

WEB 2.0 EMERGENCY APPLICATIONS: HOW USEFUL CAN TWITTER BE FOR EMERGENCY RESPONSE?

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ABSTRACT

Twitter is a free, platform-independent, Web 2.0 communication application that allows users to send short (up to 140 characters) electronic messages to other individual users and user groups. Twitter users can send messages to one another via most internet-enabled devices capable of text messaging. This new and unique service offers great potential for rapid and integrated response to disasters. We explore the upsides and the downsides of this free service as a modern communications tool in the hands of disaster response professionals, government agencies, crisis management organizations (CMOs), organizations, and victims of disasters.

CONCEPTS

“An axiom in geography is that "Hazards are threats to humans and what they value" (Harriss, Hohenemser, and Kates, 1978:6); hence if people or their goods are not "in the way" of powerful geophysical or climatological agents, there is no hazard, because there is no one there to be threatened. Extending this theme, hazards don't exist as things in and of themselves; rather, they are created by people who place themselves, and that which they value, in places that are subject to climatological, geophysical or technological extremes. They are the products of particular social, political, and economic decisions that are made either without sufficient knowledge of the environment, without the capacity to make different decisions, or are made with some calculation or hope that "it" (flood, earthquake, wildfire) won't happen in a timeframe that will negatively affect the decision-maker.” – (Mcentire et al, 2007; 77)

“Without a doubt, the clearest and most consistent role of mass media in a disaster is...passing on warnings. Warnings are effective only if they are specific about what to do and - because persons hearing a warning from one source are inclined to check with another - they are effective only if they come from all possible sources...Since one source used to check is the media, an effective warning must come through the media as well as other channels.” – (Mcentire et al, 2007; 80)

"Disaster research has shown that victims are not dazed and confused and in shock but instead do most if not all of the initial search and rescue. It has shown that panic is so rare it is difficult to study and that the real problem is not panic but an unwillingness to believe the clearest possible danger warnings.” – (Mcentire et al, 2007; 105)

“This principle of *decision-making on the ground* assisted intra-agency coordination, in that it created a ‘division of cognitive labor’ (Hutchins 1995), which prescribed who should make which type of decision. The principle appears to embody a realization of the value of recognition-primed decision-making in emergency management (Flin 1996); allocating task-oriented decisions to those with direct perceptual access to the situation, rather than on the basis of seniority.” – (Mcentire et al, 2007; 47)

“Disaster communications used to be very top-down, hierarchical and linear where public officials and experts were the one who pushed the information out... Now we have these new kinds of citizen communications tools that are decentralized, flat and lateral, creating the potential for a brand new way of communicating altogether.” – (Sutton, 2008; 1,2)

KEYWORDS

Crowd-sourcing, human networks, real-time online communication, critical information, online benevolent culture

INTRODUCTION

According a February 2009 PEW Research Center report based on information collected from December 2008, 11% of American adults use an online applications such as Twitter.com to send and post status updates (Pew, 2009). The American demographic that uses these types of online applications does not appear to be strongly skewed – the median age of a Twitter user is 31 (compared to 27 for MySpace.com, 26 for Facebook.com, and 40 for LinkedIn.com) and the population of online users seems to be racially and fiscally diverse (Pew, 2009; 1). More than 75% of Twitter users use the Internet wirelessly – either on a laptop with a wireless connection, or via PDA, handheld or cell-phone (Pew, 2009; 1). This is a good beginning point for a highly flexible and powerful emergency broadcasting, information retrieval, and communications system. We propose Twitter is already, and to an even greater extent, could become such a system, especially with more fine-tuning, investment and development, especially in the areas of network reliability, general ease-of-use, and network security. Twitter also has the potential to become a centrally-operated tool for crisis management organizations (CMOs), municipal, state and federal government agencies and other organizations involved in disaster response and recovery. Some have

remarked that there can be no better use for Twitter than communication during emergencies. It does not necessarily follow that Twitter is a good communications vehicle, but without a doubt its best and most important implementation is rapid communication in time-pressured and information-critical situations. Twitter.com recently (February 2009) received approximately \$32 million in venture capital funds to come up with a product that generates revenue (on top of circa \$25 million of prior investment). Twitter.com has yet to unveil a long-term profit scheme. We don't know whether Twitter can generate revenue from building a robust broadcasting system. But we do know that such a system is possible and would be useful and that further technical product development is necessary to realize this objective. The current product is partially viable as such a system, but a more powerful and reliable online communications network is necessary to move forward. In any case, Twitter is probably the closest thing we have at the moment. Therefore, throughout the paper we will be presenting Twitter as a disaster communications vehicle while examining ways it could improve as such a vehicle.

TWITTER.COM BACKGROUND

Twitter is a relatively new online application. So new in fact, that it wasn't used by anyone during the Hurricane Katrina emergency, because it didn't exist yet. Twitter was launched in July 2006, beginning as an intra-company experiment at Obvious Corporation (San Francisco), as a research and development project with the thought of aiding coworkers to communicate at work (Stone, 2008). It remains one of the San Francisco Bay Area's most famous Web 2.0 start-ups. One of the first breaking media stories that brought Twitter to the public eye concerned a UC Berkeley graduate student (James Buck) who used Twitter to free himself from imprisonment in Egypt in April 2008 (Tompkins, 2008). After the arrest of Buck and his translator at an anti-government protest in Cairo, Buck sent the concise SMS (short-message service) message "Arrested" to all the followers of his Twitter account from his cell phone while in the backseat of a police vehicle. Within forty-eight hours, contacts and attorneys affiliated his university arranged for his release (Tompkins, 2008). Buck had been introduced to Twitter only days before his flight to Egypt. This is merely one instantiation of communication where potentially millions of 140 character tidbits of information can be sent during an emergency by those involved. (Inspired by his experience using Twitter, James Buck has been working directly with Twitter's founders to develop an independent emergency communications system (Tompkins, 2008).)

