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Community response grids: E-government, social networks, and effective emergency management

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Abstract

This paper explores the concept of developing community response grids (CRGs) for community emergency response and the policy implications of such a system. CRGs make use of the Internet and mobile communication devices, allowing residents and responders to share information, communicate, and coordinate activities in response to a major disaster. This paper explores the viability of using mobile communication technologies and the Web, including e-government, to develop response systems that would aid communities before, during, and after a major disaster, providing channels for contacting residents and responders, uploading information, distributing information, coordinating the responses of social networks, and facilitating resident-to-resident assistance. Drawing upon research from computer science, information studies, public policy, emergency management, and several other disciplines, the paper elaborates on the concept of and need for CRGs, examines related current efforts that can inform the development of CRGs, discusses how research about community networks can be used to instill trust and social capital in CRGs, and examines the issues of public policy, telecommunications, and e-government related to such a system.

Keywords: Emergency response; Public policy; E-government; Mobile communications; Social networks; Community response grid

1. Introduction: coordination, communities, and emergencies

Before, during, and after major disasters, coordination of emergency response is an enormous problem due to the number of individuals and organizations involved in the response, issues with the interoperability of technology, impacts of the disaster on technologies used for communications, problems with adequate information sharing, and the lack of pre-existing social networks in place to support community response, among others. "The disaster network is loosely structured, organizationally diverse, motivated by a broad range of interests, and in part ad hoc" (Waugh & Sylves, 2002, p. 148). Further, "Federal Emergency Management Authority (FEMA) and state emergency managers are embedded in a network of thousands of

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non-profit organizations, private firms, ad hoc groups, individual firms, and public safety agencies that are all responding to the disaster'' (Wise, 2006, p. 307). However, the Internet and mobile communication technologies open many new opportunities for coordinating community response to major disasters among both residents and responders.

In an emergency, two key groups of people need the ability to exchange information and coordinate activities in community response: professional emergency responders (PER) and residents. PER—including police, fire, medical services, emergency management personnel, National Guard, and FEMA—have knowledge and equipment to deal with medical, fire, and law enforcement needs before and during the emergency. PER must be able to gather, analyze, and disseminate information rapidly, promptly recognizing patterns and coordinating response activities. Residents may help to identify an emergency, may help others avoid it, and can play a significant role in recovery. Residents also need information and coordination to self-organize and respond by helping each other when scarce centralized services are overwhelmed by an emergency. The ability of residents and PER to directly exchange information during an emergency is necessary to provide a more accurate portrait of the severity and breadth of major disasters. However, the responses to recent major disasters have demonstrated significant gaps in the ability of PER and residents to engage in this vital information sharing and coordination.

Based on lessons from recent natural catastrophes and the terror attacks of 9/11, the current telephone, radio, and television-based emergency response systems cannot meet all of the community-wide information sharing and communication needs of residents and responders during major disasters. The combination of mobile telecommunications devices and the Internet, however, has the potential to provide higher capacity and more effective service, as well as create interactive communication mechanisms that can facilitate just-in-time communication and collaboration among large numbers of residents and responders (Shneiderman & Preece, 2007). Instead of expecting residents to maintain and have access to battery-powered radios as part of an emergency kit, it seems more timely and appropriate to base such a system on increasingly ubiquitous portable, wireless devices such as cell phones, PDAs, and laptop computers.

In the United States, there are approximately 30,000 local governments, 30,000 local fire departments, 18,000 local police departments, 15,000 school districts, and 3400 county governments (Pelfrey, 2005). There are also numerous non-governmental organizations that may become involved in emergency response, including major international volunteer organizations like the Red Cross, Doctors with Borders, and Voluntary Organizations Active in Disasters (VOAD). In a major disaster, many organizations can become involved; for example, 1607 governmental and non-governmental organizations were involved in the response to 9/11 terror attacks in New York City (Kapucu, 2004). Incompatible technology can be a significant problem for all of these organizations. During 9/11, responders from different New York City organizations were unable to communicate due to incompatible radio systems, as the Fire Department was still using the same analog radios that failed in the same way during the response to the 1993 attack on the World Trade Center (Kettl, 2004).

