Use of SMS for Tsunami Early Warnings at a Table Top Exercise*

Vincenzo Lagani, Vasilis Kontogiannis,
Panagiotis Argyropaidas, and Catherine Chronaki

Foundation for Research and Technology – Hellas (FORTH)
N. Plastira 100 Vassilika Vouton, GR-700 13 Heraklion, Crete, Greece
{vlagani,vasilik,parg,chronaki}@ics.forth.gr

Abstract. Tsunamis are one of the most dangerous and destructive natural disasters: countries that experience a tsunami event are likely to undergo, after the immediate destruction of the regions nearby the coast, several secondary effects, for example epidemic outbreaks. Thus, early warning systems able to timely advise the authorities and the population of an imminent tsunami are valuable tools that should be implemented in any coastal region with high risk of seismic events. In this paper we present the experience that we gained during a Table Top exercise aimed at testing the effectiveness of an SMS – based Tsunami Early Warning System (TEWS). SMS showed to be a valuable additional support channel for propagating the alarm, even though some drawbacks were identified e.g. lack of reliability, formal procedures and follow-through training that must be carefully taken in account. Experience gained will be used in an operational exercise scheduled October 2011 and potentially pave the way for including SMS early warning in disaster management.

Keywords: Early Warning System, SMS, Tsunami, Disaster Management, Emergency Response.

1 Introduction

Recently, two extraordinary Tsunami events (Indian Ocean, 2004 and Pacific Coast of Japan, 2011) remind the entire world of the potential destructiveness of natural disasters. Tsunami consequences do not run out in the immediate term; on the contrary, long term effects of Tsunamis are even more devastating than the brute destruction spread by the giant waves. In particular, Tsunamis often create unsanitary health conditions that are likely to breed serious diseases and epidemics. Currently, the only countermeasures for contrasting Tsunami events consist in (a) developing emergency programs for population evacuation and (b) creating Tsunami Early Warning Systems (TEWS) that are able to timely detect the arrival of a Tsunami for

* This work was supported by the European Commission, Humanitarian Aid and Civil Protection Directorate under contract 070401/2009/534360/SUB/A3: "POSEIDON: Earthquake followed by Tsunami in the Mediterranean Sea".

P. Kostkova, M. Szomszor, and D. Fowler (Eds.): eHealth 2011, LNICST 91, pp. 76–79, 2012.

advising both the authorities and the civil population to take action in view of the imminent risk.

Real world, operating TEWS have been deployed in several countries after 2004, for example in India [1] and Indonesia [2]. Interestingly, most recent TEWS started to employ SMS services for spreading alert messages; however, using SMS for broadcasting disaster warnings is still a controversial issue. Thanks to the wide diffusion of mobile phones, SMS can easily reach a large number of recipients. Recent studies have noted the possibilities of using SMS and MMS to provide personalized, media-rich, context-aware advice [3,4] and enhance the understandability of the alert for visual/hearing impaired citizens [5]. However, SMS technology is intrinsically unreliable, and sending large numbers of SMS immediately after a disaster may contribute to overloading the communication network [6].

In this framework, our research group along with National Civil Protection Authorities, the Red Cross, and the regional Government, recently engaged in a new initiative, the POSEIDON project [7], with the aim of conducting a European civil protection exercise to train in the European Civil Protection Mechanism that includes use of Information and Communication technology in population evacuation in case of Tsunami. The operational field exercise will be held in October 2011, in the island of Crete. For our simulation we plan to employ SMS as supplementary communication channel for advising both competent authorities and the general population about the imminent Tsunami. One of the preliminary activities of the project consisted in performing a Table Top exercise (May 2011), with the objectives of both strengthening the connections among the actors involved and refining the organization of the simulation. We sent, through SMS, a Tsunami alert to all the participants of the Table Top exercise that accepted to be involved in this first experimentation. After sending the SMS, we collected the impression and the comments of the recipients with a questionnaire prepared in advance. Our scope was to exploit this first experience in planning the SMS alert system for the field exercise.

2 Methodology

Setting of the TEWS Simulation during the Table Top Exercise: The tabletop exercise was hosted in the main building of the Decentralized Administration of Crete, on May 30, 2011. Close to one hundred (100) Representatives of Health Authorities, Civil Protection, Firefighters, Police, Port Authorities and Cretan Municipalities were present. Among the Table Top participants, eighty–four (84) accepted to participate in the simulation: the participants' role consisted in receiving two alert SMS on their mobile phones and subsequently answering a questionnaire. The first message contained a Tsunami alert for the Municipality of Heraklion, while the second one for the Municipality of Chania. Both messages contained a location – dependent hyperlink pointing at a map of the coastal area at risk. Messages were sent either in English or Greek, depending by the nationality of the recipient. The prototype .NET application for sending the messages, consisting in a Graphical User Interface connected to the Skype software via an application programming interface that allowed maintaining the list of contacts, their role, and language preferences.

