

Communications Security, Reliability and Interoperability Council



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WORKING GROUP 2
Emergency Alerting Platforms

Social Media & Complementary Alerting Methods –
Recommended Strategies & Best Practices

Final Report & Recommendations

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1 Results in Brief

1.1 Executive Summary

New technologies and social media platforms have become a significant part of Americans' everyday lives. In an effort to enhance emergency alerting and incident response, the influence and capabilities of these technologies and platforms must be harnessed.

This report has two distinct goals: First, it is intended to advocate for complementary alerting. EAS and WEA are critical alerting channels, but can be made even stronger in concert with other methods and platforms. As technology continues to develop, new channels emerge and existing ones evolve – presenting additional platforms to send out emergency alerts. To be complementary and obtain maximum leverage, these methods and channels must all work together, creating new opportunities to enhance public safety.

Second, this report seeks to emphasize the potential opportunity and advantages for social media platforms in emergency alerting. In the past decade, social media has evolved and expanded across dozens of platforms, each with multiple uses. The growth of social media is projected to continue rising – providing more opportunity for emergency response efforts. Alert originators (AO) are using social media and other non-traditional technologies to engage with the public in a continuous effort to improve public safety outcomes. This report will thoroughly discuss how these platforms influence emergency alerting and increase information access for AOs and the public.

With this report, all stakeholders will understand the value complementary alerting and social media platforms provide to emergency alerting and situational awareness, as well as, the challenges that remain with complete integration into the process and procedures. The recommendations provided in this report are intended to supply a record of best practices and recommended strategies to integrate the opportunities social media provides emergency alerting and information gathering.

2 Introduction

This report is from Communications Security, Reliability & Interoperability Council V (CSRIC) Working Group 2: Alerting Subgroup which is investigating strategies and best practices related to Wireless Emergency Alerts use through social media platforms and complementary alerting

systems.

This final report documents the efforts undertaken by those in the working groups.

2.1 CSRIC V - Structure

Communications Security, Reliability, and Interoperability Council (CSRIC) V			
CSRIC Steering Committee			
<p>Working Group 1</p> <p>Evolving 911 Services</p> <p>Co-Chairs: Susan Sherwood & Jeff Cohen</p> <p>FCC Liaisons: Tim May & John Healy</p>	<p>Working Group 2</p> <p>Wireless Emergency Alert</p> <p>Co-Chairs: Francisco Sánchez & Farrokh Khatibi</p> <p>FCC Liaisons: Chris Anderson, James Wiley & Gregory Cooke</p>	<p>Working Group 3</p> <p>Emergency Alert System</p> <p>Co-Chairs: Steven Johnson & Kelly Williams</p> <p>FCC Liaison: Gregory Cooke</p>	<p>Working Group 4</p> <p>Communications Infrastructure Resiliency</p> <p>Co-Chairs: Kent Bressie & Catherine Creese</p> <p>FCC Liaison: Emil Cherian</p>
<p>Working Group 5</p> <p>Cybersecurity Information Sharing</p> <p>Co-Chairs: Rod Rasmussen, Christopher Boyer, Brian Allen</p> <p>FCC Liaisons: Greg Intoccia & Vern Mosely</p>	<p>Working Group 6</p> <p>Secure Hardware & Software</p> <p>Co-Chairs: Brian Scarpelli & Joel Molinoff</p> <p>FCC Liaisons: Steven McKinnon & Emily Talaga</p>	<p>Working Group 7</p> <p>Cybersecurity Workforce</p> <p>Co-Chairs: Bill Boni & Drew Morin</p> <p>FCC Liaison: Erika Olsen</p>	<p>Working Group 8</p> <p>Priority Services</p> <p>Co-Chairs: William Reidway & Thomas Anderson</p> <p>FCC Liaisons: Tim Perrier & Ken Burnley</p>
<p>Working Group 9</p> <p>Wi-Fi Security</p> <p>Chair: Brian Daly, AT&T</p> <p>FCC Liaisons: Peter Shroyer & Kurian Jacob</p>	<p>Working Group 10</p> <p>Legacy Systems & Risk Reduction</p> <p>Co-Chairs: John Kimmins & Danny McPherson</p> <p>FCC Liaison: Steven McKinnon</p>		

2.2 Working Group 2 – Alerting Membership.

Name	Affiliation
Francisco Sanchez - Co-Chair	Harris Co. (TX) Emergency Management
Dr. Farrokh Khatibi - Co-Chair	Qualcomm
Alexander Gerdenitsch	EchoStar
Alfred Kenyon	Federal Emergency Management Agency/IPAWS
Amanda Faulkner	Twitter
Amanda Hughes	Utah State University

Benjamin J. Krakauer	New York City Office of Emergency Management
Bob Sherry	Intrado
Brad Gaunt	Sprint
Brian Daly	AT&T
Brian Murray	Harris Co. (TX) Emergency Management
Caitlin Shockey	Centers for Disease Control
Carol Woody	Software Engineering Institute
Charity Dominguez	Harris Co. (TX) Emergency Management
Chris Anderson	Federal Communications Commission
Chris Tarantino	Epicenter Media & Training
Dana Golub	Public Broadcasting System
David Layer	National Association of Broadcasters
Denis A. Gusty	Department of Homeland Security, S&T/FRG
Dharma Dailey	University of Washington
Dr. Gina M. Eosco	Eastern Research Group
Greg Cooke	Federal Communications Commission
Dr. Keith Bhatia	TeleCommunication Systems, Inc.
Elizabeth T. Dexter	Watch Officer/EOC Team Member
Hutch McClendon	Advanced Computer and Communications,
James Tyson	Centers for Disease Control
James Wiley	Federal Communications Commission
Dr. Jeannette Sutton	University of Kentucky
Jennifer Manner	Echostar
John Davis	Sprint
Jonathan W. Gaddy	Calhoun Co. (AL) Emergency Management Agency
Jose Rivera	Department of Homeland Security

Dr. Kate Starbird	University of Washington
Larry Rybar	Verizon
Larry Walke	National Association of Broadcasters
Mark D. Annas	Riverside (CA) Fire Dept.
Mark Lucero	Federal Emergency Management Agency/IPAWS
Matthew Straeb	GSS Net
Mike Gerber	National Weather Service
Paul Lupe	Fairfax County VA Office of Emergency Management
Peter Musgrove	AT&T (ATIS)
Rick Wimberly	Galain Solutions
Robbie Turner	Nextdoor
Robert Bunge	National Oceanic and Atmospheric Administration
Scott Enright	Emmis Communications
Shelley Blakeney	T-Mobile
Steve Mace	National Cable & Telecommunications Association
Tim Dunn	T-Mobile
Tony Surma	Humanitarian Toolbox

Table 1 - List of Working Group Members

Working Group 2 chairs would like to recognize the contribution of sub-working group chairpersons Dharma Dailey and Dr. Kate Starbird of the University of Washington (Social Media) and Rick Wimberly of Galain Solutions (Complementary Alerting Strategies). Chelssie Lopez, a graduate intern at the Harris County Office of Homeland Security & Emergency Management, also contributed to the creation of the final report. Their leadership and scholarship is appreciated.

3 Background

Neither the September 11, 2001 terrorist attacks nor 2005's Hurricane Katrina occurred in the

technological era we occupy now. Smartphones, social media, and other mobile technologies were still at best nascent concepts.

The advent of the smartphone, a device now used by nearly 65% of Americans¹, has shattered previous paradigms of emergency public communication. The telephone has morphed into a personalized information device handling SMS text messaging, email, use specific mobile applications, Internet browsing and, almost as an afterthought, phone calls.

This shift has enormous implications for emergency public information and warnings. The public now has options when it comes to deciding who to get their information from. The challenge for AOs is broadcasting information where targeted recipients are accustomed to getting it. Increasingly, this is from social media sites and device based applications, or apps.

Terrorist events in Orlando, Boston, Nice, Paris, and Brussels have shown the value of multi-channel communications. In particular, social media has proven valuable in providing timely warnings and actionable information through Facebook and Twitter. Some of the first available images following the Fukushima tsunami and Haiti earthquake came from Tweets. Patrons of the Pulse Nightclub in Orlando used Facebook Messenger to plead for help or say good-bye to loved ones. The Boston Police Department used Twitter to communicate areas of public danger as they moved to apprehend the Tsarnaev brothers. The list of official uses continues to grow.

This report was compiled at the request of the Federal Communications Commission and is intended to provide guidance and best practices to AOs at all levels of government and the private sector. Recommendations and practices discussed are not intended as, and should not be construed as, regulatory in nature. Rather, this report should be regarded as a resource for the alerting community, a primer on leveraging new technologies to improve public safety outcomes.

4 Complementary Alerting Strategies

Other communications methods include, but are not limited to: traditional media, mass notification systems (telephone, SMS, email), social media (Twitter, Facebook, Nextdoor, Instagram, etc.), mobile apps, and other media capable of receiving emergency alert messaging.

¹ Smith, A. (2015). *U.S. smartphone use in 2015*. Pew Research Center Internet, Science & Tech. <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/>.

Public alerting systems are “one to many” technologies, meaning one source is communicating to the public (many) through one or more channels. This section will provide examples of these systems and discuss how they can be used to leverage Wireless Emergency Alerts (WEA) and Emergency Alert System (EAS) to improve public safety outcomes.

4.1 *Emergency Alerting Systems*

Methods used for alerting have expanded rapidly. Twenty years ago, most alerts came from either sirens or radio and television broadcast-based EAS. Now, alerts come from a wide array of platforms and communications methods. Even more alerting channels are evolving including platforms and communications methods specifically dedicated to alerting as well as those that can be used for alerting but serve another primary purpose.

Without a doubt, EAS and WEA are critical alerting channels. EAS remains the backbone of alerting, using interrupted radio and TV broadcasts to reach very large audiences. Meantime, the WEA system has become an unquestionably strong and important method for reaching a significant percentage of people in the US on their mobile devices.

EAS and WEA can be made even stronger. They can work in concert with other methods and platforms, each with its own strengths and weaknesses. But, to be truly complementary and obtain maximum leverage, these methods must all work together. When they do, significant opportunities to enhance public safety will occur.

For the purpose of this section, we describe these methods and platforms as channels. These channels can include traditional alerting methods such as radio, TV, telephone, SMS, email, and sirens. Less traditional alerting channels are social media, Internet ads, accessibility tools, and consumer devices.

