Guest Editorial
CUI Shuguang and CHENG Xiang

Channel Measurement and Modeling for Heterogeneous 5G

▶ CUI Shuguang

CUI Shuguang received his Ph.D. in electrical engineering from Stanford University, USA in 2005. He is currently a Childs Family Endowed Professor in electrical and computer engineering at the University of California-Davis. His current research interests focus on data driven large-scale information analysis and system design. He was selected as the Thomson Reuters Highly Cited Researcher and listed in the Worlds' Most Influential Scientific Minds by ScienceWatch in 2014. He was the recipient of the IEEE Signal Processing Society 2012 Best Paper Award. He has served as the general co-chair and TPC co-chairs for many IEEE conferences. He has also been serving as the area editor for *IEEE Signal Processing Magazine*, and associate editors for *IEEE Transactions on Big Data*, *IEEE Transactions on Signal Processing*, *IEEE JSAC Series on Green Communications and Networking*, and *IEEE Transactions on Wireless Communications*. He was the elected member for IEEE Signal Processing Society SPCOM Technical Committee (2009–2014) and the elected Chair for IEEE ComSoc Wireless Technical Committee (2017–2018). He is a member of the Steering Committee for both *IEEE Transactions on Big Data* and *IEEE Transactions on Cognitive Communications and Networking*. He is also a member of the IEEE ComSoc Emerging Technology Committee. He was elected as an IEEE Fellow in 2013 and an IEEE ComSoc Distinguished Lecturer in 2014.

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CHENG Xiang received the Ph.D. degree from Heriot-Watt University, UK, and the University of Edinburgh, UK in 2009, where he received the Postgraduate Research Thesis Prize. He is currently an associate professor at Peking University, China. He has published more than 120 research papers in journals and conference proceedings. His research interests include mobile propagation channel modeling and simulation, next generation mobile cellular systems, intelligent transportation systems, and hardware prototype development. Dr. Cheng was the recipient of the IEEE Leonard G. Abraham Prize (IEEE JSAC best paper award) in 2016, the IEEE Asia Pacific Outstanding Young Researcher Award in 2015, and Best Paper Awards at IEEE ITST'12, ICCC'13, ITSC'14, ICC'16, ICNC'17. He has served as Symposium Lead Chair, Co-Chair, and a member of the Technical Program Committees for several international conferences. He is an associate editor for *IEEE Transactions on Intelligent Transportation Systems*.

While cellular networks have continuously evolved in recent years, the industry has clearly seen unprecedented challenges to meet the exponentially growing expectations in the near future. The 5G system is facing grand challenges such as the ever-increasing traffic volumes and remarkably diversified services connecting humans and machines alike. As a result, the future network has to deliver massively increased capacity, greater flexibility, incorporated computing capability, support of significantly extended battery lifetime, and accommodation of varying payloads with fast setup and low latency, etc. In particular, as 5G requires more spectrum resource, higher frequency bands are desirable. Nowadays, millimeter wave has been widely accepted as one of the main communication bands for 5G. As a result, envisioned 5G research and development are inclined to be heterogeneous, with possibly ultra dense network layouts due to their capability to support high speed connections, flexibility of resource management, and integration of distinct access technologies. In such a heterogeneous 5G structure, a large number of communication scenarios should be fully supported, including special ones involving high mobility (such as vehicular and high speed train communications and networks).

Towards the heterogeneous 5G, the first and foremost hurdle lies in the channel measurement and modeling in the broad and diversified 5G scenarios. This special issue is dedicated to providing a platform to share and present the latest views and developments on 5G channel measurement and modeling issues.