Twitter is the highest traffic website of its kind and at latest count there are more than 3 million subscribers to Twitter.com worldwide. Twitter experienced an approximate 900% growth in 2008 (Nusca, 2009). At its inception, Twitter was a one-of-a-kind Web 2.0 application, achieved by essentially combining blogging, instant messaging and short messaging service (SMS). Twitter wasn't intended or designed for high performance communication, but the idea that it could be used for emergency communication certainly was not lost on the originators. "Biz Stone, co-founder of Twitter, says he and others knew that the service could have wide-reaching effects early on, when the San-Francisco, California-based company used it to communicate during earthquakes" (Simon, 2008). Much like another web phenomenon, Wikipedia, its content is generated by its users. In this way, Twitter becomes a form of an "open-source" *news network* (Wilson, 2008). With Twitter working in tandem with SMS, information and communication becomes mobile. By combining people at their computers with people on the move on their cell phones and PDAs, Twitter facilitates real-time group communication that never existed

before. The question remains of course, to the extent that this communication is almost limitless: Is an open-source news network a good thing? This is, of course, a very complex question to answer. Immediate benefits can be seen in the availability and economy of free information, but issues arise in the areas of privacy and security, for instance.

Because Twitter is a popular website for people to go to when they want to connect with others over the web, it becomes a centralized information and news marketplace. Anyone tuned into Twitter can get information from the public Twitter sphere (what is colloquially known online as the “Twitter-verse”.) Twitter has serious advantages over other types of communication technology in that it combines SMS messaging with the Internet so effectively. However, it has significant shortcomings: it is not streamlined for high performance communication and it experiences *significant* downtime in its network: around 1-2%. (Stone, 2008). Twitter.com is slowly moving forward with its product quality as potentially competitive projects spring up (Tompkins, 2008). Projects, like that of James Buck, or InSTEDD, are in the works to build a more robust online service specifically designed for emergency communication (Tompkins, 2008). However, it is not just the software of a service like Twitter.com that allows for integrated disaster response but also the emergent ‘*benevolent*’ culture of ‘Twitterers’ that will make it effective. By benevolent culture, we refer to the very apparent willingness of people online to share, search for, and relay information on the internet and the Twitter.com network. In this way, Twitter allows for the “democratization of headline news” and emergent social behavior such as *crowd-sourcing* which can be useful to perform tasks and improvise during emergencies (Ingram, 2008).

FEATURES OF TWITTER.COM SERVICE AND NETWORK

- » Free service. (Although standard cell phone texting charges apply).
- » Twitter messages are read online (at Twitter.com or other websites) via feeds, or on cell-phone interfaces. Every user has their own feed, but feeds can also be viewed based on keywords. Feeds are accessed on the Twitter.com site as well as other sites that ride on the Twitter API (Application Programming Interface). Updates can be read and sent via cell phone.
- » During a recent 24-hour worldwide sampling, the Twitter.com website accounted for 56% of all tweets that were recorded, IM and txt (SMS message), accounted for 8% and 5% of all tweets respectively, with third-party online software accounting for the remainder (Catone, 2008).
- » Twitter.com API is opened up to allow syncing of foreign applications that support different feed views, IM, and search capabilities.
- » Text messages sent over the Twitter network stay queued until delivered, unlike landline or cell phone calls which often fail to go through, especially when cellular networks are overloaded during disasters and other big events.

» *Hashtags* are a user convention for including searchable context and metadata to each 'tweet' (Messina, 2007). For instance, Twitterers responding to a certain event or topic will include hash-tags such as #SanDiegoFire or #LAFire in each post, usually at the beginning or the end of their message, in order for other users to find information regarding the fire using character string search tools such as *Summize*, *Tweetscan*, or to receive automatic updates using the Track feature which they can initialize from both computer and cell phone (Messina, 2007).

» *Summize* is a search engine for Twitter content. Twitter acquired Summize.com and its software for \$15 million in early 2008 (Arrington, 2008). Using this search engine, a user can find any messages that contain a subject such as "China + earthquake".

» Twitter supports a "track" feature. By simply sending '*track [keyword]*' to Twitter.com by IM or SMS, a user is able to receive real-time updates from across the Twitter-verse that include the searched for subject. This feature is very useful for people to obtain filtered information and automatic updates. As an example of the track feature: Twitter can help people find each other during a disaster. The Red Cross provides instructions on how to register with Red Cross's nationwide "Safe and Well" database of missing and found people, simply by typing "follow safeandwell" (keyword) after dialing 40404, Twitter.com's 'number' (Wagner, 2008).

BENEFITS OF LOW BANDWIDTH AND SMS ROUTING

According to Twitter co-founder Biz Stone, Twitter was inspired by the short 'away messages' on instant messenger programs. In designing the web-based software, they limited Twitter messages to 140 characters primarily because of the 160 character limit of text messaging, leaving 20 characters for a name in front of the message over cell phone SMS (Stone, 2008). This 140 character limit also helped ensure that Twitter messages ("Tweets") would work "more seamlessly with different technologies, such as RSS" (Stone, 2008). As one of the more recent arrivals on the social networking front, Twitter has a reputation for being a fairly reliable news source, although it is faced with large skepticism by non-users (Wilson, 2008). A practically limitless amount of concise messages can be received and sent by anyone on the network. Thus, the only theoretical limitations will be the processing speed and power of human receivers. Numerous psychological studies show what we might expect, text based visual information can be processed by a receiver much more rapidly than voice communication, such that a person acting as a hub at a 'data center' or in a management position could not receive or process ten phone calls at one time or in one minute, but can receive and process ten 140 character Twitter messages in less than a minute, even if the messages are delivered at the same time (Hilton, 2001).

