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How Mobile Devices are Transforming Disaster Relief and Public Safety

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INTRODUCTION



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Mobile technology has expanded dramatically around the world. According to the Cisco Visual Networking Index, global mobile data traffic has doubled for the fourth year in a row. And looking toward the future, the report estimates that “global mobile data traffic will increase 18-fold between 2011 and 2016.” By the end of that time period, 10 billion mobile devices are projected to be in use around the world.¹

With its growing usage, this technology is greatly improving disaster relief and public safety efforts. Countries around the world face threats from natural disasters, climate change, civil unrest, terrorist attacks, and criminal activities, among others. Mobile devices, tablets, and smart phones enable emergency providers and the general public to manage these challenges and mitigate public safety concerns.

In this paper, part of the Brookings Mobile Economy Project, we focus on how mobile technology provides an early warning system, aids in emergency coordination, and improves public communications. In particular, we review how mobile devices assist with public safety, disaster planning, and crisis

1. “Cisco Visual Networking Index: Global Mobile Data: Traffic Forecast Update, 2012-2017.” *Cisco Systems, Inc. White Paper*, February 14, 2013, accessed May 27, 2013, http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.pdf

response. We explain how these devices are instrumental in the design and functioning of integrated, multi-layered communications networks. We demonstrate how they have helped save lives and ameliorate human suffering throughout the world.

Early Warning Systems in Natural Disasters

With the onset of global warming and climate change, we are seeing increases in tsunamis, flooding, drought, hurricanes, and tornadoes. According to an overview of weather changes by the Intergovernmental Panel on Climate Change, the number of unusually cold days and nights has decreased since 1950, while the number of unusually warm days and nights has increased.²

These temperature shifts are linked to an increase in heavy precipitation events and a trend towards extreme coastal high waters. Furthermore, data suggest that some regions of the world have experienced more intense and lengthier droughts.³ Although the data is still being analyzed, observations gathered over the past fifty years suggest a dramatic rise in extreme weather.⁴

These shifts are inflicting tremendous damage in terms of human life, injuries, and property damage.⁵ With the buildup of populations along many coasts, storms have destroyed homes, upset global supply lines, injured large numbers of people, and cost countless human lives.

In response to natural disasters such as Hurricane Katrina (2005), the earthquake in Haiti (2010), earthquake and tsunamis in Japan (2011), and the Oklahoma tornados (2013), mobile invention and application have skyrocketed. Mobile development has surged in reaction to the increase in need for instant and accurate information. In Australia, for example, researchers have created software that combines voiceover IP technology with Wi-Fi to enable communication between mobile devices in areas where there is no

Mobile development has surged in reaction to the increase in need for instant and accurate information.

2. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change." *Cambridge University Press*, 2012, Accessed June 26, 2013, https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf

3. Ibid.

4. Ibid.

5. Darrell West and Marion Orr, "Race, Gender, and Communications in Natural Disasters," *Policy Studies Journal*, Vol. 35, no. 4, (November, 2007), pp. 569-86.

available reception.⁶ Such a feature is of critical importance in cases where traditional communications networks are knocked offline for extended periods of time during or after a major crisis.

Similarly, in response to the 2011 earthquake and tsunami in Thailand, Japanese developers have created *Aerial 3D*. Using laser beams, the system projects small, luminous dots to create text in local spaces.⁷ This provides emergency response information to people in need of help and allows them to use mobile devices to pinpoint their locations.

Corporations are also supporting the invention effort. This past year, AT&T launched a public safety hackathon challenge that invited mobile inventors to submit applications meant to ease the work of first responders post-disaster. Through this competition came *InstantAct*, an application that provides public safety officials with an exact field location during disaster and a more robust, dependable way of communicating via voice.⁸

In the aftermath of the devastating 2010 earthquake in Haiti, Google created a crisis response team to deliver tools to help those affected by disaster. The company's designers put together tools for use during the earthquake and tsunami in Japan. Its main search page displayed a tsunami warning and its search engine's *Person Finder* allowed people to tell friends and family they were safe.⁹

With a focus on preparation, Sesame Workshop and Qualcomm through its Wireless Reach initiative, have launched a mobile safety program in China that relies upon mobile technology. The initiative uses a mobile device to help young children and their families learn how to deal with various kinds of emergency situations. It promotes an Android application and a HTML 5 mobile website with a chalkboard that gives kids experience "writing their names and addresses, dial[ing] their home phone numbers and draw[ing] pictures of their homes or emergency meeting places."¹⁰

6. Om, Jason, "Mobile invention could be desert lifeline," *ABC Science*. July 12 2010, accessed June 10, 2013. <http://www.abc.net.au/science/articles/2010/07/12/2951206.htm#.UcxwIz7wKrh>

7. Laporte, Nichole, "From One Tragedy, Tools to Fight the Next." *The New York Times*, January 12, 2012, accessed June 15, 2013, <http://www.abc.net.au/science/articles/2010/07/12/2951206.htm#.UcxwIz7wKrh>

8. "Public-Safety Mobile App Hackathon Announces Winners," *Radio Resource Media Group News Brief*, May 24, 2013, accessed June 18, 2013, http://www.rrmediagroup.com/newsArticle.cfm?news_id=9566

9. Agger, Michael, "Japan's earthquake and tsunami: How Google responds to crises, plus good emergency apps for your phone," *Slate.com*. March 11, 2011, accessed June 18, 2013, http://www.slate.com/articles/technology/the_browser/2011/03/earthquake_japan_help.html

10. Qualcomm Wireless Reach Project, "Let's Get Ready! Mobile Safety Project", June, 2013.

This program incorporates Sesame Street content, including videos that help young people learn about emergencies and ways they can protect themselves. A pilot project has received positive responses from people living in the southern province of Guizhou. Participants say it has raised awareness, promoted crisis skills, and helped parents teach their children disaster planning and amelioration. This service is now available nationally for free over China Telecom's mobile network.