In addition to EAS and WEA, the channels shown in Table 1 are either currently being used for alerts or are emerging.

Channel	Description
Telephone	Automated dialing systems that allow targeting of alerts and other information to groups or geographic areas. Uses telephone numbers from (a) 9-1-1 telephone number databases, (b) commercially produced telephone databases, and/or (c) citizen sign-ups.

Mass emails	Alerts issued to individuals via email, either as a result of inclusion of their email addresses in existing lists (i.e. company personnel directories) or sign-ups.
Desktop alerting	Alert messages that pop up on computer screens regardless of applications being used. This occurs usually within confines of a closed network.
SMS Text	Short Message Service (SMS) delivers text characters to mobile devices. In order to receive alerts from a particular source, mobile users must sign up (or subscribe).
Other text services (including social media texting services)	Messaging services provided by various social media and other communications apps and platforms.
Social media	Use of various social media platforms to deliver alerts. Some platforms have specific alerting solutions (e.g., Facebook, Twitter, Nextdoor).
Internet ads	Internet ads are substituted with AMBER Alerts and certain weather events in affected geographic areas. https://www.Internetalerts.org/
Consumer applications	As the Internet of things matures, more consumer applications (e.g. Amazon Echo, Google Home) will become connected. Many of these applications could become alerting channels.
Digital signage	Electronic signs placed in strategic areas either for specific purpose of disseminating alerts, or for disseminating other information but also used for alerts.
Radio Data System (RDS)	Purpose-built channel that can be used for alerting; allows officials to send information via the data subcarrier of local FM radio signals via a dedicated channel for sending digital alert information. Provisioned for sending rapid alerts in less than six seconds.
NOAA Weather Radio	NOAA Weather Radio is a nationwide network of stations broadcasting continuous weather information directly from the nearest National Weather Service office.
Digital radio (path for alerting): emerging	HD Radio™ Technology Emergency Alert channel using spectrum on HD Radio transmissions. These alert notifications can generate pop-up text messages

	<p>and trigger wake-up/snooze capabilities on receivers supporting the technology during weather alerts or other local incidents.</p>
<p>Hybrid radio (e.g., NextRadio, a mobile application that combines visual and interactive features with traditional radio broadcasts)</p>	<p>Hybrid radio/visual radio synchronizes broadcast radio signals with images and interactive features delivered using broadband/IP/cellular technologies. A user of hybrid radio may view album art for the songs playing, text to win contests, phone the radio station, receive coupons for the goods being advertised, and the like. Hybrid radio may be integrated with EAS alerting at the Integrated Public Alert and Warning System (IPAWS) level to deliver images, including symbols, to radio stations for display during EAS alerts.</p> <p>These visual and interactive features may also be used by public safety officials to, among other things, show evacuation routes or closed roads when combined with an audio weather alert broadcast, or provide the means to call the proper authorities when combined with an audio AMBER Alert broadcast.</p>
<p>Advanced Warning and Response Network (AWARN) via ATSC 3.0 (aka Next Generation Television)</p>	<p>Emerging all-IP system that uses more rugged encoding made available via a new broadcast television standard (ATSC 3.0) for digital television transmission (DTV) to deliver alerts to a variety of devices. http://awarn.org/</p>
<p>Accessibility solutions</p>	<p>Various applications and solutions that facilitate alerts to people with disabilities and those with limited English proficiency. Among accessibility solutions currently working to provide alerts via IPAWS: DeafLink (sensory disabilities), Max Smart Homes (deaf, blind or low visibility, Cognitive Mobility), Safety Labs (older adults, cognitive, autistic, assisted living, independent living), Convo (deaf), Rockin Robots iRescue (older adults, cognitive-search and rescue), ECHO Minnesota - Twin Cities Public Television (Limited English Proficiency), consistent symbology for IPAWS event codes.</p> <p>Note: Georgia Tech Center for Advanced Communications Policy has produced a document for FEMA that provides examples of the types of solutions available.</p>

	http://www.cacp.gatech.edu/sites/default/files/apps4wea1.pdf .
EEWS (Early Earthquake Warning Systems): different capability other than WEA offered by carriers and possibly broadcasters.	Geographic sensors produce automated (without human intervention) earthquake alerts to cellular phones and critical infrastructure points. This capability is currently being developed by cellular operators and vendors in Alliance for Telecommunications Industry Solutions (ATIS) in collaboration with California Office of Emergency Management, CalTech, US Geological Survey (USGS), and other stakeholders.
Sirens	Large loudspeakers installed at strategic locations that make a loud sound to get attention of people within earshot.
Giant Voice	Large loudspeakers installed at strategic locations that enunciate voice announcements to provide information to people within earshot.
Mass Notification Systems	Term used by National Fire Code and military doctrine to describe in-building alerting systems, generally for purposes of fire and other emergencies.

Table 2 – Communication Channels

The concept of “ubiquitous alerting” as coined by Rick Wimberly of Galain Solutions, means that alerts can be, literally, everywhere.² In theory this would mean leveraging multiple alert-capable technologies to reach as many people, in as many ways, as possible. In practice, Virginia Polytechnic Institute & State University (Virginia Tech) offers an intriguing example of the successful integration of multiple emergency public communications channels. Called VT Alerts, the school delivers emergency notifications using some or all of these channels:

- The Virginia Tech homepage
- Broadcast emails to all vt.edu accounts
- Electronic message boards in most classrooms and campus spaces.
- The weather/emergency hotline

² Wimberly, R. (2016). *New age of alerting coming: ubiquitous alerts*. Emergency Management. Retrieved from <http://www.emergencymgmt.com/emergency-blogs/alerts/new-age-of-alerting-coming--ubiquitous-alerts.html>.

- Campus sirens and loudspeakers
- VT Phone Alerts (direct to mobile phones)
- VT Desktop Alerts (direct to Internet connected computers on campus)
- On Twitter by following @vtalerts, @vtnews, or @virginia_tech³

Several of these alerts, such as VT Phone Alerts and Twitter, are accessible and available to those who reside and visit the Blacksburg, VA area. While there are certainly other channels that can be developed, particularly reaching non-English speakers and those with sensory disabilities, the Virginia Tech example can be replicated by nearly any jurisdiction and, in some cases, at low or no cost. This is a concept that deserves further exploration and study.

5 Social Media

This section provides an analysis of social media's current role during incidents and offers a discussion of best practices based on research. It also explores how social media may further complement EAS and WEA. Recommendations are offered as voluntary guidance in the interest of promoting the cause of effective emergency public information. These recommendations encourage active participation by government agencies, alert originators (AOs), and technology partners to improve the effectiveness of social media as an alerting tool.

5.1 Background

Social media platforms are regularly used by citizens, government agencies, the media, non-governmental organizations (NGOs), and businesses during incidents. It serves as a common way for citizens to communicate, coordinate and stay informed in the event of an incident. As a result, AOs are increasingly drawn to social media to engage with the public. Social networking sites provide platforms for public safety agencies to keep the public educated and informed during a potential incident. Social media has proven advantageous across the various stages of the disaster life-cycle, presenting government agencies with the ability to improve and monitor situational awareness and spur recovery.

AOs, non-profits, businesses, and news organizations use social media for a range of communication needs in times of crisis. Social media can foster online collaborations, regardless

³ <http://emergency.stage.cms.vt.edu/plans/ens.html>

of location, to address emergency needs. These emerging behaviors have developed into recognized forms of response. For example, in 2010 the efforts of “crisis mappers” and “digital volunteers”⁴ after the earthquake in Haiti, evolved into various organizations with proven practices that are relied on by humanitarian organizations today.⁵

Social media offers flexibility, low barriers to entry, a multiplicity of ways to be used during an incident, and the ability to reach groups of diverse users. AOs using social media must consider several factors in order to effectively use this tool set. In this section, we summarize several well-documented considerations regarding how social media may be used during incidents.

5.1.1 A Diverse and Evolving Tool Set

Social media is comprised of a diverse group of Internet-based services, applications, and websites that are distinguished by the large portion of user-generated content they support and the social interaction they foster between users⁶. The most commonly used social media services are supported across multiple devices including smartphones, computers, and tablets. Their functionality overlaps with many other kinds of Internet-based services and integrates data with other interfaces: cameras, Internet-of-Things, Application Programming Interfaces, etc. Therefore, the term social media is only loosely defined.

New social media platforms are frequently appearing, and the *rules* and trends that govern their prevalence are always changing. New functionalities are incorporated and older functionalities are retired. An important distinction between social media and other emergency communication tools is the software-as-a-service (SaaS) distribution model. This model offers social media platforms the ability to rapidly change functionalities without notice. Facebook, the largest social media platform in the U.S., updates its software twice a day.⁷ So every time users log on, they encounter a slightly altered version.

Most social media companies also modify their content to best match the device used to access

⁴ Starbird, Kate, and Leysia Palen. "Voluntweeters: Self-organizing by digital volunteers in times of crisis." *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2011.

⁵ Soden, Robert, Nama Budhathoki, and Leysia Palen. "Resilience-Building and the Crisis Informatics Agenda: Lessons Learned from Open Cities Kathmandu." *Proceedings of the 11th International ISCRAM Conference—University Park, Pennsylvania, USA* May. 2014: 1-10.

⁶ Kaplan, Andreas M., and Michael Haenlein. "Users of the world, unite! The challenges and opportunities of Social Media." *Business horizons* 53.1 (2010): 59-68.

⁷ Rossi, Chuck. "Ship early and ship twice as often." Facebook. August 3, 2012.

<https://www.facebook.com/notes/facebook-engineering/ship-early-and-ship-twice-as-often/10150985860363920/>

their media site, so users on different devices have marginally different experiences. This is mostly done through computer algorithms which select the content visible to users. These algorithms are proprietary and vary from one social media service to the next. Algorithmic changes that influence content are not always visible to users or external technology developers. The volatility and lack of transparency can make social media a challenging set of tools to apply in emergency settings.

5.1.2 Trending Growth & Opportunity

During the last decade, Americans have steadily increased their use of social media. Between 2005 and 2015, social media use among adults grew from 7% to 65%.⁸ Social media have become a significant portion of web traffic today. Among the top 25 most visited Internet sites,⁹ only three¹⁰ lack any social media features, like user-generated content, interaction between users, share buttons, or log-in capability through social media accounts. It has become uncommon to separate social media from the rest of the web, as many websites have included Facebook comments or embedded Tweets on the main page.