In the response to Hurricane Katrina, overall coordination and information sharing were even larger issues for the agencies involved. During Katrina, federal, state, and local government agencies and private organizations did not know what actions to take in the response, did not have any guidance on how to coordinate and interrelate their activities, lacked an overall operational concept, and had no system to track and share information (Wise, 2006). Secretary of Homeland Security Michael Chertoff told Congress the response was ''significantly hampered by a lack of information on the ground,'' while the White House report on the failures of the Katrina response observed, ''inability to connect multiple communication plans and architectures clearly impeded coordination and communication at the federal, state, and local levels'' (Chertoff, 2005; White House, 2006).

Although there has been much discussion about emergency response, particularly in relation to the ''war against terror'' and in the wake of Hurricane Katrina, surprisingly little attention has been given to developing strong social networks empowered with appropriate technology to promote resident-to-resident assistance and foster coordinated emergency response throughout a community, a region, or even a nation. After a major disaster, community involvement through social networks—that is, groups of individuals with shared interests, values, goals, memberships, activities, or other kinds of personal relationships—is of incomparable

importance in increasing resident trust of the emergency information and in promoting coordination between residents and responders.

This paper examines the research problem of how technologies—such as mobile communication technologies, the Internet, and e-government—and social networks can be better employed to more effectively coordinate community response to major disasters. Drawing upon research from computer science, information studies, public policy, emergency management, and several other fields, this paper explores the viability of using mobile communication technologies and the Web, specifically through e-government, to build and foster response systems that would aid communities before, during, and after an emergency, providing channels for contacting authorities, uploading and distributing information, and coordinating the responses of social networks. The combination of these conceptual strands leads to the creation of community response grids (CRGs).

CRGs are web-based systems that integrate Internet and mobile technologies to facilitate response in large-scale emergency situations by enabling individuals to report information, PER to disseminate instructions, and residents to assist one another. In short, CRGs use technology to enable residents and responders to work together in community response to emergencies. This paper elaborates on the concept of CRGs, examines related current efforts that can inform the development of CRGs, and describes how research about community networks can be used to instill a social dimension in CRGs. Finally, the paper discusses policy issues related to the development of a CRG.

2. Theoretical and conceptual foundations of community response grids

In any emergency, the largest problems often derive from ''collaborative problem solving'' and other problems of coordination (Mileti, 1999, p. 7). Studies have repeatedly demonstrated the difficulties of coordination between responders, residents, government agencies, businesses, volunteers, and relief organizations in an emergency (Jones & Mitnick, 2006; Kapucu, 2004; McEntire, 1997, 2002; Portsea, 1992). Coordination in terms of information sharing, communication, and collaborative action present enormous social and behavioral problems for emergency response (McEntire, 2002). Major disasters are ''occasions in which the boundaries between organizational and collective behavior are blurred'' (Kapucu, 2004, p. 207). As a result, communication and coordination among residents and responders are among the most pressing issues in an emergency (Haddow & Bullock, 2003).

Conceptually, the preparation for responding to emergencies can be been seen as a cycle with information sharing and communication being key throughout the cycle (Pelfrey, 2005). ''Sharing information, willingness to collaborate, and shared values'' are vital bases of effective information sharing and communication in major disasters (Kapucu, 2004, p. 210). As such, the theoretical and conceptual foundations of CRGs are located in establishing trust in the system among residents and engaging the social networks in a community. ''Communities that have strong working relationships on a daily basis'' are generally better equipped to confront major disasters because of ''increased trust'' among members of the community (Kapucu, 2004, p. 210). The process of creating and fostering usage of CRGs will rely on building social capital and community collective efficacy among populations of users.

Social capital refers to connections among individuals—social networks and the norms of reciprocity and trustworthiness that arise from them (Putnam, 2000). Social capital includes the relationships and norms that shape the quality and quantity of a society's social interactions. It consists of the active connections among people—the trust, mutual understanding, and shared values and behaviors that bind the members of human networks and communities—and makes cooperative action possible (Cohen & Prusak, 2001). To respond to major disasters as a community, a community needs collective efficacy, which ''captures the link between cohesion—especially working trust—and shared expectations for action'' (Sampson, 2004, p. 108). A CRG builds social capital and community collective efficacy for the community.

