Guest Editorial
All-IP Wireless Networks

INTERNET protocol (IP) provides a universal network-layer protocol for wireline packet networks, and is viewed as an attractive candidate to play the same role in wireless systems. IP provides a globally successful open infrastructure for creating and providing services and applications. An *All-IP* wireless and wireline network could make wireless networks more robust, scalable, and cost effective. It will also enable the abundant applications and software technologies developed for wired IP networks to be used over wireless networks. Today's many different wireless systems, ranging from personal area networks (PANs) andf wireless local area networks (LANs) to wide-area cellular systems, are often not compatible with each other, making it difficult for a user to roam from one radio system to another. To date, no wireless technology has emerged as a common and long-term universal solution. With IP as the common network layer protocol, an IP-based mobile device (with multiple radio interfaces or software defined radio) could roam between different wireless systems.

The call for papers for this special issue solicited papers describing state-of-the-art research in All-IP wireless networks. In recent times, there have been several excellent special issues of the IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS (JSAC) on wireless and related topics. In contrast, this issue is distinguished by the overriding requirement of using IP. The intention in doing so was to produce a special issue that would capture the range of world-class research activity in the area of both academic and commercial importance. To architect, design, implement, and operate All-IP wireless networks raises a wide-ranging set of technical problems, and this was reflected in the cross section of topics addressed by the papers submitted. The papers that follow this editorial were selected on the basis of blind peer review, and as such represent the strongest papers submitted for this issue. Almost 60 papers were submitted, and the Guest Editors had to make several hard decisions, since space restrictions meant that not all high-quality papers could be published. The papers selected cover several key research topics, specifically, the following:

- UMTS performance;
- handoff;
- mobility management;
- quality-of-service;
- TCP and transport-layer issues.

The first paper is entitled, "Serving Radio Network Controller Relocation for UMTS All-IP Network," by Pang *et al.* It addresses the very important issue of Universal Mobile Telecommunications System (UMTS) performance, and specifically the impact of packet duplication in Third-Generation Partnership Project (3GPP) during switching of the service radio network controller. The authors propose a fast relocation mechanism that does not require packet duplication but yet avoids packet losses. They provide an analytical model and assessment of the expected performance improvements from their new approach.

Three papers follow this on the subject of handoff. In the paper, "A Network-Layer Soft Handoff Approach for Mobile Wireless IP-Based Systems," Hamdaoui and Ramanathan address the performance deficiencies of soft handoff when compared with hard handoff. The authors propose, analyze, and evaluate a soft handoff technique that avoids the need for tight synchronization and increases the capacity of the network, allowing soft handoff to outperform hard handoff. In the next paper, "Low-Latency Mobile IP Handoff for Infrastructure-Model Wireless LANs," by Sharma *et al.*, the problem of high-latency handoffs in IEEE 802.11 infrastructure-mode LANs is identified. A new scheme is proposed that expedites link-layer handoff detection and speeds up network-layer handoff by replaying cached foreign agent advertisements. The result is significantly lower latency handoffs that are achieved without having to modify mobile IP. In the third paper, "An End-to-End Multipath Smooth Handoff Scheme for Stream Media," by Pan *et al.* looks at the relationship between handoff and the delivery of streaming media. A novel scheme is proposed that combines the use of multiple paths to reach a single node with multilayer encoding. Important stream information is duplicated and sent over multiple paths so as to ensure a smoother handoff. Performance results favorably compare the throughput and quality of the proposal with existing schemes.

Mobility management is examined in two papers. In the paper, "Dynamic Hierarchical Mobility Management Strategy for Mobile IP Networks," Ma and Fang identify a critical performance problem with hierarchical mobile IP in relation to the selection of gateway foreign agents and their reliability. A new scheme is proposed in which the signaling hierarchy is dynamically established and maintained for each user, allowing an even distribution of signaling load. An analysis and evaluation show the scheme reduces signaling costs and enhances system robustness. In the next paper, "Multicast-Based Mobility: A Novel Architecture for Efficient Micromobility," Helmy *et al.* present a scheme that relies on the use of multicast within a domain to achieve efficient mobility management. Protocols that allow multiple-access routers to receive traffic for a mobile node are defined. Simulations provide interesting comparisons with the well-known cellular IP (CIP) and handoff-aware wireless access Internet infrastructure (HAWAII) schemes.

