



Mohsen Guizani

Willie W. Lu



Paul Meche

Mamoru Sawahashi

WIDEBAND WIRELESS ACCESS TECHNOLOGIES TO BROADBAND INTERNET

In recent years, we have observed an explosion in the number of new wireless transmission technologies: infrared transmission within rooms, ultra-low-power short-range RF transmission, and more ingenious coding techniques that provide for more efficient use of spectrum in both local and wide area networks. These technology advancements have come from both the traditional computer networking environment as well as the cellular networking arena. More and more, these previously disjoint networks are now seen as converging via wideband wireless access into a single broadband Internet.

Convergence of wideband wireless access and Internet will be the next wave in the information industry, and it obviously becomes one of the foci of global investments. Fueled by such emerging technologies as all-IP direct signaling, super digital signal processing, smart antenna transceiver, broadband reconfigurable core, as well as converged wireless interfaces, the wireless system is taking on a more and more important role in Internet development. As communications evolve to this convergence, a new architecture will be required to support high-data-rate connection from 2 to over 100 Mb/s with various required qualities of service (QoS) based on the new spectrum requirement as well as the coexistence of the current spectrum for wideband wireless. To meet these critical demands, improvements in the wireless physical layer (modulation, diversity, coding, etc.) and link layer (access control, bandwidth allocation, etc.) are necessary.

The articles in this special issue provide a broad survey of the systems and technologies that will enable wideband wireless access to the broadband Internet.

In the first article, Park presents a prototype implementa-

tion for wireless Internet access via General Packet Radio Service (GPRS). As a popular packet service extension for several existing cellular systems (i.e., GSM), GPRS provides a mechanism for Internet access extension to many existing cellular systems. He presents this work by introducing mobile IP via a GPRS network. He addresses the network architecture and protocols utilized in a testbed at ETRI, Korea. Simulation results are also presented that were implemented on a core network testbed.

Moustafa, Habib, Naghshineh, and Guizani, in the second article, review key resource scheduling schemes covering power-only and combined power rate control methods. The benefits provided by the combined algorithm, in terms of lower outage probability and higher capacity while maintaining QoS, are highlighted. Moreover, the authors describe the signaling details to support MS power and bit rate control over the UMTS radio interface protocol architecture. Finally, they complete the overview with a discussion of end-to-end QoS design, including interworking.

The third article, by Falconer, Ariyavisitakul, and Eidson, explores single-carrier frequency domain equalization (SC-FDE) as an alternative and/or complement to OFDM. The authors note that SC-FDE compares favorably to OFDM in terms of performance while requiring less costly power amplifiers. The authors also conclude that a hybrid OFDM/SC-FDE system (base station Tx/Rx) may offer mutual advantages while providing for cost reduction.

Next, Derryberry, Gray, Ionescu, Mandyam, and Raghothaman provide an overview of diversity techniques that focus on different classes of transmit diversity (TD) as they apply to CDMA systems. The authors explain the essential ele-

ments of TD in 3G CDMA systems. They also explain the methods adopted by various standards bodies involved in the 3G specification activities.

Finally, Murch and Ben Letaief provide an overview of antenna systems for broadband wireless communications and address the issues associated with these systems. The authors then introduce the reader to multiple-input multiple-output (MIMO) antenna systems and their associated promise of improved performance and bandwidth efficiency over more traditional antenna systems.

We hope our readers will find these articles enlightening and helpful in their research activities. We received many excellent contributions for this special issue. Unfortunately, space limitations prevented us from publishing all deserving articles. It was a challenging task to select the few that do appear given the high quality of all the submissions. We would like to thank all the reviewers for their insightful input since the task of selecting the final articles would have been impossible without their reviews. We would like to thank all the authors who submitted excellent contributions for this special issue. Last but not least, thanks to the *IEEE Communications Magazine* personnel who have been very helpful all along this process.