The concept of a CRG as a web-based system that encompasses social networks acknowledges the centrality of social networks and resident-to-resident assistance in community responses to major disasters. There is evidence to suggest that relief agencies should be restructured from hierarchies of power to social networks to improve effectiveness (Quarantelli, 2005; Stephenson, 2005). After the Kobe earthquake, 80% of victims were saved by friends and neighbors, which involved activating existing social ties and led to a renaissance of

volunteering across Japan (Kajitani, Okada, & Tatano, 2005; Shaw & Goda, 2004). Information and communication technologies supported social networks of rural, quarantined farmers in the UK during the foot and mouth disease outbreak (Hagar, 2005). After the Asian tsunami, online communities proved more effective than structured relief agencies at targeting volunteers to the places where their unique skills would be most effective (Jones & Mitnick, 2006).

As social networks are vital to community responses, the Internet provides a unique means to connect the social networks in a community when a response is needed, especially since individuals are becoming very comfortable with social uses of the Internet. Public uses of web-based social networking services, such as MySpace or Facebook, have spread and matured sufficiently to suggest that local, state, and federal agencies could build CRGs to engage residents' participation before, during, and after major disasters. Residents could report incidents and receive emergency information that would facilitate coordinated responses with emergency services. The World Wide Web has proven effective for many purposes, but government agencies have been slow to adopt social networking services for national security and emergency response and recovery efforts.

A primary consideration in developing a CRG would be determining how to engage residents as regular users of the site. Research has identified several prominent reasons for joining online communities:

- obtaining or exchanging information related to personal interests (Ridings & Gefen, 2004);
- obtaining information for problem-solving (Lakhani & von Hippel, 2003; Ye & Kishida, 2003);
- maintaining existing social relations or establishing new ones (Cummings, Butler, & Kraut, 2002);
- seeking empathy and emotional support (Maloney-Krichmar & Preece, 2005; Preece, 1999; Turner, Grube, & Meyers, 2001).

Trust of the sources of information available will also impact participation and action based on information. Unless the CRG is viewed as a trusted source of information among various social networks, the information may be ignored no matter how critical it is. Ultimately, the success of a CRG will rely on residents both joining and trusting the information it provides.

3. The need for CRGs and comparison with similar efforts

3.1. The need for and functions of CRGs in community response

CRGs are designed to provide local information and emergency instructions geared toward the immediate needs of residents in response to an emergency (Shneiderman & Preece, 2007). CRGs allow residents to employ web-enabled computers and mobile communication devices, like cell phones and PDAs, to provide information through text messages, photos, and videos. CRGs enable residents to report and receive localized information about major disaster events such as floods, tornados, hurricanes, community health concerns, and terrorist attacks. These major disasters could vary in scale from events that affect sections of one community to those that influence thousands or millions.

CRGs allow PER to synthesize and analyze this submitted information, promptly sending emergency response information directly to residents' cell phones, email accounts, and other mobile communication devices. Multiple platforms (mobile devices, the Internet) and content types (text, photo, video) ensure that CRGs will function with surviving infrastructure during and after an emergency, while supporting two-way communications among residents and responders. CRGs also support coordination by PER, since they could gather many reports rapidly and then promptly recognize patterns. PER could be collecting and disseminating information via website and cell phone, residents could be reporting and receiving information via website and cell phone, and communities could be sharing information simultaneously to respond to a crisis of any magnitude. Professional staff could separate out suspicious or low priority reports, assigning appropriate resources to the major problems. Simultaneous input from police officers on patrol, hospitals, emergency medical personnel, surveillance cameras, and other sensors would provide a more accurate portrait of the severity and breadth of disasters. A coordinated response from emergency services could be designed to use

available resources with the option of requesting assistance from neighboring jurisdictions or secondary support services.

The most significant value of CRGs is that they would enable residents to respond by helping each other—before, during, and after major disasters. When scarce centralized services are overwhelmed by natural disasters and terror attacks, CRGs may be the only way to provide assistance to large numbers of people. CRGs, interconnecting many local communities across the nation, could be used to coordinate a single community, a state, or an entire region, depending on the scale of the disaster.

