

Special Issue : Wireless Communications for Emergency Communications and Rural Wideband Services

Guest Editorial

Welcome to this Special Issue of Journal of Communications (JCM). In this issue there are five articles which cover wireless networking and technologies as the most effective means of communication for public safety, emergency response and disaster recovery operations.

During a typical day in our hyper-connected world, we can sit at our desks and communicate with the rest of the world with a few mouse clicks or by pressing a few buttons on our phones. When you walk outside, wireless networks and mobile phones maintain that connectivity. Even in remote areas, satellite phones or briefcase-sized satellite terminals provide on-demand voice and data communications. We have come to depend on these systems for business, government, and social interaction. Yet in the blink of an eye, a natural disaster, an industrial accident, or a terror attack can leave us silent and isolated.

Reliable communications can be a matter of life and death during an emergency, but as seen in countless situations across the globe, even our best trained and equipped government agencies and first responders (police, fire, rescue, medical, etc.), may struggle to communicate during a crisis.

It is well documented that inadequate communication system interoperability was a major contributor to loss of life in the September 11, 2001 terrorist attacks. Further, loss of communications contributed significantly to the loss of life during the aftermath of the August 2005 Hurricane Katrina in the USA, when much of the land-based and cellular infrastructure was destroyed leaving residential consumers, business consumers, and more importantly, emergency response personnel struggling to communicate.

In the U.S. and in every nation around the globe there is a need for government-led and integrated approaches to coordination of emergency communications that ultimately becomes a fully accepted "National Doctrine" for recovery processes based on continually upgraded and improved communications capabilities. To be effective, this initiative must work in tandem with the professional organizations of firefighters, police, and emergency medical and rescue organizations as well as national associations of cities, counties, tribes, states, mayors, governors, and other interested entities. Existing communications support is focused on voice traffic. Land mobile radio (LMR) systems can provide local and regional connectivity, while cellular telephone and satellite systems can provide national connectivity. However, data connectivity is becoming increasingly important as part of the Information Technology (IT) infrastructure required for the incident command system. Communications are required locally within the disaster site, within the surrounding region, and nationally (or even globally in some cases). Mobility tools help make working remotely more productive than ever, yet a gap remains between the information and communication resources available at headquarters and what is available in the field and at the scene of an incident.

By combining the capability and rich content of premises-based systems with the freedom of wireless networks, and by adding the intelligence and reach of the wire-line network, the resulting interoperability, coverage, and flexibility of first-responder communication systems could make these IT resources among the most critical assets available in an emergency.

We are very pleased that the technology, academic, and industry communities are discussing this important issue in our Special Issue of JCM and we are certain that the content of this SI will shed some light on this important subject.

The papers presented in this special issue discuss design and implementation of wireless networking and the challenges faced in providing applications and services in rural and emergency communications scenarios.

1. SwanMesh: A Multicast Enabled Dual-Radio Wireless Mesh Network for Emergency and Disaster Recovery Services

This paper was accepted for publication in this issue for its rich content and its presentation of original experimental results for multimedia applications and services to the first response and rescue team. The proposed architecture and design, SwanMesh, could be used for exchanging the crucial information simultaneously between teams at different disaster affected geographical locations. Using a single bandwidth and multicast operation, SwanMesh will allow smooth delivery of live multimedia images and information to multiple clients at different locations. The application suggested in this paper is very important and the proposed technology would be very beneficial for rescue operations.

2. Cluster-based Communications System for Immediate Post-disaster Scenario

This paper focuses on the vital need for providing communications facilities to the victims, immediately after the disaster and prior to the arrival of rescue teams. The proposed novel approach in emergency communications enables survivors to communicate among themselves and help each other. The authors have presented a self-organizing Disaster Response Network (DRN) which uses the features of clustered and cognitive networks. The simulation results in this paper show that the DRN reduces the end-to-end delay mainly by minimizing the number of channel switches in a

route. The authors also propose a hypothesis and calculate the probabilities for false alarming and miss detection for spectrum sensing by the Cluster Head (CH) node. The paper content is very rich and informative.

3. Statistical Analysis of Broadband Wireless Links in Rural Areas

The main contribution of this paper is the presentation of a formal statistical method – a Design of Experiments (DOE) analysis - that can be used to analyze the interactions between different variables, such as packet size, location, buffer size, and wireless provider to understand how different factors affect QoS requirements of a real time application. Their proposed method and their results show that the impacts of the two factors on the effective bandwidth and mean packet loss rate are dependent on the location and the wireless card used, whereas the impact of buffer size is less significant. Based on the analysis and results presented by the authors, If the end-user can understand the impact of such factors and their interactions, he/she may be able to make the best selection of certain controllable parameters, in an effort to improve the QoS of the 3G connection. This is especially important for users located in rural areas, where cellular coverage is limited.

