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Editorial

Recent Advances in 5G Technologies: New Radio Access and Networking

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In Sept. 2015, the International Telecommunication Union-Radiocommunications Standardization Sector (ITU-R) has released the service recommendations of the fifth generation (5G) mobile networks known as International Mobile Telecommunications 2020 (IMT-2020). Instead of solely boosting the data rates, like the past evaluations from IMT-2000 to IMT-Advanced, an IMT-2020 system shall support three categories of wireless scenarios, including enhanced mobile broadband (eMBB), ultra-reliability and low latency communication (URLLC), and massive machine-type communication (mMTC), to sustain the 20 Gbps peak data rate, 100 Mbps user experienced data rate, 10 Mbps/m^2 area traffic capacity, 10^6 devices/km^2 connection density, 1 ms latency, and 500 km/hr mobility. To compete for being an IMT-2020 system, 3GPP consequently launched the normative works of "New Radio (NR)" in Release 15 and Release 16. In Jun. 2018, Phase I normative work of NR (i.e., Release 15) has completed, and Phase II (i.e., Release 16) has subsequently begun. The feature technologies in NR thus include communications using millimeter/centimeter wave carriers (spectrum above 6 GHz), nonorthogonal multiple access (NOMA), advanced vehicle-to-everything (V2X), directional transmission/reception, software-defined network (SDN), etc.

To service the urgent needs in normative works of NR, this special issue thus aims at bringing together the state-of-the-art innovations, research activities (both in academia and industry), and the corresponding standardization impacts of NR, so as to comprehend the inspirations, requirements, implementation, and the promising technical options to boost, practice, and deploy the NR.

In the paper titled "Exploiting Impacts of Intercell Interference on SWIPT-Assisted Non-Orthogonal Multiple Access," the influence of intercell interference (ICI) on the system outage behavior with important derived results in the proposed model of simultaneous wireless information and power transfer (SWIPT) together with NOMA using the amplify-and-forward protocol is examined. The authors further derive the closed-form expression of coverage probability for two NOMA users as a function of the signal-to-interference-plus-noise ratio (SINR) and investigate the average outage probability by considering impacts of the reasonable number of participating ICI.

In the paper titled "MC-GiV2V: Multichannel Allocation in mmWave-Based Vehicular Ad Hoc Networks," a Giga-V2V (GiV2V) network is proposed, in which vehicles query and deliver high quality video and sensor data of smart and self-driving cars using mmWave communications instead of current dedicated short-range communications (DSRC). Vehicles probably form a grid topology along lanes of a road, which leads to align mmWave beams of the vehicles and cause mutual interference among them. As channel diversity can resolve effectively the interference between mmWave beams, several heuristic algorithms for channel assignment of each beam in the GiV2V networks are also proposed.

In the paper titled "Micro Operator Design Pattern in 5G SDN/NFV Network," the authors discuss the deployment of Micro Operator (μO) to reduce network latency in response

to the low-latency applications for future 5G edge computing environment. The authors consequently address the design pattern of 5G micro operator and propose a Decision Tree Based Flow Redirection (DTBFR) mechanism to redirect the traffic flows to neighbor service nodes. The proposed DTBFR mechanism thus allows different μOs to share network resources and speed up the development of edge computing in the future.

In the paper titled "Energy-Efficient Uplink Resource Units Scheduling for Ultra-Reliable Communications in NB-IoT Networks," the issue of how to guarantee the reliable communication and satisfy the quality of service (QoS) while minimizing the energy consumption for IoT devices is studied. The authors model the problem as an optimization problem and prove it to be NP-complete and then propose an energy-efficient, ultra-reliable, and low-complexity scheme. Extensive simulation is also conducted to show that the provided scheme can serve more devices with guaranteed QoS while saving their energy effectively.

In the paper titled "Genetic Algorithm-Based Beam Refinement for Initial Access in Millimeter Wave Mobile Networks," the initial access issue in 5G networks operating at carrier frequencies is investigated. The authors extend the proposed genetic algorithm- (GA-) based beam refinement scheme to include beamforming at both the transmitter and the receiver and compare the performance with alternative approaches in the millimeter wave multiuser multiple-input-multiple-output (MU-MIMO) networks. The effect of different parameters such as the number of transmit antennas/users/per-user receive antennas, beamforming resolutions, and hardware impairments on the system performance employing different beam refinement algorithms is investigated and shows that the proposed GA-based approach performs well in delay-constrained networks with multi-antenna users.

In the paper titled "RF Driven 5G System Design for Centimeter Waves," the authors describe their experiences in developing a centimeter waves mobile broadband concept satisfying future capacity requirements. The first step in the process is the radio channel measurement campaign and statistical modeling. Then the link level design is performed tightly together with the radio frequency (RF) implementation requirements to allow as large scalability of the air interface as possible. The authors started the concept development at 10 GHz frequency band and during the project World Radiocommunication Conference 2015 selected somewhat higher frequencies as new candidates for 5G. The main learning is to gain insight of interdependencies of different phenomena and find feasible combinations of techniques and parameter combinations that might actually work both in practice and in theory.

Conflicts of Interest

This is to confirm that there are no conflicts of interest.

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