Further, CRGs would particularly benefit isolated communities. As traditional local media have disappeared (i.e., local newspapers) or been purchased by multi-national corporations (i.e., local radio stations), the need for new means to foster community response to emergencies has grown (Klinenberg, 2007; Vaidhyanathan, 2006). The radio-based Emergency Alert System, originally created in 1951, has been relied upon in the United States to broadcast information in a crisis. Despite its reliability and range, radio provides only one-way communication. Telephone-based systems also have significant limitations. For example, during and after the 9/11 attacks in New York City, cell phones and land lines were limited by a combination of the loss of cell towers, broken lines, and volume of usage being attempted (Will, 2001). With limited telephone capacities, rescue personnel in New York City had serious problems sharing information, coordinating efforts, gathering data, identifying false information, and directing efforts (Dearstyne, 2007). The problems with information led to similar problems in the aftermath of Hurricane Katrina, as delay, duplication, lack of coordination, and confusion proved deadly (Dearstyne, 2006). The provision of information alone through websites has proved insufficient to deal with local emergencies in Britain (Matthews, 2005). In crisis situations, insufficient or incorrect information can lead to either complete inaction or disastrous action (Dearstyne, 2005, 2006). CRGs, by incorporating both mobile telecommunications and the Internet to allow multi-directional communication, would significantly address these types of problems in times of a major disaster.

A CRG could strongly improve the ability of a community or an entire region to cope with a major disaster. For example, in advance of Hurricane Katrina, evacuation efforts in Louisiana, Mississippi, and Texas, particularly in the city of New Orleans, might have been greatly facilitated by a system enhancing local efforts and encouraging cooperation between localities. In the aftermath of Katrina, the few local community networks, such as public libraries, that were able to function were effective in helping to rebuild neighborhoods and communities (Jaeger, Langa, McClure, & Bertot, in press). After the tsunami in Indonesia, community networks among aid workers were highly effective in coordinating local assistance, arranging for supplies, and disseminating information (Jones & Mitnick, 2006). Imagine how much more effective these networks could have been if, instead of relying on ad hoc social networks that faced previously unimagined and unimaginable social responsibilities, a government-driven system existed to coordinate preparation, resident-to-resident assistance, recovery, and rebuilding efforts across a region.

3.2. Related current efforts

Existing emergency response systems that focus on resident-to-resident assistance include Neighborhood Watch programs in which neighbors agree to look out for each other and signal these proactive intentions with signage. The Amber Alert system (http://codeamber.org/) allows people to sign up to get alerts about kidnapped children in their state. This nationwide system sends alerts to cell phones and digital traffic message boards when a child is kidnapped. The alerts are designed to coordinate with the actions of emergency services and reports being provided through the media.

Government, private, and scholarly efforts have been devised to attempt to use the power of the Internet to assist communities to deal with crises. Such efforts tend to be oriented toward preparing residents to be ready for potential crises or toward coordinating specific groups of people to prepare for responding to a crisis. In neither case is the focus on preparing entire communities and coordinating between the members of these communities. All these projects use a top-down approach, placing the emphasis not on community members but on organizations. The top-down approach suffers from the shortcoming of a lack of focus on users and the human element of emergency response. For example, a recent report by the National Research Council (2007) emphasizes the importance of traditional centralized disaster management but offers only a few limited

suggestions for greater public engagement in the form of improved reporting, reverse 911 phone calls to alert residents, and use of broadcast media to inform the public.

This top-down approach can be seen in government proposals to improve current disaster response capacities. Several members of Congress have proposed emergency reporting e-government websites, such as a November 2001 bill by Rep. Jeff Flake (R, Arizona), but these proposals have been solely to create an online emergency reporting service. Further, the US Department of Homeland Security (DHS) is developing an Information Network that "allows all states and major urban areas to collect and disseminate information between federal, state, and local agencies involved in combating terrorism" (http://www.dhs.gov). The DHS proposal has no component that engages with residents for reporting, information dissemination, and collective action. Recent tests by the DHS of an emergency information distribution system in the event of a terrorist attack relied exclusively on DHS-generated information being released through websites (Robinson, 2007). There was no means of submitting information or communicating with other responders or residents, and it relied entirely on the Internet, among other limitations. The governmental approaches to the problem of preparing communities to respond to disasters primarily focus on government agencies, technological infrastructure, or uncoordinated individuals. Attempts to link residents and emergency response personnel in coordinated action are limited in these projects.

