: Xiaojing Huang, University of Technology

1 Cooperate Caching with Multicast for Mobile Edge Computing in 5G Networks
Xiangyue Huang, Zhifeng Zhao, Honggang Zhang, Zhejiang University

2 Big Data Analytics for 4.9G and 5G Mobile Network Optimization (Invited Paper)
Peter Chiu, New South Wales Government Data Analytics Centre; Jussi Reunanen, Riku Luostari, Harri Holma, Nokia

3 5G Mobile Systems for Healthcare
David Soldani, Fabio Fadini, Heikki Rasanen, Jose Duran, Tuomas Niemela, Nokia Mobile Networks; Devaki Chandramouli, Nokia Bell Labs; Tom Hoglund, Klaus Doppler, Teemu Himanen, Jaana Laiho, Niraj Nanavaty, Nokia Mobile Networks

4 5G to the Home
David Soldani, Petro Airas, Heikki Rasanen, David Debrecht, Nokia Mobile Networks

5 A 20 Gbps Digital Modem for High Speed Wireless Backhaul Applications
Hao Zhang, Xiaojing Huang, Y. Jay Guo, University of Technology Sydney

6 Achieving Massive MIMO Gains in the FDD System for 5G: An Environment-Aware Perspective
Yingjie Zhang, Wei Feng, Tsinghua University; Yunfei Chen, University of Warwick; Ge Ning, Tsinghua University

Monday, 5 June 2017 14:00-15:30 Parkside 2
2P: MIMO

1 Analysis and Optimization of Fractional Pilot Reuse in Massive MIMO Systems
Jiancun Fan, Weiqi Li, Xi'an Jiaotong University

2 Implementation of Coordinated MIMO-OFDM with Independent Local Oscillators
Hajime Suzuki, Joseph Pathikulangara, CSIRO

3 Efficient Ordering Calculation Method Using Frequency Correlation for MU-MIMO-OFDM THP
Nobuhiro Hiruma, Tomoki Maruko, Waseda University; Hiromichi Tomeba, Takashi Onodera, Sharp Corporation; Fumiaki Maehara, Waseda University

4 Outage Constrained Robust Energy Efficiency Optimization for MISO Wiretap Channels
Weidong Mei, Zhi Chen, Jun Fang, University of Electronic Science and Technology of China

5 A New Method of MIMO-Based Non-Orthogonal Multiuser Downlink Transmission
Giovanni Geraci, Dong Fang, Holger Claussen, Bell Labs Nokia

6 An Efficient Soft MIMO Detection Based on Differential Metrics
Wang-Yueh Chang, National Cheng Kung University; Ming-Xian Chang, National Cheng-Kung University

7 HOSVD-based Denoising for Improved Channel Prediction of Weak Massive MIMO Channels
Muhammad Bilal Amin, Wolfgang Zirwas, Nokia Networks; Martin Haardt, TU Ilmenau

8 The Spatial Evolution of Clusters in Massive MIMO Mobile Measurement at 3.5 GHz
Chao Wang, Zhang Jianhua, Tian Lei, Mengmeng Liu, Beijing University of Posts and Telecommunications; Ye Wu, Huawei

Monday, 5 June 2017 16:00-17:30 Meeting Room C2-1
3A: Channel Estimation
Chair: Ming Jiang, Sun Yat-sen University

1 Optimal Pilot Symbols Ratio in terms of Spectrum and Energy Efficiency in Uplink CoMP Networks
YuHao Zhang, Cui Qimei, Wang Ning, Beijing University of Posts and Telecommunications

2 Location-aided Superimposed Pilot-based Channel Estimation for Sparse HAP Channels
Syed Junaid Nawaz, Babar Mansoor, COMSATS Institute of Information Technology, Islamabad; Shree K. Sharma, University of Western Ontario; Sardar M. Gulfam, COMSATS Institute of Information Technology, Islamabad; Mohammed N. Patwary, Staffordshire University

3 Channel Estimation Using Low-Resolution PSs for Wideband mmWave Systems
Yue Dong, Chen Chen, Na Yi, Guocheng Lu, Ye Jin, Peking University

4 Adaptive Channel Estimation Based on a Decision Method Using a Long Preamble for the IEEE 802.11p
Joo-Young Choi, Yonsei University; Cheol Mun, Korea National University of Transportation; Jong-Gwan Yook, Yonsei University

5 On the Influence of Doubly-Selectivity in Pilot-Aided Channel Estimation for FBMC-OQAM
Ronald Nissel, Vienna University of Technology; Erich Zöchmann, TU Wien; Markus Rupp, Vienna University of Technology

6 Channel Estimation for Millimeter Wave MIMO Systems over Frequency Selective Channels via PARAFAC Decomposition
Jun Fang, University of Electronic Science and Technology of China; Hongbin Li, Stevens Institute of Technology; Rick S. Blum, Lehigh University

Monday, 5 June 2017 16:00-17:30 Meeting Room C2-2
3B: Channel Measurements and Modeling III
Chair: Akram Al-Hourani, RMIT

1 A 3-D Wideband Multi-Confocal Ellipsoid Model for Wireless Massive MIMO Communication Channels with Uniform Planar Antenna Array
Lu Bai, Shandong Unviersity; Cheng-Xiang Wang, Heriot-Watt University; Shangbin Wu, Samsung R&D Institute UK; Jian Sun, University of Shandong; Wensheng Zhang, Shandong University

2 Improve Signals Discrimination for an Indoor Environment Using the Sparse Deconvolution Algorithm
Yi Yang, University of Bristol

3 Three Dimensional Modeling and Space-Time Correlation for UAV Channels
Kun Jin, Xiang Cheng, Peking University; Xiaohu Ge, Huazhong University of Science and Technology; Xuefeng, Tongji University

4 Influence of Car Body Modeling on the Gain Patterns of Automotive Antennas
Jasmeet Singh, Aidin Asgharzadeh, Ralf Stephan, Matthias Hein, Technische Universität Ilmenau

5 Temporal Analysis of Measured LOS Massive MIMO Channels with Mobility
Paul Harris, University of Bristol; Steffen Malkowsky, Joao Vieira, Fredrik Tufvesson, Lund University; Wael Boukley Hasan, University of Bristol; Liang Liu, Lund University; Mark Beach, Simon Armour, University of Bristol; Ove Edfors, Lund University

6 Channel Propagation Model Identification for Spectrum Database: A Spark Based PVOS-ELM (Invited Paper)
Bo Zhou, Tsinghua University; Xiaopu Liu, Beijing Radio Monitoring Station; Jianbin Li, National Astronomical Observatories, Chinese Academy of Sciences; Bo (Bob) Bai, Wei Chen, Tsinghua University; Tian Hui, Beijing University of Posts and Telecommunications

Monday, 5 June 2017 16:00-17:30 Meeting Room C2-3
3C: Cooperative Communications
Chair: Andrew Zhang, University of Technology Sydney

1 Generalized Buffer-State-Based Relay Selection for Fixed-Rate Buffer-Aided Cooperative Systems
Ryota Nakai, Miharu Oiwa, Shinya Sugiura, Tokyo University of Agriculture and Technology

2 Outage Probability Analysis of Shared UE-side Distributed Antenna System based Cooperative AF Relaying Network for 5G Systems
Praveen Kumar Singya, Nagendra Kumar, Vimal Bhatia, Indian Institute of Technology Indore; Faheem A. Khan, University of Huddersfield

3 Virtual Clustering for Distributed Consensus-based Estimation in Cooperative Networks
Guang Xu, Shengdi Wang, Henning Paul, Armin Dekorsy, University of Bremen

4 Relay Selection and Transceiver Design for Joint Wireless Information and Energy Transfer in Cooperative Networks
Sumit Gautam, P. Ubaidulla, International Institute of Information Technology (IIIT), Hyderabad

5 Power Allocation for Secrecy Efficiency in Full-Duplex Relay Assisted Cooperative Networks (Invited Paper)
Yunchao Gong, Li Wang, Ruoguang Li, Mei Song, Beijing University of Posts and Telecommunications; Zhu Han, University of Houston; Zhang Ping, Beijing University of Posts and Telecommunications

6 Energy-Efficient Wireless Caching in Device-to-Device Cooperative Networks (Invited Paper)
Sihua Lin, Di Cheng, Guodong Zhao, Zhi Chen, University of Electronic Science and Technology of China

Monday, 5 June 2017 16:00-17:30 Meeting Room C2-4
3D: Modulation and Coding
Chair: Rui Chen, Xidian University

1 Iterative Decoding for the Concatenated Code to Correct Nonbinary Insertions/Deletions
Yuan Liu, Weigang Chen, Tianjin University

2 Time-indexed Media-based Modulation
Bharath Shamasundar, Swaroop Jacob, A. Chockalingam, Indian Institute of Science, Bangalore

3 Hybrid Source-Channel Coding with Bandwidth Expansion for Speech Data
Minh-Quang Nguyen, Telecom-Sud Paris; Hang Nguyen, Institut Mines-Telecom, Telecom SudParis; Eric Renault, Institut Mines-telecom; Yusheng Ji, National Institute of Informatics

4 Design of Raptor Codes for Small Message Length
Lei Yuan, Jie Pan, Lanzhou University

5 A Rate-Compatible Low-Density Parity-Check Convolutional Coding Scheme Using Informed Dynamic Scheduling
Huang-Chang Lee, Chang Gung University; Yung-Hsiang Su, Yeong-Luh Ueng, National Tsing Hua University

6 Precoded Index Modulation (PIM) for Multi-Input Multi-Output OFDM
Meng Zhang, Xiang Cheng, Peking University

Monday, 5 June 2017 16:00-17:30 Meeting Room C2-5
3E: Interference Modeling and Management
Chair: Norman Haider, University of Technology Sydney

1 Layer-aware Interference Mitigation Scheme for Downlink Multi-User SCMA System
Xinmin Li, Ling Qiu, Xiaowen Liang, University of Science and Technology of China

2 Internal Collusive Eavesdropping of Interference Alignment Networks
Nan Zhao, Dalian University of Technology; F. Richard Yu, Carleton University; Yunfei Chen, University of Warwick; Bingcai Chen, Dalian University of Technology; Victor C. M. Leung, The University of British Columbia

3 Power Allocation for Interference Alignment Networks Based on Caching
Fen Cheng, Peng Sun, Nan Zhao, Dalian University of Technology

4 Modeling and Analysis of Interference for Diffusion-based Nanoscale Networks with Spatially Distributed Transmitters (Invited Paper)
Trang C. Mai, Tiep M. Hoang, Queen's University Belfast; H. D. Tuan, University of Technology, Sydney; Marco Di Renzo, Centre National de la Recherche Scientifique; Trung Q. Duong, Queen's University Belfast

5 Increasing Bandwidth Efficiency in Multi-Beam Satellite Systems under Interference Limited Condition using Overlay Coding
Nazli Ahmad Khan Beigi, M. Reza Soleymani, Concordia University

6 Interference Modelling in Cellular Networks with β-Ginibre Point Process Deployed Base Stations
Ahsan Ali, Rein Vesilo, Macquarie University

Monday, 5 June 2017 16:00-17:30 Meeting Room C2-6
3F: Heterogeneous Networks III
Chair: Diep Nguyen, University of Technology Sydney

1 Optimal Power Control and Beamforming for Full-Duplex Small Cell Wireless Networks
Rung-Hung Gau, Zh-Hong Xiao, Tseng-Lung Yuan, National Chiao Tung University

2 User Association for Offloading in Heterogeneous Network Based on Matern Cluster Process
Xie Yuxuan, Xuefei Zhang, Qimei Cui, Beijing University of Posts and Telecommunications

3 Dual Layer Small Cell On/Off Control for Ultra-Dense Small Cell Networks
Kwonjong Lee, Yosub Park, Jihaeng Heo, Yonsei University; Minsoo Na, Network R&D Center, SK Telecom, Bundang, South Korea; Hano Wang, Sangmyun University, Korea; Daesik Hong, Yonsei University

4 Indoor Deployment Strategies for Ultra Dense Urban Areas
Fernando Tavares, Aalborg University; Jeroen Wigard, István Z. Kovács, Nokia Bell Labs; Huan Cong Nguyen, Preben E. Mogensen, Aalborg University

5 The Role of Inter-Frequency Measurement in Offloading Traffic to Small Cells
Ali Mahbas, H. Zhu, Jiangzhou Wang, University of Kent

6 A Design of Synchronization Signal for Efficient Handover in Small-Cell Networks with 3D Beamforming
Rothna Pec, Chang Hwan Park, Yong Soo Cho, Chung-Ang University

Monday, 5 June 2017 16:00-17:30 Meeting Room C3-1
3G: 5G Networks III
Chair: Hajime Suzuki, CSIRO Data61