One of the main advantages of the Twitter software is the reliability of packet-based text information. Not only are Twitter messages required to be concise, but those small packets of information are generally more likely to get from computer to cell phone and from cell phone to computer and from cell phone to cell phone. Text messages stay queued until delivered, unlike landline or cell phone calls which often fail to go through, especially when cellular networks are overloaded - "SMS is a store and forward method, therefore if the end user is not available, the mobile unit is powered off, or the unit is outside a service area, when the unit comes back on line the message will appear. A SMS message can also be sent

"certified," where it will notify the message originator of the end user's receipt of the message" (ActiveXperts, 2008).

During the months after the Boxing Day Tsunami in Southeast Asia (2005), "bloggers began discussing the potential for SMS text messaging as a tool for first responders" (Carvin, 2008). The idea was that SMS was generally the most reliable communication vehicle as it's often the last technology standing during disasters. For example, during Hurricane Katrina, mobile phone calling and email became unreliable due to heavy traffic and damage to infrastructure. Satellite phones were and are very uncommon. However, text messaging will often prevail, as it requires little bandwidth and is designed to be re-routed around disrupted areas within a network, and remain queued until delivered (Carvin, 2008).

BENEFITS OF DISTRIBUTED INFORMATION AND DECISION MAKING

Crowd-sourcing is "a neologism for the act of taking a task traditionally performed by an employee or contractor, and outsourcing it to an undefined, generally large group of people, in the form of an open call" (Wikipedia- 'Crowd-sourcing'). Crowd-sourcing is exactly what can occur when CMOs and other related organizations make announcements to the public, (in our case to the Twitter-sphere), regarding a state of emergency. When a CMO-type organization announces a state of emergency with specific or detailed information, via Twitter, Twitterers share that information within the network and respond, often rapidly and innovatively, to create solutions and to perform tasks that *need to be done by the public on a volunteer basis*. Twitterers can become highly adaptable because they have a strong connection to information and are autonomous, sometimes merely exchanging and relaying information, sometimes physically involved in relief operations upon hearing of specific information. As victims, Twitterers may be persuaded to take certain actions to take themselves, their families and their possessions out of harm's way (Palatino, 2008).

W. David Stephenson, an expert on disaster management and homeland security, points to the powerful effects of distributed decision-making and is a strong advocate of Twitter and other Web 2.0 applications (Stephenson, 2008). He suggests that disaster response strategy is at its best when it is out of control, when information retrieval and exchange is 'democratized'. This so called 'out-of-control' system "generates the creativity, flexibility, and public involvement needed to respond to rapidly changing, unforeseeable circumstances" (Stephenson, 2008). Researchers such as Stephenson recognize the benefits of improvisation in disaster response, and acknowledge that disasters require innovation and rapid adaptation. According to the National Institute for Strategic Preparedness, "half a million people evacuated lower Manhattan following the attacks of 9/11, largely by the improvised conduct of ferry owners and others with boats; in New Orleans, in response to the flooding after the levees breached, the Coast Guard improvised by collaborating with the "Cajun navy", consisting of private fishing boats and other vessels responding to citizens isolated by the flooding in the city. In both instances, the improvisation resulted from what disaster response researchers call emergent organization or emergent behavior" (Stephenson, 2008). Stephenson points to Web 2.0 technologies, particularly mobile social networking applications such as Twitter, as promising tools for organizing communication to enable emergent behavior in the wake of disasters. Disaster management professionals should watch closely to what will happen when more organizations provide workers and subscribers with the Web 2.0 tools and

the freedom to play an active role in management and decision-making during disasters. According to Stephenson and others, the wildfires in the fall of 2007 around San Diego were one of the first disasters where people used a wide range of Web 2.0 applications to respond to the disaster, a mainstay being Twitter (Wagner, 2008).

CRITERIA FOR A 21st CENTURY EMERGENCY COMMUNICATIONS SYSTEM

How Twitter.com Compares

Here we enumerate what we personally consider eleven fundamental criteria for a 21st century general emergency management and communications system. Currently, the most common communication channels used in crises are e-mail, SMS, voice self-service, live assisted service and proactive automated outbound calls (Grubner, 2008). These remain independent and largely nonintegrated communications channels. This contrasts with what we might envision a broad integrated platform to be. An ideal communications *platform* or *service* should be (1) web-based; (2) low-cost, power efficient and scalable; (3) easy to use or accessible; (4) mobile; (5) reliable; (6) fast; (7) one-to-many capable; (8) GIS capable; (9) capable of analytic and management visualization tools; (10) strongly connected with local TV, radio channels and news outlets; (11) able to receive, generate, provide, and usher *useful* and *critical* information from a variety of sources.

- (1) The Internet is a marvelous technology that allows rapid information sharing. An ideal 21st century emergency communication network should be web-based or at least have a component that is web-based. Twitter.com of course is a web-based service. In so being, it does suffer from crashes, the common network ailment during peak usage. This problem needs to be surmounted. Constant and rapid uploading of information through its website needs to be provided at all times, especially during emergency events. If the network is not reliable outside of emergencies, less people are likely to rely and use it, and this undermines its potential. During a disaster, a crash is of course fatal to using the network entirely.
- (2) Losing power in remote areas is devastating to any electronic communications device. Twittering requires little nominal power from cell phones and cellular network enabled PDAs and nominal power usage from a running personal computer. Twitter provides network users access to information that they wouldn't be able to receive when power is down (and therefore most TV and radios and local information networks are down). Twitter users and every electronics user worldwide would benefit from any advances in battery technology that increases battery life and efficiency of mobile electronic communication devices.
- (3) *Ease of use* is very important in order to achieve *scalability* for Twitter.com; these go hand-in-hand. In order for Twitter to be most useful, it needs to be adopted by a critical mass of people. To some extent, the more Twitter users, the better. Twitter accounts are free; creating an account is easy; becoming functional is only a matter of, at most, a few minutes in many cases. As stated, scalability is important for Twitter because the power of Twitter lies greatly in the multitudes of Twitter users and in proselytizing the few, but important people who will voluntarily assume the role of information hubs during disasters (for example, see Mr. Nate Ritter of San Diego in relation to the San Diego fires of 2007). Because of the power of human networks, the information can be rapidly exchanged on the Twitter network.

