



8-12 JUNE 2015 • LONDON, UK
IEEE INTERNATIONAL CONFERENCE
ON COMMUNICATIONS



IEEE ICC'15 ADVANCE PROGRAM

LONDON 2015



IEEE ICC'15: SMART CITY & SMART WORLD

ExCeL London Exhibition and Convention Centre
London, United Kingdom

For more information go to: www.ieee-icc.org/2015



IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS



The **IEEE International Conference on Communications (ICC)** the leading international venue dedicated to the advancement of wireless and wireline communications worldwide, will host more than 2,500 industry professionals, scientists, academics and government officials attending presentations highlighting the entire range of global voice, data, image and multimedia technologies.

Join us at IEEE ICC for five full days of original paper presentations, tutorials, workshops, keynotes, demonstrations, industry panels and social events designed to further career opportunities and the in-depth understanding of the latest communications advancements worldwide.

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PROGRAM AT A GLANCE

Time	Monday 8 th June		Tuesday 9 th June		Wednesday 10 th June		Thursday 11 th June		Friday 12 th June	
09:00 – 10:30	AM Tutorials	Workshops	Technical Symposia	IF&E Panels	Technical Symposia	IF&E Panels	Technical Symposia	IF&E Panels	AM Tutorials	Workshops
10:30 – 11:00	Coffee break		Coffee break		Coffee break		Coffee break		Coffee break	
11:00 – 13:00	AM Tutorials	Workshops	Exhibition	Welcome, Opening Ceremony Keynotes A & B	Exhibition	Keynotes C & D CTO Forum	Exhibition	Keynotes E & F ICC 2015 Best Paper Awards Ceremony Keynote G	AM Tutorials	Workshops
13:00 – 14:30	Lunch break			Awards Luncheon/ Lunch break		Lunch break		Lunch break	Lunch break	
14:30 – 16:00	PM Tutorials	Workshops	Technical Symposia	IF&E Panels	Technical Symposia	IF&E Panels	Technical Symposia	IF&E Panels	PM Tutorials	Workshops
16:00 – 16:30	Tea break		Tea break		Tea break		Tea break		Tea break	
16:30 – 18:00	PM Tutorials	Workshops	Technical Symposia	IF&E Panels	Technical Symposia	IF&E Panels	Technical Symposia	IF&E Panels	PM Tutorials	Workshops
18:30 – 19:00	Welcome Reception (Exhibition Official Opening)									
19:00 – 21:00					Conference Banquet*					
21:00 – 22:30										

*preceded by mini-tour of Tower of London



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Olaf Swantee



Jiangzhou Wang

On behalf of the Organising Committee, it is with great pleasure that we welcome you to the 2015 IEEE International Conference on Communications (ICC), held in the magnificent city of London, the UK's capital. IEEE ICC 2015 will be an excellent presentation, networking and publicity event, offering the opportunity for researchers, engineers and business people to meet and exchange ideas and information. In addition to the traditional keynote, symposium, workshop, tutorial and industry forum sessions, this year we are offering a new event – Chief Technology Officer Forum – during the plenary session. Here, the future of mobile networks will be discussed.

London is one of the most vibrant and exciting cities in the world and increasingly recognised as one of the world's leading technology hubs. There really is something for everyone to enjoy here and you are bound to have a memorable stay.

We would like to thank all the members of the Organising, Technical Program and Advisory Committees, as well as the numerous reviewers, paper authors, presenters, speakers and volunteers, who have worked diligently to make this conference a great success. Last, but not least, the support of the IEEE Communications Society staff and all our patrons, exhibitors, and supporters is greatly appreciated.

We look forward to welcoming you all at IEEE ICC 2015.

Olaf Swantee
General Chair
(EE, UK)

Jiangzhou Wang
Executive Chair
(University of Kent, UK)



Nathan Gomes



Athanassios Manikas

On behalf of the Technical Program Committee, it is our great pleasure to welcome you to the 2015 edition of the IEEE International Conference on Communications (ICC) in London, one of the world's greatest cities. The conference theme "Smart City & Smart World" emphasises London's growing importance as a technology center and the new challenges faced by communications technology for our increasingly interconnected world. IEEE ICC 2015 brings together researchers from all over the world to discuss the latest advances in communications technology from massive MIMO and 5G to the Internet of Things.

The technical program of IEEE ICC 2015 consists of 12 symposia, 27 workshops, 20 tutorials, as well as 16 industry panels. The conference also features 7 interesting keynote speakers who will highlight industry and academic perspectives on mobile communications and cutting-edge technologies for 5G, and the smart grid. With the new CTO forum in a plenary session providing high-level technology visions from the communications industry, we believe that we have the most exciting technical programme for you. Please note that:

- The 12 symposia received a record 3,338 paper submissions from 61 countries, out of which 1,285 papers have been accepted – corresponding to an acceptance rate of 38.5%. All papers have undergone a rigorous peer review process – every symposium paper was reviewed by at least 3 experts, with many receiving up to 6 reviews.
- The 27 workshops, which had been carefully selected from 58 original proposals, also received very large numbers of paper submissions, 1,273 in total, of which 482 papers have been accepted (acceptance rate of 37.9%). The workshop papers will be presented on the Monday and Friday.

The above, together with the 20 Monday and Friday tutorials (of which one is offered free to every conference registrant), we are sure result in a vibrant technical program for the whole of the week, including both oral and interactive-style (using smart-screens) presentations of very high quality. We expect many discussions to continue outside of the technical sessions and believe that our venue and program provide plenty of space and opportunities, respectively, to do this.

We would like to especially thank the TPC Vice Chair, Symposium Co-Chairs, Workshop Co-Chairs, Tutorial Co-Chairs, and Industry Panel Co-Chairs, as well as the more than 3,300 members of the technical program committees of the symposia and workshops and the other external reviewers for their dedication. Without their help, this conference would not be possible. We also thank the Keynote Speaker Co-Chairs, and particularly, the keynote speakers themselves, for contributing this important part of the program.

We look forward to meeting you in London!

Nathan Gomes

Technical Program Committee Chair
(University of Kent, UK)

Athanassios Manikas

Technical Program Committee Chair
(Imperial College London, UK)



Tuesday, 9 June 2015
11:15 – 11:55
Paul E. Jacobs
Executive Chairman
Qualcomm Incorporated

Mobile-Powered Future

With sales expected to reach over 8 billion units over the next five years, smartphones are not only ubiquitous, they are a major source of technology innovation worldwide. The scale and pace of this innovation is impacting many other industries – including consumer electronics, automotive, health care, robotics, and smart cities – as companies look for ways to leverage the mobile ecosystem and its technology to create intelligently connected products and services.

During his presentation, Qualcomm Executive Chairman Dr. Paul Jacobs will share his unique perspectives on what the future holds for mobile devices, networks and services, and how they will transform experiences and entire industries.

Biography: **Dr. Paul E. Jacobs** is executive chairman of Qualcomm Incorporated, where he is responsible for helping guide the development of new technologies and Qualcomm's long-term opportunities.

A leader in the field of mobile communications for more than 25 years and a key architect of Qualcomm's strategic vision, Dr. Jacobs spearheaded Qualcomm's efforts to develop and commercialize mobile technology breakthroughs that have significantly contributed to the growth of both the Company and the industry. Important developments which began under Dr. Jacobs include: the first smartphone based on Palm OS®; inclusion of GPS capabilities in mobile phones; and the BREW® application download system.

As an innovative leader of a broad range of technical teams within Qualcomm, Dr. Jacobs has been granted more than 50 patents for his inventions in the areas of wireless technology and devices. Dr. Jacobs is chairman of the U.S.-Korea Business Council and of the Advisory Board of the University of California, Berkeley, College of Engineering; vice chairman and co-owner of the NBA Sacramento Kings; Global eHealth Foundation Ambassador; a member of the International Business Council of the World Economic Forum; a member of the US-India CEO Forum; and serves on the Board of Directors for FIRST®.



Tuesday, 9 June 2015
11:55 – 12:35
H. Vincent Poor
Professor
Princeton University

Smart Grid: The Role of the Information Sciences

Smart energy networks are key elements of smart cities. A notable aspect of smart energy networks is smart grid, which involves the imposition of an advanced cyber layer atop the physical layer of the electricity grid in order to improve the efficiency and lower the cost of power use and distribution, and to allow for the effective integration of renewable energy sources and distributed storage into the grid. This cyber-physical setting motivates the application of many techniques from the information sciences to problems arising in the electricity grid, and considerable research effort has been devoted to such application in recent years. This talk will illustrate this role through examples arising in demand-side management, sensing & metering, communications, and related problems.

Biography: **H. Vincent Poor** is the Michael Henry Strater University Professor at Princeton University, where is also Dean of the School of Engineering and Applied Science. He has held visiting appointments at a number of other universities, including most recently at Stanford and Imperial College. His research interests are in wireless networks, smart grid and related areas. Dr. Poor is a Member of the U. S. National Academy of Engineering and the U.S. National Academy of Sciences, and is a Foreign Member of the Royal Society. An IEEE Fellow, he is also a Corresponding Fellow of the Royal Society of Edinburgh, and an International Fellow of the Royal Academy of Engineering of the U.K. A recipient of ComSoc's Marconi and Armstrong Awards in 2007 and 2009, respectively, recent recognition of his work includes the 2014 URSI Booker Gold Medal, and honorary doctorates from several universities in Asia and Europe.



Wednesday, 10 June 2015

11:00 – 11:30

Wen Tong

Chief Technology Officer
Huawei

5G to Embrace the Vertical Industries

The emerging 5G wireless will have a huge impact on the transformation of vertical industries. These represent a significant challenge to the 5G wireless technology, especially, the high reliability for the mission critical vertical industries, the ultra-low latency for the machine control such as autonomous driving car industries and massive links for the sensing data from everything. A set of new 5G radio access capabilities have to be created to meet diverse requirements from different applications, on the other hand, the radio access network and core network architecture will evolve to adapt to different requirement, in this case, the network virtualization and slicing is the critical foundation to enable a single and unified virtualizes network architecture.

Biography: Dr. Wen Tong is the Huawei Fellow, Head of Huawei Wireless Research, 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 has pioneered fundamental technologies in wireless with 350 granted US patents. Since 2010, Dr. Tong has been the Vice President of Huawei Wireless Research. He is leading Huawei's 5G wireless research and development. In 2014, He was elected as IEEE Fellow. In 2014, he was the recipient of IEEE ComSoc's Industry Innovation Award for "the leadership and contributions in development of 3G and 4G wireless systems". Dr. Tong serves as Board Director of WiFi Alliance and Board of Director of Green Touch Consortium.



Wednesday, 10 June 2015

11:30 – 12:00

Alwyn Seeds

Professor
University College London

Wireless over Fibre Systems: from MHz to THz

Wireless over fibre (WoF) systems have found an increasing role in coverage solutions for large buildings, driven by the increased data rates in mobile systems. Optical fibre transmission has enabled greatly increased transmission rates for fixed devices, with 10Gb/s common in local area networks. End users find wireless access highly convenient, however limited spectrum availability at microwave frequencies results in per-user transmission rates which are limited to much lower values. Extending the high data-rate capacity of optical fibre transmission to wireless devices requires greatly increased carrier frequencies. This keynote will present the technologies for WoF systems and discuss how photonic techniques can enable ultra-high capacity wireless data transmission using signals at millimetre-wave and TeraHertz (THz) frequencies.

Biography: Professor Alwyn Seeds is currently Head of the Department of Electronic and Electrical Engineering at University College London. He has published over 300 papers on microwave and opto-electronic devices and their systems applications. Professor Seeds is a Fellow of the Royal Academy of Engineering (UK) and an IEEE Fellow. He has been a Member of the Board of Governors and Vice-President for Technical Affairs of the IEEE Photonics Society. He has served on the programme committees for many international conferences. He is a co-founder of Zinwave, a manufacturer of wireless over fibre systems. He was awarded the Gabor Medal and Prize of the Institute of Physics in 2012.



Thursday, 11 June 2015
11:00 – 11:30

Xiaohu You

Professor
Southeast University

5G Mobile Communications in China

In the past decade, mobile communications industry in China has developed very rapidly. China has the largest number of mobile subscribers (over one billion) in the world. The investment by Chinese government in the R&D for 5G mobile communication technologies has been increased significantly in recent years. This keynote will introduce the national strategy in 5G mobile communications in China and present its latest R&D work, especially key enabling techniques for 5G radio transmission and networking. An open architecture testbed based on the massive cooperative cloud radio will be briefly presented.

Biography: Professor Xiaohu You is currently the Director of National Mobile Communications Research Laboratory at Southeast University and a Cheung Kong Specially-appointed Professor. He has published extensively in international journals and conferences in the areas of signal processing and wireless communications. Since 1999, he has been the Principal Expert of the 3G, 4G and 5G mobile communications projects of China National "863" High-Tech Program. He was the recipient of China National First-class Technical Invention Award in 2011 and was the General Chair of IEEE WCNC2013. He is the Chairman of IEEE Nanjing Section. Professor You was selected as IEEE Fellow in 2011 for his contributions to development of mobile communications in China. He is awarded Distinguished Visiting Fellowship of Royal Academy of Engineering.



Thursday, 11 June 2015
11:30 – 12:00

Lajos Hanzo

Professor
University of Southampton

A Stroll with Shannon to Next-Generation Plaza: Large-Scale MIMOs, Single versus Multiple RF Chains and All That...

Commencing with a brief historical recital of the four wireless generations, the most potent enabling techniques are critically appraised by considering a range of radical techniques of increasing the achievable throughput. We live in an era, when the tele-traffic demand outstrips the available capacity, as tele-presence with its joy and wonder gradually becomes a commercial reality. Specifically, the pros and cons of coherent versus non-coherent large-scale MIMO systems are considered and the benefits as well as disadvantages of their multi-functional antenna array based and spatial modulation aided manifestations are touched upon.

The holistic optimization of large-scale wireless systems potentially imposes an excessive complexity, which may however be mitigated with the aid of bio-inspired or near-optimum quantum-domain search algorithms. Finally, the spectrum crunch may be mitigated by exploiting a radically increased part of the entire electromagnetic spectrum. On a predictive note, we have only seen the tip of the iceberg Dr Shannon...

Biography: Lajos Hanzo, FEng, FIEEE, FIET, Eurasic Fellow, DSc holds the Chair of Telecommunications at Southampton University, UK. He co-authored 20 IEEE Press - John Wiley books and 1434 research contributions at IEEE Xplore, organised and chaired major IEEE conferences and has been awarded a number of distinctions. His research is funded by the European Research Council's Advanced Fellow Grant.



Thursday, 11 June 2015
12:30 – 13:00

Jürgen Schindler
5G Business Program Head
Nokia

5G, Expanding the Human Possibilities of Technology

The understanding of 5G use cases and requirements are becoming clearer. 5G technology demonstrations show that many technologies that were more on idea level just a year ago can be built. Nokia as an industry leading company is helping the public 5G research to switch gears- the research will develop 5G building blocks further and organize them to an integrated 5G systems embracing also LTE-Advanced evolution, WiFi and fixed. In this keynote, Nokia 5G Business Program Head Dr. Jürgen Schindler will share his view of top 5 key technology components of 5G and explain Nokia's holistic systems research, prototyping & development.

