Guest Editorial
Special Section on Cross-Layer Design for Mobile *Ad Hoc* Networks and Wireless Sensor Networks

RECENT technological development of wireless networks such as mobile *ad hoc* and wireless sensor networks has led to new challenges for wireless multimedia service support. Many research issues such as capacity analysis/enhancement, quality-of-service (QoS) support, wireless routing, and mobility management should be considered. In addition, cross-layer design approaches have shown great potential in efficiently supporting multimedia services over wireless networks. This special section consists of 16 papers addressing recent cutting edge research and state-of-the-art technologies of QoS support in wireless networks. Among the accepted papers, two were selected from 14 submissions received from the open call for papers, and 14 were selected from 100 papers received for the Second International Conference on Quality of Service for Heterogeneous Wired/Wireless Networks (QShine), Orlando, Florida, August 22–24, 2005, with an overall 14% acceptance rate. This special section is timely and valuable for future study, implementation, and experiments.

The first seven papers focus on capacity analysis/enhancement and QoS support. In the first paper "Link scheduling with power control for throughput enhancement in multihop wireless networks," Tang *et al.* study the joint link scheduling and power control problem with the objective of maximizing network throughput. A maximum throughput link scheduling with power control (MATH-SPC) problem is formulated and a mixed integer linear programming (MILP) is presented to provide optimal solutions. In the second paper "Design and analysis of a denial-of-service-resistant quality of service signaling protocol for MANETs" Hejmo *et al.* propose a distributed QoS signaling protocol that is resistant to a large class of denial-of-service (DoS) attacks. The proposed protocol provides resistance to flooding, over-reservation, and state table exhaustion while providing QoS to real-time traffic and service differentiation between real-time and best effort traffic. In the third paper "Voice capacity analysis of WLAN with unbalanced traffic," Cai *et al.* evaluate the performance of voice transmission over a single-access point (AP) wireless local area network (WLAN) analytically and via simulation. The practical issue induced by the unbalanced traffic is considered. The analysis is applicable for unsaturated station scenarios. In the fourth paper "Improving throughput in multi-hop wireless networks," Li and Li illustrate that it is feasible and practical to increase data throughput in various scenarios of wireless communications using strategies that include multiple end-to-end paths, per-node algorithms such as coding, and rearranging transmission network topologies. In the fifth paper "On the variable capacity property of CC/DS-CDMA systems," Wang *et al.* investigate the "variable capacity property" (VCP) of a complete complementary code-based direct sequence code division multiple access (CC/DS-CDMA) system with multiple time slots. The blocking probability, variable system capacity, and throughput performance under two different code-flock assignment schemes are derived and compared. In the sixth paper "Maintaining reliability through activity management in 802.15.4 sensor clusters," Misic *et al.* address the problem of calculating and controlling network reliability in a sensor network with star topology, operating under the 802.15.4 standard. It is shown that network reliability can be kept constant over a wide range of network sizes and packet arrival rates through proper choice of activity management policy. In the seventh paper "A hierarchical energy-efficient framework for data aggregation in wireless sensor networks" Chen *et al.* study the energy consumed in wireless sensor networks in which some sensors can aggregate the data. A practical energy-efficient protocol for aggregator selection (EPAS) is presented to achieve the target number of aggregators.

The subsequent eighth to 12th papers address the routing issues. In the eighth paper "A utility-based distributed maximum lifetime routing algorithm for wireless networks," Xue *et al.* propose a utility-based nonlinear optimization formulation to the maximum lifetime routing problem. A fully distributed localized routing algorithm is further presented, which is proved to converge to the optimal point. In the ninth paper "Load-balancing routing in multichannel hybrid wireless networks with single network interface," So and Vaidya propose a routing and channel assignment protocol for multichannel multihop networks that works for nodes equipped with a single network interface. The protocol ensures that every node in the network has at least one route to an AP, while allowing nodes to switch channels to associate with an AP with minimum load. In the tenth paper "Optimal base station selection for anycast routing in wireless sensor networks," Hou *et al.* consider a wireless sensor network having multiple base stations as data sink nodes. The joint problem of base station selection and anycast flow routing is investigated with the aim of maximizing network lifetime. In the 11th paper "Reducing multicast traffic load for cellular networks using *ad hoc* networks," Lao and Cui study the multicast group selection problem in integrated cellular and *ad hoc* networks. The group selection problem is formulated as a multidimensional knapsack problem. An integer linear programming (ILP) formulation and a utility-based dynamic

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algorithm with polynomial-time complexity are proposed to solve this problem. In the 12th paper "A heuristic multicast algorithm to support QoS group communications in heterogeneous network," Cheng *et al.* develop a heuristic multicast algorithm for constructing the multicast tree spanning the source gateway and all the destination gateways in the heterogeneous network. Two procedures are proposed to generate higher delay paths that are used to replace the corresponding shortest paths on the shortest path tree.

The following four papers explore the idea of cross-layer design. In the 13th paper "A cross-layer scheduling algorithm with QoS support in wireless networks," Liu *et al.* propose a cross-layer scheduler at the medium access control (MAC) layer for multiple connections with diverse QoS requirements. Each connection is assigned a priority, which is updated dynamically based on its channel and service quality, and the connection with the highest priority is scheduled each time. In the 14th paper "Opportunistic multichannel Aloha: A distributed multi-access control scheme for OFDMA wireless networks," Bai and Zhang investigate multichannel random access based on local channel state information and propose an opportunistic multichannel Aloha. A mapping is built from a user's channel state information to its transmission probability and subcarrier allocation. In the 15th paper "Virtual MIMO-based cross layer design for wireless sensor networks," Yuan *et al.* propose a multihop virtual multiple-input multiple-output (MIMO) communication protocol by the cross layer design to jointly improve the energy efficiency, reliability, and end-to-end QoS provisioning in wireless sensor network. The overall energy consumption per packet transmission is modeled and the optimal set of transmission parameters is found. In the last paper "A cross-layer multi-hop data delivery protocol with fairness guarantees for vehicular networks," Korkmaz *et al.* introduce a cross-layer communication protocol for vehicular Internet access along highways. The proposed controlled vehicular Internet access (CVIA) protocol provides higher throughput and better fairness in multihop data delivery in vehicular networks when compared with purely IEEE 802.11-based protocols.

In closing, the guest editors would like to acknowledge the contribution of many experts who have participated in the review process and provided helpful suggestions to the authors on improving the content and presentation of the papers. We would also like to express our sincere thanks to Dr. T. Wong, the Editor-in-Chief of THE IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, for his support and help in bringing forward this special section. Last, but not least, we would like to thank Dr. Imrich Chlamtac, the Steering Committee Co-Chair for the International Conference on Quality of Sevice in Heterogeneous Wired/Wireless Networks (QShine), for his help in both the conference organization and the processing of this special section. We hope you will enjoy reading the papers in this collection.

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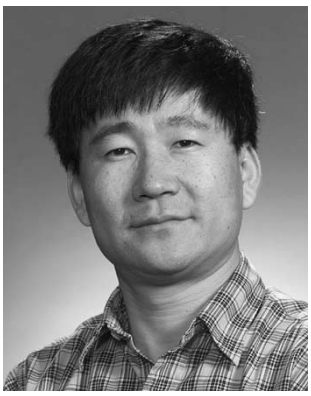

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