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# A Study of Social Media Integration in Public Emergency Alert Systems

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For the degree of Master of Science

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A STUDY OF SOCIAL MEDIA INTEGRATION IN PUBLIC EMERGENCY ALERT  
SYSTEMS

A Thesis

Submitted to the Faculty

of

Purdue University

by

**ALEXANDER G BARNETT**

In Partial Fulfillment of the

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of

Master of Science

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## ABSTRACT

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To remain effective, modern emergency alert systems must continue to investigate new methods and technologies for contacting the public. Today's emergency alert systems, which rely primarily on broadcast media, have yet to fully embrace the potential of one category of Internet technologies: Social media. Social media potentially represents a large, untapped audience for emergency alert personnel to not only contact, but also utilize when seeking information regarding an incident. The following paper investigates these technologies and their relevance to the emergency alert field.

## CHAPTER 1. INTRODUCTION

This country's emergency alert systems are in need of an upgrade. With the national EAS lagging behind the private sector in the utilization of modern technology and suffering from location targeting issues, new systems are needed at the local and state levels to fill the gap. Existing EAS, which utilize weather radio, terrestrial radio, television, and electronic billboards for notifications are effective, however they suffer from shrinking audiences as time goes by. EAS of the future will need to turn to the Internet, and the plethora of social media systems that exist there, for far-reaching and prompt notifications. In addition, the increasing utilization of always-on, complex mobile devices and their unique abilities will need to be explored and exploited not only for their instant notification abilities, but also for their abilities to relay information back to responders in times of crisis. By developing a system for local authorities that can issue alerts across a wide spectrum of notification elements, prompt, targeted messages can be delivered and information gathered during events such as child abductions, road closures, bomb threats, and a limitless variety of other crises. This chapter will provide an overview of the scope and significance of this research, as well as an outline of the research's focus.

### 1.1. Scope

This research has multiple aims: First and foremost is to research the effectiveness and reliability of social media and other tools for disseminating information to the public during an event. Tools such as Facebook, Twitter, RSS feeds, Google Maps, instant messaging, and SMS will be researched and used to distribute information during several test events. Results from these test events, as well as feedback from participants will be evaluated to determine the effectiveness of each notification method.

The second aim of this research is to develop a modular, distributable software platform for law enforcement and other emergency response agencies that makes use of the tools already described. This software must be easy to use and install, and provide measured stability, accessibility, and reliability. Ideally, the software solution will be a

web application that allows the administrator to create events, provide details about the event, and distribute information regarding the event via any number of notification methods, all from one central site. The users of the application will be able to register for updates via as few or as many notification methods as they choose, and be able to view information about the event directly on the site. This software package will be built and tested via a number of simulations with volunteers.

The final aim of this research will be to research and recommend future modules for the software system to further extend its reach and abilities. Potential avenues of expansion include iPhone and Android applications, as well as other mobile device alert applications. These applications could provide greatly enhanced abilities to the system, such as detailed feedback from users including GPS coordinate data, as well as pictures and video sent directly to law enforcement. The costs and benefits of these scenarios will be explored and proposed.

Essentially, the objective of this research is to first justify the system, then to build the system as a distributable, modular software package, and then finally to explore possible enhancements to the system. Each step will be researched, tested, and evaluated for effectiveness and reliability.

## 1.2. Significance

In times of crisis, prompt distribution of information from authorities to the public is crucial to saving lives and mitigating damage to property and infrastructure. Existing notification methods may reach some audiences, but as the number of notification methods increase, so too does the number of audiences reached. Additional audiences also mean additional sources of information for law enforcement and other emergency management officials, which in turn may increase the efficiency at which an event is handled.

This research promises to be significant in a number of ways. Primarily, it is the intention of this research to allow local governments to reach out to their citizens during times of crisis in ways they may not have considered nor had access to previously. Additionally, it will test and bring attention to the validity of using social networks for prompt delivery of information. This will allow for further research and utilization of these

resources, highlighting the utility of services that are currently being under-utilized. Finally, it will provide authorities access to a pre-made, yet customizable system that can be implemented with a minimum of effort without the need for in-house development.

### 1.3. Research Question

The primary question of this research is as follows:

1. Can public emergency alert systems benefit from the inclusion of social media and other web-based tools in their alert methods?

### 1.4. Definitions

*App* – A mobile phone application. Commonly used to describe applications on the iPhone and Android platforms.

*Blog* – Slang for ‘weblog’. Typically a dynamic website that is frequently updated and allows readers to post comments and other feedback.

*EAS* – Emergency Alert System. A system comprising many notification methods with the purpose of providing information to the public during times of crisis.

*Facebook* – A social media website. The site claims five hundred million active users.

*IPAWS* – Integrated Public Alert and Warning System. The eventual successor to EAS.

*RSS* – An acronym standing for ‘really simple syndication’. A web feed format used to publish frequently-updated works, such as blog feeds.

*SMS* – Short Message Service. A communication component of most cellular phones. Also known as ‘texting’.

*Social media* - Media designed to be disseminated through social interaction, created using highly accessible and scalable publishing techniques.

*Twitter* – A social media website where users post information in 140 characters or less. Twitter claims more than one hundred million users.

*VoIP* – Voice over IP. A technology used to make phone calls over the Internet.

### 1.5. Assumptions

The following assumptions are being made:

1. Emergency management authorities want to reach more people in more ways with their alerts and announcements
2. Emergency management authorities can benefit from receiving information via feedback from the public sector regarding disasters and other negative events
3. Existing methods of alerting the public, such as terrestrial radio, road signs, and television alerts are not reaching 100% of the general public
4. The public can benefit from receiving information regarding events and disasters

### 1.6. Limitations

The following limitations are assumed:

1. Methods for accessing social media APIs occasionally change. No guarantees are made regarding long-term compatibility after the system's initial development.
2. Only the following notification methods will be implemented: Facebook, Twitter, SMS, Blogs/RSS, Instant Messaging, Email
3. The following notification methods will be researched, but not implemented: iPhone App, Android App
4. Only Google Maps will be used to provide pictorial geographical data in notifications
5. The web application will be developed in PHP and MySQL

### 1.7. Delimitations

The following delimitations are being made:

1. Versions of the software will not be developed in other programming languages for compatibility
2. MySpace support will not be implemented
3. Mobile phone platforms outside of iPhone and Android will not be researched

### 1.8. Summary

The intent of this chapter was to provide an overview of the scope, significance, assumptions, limitations, and delimitations of this research. The following section will provide background on the topic of emergency alert systems through a literature review of existing research.

## CHAPTER 2. REVIEW OF THE RELEVANT LITERATURE

To adequately design a new emergency alert system, a wide variety of topics, proposals, and research must be evaluated. To begin, existing EAS such as the Federal EAS, its successor, the Integrated Public Warning and Alert System, and the AMBER Alert system must be reviewed. Next, research regarding each of the components of the proposed system must be adequately explored. Finally, documented situations and events that highlight the effectiveness of the proposed communications mediums must be found to justify the proposal. The following chapter will detail each of these requirements.

### 2.1. Emergency Alert Systems

The current national warning service, the Emergency Alert System (EAS), has been the subject of much scrutiny. Developed in the early 90s, the EAS superseded its predecessor, the Emergency Broadcast System (EBS), by upgrading and automating the existing infrastructure (Moore, 2010). Historically, the EAS has primarily relied on various broadcasting mediums to make announcements, such as television and radio. However, as of October 2005, EAS participation has become mandatory for digital television and digital radio services (Federal Communications Commission - Consumer & Governmental Affairs Bureau, 2006). Additionally, EAS alerts are also sent through the National Oceanic and Atmospheric Administration (NOAA) Weather Radio (NWR) broadcasts (Moore, 2010).

The primary purpose of the EAS is to transmit federal warnings in times of crisis, however neither it nor its predecessors have ever been used for this purpose. Instead, it is mainly utilized for local warnings (Moore, 2010). The lack of Federal use received a considerable amount of attention on September 11<sup>th</sup>, 2001, when the system was not utilized to issue alerts regarding the terrorist attacks. Government officials claimed that using the system would have been redundant considering the 24/7 mainstream media

coverage, while critics used the event to point out the system's outdated design and limited utility (Collins, 2001).

The successor to EAS, the Integrated Public Alert and Warning System (IPAWS), is still in development. Government officials at FEMA are designing IPAWS with features far superior to EAS, most notably the ability to distribute geo-targeted alerts via broadcast media, marine and weather radios, the Internet, cell phones and other wireless devices, electronic signs, and any other device programmed to accept alert signals (Moore, 2010). However, despite the fact that work began in 2004, the program has yet to produce any functional results. In a statement before the House of Representatives subcommittee on Economic Development, Public Buildings, and Emergency Management, Mark Goldstein, Director of Physical Infrastructure, noted that IPAWS implementation "has stalled and many of the functional goals of IPAWS, such as geo-targeting of messages and dissemination through redundant pathways to multiple devices have yet to reach operational capacity" and that the program is suffering from "shifting program vision, difficulties in planning and management, a lack of collection or organization of program information from which to make management decisions, and staff turnover." (Goldstein, 2009) There is currently no projected or mandated timeline for full IPAWS integration and deployment.

The lack of a modernized emergency alert system has prompted some local governments to develop their own. The Office of Emergency Management of Morris County, New Jersey has developed a system dubbed 'MCUrgent' that reaches out to the county's 39 towns and cities via social media and other online networks. According to the system's developer, MCUrgent utilizes Facebook, Twitter, YouTube, Scribd, and Flickr, with 1,070 followers on Twitter and a combined 747 followers on Facebook. These numbers are expected to increase once the public is properly informed of the system's existence and capabilities (Spencer, 2010).

Perhaps the best example of an emergency alert system done correctly is the AMBER Alert system. The system, which was created in 1996 in response to the abduction and subsequent murder of 9-year old Amber Hagerman (National Center for Missing and Exploited Children, 2010), has the singular purpose of alerting the public when a child is abducted. Information about the victim is relayed over the EAS and its notification methods. Additionally, digital highway signs as well as signs from participating private companies are used to alert the public. The system also incorporates an opt-in SMS messaging service that allows individuals with wireless devices to receive text messages about abductions located in their area (Wireless AMBER Alerts, 2006). More recently, an iPhone app has been created to further expand the system's capabilities. The app shows users a real-time feed of active AMBER Alerts, including information about the victim, abductor, and any other relevant information about the event. It also allows the user to forward their GPS coordinate to NCMEC, as well as push-button access to their emergency hotline (Zdziarski, 2009). According to Robert Hoever, Associate Director of Special Projects at NCMEC, there are currently plans to even further expand the system by adding applications for other smart phones, as well as Facebook integration (Hoever, 2010). Considering the variety of methods and geo-targeting capabilities of the system, it is easy to see that it is one of the more advanced emergency alert systems in the country.

Like EAS, the AMBER Alert system has its critics. In a paper published by the *Journal of Criminal Justice*, Timothy Griffin of the Department of Criminal Justice, University of Nevada, argues that the purported successes of the AMBER Alert system are exaggerated. The paper argues that an empirical evaluation of publicized AMBER Alerts shows that the majority of the abductions were resolved without the child being placed in a truly life threatening situation, and that the system did not produce results within a three-hour window deemed crucial to rescuing the victim (Griffin, 2010). Griffin also points out several situations where the restrictions placed on the issuance an AMBER Alert were detrimental to the victim, and goes on to discuss other apparent flaws in the system.

Primarily, the research is concerned with the policy and psychology of the system and not with the technical aspects.

## 2.2. Communication Methods

The system proposed in this research leans heavily on social media sources for the dissemination and collection of information. In their overview of social media services and terminologies, Kaplan and Haenlein define social media as “a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content.” (Kaplan & Haenlein, 2010). In the context of this research, the system includes Facebook, Twitter, Blogs, and RSS feeds.

Facebook, a social-networking website, is the largest social-networking site in the world, claiming 500 million users as of July 2010 (Zuckerberg, 2010). Although it was created primarily to allow people to connect with their friends and co-workers, since its creation in 2004 the site has expanded in scope and utility. With the launch of its marketing platform, Facebook has become an online advertising powerhouse. In 2009, Facebook generated nearly \$800 million in revenue, and a private equity firm recently valued the company at \$23 billion (Dealbook, 2010). In addition to its uses for business, Facebook also has uses in the political world as well. In 2008, ABC News and Facebook collaborated to allow users to give live feedback during political debates (ABC News, 2007). Political figures also utilize Facebook to communicate with their supporters. As of November 2010, President Barack Obama’s Facebook page had over sixteen million fans (Organizing for America, 2010). This page, often updated several times per day, serves as a way for supporters to keep up to date on new developments involving the president. Other organizations use Facebook to coordinate events, such as John Stewart’s Rally to Restore Sanity. As of November 2010, its page had nearly seventeen thousand fans (Facebook, 2010). Considering the sheer number of people who regularly access Facebook, combined with the multitude of uses offered by the platform, it is not difficult to see how it could be used to spread information by emergency alert personnel.

Twitter, another social media service, also has the potential to be useful in an emergency notification system. Twitter is a “micro-blogging” service that allows users to post messages up to 140 characters, called “tweets”, on their profile page. Users may subscribe to other users’ updates by “following” them, which causes their tweets to appear on the user’s home page. Posting and viewing tweets may be accomplished in a number of ways, the primary method being a visit to the site itself; however, there are several other methods. Users can utilize instant messaging programs to send and receive tweets (Twitter, 2006), or use their mobile device to send and receive via SMS (Twitter, 2010). Twitter also has an official iPhone app (Miller, 2010). Like Facebook, Twitter has grown exponentially since its creation in 2006. As of October 2010, the site boasts 175 million users (Murphy, 2010), and claims an average of 750 tweets per second (or 65 million tweets per day) (Twitter, 2010). Also like Facebook, Twitter has evolved beyond its original use as a personal activity log to include political utilization. Barack Obama’s Twitter account has close to six million followers as of November 2010 (Organizing for America, 2010) and appears to mirror the updates of his Facebook page. Perhaps the greatest example of Twitter being used for political purposes is 2009 Iranian election protests. In the wake of alleged voter fraud, massive protests in the country prompted Iranian government officials to block access to much of the Internet outside of the country. Despite this, dissidents heavily utilized Twitter to coordinate amongst each other and to relay information to the outside world (The Washington Times, 2009) (Moscaritolo, 2009). Twitter played such a large role in the event that the U.S. State Department issued a request to the company to delay their planned downtime to protect the interests of the Iranian people protesting the election (Grossman, 2009). Considering the multitude of information that can be sent and collected through Twitter, and its already sizeable user base, the uses it offers to the field of emergency management become readily apparent.