Conversely, much traffic that occurs through social media comes from media organizations. In 2015, Facebook overtook Google as the largest driver of traffic to some 400 “major news and media sites.”¹¹ In 2016, Pew reported that a 62% of Americans are getting at least some news on social media platforms.¹² 18% of Americans access daily news through social media platforms. The shift toward digital distribution continues to undermine the financial sustainability of news organizations and original reporting.¹³ Since 1994, US newsrooms jobs have declined 39%.¹⁴

These overall trends point to the increasing importance of social media platforms for public communication. Within these trends are important demographic and geographic differences in usage behaviors. Usage norms and behaviors also differ within and between specific social

⁸ Gottfried J. and Shearer E. "News Use Across Social Media Platforms 2016" Pew Research Center. May 26, 2016. <http://www.journalism.org/2016/05/26/news-use-across-social-media-platforms-2016>

⁹ "Alexa - Top Sites in United States." 14 Jun. 2016 <http://www.alexa.com/topsites/countries/US>

¹⁰ Bing, Chase, and Paypal

¹¹ Ingram, Mathew. "Facebook now drives more traffic to media sites than Google." Fortune, August 18 2015. <http://fortune.com/2015/08/18/facebook-google/>

¹² Gottfried J. and Shearer E. "News Use Across Social Media Platforms 2016" Pew Research Center, May 26, 2016. <http://www.journalism.org/2016/05/26/news-use-across-social-media-platforms-2016/>

¹³ Mitchell, A. and Holcomb, J. "State of the News Media 2016" Pew Research Center, June 15, 2016. <http://www.journalism.org/2016/06/15/state-of-the-news-media-2016/>

¹⁴ Reinardy, Scott. *Journalism's Lost Generation: The Un-doing of US Newspaper Newsrooms*. Routledge, 2016.

media platforms.

Demographic Differences: Social media usage differs based on age cohort, gender, socio-economic status, educational attainment, and race. The largest difference revealed was the generation gap, as 90% of adults 18 to 25 use social media compared to 35% of those 65 or older.¹⁵ Additionally, 10% of Americans remain without consistent and reliable Internet access due to either socio-economic factors or availability in the area.¹⁶ Despite these measures, there has been an upward trend in social media use across all demographic categories.

As the trend continues, social media are becoming a powerful tool for understanding and reaching specific populations. AOs are exploring the capability to reach specific populations more effectively, like those with access and functional needs or those with a limited understanding of English.¹⁷ However, researchers are increasingly more cautious about the initial promises of social media's large data to yield quick, accurate, and unbiased understandings. They consider social media to be an imperfect and partial lens by which to make inferences about particular populations, making it difficult to deliver a depiction of demographic and geographic factors in social media usage.

A growing form of data during incidents is user-generated information that is geo-tagged. This ties the content to a particular location, however, only a fraction of users opt to geo-tag. Researchers have raised concerns about using geo-tagged data to make inferences regarding disaster-affected populations.¹⁸ ¹⁹ For instance, areas with the most infrastructure damage may have less of a presence on social media.²⁰ A geographic study of tweets in New York City during Hurricane Sandy found varying amounts of activity for different parts of the city.²¹ The

¹⁵ "News Use Across Social Media Platforms 2016" Pew Research Center." Jun. 2016
<http://www.journalism.org/2016/05/26/news-use-across-social-media-platforms-2016/>

¹⁶Kang, Cecilia. "The Challenges of Closing the Digital Divide." The New York Times, June 7, 2016.
<http://nyti.ms/1XAOIYh>

¹⁷ Majid, A. and Spiro, E. "Crisis in a Foreign Language: Emergency Services and Limited English Populations." Proceedings of the ISCRAM 2016 Conference – Rio de Janeiro, Brazil, May 2016.
http://idl.iscram.org/files/amirahmmajid/2016/1363_AmirahM.Majid+EmmaS.Spiro2016.pdf

¹⁸ Crawford, Kate, and Megan Finn. "The limits of crisis data: analytical and ethical challenges of using social and mobile data to understand disasters." *GeoJournal* 80.4 (2015): 491-502.

¹⁹ Haworth, Billy, and Eleanor Bruce. "A review of volunteered geographic information for disaster management." *Geography Compass* 9.5 (2015): 237-250.

²⁰ Burns, Ryan. "Rethinking big data in digital humanitarianism: practices, epistemologies, and social relations." *GeoJournal* 80.4 (2015): 477-490.

²¹ Shelton, Taylor, et al. "Mapping the data shadows of Hurricane Sandy: Uncovering the sociospatial dimensions of 'big data'." *Geoforum* 52 (2014): 167-179.

Bronx and Staten Island area had lower Twitter activity than Manhattan and Brooklyn, a pattern which suggests socioeconomic differences were at play in visibility and access. Social media should therefore be considered an important, but partial resource for assessing situational awareness. AOs are encouraged to pursue their own due diligence about social media usage in their communities and align chosen strategies to match their goals, objectives, and the unique needs and expectations of their stakeholders.

Geographic Differences: Those monitoring and analyzing public activities via social media should be aware that user-generated content may have an “urban bias.”²² Researchers have compared social media use in urban to rural areas throughout the United States, consistently discovering differences across numerous platforms.^{23 24 25 26} Users in rural areas are less likely to produce publically visible content, although they may be just as active on social media. Less visible content may include, liking posts and perusing content without commenting or producing original content of their own.²⁷

Consumer usage statistics from academic research and social media companies are strongly skewed toward those who generate content, login with a particular frequency, or meet specific thresholds of use. Less research has been done focusing solely on those who are seeking information from social media or who use it intermittently— as may be the case in an incident. Data covering total consumer usage may not be as important as who in a community is using social media. Therefore, interpreting these statistics for public interest purposes should be done with care.

The gap between rural and urban user behavior is instructive for helping us to think about interacting with the public through social media. It is one example of the many ways that people

²² Hecht, Brent, and Monica Stephens. "A Tale of Cities: Urban Biases in Volunteered Geographic Information." *ICWSM 14* (2014): 197-205.

²³ Gilbert, Eric, Karrie Karahalios, and Christian Sandvig. "The network in the garden: Designing social media for rural life." *American Behavioral Scientist*(2010).<http://comp.social.gatech.edu/papers/abs09.network.gilbert.pdf>

²⁴ Gilbert, Eric, Karrie Karahalios, and Christian Sandvig. "The network in the garden: an empirical analysis of social media in rural life." *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* 6 Apr. 2008: 1603-1612.

²⁵ Johnson, Isaac L., et al. "The Geography and Importance of Localness in Geotagged Social Media." *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 2016. http://www-users.cs.umn.edu/~bhecht/publications/CHI2016_geogoflocalness.pdf

²⁶ Johnson, IL. "Not at Home on the Range: Peer Production and the Urban/Rural Divide." *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 2016. http://www-users.cs.umn.edu/~bhecht/publications/CHI2016_ruralurbanpeerproduction.pdf

²⁷ Dailey and Starbird. In review.

using social media differ from each other depending on platform, context, geography etc. Therefore, it is better to think of social media as tools for reaching distinct crowds rather than one uniform crowd that behaves the same across all locations and across all platforms.

User Expectations, Norms, and Behaviors: When engaging with social media platforms, agencies must contend with user expectations, norms, etiquette, and behaviors that have developed, as well as the preferences, habits, and patterns of individual users. These expectations, norms, and behaviors vary between the different platforms and continue to evolve, changing the dynamics of particular social media sites.^{28 29} For example, Facebook users report being more selective now about what they post compared to a few years ago. Myspace, once similar to Facebook, is now primarily a music sharing site. Dibly, an entertainment site, was launched in 2014 and is now the 20th most visited site in the United States. This shows a rapid evolution of user behaviors that is visible within and across platforms.

Platform Selection: Social media platforms are not used in isolation, rather, individuals select specific platforms for specific communication activities. A career professional might use LinkedIn to network with other professionals, Instagram to share hobby photos, and Facebook to stay in touch with friends and family. A college student may use Snapchat to talk to friends, YikYak for anonymous chats on campus, and Reddit for political discussions. Nextdoor has built extensive partnerships with public safety agencies to provide emergency public information at the neighborhood level. During an emergency, social media users selectively choose from a range of social media platforms for communication purposes. For example, a person in a disaster-affected area may search Twitter for news stories, then privately direct-message friends and family through Facebook to let them know they are okay. In addition, new mechanisms work in combination with existing social media platforms to deliver information across the multiple platforms with one click. Tweetdeck helps users monitor information available through Twitter, and other tools, Hootsuite and Nixle, assist in posting a single message to multiple social media sites.

²⁸ Sleeper, Manya, et al. "Sharing personal content online: Exploring channel choice and multi-channel behaviors." *Proc. CHI*. 2016.

²⁹ Zhao, Xuan, Cliff Lampe, and Nicole B. Ellison. "The Social Media Ecology: User Perceptions, Strategies and Challenges." *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 2016.

5.2 *Advantages of Effective Social Media Use:*

For the past fifteen years, social media platforms have been used during emergencies. But, the adoption of social media during emergency response efforts has been uneven among government agencies.

There is quite a bit of inconsistency in policies, practices, comfort, skills, and resources among AOs due to differing organizational skills and resources. In some cases, policies and procedures prohibit effective use of social media. In 2015, a survey of 241 emergency management organizations in the US found 25% prohibited the use of social media. However, much of this variability reflects lag time in the organizations innovation process as they react to the many dynamic trends named above.

Certain social media applications have proven easier to integrate into certain operational functions than others. Jurisdictional scope, operational mandate, and particular communication needs factor into how social media is used by government organizations, which platforms are used, and to what effect. Other factors include organizational size and funding. Larger, well-funded agencies tend to have the necessary resources to dedicate to maintaining a sound social media presence and monitoring media activity during an incident.³⁰ Smaller agencies tend to maintain a scaled down social media presence, if they maintain one at all.

Despite the challenges with social media use, case studies have documented the manifold value of social media during incidents. These platforms have become much more than a messaging medium.

Fill the Information Gap: During the 2016 fire that struck Fort McMurray, the Regional Municipality's Twitter account served as the primary source of news for the community, surpassing local news coverage. Yet, during other incidents, the information gap has been filled by crowd-powered journalism or citizens directly working with emergency responders as Virtual Operation Support Teams.³¹

³⁰ Hughes, Amanda L, and Leysia Palen. "The evolving role of the public information officer: An examination of social media in emergency management." *Journal of Homeland Security and Emergency Management* 9.1 (2012): 1-20.