1 A Portable SDR Non-orthogonal Multiple Access Testbed for 5G Networks
Xingguang Wei, Zhiming Geng, Haitao Liu, Kan Zheng, Beijing University of Posts and Telecommunications; Rongtao XU, Beijing Jiaotong University

2 A Time-Based Fairness Approach for Coexisting 5G Networks in Unlicensed Bands
Oluwatobi Baiyekusi, University of Surrey

3 Data Flow Delay Equalization for Feedback Control Applications Using 5G Wireless Dual Connectivity
Richard H Middleton, University of Newcastle, NSW; Torbjorn Wigren, Ericsson AB; Katrina Lau, Ramon A Delgado, University of Newcastle, NSW

4 Energy Efficient Coordinated Self-Backhauling for Ultra-Dense 5G Networks
Athul Prasad, Mikko Aleksi Uusitalo, Nokia Bell Labs; Andreas Maeder, Nokia Networks

5 Flexible Multi-Bit Feedback Design for HARQ Operation of Large-Size Data Packets in 5G
Saeed R. Khosravirad, Luke Mudolo, Nokia - Bell Labs

6 Delay-Aware LTE WLAN Aggregation for 5G Unlicensed Spectrum Usage
Bin Liu, Nanjing University of Posts and Telecommunications

Monday, 5 June 2017 16:00-17:30 Parkside 2
3P: Transmission and Detection III

1 Power Threshold based Interference Alignment in Hybrid D2D & Cellular Uplink Transmissions
Weifeng Li, Mengqi Zhang, Bo (Bob) Bai, Tsinghua University

2 Application of WFRFT in Impulsive Noise Channels of Substation Communications
Xiaolu Wang, Harbin Institute of Technology / McGill University; Lin Mei, HIT; Fabrice Labeau, McGill University

3 Joint Phase Noise Estimation and Iterative Detection of Faster-than-Nyquist Signaling based on Factor Graph
Qi Xiaotong, Nan Wu, Lei Zhou, Dewei Yang, Hua Wang, Beijing Institute of Technology

4 Joint Detector Demodulator Decoder (JDDD) over ISI Channels
Ashish James, Kheong Sann Chan, Data Storage Institute (DSI)

5 Performance of Optically Pre-amplified FSO System under Gamma-Gamma Turbulence with Pointing Errors and ASE Noise
Aashish Mathur, Prakriti Saxena, Indian Institute of Technology Delhi; Manav R Bhatnagar, IIT Delhi

6 Performance Analysis of Multi-hop Heterodyne FSO Systems over Malaga Turbulent Channels with Pointing Error Using Mixture Gamma Distribution
Wael G. Alheadary, King Abdullah University of Science and Technology; Ki-Hong Park, Mohamed-Slim Alouini, KAUST

7 On The Effects of Temperature on The Performances of FSO Transmission Under Qatar's Climate
Abir Touati, Abdaoui Abderrazak, Farid Touati, Qatar University; Murat Uysal, Ozyegin University; Ammar Bouallegue, Ecole d'Ingénieurs de Tunis

8 SC-PTM or MBSFN for Mission Critical Communications?
Alaa Daher, ETELM, Telecom ParisTech; Marceau Coupechoux, TELECOM Paris Tech; Philippe Godlewski, ENST - Paris; Pierre Ngouat, PNG-Technologies; Pierre Minot, ETELM

9 Wireless Information and Power Transfer: Spectral Efficiency Optimization for Asymmetric Full-Duplex Relay Systems
Zhongxiang Wei, The University of Liverpool; Sumei Sun, Institute for Infocomm Research / The University of Liverpool; Yi Huang, The University of Liverpool; Linhao Dong, Dong In Kim, Sungkyunkwan University

Tuesday 6 June 2017

Tuesday, 6 June 2017 11:00-12:30 Meeting Room C2-1
4A: Relay Systems I
Chair: Yi Liu, Xidian University

1 Low Complexity Algorithm for Efficient Relay Assignment in Unicast/Broadcast Wireless Networks
Le Nam Hoang, Halmstad University; Elisabeth Uhlemann, Malardalen University; Magnus Jonsson, Halmstad University

2 Low-Complexity Two-Way AF Relay Design for Millimeter Wave Communication Systems
Deepa Jagyasi, P. Ubaidulla, International Institute of Information Technology (IIIT), Hyderabad

3 Secrecy Outage Probability of Multiuser Untrusted Amplify-and-Forward Relay Networks
Dan Deng, Guangzhou Panyu Polytechnic; Wen Zhou, Lisheng Fan, Shantou University

4 ASER Analysis of Rectangular QAM with SC Receiver in OFDM-Based Nonlinear AF Relay Network Over Nakagami-m Fading
Nagendra Kumar, Praveen Kumar Singya, Vimal Bhatia, Indian Institute of Technology Indore

5 Wireless Information and Power Transfer in Full-Duplex Two-Way Massive MIMO AF Relay Systems (Invited Paper)
Junjuan Feng, Shaodan Ma, University of Macau; Guanghua Yang, The University of Hong Kong; Bin Xia, Shanghai Jiao Tong University

6 SINR Analysis of Non-regenerative Multihop Links with Asymptotically Large Hop Count (Invited Paper)
Taneli Riihonen, Risto Wichman, Aalto University

4B: RF Systems and Transceiver Design
Chair: Char-Dir Chung, National Taiwan University

1 **Transceiver Design for Cognitive Full-Duplex Two-Way MIMO Relaying System**
Nachiket Ayir, P. Ubaidulla, International Institute of Information Technology (IIIT), Hyderabad

2 **Diversity Combining for RF Energy Harvesting**
Dogay Altinel, Istanbul Medeniyet University; Gunes Kurt, Istanbul Technical University

3 **Design of an Elliptic Filter using Multiple-Loop Feedback Structure in CMOS Technology for Analogue Signal Processing**
Meriam Gay Bautista, Forest Zhu, Eryk Dutkiewicz, University of Technology Sydney; Yichuang Sun, University of Hertfordshire

4 **All-Pass Filter based Synthesis of Multifunctional Microwave Active Circuits**
Nilan Udayanga, Arjuna Madanayake, The University of Akron; Chamith Abewardana Wijenayake, University of New South Wales; Peyman Ahmadi, Leonid Belostotski, Brent Maundy, Len T. Bruton, University of Calgary; Ahmed Elwakil, University of Sharjah

5 **Concurrent, Tunable, Multi-band, Single Chain Radio Receivers for 5G RANs**
Ravinder Singh, Qiang Bai, Timothy O'Farrell, Kenneth Lee Ford, Richard Langley, University of Sheffield

6 **Double-Balanced Gilbert Mixer with Current Bleeding for RF Front-End Using 0.13μm SiGe BiCMOS Technology**
Meriam Gay, Forest Zhu, Diep Nguyen, Eryk Dutkiewicz, University of Technology Sydney

4C: Smart Systems
Chair: Rasheed Hussain, Innopolis University

1 **A Codebook Design for Ensuring Reliable Communication in Smart Grid Neighbourhood Area Networks**
Rakhi, Philippa A. Martin, Alan Wood, University of Canterbury

2 **Prediction of Station Level Demand in a Bike Sharing System using Recurrent Neural Networks**
Po-Chuan Chen, He-Yen Hsieh, Xanno Sigalingging, Yan-Ru Chen, Jenq-Shiou Leu, National Taiwan University of Science and Technology

3 **Optimal Stochastic Delivery Planning in Full-Truckload and Less-Than-Truckload Delivery**
Suttinee Sawadsitang, Rakpong Kaewpuang, Nanyang Technological University; Jiang Siwei, Singapore Institute of Manufacturing Technology (SIMTech) A*STAR; Dusit Niyato, Ping Wang, Nanyang Technological University

4 **A broadcast protocol for IEEE 802.15.4e RIT based Wi-SUN systems**
Ryota Okumura, Keiichi Mizutani, Hiroshi Harada, Kyoto University

5 **A Traffic Differentiated Hybrid Wireless Mesh Protocol for Smart Grid Neighbourhood Area Networks**
Huamiao Hu, Angela Doufexi, Simon Armour, Dritan Kaleshi, University of Bristol

6 **SmartSec: A Smart Security Mechanism for the New-Flow Attack in Software-Defined Networking**
Xu Tong, Beijing jiaotong university; Deyun Gao, Ping Dong, Tao Zheng, Jianan Sun, Beijing Jiaotong University

4D: Transmission and Detection I
Chair: Meng Cai, Huawei Technologies

1 **An Integrated Quality Assessment for IPTV Operation and Maintenance (Invited Paper)**
Xin Wei, Zhifeng Wu, Liang Zhou, Nanjing University of Post and Telecommunications; Zhenjiang Dong, ZTE Corporation

2 **Unified Design of LLR Quantization and Joint Reception for Mobile Fronthaul Bandwidth Reduction**
Kenji Miyamoto, NTT Corporation; Shinsuke Ibi, Osaka University; Tatsuya Shimizu, Jun Terada, Akihiro Otaka, NTT Corporation; Seiichi Sampei, Osaka University

3 **An Efficient NOMA V2X Communication Scheme in the Internet of Vehicles**
Boulos Wadih Khoueiry, M. Reza Soleymani, Concordia University

4 **Robust QoS-aware Multi-Service Transmission with Hierarchical Modulation in High-Speed Railway**
Qian Gao, Gang Zhu, Siyu Lin, Xiaofang Sun, Shichao Li, Xiong Lei, Beijing Jiaotong University

5 **Combined Order QRD with PIC based Signal Detection Method for High Mobility STBC System**
Jyoti Prasanna Patra, Poonam Singh, National Institute of Technology Rourkela

6 **An efficient wireless fronthaul (EWF) method for LTE signal transmission**
Meng Cai, Qiao Liu, Hongli Jiang, Ping Cao, Cheng Hong, Jiangying Wei, Huawei Technologies Co. Ltd.

4E: Vehicular Networks I
Chair: Ivan Wang-Hei Ho, The Hong Kong Polytechnic University

1 **Opportunistic radar in IEEE 802.11ad vehicular networks**
Emanuele Grossi, Marco Lops, Luca Venturino, Università di Cassino; Alessio Zappone, University of Cassino and Southern Lazio

2 **An Efficient Algorithm to Deploy Roadside Units in Vehicular Networks**
João Fernando Sarubbi, Taís Rocha Silva, Flávio Vinicius Cruzeiro Martins, Elizabeth Fialho Wanner, Centro Federal de Educação Tecnológica de Minas Gerais; Cristiano M. Silva, Universidade Federal de São João del-Rei, Brazil

3 **Analytical Modeling of Distributed Location Based Access for Vehicular Ad Hoc Networks**
Francisco J. Martin-Vega, University of Málaga; Beatriz Soret, Nokia Bell Labs; M. Carmen Aguayo-Torres, Gerardo Gomez, University of Malaga; István Z. Kovács, Nokia Bell Labs

4 **Vehicle Proximity Awareness by Inter-Vehicle Communication for Surface Mine Operation Safety**
Yusuke Nishimura, Osaka University; Tatsuaki Osafune, Seiya Kato, Hitachi, Ltd.; Akihito Hiromori, Hirozumi Yamaguchi, Teruo Higashino, Osaka University

5 **Handover Performance Improvement for Ultra Dense Network of High-Speed Railway**
Jingrong Wang, Xuanjin Yang, Shuyue Zhao, Lifei Zhang, Minming Ni, Siyu Lin, Beijing Jiaotong University

6 **Leveraging the Propagation Model to Make Greedy Routing Decisions in Urban Environments**
Abhinay Mukunthan, Craig Cooper, F. Safaei, University of Wollongong; Daniel Franklin, Mehran Abolhasan, University of Technology Sydney

4F: Positioning and Tracking
Chair: Christian Wietfeld, TU Dortmund University

1 **A Vehicle Positioning Method Based on Joint TOA and DOA Estimation with V2R Communications**
Rui Zhang, Feng YAN, Lianfeng Shen, Southeast University; Yi Wu, Fujian Normal University

2 **Miller-Coded Asynchronous Visible Light Positioning System for Smart Phones**
Zhengpeng Li, Ming Jiang, Sun Yat-sen University; Xiaona Zhang, SYSU-CMU Shunde International Joint Research Institute (JRI); Xianyu Chen, Sun Yat-sen University; Weikun Hou, Huawei Technologies Canada Research and Development Centre

3 LED-Assisted Three-Dimensional Indoor Positioning for Multiphotodiode Device Interfered by Multipath Reflections
Jindan Xu, Hong Shen, Wei Xu, Hua Zhang, Xiaohu You, Southeast University

4 FreeNavi: Landmark-based Mapless Indoor Navigation based on WiFi Fingerprints
Yao Guo, Wenjun Wang, Xiangqun Chen, Peking Unviersity

