2007

Location-Based Services in Emergency Management- from Government to Citizens: Global Case Studies

A. Aloudat
University of Wollongong, aa279@uow.edu.au

Katina Michael
University of Wollongong, katina@uow.edu.au

Jun Yan
University of Wollongong, jyan@uow.edu.au

Publication Details

This paper was originally published as Aloudat, A, Michael, K and Yan, J, Location-Based Services in Emergency Management- from Government to Citizens: Global Case Studies", in Mendis, P, Lai, J, Dawson, E and Abbass, H, Recent Advances in Security Technology, Australian Homeland Security Research Centre, Melbourne, 2007, 190-201.

Location-Based Services in Emergency Management- from Government to Citizens: Global Case Studies

Abstract
In emergencies governments have long utilised broadcasting media like radio and television to disseminate up-to-date real-time information to citizens. In the same context, however, some other technologies like mobile location-based services have not been utilised to full extent or potential. The value of such services could be foreseen in the case of critical situations where the coordination of emergency management procedures with location-awareness activities is paramount. This paper tracks the introduction of location-aware services in the realm of emergency management. It investigates case studies where text messaging has been exploited to deliver safety information and early warnings to users based on the availability of their location information. This paper also examines the reasons for not adopting and using technologies like cell broadcasting at present.

Keywords
emergency management, location-based services, public safety, real-time information, mobile alerts, case study, technology adoption

Disciplines
Physical Sciences and Mathematics

Publication Details
This paper was originally published as Aloudat, A, Michael, K and Yan, J, Location-Based Services in Emergency Management- from Government to Citizens: Global Case Studies", in Mendis, P, Lai, J, Dawson, E and Abbass, H, Recent Advances in Security Technology, Australian Homeland Security Research Centre, Melbourne, 2007, 190-201.

Location-Based Services in Emergency Management- from Government to Citizens: Global Case Studies

Anas Aloudat, Katina Michael, and Jun Yan
School of Information Systems and Technology
University of Wollongong
[aa279 | katina | jyan]@uow.edu.au

ABSTRACT: In emergencies governments have long utilised broadcasting media like radio and television to disseminate up-to-date real-time information to citizens. In the same context, however, some other technologies like mobile location-based services have not been utilised to full extent or potential. The value of such services could be foreseen in the case of critical situations where the coordination of emergency management procedures with location-awareness activities is paramount. This paper tracks the introduction of location-aware services in the realm of emergency management. It investigates case studies where text messaging has been exploited to deliver safety information and early warnings to users based on the availability of their location information. This paper also examines the reasons for not adopting and using technologies like cell broadcasting at present.

BIOGRAPHY

Anas Aloudat is a Ph.D. candidate in School of Information Systems and Technology, University of Wollongong. He has a Bachelor and Master degrees in Computer Science. His research focus is location-based solutions for emergency management. Other research interests include advance mobile technologies, navigation systems, and telecommunications.

Dr. Katina Michael PhD (UOW) 2003, BIT (UTS) 1996, Senior Member IEEE '04. Katina is on the *IEEE Technology and Society Magazine* editorial board, and is the technical editor of the *Journal of Theoretical and Applied Electronic Commerce Research*. Her research interests are in the area of location-based services, emerging mobile technologies, national security, and their respective socio-ethical implications. Katina is currently a senior lecturer in the School of Information Systems and Technology, Faculty of Informatics, University of Wollongong, Australia. She teaches eBusiness, strategy, innovation and communication security issues, and is the research administrator of the IP Location Based Services Program. Katina has authored over 40 refereed papers and is currently working towards the completion of her second book. Katina is also studying towards a Masters of Transnational Crime Prevention in the Faculty of Law. She has held several industry positions including as an analyst for United Technologies in 1993, Andersen Consulting in 1996, and a senior network and business planner for Nortel Networks (1996-2001). In her role with Nortel she had the opportunity to consult to telecommunication carriers throughout Asia.

