Guest Editorial Special Issue on 5G and Beyond—Mobile Technologies and Applications for IoT

FOLLOWING the tremendous success of 2G and 3G mobile networks and the fast growth of 4G, the next generation mobile networks (5G) was proposed aiming to provide infinite networking capability to mobile users. Differentiated from 4G, benefits offered by 5G is much more than the increased maximum throughput. It aims to involve and benefit from many current technical advances, including Internet of Things (IoT). As the IoT integrates many heterogeneous networks, such as wireless sensor networks, wireless local area networks, mobile communication networks (3G/4G/LTE/5G), wireless mesh networks, and wearable health care systems, it is critical to design self-organizing and smart protocols for heterogeneous ad hoc networks in various IoT applications, such as cyber-physical systems, cloud computing for heterogeneous ad hoc networks, large-scale sensor networks, data acquisition from distributed smart devices, green communication and applications, environmental monitoring and control, etc. Moreover, based on the survey conducted by the World Health Organization, the world will lack 12.9 million health care workers by 2035. Hence, it is important to develop wearable health care systems to perform self-health monitoring. In general, wearable health care systems demands low power consumption and high measurement accuracy. Smart technologies including green electronics, green radios, fuzzy neural approaches, and intelligent signal processing techniques play important roles for the developments of the wearable health care systems. This Special Issue aims at providing a forum to discuss the recent advances on 5G and beyond mobile technologies and applications for IoT.

The response to our above theme was overwhelming, with 30 papers submitted in the open Calls for Papers around the world. During the review process, each paper was assigned to and reviewed by multiple experts in the relevant areas, with a rigorous two-round review process. Thanks to the courtesy of the Editor-in-Chief of this JOURNAL, Dr. Sherman Shen, we are able to accept ten excellent papers covering various aspects of "5G and Beyond—Mobile Technologies and Applications for IoT." We are also glad to note that many authors of these papers have industry background. In the following, let us introduce these papers and highlight their main contributions.

In "On Social-Aware Content Caching for D2D-Enabled Cellular Networks With Matching Theory," the authors proposed a novel approach for minimizing the downloading latency and maximizing the social welfare simultaneously. In particular, authors first model the problem of maximizing social welfare as a many-to-one matching game based on the social property of mobile users. Authors study this game by exploiting users' social properties to generate the utility functions of the two-side players, i.e., content providers (CPs) and important users.

In "Insole Optical Fiber Sensor Architecture for Remote Gait Analysis—An eHealth Solution," the authors presented the development of a noninvasive optical fiber sensor architecture adaptable to a shoe sole for plantar pressure remote monitoring, which is suitable to be integrated into an IoT e-Health solution to monitor the well being of individuals. This paper explored the production of the optical fiber sensor multiplexed network (using Fiber Bragg Gratings) to monitor the foot plantar pressure distribution during gait (walking movement). From the acquired gait data, it is possible to infer the health conditions of the patient's foot and spine posture. To guarantee the patients mobility, the proposed system consists of an optical fiber sensor network integrated with a wireless transceiver to enable efficient ubiquitous monitoring of patients. This paper showed the calibration and measurement results, which reflect the accuracy of the proposed system, under normal walking in a controlled area.

In "Advancing NovaGenesis Architecture Toward Future Internet of Things," the authors addressed the current challenges for IoT and emerging architectures, including 5G and future Internet. Many architectural limitations, such as weak security, data distribution efficiency, provenance and traceability of sources, excessive human intervention, lack of interoperability, and service-awareness in device configuration, have been exposed and called the social attention. Authors also addressed these limitations by properly integrating five strategies: 1) efficient IoT data exchanging, storage and processing via information-centric networking; 2) contract-based IoT services composition; 3) software-control/management of IoT devices accordingly to the services requirements; 4) naming and name resolution of the physical and virtual entities, proving identifier/locator splitting and contextualized self-organization; and 5) name-based routing and network caching.

