

Improving First Responder Communications: A Sampling of NIST Projects

The inability of first responders from many different agencies to communicate and share data greatly hampered the emergency response to the events of Sept. 11, 2001. The Commerce Department's National Institute of Standards and Technology (NIST) is working with federal, state, and private organizations to identify specific first responder needs and to develop standards and technologies for interoperable wireless telecommunications and information systems. The goal is to take advantage of the latest technological advances to help save lives during both day-to-day and large-scale emergencies by equipping first responders with systems that best meet their requirements.

Other than NIST's World Trade Center (WTC) investigation, the projects described below are sponsored in whole, or in part, by the Department of Justice's COPS* and CommTech Programs and by the Department of Homeland Security's (DHS) SAFECOM program and Science and Technology Directorate.

Communications Standards

First responders and public safety officers often have difficulty communicating with each other in an emergency because their equipment is incompatible. In some cases, fire fighters and police officers in the same jurisdiction using equipment from the same vendor cannot talk to each other. To help overcome this problem, NIST is working with the public safety community to standardize techniques for wireless interoperability and information technology applications. (See: www.eeel.nist.gov/oles/



Illustration by: Tim McEvoy

A self-organizing wireless network developed by NIST researchers could allow first responders to track one another's movement by collecting data from building sensors.

public_safety.html.) NIST helps to validate users' requirements, considering both technical and operational needs, and evaluates factors, both internal and external to the public safety community, that might hamper standardization efforts. NIST also characterizes current and emerging technologies and provides engineering support for standards efforts. In addition, NIST works with standards development organizations to have first responder requirements included within the scope of their ongoing programs. Technical contact: Dereck Orr, dereck.orr@nist.gov, (301) 975-2296.

On behalf of the SAFECOM and CommTech programs, NIST developed the first-ever Statement of Requirements for Public Safety Communications (see www.safecomprogram.gov), which provides information on basics for achieving interoperable communications—communications across public safety disciplines and jurisdictions on demand, in real time, when authorized—for all local, tribal, state, and federal first responders. The necessary resources include adequate radio spec-

* Community Oriented Policing Services

trum and “open” (public) standards for communications technologies. Development of the requirements has led to ongoing work to develop an overall framework for public safety communications systems for SAFECOM, the federal umbrella program that helps public safety agencies improve response through more effective and efficient interoperable wireless communications. The public safety community includes more than 50,000 local and state agencies and organizations and more than 100 federal agencies engaged in law enforcement, firefighting, public health, and disaster recovery. Technical contact: Dereck Orr, dereck.orr@nist.gov, (301) 975-2296.

Issues from Sept. 11

First responder communications also is an important area being studied in the NIST building and fire safety investigation into the collapse of the WTC (<http://wtc.nist.gov/>) structures following the terrorist attacks of Sept. 11. More than 400 fire and police emergency responders were among those who died. Investigators have interviewed more than 100 public safety personnel who responded to the WTC attack as part of the study. Among findings released to date, NIST has identified a number of emergency communications issues requiring attention. These include performance requirements for radio communications systems, communications systems in buildings, and pre-emergency inspection and testing of these systems in high-rises to identify performance gaps and inadequacies. Another issue is network architecture and operational protocols for intra- and inter-agency communication, covering local networking at incident sites and dispatching, system scalability in terms of the number of first responders using the system, and interoperability with existing emergency communications systems.

Recent NIST presentations dealing with emergency communications at the WTC site are available at www.nist.gov/public_affairs/agenda_oct192004.htm. (See Projects 7 and 8.) Objectives of the communications aspect of the WTC study include enhancing evacuation systems and the safety of building occupants and emergency

responders. NIST’s WTC investigators plan to issue recommendations from the study in early 2005.

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Propagation of Radio Signals

First responders who rely on radio communications often lose signals in complex signal-propagation environments, such as building elevators, basements, or other areas that block signals. Signals from cell phones or two-way radios used by



Photo by Gail Porter/NIST

NIST guest researcher Marc Rutschlin (left) and NIST electrical engineer Chris Holloway track radio signals sent from within the NIST 11-story Administration Building to locate any “dead spots” where emergency frequencies are blocked.

building occupants or first responders trapped within pockets of collapsed buildings also can be difficult to detect through dense rubble. NIST researchers are conducting experiments on propagation of radio signals in real-world “laboratories,” including buildings that are being demolished as part of construction and recycling projects. Among its tasks, NIST is investigating new tools to improve communications, such as methods for detecting very weak radio signals and use of improvised “antennas” made of metal found in debris to boost signals. NIST also is

mapping signal strength in buildings that will remain standing to identify potential weak-signal “dead spots.” Ultimately, the researchers plan to generate a large set of public-domain data on differences in signal reception at emergency communications frequencies for different types of building environments.

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First Responder Communications Testbed

About 1,000 public safety personnel were involved in responding to the attacks on the WTC buildings on Sept. 11, 2001. Providing reliable communications in future emergencies of this scale will require new technologies, standards, and network architectures. NIST has developed a Distributed Testbed for First Responders as a venue for collaborative research on possible solutions. The testbed has been used to demonstrate communications interfaces for sensors, dissemination of building integrity data from sensors, biometrics for identification and authentication, voice over Internet, emergency personnel localization and tracking and other technologies. Goals include increasing the quality and quantity of information available to first responders, improving information display and decision support systems, and the seamless integration and interoperability of smart wireless sensor networks in buildings. The testbed has been demonstrated for fire and police chiefs from across the country. Technical contact: Nader Moayeri, nader.moayeri@nist.gov, (301) 975-3767.

Self-Organizing Wireless Networks

In the future, first responders converging on a disaster scene may be able to quickly and easily exchange emergency messages using a self-organizing wireless network developed by NIST for transmission of voice, text, video, and sensor data. The network—which has been demonstrated on the testbed mentioned above—consists of personal digital assistants (PDAs) equipped with wireless local area network (WLAN) cards. Transmission routes among the PDAs are established automatically and without need for networking infrastructure as the first

responders arrive on the scene. The network may use any nearby PDA to relay messages. If a worker leaves the disaster scene or a device is destroyed, the network automatically reorganizes itself. Small video screens can display the names of workers and their roles. In buildings equipped with radios at reference locations, the network would determine the locations of first responders and track their movements. The devices also could receive information from smoke, heat, or vibration sensors embedded in smart buildings that could be transmitted by wireless sensor networks or distributed by first responders during emergencies. Technical contact: Nader Moayeri, nader.moayeri@nist.gov, (301) 975-3767.

For general information on NIST’s first responder communications research, contact Dereck Orr, NIST Office of Law Enforcement Standards, dereck.orr@nist.gov, (301) 975-2296.