5 For better CSI Fingerprinting based Localization: a novel phase sanitization method and a distance metric
Weipeng Jiang, Huawei Technologies CO., LTD

6 Combined Wi-Fi and Inertial Navigation with Smart Phones in Out- and Indoor Environments
Hannes Hofer, TU Wien; Guenther Retscher, Vienna University of Technology

Tuesday, 6 June 2017 11:00-12:30 Meeting Room C3-1
4G: Automated Driving and Intelligent Transportation
Chair: Elmer Magsino, The Hong Kong Polytechnic University

1 Decision Frameworks for using Uncertain Predictions for Cut-In Detections in (Semi-) Automated Driving
Wolfgang Muenst, objective GmbH; Tobias Rehder, BMW AG; Fabian Boegner, Technical University Munich; Lawrence Louis, BMW AG; Christian Icking, FernUniversitaet Hagen

2 Index Coding of Point Cloud-based Road Map Data for Autonomous Driving
Kai Fung Chu, Elmer R. Magsino, Ivan Wang-Hei Ho, The Hong Kong Polytechnic University; Chi-Kin Chau, Masdar Institute of Science and Technology

3 Speed Estimation from Smart Phone in-Motion Camera for the Next Generation of Self-Driven Intelligent Vehicles
Safa Salahat, Asma Al-Janahi, Luis Weruaga, Ahmed Bentiba, Khalifa Universiy

4 A Simulation Study of Emergency Vehicle Prioritization in Intelligent Transportation Systems
Hairuo Xie, Shanika Karunasekera, Lars Kulik, Egemen Tanin, Rui Zhang, Kotagiri Ramamohanarao, University of Melbourne

5 3D Scene Understanding at Urban Intersection using Stereo Vision and Digital Map
Prarthana Bhattacharyya, Yanlei Gu, Jiali Bao, Shunsuke Kamijo, Xu Liu, University of Tokyo

6 Comparison of LTE and DSRC-Based Connectivity for Intelligent Transportation Systems
Wang Min, Martin Winbjörk, Zhang Zhang, Ricardo Blasco, Hieu Do, Stefano Sorrentino, Marco Belleschi, Yunpeng Zang, Ericsson Research

Tuesday, 6 June 2017 11:00-12:30 Parkside 2
4P: Wireless Networks

1 Quantum Entanglement Distribution in Next-Generation Wireless Communication Systems
Nedasadat Hosseinidehaj, Robert Malaney, University of New South Wales

2 A Dual Channel Routing Protocol Based on Energy and Link Quality Indicator in Wireless Body Area Networks
Sobia Omer, Rein Vesilo, Macquarie University

3 AG-MS: A User Grouping Scheme for DASH Multicast over Wireless Networks
Yaxiong Yuan, Zhilong Zhang, Danpu Liu, Beijing University of Posts and Telecommunications

4 A Sparse and Low-Rank Optimization Framework for Network Topology Control in Dense Fog-RAN
Yuanming Shi, ShanghaiTech University; Bamdev Mishra, Core ML - Amazon; Wei Chen, Tsinghua University

5 Channel Characterization at 2.53 GHz for Wireless Sensor Networks in Railway Environments
Inaki Val, Aitor arriola, Cristina Cruces, IK4-Ikerlan; Gerd Sommerkorn, Christian Schneider, Technische Universität Ilmenau

6 Call Admission Control for Weather-Impacted Multimedia Satellite Networks
Olugbenga Imole, Tom Walingo, University of KwaZulu-Natal

7 HELIOS: Outsourcing of security operations in Green Wireless Sensor Networks
Giuseppe Ateniese, Stevens Institute of Technology; Giuseppe Bianchi, Università Tor Vergata; Angelo T. Capossele, Chiara Petrioli, Dora Spenza, Sapienza University of Rome

8 Experimental Study on Low Power Wide Area Networks (LPWAN) for Mobile Internet of Things
Dhaval Patel, Myounggyu Won, South Dakota State University

9 Throughput-Maximum Resource Provision in the OFDMA-based Wireless Virtual Network
Lei Yin, Ling Qiu, Zheng Chen, University of Science and Technology of China

10 Generalized Channel-Aware Power Control Scheme for Random Access with Multi-Packet Reception
Chongbin Xu, Fudan University; Yang Hu, City University of Hong Kong; Xin Wang, Fudan University; Li Ping, City University of Hong Kong

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Tuesday, 6 June 2017 14:00-15:30 Meeting Room C2-1
5A: Relay Systems II
Chair: Nedasadat Hosseinidehaj, University of New South Wales

1 Performance Analysis of Hybrid-ARQ over Full-Duplex Relaying Network Subject to Loop Interference under Nakagami-m Fading Channels
Yun Ai, Michael Cheffena, Norwegian University of Science and Technology

2 An Efficient Time Switching Protocol with Adaptive Power Splitting for Wireless Energy Harvesting Relay Networks
Vikash Singh, Hideki Ochiai, Yokohama National University

3 Outage Probability of Multihop Relaying with Cochannel Interferences over κ-μ Fading Channels
Xiaoyu Chen, Jiayi Zhang, Yanan Liang, Li Xu, Ying Liu, Beijing Jiaotong University

4 Secure Selection in Untrusted Decode-and-Forward Relay Networks with Direct links
Dan Deng, Guangzhou Panyu Polytechnic; Wen Zhou, Lisheng Fan, Shantou University

5 Cognitive Relay in Interference Channel with Delayed feedback: Degree of Freedom Region (Invited Paper)
Hyo Seung Kang, Myung Gil Kang, Wan Choi, Korea Advanced Institute of Science and Technology

6 Secrecy Outage Analysis of Hybrid Satellite-Terrestrial Relay Networks with Opportunistic Relaying Schemes
Vinay Bankey, Prabhat Kumar Upadhyay, Indian Institute of Technology Indore

Tuesday, 6 June 2017 14:00-15:30 Meeting Room C2-2
5B: SDN
Chair: Mehran Abolhasan, University of Technology Sydney

1 Software Defined Coded Networking: Benefits of the PlayNCool protocol in wireless mesh networks
Carla Di Paola, University of Catania; Daniel Lucani, Aalborg University; Sergio Palazzo, University of Catania; Jeppe Krigslund, Aalborg University

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2 Intelligent Optimizing Scheme for Load Balancing in Software Defined Networks
Chen Yu, Zhifeng Zhao, Yifan Zhou, Honggang Zhang, Zhejiang University

3 Game-Theoretic Analysis for Security of Various Software-Defined Networking (SDN) Architectures
Chao Qi, Jiangxing Wu, Hongchang Chen, Hongtao Yu, Hongchao Hu, Guozhen Cheng, National Digital Switching System Engineering & Technology R&D Center

4 AC-PROT: An Access Control Model to Improve Software-Defined Networking Security
Alven Wu, Ren Ping Liu, University of Technology Sydney; Wei Ni, Dali Kaafar, CSIRO; Xiaojing Huang, University of Technology Sydney

5 Three-Tier SDN Architecture for 5G: A Novel OpenFlow Switch or Traditional (Invited Paper)
Ibrahim Elgendi, Kumudu Munasinghe, University of Canberra; Abbas Jamalipour, University of Sydney; A/Prof Dharmendra Sharma, University of Canberra

6 Design and Implementation of Programmable Nodes in Software Defined Sensor Networks
Cui Ding, Southeast Universuty; Lianfeng Shen, Southeast University

Tuesday, 6 June 2017 14:00-15:30 Meeting Room C2-3
5C: Spectrum Sharing I
Chair: Beeshanga Jayaeickrama, University of Technology Sydeny

1 Spectrum Sharing Between Geostationary and Terrestrial Communication Systems (Invited Paper)
Chi Zhang, Linling Kuang, Chunxiao Jiang, Tsinghua University

2 Traffic Profiles and Licensed Spectrum Sharing in Cellular Networks
Brett Shaw, University of Auckland; Kevin Sowerby, The University of Auckland

3 Design of Contour based Protection Zones for Sublicensing in Spectrum Access Systems
Huiyang Wang, Eryk Dutkiewicz, Beeshanga Abewardana Jayawickrama, University of Technology, Sydney; Markus Dominik Mueck, Intel Mobile Communications

4 Analysis of Energy Detection of Unknown Signals under Beckmann Fading Channels
Juan P. Peña-Martin, Juan Manuel Romero, F. Javier Lopez-Martinez, Universidad de Malaga

5 Spectrum Sharing Optimization in Cellular Networks under Target Performance and Budget Restriction
Md Asaduzzaman, Raouf Abozariba, Mohammed N. Patwary, Staffordshire University

6 Radio environment map estimation based on communication cost modeling for heterogeneous networks
Fabiola Frantzis, Vinay Prasad Chowdappa, Carmen Botella, J. Javier Samper Zapater, Rafael Javier Martínez Durá, Universitat de València

Tuesday, 6 June 2017 14:00-15:30 Meeting Room C2-4
5D: Transmission and Detection II
Chair: Rui Chen, Xidian University

1 Image Compressed Sensing Reconstruction By Collaborative Use of Statistical and Structural Priors
Huan Huang, Shaohua Wu, Tiantian Zhang, Bin Cao, Zhang Qinyu, Harbin Institute of Technology

2 Interleaver-based Pattern Division Multiple Access with Iterative Decoding and Detection
Jie Zeng, Tsinghua University; Bei Liu, Chongqing University of Post and Communications; Xin Su, Tsinghua University

3 A Code-aided and Moment-based Joint SNR Estimation for M-APSK over AWGN Channels
He Rui, Dewei Yang, Beijing Institute of Technology

4 Misalignment-Robust Receiving Scheme for UCA-Based OAM Communication Systems
Hui Xu, Rui Chen, Jiandong Li, Yan Zhang, Xidian University

5 A Joint Detector for QAM Filter-Bank Multicarrier Systems
Fan Yang, Xin Wang, Fujitsu Research and Development Center Co., Ltd

6 Wavelet-Time Diversity Transmission in Wireless Systems: Bit-Error Probability
Luiz Gonzaga de Q. Silveira Junior, Universidade Federal do Rio Grande do Norte; Rui Dinis, IT Porugal

Tuesday, 6 June 2017 14:00-15:30 Meeting Room C2-5
5E: Vehicular Networks II
Chair: Ivan Wang-Hei Ho, The Hong Kong Polytechnic University

1 Modeling CCH switch to SCH in IEEE 802.11p/WAVE vehicular networks
Guilu Wu, Southeast University; Ren Ping Liu, University of Technology Sydney; Wei Ni, CSIRO; Pingping Xu, Southeast University

2 SimuCRV−A Simulation Framework for Cognitive Radio Enabled Vehicular Ad Hoc Networks
Rajith C. Abeywardana, Kevin Sowerby, Stevan M. Berber, The University of Auckland

3 Analysis of Downlink Connectivity Probability within Two-Hop Coveragre of RSU in VANET
Zhenyu Wang, Jun Zheng, Yuying Wu, Southeast University

4 The Implementation and Performance Evaluation of WAVE based Secured Vehicular Communication System
Jie Dai, Lin Pu, Ke Xu, Zhen Meng, Zishan Liu, Zhang Lin, Beijing University of Posts and Telecommunications

5 ROR:An RSSI based Omni-Directional Routing Algorithm for GeoBroadcast in VANETs
Ke Xu, Lin Pu, Jie Dai, Zishan Liu, Zhen Meng, Zhang Lin, Beijing University of Posts and Telecommunications

6 Cooperative Relay Selection and Forwarding in Vehicle-to-Infrastructure Communications
He Li, Yang Yang, Qiu Xue-song, Zhipeng Gao, Guizhen Ma, Beijing University of Posts and Telecommunications

Tuesday, 6 June 2017 14:00-15:30 Meeting Room C2-6
5F: Localization and Navigation
Chair: Michael Walter, DLR (German Aerospace Center)

1 Waveform Parameter Selection for ITS Positioning
Michael Walter, Armin Dammann, Thomas Jost, Ronald Raulefs, Siwei Zhang, German Aerospace Center (DLR);

2 Hypothesis Testing Based Model for Fingerprinting Localization Algorithms
Arash Behboodi, RWTH Aachen University; Filip Lemic, Adam Wolisz, Technische Universität Berlin

3 Indoor Floor Map Crowdsourcing Building Method Based on Inertial Measurement Unit Data
Lin Ma, Leqi Tang, Yubin Xu, Yang Cui, Harbin Institute of Technology

4 A Fast C-GIST Based Image Retrieval Method for Vision-based Indoor Localization
Lin Ma, Hao Xue, Tong Jia, XueZhi Tan, Harbin Institute of Technology

5 Joint Navigation and Synchronization in LEO Dual-Satellite Geolocation Systems
Junhui Zhao, Lei Li, Beijing Jiaotong University; Yi Gong, South University of Science and Technology of China

