Radiopaging for Alerting First Responders and Informing the Public during Emergencies

Introduction

Natural disasters such as tsunamis, earthquakes, floods, tropical storms and forest fires cause billions of dollars of damage each year to homes, businesses and infrastructure along with serious disruption to communities. Governments around the world are giving greater importance to how they can communicate with their citizens in advance of, and during, such events.

In addition to natural disasters the world has recently witnessed many man-made, accidental disasters such as the fuel terminal explosion at Hemel Hempstead in the UK and the explosion of a fireworks factory at Enschede in the Netherlands.

On top of this the world has recently witnessed terrorist attacks in many countries, witness New York on 11th September 2001, Bali on 12th October 2002, Madrid on 11th March 2004, and London on 7th July 2005. There have reputedly been many other attacks that have fortunately been foiled by security forces throughout the world but the terrorist phenomenon is now with us to stay at least for the foreseeable future, and no country would appear to be exempt.

Against this backdrop of natural and man made disasters many Governments are at last adopting a fundamental shift in focus towards disaster mitigation. This represents a move beyond disaster response towards anticipation, preparedness, forewarning, and informing. The political consequences for democratic Governments that fail in these responsibilities are significant, witness the USA as a result of the recent hurricanes that hit New Orleans, and in the UK as a result of the terrorist attacks targeted at users of the public transport systems.

Although governments generally have adequate systems for communicating within and between authorities during these events, they are sadly lacking when it comes to informing affected citizens (those within an emergency zone) and potentially affected citizens (those travelling to an emergency zone). Much work is going on throughout the world on defining requirements in these circumstances (although little is being done to deploy appropriate networks) but no one seems to be focussing on an obvious, existing solution, radiopaging.

During recent disasters the affected citizens have not been adequately informed by the authorities about what to do or where to go. They have also found it impossible to access public telecommunications systems for various reasons; these are generally damaged infrastructure or congestion in both the terrestrial and cellular systems due to the lack of capacity required at these times. During the London incident on 7 July 2005 the public found it impossible to make voice calls on their cellphones; SMS texting was used between citizens with some success, but even these were often taking hours to get through. Throughout the event paging calls were being transmitted within seconds. (Indeed, PageOne a UK Paging Operator transmitted almost 200,000 paging messages between 9.00 AM and 11.00 AM with no congestion whatsoever, messages were received within seconds). In New Orleans in the wake of Hurricane Katrina it took over a week to get the cellular networks operating. Paging networks were affected but not nearly as severely and were used as a media to communicate between affected citizens.

Radiopaging is not only a good way to communicate with affected citizens during an event, it is also an ideal method for alerting and informing first responders due to its unique "group calling" facility which enables a whole group of people to be alerted with only one call. Indeed, radiopaging is already used in many countries to alert first responders to an emergency, these could be off duty hospital staff, volunteer firemen, lifeboat crews etc.

Paging is a mature and proven technology, it has been in use since 1956 and the first global standards were adopted in 1984. It uses a broadcasting technology known as "simulcasting" which enables radio signals to be received from a variety of base stations at the same time thus allowing pagers to work even if one or more transmitters are not functional. Finally pagers are very small and use very little power so they are easily integrated with other equipment such as large notice boards or smoke detectors.

This paper looks at the role mobile communications, and in particular radio paging, could play as a tool to assist those organizations responsible for the preparedness and response to disasters by alerting first responders and the public, and keeping them informed throughout such an event.

EMERGENCY MANAGEMENT RESPONSIBILITY

Governments are increasingly adopting an "all hazards" approach as the basis by which they manage hazard and risks. Consequently governments (whether local, regional, or national) do not use a separate set of management arrangements for a particular category of disaster. Universally, and consistent with best practice, governments deal with emergencies by addressing the consequences for individuals, communities, infrastructure, effected sectors of industry, and the economy.

By taking an "all hazards" approach the arrangements developed for handling for example natural disasters, will be consistent with directions taken for other emergencies.

Usually local or regional authorities have principal accountability for disaster preparedness and are fully responsible for managing any natural disaster within their jurisdiction.

In many cases national governments have established umbrella organizations to manage disasters at a national level. These organizations are generally responsible for, among others things, taking the leadership role in policy, education and training, co-ordination, and risk mitigation. Vision statements of such organizations will be along the lines of "safer sustainable communities".