Dr. Jun Yan is currently an Australian Postdoctoral Fellow (APD) and a Lecturer in School of Information Systems and Technology, University of Wollongong. He received a PhD, a Master degree, and a Bachelor degree, all in Information Technology. His research interests include location-based services, service-oriented computing, workflow, and agent technologies.

1 Introduction

Emergencies and their aftermath have been a part of civilisation since time began. Emergencies including natural and man-made disasters, by their nature, cannot be predicted precisely in their timing, effects, or intensity. However, human societies have always

practiced Emergency Management (EM) activities. Such activities have evolved from simple precautions and scattered procedures into more sophisticated management systems that include preparedness, response, mitigation, and recovery strategies (Canton, 2007). In the twentieth century, countries have utilised technologies like sirens, radio, television, and Internet to deliver warnings and real time information to citizens. Over the past few years, other technologies like mobile phone messaging systems have been exploited to complement traditional emergency systems. They have emerged as a practical solution since users' location(s) can be determined using different existing positioning techniques, which then facilitates the providing of services based on derived location information (Küpper, 2005). European Telecommunications Standards Institute has discerned between two types of mobile emergency service applications (European Telecommunications Standards Institute, 2006). The first is initiated by a citizen in the form of a mobile phone call or a distress Short Message Service. This service is known as wireless E911 in the United States and E112 in the European Union. In this case, mobile service providers are obliged to provide information regarding the location of the originated call or message with accuracies within 50 to 150 metres (International Telecommunication Union, 2002). The second is initiated by the government in which alerts, notifications, or early warnings are disseminated (pushed) to all citizens located in designated area(s).

Several studies have proposed mobile technologies as possible solutions to deliver location-based emergency information and warning notifications (Krishnamurthy, 2002), (Weiss et al., 2006); however, their feasibility has not been well documented. This paper provides an overview of the technologies and their use in real global EM cases. The focus here is to investigate the value of such services and the obstacles behind their late adoption. The rest of the paper is organised as follows. Section 2 provides a background of different mobile technologies in the realm of EM. Section 3 investigates the reasons behind the late adoption of such technologies and presents actual global case studies of Government-to-Citizens (G2C) Location-Based Services (LBS). Section 4 concludes this paper and outlines authors' future work.

2 Applied Mobile Technology Solutions for Emergency Management Applications

Mobile technologies have emerged as possible solutions to deliver warning notifications and emergency alert information. For example, the new 3G standard "Multimedia Broadcast Multicast Service (MBMS)" could be used to broadcast emergency information to disaster areas with rich multimedia content like voice instructions and evacuation maps (Ericsson.com, 2007). Determining which technology to utilise depends essentially on emergency services providers' perception of the types, capabilities, and limitations of currently used mobile handsets and other handheld devices. Perhaps the two most feasible technologies that fulfil the requirements of emergency alert information service are the common Short Message Service (SMS) and the less used but comparable Cell Broadcast Service (CBS). Both could be used for geo-specific EM purposes and two technologies would operate with almost all mobile devices available today. A brief introduction of the two technologies and their characteristics are presented in this section.

2.1 Short Message Service

SMS is a well-know asynchronous protocol of communication. It is capable of transmitting limited size of binary or text messages to one or more recipients. SMS offers virtual guarantee for message delivery to its destination (European Telecommunications Standards Institute, 2006). In case of an unavailable network coverage or temporary failure, the message is stored in the Short Message Service Centre (SMSC) network component and delivered when the destination becomes available. The message will also be delivered if the mobile handset is engaged with a voice and/or data activity. SMS messages do not consume

much bandwidth although the network might become overloaded if an immense number of SMS messages and/or phone calls have been initiated simultaneously. Delays can occur and may result in delivery failure, especially during emergencies and disasters time. SMS does not provide any geo-specific location information by itself. Such information like cell ID must be obtained from other resources by mobile service provider. However, SMS does have the potential to be used in location-based emergency services. Mass SMS messages can be directed to specific mobile numbers when they have been identified to exist in designated area(s).