4. Emergency Video Multi-Path Transfer over Ad Hoc Wireless Networks

This paper presents a proposed method to implement an Adhoc network with multi hop radio for emergency and disaster scenarios since its deployment is very timely in the emergency response domain and more practically, in the area of U.S. Department of Defense (DoD) Support to Civil Authorities (DSCA) after a major disaster. The authors have made a good use of technical illustration, visual examples and very credible references to support their thesis. Those points along with their excellent closing argument, make this document a good article for study.

5. Robust Emergency Communications Using TxID Watermark of ATSC DTV System

This paper presents an emergency communication technique which is enabled by ATSC DTV transmitter identification (TxID) watermark signal. Theoretical and simulation results in this paper show that the ATSC TxID watermark signal can reach a larger coverage area and hence can be used to enable emergency communication during national disaster situations. The Hata–Davidson propagation model has been used for analysis and comparison with other existing emergency communication systems. It is found from the coverage analysis that the proposed technique can provide a much larger coverage than other existing emergency communication systems. Performance of the proposed method/technique is evaluated in terms of communicating station/node requirement and network reliability and it has been shown to have improved performance as compared to other existing emergency communication systems. This is a very good experimental paper with an in-depth analysis.

We are very pleased with the results of our “call for paper” for this SI and hope you enjoy this issue of JCM.

Guest Editors:

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Abdulrahman Yarali received his B.S. and M.S. in Electrical Engineering from University of Florida and George Washington University in 1985 and 1988 respectively. He received his Ph.D. degree in Electrical Engineering from Virginia Polytechnic Institute and State University (VPI) at Blacksburg, VA, in 1995. From 1995 to the present, he has been working as a technical advisor, an engineering director and an associate professor in wireless mobile technology. He has led research teams working on location completing numerous contracts in wireless mobile systems design and optimization for leading telecommunications companies such as AT&T, Motorola and Sprint PCS in the U.S. Dr. Yarali has been a faculty member in the Telecommunication System Management (TSM) and Industrial Engineering Technology at Murray State University since 2003 where he has developed a wireless option in the TSM program. Yarali has published abstracts and papers

in technical journals and at national and international conferences. He has presented several of his papers in North America, Asia, Middle East, and Australia. Currently he is conducting a research project titled “Wireless Mobile Migration to Next Generation Networks (NGN)” with telecom research center at overseas as part of his research activities at MSU. Several students have completed their Master theses using the engineering theory and principles advanced in his projects. Yarali is vice president of International Association of Journals and Conferences (IAJC). Dr. Yarali’s research interest continues to be focused in the field of higher generation for wireless mobile communication applications and services.



Saifur Rahman is the director of the Advanced Research Institute at Virginia Tech where he is the Joseph Loring Professor of electrical and computer engineering. He also directs the Center for Energy and the Global Environment at the University. Professor Rahman has served as a program director in engineering at the US National Science Foundation between 1996 and 1999. In 2008-09 he is serving as the vice president for New Initiatives and Outreach for the IEEE Power & Energy Society. He has also served on the IEEE PES Governing Board as VP of industry relations, and VP of publications between 1999 and 2003. In 2006 he served as the vice president of the IEEE Publications Board, and a member of the IEEE Board of Governors. He is also a member-at-large of the IEEE-USA Energy Policy Committee. He is a distinguished lecturer of IEEE Power & Energy Society and has published over 300 papers on conventional and renewable energy systems, load forecasting, uncertainty evaluation and infrastructure planning. He is an IEEE Fellow.



Dr. Mike Bowman is currently an Assistant Professor of Telecommunications System Management at Murray State University where he teaches graduate and undergraduate courses in Telecommunications, Information/Network/Computer Security, and Computer Science. He retired from the United States Army in 2005 at the rank of Colonel after 26 years of service. From 1992 to 2005 his primary responsibility was the management of large scale research, development, and acquisition programs for military communications, command and control, and intelligence systems His fields of expertise include information system security, communication systems and networking, artificial intelligence, knowledge engineering, and military command-control-communications and computer (C4) systems. Dr. Bowman earned a PhD in 2002 from George Mason University with study and research for the U.S. Defense Advanced Research Projects Agency (DARPA) investigating advanced methods in artificial intelligence, knowledge engineering and intelligent agents for real-world problem solving in the military domain. Dr. Bowman is the Chair and

project leader for the North Atlantic Treaty Organization (NATO) Information System Technology workgroup investigating Tactical Communications in Urban Operations (IST 067) and a participant in several communications and information systems projects funded by the U.S. Department of Homeland Security. His publications include articles in the International Journal of Emergency Management, Journal of Information Technology Education, AI Magazine, Military Review, and Crosstalk; book chapters on the development of intelligent agents; and a variety of papers in conference proceedings and professional journals. Dr. Bowman is a member of AAAI, ACM, AFCEA, IEEE, and ITERA.