6 A Practical Indoor Localization Scheme for Disaster Relief
Hyo Won Lee, Wha Sook Jeon, Seoul National University; Dong Geun Jeong, Hankuk University of Foreign Studies

5G: Resource Allocation and Management I

Chair: Gengfa Fang, University of Technology Sydney

1 **Profile-based Power Allocation in OFDM with Index Modulation**
Xiaobo Liu, University of Electronic Science and Technology of China

2 **Energy Efficient Resource Allocation for MIMO SWIPT Broadcast Channels**
Jie Tang, South China University of Technology; Daniel K C So, University of Manchester; Arman Shojaeifard, Kai-Kit Wong, University College London

3 **An Efficient and Balanced BBU Computing Resource Allocation Algorithm for Cloud Radio Access Networks**
Fan Zhang, Jun Zheng, Yuan Zhang, Liangyu Chu, Southeast University

4 **Gain-Aware Joint Uplink-Downlink Resource Allocation for Device-to-Device communications**
Pan Zhao, Peng Yu, Lei Feng, Wenjing Li, Qiu Xue-song, Beijing University of Posts and Telecommunications

5 **Greedy Scheme for Optimal Resource Allocation in HetNets with Wireless Backhaul (Invited Paper)**
Swaroop Gopalam, Stephen Hanly, Phil Whiting, Macquarie University

6 **A QoS-Aware Resource Allocation Algorithm for Device-to-Device Communication Underlaying Cellular Networks**
Chengzheng Liu, Jun Zheng, Southeast University

5P: 5G Innovations

1 **Analysis of Different Planar Antenna Arrays for mmWave Massive MIMO Systems**
Weiqiang Tan, Southeast University; Stylianos D. Assimonis, Michail Matthaiou, Queen's University Belfast; Shi Jin, Southeast University

2 **Low-Complexity Uplink Multiuser Receivers for MIMO System with Massive Hybrid Array**
Hang Li, Thomas Q. Wang, Xiaojing Huang, Andrew Zhang, University of Technology Sydney

3 **Massive MIMO Pre-coding Algorithm Based On Improved Newton Iteration**
Yongqiang Man, Chi Zhang, Southeast University; Zhengquan Li, Southeast University&Jiangnan University; Feng Yan, Southeast University; Song Xing, California State University; Lianfeng Shen, Southeast University

4 **Multi-cell Joint Optimization to Mitigate Pilot Contamination for Multi-Cell Massive MIMO Systems**
Ting Du, Yongchao Wang, Jiangtao Wang, University of Xidian

5 **Placement of 5G Drone Base Stations by Data Field Clustering**
Stefano Iellamo, FORTH-ICS; Janne Lehtomäki, University of Oulu; Zaheer Khan, University of Liverpool

6 **Available Range of Different Transmission Modes for Ultra-reliable and Low-latency Communications**
Changyang She, Chenyang Yang, Beihang University, Beijing

7 **On-demand power boost and cell muting for high reliability and low latency in 5G**
Beatriz Soret, Nokia Bell Labs; Klaus I. Pedersen, Nokia - Bell Labs

8 **Performance Evaluation of Grant-free Transmission for Uplink URLLC Services**
Wang Chao, Yan Chen, Yiqun Wu, Liqing Zhang, Huawei Technologies. Co., Ltd.

9 **Prototyping Takes 5G from Concept to Reality (Invited Paper)**
Wu Rong, National Instruments

6A: Relay Systems III

Chair: Le Chung Tran, University of Wollongong

1 **Lifetime Constrained Relay Node Placement in WSNs: A Cluster-based Approximation Algorithm**
Chaofan Ma, Wei Liang, Meng Zheng, Shenyang Institute of Automation - Chinese Academy of Sciences

2 **The Impact of Loopback Channel Estimation Error on Performance of Full-duplex Two-way AF Relaying Communication Systems**
Chen-Ting Chen, Yen-Chang Chen, Min-Kuan Chang, Guu-Chang Yang, National Chung Hsing University

3 **Wireless-Powered Two-Way Relaying via A Multi-Antenna Relay with Energy Beamforming (Invited Paper)**
Zihao Gao, He Chen, The University of Sydney; Gan Zheng, Loughborough University; Yonghui Li, Branka Vucetic, The University of Sydney

4 **Relay Selection in Power Splitting Based Energy-Harvesting Half-Duplex Relay Networks (Invited Paper)**
Dexin Wang, Rongqing Zhang, Colorado State University; Xiang Cheng, Peking University; Liuqing Yang, Colorado State University

5 **Secure Underlay Cognitive Relay Networks in Presence of Primary User's Interference**
Sourabh Solanki, Prabhat Kumar Upadhyay, Indian Institute of Technology Indore

6 **Optimal Resource Allocation and Relay Selection for Self-Sustainable Relaying Networks**
M.Prudhvi Deep, Shubham Jain, P. Ubaidulla, International Institute of Information Technology (IIIT), Hyderabad

6B: Sensor Networks

Chair: Myounggyu Won, South Dakota State University

1 **Modeling the Impact on Performance of Memory Pooling in Heterogeneous MPSoCs**
Friedrich Pauls, Gerhard Fettweis, Technische Universität Dresden

2 **Test Methodology for Automotive Surround Sensors in Dynamic Driving Situations**
Alexander Kamann, Hasirlioglu Sinan, Igor Doric, Thomas Speth, Brandmeier, Technische Hochschule Ingolstadt; Ulrich Schwarz, Technische Universität Chemnitz

3 **Data Collection in Nonuniformly Deployed Wireless Sensor Networks by Public Transportation Vehicles**
Hailong Huang, Andrey V. Savkin, University of New South Wales

4 **Machine Learning Based Channel Error Diagnostics in Wireless Sensor Networks**
Su Yi, Hao Wang, Fujitsu Research and Development Center., Ltd; Jun Tian, Fujitsu; Wenqian Xue, Lefei Wang, Xiaojing Fan, Fujitsu Research and Development Center Co., Ltd; Ryuichi Matsukura, Fujitsu Laboratories Ltd.

5 **Decentralized Target Search in Topology Maps Based on Weighted Least Square Method**
Ashanie Gunathillake, Andrey V. Savkin, University of New South Wales

6 **An Event-based Data Aggregation Scheme Using PCA and SVR for WSNs**
Xiaojing Zhang, Hao Wu, Qingyuan Li, Bin Pan, Beijing Jiaotong University

6C: Spectrum Sharing II
Chair: Ying He, University of Technology Sydney

1 Radio Resource Management for Utra-dense Smallcell Networks: A Hybrid Spectrum Reuse Approach
Shangjing Lin, Jianguo Yu, Beijing University of Posts and Telecommunications; Wei Ni, CSIRO; Ren Ping Liu, University of Technology Sydney

2 Joint Dynamic Spectrum Access and Multi-Relay Selection: A Matching-Theory-based Approach (Invited Paper)
Wenjun Xu, Xue Li, Yixin Wang, Beijing University of Posts and Telecommunications; Chia-Han Lee, National Chiao Tung University; Feng Zhiyong, Beijing University of Posts and Telecommunications

3 Stochastic Geometry Analysis of Spatial Grid-based Spectrum Database
Shota Yamashita, Koji Yamamoto, Takayuki Nishio, Masahiro Morikura, Kyoto University

4 Spatio-Temporal Opportunistic Spectrum Sharing Between Rotating Radar and Cellular Networks
Sabogu-Sumah Raymond, Alidu Abubakari, Han-Shin Jo, Hanbat National University

5 Spectrum Allocation in Cellular Networks With Wireless In-band Backhaul
Hao Ge, Zhiyi Zhou, Northwestern University; Jialing Liu, Weimin Xiao, Huawei

6 A New PRACH Transmission Scheme in Unlicensed Spectrum
Zhe Luo, Tao Tao, Yan Meng, Nokia Shanghai Bell

6D: Visible Light Communications
Chair: Nedasadat Hosseinidehaj, University of New South Wales

1 Minimal Noise Variance Decoder for Uncoordinated Multiple Access in VLC
Abdullah, Siu-Wai Ho, University of South Australia; Jean-Marie Gorce, INSA Lyon; Chung Shue Chen, Bell Labs, Nokia

2 Joint Beamforming and DC Bias Optimization in VLC with Dimming Control
Sike Yao, Xiaoyu Zhang, ShanghaiTech University

3 Efficient Real-Fourier Domain-based Color Shift Keying OFDM Implemented With Hartley Transform for Visible Light Communication System
Jian Tang, Lin Zhang, Sun Yat-sen University

4 High Security Orthogonal Factorized Channel Scrambling Scheme with Location Information Embedded for MIMO-based VLC System
Yiru Wang, Lin Zhang, Sun Yat-sen University

5 Probabilistic Neural Network Based Equalizer for Indoor Visible Light Communications
Boyuan Zhuang, Jiyan Pan, Lin Zhang, Ming Jiang, Sun Yat-sen University

6 Dimming Compatible Optical OFDM for High Speed Visible Light Communications
Thomas Q. Wang, Xiaojing Huang, University of Technology Sydney

6E: Vehicular Networks III
Chair: Wei Ni, CSIRO Data61

1 An Unsupervised-learning-based Method for Multi-hop Wireless Broadcast Relay Selection in Urban Vehicular Networks
Weinan Song, Xinyu Mao, Peking University

2 Social-aware Bootstrapping and Trust Establishing Mechanism for Vehicular Social Networks
Dzhamal Alishev, Rasheed Hussain, Waqas Nawaz, JooYoung Lee, Innopolis University

3 An Approach to Mitigate Black Hole Attacks on Vehicular Wireless Networks
John Tobin, University College Dublin

4 A Cluster-based Delay Tolerant Routing Algorithm for Vehicular Ad Hoc Networks
Jun Zheng, Hui Tong, Yuying Wu, Southeast University

5 An Interference-Free Graph Based TDMA Scheduling Protocol for Vehicular Ad-Hoc Networks
Yanyan Zhu, Institute of Automation, Chinese Academy of Sciences; Rongqing Zhang, Colorado State University; Xiang Cheng, Peking University; Liuqing Yang, Colorado State University

6 System Level Evaluation of LTE-V2V Mode 4 Communications and its Distributed Scheduling
Rafael Molina-Masegosa, Javier Gozálvez, Universidad Miguel Hernandez de Elche (UMH)

6F: Localization and Tracking
Chair: Michael Walter, DLR (German Aerospace Center)

1 A Novel Ultra-wideband-based Localization and Tracking Scheme with Channel Classification
Zhongling Liu, Ming Yang, Chaojie Xu, Hui Yu, Shanghai Jiao Tong University

2 Indoor Localization System for Mobile Target Tracking based on Visible Light Communication
Zhiming Guo, Weiwei Xia, Ziyan Jia, Yueyue Zhang, Lianfeng Shen, Southeast University

3 The Impact of Road Configuration in V2V-based Cooperative Localization
Macheng Shen, Ding Zhao, Jing Sun, University of Michigan

4 Indoor Tracking Based on Fusion of Wireless Positioning, Motion Recognition and Map Matching
Genming Ding, Fujitsu Research & Development Center, Co. Ltd.

5 A VLC-based 3-D Indoor Positioning System Using Fingerprinting and K-Nearest Neighbor
Ming Xu, Weiwei Xia, Southeast University; Ziyan Jia, Jiangsu University of Technology; Yaping Zhu, Lianfeng Shen, Southeast University

6 Beam Tracking Techique for Multiple Unmanned Aircraft Vehicles
Sung Joon Maeng, Haein Park, Yong Soo Cho, Chung-Ang University

6G: Resource Allocation and Management II
Chair: Gengfa Fang, University of Technology Sydney

1 Multi-Pass Decoding for the Robust Transmission of Deep-Space Images
Rehan Mahmood, Qin Huang, Beihang Univeristy

2 QoE-Oriented Resource Allocation for DASH-Based Video Transmission over LTE Systems
Anyue Wang, Zhilong Zhang, Danpu Liu, Beijing University of Posts and Telecommunications

3 Monitoring Vehicular User Mobility to Predict Traffic Status and Manage Radio Resources
Nandish P. Kuruvatti, Julian F. Saavedra Molano, Hans Schotten, University of Kaiserslautern

4 RAN Moderation in 5G Dynamic Radio Topology
Ömer Bulakci, Alexandros Kaloxylos, Huawei Technologies GRC; Josef Eichinger, Chan Zhou, Huawei European Research Center

5 Radio resource management for V2V discovery
Beatriz Soret, Nokia Bell Labs; Marta Gatnau, Aalborg University; István Z. Kovács, Nokia Bell Labs; Francisco J. Martin-Vega,

University of Málaga; Gilberto Berardinelli, Nurul Huda Mahmood, Aalborg University

6 Resource Allocation for an Underlay Wireless Powered Cognitive Radio
Min Song, Shenyang Institute of Engineering; Meng Zheng, Shenyang Institute of Automation - Chinese Academy of Sciences

Tuesday, 6 June 2017 16:00-17:30 Parkside 2
6P: Multiple Antenna Systems

1 Pilot Contamination Attack Detection using Random Symbols for Massive MIMO Systems
Xiaoyi Wang, Ming Liu, Dong Wang, Beijing Jiaotong University; Caijun Zhong, Zhejiang University

2 Robust Sum Secrecy Rate Optimization for MISO Systems with Device-to-Device Communication
Weidong Mei, Zhi Chen, University of Electronic Science and Technology of China; Jun Fang, National Key Lab. of Sci. and Tech. on Communications,UESTC,China

3 Seamless Switching using Distributed Antenna Systems for High-Speed Railway
Wael Ali, Junyuan Wang, H. Zhu, Jiangzhou Wang, University of Kent

4 An Extension of Tomlinson-Harashima Precoding for Downlink Multi-User MIMO Systems
Kenji Hoshino, Manabu Mikami, Sourabh Maiti, Hitoshi Yoshino, SoftBank Corp.