BIOGRAPHIES

MOHSEN GUIZANI (mguizani@cs.uwf.edu) is currently a full professor and chair of the Computer Science Department at the University of West Florida, Pensacola. From 1996 to 1999 he was an associate professor of electrical and computer engineering at the University of Missouri-Columbia. Prior to joining the University of Missouri, he was a research fellow at the University of Colorado-Boulder. From 1989 to 1996 he held academic positions at the Computer Engineering Department at the University of Petroleum and Minerals, Dhahran, Saudi Arabia. He was also a visiting professor at the Electrical and Computer Engineering Department of Syracuse University, New York, during academic year 1988-1989. He received his B.S. (with distinction) and M.S. degrees in electrical engineering, and M.S. and Ph.D. degrees in computer engineering in 1984, 1986, 1987, and 1990, respectively, from Syracuse University. His research interests include computer networks, design and analysis of computer systems, wireless communications and computing, and optical networking. He currently serves on the editorial boards of *Optical Network Magazine*, *Journal of Parallel and Distributed Systems and Networks*, as well as *International Journal of Computer Research*. He has served as a guest editor of *IEEE Communication Magazine* (2000 and 2002), *Informatica Journal*, *International Journal of Computer Systems and Networks*, *International Journal of Communication Systems*, *International Journal of Computing Research*, and *Journal of Clus-*

ter Computing. He is the founder and Editor-in-Chief of *Wireless Communications and Mobile Computing Journal* (<http://www.interscience.wiley.com/jpages/1530-8669/>). He is the author of three books: *Designing ATM Switching Networks* (McGraw-Hill, 1999; <http://www.pbg.mcgraw-hill.com/computing/authors/guizani.html>), *Wireless Systems and Mobile Computing* (Nova Science Publishers, 2001), and *Optical Networking and Computing for Multimedia Systems* (Marcel Dekker, to appear May 2002).

WILLIE W. LU [M] (wwlu@ieee.org), is senior principal wireless architect at Siemens-Infineon and a member of the Technological Advisory Council of the United States Federal Communications Commission (FCC). He is also an internationally very well recognized expert in the emerging wireless technologies and has been a technical advisor for over 15 telecommunications authorities in more than 10 countries. He is an independent technical examiner for lots of high-tech venture capitals in Silicon Valley and elsewhere, and listed in major Who's Whos in the world. He has guest edited over 20 special issues on emerging wireless communications in IEEE, IEICE, ACM, and other major publications, and has had over 120 papers published in major professional publications. He is chair of numerous IEEE conferences including GLOBECOM, WCNC, and VTC, and is featured wireless editor of *IEEE Communications Magazine* and *IEEE Transactions of Wireless Communications* (former J-SAC Wireless). He is a frequent keynote and featured speaker at lots of global technical forums, and a well-known wireless pioneer in Silicon Valley. He is a member of ACM, IEICE, CIC, and Sigma Xi.

PAUL MECHE [SM] is principal scientist for Nokia Mobile Phones product creation center in Dallas and chief technical officer for Instituto Nokia de Tecnologia (INT). In his principal scientist role, he is responsible for various standardization strategies, research programs, and industry/university relations functions. As CTO, he is responsible for all aspects of research and development for INT. He is a member of the Southern Methodist University Corporate Council and the University of Texas at Arlington Computer Engineering Advisory Board. As the inaugural Chairman of the Universal Wireless Communication Consortium's (UWCC) Global TDMA Forum, he was responsible for technical programs for the evolution of TDMA including the UWC-136 Radio Transmission Technology which was adopted by ITU as an IMT-2000 (3G) system. During the IMT-2000 process, he served as the primary technical representative for the UWCC and Telecommunications Industry Association's (TIA) committee TR45.3. He has been responsible for a variety of AMPS, CDMA, GSM1900, and TDMA programs, and has received numerous patents and industry achievement awards. He is recognized as a contributing author of IS-136, editor of UWC-136, and editor of PCS-1900 call control functions. Prior to joining Nokia in 1994, he was employed by Bell Northern Research for over 11 years, where he held various technical and managerial positions in wireless research and development.

MAMORU SAWAHASHI received his B.S. and M.S. degrees from Tokyo University in 1983 and 1985, respectively, and received his Dr.Eng. degree from Nara Institute of Technology in 1998. In 1985 he joined NTT Electrical Communications Laboratories, and in 1992 he transferred to NTT Mobile Communications Network, Inc. (now NTT DoCoMo, Inc.). Since joining NTT, he has been engaged in the research of modulation/demodulation techniques for mobile radio and research and development of W-CDMA wireless access and broadband packet wireless access technologies. He is now director of the Wireless Access Laboratory of NTT DoCoMo, Inc.