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WIRELESS TECHNOLOGIES ADVANCES FOR EMERGENCY AND RURAL COMMUNICATIONS

The need for integrated voice and wideband data communication services is ever growing in several fields of human endeavor. The main goal of this special issue is to outline the influence of this need in the area of wireless communications for public safety and emergency, as well as networks and technologies for delivery of wideband services to rural communities. The two topics have been largely investigated (see, e.g., [1–6, references therein]) during the last two decades. The quality of communications services offered by communications systems for public safety applications, such as land mobile radio systems (LMRs), is generally lagging behind that of commercial systems. Due to cost of radio coverage and trunking, the quality of the services offered by existing commercial mobile systems in rural areas, characterized by low densities of populations, is well below that offered by operators in urban and suburban areas. Thus, current communications systems for rural areas provide basic telephone services and are rarely suitable for effective data access.

The necessity of advanced communications services in public safety operations has led to the evolution of LMR systems toward a new generation of professional mobile radio (PMR) and standard communication systems. Presently, many of these communication systems are based on terrestrial trunked radio (TETRA) specifications. TETRA technology has gained wide acceptance (especially in Europe), and is considered one of the most mature and prominent technologies for the PMR and even public access mobile radio (PAMR) markets. TETRA specifications have been conceived to support the requirements of public safety agencies, such as law enforcement, ambulance services, civil emergency management/disaster recovery, fire services, coast guard services, search and rescue services, and government administration. Its specifications are constantly being evolved by the European Telecommunications Standards Institute (ETSI), and new features are being introduced to fulfill the growing and ever more demanding public safety and disaster recovery (PSDR) requirements.

Up to now, PMR systems such as TETRA and modern broadband wireless systems have evolved independently. However, mobile broadband technology could greatly enhance and complement present and future TETRA networks to better achieve the advanced services envisioned in the next generation for PSDR communication systems. In general, data rates required for emergency services provisioning plus the demand for enhanced mobility, improved ad hoc functionality, and international interoperability reach far beyond the scope of current PSDR narrowband telecommunication systems and call for mobile broadband enhancements that can arise from integration of TETRA with existing and future broadband technologies. Several projects are undergoing to provide guidelines for solving these problems by suggesting interoperability among different communication technologies and, possibly, enhanced functionalities of public safety communication (PSC) systems.

An interesting question is how to architect networks for future PSC systems. As already pointed out, considering realistic integrated scenarios, PSC networks will be heterogeneous and comprise terminals with different capabilities in terms of bandwidth and services. These devices will also be able to locally manage the spectrum and form ad hoc/mesh local area networks. Integration of several communications technologies for PSC is not straightforward, and poses serious and interesting challenges at every protocol layer of the network architecture, even accounting for possible worldwide standardization, security, and reliability. Starting from a review of the current status of the PMR technologies, one task of this special issue is to point out the current trend of PMR systems, and their integration with existing third-generation (3G) and future 4G wireless technologies for providing enhanced communication services such as fast and effective access to databases for retrieving audio, video, and geographical information to improve efficiency and security of the personnel involved in the emergency. In parallel, on the commercial side, broadband access to communication services has become an established global commodity required by a large percentage of the population. Several countries look at setting up broadband networks to solve the "digital divide." Efforts to bring mass market broadband services to rural areas follow the initiative of the European Commission called Bridging the Broadband Gap, which is intended to bring high-speed broadband Internet to all Europeans and in particular to the EU's less developed areas. It is widely believed that introducing broadbandInternet connections to rural areas is a prerequisite for ebusiness, growth, and jobs throughout the economy. Wireless digital subscriber line (WDSL) even for mobile users, based on Worldwide Interoperability for Microwave Access (WIMAX) and other technologies such as rural wideband code-division multiple access (R-WCDMA), which promises to extend the existing UMTS solution to rural areas, can play a significant role in the broadband wireless access market.

