IEEE 5G Summit Nanjing

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Saturday, October 14, 2017

Organized by

IEEE 5G Initiative

Southeast University National Mobile Communications Research Laboratory
东南大学移动通信国家重点实验室

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Agenda

8:30-8:40	**Welcome Address:** General Co-Chairs
8:40-9:20	**Dr. Chih-Lin I**, China Mobile R16 and Beyond: An Exploration
9:20-10:00	**Prof. Fumiyuki Adachi,** Tohoku University, Sendai, Japan Distributed MIMO and Radio Resource Management for 5G Enhanced Mobile Broadband
10:00-10:20	**Coffee/Tea Break**
10:20-11:00	**Dr. Yunyong Zhang**, China Unicom Mobile Internet Development Strategy for Operators
11:00-11:40	**Dr. Ian Wong**, National Instruments, USA A Platform Approach to 5G: From Design to Prototype to Test
11:40-12:20	**Prof. Mehmet Ulema**, IEEE ComSoc Director of Standards Development; Manhattan College, New York, USA IEEE and 5G: Towards Standardization
12:20-13:30	**Lunch**
13:30-14:10	**Prof. Wen Chen**, Shanghai Jiao Tong University 5G Multiple Access
14:10-14:50	**Dr. YiFei Yuan**, ZTE Potential technical solutions to grant-free non-orthogonal multiple access (NOMA) for 5G
14:50-15:30	**Prof. Feifei Gao**, Tsing Hua University, Beijing Massive MIMO: where Array Signal Processing Meets Wireless Communications
15:30-15:50	**Coffee/Tea Break**
15:50-16:30	**Prof. Dongming Wang,** Southeast University 5G Large-scale Distributed Antenna Systems
16:30-17:20	**Panel: 5G Roadmap and Standards** **Hosted by Prof. Rose Hu and Dr. Chi-Ming Chen**, IEEE 5G Initiative Roadmap Project Co-Chairs
17:20-18:00	**Tour/Demo:** Southeast University mmWave and Massive MIMO Lab

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- **Prof. Xiaohu You**, Southeast University, China
- **David Lu**, AT&T, USA
- **Jingyi Zhou**, ZTE Corporation

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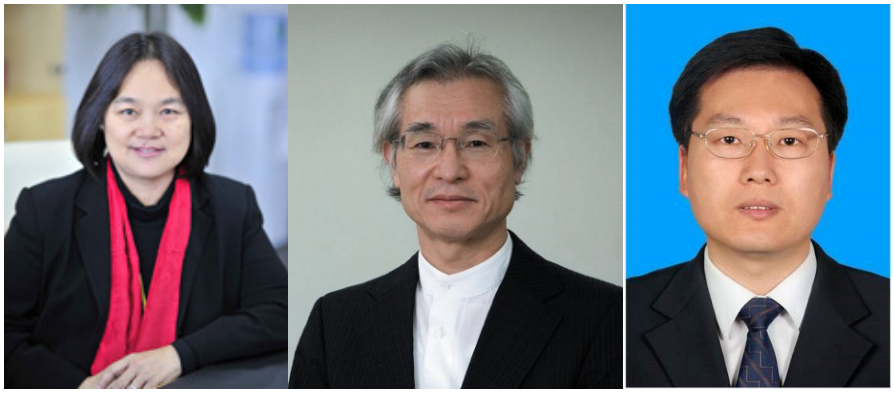
- **Prof. Jiangzhou Wang**, University of Kent, UK
- **Prof. Rose Q. Hu**, Utah State University, USA
- **Prof. Yang Yang**, Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
- **Chi-Ming Chen**, AT&T Labs, USA

Technical Program Management: **Tzyh-Jong (TJ) Wang**, AT&T, USA

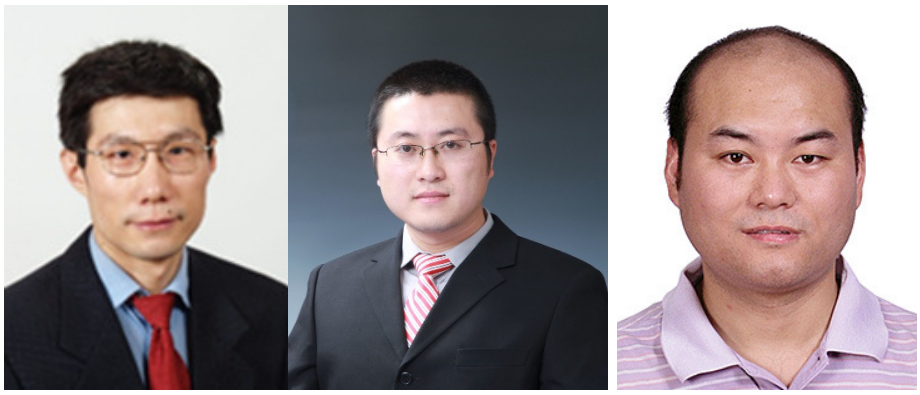
Finance and Local Arrangement Chair: **Prof. Xiangyang Wang**, Southeast University, China