Also worth mentioning in the social media category are weblogs (or ‘blogs’), and their published RSS feeds. Simply put, a blog is a dynamic website that is frequently updated and usually allows for user comments. Normally, a blog would have limited utility for emergency response personnel during times of crisis, but thanks to RSS, its usefulness

is greatly expanded. RSS, which stands for ‘Really Simple Syndication’, is a protocol used by many popular blogging platforms to alert readers, search engines, and other sites when a new post is made (WebReference, 2010). Many software utilities, such as web browsers, have RSS readers built-in, and RSS utilities are common in modern mobile phones. By using a blog with RSS, emergency management personnel can not only provide detailed information regarding an event, they can also quickly notify subscribers. Additionally, a blog can serve as a good place to provide more verbose accounts of event information, which can then be linked to from other notification services (Facebook, Twitter, etc).

Although social media technologies offer exciting possibilities in the field of emergency alerts, older web-based technologies cannot be ignored. Mass messaging via email mailing lists has long been used for a variety of purposes ranging from marketing to company newsletters. Considering the prevalence of always-on devices with email clients, it is easy to see how no robust alert platform would be complete without email notifications. Another legacy technology that could be useful for mass-alerts is the plethora of instant messaging services. Popular services like AOL, Windows Live, Yahoo, ICQ, and many other instant messengers may be losing ground to newer social networking tools, but are still used by millions every day and provide an additional way to reach the public. AOL provides a first-party solution for mass-messaging (AOL, 2011), and third-party software has been developed for other IM networks. Although it may be redundant with SMS alerts, many modern smartphones incorporate IM clients for connecting to the services previously mentioned, allowing officials to reach IM users who aren’t in front of their computers.

### 2.3. Other Casework and Examples

There are many documented instances of law enforcement officials using Facebook to gather information about various crimes. In 2009, Police in New Zealand posted photos from a surveillance camera in their Facebook page, hoping their contacts could help them identify a burglary suspect. By the next day, the suspect was identified and in custody (Ahmed, 2009). A similar situation occurred in Maine, where a police department was able to solve a vandalism case with tips received from Facebook users (Canfield, 2009). Yet

another example occurred more recently, when Denver Police contacted every person on a suspect's friend list to obtain information about his whereabouts, a move that directly led to his arrest (Young, 2011). Instances like these help demonstrate the great potential Facebook holds for law enforcement and emergency management officials, and why it should be included in any modern emergency alert system.

Another example of law enforcement using social media to their benefit include Crime Stoppers' use of Twitter to alert the public and request anonymous tips (Central Ohio Crime Stoppers, 2011). Tools like Google Earth can also prove useful to law enforcement, such as in 2007 when Wisconsin police used the service to locate several illegal marijuana fields discovered through the seizure of GPS coordinate data (Terdiman, 2007). One final example regarding the usefulness of instant messaging and chat tools can be best illustrated through an organization called 'Perverted Justice'. This organization uses instant messaging systems to launch sting operations against pedophiles who are seeking to solicit minors for sexual activities. After obtaining evidence, Perverted Justice works with law enforcement officials to bring the offenders to justice, and also publishes chat transcripts on their site with the intention of creating a "chilling effect in chat rooms" (Perverted Justice, 2008). Examples like these, while not as common as they could be, serve to show how the creative usage of modern, web-based tools can greatly increase the amount of information available to law enforcement officials.

#### 2.4. Summary

While there exists little in the way of academic research regarding the viability of social media tools in the emergency alert and law enforcement fields, we can learn from reviews and critiques of existing emergency alert systems to gain an understanding of how these tools may be utilized. Additionally, the review of publicized incidents where law enforcement adapted these tools to their own ends with positive results can be analyzed and mimicked by future responders. By combining and reviewing these accounts, it becomes clear that law enforcement and emergency alert personnel can benefit in a variety of ways from the inclusion of social media and other web-based technologies in their arsenals.

## CHAPTER 3. FRAMEWORK AND METHODOLOGY

The purpose of this study is to explore the viability of social media and other online communication methods in emergency alert systems, and to then develop a distributable, modular platform available for use by law enforcement. This study will benefit those in law enforcement and emergency management positions by providing additional ways to reach out to and gather information from the public during times of crisis.

### 3.1. Framework

This research is both quantitative and qualitative in nature. For the quantitative aspect, volunteer participant response times to alerts via the various mediums discussed above will be tested and recorded. For the qualitative aspect, a practice event will be staged on campus (such as requesting information regarding an abductor's car), and the information received from volunteers will be evaluated based on its value relative to the incident and the speed at which it is received. Additionally, the ability to issue alerts over multiple mediums from a single web-based application will be determined.

### 3.2. Participants

For initial testing, all alerts will be sent and received in a lab environment by the researcher. After the first round of testing, alerts will be sent to volunteers recruited from the campus. These volunteers will indicate which mediums they wish to receive alerts from and will be provided with instructions on how to begin receiving announcements. They will be instructed to note when they noticed the alert and respond with this information in a timely manner.

### 3.3. Survey

Following the test alerts and test event, participants will be asked to respond to a survey. This survey will request basic demographic information, as well as which alert

method(s) they received the messages by and approximately what time they first noticed the alert. The survey will also ask what platform they received the alert on (for example, Facebook messages can be viewed on both computers and cellular phones). Additional information about their preferred alert method will be requested specific to the method (ie, how many times per day do you log onto Facebook?). Finally, any additional thoughts or questions regarding the experiment will be requested.

### 3.4. Software Design

The ability to create a web-based application that can remotely issue multiple alerts via one interface will be explored. The software will be designed in PHP with a MySQL backend for information storage. It will be designed to issue alerts to Facebook, Twitter, mailing lists, and a blog with RSS from one central location for simplicity. Regarding the other alert methods, it will contain links and instructions with validation. Information about the event and what alerts have already been issued, as well as timestamps, will be present in the interface to allow multiple officials to use the software without issues duplicate alerts.

The database will be designed to contain as much information as possible regarding events while being easily searchable by the user. An example table structure can be viewed in appendix A. In this example, the table 'VictimTable' allows administrators to store many details about event victims, including name, hair color, information about the victim's clothing, a picture of the victim, and so on. Each entry in the table will have a unique identifier while being tied to another table via the 'IncidentID' field, which is the primary key for the 'IncidentTable' table. This table will serve as the primary index for incidents and will always be referenced by other tables in the database. Each incident type, such as abductions, public threats, and weather alerts, will have its own table and sub-tables. For example, the abduction incident table will have a victim sub-table as well as a suspect sub-table. The goal of distributing information throughout multiple table categories is to simplify queries and maximize efficiency.

### 3.5. Conclusion

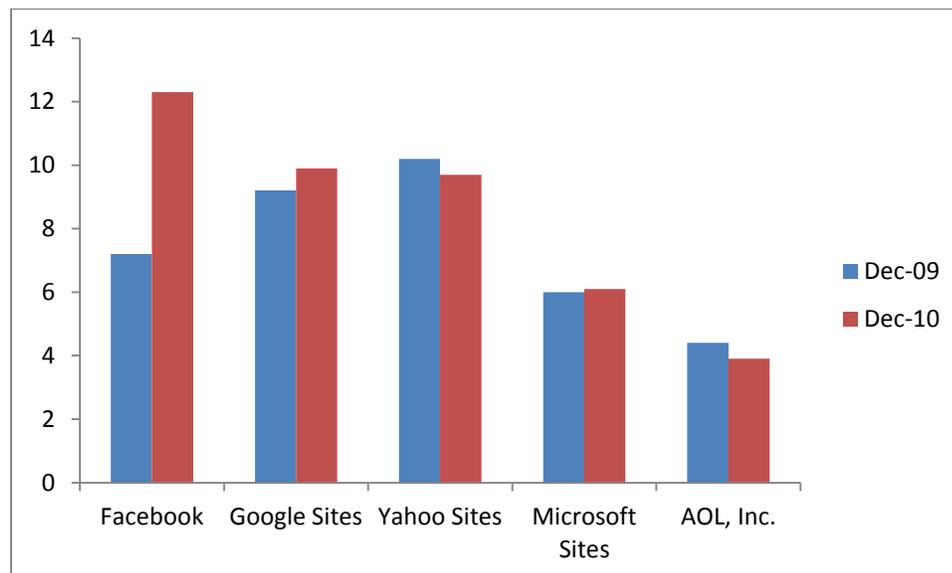
This chapter provided an overview of the proposed framework and methodology of this study. The next chapter will cover data collection, analysis, survey results, and findings of the research.

## CHAPTER 4. DATA ANALYSIS AND FINDINGS

These results were gathered from a number of papers and studies published by several market research institutions. The following subsections are grouped by category pertaining to the suggested elements of a social media-based alert system. Each subsection will provide various data regarding the suggested element, as well as an interpretation of the data as it pertains to the suggested system.

### 4.1. Facebook

Information regarding Facebook users' demographics, browsing habits, frequency of use, and other such data is essential for determining the suitability of Facebook as a medium for the distribution and collection of emergency information. The following information graphs are constructed from data taken from the comScore 2010 Digital Year in Review (comScore, 2011).



*Figure 4.1.* Trend in Share (%) of Time Spent for Top 5 U.S. Web Properties (comScore, 2011).

Key points from this data:

- U.S. users now spend 12.3% of their time online browsing Facebook, up from 7.2% one year ago.
- Facebook is the most-browsed site online, overtaking Google and Yahoo sites in 2010.
- Facebook usage is on the rise.

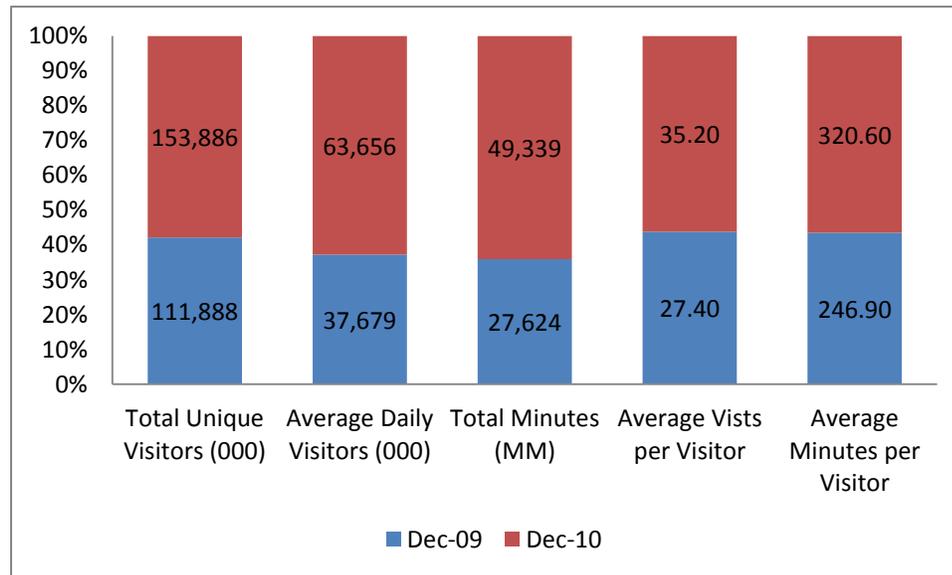
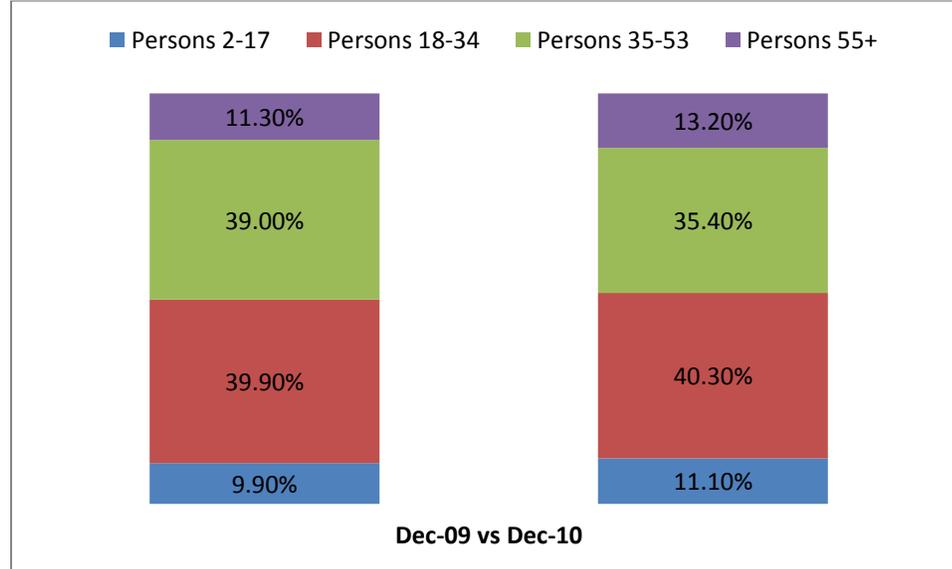


Figure 4.2. Facebook Usage Patterns (comScore, 2011).

Key points from this data:

- Usage of Facebook from 2009-2010 has increased in many measurable categories.
- Unique visitors are up 38%.
- Daily visitors are up 69%.
- Total minutes spent on the site are up 79%, while average minutes per visitor are up 30%.
- Average visits per user are up 29%.
- 49.3 billion minutes spent on Facebook in December 2010, up from 27.6 billion in December 2009.