(4) Cell phones are mobile, and ubiquitous, cell phone coverage is not. Smaller local networks are sometimes necessary in situations where cellular and satellite coverage is unavailable-, for instance, handheld radios (“walkie-talkies”) In this case, Twitter and web based communication might be overlooked. (For highest performance, Twitter users would have phones on both cellular and satellite networks and also such Internet connections.)

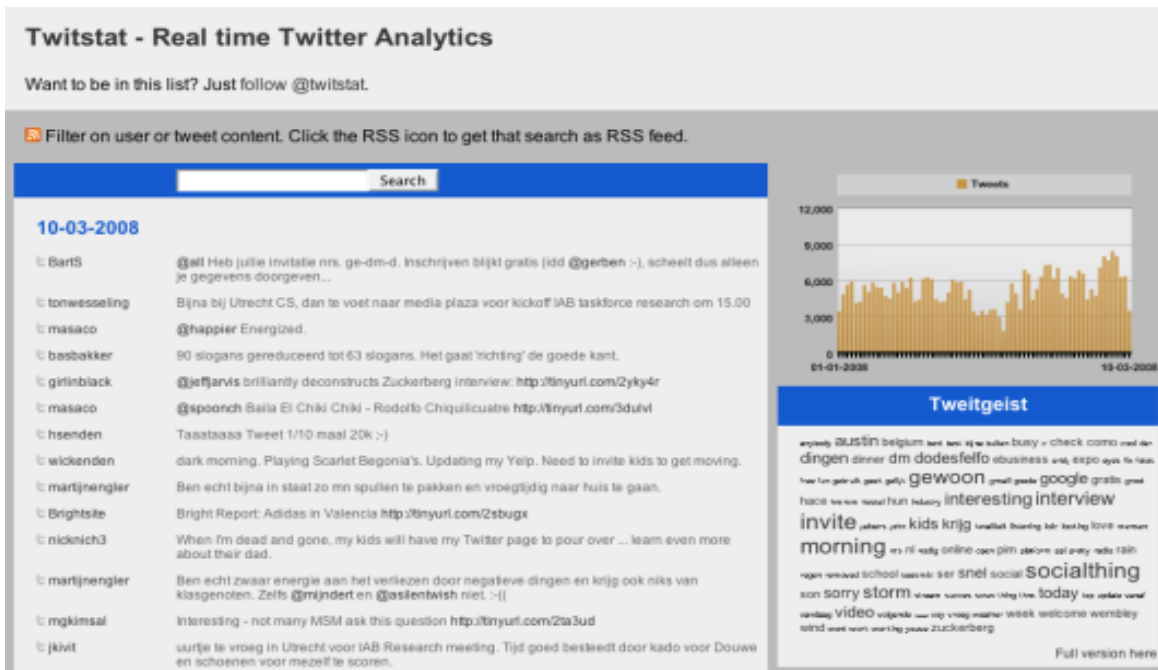
(5) *Reliability* of the communications network is vital. What is common is that networks fail under duress because of the high traffic during large events (Stephenson, 2008). Unfortunately, Twitter does not seem to be an exception. It does however depend largely on lower bandwidth SMS messages rather than voice connections- SMS will very often go through when calls do not. At the moment, Twitter.com experiences downtime even in non-events (around 1-2%), which is unacceptable and translates to roughly 3-5 whole days of downtime per year (Gabarain, 2008). Twitter.com is currently working to improve its infrastructure and software to produce a more robust system and reduce downtime to more acceptable levels, in the last year they received help from high-performance website designers Pivotal Labs (Eldon, 2008).

(6) Twitter is no enemy to quick communication, and is a great way to keep messages short and concise. Founder Biz Stone emphasizes this characteristic of Twittering. “No subject, no body, one line, you just do it. Decisions up front are potentially distracting” (Stone, 2008).

(7) Many forms of electronic communication are *one-to-many* capable including email, SMS, and automated phone systems. Twitter is also a great way to get short messages out to many phones and web addresses. Pre-existing networks of people on Twitter will be able to share information immediately during the beginning stages of a disaster.

(8) *Geographic information* can be vital in disaster mitigation. CMOs, disaster relief and response organizations, and civilians need to know the answer to the question “Where?” Twitter immediately lacks some functionality in this area. Some web programming gurus have created a Web 2.0 “mash-up” between GoogleMaps and Twitter. This application allows Twitter users to see where other Twitter users are on GoogleMaps, and currently comes in three flavors, *TwitterMap*, *TwitterVision*, or *GeoTwitter* (Clarke, 2008). Another project developed by Where.com includes a widget created for mobile phones allowing a GPS coordinate to be included with each tweet (Zatz, 2008). However, a powerful, streamlined and integrated geographic information system for Twitter does not appear close at hand.

(9) Twitter itself does not provide outright tools to *visualize information*, whether geographic or other, but a variety of applications can be synchronized with Twitter in order to provide these capabilities. *Visualization tools* will be very useful for CMOs and other types of emergency mitigation or management organizations including network diagrams, visual statistics, (also visual-geographic information), and other visual-analytic tools. *TweetStat*, *TweetVolume* and *TwitStat* are three *very* basic visualization tools, showing message volumes versus time, top responders, top phrases or keywords, and recent tweets containing searched-for keywords (Nathan, 2008). These features are not far-reaching or powerful enough for professional use. However, as long as the information is available for online analytic software to use, we should expect analytic programs to pop up from independent developers.



