Special Issue on 6G Wireless Systems

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While 5G is currently being deployed around the globe, research on 6G is under way aiming at addressing the coming challenges of drastic increase of wireless data traffic and support of other usage scenarios. 6G is expected to extend 5G capabilities even further. Higher bitrates (up to Tbps) and lower latency (less than 1ms) will allow introducing new services – such as pervasive edge intelligence, ultra-massive machine-type communications, extremely reliable low-latency communications, holographic rendering and high-precision communications – and meet more stringent requirements, especially in the following dimensions: energy efficiency; intelligence; spectral efficiency; security, secrecy and privacy; affordability; and customization. Artificial intelligence approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), and machine reasoning (which includes planning, scheduling, knowledge representation and reasoning, search and optimization), are the new fundamental enablers to operate networks more efficiently, enhance the overall end user experience and provide innovative service applications. Quantum Optics Computing (QOC) and Quantum Key Distribution (QKD) are almost ready for industrial applications. In particular, massive Internet of Things (mIoT), Industrial IoT (IIoT), fully automated robotic platforms (which include control, perception, sensors and actuators, as well as the integration of other techniques into cyber-physical systems), vehicles and multisensory extended reality are examples of the new data-demanding applications, which will impose new performance targets and motivate 6G design and deployment.

This special issue of JCN presents three high quality research articles related to the area of 6G Wireless Systems. The Guest Editors want to express their thanks to all authors who submitted their manuscripts to this Special Issue, as well as all the reviewers for their competent and timely reviews. Our thank goes to the Journal of Communications Networks for the opportunity to establish this Special Issue and to Grace Kim for her support and guidance during the whole editorial process.

The papers in this special issue report latest research on promising techniques for wireless systems enhancements towards 6G, namely: Spectrum Sharing, Machine Learning and Unmanned Aerial Vehicles for Wireless Communications.

The first paper "*Expansive Networks: Exploiting Spectrum Sharing for Capacity Boost and 6G Vision*" by Gurkan Gur, proposes the concept of "expansive networks" for 6G networks to address capacity and scalability challenges. To illustrate this concept, the author considers spectrum resources as a case study and discusses the spectrum sharing vision in 6G networks from a co-existence perspective of diverse networks.

The paper "*A Deep-Q Learning Approach to Mobile Operator Collaboration*" by Athanasios Karapantelakis and Elena Fersman proposes an agent-based architecture that utilizes machine learning to predict future service demand through the collaboration of Mobile Network Operators. The results of the considered approach demonstrate that the proposed optimal operator collaboration is very efficient in fulfilling service demand and requirements.

The third paper "*Optimal 3D UAV BS Placement by Considering Autonomous Coverage Hole Detection, Wireless Backhaul and User Demand*", co-authored by Shahriar Abdullah Al-Ahmed, Muhammad Zeeshan Shakir and Syed Ali Raza Zaidi, studies the problem of coverage holes in the region of network operators. The proposed approach considers the use of Unmanned Aerial Vehicles (UAVs) and Q-learning for the detection of coverage holes in a given area together with the optimal deployment of UAV based Base Stations (UAV-BSs), in order to provide an efficient on-demand coverage.

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Sajal K. Das is a professor of Computer Science and the Daniel St. Clair Endowed Chair at the Missouri University of Science and Technology, where he was the Chair of Computer Science Department during 2013-2017. He served the NSF as a Program Director in the Computer Networks and Systems division during 2008-2011. Prior to 2013, he was a University Distinguished Scholar Professor of Computer Science and Engineering and founding director of the Center for Research in Wireless Mobility and Networking at the University of Texas at Arlington. His research interests include wireless and sensor networks, mobile and pervasive computing, mobile crowd sensing, cyber-physical systems and IoT, smart environments (e.g., smart city, smart grid, smart transportation, and smart health), distributed and cloud computing, cyber security, biological and social networks, and applied graph theory and game theory. He has made fundamental contributions to these areas, and published extensively with over 700 research articles in high quality journals and refereed conference proceedings. Dr. Das holds 5 US patents and coauthored 4 books – Smart Environments: Technology, Protocols, and Applications (John Wiley, 2005), Handbook on Securing Cyber-Physical Critical Infrastructure: Foundations and Challenges (Morgan Kauffman, 2012), Mobile Agents in Distributed Computing and Networking (Wiley, 2012), and Principles of Cyber-Physical Systems: An Interdisciplinary Approach (Cambridge University Press, 2020). His h-index is 88 with more than 34,500 citations according to Google Scholar. He is a recipient of 10 Best Paper Awards at prestigious conferences like ACM MobiCom and IEEE PerCom, and numerous awards for teaching, mentoring and research including the IEEE Computer Society's Technical Achievement Award for pioneering contributions to sensor networks and mobile computing, and University of Missouri System President's Award for Sustained Career Excellence. Dr. Das serves as the founding Editor-in-Chief of Elsevier's Pervasive and Mobile Computing Journal, and as Associate Editor of several journals including the IEEE Transactions on Dependable and Secure Computing, IEEE Transactions on Mobile Computing, and ACM Transactions on Sensor Networks. He is an IEEE Fellow.