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Editorial: Reliable Communication for Emerging Wireless Networks

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1 Editorial

As many as 50 billion devices will be connected to the Internet by 2020. It is predicted that the number of mobile-connected devices will exceed 11.5 billion by 2019 (nearly 1.5 mobile devices per capita), which poses a huge traffic demand for ubiquitous communications. Data rates are projected to increase by a factor of ten every five years, and with the emerging Internet of Things (IoT) predicted to wirelessly connect trillions of devices across the globe. It is anticipated that we will witness an up to 10,000- fold growth in wireless data traffic by the year 2030. Predictions evidently indicates that the growth in data traffic will cater unprecedented services and applications for machine type communication such as driverless vehicles and drone-based deliveries, smart cities and factories, remote medical diagnosis and surgery, and artificial intelligence- based personalized assistants along with traditional human-centric communications. Coexistence of human-centric and machine-type services as well as hybrids of these will make next generation wireless networks more diverse and complex. Current wireless radio access techniques are not capable of delivering these new applications and services as they are very different from traditional human-centric communications in terms of reliability, latency, energy efficiency, security, flexibility, and connection density. Without novel approaches, future wireless mobile networks (5G and beyond) will grind to a halt unless more capacity is created, on the other hand, to cope with the challenges due to new service categories, a new look on the wireless networks is required to meet performance requirements such as massive connectivity, lower latency, higher reliability, better energy efficiency and security.

To overcome the aforementioned challenges of emerging wireless communications and networks for 5G and Beyond, this special issue focuses on (but are not restricted to) the following topics: Ultra-reliable and low latency communication (URLLC); Massive machine-type communication (mMTC); New air interface design for 5G (New Radio (NR)); QoS/QoE mechanisms for wireless communications and networks; 5G wireless heterogeneous networks: design and optimization; Sensing technologies and applications for 5G; 5G wireless communications and networks for surveillance and management; 5G Cognitive networks and IoT; Experimental results, prototypes, and testbeds of 5G wireless communications and networks; Integration and co-existence of 5G wireless communication and network technologies; Energy efficiency (harvesting and saving) wireless protocols and algorithms for 5G; Security and privacy concerns in 5G wireless communications; NOMA, full-duplex, massive MIMO; Green 5G multimedia wireless networks; AI techniques for Wireless Communication and security; MmWave Massive MIMO; and Hardware impairments affecting wireless communications.

This special issue includes eight high-quality papers. In the first paper entitled "Joint User Association and Power Allocation for Millimeter-Wave Ultra-Dense Networks," the authors consider millimeter-Wave (mmWave) communication in ultra-dense networks (UDNs), where many small-cell base stations (SBSs) are deployed. The key idea of the proposed scheme is to jointly optimize the SBS-UE association and power allocation to maximize the system energy efficiency while guaranteeing the quality of service (QoS) constraints for each user. Towards a practical application, successive convex approximation is developed to for its solution, where the nonconvex parts are converted into the simple convex quadratic functions at each iteration.

In the second paper, entitled "Coordinated Handover Signaling and Cross-Layer Adaptation in Heterogeneous

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Wireless Networking," a cross-layer-based adaptive vertical handoff algorithm to reduce the handover latency and signaling overhead. In this way, the proposed cross-layer scheme is able to provide the sender with prediction of the available bandwidth. Evaluation results demonstrate the achieved improvements over the existing schemes.

In the third paper, entitled "Uplink Resource Allocation for Multi-Cluster Internet-of-Things Deployment Underlaying Cellular Networks," to enable uplink transmission in multiple IoT groups/clusters, the authors consider Device-to-Device (D2D) communication technology, where the resource block (RB) of each cellular user is reused by multiple IoT devices (IoTDs). The authors formulate the optimization problem of joint resources and power allocation optimization to maximize both the IoTDs connectivity and cell throughput under the interference constraint. A heuristic, but efficient algorithm, namely greedy iterative matching (GIM), is proposed as for its suboptimal solution. Simulations results are provided to demonstrate that the proposed algorithm is capable of enhancing cell throughput gain and accessibility to IoTDs.