³¹ St. Denis, L. A., Hughes, A. L., & Palen, L. "Trial by Fire: The Deployment of Trusted Digital Volunteers in the 2011 Shadow Lake Fire." In *Proceedings of the Information Systems for Crisis Response and Management Conference (ISCRAM 2012)*. Vancouver, BC.

Information Infrastructure: Social media platforms have not changed the elements of good incident communication, but it has dramatically changed how and by whom information is processed and relayed. Digital humanitarians and crisis mappers are now established populations which leverage social media to not only provide users information during disasters but also assist in compiling situational awareness that can be extremely helpful to first responders. It can be challenging to incorporate the efforts of digital volunteers into professional response efforts due to the differences in organizational structure and expectations, miscommunication, and issues of trust.³² In spite of these challenges, social media can aid in forming an infrastructure of information during incidents.³³ These arrangements indicate the combined capabilities of individuals and organizations that form a “human-powered mesh network,”³⁴ working together to collect and verify information, craft how it is shared for various audiences, and move it across various platforms to reach targeted audiences.

Back Channel Communications: Some social media tools have gained wide acceptance among responders and have been adopted where resources are available. The most prevalent usages include media monitoring, informing external publics, community engagement in affected areas, emergency alerts and warnings, situational awareness and monitoring, rumor patrol, and coordination with volunteer and responder-to-responder communications. Many responders and response organizations are Twitter followers or Facebook friends with other response organizations creating an informal communication channel outside of an incident. Similarly, platforms like Facebook Groups, Twitter Direct Messages, Slack groups, and other social media features are also able to act as auxiliary backchannels for communication between responders.

Broadcasting Medium: AOs have widely adopted social media as an alternate broadcast medium for sharing one-to-many communications including announcements, alerts, and press releases. Today, Twitter and Facebook are additional paths for press releases and the distribution of general information to reach the public.

Vast follower/following relationships are common between news organizations, AOs, and

³² Hughes, Amanda Lee, and Andrea H. Tapia. "Social Media in Crisis: When Professional Responders Meet Digital Volunteers." *Journal of Homeland Security and Emergency Management* 12.3 (2015): 679-706.

³³ Dailey, D. and Starbird, K. 2016. Addressing the Information Needs of Crisis-Affected Communities: The Interplay of Legacy Media and Social Media in a Rural Disaster. In *The Communications Crisis in America, and How to Fix It*. Friedland L. and Lloyd, M. editors. Palgrave MacMillan, 2016.

³⁴ Dailey, Dharma, and Kate Starbird. "Journalists as Crowdsourcers: Responding to crisis by reporting with a crowd." *Computer Supported Cooperative Work (CSCW)* 23.4-6 (2014): 445-481.

bloggers on Twitter, which has been widely adopted by news producers. As such, media monitoring and media relations now take place through social media. With the aid of the media and other influencers who have extensive social media *Friends* or *Followers*, AOs can rapidly reach the public. In addition to situational awareness, social media is another path for broadcasting information on the most widely adopted social media practices among AOs.

Many AOs are concerned with the spread of misinformation through these new pathways. It has become a priority to detect, stop, and counter the distribution of such information. Reddit played a notable role in spreading misinformation after the Boston Marathon Bombing as users launched their own informal investigation. Guidance around successful social media use by AOs is highly-contextual and does not easily transfer to other agency types, social media platforms, or emergency events. Consequently, there is a lack of direction that generalizes well, which can be challenging for AOs that want to use social media, but who do not fully understand how it works or the most effective uses for the technology.

Monitoring for Situational Awareness: Monitoring social media for situational awareness has become widespread across AOs of all sizes. When organizational capacity is not a factor, using social media as a broadcast and monitoring tool is relatively easy to integrate into existing operational practices and can often yield valuable and timely information.^{35 36} Data and intelligence gathering through these techniques informs and enhances incident operations, public information management, and outreach with stakeholders and affected populations.

Social media monitoring, known as listening, is frequently undertaken even when a given agency does not outwardly engage with their stakeholders online. It is often aided by the use of free or proprietary software tools. Social media monitoring can contribute to general situational awareness and incident-specific investigations. For example, network analyses can be used to evaluate the interconnectedness of various community members, which is frequently used by law enforcement. Geographically-targeted or keyword-focused searching can be used to identify geographical trends or sentiment. These methods can help identify trapped or stranded victims, assessment of themes and emerging issues, and other objectives that enhance the common

³⁵ Reuter, Christian, et al. "Emergency services' attitudes towards social media: A quantitative and qualitative survey across Europe." *International Journal of Human-Computer Studies* (2016).

³⁶ Tapia, Andrea H., and Kathleen Moore. "Good enough is good enough: Overcoming disaster response organizations' slow social media data adoption." *Computer Supported Cooperative Work (CSCW)* 23.4-6 (2014): 483-512.

operating picture between AOs and partners.

AOs are also able to monitor Twitter and Facebook for information from citizens on scene who report what they are experiencing and seeing. This passive social media monitoring uses pre-established searches for specific content and accounts set up to search specific keywords, parameters, and geographic area. Many organizations have computer monitors dedicated to information dashboards that help them to identify issues and watch for trends. During an incident, monitoring becomes more active, narrowing to incident-specific searches.

As alluded to above, researchers have identified several places where bias can be introduced into interpreting social media data: 1) the underlying data may not be representative, 2) analytic tools and algorithms can introduce bias, and (3) those conducting the analysis can make incorrect inferences. As social media monitoring becomes increasingly integrated into incident response, greater awareness of these limitations must also proliferate.

Public Interaction: A distinguishing feature of social media is its ability to foster timely interaction between individuals. Mastering this capability is where we see the greatest variability among AOs during an incident. Capacity, capability, policy, and procedures vary dramatically among AOs when it comes to tapping into the advantages social media offers for interacting with the public.

A common use of social media by AOs during incidents— rumor patrol— is illustrative of the challenges these organizations face when more interactive with the public. The spread of misinformation by the public is commonly cited fear by responders as a barrier to social media use.^{37 38} Though some optimistically tout the power of the self-correcting crowd to mend misinformation, research shows that rumors do spread in the aftermath of an incident. Unfortunately, the reach of rumors is often greater than the reach of rumor-corrections.³⁹ Recent research does show that official AO social media accounts can effectively dampen and even halt the spread of online rumors if they react quickly and decisively.⁴⁰ The study examined two

³⁷ Hughes, Amanda L, and Leysia Palen. "The evolving role of the public information officer: An examination of social media in emergency management." *Journal of Homeland Security and Emergency Management* 9.1 (2012): 1-20.

³⁸ Hiltz, Starr Roxanne, Jane Kushma, and Linda Plotnick. "Use of social media by US public sector emergency managers: Barriers and wish lists." *Proceedings of ISCRAM* (2014).

³⁹ Starbird, Kate et al. "Rumors, false flags, and digital vigilantes: Misinformation on twitter after the 2013 boston marathon bombing." *iConference 2014 Proceedings* (2014).

⁴⁰ Andrews, Cynthia, et al. "Keeping Up with the Tweet-dashians: The Impact of 'Official' Accounts on Online

rumors that spread on Twitter during two different incidents: a terrorist attack and a rumored plane hijacking. The study demonstrated that denials from official AO social media accounts are widely propagated by online users and can slow or stop the spread of rumors. These two cases demonstrate that the social media users value the voices of official AO accounts, and that they deem these accounts credible in regards to incident rumors. They also underscore the need for proactive community engagement prior to an incident and a speedy response to any and all misinformation—a rumor can take off quickly and officials need to detect and address these rumors as soon as possible to stem their flow.

The timeliness of communication necessary to influence rumors is first predicated on having accurate and timely information related to incident operations, identifying misinformation early, knowing where to look for rumors, how to effectively communicate with those spreading them, and having the authority to do so. These can be difficult to align. For example, to influence a rumor posted in a member-only Facebook Group, AOs will need to join the Group with their personal Facebook account. This raises concerns with public record keeping and public disclosure that have not been settled in safety-critical situations.

Likewise, identifying and communicating with social media users affected by an incident, as opposed to the generally much larger social media crowd sharing information about an incident presents similar challenges. Effective engagement of affected populations via social media demands a continuity of communication, knowledge, procedures and personnel that can be difficult to maintain during an incident. During the 2010 Deepwater Horizon Oil spill Response, 1% of tweets using #Oilspill on Twitter were about the use of chemicals used to disperse the oil. However, a high percentage of those Tweeting about their use were Gulf residents concerned about possible health impacts to themselves and their families. Among this sub-group of social media users, signs of emotional distress and concern increased over the course of the response. Researchers documented several miscommunications between concerned locals and response accounts that represent missed opportunities to relieve the distress these local individuals felt.⁴¹ Conversely, when social media is integrated into a comprehensive community relations strategy,

Rumoring." *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. ACM, 2016.

⁴¹ Starbird, Kate et al. "Social media, public participation, and the 2010 BP deepwater horizon oil spill." *Human and Ecological Risk Assessment: An International Journal* 21.3 (2015): 605-630.

it can be a powerful tool for aiding community response and recovery.⁴² Such a strategy includes tailoring social media communications to the affected area, continuity in response personnel capable of timely communication, and social media policies that are adaptable to address community information needs, communication styles, and preferences of those affected.

A major underlying challenge to increasing interaction with the public via social media is how resource intensive it can be. Many AOs lack the resources or manpower to fully do so. Others do not prioritize public communication through social media.

5.3 Social Media Challenges and Opportunities

Alert Originators: There is limited research on the number of AOs that utilize social media as part of their official alert and warning strategy, however, there is considerable evidence that local, state, and federal agencies do integrate platforms such as Twitter and Facebook into their toolkit of warning strategies. For example, a large number of National Weather Service regional weather forecasting offices use Twitter to relay timely information about imminent threats in addition to their more traditional warning products that are released via the Internet and emergency alerting services. Furthermore, local public health agencies nationwide have adopted Twitter to deliver vital warnings regarding public health emergency information during recent outbreaks.

Technical integration of social media into alerting systems varies, but is not widespread at this point. AOs who are using social media to complement other means of alerting the public typically do so by negotiating multiple technologies in quick succession. Virginia Tech has implemented a one-step system for getting alerts out through multiple channels. However, in most cases integration it is not one touch.

