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Editorial

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Broadband wireless networks and distributed computing have witnessed significant advancements as network architectures, protocols, applications emerge. New technologies in communication systems, sensing, and embedded systems not only cultivate increasing demands for a wide variety of services and deployment of networks, but also bring about many challenging issues to the research community. For instance, in contrary to well-studied traffic models and TCP performance in telecommunication systems and the Internet, we have much less understanding of traffic behaviors, TCP performance, and resource allocation in WiFi (e.g., IEEE 802.11a/b/g) and WiMAX (e.g., IEEE 802.16e) networks that are becoming widely deployed as a popular wireless internet platform. In addition, multi-hop wireless architectures, such as ad hoc networks, sensor networks, and delay tolerant networks have undergone tremendous developments in recent years. The integration of advanced communication technologies such as MIMO techniques in these networks further motivate the design of novel solutions to medium access control, network planning, path selection, and detection of attacks. This special issue, including 11 high-quality papers selected from 90 submissions, focus on the aforementioned issues and feature the state-of-the-art research outcomes.

The first paper in this special issue is "Linear Representation of Network Traffic With Special Application to Wireless Workload Generation" by Stefan, Elizabeth, Kevin, and John. In order to study the interdependence of packet, flow, and node behavior, it is argued in the paper that prevail assumptions of traffic models and analysis may not be true. Therefore, the concept of linear representation of network traffic is proposed, which maps each flow to a vector such that the sum of two flows is a vector that represents the aggregate behavior of the two flows. Through experimental studies, it is shown that uniform and marginal traffic models severely distort some network performance metrics. By using matrix factorization, network traffic can be mapped to typical network behaviors.

Lei, Qunwei, Jun, and Xiaoyan in "Selective Message Forwarding in Delay Tolerant Networks" proposed a new routing protocol for DTN, which is namely SMART. The basic idea of SMART is to use travel companions of the destination nodes to increase delivery opportunities while limiting the message overhead to a bounded number, by taking the advantage of node mobility pattern. With analytical and simulation results, SMART demonstrates higher delivery ratio and smaller delivery latency than controlled opportunistically-forwarding schemes and less overhead than flooding schemes.

Santosh, Shaoqiang, Prathima Agrawal, and Krishna studied the node placement problem for two-tiered sensor networks in "On Performance of Node Placement Approaches for Hierarchical Heterogeneous Sensor Networks." The design objective is to use the minimum number of sophisticated nodes with higher power, storage and communication capacity, while maintaining network operation together with a number of low-end nodes with less power. The issue is formulated

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and solved as a multi-constraint optimization problem by using Binary Integer Linear Programming, Greedy approach, and Genetic algorithms. Moreover, a hybrid approach is proposed based upon the above three solutions to achieve better performance.

Moshe, Ari, Reuven, and David presented an efficient and robust monitoring and routing solution in "Joint Monitoring and Routing in Wireless Sensor Networks using Robust Identifying Codes" to achieve near-optimal routing with very small routing tables. With the abstraction based on identifying codes, the monitoring area is divided into a finite number of regions and modeled as a graph, where a collection of monitors in a network forms an identifying code if any given identifying set uniquely identifies a vertex in the graph. Therefore, the proposed solution takes the advantage of identifying codes that allow monitoring an area without deploying active monitors in each subregion. A polynomial-time approximation algorithm is also developed to utilize only local information, which results in two distributed implementations.

Mohammad and Marwan presented a power-controlled MAC protocol for a wireless network with two antennas per node in "Channel Access Scheme for MIMO-Enabled Ad Hoc Networks with Adaptive Diversity/Multiplexing Gains" for improving channel reuse and reducing energy consumption. Through dynamic switching between diversity and multiplexing modes, a utility function, depending on both energy consumption and throughput, is maximized. Five configurations are proposed for different diversity and multiplexing gains. Simulations are carried out to demonstrate the performance of the proposed MAC protocol in ad hoc topologies.

Suraj, Aura, and Ramgopal in "An Optimization Framework for Demand-based Fair Stream Allocation in MIMO Ad Hoc Networks" proposed a solution to achieve the proportional fairness of the stream allocation in the minimum possible schedule length. The concept of stream allocation to flows is proposed and used for contention-free scheduling in single- and multi-user communications based on traffic demands and classes. The proposed solution is implemented and compared with other solutions over a number of sample topologies toward fairness.

Jeonggyun, Sunghyun, and Daji in "Analytical Study of TCP Performance over IEEE 802.11e WLANs" presented a model for TCP performance analysis with 802.11e EDCA (Enhanced Distribution Channel Access). The effects of minimum contention window sizes and transmission opportunity (TXOP) limits on the aggregate TCP throughput are studied in analytical models and simulations. It is shown that the best aggregate TCP throughput can be achieved by the combination of contention-free access for downlink packet transmissions and TXOP transmissions.

Miao, Ming, and Yuanyuan presented the joint design of medium access control (MAC) access and multiuser MIMO technique in "Applying Opportunistic Medium Access and Multiuser MIMO Techniques in Multi-Channel Multi-Radio WLANs." User selection and channel negotiation are conducted between the access point (AP) and multiple users by using Ad-hoc Traffic Indication Message (ATIM) windows. By exploiting multiuser diversity, data transmission rate is maximized via opportunistic scheduling.

Bo, Guanling, Jie, and Hongda investigated an important security issue in "Robust Detection of Unauthorized Wireless Access Points," that is, the detection of rogue access points in Wi-Fi networks, especially when these unauthorized APs are configured as routers. The proposed solution uses a verifier on the internal wired network to send test traffic towards wireless edge devices, and uses sniffers to identify rogue APs. A probabilistic algorithm is proposed to work with encrypted AP traffic load, which is demonstrated in experiments to be effective with moderate traffic overhead.

Yeonsik, Sandeep, Cheng-Lin, and Raghupathy studied the performance and capacity issue of VoIP in IEEE 802.11b network with G.711 voice code in "VoIP over Wi-Fi Networks: Performance Analysis and Acceleration Algorithms." They identified a comprehensive set of components that could be improved to increase VoIP call capacity for small frame size which is considered a good option for real-time traffic. Further they select three dominant components and present algorithms to improve call capacity. One of the algorithms, namely Frame Aggregation (FA) is implemented and demonstrated to be an effective solution toward their design goal.

Marc in "Scheduling Constraints and Interference Graph Properties for Graph-based Interference Coordination in Cellular OFDMA Networks" proposed a new approach to the problem of heavy inter-cell interference between neighboring base stations due to channel allocation in WiMAX and 3GPP systems. The main idea is to use beamforming antennas in combination with interference coordination mechanisms which is formulated as a graph coloring problem. The analysis and simulation results demonstrate that resource utilization is significantly improved, while satisfying scheduling constraints of applications.

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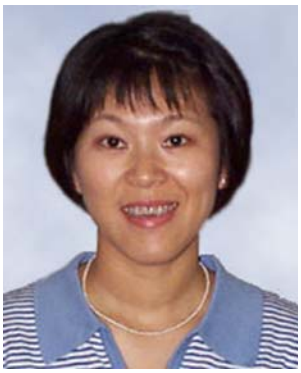
Guest Editors



Wenye Wang (M'98/ACM'99) received the B.S. and M.S. degrees from Beijing University of Posts and Telecommunications, Beijing, China, in 1986 and 1991, respectively. She also received the M.S.E.E. and Ph.D. degree from Georgia Institute of Technology, Atlanta, Georgia in 1999 and 2002, respectively.

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