5 A Raptor-coded Distributed Noncoherent Scheme Using Non-orthogonal Space-time Modulation
Yen-Ming Chen, National Sun Yat-sen University; Wei-Min Lai, Yeong-Luh Ueng, National Tsing Hua University

6 A Low-complexity Soft-Decision-aided Detector for Differential Spatial Modulation
Jiang Liu, Lixia Xiao, Yue Xiao, Ping Yang, Lilin Dan, Bin Fu, University of Electronic Science and Technology of China

7 MSE-based Precoder Designs for Receive Quadrature Spatial Modulation Systems
Chiao-En Chen, Ting-Wei Kuo, National Chung Cheng University

8 An Area-efficient Multi-Mode LLR Computing Engine for MMSE-based MIMO Detectors
Wei-Cheng Sun, National Tsing Hua University; Chia-Hsiang Yang, National Taiwan University; Yen-Ming Chen, National Sun Yat-sen University; Yeong-Luh Ueng, National Tsing Hua University

Wednesday 7 June 2017

Wednesday, 7 June 2017 11:00-12:30 Meeting Room C2-1
7A: Electric Vehicles
Chair: Christian Wietfeld, TU Dortmund University

1 Mobility Analysis of Electric Autonomous Vehicle Networks Driven by Energy-efficient Rerouting
George Bucsan, Toyota Research Institute of North America; Alex Goupilleau, Pierre Frene, Manish Pokhrel, Michael Balchanos, Dimitri Mavris, Georgia Institute of Technology; Masanori Ishigaki, Atsushi Iwai, Jae Seung Lee, Toyota Research Institute of North America

2 Operating Strategy of an Active Battery Switching System in Electric Vehicles
Philip Wacker, Technical University of Munich

3 A Comparative Fuel Analysis of a novel HEV with conventional vehicle
Mohamed Awadallah, Peter Tawadros, Paul Walker, Nong Zhang, James Tawadros, University of Technology Sydney

4 Mitigating Range Anxiety via Vehicle-to-Vehicle Social Charging System
Eyuphan Bulut, Virginia Commonwealth University; Mithat Kisacikoglu, University of Alabama

5 Evaluation of the Potential of Integrating Battery Electric Vehicles into Commercial Companies on the Basis of Fleet Test Data
Johannes Betz, Moritz Hann, Benedikt Jäger, Lienkamp Markus, Technical University of Munich

6 Joint Routing and Charging Scheduling Optimizations for Smart-grid Enabled Electric Vehicle Networks
Wanrong Tang, The Chinese University of Hong Kong; Suzhi Bi, Shenzhen University; Yingjun Zhang, Chinese University of Hong Kong; Xiaojun Yuan, ShanghaiTech University

Wednesday, 7 June 2017 11:00-12:30 Meeting Room C2-2
7B: Massive MIMO I
Chair: Chao Wang, Huawei Technologies

1 Propagation Characteristics Investigation in Measured Massive MIMO Channel at 1.4725GHz
Yanping Lu, Beijing Jiaotong University; Cheng Tao, Southeast University; Liu Liu, Southeast University

2 On Transmission Model for Massive MIMO under Low-Resolution Output Quantization (Invited Paper)
Bin Li, Ning Liang, Wenyi Zhang, University of Science and Technology of China

3 Dynamic Pilot Reuse in Distributed Massive MIMO Systems
Ramiz Raoof, University of Kent; Cunhua Pan, Southeast University; H. Zhu, Jiangzhou Wang, University of Kent

4 Energy Efficiency of Wireless Information and Power Transfer with Massive MIMO
Talha Ahmed Khan, The University of Texas at Austin; Ali Yazdan, Yael Maguire, Facebook; Robert Heath, The University of Texas at Austin

5 Energy Efficiency Optimizations of Massive MIMO Systems with Linear Receivers
Guan Xue, Lihua Li, Guangyan Lu, Tian Hui, Liutong Du, Beijing University of Posts and Telecommunications

6 Nonlinear Equalizer for Multi-User Hybrid mmW Massive MIMO Systems
Roberto Magueta, DETI/Instituto de Telecomunicações/University of Aveiro; Daniel Castanheira, University of Aveiro; Adão Silva, DETI / Instituto de Telecomunicações / University of Aveiro; Rui Dinis, Universidade Nova de Lisboa; Atílio Gameiro, Instituto de Telecomunicações

Wednesday, 7 June 2017 11:00-12:30 Meeting Room C2-3
7C: Millimeter Wave Communications I
Chair: Hongjie Hu, Huawei Technologies

1 Frequency-domain detection without matrix inversions for mm-wave communications with correlated massive MIMO channels
Pedro Bento, Andreia Pereira, Instituto de Telecomunicações - University of Coimbra; Rui Dinis, Universidade Nova de Lisboa; Marco Gomes, Vitor Silva, Instituto de Telecomunicações - University of Coimbra

2 Interpolative Reconstruction of Millimeter Wave Mobile Channel Responses from Randomly Scattered Snapshots
Chih-Hao Chang, David Lin, National Chiao Tung University

3 Power Efficient OFDM-mmWave Communications with Low Resolution and Subsampling ADC
Rakesh R T, Rupesh Ranjan, Shyla Gangwar, Debarati Sen, Indian Institute of Technology Kharagpur; G Das, IIT Kharagpur

4 Efficient Signaling Schemes for mmWave LOS MIMO Communication Using Uniform Linear and Circular Arrays
G. D. Surabhi, A. Chockalingam, Indian Institute of Science, Bangalore

5 Two-Stage 3D Codebook Design and Beam Training for Millimeter-Wave Massive MIMO Systems
Wei Wu, Danpu Liu, Zhaoqiang Li, Beijing University of Posts and Telecommunications; Xiaolin Hou, Min Liu, DOCOMO Beijing Communications Laboratories Co., Ltd.

6 Pilot Design for Phase Noise Mitigation in Millimeter Wave MIMO-OFDM Systems
Yong-Ping Zhang, Liu Jinnan, Shulan Feng, Hisilicon Technologies, Huawei; Philipp Zhang, Huawei Technologies Co., Ltd.

Wednesday, 7 June 2017 11:00-12:30 Meeting Room C2-4
7D: Energy Efficient Transmission
Chair: Xiaojing Huang, University of Technology Sydney

1 Qos-Constrained Transmission Policy in Hybrid Energy Supply Wireless Communication System
Jinsen Xie, Weizhe Cai, Licong Deng, Jian Yang, University of Science and Technology of China

2 On Designing Energy Efficient Wi-Fi P2P Connections for Internet of Things
Chih-Chiang Liao, Shin-Ming Cheng, National Taiwan University of Science and Technology; Menachem Domb, Ashkelon Academy

3 Energy Efficiency Optimization for Spatial Switching-based MIMO SWIPT System
Jie Tang, South China University of Technology; Daniel K C So, University of Manchester; Arman Shojaeifard, Kai-Kit Wong, University College London

4 User Association for Energy Balancing in HetNets with Hybrid Energy Sources
Tiankui Zhang, Hongzhang Xu, Beijing University of Posts and Telecommunications; Yue Chen, Queen Mary University of London

5 Energy Efficiency Evaluation of Uplink Transmissions with Maximum Power Constraint
Jing Zhang, Yajie Diao, Yanxia Zhang, Huazhong University of Science and Technology

6 Relay Selection and Resource Allocation for Energy Harvesting Cooperative Networks
M.Prudhvi Deep, Shubham Jain, P. Ubaidulla, International Institute of Information Technology (IIIT), Hyderabad

Wednesday, 7 June 2017 11:00-12:30 Meeting Room C2-5
7E: Performance Analysis I
Chair: Liang Yang, Guangdong University of Technology

1 Outage performance analysis of Content Delivery in Multiple Devices to Single Device Communications
Asaad Daghal, H. Zhu, University of Kent; Qasim Ahmed, University of Huddersfield; Yijn Pan, University of Kent

2 Unified Performance Analysis of Mixed eta-mu and M-Distribution Dual-Hop RF/FSO Systems
Liang Yang, Jun Zhang, Guangdong University of Technology

3 Performance Analysis of ACO-OFDM and DCO-OFDM using Bit and Power Loading in Frequency Selective Optical Wireless Channels
Mohammed Mansoor Ahmed Mohammed, Cuiwei He, Jean Armstrong, Monash University

4 Performance Analysis of PLC over Fading Channels with Colored Nakagami-m Background Noise
Yun Ai, Norwegian University of Science and Technology; Tomoaki Ohtsuki, Keio University; Michael Cheffena, Norwegian University of Science and Technology

5 Alternating Optimization for Capacity Region of Gaussian MIMO Broadcast Channels with Per-antenna Power Constraint (Invited Paper)
Thuy M. Pham, Ronan Farrell, Le-Nam Tran, Maynooth University

6 Low-complexity Approaches for MIMO Capacity with Per-antenna Power Constraint (Invited Paper)
Thuy M. Pham, Ronan Farrell, Le-Nam Tran, Maynooth University

Wednesday, 7 June 2017 11:00-12:30 Meeting Room C2-6
7F: Physical Layer Security I
Chair: Tom Wang, University of Technology Sydney

1 Enhancing Physical Layer Security through the Use of Suprathreshold Stochastic Resonance and Jamming
Chen Tian, Pinyi Ren, Xi'an Jiaotong University

2 Performance Analysis of Physical Layer Security Over Rician/Nakagami-m Fading Channels
Shunya Iwata, Tomoaki Ohtsuki, Keio University; Pooi-Yuen Kam, National University of Singapore

3 On Mitigation of Active Eavesdropping Attack by Spoofing Relay
Jitendra K Tugnait, Auburn University

4 Physical Layer Secret Key Capacity of Two Moving Terminals
Xu Wang, Mingliang Li, Liang Jin, NDSC; Kaizhi Huang, Information Engineering University

5 Signal Conversion: Combat Eavesdropping for Physical Layer Security Improvement
Datong Xu, Pinyi Ren, Qinghe Du, Li Sun, Yichen Wang, Xi'an Jiaotong University

6 Weighted-Voronoi-Diagram Based Codebook Design against Passive Eavesdropping for MISO Systems
Dongyang Xu, Pinyi Ren, Qinghe Du, Li Sun, Yichen Wang, Xi'an Jiaotong University

Wednesday, 7 June 2017 11:00-12:30 Meeting Room C3-1
7G: IoT
Chair: Renping Liu, University of Technology Sydney

1 Self-Sustainable Robotic Environment Discovery for Energy Harvesting Internet of Things
Yen-Kai Cheng, Ronald Y. Chang, Academia Sinica

2 Coverage comparison of GPRS, NB-IoT, LoRa, and SigFox in a 7800 km^2 area
Mads Lauridsen, Huan Cong Nguyen, Benny Vejlgaard, Aalborg University; István Z. Kovács, Nokia Bell Labs; Preben E. Mogensen, Aalborg University; Mads Sorensen, Telenor Denmark

3 Performance Analysis of Voice over LTE using Low-Complexity eMTC Devices
Rapeepat Ratasuk, David Bhatoolaul, Nitin Mangalvedhe, Amitava Ghosh, Nokia

4 Analysis of NB-IoT Deployment in LTE Guard-Band
Rapeepat Ratasuk, Nokia Networks; Jun Tan, Nitin Mangalvedhe, Man Hung Ng, Amitava Ghosh, Nokia

5 Activity Recognition via Channel Response: From Theoretical Analysis to Real-world Experiments
Yu Gu, Jianwen Tian, Liwen Zhang, Hefei University of Technology; Zhi Liu, Waseda Univeristy; Fuji Ren, University of Tokushima; Xiaoyan Wang, Ibaraki University