Social Media Platforms: Several social media developers have experimented with and implemented features that are specific to incidents, including alert functionality.

- Facebook launched Safety Check⁴³ in 2014, a feature they activate during a major incident. The first use in the U.S. came in the wake of the Orlando nightclub shootings but Safety Check has also been activated after the series of terror attacks in Paris in November 2015 as well as for Tropical Storm Ruby, which struck the Philippines in

⁴² Dailey and Starbird. In review.

⁴³ "Facebook Safety Check." 2014. Retrieved 18 June 2016. <https://www.facebook.com/about/safetycheck/>

2014. When Facebook identifies individuals who are likely to be in a crisis-affected area, when the user logs in, an 'I'm safe' box appears on their screen. After clicking 'I'm Safe,' all their Friends are then alerted of their safety. Individuals can also tag friends as potentially crisis affected. Those friends then get the same 'I'm safe' box. In 2015, 950 million people had checked in or experienced a friend do so.⁴⁴ Safety Check has been activated after the series of terror attacks in Paris in November 2015 as well as for Tropical Storm Ruby, which struck the Philippines in 2014. This reach is achieved in spite of the fact that Facebook's geo-targeting is not exact.⁴⁵ Facebook chooses which incidents to implement Safety Check. Criteria for doing so are not public. Facebook has however tested whether to allow users to initiate Safety Check.

- Nextdoor enables individuals who are confirmed to live within a specified neighborhood to compose an Urgent Alert⁴⁶ to share with others in their geographic neighborhood. Neighbors may choose to see Nextdoor Urgent Alerts via text message (SMS), email, or through push notifications on a mobile app. AOs who participate on the platform may also send Urgent Alerts to targeted areas.
- Twitter has an Alerts⁴⁷ feature that has been in beta testing with government organizations and NGOs from across the globe. Individuals can sign up to receive Alerts from about 100 organizations at present. Alerts are visually distinct from Tweets and can be received via SMS or push notifications. Twitter Alerts are also preferred algorithmically, allowing a Twitter Alerts message to be displayed near the top of a subscriber's timeline regardless of chronology. Introduced in 2013, it has not been expanded to include any additional organizations beyond those that launched with it.

User Dependent Diffusion: AOs wishing to use social media for alerts and warnings are reliant on the patterns of diffusion that occur on them. Information is only diffused if users elect to pass messages on. That is, the most common way that AOs use social media as a means of pushing

⁴⁴ CBS News. "Facebook activates Safety Check after Orlando nightclub shooting" June 12., 2016

<http://www.cbsnews.com/news/orlando-nightclub-shooting-facebook-safety-check-the-pulse/>

⁴⁵ Hoff, Todd. "How Facebook's Safety Check Works" High Scalability, November 14, 2015.

<http://highscalability.com/blog/2015/11/14/how-facebooks-safety-check-works.html>

⁴⁶ Grady, Kelsey. "Nextdoor Releases Urgent Alerts for Neighborhoods Nationwide" Nextdoor, April 3, 2012.

<https://Nextdoor.com/press/20120403/>

⁴⁷ Twitter. "A step-by-step guide to Twitter Alerts" Retrieved 18 Jun. 2016.

<https://about.twitter.com/products/alerts/how-it-works>

out information is similar to how one would use a broadcast medium. It is somewhat at odds with how information is typically shared. Social media provides consists of more pull platforms than push platforms. In general, the user must be tuned in to the technology to receive an alert. Alerts are by definition designed to capture a person's attention, therefore, they must break through the individual users routine and help them to recognize that they are at risk. This is extremely difficult to do because most people live their lives believing that they are not at risk. Most individuals do not receive official warnings, rather, they get alert and warning information from friends, family and colleagues. However, research has shown that people are more likely to respond when the message is confirmed by people they know and trust.⁴⁸ Thus while messages do not diffuse widely on social media unless users choose to forward them, there is reason to believe that people who receive messages from those they know are more likely to pay attention to them and may be more likely to take protective action. This alone should encourage every AO to integrate social media into their alerting strategy.

5.3.1 Technology Constraints

In this section we note a few aspects of social media technology that are particularly impactful for alerting use: short or terse message lengths, algorithms that shape the visibility of content on each platform, potential security issues that may occur when social media is embedded into other alerting technologies, and sustainability concerns due to the rapid rate of technological evolution.

Terse Messaging: Some social media platforms, such as Twitter, restrict content length. Researchers have found that content constrained messages generally do not deliver enough information for individuals to understand the threat or know what to do in response.⁴⁹ AOs using short messaging channels need to consider alternatives to the one shot message that has been the common practice to alert the public. Three possible solutions have been suggested to overcome these issues: 1) include a .gov web link that will direct individuals to additional information on the official organization's website, 2) send a sequence of messages rather than one single, short message, 3) embed an image as part of the tweet to deliver additional content.

⁴⁸ Vihalemm, T., Kiisel, M., & Harro-Loit, H. (2012). "Citizens' Response Patterns to Warning Messages." *Journal of Contingencies and Crisis Management*, 20, 13–25.

⁴⁹ Bean, Hamilton, et al. "Comprehensive testing of imminent threat public messages for mobile devices." *College Park: National Consortium for the Study of Terrorism and Responses to Terrorism* (2014).

http://www.nccpsafety.org/assets/files/library/Imminent_Threat_Public_Messages_for_Mobile.pdf

Research on retransmission of constrained messages has led to the identification of key messaging content that, when included, increase or decrease the likelihood of being passed on within the social network.^{50 51 52 53} Importantly, this research points beyond the technological capacity that exists within social media to highlight the design and construction of effective messages themselves. In other words, the technological capability may exist, but the AOs, including public information officers or other communicators, must know how to effectively craft a message in order to increase either its retransmission or to persuade individuals under threat to take action. Content that increases retransmission include descriptions of the hazard and the actions that should be taken, use of an instructive or imperative voice, and include a hashtag. Content that decreases message retransmission include directed messages and the inclusion of an URL or web link.

Invisible Algorithms: Social media developers influence the visibility of messages on their platforms. These algorithms are considered proprietary secrets and subject to change without notice. For example, Facebook users may elect to follow a local government’s Facebook page where they may see posts made by government workers. But agencies may be uncertain if their messages reach all of their followers or when exactly they are visible to the AOs are more certain that Direct Messages sent to selected individuals on Facebook and Twitter (as opposed to those sent publically as general posts) are received without delay. This is anecdotal. Given the importance of timeliness in diffusing alerts, better understanding of how diffusion occurs when different social media strategies are employed is important.

Security: The technological integration of social media with other alerting technologies already in use could expedite the diffusion of alert messages. A few AOs, including Virginia Tech, are moving to one touch solutions that diffuse alerts through multiple technologies. One touch systems, however, can increase the risk of widely diffusing misinformation should such systems

⁵⁰ 2015 Jeannette Sutton, C. Ben Gibson, Nolan Edward Phillips, Emma S. Spiro, Cedar League, Britta Johnson, Sean M. Fitzhugh, and Carter T. Butts. (2015). “A Cross-Hazard Analysis of Twitter Warning Messages.” Proceedings of the National Academy of Sciences. 201508916.

⁵¹ 2015 Jeannette Sutton, Emma S. Spiro, Ben C. Gibson, Sean Fitzhugh, Britta Johnson, Cedar League, and Carter T. Butts. "What It Takes to Get Passed On: Message Content, Style, and Structure as Predictors of Retransmission in the Boston Marathon Bombing Response." PLoS ONE 10(8): e0134452. doi:10.1371/journal.pone.0134452

⁵² 2015 Jeannette Sutton, Cedar League, Tim Sellnow and Deanna Sellnow. “Emergency Public Health Messaging in a Disaster Event: Content and Style Factors for Terse Messages.” Health Communication. 30(2): 135-143.

⁵³ 2013 Sutton, Jeannette, Emma S. Spiro, Britta Johnson, Sean Fitzhugh, Ben Gibson, and Carter Butts. “Warning Tweets: Serial Transmission of Warning Messages during a Disaster Event.” Information Communication and Society. 17(6): 765-787.

be compromised. Thus, integration of technologies must consider mitigating technologies and procedures to reduce that risk.

Sustainability: The dynamic nature of social media and the continued evolution of their potential uses raise questions regarding the sustainability of policy, procedure, and technological integration by AOs. Agencies are encouraged to adopt and plan for social media integration into a larger, cohesive messaging and alerting strategy that identifies social media by stakeholder audience and objective, rather than naming platforms and aligning their exact strategies to functionality that may be subject to change without notice.

6 Findings and Best Practices

Social media plays a significant role in disseminating information to the public during an incident. This role has the potential to grow in at least two directions:

- 1) Social media can be augmented into other alerting tools through technological integration,
- 2) Social media can be integrated into the alerting process and procedures.

Nearly all stakeholders that touch these paths can initiate potential improvements.

6.1 Complementary Alerting

People are now accustomed to receiving their information via a wide array of communications channels. Mobile devices are only one of several apparatus people use for communications, which include multiple communications channels themselves: basic phone calls, SMS texting, email, social media apps (i.e. Facebook Messenger), FM radio, and other apps. Individuals' communication channel preferences are also dynamic as new methods, devices, and platforms become available. If alerting is to be successful, a wide and growing variety of channels must be used to reach the public. Yet, using an array of channels for alerting can create complications, for example:

1. Contradictory information could create confusion and even jeopardize lives,
2. Alerts could become too repetitive, which could subject recipients to alert fatigue,
3. Activating multiple alerting channels could be confusing and complicated for AOs during very busy periods.

To be complementary and create leverage for EAS and WEA, alerting methods must work together in a coordinated fashion. When leveraged properly, the use of an array of alerting channels, in addition to EAS and WEA, can produce significant benefits:

1. Alerts can be delivered in a more timely manner,
2. Specific geographic areas or groups can be targeted,
3. A second source of alerts can be provided, which social science studies show is necessary to motivate people to take action. “When warning information is received, most people try to verify what they heard by seeking out information in another warning message or from another warning source or person,”⁵⁴
4. Redundancy and resiliency for alerts can be provided which is particularly important during an emergency,
5. Use of multiple pathways and distribution methods can mitigate bandwidth issues.
6. “Many-to-one” methods could be facilitated for Public Safety officials to rapidly receive and accumulate feedback from the public concerning developing incidents. Using an array of channels for alerting can may offload data traffic from wireless networks if those channels are accessed from devices other than the mobile device; this could and make more bandwidth available for point-to-point communications. However, if users access the array of channels from the mobile devices, this will add to the traffic on those networks possibly resulting in added congestion of the wireless networks. Coordinated alerts via different channels can provide opportunities for distribution of messages that encourage information sharing by individuals. As leverage concepts catch on, development of two-way communication solutions would emerge.
7. Credibility for alerts in general could be built as the public understands they originate from trusted sources using multiple channels. The more alerting is used effectively, the more effective alerting will become.