Grassroots efforts hold promise, but tend to be highly uncoordinated. In the face of some disasters, online community networks through the medium of blogs and wikis—collaboratively authored websites that allow readers to add new content or to edit existing content—have been more effective at disseminating and exchanging information than have government organizations (Palen, Hiltz, & Liu, 2006). During the response to the Asian Tsunami in 2004, Sahana (www.sahana.lk) was created as a free and open source web-based collaboration tool to use information technology to address the common coordination problems in emergency response, such as finding missing persons and facilitating communication between volunteers. Sahana and other projects designed to promote coordination and open collaboration for response to major disasters have been spontaneously created by volunteers to respond to the needs of relief and community organizations after major disasters. Each of these projects "involved a dispersed community of volunteers making variously sized contributions to development in a fairly decentralized fashion" (Jones & Mitnick, 2006, n.p.). These efforts have employed social networking tools like blogs and wikis to share information, offer assistance, and deploy volunteer resources. In many ways, these collaborative online systems have been highly adept at identifying specific needs and directing people and resources to meet those needs (Jones & Mitnick, 2006).

Grassroots efforts also exist in more organized ways through volunteer organizations. The United States federal government created the Citizen Corps as local volunteer councils to coordinate community preparedness for major disasters by offering education, promoting volunteerism, and encouraging cooperation among community leaders. DHS also has a program called Community Emergency Response Teams (CERT), which is an education program for individuals who wish to learn more about emergency preparedness and basic disaster response skills. However, organizations like Citizen Corps lack a means of coordination of information sharing and have no authority in emergency response, while the CERT program is focused on training individuals rather than preparing communities to respond collectively.

4. Practical foundations of CRGs

4.1. CRGs and response

CRGs can be a platform for facilitating communication among emergency responders and between emergency responders and the local community. CRGs can make the relationships and hierarchies among various types and levels of emergency response more coherent and transparent, unifying diverse types of emergency response at the local, state, and national levels. Established organizations that provide emergency response for communities can play a role in the development and maintenance of CRGs, although ideally such a system should arise as collaboration between emergency response organizations and local governments, as well as organizations like county emergency management offices and state emergency planning offices. The governance structure of CRGs can be more dynamic and sensitive to changing conditions and situations than existing systems, which will help to ensure that all responding organizations, both governmental and

non-governmental can be incorporated to the maximum extent in the response. Currently, non-governmental organizations like the Red Cross are heavily relied upon, but are not sufficiently incorporated into the communication and information sharing structure.

No matter how CRGs would be formally staffed, the members of a community will play a major role in supporting the emergency responders. In many disasters, and particularly life-threatening ones to large populations, different groups may have different roles in using CRGs. For example, in the case of a devastating hurricane, neighbors can provide resident-to-resident assistance (such as assisting in an evacuation), while residents from the surrounding areas might also help those who are rescued and help to calm and comfort those in distress and shock, which might go on for hours or weeks after the event—such as housing evacuees or providing them with food, social or psychological support, money, or jobs.

Direct citizen involvement is extremely important in emergency response and recovery, with the potential to noticeably speed both response to and recovery from an emergency (Kweit & Kweit, 2004). "Community engagement equips leaders to face the complex and ever-shifting realities of an extreme event" (Schoch-Spana, Franco, Nuzzo, & Usenza, 2007, p. 16). Increases in the number of active residents, and therefore resident responders, will allow decision makers to better allocate government resources where they are most badly needed and supplement these scarce resources, helping them to go further (Schoch-Spana et al., 2007).

In the context of CRGs, emergency response will firmly remain the job of PER, except in the most dire circumstances. The community members will generally be serving as support to PER, helping the affected individuals in community support roles that fall outside the traditional functions of emergency response. In a large-scale disaster, when PER are not available—because they are overwhelmed or because they cannot reach a particular area—CRGs would help average community members to provide whatever resident-to-resident assistance they can to save those affected. A prime example of this kind of situation would be the individual residents who drove their boats into the flooded remains of New Orleans to rescue anyone trapped that they could find before the government began attempting to rescue the stranded.

4.2. Information sharing and coordination through a mixed network

Another important consideration is the communication structure used to facilitate communication between PER and residents. Traditional media involve several communication structures, including a one-to-one approach of typical telephone use, many-to-one reporting that results from many residents calling a central hotline such as 911, and one-to-many publishing and broadcasting through mass media such as newspapers, magazines, television, and radio. The Internet combines each of these communication structures, including one-to-one (or one-to-many) via e-mail, one-to-many via static web pages, and many-to-one via web-based surveys and forms. The Internet also adds another communication structure, many-to-many communication as found in bulletin board systems and wikis.

