A paper presentation on

TSUNAMI WARNING SYSTEM TO MOBILE PHONES

ABSTRACT

The term tsunami originates from Japanese and means “harbour wave”. It is a series of waves when a body of water, such as an ocean is rapidly displaced on a massive scale. Tsunamis cannot be prevented or precisely predicted, but there are many systems being developed to warn and save the people of regions with a high risk of tsunamis before the wave reaches land.

Our paper focusses on the TSUNAMI WARNING SYSTEM TO MOBILE.

This system warns subscribers of an impending tsunami, wherever they are, via a mobile text message. The tsunami alarm system picks up seismic signals from global stations and consolidates the information. If there is a danger of a tsunami, an alarm is sent out to subscribers via an SMS. The Global System for Mobile
Communications (GSM) is the most popular standard used here for making calls such as text messaging. The ubiquity of the GSM standard makes international roaming very common between mobile phone operators, enabling subscribers to use their phones in many parts of the world.

The paper discusses about the reception and consolidation of the relevant information of tsunami by the satellite and the way in which this information is transmitted by the satellite and received by the mobile. This system is an efficient and a promising attempt to minimize destructions and save the lives of millions of people around the world.

**WHAT IS A TSUNAMI?**

**DESTRUCTION OF TSUNAMI:**
The term tsunami comes from the Japanese language meaning *harbour* ("tsu") and *wave* ("nami"). The term was created by fishermen who returned to port to find the area surrounding their harbour devastated, although they had not been aware of any wave in the open water. A tsunami is a series of waves when a body of water, such as an ocean is rapidly displaced on a massive scale. Earthquakes, mass movements above or below water, volcanic eruptions and other underwater explosions, and large meteorite impacts all have the potential to generate a tsunami. The effects of a tsunami can range from unnoticeable to devastating.

**CAUSES**

**GENERATION OF TSUNAMI:**
Tsunamis can be generated when the sea floor abruptly deforms and vertically displaces the overlying water.
Such large vertical movements of the Earth’s crust can occur at plate boundaries. Subduction earthquakes are particularly effective in generating tsunamis. As an Oceanic Plate is subducted beneath a Continental Plate, it sometimes brings down the lip of the Continental with it. Eventually, too much stress is put on the lip and it snaps back, sending shockwaves through the Earth’s crust, causing a tremor under the sea, known as an Undersea Earthquake.

Sub-marine landslides as well as collapses of volcanic edifices may also disturb the overlying water column as sediment and rocks slide downslope and are redistributed across the sea floor. Similarly, a violent submarine volcanic eruption can uplift the water column and form a tsunami.

CHARACTERISTICS

Often referred to as "tidal waves", a tsunami does not look like the popular impression of "a normal wave only much bigger". Instead it looks rather like an endlessly onrushing tide which forces its way around and through any obstacle. Most of the damage is caused by the huge mass of water behind the initial wave front, as the height of the sea keeps rising fast and floods powerfully into the coastal area. The sheer weight of water is enough to pulverise objects in its path, often reducing buildings to their foundations and scouring exposed ground to the bedrock. Large objects such as ships and boulders can be carried several miles inland before the tsunami subsides.

Tsunamis act very differently from typical surf swells: they contain immense energy, propagate at high speeds and can travel great trans-oceanic distances with little overall energy loss. A tsunami can cause damage thousands of kilometres from its origin, so there may be several hours between its creation and its impact on a coast, arriving long after the seismic wave generated by the originating
event arrives. Although the total or overall loss of energy is small, the total energy is spread over a larger and larger circumference as the wave travels.

“A single tsunami event may involve a series of waves of varying heights; so the set of waves is called a train.”

In open water, tsunamis have extremely long periods, from minutes to hours, and long wavelengths of up to several hundred kilometres. This is very different from typical wind-generated swells on the ocean, which might have a period of about 10 seconds and a wavelength of 150 metres. The wave travels across open ocean at an average speed of 500 mph. As the wave approaches land, the sea shallows and the wave no longer travels as quickly, so it begins to 'pile-up'; the wave-front becomes steeper and taller, and there is less distance between crests. While a person at the surface of deep water would probably not even notice the tsunami, the wave can increase to a height of six stories or more as it approaches the coastline and compresses. The steepening process is analogous to the cracking of a tapered whip. As a wave goes down the whip from handle to tip, the same energy is deposited in less and less material, which then moves more violently as it receives this energy.

A wave becomes a 'shallow-water wave' when the ratio between the water depth and its wavelength gets very small, and since a tsunami has an extremely large wavelength (hundreds of kilometres), tsunamis act as a shallow-water wave even in deep oceanic water. Shallow-water waves move at a speed that is equal to the square root of the product of the acceleration of gravity (9.8 m/s²) and the water depth. For example, in the Pacific Ocean, where the typical water depth is about 4000 m, a tsunami travels at about 200 m/s (720 km/h or 450 mi/h) with little energy loss, even over long distances. At a water depth of 40 m, the speed would be 20 m/s (about 72 km/h or 45 mi/h), which is much slower than the speed in the open ocean but the wave would still be difficult to outrun.