6 Non-Orthogonal Multiple Access in a mmWave Based IoT Wireless System with SWIPT (Invited Paper)
Haijian Sun, Qun Wang, Shakil Ahmed, Rose Qingyang Hu, Utah State University

Wednesday, 7 June 2017 14:00-15:30 Meeting Room C2-1
8A: LTE
Chair: Wei Ni, CSIRO Data61

1 Preventing Congestion by Selective Admission Control in LTE-Based Public Safety Network
JialuSun, Lei Feng, Peng Yu, Wenjing Li, Qiu Xue-Song, Meng Luo-ming, Beijing University of Posts and Telecommunications

2 The impact on Full Duplex D2D Communication of different LTE Transmission Techniques
Noman Haider, University of Technology Sydney, Global Big Data Technologies; Eryk Dutkiewicz, Diep Nguyen, University of Technology Sydney; Markus Dominik Mueck, Intel Mobile Communications; Srikathyayani Srikanteswara, Intel Corporation

3 LTE-A Virtual Drive Testing for Vehicular Environments
Michael Charitos, Di Kong, Jue Cao, Denys Berkovskyy, Angelos A. Goulianos, University of Bristol; Tom Mizutani, Jaguar Land Rover; Fai Tila, Geoffrey Hilton, Angela Doufexi, Andrew Nix, University of Bristol

4 Support Vector Machine-Based Wireless Channel Classification for Adaptive AFC in LTE Downlink
Young Yun Kang, Hyun Ju Go, Min-Ho Shin, Woonhaing Hur, Samsung

5 Implementation of a Non-codebook Based MU-MIMO System for TDD LTE-Advanced (Invited Paper)
Daejin Kim, Sangwook Han, Yong Jin, Heungseop Ahn, Seungwon Choi, Hanyang University

6 Rushing Full Speed with LTE-Advanced is Economical - A Power Consumption Analysis
Robert Falkenberg, Benjamin Sliwa, Christian Wietfeld, TU Dortmund University

Wednesday, 7 June 2017 14:00-15:30 Meeting Room C2-2
8B: Massive MIMO II
Chair: Hang Li, University of Technology Sydney

1 On the Feasibility of OFDM-Based Massive MIMO Systems with Low Resolution Quantizers
João Guerreiro, Instituto de Telecomunicações, Universidade Nova de Lisboa; Rui Dinis, Universidade Nova de Lisboa; Paulo Carvalho, FCT- Universidade Nova de Lisboa

2 Sum-Rate of Block-wise SC Massive MIMO Systems in the Presence of Carrier Frequency Offset
Zahra Mokhtari, Maryam Sabbaghian, University of Tehran; Rui Dinis, Universidade Nova de Lisboa

3 Geometrical Model for Massive MIMO Systems (Invited Paper)
Xudong Cheng, Yejun He, Shenzhen University

4 A Group-Blind Detection Scheme for Uplink Multi-Cell Massive MIMO
Guido Carlo Ferrante, Massachusetts Institute of Technology; Giovanni Geraci, Bell Labs Nokia; Tony Q.S. Quek, Singapore University of Technology and Design

5 A Sub 6GHz Massive MIMO System for 5G New Radio
Hongjie Hu, Gao Hui, Zhongfeng Li, Ltd.; Youtuan Zhu, Huawei Technologies

6 Low-Cost Superimposed Pilots Based Receiver for Massive MIMO in Multicarrier System
Yejian Chen, Bell Labs, Nokia

Wednesday, 7 June 2017 14:00-15:30 Meeting Room C2-3
8C: Millimeter Wave Communications II
Chair: Yonghui Li, The University of Sydney

1 On Beam Aggregation in Millimeter-Wave System
Yushu Zhang, Intel Mobile Communication Beijing Ltd; Yuan Y Zhu, Intel; Gang Xiong, Intel Coorperation

2 Low Complexity Hybrid Digital-to-Analog Beamforming for Millimeter-Wave Systems with High User Density
Manish Nair, The University of Kent; Qasim Ahmed, University of Huddersfield; Junyuan Wang, H. Zhu, University of Kent

3 Hybrid Digital-to-Analog Beamforming Approaches to Maximise the Capacity of mm-Wave Systems
Osama Alluhaibi, University of Kent; Qasim Ahmed, University of Huddersfield; Cunhua Pan, H. Zhu, University of Kent

4 Highly Efficient Leaky-Wave Antenna Array for Millimeter-Wave 5G Hand-Held Devices
Khaled Morshed, Macquarie University; Debabrata K. Karmokar, University of Technology Sydney; Karu P. Esselle, Macquarie University

5 User-Directed Analog Beamforming for Multiuser Millimeter-Wave Hybrid Array Systems
Andrew Zhang, UTS; Hang Li, Xiaojing Huang, Y. Jay Guo, University of Technology Sydney; Antonio Cantoni, University of Western Australia

6 Millimeter-Wave Multi-Hop Wireless Backhauling for 5G Cellular Networks
Biswapratapsingh Sahoo, Chun-Han Yao, Hung-Yu Wei, National Taiwan University

Wednesday, 7 June 2017 14:00-15:30 Meeting Room C2-4
8D: Multiple Access
Chair: Daniel K. C. So, University of Manchester

1 A Link Quality Model for Generalised Frequency Division Multiplexing
Ghaith Al-Juboori, University of Bristol; David Halls, Toshiba Research Europe Ltd; Angela Doufexi, Andrew Nix, University of Bristol

2 Pattern Division Multiple Access with Large-scale Antenna Array
Peng Li, Yanxiang Jiang, Southeast University; Shaoli Kang, China Academy of Telecommunications Technology; Fuchun Zheng, The University of Reading; Xiaohu You, Southeast University

3 Interference Fusion Multi-Access: A Novel Multiple User Superposition Transmission Scheme for Cellular Networks
Xuesong Wang, Yong-Ping Zhang, Research Department of Hisilicon, Huawei Technologies; Wu Yu-chun, Shulan Feng, Philipp Zhang, Hisilicon Technologies, Huawei

4 A Random Non-Orthogonal Multiple Access Scheme for mMTC
Ye Neng, Wang Aihua, Xiangming Li, Yu Hanxiao, Beijing Institute of Technology; Anxin Li, Jiang Huiling, DOCOMO Beijing Communications Laboratories Co., Ltd

5 Contention Based Uplink Transmission with NOMA for Latency Reduction
Anxin Li, Xiaohang Chen, Huiling Jiang, DOCOMO Beijing Communications Laboratories Co., Ltd

6 Energy Efficient Resource Allocation in Downlink Non-Orthogonal Multiple Access (NOMA) System
Ziad Qais Al Abbasi, Daniel K C So, University of Manchester; Jie Tang, South China University of Technology

Wednesday, 7 June 2017 14:00-15:30 Meeting Room C2-5
8E: Performance Analysis II
Chair: Lin Zhang, Sun Yat-Sen University

1 Performance Analysis of a Hybrid Downlink-Uplink Cooperative NOMA Scheme (Invited Paper)
Zhiqiang Wei, University of New South Wales; Linglong Dai, Tsinghua University; Derrick Wing Kwan Ng, Jinhong Yuan, University of New South Wales

2 Performance Evaluation of Linear Beamforming Receiver for Large CoMP Sparse Massive MIMO Channel Matrices
Amir Ahmadian, Rakash Sivasivaganesan, Wolfgang Zirwas, Nokia Bell Labs

3 New Results on Moment Generating Functions of Generalized Wireless Fading Channels and Applications
Ehab Salahat, IEEE; Ali Hakam, UAE University; Nazar Ali, Khalifa University of Science, Technology and Research

4 Performance Analysis and Optimization of Millimeter Wave Networks with Dual-Hop Relaying
Ali Chelli, Kimmo Kansanen, Ilangko Balasingham, Norwegian University of Science and Technology; Mohamed-Slim Alouini, KAUST

5 Performance Analysis of Cooperation Schemes in Cooperative Cognitive Radio Networks
Dingjie Xu, Yichen Gao, Chenchen Yang, Shanghai Jiao Tong University; Yao Yao, Huawei Technologies Co. Ltd.; Chaoxian Zhang, Xiamen University Tan Kah Kee College,; Bin Xia, Shanghai Jiao Tong University

6 Analysis of the delay of confirmed downlink frames in Class B of LoRaWAN
François Delobel, Université d'Auvergne; Nancy El Rachkidy, Université Blaise Pascal; Alexandre Guitton, Clermont Université, Université Blaise Pascal / LIMOS

Wednesday, 7 June 2017 14:00-15:30 Meeting Room C2-6
8F: Physical Layer Security II
Chair: Tom Wang, University of Technology Sydney

1 Physical Layer Security Scheme based on Basestation Cooperation in Dense Heterogeneous Networks
Zhang Bo, NDSC of China; Kaizhi Huang, Information Engineering University

2 Pilot Contamination with MITM Attack
Yu Huang, Liang Jin, Hongquan Wei, Yangming Lou, Xiaolei Kang, National Digital Switching System Engineering and Technologic Center

3 Channel Impulse Response-based Distributed Physical Layer Authentication
Ammar Mahmood, Waqas Aman, Muhammad Ozair Iqbal, Muhammad Mahboob Ur Rahman, Information Technology University, Lahore

4 Covert Communication in Fading Channels under Channel Uncertainty
Khurram Shahzad, Australian National University; Xiangyun Zhou, Shihao Yan, Australian National University

5 Exploiting Lack of Hardware Reciprocity for Sender-Node Authentication at the PHY Layer
Muhammad Mahboob Ur Rahman, Information Technology University, Lahore; Aneela Yasmeen, The University of Iowa, USA

6 Physical Layer Authentication for Mission Critical Machine Type Communication using Gaussian Mixture Model based Clustering
Andreas Weinand, Michael Karrenbauer, Lianghai Ji, Hans Schotten, University of Kaiserslautern

Wednesday, 7 June 2017 14:00-15:30 Meeting Room C3-1
8G: M2M and IoT
Chair: Renping Liu, University of Technology Sydney

1 A Comparison of OFDM and GFDM-based MFSK Modulation Schemes for Robust IoT Applications
Ghaith Al-Juboori, Evgeny Tsimbalo, Angela Doufexi, Andrew Nix, University of Bristol

2 RACH Dimensioning for Reliable MTC over Cellular Networks
Amin Azari, Mohammad Istiak Hossain, Jan I Markendahl, KTH Royal Institute of Technology

3 Energy Efficient Self-Reconfiguration Scheme for Visual Information based M2M Communication
Anas Amjad, Mohammed N. Patwary, Alison Griffiths, Staffordshire University

4 Power Saving Mechanism for Contention-Based M2M Transmission
Yang Li, Bell Labs, Nokia Shanghai Bell Co., Ltd.

5 Energy-Efficient D2D Discovery for Energy-Harvesting Proximal IoT Devices
Yuan-Kang Shih, Mei-Ju Shih, Hung-Yu Wei, National Taiwan University

6 A Simple Modified Peak Detection Based UWB Receiver for WSN and IoT Applications
Sanjeev Sharma, Indian Institute of Technology Indore; Anubha Gupta, Indraprastha Institute of Information Technology-Delhi; Vimal Bhatia, Indian Institute of Technology Indore

Wednesday, 7 June 2017 16:00-17:30 Meeting Room C2-1
9A: Wireless Networks and Security
Chair: Lin Zhang, Sun Yat-Sen University

1 Applying Robust Header Compression version 2 for UDP and RTP Broadcasting with Field Constraints
Mate Tomoskozi, Budapest University of Technology and Economics; Patrick Seeling, Central Michigan University; Peter Ekler, Budapest University of Technology and Economics; Frank Fitzek, TU Dresden

2 Anchor-Chain:A Seamless Producer Mobility Support Scheme in NDN
Yizhe Zheng, Xuewei Piao, Kai Lei, Peking University

3 Performance Improvement of the Uplink WCDMA Scrambling Code Identification Using Multiple Antenna Combining
Chankeun Park, Sung-Ho Lim, Jaeseok Lee, Ji-Woong Choi, Daegu Gyeongbuk Institute of Science and Technology

4 Fine-grained Access Control for Personal Health Records in Cloud Computing
Wei Li, BUPT; Wei Ni, Dongxi Liu, CSIRO; Ren Ping Liu, University of Technology Sydney; Peishun Wang, IBM Australia; Shoushan Luo, BUPT

5 Privacy-Aware QoE Evaluation (Invited Paper)
Liang Zhou, Xin Wei, Jingwu Cui, Nanjing University of Post and Telecommunications

6 Content Clustering and Popularity Prediction Based Caching Strategy In Content Centric Networking
Xinwei Jiang, Tiankui Zhang, Zhimin Zeng, Beijing University of Posts and Telecommunications

Wednesday, 7 June 2017 16:00-17:30 Meeting Room C2-2
9B: Massive MIMO III
Chair: Andrew Zhang, University of Technology Sydney