Evaluating the Results from the Table Top Exercise: We measured the performance of the SMS service under two different aspects: (a) *technical effectiveness*, consisting in evaluating whether the SMS service succeeded in timely delivering all planned messages, and quantified as the percentage of sent SMS over the number of planned messages (%SENT) and the percentage of participants that actually received the SMS over the number of intended recipients (%DEL); (b) *informativeness*, much more complex to measure, since it involves the interaction between the reader and the message itself. For evaluating SMS informativeness we devised an ad-hoc questionnaire subdivided in the following sections (dimensions): *understandability*, *credibility*, *usability* and *usefulness*. Question are structured as five points items, ordered from "totally negative" (score: 1) to "totally positive" (score: 5). The questionnaire is available online at: http://kwiksurveys.com/?u=poseidon

3 Results

Out of one–hundred sixty eight (168) planned messages (eighty–four (84) recipients, two messages each), we managed to send one–hundred nine SMS (%SENT = 64.9%) to sixty two (62) distinct recipients. At the end of the table-top exercise, we collected twenty eight (28) filled and four (4) blank questionnaires (thirty two (32) in total). We estimated the percentage of delivered messages as %DEL = 28/32 = 87.5%. After the questionnaires collection, we evaluated the results as follows: for each dimension D we calculated a normalized score as the average score of the questions associated to D. We then calculate the mean of the normalized scores across all questionnaires. This procedure produced a single, mean normalized score for each dimension, ranging from 1 to 5, where "1" indicates that the participants' average evaluation of the message was completely negative, while "5 "corresponds to a totally positive assessment. In particular, the score for each dimension are the following: Understandability, 3.66; Credibility, 3.58; Usability, 3.67; Usefulness, 2.26.

4 Discussion and Conclusion

The scope of our first experience in using SMS for TEWS during a Table-Top exercise consisted in detecting possible technical and organizational problems to be solved before the wider and more complex POSEIDON field exercise. From this perspective, our simulation was a success: the outcomes of the exercise pointed out a number of unexpected problems that otherwise would have never been identified. It was confirmed that exercises are the best way to prepare for the unexpected.

The first difficulty that we experienced was a malfunctioning of the Skype software; due to this blatant technical problem, our simulation plan was substantially subverted. This inconvenient taught us that SMS technology in general is not reliable, even for sending a few hundreds of messages, especially if an external application (Skype) is used as SMS gateway. However, SMS unreliability does not only reside into the application employed for sending the messages: any part of the technical infrastructure used for transmitting the SMS can fail. Despite SMS low reliability, the results of our simulation also underlined that SMS can still be a useful media for diffusing Tsunami alerts. The participants generally rank as "sufficient" to "good" the

Understandability, Credibility and Usefulness of the message. This result suggests that, once the message is received, it can be an effective tool for informing the recipient about the imminent risk of Tsunami. The only dimension that did not pass the threshold of sufficiency was "Usefulness", the questionnaire dimension measuring the helpfulness of the accessory information provided by the hyperlinks; we hypothesize that the difficulties in accessing the hyperlinks may be due to a lack of training in processing and acting upon the information in the SMS message. Thus, the results of the Table Top exercise suggested us the following actions:

- the reliability of the SMS service must be improved, at least as far as concern the SMS gateway;
- the content of the message must be improved, especially regarding the accessibility of the multimedia information;
- participants (i.e. civil workers) and the public (should the service be expanded) need to be prepared and trained to receive and process SMS information;
- Alternative means of communicating the information in the SMS message need to be explored in tandem. SMS messages alone are not adequate for public awareness and informed response to disasters.

In synthesis, this experience confirmed that SMS messages seem to be a valuable tool for diffusing Tsunami alerts. However, the low reliability of SMS technology indicates that SMS can only be employed as a *complementary* medium along with other communication and awareness methods. Civil protection workers and the public need practical training on action upon SMS receipt through customized profiles that are included in preparedness exercises, to cultivate trust and improve effectiveness of response and follow-through based on the individual role and skills.

References

1. Kumar, T.S., Kumar, C.P., Nayak, S.: Performance of the Indian Tsunami Early Warning System. In: International Archives of the Photogrammetry, Remote Sensing and Spatial Information Science, Kyoto, Japan, vol. XXXVIII, part 8 (2010)
2. Lauterjung, J.: Installation of a tsunami early warning system in the Indian Ocean. In: Proceedings of the 13th Annual ACM International Workshop on Geographic Information Systems (GIS 2005), p. 1. ACM, New York (2005)
3. Meissen, U., Voisard, A.: Increasing the Effectiveness of Early Warning via Context-aware Alerting. In: Proceedings of ISCRAM Conference, Washington, DC, USA (May 2008)
4. Malizia, A., et al.: CAP-ONES: An Emergency Notification System for all. In: Proceedings of the 6th International ISCRAM Conference, Gothenburg, Sweden (May 2009)
5. Mitchell, H., Johnson, J., La Force, S.: Wireless Emergency Alerts: An Accessibility Study. In: Proceedings of the 7th International ISCRAM Conference, Seattle, USA (May 2010)
6. Pau, L.F., Simonsen, P.: Emergency messaging to general public via public wireless networks. In: Proceedings of ISCRAM Conference, Washington, DC, USA (2008)
7. Evangelia, T., et al.: Risk Assessment Study based of the 365AD Earthquake to Drive a Civil Protection Exercise. ERCIM News (April 2010), `http://ercim-news.ercim.eu/en81/special/risk-assessment-study` (visited on July 11, 2011)