COMMUNICATION CHALLENGES IN EMERGENCY RESPONSE

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A primary challenge in responding to both natural and man-made disasters is communication. This has been highlighted by recent disasters such as the 9/11 terrorist attacks and Hurricane Katrina [2, 5, 6]. A problem frequently cited by responders is the lack of radio interoperability. Responding organizations must work in concert to form a cohesive plan of response. However, each group—fire, police, SWAT, HazMat—communicates with radios set to orthogonal frequencies, making inter-agency communications extremely difficult. The problem is compounded as more local, state, and federal agencies become involved.

The communication challenges in emergency response go far beyond simple interoperability issues. Based on our research, practical observation of first responder exercises and drills, and workshop discussions, we have identified three categories of communication challenges: technological, sociological, and organizational. These three major areas are key to developing and maintaining healthy and effective disaster communication systems.

The primary technological challenge after a disaster is rapid deployment of communication systems for first responders and disaster management workers. This is true regardless of whether the communications network has been completely destroyed (power, telephone, and/or network connectivity infrastructure), or, as in the case of some remote geographic areas, the infrastructure was previously nonexistent. Deployment of a new system is more complicated in areas where partial communication infrastructures remain, than where no prior communication networks existed. This can be due to several factors including interference from existing partial communication networks and the dependency of people on their prior systems.

Another important obstacle to overcome is the multi-organizational radio interoperability issue. To make future communication systems capable of withstanding large- or medium-scale disasters, two technological solutions can be incorporated into the design: dual-use technology and built-in architectural and protocol redundancy.

Dual-use technology would enable both normal and emergency operational modes. During crises, such devices would work in a network-controlled fashion, achieved using software agents within the communication

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equipment. In an emergency, the software agent takes control such that the user gets information updates and limited, controlled access to network bandwidth.

Examples of architectural and protocol redundancy solutions that need to be built into future communication systems include devices with multiple network capabilities, such as cellular phones with IEEE 802.11 (WLAN) or Bluetooth interfaces. In the event that base stations fail, these phones could form local networks.[1]

Another potential solution for quickly restoring a communications infrastructure is a hybrid wireless mesh network such as the CalMesh platform, developed at the University of California-San Diego's Calit2 (see calmesh.calit2.net). However, setting up such mesh networks is not without challenges. For example, Braunstein et al. [1] observed that unexpected radio interference can inhibit network performance; and concluded that infrastructure-less networking forms such as mobile ad-hoc networks and wireless mesh networks need further research in order to improve network scalability, capacity, and efficiency.

The social challenges that arise with communications within and between ephemeral groups must also be considered. An understanding of human activity and communication behavior models should be incorporated into communication system design. Important areas include human behavioral models and their impact on emergency communication and affordability, availability, and applicability of emergency communication solutions.

Sharing and dissemination of information is both critical and problematic, beginning with whom to trust in unfamiliar settings. Even after a level of trust is established, security issues must still be considered. Another important factor is the emotional volatility of the victim population. Fear, stress, and other emotions are aggravated by the lack of information. Therefore, periodic information updates are important. Hegde et al. [4] presented a technological solution that provides differentiated services for an agitated caller by detecting the emotional content in speech packets over a wireless network.

Some technologies created to improve communications among and across responders and their many agencies may not be willingly adopted. This can be due to several factors, some of which involve resource constraints that inhibit the purchasing or upgrading of equipment and paying for training costs (which can be prohibitive) to learn new technologies not used on a regular basis [7, 8].

At a higher level, the lack of a common vocabulary between response organizations and between organizations and citizens adds to the problems. While the communication between organizations has improved in terms of a common language, it still lacks efficiency. Additional social science research is needed to investigate common languages and principles such as icon languages for use between response organizations and the victim population. Above all, the emergency communication tools for the general public must be affordable, available, and applicable during their day-to-day life in order to ensure that they will be used during a crisis.

Organizational challenges are prevalent in disaster response, especially when groups that are accustomed to hierarchy and hierarchical (centralized) decision making must suddenly work in a flatter, more dynamic, ad-hoc organization that emerges during post-disaster relief efforts. There are advantages to both. Collaborative technologies such as mobile applications, Web-based email, and communications applications such as Groove can aid in the effectiveness of cross-organizational communication [3]. Hierarchical organization leads to wider information gaps across organizations, but flat organizations are not scalable. Therefore, a hybrid organizational model needs to be developed to best utilize the two organizational approaches.

The availability of information has a temporal

[1]Recent innovative networking products such as Qualcomm GSP1600 CDMA/Satellite phone (www.qualcomm.com) and Telit SAT550 (www.globalstar.com) GSM/Satellite phone are two examples of communication devices with multiple network capabilities.

dimension. For example, there is a significant lack of information about the scale of a disaster in the immediate aftermath; this is followed by large amounts of imprecise information. The chief challenge for the emergency response organization is not the scarcity of information, but the glut: too many resources and too much information strains the capacity of the management system as well as the communication system. Art Botterell observed that while communication failures tend to propagate downward (begin with culture, but ultimately blame the technology for failing), the change needed to address these failures must propagate upward: given an enabling technology, new procedures for use are required, human and organizational factors must be considered, and ultimately the entire culture of an organization may need to be changed.[2]

In conclusion, only a comprehensive approach involving solutions for each of the three major issues—technological, sociological, and organizational—can provide a reliable communication system during crisis situations. C

[2]Art Botterell is the community warning system manager for the Office of the Sheriff of Contra Costa County, CA. His observations were taken from a panel discussion on emergency response communications that took place during the Third International ISCRAM conference in May 2006.

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