⁵⁴ Communication of Emergency Public Warnings: A social Science Perspective and State-of-the-Art Assessment
Dennis S. Mileti/John H. Sorensen; August 1990

With no major change in structure, many of the benefits can be obtained, as well as complications mitigated, through an existing initiative - FEMA's Integrated Public Alert and Warning System (IPAWS). IPAWS already offers controlled routing for EAS and WEA. Using the Common Alerting Protocol (CAP) standard, IPAWS facilitates EAS and WEA alerts by accepting CAP-compliant alerts from authorized AOs using approved vendor solutions. IPAWS then provides switching that helps ensure that EAS and WEA alerts are received in a timely manner by their distribution channels. Radio and TV then disseminate EAS alerts and mobile carriers disseminate WEA.

However, IPAWS can facilitate even more alerting channels through a little known capability called the IPAWS All Hazards Information Feed. Any authorized communications channel, whether intended primarily for alerting or other purposes, can monitor the feed then disseminate alerts to targeted audiences. This could expand channels used for alerting dramatically to the point alerts could become ubiquitous. Since the expanded alerts would flow through a single system, they would be coordinated and originate only from authorized AOs. A profound effect on alerting, thus public safety, could result.

6.2 Social Media

We found and summarized best practices and lessons learned that AOs can build upon, with the caveat that these best practices are still evolving:

- Know who is, and who is not using specific social media platforms in your community,
- Assume that social media is a partial solution to understanding and reaching the public and should be utilized as a supportive and complementary tool,
- Be aware of potential biases in social media data, analysis, or inferences derived from it,
- Adopt and plan for social media integration into a larger, cohesive messaging & warning strategy that identifies social media by stakeholder, audience, and organizational objective,
- Have a social media policy that allows flexibility in utilizing many different social media platforms and makes it easy to adopt new technologies as they emerge and as organizational objectives and goals require,
- Understand the general expectations, norms, etiquette, and behaviors of each social

media platform – Twitter, Facebook, Nextdoor, Periscope, Instagram, Reddit, etc.,

- Select specific social media platforms for particular communication activities – media monitoring, media relations, rumor patrol, breaking news, geo targeted messages, etc.,
- Use social media for community engagement and expectations management of affected areas,
- Monitor social media for situational awareness and to foster a common operating picture with partner agencies,
- Maintain an informed, stakeholder-centric social media presence during non-emergencies,
- Follow news media and other community influencers on social media so they can help spread relevant and timely messages during all phases of incident management,
- Include maps, videos, photos, audio, links to articles, press releases, or other live communications channels with your social media messages,
- Learn how to write effective, persuasive messages that leverage the affordances of social media to increase self-protective action among those who are at risk,
- Determine the goal of your social media communication - different goals require different message strategies, different platforms, and different resources,
- Educate your stakeholders, both internal and external, about what types of communication they may expect from your organization through social media,
- Treat social media policies as living documents that will likely need to be updated every few months to stay relevant,
- Assure social media policies are proactive, responsive, and flexible. Further, endeavor to write policies and procedures that are prescriptive (provide good information on what to do) and not restrictive (provide information on what is not permitted) of agency users. Encourage influential social media users to learn more about emergency response through formal means like Community Emergency Response Teams (CERT) programs, and informal means such as direct communication and coaching over social media,
- Empower internal stakeholders, such as employees and volunteers, to be stewards of

good information through proactive fact-checking and information sharing,

- Define and visualize what effective social media engagement, monitoring, alerting, archiving, analysis, and other goals look like to your agency and share these expectations.

7 Recommendations

7.1 Complementary Alerting

Recommendation 1: Working Group 2 recommends that the use of IPAWS be expanded, through outreach and education initiatives among (a) practitioners, (b) channel proprietors, (c) organizations that support people with disabilities, limited English proficiency and older adults, and (d) alert vendors. IPAWS is at the center of opportunities for alerting strategies to complement EAS and WEA. In addition to providing the conduit for EAS and WEA alerts, it provides a means for orderly activation and dissemination of alerts using a wide variety of alerting channels. While use of IPAWS has grown substantially in recent years, significant potential remains.

Practitioners: Working Group 2 recommends that FEMA’s Emergency Management Institute (EMI) create and sustain a training program designed to educate local and state practitioners on the proper use of the IPAWS system, Imminent Threat alerts and other public safety alerting categories that may be added. As practitioners become more familiar with these capabilities and how it can help leverage EAS and WEA, its use will expand. Plus, awareness will increase within their communities, which could prompt additional channel proprietors to use the Feed for alerts.

The number of state and local authorities authorized to originate alerts via IPAWS has increased markedly in recent years. Over 720 organizations had received IPAWS alerting authority as of May, 2016. (A list can be found at <http://www.fema.gov/media-library/assets/documents/117152>). More jurisdictions should be encouraged to apply to become IPAWS alerting authorities per state guidelines. Most WEA alerts have originated from the National Weather Service or the National Center for Missing and Exploited Children, and not local practitioners.

Broadcasters (All Media): In its current state, IPAWS offers a means for jurisdictions to send

alerts to WEA and EAS. Public safety can be enhanced significantly as more alerting channels become part of the IPAWS eco-system. Among other things, expanded use helps exploit the original intentions of the Common Alerting Protocol (CAP), a standard designed to facilitate execution of alerts via WEA and EAS and other channels using a common language. Expansion of alerting channels through IPAWS can be accomplished by the IPAWS All Hazards Information Feed, a mechanism for organizations to monitor and retrieve IPAWS alerts over an Internet connection. When an organization identifies an IPAWS alert that is pertinent to its audiences, it can disseminate the alert using its own channel(s). Organizations currently authorized to monitor the All Hazards Information Feed include Facebook, Public Broadcasting Service, and The Weather Channel.

FEMA and the FCC should work to increase awareness of the All Hazards Information Feed among channel proprietors. Again, this may best be accomplished through revised and intensified training offered by FEMA through EMI. By stimulating more organizations to disseminate alerts through IPAWS, the channels used for alerting could be expanded dramatically advancing a concept that alerts could become ubiquitous. Since the alerts would flow through IPAWS, this method would maintain the authoritative nature of the messaging without the inclusion of additional, language.

Organizations that support people with disabilities, limited English proficiency and older adults: FEMA has made a concerted effort to encourage use of the IPAWS All Hazards Information Feed for the purposes of supporting people with disabilities, limited English proficiency, and older adults. Among accessibility solutions currently working to provide alerts via IPAWS: DeafLink (sensory disabilities), Max Smart Homes (deaf, blind or low visibility, Cognitive Mobility), Safety Labs (older adults, cognitive, autistic, assisted living, independent living), Convo (deaf), Rockin' Robots iRescue (older adults, cognitive-search and rescue), ECHO Minnesota - Twin Cities Public Television (Limited English Proficiency), consistent symbols for IPAWS event codes (See Recommendation 4). Outreach should be increased to (1) make people who can benefit from alerts through accessibility solutions aware of existence of such alerting capability, and (2) encourage more accessibility solutions to become involved with IPAWS.

Vendors: IPAWS alerts originate from interfaces provided by commercial alert vendors, thus vendors are critical to the success of IPAWS and complementary alerting strategies. Alert

vendors should be encouraged to be active participants in pursuit of leverage for WEA and EAS and complementary alerting strategies. Changes may be required to vendor interfaces to accommodate use of more channels. As well, vendors could facilitate many-to-one feedback. In any event, interfaces for feeding alerts to vendors should be easy to use for practitioners with a single launch point for multi-channel messaging.

Recommendation 2: Working Group 2 recommends that the FCC, broadcasters, the wireless industry, device manufacturers and AOs support radio and TV initiatives to complement alerts. Wireless networks struggle to handle increased usage that occurs during emergencies like Hurricane Sandy and the Boston Marathon Bombing (“Why Cell Phone Networks Fail in Emergencies,” Bloomberg Business, April 16, 2013). While WEA is designed to use cell broadcast that minimizes the impact to cellular networks, Radio and TV through legacy, new and emerging services can also help to provide emergency information and help to offload cellular network bandwidth issues during a serious event.

Radio: Wireless carriers and mobile device vendors are enabling more and more devices with FM capability; introducing such capability in additional devices will enhance public safety. Functioning FM radio on smartphones provides consumers with ~~two~~ several separate information infrastructures in their pockets – the cell broadcast based WEA and “apps” and streaming services over the cellular infrastructure, and the analog FM infrastructure (Additionally, the FM radio platform supports up to four independent channels including EAS, Radio Data System (RDS), hybrid radio and digital radio alerts.)

It is recommended that the FCC encourage the ongoing voluntary efforts between device manufacturers and the wireless industry to toward enabling FM radio in smartphones to the extent commercially viable for all parties.

Having access to terrestrial FM radio broadcasts, as opposed to streaming audio services, may enable smartphone users to receive broadcast-based EAS alerts and other vital information in emergency situations – particularly when the wireless network is down or overloaded. Access to FM radio via a smartphone requires use of a wired headset or earbuds for an antenna. Not all radio stations are regularly providing information that is supplementary to WEA alerts. However, listening to FM radio broadcasts extends battery life by up to six times when compared to streaming audio (Sprint/NextRadio study, July 2013), and is not contingent upon the availability of wireless networks. Thus, a smartphone with FM radio may be an emergency

information source for longer periods of time when the power is out or when the wireless network is unavailable.

Finally, WEA messages often direct recipients to tune to local media, so having an activated FM radio on the same device that receives the WEA message will enhance the recipient's ability to receive complimentary alerting messages. Working Group 2 further recommends that local broadcasters be encouraged to complement the WEA broadcast by providing more information about the alert for the duration of the alert.