In the weeks following the Japanese tsunami, downloads of mobile disaster applications soared around the world. Many of these applications were built using various Japanese early warning applications - including *Yurekura Call* and *Japan AED Map* - as models.¹¹ Apple featured a new section in its App Store called "Stay in Touch," providing a number of disaster relief applications such as: The American Heart Association's *Pocket First Aid & CPR*; *QuakeWatch*, which tracks earthquakes and sends warnings using U.S. Geological Survey data; *Disaster Alert*, which provides information on instant global "active hazards;" the American Red Cross's *Shelter View*, which helps users locate a nearby shelter; and *Emergency Radio*.¹²

A number of government agencies, such as the U.S. Department of Health and Human Services (HHS) and global netizens have compiled lists of helpful disaster relief tools. David Burns of *Campus Safety Magazine* broke down a number of disaster applications into useful categories: reference, materials such as applications like *First Aid*; *WISER*, or Wireless Information System for Emergency Responders; *FEMA's mobile app* and *Emergency Survival Handbook*; personal preparedness, such as *Survive Now*; *ICE*, In Case of Emergency; *BuddyGuard*; *iTsunami*; and *IMPrepared*; and situational awareness, which includes the *USGS's mobile app*; *Floodwatch*; and the American Red Cross's *Shelter View*.¹³

HHS's website features disaster applications as well as mobile optimized web pages (or pages easily viewed on a user's phone), including disaster medicine tools such as *First Aid* by the American Red Cross; *Hands-Only CPR* by the American Heart Association, and *REMM* (radiation emergency medical management), which provides information about treatments of radiation and nuclear injuries and emergencies.

11. "Disaster-related Mobile Apps From Japan." *Emergency Journalism*, November 26, 2012, accessed June 18, 2013, <http://emergencyjournalism.net/disaster-related-mobile-apps-from-japan/>

12. Saltzman, Marc. "Japan quake popularizes disaster apps," *USA Today*, March 20, 2011, accessed June 18, 2013, <http://usatoday30.usatoday.com/tech/news/2011-03-17-disaster-apps.htm>

13. Burns, David. "Emergency Management Apps: A Primer," *Campus Safety Magazine*, November 29 2011, accessed June 3, 2013, <http://www.campussafetymagazine.com/Blog/Campus-Command-Post/Story/2011/11/Emergency-Management-Apps-101.aspx>

The page includes disaster-related resources such as *SOS* by ARC, which offers step-by-step videos for common emergency situations; *Hurricane*, *Tornado*, *Earthquake* and *Wildfires* applications by the American Red Cross, which provide real-time information on these natural disasters; and *MyMedList*, which allows a user to program his or her medicines into a virtual list for first responders. There is also information about hazardous events and weather, such as The National Weather Service's mobile enhanced webpage, and disease outbreak, such as the *Outbreaks Near Me* application and *FluView*, a CDC application that tracks influenza illness across the U.S.¹⁴

Communities around the world have adopted mobile technologies for disaster relief coordination. The Bangladeshi government announced that tens of thousands of mobile users in flood and cyclone-prone areas would receive advanced warning of impending natural disasters via mobile alerts. These alerts, unlike SMS texts that are delivered to users' inboxes, flash directly on the screens of mobile device, ensuring more users see the message.¹⁵

In Britain, the London Fire Brigade (LFB) launched the world's first 999 emergency twitter feed in December 2012. According to the LFB press release, text-based communications surpassed traditional phone calls and in-person meetings in 2012 as the most frequent form of communication between United Kingdom adults. That development, combined with the fact that over 2,000 tweets are sent *every second* worldwide, made the 999 emergency feed a very appealing and effective emergency option.¹⁶

Moreover, mobile devices have become increasingly important in the developing world, facilitating communication between locals, government officials and first responders. Many applications provide important information in areas of health, agriculture, disaster relief, and crime. Mobile broadband is growing dramatically in emerging nations. According to the World Economic Forum, it will grow from 61 percent of broadband connections in 2011 to 84 percent in 2016.¹⁷

14. U.S. Department of Health and Human Services. "Disaster Information Management Research Center: Disaster Apps and Mobile Optimized Web Pages," *U.S. Department of Health and Human Services*, July 12, 2012, accessed June 3, 2013, <http://sis.nlm.nih.gov/dimrc/disasterapps.html>

15. Bhalla, Nita. "Disaster-prone Bangladesh trials early warning cell phone alerts," *Thomson Reuters Foundation*, June 23, 2009, accessed June 23, 2013, <http://in.reuters.com/article/2009/06/23/idINIndia-40548720090623>