Biography: Dr. Jürgen Schindler is responsible for building up the 5G Radio organization in Nokia with the target to provide a complete portfolio of 5G products. Prior to the current position, Jürgen was heading LTE Lead Customer Product Management in Nokia Siemens Networks where he was working with leading customers to define the LTE product strategy. From 2004 to 2007, Jürgen was heading Portfolio Management Radio and was responsible for the Siemens Mobile Network Product Portfolio. From 2001 to 2004, Jürgen was heading Network Engineering department being responsible for planning and optimization of Mobile Networks. Jürgen started his professional career in Siemens in 1997 doing research on 3G. He was then heading the 3GPP Radio Standardization.

Wednesday, 10 June 2015
12:00 – 13:00

CTO Executive Forum

How far can we evolve Mobile Networks - What is next?

CTOs are currently experiencing significant data traffic volume in their mobile networks. Capacity is becoming one of the major challenges. Mobile Networks as they are today will not be able to maintain a high Quality of Service in the future. Consequently, CTOs must evolve their networks to offer higher capacity and more reliable data services. In this forum, five CTOs from EE, O2, Three, Qualcomm and Huawei will address the question – What is next for mobile networks?

INTERNATIONAL CONFERENCE
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CHAIR



Bryn Jones
CTO, Three UK



Fotis Karonis
CTO, EE



Brendan O'Reilly
CTO, Telefonica UK Ltd



Ed Tiedemann
EVP, Qualcomm



Wen Tong
CTO, Huawei

PANELISTS

Bryn Jones

Bryn Jones is CTO at Three in the UK and responsible for the development and deployment of the UK's most reliable network which carries 45% of the UK's mobile internet data. Bryn has nearly 30 years industry experience with equipment suppliers, systems integrators and operators. Bryn joined Three in 2012, prior to this he spent 11 years at Virgin Media in a number of technical and business roles helping to launch and run the world's largest MVNO, his final role being Technical Director for the Mobile and Virgin National Broadband divisions.

Fotis Karonis

Fotis is the Chief Technology Officer for EE, responsible for the IT and network development strategy and implementation. Fotis has overseen IT since EE was formed in 2010 with the merger of Orange and T-Mobile. Prior to his role at EE, he held the role of Chief Information officer for Romtelecom. Prior to that, he worked at Athens International Airport, as director of information technology and the telecommunications business unit. In this role, Fotis planned, implemented and ensured round-the-clock integrated IT services and infrastructure to the airport that serves over 16 million passengers and five million visitors every year. Prior to this, he worked with Cap Gemini and Alcatel in France.

Brendan O'Reilly

Brendan is the Chief Technology Officer of Telefonica UK Ltd, with over 15 years' experience in Mobile Telecoms. Brendan has accountability for O2 UK's strategy, design, planning, test, delivery and operation of the entire mobile and fixed network, messaging and wifi supported by his team of more than 600 professional engineers. Working closely with key areas in the UK and Telefonica Group, Brendan is developing the high level principles needed to develop the O2 network focusing on the ever changing needs of our customers. Brendan has held a number of senior roles in the Networks Leadership Team over the past seven years, with achievements including leading the development of O2's network share partnership with Vodafone in June 2012. He is also experienced in detailed planning and delivery of radio and transmission networks. Delivering the best experience to our customers is at the heart of how Brendan works and knows his people are key to achieve this.

Ed Tiedemann

Dr. Edward G. Tiedemann, Jr. is a QUALCOMM Fellow and a Senior Vice President of Engineering at QUALCOMM. He leads QUALCOMM's worldwide standardization and industry organization activities. Dr. Tiedemann was instrumental in the design and development of the TIA/EIA/IS-95 CDMA system, also called cdmaOne™. He led QUALCOMM's and much of the industry's efforts in the design and development of the third-generation cdma2000® system. For many years, he chaired the 3GPP2 physical layer working group. Dr. Tiedemann led the offline industry group on M2M convergence, which resulted in oneM2M. Dr. Tiedemann has been particularly interested in the technical issues related to handoff, power and rate control, scheduling, control of random access channels, advanced antenna techniques, location technology, and the tracking and paging of mobile users. Dr. Tiedemann holds over 200 US patents and has participated in many papers, conference lectures, and industry panels. Prior to becoming involved with terrestrial wireless communications, Dr. Tiedemann was involved with numerous commercial and military satellite systems.

Wen Tong

Dr. Wen Tong is the Huawei Fellow, Head of Huawei Wireless Research, 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 has pioneered fundamental technologies in 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, he spearhead to lead Huawei's 5G wireless research and development. In 2011, Dr. Tong was elected as Huawei Fellow. In 2014, He was elected as IEEE Fellow. In 2014, he was the recipient of IEEE ComSoc's Industry Innovation Award for "the leadership and contributions in development of 3G and 4G wireless systems." Dr. Tong serves as Board of Director of WiFi Alliance and Board of Director of Green Touch Consortium.

Tuesday, 9 June 2015 • 09:00 – 10:30

IFP-01: 5G Challenges and Opportunities

Chair: Hamid Aghvami (King's College London, UK)
Panelists: Reinaldo Valenzuela (Bell Labs, Alcatel-Lucent, USA)
 Mike Short (O2 Telecoms, UK)
 Luke Ibbetson (Vodafone, UK)
 Pedro Raio (Ericsson, Germany)
 Rahim Tafazolli (University of Surrey, UK)

5G Challenges and opportunities 3G and 4G are mainly content-centric networks. 5G is expected to be not only a fast and efficient content delivery network but also a communication platform to enable touching, monitoring, controlling and steering objects (things) remotely (Tactile Internet) to support a wide range of emerging and future applications in the vertical business sectors. As envisaged, 5G comprises heterogeneous networks, both cellular (wide-area) and non-cellular (local area) networks. What are not yet known are the design approach (evolutionary or revolutionary) and design road maps.

The panel will address end-to-end 5G requirements, challenges and opportunities, and user, operator and service provider expectations. It will also discuss the potential use of the following mechanisms and techniques for the design of 5G networks:

- Software Defined Network (SDN) (Separation of control and data planes)
- Self-Organising Network (Extension of SDN for wireless segment)
- End-to-end Network Function Virtualization (NFV) (decoupling network functions run in software from physical elements of a network)
- Full automation (measurements, reporting and analytics)
- Spectrum extension, sharing, millimetre wave

These techniques offer other advantages such as easy and fast roll out, easy capacity and coverage expansion, easy network upgrading, support for multi-vendors' equipment, lower energy consumption, network sharing and more.

Tuesday, 9 June 2015 • 09:00 – 10:30

IFP-02: Can we ensure the long-term sustainability of the Internet?

Chairs: Jaafar Elmirghani (University of Leeds, UK)
 Kerry Hinton (Centre for Energy Efficient Telecommunications, Australia)
Panelists: Oliver Blume (Alcatel-Lucent Bell Labs, Germany)
 N. Prasanth Anthapadmanabhan (Bell Labs, Alcatel-Lucent, USA)
 Louise Krug (British Telecom, UK)
 Chris Chambers (BBC, UK)

In 2011, a projection for the growth of power consumption by the Internet indicated that, by 2025, the Internet's power consumption (excluding data centres) will grow from about 1.5% of global electricity consumption to greater than 10% and even over 50%. Since then the telecommunications industry has been working on avoiding such an unsustainable outcome by allocating significant resources to improve the energy efficiency of networks. This panel will provide several perspectives on key areas of the network in which significant work has been undertaken in developing technologies and strategies for improving network energy efficiency.

The areas to be covered will be:

- Wireless access networks
- Wireline access networks
- Metro/core networks
- Anywhere, anytime, ubiquitous cloud services and content distribution
- The Internet of Things Participants will gain an up-to-date overview of the current situation and future trends in Internet energy efficiency.

Tuesday, 9 June 2015 • 14:30 – 16:00

IFP-03: Smart City and Sustainable Ecology: A Trans-disciplinary and Trans-continental Perspective

Chair: Paulina Chan (Imperial College Ambassador; Principal & CEO of Global Mutual Consortium, Hong Kong)
Panelists: David Gann (CBE, Chairman Smart London Board, Vice President (Development & Innovation) Imperial College London, UK)
 Toula Onoufriou (Vice Rector, Cyprus University of Technology; Coordinator, SmartEN Marie Curie ITN, EU, Cyprus)
 Christer Ljungwall (Science and Innovation Counsellor, Swedish Agency for Growth Policy Analysis, Sweden)
 Sanqi Li (Chief Scientist, Huawei Technologies, China)

Planning and building Digital Portals, Smart Cities & Smart Nations, and transforming our world as an Intelligent Planet have been a major focus of novel technologies and innovative development across industries, academic institutions, and political parties. Successful translation and deployment of smart technologies into commercial products and services, as well as their social acceptance require trans-disciplinary commitments, cross-cultural partnerships, and trans-continental support. All is done for the benefits of improving quality of life and global ecology. Invited panelists of this international session are notable leaders and distinguished professionals in multidisciplinary industries, academia, and governments. They are responsible for and committed to approving, planning, building, and maintaining digital cities, intelligent-projects, and sustainable environment worldwide. Showcase implementations, success stories and lessons learned in London, the European Union, People's Republic of China, Hong Kong, and the USA will be shared and discussed. Audience at the session will also be invited and encouraged to interact with the subject matter experts to share common interests and ideas such as application-based R&D, feasible opportunities, and user experience.

Tuesday, 9 June 2015 • 14:30 – 16:00

IFP-04: 5G Architecture

Chair: Simone Redana (Nokia Siemens Networks, Germany)
Panelists: Mischa Dohler (King's College London, UK)
 Jan Melen (Ericsson, Finland)
 Chris Pudney, Vodafone

Mobile networks have become the main communication vehicle for the upcoming connected society. In addition to humans, billions of machines will be connected to the network in the future, yielding a 10.000 traffic increase beyond 2020. However, such traffic increase does not necessarily lead to a similar increase in the revenue of mobile network operators, which need to make very high investments to handle all this traffic. This challenges the deployment of a mobile network that can satisfy the requirements of the society and at the same time is sustainable for network operators. A fundamental piece to address this challenge is the design of a novel mobile network architecture that provides the necessary flexibility to offer new services in an efficient way and inherently can share or distribute infrastructure resources dynamically, such that operators can increase their revenue through the new services, while leveraging the efficiency of the architecture to do so in a cost-effective way. Current mobile networks are not well suited to address the above challenge. In 4G mobile networks, large effort was made in making the air interface fully adaptive to changing radio conditions, but lack similar functionality to optimize the network side. Eventually, while current architectures have been very successful in the last few years, they do not provide the required flexibility to cope with the service and traffic diversity required by 5G mobile networks as well as the current trends in terms of topologies. Such trends (in terms of traffic and topologies) make networks increasingly heterogeneous and require tailored solutions to adapt to each specific scenario and service in an efficient way. In order to overcome the limitations of today's networks, the central goal of this panel is to discuss about future mobile network architectures that can flexibly adapt its operation to the specific characteristics and requirements of a given service and scenario.

Tuesday, 9 June 2015 • 16:30 – 18:00

IFP-05: 5G Eco-systems and Platforms in Future Cities

Chairs: Simon Fletcher (NEC, UK)

Stuart Revell (TechUK, UK)

Panelists: Mischa Dohler (King's College London, UK)

Mark Beach (University of Bristol, UK)

Michael Fitch (BT Exact, UK)

Paul Copping (Digital Greenwich, UK)

David Wong (SMMT, UK)

The TechUK Future Technologies Network (FTN) brings thought leaders from public and private organisations working together with industry and especially SMEs to stimulate new business models and service innovations. Representatives from the FTN Radio and IoT working groups come together in this session to analyse the key elements of the 5G and IoT technologies and identify any unifying themes that may signify emerging platforms upon which SMEs can locate their business models.

Tuesday, 9 June 2015 • 16:30 – 18:00

IFP-06: 5G Initiatives

Chair: Peiyong Zhu (Huawei Technologies, Canada)

Panelists: Chih-Lin I (China Mobile Research Institute, China)

Takehiro Nakamura (NTT DOCOMO, INC., Japan)

Eric Hardouin (Orange Labs, France)

Alistair Urie (Alcatel-Lucent, France)

Y.-P. Eric Wang (Ericsson Research, USA)

Edward G. Tiedemann (Qualcomm Incorporated, USA)

Over the past few years, 5G has been a hot topic both in industry and academia. Several 5G vision and white papers have been published by various companies, 5G forums and research committees. Recently, NGMN published the 5G white paper to express the operators' views. 3GPP RAN will organize workshop in Sept 2015 to discuss standardization aspects, which signaling a step forward bringing 5G from concept to reality. Various potential technologies have been discussed; however, it is far from consensus what the 5G key enabling potential technologies are and whether the proposed technologies can meet the 5G requirements.

In this panel, we propose to invite representatives from key vendors and operators to have interactive dialogues and debates on the following (not limited) topics:

- What are the key technologies?
- Why and when do we need these technologies?
- How can these technologies meet 5G requirements?
- What are the relatively mature technologies to be standardized?
- What are the steps/processes to ensure a successful 5G standard and products?
- Which mmWave band will have the best chance in 5G?

Wednesday, 10 June 2015 • 09:00 – 10:30

IFP-07: 5G Channel Measurement and Model

Chair: Yi Wang (Huawei Technologies Co., Ltd, China)

Panelists: Yi Wang (Huawei Technologies Co., Ltd, China)

Takehiro Nakamura (NTT DOCOMO, INC., Japan)

Amitava Ghosh (Nokia Networks, USA)

Henrik Asplund (Ericsson Research, Sweden)

Andrzej Partyka (Qualcomm Incorporated, USA)

With the explosive increase in mobile traffic in recent years, it has become urgent to study a new generation of wireless communication systems to meet future needs. Recently a growing discussion on 5G wireless is emerging both in industry and academia. A widely accepted view is that 5G will consider both low frequency bands (below 6GHz) as well as higher frequency bands, typically 6-100GHz, to get additional and wider bandwidth

spectrum for radio access networks. New technologies such as massive MIMO, new waveforms and new networks architectures are being widely discussed for use with both low frequency bands and higher frequency bands. A fundamental question is whether the channel studied for 5G will be much different than current 4G channels.

The changes are coming from a few factors:

1) Carrier frequencies are moving to higher frequency bands (e.g., above 6GHz) and the corresponding channel propagation properties are still not well known in cellular environments. Recently there have been a number of publications on channel propagation for the mmWave bands, but not enough measurements have been done to provide full insight into the channel characteristics. Moreover, it is not clear whether traditional channel models (e.g., models in 3GPP, ITU and WINNER projects) are suitable for bands above 6GHz.