Speakers



Dr. Chih-Lin I, Prof. Fumiyuki Adachi, Dr. Yunyong Zhang

Dr. Ian Wong, Prof. Mehmet Ulema, Prof. Wen Chen



Dr. Yifei Yuan, Prof. Feifei Gao, Prof. Dongming Wang

Dr. Chih-Lin I 易芝玲**,** China Mobile Research Institute

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

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

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

Topic: R16 and Beyond: An Exploration

Abstract: With the rapid progress of 5G NR standardization in phase 1, the profile of Release 15 is becoming more and more vivid. Some fundamental features of R15 are identified, including, for example, a two layer CU-DU RAN architecture, polar code, flexible frame structure, beamformed control channel, and slicing support. Is Release 15 sufficient for meeting the requirements of mobile communications in the 2020s? What are the key standardization issues remaining for future Release 16? To answer these questions, this talk will first survey the latest progress of Release 15 standardization activities. Then, contributions from CMCC on 5G will be presented. Furthermore, some potential release 16 NR standardization topics are explored. These include, for example, harmonization of the multiple NOMA schemes possibly via one unified multiple access framework, new channel models/waveforms/MIMO modes for high mobility scenarios, and potential introduction of big data analytics in RAN side for enhanced network performance.

Prof. Fumiyuki Adachi 安達文幸, Specially Appointed Professor for Research,
Research Organization of Electrical Communication, Tohoku University, Japan

Fumiyuki Adachi received the B.S. and Dr. Eng. degrees in electrical engineering from Tohoku University, Sendai, Japan, in 1973 and 1984, respectively. In April 1973, he joined the Electrical Communications Laboratories of Nippon Telegraph & Telephone Corporation (now NTT) and conducted various research on digital cellular mobile communications. From July 1992 to December 1999, he was with NTT Mobile Communications Network, Inc. (now NTT DoCoMo, Inc.), where he led a research group on Wideband CDMA for 3G systems. Since January 2000, he has been with Tohoku University, Sendai, Japan. He was a full professor at the Graduate School of Engineering until March 2016, and now a Specially Appointed Professor for Research at the Research Organization of Electrical Communication (ROEC) at the same university. His research interests lie in the area of wireless signal processing and networking, e.g., multi-access, equalization and diversity, MIMO, radio resource management, etc.).

He is an IEICE Fellow and an IEEE Life Fellow. He is a recipient of the IEEE Vehicular Technology

Society Avant Garde Award 2000, IEICE Achievement Award 2002, Thomson Scientific Research Front Award 2004, Ericsson Telecommunications Award 2008, Telecom System Technology Award 2009, Prime Minister Invention Award 2010, British Royal Academy of Engineering Distinguished Visiting Fellowship 2011, KDDI Foundation Excellent Research Award 2012, C&C Prize 2014, Rinzaburo Shida Award 2017, and Sendai Municipal Commendation 2017. He is listed in Highly Cited Researchers 2001 (http://hcr.stateofinnovation.thomsonreuters.com/page/archives).

Topic: Distributed MIMO and Radio Resource Management for 5G Enhanced Mobile Broadband

Abstract: Mobile communications network has now evolved into the 4th generation (4G). Mobile broadband services have been becoming more and more popular. Recently, the development of 5G network for providing 5G enhanced mobile broadband (eMBB) services is on-going worldwide. Since the available frequency bandwidth is limited, the area spectrum efficiency (ASE), bps/Hz/km^2, has been the most important concern for the last few decades. An increasing popularity of broadband services causes a problem of increased energy consumption. Therefore, the energy efficiency (EE), bits/Joule, has also become an important concern for battery operated mobile terminals in particular. Both ASE and EE can be simultaneously improved by adopting small-cell structured networks. There are two approaches towards an efficient realization of 5G small-cell structured networks: distributed MIMO network and a dense heterogeneous networks (HetNet).