16. "Brigade to lead the way on emergency tweets," *London Fire Brigade*, 8 December 2012, accessed June 23, 2013, http://www.london-fire.gov.uk/news/LatestNewsReleases_1812201220.asp#.UcxyuD7wKrg

17. See Table 1 in World Economic Forum Report at <http://reports.weforum.org/global-information-technology-2012/>.

It is notable that there were fewer than 20 million fixed-line phones across Africa in 2000, but by 2012, there were nearly 650 million mobile phone subscriptions.¹⁸ Mobile devices are crucial in providing assistance to those in need by allowing extended families to assist from afar. Members of Zimbabwe's British Diaspora, for instance, can visit the website Mukuru.com to order goods such as petrol for their loved ones back home. Recipients in Africa are texted a code to their mobile devices, which they show the petrol station to receive their goods.¹⁹

In Eastern Africa, livestock herders use mobile phones to send early drought warnings, in an attempt to skirt disastrous agricultural calamities such as the drought that struck the Horn of Africa in 2011.²⁰ By November of that year, the European Union had allocated more than €705 million to the Horn of Africa.²¹ In a 2013 statement, U.N. Food and Agricultural Organization official Robert Allport reported that "cellular phones eliminate delays in receiving field data, since all the information is relayed via mobile network. In addition, the information is assigned a geographic location, so locations are extremely accurate and available in real-time."²²

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Mobile devices have become paramount in Africa's efforts to better prepare for - and respond to - natural disasters such as extreme drought. And, importantly, mobile technology has put action directly into the hands of Africa's own citizens. A few years ago, two U.N. officials (one in London, the other in Nairobi) received the following text message: "My name is Mohammed Sokor, writing to you from Dagahaley refugee camp in Dadaab. Dear Sir, there is an alarming issues here. People are given too few kilograms of food. You must help." Using

18. "The Transformational Use of Information and Communication Technologies in Africa," *The World Bank Group*, 10 December 2012, accessed June 23, 2013, <http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/282822-1346223280837/Summary.pdf>

19. "Flood, famine and mobile phones," *The Economist*, July 26 2007, accessed June 20, 2013, <http://www.economist.com/node/9546242>

20. Spence, Timothy. "African herdsmen use mobile phones for drought alerts." *EurActiv*. April 15, 2013, accessed June 1, 2013 <http://www.euractiv.com/development-policy/text-messages-deliver-early-warn-news-519088>

21. "European Commission Fact Sheet: Horn of Africa Drought: Covering Kenya, Ethiopia, Somalia and Djibouti," *The European Commission Humanitarian Aid and Civil Protection*, November 11, 2011, accessed June 26 2013, http://ec.europa.eu/echo/files/aid/countries/hoa_drought_factsheet.pdf

22. McNally, Nancy. "Cell phones revolutionizing Kenya's livestock sector," Food and Agricultural Organization of the United States. March 1, 2012. Web. June 25, 2013, <http://www.fao.org/news/story/en/item/170807/icode/>

the web at a local internet café, Mr. Sokor found the officials' numbers and solicited their help directly.²³

Terrorist Attacks and Domestic Shootings

It is not just natural disasters that pose problems for community planners. Terrorist attacks such as 9/11 and domestic crises like the recent elementary school shooting in Newton, Connecticut, have brought public safety to the forefront of first responder and law enforcement concern, particularly in educational settings.

Two days after the Virginia Tech shootings, North Carolina Attorney General Roy Cooper established the Campus Safety Task Force, assigned with analyzing the events of school shootings like Virginia Tech and preparing a report of lessons learned. The January 2008 *Report of the Campus Safety Task Force Presented to Attorney General Roy Cooper* drew upon three task force meetings, which reviewed testimony from over 30 experts, law enforcements officials, emergency management experts, campus administrators, educators, emergency responders, victims' advocates, and psychologists. In addition, the team analyzed extensive literature reviews and the results of a web survey of 110 public universities, community colleges and private instructions.

In its report, the committee found that fewer than one in ten campuses were equipped with a siren system or campus-wide public address system. They urged the adoption of a variety of notification systems with unique approaches for individual schools.²⁴ Following publication of the report, AG Cooper worked with North Carolina legislators to pass a new law requiring court clerks to enter mental health commitments into a national gun permit database.²⁵

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23. "Flood, famine and mobile phones," *The Economist*, July 26 2007, accessed June 20, 2013, <http://www.economist.com/node/9546242>

24. "Report of the Campus Safety Task Force Presented to Attorney General Roy Cooper," Attorney General Roy Cooper Campus Safety Task Force, January 2008, accessed June 25, 2013 http://vptm.ehps.ncsu.edu/files/2213/2750/6549/CampusSafetyReport_2008.pdf

25. "North Carolina Department of Justice: Campus Safety news report," accessed June 26, 2013 <http://www.ncdoj.gov/Top-Issues/School-Safety/Campus-Safety.aspx>

vention and applications have improved considerably. Kristina Anderson, a survivor of the Virginia Tech shootings, recently launched an application that aims to help police better prevent and respond to campus crime. *LiveSafe* connects students and campus police in a two-way dialogue via their smartphones.²⁶