Authorities such as the Police, Ambulance, Fire Fighting Services, and other Emergency Response Services are usually the first to be called to an emergency. Usually a combination of two or three of these units, responding together, are the first to be called to an emergency, depending on the type of call out and the location.

Of the lessons learnt after September 11 the most important was that cooperation and goodwill has to exist between all levels of the response teams and their hierarchies. Also identified as key to operational success were, interoperability, standardized communications systems, compatible equipment and information sharing to enable a co-ordinated multi-agency approach to emergency management.

COMMUNICATIONS IN A DISASTER SITUATION

Global Standards Collaboration (GSC) Resolution GSC-8/1 (2003) concludes that emergency communications can be partitioned into concerns covering communication for the following;

- Citizen to Authority
- Authority to Authority
- Authority to Citizens
- Citizens to Citizens

- Citizens to Authorities - for alerting the authorities to an event and providing information during an event. Although work is being done on this it is realistic to say that in most disaster situations the authorities rely on a member of the public calling the local emergency number (112, 999, 911 etc.) and alerting a Public Safety Answering Point (PSAP) to the emergency. The PSAP then informs the local Emergency Control Centre (ECC) to the incident and management of the incident is then taken over by the appropriate authorities. We believe that radiopaging is not a suitable solution for telecommunications from Citizens to Authorities

- Authorities to Authorities - for communications between authorities during an event, for instance an ECC to the Police Authorities to attend an incident. During an emergency the lines of communication can be very complex. Inter authority communications currently involve land lines, intranets and radio. We believe that radiopaging is a very good means of communications for authorities to alert the first responders to an emergency situation. This is because of the excellent coverage (generally better than 98% of the population), time to page (generally less than thirty seconds), and the Group Calling facility which allows a whole group of people to be alerted simultaneously with only one paging call. Whole teams of first responders can therefore be alerted to an emergency very quickly. We also believe that radiopaging can be used in a situation where there is no other radio coverage or to get time critical emergency messages through to attending officers very quickly (i.e. evacuate the area). However, once the groups are alerted we believe that radiopaging is not a suitable solution for telecommunications for the normal ongoing management of an emergency situation.

- Authorities to Citizens - for alerting citizens within the affected area and citizens travelling to the

affected area. With other forms of telecommunications likely to be unusable due to congestion or possibly even the destruction of the infrastructure, paging is an excellent means of communicating with citizens involved in the crisis and with citizens travelling to the affected area. Pagers are very small and use very little power so they can easily be built into hybrid devices such as smoke detectors, fixed or mobile notice boards, and even mobile phone batteries. We believe that radiopaging is a suitable solution for telecommunications from Authorities to Citizens.

- Citizens to Citizens – for affected citizens to communicate with each other and other citizens. Very often citizens that are caught up in an emergency incident want to inform their loved ones, colleagues etc that they are ok and that plans need to be changed. During emergency incidents cellphone channels are often not usable for various reasons, payphones can have very long queues (if they are working) and even line based systems can be congested however we believe that radiopaging is not a suitable solution for telecommunications from Citizens to Citizens.

Much work is going on throughout the world on defining the requirements for these areas of communication but at the moment little of substance appears to have been actually realised.

There is a considerable body of work being developed in Europe that suggests that paging is one of the most effective methods of communication available to address the Authority to Citizens requirements, particularly in hybrid devices such as a paging receivers built into mobile phones or smoke detectors. Other forms of communications do not meet all of the stated requirements.

FIRST RESPONDERS

While there is considerable focus by governments over the last few years on catastrophic disasters, by far the majority of disasters are more localized. In these cases it is usually the fire fighting and emergency response teams (sometimes referred to as Emergency Service Organizations or ESO's) that are first to be called out. These teams are then usually supported by Police, Ambulance and other bodies as required.

In many cases the ESO response teams are made up of career personnel (full time employees of the agency) and volunteers who can make up the majority of the total ESO human resources. Volunteers are seen in many counties as an indispensable part of the disaster and emergency management capability and these countries are nurturing their volunteers by providing legal protection, incentives, recognition and training. In many places like Australia it would be virtually impossible to manage all emergency events without volunteers due to the population distribution of the country.

