Over the past decade, multicarrier transmission has become one of the hottest topics in wireless communications. After its adoption in digital audio and video broadcasting systems standards in the 1980s, this transmission technique appears now in several recent wireless communications systems standards. Indeed, recent IEEE 802.11 standards for wireless local area networks are based on orthogonal frequency-division multiplexing (OFDM), and the IEEE 802.16 standards for wireless metropolitan area networks (for both fixed and mobile services) include a physical layer based on OFDM/TDMA and one physical layer based on orthogonal frequency-division multiple access (OFDMA). Furthermore, the 3GPP long-term evolution (LTE) group, working on fourth-generation (4G) cellular system specifications, has converged to OFDM-based transmission and multiple access.

Although the literature is now abundant on multicarrier transmission, many problems related to the use of this technology in future wireless systems are still looking for efficient solutions. Among the main research topics, we can mention peak-to-average power ratio (PAPR) reduction for efficient use of the transmit power amplifier, linear precoding, synchronization and channel estimation issues, receiver structures and performance, interference cancellation, optimum bit and power allocation, radio resource allocation, scheduling, and cross-layer optimization. This special issue is devoted to those and several other research topics concerning multicarrier transmission, related technologies and their application in future wireless systems. We received 71 high-quality submissions, which were peer-reviewed by experts in the field and selected 24 papers for inclusion in this special issue. These papers can be grouped in five categories in terms of the topics addressed.

The first category concerns transmission problems including PAPR reduction and linear precoding. The first paper entitled “Power back-off reduction techniques for generalized multicarrier waveforms” by D. F. Danilo-Lemoine et al. addresses power amplifier back-off problems in multicarrier systems and related single-carrier systems with frequency-domain processing. The paper analyzes several PAPR reduction and signal predistortion techniques and points out their applicability to generalized multicarrier systems which include single-carrier systems. The second paper entitled “Partial transmit sequences for peak-to-average power ratio reduction in multiantenna OFDM” by C. Siegl and R. F. H. Fischer investigates the partial transmit sequences (PTSs) methods (well known for single antenna systems) for multiantenna OFDM. The directed approach (dPTSs) is shown to be able to utilize the multiple antenna in the sense that when more antennas are used, a better PAPR reduction is achieved. The third paper entitled “Universal linear precoding for NBI-proof widely linear equalization in MC Systems” by D. Darsena et al. deals with precoding in multicarrier (MC) systems. It is shown that, with appropriately designed precoders, it is possible to synthesize widely linear zero-forcing (WL-ZF) universal equalizers, which guarantee perfect symbol recovery for any FIR channel for both cyclic-prefixed and zero-padded transmission techniques. Furthermore, it is theoretically shown that the intrinsic redundancy of the improper symbol sequence also enables WL-ZF equalization, based on the minimum mean output-energy criterion, with improved narrowband interference (NBI) suppression capabilities. The fourth paper entitled “Optimization of linear precoded OFDM for high data rate UWB systems” by A. Stephan et al. investigates the application of linearly precoded OFDM transmission to ultra wideband...
(UWB) systems. It provides an analytical study and a global system study and analyzes the improvements which can be brought to the UWB-OFDM system proposed by the multiband OFDM alliance. The fifth paper authored by M. G. Konrad and W. Gerstacker is entitled “Interference robust transmission for the downlink of an OFDM-based mobile communications system.” The authors introduce a single antenna interference cancellation algorithm for ASK (amplitude shift keying) modulation schemes combined with bit interleaved coded OFDM. The superior performance of the scheme is confirmed by analytical derivation of the bit error probability for an uncoded transmission with a single interferer. Adaptive versions are proposed for scenarios with multiple interferers. The sixth paper entitled “CDMA transmission with complex OFDM/OQAM” by C. Léle et al. proposes an alternative to the well-known multicarrier code-division multiple access (MC-CDMA) technique for downlink transmission by replacing the conventional cyclic-prefix OFDM modulation by an advanced filterbank-based multicarrier system (OFDM/OQAM). This scheme permits a perfect reconstruction of the complex symbols transmitted over a distortion-free channel. The validity and efficiency of this theoretical scheme are illustrated by means of a comparison, using realistic channel models, with conventional MC-CDMA and also with an OQAM-CDMA combination conveying real symbols.

