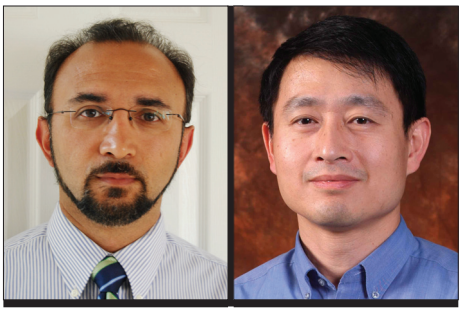
TOPICS IN WIRELESS COMMUNICATIONS



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The ever growing demand for mobile broadband Internet services, and recent advancements in design of new mobile Internet devices and applications have created new challenges and opportunities for innovations in the design of wireless access networks. The expedited increase in data traffic and higher expectations for the broadband experience are pushing operators to upgrade and evolve their networks to next-generation systems on historically shorter timescales. The six articles included in this issue have been selected to provide readers with different perspectives on this evolution.

The first four articles provide introductions to some important features of next-generation broadband wireless systems, with a focus on IEEE 802.16e/m and Third Generation Partnership Project (3GPP) Long Term Evolution (LTE): enhanced multiple-input multiple-output (MIMO), power saving, and quality of service (QoS) support.

The first article presents advancements in MIMO technologies in IEEE 802.16m and LTE-Advanced that play an essential role in meeting the IMT-Advanced requirements. These enhancements not only improve the conventional point-to-point link performance, but also enable new types of links such as downlink multi-user MIMO. A large family of MIMO techniques has been developed for various links and with various amounts of available channel state information in both IEEE 802.16e/m and 3GPP LTE/LTE-Advanced. This article provides a survey of the improvements in MIMO techniques in the two standards, and highlights the comparison and the engineering considerations in their design.

One of the key challenges in designing mobile broadband networks with "always on" connectivity is efficient power management to maximize the battery lifetime of user devices. The second article presents the state-of-the-art power management methods in next-generation wireless networks with a focus on solutions developed for the next generation of WiMAX systems based on IEEE 802.16m and also those used in 3GPP LTE. While 802.16m defines two power saving modes, sleep and idle modes, 3GPP LTE adopts a discontinuous reception (DRX) mechanism for power conservation in connected and idle states. These power management techniques provide less control signaling and operational overhead while providing more efficient power saving, and use simpler operation procedures than the existing power management techniques.

Another important aspect of any 4G broadband radio access technology is how to address the QoS needs for satisfactory service delivery of the evolving Internet applications to end users, and managing the network resources. The third article presents the highlights of QoS frameworks in IEEE802.16e, IEEE802.16m, and LTE to support various QoS requirements. The article highlights a few advanced QoS related features such as new scheduling services, quick access, delayed bandwidth request, and priority controlled access, and it also provides some comparisons between the aforementioned access technologies.

The fourth article is also a survey of adaptive MIMO transmission techniques. With the use of MIMO, better system capacity performance and user experience are expected. But the complexity of adapting to different channel conditions can be prohibitive. A practical way to deal with this problem is "system reduction," meaning reducing the transmit modes to a small subset by aggregation. A framework is proposed for how this can be done, and an example based on IEEE 802.16e is provided.

The fifth article introduces the technology and standards of digital television terrestrial multimedia broadcasting (DTMB). DTMB is the digital TV standard of China for both fixed and mobile terminals. The first DTMB broadcast was on 31 December, 2007 in Hong Kong. Subsequently, it was used to broadcast the 2008 Beijing Olympics. Of particular interest are the joint R&D effort of the Hong Kong Applied Science and Technology Research Institute (ASTRI) and Tsinghua University, and the comparison of DTMB with the other three standards. As the latest standard, many advanced features can be incorporated.

The last article in this issue is an in-depth case study of broadband Internet service in the rural areas of Montana, United States. It shows that nationwide and statewide statistics of service coverage are often misleading. In rural areas where e-government service is needed most, Internet service is often least available. This is a common problem

in big countries like Russia, India, China, and Indonesia. There are success stories of a national effort to cover the most remote villages from Japan and Sweden from which we can learn.

BIOGRAPHIES

KAMRAN ETEMAD (kamran.etemad@intel.com) is currently the director of technology standards at Intel Corporation, where he leads various technical and strategic initiatives related to WiMAX technology. He has also served as the chair of the Technical Advisory Committee of the WiMAX Forum. Prior to Intel, he held senior technical and management positions with Sprint-Nextel as an executive technology advisor, WFI as vice president of advanced technology, and Hughes Network Systems as a senior member of technical staff. His current focus is on advanced development and standardization of the next generation of mobile broadband technologies and networks. He also actively contributes to IEEE 802.16m and various working groups of the WiMAX Forum in various areas such as inter-RAT and multicarrier operation, enhanced mobility, positioning, femto-cells, and multicast/broadcast services; and holds many patents on advanced network, MAC, and PHY layer system designs. He has also made many contributions in the development of cdma2000 technology in 3GPP2 and authored a book titled *CDMA2000 Evolution*. He received his B.S. degree in electronic engineering from Sharif University of Technology, and M.S. and Ph.D. degrees in electrical engineering from the University of Maryland.

PETER YUM (tsyum@ie.cuhk.edu.hk) received his primary and secondary school education in Hong Kong. He went to Columbia University and was awarded B.S., M.S., M.Ph., and Ph.D. degrees in 1974, 1975, 1977, and 1978, respectively. He joined Bell Telephone Laboratories in April 1978 working on switching and signaling systems for two and a half years. Then he taught at National Chiao Tung University, Taiwan, for two years before joining the Chinese University of Hong Kong in 1982. He is a senior advisor with the Applied Science and Technology Institute (ASTRI, http://www.astri.org) since 2010. He has published widely in Internet research with contributions to routing, buffer management, deadlock handling, message resequencing, and multi-access protocols. He then branched out to work on cellular networks, lightwave networks, video distribution networks, and 3G networks. His recent research is in the areas of RFID, sensor networks, and wireless positioning technologies. His diverse industrial experience includes Bell Labs, Bellcore (now Telcordia), IBM Research, Motorola Semiconductors, and ITRI of Taiwan, SmarTone Communications, and Radio-Television (Hong Kong) Ltd. He has also lectured extensively in major universities in China and was appointed an adjunct professor of South East University, Zhejiang University, and Huazhong University of Science and Technology. In 2008 he accepted a chair professorship appointment at Tsinghua University. He was appointed the Fulbright Hong Kong Distinguished Scholar (2005–2006) for lecturing in U.S. universities for three weeks. In 2008 he was awarded the Distinguished Visiting Fellowship from the Royal Academy of Engineering, United Kingdom, for a three-week lecturing tour of U.K. universities. Recently, he and student Lei Zhu were awarded the Best Paper Award of ACM MSWiM 2009 for "The Optimization of Framed Aloha Based RFID Algorithms."