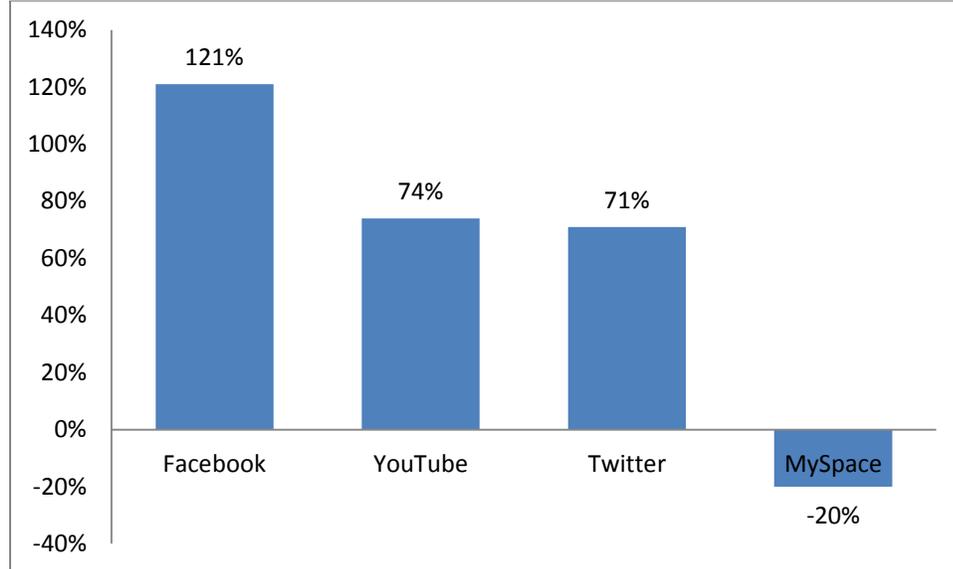


*Figure 4.3.* U.S. Demographic Profile – Share of Visitors to Facebook.com (comScore, 2011).

Key points from this data:

- 18-34 year olds make up the largest share of users at 39.9%
- Users 35-54 are the second-largest group at 39%, down from 42.6%.
- Users 55+ accounted for 9.9% of visitors in 2010, up 1.2%.

While the previous data deals with Facebook usage in general, looking at Facebook usage specifically from the perspective of the mobile user market is especially valuable for determining its suitability for emergency alerts. The following data is taken from the comScore 2010 Mobile Year in Review (comScore, 2011).



*Figure 4.4.* Top Social Media Brands by Total Audience Percent Growth 2009-2010 (comScore, 2011).

Key points from this data:

- Mobile Facebook usage has increased 121% in the last year.
- 90% of U.S. mobile social media users utilize Facebook.

#### 4.1.1. Interpretation of Facebook Data

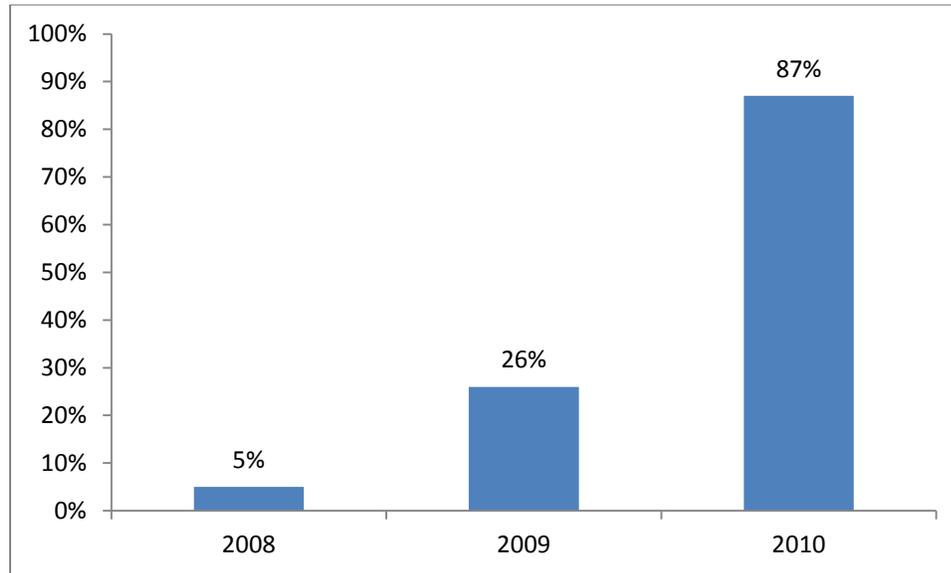
The previous data is significant in a number of ways. First and foremost, it demonstrates that Facebook is a heavily-utilized tool in social networking, accounting for an enormous amount of time spent online. Also, the data shows that Facebook usage grew last year, overtaking more traditional web portals such as Google and Yahoo. Additionally, the data shows that Facebook reaches a wide variety of age groups, and that non-adult traffic only accounts for 11.3% of total usage. Finally, the data show that mobile Facebook usage is growing and currently far exceeds utilization of other social media tools.

Taking into consideration Facebook's large audience, the frequency at which this audience accesses the site, and the availability of the site from mobile devices, it is clear that a social media-integrated emergency alert system would benefit from the inclusion of

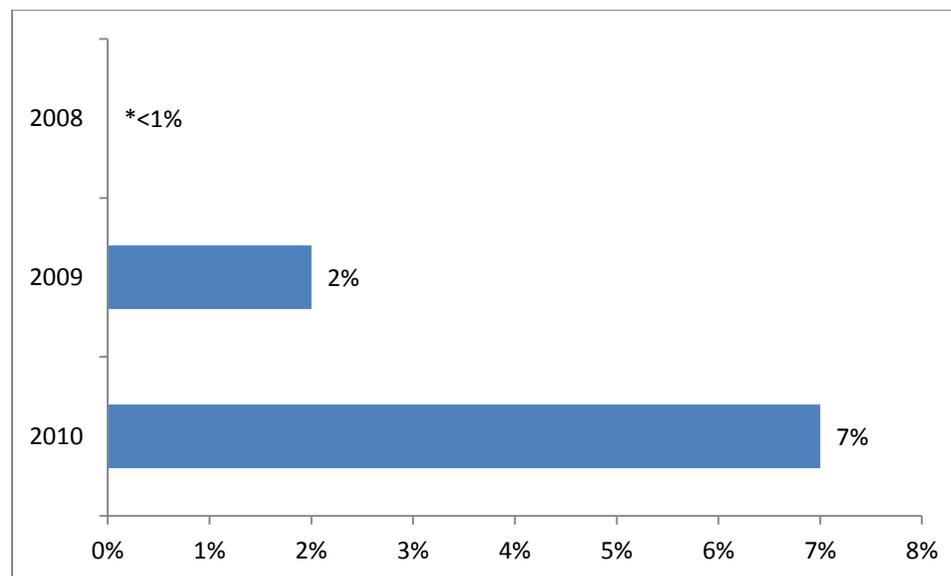
Facebook. Aside from its potential to reach a large number of users in a timely manner, Facebook's users are also able to quickly repost information sent by authorities on their own pages, dramatically increasing the audience of the alert. For example, a small regional police department utilizing Facebook may only have fifty "friends," however this does not limit a message's audience to those fifty alone. If five of those contacts repost a story, and they each have fifty friends, that expands the audience by an additional two hundred and fifty users. While it is unknown if a user will initially repost a message, an event of sufficient importance may produce a chain of reposted stories, dramatically increasing awareness of the event. Additionally, users can submit information or tips back to the agency in charge of the system via Facebook's messaging system, or even on the agency's page. Text, pictures, and even video can be submitted this way, potentially allowing the agency to easily collect a large amount of information with little effort. Finally, Facebook features a robust API, allowing third party applications access to the site. The potential uses of this API will be discussed more in chapter five.

#### 4.2. Twitter

Much like Facebook, examining Twitter's users, their browsing patterns and demographics, and the overall impact of Twitter as a technology in the last year is important for determining its value in emergency alert systems. The following data was retrieved from a study performed by Edison Research in 2011 (Webster, 2011).



*Figure 4.5. % Who Have Ever Heard of Twitter (Webster, 2011).*



*Figure 4.6. "Do you currently ever use Twitter?" (Webster, 2011).*

Key points from this data:

- Although awareness of Twitter has dramatically increased, usage remains low.

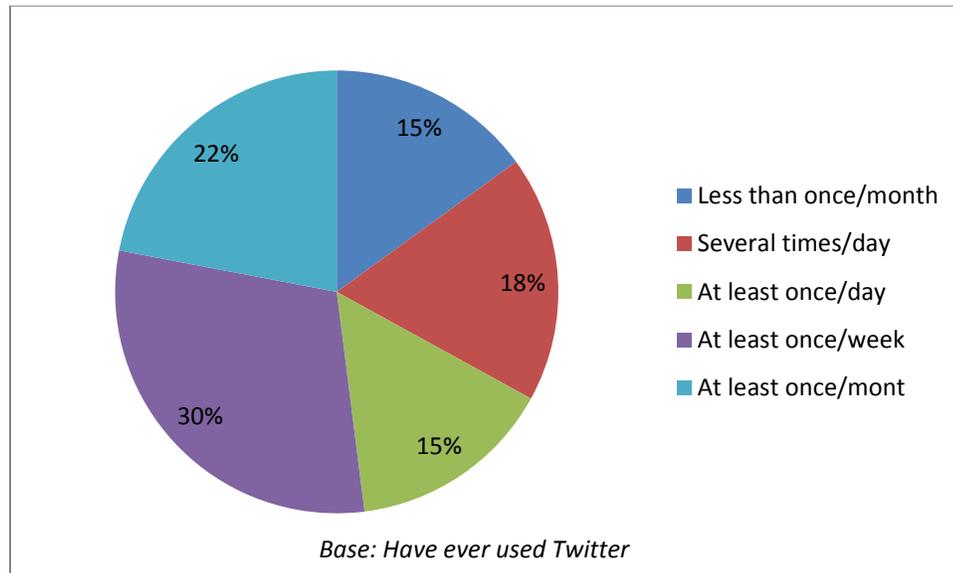


Figure 4.7. “How often do you use Twitter?” (Webster, 2011).

Key points from this data:

- Only 33% of Twitter users use the service once or more per day

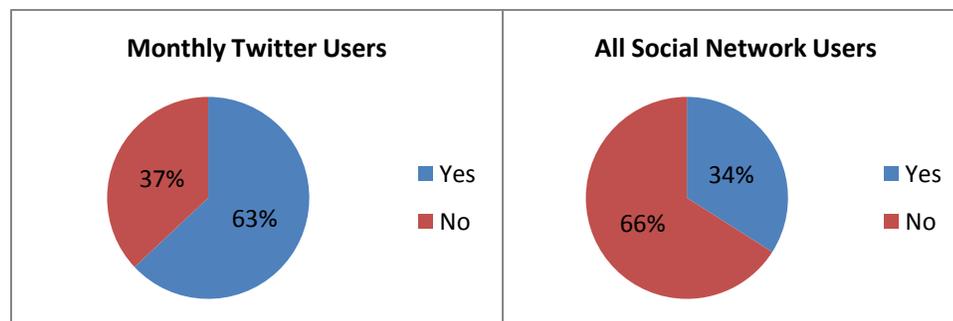


Figure 4.8. “Do you ever access social networking sites via mobile phone?” (Webster, 2011).

Key points from this data:

- Twitter users are more likely to access social networking services via a mobile phone than the average social network users.

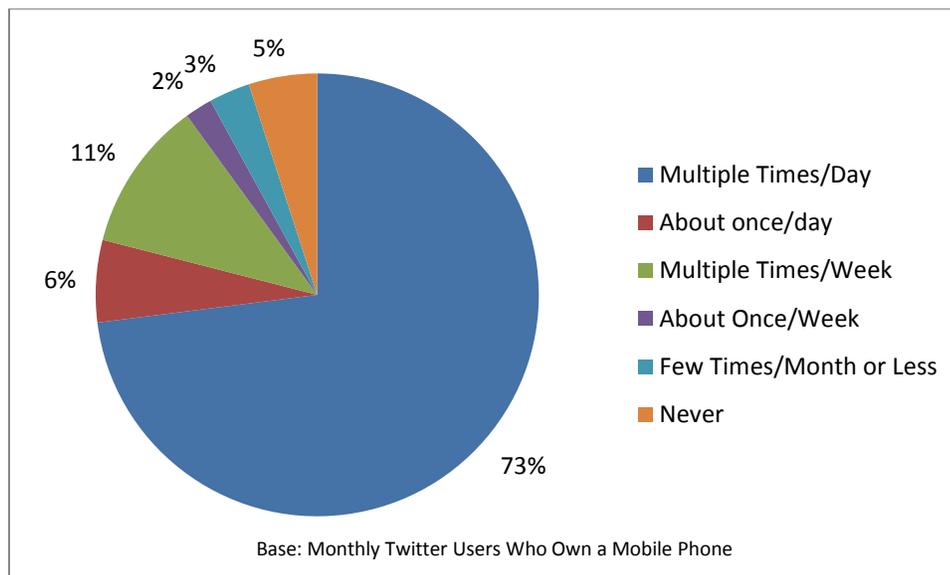


Figure 4.9. “How often do you send/receive text messages on your cell phone?” (Webster, 2011).

Key points from this data:

- Twitter users are very likely to use their phone for SMS.