In the first part of my talk, we will present the recent advances in distributed MIMO. A number of distributed antennas are deployed over a traditional macro-cell area covered by a macro-cell base station (MBS). They are connected to the MBS by the optical mobile fronthaul. Distributed MIMO exploits the spatial distribution of both antennas and users. Some of distributed antennas near a user terminal are selected to perform distributed MIMO cooperative transmission, which includes frequency-domain equalization, single-user MIMO diversity, multi-user MIMO multiplexing, and low peak-to-average power ratio (PAPR) waveform design. Also, we will present multi-user scheduling and MIMO channel estimation. Since distributed antennas near a user are selected, MIMO channel has a sparse structure. This sparsity of MIMO channel can be exploited for channel estimation.

In the second part of my talk, we will present the recent advances in distributed radio resource management for the dense HetNet. A number of small base stations (SBSs) are deployed over a traditional macro-cell area covered by a MBS. A game theoretic SBS power on/off algorithm and a distributed dynamic channel assignment will be presented.

Dr. Yunyong Zhang 张云勇, China Unicom

Expert with State Department Special Allowance, Professor Level Senior Engineer. Joined China Unicom in 2003, Dr. Zhang has worked for the Department of Technology, Department of Data and China Unicom Research Institute and currently serves as the President and Director of Technical Committee of China Unicom Research Institute. Dr. Zhang also takes the positions of adjunct professor in Beijing University of Post & Telecommunication and Sichuan University. Dr. Zhang successfully holds the posts of Expert of 863 and National Major Projects; Core Expert of the National Office for Science & Technology Awards; Fellow of China Institute of Telecommunications and member of its Academic Committee; Vice President of the Ministry of Industry and Information Technology SDN Industry Alliance; Vice President of China's ICT & Big Data Industry Alliance; Vice President of the Technical Committee for New Prominent Forum in China Institute of Telecommunications; Director and Chief Editor of Information and Communication Editorial Board and editors and reviewers of many journals such as Journal of Communications and Telecommunication Science. Dr. Zhang has published 19 books in Mandarin (3 of which have been published in Taiwan), 1 book in English, and more than 70 theses in academic periodicals both in and abroad, of which 29 have been indexed by SCI and 14 by EI. Dr. Zhang has achieved 64

authorized patents, and 37 software copyrights. More than 300 of his proposals have been accepted by international organizations. Dr. Zhang also led the very first worldwide ITU cloud computing framework and SDN standard, submitted and published 9 international and industrial standards, received Outstanding Paper Award and Outstanding Individual Award twice respectively, from the Ministry of Industry and Information Technology, and obtained 1 international award as well as 15 provincial awards.

Topic: Mobile Internet Development Strategy for Operators **（运营商移动互联网发展策略）**

Abstract: 5G technology, featuring high speed, low latency and high connection density and other characteristics, is designed from the very beginning for application scenarios such as mobile Internet, Internet of things and low latency and high reliability scenarios. It will definitely drive the development of mobile internet towards a new level. The speech will analyze the characteristics of 5G application scenarios from operators' view, dive deep into the driving factors of the 5G applications, and put forward operators' mobile Internet strategies in the era of 5G.

Dr. Ian Wong, National Instruments, USA

Dr. Ian C. Wong is Senior Manager of the Advanced Wireless Research group at National Instruments where he leads the company's 3GPP and 802.11 wireless standards strategy and platforms for wireless system design, simulation, prototyping, and implementation. From 2007-2009, he was a systems research and standards engineer with Freescale Semiconductor where he represented Freescale in the 3GPP LTE standardization efforts. He is a senior member of the IEEE, the acting Director of Industry Communities for IEEE Communications Society, and was the Industry Program Chair for IEEE Globecom 2014 in Austin. His current research interests include 5G wireless systems design and prototyping, and design automation tools for rapid algorithm development.

Dr. Wong is the co-author of the Springer book "Resource Allocation for Multiuser Multicarrier Wireless Systems," has over 10 patents, over 25 peer-reviewed journal and conference papers, and over 40 standards contributions. He was awarded the Texas Telecommunications Engineering Consortium Fellowship in 2003-2004, and the Wireless Networking and Communications Group student leadership award in 2007.

He received the MS and PhD degrees in electrical engineering from the University of Texas at Austin in 2004 and 2007, respectively, and a BS degree in electronics and communications engineering *(magna cum laude)* from the University of the Philippines in 2000.