This special issue includes five technical contributions from leading researchers in channel measurements and modeling. The first paper entitled "An Overview of Non-Stationary Property for Massive MIMO Channel Modeling" by ZHANG, CHEN, and TANG presents an overview of methods of modeling non-stationary properties on both the array and time axes, which are mainly divided into two major categories: birth-death (BD) process and cluster visibility region (VR) method. The main concepts and theories are described, together with useful implementation guidelines. In conclusion, a comparison between these two methods is made. The second paper is entitled "Measurement-Based Channel Characterization for 5G Wireless Communications on Campus Scenario" by YANG, HE, AI, XIONG, DONG, LI, WANG, FAN, and QIN. It investigates the radio channels of 5G communications below 6 GHz according to the requirements and scenarios of 5G communications. Channel measurements were conducted on campus of Beijing Jiaotong University, China at two key optional frequency bands below 6 GHz. By using the measured data, the key channel parameters at 460 MHz and 3.5 GHz are analyzed, such as power delay profile, path loss exponent, shadow fading, and delay spread. The results are helpful for the 5G communication system design. The third paper, co-authored by ZHANG, WANG, WU, and ZHANG, is entitled "A Survey of Massive MIMO Channel Measurements and Models". In this paper, the channel measurements and models of massive MIMO in recent years are summarized globally. Besides, their

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work on related 256 antenna elements with 200 MHz bandwidth at 3.5 GHz, the verification of rationality of measurement method, and the spatial evolution of clusters in mobile scenario are provided. The next paper, co-authored by WANG, GENG, ZHAO, HONG, and Haneda, is entitled "Feasibility Study of 60 GHz UWB System for Gigabit M2M Communications". In this paper, the feasibility and performance of mm-wave 60 GHz ultra-wide band (UWB) systems for gigabit machine-to-machine (M2M) communications are analyzed. Specifically, based on specifications and channel measurements and models for both line-of-sight LOS and non-LOS (NLOS) scenarios, 60 GHz propagation mechanisms are summarized and 60 GHz UWB link budget and performance are analyzed. The goal of this work is to provide useful information for standardizations and design of 60 GHz UWB systems. The last (but not least) paper "Measurement-Based Spatial-Consistent Channel Modeling Involving Clusters of Scatterers" is co-authored by YIN, ZHANG, WANG, and CHENG. In this paper, the conventional method of establishing spatial channel models (SCMs) based on measurements is extended by including clusters-of-scatterers (CoSs) that exist along propagation paths. Channel models resulted by utilizing this new method are applicable for generating channel realizations of reasonable spatial consistency which is required for designing techniques and systems of the 5G wireless communications.

We would like to thank all the authors for choosing this special issue to publish their new research results and all the reviewers for their meticulous review comments and suggestions that help to improve the technical quality and presentation of this special issue. We hope that our readers will enjoy reading the articles and find this special issue helpful to their own research work.

Call for Papers

ZTE Communications Special Issue on

Cloud Computing, Fog Computing, and Dew Computing

Cloud Computing has drastically changed the landscape of IT industry by providing some major benefits to IT customers: eliminating upfront IT investment, scalability, proportional costs, and so on. However, the delay-sensitive applications face the problem of large latency, especially when several smart devices are getting involved. Therefore, cloud computing is unable to meet the requirements of low latency, location awareness, and mobility support.

To overcome this problem, Cisco has first introduced a trusted and dependable solution through the Fog Computing to put the services and resources of the cloud closer to users, which facilitates the leveraging of available services and resources in the edge networks. Fog Computing is a scenario where a huge number of heterogeneous ubiquitous and decentralized devices communicate and potentially cooperate among them and with the network to perform storage and processing tasks without the intervention of third-parties.

Dew Computing is an on-premises computer software-hardware organization paradigm in the cloud computing environment where the on-premises computer provides functionality that is independent of cloud services and is also collaborative with cloud services. The goal of Dew Computing is to fully realize the potentials of on-premises computers and cloud services.

The definition and features of Cloud Computing, Fog Computing, and Dew Computing, the relationships among them, and their applications are still under heated discussion and are the focus of this special Issue.

This special issue intends to gather the preeminent minds of the field to discuss and envision the future development of cloud-related technologies, which would be of interest for researchers, entrepreneurs, and customers. This special issue seeks original, high quality and unpublished research contributions as well as implementation experiences from researchers in the related areas.

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Important Dates

- First Submission Due: May 15, 2017
- Review and Final Decision Due: July 1, 2017
- Final Manuscript Due: July 25, 2017
- Publication Date: October 25, 2017

Preparation & Submission

For detailed information on the submission and preparation of manuscripts, please visit ZTE Communications Author Guidelines (http://wwwen.zte.com.cn/endata/magazine/ztecommunications/index_5104.html).