2.2 Cell Broadcasting Service

Cell broadcasting technology is a service delivered by mobile providers where uniform text messages are broadcast indiscriminately to all mobile handsets in a specific geographic area. The messages could be broadcast to all towers in a carrier network covering a whole country or to a specific cell covered by a single tower.

Cell broadcast service (CBS) has not been widely adopted in commercial applications. Unlike SMS, the nature of CBS does not allow for two-way interactive communication. Although there are few proprietary solutions that exist today, they require specific Subscriber Identity Module (SIM) toolkit and special back-end content management systems (celltick.com, 2003). However, one example is found in the United States where television and radio stations in rural states pay to broadcast messages to mobile users in situations like severe weather in hope to attract users to their channels for further information (O'Brien, 2006).

The cell broadcasting spectrum has the capacity of 64000 different channels. Each channel could be used for a different type of messaging, e.g. weather warnings, traffic reports, public health advices, etc. Some channels are reserved for broadcasting specific-purpose messaging types. For example, the "cell/area info display" service allows a cell to broadcast its geo-specific information (Name or ID) directly to its handsets by utilising channel 050. In Figure 1, the info message is directly exposed on the handset screen in the idle state.

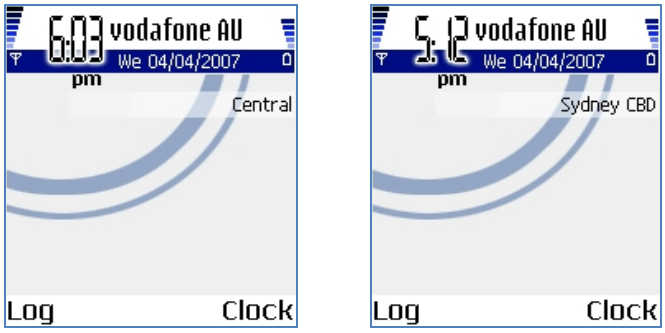

Figure 1. Vodafone Cell info display service

CBS does not require the foreknowledge of mobile phone numbers. Analogous to radio, only the activated channel (switched to) would receive the broadcast. The handset has to be switched on to start receiving messages. A message will not be received if the handset is switched on after broadcasting. CBS is conveyed on dedicated channels by using a fraction of the bandwidth that is normally used for mobile phone calls and SMS text messages. Therefore, it will not place additional demand on carrier resources or suffer any degradation when network becomes highly congested during emergency incidents or calamity events (CellCast Communications, 2006).

2.3 SMS and CBS for Location-Based Emergency Management

It is important to mention that other technologies such as Enhanced Messaging Service (EMS), Multimedia Messaging Service (MMS), and MBMS might be potentially used to deliver geo-specific emergency alert messages. However, all the cases that have been

recorded were deployed by using either SMS or CBS. Table 1 presents a comparison of characteristics of two technologies in the domain of EM.

Table 1. Characteristics of SMS and CBS for EM

Characteristic	Short Message Service	Cell Broadcast Service
Handset compatibility	All handsets support SMS	Most handsets support CBS except few e.g. Nokia 3310 (celltick.com, 2003)
Transmission form	Unicast and Multicast communication	Broadcast service. Message received indiscriminately by every handset within broadcast range
Mobile number dependency	Dependent. Foreknowledge of mobile number(s) is essential	Independent. Message is received on activate broadcasting channel
Location dependency	Independent. User receives the message anywhere	Dependent. Targets one cell or more
Geo-information	Achieved by obtaining cell ID from the network operator	Cell(s) location is known for broadcaster beforehand
Service barring	No barring	Received only if the broadcast reception status is set to "ON"
Reception	Message is received once the mobile is switched on	No reception if handset is switched on after broadcasting
Congestion and delay	Affected by network congestions. Immense number of SMS may produce delays	Congestion is unlikely as CBS are sent on dedicated channels. Almost no delays except if received in poor coverage area
Delivery failure	Network overload might cause delivery failure	Busy mobile handset might fail to process a CBS message
Delivery confirmation	Sender can request delivery confirmation	No confirmation of delivery
Repetition rate	No repetition rate	Can be repeated periodically within 2 to 32 minutes intervals
Language format	Identical to all receivers	Multi-language messages can be broadcast on multiple channels simultaneously
Spamming	Some mobile service providers support internet connectivity. Internet-based SMS spamming is possible	Not possible expect through uncontrolled access to mobile network infrastructure and lack of safeguards by an irresponsible service provider