2) With the introduction of new technologies to 5G (e.g., massive MIMO) and new scenarios to 5G (e.g., UDN), traditional channel models may no longer be suitable. Such changes may include the power delay profile, different materials, and the coupling of the antenna pattern with channels. Thus, it is widely accepted that 5G needs to have a new channel model for technical studies and standardization.

In this panel, we focus on the topic of 5G channel measurement and models in order to clarify the latest progress from various companies and academics in trying to answer the above questions. Initial topics from invited speakers will cover:

1. Channel measurements of higher frequency bands (6-100GHz)
2. Channel measurements of massive MIMO channels
3. New channel models of 5G in both low frequency bands as well as higher frequency bands
4. The implications of mmWave propagation on the overall 5G system

Wednesday, 10 June 2015 • 09:00 – 10:30

IF Panel 08: CAP Theorem Challenges and DevOps approaches to Operating Next-generation Virtualized Telecom Network Infrastructure

Chairs: Catalin Meirosu (Ericsson Research, Sweden)

Fritz-Joachim Westphal (Deutsche Telekom AG, Germany)

Panelists: Diego Lopez (Telefonica I+D, Spain)

Antonio Manzalini (Telecom Italia, Italy)

DevOps is a paradigm shift in the way of developing and operating software and systems, based on close ties between Dev (writing and testing code) and Ops (operating the virtual infrastructure, functions and applications) activities. Next-generation telecom infrastructure as defined by the ETSI NFV initiative consists of series of virtualized network functions implemented in software and executed on general-purpose compute, network and storage platforms. Expectations are that such infrastructure is able to fulfill carrier-grade requirements in terms of availability, performance, management and security. The Consistency Availability Partition tolerance (CAP) theorem poses a set of interesting challenges with respect to what could be achieved through sheer technological power in a software-defined infrastructure. The purpose of the panel is to briefly discuss the most important requirements for operating next-generation telecom virtualized infrastructure and debate the applicability of agile operations techniques inspired by large-scale cloud computing infrastructure, as well as the effect of automation introduced by intelligent orchestrator and controller functions.

Wednesday, 10 June 2015 • 14:30 – 16:00

IFP-09: 5G Networks in Frequency Bands over 6 GHz

Chair: Amitava Ghosh (Nokia Networks, USA)

Yoshihisa Kishiyama (NTT DOCOMO, INC., Japan)

Panelists: Erik Dahlman (Ericsson Research, Sweden)

Ali Sadri (Intel; President & Chairman, WiGig Alliance, USA)

Robert Heath (University of Texas, Austin, USA)

Nuria González-Prelcic (University of Vigo, Spain)

Howard Benn (Samsung, UK)

The wireless industry is currently looking to define 5G as a higher-capacity, lower-latency successor to 4G. The exact details of what 5G will look like is still being debated, but general consensus is for peak rates of greater than ten times 4G, "everywhere" rates of at least 100 Mbps, and latencies less than 1 msec. One of the key components of meeting these 5G targets will be exploiting the incredible amount of spectrum available from 6 to 100 GHz. This panel attempts to answer some of the key questions on how 5G will look and operate at bands greater than 6 GHz.

The first discussion topic will be the view of each panelist on what will characterize a 5G system above 6 GHz. Next the panel will provide their views of the world-wide spectrum and regulatory issues which will determine which particular frequencies above 6 GHz are likely to be available for use in 5G. Next the panel will give their views of how 5G above 6 GHz will evolve from a standards viewpoint including their projected timeline for standards completion. From the panel's extensive knowledge of channel modeling above 6 GHz, challenges of the propagation environment at these frequencies will be elaborated including the differences/similarities expected across the frequencies from 6 to 100 GHz. The panel additionally will comment on their views of which 5G air interface or interfaces are most appropriate for the various frequencies above 6 GHz. Finally discussions of the RF and antenna technologies needed for these frequencies will be provided including the risks associated with these technologies

Wednesday, 10 June 2015 • 14:30 – 16:00

IFP-10: Real-world Experience of Self Organizing Networks (SON)

Chair: Michael Motta (P.I. Works, Turkey)

This panel will explore the benefits and challenges for the Mobile network operator to deploy automated SON solutions to complex heterogeneous networks.

1. The need for SON. Self-Configure, Self-Optimize, and Self-Heal complex HetNets.
2. Benefits of SON. Summary of Key business and technical advantages. Tips for getting the most from SON.
3. SON deployment strategy. Centralized, Distributed, and hybrid SON solutions.

Wednesday, 10 June 2015 • 16:30 – 18:00

IFP-11: Towards a Complete Picture for mmW based 5G Technology: From Regulatory Issues to First Deployment

Chair: Monisha Ghosh (InterDigital, USA)

Panelists: Onur Sahin (InterDigital, USA)

Thomas Hausteiner (Fraunhofer HHI, Germany)

Amitava Ghosh (Nokia Networks, USA)

Sana Salous (Durham University, United Kingdom)

It is widely accepted today that the use of higher frequency bands will be a fundamental enabler for next generation networks, e.g. 5G systems. Recently, there have been significant industry and academic research and development efforts driven by the new and encouraging mmW channel measurement results as well as encouraging progress in the antenna,

silicon and system architecture domains. Moreover, recent supportive actions by the world leading regulatory bodies, e.g. FCC, ECC, and their Asian counterparts on allowing additional mmW frequency availability has further solidified the role of mmW in 5G systems.

Some of the core areas to be explored in the panel include:

- Can mmW be a reliable carrier for the outdoor network considering the propagation characteristics and mobility?
- Is mmW destined to be a stand-alone technology or a supplemental carrier under the umbrella of incumbent O-band systems, e.g. LTE-A?
- World-wide regulatory issues, orchestration of mmW bands
- Standardization aspects: 3GPP vs independent track
- mmW technology for machine type communications (MTC)
- Health issues: How confident are we? Is more research and data needed?

Wednesday, 10 June 2015 • 16:30 – 18:00

IFP-12: Preparing the Next Generation of Communications Designers with Education and Training

Chair: Erik Luther (National Instruments, USA)

Panelists: Michele Zorzi (University of Ferrara, Italy)

Tarek S. El-Bawab (Jackson State University, USA)

Ramiro Jordan (University of New Mexico, USA)

Rhys Bowley (National Instruments, USA)

Michael Rice (Brigham Young University, USA)

Communications engineering education is very close to being recognized as distinct education discipline by ABET (Accreditation Board for Engineering and Technology, Inc) which accredits more than 680 universities and colleges in 24 countries. It's now the role of the communications community to design programs and the underlying courses and course materials needed to effectively train and prepare students for their careers. In this session divide the time among invited lectures and panel discussion to learn the needs, available resources, and best practices that educators should consider and benefit from as they develop the classrooms and labs of the future. Panelists include educators, tool vendors, and employers to provide a balanced view covering all aspects of the classroom and lab.

Thursday, 11 June 2015 • 09:00 – 10:30

IFP-13: Evolving LTE-Advanced in 3GPP Release 13 and 14

Chairs: Juho Lee (Samsung Electronics. Co., Ltd, Korea)

Jianzhong Zhang (Samsung Telecommunications America, USA)

Panelists: Dino Flore (Qualcomm Inc., USA)

Amitava Ghosh (Nokia Networks, USA)

Wan Lei (Huawei Technology Ltd, China)

Takehiro Nakamura (NTT DOCOMO, INC., Japan)

Stefan Parkvall (Ericsson Research, Sweden)

Tim Frost (Vodafone, UK)

In this proposed panel, we will bring together leading experts from major operators, infrastructure, terminal and chipset vendors as well as other key members of wireless communications industry ecosystem. We believe this panel can articulate a clear evolution path of LTE-Advanced to 5G, and to shed some lights on the important technology drivers for the industry to focus on in LTE Rel-13/14 so that we will have a smooth transition from current 4G to the future 5G network. The views and insights shared by these experts will have a lasting impact on the extended cellular R&D community for years to come.

Thursday, 11 June 2015 • 09:00 – 10:30

IFP-14: SDN and NFV:

Opportunities and Challenges for Network Management

Chair: Chen Liu (Microsoft, USA)

Panelists: Inder Monga (ESnet, USA)

Kashinath Basu (Oxford Brookes University, UK)

Kuang-Ching Wang (Clemson University, USA)

Ilya Baldin (RENCI/UNC Chapel Hill, USA)

Sergi Figuerola

(Chief Technology & Innovation Officer, i2CAT Foundation, Spain)

For last few years there has been a tremendous growth in data traffic due to high adoption rate of mobile devices and cloud computing. Internet of things (IoT) will stimulate this even further growth. This is increasing scale and complexity of telecom/internet service provider (SP) and enterprise data center (DC) compute and network infrastructures. As a result, managing these large network-compute converged infrastructures is becoming complex and cumbersome. Traditional network management approaches and Network Management Systems (NMS) are falling short on this. This problem has a complex interplay with SDN and NFV. Some aspects of this problem will be addressed by SDN and NFV solutions. On the other hand, this problem also hinders SDN and NFV adoption.

In this panel discussion we propose to the following high level questions:

- How does SDN, NFV interplay with network manageability?
- How SDN, NFV is going to change network management practice?
- What are the security related imperatives of SDN, NFV?

Thursday, 11 June 2015 • 14:30 – 16:00

IFP-15: Cellular IoT Technology

Chair: John Haine (U-blox, UK)

Panelists: Ming Fang (Huawei Technologies Co., Ltd., China)

Gaoke Du (Huawei Technologies Co., Ltd., China)

Luis Barreto (Neul, UK)

Weiliang (David) Zhang (Huawei, China)

Tony Sammut (Vodafone, UK)

Rasmus Krigslund (Kamstrup, Denmark)

It is predicted that by the early years of the next decade over 20 billion devices will be wirelessly connected in the Internet of Things (IoT). A ubiquitous public cellular network that was easy to use, penetrated deeply into almost all locations, and allowed for truly low-cost/low-energy devices capable of operating for years on a small battery, would be of enormous benefit. It would serve many existing machine-to-machine (M2M) applications such as metering, remote sensing, and telemetry; but more importantly would fuel the rapid development of the mass Internet of Things market by providing reliable and accessible connectivity for even the most low-cost/low-energy device. It would be a platform for substantial revenue growth for mobile network operators globally.

Today's cellular networks have a few shortcomings in relation to the new demands from IoT. Whilst existing cellular technologies give in-building service they do not provide sufficiently deep coverage for some m2m applications such as metering. No current cellular technology (Rel-11 and earlier) can support very long terminal operating life on a small battery. Today, cellular GSM/GPRS comes closest to serving this market but does not sufficiently provide all characteristics of the ubiquitous cellular network for IoT. LTE, the latest cellular radio access technology, has been designed from the ground up to provide efficient mobile broadband data communications. Both LTE and UMTS/HSPA devices in their current forms are significantly more expensive than GSM/GPRS.

In this Cellular IoT panel, the speakers will discuss the opportunity and technology feasibility of the revolutionary technology which is being standardized in GERAN. And different aspects of the Cellular IoT will be

deeply discussed by each party from end-to-end point of view, such as the mobile operator, infrastructure vendor, chipset provider, module provider and applications such as the water meters.

Thursday, 11 June 2015 • 14:30 – 16:00

IFP-16: Mobile Fronthaul Era - Are we there yet?

Chair: Anthony Magee (ADVA Optical Networking, UK)

Panelists: Nathan J. Gomes (University of Kent, UK)

Volker Jungnickel

(Fraunhofer HHI & Technische Universität Berlin, Germany)

Chih-Lin I (China Mobile Research Institute, China)

Andy Sutton (EE Ltd, UK)

Nick Edwards (BT plc, UK)

ADVA Optical Networking Mobile architectures are coming under a lot of attention at the moment in order to serve the growing demand in mobile cell sites and coverage. Challenges such as how to deploy small-cells, how to enable CoMP, and how to prepare for future architectures that may arise from 5G are leading many to look at and evaluate Fronthaul as an enabler. Fronthaul is not without its challenges and mobile operators and carriers need to be convinced of the technology and business case. A panel discussion covering the following questions will drive interest and attendance, and hopefully provide answers to help industry understand whether this technology is still to mature or whether it is ready for deployment.

1. Introduction short statement of interests in fronthaul, explaining need for industry debate
2. Fronthaul State/C-RAN of play, Business Case and deployment readiness
3. Challenges and Carrier/MNO Needs for Fronthaul, the need for SLAs, and evolution to 5G
4. Solutions and ideas for overcoming barriers to entry, possible adoption of Mid-Haul
5. Questions and Answers directed towards the Panel
6. Summing up and Key Messages
 - a. Fronthaul needed today
 - b. Long term Mid-haul may be needed
 - c. Fronthaul Networks will enable Mid-haul and 5G

Thursday, 11 June 2015 • 16:30 – 18:00

IFP-17: 5G Testbeds, Experiments, Demonstrations

Chairs: David Soldani (Huawei Technologies Duesseldorf GmbH; European Research Centre, Germany)

Bernard Barani (European Commission, Belgium)

Panelists: Rahim Tafazolli (University of Surrey, UK)

Chih-Lin I (China Mobile Research Institute, China)

Juha Sipila (Nokia, Finland)

The panel will present the crucial test cases and corresponding scenarios to demonstrate the new capabilities of the advanced 5G infrastructure, especially for meeting latency, reliability and spectral efficiency requirements, looking at mission critical machine communication and massive machine type of traffic, with maximal exploitation of available spectra: from cellular band to visible light. How, what and when to be tested (from link level performance to capacity tests for Full Immersive 3D Experience and Anything or Everything as a Service, beyond the SPI Models of Cloud Computing) to achieve large scale trials in EU and globally, through International Collaborations, will be also discussed. The main target is to verify the technical feasibility and business viability of the new 5G enabling technologies, leveraging SDN, NFV and MEC.

Thursday, 11 June 2015 • 16:30 – 18:00

IFP-18: Electronic Healthcare, IoT, Telemedicine and Cloud: Standards, Challenges and Opportunities

Chair: Masum Z. Hasan (Cisco Systems, USA)

Panelists: Augusto J. Venancio Neto (Federal University of Rio Grande do Norte; Centro de Ciências Exatas da Terra, Brazil)

Gerard P. Parr (University of Ulster, UK)

Stefan Covaci (Technische Universität Berlin, Germany)

This panel will discuss following (but not limited to):

- Issues, challenges and opportunities in delivering electronic healthcare (e-health) and relevant information/data via Cloud, specially Community Cloud.
- E-health and Cloud standards issues.
- Potential confluence of e-health and Cloud standards.
- Telemedicine for long distance patient care over MAN/WAN and via Cloud and potential communications standards with unique requirements.
- Personally wearable or mobile IoT (Internet of Things) device based e-health delivery via Cloud and relevant standards issues.
- Issues of privacy, security and regulatory compliance as e-health delivered via Cloud.

Tuesday, 9 June 2015 • 10:30 – 11:00

Anritsu: Understanding and Improving the Mobile Device User Experience

Presenter: Jonathan Borrill, Anritsu

The complexity involved in delivering acceptable service to mobile network and device users makes gaining visibility of service quality very difficult. Monitoring of legacy and LTE networks can be expensive and not give a complete or sufficiently granular picture. Tools able to relate data from network monitoring to the performance of today's multitude of devices operating on the same network can provide powerful insights for mobile network operators.