A number of schools have followed suit: the University of Chicago announced its plans to launch a smartphone app called *Pathlight* to allow students to opt in to GPS tracking services;²⁷ in 2012, the University of North Carolina at Charlotte tested a new application called the Effective Emergency Response Communication (EERC) System for iPod Touches;²⁸ and Northwestern State University launched a *Personal Guardian* application that allows users to opt-in to a feature that tells police where they are going and when they arrive.²⁹

In the last decade, mass notification systems have evolved from disparate systems, which were often slow and clunky, into fully integrated, multi-layered and robust systems.³⁰ In recent years, universities have invested big dollars into mass notification systems, adding layers of needed redundancy such as digital signage in classrooms and meeting areas, indoor and outdoor sirens, social media outlets like Facebook and Twitter, computer pop-ups, and wireless alerts.³¹ This reflects the increasingly varied ways in which people access information.

Florida State University's "easy button" mass notification system is an example of one of the most aggressive systems - with 32 layers - in the country.³² That network deploys a variety of new technologies - such as rely-to-text alerts, whereby students solicit

26. Fox, Zoe. "Virginia Tech Shooting Survivor Launches Campus Safety App," *Mashable*. April 20 2013, accessed June 1, 2013, <http://mashable.com/2013/04/20/livesafe/>

27. Maroon Editorial Board. "Safety in Knowledge," *The Chicago Maroon*, May 14, 2013, accessed June 26, 2013 <http://chicagomaroon.com/2013/05/14/safety-in-knowledge/>

28. "UNCC Officers Test New App During Training," *Campus Safety Magazine*, July 31, 2012, accessed June 26, 2013 <http://www.campussafetymagazine.com/Channel/Emergency-Management/News/2012/07/31/UNCC-Officers-Test-New-App-During-Training.aspx>

29. "Wash. District Implements Mobile Surveillance Application," *Campus Safety Magazine*, August 12, 2012, accessed June 26, 2013 <http://www.campussafetymagazine.com/Channel/School-Safety/News/2012/08/12/Wash-District-Implements-Mobile-Surveillance-Application.aspx>

30. Canfield, Amy. "Campus mass notification evolves," *Security Director News*, January 11, 2013, accessed June 20, 2013 <http://www.securitydirectornews.com/special-report/campus-mass-notification-evolves>

31. *Ibid.*

32. Richardson, Whit. "Schools seek 'easy button' approach to mass notification systems," *Security Systems News*, February 21, 2012, accessed June 20, 2013 <http://www.securitysystemsnews.com/article/schools-look-for-easy-button-approach-mass-notification-systems>

via text the location of the nearest safe exit, and cloud-hosted emergency notification systems that never go down and can be accessed from anywhere.³³ University officials warn there is still much work to be done in order to improve system integration in their communications networks. In some of these institutions, funding is a major barrier, particularly in regard to community colleges that tend to be underfunded.³⁴

First Responders and Public Safety

A number of public authorities have identified interoperable communications as a top security concern. The 9/11 Commission Report highlighted this area in its 2004 recommendations and indicated how important it was to have communications systems that could talk to one another in real-time.³⁵ The National Governor's Association Center for Best Practices has recently identified interoperable communications as the nation's top priority in the national security area.³⁶

The importance of such communication was highlighted by the shootings at Columbine High School in 1999 and the terrorist attacks on the World Trade Centers and Pentagon in 2001 and reverberated during recent tragedies such as the Boston Bombings in April 2013. As noted in the aforementioned campus safety report, first responders are dependent on fast, reliable communications during and after national tragedies and natural disasters.³⁷ While mobile technology has improved significantly in the last decade, concerns following recent national tragedies have demonstrated there is room for improvement.

As the use of smartphones becomes increasingly ubiquitous, more people are turning to mobile applications for information on preparing for and responding to emergency situations than ever before. Private companies and netizens alike are creating new applications for first responders and affected citizens. In 2010, IBM patented a natural disaster warning system that gathers data provided by MEMS accelerometers, or vibration

33. Canfield, Amy. "Campus mass notification evolves," *Security Director News*, January 11, 2013, accessed June 20, 2013 <http://www.securitydirectornews.com/special-report/campus-mass-notification-evolves>

34. Ibid.

35. National Commission on Terrorist Attacks Upon the United States, "The 9/11 Commission Report", 2004.

36. "Issue Brief: 2007 State Homeland Security Directors Survey," *National Governor's Association for Best Practices*, December 18, 2007, accessed June 20, 2013 <http://www.nga.org/files/live/sites/NGA/files/pdf/0712HOMELANDSURVEY.PDF>

37. "Report of the Campus Safety Task Force Presented to Attorney General Roy Cooper," Attorney General Roy Cooper Campus Safety Task Force, January 2008, accessed June 25, 2013 http://vptm.ehps.ncsu.edu/files/2213/2750/6549/CampusSafetyReport_2008.pdf

sensors, and analyzes the information generated by seismic events.³⁸

Verizon Wireless provided wireless technology - including *XORA*, a field-force management application that tracks SWAT vehicles; *LiveCast*, a live video streaming application; *Blue Force*, a hand-propelled video equipped drone and K-9 tracker; and *FuzeBox*, another video conferencing application - at Alameda County Urban Shield 2011, a Department of Homeland security exercise for first responders.³⁹