In "Spectrum Sharing With Network Coding for Multiple Cognitive Users," the authors considered an intelligently

Digital Object Identifier 10.1109/JIOT.2019.2896749

cooperative communication network with cognitive users, wherein a primary system and a secondary system, respectively, a message is communicated to their respective receiver over a packet-based wireless link. The secondary system assists in the transmission of the primary message employing network coding, on the condition of maintaining or improving the primary performance, and is granted limited access to the transmission resources as a reward. The users in both systems exploit their previously received information in encoding and decoding the binary combined packets.

In "Design of Hybrid Wireless and Power Line Sensor Networks With Dual-Interface Relaying in IoT," the authors designed a relay equipped with a dual wireless and PLC interface, which connects both the PLC and wireless sensors into an IoT network. Furthermore, the dual-interface relay forwards messages by adaptively selecting an interface according to the channel state. A general mathematical probability model of the dual-interface relaying system is presented. The probability density function of the output signal-to-noise ratio is developed, which is based on explicit closed-form expressions derived from the statistics character of the PLC and wireless channel.

In "Energy Management in RFID-Sensor Networks: Taxonomy and Challenges," the authors presented an overview of an RFID sensor network (RSN), its types of integration and relative applications. We then provided the state-of-the-art energy management techniques and strategies for RSN from August 2009 to date, thereby reviewing the existing energy harvesting and energy transfer mechanisms designed for RSN. The taxonomy on various challenges for EM in RSN has also been articulated for open research directives.

In "Industrial Internet of Things Driven by SDN Platform for Smart Grid Resiliency," the authors proposed a new SDN platform based on IIoT technology to support resiliency by reacting immediately whenever a failure occurs to recover smart grid networks using real-time monitoring techniques. We employ the SDN controller to achieve multifunctionality control and optimization challenge by providing operators with real-time data monitoring to manage demand, resources, and increasing system reliability. Data processing will be used to manage resources at the local network level by employing an SDN switch segment, which is connected to the SDN controller through an IIoT aggregation node.

In "Cross-Layer Optimization for Cooperative Content Distribution in Multihop Device-to-Device Networks," the authors discussed the content distribution problem by multihop D2D communication with decentralized CPs located in the networks. The authors considered a cross-layer multidimension optimization involving frequency, space, and time, to minimize the network average delay. Considering the multicast feature, the authors first formulate the problem as a coalitional game based on the payoffs of content requesters, and then, propose a time-varying coalition formation-based algorithm to spread the popular content within the shortest possible time.

In "A Lightweight Authentication Mechanism for M2M Communications in Industrial IoT Environment," the authors proposed a lightweight authentication mechanism, based only on hash and XOR operations, for M2M communications in the Industrial IoT environment. The proposed mechanism is characterized by low computational cost, communication, and storage overhead, while achieving mutual authentication, session key agreement, device's identity confidentiality, and resistance against the following attacks: replay attack, man-in-the-middle attack, impersonation attack, and modification attack.

In "Interference Cooperation via Distributed Game in 5G Networks," the authors designed a novel framework of the Nash noncooperative game with iterative convergence for downlink MU-MIMO. The authors first decompose the MU-MIMO into multiple virtual single-antenna transmit-receive pairs with a stream analytical model. Afterward, based on streams, the authors proposed a noncooperative water-filling power game with pricing (WFPGP) where the power strategy space of each stream can be dynamically determined by iterative water-filling. The authors derive the sufficient condition for the existence and uniqueness of the WFPGP game, in which the verification of the sufficient condition can be executed in a distributed manner.

To conclude, we first would like extend our appreciation to all the authors for their support and excellent contributions. We also would like to thank all the reviewers for their efforts in reviewing the papers, and for their valuable comments and constructive suggestions for improving the quality of the papers. Finally, we appreciate the advice and support of the Editor-in-Chief of this JOURNAL, Dr. Sherman Shen, for his help in the whole publication process.

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