Tsunamis propagate outward from their source, so coasts in the "shadow" of affected land masses are usually fairly safe. However, tsunami waves can diffract around land masses. It's also not necessary that they are symmetrical; tsunami waves
may be much stronger in one direction than another, depending on the nature of the source and the surrounding geography.

**TSUNAMI WAVE**

Ocean waves are normally divided into 3 groups, characterized by depth:

- Deep water
- Intermediate water
- Shallow water

Even though a tsunami is generated in deep water (around 4000 m below mean sea level), tsunami waves are considered shallow-water waves. As the tsunami wave approaches the shallow waters of shore, its time period remains the same, but its wavelength decreases rapidly, thus causing the water to pile up to form tremendous crests, in an effect known as "shoaling".

**WARNINGS AND PREVENTION**

Tsunamis cannot be prevented or precisely predicted, but there are some warning signs of an impending tsunami, and there are many systems being developed and in use to reduce the damage from tsunamis. In instances where the leading edge of the tsunami wave is its trough, the sea will recede from the coast half of the wave's
period before the wave's arrival. If the slope is shallow, this recession can exceed many hundreds of metres. People unaware of the danger may remain at the shore due to curiosity, or for collecting fish from the exposed sea bed. In instances where the leading edge of the tsunami is its first peak, succeeding waves can lead to further flooding. Again, being educated about a tsunami is important, to realize that when the water level drops the first time, the danger is not yet over. In a low-lying coastal area, a strong earthquake is a major warning sign that a tsunami may be produced.

No system can protect against a very sudden tsunami. Detection and prediction of tsunamis is only half the work of the system. Of equal importance is the ability to warn the populations of the areas that will be affected. While there remains the potential for sudden devastation from a tsunami, warning systems can be effective. Hence warning systems are being developed which give information of an arriving tsunami, giving people some time to evacuate areas likely to be affected.

**TSUNAMI WARNING SYSTEM TO MOBILE**

**HOW CELL RECEIVES WARNING?**

Broadcast" or "Area Information System" was originally designed to let network operators offer location based services, but is now rarely used.
To turn it into an early warning service, a customised PC needs to be installed at the headquarters of each network operator. This contains the geographical co-ordinates of all phone masts, enabling operators to target emergency messages to all phones in the required region.

As these messages are delivered separately from other traffic, they ought to get though even when a network is jammed with normal traffic. Unlike voice communications, text messages still get through with a weak and inconsistent signal. Another project reverses the use of text messages in emergencies, allowing those on the ground to send calls for help to a single number, which would then be routed via the internet to the relevant authority. Travellers and coastal residents can now be warned in time of catastrophes like the tsunami, that occurred 2004 in Asia, with the world-wide unique tsunami alarm system for everybody. In every reachable place in the world, coastal inhabitants, tourists, business travellers, employees, who are deployed in such regions, and tour guides can receive a message on their mobile phone in case there is a threat to their lives in places where they are. They only have to register their mobile phone with the Tsunami Alarm System and in the event of an alarm it will send a message that cannot be ignored.

**BACKGROUND – INFORMATIONS**

Measuring stations all around the world operate day and night to be able to warn quickly and reliably of tsunamis: Seismic sensors measure the earth tremors. Pressure and velocity sensors in the oceans detect fast changes of water bodies in the sea. Advance warning systems check first alarm signals. With the Tsunami alarm system, users can visit popular holiday destinations at the seaside now without having to worry about their safety or life and health of family and children travelling with them. Subscribers to the Tsunami Alarm System receive a warning on their mobile phones, promptly and virtually anywhere in the world. Users can be sure that the Tsunami Alarm System does not overlook any warning messages and that a warning will set off an alarm on his mobile phone as soon as possible.

Despite the complex technologies behind the alarm system, it is very easy to use for subscribers. Coastal residents, tourists, business travellers, employees of...
companies working in coastal regions, for example tour guides, can subscribe to the Tsunami alarm system by simply entering the number of their mobile phone on the web site, thus quickly enabling the alarm system on their phone. Nothing has to be installed or downloaded. As the system is so easy to use, some international companies are already interested in providing their employees with the Tsunami alarm system to offer them additional security for their stay in coastal regions.

The Tsunami alarm system works wherever the user can connect to a GSM mobile phone network, even in developing countries and in remote areas. The tsunami alarm system uses “Flash SMS” messaging which “pushes” the message onto the front screen of the phone even if it is being used.

The Global System for Mobile Communications (GSM) is the most popular standard for mobile phones in the world. The ubiquity of the GSM standard makes international roaming very common between mobile phone operators, enabling subscribers to use their phones in many parts of the world. GSM differs significantly from its predecessors in that both signaling and speech channels are Digital call quality, which means that it is considered a second generation (2G) mobile phone system. From the point of view of the consumer, the key advantage of GSM systems has been higher digital voice quality and low cost alternatives to making calls such as text messaging. The advantage for network operators has been the ability to deploy equipment from different vendors because the open standard allows easy inter-operability. Like other cellular standards GSM allows network operators to offer roaming services which mean subscribers can use their phones all over the world. GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands.

