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Editorial
Broadband Wireless Access

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Welcome to this special issue of the EURASIP Journal on Wireless Communications and Networking (JWCN). This special issue is devoted to the topic of the latest research and development on Broadband Wireless Access (BWA) from physical and network layers to practical applications. BWA is the combined consequence of recent advances in wireless communications, high demands on multimedia services, and also increasing requirements on the ubiquitous computing capability. Various BWAs are being standardized by international organizations, for example, IEEE 802.16 WiMAX and the 3rd Generation Partnership Project's High Speed Packaet Access (HSPA) and its Long-Term Evolution (LTE). These technologies provide the reliable means for delivering telecommunication services over the Internet, supporting transmission rates up to several megabits per second at distances as far as tens of kilometers.

However, BWA technologies are still in their infancy and many are far from complete and optimized. Regardless of the technology used, BWA networks should not only be able to provide resilient and high-quality services but also be implemented cost-effectively and operated efficiently. These requirements present many challenges in the design of the BWA physical layer, architectures, and protocols, which are currently receiving much attention in the research community. The efforts cover advanced antenna technologies to cooperative relays to mesh networking systems and many more: future networks will likely employ some mix of these different mechanisms.

The aim of this special issue is to present a collection of high-quality research papers that report the latest research advances in BWA communications, networks and systems. The whole special issue includes the extended papers in the 4th edition of BWA workshop in Globecom 2008 (http://www.bwaws.org/). In this special issue, we selected 12 papers from 35 submissions. The selected papers may be classified into three categories: Channel Estimation, quality of service (QoS) and resource allocation, and Systems and Implementation. In the first part, 3 papers are included. There are 6 papers about QoS and resource allocation management, and 3 papers are selected for systems and implementation issues. A detailed overview of the selected works is given below.

Channel Estimation

This part describes the recent advances on channel estimation in BWA systems.

The first paper, "*On channel estimation for OFDM/TDM using MMSE-FDE in a fast fading channel*," presents an MMSE-FDE with pilot-assisted channel estimation over a fast fading channel. To improve the tracking ability against fast fading a robust pilot-assisted channel estimation is presented that uses time-domain filtering on a slot-by-slot basis and frequency-domain interpolation. The mean square error (MSE) of the channel estimator is derived. The achievable bit error rate (BER) performance is evaluated by computer simulation and compared with conventional

OFDM. It is shown that the OFDM/TDM using MMSE-FDE achieves a lower BER and a better tracking ability against fast fading in comparison with conventional OFDM.

The second paper, "*Degenerated-inverse-matrix-based channel estimation for OFDM systems*," investigates time-domain channel estimation for OFDM systems. The author demonstrates that reducing the matrix size by splitting the dispersive channel impulse response into clusters means that the degenerated inverse matrix estimator (DIME) is feasible for broadband, OFDM transmission systems. Using computer simulation it is demonstrated that the proposed technique is robust to intersymbol interference (ISI) channels and fast time-invariant channels where a minimum mean squared error (MMSE) estimator does not work well.

The third paper, "*Ergodic capacity for the SIMO nakagami-m channel*," provides valuable new insights into the performance of a range of diversity combining techniques when operating over the Nakagami-m fading channel. Specifically, the authors develop a powerful analytical model for maximum ratio combining, equal gain combining, selection combining, and switch and stay diversity schemes. One of the key contributions of this paper is the computation of the ergodic capacity of a single input multiple output (SIMO) system without using any diversity combining technique over identical and independently distributed Nakagami-m branches.

QoS and Resource Allocation

The second part focuses on resource allocation and QoS issues. The issues cover medium access control, congestion control, service differentiation, and admission control in generic BWA and IEEE 802.16 WirelessMAN (or WiMAX).

The first paper, "*Dynamic subcarrier allocation for real-time traffic over multiuser OFDM systems*," proposes a new algorithm for dynamic resource allocation taking into account two constraints: (i) satisfying packet delay requirements and (ii) maximizing throughput of the whole system. At the MAC layer expected transmission rates of active users are firstly evaluated. Taking into account different states of subcarriers, the authors propose to modify Kuhn-Munkres algorithm such that users requirements and system SNR constraints are satisfied. Demonstrated numerical results suggest that the proposal may work well in operational systems.