The second category addresses receivers and performance. In the first paper entitled “Zero-forcing and minimum mean-square error multiuser detection in generalized multicarrier DS-CDMA systems for cognitive radio” by L.-L. Yang, and L.-C. Wang, the authors consider multiuser detection in MC-DS-CDMA. A range of low complexity multiuser detectors are derived for zero-forcing, MMSE, and interference cancellation criteria. The performance is illustrated by simulations, and modular structures are proposed for the implementation of the multiuser detectors. The second paper entitled “Interference cancellation schemes for single-carrier block transmission with insufficient cyclic prefix” by K. Hayashi and H. Sakai proposes intersymbol interference (ISI) and interblock interference (IBI) cancellation schemes at the transmitter and the receiver for the single-carrier block transmission with insufficient cyclic prefix (CP). Moreover, the authors propose a pilot signal configuration, which enables them to estimate a channel impulse response whose order is greater than the guard interval (GI). Computer simulations show that the proposed interference cancellation schemes can significantly improve bit-error rate (BER) performance. The third paper entitled “On inter-cell interference and its cancellation in cellular multicarrier CDMA systems” by S. Plass considers the cancellation of the intercell interference in cellular MC-CDMA at the receiving end of the downlink, by means of iterative techniques. Signal reconstruction from hard decisions or soft values are investigated. The fourth paper entitled “How equalization techniques affect the TCP performance of MC-CDMA systems in correlated fading channels” by B. M. Masini et al. investigates the impact of several classical equalization techniques for MC-CDMA systems on the performance at both lower and upper layers. The results are obtained through an integrated simulation platform carefully reproducing all main aspects affecting the quality of service perceived by the final user, allowing an investigation of the real gain produced by signal processing techniques at TCP level. The fifth paper entitled “OFDM link performance analysis under various receiver impairments” by M. Krondorf and G. Fettweis presents a methodology to evaluate the influence of receiver impairments on the performance of OFDM systems. Considered impairments include carrier frequency offset, channel estimation errors, I/Q imbalance, and others. The probability density function of the frequency-domain signal is obtained and used to compute the BER and OFDM link capacity. The sixth paper entitled “Analysis and compensation of transmitter and receiver of I/Q imbalances in space-time coded multiantenna OFDM systems” by Y. Zou et al. analyzes the influence of frequency-selective I/Q imbalances and derives analytic results for the signal-to-interference ratio at the detector input in a Alamouti-based system. The paper next provides an analytical analysis tool for MIMO systems with any spacetime code. It also analyzes the influence of I/Q imbalances on channel estimation and it proposes a pilot-based I/Q imbalance compensation scheme.

The third category concerns radio resource allocation. The first paper “Bit loading algorithms for cooperative OFDM systems” by B. Gui and L. Cimini addresses optimum bit and power allocation in cooperative systems with multiple relays. An efficient bit loading algorithm is proposed when the relay uses the same channel as the source node. To further enhance performance, the paper also proposes a subchannel permutation algorithm and it proposes a distributed resource allocation mechanism for ad hoc networks. The second paper entitled “Other cell interference reducing power allocation in OFDM-based asynchronous cellular systems” by J.-W. Lee addresses the interference from other cells and describes a scheme which reduces this interference using the cyclic prefix of OFDM-based systems and the asynchronism between user signals. A gain of 15% is reported in terms of throughput at cell boundaries. The third paper entitled “Practical approaches to adaptive resource allocation in OFDM systems” by N. Y. Ermolova and B. Makarevitch investigates link adaptation for single and multiuser OFDM. For the single-user case, a power loading method associated with incomplete channel state information is proposed. For multiuser scenarios, subcarrier allocation is shown to be crucial. The fourth paper entitled “A new OFDM scheduler for delay sensitive traffic based on Hopfield neural networks” by N. Garcia et al. investigates a novel joint channel and queuing-aware OFDMA scheduler for delay sensitive traffic based on a Hopfield neural network scheme. The algorithm operates by minimizing an energy function built from the requirements. It is shown to outperform existing methods in the sense of packet dropping probability. The fifth paper entitled “A hybrid single-carrier/multicarrier transmission scheme with power allocation” and authored by D. Z. Filho et al. proposes a flexible structure switching easily between cyclic prefixed single carrier (CP-SC) and cyclic prefixed multicarrier (CP-MC). The optimum power allocation is derived for a CP-SC transmission scheme with ZF and MMSE receivers. Taking the PAPR
into account, the advantages of CP-SC-MMSE and CP-MC are analyzed for different channel models.