THE POTENTIAL OF CELL BROADCAST TECHNOLOGY

The ability to broadcast messages has been around since the GSM Phase 2 Technology Specification was introduced in 1995. In today's handsets, selecting a channel can be a tedious task. Another helpful GSM feature is "Over the Air
programming of the SIM card." Potentially, subscribers could select their preferred channels on the carrier's Web site and have them downloaded onto the SIM card in their handsets via this technology (under full control of the carrier). The warnings, for terrorist attacks or natural disasters such as hurricanes, are intended to be of use to both emergency responders and the general public. In many cases, the text messages sent to mobile phones will alert the reader to check TV stations for more information.

By nature, all radio systems are multi point to multi point systems, unless you force them not to be so, by adding elaborate protocols. Cellular phone networks are radio networks and are therefore naturally suited to Broadcasting. Nevertheless the fact remains that signals are broadcast from a base station, but reception is intentionally limited by means of protocols resident in the terminal (the phone). A simple change in those protocols would enable any terminal to pick up Broadcasts from any base station. By now all GSM phones and base stations have the feature latent within them, though sometimes it is not enabled in the network.

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**NETWORK STRUCTURE**

The network behind the GSM system seen by the customer is large and complicated in order to provide all of the services which are required.
The network is divided into a number of sections, namely:

- **Mobile station**.
- The **Base Station Subsystem** (the base stations and their controllers).
- The **Network and Switching Subsystem** (the part of the network most similar to a fixed network). This is sometimes also just called the core network.

**MOBILE STATION**

The mobile station (MS) consists of the mobile equipment (the terminal) and a smart card called the Subscriber Identity Module (SIM). The SIM provides personal mobility, so that the user can have access to subscribed services irrespective of a specific terminal. By inserting the SIM card into another GSM terminal, the user is able to receive calls at that terminal, make calls from that terminal, and receive other subscribed services.

**BASE STATION SUB-SYSTEM**

The Base Station Subsystem is composed of two parts,
• The Base Transceiver Station (BTS) - it houses the radio tranceivers that define a cell and handles the radio-link protocols with the Mobile Station.  
• The Base Station Controller (BSC) – it manages the radio resources for one or more BTSs.  

These communicate across the standardized Abis interface, allowing (as in the rest of the system) operation between components made by different suppliers.  

**NETWORK SUB-SYSTEM**

The central component of the Network Subsystem is the Mobile services Switching Center (MSC). It acts like a normal switching node of the PSTN or ISDN, and additionally provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber. These services are provided in conjunction with several functional entities, which together form the Network Subsystem. The MSC provides the connection to the fixed networks (such as the PSTN or ISDN). Signalling between functional entities in the Network Subsystem uses Signalling System Number 7 (SS7), used for trunk signalling in ISDN and widely used in current public networks.  

**SAFETY PRECAUTIONS AT THE COAST**

*The first rule:* The mobile telephone should always be with us. The mobile phone should be within earshot and switched on. It is to be checked from time to time that it is actually logged on to a GSM network. This should be done in particular before going to sleep. In areas with weak network coverage we may discover that we do not always have network signals at all points within our room. In such an event it could be helpful to move the telephone few meters or to put it on a window sill.  

*The second rule:* One must act immediately when an alarm is received. We must trust that the alarm that arrives on our mobile phone is genuine - even if other people around us appear to be unconcerned. Based on the tsunami alarm message, we must check whether we are in the region of the tsunami. The rescue procedures consist of moving immediately a few kilometers to the interior, away
from the coast, and if possible to higher grounds. With the Tsunami Alarm System we and the people who are with us have the advantage of this critical pre-warning period.

It is better to act in vain than to be hit by a Tsunami unprepared. When the Tsunami arrives it will already be too late.

**ADVANTAGES OF CELL BROADCAST**

There are four important points to recall about the use of Cell Broadcasting for emergency purposes.

- It is already resident in most network infrastructure and in the phones, so there is no need to build any towers, lay any cable, or write any software or replace terminals.
- It is not affected by traffic load; therefore it will be of use during a disaster, when load spikes tend to crash networks, as the London bombings 7/7 showed. Also it does not cause any significant load of its own, so would not add to the problem.
- It is geo scalable, so a message can reach hundreds of millions of people across continents within a minute.
- It is geo specific, so that government disaster managers can avoid panic and road jamming, by telling each neighborhood specifically, if they should evacuate or stay put.

In short, it is such a powerful national security asset, that it would be inexcusable not to seize the chance to put an existing technology, to the benefit of the safety of citizen.
CONCLUSION

With the Tsunami Alarm System we will be able to live at the Sea or visit our favourite coastal destinations, without worrying about our safety. We need to subscribe to the Tsunami-AS and we will receive these life-saving alarms reliably and timeously on our mobile Telephone wherever we have GSM coverage in the world. This tsunami alarm system to mobile is an effective means to protect the health and lives of families and children. This is a promising attempt for the world to move ahead with new and bright hopes into the future.

References:
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