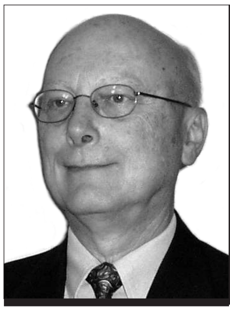
GUEST EDITORIAL

PUBLIC SAFETY



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For many years now, land mobile radio (LMR), based on analog voice communications over locally dedicated radio frequencies and transmission facilities, has been the mainstay of public safety agencies: law enforcement, fire, EMS, and other emergency response departments. Although developments such as trunking and computer-aided dispatch-have been introduced to improve the performance and capacity of LMR systems, and access to wireless data has been implemented in some jurisdictions, the quality of public safety communication systems has generally lagged behind that of commercial systems. This disparity in performance and the lack of interoperability between emergency response departments were not fully appreciated until recent crises highlighted the importance of coordinated operations on a wide scale and the need for access to critical data in real time. Now, it is widely recognized that upgrading public safety communications (PSC) infrastructure is a high-priority task, and progress has been made toward implementing interoperability standards and increasing system capacity. Because of their outdated state, in many instances, when LMR equipment and systems are replaced, there is an opportunity to "skip" several generations of wireless communications developments. However, for the most favorable design, one needs to understand which features and capabilities of current and near future wireless technology are most suitable for operational and other requirements of local and regional public safety agencies.

The purpose of this feature topic is to update the IEEE Communications Society community on the status and progress in upgrading PSC systems, in regard to both interoperability and the introduction of state-of-the-art systems and protocols. Contributions for this feature topic were solicited that discuss recent research, development, deployment, application, and business issues related to the use of wireless technologies for local and regional PSC. The topics of interest included, but were not limited to:

- Status of initiatives to improve PSC interoperability and performance
- Requirements for future public safety wireless systems
- Quality of service and security issues involved in using commercial technologies
- Potential of wireless technologies to improve PSC systems and operational performance
- Architectures and protocols for broadband, wide area, and digital voice and data public safety networks

In response to the call for papers, we received numerous papers of interest; to preserve coherence of the issue and broad scope of coverage, we selected six articless that provide an overview of the state of the art and indicate trends in PSC.

The first article, by T. Doumi, "Spectrum Considerations for Public Safety in the United States," provides an update on the use of radio frequency spectrum dedicated for PSC. In particular, the article describes the efforts to enhance the spectral efficiency of traditional PSC systems, and introduce relative broadband capabilities using the recently assigned 700 MHz and 4.9 GHz bands. The article also discusses the impact of PSC operational requirements and architectural concepts on the selection of communications applications. Finally, the article surveys the wireless technologies considered applicable to expanded PSC requirements, applications, and spectrum capacities.

Internetworking of different wireless technologies, developed for different applications, to produce an advantage for PSC is advocated in the second article, "Evolving Public Safety Communication Systems by Integrating WLAN and TETRA Networks" by A. K. Salkintzis. The article describes a solution for interoperability of wireless local area networks (WLANs) with terrestrial trunked radio (TETRA), the digital LMR system now the standard in Europe. This internetworking initiative makes Internet and WLAN data services available to conventional PSC terminals, and provides an extension of the conventional network over IP-based networks.

The third article of this issue, by L. A. DaSilva *et al.*, is entitled "The Resurgence of Push to Talk Technologies." The article overviews the development of methods for incorporating one of the most distinctive features of the traditional PSC systems, push-to-talk voice communications, into the end-to-end use of digital wide-area networks that have been developed for commercial applications, while satisfying the latency requirements for PSC.

The recent emphasis on mobility in commercial wireless systems is the basis for a "paradigm shift," as envisioned by K. Balachandran *et al.* in their article "Mobile Responder Communication Networks for Public Safety." The vision presented in this fourth article involves unifying PSC resources by bridging commercial wireless and LMR access infrastructures through a common IP-based core network. The article addresses the manner in which the tactical requirements of PSC can be met by commercial wireless networking technology.

The special engineering requirements of the extreme environments of fire and rescue applications are exemplified in the fifth article, "The Acoustic Properties of SCBA Equipment and Effects on Speech Communication" by W. M. Kushner *et al.* This article provides an aspect of PSC only infrequently revealed to communications engineers: the challenge to overcome distortion and interference present in firefighter voice communications.

Finally, the use of wireless technologies for general public safety applications, as opposed to first responder scenarios, is represented by the sixth article, "Vehicle-to-Vehicle Wireless Communication Protocols for Enhancing Highway Traffic Safety" by S. Biswas *et al.* This article discusses the effect of the design of wireless networking protocols on the performance of a radio system intended to prevent or mitigate the extent of automobile collisions.ß

BIOGRAPHIES

LEONARD E. MILLER [S'63, M'64, SM'92] (lmiller@antd.nist.gov, Len-Miller42@cs.com) received a B.E.E. degree from Rensselaer Polytechnic Institute, Troy, New York, in 1964; an M.S.E.E. degree from Purdue University, West Lafayette, Indiana, in 1966; and a PhD degree from the Catholic University of America, Washington, DC, in 1973. From 1964 to 1978 he was with the Naval Surface Warfare Center, Silver Spring, Maryland, where he was a member of the Signal Processing Branch. From 1978 to 2000 he was with J. S. Lee Associates, Inc., Rockville, Maryland, as vice president for research, and was involved initially in analyzing the survivability and performance of military communications and electronic support systems, and later in modeling of propagation in the mobile environment, and the design and analysis of cellular and personal communication systems. Since 2000 he has been a member of the Wireless Communication Technologies Group, National Institute of Standards and Technology, Gaithersburg, Maryland, where he is responsible for research on wireless ad hoc networks, wireless standards, and public safety wireless applications. He is coauthor (with J. S. Lee) of *CDMA Systems Engineering Handbook* (Artech House, 1998). Further details are available at http://www.antd.nist.gov/wctg/people/lmiller.html.

ZYGMUNT J. HAAS (haas@ece.cornell.edu) received his B.Sc. in 1979 and his M.Sc. in 1985, both in electrical engineering. In 1988, after earning his Ph.D. from Stanford University, he joined AT&T Bell Laboratories in the Network Research Department. There he pursued research on wireless communications, mobility management, fast protocols, optical networks, and optical switching. From September 1994 to July 1995, he worked for the AT&T Wireless Center of Excellence, where he investigated various aspects of wireless and mobile network technologies. In August 1995 he joined the faculty of the School of Electrical and Computer Engineering at Cornell University, where he is now a professor and associate director for academic affairs. He is an author of numerous technical conference and journal papers, and holds 15 patents in the areas of high-speed networking, wireless networks, and optical switching. He has organized several workshops, delivered numerous tutorials at major IEEE and ACM conferences, and serves as an editor of several journals and magazines, including *IEEE Transactions on Networking*, *IEEE Transactions on Wireless Communications*, *IEEE Communications Magazine*, and *ACM/Kluwer Wireless Networks*. He has been a guest editor of *IEEE JSAC* issues on Gigabit Networks, Mobile Computing Networks, and Ad Hoc Networks. He has served as Chair of the IEEE Technical Committee on Personal Communications and is currently serving as Chair of the Steering Committee of *IEEE Pervasive Computing*. His interests include mobile and wireless communication and networks, performance evaluation of large and complex systems, and biologically inspired networks. His URL is http://wnl.ece.cornell.edu.