Tuesday, 9 June 2015 • 16:00 – 16:30

National Instruments: Rapid Prototyping 5G Systems with a Platform Based Design Flow with Software Defined Radio

Presenter: Erik Luther, National Instruments

With recent advances in RF and FPGA technologies and software design flows, Software defined radio (SDR) is emerging as a viable way to rapidly prototype custom protocols and analyze performance in real-world environments. SDRs allow rapid iteration on designs because it closely mirrors the functionality found in real wireless devices with the added flexibility of broader frequency coverage and re-programmable baseband processing. In this talk we discuss the platform based approach to designing next generation wireless systems that allows design teams more efficiently utilize new, more advanced hardware and software while shortening time to results with deployment through reuse along the product development, validation, verification and deployment cycle. We cover several case studies in the design and prototyping of 5G wireless communications systems that include physical layer development and prototyping of new LTE and 802.11 waveforms to incorporate filter bank multicarrier approaches with the aim of meeting growing demands for latency, capacity and reliability.

Wednesday, 10 June 2015 • 10:30 – 11:00

GENBAND: WebRTC Un-wiring the Communications Network

Presenter: David Tubb, GENBAND

VoIP has been widely deployed in the transformation of the telecommunications industry over the past decade. It is largely used in "controlled" environments where the network or implementation is locked down to ensure quality of experience. WebRTC is a specification that allows a browser or device to securely access media resources and exchange real-time communications with another browser or device. It leverages VoIP standards but has specified new techniques to deliver a secure and reliable service in uncontrolled network environments. Internet-tolerant real-time communications provided without royalties in hundreds of millions of browser installations is a catalyst for innovative new communications services. Cloud-hosted and developer-friendly platforms like GENBAND KANDY complement WebRTC by providing some fundamental "addressing" between endpoints along with control and collaboration services. With KANDY and WebRTC, we expect communications experiences to be embedded into everyday applications and to see a wave of disruptive over-the-top services.

Wednesday, 10 June 2015 • 13:00 – 13:30

Digile: DIGILE IoT Program

Presenter: Jan Melén, Ericsson, Digile

The Internet of Things Research Program in DIGILE interconnects things, people and services. The program is a national effort in Finland funded by the Finnish Funding Agency for Innovation. It develops key solutions for IoT with 50 academic and industrial partners and over 300 researchers and developers. The four-year program is closing end of 2015 and the results achieved include protocols, standards and concrete pilots to smart homes, smart cities and industries.

In the exhibition, DIGILE will showcase different pilots. One of them will show how to deploy and manage large-scale IoT networks and make it possible to handle low latency control loops using the mobile network. A large portion of the devices in future 5G systems will be unattended machine devices, and the management paradigm needs to be changed from one-to-one to one-to-many. Automated machine operations calls for processing close to the devices. A flexible computing platform includes resources across the mobile network in an efficient way.

Wednesday, 10 June 2015 • 13:30 – 14:00

Rohde & Schwarz: From mm-wave Frequencies to Gbps Experience: The Need for All-embracing Performance Assessment in 5G

Presenter: Meik Kottkamp, Rohde& Schwarz

The presentation will cover:

- Impact from 5G technology components to the T&M sector
- Assessing the need for channel impulse response measurements in the cm- / mm-wave frequency range as input to new channel models
- Assessing the impact from IP applications to both the cellular network and to end user devices in terms of signalling load and power consumption

Wednesday, 10 June 2015 • 14:00 – 14:30

InterDigital: oneTRANSPORT: Reshaping the Transport Sector with oneM2M

Presenter: Rafael A. Cepeda, InterDigital

oneTRANSPORT aims to make transport more user friendly and accessible. This is achieved by using the recently published oneM2M standard to create an open and self-sustainable transport-data marketplace. With transport data assets from five Local Authorities in the UK, this solution is the world's first open and scalable platform enabling multimodal and multi-system transport integration. This talk introduces the project and describes technical and practical issues to achieve sustainable IoT solutions, related to the transport sector, for the benefit of data owners, service providers and end users.

Wednesday, 10 June 2015 • 16:00 – 16:30

Keysight: 5G-Wireless: A Measurement and Metrology Perspective

Presenter: Roger Nichols, Keysight

The visions of what our work on the fifth generation of mobile wireless communications (5G) will provide continue to be repeated and occasionally refined. This relentless progress of technology, bound and stretched by policy and business models, makes the news, but how will we make sure it works the way we expect and envision? This paper and presentation

PODIUM INDUSTRIAL PRESENTATIONS (PIP)

For further details, visit <http://icc2015.ieee-icc.org/content/presentations-podium>

will explore how test and measurement companies like Keysight are approaching this next generation, some of the tools and solutions that the research and development community can expect now and some of the challenges we have to overcome in test and metrology in the coming years. This will include system and component modeling, simulation, and design as well as new measurement demands related to the air-interfaces and network interfaces envisioned for 5G.

Thursday, 11 June 2015 • 10:30 – 11:00

Nokia: Looking Ahead to 5G

Presenter: Amitabha Ghosh, Nokia

Wireless data traffic is projected to skyrocket more than 10,000 fold beyond 2020 due to increased usage of smart-phones, tablets, new wireless devices and IoT. The 5G research is just starting and the industry have a preliminary view of the key requirements of a new technology generation.

In this talk, we will present an overview of 5G technology with emphasis on 5G requirements, spectrum considerations, propagation and channel modeling, air-interface and multi-antenna design. We will also briefly discuss the standards and commercialization timeline of next generation wireless systems. Finally, we conclude with the vision that 5G technology will provide a scalable service experience everywhere and anytime where people and machines will enjoy virtual zero latency gigabit experience when and where it matters.

Thursday, 11 June 2015 • 13:00 – 13:30

Solid Inc: How does DAS Resolve in-building Mobile Coverage Challenges?

Presenter: James Kim, Solid Inc

What is DAS? General Market demand for in-building mobile coverage (by Segmentation of the building), customer. The positioning of the DAS among various in-building solutions (comparing to RRH, Femto/Metrocell, Repeater, Pico-cell etc.).

Thursday, 11 June 2015 • 13:30 – 14:00

P.I. Works: Next Generation Centralised SON

Presenter: Michael Motta, P.I. Works

P.I. Works will present their Next Generation Optimization Solution powered by Centralized SON. P.I. Works is changing the SON space with the world's first closed-loop C-SON deployed for LTE. The SON will be introduced to improve the efficiency of 3G and 4G assets, and improve the Mobile experience.

Thursday, 11 June 2015 • 14:00 – 14:30

Nutaq: Reducing the Complexity and Cost of Next Gen Massive MIMO Systems

Presenter: Jean-Benoit Larouche, Nutaq

Massive MIMO is a cornerstone technology in reaching the 5G target of a thousandfold capacity increase by 2020. The paradigm is based on the fact that if there are enough antennas at the base station (several hundreds to a thousand or more), the so-called massive effect is observed whereby simple linear processing (eigenbeamforming and maximal-ratio combining) becomes optimal. This is attractive because such processing is not only extremely simple, it scales linearly with the size of the array and requires very little inter-processor communication. However, while antennas are not in themselves costly, such very large arrays with hundreds or thousands of RF front-ends, A/D and D/A converters are cumbersome and energy-hungry, to say the least. It is therefore of interest to explore the quasi-massive case, where the number of antennas is not sufficient to achieve the massive effect, but still large enough to make full-fledged interference nulling processing — such as minimum mean-square error (MMSE) and zero forcing (ZF) — undesirable because their complexity scales in polynomial fashion, according to the cube of the number of antennas. We show here that applying MMSE or ZF on subsets of antennas and further combining the resulting outputs in a second layer of processing constitutes an attractive approach to achieve good performance with reduced numbers of antennas, while limiting complexity. Furthermore, this approach maps extremely well to the TitanMIMO modular architecture where remote radio head (RRH) units of 8 antennas, each equipped with local baseband processing capability, are aggregated together to form massive MIMO prototyping platforms of various sizes.

DEMONSTRATIONS

For further details, visit <http://icc2015.ieee-icc.org/content/demos>

Tuesday, 9 June – Thursday, 11 June 2015

Nokia: 5G Demo

Location: Nokia Booth

Huawei: 5G Demo

Location: Huawei Booth

Keysight Technologies: 5G mmWave MIMO Channel Sounding Demo

Location: Keysight Technologies Booth

InterDigital: oneTRANSPORT: oneM2M in Action

Location: InterDigital Booth

GenBand Demo 1: WiFi Data Offloading Demo 2: NFV and Cloud

Location: GenBand Booth

Anritsu: M2M Connected Vehicle Simulation

Location: Anritsu Booth

Digile: Finnish Internet of Things Demo

Location: Digile Booth

P.I. Works: SON Demo

Location: P. I. Works Booth

Nutaq: Sub 6 GHz MIMO Demo

Location: Nutaq Booth

National Instruments Demo

Location: National Instruments Booth
(Wednesday, 10 June • 14:00 – 17:00)

TECHNICAL SYMPOSIA

For further details, visit <http://icc2015.ieee-icc.org/content/symposia>

The Technical Symposia will feature 1,285 peer-reviewed papers on current research and development organized into the following 12 Symposia consisting of 69 oral and interactive sessions.

AHSN:	Ad Hoc and Sensor Networking Symposium	SAC02-DSCC:	Data Storage and Cloud Computing Track
CISS:	Communication and Information Systems Security Symposium	SAC03-CEH:	Communications for E-Health Track
CQRM:	Communications QoS, Reliability and Modeling Symposium	SAC04-IT:	Internet of Things Track
CRN:	Cognitive Radio and Networks Symposium	SAC05-CSG:	Communications for the Smart Grid Track
CSSMA:	Communications Software, Services and Multimedia Applications Symposium	SAC06-SSC:	Satellite and Space Communications Track
CTS:	Communication Theory Symposium	SAC07-ANS:	Access Network System Track
MWN:	Mobile and Wireless Networking Symposium	SAC08-NMQN:	Nanoscale, Molecular and Quantum Networking Track
NGN:	Next Generation Networking Symposium	SAC09-SN:	Social Networking Track
ONS:	Optical Networks and Systems Symposium	SAC10-MWC:	Millimeter-wave Communications Track
SAC01-GC:	Green Communications Track	SPC:	Signal Processing for Communications Symposium
		WC:	Wireless Communications Symposium

Tuesday, 9 June 2015

09:00 – 10:30 • Technical Sessions

AHSN-01: Physical Layer Design
AHSN-02: Scheduling
CISS-01: Big Data Security and Privacy
CQRM-01: SDN and Virtualization
CRN-01: Spectrum Sensing I
CSSMA-01: Adaptive Video Streaming
CTS-01: Fundamentals and Optimization of Cellular Networks
MWN-01: D2D Communications
MWN-02: Machine to Machine Communications
NGN-01: Future Internet and Next-generation Networking Architectures I
ONS-01: Optical Access Networks
SAC01-GC-01: Energy Efficient Heterogeneous Wireless Systems
SPC-01: Compressed Sensing
WC-01: Cognitive Radio
WC-02: Massive MIMO
WC-03: Small Cells and Heterogeneous Networks
WC-04: Cooperative Networks and Relaying

09:00 – 09:45 • Interactive Sessions

MWN-I01: Security, Privacy and Trust
NGN-I01: Software Defined Networking
SAC10-MWC-I01: Signal Processing for Millimeter-wave
SAC03-CEH-I01 Communications
SPC-I01: Massive MIMO

09:45 – 10:30 • Interactive Sessions

MWN-I02: Game Theory
NGN-I02: QoS and QoE in Next-generation Networks
SAC10-MWC-I02: Millimeter-wave Networking
SPC-I02: Localization

14:30 – 16:00 • Technical Sessions

AHSN-03: Security and Privacy
CISS-02: Firewall, Intrusion Detection and Other Topics
CRN-02: Spectrum Sensing II
CSSMA-02: Engineering the Media Cloud Services
CTS-02: Channel Capacity
MWN-03: Multimedia Communications
MWN-04: LTE Networks I
MWN-05: LTE Networks II
NGN-02: Future Internet and Next-generation Networking Architectures II
NGN-03: Energy-efficient Green Communications
SAC02-DSCC-01: Data Storage I
SAC04-IT-01: Security and Privacy in IoT
SAC07-ANS-01: Copper DSL Access and PLC Home Networks
SPC-02: Multiuser Communications
WC-05: WLAN
WC-06: Massive MIMO
WC-07: Cooperative Networks and Relaying

14:30 – 15:15 • Interactive Sessions

AHSN-I01: Delay Tolerant Networks and Opportunistic Networking
CQRM-I01: Networks and Demands
CTS-I01: Coding Theory
WC-I01: Interference Management and Resource Allocation

15:15 – 16:00 • Interactive Sessions

AHSN-I02: Wireless Network Applications
CTS-I02: Estimation and Detection
SAC01-GC-I01: Energy Efficient Wireless Systems II
WC-I02: Massive MIMO

16:30 – 18:00 • Technical Sessions

AHSN-04: Topology Control and Management
CQRM-02: Resources Management
CRN-03: Cognitive Radio Networks
CTS-03: Interference Management and Power Control
CTS-04: Physical-Layer Security
MWN-06: Energy Efficiency
MWN-07: Mobile Social Networks
NGN-04: Internet of Things
ONS-02: Optical Wireless
SAC01-GC-02: Energy Harvesting
SAC05-CSG-01: Powerline Communication Channel Characterization and Noise Mitigation
SAC08-NMQN-01: Nanoscale, Molecular and Quantum Networking: Communication- and Information-theoretic Aspects
SPC-03: Green Communications
WC-08: Distributed Antenna System
WC-09: Massive MIMO
WC-10: Cooperative Networks and Relaying

16:30 – 17:15 • Interactive Sessions

CISS-I01: Operating Systems and Application Security
MWN-I03: Localization
SAC04-IT-I01: CrowdSensing and Mobile IoT Solutions
WC-I03: Small Cells and Heterogeneous Networks

17:15 – 18:00 • Interactive Sessions

CISS-I02: Network Security Metrics and their Performance Evaluation
MWN-I04: Wireless Relay Networks
SAC04-IT-I02: MAC Optimizations and Deterministic IoT
WC-I04: MIMO

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CSSMA:	Communications Software, Services and Multimedia Applications Symposium	SAC06-SSC:	Satellite and Space Communications Track
CTS:	Communication Theory Symposium	SAC07-ANS:	Access Network System Track
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ONS:	Optical Networks and Systems Symposium	SAC10-MWC:	Millimeter-wave Communications Track
SAC01-GC:	Green Communications Track	SPC:	Signal Processing for Communications Symposium
		WC:	Wireless Communications Symposium