To cope with the mass and different communication requirements of tremendous intelligent vehicles, the authors of the fourth paper "Consortium Blockchain-Based Secure Software Defined Vehicular Network" design a decentralized trust management architecture which constitutes of three layers based on consortium blockchain. They propose a joint proof-of-stake and modified practical Byzantine fault tolerance (PoS-mPBFT) algorithm to reduce the confirmation time, where a prediction model is used to estimate trust value of vehicles in the next period. Numerical results show that the proposed trust management architecture and algorithm could provide better safety in SDVN and reduce consensus time.

To improve the efficient data transmission in 5G networks, the fifth paper "PBDT: An Energy-Efficient Posture based Data Transmission for Repeated Activities in BAN" considers a scheme, namely posture based data transmission (PBDT) which is based on the occurrence of potential (best) posture over time in repeated activities. In the proposed PBDT, each node first recognizes the sequence of postures by observing the variation of received signal strength indicator from neighbor nodes over time, and then finds the best posture from posture sequence for data transmission, and maintains a dynamic active/sleep schedule in order to reduce lossy transmission, collision and overhearing.

Motivated to solve the problem of the users' discovery to timely communicate the emergency information, the sixth paper entitled "Full-Duplex Enabled Time-Efficient Device Discovery for Public Safety Communications" proposes to use the in-band full duplex (IB-FD) communication as an enabler to quickly discover the user due to simultaneous transmission and reception in the same time-frequency resource. In particular, the frame structure for IB-FD system with prioritized public safety (PS) users is proposed. Aiming at spectral efficiency, time-efficient device discovery resource allocation (TE-DDRA) scheme is also proposed, which is capable of switching the transmission mode from HD to IB-FD if the demand exceeds the available resources. Simulation results verify that with PS priority mode around 37% discovery time as compared with random access mode.

The seventh paper is on "Topology Optimizing in FSO-based UAVs Relay Networks for Resilience Enhancement" in which the free space optical (FSO) in unmanned aerial vehicles (UAVs) relay networks is considered. In particular, the authors investigate the network topology formation problem by considering the network resilience, where the resilience is referred to the ability of a network topology to defend against link failures. The network topology formation problem is formulated as a mixed integer nonlinear optimization problem to maximize the network resilience. To this end, two network resilience aware topology formation (NRATF) methods (i.e., centralized-NRATF and distributed-NRATF) are proposed to solve the topology designing problem efficiently.

The last paper in this special issue is "Performance Analysis of Full-Duplex Vehicle-to-Vehicle Relay System over Double-Rayleigh Fading Channels." In this paper, the authors study the performance of a full-duplex (FD) relay system in vehicle-to-vehicle (V2V) communication, where the communication link from the source to relay node can be modeled by Rayleigh fading or double (cascaded) Rayleigh fading distributions while the link from the relay to the destination is modeled by double Rayleigh fading distribution. They derive the exact analytical expressions for the outage probabilities (OPs) and symbol error rates (SERs) in two cases, i.e. case A (the first hop is the Rayleigh fading channel and the second hop is double Rayleigh fading channel) and case B (two hops are the double Rayleigh fading channels). In addition, the impacts of the distances between the nodes and the residual self-interference at the FD relay are studied. Extensive numerical results are provide to show that the system performance in terms of OP and SER in the case of double Rayleigh fading channels is significant lower than the case of Rayleigh fading channels.

Trung Q. Duong (Senior Member of IEEE) is a Reader (Associate Professor) at Queencs University Belfast, U.K. His current research interests include IoT (applied to disaster management, agriculture, hydro-meteorological hazards, smart grid) 5G networks (small-cell networks, ultra-dense networks, HetNets, physical layer security, massive MIMO, cell-free massive MIMO, caching, energy-harvesting), and nanoscale, molecular communications networks. He has authored or co-authored of more than 340+ papers including 210 ISI journal articles with 9000+ citation and a h-index 50 in Google Scholar. He is currently serving as an Editor for IEEE Trans on Wireless Communications, IEEE Trans on Communications, IET Communications and a Lead Senior Editor for IEEE Communications Letters. He has served as a Guest Editor for more than 30 times on ISI-index journals including the IEEE Journal in Selected Areas on Communications 2015, IET Communications 2014, 2016, 2017, IEEE Communications Magazine 2014 and 2015, IEEE Access 2016, 2017, 2018, IEEE Wireless Communications Magazine 2015, EURASIP JWCN, EURASIP JASP. He was an Editor of Electronics Letters, Emerging Telecommunications Technologies, IEEE Communications Letters. He has served as a chair/organiser for more than 30 conferences/workshops including the IEEE GLOBECOM 2016 Symposium Chair. Dr. Duong was awarded the Best Paper Award at the IEEE Vehicular Technology Conference (VTC-Spring) in 2013, the IEEE International Conference on Communications (ICC) 2014, the IEEE Global Communications Conference (GLOBECOM) 2016 and 2019, IEEE Digital Signal Processing (DSP) 2017. He is a recipient of prestigious Royal Academy of Engineering Research Fellowship from 2016 to 2021 and has won the prestigious Newton Prize 2017.