Individually, each of these communication structures contains limitations in its application to emergency response. Communication travels too slowly through one-to-one communication to be useful in emergency response. Many-to-one communication has the flaw that only the central network can benefit from hearing from everyone who is having an emergency, while those who are reporting the emergency do not learn what others are reporting. One-to-many communication is limited by corporate controls of mass media, as well as the inefficiency of some of those media in emergencies. Further, a one-to-many approach assumes that those doing the broadcasting have and can disseminate all of the needed information to those affected by the emergency. Finally, a purely many-to-many approach carries with it a danger of information overload and lacks coordination and quality controls on the information.

CRGs combine the strengths of each of these communication structures within a single mixed network, ameliorating the problems associated with relying on just one of these communication structures. At the early stages, one-to-one communication among neighbors and social networks may be used to request local assistance and assess the scale of the emergency. Many-to-one can be used for individuals to report emergencies and request assistance. One-to-many communication can be used to broadcast alerts and recommendations from emergency response professionals. Finally, with the many-to-many approach, residents can benefit from hearing not only from government agencies, but also from others who are affected by the emergency, so that they can get an immediate sense of the scope of the emergency and react

accordingly. The many-to-many approach will be constrained to avoid information overload and exposure to irrelevant information by allowing users to subscribe to specific social networks and to receive specific types of information, thus giving users the ability to choose how much information to receive. Thus, the most efficient, resilient, and effective approach is a mixed network that combines the best features of each of these communication structures.

4.3. Technical requirements

One major technological requirement of CRGs is that they integrate cellular telephones and other battery-operated, portable wireless devices. In times of emergency, it is not wise to count on reliable access to power and Internet access. Thus, the idea behind making the network accessible via handheld devices, as well as computers, is similar to the past reliance on battery-operated radios for dissemination of emergency news. Portable wireless devices are now much more readily available than battery-operated radios, as an increasing number of residents carry them everywhere. Further, they can serve as both input and output devices, facilitating one-to-one, many-to-one, and many-to-many communication. As people using CRGs may be doing so while under great amounts of stress, the familiarity of devices will help users to employ the system effectively when it is most needed.

The support system for CRGs will also involve multiple technologies. CRGs, like all other forms of e-government, will need to have back-up servers just as large companies do. There will need to be emergency generators and battery-driven devices to support phone systems. Other technical factors will include developing a web-based version and version for cell phones and other mobile devices that provide the same vital information in different formats that best fit the devices being used. For situations with significant disruptions of infrastructure, a fast text-only version will have to be developed so that the system will function maximally when only small amounts of airwaves and bandwidths are functioning.

5. Implications for telecommunications, e-government, and public policy

As the infrastructure for mobile communication technologies is already in place in many nations and is widely distributed in availability, the primary concerns for telecommunications policy will relate to ensuring universal access to CRGs and to enhancing coordination of policies related to telecommunications and to e-government. Many societies already have a notion of universal access, most frequently applied to land telephone lines, since they are viewed as essential to emergency response and other important activities (Compaine & Weinraub, 1997; Kennard & Lyle, 2001; Stephanidis & Savidis, 2001). Increasingly, Internet access and mobile technologies are becoming similar necessities. If CRGs are able to provide superior emergency response as compared to 911, then all residents should have equal access to the Internet. As such, technologies required to use CRGs, such as wireless technologies and Internet access, should be affordable and available to all.

Further, universal access in this case requires not only access to and affordability of the technologies themselves, but also the universal usability of the technology (Shneiderman, 2000). Telecommunication policies need to reflect the composition of society and the people who comprise a society (Burgelman, 2000). Educational programs should be provided to ensure that everyone can learn to use CRGs. Even more important is designing CRGs so that the amount of learning required is minimal and so that the interface is as usable as possible in times of duress. If the technology is made usable and affordable, and sufficient educational opportunities are provided, then CRGs can serve as an emergency response system for all residents.