Wednesday, 10 June 2015

09:00 – 10:30 • Technical Sessions

AHSN-05: Resource Management I
CISS-03: Security of Cyber-physical Systems
CQRM-03: Energy Efficiency
CSSMA-03: HTTP Video Streaming
CTS-05: Network Information Theory
MWN-08: Cellular Networks I
MWN-09: Cellular Networks II
NGN-05: Cloud-based Networking I
ONS-03: Free Space Optics
SAC01-GC-03: Cloud and Core Energy Efficiency
SAC02-DSCC-02: Cloud Computing I: Network Modeling and Service
SAC06-SSC-01: Satellite Networking
SAC10-MWC-01: Advanced Spatial Diversity in Millimeter-wave Communications
SPC-04: Channel Estimation and Synchronization
WC-11: Full Duplex
WC-12: Massive MIMO
WC-13: Cooperative Networks and Relaying

09:00 – 09:45 • Interactive Sessions

AHSN-103: Performance Evaluation II
CRN-101: Spectral Whitespaces, Auctions and Leasing
SPC-103: MISO Communications
WC-105: Massive MIMO

09:45 – 10:30 • Interactive Sessions

AHSN-104: Resource Management II
CRN-102: Emerging Topics on Cognitive Radio
MWN-105: Routing in Wireless Networks
WC-106: Network Coding

14:30 – 16:00 • Technical Sessions

AHSN-06: Performance Evaluation I
CISS-04: Mobile and Wireless Network Security
CQRM-04: Heterogeneous Networks
CRN-04: Spectral Sharing
CSSMA-04: Service Traffic Engineering
CTS-06: Energy Constrained Communications
MWN-10: Small Cell and HetNet I
MWN-11: Small Cell and HetNet II
NGN-06: Cloud-based Networking II
SAC03-CEH-01: e-Health I
SAC04-IT-02: IPv6 and IoT Network Protocols
SAC09-SN-01: Security, Trust and Profiling in Social Networks
SPC-05: OFDM, FBMC and GFDM
WC-14: Device-to-Device Communications
WC-15: MIMO
WC-16: Small Cells and Heterogeneous Networks
WC-17: Cooperative Networks and Relaying

14:30 – 15:15 • Interactive Sessions

CTS-103: Performance Analysis Techniques
MWN-106: Wireless Scheduling
ONS-101: General I
SAC02-DSCC-101: Cloud Computing III

15:15 – 16:00 • Interactive Sessions

CTS-104: PHY-Layer Advances in Communications I
MWN-107: Sensor Networks
ONS-102: General II
SAC02-DSCC-102: Cloud Computing and Data Storage

16:30 – 18:00 • Technical Sessions

AHSN-07: Mobile and Vehicular Ad Hoc Networks
CISS-05: Security and Privacy of VANETs and Sensor Networks
CTS-07: MIMO and Massive MIMO
MWN-12: Modeling and Performance Analysis I
MWN-13: Modeling and Performance Analysis II
MWN-14: Vehicular Networks
NGN-07: Content-based Networking I
SAC01-GC-04: Wireless and Renewable Powered Systems
SAC02-DSCC-03: Data Storage II
SAC07-ANS-02: PON and Wireless Fronthaul in Access
SAC08-NMQN-02: Nanoscale, Molecular and Quantum Networking: Applications, Implementations and Experiments
SPC-06: Spectrum Sensing and Interference
WC-18: Mobile and Cellular Networks
WC-19: MIMO
WC-20: Cooperative Networks and Relaying

16:30 – 17:15 • Interactive Sessions

CQRM-102: Patterns and Protections
NGN-103: Traffic Engineering
SAC09-SN-101: Data Discovery and Applications in Social Networks
WC-107: MIMO

17:15 – 18:00 • Interactive Sessions

CQRM-103: Data Center Control and Modeling
NGN-104: Next-generation Access Networking
SAC06-SSC-101: Satellite Communications and Networking
WC-108: MIMO

TECHNICAL SYMPOSIA

For further details, visit <http://icc2015.ieee-icc.org/content/symposia>

The Technical Symposia will feature 1,285 peer-reviewed papers on current research and development organized into the following 12 Symposia consisting of 69 oral and interactive sessions.

AHSN:	Ad Hoc and Sensor Networking Symposium	SAC02-DSCC:	Data Storage and Cloud Computing Track
CISS:	Communication and Information Systems Security Symposium	SAC03-CEH:	Communications for E-Health Track
CQRM:	Communications QoS, Reliability and Modeling Symposium	SAC04-IT:	Internet of Things Track
CRN:	Cognitive Radio and Networks Symposium	SAC05-CSG:	Communications for the Smart Grid Track
CSSMA:	Communications Software, Services and Multimedia Applications Symposium	SAC06-SSC:	Satellite and Space Communications Track
CTS:	Communication Theory Symposium	SAC07-ANS:	Access Network System Track
MWN:	Mobile and Wireless Networking Symposium	SAC08-NMQN:	Nanoscale, Molecular and Quantum Networking Track
NGN:	Next Generation Networking Symposium	SAC09-SN:	Social Networking Track
ONS:	Optical Networks and Systems Symposium	SAC10-MWC:	Millimeter-wave Communications Track
SAC01-GC:	Green Communications Track	SPC:	Signal Processing for Communications Symposium
		WC:	Wireless Communications Symposium

Thursday, 11 June 2015

09:00 – 10:30 • Technical Sessions

AHSN-08: Localization, Tracking and Mobility I
CISS-06: Privacy and Privacy Enhancing Technologies
CQRM-05: Loss, Latency, and Demand
CRN-05: Cognitive Radio Optimization
CSSMA-05: Wireless Multimedia
CTS-08: Cooperative and Relay Communications
MWN-15: Wireless Mesh Networks
MWN-16: Cognitive Radio Networks
NGN-08: Content-based Networking II
ONS-04: Elastic Optical Networks
SAC04-IT-03: IoT Applications and Energy Optimization
SAC06-SSC-02: Satellite Communications
SAC10-MWC-02: Experimental Demonstrations of Millimeter-wave Systems
SPC-07: Detection and Decoding
WC-21: Millimeter Wave Communications
WC-22: Interference Management and Resource Allocation
WC-23: Cooperative Networks and Relaying

09:00 – 09:45 • Interactive Sessions

AHSN-105: Localization, Tracking and Mobility II
CISS-103: Physical Layer Security
SPC-104: Networks and Network Processing
WC-109: Device-to-Device Communications

09:45 – 10:30 • Interactive Sessions

NGN-105: Network Service and Resource Management
SAC05-CSG-101: Storage, EV Charging and Energy Management for Smart Grid
SPC-105: Selected Topics in Signal Processing for Communications
WC-110: Cooperative Networks and Relaying

14:30 – 16:00 • Technical Sessions

AHSN-09: Sensing and Recovery
AHSN-10: Distributed Algorithms
CISS-07: Cryptography and Evaluation
CQRM-06: Performance Analysis
CSSMA-06: Multimedia Traffic and Quality Modeling
CTS-09: Source and Channel Coding
MWN-17: Mobile Network Applications I
MWN-18: Mobile Network Applications II
NGN-09: Content-based Networking III
ONS-05: Next Generation Optical Networks
SAC01-GC-05: Energy Efficient Wireless Systems I
SAC05-CSG-02: Privacy, Security and Performance Enhancements in Smart Grid Communication Networks
SAC09-SN-02: Modeling and Structure of Social Networks
SPC-08: MIMO Communications I
WC-24: Detection and Estimation
WC-25: Interference Management and Resource Allocation
WC-26: Multiple Access

14:30 – 15:15 • Interactive Sessions

CTS-105: PHY-Layer Advances in Communications II
MWN-108: Delay Tolerant Networks
SAC06-SSC-101: Satellite Communications and Networking
SAC08-NMQN-101: Nanoscale, Molecular and Quantum Networking: Models and Algorithms
WC-111: Detection and Estimation

15:15 – 16:00 • Interactive Sessions

CTS-106: Network-Layer Advances for Communications
MWN-109: Resource Allocations
WC-112: Detection and Estimation

16:30 – 18:00 • Technical Sessions

AHSN-11: Energy-Efficient Networks
CISS-08: Cloud and Large-scale System Security
CQRM-07: Demand and Scheduling
CRN-06: Cognitive Radio Resource Allocation
CTS-10: Network Coding
MWN-19: 5G Networks I
MWN-20: 5G Networks II
NGN-10: Next-generation Network Management and Control
NGN-11: Next-generation Flow Management
SAC02DSCC-04: Cloud Computing II: Algorithms and Optimization
SPC-09: MIMO Communications II
WC-27: Detection and Estimation
WC-28: Interference Management and Resource Allocation
WC-29: Small Cells and Heterogeneous Networks
WC-30: Multiple Access

16:30 – 17:15 • Interactive Sessions

CSSMA-101: P2P and Opportunistic Communications
SAC01-GC-102: Energy Efficient Communications I
SAC07-ANS-101: Access Networks and Systems
WC-113: Multiple Access

17:15 – 18:00 • Interactive Sessions

CSSMA-102: Multimedia Applications and Security
MWN-110: Mobility Management
SAC01-GC-103: Energy Efficient Communications II
SAC03-CEH-101: e-Health II

Monday, 8 June 2015 • 09:00 – 12:30

T-01: 5G Evolution and Candidate Technologies

Presenter: Rath Vannithamby (Intel Labs, USA)

The objective of this tutorial is to provide a comprehensive guide on the emerging trends in mobile applications, and the challenges of supporting such applications with 4G technologies. We will describe requirements for 5G systems on data rate, capacity, latency, power, etc., and explore candidate technologies currently being considered to meet 5G requirements. We will differentiate between the natural extension and enhancements of 4G technologies, and the technologies that are fundamentally different from the 4G technologies.

Monday, 8 June 2015 • 09:00 – 12:30

T-02: Massive MIMO for 5G: Fundamentals and Recent Theory

Presenters: Erik G. Larsson and **Emil Björnson** (Linköping University, Sweden)

The next generation wireless networks need to accommodate 1000x more data traffic than contemporary networks. Since the spectrum is scarce in bands suitable for coverage, the main improvements need to come from spatial reuse of spectrum; many concurrent transmissions per area unit. This is achieved by massive MIMO technology, where the access points are equipped with hundreds of antennas. These antennas are phase-synchronized and can thus radiate the data signals to multiple users such that each signal only adds up coherently at its intended user. In recent years, massive MIMO has gone from a theoretical concept to one of the most promising 5G-enabling technologies, because it can achieve 5G-like throughput by upgrading existing sites—instead of installing orders of magnitude more access points. This tutorial introduces the basic communication theory and motivation behind massive MIMO, as well as recent theoretical results on power control, energy efficiency, and impact of hardware impairments.

Monday, 8 June 2015 • 09:00 – 12:30

T-03: Greening Cloud Networks

Presenter: Jaafar Elmirghani, (University of Leeds, UK)

In this tutorial we will introduce and discuss a number of measures that can be used to reduce the power consumption of cloud networks. We will introduce network optimization through the use of mixed integer linear programming (MILP) giving a short tutorial on MILP and build on this and heuristics inspired by it to explore a number of energy and carbon footprint reduction measures including (i) Optimum use of time varying renewable energy in cloud networks (ii) Physical topology design considering operational and embodied energies (iii) Elastic optical networks using mixed line rates and optical OFDM, (iv) Optimum resource allocation and green network design with data centres (v) Dynamic energy-efficient content caching (vi) Energy-efficiency through data compression (vii) Energy-efficient peer-to-peer content distribution (viii) Energy-efficient distributed clouds (ix) Energy-efficient network virtualisation.

Monday, 8 June 2015 • 09:00 – 12:30

T-04: Dedicated Short Range Vehicular Communications: Overview, Technical Challenges and Applications

Presenters: John B. Kenney and **Gaurav Bansal** (Toyota InfoTechnology Center, USA)

This tutorial covers a critical emerging field, vehicular communication based on Dedicated Short Range Communications (DSRC). DSRC is in the early stages of deployment around the world, enabling a set of

e-Health II compelling vehicle safety, mobility, and automated driving applications. We explain the DSRC protocol stack, collision avoidance applications, and technical challenges. We discuss large-scale field tests in the US, Europe, and Japan. We then focus on a specific research problem: DSRC Channel Congestion, examining the merits of various congestion control approaches. As a case study we present our research on adaptive congestion control, which is under consideration for standardization in the US and Europe. We end the tutorial with a discussion of the role DSRC can play in support of automated vehicles. The primary goal of the tutorial is to empower the attendee to participate in this important emerging technology, whether as a researcher, a e-Health II developer, or a planner.

Monday, 8 June 2015 • 09:00 – 12:30

T-05: Device-centric Cooperative Wireless Networks: Theory and Applications in 5G and Beyond

Presenters: David Gesbert (EURECOM, France) and **Paul de Kerret** (Télécom Bretagne, France)

When suitably exploited, direct communications between devices can enable a powerful collective intelligence among user terminals, allowing them to cooperate effectively. Because device cooperation is carried out on the basis of partial and noisy channel state measurements, a framework for robust decentralized decision making is essential. We will start by showing how fundamental limitations of cellular networks can be addressed via device-centric cooperation. This includes wide ranging issues such as interference management, spectrum allocation, coordinated multipoint transmissions, MIMO feedback design. In a second part, we give an introduction to the general fields of coordination and team decision theories. In a third part, we review practical applications of device-centric cooperation to the problem of wireless network optimization. Considering the most common and practically relevant scenarios, we show how the obstacles initially formulated can be overcome. Practical gains for the performance of wireless networks are illustrated.

Monday, 8 June 2015 • 14:30 – 18:00

T-06: Energy Harvesting and Energy Cooperation in Wireless Communications

Presenters: Sennur Ulukus (University of Maryland, USA) and **Aylin Yener** (Penn State University, USA)

Wireless communication networks composed of devices that can harvest energy from nature represent the green future of wireless. Energy harvesting technologies offer the possibility of perpetual operation and no adverse effects on the environment. Energy harvesting brings new dimensions to communication system design in the form of randomness and intermittency of available energy, as well as additional system issues to be concerned about such as energy storage capacity and processing complexity. In addition, energy cooperation, through wireless energy transfer, enables controlled and optimized energy harvesting from man-made resources. The goal of this tutorial is to furnish the audience with fundamental design principles of energy harvesting wireless communication networks with energy cooperation, building on foundations of energy efficient communications and these new ingredients that provide design insights specific to this emerging topic. The focus will be on physical and medium access layers incorporating the state of the research in this topic.

Monday, 8 June 2015 • 14:30 – 18:00

T-07: Massive MIMO for 5G: From Theory to Practice

Presenters: **Fredrik Tufvesson** (Lund University, Sweden)
Andre Bourdoux (IMEC, Belgium)

The next generation wireless networks need to accommodate 1000x more data traffic than contemporary networks. Since the spectrum is scarce in bands suitable for coverage, the main improvements need to come from spatial reuse of spectrum; many concurrent transmissions per area unit. This is achieved by massive MIMO technology, where the access points are equipped with hundreds of antennas. These antennas are phase-synchronized and can thus radiate the data signals to multiple users such that each signal only adds up coherently at its intended user. In recent years, massive MIMO has gone from a theoretical concept to one of the most promising 5G-enabling technologies. This tutorial covers practical aspects of massive MIMO implementation. For example, channel properties in a massive MIMO perspective, implementation of signal processing algorithms for massive MIMO, test bed implementation issues, influence of hardware impairments.