The Mobile Emergency Alert System (M-EAS), deployed at the Association of Public-Safety Communications Officials' (APSO) 2012 annual conference, uses mobile digital TV broadcasting to provide media alerts. Because the system relies upon digital broadcasting instead of wireless networks, M-EAS provides content to multiple users simultaneously. Using LG mobile devices, M-EAS features both audio and visual emergency alerts to mobile phones, tablets and the APCO-25 standardized emergency responder radios.⁴⁰

Raytheon has introduced an application to improve network reliability during emergencies. Its *One Force* mobile application, launched in August 2012, allows first responders to communicate via data networks when outside the standard Land Mobile Radio (LMR) coverage. These "virtual radios," modeled after commercial and military designs, are reliable, secure and provide real-time communication. In addition to voice capabilities, the *One Force* mobile application is equipped with maps, drawing tools, real-time positioning, video streaming, and image sharing.⁴¹

Motorola's *PremierOne* application for first responders also accesses and shares information across multiple applications and platforms, such as real time information from computer aided dispatch (CAD), records management systems (RMS) and local, state

38. Cooney, Michael. "IBM says software helps predict natural disasters," *NetworkWorld.com*, October 23, 2010, accessed June 1, 2013 <http://www.networkworld.com/community/blog/ibm-says-software-helps-predict-natural-disas>

39. Pica, Tom. "The New Jersey Shore Days After Hurricane Sandy," *Verizon Wireless News Center*, November 20, 2012, accessed June 20, 2013 <http://news.verizonwireless.com/news/2012/11/new-jersey-hurricane-sandy-recovery.html>

40. PBS. "Mobile Emergency Alert System Promises Flexible New Option for Emergency Managers and First Responders," LG, Harris and PBS, August 20, 2012, accessed June 1, 2013, <http://mobileeas.org/wp-content/uploads/2013/06/MEAS-at-APCO-Minneapolis-FINAL-copy.pdf>

41. "Raytheon releases One Force Mobile Collaboration app for first responders," *PR Newswire*, February 11, 2013, accessed June 3, 2013, <http://www.prnewswire.com/news-releases/raytheon-releases-one-force-mobile-collaboration-app-for-first-responders-190682901.html>

and federal databases.⁴² Both of these applications focus on facilitating communication between first responders to improve response time and accuracy.

Other first responder applications include *InterAct*, a data source used to dispatch instructions and provide driving directions, incident details and responder GSP locations to law enforcement officials, and *Ping4Alerts!*, which allows community subscribers to receive instant notifications from law enforcement or public safety officials via mobile devices with cell, Wi-Fi or GPS connectivity. These applications are critical for public safety officials, who rely on fast and accurate communications.

Another application, *NowForce* transforms mobile devices into “life-saving networks” through use of Geographical Information Systems (GIS), and has provided significant benefits to first responders in developing nations. In a country such as Nigeria, whose poor infrastructure impedes transportation and contributes to a poor electrical supply, law enforcement command and dispatch is incredibly difficult, often severely hindering reaction time. A month after local police departments launched *NowForce*, heavily armed response time fell to seven minutes in a city of six million people with heavy traffic to match.⁴³

Public safety applications have proliferated in recent years, largely in reaction to specific incidents, such as the startling rise of reported crimes against women in India. According to India’s National Crime Records Bureau, reported crimes against women rose 6.8 percent between 2011 and 2012 and 24.7 percent between 2008 and 2012.⁴⁴

In 2013, the National Association of Software and Services Companies (NASSCOM) held an All India App Fame Contest, focused on developing solutions for female safety. Submissions included: *GoSurakshait*, by Hughes Systique India, an application that allows users to seek help from their most trust contacts from any location; *Sentinel*, by MindHelix Technosol PVT, a GPS-based mobile application that allows users to send their GPS location to the company’s security division, friends or cops through SMS alerts; and *Nirbhaya: Be Fearless*, by SmartCloud Infotech, a very accurate GPS application that

42. “PremierOne Mobile,” *Motorola Solutions*, accessed June 3, 2013, http://www.motorolasolutions.com/US-EN/Business+Solutions/Industry+Solutions/Government/Law+Enforcement/PremierOne_Mobile_US-EN

43. Marks, Kathy. “Emergency-Response Mobile Applications,” *Law and Order: The Magazine for Police Management*. April 2013, accessed June 25, 2013, http://www.hendonpub.com/law_and_order/articles/2013/04/emergency_response_mobile_applications

44. National Crimes Records Bureau, Ministry of Home Affairs, “Crime in India 2012,” *Ministry of Home Affairs*, 2012, accessed June 24, 2013, <http://ncrb.gov.in/>

sends SOS messages containing the users location to predefined SMS contact groups.⁴⁵

In El Salvador, mobile technology is enabling real-time monitoring and analysis of crime patterns in order to improve crime prevention. The Santa Tecla Municipality, the U.S. Government through its Agency for International Development (USAID), RTI International (RTI), the National Civilian Police (PNC) and Qualcomm Wireless Reach provide law enforcement personnel with mobile and web-based applications that allow municipalities to map and analyze real-time crime data. Law enforcement officers use the smartphone application, built-in camera, Global Positioning System (GPS) capability and other features to create detailed reports on crime incidents. Once a report is completed, the officer can immediately send it from the smartphone to an Internet crime database.⁴⁶