Modern wideband wireless communications technologies for broadband services should offer, at least:
- Mobile telephony
- Video telephony
- Basic data services, such as SMS and MMS
- Advanced data applications, including music downloads to a mobile handset
- Mobile broadband targeting laptop users
- Fixed-wireless broadband (asymmetric DSL alternative)
- Mobile small-screen TV streaming
- Fixed PSTN-equivalent telephony
- Government, health and educational services

Both R-WCDMA and WiMAX are promising solutions for the provisioning of broadband services to rural areas since they can easily incorporate all the technical solutions to improve the link-budgets. In general, it is known that networks for rural coverage at convenient costs can be deployed from the integration of more than one communication technologies such as satellite and terrestrial. In this case the intelligent partitioning of services among different technologies allows reduced deployment costs and improved spectrum usage. Other alternatives, not necessarily independent of the previous one, can be based on structured terrestrial networks adopting relatively cheap techniques for enlarging the coverage area of a single base station offering point-to-multipoint (PMP) service. These solutions include relay stations and/or distributed (sub) networks organized in a mesh or ad hoc that are connected to a base station providing access to a core network. In this case issues related to the capacity and quality of service offered by relay and/or hybrid mesh-PMP networks need to be solved in order to enhance the economic feasibility of these solutions.

This issue combines an array of interesting articles that address recent activities in this important and highly evolving field. In closing, the guest editors would like to acknowledge the many experts in the field who participated in the reviewing process for providing helpful suggestions to the authors on improving the content and presentation of their articles.

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BIOGRAPHIES

IBRAHIM HABIB (habib@ccny.cuny.edu) received a Ph.D. degree from the City University of New York, an M.Sc. degree from Polytechnic University of New York, and a B.Sc. degree from Ain Shams University, Cairo, Egypt, all in electrical engineering. From 1981 to 1983 and from 1984 to 1988 he was a computer networks engineer working on the planning, system engineering, and installation of several IBM SNA networking projects in Egypt and Saudi Arabia. In 1991 he joined the Faculty of the City University of New York, where is now a full professor. His research interests span different areas of traffic engineering in IP, wireless, and optical networking. He has published more than 100 papers and reports in those areas. From 1998 to 2000 he was with AT&T Labs, and from 2000 to 2001 with Telcordia Technologies, Applied Research Department, working on the architecture design of IP over optical networks, optical control plane, and operations support systems (OSS). He was a Guest Editor of *IEEE Journal on Selected Areas in Communications* three times in 1997, 2000, and 2004. He was also a Guest Editor of *IEEE Communications Magazine* in 1995, 1997, and 2007, and was an Editor of the same magazine from 1994 to 1997. He has chaired many technical sessions, symposia, and conferences. He is listed in many Marquis's *Who's Who in the World* (2001, 2004, 2005) and *Who's Who in America* editions.

FRANCO MAZZENGA received a Dr.Ing. degree in electronics engineering cum laude from the University of Rome Tor Vergata, Italy, in 1993. From 1993 to 1994 he was involved in Fondazione Ugo Bordoni on the analysis of electromagnetic propagation at high and very high frequencies. In 1997 he obtained a Ph.D. degree in microelectronic and telecommunications from the University of Rome Tor Vergata. From 1998 to 2000 he was a researcher in the Consorzio di Ricerca in Telecomunicazioni (CoRiTel) founded by Ericsson and the Department of Electronic Engineering of the University of Rome Tor Vergata. In November 2000 he joined as a researcher in telecommunications in the same department. Since November 2006 he has been an associate professor in communications. He is an author of about 80 technical conference and journal papers, and holds one patent in the area of wireless communications. He collaborates as a reviewer on all major IEEE journals and magazines. His interests are on 3G and 4G wireless communications systems, GNSS systems, and statistical and digital signal processing.

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incumbents and innovators. Hopefully more discussion within the technical community about how to quantify interference expectations will be helpful to all involved.

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