Monday, 8 June 2015 • 14:30 – 18:00

T-08: Output Feedback in Wireless Networks

Presenters: **Samir M. Perlaza** (INRIA, France)
Ravi Tandon (Virginia Tech, USA)
H. Vincent Poor, (Princeton University, USA)

This tutorial aims to familiarize the attendees with a new role of channel-output feedback (COF) in wireless networks: harnessing interference as side information. Using tools from game theory, information theory and signal processing, the relevance of COF is highlighted via several insightful examples. The first part introduces the technique and presents some of the benefits of COF in interference networks using typical scenarios from 5G. The second part is dedicated to revisiting the theory behind channel-output feedback. Starting with Shannon's contributions to point-to-point communications, more recent results in centralized multi-user scenarios are described. The third part focuses on decentralized networks. The notions of network stability and equilibrium regions are respectively introduced as analogous concepts of achievability and capacity regions in centralized networks. The tutorial is concluded by a discussion of the main engineering challenges of implementing COF in both centralized and decentralized wireless networks.

Monday, 8 June 2015 • 14:30 – 18:00

T-09: Communication Architectures and Networking for Electric Vehicles in the Smart Grid

Presenters: **Hussein Mouftah** (University of Ottawa, Canada)
Melike Erol-Kantarci (Clarkson University, USA)

Worldwide electric vehicle sales are expected to be over 3.5 million annually by 2020 according to a Forbes forecast. The volume of electric vehicle charging load is expected to be correlated with peak electricity usage which will dramatically impact the stability of the already stressed power grid. A large number of recent studies have addressed the uncontrolled charging problem and came up with novel architectures, models and networks that allow controlling the heavy PEV loads. Meanwhile, electric vehicle batteries can be considered as Distributed Energy Resources (DERs) once several batteries are controlled as one by an aggregator. In this tutorial, we will first provide a comprehensive background on electric vehicles, batteries, electric vehicle supply equipment types, charging properties, in addition to fundamentals of operation of the generation, transmission and distribution in the smart grid. Utility operators, telecom operators, electric vehicle OEMs, electric vehicle service providers, university professors, researchers and students are among the target audience of this tutorial.

Monday, 8 June 2015 • 14:30 – 18:00

T-10: Towards Spectrum Efficient, Energy Efficient and QoE Aware 5G Wireless Systems

Presenter: **Rose Qingyang Hu** (Utah State University, USA)

The recent surge of mobile traffic is stressing the mobile and wireless network infrastructure. The fast growing data traffic and dramatic expansion of network infrastructures will also inevitably trigger tremendous escalation of energy consumption in wireless networks. The exponential growth of video traffic will undoubtedly have a significant impact on the energy and bandwidth consumption of future wireless infrastructure, greatly challenging their ability to deliver the users' expected QoS and QoE. In this tutorial, we will present an ultra-dense, highly heterogeneous 5G wireless communication system with coexistence of overlay and underlay deployments. We will survey the state-of-the-art research activities on spectrum efficiency (SE), energy efficiency (EE) and QoE based mobile association, radio resource management, multi-layer interference management and power control, network wide cooperation and dynamic resource allocation. Moreover, we will consider QoS/QoE as one of the design objectives together with SE and EE, to characterize the design tradeoffs.

Friday, 12 June 2015 • 09:00 – 12:30pm

T-11: Towards 5G: Carrier-Grade Programmable Virtual Mobile Networks

Presenter: **Tarik Taleb** (Aalto University, Finland)

This tutorial will be shedding light on carrier grade virtual mobile networks, an important vision towards the realization of 5G mobile systems. The tutorial will commence with a brief introduction of major 3GPP wireless technologies, comparing among the different relevant architectures and their evolution to the nowadays' Evolved Packet System (EPS). The tutorial will subsequently lay emphasis on the functional and technical requirements of 5G mobile systems and discuss relevant opportunities, challenges, and expectations. The tutorial will be afterwards touching upon cloud computing technologies, virtualization techniques, and software defined networking (SDN), focusing on the use-case of these technologies in the context of carrier-grade programmable virtual mobile networks. The tutorial will also cover the concept of network function virtualization (NFV), showcasing NFV and SDN as key technology enablers for 5G. The tutorial will be then describing, using concrete examples, how cloud-based virtual mobile networks can be instantiated and orchestrated.

Friday, 12 June 2015 • 09:00 – 12:30pm

T-12: Network Coding: From Theory to Practice

Presenters: **Muriel Medard** (MIT, USA)
Frank Fitzek (TU Dresden, Germany)

The tutorial provides an introduction to the rapidly growing research area of network coding. Network coding allows intermediate nodes in a network to manipulate data, for example by sending out packets that are combinations of previously received packets instead of simply forwarding them. The initial theoretical results on network coding are followed by a wealth of applications in a number of different areas, covering transport and storage, which show that the theoretical insights can be translated into practical gains.

Friday, 12 June 2015 • 09:00 – 12:30pm

T-13: Emerging Concepts and Technologies toward 5G Wireless Networks

Presenter: Halim Yanikomeroglu (Carleton University, Canada)

Despite the recent advances in wireless technologies, the wireless community faces the challenge of enabling a further traffic increase of around 1,000 times, latency reduction of around 100 times, device increase of around 100 times in the next 15 years or so, while no customer is willing to pay more for the wireless pipe itself: the so called "traffic-revenue decoupling". Moreover, many experts warn that the low-hanging fruit in wireless research (especially in information theory, communications theory, and signal processing) have already been collected. While the research community is full of ideas (as usual), many of these ideas are either not-too-relevant (i.e., not in the bottleneck areas) or they are in areas in which progress toward a tangible implementation is too slow.

Friday, 12 June 2015 • 09:00 – 12:30pm

T-14: Resource Allocation for Full-Duplex Communication and Networks

Presenters: Lingyang Song (Peking University, China)
Zhu Han (University of Houston, USA)

The recent significant progress in realizing full-duplex (FD) systems has opened up another promising avenue for increasing the capacity of future wireless networks. There is an urgent need to address the diverse set of challenges regarding different aspects of FD network design, theory, and development. In addition to the self-interference cancellation signal processing algorithms, network protocols such as resource management are also essential in the practical design and implementation of FD wireless networks. This tutorial aims to present the latest development and future directions of resource allocation in different full duplex systems by exploring the network resources in different domains, including power, space, frequency, and device dimensions. Four representative application scenarios are considered: FD MIMO networks, FD cooperative networks, FD OFDMA cellular networks, and FD heterogeneous networks. Resource management problems and novel algorithms in these systems are presented, and key open research directions are discussed.

Friday, 12 June 2015 • 09:00 – 12:30pm

T-15: Optical Wireless Communications

Presenters: Maite Brandt-Pearce (University of Virginia, USA)
Zhengyuan Xu (University of Science and Technology of China, China)
Steve Hranilovic (McMaster University, Canada)

As the radio frequency spectrum congests, the optical medium provides an attractive alternative, supplying ample and easily-reusable spectral resources. Optical wireless communications that use light to carry information through a tetherless channel can offer Gbps connectivity to wireless users. This tutorial covers the essential characteristics of optical wireless systems to provide communications engineers the ability to work within this exciting field. State-of-the-art system design, performance, and applications are described.

Friday, 12 June 2015 • 14:30 – 18:00

T-16: The Path towards 5G: Essential Technologies, Protocols and Tools for Enabling 5G Mobile Communications

Presenters: Marco Di Renzo
(French National Center for Scientific Research, France)
Christos Verikoukis
(Telecommunications Technological Centre of Catalonia, Spain)
Erik G. Larsson (Linköping University, Sweden)
Eduard Jorswieck (TU Dresden, Germany)
Cheng-Xiang Wang (Heriot-Watt University, UK)

The fifth-generation (5G) is coming. Quo vadis 5G? What architectures, network topologies and technologies will define 5G? Are methodologies to the analysis, design and optimization of current cellular networks still applicable to 5G? The proposed tutorial is intended to offer a comprehensive and in depth crash course to communication professionals and academics. It is aimed to critically illustrate and discuss essential and enabling transmission technologies, communication protocols and architectures that are expected to make 5G mobile communications a reality. This includes: massive MIMO, mmWave channel modeling and communications, smart protocol and decoupled uplink/downlink access, heterogeneous cellular networks, game theory, optimization theory and stochastic geometry.

Friday, 12 June 2015 • 14:30 – 18:00

T-17: Cloud Radio Access Networks: Principles, Challenges, and Technologies

Presenters: Navid Nikaein and **Raymond Knopp** (EURECOM, France)
Chih-Lin I (China Mobile Research Institute, China)

Cloud radio access network is a novel architecture which can address the cost, energy, and bit rate concerns the mobile operators are facing to support explosive growth in mobile data traffic. Unlike a typical RAN, the C-RAN decouples the baseband unit (BBUs) from the radio units by locating the BBUs at the high performance cloud infrastructure. The key insight is that if the network capacity is limited by the interference and its workload is changing over time and space, then centralizing radio processing can dramatically increase the network capacity through joint and coordinated processing and reduce the overall energy consumption by exploiting load variations.

This tutorial aims at providing a big picture of C-RAN, a well-balanced state-of-the-art research topics and advances, and the role of C-RAN in 5G systems. It is organized in four technical parts covering principles, challenges, key technologies, and proof-of-concept prototypes and field trials in C-RAN.

Friday, 12 June 2015 • 14:30 – 18:00

T-18: Game Theory for Future Wireless Networks: Challenges and Opportunities

Presenters: Walid Saad (Virginia Tech, USA)

Mehdi Bennis (University of Oulu, Finland)

This tutorial will provide an overview on the confluence of seemingly disparate disciplines: game theory, economics, and wireless networking; while presenting the state of the art in this interdisciplinary area. In particular, this tutorial will provide a comprehensive introduction to game theory in its two branches: non-cooperative and cooperative games, as it applies to the design of future wireless networks. We will also discuss new emerging types of games such as matching theory. For each type of games, we present the fundamental components, introduce the key properties, mathematical techniques, solution concepts, and we describe the challenges and methods for applying these games in two emerging fields: (i)- The design and analysis of heterogeneous and cognitive small cell wireless networks and (ii)- the development of innovative wireless security solutions for thwarting key threats such as eavesdropping and jamming. We conclude by shedding light on future opportunities and challenges in this area.

Friday, 12 June 2015 • 14:30 – 18:00

T-19: Wi-Fi Data Offloading

Presenter: Jianwei Huang (Chinese University of Hong Kong, Hong Kong)

With the proliferation of smartphones and tablets, the demand for mobile data has been growing very rapidly, which is pushing the mobile cellular network to its capacity limit. On the other hand, the Wi-Fi technology is uniquely positioned to complement the cellular technology, due to its unlicensed nature and the worldwide adoption at home and work. In particular, Wi-Fi networks can help to offload the traffic from over-stressed cellular networks, reduce network costs and increase user satisfactions. To achieve a seamless integration of cellular and Wi-Fi technologies, however, demands forward-looking policy reforms, effective economic mechanism designs, and innovative technology solutions. This tutorial will provide an overview, both in terms of industry practice and academic research, for understanding of opportunities and challenges of designing future mobile broadband networks with integrated offloading capabilities between cellular and Wi-Fi.

Friday, 12 June 2015 • 14:30 – 18:00

T-20: Android Security

Presenters: Thomas Chen and Jorge Blasco (City University London, UK)

This tutorial provides an essential overview of the Android security architecture that many users may find helpful to understand the strengths and limitations of security protections in their phones. The tutorial will also be useful to researchers to learn about open research issues in the field of smart phone security. The expected audience will have a background of computer science with desirable previous experience in information security or software development. The tutorial includes an overview of the Android OS. The audience is not required to have any previous experience in Android app development or mobile malware.

Monday, 8 June 2015 • 09:00 – 18:00

WS-01: Next Generation Backhaul/Fronthaul Networks (BackNets)

Organizer: Muhammad Zeeshan Shakir (Texas A&M University, Qatar)

There are considerable market interests on the development of smart backhaul/fronthaul solutions for next generation of networks that are an evolution of the existing backhaul technologies, i.e., SDH, ATM, MPLS and Ethernet. One of the main considerations the operators are faced with today is how to migrate existing backhaul/fronthaul network toward a smart backhaul infrastructure suitable for the next generations of cellular technology. The debut edition of IEEE ICC Workshop on Next Generation Backhaul/Fronthaul Networks (BackNets) is anticipated as a collection of outstanding technical research and industrial papers covering research results with wide range of ingredients within the 5G framework. IEEE ICC BackNets 2015 is expected to provide an opportunity for exchanging new ideas and creating new space for innovative concepts in solving the challenging problems of smart backhauling for the excessive traffic and prepare the network for “The Age of the ZetaByte.”

Monday, 8 June 2015 • 09:00 – 18:00

WS-03: Small Cell and 5G Networks (SmallNets)

Organizer: Walid Saad (Wireless@VT, Virginia Tech, USA)

The demand for high-speed wireless access is expected to grow significantly in the foreseeable future. The emergence of new services such as mobile video streaming leads to stringent requirements on the quality-of-service that next generation wireless networks must deliver. This has urged wireless and mobile operators to examine new ways for improving their coverage, boosting their network's capacity, and lowering their expenditures. A promising approach to solving this problem is through network densification via the massive deployment of Small Cell Networks (SCNs). SCNs will enable next-generation networks to provide seamless, high-quality wireless access. Combined with emerging paradigms such as millimeter wave communication, SCNs are expected to lie at the heart of 5G wireless systems. This workshop will bring together academic and industrial researchers in an effort to identify and discuss the major technical challenges and recent results related to small cell and 5G networks.

Monday, 8 June 2015 • 09:00 – 18:00

WS-10: Advances in Software Defined and Context Aware Cognitive Networks (SCAN)

Organizer: Danda B. Rawat (Georgia Southern University, USA)

Future generation wireless systems will require a paradigm shift in how they are networked, organized, configured, optimized, and recovered automatically based on their operating situation. With the emergence of Software Defined Networks (SDN), context awareness and dynamic adaptive services and application are gaining much attention since they allow automatic configuration of devices and their parameters, systems, services, and applications to user's context change. In addition, context awareness, with the help of software defined and cognitive systems, allows customization of operating parameters of devices, users, applications, and networks based on the current context. IEEE SCAN-2015 serves as a forum for researchers from academia, government and industries to exchange ideas, present new results and provide future visions on these topics.