ALERTING THE ESO MEMBERS

Radio Paging is still one of the most widely used, cost effective, and reliable communication methods used around the world for contacting ESO members so they can respond to an emergency call out. Typically ESO's are organized into "cells" consisting of a number of members; such a cell could be say a lifeboat crew, or a chemical spillage team. Each cell member will carry a pager which will be programmed to receive messages for that particular cell or "group" only. When a cell is required to respond to an emergency, a paging message will be sent to that cell with details of the situation and a call to action. Once sufficient crew members have responded to the call they will attend to the emergency.

The pagers are usually "grouped" so that relevant information can be distributed through the ESO's chain of command. This ensures that members, supervisors, regional managers etc. are fully aware of information vital to any decision making process for their specific needs.

ALERTING THE PUBLIC TO A DISASTER

In most countries paging is not currently used to forewarn and prepare the public about an impending disaster. However, such a system, based on paging technology, would be extremely simple to realise; for instance, in Israel all schools are equipped with a "fixed" pager to alert them of any impending danger.

In some parts of Germany there is a move to equip every smoke detector with a paging receiver. Such a device could inform every household within a certain area of a forthcoming event (Flood, Gas Leak, etc.) or one that has already happened (Fire, chemical spillage, etc.). As soon as an emergency is detected the signal could be sent to every household within seconds.

The fatal effects of the Tsunami of 2004 could so easily have been reduced significantly if a paging based siren and notice board information system had been operational at the time. This would have alerted people to the danger and advised them to move inland within seconds of the danger being detected. Such notice boards could be situated on beaches, in hotels, shopping centres, railway stations etc. They could also have been used to instruct the public of what to do after the event.

VIABLE OPTIONS FOR COMMUNICATIONS IN A DISASTER SITUATION

This paper concentrates on the use of radiopaging as a means of communications in the event of an emergency. We believe that paging is suitable for authority to authority communications to alert first responders very quickly and as a means to communicate to personnel if other means are not available. We also believe that radiopaging is very suitable for communications from the authorities to citizens. We think that authorities should not rely on only one means of telecommunications during an event; this will increase the reliability of emergency communications procedures and the probability that messages will get through. For this reason we have listed other suitable methods of telecommunications during an event along with their attributes.

For mobile terminals the options under discussion throughout the world are Paging, the Cell Broadcast Service (CBS) in 2G and 3G mobiles, the Short messaging Service (SMS) in 2G and 3G mobiles, Multimedia Broad Messaging Service (MBNS) in 2G and 3G mobiles, Multimedia Messaging Service (MMS) and the Universal Supplementary Services Data (USSD) in 2G and 3G mobiles. A comparison of what each of the services can supply to mobiles is given in Table 1 below and it can be seen that paging is the most compliant of all of the services.

Table 1: Comparison of requirements for mobile terminals

Emergency notification systems shall	Paging	CBS	SMS	MBMS	MMS	USSD	Legend
be able to reach citizens in their own dwelling	V	V	V	V	V	V	V = compliant
be able to reach citizens at their place of work	V	V	V	V	V	V	V = compliant
be able to reach citizens in public venues	V	V	V	V	V	V	V = compliant
be able to reach a citizens on foot	V	V	V	V	V	V	V = compliant
be able to reach a citizens in a vehicle	V	V	V	X	V	V	V = compliant X = watching video while driving a vehicle is not desired
provide sufficient instructions regarding actions to be taken	V	V	V	V	V	V	V = compliant X = non-compliant
provide identification of the message/notification originator;	V	V	O	V	O	O	V = compliant O = compliant, but no certainty
deliver messages within a planned specified time;	V	V	O	V	O	O	V = compliant O = non-compliant for large audiences
allow simultaneous delivery to targeted,	V	V	X	V	X	X	V = compliant X = non-

large audiences or geographies;							compliant
offer sufficient details of the emergency situation	V	V	V	V	V	V	V = compliant
be able to retry delivery when the initial message delivery fails.	O	O	V	V	V	V	V = compliant O = messages can be repeated
support delivery of notification messages to those with special needs and unique devices, like terminals of hearing and speech impaired persons.	V	O	V	O	V	V	V = compliant through terminal capability 0 = partly-compliant
have the ability to deliver messages in multiple languages;	V	V	V	V	V	V	V = compliant
be capable of addressing congestion management across the various networks used.	V	V	X	X	X	X	V = compliant X = non-compliant