Adapted from: (National Communications System, 2003), (European Telecommunications Standards Institute, 2006)

3 Worldwide Adoption of Location-Based Services for Emergency Management

3.1 Late Adoption and Diffusion

Very recently, a few countries have deployed LBS but some seem reluctant to integrate such technologies in their existing emergency alert systems due to reasons such as regulations, resistance of mobile providers, and privacy concerns. However, the characteristics of previously-used technologies indicate great potential for LBS to be used alongside existing emergency alert systems to complement their role of keeping people informed. Among the pioneers who have tested and adopted LBS technology are Belgium

(Libbenga, 2005), The Netherlands, Singapore, Japan, and South Korea. In particular, South Korea is the first country in the world to implement a nationwide mobile alert CBS-based emergency system (Ho, 2006). The following points summarise legal, political, and technical arguments behind the lack of adoption and diffusion of LBS in EM.

- Attractive Business Model: One of the biggest obstacles for adoption of CBS has been finding a visible business model that can lure mobile operators to use it since information is sent without registration to whom it is delivered (celltick.com, 2003). Because it is a broadcasting service, there is no way to know the number of people who will receive it. It is not peer-to-peer communication model where potential recipients can be clearly quantified.
- Obligation of National Service Providers: Existing emergency regulations are largely subject to voluntary participation. No country except Singapore has mandated the involvement of commercial mobile service providers in the case of emergencies. In the United States, for example, even after 9/11 terrorist attacks and the devastating Hurricane Katrina, the Federal Communications Commission (FCC) is debating whether to obligate mobile service providers in a mandatory mobile emergency alert system or leave it voluntary as it is (Washington, 2006).
- Regulations: No standard regulations have been established to control the deployment of any proposed mobile alert system. For countries that intend to start deploying such systems, it is necessary to have a dedicated department or organisation that is specifically assigned to such tasks. Some of its duties will be shaping regulations, maintaining plans, and associate performance standards, goals, and metrics (Washington, 2005).
- Security and Privacy Concerns: There are no guarantees that spammers would not be able to control the broadcast. Concerns from legal liability in case of hoaxes and false alarms arise as well. Therefore, in The Netherlands and South Korea the cell broadcasting is restricted by law to government agencies and only authorities can send warning messages (O'Brien, 2006).

3.2 Global Case Studies of G2C Location-Based Services

The following cases have been acquired from attainable news and media resources. As there is scantly documented literature in the investigation of cases where location-based mobile technologies have been used in the realm of EM the authors postulate that such work would present a proof of concept and provide concrete examples for any reluctant government to endorse and adopt the technology.

- Text messages to allay SARS fears: Began on April 1, 2003, a rumour by a 14-years-old boy left many people panicked. The teenager mimicked the website design of a popular Chinese newspaper saying that SARS has hit Hong Kong (HK) and the city had been declared an “infected city”. HK city previously faced the death of 16 people because of SARS and more than 700 places under quarantine. The government of HK sent uniform SMS text messages to nearly six million mobile phones in order to allay fears and clear the situation as quickly as possible. The message body was direct yet simple “Director of health announced at 3pm today there is no plan to declare Hong Kong as an infected area" The authorities who have been responsible for dispatching the messages were the Hong Kong government, the Health Department, and the Commerce Information and Technology Bureau. The only drawback was network overload. Some people got the message after six hours while others never got it at all (Perrone, 2003).
- Relief fears after a massive power failure in Italy: On September 28, 2003, a massive blackout hit Italy, leaving nearly 57 million people in the dark. Around 17% of Italy’s electricity is imported from its neighbours. The failure began in Switzerland and involved France, Austria, then Italy. Rail and air traffic faced interruptions with most of the emergency phone lines jammed. Three people were killed as a direct result of the power failure. The failure coincided with a cultural festival in the capital Rome with more than a

