Demestichas et al. EURASIP Journal on Wireless Communications and Networking (2017) 2017:184
DOI 10.1186/s13638-017-0973-5

EURASIP Journal on Wireless Communications and Networking

EDITORIAL

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Emerging Air Interfaces and Management Technologies for the 5G era

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Abstract

This Special Issue originates from the international conference EuCNC2016, which was held in June 2016 in Athens, Greece. Initially, it publishes some key contributions presented at the conference describing different aspects in the most recent 5G (5th generation) activities in the areas of Air Interfaces and Management Technologies. The series continues with further articles in the context of the same area.

5G mobile networks/wireless systems are the next step of mobile telecommunication standards, offering services and speed far beyond what 4G may offer. The most recent research activities focus on the development of 5G communications and networks, aiming to be fully available for the consumers through their devices by 2020. The scope of this Special Issue is to focus on aspects like 5G communications and networks technologies and more specifically Air Interfaces and Management Technologies.

In the context of this Special Issue, numerous high-quality papers were received. After rigorous peer review, the following papers have been accepted and included in the Special Issue.

Context-aware radio resource management below 6 GHz for enabling dynamic channel assignment in the 5G era, authored by Ioannis-Prodromos Belikaidis, Stavroula Vassaki, Andreas Georgakopoulos, Aristotelis Margaris, Federico Miatton, Uwe Herzog, Kostas Tsagkaris, Panagiotis Demestichas. Heterogeneous networks constitute a promising solution to the emerging challenges of 5G networks. According to the specific network architecture, a macro-cell base station (MBS) shares the same spectral resources with a number of small cell base stations (SBSs), resulting in increased co-channel interference (CCI). The efficient management of CCI that has been studied extensively in the literature and various dynamic channel assignment (DCA) schemes have been proposed. However, the majority of these schemes consider a uniform approach for the users without taking into account the different quality requirements of each application. In this work, we propose an algorithm for enabling dynamic channel assignment in the 5G era that receives information about the interference and QoS levels and dynamically assigns the best channel. This algorithm is compared to state-of-the-art channel assignment algorithm. Results show an increase of performance, e.g., in terms of throughput and air interface latency. Finally, potential challenges and way forward are also discussed.

The 5G candidate waveform race: a comparison of complexity and performance, authored by Robin Gerzaguet, Nikolaos Bartzoudis, Leonardo Gomes Baltar, Vincent Berg, Jean-Baptiste Doré, Dimitri Kténas, Oriol Font-Bach, Xavier Mestre, Miquel Payaró, Michael Färber and Kilian Roth. 5G will have to cope with a high degree of heterogeneity in terms of services and requirements. Among these latter, the flexible and efficient use of non-contiguous unused spectrum for different network deployment scenarios is considered a key challenge for 5G systems. To maximize spectrum efficiency, the 5G air interface technology will also need to be flexible and capable of mapping various services to the best suitable combinations of frequency and radio resources. In this work, we propose a comparison of several 5G waveform candidates (OFDM, UFMC, FBMC, and GFDM) under a common framework. We assess spectral efficiency, power spectral density, peak-to-average power ratio, and robustness to asynchronous multi-user uplink transmission. Moreover, we evaluate and compare the complexity of the different waveforms. In addition to the complexity analysis, in this work, we also demonstrate

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the suitability of Filter Bank Multi-Carrier (FBMC) for specific 5G use cases via two experimental implementations. The benefits of these new waveforms for the foreseen 5G use cases are clearly highlighted on representative criteria and experiments.

Efficient Bayesian compressed sensing-based channel estimation techniques for massive MIMO-OFDM systems, authored by Hayder AL-Salihi and Mohammad Reza Nakhai. Efficient and highly accurate channel state information (CSI) at the base station (BS) is essential to achieve the potential benefits of massive multiple input multiple output (MIMO) systems. However, the achievable accuracy that is attainable is limited in practice due to the problem of pilot contamination. It has recently been shown that compressed sensing (CS) techniques can address the pilot contamination problem. However, CS-based channel estimation requires prior knowledge of channel sparsity to achieve optimum performance, also the conventional CS techniques show poor recovery performance for low signal to noise ratio (SNR). To overcome these shortages, in this paper, an efficient channel estimation approach is proposed for massive MIMO systems using Bayesian compressed sensing (BCS) based on prior knowledge of statistical information regarding channel sparsity. Furthermore, by utilizing the common sparsity feature inherent in the massive MIMO system channel, we extend the proposed Bayesian algorithm to a multi-task (MT) version, so the developed MT-BCS can obtain better performance results than the single task version. Several computer simulation-based experiments are performed to confirm that the proposed methods can reconstruct the original channel coefficient more effectively when compared to the conventional channel estimator in terms of estimation accuracy.

RIePDMA and BP-IDD-IC detection, authored by Jie Zeng, Dan Kong, Bei Liu, Xin Su and Tiejun Lv. Pattern division multiple access (PDMA) is a non-orthogonal multiple access (NOMA) scheme which is proposed to meet the demand of massive connection in the future 5G communications. In this paper, we build a random interleaver (RI) enhanced PDMA (RIePDMA) system by bringing the random interleaver into a PDMA system to further improve the overload of PDMA. Furthermore, we analyze several integrated detection and decoding algorithms with interference cancelation (IC) and propose the iterative detection and decoding based on belief propagation and interference cancelation (BP-IDD-IC). Simulation results show that the proposed RIePDMA system can achieve better block error rate (BLER) performance without increasing the complexity of the receiver. Compared with several other integrated detection and decoding algorithms, the proposed BP-IDD-IC algorithm can get better BLER performance with an acceptable complexity.

Performance of emerging multi-carrier waveforms for 5G asynchronous communications, authored by Mathieu Van Eeckhaute, Andre Bourdoux, Philippe De Doncker and Francois Horlin. This paper presents an extensive and fair comparison among the most promising waveform contenders for the 5G air interface. The considered waveform contenders, namely Filter Bank Multi-Carrier (FBMC), Universal Filtered Multi-Carrier (UFMC), generalized frequency-division multiplexing (GFDM), and resource-block filtered orthogonal frequency-division multiplexing (RB-F-OFDM), are compared to orthogonal frequency-division multiplexing (OFDM) used in 4G in terms of spectral efficiency, numerical complexity, robustness towards multi-user interference (MUI) and resilience to power amplifier non-linearity. FBMC shows the best spectral containment and reveals to be almost insensitive to multi-user interference. It, however, suffers from its bad spectral efficiency for short bursts and from its poor multiple input multiple output (MIMO) compatibility. GFDM reveals to be the most promising contender, with the best spectral efficiency and the smallest complexity overhead compared to OFDM. It is also the most resilient to multi-user interference after FBMC and is MIMO compatible as soon as the interference can be managed. UFMC and RB-F-OFDM are finally the closest to OFDM and benefit, therefore, from a better compatibility with existing systems, even if their performance is generally lower than FBMC and GFDM.

We would like to thank the authors and reviewers that participated in this Special Issue.

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Received: 22 September 2017 Accepted: 23 October 2017
Published online: 06 November 2017