1 On the Performance of TDD Massive MIMO Systems with Pilot Contamination
Makram Alkhaled, Emad Alsusa, Daniel K C So, University of Manchester

2 The Potential of Using Large Antenna Arrays on Intelligent Surfaces
Sha Hu, Fredrik Rusek, Ove Edfors, Lund University

3 Fractional Pilot Reuse with Vertical Sectorization in Massive MIMO Systems
Jiancun Fan, Weiqi Li, Xi'an Jiaotong University; Ying Zhang, Xi'an Jiaotong University; Jianguo Deng, Xi'an Jiaotong University

4 Secure Massive MIMO Amplify-and-Forward Relaying Networks in Poisson Field
Tiep M. Hoang, Queen's University Belfast; H. D. Tuan, University of Technology, Sydney; Trung Q. Duong, Queen's University Belfast

5 Massive MIMO in Line-of-Sight Propagation (Invited Paper)
Hong Yang, Thomas L. Marzetta, Bell Labs, Nokia

6 A Novel Network Optimization Method for Cooperative Massive MIMO Systems (Invited Paper)
Kai Li, Yang Yang, Shanghai Institute of Microsystem and Information Technology; Yu Chen, Beijing University of Posts and Telecommunications; Xiumei Yang, Huiyue Yi, Shanghai Institute of Microsystem and Information Technology

Wednesday, 7 June 2017 16:00-17:30 Meeting Room C2-3
9C: Mobile Network Applications
Chair: Myounggyu Won, South Dakota State University

1 Looxy: Web Access Optimization for Mobile Applications with a Local Proxy
Yao Guo, Mengxin Liu, Xiangqun Chen, Peking Unviersity

2 GoSense: Efficient Vehicle Selection for User Defined Vehicular Crowdsensing
Tzu-Yang Yu, Xiru Zhu, Hongji Chen, McGill University

3 Senz: A Context Awareness Middleware System Used in Mobile Devices
Hengyang Zhang, Beijing University of Posts and Telecommunications; Guan Gui, The University of Melbourne; Shixiang Zhu, Georgia Institute of Technology; Tao Huang, Beijing University of Posts and Telecommunications; Yuanying Chi, Beijing University of Technology; Yunjie Liu, Beijing University of Posts and Telecommunications

4 MTV: Mobile BitTorrent Video Sharing Using Harmonized LTE and WiFi Coexistence
Yang Yang, Xiaoyi Zhang, Zhang Lin, Beijing University of Posts and Telecommunications

5 VehSense: Slippery Road Detection Using Smartphones
Yunfei Hou, California State University, San Bernardino; Abhishek Gupta, Tong Guan, University at Buffalo; Shaohan Hu, IBM Research; Lu Su, University at Buffalo; Chunming Qiao, SUNY at Buffalo

6 A Practical System towards the Secure, Robust and Pervasive Mobile Workstyle (Invited Paper)
Zhan Ma, Tao Yue, Xun Cao, Nanjing University; Yiling Xu, Shanghai Jiaotong University; Xin Li, Yun Ge Zhi Li Inc; Yongjin Wang, Nanjing University of Posts and Telecommunications

Wednesday, 7 June 2017 16:00-17:30 Meeting Room C2-4
9D: OFDM
Chair: Hao Wu, ZTE Corporation

1 Analysis of Two-Step Subspace-Based Channel Estimation Method for OFDM Systems
Shih-Hao Fang, Jing-Shiun Lin, Industrial Technology Research Institute

2 Unique Word DFT-spread-OFDM for fast time-varying channels
Gilberto Berardinelli, Aalborg University; Klaus I. Pedersen, Frank Frederiksen, Nokia - Bell Labs; Troels B. Sørensen, Aalborg University; Preben E. Mogensen, Nokia - Bell Labs

3 Generalized OFDM for the 5th Generation Mobile Communications
Myungsup Kim, Tunitel Co.; Do Young Kwak, KAIST

4 Enhanced UF-OFDM for Long-delay Multipath Fading Environment
Hiroto Kuriki, Keiichi Mizutani, Kyoto University; Takeshi Matsumura, National Institute of Information and Communications Technology; Hiroshi Harada, Kyoto University

5 Hybrid spectral precoding/windowing for low-latency OFDM
Tayebeh Taheri, Rickard Nilsson, Jaap van de Beek, Luleå University of Technology

6 The Impact of AGC on Cyclic prefix Length for OFDM Systems
Hao Wu, Jun Li, Bo Dai, Yuan Liu, ZTE Corporation

Wednesday, 7 June 2017 16:00-17:30 Meeting Room C2-5
9E: Radar and Remote Sensing
Chair: Forest Zhu, University of Technology Sydney

1 Spectrum Sharing Solution for Automotive Radar
Kumar Vijay Mishra, Andrey Zhitnikov, Yonina C. Eldar, Technion - Israel Institute of Technology

2 Efficient Range-Doppler Processing for Random Stepped Frequency Radar in Automotive Applications
Akram Al-Hourani, RMIT University; Rob Evans, The University of Melbourne; Bill Moran, Kandeepan Sithamparanathan, RMIT University

3 A Generalized Continuous Wave Synthetic Aperture Radar
Yijiang Nan, Xiaojing Huang, Y. Jay Guo, University of Technology Sydney

4 Online Bayesian Learning for Remote-Sensing Imagery Compression
Zizhuo Zhang, Shaoyang Li, Tao Xiaoming, Linhao Dong, Jianhua Lu, Tsinghua University

5 Prior-Information-Based Remote Sensing Image Compression with Bayesian Dictionary Learning
Tao Xiaoming, Shaoyang Li, Zizhuo Zhang, Liu Xijia, Juan Wang, Jianhua Lu, Tsinghua University

6 A Statistical Method for Parking Spaces Occupancy Detection via Automotive Radars
Qi Luo, Romesh Saigal, Robert Hampshire, Xinyi Wu, University of Michigan

Wednesday, 7 June 2017 16:00-17:30 Meeting Room C2-6
9F: Radio Access Techniques
Chair: Xiangyun Zhou, The Australian National University

1 Thermal-Aware Dynamic Computing Resource Allocation for BBU Pool in Centralized Radio Access Networks
Sumarga Kumar Sah Tyagi, Lin Tian, Yiqing Zhou, Institute of Computing Technology, Chinese Academy of Sciences

2 Joint Channel Access Mechanism and Scheduling Design for Licensed Assisted Access System
Dawei Wang, Nokia Bell Labs; Tao Tao, Jianguo Liu, Nokia Shanghai Bell

3 Energy Signal Assisted Access Method for Licensed Assisted Access
Wei Wang, Pingping Xu, Yuan Zhang, Hongyun Chu, Southeast University

4 Opportunistic Access to PAL Channel for Multi-RAT GAA Transmission in Spectrum Access System
Shubhekshya Basnet, Beeshanga Abewardana Jayawickrama, Ying He, Eryk Dutkiewicz, University of Technology Sydney; Markus Dominik Mueck, Intel Mobile Communications

5 QoE-oriented Random Access for Hybrid MTC and Cellular Communications
RuiqiWang, Xuefei Zhang, YueWang, KechenChen, Tao Xiaofeng, Beijing University of Posts and Telecommunications

6 Sensitivity to RAN in a Mobile Field Survey
Laurent Schumacher, Marie-Ange Remiche, UNamur

Wednesday, 7 June 2017 16:00-17:30 Meeting Room C3-1
9G: Machine Learning and Applications
Chair: Ronald Y. Chang, Academia Sinica

1 Vehicle Classification and Identification Using Multi-Modal Sensing and Signal Learning
Ryan Kerekes, Thomas P. Karnowski, Mike Kuhn, Michael R. Moore, Brad Stinson, Ryan Tokola, Oak Ridge National Laboratory; Adam Anderson, Tennessee Tech University; J. Michael Vann, Oak Ridge National Laboratory

2 Learning-based Caching with Unknown Popularity in Wireless Video Networks
Yuanyuan Tan, Yiling Yuan, Yang Tao, Bo Hu, Fudan University

3 Machine-Learning-Based Throughput Estimation Using Images for mmWave Communications
Hironao Okamoto, Takayuki Nishio, Masahiro Morikura, Koji Yamamoto, Kyoto University; Daisuke Murayama, Katsuya Nakahira, NTT Corporation

4 Ultra-Wideband Antenna-Induced Error Prediction using Deep Learning on Channel Response Data
Janis Tiemann, Johannes Pillmann, Christian Wietfeld, TU Dortmund University

5 Caching Policy Optimization for D2D Communications by Learning User Preference (Invited Paper)
Binqiang Chen, Chenyang Yang, Beihang University

6 A Comparative Study of Machine-Learning Indoor Localization Using FM and DVB-T Signals in Real Testbed Environments
Yen-Kai Cheng, Ronald Y. Chang, Ling-Jyh Chen, Academia Sinica

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LTE or LAA: Choosing network mode for my mobile phone in 5G network

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Abstract— **Long Term Evolution (LTE) in unlicensed spectrum, Licensed Assisted Access (LAA), has been considered as an effective complement in offloading growing traffic. The LAA is expected to be deployed initially through the small cell integrated under LTE macro cell. Therefore, LTE users under the coverage of LAA small cell must decide to connect one of the co-located networks either LTE or LAA to maximize their performance. In this scenario, we model a network selection game for LTE users using mixed strategy game theoretic approach. Afterwards, we formulate behavior of strategic users toward network selection as a function of the number of nearby users. The simulation results show that increasing number of nearby users make a user less likely to switch to LAA small cell. Additionally, more users nearby make it less likely that LAA resources is being utilized.**

Keywords— Coexistence; Mixed Strategy Game; LAA; LTE.

I. INTRODUCTION

Fifth generation (5G) communication has been proposed as next generation wireless telecommunication standard. Rather than faster peak internet connection speeds, 5G design aims to accomplish higher capacity than current fourth generation (4G) communication. Hence, will allow a higher number of mobile broadband users with consumption of higher or limitless data quantities in gigabytes. This unprecedented escalation in capacity demand has imposed significant challenges due to the limited licensed spectrum for cellular networks. Any effort to achieve capacity growth through network densification faces the challenge of severe inter-cell interference. The solution to this issue is to make the best use of all spectrum types through matured technology. Therefore, the significant amount of underutilized spectrum below 6 GHz band is motivating operators to combine LTE with Wi-Fi technologies in 5G. LTE in unlicensed bands, popularly known as LAA, is considered as one of the latest groundbreaking innovations by 3rd Generation Partnership Project (3GPP) [1] to provide high performance and a seamless user experience under a unified radio technology. This innovative LAA has the physical layer topology to access Wireless Local Area Network (WLAN) band, specifically the 5GHz U-NII (Unlicensed National Information Infrastructure)[1] bands. However, in datalink layer different medium access techniques such as Clear Channel Access (CCA) [2], Carrier Sensing Adaptive Transmission Access (CSAT) [3], Listen Before Talk (LBT) [4] etc. have been proposed to reduce
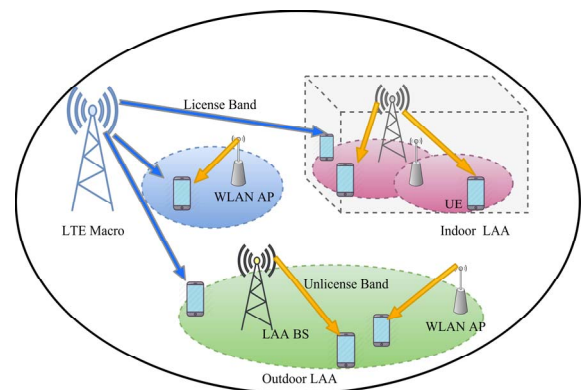

Fig. 1. LAA deployment scenario.

interference and fairly coexist with the incumbent systems. Nerveless, due to operation of LTE in unlicensed spectrum shared by multiple incumbent systems such as the WLANs, operation in unlicensed carrier is unable to match the licensed carrier in terms of mobility, reliability, and quality of service.

According to 3GPP TR 36.889 [1], LAA deployment scenarios can be grouped into two categories: outdoor and indoor small cells as shown in Fig. 1. In both of the scenarios, LTE constitute of macro coverage along with small cell LAA deployments with often co-located with Wi-Fi network both in space and frequency. The users under the coverage area of this network have provision to decide which network to connect. Mostly in the network selection process, users select the network, which maximizes their performance in terms of signal strength or an interference. Therefore, the optimal network selection strategy for each user is a function of the network characteristics and the behaviors of others User Equipments (UEs) sharing the same resources. Each user must selfishly act to boost its performance through selecting best network. This situation leads itself to a game theoretic analysis in which UEs are playing mixed strategy game with complete information. The payoff of the user is the function of their action and other nearby users connected to the same network.