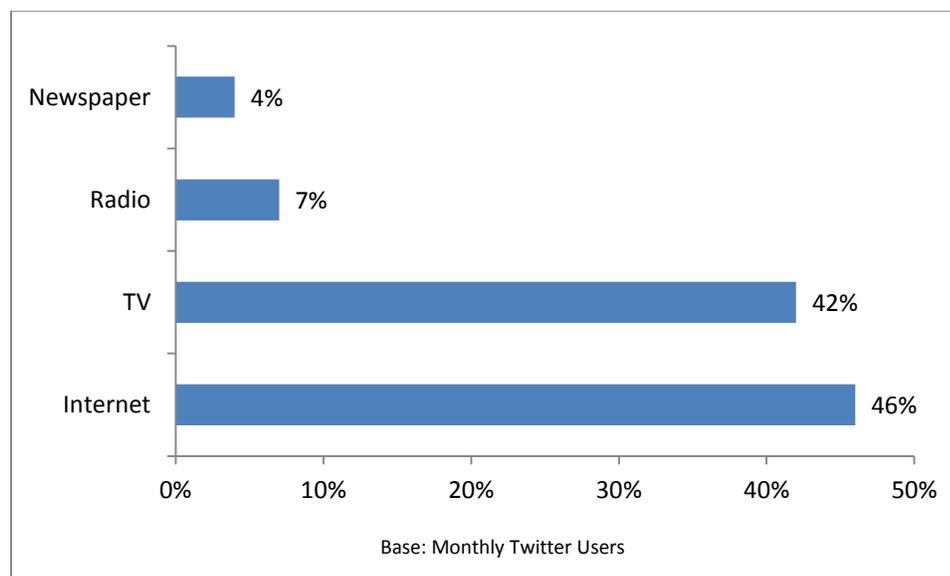
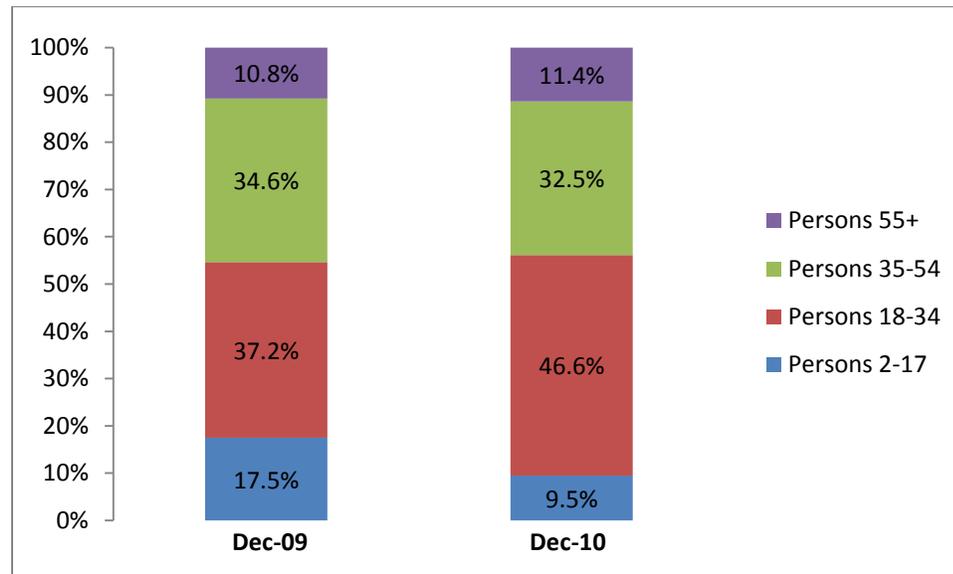


Figure 4.10. “Which Medium do you turn to FIRST to learn about a breaking news story?” (Webster, 2011)

Key points from this data:

- Twitter users are likely to check the Internet for information regarding breaking news stories.

The following data was retrieved from the comScore study (comScore, 2011).



*Figure 4.11.* U.S. Demographic Profile – Share of Visitors for Twitter.com (comScore, 2011).

Key points from this data:

- Non-adult Twitter users only account for 11.4% of the user base.
- Twitter is gaining acceptance in the 18-34 category.

#### 4.2.1. Interpretation of Twitter Data

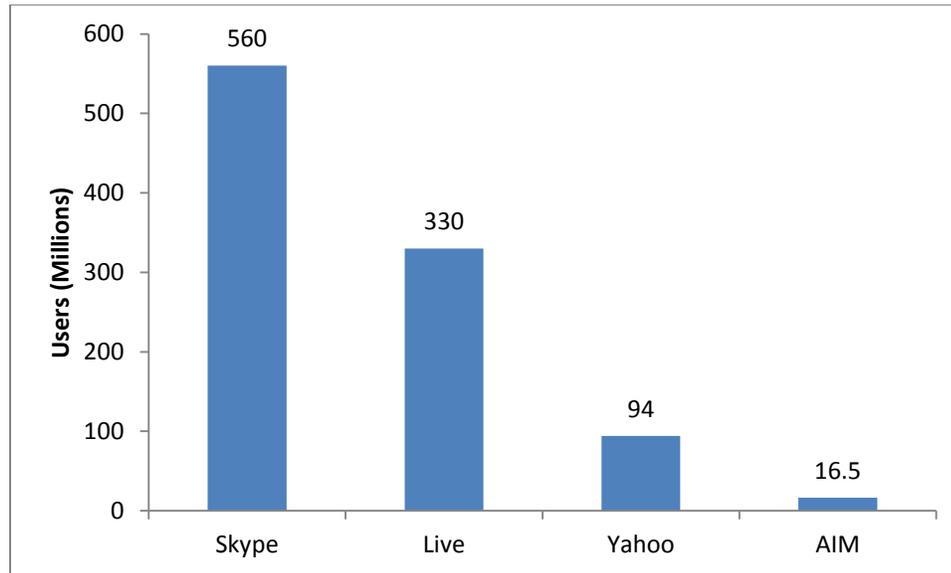
The data from these studies can be interpreted in a number of ways. Given that awareness of Twitter is high (87%), while usage is low (7%), the numbers appear to suggest that the service is undesirable. Also, given that only 33% of Twitter users use the service at least once per day, the majority of users would be unlikely to see alerts issued via Twitter in a timely manner.

However, another way to interpret the data would be to assume that the majority of people who are aware of Twitter, but have not yet used the service, simply have not been presented with a valid reason to use it. If a non-user were presented with a reason to utilize the service (such as emergency alerts), given Twitter's high adoption rate in the mobile market, it stands to reason that the service could be highly desirable for reaching the mobile market. While not as comprehensive or reliable as SMS, mobile Twitter could provide much-needed redundancy, or serve as a low-cost alternative.

Whether or not an emergency alert system could benefit from the inclusion of Twitter-based alerts is up to the developer to decide. Current low-usage rates may make the service undesirable and a time-sink to integrate, however high utilization in the mobile market may be indicative of increasing usage numbers as time goes on. From a cost perspective, Twitter is free to use, so individual region analysis would be needed to determine if a particular area would benefit from its inclusion.

#### 4.3. Instant Messengers (IM)

Given the large number of instant messaging networks available online, whether or not a particular network will be useful from an emergency alert perspective is entirely dependent on the number of users it claims. Nearly all of the reviewed networks offer features that would be desirable for an emergency alert system (real-time text-based messaging and mobile access), so an broad overview of IM network statistics will be more helpful than an individual analysis of each network's features. The following data was compiled by Pingdom (Pingdom, 2010).



*Figure 4.12. Users on Popular IM Networks (Pingdom, 2010).*

Key points from this data:

- Skype claims 560 million registered users.
- Live (MSN) claims 330 active users.
- Yahoo claims 94 million users as of 2007.
- AIM (AOL Instant Messenger) claims 16.5 active users.

Other data from this study:

- Public IM made up 68% of all IM traffic in 2009, the rest being Enterprise IM.
- At peak hours, Live messenger claims 40 million users logged in at the same time.
- At peak hours, Skype messenger claims 23 million users logged in at the same time.
- In 2009, the average IM user sent 53 messages per day.
- IM usage is expected to grow. 1 billion messages were sent in 2009, and this is expected to increase to 1.7 billion by 2013.

#### 4.3.1. Interpretation of IM Data

This data primarily reveals that IM integration may be desirable, but only on select networks. Skype and Live appear to have the largest user bases, making them highly desirable, while Yahoo and AIM appear to have diminished in popularity. Given the challenges posed by developing an automated messaging system for these networks, it may not be feasible for an emergency alert agency to invest time and resources in unpopular networks.

One aspect of this data worth noting is the large lead Skype has over its competitors. Skype, an IM service that also incorporates voice over IP and video chat, can be used on mobile phones and computers as a substitute for traditional phone technology. Also, traditional phones can directly dial some Skype users, and Skype users can pay to dial out to traditional phone numbers. This functionality could potentially offer benefits to an emergency alert system that Skype's competitors cannot. This, combined with its large user base, makes Skype integration very desirable.

#### 4.4. Email

As of 2010, if an individual uses the Internet, it is assumed that they have at least one email address. The 2010 Pew Research Center's Internet & American Life Project concluded that 94% of adult Internet users send or read email (Pew Research Center, 2010). Also, despite its near-complete adoption rate, email usage is predicted to increase. The following data was retrieved from a report by the Radicati Group (The Radicati Group, 2010).

*Table 4.1. Corporate vs. Consumer Email Accounts, 2010-2014 (The Radicati Group, 2010).*

	2010	2011	2012	2013	2014
Worldwide Active Email Accounts (M)	2,926	3,146	3,375	3,606	3,843
Corporate Email Accounts (M)	730	788	850	918	991
% penetration	25%	25%	25%	25%	26%
Consumer Email Accounts (M)	2,196	2,358	2,525	2,688	2,852
% penetration	75%	75%	75%	75%	74%

*Table 4.2. Corporate Email Sent and Received Per User/Day, 2010-2014 (The Radicati Group, 2010).*

Business Email	2010	2011	2012	2013	2014
Avg. # of Emails Sent/Received per User/Day	110	112	115	117	119
Average Number of Emails Received	74	75	77	79	80
Average Number of Legitimate Emails	61	62	63	65	65
Average Number of Spam Emails	13	13	14	14	15
Average Number of Emails Sent	36	37	38	38	39

Key points from this data:

- Despite the availability of newer messaging technologies, email usage is predicted to grow.

Although email usage is predicted to remain strong, comScore makes an interesting observation regarding webmail usage in their report (comScore, 2011).

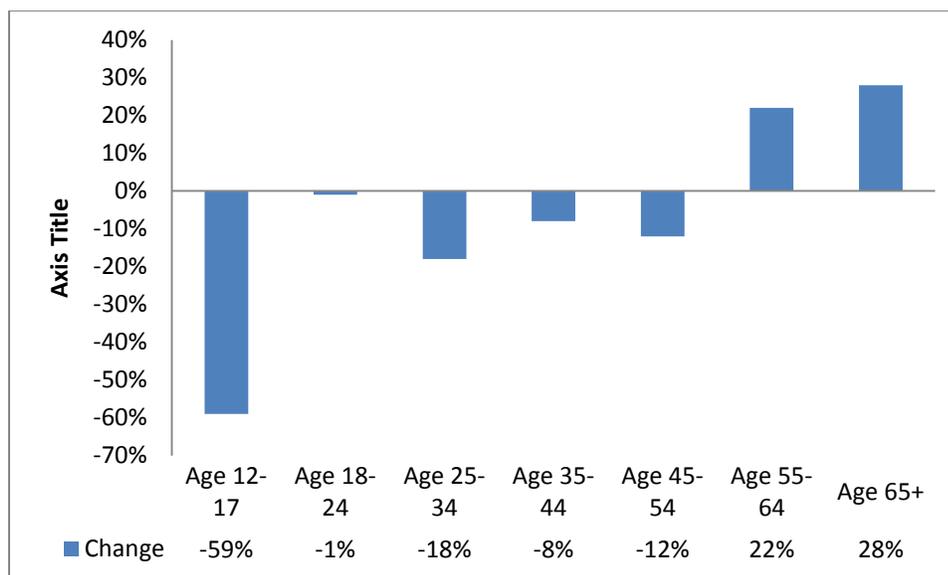


Figure 4.13. Year-over-Year Change in Time Spent Using Web-Based Email by Age Segment in the U.S. 2009-2010 (comScore, 2011).

Key points from this data:

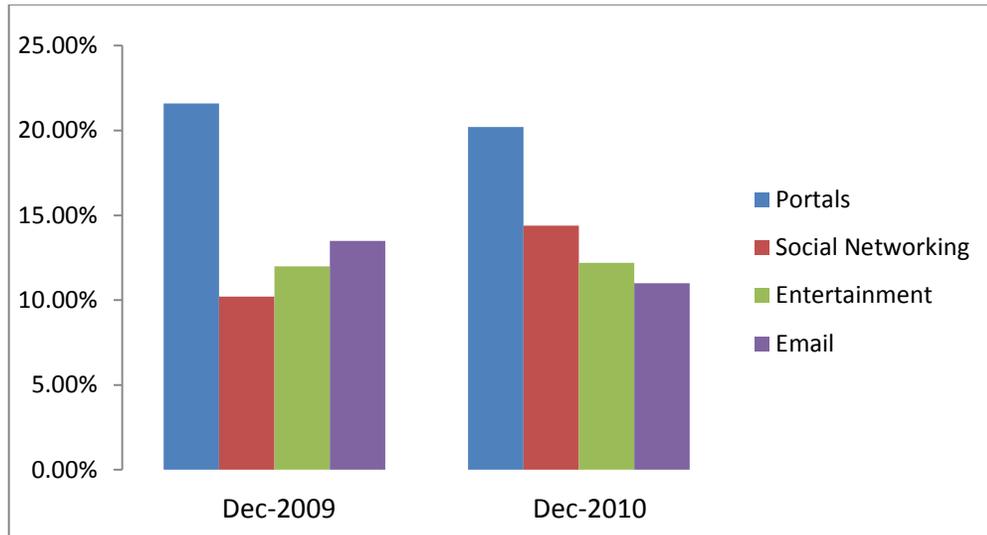
- Webmail popularity is decreasing in younger audiences, while growing in older audiences.
- This appears to indicate growing acceptance of email as a communication tool among older populations.

#### 4.4.1. Interpretation of Email Data

Email usage is near-universal, and therefore should always be utilized in any web-integrated alert system. Given that it can be accessed from mobile devices in addition to traditional computers, it offers an exceptional way for system administrators to contact their audiences. Even though webmail usage appears to be declining for certain populations, email should still form the backbone of any web-based alert system.

#### 4.5. General Social Media Statistics

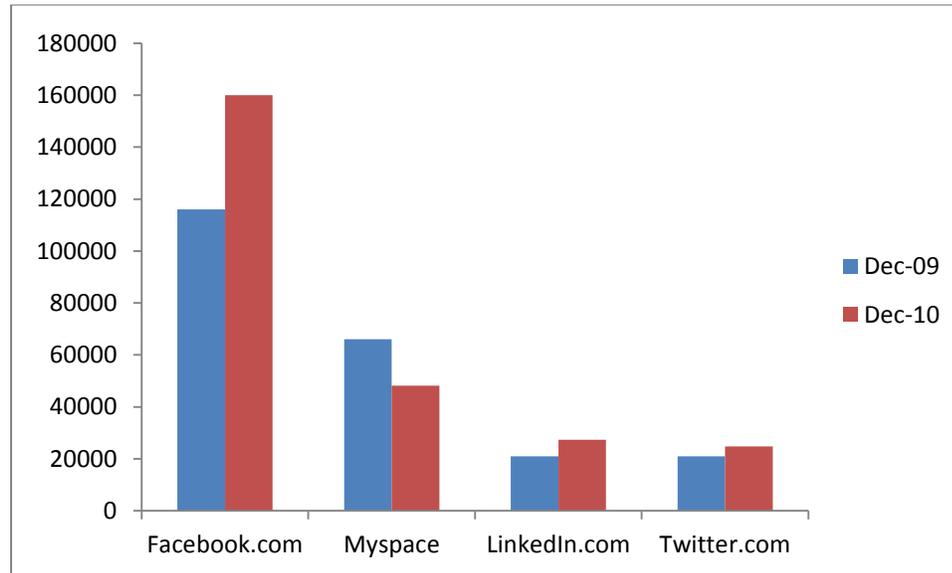
When determining whether or not to invest time and capital in a social media-integrated system, an overall view of current social media browsing patterns and demographics is necessary to determine its relevance. The following data was retrieved from comScore's Digital Year in Review (comScore, 2011).