Ensuring universal access to the websites and mobile communication technologies that will drive the information exchange at the heart of CRGs will necessitate other changes to telecommunications policy. First, the inequalities in access to the telecommunications networks for mobile communication technologies, broadband, and even basic Internet for poor and rural communities must be eliminated through policy (Grubesic, 2006). If all residents are to have access to CRGs, cell phones and Internet access must not only be affordable, but it must literally be available everywhere people live. As the economically disadvantaged are inherently more vulnerable during major disasters, this vulnerability cannot be exacerbated by the lack of availability of phone and Internet access. The efforts of many local communities to create free wi-fi networks

will certainly help to ensure access to the CRGs in those particular communities for residents who have portable computers.

Secondly, greater federal, state, and local government support must be provided to community agencies that provide e-government access for those who have no other means of getting online. In the United States, public libraries have become the unofficial e-government access facility for those who cannot otherwise reach it (Bertot, Jaeger, Langa, & McClure, 2006a ,b). This social position has resulted from the availability of help and training in using the Internet from librarians, from direct government action of sending people to public libraries, and from their traditional position of ensuring information access for even the most disadvantaged (Bertot et al., 2006a, b). During a major emergency, the access to the FEMA and other e-government websites provided by public libraries can be essential in the recovery of a community (Jaeger et al., in press). However, less than 2% of funding for public libraries in the United States comes from the federal government (Bertot et al., 2006a). As a result of this reliance without assistance, many public libraries are having a difficult time meeting the e-government needs of patrons (Jaeger, Bertot, McClure, & Rodriguez, 2007). If CRGs are to be truly universally available, federal, state, and local governments will have to provide meaningful economic support to the community agencies that provide access to the Internet for those with no other access.

Thirdly, the capability of telecommunications infrastructure and networks to withstand the impacts of major disasters must attract greater planning and investment (Grubesic & Murray, 2005). Using currently available technologies, emergency responders must anticipate that there will be breakdowns in communication (Cohen, Eimicke, & Horan, 2002). Many events in which CRGs would be most vital are also those that might pose serious threats to telecommunications infrastructure and networks. In the most extreme events, like Hurricane Katrina or the 9/11 attacks in New York City, telecommunications infrastructure and networks were severely impaired. Implementation of new information technologies in emergency response have the potential to significantly improve communication and coordination (Comfort, 1999; Comfort & Kapucu, 2006). A more robust information network with greater distribution will further improve communication and coordination in major disasters (Graber, 2003). Internet-based systems are particularly appealing for emergency response and recovery as the Internet was originally designed to continue working in the event of the destruction of major communication points, so it intelligently routes traffic around congested or non-functional parts of the system (Graber, 2003; Kapucu, 2004). While a series of interconnected CRGs would ensure that interruptions in access would be limited to certain areas, CRGs will be more valuable if the underlying infrastructure is better able to survive disasters.

In application, CRGs could become a manifestation of the goal of e-government as transformative of relationships between governments, businesses, and residents. In many societies, e-government has come to be seen by many residents and governments as a force that will enhance democratic participation, more closely link residents and their representatives, and help disadvantaged populations become more active participants in government and in society (Jaeger, 2005; Noveck, 2003). CRGs are a rare example of a proposed e-government program that could achieve these goals.

There will also be other issues of public policy that will need to be addressed in relation to the development of CRGs. These issues include

- protecting the privacy of residents,
- ensuring the security of sensitive information,
- guarding against malicious attack on services and websites,
- developing ways to prevent the spread of unfounded rumors or pernicious information,
- coordinating CRGs with existing emergency response services,
- building support among federal, state, and local governments,
- building connections and support structures with utility companies and telecommunications providers,
- coordinating with non-profit community support organizations, like the Red Cross,
- measuring system success and impact, and
- creating back-up measures in case of a failure of the Internet.

While these issues are not insignificant, none should be so overwhelming or of great enough concern to tell against the development of CRGs.

Ultimately, the biggest obstacles to the development of CRGs may ironically be the federal government and government vendors. The federal government has previously shown resistance to creating policy solutions to emergency management issues, such as those related to CRGs. Even after the disastrous response to Hurricane Katrina, the federal government policies assume that the federal government will play an ancillary role in response to major emergencies (Wise, 2006). This indicates that the federal government may not engage in major policy initiatives to promote the changes necessary to support CRG development on a national scale. Based on the approach that the federal government has taken to community preparedness—encouraging individual preparation rather than community response through websites like www.ready.gov—developing community response may not be a priority of the federal government. Further, the development of CRGs may be resisted by vendors of non-interoperable emergency response technologies currently being used by all of the various organizations related to emergency response, despite the problems caused by such interoperability (Kettl, 2004). CRGs would be designed to promote interoperability and eliminate many of the different technologies currently being used by responding organizations to share information, communicate, and coordinate activities. As such, the federal government and vendors may not be primary supporters of the development of CRGs.