In the wake of the surge in rape and gender-based violence cases, Indian IT provider Tech Mahindra provided its mobile application, *Fightback*, for free. The application enables real-time tracking and sends alerts to five pre-selected contacts. Tech Mahindra is currently working with the Delhi police to integrate the application into their systems.⁴⁷

Around the world, public safety applications are calling on citizens to use mobile technology to inform law enforcement agents of crimes and accidents. Taiwan's ministry of the interior, for example, launched a mobile application that allows users to access safety service and help the police fight crime. It features the 110 police service line, 113 abuse prevention line and 165 fraud prevention line, in addition to fugitive and stolen car information, missing persons reports, road traffic updates, and taxi calling services.⁴⁸

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In Africa, law enforcement officials are taking advantage of the boom of mobile devices to educate and engage citizens. Kenyan law enforcement officers and humanitarian

45. "Nasscom felicitates women safety mobile app makers," *The Economic Times*, June 19, 2013, accessed June 25, 2013, http://articles.economictimes.indiatimes.com/2013-06-19/news/40069847_1_women-safety-sms-alert-appfame-contest

46. Qualcomm Wireless Reach report, <http://www.qualcomm.com/media/documents/files/wireless-reach-case-study-el-salvador-wireless-security-english-.pdf>

47. Puri, Niltin, "Fight back with mobile safety app Fightback," *ZD Net*, March, 8 2013, accessed June 15, 2013, <http://www.zdnet.com/fight-back-with-mobile-safety-app-fightback-7000012249/>

48. Africa, Clarice. "Taiwan launches Mobile App for Public Safety," *Mobile Government*. August 27, 2012, accessed June 4, 2013, <http://www.futuregov.asia/articles/2012/aug/27/taiwan-launches-mobile-app-public-safety/>

workers have launched a phone application, comprised of interactive games users can play with their friends, that simulates first aid exercises designed to supplement training programs run through the Kenyan Red Cross. No real emergency services for those injured in traffic accidents currently exist in Kenya, and as motorbikes become increasingly popular, bike accidents are on the rise. The idea behind the application is to train riders - who often reach the accident before first responders - in basic emergency aid to administer at the scene. This has the potential to save hundreds of lives.⁴⁹

Law enforcement officers are working together across borders to better utilize new technology. This past May, the U.S. Federal Communications Commission and its Canadian counterpart, Industry Canada, reached an agreement to share spectrum across their common border areas. As part of the agreement, the countries will share spectrum in the 3650-3700 MHz band, allowing public safety licensees on both side of the border to implement wireless broadband and high-speed Internet services.⁵⁰ The agreement hopes to improve public safety communications by facilitating spectrum sharing without the harmful interference of other bandwidths.⁵¹

Using Mobile Technology to Overcome Challenges

Japan's 2011 tsunami made it clear to its leaders that the country needed communication networks that were - in the words of Japanese Information Technology officials - "robust, resilient and dependable." Japanese inventors looked to Taiwan's SMS open standard, called Open GeoSMS, as a model. The tool, approved by the Open Geospatial Consortium, has been very effective in terms of humanitarian coordination and disaster relief.⁵²

In recent years, Japan has combined cellular, regional Wi-Fi and satellite networks to create a disaster-resilient, multilayered communications network.⁵³ 3G cell phones

49. Kelly, Annie. "Kenya turns to mobile app to stop motorbike mayhem on the roads," *The Guardian*, May 13, 2013, accessed June 5, 2013, <http://www.guardian.co.uk/global-development/2013/may/13/kenya-mobile-app-motorbike-roads>

50. FCC statement: U.S. and Canada reach agreement on border spectrum sharing arrangements <http://www.fcc.gov/document/us-canada-reach-agreement-border-spectrum-sharing-arrangements>

51. Kurz, Phil. "U.S. - Canada reach deal on mobile, public safety spectrum sharing." *BroadcastEngineering*, May 16, 2013, accessed June 26, 2013, <http://broadcastengineering.com/rf/us-canada-reach-deal-mobile-public-safety-spectrum-sharing>

52. Torres, Ida, "Japan to learn from Taiwan in disaster-proofing telecoms." *The Japan Daily Press*, February 13, 2012, accessed June 20, 2013 <http://japandailypress.com/japan-to-learn-from-taiwan-in-disaster-proofing-telecoms-1323248>

53. Torres, Ida, "Japan to learn from Taiwan in disaster-proofing telecoms." *The Japan Daily Press*, February 13, 2012, accessed June 20, 2013 <http://japandailypress.com/japan-to-learn-from-taiwan-in-disaster-proofing-telecoms-1323248>

equipped to receive earthquake early warning systems (EEW) have been on the market in Japan since 2007. And three major Japanese mobile carriers (NTT docomo, au and SoftBank mobile) have launched simultaneous broadcast system to receive these alerts.⁵⁴