*Figure 4.14.* Percent Share of U.S. Time Spent Online for Top Content Categories (comScore, 2011).

Key points from this data:

- Social media usage is growing and was accounted for 14.4% of all time spent online as of December 2010.
- Time spent using traditional web portals is decreasing down 1.4% from December 2009 (at 20.2% as of December 2010).
- Time spent using email is decreasing.

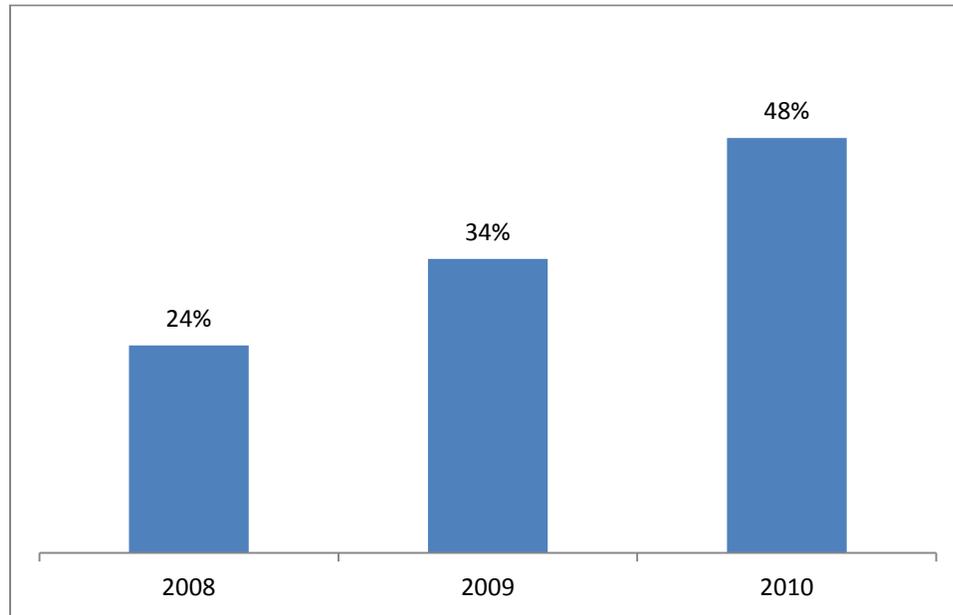


*Figure 4.15.* U.S. Unique Visitor (000) Trend for Leading Social Networking Sites (comScore, 2011).

Key points from this data:

- Facebook usage increased sharply in 2010.
- MySpace usage continues to fall (Audience declined 27% and total time spent on the site declined 50%).
- LinkedIn usage rose 30%.
- Twitter rose 18%, not including mobile or 3<sup>rd</sup> party application usage.

Other useful data retrieved from the Edison Research Group's report helps demonstrate the rapid rise in popularity of social media over the past three years (Webster, 2011).



*Figure 4.16.* % Who Currently Have a Personal Page on Facebook, MySpace, LinkedIn or Other Social Networking Web Site (Webster, 2011).

Key points from this data:

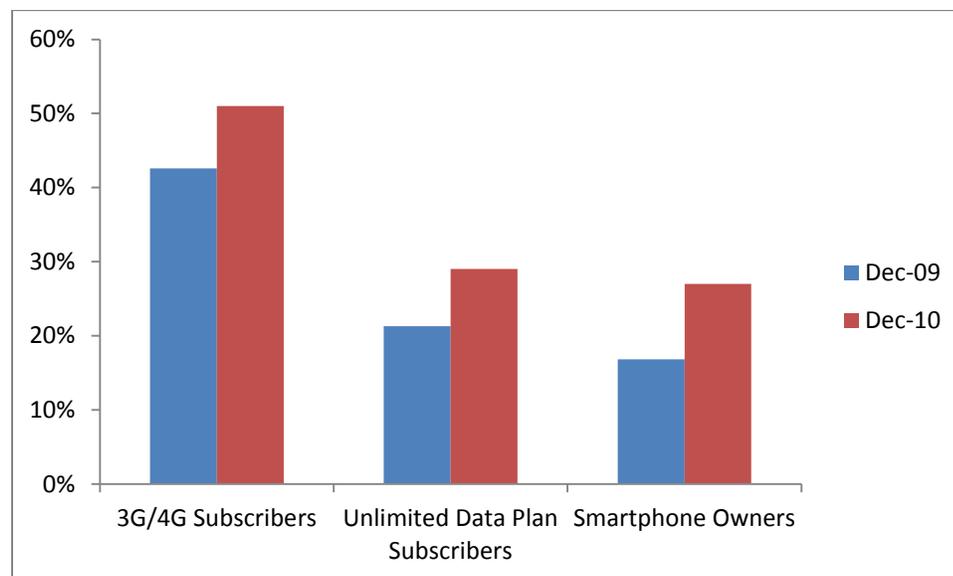
- The percentage of the total population who maintain an account on a social media site has increased over time.

#### 4.5.1. Interpretation of Social Media Data

Social media as a concept, for the most part, is gaining popularity. Although MySpace, a former leader in this area, is losing popularity, this can be attributed to being a direct competitor with Facebook, users not wanting to maintain redundant profiles, user saturation, and other variables. Overall, it is not indicative of the social media market as a whole. With more users and more time being devoted to social media websites, upgrading infrastructure to integrate with these tools may be extremely valuable to emergency alerts systems.

#### 4.6. Mobile Devices, SMS, and Mobile Apps

Mobile devices (such as cellular phones and 3G/4G enabled tablets) offer multiple avenues of contact for emergency alert systems to utilize. Not only can these devices be used to instantly receive messages via a variety of methods (SMS, email, instant messaging, social media, etc), they can also be used to transmit data back to emergency management authorities in the form of text, pictures, videos, GPS data, and more. To understand the value these devices hold for emergency alert systems, data regarding their use, user demographics, and usage patterns must be evaluated.



*Figure 4.17. Growth of Mobile Market Enablers in the U.S. (comScore, 2011).*

Key points from this data:

- Smartphone ownership is rising, at 27% as of December 2010.
- Unlimited data plan subscriptions are becoming more popular, at 29% as of December 2010.
- High speed (3G and 4G) subscriptions are increasing, at 51% as of December 2010.

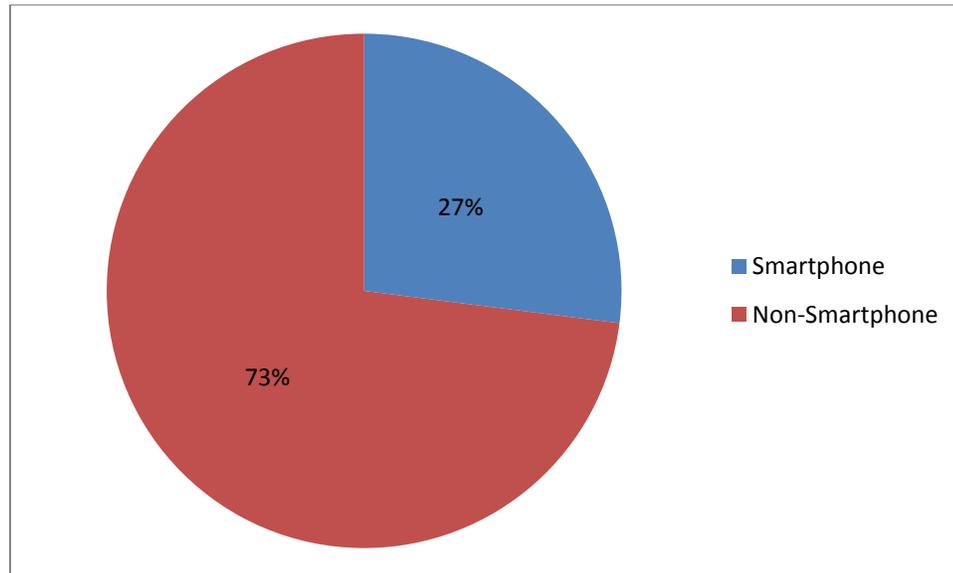


Figure 4.18. U.S. Smartphone Penetration (comScore, 2011).

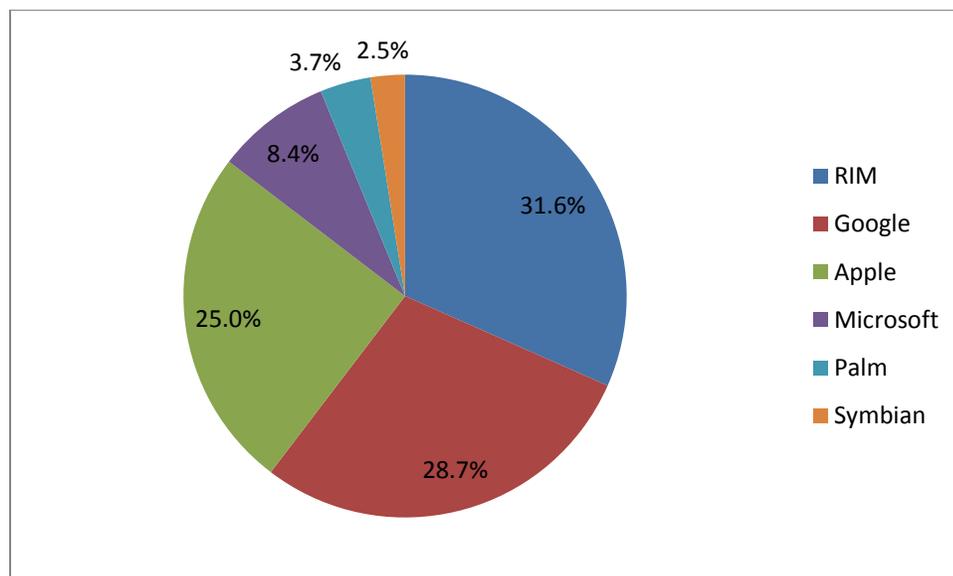
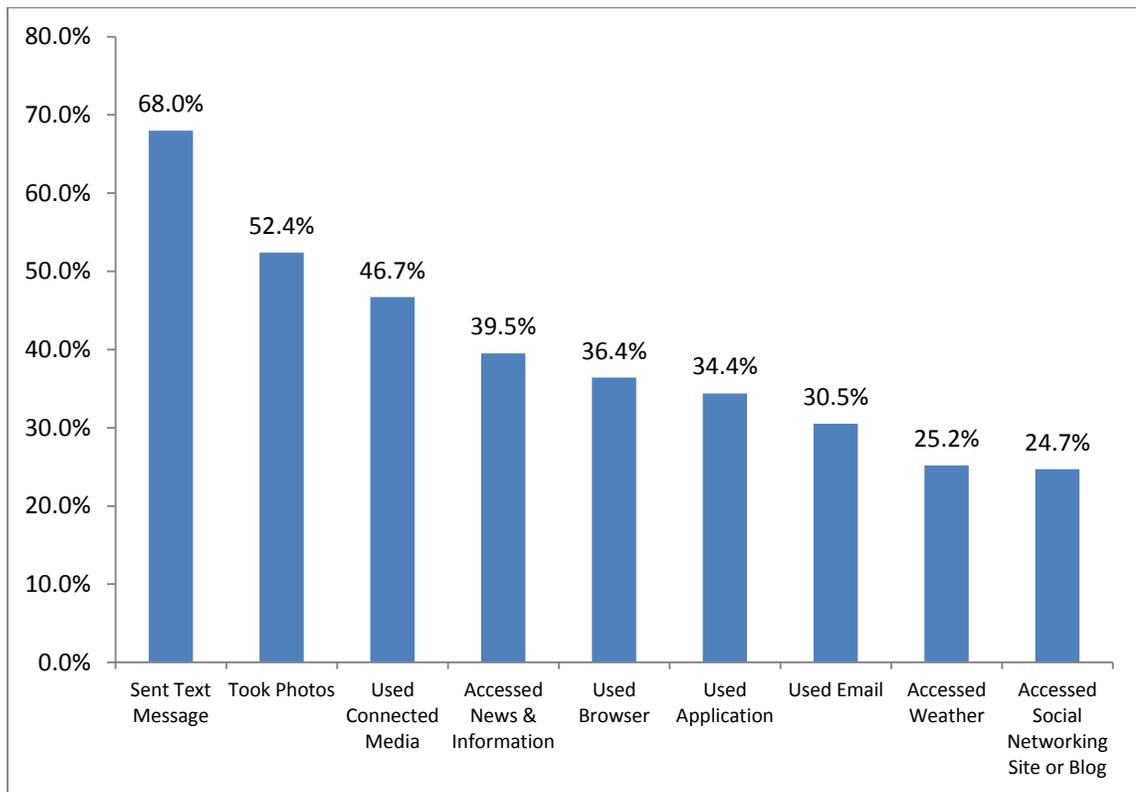


Figure 4.19. U.S. Smartphone OS Market Share December 2010 (comScore, 2011).

Key points from this data:

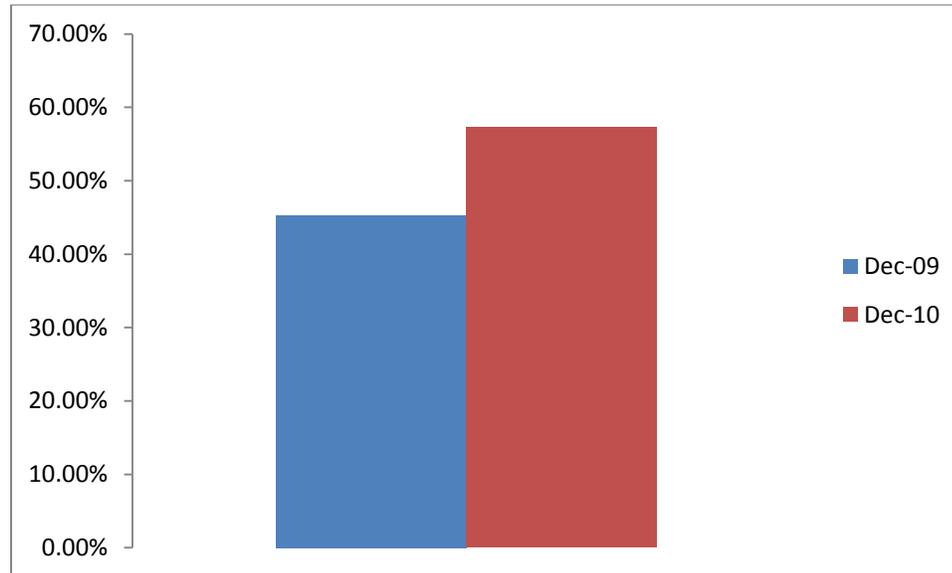
- RIM (Blackberry) has the largest market share at 31.6%.
- Google (Android) has the second largest share at 28.7%.
- Apple has the third largest share at 25%.