Television: Working Group 2 recommends that the FCC convene a panel of experts including ATIS, AOs, device manufacturers, and the wireless industry to study the potential for leveraging television to improve accessibility to emergency information and alerts. Television may also offers opportunities to mitigate bandwidth issues and expand the reach of emergency alerts. The emerging ATSC 3.0 Next Generation Television all-IP standard uses more rugged encoding and can deliver alerts to a variety of devices. The AWARN Alliance was formed in April by leading broadcasters, consumer electronics manufacturers, and other technology companies to leverage Advanced Emergency Alerting capabilities built to the ATSC 3.0 Next Generation Television standard. Alliance members own nearly 400 TV stations that reach approximately 85% of U.S. households. <http://awarn.org/>

Recommendation 3: Working Group 2 recommends that AOs and other entities communicate with each other as well as their stakeholders when alerts are issued. One possible avenue for doing so is through use of IPAWS COG-to-COG system. A Collaborative Operating Group (COG) is a term used by IPAWS to designate organization(s) responsible for coordinating emergency management

or incident response activities, including alerts. COGs are usually formed by government, but private sector representatives may also be COG members. Participation could include:

- Public safety practitioners
- Organizations made up of critical infrastructure owner operators
- Groups that support people with disabilities, older adults, and those with limited English proficiency
- Community partners (schools systems, etc.)

The COG-to-COG service offered by IPAWS facilitates messages among individual COG members, as well as among multiple COGs. While information shared is not necessarily restricted to alerts, COG to COG communications can be particularly helpful at a time when alerts are issued.

Recommendation 4: Working Group 2 recommends that the FCC collaborate with ATIS, AOs, CMSPs and other stakeholders to develop internationally accepted and promoted symbols for communicating types of alerts. The IPAWS program, working with regional and global standards organizations and stakeholder participants, should proceed to adopt a consistent set of symbols for the IPAWS event codes that complement and support public alerts & warnings. These symbols could be used by a number of communications channels used for alerting. For example, hybrid radio as described above could broadcast symbols when WEA/EAS or other alerts are issued via IPAWS.

These symbols should use a consistent framework and treatment structure specific to symbols for public alerts and warnings. They should be free of language-specific text and be easily understood by a broad population. The adopted symbols should be aligned with the DHS Geospatial Management Office's existing symbology efforts to ensure alignment and community acceptance across local, state, tribal, and Federal levels in coordination with the National Alliance for Public Safety GIS Foundation's national symbol set and guideline (<http://www.napsgfoundation.org/all-resources/symbology-library/>). The symbols should be tested for effective use in GIS or location-enabled decision support tools commonly used by the emergency management community and any other commonly used public alert and warning applications.

Recommendation 5: Working Group 2 recommends that FEMA include concepts presented in this report in its agenda for the IPAWS Subcommittee to the National Advisory Council as established by the Integrated Public Alert and Warning System Modernization Act of 2015.

Recommendation 6: Working Group 2 recommends that FEMA publish and aggressively distribute best practices document(s) that support leverage concepts recommended. Include best practices for leveraging alerting channels in IPAWS training course (IS-247). Encourage inclusion of complementary alerting concepts in State EAS Plans.

Recommendation 7: Working Group 2 recommends that the FCC support FEMA's efforts to

strengthen the IPAWS infrastructure. The IPAWS infrastructure should ensure a fully robust, redundant and highly available system of systems for the rapid dissemination of public information and warning in response to manmade and/or natural disasters

Recommendation 8: Working Group 2 recommends that local and federal public safety agencies, who are beginning to build and release their own non-WEA, public safety apps, be encouraged to develop minimally viable solutions (MVS) that are CAP compliant and integrate easily into other platforms for sharing of information. In trying to keep up with the fast pace of technology, AOs often try to build apps and other technological solutions that are very comprehensive and robust. Using MVS concepts, more simplistic solutions will allow quick deployment, giving constituents a product in hand. This approach focuses on keeping code simple, testing often, and delivering functional bits of the application as soon as they are ready. It promotes adaptive planning, evolutionary development, early delivery, and continuous improvement, while encouraging rapid and flexible response to change.

7.2 Social Media

Recommendation 9: Working Group 2 recommends that social media platforms be integrated into other alerting technologies. AOs should identify operational improvements for better integration into alerting procedures and protocols. Technological integration of social media into “one touch” solutions is another thing to consider, but would necessitate algorithmic improvements to the status of identified alerts on native social media platforms. Increased technological integration of alerts could amplify security and public safety issues should an alerting system be compromised. However, since some AOs and technology developers who support them are already moving in this direction, this seems an expedient direction for improving timely spread of alerts in the near term.

Recommendation 10: Working Group 2 recommends that the FCC investigate potential improvements in the manner in which alerts are digested by complementary alerting platforms. An IPAWS application programming interface (API), such as using CAP, that focuses on standardizing ways that social media applications receive alert information and manipulate/use WEA data points would allow new technologies to easily and seamlessly integrate with WEA, IPAWS, and future systems. This would obviously be important for alerting technologies and social media applications (like Twitter) that have their own alert platforms, but would also improve and standardize the integration of IPAWS and alert originator data points into products

that could reference alerts as well (e.g. Facebook “Safety Check” pulling data from a relevant alert issued in a given area). Similarly non-handset APIs can be developed by technology developers to customize how social media users receive alerts. Technology developers should more-appropriately streamline the user experience, provide more consistency, and improve the development of appropriate emergency-specific technologies. While creation of a non-handset, user-choice focused API would be no small undertaking, the long term rewards across stakeholders make it worthy of consideration. It would also be beneficial for users if there was consistency across platforms (beyond social media) in how users opt in/opt out of alerts, confirm areas of geographic interest, etc.

Recommendation 11: Working Group 2 recommends that the FCC and FEMA encourage alert originators, software programmers, and designers to work toward better procedural integration of emergency operation center and public information practices. AOs can use these “stitching” technologies, to link to articles, press releases, or other live communication channels. Diffusing alerts through social media brings those messages into a rich communications ecology. Social media are widely and frequently used. Importantly, they support many types of interactions including both gathering information from the community (many-to-one) and feeding that back to the community (one-to-many). These capabilities can make alerting more effective— when they are appropriately integrated into operations in a way that is responsive to the context of operation.

Recommendation 12: Working Group 2 recommends that AOs, alerting software programmers and designers gear their platforms toward a holistic messaging strategy. Social media offer additional avenues for distributing WEA messages. They can also extend the content of WEA messages in important ways because they are a more flexible medium. However, a holistic messaging strategy must be considered in an integrative manner and be adopted at the highest level of the organization. As alerting strategies and technologies evolve, the innovations that take place in terms of complementary strategies should be documented and evaluated. Similar to WEA, social media are sometimes content constrained, meaning that alert originators must take into account effective designs for persuasive messaging. Knowing that a message has been delivered is only the first part of the battle -- increasing individual efficacy among those who are at risk is the end goal to reducing the loss of lives and this means delivering effective messages.

Recommendation 13: Working Group 2 recommends that policymakers support alert generators:

FEMA, through EMI, should provide training and other material resources to help develop context-specific local procedures and policies. Some alerting organizations will have the capacity to build robust in-house social media use. Others will be more dependent on outside resources such as citizen volunteers and media organizations.

- The FCC should convene a panel of academics, social media industry and crowdsourcing experts, and AOs to catalogue best practices and make recommendations on how to make effective use of information obtained from social media and promote data science literacy around social media monitoring. Numerous studies have now documented that it is all too easy to make incorrect inferences based on social media data. Given the increasing popularity of social media as a monitoring tool by government organizations, it is essential that those using it to monitor are aware of potential biases introduced through either the data, the analytical tools used to make sense of the data, and the way analysis occurs. This panel should also consider privacy implications and other ethical issues.
- The FCC should convene a panel of academics, social media experts, citizen journalists (e.g.: The National Federation of Community Broadcasters, The Citizen's Campaign, and The Local Journalism Lab), and AOs to catalogue best practices in crisis communication to social media influencers (and those who would like to be influential). Just as individual alert originating organizations can improve the ecology of crisis communication in their communities by developing relationships with people who are influential on social media in their communities, large organizations such as FEMA can target networks of citizens who aim to take an active role in crisis communication.

Recommendation 14: Working Group 2 recommends that key knowledge gaps be addressed through future CSRIC working groups:

- Monitor and report on the location specific changes to media environments that impact how crisis communication occurs. Capacity of the overall information environment respective to crisis response and recovery should be evaluated for different locales. Public information officers are taking an increased role in many locations as work in newsrooms across the country continue to shed jobs. There is a real possibility that areas

described as “news deserts,” may overlap with less resourced emergency management organizations, thereby exacerbating the challenge of getting timely/accurate emergency information to the public in many locales. The few systematic studies that have been done have not considered demographic, geographic, and other context-specific factors influencing crisis communication.

- Systematically identify barriers to effective use of social media by alerting organizations. Little systematic research has been done addressing the range of capacity, skills, need, and resources across response organizations. The best and most recent survey research available shows a wide variability in policies around social media use, with some 25% of U.S. county emergency management agencies prohibiting its use.⁵⁵ In some cases, this is tied to a culture in an emergency management agency that does not prioritize communicating with the public.⁵⁶ In many cases, it is tied to questions of organizational capacity and skill. Understanding the efficacy of social media for particular organizations will take more than asking if they use social media. It will mean improving understanding of the context in which they operate, the information behaviors of the populations they serve, and the overall resources available to them (e.g. capacity of news organizations in their community to push out alerts).
- Evaluate social media as complementary infrastructure. Local and regional response organizations and media organizations are increasingly reliant on social media platforms in crises because their own web presence may not be able to handle the traffic in large-scale crises.⁵⁷ The seemingly local infrastructures of print and broadcast media are increasingly reliant on Internet-based services throughout their operations.⁵⁸ This raises questions of complementary infrastructure redundancy and local resiliency that deserve further examination.

⁵⁵ Plotnick, Linda, et al. "Red Tape: Attitudes and Issues Related to Use of Social Media by US County-Level Emergency Managers." *Proc. of ISCRAM(2015)*. <http://iscram2015.uia.no/wp-content/uploads/2015/05/8-f.pdf>

⁵⁶ Potter, Emma. "Balancing conflicting operational and communications priorities: social media use in an emergency management organization." Proceedings of the ISCRAM 2016 Conference – Rio de Janeiro, Brazil, May 2016. http://idl.iscram.org/files/emmapotter/2016/1398_EmmaPotter2016.pdf

⁵⁷ Dailey, D. and Starbird, K. "Addressing the Information Needs of Crisis-Affected Communities: The Interplay of Legacy Media and Social Media in a Rural Disaster." In *The Communications Crisis in America, and How to Fix It*. Friedland L. and Lloyd, M. editors. Palgrave MacMillan, 2016.