(10) Twitter does not have a strong immediate connection to *radio and TV channels* with the exception of information being transferred to the Twitter network by users themselves. However, any sort of connection to mainstream media and non-web based technology that streams in data may be unnecessary or even impossible to actually incorporate into Twitter.com. The very nature of Twitter is a simple network of people sharing text-based information over the web. The inclusion of actual sound files and video files to the network will quickly eliminate some of the inborn advantages of Twitter.com communication. Nevertheless, information drawn from TV and radio channels is often vital, and during disasters, Twitterers will transfer that information to the Twitter network. This provides an important connection to mainstream media. As stated, actual inclusion of radio and TV sound and video files and the bandwidth that goes with it undermines some of the benefits of using the simple and light-weight Twitter network.

(11) The *usefulness of the information on the network* is more important than anything else; without useful information, none of the other features of the communications system would make up for lack of useful content. After the following summary table, we provide instances of usage and dependence on the Twitter network for information during emergencies.

How Twitter matches with our ideal emergency communications system

Ideal Network

Twitter.com Network

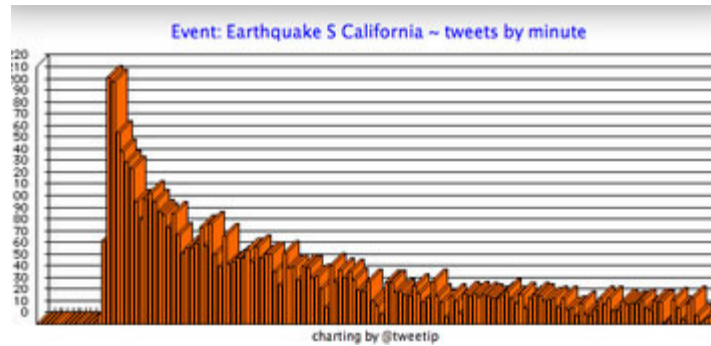
<p><i>Low-cost</i></p>	<p>Twitter is free. Twittering with SMS is not- see typical texting charges. Requires owning and powering a computer and/or cell phone (with</p>
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	monthly service fee rates; low-energy requirements for cellular use (less than phone calls)).
<i>Easy to use</i>	It takes a matter of seconds to create an account and to understand how to use Twitter on the web; using SMS takes more time and configuration. All that is needed is a computer with an internet connection or a networked cell phone.
<i>Scalable</i>	Twitter can accommodate millions of human players in the system. The only foreseeable limit is the amount of followers per person. Facebook.com has a limit of 5000 “friends” per user because of the computing/server power required to maintain Facebook.com. Twitter is under similar theoretical constraints (Stone, 2008).
<i>Mobile</i>	Twitter can be used from anywhere on earth with a satellite, cellular or wired connection.
<i>Reliable</i>	The information network should not fail at any time- Twitter’s network is far from fail-proof.
<i>Fast</i>	Twitter messages are received within seconds- and messages are concise. “ <u>W</u> hen a second user takes an original tweet and forwards it, it’s referred to as “re-tweeting” — a process that enables a very fast flow of information between mobile devices as well as computers”(Sutton, 2008).

<i>One-to-many</i>	Twitter allows quick one-to-many communication, just like email, phone-trees etc.
<i>GIS capable</i>	Twitter does not yet have high-powered GIS or GPS capabilities but some very basic features are in place already.
<i>Visualization tools for emergency management</i>	Twitter does not yet have good visualization or analytic tools/software for users to visualize network information, statistics, or geographic information of users and disaster sites. Possibility for inclusion of global coordinates in 140 character messages.
<i>Usefulness of network information</i>	Twitter provides a wealth of mostly unfiltered information. Information can be filtered by keyword searches. (Summize, Tweetscan, Track). Most information is unaccountable – but large quantity and diversity of information is readily available.

USAGE OF TWITTER.COM NETWORK DURING EVENTS

According to Twitter.com, Twitter usage noticeably spikes during disasters and other large events. People use Twitter during emergencies at levels far above average, and we can probably induce this is often for personal information and personal safety (statistics concerning total number of users or messages sent at any time or time interval are not disclosed by Twitter.com).



Southern California Earthquake, 2008 A

Three general phenomena have occurred so far in the use of Twitter in emergency communications: (1) Large relief organizations such as the Red Cross or AmeriCares, local and municipal governments and state agencies, and various other organizations with concern for the public, disseminating critical updates and information to all their Twitter subscribers as information comes in to the organization from the field. (2) Individual and independent Twitter users who do not belong to larger organizations giving real-time news updates and first-person accounts of disasters, resulting in the phenomenon of complex systems of people, solving problems during emergencies without reliance on long-standing/pre-existing organizations (what we have referred to as *crowd-sourcing*). (3) Crisis management organizations and relief operations using Twitter.com to communicate *within* organizations during relief operations, using it as a form of organizational management and communication tools. At times, for any given event, we see instances of all three (although the third case is probably the least common and certainly the least documented.)

California Fires

Almost every year California experiences wildfires, usually during late summer and fall when the grasses away from the coast become dry. In 2007, "Twitter was amazingly useful" in distributing information to people affected by fires in Los Angeles and San Diego Counties (Wagner, 2008). In San Diego, three Twitter feeds had been particularly useful for fire updates. One feed was published by KPBS News, the others published by two San Diego residents and Twitter users, @NateRitter and @Viss (Wagner, 2008).