million people located outdoors that night. During the blackout people were forced to leave shopping centres and stores for security reasons. Many people found themselves in the streets with rain starting to fall. About 12,000 people took refuge in Rome's subway stations with other 30,000 were stranded on 110 trains. People started to panic as many of them did not have any kind of information about the incident. With no electricity, conventional notification channels were useless. Therefore, the Civil Protection Agency (CPA) with the cooperation of mobile carriers targeted every mobile handset in metropolitan Rome and successfully sent SMS messages to all mobile phones in Rome informing people (Povoledo, 2003).

- Lightning risk alert system: Starting in 2007, Singapore deployed an early warning system as a part of the "lightning risk alert system". Singapore as a country has one of the highest rates of lightning activities in the world with an average of 166 days of thunderstorms and almost 187 days of lightning a year. The system basically tracks and monitors 400 predefined geographical locations. If there is high possibility for lightning activity in a specific location it will initiate warning messages to schools in the targeted areas. A school principal will receive the SMS message that includes information such as the beginning and duration of high lightning risk situations. Messages are also sent if the warning is cancelled. Chemical companies that have subscribed to the service also get the same message content. The initiative is controlled by National Environment Agency and the Ministry of Education (Mulchand, 2007).
- Warning system for impending disasters: In 2007, New Zealand started a new warning system providing mobile phone users in perilous areas with free live text updates about pending emergencies. The system sends alert messages in emergencies that include lahars, major flooding, Tsunami, or other natural or man-made disasters. The system explicitly requires the registration of any citizen who wants to use it. Registration can be done by texting the word OPTNNCD to a specific number. Citizens can also register by completing a permission form available from the regional councils' websites. Only users who have already subscribed and happen to coincide in danger areas would receive warning messages. A user can unsubscribe anytime. The service is free and the regions Civil Defence Emergency Management Group (CDEM) which has the authority over the project will bear the cost of each SMS that will be delivered by OPTN Ltd mobile network provider (New Zealand Press Association, 2007).
- Tsunami Disaster in Sri Lanka: When the Tsunami disaster hit Asia on December 26, 2004, Dialog GSM, a mobile service provider, used location-based cell broadcasting technology to provide ongoing updates and emergency information to its subscribers along the costs of Sri Lanka. The information included coming waves, brief news reports, hospital help lines, and supply distribution centres. The company has been using mobile cell broadcasting for advertising and commercial purposes. The solution is based on Celltick Proprietary LiveScreen technology. During and after the events that followed the cataclysm, the system has been used to disseminate CBS emergency alerts messages to relevant areas under the provision of the Ministry of Disaster Management and Human Rights. While other communication systems like voice calls and SMS collapsed, CBS has proven to be great success in delivering ongoing emergency alerts. The network as a whole suffered extreme traffic overload because millions of people tried to call or send SMS messages. Contrary to phone calls and short message service, CBS does not virtually consume any bandwidth (Writer, 2005).
- Satellite-based alert systems: Both Japan and South Korea have launched a satellite-based alert system. The system will provide both countries with instant warnings of natural disasters. Japan is one of the most natural disaster-prone countries in the world with 108 active volcanoes and more than 10 percent of worldwide magnitude 6 earthquakes or greater is recorded every year. The Fire and Disaster Management Agency is the authority which is responsible for disseminating immediate warnings to local municipalities, affected in the case of Tsunami, cyclones, or volcano eruptions. The warnings will

automatically activate communication devices connected to the system and operate sirens and voice alarms. South Korea which also experiences dire natural hazards like typhoons, set a similar system but it has been extended to be able to send text messages to citizens if they are in or at the vicinity of affected areas. The National Emergency Management Agency is the authority responsible for diffusing location-based text alert messages (Mizoguchi and Kim, 2007).

