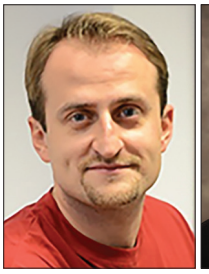
MOBILE COMMUNICATIONS AND NETWORKS


Tom Alexander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The widespread deployment of mobile networks that we have witnessed in the last decade has made ubiquitous and seamless mobile broadband data connectivity a reality to the benefit of people, businesses, and governments in many regions of the world. Nevertheless, new emerging applications demand future networks to provide more efficient, flexible, reliable, and massive mobile connectivity according to previously unseen modalities.

Imagine 50 billion IoT devices connected to the Internet (by 2020, according to Cisco's estimate) without licensed spectrum or exclusive frequency assignments for the communication. How can that be possible, you may wonder? Fortunately, the Third Generation Partnership Project (3GPP) in Release 13 has already standardized three possible solutions for this purpose by proposing to share the cellular spectrum with IoT. Extended Coverage GSM IoT, Narrowband IoT, and Enhanced Machine Type Communication are these three solutions, which are the focus of the article, "Multi-Operator Network Sharing for Massive IoT" included in the present issue of this Series. This well written article covers the architectural specifics of the solutions, associated design challenges with spectrum sharing, and the tolerable throughput degradation to be experienced by cellular subscribers.

Mesh networks for wireless LANs have been proposed for nearly two decades now, and standardized as IEEE 802.11s more than eight years ago. However, many practical issues created obstacles to reliable and efficient mesh networks, and as a result they have only found widespread adoption in the past few years. The vagaries of radio channels pose very hard optimization problems for mesh networks; machine learning (ML) techniques have recently been proposed for solving these issues. The second article, "An Overview of Machine Learning Approaches in Wireless Mesh Networks," provides a good introduction and survey of ML applications to wireless meshes. The article not only covers the various ML techniques, but also describes the key issues to be solved for meshes to work properly, and then explains how different ML techniques may be applied to these solutions.

As the manufacturing industry is approaching a new era along its evolution, Industry 4.0, adoption of wireless technologies in its processes has remained rather limited. The article "A Square Peg in a Round Hole: The Complex Path for Wireless in the Manufacturing Industry" contains an in-depth analysis of the possible reasons for the scarce penetration of wireless in the manufacturing industry. The article discusses major shortcomings of wireless technologies when faced with the challenging requirements of certain applications. The article investigates the causes of the present situation, argues about a mismatch between research efforts and industry expectations/requirements as a plausible cause, and reveals possible convergence paths.

In the article "Customization and Trade-offs in 5G RAN Slicing," Sexton *et al.* investigate how adding lower layer flexibility to the 5G radio access network (RAN) impacts the slicing process with special focus on providing isolation among the resulting slices. The authors first analyze how slices can be customied according to the specifics of various services. Then they analyze the time-frequency resource structure of the RAN and emphasize the trade-off between flexibility and the overhead incurred due to coexistence of divergent slices. Finally, the separation of the service-type-based resource allocation from the allocation for individual services of this type is proposed.

Fifth generation cellular networks are expected to deliver gigabits-per-second data rates to mobile users through the wide bandwidths available at mmWave frequencies. At such high frequencies, radio signals experience high propagation loss and harsh channel conditions. Thus, adoption of efficient beamforming solutions and accurate beam management procedures are needed to address those drawbacks. The article "Standalone and Non-Standalone Beam Management for 3GPP NR at mmWaves" analyzes beam management in the 3GPP NR standard specification. The article discusses NR networks deployed according to standalone and non-standalone paradigms and proposes possible enhancements. The authors evaluate the benefits that the NR mmWave network would enjoy if NR beam reporting could be carried out with lower latency through the LTE network.

The Mobile Communications and Networks Series Editors are grateful to many committed reviewers, for their valuable efforts in providing sound recommendations and guidance, and to the authors of published papers, for their efforts in improving their manuscripts. Finally, we would like to encourage our readership to submit new high-quality manuscripts to our Series.

BIOGRAPHIES

THOMAS ALEXANDER (tom@uplevelsystems.com) is CEO of Uplevel Systems Inc., Portland, Oregon. Previously he held senior technical positions at Ixia Communications, VeriWave Inc (acquired by Ixia), PMC-Sierra Inc, and Bit Incorporated (acquired by PMC-Sierra). Prior to that, he was a research assistant professor at the University of Washington. He has been involved in various aspects of wired and wireless networking R&D since 1992, in the areas of ATM, SONET/SDH, Ethernet, and 802.11. He has also been active in standards development, and has served as Editor for IEEE 802.3ae, Chief Editor for IEEE 802.17, and Technical Editor for IEEE 802.11. He received his Ph.D. from the University of Washington in 1990.

WOJCIECH MAZURCZYK [M'11, SM'13] received his M.Sc., Ph.D. (Hons.), and D.Sc. (habilitation) degrees in telecommunications from Warsaw University of Technology (WUT), Poland, in 2004, 2009, and 2014, respectively. He is currently an associate professor with the Institute of Telecommunications, WUT. His research interests include network security, bio-inspired cybersecurity and networking, and information hiding. Since 2018 he has been an Associate Editor of *IEEE Transactions on Information Forensics and Security*.

AMITABH MISHRA (amitabh@cs.jhu.edu) studies mobile wireless computer-communication networks in two distinct areas. The performance and architectures of cellular, ad hoc, sensor, dynamic spectrum access (DSA), and mobile cloud is the first area that involves the cross-layer optimization of sensor networking protocols, fluid flow modeling of multipath TCP, and MAC for cellular-ad hoc interworking for DSA as examples. Network security and computer forensics is the second area in which he analyzes the vulnerabilities of emerging mobile networks using traditional and machine learning approaches (e.g., adversarial machine learning for IoT). He is affiliated with Johns Hopkins University.

ALBERTO PEROTTI [SM'14] is a senior research engineer at Huawei Technologies, where he is performing research on the PHY layer of wireless networks. Previously, he carried out research and teaching of wireless communications at Politecnico di Torino, Italy, from which he received his Ph.D. in telecommunications in 2003. His research interests include channel coding and modulation, multiple access, and software-defined radio.