The second paper, "*On adaptive contention resolution schemes for IEEE 802.16 BWA systems*," addresses the problem of choosing a set of back-off parameters for IEEE 802.16 contention resolution scheme. The authors propose two dynamic algorithms that allow the base station to adjust its back-off window size based on current channel status and network conditioned. Performance evaluation carried out using simulations studies demonstrated that both these schemes provide fairly good results in IEEE 802.16 environment. The authors also discuss implementation specific complexity of their algorithms.

The third paper, "*The performance of relay-enhanced Cellular OFDMA-TDD network for mobile broadband wireless services*," evaluates the performance of multihop relay strategy for broadband packet access system and compared its performance to that of optical receivers. Performance evaluation is carried out using system level simulations for a OFDMA-TDD system, where performance metrics of interest are the throughput and coverage of the system. They demonstrate that multihopping may significantly increase capacity of the system providing more gain compared to the classic approach based on optical repeaters. At the same time they show that optical receivers may often provide inadequate performance due to cochannel interference from all repeaters in the neighboring cells.

The fourth paper, "*HSUPA transport network congestion control*," shows that with the arrival of advanced high-speed packet access networks, there is an increasing demand on the performance of the underlying transport network. In the transport network, the transmission control protocol (TCP) cannot efficiently resolve congestion because of the lower layer retransmissions. The authors propose a transport network congestion detection and avoidance technique that supports quality of service differentiation and among HSPA flows and maintains high transport network utilization while keeping the loss and delay low.

The fifth paper, "*QoS differentiated and fair packet scheduling in broadband wireless access networks*," studies the packet scheduling problem in BWA networks. The authors introduce learning-based approach for a better solution. The packet scheduling problem is formulated as an average cost Semi-Markov Decision Process (SMDP). The proposed algorithm, called Reinforcement Learning Scheduling (RLS), has in-built capability of self-training. It is able to adaptively and timely regulate its scheduling policy according to the instantaneous network conditions. Simulation results indicate that RLS outperforms two classical scheduling algorithms and simultaneously considers effective QoS differentiation, high bandwidth utilization, and both short-term and long-term fairness.

The sixth paper, "*A user cooperation stimulating strategy based on cooperative game theory in cooperative relay networks*," develops a user cooperation stimulating strategy in the context of cooperative relay networks. The strategy is based on cooperative game theory and applies a pricing-based mechanism to stimulate cooperation. Under the assumption that each node can decide whether and how to cooperate, some key questions, including "what is each node's best behavior to maximize its utility," are investigated and an optimal system utility is derived. Simulation results demonstrate the benefit that nodes can enjoy by employing the proposed strategy in terms of utility increase, while maintaining fairness among the nodes.

Systems and Implementation

The first paper, "*OFDMA cellular networks with opportunistic two-hop relay*," examines the benefits of two-hop opportunistic relaying in time division duplex orthogonal frequency division multiple access (OFDMA) cellular networks. The authors propose a model that allows the estimation of the probability of relaying for throughput increase and coverage

extension. Thus the benefits of opportunistic relaying in terms of coverage extension and spectrum efficiency increase can be studied by realistic Monte Carlo simulations. Both the analytical model and the simulations indicate that the benefits of the proposed relaying scheme increases with increasing user density and the throughput increase can be significant. This analysis improves our understanding of the opportunistic relaying technology in a cellular environment.

The second paper, "*Decentralising multi-cell cooperative processing: a novel robust framework*," proposes a methodology to incorporate multicell processing capabilities to existing cellular systems such that no significant modifications are required. Multicell processing is an advantageous capability that is required to mitigate intercell interference when aggressive frequency reuse is used in a cellular system. The proposed architecture shows only little performance degradation compared to centralized approach which is good considering the amount of resources it allows to save.

The third paper, "*Computationally efficient MIMO HSDPA system-level modeling*," presents a computationally efficient link-to-system level model and its MATLAB-Based implementation that allows the evaluation of MIMO HSPA systems. This model can be utilized for various system level simulation concepts, network performance investigations, algorithm development, and cross layer optimizations.

In conclusion, this issue of EURASIP JWCN offers a ground-breaking view into the recent advances in BWA. The popularity of submissions indicates that BWA is a worldwide focus that has universal appeal in terms of research, industry, and standardization. This issue offers both academic and industry appeal—the former as a basis toward future research directions, and the latter toward viable commercial applications. We hope you will enjoy reading the great selection of papers in this issue.

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