When landlines go down in storms, mobile networks often stay up, enabling social networking and mobile applications to keep the lines of communication open for emergency crews, first responders, and citizens.⁵⁵ Emergency services that are using Twitter successfully can inform the public and source information from Twitter feeds during emergencies. Taiwan's 2009 Morakot Typhoon demonstrated the usefulness social media can have during disasters: web users instantly updated PTT, a popular Taiwanese social network, with information regarding the typhoon - even before government and mass media.⁵⁶ Twitter also played a critical role in the 2011 floods in Queensland, Australia; the 2011 Arab Spring; and 2011 earthquake and tsunami in Japan.⁵⁷ Today, Japan's Internet disaster message boards allow users to publish messages regarding their safety as a means to communicate with concerned family and friends.⁵⁸

In the areas of disaster response and recovery, emergency technicians and hospitals are critical. A recent Italian pilot study tested an emergency system solution, called Mobile Emergency, designed to improve the readiness of hospital personnel during disasters and facilitate treatment of and procedures on victims of disasters. The application stores hospital map information, sends emergency alarms, provides personnel support during the disaster, and allows users to locate nearby colleagues.

The application was piloted at the Careggi Hospital in the Florence and Tuscany area in Italy, and yielded encouraging results. The pilot found that the total time from receiving an emergency call to reaching the emergency scene dropped from an average of 16 minutes 20 seconds to 9 minutes 57 seconds, a reduction of 35 percent.⁵⁹ These results

54. Szjie, Sung. "How can we use mobile apps for disaster communications in Taiwan: Problems and possible practice," *EconStor*, June 2011, accessed June 25, 2013 <https://www.econstor.eu/dspace/bitstream/10419/52323/1/67297973X.pdf>

55. Ibid.

56. Ibid.

57. Bruns, Axel and Yixian Eugene Liang, "Tools and Methods for Capturing Twitter Data during Natural Disasters." *First Monday* 17.4, 2012.

58. Szjie, Sung. "How can we use mobile apps for disaster communications in Taiwan: Problems and possible practice," *EconStor*, June 2011, accessed June 25, 2013 <https://www.econstor.eu/dspace/bitstream/10419/52323/1/67297973X.pdf>

59. Pagliari, Claudia and Francesco Pinciroli. "Mobile Emergency, and Emergency Support System for Hospitals in Mobile Devices: Pilot Study," *JMIR*, May 23, 2013, accessed June 5, 2013 <http://www.ncbi.nlm.nih.gov/pubmed/23702566>

demonstrate the ways in which mobile technology is improving speed and accuracy for medical professionals and first responders. The use of mobile technology at every stage of disaster - from preparation to response to recovery - has the very real potential to reduce errors and save lives.

An illustration of an inexpensive application for firefighters in Latin America further demonstrates the usefulness of mobile technology. In many parts of Latin America, firefighters are volunteers who have minimal support or funding from government agencies. Applications such as MobileMap largely reduce the need for costly equipment. This mobile tool runs on handheld devices such as cell phones, laptops, and notebooks. The feature allows firefighters in Latin America to communicate with central command centers through Wi-Fi, cellular or, if these are unavailable, a Mobile Ad hoc Network (MANET). Through pre-loaded maps and more accurate and robust communication features (such as image file transfer), MobileMap greatly improved firefighter arrival time and accuracy during pilot tests in Santiago, Chile.⁶⁰

Providing reliable facts and up-to-date information through social media outlets and encouraging citizens to tweet, text or blog crucial information to first responders and government officials is an easy and effective way to coordinate responses. For example, the Philippines used Twitter to update and engage its citizens during disaster. During its 2012 typhoon, the Philippine government suggested hashtags for followers to provide important information to officials and stay updated on the evolving situation.⁶¹

Hong Kong and Australia turned to mobile technology to mitigate rumors during periods of crisis. At the height of the SARS pandemic, the government of Hong Kong sent SMS messages to 6 million mobile phones in an attempt to allay fears surrounding supposed government action.⁶² These messages direct people via 3G networks to websites that provide maps, videos, and other kinds of helpful information. In Australia, Queensland police created a "mythbusters" hashtag to manage misconceptions and diffuse rumors during the flooding.⁶³

As with any form of instant communication, information verification is a top priority. During April's bombings in Boston, some untrue statements permeated social media -

60. Monares, Alvaro et. al., "Mobile computing in urban emergency situations: Improving the support to firefighters in the field," *Elsevier*, 2010, accessed June 3, 2013 <http://www.elsevier.com/locate/eswa>

61. Ibid.

62. Lallana, Emmanuel. "eGovernment for Development," *Institute for Development Policy and Management*, October 19, 2008, accessed June 25, 2013 <http://www.egov4dev.org/mgovernment/applications/index.shtml>

63. Ibid.

including the suggestion that the government had shut down cell phone networks to prevent remote bomb detonation. But in fact, the Boston Police Department used mobile social media to provide relevant and timely information. Its twitter feed increased from approximately 35 thousand followers to nearly a quarter of a million, thereby revealing the desire for trusted and reliable information during a time of great public concern.⁶⁴

During April's bombings in Boston, some untrue statements permeated social media...

Maintaining a functioning system is another challenge.

