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Guest Editorial

Special Issue: Radio Link and Transport Protocol Engineering for Future-Generation Wireless Mobile Data Networks

By Victor C. M. Leung, Ekram Hossain, and Shahrokh Valaee, Guest Editors

The emergence of wireless packet data applications (e.g., wireless web access, interactive and real-time mobile multimedia applications, wireless interactive gaming, client/server applications) is the key driver for the evolution of future-generation wireless networks from the current 2G/3G systems. To support such applications, efficient and intelligent engineering of protocols at different layers in the protocol stack, with the wireless network in mind, and the development of related concepts and technologies will be essential. While in wired networks the applications and protocols are quite fine-tuned, the unique characteristics of wireless networks such as user mobility, frequent link failure, limited link capacity, and limited battery and computational resources of mobile devices pose significant challenges in designing link-level and transport protocols for future-generation high-speed wireless data networks. Within this context, this special issue addresses some of the radio link and transport protocol engineering aspects for future wireless data networks.

We have selected 8 papers for this special issue from 24 submissions. The first paper by T. Farnham proposes a flexible protocol stack framework with an open application programming interface to support dynamic configuration of link layer protocols in different wireless networking scenarios. Also, using the proposed framework, link layer optimization can be performed to adapt to the changing radio environment by utilizing dynamic run-time software download and configuration. It is shown that the performance benefits from optimizing the link layer protocols depend largely on the specific scenario and user or service preferences.

The second paper by L.-C. Wang, Y.-C. Chen, and M.-C. Chen proposes a cost-function-based radio link layer rate adaptation mechanism for the wideband code division multiple access (WCDMA) networks by taking channel impacts, link level buffer occupancy, and service priority into account. The rate adaptation mechanism can be implemented by exploiting the transport format selection procedure in the medium access control layer. The authors show that the proposed rate adaptation mechanism can effectively improve throughput in a multiservice environment at the cost of marginal decrease in power efficiency.

For the future-generation wireless networks, IP-centric radio resource management schemes will be required in the radio access network. The third paper by V. Friderikos, L. Wang, M. Iwamua, and A. H. Aghvami proposes a radio link level power and rate adaptation scheme that integrates QoS information from the IP layer of the differentiated services (DiffServ) architecture together with lower layer criteria in order to optimize packet transmission over a CDMA-based air interface. The proposed scheme achieves the required per-class aggregate data rate and at the same time increases aggregate power gains by differentiating transmission of in-profile and out-of-profile packets.

Streaming multimedia content over wireless links is a significant research challenge. In the fourth paper by I. Haratcherev *et al.*, the authors present a signal-strength-based link adaptation algorithm for rate control for real-time multimedia streaming over IEEE 802.11-based wireless LANs. Experimental results based on the actual implementation of the proposed scheme shows that the rate control algorithm, due to its faster responsiveness to the fluctuating link conditions, can achieve a much higher video quality compared to that of a statistics-based rate controller, which is more common in current 802.11 products.

Designing and optimizing reliable transport protocols for wired-wireless networks is a fundamental research problem. The fifth paper by K. Ghaboosi and B. H. Khalaj presents a new modification to the TCP, namely CICADA, which aims at isolating

problems related to wireless section of a TCP connection from its wired portion. Also, the proposed modification prevents undesired disconnections during handoff scenarios.

In the sixth paper, Y. Wu, Z. Niu, and J. Zheng investigate the TCP upstream/downstream unfairness issue over IEEE 802.11-based wireless LANs with per-flow queuing employed at the access point. The interactions between the MAC protocol and TCP are evaluated by analysis and simulation. Also, a scheme to achieve fairness between upstream and downstream TCP flows is presented.

The seventh paper by M. Assaad, D. Zeghlache, and B. Jouaber presents an analytical model to study the interaction between the TCP and the radio link layer in an UMTS-HSDPA (high speed downlink packet access) network. Also, a method to guarantee a given application flow rate is proposed, which is based on the idea of operating the air interface at higher rates than the target TCP flow rate using an appropriate scheduler to mask the radio impairments. Therefore, the proposed solution to reduce the impact of TCP on the application layer performance does not require any modification to the TCP implementation.

Supporting multicast communications will be a significant component in the future-generation wireless data networks. The last paper by E. H.-K. Wu and W.-R. Yang presents a pragmatic general multicast congestion control protocol for wireless networks to alleviate the deleterious impact of wireless loss on the multicast performance. The proposed scheme, by differentiating wireless losses from congestion losses, can improve the network performance for reliable multicast under various wireless scenarios.

In closing, we thank the authors and the reviewers for their contribution to this special issue.

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Ekram Hossain is an assistant professor in the Department of Electrical and Computer Engineering at the University of Manitoba, Canada. He obtained his Ph.D. in Electrical Engineering from the University of Victoria, Canada, in 2000. Since 2001, he has been in the Editorial board of the *IEEE Transactions on Wireless Communications*. Currently, he is also serving as an editor for the *Wireless Communications and Mobile Computing* (Wiley InterScience) and the *IEEE/KICS Journal on Communications and Networks*. Dr Hossain was a fellow at the University of Victoria. He was awarded the Lucent Technologies Research Award in 1997 for his contribution in the IEEE International Conference on Personal Wireless Communications (*IEEE ICPWC'97*). He also won the British Columbia Advanced Systems Institute (ASI) graduate student award in 1998. Dr Hossain's research interests are in the area of modeling, analysis, and design of wireless networks, cross-layer protocol optimization for

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