New England Ice Storm (December 2008-January 2009)

In December 2008, a severe ice storm hit New England and the state of New Hampshire. PSNH (Public Service of New Hampshire) is an Electric Utility that supplies much of the state, which was hardest hit by the storm, with electricity. PSNH needed to communicate with its customers while regional power was out. "The Public Service of New Hampshire used Twitter to keep customers informed. In the midst of a Dec. 11 ice storm, unprecedented in its destruction, Martin Murray, senior corporate news representative for the Public Service of New Hampshire, reached beyond the typical telephone customer service lines and press conferences. In doing so, he found the most effective way to provide news to customers was to bypass the media and give it to them directly, 140 characters at a time. The ice storm left more than 400,000 homes and businesses without power, about 322,000 of which were customers of Public Service of New Hampshire, the state's largest electric utility company. To inform customers what the utility was doing to address the outages, Murray turned to Twitter. There he posted details, both from the office and

the field, such as where outages occurred, what the utility was doing to address the situation and which outages would be addressed first. Since Murray's corporate news office runs 24/7 during a crisis, Murray or his colleague Matt Chagnon provided a constant stream of tweets. In nine days the utility's Twitter following grew from about 100 to nearly 1,900, with followers ranging from NHPR, New Hampshire's public radio station to Web-savvy 20-somethings to a middle-aged couple in a rural part of the state. "We were shocked that our followers were responding to us from their phones, from coffee shops, from their friends' houses where they went to recharge their batteries," says Murray. "They were eager for news." Using social media enabled PSNH to proactively and directly provide information to customers, as well as emergency responders and the media. "It's at the point where we almost don't need to use press releases," says Murray. The value of that steady stream of information, as well as the dialogue that it sparks, cannot be measured, says Murray. "It keeps us engaged with our customers in a way that previously wasn't possible". he says. And there are some tangible results. After the storm, Murray switched from using Twitter's standard tinyurl link format to bit.ly (both URL shorteners), which allows users to track the number of clicks they receive. Since doing so, Murray has been shocked at the traffic PSNH's links are generating. For instance, when PSNH posted a link to its investigation of its response to the ice storm, more than 10,000 people followed the link. "People are engaged with us in a whole new way," he says." (Ragan, 2009)

Sichuan Earthquake (2008)

The "Great Sichuan Earthquake" occurred in May 2008, just a few months before China was to host the 2008 Beijing Olympics, killing nearly 70,000 people. Twitter users in and near the Sichuan province of China who first felt the earthquake reported the tremor on Twitter, beating the first official USGS report by more than two minutes (Gabarain, 2008). Two minutes is of course not an extraordinary amount of time. What it did provide people outside the affected area was the knowledge and ability to look for information about the earthquake immediately. Perhaps these people had relatives or friends who were directly affected by the earthquake. Reliance on mainstream media outlets alone, such as television and radio, may be too little too late as it may take several to even twenty four hours for a disaster to be reported on the TV, radio or in newspapers (O'Brien, 2008). It may only take 15 minutes for online news media to publish stories after an event, such as an earthquake has occurred. This certainly takes some of Twitter's advantage away, but also shows that the information on the Twitter network should be of no less average quality than the information of online journals and media within the first few minutes of a disaster, because the information is often coming from the same sources (O'Brien, 2008).

Gulf of Mexico Hurricanes (reoccurring)

The eminent threat of a hurricane often provides potential victims with at least several days warning. In the case of hurricane Gustav, the National Hurricane Center (NHC) predicted how strong the hurricane would be once it made landfall in Haiti, the Dominican Republic, Cuba, and the United States (Berger, 2008). *One of the most potent effects of Twitter usage during these hurricanes that hit the southern coast is providing an urgency and encouragement to evacuate the areas prior to danger* (Janega, 2008). Twitter provides a vehicle for person-to-person (connecting neighbors and strangers) communication and allows people to keep in personal contact with many different people prior to the arrival of the hurricane. "The fearful weather reports about Hurricane Gustav did not persuade Sheila Moragas to leave Old Jefferson, a suburb just west of New Orleans. It was the 38-year-old mother's dwindling ranks of online friends on the micro-blogging network Twitter" (Janega, 2008). This type of behavior suggests that people will often

remain indifferent to alarmist national and regional warnings from mainstream media, but will respond through conversation with other people, especially if they are proximate, they feel they can trust. Twitter provides a network of informed, interested, and potentially highly trustworthy people willing to share information, their thoughts and their current actions.

Cyclone Nargis in Myanmar

Cyclone Nargis hit the Burmese coast on May 2, 2008 and caused major destruction and nearly 150,000 fatalities. “Burmese bloggers have been using Twitter to give updates and reports about the situation in Myanmar...The Twitter account: @MBS or @MyanmarBlogs, provides useful links to recent news articles and blog posts about the relief efforts, donation information details and other eyewitness accounts of the continuing tragedy in Myanmar” (Palatino, 2008).

Mississippi Department of Transportation – Hurricane Season Preparedness

“Mississippi Department of Transportation officials will use the micro-blogging platform Twitter to relay information to evacuees during the upcoming Atlantic hurricane season, (which started June 1 (2009)). During hurricane season, the department's tweets will provide short, concise updates on the best evacuation routes. MDOT has created six separate Twitter feeds to provide route-specific traffic information to evacuees traveling on interstates 10, 20, 55 and 59, and U.S. highways 49 and 98. All are major hurricane evacuation routes. Transportation officials had been discussing ways to provide instant updates during hurricanes, including traffic delays, fuel availability, contra-flow information and road openings. MDOT Outreach Division staff members will feed information to Twitter and when the updates are posted, it will go directly to Twitter. Evacuees who have signed up to receive route-specific updates will receive information instantaneously. ‘Utilizing this system will give MDOT the ability to not only get information directly into the hands of Mississippians evacuating, but also to evacuees from Alabama and Louisiana,’ Larry Brown, MDOT's executive director says.” (Brown, 2009)