⁵⁸ Dailey and Starbird. In review.

Recommendation 15: Working Group 2 recommends that the FCC coordinate with ATIS convene a panel of experts including CMSPs, FEMA, AOs, device manufacturers, the wireless industry and other WEA stakeholders to conduct a study of the impact of using social media complementary alerting techniques on commercial mobile network congestion. In times of emergency, wireless network traffic may spike exponentially well beyond the engineered limits (e.g., Boston Marathon bombing). However, CMSPs are expected to continue to provide service to citizens who use their networks for critical communications, including providing a means for the public to reach 911 to report true emergencies; in addition, CMSPs have obligations to provide Wireless Priority Service (WPS) to first responders and government officials in times of emergency. By using social media (or any point to point technology) as a complement to WEA alerts as recommended in this report, the potential exists to exhaust scarce spectrum during the time of emergency even more than it occurs today, since social media establishes a point-to-point “push” data session with users of those services who are located in the emergency area. A study needs to be conducted to strike a balance between sending the proper amount of alerting information versus the use of the licensed wireless spectrum for important emergency use such as WPS, 911 and other uses.

8 Items for Further Discussion

Based on the findings and recommendations of this report, the following items deserve additional discussion before the FCC:

1. Social media and other channels can improve communication of emergency public information to the non-English speaking and Functional Access Needs communities. To that end, these issues should be investigated by future a CSRIC working group.
2. A panel of subject matter experts from the alerting community, the mass notification system developers, and others who may have expertise should be convened to identify and review best practices and technology for devising and implementing system dashboards that enable one-step alert distribution via multiple channels. This might also be an appropriate subject for a future CSRIC working group.

9 Conclusion

Alerting methods have significantly expanded, adding a vast amount of channel options. While

EAS and WEA remain critical alerting channels, they can be made stronger in concert with other methods and channels. To maximize alerting methods, channels need to be truly complementary and work together. Social media can further complement EAS and WEA due to the wide use among the general public and the variety of tools it offers alert originators.

While there are some obstacles, in order to be useful to AOs, social media should be integrated and accepted as part of the alerting process and procedures, with attention to the list of best practices that have been cumulatively developed.

10 Appendix A: Social Media Platforms

This appendix contains a list of major social media platforms used during incidents. This list is not exhaustive.

Platform	Description	Common Practices & Incident Examples
Facebook	Facebook suite of “products” include Profiles; Pages; Messenger; News Feed; Search; Events; Groups; Instagram; Safety Check; and others. Each supports different kinds of crisis communication with different patterns of information diffusion. Additionally, Facebook offers a tool to be used during major incidents - safety checks. The Safety Check feature allows one to let family and friends know they are safe, check on others in affected area, and mark your friends as safe.	Public Agencies monitor Facebook during emergencies and post messages during all phases of crisis. <ul style="list-style-type: none"> • Hurricane Sandy (2012)⁵⁹ • Valley Fire - Lake County CA (2015) • Monson, MA tornado (2011 - present) • Paris Bombings/ Attacks (2015) The Safety Check feature has been used: <ul style="list-style-type: none"> • Nice, France attack • Orlando Night Club shooting • Suicide bombing at Istanbul Ataturk Airport
GoFundMe; Crowdrise	Public fundraising platforms, sometimes known as “crowdfunding”.	Used to collect money for individuals affected by an incident, ad-hoc relief efforts, and efforts by established organizations. <ul style="list-style-type: none"> • Nagorno-Karabakh Crisis (2016) • Flint Michigan Water Crisis (2016)
Instagram	Photo and video sharing site.	Used for morale boosting messages after

⁵⁹ Virtual Social Media Working Group and DHS First Responders Group. *Lessons Learned Social Media Hurricane Sandy*. Homeland Security Science and Technology. June 2013.
<https://www.dhs.gov/publication/lessons-learned-social-media-hurricane-sandy>

(owned by Facebook)	The Instagram community tends to share more polished forms of multimedia, compared to raw images seen on Twitter. The platform does not lend itself to organic network sharing of original content.	emergencies. <ul style="list-style-type: none"> • Paris Attacks (2015) • Belgium Attacks (2016)
Nextdoor	Nextdoor allows communities to create private, geographically specific websites to facilitate communication among neighbors to build stronger neighborhoods. Nextdoor partners with public agencies across the country, providing them with a custom Nextdoor interface that allows them to share important updates and request information/action from residents.	Public agency officials use Nextdoor to prepare residents for emergencies, as a secondary alerting platform and in recovery efforts. Residents use Nextdoor to prepare for and help each other during and after emergencies. <ul style="list-style-type: none"> • Houston TX Flooding (4/2016)⁶⁰ • Valley Fire, Napa CA (10/2015)⁶¹
Periscope (owned by Twitter)	This live streaming video platform was quickly adopted by citizens and journalists after it was introduced in 2015.	Officials use this platform to stream live press conferences during emergencies, as well as monitor crowd-source information at scenes of emerging incidents. <ul style="list-style-type: none"> • Orlando Nightclub Shooting (2016) • Baltimore riots (2015)⁶² • Paris attacks (2015) • Umpqua campus shooting (2015) • Texas Floods (2015)
Pinterest	Pinterest is an online pin board or social bookmarking site. Content shared on Pinterest is driven entirely by visuals. In fact, you cannot share anything on Pinterest unless an image is involved.	Public boards are used by agencies to share preparedness information, or by the public to document and share damages. Private boards are used by responders to quickly share damage assessment photos and other situational awareness information. <ul style="list-style-type: none"> • Oso Landslide 2014
Reddit	User-shared links and	Reddit played a notable role in spreading

⁶⁰ Dreshfield, Anne. "Houston Neighbors Turn to Nextdoor During Extreme Flooding" Nextdoor Blog, April 29, 2016. <https://blog.Nextdoor.com/2016/04/29/houston-neighbors-turn-to-Nextdoor-during-extreme-flooding/>

⁶¹ Abrams, Lemor. "Nextdoor Helped Community Organize In Wake Of Fast-Moving Valley Fire" CBS Sacramento, November 4, 2015. <http://sacramento.cbslocal.com/2015/11/04/Nextdoor-helped-community-organize-in-wake-of-fast-moving-valley-fire/>

⁶² Fichet, E. et al. "Eyes on the Ground: Emerging Practices in Periscope during Crisis Events." Proceedings of the ISCRAM 2016 Conference – Rio de Janeiro, Brazil, May 2016.

	discussions are voted on by sub-community members in this collaborative, user-moderated Internet forum.	misinformation after the Boston Marathon Bombing as users launched their own informal investigation. <ul style="list-style-type: none"> • Boston Marathon Bombing (2013)⁶³
Twitter	Twitter provides communication and connection through the exchange of quick and frequent messages. Users post Tweets, which may contain photos, videos, links and up to 140 characters of text. Messages are posted to the sender's profile, sent to people who follow or are subscribed to the sender, and are searchable on Twitter.	Individuals and organizations use Twitter for situational awareness and to help coordinate response and relief efforts. It is also used by officials as a secondary alerting platform and official source of agency updates. <ul style="list-style-type: none"> • Alabama Tornadoes (2011) • Joplin Tornado (2011) • Paris Terror Attacks (2015) • Texas Floods (2015, 2016) • Dallas Police Shooting (2016) • Nice, France Terror Attack (2016) • Brussels Terror Attack (2016) • Orlando Nightclub Shooting (2016)
Ushahidi; Open Street Maps; SeeClickFix	Collaborative mapping tools which allow residents and officials to add information to a map.	Collaborative mapping tools have become an important resource in response efforts. During non-emergency conditions, it is used to report public works issues, identify and mobilize spontaneous volunteers, and assess damage to critical infrastructure. <ul style="list-style-type: none"> • Haiti Earthquake (2010) • Nepal Earthquake (2015)⁶⁴
WhatsApp (owned by Facebook)	WhatsApp is the largest mobile messaging service with more than 30 billion messages sent daily. ⁶⁵	This mobile messaging service is widely used by refugees fleeing from Syria and elsewhere, destined for Europe. <ul style="list-style-type: none"> • European Refugee Crisis (2015 - present)⁶⁶
Wikipedia	A free encyclopedia built collaboratively using wiki software.	User-generated and user-moderated pages on recent newsworthy events are a major driver of activity on the 7th most visited site on the Internet. <ul style="list-style-type: none"> • Fukushima Daiichi nuclear disaster (2011)⁶⁷

⁶³ Tapia, Andrea H., Nicolas LaLone, and Hyun-Woo Kim. "Run amok: group crowd participation in identifying the bomb and bomber from the Boston Marathon bombing." *Proceedings of the 11th Int. ISCRAM Conf.* 2014.

⁶⁴ Soden, Robert, and Leysia Palen. "Infrastructure in the Wild: What Mapping in Post-Earthquake Nepal Reveals about Infrastructural Emergence." *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 2016.

⁶⁵ "How Many People Use 1000+ of the Top Social Media, Apps and Digital Services (May 2016), DMR Stats Gadgets. <http://expandedramblings.com/>

⁶⁶ Specia, M. "WhatsApp offers lifeline for Syrian refugees on journey across Europe." Mashable, July 3, 2015. <http://mashable.com/2015/07/03/syrians-europe-whatsapp-refugees/>

⁶⁷ Keegan, Brian C. "Emergent Social Roles in Wikipedia's Breaking News Collaborations." *Roles, Trust, and Reputation in Social Media Knowledge Markets* (2015): 57-79.

<p>Blogs, liveblogs, chat rooms, forums, Google Drive</p>	<p>Social media and other networked information and communication technology (ICTs) that enable a connected crowd to do information work together</p>	<p>Documented use in crises going back to September 11, 2001. Utilized during all phases of an incident.</p> <ul style="list-style-type: none"> • 9/11 • Hurricane Katrina⁶⁸
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Table 4 – A General List of Social Media Platforms

⁶⁸ Shklovski, I., Burke, M., Kiesler, S., & Kraut, R. (2010). Technology Adoption and Use in the Aftermath of Hurricane Katrina in New Orleans. *American Behavioral Scientist*, 53, 1228–1246.