- South Korea foreign ministry mobile alert system: In May, 2005, the foreign ministry of South Korea in cooperation with SK Telecom (a mobile service provider) established a mobile alert system for natural disasters and acts of terrorism. The system provides location-based alerts to South Koreans travelling abroad if emergencies happen in their areas. SK Telecom global roaming service is used to deliver message and information in Korean language regarding the type of incident, telephone numbers of the Korean embassy or consular office in that country, regional hospital numbers, and police numbers. The information might turn out to be vital especially in the case where language could become a barrier. South Koreans may not know about the emergency until too late. The system has been successfully used to update South Koreans in The UK about the 7th of July London terror incident (Joins.com, 2005).
- Early Warning Location-Based Alert System in Australia: Australia has recently started to test its national mobile alert system. Tests have been done in Western Australia and Victoria to warn people about bushfires. The Victorian state government accompanied with Telstra partnership and with the cooperation of Emergency Management Australia (EMA) have successfully tested a trial emergency alert system that simultaneously telephoned every landline in a specific area. Victoria State will initiate a mobile emergency alerting system that will be able to send SMS alert messages and emails to people in specific areas in case of natural disasters or emergencies (Dunn and Collier, 2007). Another similar system will be introduced in New South Wales (NSW). The system sends SMS warnings and emergency information in the case of terrorist acts or natural disasters to all mobile users in suspected or endangered area. The information will include details like evacuation procedures, advices in case of bushfires, alternative routes, etc. The system is expected to operate with all mobile service providers. (The Australian, 2007). Both systems in NSW and VIC are supposed to function in 2007.

While technologies like SMS and CBS have been successfully used, it is interesting to see whether advanced LBS will be diffused using new standards and protocols like MBMS. Such technologies are capable of delivering full multimedia content of voice instructions and detailed evacuation maps. How governments will approach the private sector is another issue as well. It is argued that many users are worrying about the revealing of their mobile location information without knowing who is accessing it and why (Morris, 2002). Such information might reveal the whereabouts of the user, and with the possibility of privacy intrusion the danger can be greater than revealing other personal details. Therefore, the importance of privacy safeguards that are protected by privacy laws is emphasised and a maximum success would be achieved if privacy to become a component in the technology itself (Morris, 2002).

4 Conclusion and Future Work

In spite of pervasive presence of mobile technologies, their feasibility in EM has been scarcely documented. This paper gives an overview of two mobile technologies and provides a comparison in the domain of EM. It highlights the need to address unanswered questions relating to their viability as legal, political, and technical concerns are still the main challenges behind their late adoption worldwide. Other issues like defining performance standards and the participation of the private sector are paramount as well. Nonetheless, authors believe future looks promising for adoption and diffusion of such services on a broader scale based on the success of several global real case studies that are presented.

Authors' future work will include inquiring Australia preparedness to launch its states and national LBS systems in EM. A survey will be prepared to measure political and technical readiness for such initiatives. Novel trends of using new generation of mobile technologies in EM will be investigated as well.

References

CANTON, L. G. 2007, *Emergency Management: Concepts and Strategies for Effective Programs,* Hoboken, New Jersey:John Wiley & Sons, Inc.

CELLCAST COMMUNICATIONS, 2006, 'First U.S. Emergency Alerts on Cell Phones By CellCast Communications and Einstein Wireless Prove Viable in Disasters or Terrorist Acts', *PR Newswire (U.S.)*, 16 August, accessed 11 May 2007, Factiva

CELLTICK.COM. 2003, *Cell broadcast:New interactive services could finally unlock CB revenue potential*, accessed 3 May 2007. Available: http://www.celltick.com/technology.asp?id=WhitePapers&cid=14

DUNN, M. & COLLIER, K., 2007, 'Plan to use SMS for SOS', *Herald-Sun*, 27 February 2007, p11, accessed 14 April 2007, Factiva

ERICSSON.COM. 2007, *Mobile networks go broadcast with Ericsson*, accessed 12 May 2007. Available: http://www.ericsson.com/ericsson/press/releases/20060405-1043320.shtml

EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE. 2006, *Analysis of the Short Message Service and Cell Broadcast Service for Emergency Messaging applications*, accessed 10 May 2007. Available: http://pda.etsi.org/pda/home.asp?wki_id=jhPgAkxRGQ2455A550@55

HO, C. K., 2006, 'Emergency alerts on mobile phones? Govt studying idea', *Straits Times*, 15 January, accessed 11 May 2007, Factiva

INTERNATIONAL TELECOMMUNICATION UNION. 2002, *ITU Internet Reports: Internet for a Mobile Generation*, accessed 02 May 2007. Available: http://www.itu.int/wsis/tunis/newsroom/stats/Mobile_Internet_2002.pdf

JOINS.COM, 2005, 'Ministry will provide terror, disaster alerts', *Joins.com*, 11 May 2005, accessed 02 April 2007, Factiva

KRISHNAMURTHY, N. 2002, 'Using SMS to deliver location-based services', in *Personal Wireless Communications*, accessed 2 July 2007, IEEEXplore

KÜPPER, A. 2005, *Location-based Services: Fundamentals and Operation,* Chichester, West Sussex:John Wiley & Sons Ltd.

LIBBENGA, J. 2005, *SMS - Belgium's first line of defence*, accessed 17 May 2007. Available: http://www.theregister.co.uk/2005/06/17/belgian_sms/

MIZOGUCHI, K. & KIM, K.-T., 2007, 'Japan starts alert system using satellites to send warnings on natural disasters', *Associated Press Newswires*, 9 February 2007, accessed 15 April 2007, Factiva

MORRIS, J. B. 2002, The Elements of Location Tracking and Privacy Protection. IN SARIKAYA, B. (Ed.) *Geographic location in the Internet:*163 - 178. Boston:Kluwer Academic Publishers.

MULCHAND, A., 2007, 'SMS service alerts schools to danger of lightning strike', *Straits Times*, 24 March 2007, accessed 15 April 2007, Factiva

NATIONAL COMMUNICATIONS SYSTEM. 2003, *Short Message Service Over Signaling System 7*, accessed 13 May 2007. Available: http://www.ncs.gov/library.html#info

NEW ZEALAND PRESS ASSOCIATION, 2007, 'TEXT MESSAGES TO WARN OF IMPENDING DISASTER', *Mediacom*, 12 March 2007, accessed 15 April 2007, Factiva

O'BRIEN, K. J., 2006, 'Mobile providers resisting SOS alerts Loss of text-messaging sales feared', *International Herald Tribune*, 11 January, p1, accessed 11 May 2007, Factiva

PERRONE, J. 2003, *Text messaging used to allay Sars fears*, accessed 02 April 2007. Available: http://www.guardian.co.uk/sars/story/0,,929609,00.html

POVOLEDO, E., 2003, 'Massive Power Failure Sweeps Across Italy', *International Herald Tribune*, September 28, 2003, accessed 02 March 2007

THE AUSTRALIAN, 2007, 'NSW: Iemma promises mobile phone terrorism alert', *Australian Associated Press General News*, 26 February 2007, accessed 15/04/2007, Factiva

WASHINGTON, J. S., 2005, 'Expert offers advice on how to overhaul alert system', *RCR Wireless News*, 3 October, p1, accessed 11 May 2007, Factiva

WASHINGTON, J. S., 2006, 'Cell phones to be included in upgraded EAS system', *RCR Wireless News*, 11 September, p3, accessed 11 May 2007, Factiva

WEISS, D., KRAMER, I., TREU, G. & KUPPER, A. 2006, 'Zone Services - An Approach for Location-Based Data Collection', in *The 8th IEEE International Conference on E-Commerce Technology, The 3rd IEEE International Conference on Enterprise Computing, E-Commerce, and E-Services*, accessed 14 May 2007, IEEE Xplore

WRITER, S. 2005, *Celltick's LiveScreen operated as mobile emergency alert system during Tsunami crisis in Sri Lanka*, accessed 13 May 2007. Available: http://www.newswireless.net/index.cfm/article/1845#