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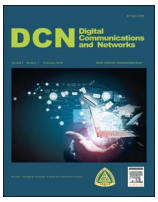

Editorial

Editorial: Special issue on "next generation wireless communication technologies"

There have been considerable research efforts on developing the enabling technologies for the next generation of wireless communication systems all over the world, leading towards the future 5G and beyond 5G wireless systems. The key demands now are user-centric (instead of the traditional carrier-centric) mobile applications, high mobile data traffic volume, large number of connected devices, long device/network lifetime, improved Quality of Services (QoS) and Quality of Experience (QoE) for users, i.e., high-transmission rate, low delay, and small jitter etc. In recent years, a lot of promising wireless technologies have been proposed or developed to improve the quality of wireless communications and to enable new wireless applications. Such technologies are focused on new spectrum such as millimeter wave, wider bandwidths, new modulation techniques, enhanced small cells, massive MIMO, and so on.

This special issue was aimed at offering an overview of the state-of-the-art in technology and research advances for 5G and beyond mobile communication technologies and systems. We invited high quality original research papers describing recent and expected challenges or discoveries along with potential solutions for next generation wireless communication technologies, while both theoretical and experimental papers were welcomed. After a rigorous review and revision process, we assembled for this special issue a collection of papers on the latest advances in state-of-the-art wireless communication systems and applications. We expect a timely special issue to serve as a valuable reference for a large audience of engineers, scientists, researchers, and academics in the field of wireless communications and networks.

Specifically, this special issue consists of 12 papers covering various aspects of the next generation wireless communication systems, including (i) next generation cellular networks (papers one through four), (ii) cognitive radio networks (papers five and six), (iii) 5G technologies (papers seven to nine), and (iv) emerging wireless applications (papers ten to twelve).

The first four papers are focused on the next generation cellular networks. In the *first* paper, titled “Coverage Probability of Cellular Networks Using Interference Alignment Under Imperfect CSI,” the authors present a study on applying Interference Alignment (IA) to mitigate inter-cell interference, where the base station locations are modeled by a Poisson Point Process (PPP). Under imperfect Channel State Information (CSI), the authors derive the coverage probability of the network and validate its accuracy with simulations. In the *second* paper, titled “Universal Intelligent Small Cell (UnISCell) for Next Generation Cellular Networks,” the authors propose a new concept of a Universal Intelligent Small Cell (UnISCell) for enabling the densification of the next generation of cellular networks, which is based on an integrated platform for providing a strong linkage between different stakeholders, and is universal in nature being independent of the operating frequency bands and traffic types. In the *third* paper titled Clustering-based “Interference Management in Densely Deployed Femtocell Networks,” the authors propose an interference management scheme based on joint clustering and resource allocation for two-tier Orthogonal Frequency Division Multiplexing (OFDM)-based femtocell networks. The problem is formulated and solved with a cross-layer optimization approach and the solutions are validated with simulations. In the *fourth* paper titled “Energy Efficiency based Joint Cell Selection and Power Allocation Scheme for HetNets,” the authors jointly consider cell selection and transmit power allocation in a heterogeneous Network (HetNet) consisting of multiple cells. They start from the simple one User Equipment (UE) case, and then extend the study to the more general multiple UEs case. The formulated nonlinear fractional optimization problems transformed into subproblems and solved respectively.

The next set of two papers is on effective spectrum sharing in Cognitive Radio (CR) networks. In the *fifth* paper titled “Cooperative Spectrum Sharing of Multiple Primary Users and Multiple Secondary Users,” the authors propose a Multiple Input Multiple Output (MIMO) based cooperative Dynamic Spectrum Access (DSA) framework that enables cooperative spectrum sharing among multiple Primary Users (PUs) and multiple Secondary Users (SUs). The network-wide cooperation and competition is formulated as a bargaining game, and solved with an optimal algorithm. In the *sixth* paper titled “Kernel Fuzzy C-Means Clustering on Energy Detection Based Cooperative Spectrum Sensing,” the authors aim to improve the performance of cooperative spectrum sensing in CR networks by exploring the scope of Kernel Fuzzy C-Means (KFCM) on energy detection. The proposed scheme is shown to improve the detection of multiple PUs at low SNR with low energy consumption.

The third set of three papers addresses the three key technologies of 5G wireless systems, namely, millimeter Wave (mmWave) communications, massive MIMO, andDevice to Device (D2D) communications. The *seventh* paper, titled “Rank-defective Millimeter-Wave Channel Estimation Based on Subspace-Compressive Sensing,” develops a new algorithm to estimate the mmWave channel by exploiting the sparse nature of the channel. A modified approach based on Multiple Measurement Vector (MMV) greedy sparse framework and subspace method of Multiple Signal Classification (MUSIC) is proposed to recover the indices of non-zero elements of an unknown channel matrix when the rank of the channel matrix is defected. In the *eighth* paper titled “Fixed-Point Implementation of Approximate Message Passing (AMP) Algorithm in Massive MIMO systems,” the authors

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address the challenge on how to detect the individual signals from the composite signal in a massive MIMO system. The paper is focused on implementing the Approximate Message Passing (AMP) algorithm in a fixed-point format, with approximations for the mean and variance estimation functions within the algorithm. In the *ninth* paper titled "Radio Resource Management Scheme and Outage Probability for Multi-hop D2D Communications With Distance Constraint," the authors analyze the outage probability of D2D communication enabled LTE cellular networks from a general threshold-based perspective. Both single-hop and multi-hop cases of D2D communications are investigated.