*Figure 4.20. Top Mobile Activities in the U.S. by % Share of Total Mobile Users December 2010 (comScore, 2011).*

Key points from this data:

- 68% of users sent text messages.
- 39.5% of users accessed news and information.
- 36.4% of users used their phone's browser.
- 30.5% of users used mobile email.
- 24.7% accessed a social networking site or a blog.



*Figure 4.21. % of Smartphone Subscribers Accessing Social Networking Sites or Blogs Ever in a Month (comScore, 2011).*

Key points from this data:

- As of December 2010, 57.3% of Smartphone subscribers accessed a social networking or blog site during the month.

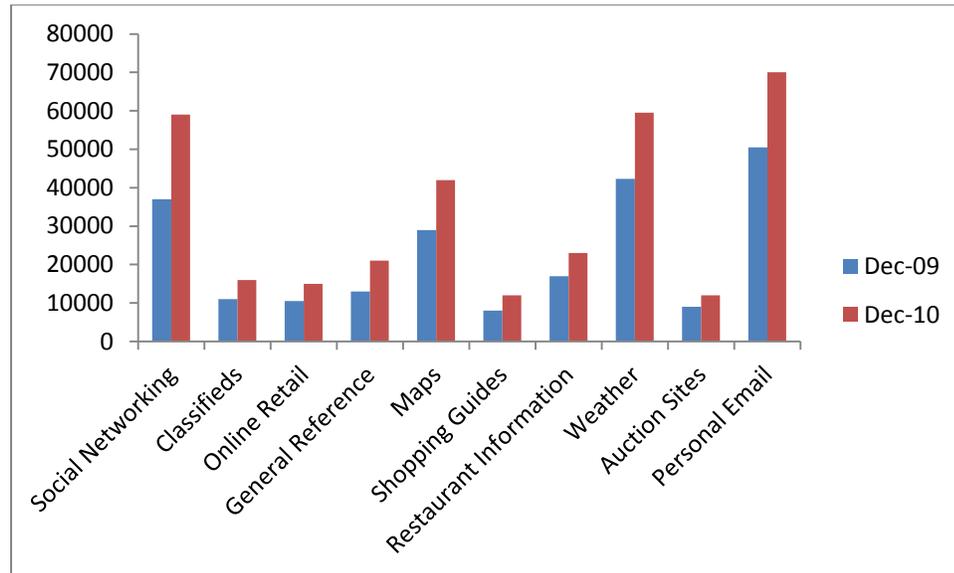
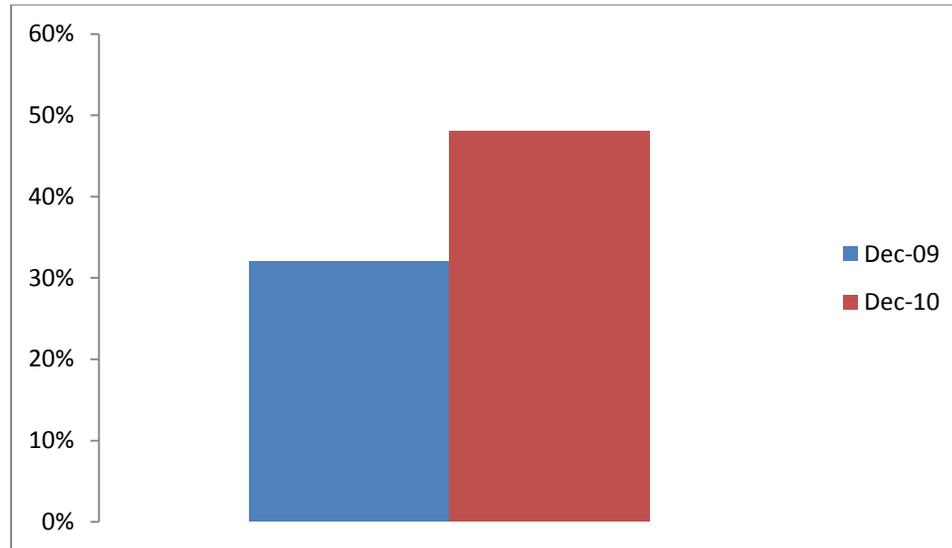


Figure 4.22. Fastest Growing Mobile Categories in the U.S. by Total Audience (000) (comScore, 2011).

Key points from this data:

- Social networking usage is up 56%.
- Personal email usage is up 39%.



*Figure 4.23. % Share of Mobile Handsets with Full Web Browsing Capabilities (comScore, 2011).*

Key points from this data:

- 48% of mobile users have full web browsing capabilities.
- Greater than 90% have full or partial web browsing capabilities.

#### 4.6.1. Interpretation of Mobile Device Data

With the observed level of growth of the smartphone market, combined with the increased popularity of high-speed data connections, it is reasonable to assume that the availability and usage of advanced mobile devices will continue to grow. The increased level of market penetration for these devices presents emergency alert system developers with exciting new tools and methodologies to exploit both in sending alerts and receiving data back from the public. Additionally, the increasing popularity of social media services on these devices adds credibility to these services, increasing their desirability for integration into alert systems. Regarding mobile device operating systems and application development, although there are many operating systems to choose from, the data suggests that the largest market shares belong to Apple, RIM, and Google. Accordingly, any specialized application development should be focused on these three markets to maximize

the potential user base. Overall, personal mobile devices represent incredible potential in emergency alert systems, and should be focused on appropriately.

#### 4.7. Cost Analysis

All of these alert methods have costs associated with their use, whether it is recurring per usage costs, or one-time development costs. This section will analyze the potential costs associated with each alert method, as well as classify each method as a high, medium, or low cost system.

##### 4.7.1. Facebook

Facebook as a service is free to use, so there are no recurring costs to be associated with its utilization. Developing the software to integrate Facebook with a web-based alert system would be a fairly simple task for an experienced web developer due to its well-documented API, so in terms of billed development time, the costs would be low. Making the public aware of the system's use of Facebook can be accomplished a number of ways, with varying costs. If an existing alert system is in place, sending out a message over available alert methods would be an effective way to advertise while only incurring the normal costs of operation. For a new system, utilizing Facebook's marketing platform would be an effective way of notifying the public, with the cost scaling with the size of the target audience. Facebook's advertising system bills based on the number of times the ad is clicked, or how many times the ad is viewed. For a small town, this could be extremely cost-effective based on the small audience size. For a larger city, the costs associated would rise with the number of clicks or views that ad receives. However, costs could be minimized by efficient ad targeting on the part of the agency, such as only targeting persons 18+ or residents of a certain area. Once a certain level of awareness of the new system is obtained, users could be encouraged to share the page with their friend via their Facebook wall or messaging system, effectively expanding awareness for free. Due to these factors, the initial costs associated with Facebook utilization can be classified as low to medium for implantation and marketing, and low for long-term usage.

#### 4.7.2. Twitter

Like Facebook, Twitter is free to use as a service and therefore has no associated long-term costs. Integration with existing systems, again, would be relatively simple for an experienced web developer, so development costs can be considered low. In terms of marketing and awareness, Twitter does not feature an advertising platform like Facebook's, so marketing would have to be handled via other implemented alert methods. After a certain level of awareness is attained, users can be asked to share information regarding the service among their followers, effectively creating free advertising. Considering these factors, costs associated with Twitter should be considered low.

#### 4.7.3. Instant Messaging (IM)

Basic text-based instant messaging services are free. The only potential costs associated with usage can be attributed to Skype, which charges the user if calls are made to traditional phone numbers (note that calls made to other Skype users are free). Advertising costs are likewise based on existing system usage costs, since IM network information is not shared socially as with Facebook and Twitter. The real costs associated with utilizing IM would be incurred in development. Developing an automated, scalable bulk-IM system for each network could be very time and resource-intensive depending on how many networking are being utilized, as well as the skills of the developers. Contracting with a bulk-IM service provider could also incur high usage costs. Given these concerns, IM costs should be considered medium to high depending on the complexity of the system being developed and the resource utilization required for development. However, once the system is in place, there are no costs associated with long-term usage.

#### 4.7.4. Email

A variety of variables factor in to the costs associated with bulk mailing. If the mail server is in-house and the software is available, the costs are defined by server utilization and bandwidth. A simple mail server setup may have practically no costs associated with its use, however a more robust, redundant mass-mailing server setup may have significantly higher costs associated. If the mailing is handled by a bulk mail service

provider, costs vary significantly. Some providers may charge based on the number of recipients, while others may charge based on the number of messages sent. Based on a review of sixteen service providers, assuming a hypothetical situation where 25,000 users are messaged four times per month (for a total of 100,000 messages sent), the per-user providers would charge \$75-\$160 per month, while the per-message providers, would charge \$160-\$815 per month (Karelia Software, 2010). Given these numbers, a per-user, rather than per-message, pricing structure would be more favorable if services would be rendered by a third party. Due to the number of variables associated with a mass-mailing implementation, overall cost can be considered low, medium, or high, depending on the individual situation.

#### 4.7.5. Blog/RSS

As with email, there are a multitude of variables to consider when approximating the costs associated with blog and RSS implementation. The first factor to consider is web hosting. If the web hosting is provided in-house by the managing agency, costs could be as low as a single web server plus bandwidth costs, or as high as a robust, multi-server web hosting setup with advanced redundancy and high-bandwidth, high-availability systems. Provided by a third party, the cost situation would be similar: A single website on a shared hosting platform can be very inexpensive, while a guaranteed-uptime dedicated solution would be considerably more expensive. Another factor to consider is the development of such a website. While free blog platforms (such as Wordpress and Drupal) exist, customizing them for the purpose of an emergency alert system would take a considerable number of development hours. Likewise, building the site from the ground up would also be very time-intensive from a development standpoint. Additionally, the maintenance involved with maintaining such a site, such as security fixes, addressing API changes, and feature upgrades, can also be resource-intensive. With all of these factors in mind, the costs associated with building and maintaining a suitable site should be considered medium to high.

#### 4.7.6. SMS

Since SMS services would almost certainly be handled by a third-party, costs can simply be attributed to their fees. Some providers, such as Nixle (Nixle, 2011), offer free SMS services to government agencies. However many other services charge on a per-message basis. As of this writing, the average fee per 1,000 messages appears to be around \$50, although the average cost per individual message tends to decrease as the number of messages purchased increases (EZ Texting Group, 2011) (Email Marketing Software, 2011) (SMS Roaming, 2011). Other providers charge a flat monthly rate based on the number of subscribers, however this varies significantly from vendor to vendor. Another factor to consider is that services like these may also bundle in other messaging services, such as email or IM, which can be more cost-effective for the organization depending on individual usage needs. Again, because the costs associated for a small town are significantly less than those of a large city, SMS costs can be classified as low, medium, or high.

#### 4.8. Conclusion

This section detailed data from numerous studies regarding the usage and implementation of various alert methods. Demographics, usage patterns, and overall costs were detailed and evaluated. The final chapter will discuss recommendations and guidelines for the implementation of a social media-based alert system.

## CHAPTER 5. CONCLUSIONS AND RECOMMENDATIONS

The following chapter will provide a set of guidelines and specifications for developing a social media and web-based emergency alert system. Recommended and optional alert methods will be discussed along with their integration methodologies, as well as reasoning for including specific methods in the system. Policies for implementing the system will also be recommended. Finally, an overall framework for the proposed system will be provided based on the gathered data.

### 5.1. Recommended Services

This section will detail services that should form the core of any web and social media-based alert system. Based on the available data, system features, and large user bases, these systems represent a profound opportunity for emergency alert system management personnel to exploit, both for reaching out to the public and also for receiving information back from them. Each subsection will discuss these alert methods, as well as how best to utilize them.

#### 5.1.1. Blogs/RSS

A blog can provide the ideal starting point for an online alert system. Although many advanced blogging platforms exist, the core of the blog is simply a dynamic front-end that shows recent posts/updates, and an administrative section that allows for the creation of new posts as well as updates or edits to existing posts without the need to manually edit any webpage code. A simple in-house blog setup can be created utilizing PHP and MySQL, which are both recommended due to their platform-independence. By establishing this basic blog site, an administrator gives the end-user one place to visit to receive detailed information regarding events that have been sent out via a multitude of alert methods.

RSS, which is a core feature of the modern blog, is highly recommended due to the proliferation of RSS readers on many platforms, both traditional PCs and mobile devices. RSS allows any end user to receive notification of new posts made on the site's blog via email, web browser, or a plethora of other feed reader applications. An RSS feed can be configured by the system administrator, or outsourced to one of many free RSS feed generators available online.

### 5.1.2. Facebook

The data shows that Facebook is currently the undeniable leader in social media. With its large user base, vast array of features, and friendly API for third-party developers, Facebook should undoubtedly be counted first in any alert system's array of notification methods. The aforementioned API provides a multitude of options for third-party developers to utilize, allowing a system administrator to post messages on Facebook, retrieve feedback from users, and send messages via Facebook all without actually accessing the Facebook site.

These features can be utilized through Facebook's app system. A Facebook app is an optional add-on to a user's Facebook account, one that allows for new features such as games, messaging, music, and potentially any sort of experience that can be created on a traditional website. For the purposes of an emergency alert system, a Facebook app could simply be utilized as a page for posting alerts on (which can then be seen by any user who 'likes' the app), although this is only the simplest method of utilizing an app. A system developer could also elect to use the app for a variety of other features, such as directly messaging users, retrieving information about their users, or even posting directly to a user's wall. Utilizing an app in this way, however, requires the user to allow the app specific permissions (such as profile access), and the more permissions requested, the more uncomfortable a user can become with allowing access to the app. A reputable entity (such as a police department) would likely have fewer 'trust' issues when it comes to app permissions, so it is up to the individual organization to determine what level of usage the app will require. At the bare minimum, though, an app page can serve as a place to simply post information with no special permissions required.

