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IEEE *ACCESS* SPECIAL SECTION EDITORIAL: 5G WIRELESS TECHNOLOGIES: PERSPECTIVES ON THE NEXT GENERATION OF MOBILE COMMUNICATIONS AND NETWORKING

To meet the requirements of 5G on enabling higher capacity, faster rates, more connectivity, higher reliability, lower latency, greater versatility, and application-domain specific topologies, new concepts and design approaches are in great need. Current standards for 4G may influence the introduction of radio features and network solutions for 5G systems. New network architectures extending beyond heterogeneous networks and exploiting new frequency spectra (e.g., millimeter wave) are emerging from research laboratories around the world. In addition to the network side, advanced terminals and receivers are being developed to optimize network performances. Splitting the control and data planes [currently studied in 3G Partnership Project (3GPP)] is an interesting paradigm for 5G, together with massive multi-input multi-output (MIMO), advanced antenna systems, software-defined networking (SDN), network functions virtualization (NFV), the Internet of Things, and cloud computing. Also, new radio protocols enabling heterogeneous traffics are required.

This special section in the IEEE ACCESS aims to present the latest advances in the fundamental technologies and market trends that will impact the design and standardization of 5G networks by bringing together academic and industrial researchers to identify and discuss technical challenges related to 5G. In response to the Call for Papers, we were pleased to see many submissions from various countries and regions all over the world. In this section, we have selected the following outstanding articles that reflect the importance of this research field.

In the first article, "Radio Interface Evolution Towards 5G and Enhanced Local Area Communications", Levanen *et al.* present their novel physical layer numerology and frame design that are envisioned to combine the best aspects of the IEEE WLAN 802.11 product family and 3GPP LTE-A femtocells. The new design facilitates very low latencies and high energy efficiency while providing very high throughput and spectral efficiency in ultradense small cell deployments with minimal coordination. This article provides new ideas regarding how the physical layer should be built in order to drop the heavy burden of backward compatibility. The authors especially seek to catalyze discussion and research on new radio interfaces for 5G local area communications.

In the second article, "Service-Specific Network Virtualization to Reduce Signaling Processing Load in EPC/IMS", Ito *et al.* demonstrate that the signal processing load can be reduced by constructing virtual networks specialized for particular services. This article proposes a mechanism that enables services to be processed in appropriate virtual networks by forwarding a sequence of signaling messages to appropriate virtual networks. This work could be useful for 5G to enable higher capacity for a wide range of services.

The challenge of identifying the cause of link congestion between any pair of switch ports in a typical 5G data center network is addressed in the third article, "Scalable and Efficient Diagnosis for 5G Data Center Network Traffic", in which Liu *et al.* propose two sketch-based algorithms, called a-conservative update (CU) and P(d)-CU, based on the existing CU approach. They also introduce a way to produce the real-time moving average of the reported results. Experimental results prove its superior performance in terms of low error, space cost, time complexity, and high recall.

In the fourth article, "Novel UWB and Spread Spectrum System Using Time Compression and Overlap-Add Techniques", Driessen *et al.* introduce a new concept and design approach to the air interface physical layer that may be relevant to 5G wireless technologies. A key feature of this scheme is that an exact sample rate match is not required to recover the signal. This method is implemented in a custom wideband software-defined radio (SDR) with good results in the presence of interference and multipath.

In the fifth article, "Lightweight Mobile Core Networks for Machine Type Communication", Ksentini *et al.* propose an architecture-level solution, whereby cloud-based lightweight mobile core networks dedicated for specific machine-type communication (MTC) services are created on demand and in an elastic manner. The network attach procedure for MTC devices is further simplified. The authors also shed light on how the creation of MTC-dedicated cloud-based mobile core networks and their lifecycle management can be orchestrated

and showcase existing tools and technologies useful for their real-life implementation.

The sixth article, "A LISP-Based Implementation of Follow Me Cloud", describes the local/identifier separation protocol (LISP) implementation of the follow me cloud (FMC) concept, wherein not only content/data, but also service follows the user. LISP-based FMC implementation is able to ensure efficient virtual machine (VM) mobility (migration), and hence service continuity, by reducing the VM downtime to the subsecond level. Moreover, to be compliant with the 5G vision, all the FMC as well as LISP entities are developed according to the NFV concept.

In the seventh article, "MIMO Characterization on System Level of 5G Micro Base Stations Subject to Randomness in LOS", Per-Simon *et al.* introduce a systematic approach to include the statistical properties of the user and his terminal when characterizing performance. The authors elaborate on the characterization of an example antenna in both rich isotropic multipath and random line-of-sight (LOS).

The eighth article, "Dense Dielectric Patch Array Antenna With Improved Radiation Characteristics Using EBG Ground Structure and Dielectric Superstrate for Future 5G Cellular Networks", proposes a novel dense dielectric (DD) patch array antenna prototype operating at 28 GHz for 5G cellular networks. It also presents a detailed comparison of performance between the proposed DD patch array and a conventional metallic one.

In the ninth article, "User Grouping for Massive MIMO in FDD Systems: New Design Methods and Analysis", Yi *et al.* present three novel similarity measures for user grouping based on weighted likelihood, subspace projection, and Fubini–Study, respectively, as well as two novel clustering methods, including hierarchical and K-medoids clustering. Furthermore, this article proposes a dynamic user scheduling scheme to further enhance the system throughput once the user groups are formed.

The tenth article, "Integration of SDR and SDN for 5G" by Hsin-Hung *et al.* presents a cross-layer architecture combining SDR and SDN characteristics. As the simulation evaluation results suggest, the proposed architecture can effectively use the frequency spectrum and considerably enhance network performance.

In the eleventh article, "Device-to-Device Communications for National Security and Public Safety", G. Fodor *et al.* extending the concept of network-assisted (underlay) device-to-device communications to situations in which the cellular coverage is partially or completely missing and propose a clustering-procedure-based approach to the design of a system that integrates cellular and ad hoc operation modes depending on the availability of infrastructure nodes.

The last article, "Exploring Coordinated Multipoint Beamforming Strategies for 5G Cellular", provides a thorough overview of existing algorithms for transmission coordination and interference cancellation in the context of cellular wireless systems. It also provides guidelines for selecting the best performing method depending on the particular transmission situation.

In closing, we would like to thank all the authors who submitted their research work to this special section. We would also like to acknowledge the contribution of many experts in the field who have participated in the review process and provided helpful suggestions to the authors to improve the content and presentation of the articles. We would, in particular, like to thank Prof. Michael Pecht, the Editor-in-Chief, for his support and very helpful suggestions and comments during the delicate stages of concluding this special issue.

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