The last set of three papers provides a nice sampling of thriving wireless applications. The *tenth* paper, titled "An Empirical Study of DSRC V2V Performance in Truck Platooning Scenarios," studies the performance of Dedicated Short Range Communications (DSRC) Vehicle-to-Vehicle (V2V) communications in truck platooning scenarios through real-world experiments, which consists of commercial DSRC equipment and semi-trailer trucks. The authors verify several speculations with their test results. In the *eleventh* paper titled "Experimental Approach for Seeing Through Walls Using Wi-Fi Enabled Software Defined Radio Technology," the authors develop through-wall virtual imaging using Wi-Fi enabled software defined radio to see moving objects and their relative locations. An implementation based on LabVIEW and NI Universal Software Radio Peripheral devices is developed to virtually detect moving objects behind the walls by sending and receiving a signal with respect to the USRP's location. The last paper of this special issue, titled "Antenna Design for a Massive Multiple Input Environmental Sensor Network," presents the design and simulation of a pair of antennas on a small Printed Circuit Board (PCB) with minimal coupling for a massive multiple input sensor network, where a huge amount of such sensors are deployed in the air for in-situ measurements for hurricane reconnaissance.

We would like to thank all the authors for contributing their work to this special issue, and all the reviewers for their great efforts in the review process, which together ensure a high quality and timely special issue in the cutting edge of wireless communications and networking research. In addition, we would like to thank the Editor-in-Chief (EiC) Drs. Chonggang Wang, Huosheng Hu, and Jinhao Lin for approving of this special issue, and the great support from the EiCs and DCAN editorial staff, including Drs. Yun Li, Yi Guo and Dapeng Wu, and many others. This special issue would be impossible without their strong support and guidance. We believe that the papers in this special issue will contribute to the further development of next generation wireless technologies and applications.

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Tao Jiang is currently a Distinguished Professor in the School of Electronics Information and Communications, Huazhong University of Science and Technology, Wuhan 430074, P. R. China. He received his B.S. and M.S. degrees in applied geophysics from China University of Geosciences, Wuhan, P. R. China, in 1997 and 2000, respectively, and his Ph.D. degree in information and communication engineering from Huazhong University of Science and Technology in April 2004. From August 2004 to December 2007, he worked in some universities, such as Brunel University and the University of Michigan-Dearborn. He has authored or co-authored over 200 technical papers in major journals and conferences, and 8 books/chapters in the areas of communications and networks. He has served or is serving as a Symposium Technical Program Committee member of some major IEEE conferences, including INFOCOM, GLOBECOM, ICC, and others. He was invited to serve as TPC Symposium Chair for IEEE GLOBECOM 2013, IEEEE WCNC 2013, and ICCC 2013. He has served or is serving as Associate Editor of some technical journals in communications, including IEEE Transactions on Signal Processing, IEEE Communications Surveys & Tutorials, IEEE Transactions on Vehicular Technology, and the IEEE Internet of Things Journal. He is a recipient of the NSFC for Distinguished Young Scholars Award in 2013, and he is also a recipient of the Young and Middle-Aged Leading Scientists, Engineers and Innovators by the Ministry of Science and Technology of China in 2014. He was awarded as the Most Cited Chinese Researcher in Computer Science announced by Elsevier in 2014 and 2015.

Shiwen Mao received his Ph.D. in electrical and computer engineering from Polytechnic University, Brooklyn, NY in 2004. Currently, he is the Samuel Ginn Endowed Professor and Director of Wireless Engineering Research and Education Center (WEREC) at Auburn University, Auburn, AL, USA. His research interests include wireless networks and multimedia communications. He is a Distinguished Lecturer of IEEE Vehicular Technology Society. He is on the Editorial Board of IEEE Transactions on Multimedia, IEEE Internet of Things Journal (Area Editor), IEEE Multimedia, and Elsevier Digital Communications and Networks Journal, among others. He serves as TPC Co-Chair of IEEE INFOCOM 2018, and Area TPC Chairs and symposium co-chairs for many conferences, including IEEE INFOCOM, ICC, IEEE GLOBECOM, ICCCN, among others, and in various roles in the organizing committees of many conferences. He is the Chair of IEEE ComSoc Multimedia Communications Technical Committee. He received the 2015 IEEE ComSoc TC-CSR Distinguished Service Award, the 2013 IEEE ComSoc MMTC Outstanding Leadership Award, and the NSF CAREER Award in 2010. He is a co-recipient of the Best Paper Awards of IEEE GLOBECOM 2016, IEEEGLOBECOM 2015, IEEE WCNC 2015, and IEEE ICC 2013, and the 2004 IEEE Communications Society Leonard G. Abraham Prize in the Field of Communications Systems.

Zhifeng Zhang received the BS degree in information engineering and the Ph.D. degree in control science and engineering from Tongji University in 1999 and 2006, respectively. He is currently a lecturer at Tongji University. His research interests include computer architecture, VLSI, and brain-computer interface.

Da Chen received the Ph.D. degree in 2015, M.S. degree in 2011, and B.S. degree in 2009 from Huazhong Universityof Science and Technology, Wuhan, P. R. China, all in Electrical and Information Engineering. He is currently an Assistant Professor in the School of Electronic Information and Communications, Huazhong University of Science and Technology. From September 2012 to August 2013, he has been a visiting scholar at Northwestern University, USA. From September 2013 to September 2014, he was a visiting scholar at Universityof Delaware, USA. His current research interests include various areas in wireless communications, such as, OFDM and FBMC systems.

Tao Jiang
Huazhong University of Science and Technology, PR China
Shiwen Mao
Auburn University, USA
E-mail address: smao@iee.org
Zhifeng Zhang
Tongji University, PR China
Da Chen
Huazhong University of Science and Technology, PR China