Though not required, developers should seek to utilize the API to integrate posting features directly into their website to avoid unnecessary steps in sending out alerts. By using Facebook's Graph API (Facebook, 2011) and cURL, a developer can create a form in the administrative section of their site to post messages to their app's wall. This simple feature can save an administrator time by keeping all update activity confined to the one website. Updates posted this way should provide a brief description of the event, as well as a link back to the main site where the event is described in greater detail. When an alert is sent via this method, it appears instantly on the user's newsfeed (depending on the user's personal settings).

Although users can be mass-messaged through Facebook's messaging system, this is not recommended unless specifically approved by the user. Use or overuse of this feature may discourage users from utilizing the system for fear of 'spam', and if a user replies to the message, all users who received the initial message will also receive the reply. This can create confusion amongst users and may lead to false information being spread. Accordingly, the mass-messaging feature should only be used with prior approval, or in the case of a significant emergency. Note also that, depending on the user's personal settings, messages sent through Facebook's messaging system will also be emailed to the user.

### 5.1.3. Twitter

Although the data shows that usage is comparatively low, Twitter presents a number of features to emergency alert systems that could be effectively utilized. To begin, Twitter usage has substantial room to grow. Non-users may just need a reason to make use the service, something an emergency alert system could provide. Additionally, Twitter seems to be an ideal messaging service on mobile devices. With many smart phones offering a number of Twitter applications, sending alerts via Twitter could potentially be as effective as SMS on a mobile phone (depending on how the app alerts the user regarding new messages). Finally, similar to Facebook, Twitter offers developers a robust API for third-party application development, a feature that makes integration with an alert system fairly simple. Utilizing the API, developers could potentially integrate Twitter directly into

the administrative section of their site, allowing them to submit an alert to Twitter without having to directly use the main site.

When utilizing Twitter, administrators will need to note that they are limited to 140-character messages. With this limitation in place, the best way to make use of Twitter for alerts would be to only send the type of alert, a very brief description, and a link to the event's page on the system's main site. In this manner, emergency management authorities can direct an interested user's attention towards more information while sending a very short message, a method desirable for users on a mobile device with a limited viewing area.

#### 5.1.4. SMS and Phone Apps

SMS is the ideal solution for reaching out to mobile phone users, however sending out large volumes of text messages on a regular basis can become extremely cost-prohibitive. Smaller agencies will likely not have the resources to create such a system in-house, and although there are many vendors who supply bulk-SMS services, the cost can still be an issue. Likewise, a small agency will not likely have the resources to develop a phone app specifically for their own use and would not receive enough benefits from such a system to justify the cost. Still, SMS is an extremely effective method for providing prompt alerts to the public, and should be a core part of any emergency alert system.

The solution to this cost/benefit issue can be fulfilled by free third-party service providers such as Nixle. Nixle is a service that provides free messaging solutions to government agencies. Using Nixle, an agency can send SMS and email alerts to anybody who opts in to the service, free of charge. Nixle claims that, in February 2011, it "provided its free commercial-grade text-based notification platform to almost 5,000 agencies and ... processed and paid for over 2,000,000 text messages" (Nixle, 2011). Nixle also provides a free iPhone app for its users to download. The availability of such a system provides an enormous opportunity to agencies that wish to make use of SMS and mobile phone apps, but do not have the resources to create their own systems. Any agency that utilizes a third-party service for these types of communication should clearly explain the partnership on their own website, and provide instructions to their users on how to sign up for the provided services.

### 5.1.5. Email

Email is used by nearly everybody with an Internet connection, and is now available nearly anywhere with a mobile device. It provides a near-instant way of sending information, and most modern webservers offer some sort of bulk mailer program. Administrators not wanting to manage their own mailing services can opt to make use of a plethora of third-party mailing services, some free and some paid with advanced redundancy and uptime features. Like SMS, email should be considered a core alert method.

## 5.2. Optional Services

This section will detail services that may be of benefit in certain situations, but should not be considered core components of an emergency alert system. It is up to the individual agency to determine if these services are worth the time and resources it takes to integrate them, and should only be pursued after surveying local users to determine the level at which the service would be utilized. These services could also be included to provide additional redundancy in alerts.

### 5.2.1. Instant Messengers (IM)

Although some IM networks boast an impressive number of users and offer an exceptional method for deploying text based messages instantly to PCs and mobile devices alike, integrating these methods into an emergency alert system may not be worth the resources it would take to develop a scalable, automated solution. Also, the messages sent via IM would be redundant to more traditional, reliable services such as email and SMS. Accordingly, investing in the development of a mass-IM deployment solution should only be considered if the agency in question has a large number of users in their particular area that favor one specific IM network. In lieu of a survey, development should be focused on the networks claiming the largest user bases.

One interesting exception is Skype, which offers a VoIP service that its competitors have yet to match. An agency could potentially use Skype to send pre-recorded audio messages to users, although this is not ideal for emergency alerts. For agencies wanting to

develop a more general alert system, this feature could be used to solicit data, alert the community regarding planned outages or events, and other suitable uses. After developing a system capable of this kind of operation, an agency could then treat their Skype users no different than traditional telephone users.

### 5.2.2. Social Bookmarking Services

While not technically an alert method, utilizing a social bookmarking service on an emergency alert system's website can potentially increase the awareness of an event by providing users with an easy way to share the event page on their preferred social media site. One example of an embeddable social bookmarking service is AddThis (AddThis, 2011). This service provides website administrators with code to embed a toolbar on their pages. This toolbar then allows users of the site to repost (or share) the page they are viewing with one click via Facebook, Twitter, email, and many other services. The availability of this feature can prompt users to share information about an event they feel strongly about, increasing awareness of the event and potentially opening up new avenues of information and exposure for an agency. While not a required service, social bookmarking integration is highly recommended due to the potential exposure it can provide for an event.

### 5.3. Policy and Usage

When and how to activate the emergency alert system plays a large role in its effective usage. Utilizing the system too often may be expensive, and can cause users to feel like they're being "spammed". Not utilizing the system enough may draw complaints from the public regarding their perceived safety upon discovery of the incident. To effectively balance these issues, administrators should choose to activate only certain parts of the system, depending on its severity. The following table presents an example policy breakdown for system usage.

*Table 5.1. Example alert policy breakdown.*

Severity	Alert Methods	Costs
High (Active Gunman, bomb threat, child abduction)	<ul style="list-style-type: none"> <li>All methods should be utilized for high-risk situations.</li> </ul>	High
Medium (traffic, weather alert)	<ul style="list-style-type: none"> <li>Email</li> <li>All social media channels</li> <li>IM (if available)</li> </ul>	Medium
Low (planned outages, community information)	<ul style="list-style-type: none"> <li>All social media channels</li> <li>Email (Depending on social media adoption rates)</li> </ul>	Low

Another way to implement effective alert policy is to allow users to decide what kind of alerts they want to receive over which alert methods (for example: Child abductions and public safety alerts over SMS, all alerts over email, etc). This ensures that the user does not “tune out” any alert methods they may have registered for, and may prevent accusations of “spamming”. However, the implementation of this method may significantly increase development time and system overhead.

#### 5.4. System Framework

The following framework will provide a set of guidelines and suggestions for designing and creating a social media-integrated web-based alert system. These guidelines assume a PHP/MySQL development environment due to the platform-independence of those languages, however it can be adapted to fit any preferred programming language and database backend.

##### 5.4.1. Site Design

The core of the system is the website, which can be divided into two sections: Public and administrative. The goal of the public section of the website is to present information to the public in a clear, concise manner, and to allow easy navigation to other parts of the site. The goal of the administrative section of the site is to provide the

administrator with an easy method for creating new posts and events, and to allow the administrator to modify the content of the site with minimal technical knowledge required. As with the database framework, this section will outline various pages belonging to the system and recommend core features to be included. To begin, the public section of the website, depicted in table 5.2.:

Table 5.2. Proposed public-side web site structure.

Page Name	Attributes
Index.php	<ul style="list-style-type: none"> <li>• The first page the user sees upon visiting the site</li> <li>• Displays most recent post as well as links to the next ten recent posts OR displays the five most recent posts and includes links to the five previous recent posts</li> <li>• Displays a list of recent incidents as links to the specific incident page</li> </ul>
Header.php	<ul style="list-style-type: none"> <li>• Included in all pages</li> <li>• Serves as a navigation bar with links to other pages on the site</li> <li>• Contains tracking code, such as Google Analytics</li> <li>• Dynamically sets the page's title</li> </ul>
Viewpost.php	<ul style="list-style-type: none"> <li>• Used to view individual posts from the blog</li> <li>• Dynamically loads post content based on POST or GET values passed by the browser</li> <li>• Contains links to other posts in the sidebar</li> </ul>
Incident.php	<ul style="list-style-type: none"> <li>• Displays data regarding an incident</li> <li>• Dynamically loads all content from the database based on the incident ID, which is passed via a GET or POST variable</li> <li>• Contains a social bookmarking toolbar to allow users to easily share the incident</li> <li>• Dynamically loads a Google Map if location data is present</li> </ul>
Register.php	<ul style="list-style-type: none"> <li>• Allows users to register for alerts</li> <li>• Contains a list of alert methods (checkboxes) which users may select to be notified by</li> <li>• Contains links to the site's Facebook and Twitter pages (if applicable) for users to follow</li> </ul>
Login.php	<ul style="list-style-type: none"> <li>• Allows administrators access to the administrative section of the site</li> <li>• Allows users to modify their selected alert methods</li> </ul>
Tipform.php	<ul style="list-style-type: none"> <li>• Allows users to submit tips regarding incidents</li> <li>• All fields except the tip content are optional to allow for anonymous tips</li> <li>• Upon submission of a new tip, emails the tip to the administrator in addition to storing it in the database</li> </ul>

A recommended layout for the administrative section is as depicted in table 5.3.

*Table 5.3. Proposed administrator-side web site structure.*

Page Name	Attributes
Admin.php	<ul style="list-style-type: none"> <li>• Allows administrators to add new posts</li> <li>• Allows administrators to edit or delete existing posts</li> <li>• Allows administrators to create or modify incidents</li> </ul>
Adminheader.php	<ul style="list-style-type: none"> <li>• Included in all administrative pages</li> <li>• Includes links to other pages in the administrative section</li> <li>• Unnecessary if header.php checks for user type before displaying links</li> </ul>
Settings.php	<ul style="list-style-type: none"> <li>• Allows users to set various attributes regarding the site's functions               <ul style="list-style-type: none"> <li>○ Organization Name</li> <li>○ Facebook API Data</li> <li>○ Twitter API Data</li> <li>○ Alert methods available</li> </ul> </li> </ul>
Alert.php	<ul style="list-style-type: none"> <li>• Allows administrators to send alerts</li> <li>• Contains text fields for submitting data to Facebook, Twitter, and other sources OR contains one text field for submitting to all sources               <ul style="list-style-type: none"> <li>○ Note that the unified field may be more efficient than multiple fields, but can be restricted by Twitter's 140 character limit</li> </ul> </li> </ul>
Newincident.php	<ul style="list-style-type: none"> <li>• Multi-part, state-based file that displays contents based on POST variables</li> <li>• First state allows the administrator to create a new incident name and type</li> <li>• Second state allows the administrator to add a child entry table to the incident via a list of available child table types</li> <li>• Third state allows the administrator to add data to a child table entry</li> <li>• After creating a new child table entry, cycles back to the second state</li> </ul>

*Table 5.3. Proposed administrator-side web site structure continued.*

Editincident.php	<ul style="list-style-type: none"> <li>• Dynamically loads all existing child table entries in a list</li> <li>• Administrator can select child table entries to edit or delete them</li> <li>• Allows the administrator to create new child table entries</li> <li>• Allows the administrator to delete or rename the incident</li> </ul>
Upload.php	<ul style="list-style-type: none"> <li>• Allows administrators to upload or remove images to/from an incident</li> <li>• Allows administrators to add or edit image descriptions</li> </ul>
Viewtips.php	<ul style="list-style-type: none"> <li>• Displays recent tips</li> <li>• Contains a dropdown box with all incident which loads all related tips upon selection</li> </ul>
Export.php	<ul style="list-style-type: none"> <li>• Exports contacts to a file for selected alert methods             <ul style="list-style-type: none"> <li>○ This feature is suggested for ease of importing contacts to other programs, such as a mailing list</li> </ul> </li> </ul>

These files are recommended as a minimum for a functional alert system, and do not include backend code files for processing and methods. The methodologies for these types of files changes based on programming language and personal preference, and are up to the individual developer to implement. Overall design should focus on ease of use and functionality, with aesthetic appeal an important concern to keep the user interested. As with any software tool, proper programming standards should be observed, with particular focus being paid to securing the system's user data, as well as protection against SQL injection attacks. Additionally, before beginning any extensive developmental tasks, the local market should be surveyed to gauge the acceptance of the new system, as well as gain a sense of how much the system would be utilized.

### 5.5. Conclusion

Based on these data, the priority for integration and desirability of the proposed systems can be represented by table 5.4. Priority is determined partially by the potential reach and cost-effectiveness of the system, and partially by the necessity of other systems to be in place prior to the integration of the system. For example, effectively integrating Twitter would require systems already in place to advertise the existence of the Twitter integration. With a blog site and Facebook integration already in place, alerting Twitter users to the availability of the new system would be inexpensive and prompt.

*Table 5.4. System priority and desirability.*

System	Cost	User Base	Ease of Development	Reliability	Priority
Blog/RSS	Medium	N/A	Simple	High	Highest
Facebook	Low	High	Simple	High	High
SMS	Medium to High	High	N/A	High	High
Email	Medium	High	N/A	High	High
Twitter	Low	Low	Simple	Medium to High	Medium
IM	Low to High	High	Complex	Medium to High	Low
Mobile Apps	Low to High	Low	Simple to Complex	High	Low

The emergency alert field has much to gain from the adoption of social networking techniques, as well as the inclusion of existing social media services in their alert systems. Many of the proposed systems have no operating expense outside of the initial development costs and offer large audiences to be interacted with. These systems represent new and valuable ways of interacting with the public, both from an alert as well as

information-gathering standpoint. The overall effect of the implementation of the suggested systems is one of redundancy, allowing more users to be reached in more ways. Every additional user potentially represents one more crucial piece of information, or one fewer victim, and steps should be taken to ensure they are reached.