Local and state governments, however, may turn out to be the strongest advocates of CRGs. The federal government's National Response Plan (NRP) and National Incident Management System (NIMS) place primary responsibility for emergency response on local and state governments, as the federal government does not want to appear to be undermining states' rights (Wise, 2006). However, state and local governments have fewer financial and personnel resources, so they have a greater incentive to find better ways to coordinate emergency response, allocate the resources they do have, and promote resident-to-resident assistance to ensure sufficient help is available within the community. Also, the chaos created by the lack of coordination surrounding the Katrina response may give further incentive to local and state governments to pursue projects such as CRGs. Currently, for example, a prototype CRG for the University of Maryland campus is being designed and implemented by the authors of this paper (see: http://www.cs.umd.edu/hcil/911gov). Local and state governments may ultimately be the most inclined to support CRGs as the benefits will be most immediate for these levels of government.

6. Conclusion

In a society where information and telecommunications technologies have become so vital to the everyday existence of individuals, the nature of telecommunications policy must constantly evolve to meet new social developments (Burgelman, 2000). The concept of CRGs offers a way in which the potential power of the Internet, e-government, and mobile communications technologies can be harnessed to create a previously unavailable social benefit to communities and to individuals. By linking telecommunications, e-government, and social networks, CRGs could prove to be a revolution in the use of technology and infrastructure to help individuals and communities respond to and recover from disasters.

While some have anticipated that the Internet, e-government, and mobile communications technologies would radically alter interactions between governments and the communities they serve, the current situation does not yet reflect any such major changes. Many commentators have asserted that e-government will have a positive impact on participation in government by residents (e.g., Barber, 1997; Noveck, 2003). Yet, e-government sites rarely involve any meaningful communication between residents and government officials, with most sites simply being a collection of documents, forms, and positive press about the agency whose site it is (Chadwick & May, 2003; Jaeger, 2005). Many interactive experiments through e-government have simply been abandoned due to lack of interest on the part of government officials (Coleman, 2004).

Mobile telecommunications devices have also thus far not been properly employed to facilitate communication between governments, communities, responders, and residents beyond limited circumstances like the Amber Alert system. More commonly, the communities fostered through mobile telecommunications devices are already existing social networks. With a cell phone, however every resident is a potential reporter of emergency information, a potential responder to provide community support to those affected in an emergency, and a potential recipient of information that might prove lifesaving. These capacities remain sadly underused. News organizations have learned the lessons of leveraging the capacities and prevalence of mobile

telecommunications devices to involve residents in the process of news gathering and reporting, providing more information and footage than a news organization could gather on its own (Masie, 2005). The day after Hurricane Katrina made landfall, at any given moment, "there were hundreds of Citizen Journalists feeding content in real time" through cell phones and computers (Masie, 2005, p. 74).

This lesson has proven elusive to government agencies thus far, particularly at the federal level. As a result, news organizations were far ahead of government agencies in understanding the extent of the damage from Katrina and identifying where refugees were trapped after the storm, such as the thousands of survivors in the New Orleans Convention Center that FEMA was unaware of until informed by the news media. A CRG would have allowed people to use mobile telecommunications devices or wireless computers to report such facts to the government to facilitate search and rescue. With such a system in place, the individuals trapped in the New Orleans Convention Center would at least have had an outlet to report their plight directly to the local agencies, state agencies, or FEMA and request resident-to-resident assistance in order to facilitate their own rescue.

The development of CRGs would offer a unique opportunity to conjoin new technologies, governmental goals, and social benefits. Too often in public policy related to communications and technologies, the potential social benefits of new technologies are ignored in favor of more immediate business, consumer, or governmental goals. Ultimately, policy decisions to develop and foster CRGs would bring significant benefits to governments, communities, responders, and residents faced with ever-present threats of natural disasters and terrorism by harnessing the power and presence of technology and of social networks to change the way in which responders and residents are able to share information about and deal with crises.

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