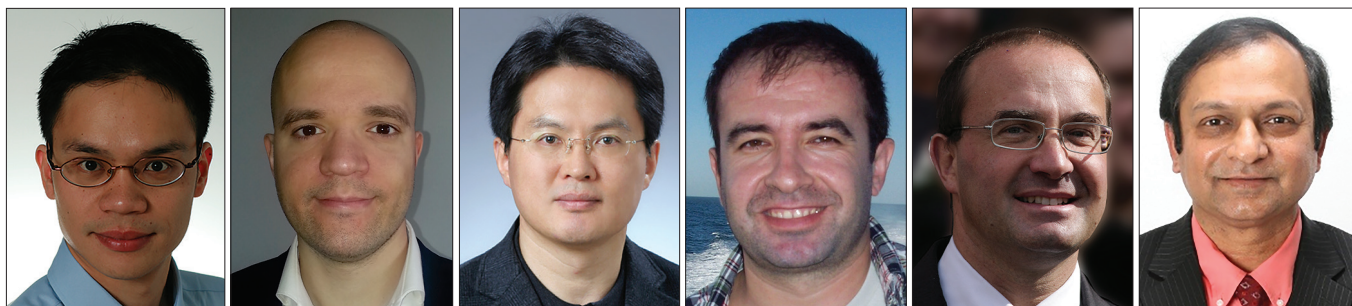


PRACTICAL PERSPECTIVES ON IoT IN 5G NETWORKS: FROM THEORY TO INDUSTRIAL CHALLENGES AND BUSINESS OPPORTUNITIES



Dusit Niyato

Marco Maso

Dong In Kim

Ariton Xhafa

Michele Zorzi

Ashutosh Dutta

The Internet of Things (IoT) is a proposed development of the Internet in which everyday objects are equipped with electronics, software, sensors, and network connectivity, allowing them to send and receive data through the Internet. Formally, IEEE has described IoT as “a network of items — each embedded with sensors — which are connected to the Internet.” From a practical perspective, the main difference between IoT and the existing network paradigms is that every element of IoT is able to collect and exchange data through the network without or with minimal human intervention. This opens a whole new set of interesting research challenges for future communication networks, in terms of overall system design, software implementation, data management, and service deployment.

IoT integrates different technologies and has a non-negligible impact on a variety of applications in different fields. With such capabilities, IoT has also opened interesting business opportunities in practically relevant fields such as healthcare, transportation, logistics, and manufacturing. This Feature Topic focuses on the practical aspects of IoT in 5G networks. The aim is to pave the way toward the identification of the bridge between recent theoretical findings/analytical solutions and future industrial challenges/business opportunities. Our Call for Papers attracted a number of submissions. After a thorough review process, the five papers that were best aligned with the aforementioned goal were chosen for publication.

The article “Latency Critical IoT Applications in 5G: Perspective on the Design of Radio Interface and Network Architecture” authored by P. Schulz *et al.* focuses on latency critical IoT applications, including factory automation, smart grids, and intelligent transportation systems. The article then discusses related requirements such as delay, reliability, data size, device density, and communication range. Solutions for radio interface and network architecture to meet such requirements and address the challenges, such as radio resource management, fast uplink access, transmission time shortening, and waveform design, are proposed. The article finally discusses the advantages brought by the new architecture in terms of flexibility and potential to meet all requirements.

The article “Effects of Heterogeneous Mobility on D2D- and Drone-Assisted Mission-Critical MTC in 5G” authored by A. Orsino *et al.* considers mission-critical machine type communications in LTE to support IoT applications with a variety of requirements in terms of low power, high reliability, and low latency. The article examines the impacts of mobility and heterogeneity of users and devices. Finally, the article presents numerical results to corroborate intuitions, insights, and proposals, and is concluded by a discussion on future research directions.

The article “IoT Connectivity in Radar Bands: A Shared Access Model Based on Spectrum Measurements” authored by Z. Khan *et al.* introduces a shared access framework to support IoT connectivity. The framework is developed based on the measurement results for the spectrum usage patterns and signal characteristics of ground-based fixed rotating radar systems deployed in Oulu, Finland. Subsequently, the article presents a radio environment map architecture composed of an information and measurement resource module, a database module, gateways, and device connectivity for the framework. Finally, the article highlights the benefits brought by the adoption of such a design, and outlines future research and development directions.