DISCUSSION: FOR THE FUTURE

One of the biggest moves Twitter has made was to make its API public. Since that decision, there have been hundreds of software programs designed to work on top of Twitter. As a result, there have become a variety of ways to interact with Twitter, which creates more traffic for the website (Stone, 2008). Opening up the API allowed for greater creativity in creating external applications, but has not made Twitter more powerful or streamlined alone. For professional emergency management purposes it would probably be more effective for Twitter to be a complete all-in-one service, where everything could be accessed right at Twitter.com. This might be accomplished if Twitter were to acquire the rights to many of its most useful third-party applications. Notice that Twitter has acquired Summize and some other third-party tools that it found essential. However, Twitter.com probably cannot afford to spend the \$15 million it spent to acquire Summize on a continual basis, whether to acquire third party software or to run internal development (this lack of funding also has security experts worried about the state of network security at Twitter.com, some calling for a complete security revamping – see the following section). One main conclusion we draw is that Twitter has never been very focused towards any one type of communication, let alone an ‘emergency broadcasting system’. It so happens that its features fall in line with such a thing. However,

perhaps mostly for want of external funding, it has not seen the development many people would like to see, including those who would like to see it developed for use in more professional arenas.

At the moment, for quick news updates, Twitter acts more like a grassroots source of information than anything else (Gabarain, 2008). The fear is that as it becomes more mainstream, the accuracy and candidness of individual reports on Twitter will get interspersed with marketing, one-sided accounts, and even spam (Gabarain, 2008). However, some studies have assuage those fears: “One of the biggest concerns shared by those in emergency management is that there’s going to be a lot of rumor in the information that’s posted through these types of social networks...Instead, from what we’ve seen so far, the information is actually self-correcting” (Sutton, 2008; 1,2). With Twitter, there is potentially more information than any other information network, but the variability in quality, and the sheer quantity may make it difficult to manage and harness. This quantity of easily accessible information also poses problems for network security and threats to the privacy of users on Twitter.com.

Information and Network Security and Privacy on Twitter

One enormous issue with many online networks such as email or Twitter is the dual issue of security and privacy. In becoming a popular online network and opening its API to third party developers it inevitably brought on security and privacy issues that many online networks face. There are two broad categories of problems: problems that arise from the legitimate use of the service in unwise ways (generally *privacy* issues) and people taking illegitimate or unauthorized action through the service (generally *security* issues). Thus far, issues of security and privacy have not severely reduced user numbers and new user uptake and Twitter is widely accepted in the corporate workplace. However, a few large breaches of security on the network have occurred and are cause for major concern. A leak happened in May 2009 when a hacker’s “dictionary” attack captured a Twitter employee’s password gaining access to some Twitter corporate documents (Lowensohn and McCarthy, 2009). (Earlier phishing attacks in late 2008 brought access to passwords to a few Twitter users’ accounts, including several celebrities.) These incidents could happen to any targeted Twitter user, not only a Twitter employee or a Hollywood celebrity. These threats can be overcome by imposing a requirement of strong passwords for all Twitter users and possibly limiting the number of failed logon attempts or imposing time penalties for failed logon attempts to Twitter.com. However, there is a clear tradeoff between ease-of-access and security, which goes not only for Twitter.com but all online services that people use regularly for which they may have common passwords, even sharing the same password with Twitter. Consequently, if a hacker acquires the password for a Twitter account, one of the main problems is that they may now have access to that user’s bank accounts, PayPal accounts, or any number of highly sensitive password-entry websites. Undoubtedly, one of the largest sources of threat is the fact that for most Twitter accounts anybody can choose to follow a users updates. Users must actively remove other users from receiving their updates. This means that if a user tweeted “Going camping for the weekend”, or as relates to disaster response “Evacuating today”, the user could be inviting a burglary, since a user cannot necessarily account for everyone who will see their posts. This type of privacy issue is broad, but easily understood.

Issues that can arise with people simply posting to or using Twitter:

- » Spam
- » It's very easy to trick somebody to visiting a URL you control via Twitter, due to the use of link

shorteners (such as TinyURL and Bit.ly), and the culture of sharing links. Tricking people to visit sites they don't know the provenance of is a frequent first step in attacks such as phishing or cross-site request forgery (XSRF).

» Impersonation (especially of celebrities).

» Other members of one's social graph sharing more than they should about you (the Facebook equivalent of someone tagging you in photos you don't want to be associated with).

» People being able to infer more than they should from your social graph alone (from a graph, you could guess where a user may live, where they work, where they went to college, etc.)

Twitter also has a number of security issues that almost all web applications are vulnerable to:

» 'Phishing' attacks which aim to steal people's passwords. These are compounded by the fact that people tend to re-use passwords across services, so even if a non-twitter password is compromised, this can often be leveraged into access to twitter accounts.

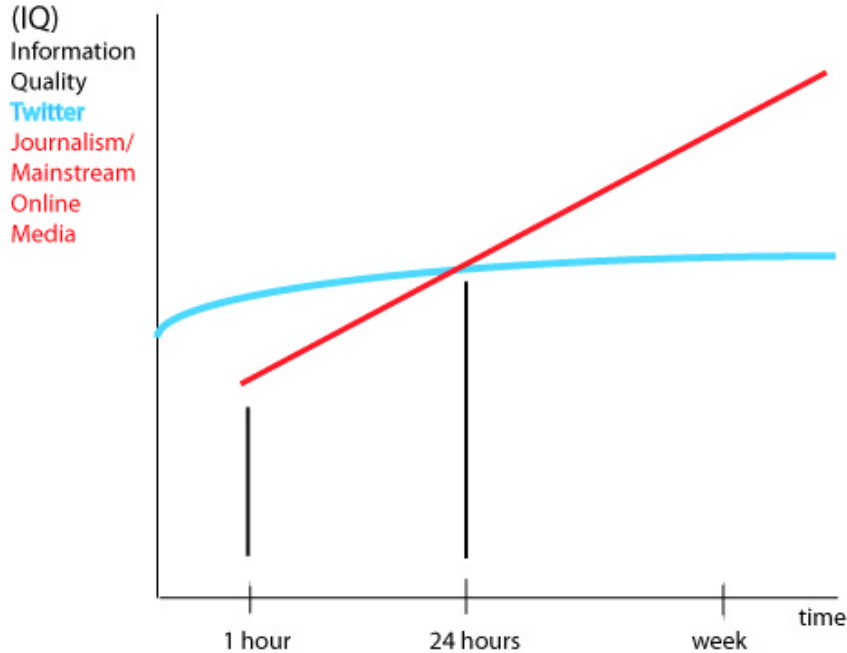
» Worms use Facebook as a method of transmitting (send a copy of yourself to all your friends). Worms in the future will certainly broadcast themselves via Twitter.