Topic: A Platform Approach to 5G: From Design to Prototype to Test

Abstract: 5G promises a transformation in the way industries do business and consumers live their lives with wealth of new features and capabilities compared to today's status quo. Reviewing the timeline and potential launch of 5G technologies and services, the tasks ahead coupled with the enormous complexity of the work renders traditional approaches obsolete. Any new transformation especially one of this magnitude must follow a systematic process to deliver on the promise. New approaches are needed to compress the time from concept to commercialization otherwise introductions may be delayed, investments may skyrocket, or a combination of both. NI proposes a platform based approach to speed time to market that combines an innovative approach to system design with logical and efficient transitions to the testing of these new technologies in the product development and commercialization phases. Providing innovative platform components

encompassing both hardware and software for prototyping this approach can be extended to product development by reusing these components in a number of different ways to break down the conventional barriers between design and test. This approach also facilitates more active collaboration between researchers and product teams to solve tough business challenges and accelerate the path to a connected 5G landscape.

Prof. Mehmet Ulema, Chair of IEEE ComSoc Standards Development Board; Manhattan College, New York, USA

Mehmet received BS and MS degrees from Istanbul Technical University and PhD from Brooklyn Polytechnic Institute (now New York University). Dr. Ulema is a professor at Manhattan College, New York, and has been a consultant to several international companies. Previously, he held management and technical positions in AT&T Bell Labs and Bellcore, involved in numerous telecom projects.

While working in industry and academia, Mehmet was actively involved in standardization in ITU, TIA, ATIS, and IEEE. More recently, he founded and has been leading the IEEE P1903 project on Next Generation Service Overlay Networks. Mehmet has been a prominent volunteer at ComSoc and IEEE Standard Association. Currently he is the ComSoc Director of Standards Development. He is a member of the IEEE-SA Standard Board, where he works to position ComSoc as a major player in IEEE standards governance. He has authored numerous industry reports and scholarly publications. He has been on the editorial board of several major journals.

Previously, Mehmet held leadership positions in ComSoc, including Director of Membership Programs, served in leadership positions in major IEEE conferences including IEEE GLOBECOM, ICC, NOMS, BlackSeaCom. Mehmet has received several awards, including IEEE-SA Standards Medallion and ComSoc Harold Sobol Award for Exemplary Service to Meetings and Conferences.

Topic: IEEE and 5G: Towards Standardization

Abstract: After a brief introduction to IEEE, the talk will provide a high level overview to 5G and related technology areas. Then, various activities, including conferences, publications, that take place within IEEE with respect to 5G will be discussed in length. A general discussion of worldwide standardization effort around 5G will follow. Finally, the process that IEEE follows in the standards development effort will be presented.

Prof. Wen Chen, Shanghai Jiao Tong University

Wen Chen is a professor of Communication Engineering at Shanghai Jiao Tong University, where he is the director of the Institute for Signal Processing and Systems, and the chairman of SJTU Intellectual Property Corporation. Professor Chen is an editor of IEEE Transactions on Wireless Communications and an Associate Editor of IEEE Access. He is the Chair of IEEE VTS Shanghai Chapter, and in the Board of Governor, Shanghai Institute of Electronics. He has published 83 papers in IEEE Journals and over 100 papers in IEEE conferences. He was awarded the Innovate 5G competition award in 2015 and the WCSP2015 best paper award. He has made keynote speech in IEEE APCC2016, and Tutorials in IEEE VTC2017 and IEEE ICCC2016. He has served the general chair and TPC chair for many IEEE sponsored conferences.

Topic: 5G Multiple Access

Abstract: The demands on massive connectivity, large capacity and low latency for 5G network drastically push the development of non-orthogonal multiple access technology over the conventional orthogonal access technology. Recently, some new type non-orthogonal multiple access techniques such as sparse code multiple access (SCMA), multiuser shared access (MUSA) and pattern division multiple access (PDMA) have attracted lots of attention and have been looked as the potential 5G New Air Interface Technologies. In this presentation, I will extensively introduce SCMA, where I will majorly focus on the codebook and decoder design, resource allocation and grant free access, By this, one can get full image of SCMA, the importance of SCMA, SCMA design and some open problems related to SCMA.

Dr. Yifei Yuan, ZTE Corporation

Yifei Yuan (yuan.yifei@zte.com.cn) received Bachelor and Master degrees from Tsinghua University of China, and a Ph.D. from Carnegie Mellon University, USA. He was with Alcatel-Lucent from 2000 to 2008, working on 3G/4G key technologies. Since 2008, he has been with ZTE, responsible for standards research on LTE-Advanced physical layer, and 5G technologies. His research interests include MIMO, iterative codes, resource scheduling, non-orthogonal multiple access, internet-of-things (IoT). He was admitted to Thousand Talent Plan Program of China in 2010. He has extensive publications, including a book on LTE-A relay, a book on LTE-Advanced key technologies and system performance, and a book on narrow-band IoT. He has over 50 granted patents.

