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Editorial

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The wireless communication revolution has brought fundamental changes to telecommunications and data networking, and has made mobile society a reality. By freeing the user from the cord, personal communications networks, wireless LANs, mobile radio networks and cellular systems promise fully-distributed mobile computing and communications, any time and anywhere. Along with wireless infrastructure, numerous wireless services and applications have matured or are emerging and are poised to change the manner and scope of communications. Further, specialized wireless networks such as ad hoc and sensor networks promise to have a significant impact throughout society, which could quite possibly dwarf previous milestones in wireless communications. Finally, new advances in physical layer technologies, such as UWB, smart (directional) antennas, space-time processing, MIMO, and software-defined radio, have all pushed the performance limits of wireless communications to a new frontier.

The purpose of this issue is to disseminate recent advances in wireless networking area. The eight papers selected for this special issue address research problems for several different types of wireless networks and at various layers. Although not exhaustive, these papers present some novel approaches that will advance basic knowledge and understanding of some interesting and critical problems in wireless networking research.

The first paper in this issue, Rajeswaran, Kim and Negi's "A Scheduling Framework for UWB & Cellular Networks," analyzes the scheduling problem in the UWB regime. In particular, the authors develop a general framework in the form of a non-convex optimization problem for the max-min scheduling problem in static wireless networks. Subsequently, a scheduling algorithm is devised and yields the optimal solution to the general multi-band power assignment problem. The authors then successfully apply this scheduling framework to UWB networks and cellular networks. For UWB networks, the authors develop an iterative procedure to construct sub-band sizes and power allocation, thus optimally solving the UWB max-min fair scheduling problem. For cellular networks, the authors prove that FDMA is the optimal scheduling for a multi-band cellular architecture.

The paper by Sanzgiri, Chakeres, and Belding-Royer, "Pre-Reply Probe and Route Request Tail: Approaches for Calculation of Intra-Flow Contention in Multihop Wireless Networks," studies the so-called intra-flow contention problem, i.e., contention among packets that belong to the same single flow along a multihop path. Correct determination of the number of contending nodes is important in order to accurately estimate the bandwidth requirement of a flow and make admission control decisions. In this paper, the authors propose two approaches to the intra-flow contention problem, namely, Pre-Reply Probe and Route Request Tail. Both approaches are based on the idea that carrier-sensing information can be used to gather information about carrier-sensing neighbors. Through simulation, the authors show that the proposed approaches offer some good properties such as reduced network load, lower energy consumption, and faster response time than an existing approach.

Next, Dunn et al. study the fairness problem in bandwidth allocation for 802.11 networks with multiple clients running at different rates in their paper "A Practical Cross-Layer Mechanism for Fairness in 802.11 Networks." The authors propose to exploit path MTU to automatically control bandwidth allocation. They present three possible implementations of the mechanism. Through actual experimental implementation, the authors show that, unlike previous solutions to this problem, the proposed mechanism is easy to implement, works with common operating systems and requires no change to the MAC protocol on the stations.

In the next paper, "QoS-Aware Multi-Channel Scheduling for IEEE 802.15.3 Networks," Rangnekar and Sivalingam present a scheduling mechanism that simultaneously uses the multiple channels available in UWB-based networks for IEEE 802.15.3 WPANs. The scheduling mechanism employs a distributed dynamic channel allocation algorithm to distribute the channels among neighboring piconets based on dynamic traffic demand. Through simulations, the authors show that the simultaneous use of multiple channels increases the throughput of piconets and reduces average packet delay.

In their paper "Multiple Description Video Multicast in Wireless Ad Hoc Networks," Mao et al. study the problem of how to support multicast service for multiple description (MD) video in ad hoc networks. The authors follow an application-centric, cross-layer routing approach, with the objective of minimizing the overall video distortion. On the topology level, the authors propose to use multiple source-based tree where each tree supports one video description. At the video coding level, the authors advocate the use of layered coding for each video description so as to cope with diversity in end systems.

A heuristic algorithm based on Genetic Algorithms (GAs) is proposed and is shown to have good performance over a wide range of network operating conditions.

The paper on "Analytical Models for Single-Hop and Multi-Hop Ad Hoc Networks" by Alizadeh-Shabdiz and Subramaniam presents approximate analytical models for the throughput performance of single-hop and multi-hop ad hoc networks. An inherent difficulty in this research is that the behavior of a node is dependent upon not only its neighbors' behavior, but also the behavior of other unseen nodes. In this paper, the authors propose an approximation model with moderate complexity. The approach is based on characterizing the behavior of a node by its state and the state of the channel that it sees. This approach is used to carry out an analysis of single-hop and multi-hop ad hoc networks in which different nodes may have different traffic loads. Subsequently, the authors apply this approach to 802.11-based networks, using simulations to validate its accuracy.

Wu and Negi investigate QoS measures for wireless networks in their paper on "Effective Capacity-Based Quality of Service Measures for Wireless Networks." This research is motivated by the need for a simple and efficient wireless channel model that can be easily used to obtain connection-level QoS measures such as data rate, delay, and loss probability. In their previous work, the authors developed a link-layer channel model termed effective capacity, under the setting of a single hop, constant-bit-rate arrivals, fluid traffic, and wireless channels with negligible propagation delay. In this paper, the authors apply this effective capacity technique to derive QoS measures for more general situations, namely networks with multiple wireless links, variable-bit-rate sources, packetized traffic, and wireless channels with non-negligible propagation delay.

The final paper in this issue, by Yu, Wong, and Leung, addresses the issue of QoS provisioning in adaptive multimedia services, within which the bandwidth of each individual flow can change. In this paper, entitled "Efficient QoS Provisioning for Adaptive Multimedia in Mobile Communication Networks by Reinforcement Learning," the authors formulate the joint call admission control and bandwidth adaptation problem as a constrained Markov decision problem. They present an approach that uses a form of discounted reward reinforcement learning known as Q-learning to solve the decision problem. Through simulations, the authors demonstrate the efficacy of the proposed approach in addressing QoS provisioning for adaptive multimedia mobile communication networks.

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