» Twitter has to be careful about cross-site scripting (XSS) and cross-site request forgery (XSRF), which are ways for an attacker to take over a web browser by posting malicious content to a third-party web service you're viewing, such as Twitter.

Many of these issues are general symptoms of online networks. Protecting the privacy of its subscribers is one of several large issues that Twitter is confronted with. Network security is perhaps the most important area where Twitter needs to improve if it wants to play a role in large organizations, including being used by CMOs or the public sector, working in disaster management.

Information Reliability and Quality

If we lump together information reliability and accuracy along with relevance and usefulness for (red) average mainstream media (including online journalism) and (blue) Twitter.com, for the average citizen affected during a disaster, we might arrive at something like the figure below. The rudimentary figure reflects that within the first hour of an emergency, using Twitter for information retrieval is almost essential (if a user needs any information within minutes to an hour). Within 24 hours, mainstream media “catches up” to the *average level of information quality* on the Twitter network. After a week, during the stage of what would be for most disasters recovery, relevant information pertaining to 2nd and 3rd wave responders may be found perhaps with greater reliability in mainstream media and special information outlets, although we would never doubt that trawling Twitter.com for information from those in affected areas might provide critical information to 2nd and 3rd wave responders. Although large quantities of valuable information, such as finding hotline or direct phone numbers for professional organizations could be found on the Twitter network more easily than anywhere else, complex ideas, the weighing of pros and cons, and decision analysis, are difficult to express in 140 characters or less and may be better found by looking to mainstream media or directly to professional organizations.



InSTEDD project

One emergency management and communications project involving Twitter will be a project funded largely by Google and developed by the non-profit InSTEDD (Olsen, 2008). “The project, called Innovative Support to Emergencies, Diseases and Disaster (InSTEDD), is a nonprofit organization that ambitiously aims to help communities around the world use Web and communications technology to identify and warn others of outbreaks like Avian flu or disasters like Hurricane Katrina. The technology will be aimed to coordinate rescue responses and help save lives during nascent stages of emergencies, according to Eric Rasmussen, the president and CEO of InSTEDD. One such application will be the so-called Twitter-bot framework, which Rasmussen says will bridge Web services and phones with a location-detection feature linked to a layer in Google Earth. For example, Rasmussen could send a message via SMS on his phone, which might only have one signal bar of service, regarding a patient with untreated symptoms in Laos. That message could then be broadcast to anyone subscribing to his messages, including aid workers at UNICEF or InSTEDD’s headquarters in Palo Alto, California. This message could show his location and note on a GoogleEarth map (Olsen, 2008). ‘We can send an SMS message onto GoogleEarth in an emergency center, and it sees a dot with a color-coded response, with my name and date. Right underneath that, there’s a button that says reply, and (aid workers can send a note that says) ‘we have the resources you need 2 miles north’ -- Suddenly there’s a two-way conversation using nothing but a cell phone with one bar (Stephenson, 2008).’ ” Twitter.com is a simple, but powerful piece of Web 2.0 software, yet we may have to wait for well-funded commercially independent projects such as InSTEDD to come to fruition in order to fully capitalize on the communication capabilities of a web-based technology like Twitter.

CONCLUSION

Twitter is being called the “new first draft of history” by bloggers excited about its potential (Journalism being of course the ‘old’ first draft) (Ingram, 2008). Twitter allows us “to compare notes with more than a million people around the world in real time in a way that’s searchable, reusable, relinkable, which has never been possible before” (Kuo, 2008). However, as InSTEDD project leader Eric Rasmussen notes: “We've learned that going one layer in social networking is reliable, but two layers isn't.” Twitter is not yet seen as reliable, deep or broad enough to meet the information needs of professional organizations, more likely to rely on professional reporters, not unsubstantiated accounts from ordinary citizens (Olsen, 2008). We prescribe Twitter for what it’s especially good for, providing information not covered on radio and television, such as details and first-hand accounts within moments of an event, anywhere in the world. There is no other medium that can compete with Twitter in that arena. However, at the present time, it is nowhere near a complete emergency communications system and is not particularly useful for management purposes. For the moment, we recommend it strongly for civilian use during disasters to find information useful to them, especially using keyword searches. We also highly recommend that civilians in disaster prone areas create an account and become familiar with how Twitter can be used during emergencies, and to become followers of local news networks and other likely sources of information during an event. We recommend it tentatively for organizations working with disaster mitigation, in order for them to search for specific information and get a pulse on the thoughts of people in affected areas. It may be most useful for second or third waves of emergency response rather than for disaster victims and first-wave responders, depending on how dialed-in those people are to the network. Lastly, there is very little doubt that Twitter can be used at the very least as a useful complementary tool for any person or group during time and information critical events. Nevertheless, at this stage, other mediums and communications tools will be necessary to provide the backbone of emergency communication in crises.

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