The fourth category of papers in this special issue is on synchronization, channel estimation, and related issues. The first paper in that category, entitled “An ML-based estimate and the Cramer-Rao bound for data-aided channel estimation in KSP-OFDM” by H. Steendham et al., derives an approximate analytic expression for the Cramer-Rao bound (CRB) and analyzes it at high and low signal-to-noise ratio (SNR) values. It is shown that the CRB is independent of the FFT-size and the type of pilot sequences used. The paper also derives an ML-based channel estimator that is nearly independent of the data symbols. The second paper entitled “MAP channel estimation-based PIC receiver for downlink MC-CDMA systems” by H. Dogan et al. proposes a joint MAP channel estimation and data detection technique based on the expectation maximization (EM) method with parallel interference cancelation (PIC) for downlink MC-CDMA systems in the presence of frequency selective channels. The performance of the proposed approach is studied in terms of BER and mean square error. Extensive simulations and comparisons with previous studies show that the new scheme can offer superior performance. The third paper is entitled “DOA estimation in the uplink of multicarrier CDMA systems” and is authored by A. A. D’Amico et al. It investigates the estimation of the directions of arrival (DOAs) of the signals of active users in the uplink of an MC-CDMA system where the base station is equipped with a uniform linear array. Two alternative solutions based on SAGE and ESPRIT are discussed. They are simpler than maximum likelihood estimation, and make it possible to perform DOA estimation for each user independently.

The final category includes papers addressing different topics. The first paper entitled “Throughput maximization under rate requirements for the OFDMA downlink channel with limited feedback” by G. Wunder et al. shows the potential of UMTS long-term evolution (LTE) using OFDM modulation by adopting a combined perspective on feedback channel design and resource allocation for OFDMA multi-user downlink channel. An efficient feedback scheme together with a scheduling strategy is proposed and shown to outperform a standard approach both in achieved throughput, delay, and computational complexity. The second paper is entitled “An efficient differential MIMO OFDM scheme with coordinate interleaving” and is authored by K. Aksoy and U. Aygolu. It proposes a concatenated trellis code and coordinate interleaved differential space-time block code for OFDM. The Viterbi branch metrics for differential decoding are derived and design criteria are investigated for trellis codes. The third paper in that category entitled “Reverse link outage probabilities of multicarrier CDMA systems with beamforming in the presence of carrier frequency offset” by X. Hu and Y. Yao investigates the outage probability using a Nakagami fading channel and uniform linear array beamforming. The impact of different types of beamforming impairments is evaluated and numerical results are reported which show that performance improves as the number of antenna elements increases. The fourth paper in this category is entitled “An MC-SS platform for short-range commu-

We hope that the papers included in this special issue will significantly contribute to the multicarrier systems literature and stimulate further research and development in this important area. We would like to thank all the authors who submitted papers and the numerous reviewers who spent much of their time to review the submitted papers and ensure the high quality of the special issue. Finally, we all acknowledge the contribution of the European Commission to our research through the FP6 and FP7 research programs. Indeed, the three of us were members of the European Network of Excellence (NoE) NEWCOM, which ran from March 2004 to February 2007, and we are now members of NEWCOM++, which started in January 2008 for a period of 3 years.

Hikmet Sari
Arne Svensson
Luc Vandendorpe
Preliminary call for papers

The 2011 European Signal Processing Conference (EUSIPCO-2011) is the nineteenth in a series of conferences promoted by the European Association for Signal Processing (EURASIP, www.eurasip.org). This year edition will take place in Barcelona, capital city of Catalonia (Spain), and will be jointly organized by the Centre Tecnològic de Telecomunicacions de Catalunya (CTTC) and the Universitat Politècnica de Catalunya (UPC).

EUSIPCO-2011 will focus on key aspects of signal processing theory and applications as listed below. Acceptance of submissions will be based on quality, relevance and originality. Accepted papers will be published in the EUSIPCO proceedings and presented during the conference. Paper submissions, proposals for tutorials and proposals for special sessions are invited in, but not limited to, the following areas of interest.

Areas of Interest

- Audio and electro-acoustics.
- Design, implementation, and applications of signal processing systems.
- Multimedia signal processing and coding.
- Image and multidimensional signal processing.
- Signal detection and estimation.
- Sensor array and multi-channel signal processing.
- Sensor fusion in networked systems.
- Signal processing for communications.
- Medical imaging and image analysis.
- Non-stationary, non-linear and non-Gaussian signal processing.

Submissions

Procedures to submit a paper and proposals for special sessions and tutorials will be detailed at www.eusipco2011.org. Submitted papers must be camera-ready, no more than 5 pages long, and conforming to the standard specified on the EUSIPCO 2011 web site. First authors who are registered students can participate in the best student paper competition.

Important Deadlines:

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<td>Proposals for special sessions</td>
<td>15 Dec 2010</td>
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<td>Proposals for tutorials</td>
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