The article “Efficient IoT Gateway over 5G Wireless: A New Design with Prototype and Implementation Results” authored by N. Saxena *et al.* introduces the design and development of gateways to support IoT devices’ communications. The gateways are able to receive IoT data traffic from the devices and provide classification and compression of delay-tolerant traffic. Then the gateways forward the traffic to a 5G cloud radio access network (C-RAN), which includes virtual base stations for processing. A prototype and testbed development based on off-the-shelf hardware and software, characterized by flexibility and suitability for real IoT applications, is presented.

The article “Wireless Caching for 5G Networks: From Theory to Implementation” authored by Y. Fadlallah *et al.* discusses the integration of wireless edge caching and coded multicast transmissions in 5G networks, with potential to support IoT applications. First, theoretical analyses of the caching-aided coded multicast technique are performed to assess

its analytical performance. Afterward, the article introduces a prototype implementation based on single-input single-output (SISO) and multiple-input multiple-output (MIMO) software defined radio platforms and a GNU Radio framework. A set of experimental results is then provided to characterize the throughput of the considered system/solution.

This Feature Topic was conceived to provide comprehensive practical perspectives on IoT in 5G networks with the focus on the transition from theory to applications. Many design and development issues for network architecture and communications technologies are reviewed. The numerous open research and development directions outlined in the five accepted papers will be useful for researchers in academia and practitioners in industry to steer the direction of their future efforts in this area.

BIOGRAPHIES

DUSIT NIYATO [M'09, SM'15, F'17] is currently an associate professor in the School of Computer Science and Engineering, Nanyang Technological University, Singapore. He received his B.E. from King Mongkuts Institute of Technology Ladkrabang, Thailand, in 1999. He obtained his Ph.D. in electrical and computer engineering from the University of Manitoba, Canada, in 2008. His research interests are in the area of radio resource management in cognitive radio networks and energy harvesting for wireless communication.

MARCO MASO [S'08, M'14] received a Ph.D. degree in information engineering from the University of Padova as well as a Ph.D. degree in telecommunications from Supélec, France, in 2013. Since September 2014 he has been a researcher with the Mathematical and Algorithmic Sciences Lab of Huawei France Research

Center. His research interests broadly span the areas of wireless communications and signal processing for the physical layer, with focus on heterogeneous networks, MIMO systems, wireless power transfer, and cognitive radios.

DONG IN KIM [S'89, M'91, SM'02] received his Ph.D. degree in electrical engineering from the University of Southern California in 1990. He was a tenured professor with the School of Engineering Science, Simon Fraser University, Canada. Since 2007, he has been with Sungkyunkwan University, Suwon, Korea, where he is currently a professor with the College of Information and Communication Engineering. Previously he served as the Founding Editor-in-Chief of *IEEE Wireless Communications Letters* from 2012 to 2015.

ARITON XHAFA [SM'10] received his Ph.D. degree from Carnegie Mellon University, Pittsburgh, Pennsylvania, in 2003. Since 2004 he has been with Texas Instruments (TI) leading projects that enable and differentiate TI's radio platforms and make them Internet of Things and Industry 4.0 ready. He is a senior member of technical staff at TI, volunteers regularly at IEEE conferences, and holds workshops for science, technology, engineering, and math (STEM) high school students in Dallas, Texas.

MICHELE ZORZI [F'07] is with the Information Engineering Department of the University of Padova. His present research interests focus on various aspects of wireless communications. He was Editor-in-Chief of *IEEE Wireless Communications* from 2003 to 2005, *IEEE Transactions on Communications* from 2008 to 2011, and, at present, *IEEE Transactions on Cognitive Communications and Networking*. He served as a Member-at-Large of the ComSoc Board of Governors from 2009 to 2011, and as Director of Education and Training from 2014 to 2015.

ASHUTOSH DUTTA [SM'03] is currently Lead Member of Technical Staff at AT&T in Middletown, New Jersey. He is co-author of the book *Mobility Protocols and Handover Optimization: Design, Evaluation and Application*, and has 30 issued patents. He serves as Director of Industry Outreach for the IEEE Communications Society and co-lead for the IEEE 5G initiative. He obtained his B.S. in electrical engineering from NIT Rourkela, his M.S. in computer science from New Jersey Institute of Technology, and his Ph.D. in electrical engineering from Columbia University.

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*We learn by pushing ourselves
and finding what really lies at the
outer reaches of our abilities.*”

~ Josh Waitzkin

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