Topic: Potential technical solutions to grant-free non-orthogonal multiple access (NOMA) for 5G

Abstract: Recently there has been significant interests in non-orthogonal multiple access (NOMA) for 5G communications. Compared to orthogonal multiple access, NOMA can provide performance benefit in capacity and the systems' resilience to high traffic load and fluctuation. Grant-less or grant-free transmission is desirable to be designed together with NOMA, especially for small data. In grant-free, UE can randomly select the time-frequency resources and signatures for transmission at any time in inactive state, resulting in non-orthogonal transmission in general, since data of different users may be superposed or collide. In addition to the capacity gain, grant-free NOMA can provide more efficient transmission in terms of energy efficient on the UE side, reduced signaling overhead, and low latency. This talk will describe the general concept and design aspects of grant-free NOMA, the candidate grant-free NOMA schemes and the standardization progress in the 3GPP specification, the preliminary field test results in the recent national trial of China, and so on.

Prof. Feifei Gao, Tsing Hua University, Beijing

Feifei Gao received the B.Eng. degree from Xi'an Jiaotong University, Xi'an, China in 2002, the M.Sc. degree from McMaster University, Hamilton, ON, Canada in 2004, and the Ph.D. degree from National University of Singapore, Singapore in 2007. He was a Research Fellow with the Institute for Infocomm Research (I2R), A*STAR, Singapore in 2008 and an Assistant Professor with the School of Engineering and Science, Jacobs University, Bremen, Germany from 2009 to 2010. In 2011, he joined the Department of Automation, Tsinghua University, Beijing, China, where he is currently an Associate Professor.

Prof. Gao's research areas include communication theory, signal processing for communications, array signal processing, and convex optimizations, with particular interests in MIMO techniques, multi-carrier communications, cooperative communication, and cognitive radio networks. He has authored/ coauthored more than 100 refereed IEEE journal papers and more than 100 IEEE conference proceeding papers, which have been cited more than 4000 times from Google Scholar.

Prof. Gao has served as an Editor of IEEE Transactions on Wireless Communications, IEEE Communications Letters, IEEE Signal Processing Letters, IEEE Wireless Communications Letters, International Journal on Antennas and Propagations, and China Communications. He has also served as the symposium co-chair for 2015 IEEE Conference on Communications (ICC), 2014 IEEE Global Communications Conference (GLOBECOM), 2014 IEEE Vehicular Technology Conference Fall (VTC), as well as Technical Committee Members for many other IEEE conferences.

Topic: Massive MIMO: where Array Signal Processing Meets Wireless Communications

Abstract: We provide a new solution for massive MIMO communications from array signal processing viewpoints. It will be seen that using array signal processing could help understand more deeply into massive MIMO and could fully exploit the potential of massive MIMO by bringing many advantages not offered from communications viewpoint. For example, we would understand that the sparsity of the massive MIMO channel inherently comes from the sparsity of the surrounding environment, i.e., the sparsity in angular domain. Moreover, the angular information discovered by array signal processing could not only offer accurate beam-pointing but also provide angle reciprocity that greatly eases the downlink channel estimation. With angular information, the channel covariance matrix could be immediately computed instead of time-consuming accumulation of training sample. The newest result from MIT even claims that the instantaneously downlink channel can also be obtained via computation from the uplink channel rather than sending any downlink training resource, if angular information of the channel is extracted. In fact, using array signal processing could present a unified framework for both UL/DL transmission in both TDD/FDD systems. Some other interesting issues of what a “really massive” array could face will also be briefly discussed.

Prof. Dongming Wang, Southeast University

Dongming Wang received the Ph. D. degree from Southeast University, China, in 2006, and since then he has been with the National Mobile Communications Research Laboratory at Southeast University, where he is currently an Associate Professor. His current research interests include distributed antenna systems, large-scale MIMO systems, channel estimation and MIMO detection. Dr. Wang served as a symposium co-chair in the 2015 IEEE International Conference on Communications (ICC 2015) and the IEEE Wireless Communications and Signal Processing Conference (IEEE WCSP 2017). He is currently an associate editor for the SCIENCE CHINA Information Sciences.

Topic: 5G Large-scale Distributed Antenna Systems

Abstract: Large-scale distributed antenna system (large-scale DAS) can greatly improve the spectral efficiency and energy efficiency for 5G systems. Compared with massive co-located MIMO (massive MIMO), large-scale DAS could not only obtain three types of gains of MIMO, but also get the macro-diversity and the power gain due to smaller path loss. In this talk, some recent results of large-scale DAS including spectral efficiency analysis, channel state information acquisition, low complexity multi-user transmission techniques, and the software design of the GPP-based (general purpose processors) demo system in southeast university will be discussed.