Monday, 8 June 2015 • 09:00 – 18:00

WS-11: Wireless Physical Layer Security (WPLS)

Organizer: Eduard Jorswieck (TU Dresden, Germany)

The emergence of large-scale, dynamic, and decentralized wireless networks imposes new challenges on classical security measures such as cryptography. To this end, researchers have been seeking new solutions to complement cryptography and significantly improve the overall security of wireless communication networks. One of the most promising ideas is to exploit the physical layer characteristics of the wireless channel such as fading or noise, which are traditionally seen as impediments, for improving the security of wireless transmission against passive (e.g., eavesdropping) or active (e.g., jamming) attacks. This emerging security technique, known as physical layer security, has drawn considerable attention in the past few years. This workshop will bring together academic and industrial researchers in an effort to identify and discuss the major technical challenges and recent results related to physical layer security in wireless networks.

Monday, 8 June 2015 • 09:00 – 18:00

WS-14: Device-to-Device Communication for Cellular and Wireless Networks

Organizer: Benoit Pelletier (InterDigital Canada Ltée, Canada)

This workshop will present technical contributions from researchers from academia and industry on Device-to-Device (D2D) communications for Cellular and Wireless Networks. D2D communication is at an early stage of development in LTE-A and is expected to substitute an integral part of future 5G systems, with benefits including ubiquitous computing and communication, traffic offload from cellular networks, improved energy efficiency, extended coverage, peer-to-peer communication supporting public safety communications, social networks, massive M2M, etc. Many issues remain to be addressed before D2D communication is commercialized at mass scale and its benefits fully exploited. The objective of this workshop is to bring together researchers and practitioners to share the most recent technological advances and state-of-the-art results in the field of D2D communications for wireless mobile cellular networks. Papers in this workshop will address topics of physical layer and networking issues under the context of D2D cellular-coordinated and distributed ad-hoc networking approaches, as well as D2D-enabled applications and services.

Monday, 8 June 2015 • 09:00 – 18:00

WS-15: Advances in Network Localization and Navigation (ANLN)

Organizer: Klaus Witrisal (Graz University of Technology, Graz, Austria)

Indoor localization, tracking, and navigation have been gaining relevance due to steadily expanding range of enabling devices and technologies, as well as the necessity for seamless solutions for location-based services. A current trend in the design of indoor localization systems is to use standard, low-cost, and already deployed technologies, including, for example, inertial measurement units, sonar, laser, IR, visual light communications, or radiofrequency signals. All this entails that the latest challenge is not only to design specialized sensors for these tasks but to design and implement methods exploiting the cooperation of the already available technologies. The goal of the workshop is to solicit the development of new positioning algorithms based on short-range wireless communications as well as new position-aware procedures to enhance the efficiency of communication networks. This workshop will bring together academic and industrial researchers to identify and discuss technical challenges and recent results related to short-range positioning.

Monday, 8 June 2015 • 09:00 – 18:00

WS-16: Cooperative and Cognitive Networks (CoCoNet7)

Organizer: Qi Zhang (Aarhus University, Denmark)

The scope of the CoCoNet7 workshop is to bring together a highly qualified group of people with interest in cooperative and cognitive wireless networks. Cooperation has been identified as one of the underlying principles for future wireless communication systems. Cooperation, altruistic or non-altruistic, is the basis to break up the cellular concept and enrich it by multi hop, peer-to-peer, or cloud functionalities. The workshop will highlight the newest trends in this emerging area, complementing it with first practical implementations and demonstrations in this field. New technologies and concepts such as network coding and mobile clouds are the driving forces for cooperative and cognitive networks. Besides the technical insights, the CoCoNet workshop will serve as an active discussing and networking forum for participants. The workshop organises papers for oral presentations and papers which will be presented in poster sessions possibly accompanied with demonstrations or test-beds.

Monday, 8 June 2015 • 09:00 – 18:00

WS-23: 5G & Beyond: Enabling Technologies and Applications

Organizer: Mischa Dohler (King's College London, UK)

To provide a solution towards meeting new and evermore stringent end-user requirements, mobile stakeholders are already preparing the technology roadmap for next generation 5G networks. From the network perspective, 5G should address various spectrum, capacity, management complexity and cost issues. From a user perspective, 5G should significantly transform wireless service experience by enabling a uniform service experience anytime anywhere, and by providing a high level of service quality. Furthermore, from service perspective, 5G should enable delivering new services in a faster time-frame, and through more programmable interfaces. To this end, this workshop cordially invites researchers to share latest research insights and present key and emerging results on the new mobile communications technology enablers, including novel networking protocols, wireless techniques, new hardware designs, and tactile Internet applications. Keynote talks, panel sessions, technical paper and poster presentations describing and challenging recent research results and influencing the direction of future R&D work are presented on the day.

Monday, 8 June 2015 • 09:00 – 18:00

WS-24: Visible Light Communications and Networking (VLCN)

Organizer: Anna Maria Vegni (Roma Tre University, Italy)

The growing international interest in research and development in Visible Light Communications (VLC) has provided novel applications, from smart city scenarios to indoor positioning, and fast downstream internet access.

Moreover, recent advances made in the field of semiconductor sources, such as Light Emitting Diodes (LEDs) in visible light and ultraviolet wavelengths, allowed developing short/medium range optical wireless communications at low power and low cost.

The full-day workshop on Visible Light Communications and Networking (VLCN) aims to bring together researchers and hardware developers from academia and industry, working in the emerging VLCs technology, to present, share and discuss their latest research finding. The workshop plans to include all aspects and open issues of VLCs, from indoor to outdoor scenarios, from atmosphere to ground based applications, underwater and also medical applications, as well as novel modulation, coding and detection techniques for a range of optical spectra.

Monday, 8 June 2015 • 09:00 – 18:00

WS-26: Smart Communication Protocols and Algorithms (SCPA)

Organizer: Jaime Lloret Mauri (Universitat Politècnica València, Spain)

The 4th IEEE International Workshop on Smart Communication Protocols and Algorithms (SCPA 2015) promotes the research on the design, development, analysis and optimization of smart communication protocols or algorithms at any communication layer. Smart communication protocols and algorithms make use of artificial intelligence methods and techniques to communicate the network devices in order to transfer data between them. The organizers of the workshop will introduce technical papers presenting analytical research, simulations, practical results, position papers addressing the pros and cons of specific proposals, and papers addressing the key problems and solutions. The topics suggested for the workshop have been discussed in terms of concepts, state of the art, standards, deployments, implementations, running experiments and applications.

Monday, 8 June 2015 • 09:00 – 13:00

WS-27: Dynamic Social Networks (DySON)

Organizer: Symeon Papavassiliou

(National Technical University of Athens, Greece)

Social cyber-physical and mobile networks have gained considerable interest. They are now well-known as the principal channels for communication, increasing marketing potentials, tools for enabling social research, and policy forums, all of which eventually indicate a more than ever increasing penetration of networks in human lives.

DySON mainly covers the technical aspects of the interplay between social and wireless mobile and other cyber-physical networks, and focuses on original contributions regarding their structure, behavior, and optimization. Emphasis is placed on the interplay between social and mobile wireless networks. DySON, will present the highest quality contributions regarding analysis, control and optimization from the perspective of complex network analysis, promoting the most interesting interdisciplinary and cross-disciplinary analytical methodologies.

DySON is centered both on formal methods, as well as on noteworthy technical contributions of more practical flavor. It will present papers combining knowledge from several fields and addressing the corresponding challenges, while opening new frontiers and opportunities in relevant research.

Friday, 12 June 2015 • 09:00 – 18:00

WS-02: Cognitive Radios and Networks for Spectrum Coexistence of Satellite and Terrestrial Systems (CogRaN-Sat)

Organizer: Daniele Tarchi (University of Bologna, Italy)

Cognitive radio systems pose some of the most important challenges in the ICT world in terms of tackling spectrum scarcity and enabling ubiquitous broadband access. Although their application in terrestrial context has been studied in depth in the last years, their applications in satellite or hybrid satellite/terrestrial environments is still largely unexplored due to technical and regulatory issues. More specifically, in the technical domain, the wide coverage areas enabled through satellite communications limit the flexibility of spatially reusing the spectrum in conjunction with terrestrial systems. Furthermore, from a regulatory perspective, the heterogeneous adoption of terrestrial spectrum directives by national authorities complicates the coexistence of terrestrial deployments with internationally operating satellite systems. In this direction, a holistic techno-regulatory approach is needed in order to set the foundations for engineering and deploying cognitive systems that enable the coexistence of satellite and terrestrial services.

Friday, 12 June 2015 • 09:00 – 18:00

WS-04: Quality of Experience-based Management for Future Internet Applications and Services (QoE-FI)

Organizer: Raimund Schatz

(Telecommunications Research Centre Vienna, Austria)

To enable the rapid and widespread adoption of advanced applications like social TV, immersive environments, mobile gaming, HDTV over mobile, 3D virtual worlds, social networking, and IPTV, the overall service quality as experienced by the end user must be taken into account and maximized during capturing of content, processing, delivery over networks, and presentation on users' terminals. In addition, media processing and consumption in the cloud requires significant attention to timely execution of application-related quality requirements via dynamic resource provisioning and efficiently pipelining of processing tasks. In this dynamically evolving context, network operators are forced to keep their increasingly sophisticated customers happy while remaining profitable, requiring proper optimization and management of the QoE (Quality of Experience) for the products and services offered. With this background, the QoE-FI workshop will bring together researchers from academia and industry to identify, discuss and address technical challenges related to QoE measurement and management.

Friday, 12 June 2015 • 09:00 – 18:00

WS-05: Cloud Computing Systems, Networks, and Applications (CCSNA)

Organizer: Chuan Heng Foh (University of Surrey, UK)

Cloud Computing, as well as Cloud-inspired business models, enable on-demand access to a shared pool of resources, namely computing, storage, networks, services, and applications. As the Cloud infrastructure aims at offering various IT resources as services, requirements of Cloud applications vary based on the resources which are requested as services. Thus, the resources may refer to heavy computation resources, massive storage resources, high-capacity network resources and others. The heterogeneity of cloud applications leads to the challenge of holistic design of a robust Cloud system which can oversee and handle the diverse needs of numerous types of applications. On the other hand, these challenges enforce cooperation of various players in the Cloud system, each of which focuses on a different segment such as network, computing, applications, and systems. This workshop is a venue for scientists, researchers, practitioners and research students to discuss a wide range of technologies related to Cloud Computing.

Friday, 12 June 2015 • 09:00 – 18:00

WS-06: Green Communications and Networks with Energy Harvesting, Smart Grids, and Renewable Energies

Organizer: Woon Hau Chin (Toshiba Research Europe, UK)

The workshop is dedicated to networking, communication theory, information theory, and signal processing aspects of wireless networks composed of devices that are powered by smart grids, energy harvesting, and renewable power sources. Smart grids allow greater flexibility in the energy aware resource allocation for the ICT sector. In green wireless networks, renewable power sources can be used to replenish the energy of wireless network nodes as an alternative to a traditional power source. Renewable power sources and the smart grid open up new exciting possibilities in wireless communication and networking. On the other hand, energy harvesting is a promising technology that can power small devices and can enable smart cities, wide area rural communications, or next generation machine to machine communications. The workshop will serve as a platform for researchers to exchange and propose ideas for these topics.

Friday, 12 June 2015 • 09:00 – 18:00

WS-07: Massive Uncoordinated Access Protocols (MASSAP)

Organizer: Enrico Paolini (University of Bologna, Italy)

Uncoordinated multiple access protocols, such as random access ones, represent a key element of communications systems where a very large population of users, each with sporadic and unpredictable activity, need to transmit over a shared medium. Their role is relevant in delay-critical applications, such as interactive satellite communications, real-time machine-type communication, etc. While traditional uncoordinated access protocols treat collisions as a waste and are designed to avoid them, several innovative developments were recently proposed, such as physical layer network coding and various techniques based on successive interference cancellation, where interference is embraced and creatively utilized. A completely new perspective was thus opened for uncoordinated protocols, paving the way to dramatic performance improvements, and rendering the throughput of random access channels competitive with that of coordinated protocols. These new approaches also created a new conceptual relationship with error correcting codes, thereby opening fundamentally new problems for two rather separated research communities.

Friday, 12 June 2015 • 09:00 – 18:00

WS-08: ICT-enabled Services and Technologies for eHealth and Ambient Assisted Living

Organizer: Sofoklis Kyriazakos (CTIF, Aalborg University, Denmark)

This workshop aims to provide a discussion framework towards enhanced AAL support for seniors with different types of diseases. The workshop will focus on:

- State of the Art, namely the current landscape of AAL initiatives, their innovative approaches and drawbacks.
- Interaction and service design concepts that view AAL systems from a user's perspective.
- Edge technology solutions such as wearable and non-wearable sensors monitoring users' vital signs, domotics systems monitoring critical in-home parameters, notification systems sending relevant data to medical experts or family members, etc.
- Regulatory framework and the role of the National Health System

The workshop will attract experienced professionals and researchers in the field to discuss innovative approaches and pinpoint the current gaps in the field with the goal to contribute to the development of a roadmap for AAL. The workshop will stimulate open discussions and exchange of participants' personal experience and insights.

Friday, 12 June 2015 • 09:00 – 18:00

WS-12: MIMO and Cognitive Radio Technologies in Multihop Network (MIMOCR)

Organizer: Xuemin (Sherman) Shen (University of Waterloo, Canada)

Multiple-input multiple-output (MIMO) and cognitive radio (CR) technologies have gained increasing attention recently. MIMO effectively increases data throughput without using additional radio spectrum, and CR exploits the existing wireless spectrum opportunistically. MIMO and CR effectively address the problem of limited available spectrum. However, the distributed coordination of MIMO and CR functionalities in a multihop ad hoc network remains to be addressed. The non-trivial coupling of ad hoc networks with MIMO and CR will pose new challenges on protocol design and resource management, create exciting new topics in MIMO and CR research pertaining to optimal leveraging of local information, and greatly advance both the networking and communication technology of decentralized architecture. The objective of the workshop is to bring together practitioners and researchers from both academia and industry in order to have a forum for discussion and technical presentations on applying MIMO and CR technologies to ad hoc networks.

Friday, 12 June 2015 • 09:00 – 18:00

WS-13: Advanced PHY and MAC Techniques for Super Dense Wireless Networks

Organizer: Rahim Tafazolli (University of Surrey, UK)

IWSDN is one of the ICC2015 workshops jointly organized by EU FP7 RESCUE project partners, EU FP7 DIWINE project partners, and the UK 5G Innovation Centre (5GIC). This workshop aims to gather researchers, regulators, and users to present and debate advanced PHY and MAC techniques for super dense wireless networks and applications, with the perspective of current cellular, M2M, and V2V standardisation activities in 3GPP, ETSI, IEEE and IETF. IWSDN will be a full-day workshop, which includes two keynotes, technical sessions, posters, as well as workshop panel with a good mixture of participants from the academy and industry. The technical sessions will be mainly focused on the timely topics of physical layer network coding, massive and network MIMO, as well as asynchronous and non-orthogonal multiple access techniques.