Three papers address quality-of-service (QoS). In the first paper, "Architecture for Mobility and QoS Support in All-IP Wireless Networks," Lo *et al.* adopt an integrated approach to dealing with mobility and QoS for All-IP wireless. They propose and evaluate the use of resource reservation protocol

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(RSVP) aggregation and passive resource reservation with fast handoff to reduce the influence of host mobility on service quality. In the second paper, "Call Admission Control for Voice/Data Integrated Cellular Networks: Performance Analysis and Comparative Study," by Li *et al.*, the authors propose a dynamic threshold-based approach for bandwidth partitioning among different classes of traffic in wireless networks, taking advantage of the adaptive nature of data traffic. This is shown to offer service guarantees and service differentiation, while resulting in improved bandwidth utilization when compared with existing bandwidth partitioning schemes. In the third paper, "A Flow Rejection Algorithm for QoS Maintenance in a Variable Bandwidth Wireless IP Environment," Passas *et al.* propose a scheme in which the flow dropping probability of dynamic RSVP is reduced, but without affecting the overall bandwidth utilization. Flow rejection occurs when the channel quality decreases to a level that even the minimum bandwidth requirements per flow cannot be fulfilled. Dynamic RSVP is an enhanced version of RSVP for use in variable bandwidth environments.

A total of six papers address transport layer issues for All-IP wireless networks—two looking at SCTP, four at TCP. In the paper, "Improving Stream Control Transmission Protocol Performance Over Lossy Links," Ye *et al.* introduce a fine-tuned explicit congestion notification (ECN) mechanism for stream control transmission protocol (SCTP), allowing SCTP to differentiate between noncongestion losses from congestion losses and, therefore, make it more suitable for lossy wireless links. SCTP is also the subject of the paper "Unified Transport Layer Support for Data Striping and Host Mobility," by Goff and Phatak. In this paper, the authors use an enhanced version of SCTP that allows striping of data at the transport layer and the use of multiple simultaneous network interfaces. Results show a range of advantages including higher bandwidth and reliability, achieved in a way that is independent of the network-layer.

The four papers on transmission control protocol (TCP) address performance, security, and TCP-friendly streaming. In the paper, "TCP-Jersey for Wireless IP Communications," Xu *et al.* propose a new scheme that distinguishes wireless packet losses from congestion packet losses and reacts accordingly. In the next paper, "JTCP: Jitter-Based TCP for Heterogeneous Wireless Networks," Wu and Chen propose a jitter-based scheme to adapt sending rates taking into account packet losses and jitter ratios. Security issues are examined by Zhang in "A Multilayer IP Security Protocol for TCP Performance Enhancement in Wireless Networks." The author addresses the conflict between the use of TCP enhancement proxies and IP security, proposing a multilayer protection model that allows limited access to TCP headers. In the fourth paper, "End-to-End TCP-Friendly Streaming Protocol and Bit Allocation for Scalable Video Over Wireless Internet," Yang *et al.* propose a TCP-friendly streaming protocol that explicitly takes account of running over a wireless last-hop. This protocol is then used with scalable video and unequal loss protection, minimizing the end-to-end distortion.

In closing, the Guest Editors would like to extend their thanks to those individuals who gave their time to help make this issue a success. Thanks are extended to the Editor-in-Chief and the IEEE Editorial Staff for their advice and assistance. Special thanks to Mr. S.-C. Huang, National Tsing Hua University, Taiwan, for his easy-to-use and reliable web-based submission and review management system. The editors also thank the many authors who submitted papers and showed patience when deadlines slipped because of the very large number of submissions. Last but not the least, the editors are especially thankful to the legion of global reviewers that freely gave their time to provide a detailed assessment for each paper. The result is a collection of solid papers that represent the highest quality research in All-IP wireless networks.

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