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GUEST EDITORIAL

Quality of service in heterogeneous wired/wireless networks

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Recent technological developments in broadband peer-to-peer and overlay networks, wireless and mobile networks, and grid computing have led to a wide variety of new challenging problems. These include the provisioning of Quality of Service (QoS), survivability, resilience and scalability in a wide range of emerging applications—such as large-scale multimedia systems—across both wired and wireless networks. Many aspects of the challenges should be considered, including the QoS provisioning, performance optimization, cross-layer design, resilience, scalability and survivability of distributed applications in heterogeneous networks. The special issue consists of eight papers addressing recent cutting edge research and state-of-the-art technology of multimedia QoS support in heterogeneous wired/wireless networks. It is timely and valuable for those involved in the research areas.

The first three papers propose novel energy efficient algorithms to improve the performance of wireless sensor networks (WSNs). In the first paper "Localized Coverage Boundary Detection for Wireless Sensor Networks", Zhang, Zhang, and Fang propose two deterministic, localized algorithms for coverage boundary detection in WSNs. The algorithms are based on two novel computational geometric techniques called localized Voronoi and neighbour embracing polygons. They are truly distributed and localized by merely needing the minimal position information of one-hop neighbours and a limited number of simple local computations, and thus are of high scalability and energy efficiency. In the paper "Algorithm Design for Base Station Placement Problems in Sensor Networks", Shi, Hou and Efrat theoretically study the base station placement problem. They propose a set of procedure to design $1–\varepsilon$ approximation algorithms and apply this procedure to address base station placement problem with the optimization objectives to be maximizing network lifetime and network capacity. The proposed approach has the potential to solve other difficult optimization problems involving continuous search space. In the paper "Energy-Aware Geographic Routing in Lossy Wireless Sensor Networks with Environmental Energy Supply", Zeng et al. propose two energy aware geographic routing protocols, GREES-L and GREES-M, which make routing decision locally by jointly taking into account the realistic wireless channel condition, packet progress to the destination, the residual battery energy level of the node, and the environmental energy supply. The proposed protocols exhibit graceful degradation on end-to-end delay, but do not compromise the end-to-end throughput performance.

Achieving high capacity and fairness are two of the main design objectives of wireless mesh networks (WMNs). In the fourth paper "Cross-Layer Optimization for End-to-End Rate Allocation in Multi-Radio Wireless Mesh Networks", Tang, Xue and Zhang propose three cross-layer schemes in multi-radio WMNs to solve the joint rate allocation, routing, scheduling, power control and channel assignment problems with the goals of maximizing network throughput and achieving certain fairness. In the fifth paper "Real-Time CBR Traffic Scheduling in IEEE 802.16-Based Wireless Mesh Networks", Zou and Zhao study packet transmission scheduling for real-time constant-bit-rate (CBR) traffic in IEEE 802.16-based WMNs. The scheduling issue is formulated as a binary linear programming problem. A novel bottleneck first scheduling (BFS) scheme is then proposed.

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It is shown that the proposed scheme achieves the optimal capacity while obtaining satisfactory delay performance.

The next two papers analytically study the performance of contention-based CSMA/CA MAC protocol under unsaturated conditions. In the paper "Statistical Multiplexing, Admission Region, and Contention Window Optimization in Multiclass Wireless LANs", Cheng et al. present an analytical model for evaluating the statistical multiplexing effect, admission region, and contention window design in a WLAN supporting multiclass services. They investigate the MAC resource sharing between the short-range dependent (SRD) on/off sources and the long-range dependent (LRD) fractional Brownian motion (FBM) traffic. The WLAN's QoS capability can be significantly improved by using the optimal contention window and the maximum admission region of each class. In the paper "Performance of A Burst-Frame-Based CSMA/CA Protocol for High Data Rate Ultra-Wideband Networks: Analysis and Enhancement", Lu et al. develop an analytical model to evaluate the delay performance under the burst-frame-based CSMA/CA protocol. Based on the analysis, they propose an efficient adaptive burst assembly policy to optimize the throughput and delay performance.

Adaptive document access strategies are necessary in the future heterogeneous access systems. In the final paper "Performance of Network Aware Prefetching in Heterogeneous Wireless Systems", Liang and Drew study the performance of multiuser document prefetching in a two-tier heterogeneous wireless system. A novel analysis framework is proposed to evaluate the performance of the thresholding approach and provide optimization guidelines for systems with non-Markovian access, service and mobility patterns. It is shown that with dynamic control of the prefetching threshold, multiuser network-aware prefetching can scale well under heavy usage, even with many concurrent selfish users.

In closing, the guest editors would like to acknowledge the contribution of many experts who participated in the review process and provided helpful suggestions to the authors on improving the content and presentation of the articles. The advice and support from the journal Editor-in-Chief, Dr. Chlamtac, and Ms. Karen Decker, are greatly appreciated.

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