#### 5.6. Future Work

More research is needed before a complete understanding of social media interactions in an emergency alert system is attained. Topics that are in need of further scrutiny include how the size of an organization impacts the availability and use of certain systems, how the number of users of or messages sent with each system effects the delivery time of alerts, the proportion of users who retrieve information from the services rather than having it sent directly to them (push vs. pull), and how this effects notification time, the differences between PC and mobile alert methods, the total reach of the proposed systems and how they can be expanded, and other usability and accessibility concerns. Efficient system development is also a pressing concern. Appendix C depicts certain elements of an alert system's database that may prove useful, however the ideal structure of such a database is unknown and therefore requires additional research.

Increased understanding will produce better systems, and through better systems, more people will be alerted to dangerous situations. As technology continues to improve, emergency alert systems must continue to advance to take advantage of these improvements. Therefore, research in this field must be constantly ongoing and always searching for ways to improve.

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APPENDICIES

## APPENDIX A

localhost ▶ alexb\_forensics ▶ VictimTable

MySQL returned an empty result set (i.e. zero rows). (Query took 0.0004 sec)

```

SELECT *
FROM `VictimTable`
LIMIT 0, 30

```

Field	Type	Collation	Attributes	Null	Default	Extra	Action
<input type="checkbox"/> Victim_ID	int(5)			No	None		
<input type="checkbox"/> Indiciant_ID	int(5)			No	None		
<input type="checkbox"/> Victim_FName	varchar(16)	latin1_swedish_ci		No	None		
<input type="checkbox"/> Victim_LName	varchar(16)	latin1_swedish_ci		No	None		
<input type="checkbox"/> Victim_Gender	text	latin1_swedish_ci		No	None		
<input type="checkbox"/> Victim_Age	int(3)			No	None		
<input type="checkbox"/> Victim_Height	int(3)			No	None		
<input type="checkbox"/> Victim_Weight	int(3)			No	None		
<input type="checkbox"/> Victim_HairColor	varchar(10)	latin1_swedish_ci		No	None		
<input type="checkbox"/> Victim_EyeColor	varchar(10)	latin1_swedish_ci		No	None		
<input type="checkbox"/> Victim_Clothing	longtext	latin1_swedish_ci		No	None		
<input type="checkbox"/> Victim_Picture	blob		BINARY	No	None		

Check All / Uncheck All With selected:

Print view [Propose table structure](#)

Add 1 field(s) At End of Table At Beginning of Table After Victim\_ID Go

Indexes: 0

Action	Keyname	Type	Unique	Packed	Field	Cardinality	Collation	Null	Comment
	PRIMARY	BTREE	Yes	No	Victim_ID	0	A		
	Indiciant_ID	BTREE	No	No	Indiciant_ID	0	A		

Create an index on 1 columns Go

+ Details...

Figure A.1. An example table structure from the system database.

## APPENDIX B

*The following PHP code creates the proposed database structure.*

```

<?php
include("connection.php");
echo "Creating database structure...please wait.";
$cxn=mysqli_connect($host,$user,$password,$dbname)
or die ("Couldn't connect to server.");

$query="CREATE TABLE IncidentTable (
            incident_ID int AUTO_INCREMENT,
incident_TypeID VARCHAR(30) NOT NULL,
            incident_Title VARCHAR(100) NOT NULL,
            incident_Date VARCHAR(30) NOT NULL,
            PRIMARY KEY(incident_ID));";

$query2="CREATE TABLE user (
            username VARCHAR(30) NOT NULL,
            password VARCHAR(30) NOT NULL,
            PRIMARY KEY(username));";

$query3="CREATE TABLE IncidentType (
            incident_TypeID int AUTO_INCREMENT,
            incident_TypeName VARCHAR(30) NOT NULL,
            PRIMARY KEY(incident_TypeID));";

$query4="CREATE TABLE VictimTable (
            victim_ID int AUTO_INCREMENT,
            incident_ID int NOT NULL,
            victim_FName VARCHAR(30) NULL,
            victim_LName VARCHAR(30) NULL,
            victim_Gender VARCHAR(30) NULL,
            victim_Age VARCHAR(30) NULL,
            victim_Height VARCHAR(30) NULL,
            victim_Weight VARCHAR(30) NULL,
            victim_Hair TEXT NULL,
            victim_EyeColor VARCHAR(30) NULL,
            victim_Clothing TEXT NULL,
            victim_LastLocation TEXT NULL,
            victim_OtherInfo TEXT NULL,

```

```

image_id INT NULL,
PRIMARY KEY (victim_ID));

$query5="CREATE TABLE SuspectTable (
    suspect_ID int AUTO_INCREMENT,
    incident_ID int NOT NULL,
    suspect_FName VARCHAR(30) NULL,
    suspect_LName VARCHAR(30) NULL,
    suspect_Gender VARCHAR(30) NULL,
    suspect_Age VARCHAR(30) NULL,
    suspect_Height VARCHAR(30) NULL,
    suspect_Weight VARCHAR(30) NULL,
    suspect_Hair TEXT NULL,
    suspect_EyeColor VARCHAR(30) NULL,
    suspect_Clothing TEXT NULL,
    suspect_LastLocation TEXT NULL,
    suspect_OtherInfo TEXT NULL,
    image_id INT NULL,
    PRIMARY KEY (suspect_ID));

$query6="CREATE TABLE VehicleTable (
    vehicle_ID int AUTO_INCREMENT,
    incident_ID int NOT NULL,
    vehicle_make VARCHAR(30) NULL,
    vehicle_model VARCHAR(30) NULL,
    vehicle_year VARCHAR(30) NULL,
    vehicle_color VARCHAR(30) NULL,
    vehicle_type VARCHAR(30) NULL,
    vehicle_LicensePlate VARCHAR(30) NULL,
    vehicle_OtherInfo TEXT NULL,
    image_id INT NULL,
    PRIMARY KEY (vehicle_ID));

$query7="CREATE TABLE Posts(
    post_ID int AUTO_INCREMENT,
    post_title VARCHAR(50) NOT NULL,
    post_content VARCHAR(5000) NOT NULL,
    post_datetime VARCHAR(20) NOT NULL,
    PRIMARY KEY (post_ID));

$query8="CREATE TABLE LocationTable(
    location_ID int AUTO_INCREMENT,
    incident_ID int NOT NULL,
    location_Name VARCHAR(30) NULL,
    location_CrossStreet VARCHAR(30) NULL,
    location_Address VARCHAR(30) NULL,
    location_City VARCHAR(30) NULL,

```

```

location_State VARCHAR(30) NULL,
location_Type VARCHAR(30) NULL,
location_Radius VARCHAR(30) NULL,
location_Other TEXT NULL,
PRIMARY KEY(location_ID));
$query9="CREATE TABLE OtherInfoTable(
otherinfo_ID int AUTO_INCREMENT,
incident_ID int NOT NULL,
other_info TEXT NULL,
PRIMARY KEY(otherinfo_ID));
$query10="CREATE TABLE fbappTable(
ID int AUTO_INCREMENT,
app_ID VARCHAR(100) NOT NULL,
app_Secret VARCHAR(100) NOT NULL,
access_Token VARCHAR(100) NOT NULL,
PRIMARY KEY (ID));
$query11="CREATE TABLE Settings(
ID int AUTO_INCREMENT,
twitter_username VARCHAR(30) NULL,
facebook_notify VARCHAR(30) NOT NULL,
twitter_notify VARCHAR(30) NOT NULL,
email_notify VARCHAR(30) NOT NULL,
aim_notify VARCHAR(30) NOT NULL,
msn_notify VARCHAR(30) NOT NULL,
yahoo_notify VARCHAR(30) NOT NULL,
SMS_notify VARCHAR(30) NOT NULL,
org_name VARCHAR(30) NOT NULL,
PRIMARY KEY (ID));
$query12="CREATE TABLE Contacts(
contact_ID int AUTO_INCREMENT,
email_address VARCHAR(50) NULL,
phone_number VARCHAR(20) NULL,
aim VARCHAR(30) NULL,
msn VARCHAR(30) NULL,
yahoo VARCHAR(30) NULL,
PRIMARY KEY (contact_ID));
$query13="CREATE TABLE images(
image_id serial,
incident_ID int NOT NULL,
image_description VARCHAR(350) NULL,
filename varchar(255) NOT NULL,
mime_type varchar(255) NOT NULL,
file_size int NOT NULL,

```

```
file_data longblob NOT NULL,
PRIMARY KEY (image_id),
index (filename));
```

```
$query14="INSERT INTO Settings (ID, twitter_username, facebook_notify,
twitter_notify, email_notify, aim_notify, msn_notify, yahoo_notify, SMS_notify,
org_name) VALUES(,,,,,,,'New SMIRCS Installation');"
```

```
$query15="INSERT INTO IncidentType (incident_TypeName)
VALUES('Abduction'),('Public Disturbance'), ('Public Safety'), ('Active Gunman'),
('Weather'), ('Traffic Alert'), ('Robbery'), ('Arson'), ('Other');"
```

```
$query16="CREATE TABLE tips(
```

```
tip_ID int AUTO_INCREMENT,
tip_IncidentID int NOT NULL,
tip_Name VARCHAR(30) NULL,
tip_Email VARCHAR(30) NULL,
tip_Phone VARCHAR(30) NULL,
tip_Content TEXT NULL,
PRIMARY KEY (tip_ID));"
```

```
mysql_query($cxn,$query)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query2)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query3)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query4)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query5)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query6)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query7)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query8)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query9)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query10)
or die ("A problem occurred during installation.");
mysql_query($cxn,$query11)
or die ("A problem occurred during installation.");
```

```
        mysqli_query($cxn,$query12)
or die ("A problem occurred during installation.");
        mysqli_query($cxn,$query13)
or die ("A problem occurred during installation.");
        mysqli_query($cxn,$query14)
or die ("A problem occurred during installation.");
        mysqli_query($cxn,$query15)
or die ("A problem occurred during installation.");
        mysqli_query($cxn,$query16)
or die ("A problem occurred during installation.");
```

```
mysqli_close($cxn);
?>
```

## APPENDIX C

*Proposed database elements*

Table C.1. Database elements part 1.

Table Name	Attributes
Users	<ul style="list-style-type: none"> <li>• Username</li> <li>• Password</li> </ul>
Posts	<ul style="list-style-type: none"> <li>• Post ID</li> <li>• Post Title</li> <li>• Post Date</li> <li>• Post Content</li> </ul>
Settings	<ul style="list-style-type: none"> <li>• Organization Name</li> <li>• Facebook API Data <ul style="list-style-type: none"> <li>○ App ID</li> <li>○ Access Token</li> <li>○ App Secret</li> </ul> </li> <li>• Twitter API Data</li> <li>• Alert method Booleans <ul style="list-style-type: none"> <li>○ Facebook</li> <li>○ Twitter</li> <li>○ Email</li> <li>○ SMS</li> <li>○ IM Networks</li> </ul> </li> </ul>
Contacts	<ul style="list-style-type: none"> <li>• Email Address</li> <li>• Phone Number</li> <li>• IM Network Username(s)</li> <li>• Twitter Username</li> <li>• Facebook Username</li> </ul>
Images	<ul style="list-style-type: none"> <li>• Image ID</li> <li>• Incident ID</li> <li>• Image Description</li> <li>• Image Filename</li> <li>• Image MIME Type</li> <li>• Image File Size</li> <li>• Image File Data</li> </ul>
Tip Form	<ul style="list-style-type: none"> <li>• Tip ID</li> <li>• Incident ID</li> <li>• Tip Name (the name of the user submitting the tip)</li> <li>• Tip Email Address</li> <li>• Tip Phone Number</li> <li>• Tip Content</li> </ul>

Table C.2. Proposed database elements part 2.

Table Name	Attributes
Incident Table	<ul style="list-style-type: none"> <li>• Incident ID</li> <li>• Incident Name</li> <li>• Incident Date</li> <li>• Incident Type</li> </ul>
Incident Type	<ul style="list-style-type: none"> <li>• Incident Type ID</li> <li>• Incident Type Name (Abduction, Public Disturbance, Active Gunman, etc)</li> </ul>
Victims	<ul style="list-style-type: none"> <li>• Incident ID</li> <li>• Victim ID</li> <li>• Victim First Name</li> <li>• Victim Last Name</li> <li>• Victim Gender</li> <li>• Victim Age</li> <li>• Victim Hair Color</li> <li>• Victim Eye Color</li> <li>• Victim Height</li> <li>• Victim Weight</li> <li>• Victim Clothing</li> <li>• Victim Last Location</li> <li>• Victim Other Info</li> <li>• Victim Image ID</li> </ul>
Suspects	<ul style="list-style-type: none"> <li>• Incident ID</li> <li>• Suspect ID</li> <li>• Suspect First Name</li> <li>• Suspect Last Name</li> <li>• Suspect Gender</li> <li>• Suspect Age</li> <li>• Suspect Hair Color</li> <li>• Suspect Eye Color</li> <li>• Suspect Height</li> <li>• Suspect Weight</li> <li>• Suspect Clothing</li> <li>• Suspect Last Location</li> <li>• Suspect Other Info</li> <li>• Suspect Primary Image ID</li> </ul>

*Table C.2. Proposed database structure part 2 continued.*

Vehicles	<ul style="list-style-type: none"> <li>• Incident ID</li> <li>• Vehicle ID</li> <li>• Vehicle Make</li> <li>• Vehicle Model</li> <li>• Vehicle Color</li> <li>• Vehicle License Plate</li> <li>• Vehicle Other Info</li> </ul>
Locations	<ul style="list-style-type: none"> <li>• Incident ID</li> <li>• Location ID</li> <li>• Location Name</li> <li>• Location Address</li> <li>• Location City</li> <li>• Location State</li> <li>• Location Exclusion Zone (event radius)</li> <li>• Location GPS coordinates</li> <li>• Location Type (business, private residence, etc)</li> <li>• Location Cross Street</li> </ul>
Other Info	<ul style="list-style-type: none"> <li>• Incident ID</li> <li>• Other Info ID</li> <li>• Other Info Text</li> </ul>