Chinmoy Kundu received the B.Tech. and M.Tech. degrees in communication engineering in 2007 and 2010, respectively, and the Ph.D. degree in electrical communication engineering from the Bharti School of Telecommunication Technology and Management, IIT Delhi, in 2015. From 2007 to 2008, he was with IBM India Pvt. Ltd., as an Associate System Engineer. From 2008 to 2010, he was with the Central Mechanical Engineering Research Institute, Durgapur, India, as a Junior Research Fellow. From 2015 to 2016, he was a Post-Doctoral Fellow in Memorial University, NL, Canada. He has been a Visiting Research Fellow with the School of Electronics, Electrical Engineering and Computer Science, Queen's University Belfast, U.K., since 2016. His current research interests are physical layer security, optimization, and cooperative communication. He has served as a reviewer and member of Technical Program Committees for several IEEE journals and conferences in communications. He was a recipient of the Newton International Fellowship from the Royal Society, U.K., in 2016, the INSPIRE Faculty Award from the Department of Science and Technology, Government of India, in 2016, and the Junior Research Fellowship from the Council of Scientific and Industrial Research, Government of India, in 2008. He has published in total 16 journals and 18 conferences many of them were published in reputable journals and conferences like IEEE Transactions on Wireless Communications, IEEE Wireless Communications Letters, IEEE Communications Letters, IET Communications, IEEE Global Communications Conference etc. He has been awarded the Best Paper Award at SigTelCom 2018. He has served as TPC members of many reputable IEEE conferences, session chair at IEEE GLOBECOM and workshop chair at INSICOM-18.

Antonino Masaracchia received the M.Sc. degree in Telecommunication Engineering (magna cum Laude) from the University of Palermo in 2012. In 2013 he started his Ph.D. studies at the University of Palermo in joint supervision with the Institute of Informatics and Telematics (IIT) of the National Research Council (CNR) of Pisa. His research activities were related to the design and validation of a new network architecture able to perform data traffic offloading from the 4G/LTE cellular networks to another complementary network, e.g. Wi-Fi or Bluetooth, by exploiting device-to device (D2D) communication according to the opportunistic networking paradigm. Furthermore, he analyzed mathematically and through numeric simulations the performance and limits of some LTE subsystems through a cross-layer approach considering key aspects of the PHY and MAC layers of the LTE standard. All results obtained from his research activities have been important contributions from IIT-CNR to the FP7-MOTO European Project, which has been considered by the European Commission as one of the precursor projects for the development 5G technologies inside the 5G-PPP Programme. On March 2016 he obtained his Ph.D. in Electronics and Telecommunication Engineering from the University of Palermo. From November 2016 to June 2017, he was Post-Doctoral Fellow at the Department of Information Engineering of Pisa. During this period, he conducted activities related to the European Project Umi-Sci-Ed, developing educational scenarios based on Ubiquitous Computing, Mobile Computing and IoT for promoting STEM education. In addition, he conducted research activities related on SDN, NFV and IoT. From July 2017 to August 2018, he was Post-Doctoral Fellow at the BioRobotics Institute of Sant'Anna School of Advanced Studies, conducting research activities related to the European Project Endoo in the vision of Industry 4.0. He has served as a reviewer for some IEEE and Springer journals and conferences on communication Networks. He has published in total 1 journal and 4 conference some of them published in reputable journal and conferences like, Annals of Biomedical Engineering, IEEE Vehicular Technology Conference (VTC), IEEE International Conference on Mobile Ad hoc and Sensor Systems (IEEE- MASS) and IEEE World Of Wireless, Mobile and Multimedia networks (IEEE WoWMoM).

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