In this paper, we model the characteristics of LTE user trying to optimize its performance in the environment where other users are attempting to do the same. To the best of our

knowledge, this is first work that applies the mixed strategy game theory to study the LTE user's behavior for switching LAA network. Analytical and simulation results show that LTE user prefers to switch unlicensed band only when there are a limited number of users nearby. Hence, this collective behavior of individual user acts as a dominant factor while considering average LAA resource utilization (as increase number of users also increases the chance of selection of LAA resources at the same time).

The rest of the paper is organized as follows. Section II discusses a work related to LAA and available network selection approach in heterogeneous networks. Section III describes system model of LAA network for 5G communication. In Section IV, we show the evaluation results based on an increasing number of users. Finally, the conclusions and future work are presented in Section V.

II. RELATED WORK

Early studies [5-7] investigate basic coexistence problems between Wi-Fi and LTE triggered by the dissimilarity in their MAC designs, and develop potential strategies to assist the coexistence. So far, the proposed model was mainly based on Wi-Fi MAC resistance to the LTE always "ON" model, operating in same channel. It includes Discontinuous Transmission [8], Random Back-off [9], Carrier Sensing [8], Clean Channel selection [6], Listen Before Talk (LBT) etc. [4], [7]. Since, LAA operates in a heterogeneous environment, therefore much research has been also related to the appropriate channel selection [6] and network selection [11-13] in between operators and users. In [10], the authors present a reinforcement learning mechanism within an evolutionary game framework for users competing for bandwidth across multiple networks. In [11], the author analyze the network selection process as an infinitely repeated game between the UEs in which they find an optimal downlink network from various learning strategies. In papers [12] and [13], LAA handover process and scenarios for coexistence between, LTE and LAA cells were presented respectively.

However, this paper is distinct from the existing network selection literature in several ways. First, to the best of our knowledge, no literature so far has studied about the network selection behavior of the users collocated between LTE and LAA. Second, we explore how number of user impact the decision of network selection process. Thirdly, we show the effect of additional number of users in the utilization of LAA network.

III. SYSTEM MODEL

The deployment scenario of LAA consists of several Wi-Fi access points and LAA small cells coexisting in the coverage area of a single LTE macro cell as shown in Fig.1. LTE BS operates on its own licensed band while LAA BS and WLAN access points share 20 MHz unlicensed spectrum frequency band at 5.8 GHz for providing radio access to users. Being operated in common spectrum, the impact of interference from WLAN networks to an LAA network depends on various parameters such as traffic generated from Wi-Fi networks, the location of Wi-Fi/LAA networks, and channel conditions, which
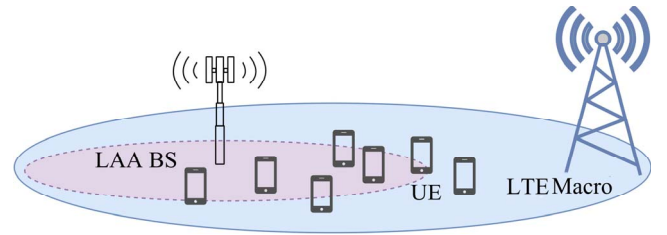

Fig. 2.   System model.

are all random. Hence, this heterogeneous network provides users with different data rate and Quality of Service (QoS). Though, the users under the coverage of this network have opportunity to choose from different radio access technologies for their better experience. Nevertheless, Network selection is a challenging task that influences the performance metrics for both service provider and a subscriber.

In this paper, we consider the network selection in between single LTE macro and LAA standard as shown in Fig. 2. We consider N LTE users that are able to monitor both standards (LAA and LTE) and select the best standard to connect depending on their quality-of-service requirements. We assume that there are MAC schedulers at every access point (or base station), which gives opportunity to each user to use a channel and transmit according to the number of users connected to a given base station, and to its own channel conditions. For any user n connected to an access point or base station s, the throughput is given by

$$\text{User Perceived Throughput} = \frac{C_{ns}}{N_s} \qquad (1)$$

Where, N_s is the number of users connected to access points or base station. $C = \mathcal{B}\log(1+\gamma_{ns})$ is instantaneous capacity of the base station that user n could achieve if it were connected to the base station s alone. $\gamma_{ns} = \frac{h_{ns}P_n}{\sigma^2}$ is the signal to noise ratio (SNR) of the user n, where P_n is the transmit power of user n, h_{ns} the channel gain from user n to base station s and σ^2 is the variance of the Gaussian noise.

In this model, the key problem is to determine which user connects to which network standard out of the two considered network types. Clearly, this leads to the use of a non-cooperative game model for the users. Formally, we define a non-cooperative game in strategic form with the following components:

- The players are the users in the set N.

- The strategy of each user $n \in N$ is represented by variable SW_ LAA, if user n selects LAA network, and SW_LTE, if user selects LTE network.

- The utility for each user's n is given by the user perceived throughput as given in equation (1).

Clearly, in this game, each (selfish) user aims to select the wireless standard that can maximize its utility function which leads to the game of N pure strategy Nash equilibria with each

TABLE I. PAYOFF MATRIX OF N USERS, 2BASE STATION

User		Other Users	
		All in LTE	*At least one selects LAA*
	SW_LAA	R_{umax}	R_{umin}
	SW_LTE	R_{lmin}	R_{lmax}

point in equilibria has one player switching the LAA and other *N-1* player has stayed in LTE network. These equilibria are asymmetric because the entirety of the burden of selecting LAA network falls on single player. A more symmetric solution can be found by deriving an equilibrium in mixed strategies. A mixed strategy is the one in which a player plays his available pure strategies with certain probabilities. Mixed strategies are best understood in the context of repeated games, where each player aim is to keep the other players guessing of their moves. If each player in *N* player game has a finite number of pure strategies, then there exists at least one equilibrium in mixed strategies. A mixed strategy in this game denotes a probability distribution over the two possible pure strategies SW_ LAA and SW_LTE. This mean that each user select the LAA network with a certain common probability *p* and the LTE with a probability *q =1−p*. Each user then aim to find the probability distribution that maximizes its expected payoff.

Table I contains the matrix for *N* users in the coverage of LTE and LAA network standard in which each time step exhibits as an independent game. Here, for a given condition of other players, R_{lmax} and R_{lmin} are maximum and minimum achievable payoff of user in licensed band and for unlicensed band is R_{umax} and R_{umin}.

Given that *N-1* other players, each select LAA with probability *p* and selects LTE with probability *1-p*. Since their choices are independent, the probability that *N-1* of them ignores LAA is *1-p* multiplied *N -1* times which becomes $(1-p)^{N-1}$. In other hand, at least one of the other players group selects LAA becomes $1-(1-p)^{N-1}$.

In the event that none of the other user select LAA (all other player selects LTE), this user receives a maximum payoff of R_{umax} by selecting LAA. With probability $1-(1-p)^{N-1}$, at least one of the other players selects LAA, the payoff of this user from also selecting LAA is only R_{umin}. Hence, the expected payoff from LAA is given by

Expected payoff from LAA $= (1 - p)^{N-1} x\ R_{umax} +$
$$[1 - (1 - p)^{N-1})]\ x\ R_{umin} \quad (2)$$

Given their mixed strategies, all of the other users stay in LTE with probability $(1-p)^{N-1}$. In this case, if this user also chooses LTE, then the payoff is only R_{lmin}. Again, with this probability $1-(1-p)^{N-1}$, at least one of the other users switch LAA, so the payoff for selecting LTE in this situation upsurges to R_{lmax}. Thus, the payoff of user choose to stay in LTE is given as

Expected payoff from LTE $= (1 - p)^{N-1} x\ R_{lmin} +$
$$[1 - (1 - p)^{N-1})]\ x\ R_{lmax} \quad (3)$$

Therefore, in this scenario mixed strategies Nash equilibrium can be formed by randomize value of probability *p* such that the
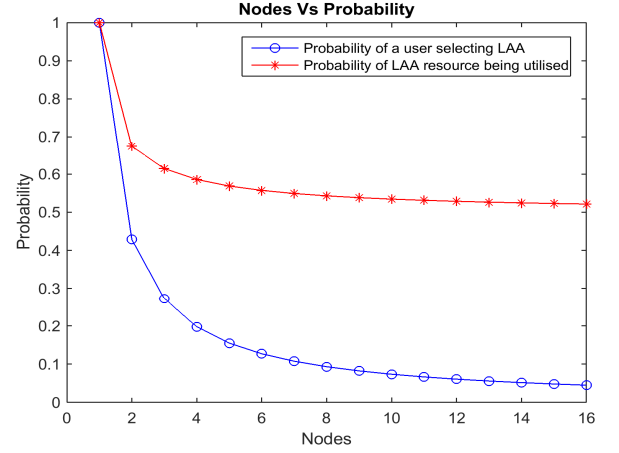

Fig. 3.   Probability of User selecting LAA network.

other user is indifferent between selecting LAA and LTE. So, from equation (1) and (2), we get

Expected payoff from LAA = Expected payoff from LTE

$$(1 - p)^{N-1} x\ R_{umax} + [1 - (1 - p)^{N-1})]\ x\ R_{umin}$$
$$= (1 - p)^{N-1} x\ R_{lmin}d + [1 - (1 - p)^{N-1})]\ x\ R_{lmax}$$

Performing some algebraic operations on this equation, we can solve for the equilibrium mixed strategy as

$$p = 1 - \left[\frac{R_{lmax} - R_{umin}}{(R_{umax} - R_{lmin}) + (R_{lmax} - R_{umin})}\right]^{\frac{1}{N-1}} \quad (4)$$

IV.   EVALUATION

For the analysis of the properties of the equilibrium given by equation (4), we perform a simulation in Matlab. The LAA simulation parameters are utilized according to the 3GPP simulation standardization requirements in [14]. For LTE, we use single chain LTE FDD with the perfect idle condition of 64 QAM. The achievable data rate for LAA and LTE are 75Mbps and 100.8Mbps, respectively. We assume that the user present in coexisting area switches to either network when they find beneficial to do so.

The equilibrium probability is plotted in Fig.3 against the number of nearby users in the game. We find out that the probability that a user selecting LAA decreases gradually as the number of nearby users increase. This is because larger the size of akin (similar network condition) users, the more likely that somebody else also chooses the same, and as a consequence user do not take the risk of choosing LAA. Instead, prefer to remain in the same network.

As we understand from the previous Fig.3 (probability of a user selecting LAA) that as user increases, each user is less likely to select LAA network. But then again, there are also more users who possibly may select LAA. Hence, this leads to confusing situation that whether having a bigger group of users makes it more or less likely that at least one user decides to switch LAA. In response to this question, we calculate the probability that at least one of the *N* users will select LAA, which is $1-(1-p)^N$.
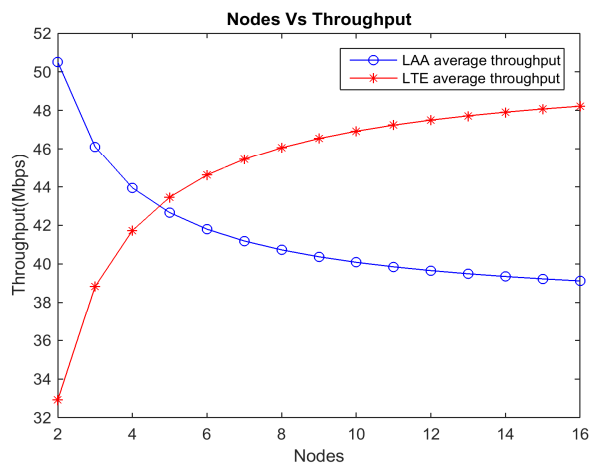
Fig. 4. Average user perceived throughput in LAA and LTE.

And, from the results, we understand that the addition of new users in the group brings a positive and a negative effect on probability that LAA resources being utilized. The positive effect is the additional individual, with its own probability of switching LAA, p, increases the chance of LAA resources being utilized. Whereas in other hand, the additional user makes more likely, that some other user will also select LAA network, thus leading each user to reduce his own probability of switching LAA, i.e., p decreases in N. The result that probability decreases in N implies that the negative effect offsets the positive effect i.e. more people make it less likely that the LAA resource is being utilized.

Fig. 4 shows the average user perceived throughput in LAA and LTE networks. We can see that the average perceived throughput of LAA decreases as the user increases. This is because of the fact that available bandwidth are shared among the increased users dominates the user's preference towards LTE and vice versa for LTE.

V. Conclusion

In this paper, we studied about the network selection behavior of the users collocated between LTE macro and LAA small cell. We find out that increased number of nearby users makes user less likely to switch to LAA small cell. Hence, more users at LAA coverage make it less likely that unlicensed band is being utilized.

In future, we have planned to integrate the WLAN network along with this scenario and analyze the user behavior under these three technologies.

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