Editorial

Smart Spectrum and Radio Resource Management for Future 5G Networks

This Special Issue on *Smart Spectrum and Radio Resource Management for Future 5G Networks* brings together state-of-the-art research contributions that describe original work addressing the challenges of spectrum and radio resource management in future 5G networks. The radio spectrum is a scarce and precious resource in wireless communications, in general, and mobile communication networks, in particular. The imperative need for an utterly efficient exploitation of the available spectral resources has historically shaped the evolution of the mobile network technology. This remains true in the context of 5G mobile networks and beyond, where the deployment of enhanced Mobile Broadband (eMBB), massive Machine Type Communication (mMTC) and Ultra-Reliable Low-Latency Communication (URLLC) services poses unprecedented challenges in terms of required network capacity, coverage, spectrum and energy efficiency, user and aggregated data rates, network reliability and latency. This heterogeneous scenario of complex and demanding performance requirements claims for innovative solutions that can effectively optimize the exploitation of the limited spectrum and radio resources available in order to facilitate the vision for 5G networks and beyond.

We are very pleased to introduce this Special Issue on *Smart Spectrum and Radio Resource Management for Future 5G Networks*, which is the result of an extensive collective effort from authors, reviewers, guest editors and the journal staff. The purpose of this Special Issue is to gather recent advances in the area of smart spectrum and radio resource management for future 5G networks. The relevance of the research area addressed by this Special Issue has stimulated a great response from the research community, attracting multiple submissions from around the world. All submissions have undergone a rigorous review process coordinated by the Guest Editorial team and supported by international expert reviewers. As a result, six high-quality articles have been selected for publication in this special issue. The selected articles provide a representative snapshot of some of the latest developments in the field.

The paper "A novel method for the optimization of spectral-energy efficiency tradeoff in 5G heterogeneous cognitive radio networks" by S. Sasikumar and J. Jayakumari addresses the crucial and well-known problem of energy and spectrum efficiency trade-off in the context of 5G heterogeneous networks with a novel technique based on the principles of cognitive radio and carrier aggregation. The technique proposed in this article performs resource allocation according to a multi-objective optimization approach based on a modified genetic algorithm, outperforming conventional methods and providing a faster convergence to Pareto-optimal solutions.

The paper "Joint user association and resource allocation in HetNets based on user mobility prediction" by Z. Cheng, N. Chen, B. Liu, Z. Gao, L. Huang, X. Du and M. Guizani explores the problem of user association and resource allocation in heterogeneous networks. Concretely, a scenario of virtual small cells formed by directional beams is considered in order to increase system capacity and reduce site cost, which is seen as an alternative to the concept of small cells within the coverage range of macro cells. A Markov model for user mobility prediction is introduced and exploited to find the optimal user association and resource allocation strategies, based on a multi-agent Q-learning method supported by a deep Q-network to accelerate convergence.

Scalability and flexibility are two important targets for the 5G radio access network. The cloud radio access network concept has emerged in this context with the aim to maximize physical resource utilization while minimizing its associated cost. The paper "Utilization-aware VB migration strategy for inter-BBU load balancing in 5G cloud radio access networks" by B. Mahapatra, A. K. Turuk, S. K. Panda and S. K. Patra proposes a framework to balance the load between different base-band units of a cloud radio access network architecture based on a virtual box live migration strategy. The proposed strategy achieves load balancing in two steps, an expected completion time-based resource allocation step and a utilization factor-based virtual box migration step. The proposed live migration technique can enhance the quality of service experienced in a cloud radio access network by reducing the server downtime and migration time.

With the expectation of 5G becoming a key connectivity technology for a rapidly growing number of machine type devices, the shift to higher frequency ranges such as the lower terahertz band seems inevitable. The paper "Application of non-orthogonal multiple access for machine type communication in sub-terahertz band" by S. R. Sabuj, A. M. M. S. Khan and M. Hamamura presents a machine type communication system model in the sub-terahertz band based on a non-orthogonal multiple access technique and provides its performance analysis and optimization in terms of data rate as well as spectral and energy efficiencies.

The paper "Mathematical evaluation of spectrum sharing in cognitive radio networks for 5G systems using Markov processes" by A Briones-Reyes, L. A. Vásquez-Toledo, A. Prieto-Guerrero and R. Aguilar-González presents a Markovian mathematical teletraffic model for resource allocation using power-domain non-orthogonal multiple access in a cognitive radio environment. The proposed model considers an interweave spectrum sharing scenario where the proposed non-orthogonal multiple access method enables a significantly higher number of active users compared to conventional orthogonal multiple access schemes while keeping a low blocking probability.

The paper "Social-aware spectrum sharing for D2D communication by artificial bee colony optimization" by Y. Peña-Llerena and P. R. L. Gondim explores the synergic integration of social networks and device-to-device communications into 5G networks, where the social relationships of mobile users are exploited for a more efficient resource management and better performance of device-to-device communications. In particular, this article proposes a social-aware radio resource allocation

optimization solution based on an artificial bee colony algorithm, relying on a low-overhead feedback scheme with partial channel state information, configured to maximize the system throughput.

The guest editors would like to thank the authors of all submitted papers for their interest in this special issue and diligence throughout the multiple stages of the review process, the international expert reviewers for the tremendous and invaluable effort devoted to assessing the articles submitted to this Special Issue and for the quality and timeliness of their reviews, and the Editors-in-Chief of Computer Networks, Antonio Iera and Tommaso Melodia, for making this special issue possible. We hope that the readers of Computer Networks will enjoy the collection of articles gathered in this Special Issue and that the original work here presented will encourage further research in this exciting area.

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