Testbed for High-Speed 'End-to-End' Communications in Support of Comprehensive Emergency Management

A Project of
Virginia Tech's Center for Wireless Telecommunications (CWT)
Science Applications International Corporation (SAIC)
Sponsored by the National Science Foundation
(Digital Government Program Award 9983463)
With additional support from the National Response Center (NRC)

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Project Description and History

We are completing the fourth and final year of our project "Testbed for High-Speed 'End-to-End' Communications in Support of Comprehensive Emergency Management" (NSF Award 9983463) [1]. Our original 1999 proposal envisioned building an operational high-capacity rapidly deployable communications system for disaster response. It would seamlessly link first responders with all local, state, and national command centers and resources. Reviewers liked the proposed system but felt that the project might be an infrastructure application, and some asked, "Where is the new research?" We satisfied their concerns, and the project was ultimately funded at about half the $3M original budget. The funding limitation was dictated by the limits of NSF's resources for a single project of this kind. The final budget was front-loaded so that we could construct the minimum prototype equipment and (it was assumed) then get money for the operational phase from agencies like the Federal Emergency Management Agency (FEMA).

The terrorist attacks of 9/11/2001 tragically illustrated the need for a system like ours. The telecommunications industry rushed to fill the gap and deluged the government with equipment offers and proposals. We had almost no competition before 9/11 and overwhelming competition afterwards.

FEMA praised our demonstrations and endorsed our goals, but made it clear that they do not support "research." DoD promised funding, but the Iraq war intervened. We were promised participation in the TOPOFF-2 exercise, but it had serious internal problems and our corporate partners withdrew. Without funding from other agencies, NSF alone could not support the full construction and deployment of an operational system. Nevertheless, the NSF investment in this program led to significant technological and scientific advances that will benefit disaster communications in the future.

The communications needs of disaster first responders and the technical problems of meeting them made us investigate cognitive radio. This technology was not popular with the public safety community who viewed it as needlessly expensive and complicated. We made a patentable breakthrough in cognitive radio methodology that allowed us to implement a proof of concept demonstration using Apple laptop computers and the Proxim point-to-point radios favored by FEMA for disaster communications. Before the end of the project, this demonstration system will be installed at SAIC's Public Safety Integration Center for use by public safety and DHS personnel in a variety of tests.

Summary of Accomplishments

- **Operational Demonstrations** – Virginia Governor's Commission on Preparedness and Security (11/14/01), U.S. Rep. Goode, FEMA, DoD, Local Officials (1/07/02), SAIC Public Safety Integration Center (5/14/2003),dg.o 2003 (5/18-21/2003)
- **Government Briefings** – National Response Center (7/24/2001), U.S. Coast Guard National Strike Force (7/06/2001), Defense Information Systems Agency(5/07 & 8/28 2002), U.S. Rep. James Moran (10/03/02)
- **Influence on the Public Safety Communications Community**- Co-sponsored Workshop on Disaster Communications 7/12-13/2001. Invited presentations at 2003 Software Defined Radio Forum (SDR03) and 2004 International Symposium Advanced Radio Techniques (ISART2004) through auspices of DHS Project SAFECOM
- **Technical Achievements** – First demonstration of 28 GHz rough surface scattering and its effect on radio channels, development of significant breakthrough in cognitive radio technology

Conclusions

It is very difficult or impossible for an operational agency with no external research budget to co-fund NSF Digital Government projects. Operational agencies do not fund field trials. If researchers do not have firm financial commitments from other federal agencies when they submit a Digital Government proposal, they are almost certainly not going to be able to obtain funding from those agencies.

Nevertheless, the collaboration with other agencies that the Digital Government program imposes on its grantees is a powerful catalyst for cross-fertilization and strongly aligns the grantees' research with the practical needs of potential users.

Therefore, the NSF Digital Government program should continue to fund projects that combine good solutions to real government problems (e.g., disaster communications) and good engineering and science (e.g. developing a broadband rapidly deployable disaster communications system), even if insufficient funding is available for the total project budget. Solving real government problems helps guarantee that the results will be useful, and supporting good engineering and scientific research are the key parts of NSF's mission.

Selected Project Publications

[1] C.W. Bostian, S. F. Midkiff, W. M. Kurgan, L. W. Carstensen, D. G. Sweeney, and T. Gallagher, "Broadband Communications for Disaster Response", *Space Communications*, Vol. 18 Nos. 3-4 (double issue), pp. 167-177, 2002
[2] C.L. Dillard, T.M. Gallagher, C.W. Bostian, and D.G. Sweeney, "Rough Surface Scattering from Exterior Walls at 28 GHz," *IEEE Trans. Antennas and Propagation*, in press.
[3] M.T. Miniuk, T. M. Gallagher, C. W. Bostian. "Transmission Characteristics of 28 GHz NLOS Paths." 2004 IEEE Antennas and Propagation Society International Symposium
[4]T.W. Rondeau, C.J. Rieser, T.M. Gallagher, and C.W. Bostian. "Online Modeling of Wireless Channels with Hidden Markov Models and Channel Impulse Responses for Cognitive Radios," 2004 International Microwave Symposium
[5] C. W. Bostian, S. F. Midkiff, T. M. Gallagher, C. J. Rieser, and T. W. Rondeau. "Rapidly Deployable Broadband Communications for Disaster Response," 2004 International Symposium on Advanced Radio Technologies (SAFECOM Session).