In addition to the above:-

- For paging the time between message reception and despatch is normally a few seconds;
- Paging relies on simulcasting which enables a radio signal to picked up from various base stations thus increasing the probability of reception;
- Paging base stations are typically located on high ground which is usually outside of a conurbation centre where disasters usually take place so they are physically unaffected by any disaster;
- The duty cycle of paging transmitters is very low so they can last a long time on battery power;
- Paging chips can be integrated into other equipment such as cell-phone batteries, sirens, electronic notice boards, and smoke detectors;
- Pagers use very little power so batteries last a long time;
- Pagers and paging technology are very inexpensive.
- Paging reception is independent of where the ESO member may be located i.e. at work, home or play
- Paging has superior in building penetration due to the radio frequencies it uses
- Paging works both for mobile and non mobile applications
- Paging can deliver sufficient information for situation status
- Paging allows strategic information to be sent to target audience i.e. groups
- Paging delivers message simultaneously to a large audience i.e. broadcast
- Pagers can be programmed "over the air"
- Paging is a robust technology
- Paging is easy to operate and it is easy to train personnel
- Intrinsically Safe products are available
- Paging can be hands free
- Pagers can be passed between team members with a minimum of fuss
- Paging is supported by many operators, manufacturers and developers throughout the world

These are among many reasons why pagers can be used to alert first responders at the first sign of an emergency and to inform citizens during such an emergency.

THE AUSTRALIAN EXPERIENCE

When the Victorian State Government sought to upgrade the performance of its emergency services, it turned to paging technology. The government saw the key to improving response times lay in enhanced

communication systems, the sort Infostream (an Australian developer and manufacturer) has been developing and continually adapting over the past decade.

After LSE Technology Australia Pty Ltd, a subsidiary of Leighton Corporation, was chosen to build the new $100 million Emergency Alerting System (complete with 190 transmitter sites across the state, a control site and disaster recovery centre in Melbourne), Infostream was chosen to supply pager and IT hardware, CAD software, network architecture and ESO training and transition services.

The new network replaces Victoria's "fragmented, ageing and unreliable" system, which covers only 50 per cent of the state. The new low frequency paging system will provide 97 per cent coverage of Victoria. It will significantly boost response times and enhance the safety of emergency services workers.

Tens of thousands of volunteers have been issued with Infostream's award-winning product, the Xstream. The splash-and-dust-proof wireless messaging device is high-tech on the inside, rugged on the outside - ideal for use in hazardous situations and emergencies.

THE DUTCH EXPERIENCE

With a reputation internationally for user-friendly design and reliability, Infostream is providing customised Emergency Alerting hardware to the Dutch government. The government has installed a national paging network to support all of its emergency services throughout Holland, including fire, police and ambulance. And as part of this massive project, named LARA, Koning & Hartman are relying on Infostream to supply some 30,000 wireless paging devices.

Infostream is willing to assist any country in establishing a reliable, cost effective emergency alerting system to mitigate the effects of emergencies or disasters.

THE SITUATION IN FRANCE

There is a significant difference between the numbers of fatal home fires in France and other European countries. This has been linked to the lower level of smoke detectors in French houses than in other countries.

Only certain buildings (those higher than 50 m or public buildings) have to fulfil specific obligations about fire warning systems. There is no obligation for French citizens to have a smoke detector at home (unless they live in a building of the aforementioned type).

Some tragic fires in collective housing estates have led the French government to discuss the topic.

Further to a report made by two deputies a draft statute was adopted by the Assemblée Nationale in October 2005. It still has to be discussed before being coming to a vote and thus having statute status. Given the present time schedule of the two chambers of the French Parliament (the Assemblée Nationale and the Sénat), the vote of the statute will take place in 2007.

According to the draft:

-        There will be an obligation to have at least one smoke detection device per home

-        Specifications of the smoke detector to be defined by decree

-        The deadline to fulfil the obligation will be five years from the effective date of the statute.

With e*Message Wireless Information Services France SAS based in Le Chesnay near Paris as well as in other countries there exists a nationwide paging operator able to transport regional or governmental alerting information to French households. How this capacity will be used with the capacity of typical smoke detectors is now being discussed at Prefecture level.

EMMA AND A FRESH APPROACH TO ALERTING

EMMA strongly believes that wireless messaging and associated software provides the best solution for governments and international organisations to effectively manage the alerting requirements of their

emergency organizations in the face of a disaster.

EMMA also believes that Paging is an excellent way to alert and inform the public at times of emergency through paging activated sirens, notice boards and even having receivers embedded in domestic and industrial smoke detectors.