After the earthquake in Haiti, conventional phone networks were knocked offline for 48 hours.⁶⁵ In the days after Hurricane Sandy hit the northeastern United States, nearly a quarter of cell phone towers in ten east coast states were damaged or destroyed. Data centers submerged in water shut down websites such as BuzzFeed, Gawker, Gizmodo, and the Huffington Post and affected traders on the floor of the New York Stock Exchange.⁶⁶

Broadband networks require adequate bandwidth and reliable sources of electrical power. Some cell towers are tied to the electric grid, making them vulnerable to strong winds, flooding, or natural disasters. While many cell towers are equipped with backup generators, some of them operate only for limited durations of a day or so.⁶⁷ We need resilient networks with sufficient spectrum that can operate during lengthy power outages or massive call volume spikes.⁶⁸

There has been some progress on this front, such as building redundant networks where necessary; utilizing portable or temporary base stations during emergencies; relying on back-up power sources for cell stations and switches during electrical grid failures; and

64. Glennon, Britta, "The Role of Technology in Crisis Management and How it Could Be Done Better," *The Chicago Policy Review*, May 7, 2013, accessed June 3, 2013 <http://chicagopolicyreview.org/2013/05/07/the-role-of-technology-in-crisis-management-and-how-it-could-be-done-better/>

65. Om, Jason, "Mobile invention could be desert lifeline," *ABC Science*. July 12 2010, accessed June 10, 2013. <http://www.abc.net.au/science/articles/2010/07/12/2951206.htm#.UcxwIz7wKrh>

66. Knight, Shawn, "Hurricane Sandy damages crucial wireless and Internet infrastructure." *Techspot*, October 31, 2013, accessed June 3, 2013, <http://www.techspot.com/news/50668-hurricane-sandy-damages-crucial-wireless-and-internet-infrastructure.html>

67. Wood, Matt and Alexandra Martines, "Why Did Wireless Networks Fail after Hurricane Sandy?" *Freepress.net*, November 21, 2012, accessed June 4, 2013 <http://www.savetheinternet.com/blog/2012/11/21/why-did-wireless-networks-fail-after-hurricane-sandy>

68. Smith, Gerry. "Oklahoma City Area Hit by Phone, Internet Outages After Tornado," *Huff Post Tech*, May 21, 2013, accessed June 3, 2013 http://www.huffingtonpost.com/2013/05/21/oklahoma-city-phone-internet-outages_n_3312790.html

tailoring network needs to individual locations and disasters.⁶⁹ In addition, organizations such as the International Telecommunications Union (ITU) have provided assistance - for example during the Haiti earthquake, where it deployed forty satellite terminals as well as a deployable base station in order to re-establish basic communication following that country's devastating earthquake.⁷⁰

As people increasingly rely on mobile phones and the Internet as their main source of information and communication, the government and private sector must work together to ensure that systems respond effectively to natural disasters and have the bandwidth to maintain operability during times of massive volume increases.

Many police departments and first responders currently have public safety systems that aren't interoperable. This makes it difficult for them to communicate with each other during times of major disasters or public safety challenges. They often end up relying on commercial networks due to their ubiquity and reliability.⁷¹

In future efforts to improve interoperability, it is important to build on technologies that connect users. For example, LTE-Direct and Small Cell Technology make it possible for emergency responders to stay in touch during periods of crisis. They provide low power, autonomous access to users across distances of up to one kilometer. These and other kinds of device-to-device communications can help people stay in touch during local emergencies.

The Department of Commerce's National Telecommunications and Information Administration is working on the creation of a nationwide interoperable wireless broadband network for public safety officials. This First Responder Network Authority, or FirstNet, is an independent authority within NTIA, and it is assigned to building, deploying and operating the FirstNet network.⁷²

69. "Before the Federal Communications Commission, Washington, D.C. 20554: Comments of the CTIA - The Wireless Association," *PS Docket No. 11-60, PS Docket No. 10-92, EB Docket No. 06-119*, July 7, 2011, accessed June 25, 2013 http://files.ctia.org/pdf/filings/110707_-_FILED_CTIA_Network_Reliability_Comments.pdf

70. International Telecommunication Union, "ITU Joins International Effort to Assist Haiti," see release at http://www.itu.int/newsroom/press_releases/2010/02.html

71. Slabodkin, Greg, "National wireless communications system for first responders years away." *Fierce Mobile Healthcare*, December 10, 2012, accessed June 20, 2013, <http://www.fiercemobilehealthcare.com/story/national-wireless-communications-system-first-responders-years-away/2012-12-10>

72. Department of Commerce. "Fact sheet: First Responder Network Authority (FirstNet)," *United States Department of Commerce*, August 20, 2012, accessed June 20, 2013 <http://www.commerce.gov/news/fact-sheets/2012/08/20/fact-sheet-first-responder-network-authority-firstnet>

Such efforts should take advantage of commercial applications that directly connect users and that offer network redundancy. In emergency situations, it is valuable to have multiple modes of connection. In case one system is compromised, it is worthwhile to have backup systems that connect emergency personnel.

In conclusion, we cannot prevent future natural disasters. We can, however, make better use of the current mobile technologies and promote future advances. As mobile devices become more common around the globe, policymakers have the chance to provide first responders and citizens with the tools necessary to save lives during threatening events. Governments and businesses should take full advantage of these technologies in order to help people and ameliorate suffering.

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