Friday, 12 June 2015 • 09:00 – 18:00

WS-18: LTE in Unlicensed Bands: Potentials and Challenges

Organizer: Andrea Goldsmith (Stanford University; Acclera, Inc., USA)

The exponential growth of mobile data traffic and the scarcity and costliness of licensed spectrum are driving mobile network operators to consider offloading at least part of their traffic onto the unlicensed spectrum. Most recently, the 3GPP is considering extending the use of LTE into the unlicensed spectrum as a seamless approach to enable traffic offload. This new approach is dubbed LTE Unlicensed (LTE-U). Compared to Wi-Fi, LTE-U offers MNOs a way to offload traffic onto the unlicensed spectrum with a technology that seamlessly integrates into their existing LTE evolved packet core (EPC). Furthermore, LTE-U promises higher throughput and spectral efficiency than Wi-Fi. However, LTE-U introduces new coexistence challenges for other technologies in the same unlicensed bands particularly for legacy Wi-Fi. The goal of this workshop is to bring together academics, researchers, and practitioners to discuss the opportunities, challenges and potential solutions for operation of LTE in the unlicensed bands.

Friday, 12 June 2015 • 09:00 – 18:00

WS-19: Dependable Vehicular Communications (DVC)

Organizer: Thomas Zemen (Austrian Institute of Technology, Austria)

Wireless vehicular communication systems constitute the backbone of intelligent transportation systems (ITS). Currently, wireless communications inform the human driver. In the future wireless communications will influence the movement of vehicles. Automated driving and driver assistance systems require the exchange of kinematic information in distributed control algorithms with very short latency. Future ITS that network automated vehicles with the goal of zero accidents have the potential to save more than 1 Mio. human lives worldwide every year.

Dependable wireless communications with short-latency, low outage probability, and in non-stationary vehicular communication channels is a challenging task. It involves a multi-disciplinary effort including vehicular channel measurements, characterization and modeling; cooperative communications; and low-latency protocol design. A dependable wireless communication framework will be essential for vehicular ad-hoc networks, device-to-device communication links in future 5G systems, and cyber physical systems in general.

This workshop will bring together academic and industrial researchers to discuss technical challenges and recent results.

Friday, 12 June 2015 • 09:00 – 18:00

WS-21: Heterogeneous Converged Networks

Organizer: Yun Rui (Chinese Academy of Sciences, China)

The telecommunication industry is entering a new era, called 5G which to support 1000 times higher mobile data volume per area, 100 times higher number of connected devices, 5 times reduced E2E latency. We envision that the future wireless networks will be the co-existence of multiple types of deployment scenarios, the co-existence of multiple types of radio access specifications, and the co-existence of a vast variety of services and applications. A looming problem is how to identify a novel network architecture and many essential technology components, to fulfill these requirements. A feasible cost-efficient solution is to integrate several existing network resources, which have been allocated for different services, to form a single heterogeneous converged network. The network integration necessitates a harmonious interaction among heterogeneous networks at different levels, thus requiring a careful design of network architecture, coordination protocols and resource allocation algorithms for the efficient operation of the converged network. This workshop is expected to bring together both academic and industrial researchers to study the major challenges related to heterogeneous converged networks.

Friday, 12 June 2015 • 09:00 – 18:00

WS-22: Security and Privacy for Internet of Things and Cyber-Physical Systems

Organizer: Anastasios A. Economides (University of Macedonia, Greece)

The Internet of Things (IoT) and Cyber-Physical Systems (CPS) will fuel the realization of a new, globally interconnected cyber-world. Yet, the success, prosperity, and advancement of IoT and CPS systems strongly depend on the security, privacy and trust of the interconnected devices, networks and data being exchanged. Successful attacks targeted to IoT/CPS systems not only affect a single device, but also all interconnected systems with severe financial, environmental and health losses. This fact highlights the need to develop novel tools that will constitute the heart of a much-needed science of security for IoT and CPS. The 2015 IoT/CPS-Security workshop will bring together internationally leading academic and industrial researchers in an effort to identify and discuss the major technical challenges and recent results aimed at addressing all aspects of security and privacy for IoT and CPS.

Friday, 12 June 2015 • 09:00 – 18:00

WS-25: Cloud-Processing in Heterogeneous Mobile Communication Networks

Organizer: Dirk Wübben (University of Bremen, Germany)

Heterogeneous radio access networks where macro-cellular networks are complemented by dense small-cell deployments promise to provide exceptionally greater wireless area capacity through an increased spatial utilization of the spectrum. Due to strong inter-cell interference, heterogeneous networks will require a high degree of coordination as offered by centralized processing. The IWCPM workshop explores novel concepts to allow for flexibly centralized radio access networks using cloud-processing based on open IT platforms, and to allow for a high quality of experience for mobile access to cloud-processing resources. This requires new concepts for the design, operation, and optimization of radio access networks, backhaul networks, operation and management algorithms, and architectural elements, tightly integrating mobile networks and cloud-processing. The workshop covers technologies across physical layer, medium access control layer, and network layer, and it will cover technologies which translate the cloud-paradigm to the radio access network and backhaul network. It will study the requirements, constraints, and implications for mobile communication networks.

Friday, 12 June 2015 • 09:00 – 18:00

WS-28: Next Generation Green ICT

Organizer: Martin Jacobsson (Uppsala University, Sweden)

Contributing to a more sustainable planet is urgent from both economical and environmental point of views. With Information and Communication Technologies (ICT) encompassing wireless networks, the Internet of Things (IoT), Cyber Physical Systems (CPS), Wireless Sensor Networks (WSN), Machine-to-Machine Communications (M2M), and cognitive networking, we have the opportunity to develop solutions for energy efficiency as well as creating a more sustainable society. For this to be a viable option, also the ICT technologies must be energy efficient. Another important aspect is broadband access, which is estimated to consume 8% of the globally generated power. Instead of looking at these three problems in silo, we created a venue for researchers and practitioners to come together and interact. This workshop aims to put together the three areas of energy efficient ICT, using ICT for energy efficiency and green broadband access, and to enable interactions between them.

Friday, 12 June 2015 • 09:00 – 13:00

WS-09: Fiber-Wireless Integrated Technologies, Systems and Networks

Organizer: John E. Mitchell (University College London, UK)

The scope of this workshop is to explore the new trends that are emerging in combined fiber-wireless integrated technology for systems and networks. The support of high bandwidth and high mobility is central to the driving vision of the network of the future, but this cannot be at any cost. Increased pressure on the cost/bit, both in terms of the cost of infrastructure (CAPEX) as well as the cost of operations (OPEX), demands high levels of integration in the underlying networks. A large number of technologies will need to converge, co-exist and interoperate, and most importantly, cooperate, if this vision is to be efficiently and cost effectively realized. A key area within this next generation jigsaw is the interplay of optical fiber networks and radio networks, to enable scalable and manageable networks without a highly complex interface structure and multiple overlaid protocols.

Friday, 12 June 2015 • 14:30 – 18:00

WS-20: Radar and Sonar Networks

Organizer: Mathini Sellathurai (Heriot-Watt University, UK)

Radar and sonar are widely used in many areas of defence and communications of land, sea and air but the recent demands from various military, commercial and scientific applications as well as the plethora of interest in furthering radar and sonar research has generated significant attention in the design and analysis of networks of radar and sonar systems. The goal of the workshop is to solicit the most recent developments in radar and sonar systems with particular emphasis on the following communications and signal processing aspects: active routing and localization, modulations and cellular/WiFi concepts, spectrum sensing/power/resource allocation, sparse signal reconstruction and detection performance, target/feature/device tracking, and time-frequency analysis of underwater acoustic sensor networks, SAR and MIMO radar sensor networks. This workshop will bring together multidisciplinary experts from academia, industry and government research organizations to identify and discuss technical challenges and recent results in this area.



Welcome Reception

Monday, 8 June 2015 • 18:30 – 21:00

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The welcome reception with a British flair is your chance to connect with peers, interact with exhibitors while giving the organizing committee's a chance to celebrate your arrival at IEEE ICC 2015. All registrants and their guests are welcome to attend.



Awards Luncheon

Tuesday, 9 June 2015 • 13:00 – 14:30

Join us as we celebrate and honor fellow members of the IEEE Communications Society with a myriad of paper awards for their various contributions to the society. The Awards Luncheon is included in full registrations. Additional tickets are available for purchase via the registration system at a cost of US\$75 per person.



Conference Banquet

Wednesday, 10 June 2015 • 19:00 – 22:30 • Pavilion at the Tower of London

IEEE ICC 2015 welcomes you to an exclusive private evening tour of this unique and intriguing historic monument followed by a summer banquet beside the Tower Walls.

On arrival at the Tower of London you will be greeted by the Yeoman Warders who will guide you through the walkways, past Traitors Gate, The Bloody Tower and the imposing White Tower to the spot where Anne Boleyn and many other nobles were beheaded.

Then a visit to the Jewel House to see the one of the largest diamonds in the world, the Star of Africa amongst other priceless gems in the British Crown Jewels collection.

The tour then ends with a stroll down to the banquet pavilion where a refreshing drink awaits you before a night of good food, entertainment and great memories.

The Banquet is included in full registrations. Additional tickets are available for purchase via the registration system at a cost of US\$200 per person.

REGISTRATION

To register online, visit <http://icc2015.ieee-icc.org/registration>



FULL and LIMITED TECHNICAL PROGRAM REGISTRATION		
	(On/by 8 May)	(After 8 May)
RG-01 – Full IEEE ComSoc Member	US\$ 995	US\$ 1,015
RG-02 – Full IEEE Member ¹	US\$ 1,025	US\$ 1,175
RG-03 – Limited IEEE ComSoc Member	US\$ 750	US\$ 900
RG-04 – Limited IEEE Member ¹	US\$ 775	US\$ 925
RG-05 – Full Non Member ²	US\$ 1340	US\$ 1550
RG-06 – Limited Non Member ²	US\$ 1090	US\$ 1,300
ONE DAY TECHNICAL PROGRAM REGISTRATION		
	(On/by 8 May)	(After 8 May)
RG-07 – 1 Day IEEE ComSoc Member	US\$ 525	US\$ 630
RG-08 – 1 Day IEEE Member	US\$ 550	US\$ 655
RG-09 – 1 Day Non Member	US\$ 760	US\$ 910
OTHER REGISTRATIONS		
	(On/by 8 May)	(After 8 May)
RG-10 – IEEE Life Member	US\$ 50	US\$ 50
RG-11 – IEEE Student Member (FULL TIME STUDENTS ONLY)	US\$ 375	US\$ 450
RG-12 – Student Non-Member	US\$ 450	US\$ 525
RG-13 – Workshops Only (Full day)	US\$ 350	US\$ 450
RG-14 – Workshops Only (Half day)	US\$ 250	US\$ 350
RG-15 – Tutorials Only	US\$ 250	US\$ 350
RG-17 – Industry Forum and Exhibition Access Only	US\$ 400	US\$ 500

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You may register for Tutorials without registering for the conference. Admission to ONE tutorial is included with the Full or Limited Registration.

You may register for Workshops without registering for the conference. Workshops require an additional fee. Workshops are not included in any conference registration category.

Accompanying Companion Spouse / Significant Other

You are allowed to register only one Guest, who will receive a GUEST badge. Your Guest will not be allowed to attend any conference sessions. However, you may purchase Social Event Tickets for your Guest. Guests must not be an author or co-author. ALL GUEST REGISTRATIONS WILL BE VERIFIED FOR EVALUATION.

To register online, visit <http://icc2015.ieee-icc.org/registration>

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Huawei is a leading global ICT solutions provider. Through our dedication to customer-centric innovation and strong partnerships, we have established end-to-end capabilities and strengths across the carrier networks, enterprise, consumer, and cloud computing fields. We are committed to creating maximum value for telecom carriers, enterprises and consumers by providing competitive ICT solutions and services. Our products and solutions have been deployed in over 140 countries, serving more than one third of the world's population.

Huawei's vision is to enrich life through communication. By leveraging our experience and expertise in the ICT sector, we help bridge the digital divide by providing opportunities to enjoy broadband services, regardless of geographic location. Contributing to the sustainable development of society, the economy, and the environment, Huawei creates green solutions that enable customers to reduce power consumption, carbon emissions, and resource costs.

Huawei has over 70,000 product and solution R&D employees, comprising more than 45% of our total workforce worldwide. We have set up 16 R&D centers in countries that include Germany, Sweden, the US, France, Italy, Russia, India, and China. Huawei began investing in 5G in 2009. In December of 2013 Huawei announced to pour \$600m into 5G research over the next five years, ahead of the expected launch of 5G networks in 2020.



NOKIA

5G

How 5G will expand the human possibilities of technology

The future of communications will be very different to that of today. Ever-growing demand for mobile broadband, largely driven by high definition video and better screens, is already giving us a glimpse of the future. And the pace of change will quicken as the things around us become even more profoundly connected. Expect fully automated production processes; super-efficient public infrastructure; remote zero-latency control of machines; and many more exciting prospects to emerge around us.

At IEEE ICC'15 Nokia will showcase the latest 5G advances. We will explain how 5G will fundamentally change the world of communications. We will take you on a journey into the 5G future, with real-life scenarios such as massive broadband that delivers gigabytes of bandwidth on demand; almost limitless Internet of Things connectivity; and ultra-reliable, low latency communications that will take automotive safety to new levels.

Building 5G technology with practical prototypes

Nokia will also show the key technologies for 5G radio design, such as the use of centimeter and millimeter wave spectrum and using beam forming to track mobile users. Our real-time Radio Resource Management for 5G systems delivers seamless connectivity between 4G and 5G, revealing how 4G will be evolved and integrated with 5G. Different mobile generations and layers will be managed as one system.

A well-developed research programme

Nokia began its research into 5G several years ago. We are focusing on the critical areas needed to make 5G capabilities a reality, including:

- physical layer and system level developments
- the use of frequency bands from 1-100 GHz
- small cells and wide area solution and deployments
- the overall network architecture.

We have already delivered high-quality proofs-of-concept of key technologies and use cases for 5G era networks. We recently demonstrated how 5G technology is able to deliver peak speeds of 10 Gbps over the air under fully realistic conditions.

Collaborative innovation is built into our approach

Ultimately, creating a successful 5G standard will require the best ideas to be adopted, no matter where they come from. To enable this to happen, we engage in fully collaborative research with operators, governmental bodies, regulatory organizations, industry bodies, other industry players, the scientific community, 5G labs and universities.

Together we can make 5G a working reality and expand the human possibilities of technology.

<http://networks.nokia.com/innovation/5g>

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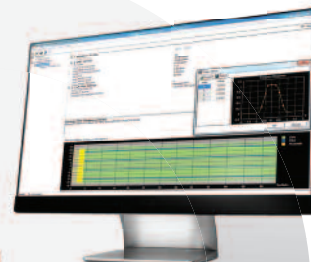
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Software platforms and applications that work seamlessly across our 5G instruments

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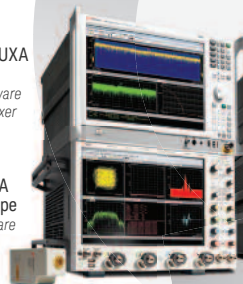
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