

Implementing Inclusive ICTs: Mobile Cell Broadcasting for a Public Warning System in the Maldives

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This research was carried out as part of the Mobile 2.0 research theme at LIRNEasia (www.lirneasia.net) and was funded through a grant from the International Development Research Center (Canada) and Department for International Development (UK).

Cell broadcast is an integrated open system that allows emergency officials one-touch notification to cell phones with guarantee of covering all carriers. Cell broadcast technology enables a government entity to securely transmit an emergency alert of natural or manmade disasters to cell phones in an affected area within two minutes, regardless of the size of the area and regardless of the subscriber's carrier. Given its geographic location and distribution, and its 2004 tsunami experience, the Maldives exhibits unique characteristics that would enable cell broadcast's success in the dissemination of both general and hazard information.

Currently there are two main GSM service providers in the Maldives. Each has the in-built capability for cell broadcast. Recently, a technical committee on early warning and emergency telecommunications, and a national plan on early warning dissemination and emergency communication was set up and developed, respectively. The atoll nation has made some notable initiatives in emergency alert, including: emergency alert via broadcasting (EAB), and the use of bulk SMS on a mobile network, priority calling and national roaming, and the establishment of a national Emergency Operating Center.

While public warning is of paramount interest, the Maldives wants to ensure sustainability and optimal use of this novel technology. This paper will explore the ways in which the Maldives can provide an ideal environment for cell broadcasting to improve information dissemination, both hazard and general, inclusive of all.

List of Acronyms

ATIS	Alliance for Telecommunications Industry Solutions
ATM	Automatic Teller Machine
BSC	Base Station Controller
BSS	Base Station System
BTS	Base Transceiver Station
CB	Cell Broadcast(ing)
CBE	Cell Broadcast Entity
CBS	Cell Broadcast Service
CDMA	Code Division Multiple Access
CGAP	Consultative Group to Assist the Poor
EIR	Equipment Identity Register
EFTPOS	Electronic Funds Transfer at Point of Sale
GoM	Government of the Maldives
GSM	Global System for Mobiles
ITU	International Telecommunications Union
M-Banking	Mobile Banking
MMA	Maldives Monetary Authority
MS	Mobile Station
NECC	National Emergency Communications Center
TAM	Telecommunications Authority of the Maldives
TETRAnet	Terrestrial Trunked Radio Network
TIA	Telecommunications Industry Association
TVM	Television Maldives
UMTS	Universal Mobile Telecommunications System
UNDP	United Nations Development Programme
VOM	Voice of the Maldives
SAARC	South Asian Association for Regional Cooperation
SIM	Subscriber Identity Module

SMS	Short Message Service
WAP	Wireless Application Protocol
WiFi	“Wireless Fidelity”

Introduction

The Maldives is prone to a number of hazards including tsunamis, earthquakes, flash floods, tidal waves, thunderstorms, tornadoes and waterspouts, strong winds, and drought. The December 2004 tsunami submerged many of its islands and wrought considerable devastation to its infrastructure, particularly telecom. Not only did it destroy shelters, but it affected five major nodes, disrupted service to 13 atolls (163 islands), destroyed power systems and batteries, and damaged radio equipment.¹

Maldives, a country of 1,192 islands and 290,000 citizens, is highly dependent on its natural resources. Along with tourism, which provides more than 30 percent of the country's income, fisheries and agriculture are essential to livelihoods on the country's 199 inhabited islands.² Can early warning help save lives? The need for early warning has become greater since the tsunami and the growing threat of the atoll nation fast receding under a rapidly increasing sea level.³ These claims are further reinforced by a study conducted by RMSI for UNDP Maldives that "It is estimated that Male will be inundated by 15 per cent by 2025 and 50 per cent by 2100 due to climate change and consequent sea level rise".⁴

Therefore, early warning is essential in timely notification of alerts so that the general populace may be able to take the necessary precautions. In the case of the Maldives, if an early warning is introduced, it must be able to reach every community on all of the outlying islands including tourists on resorts. With the increasing prevalence of the mobile phone, it may be an ideal time to introduce an existing, but still relatively obscure, technology – cell broadcasting – for public early warning dissemination.

Cell Broadcasting and the Maldives

A study was conducted by LIRNEasia⁵ from August 2008 until February 2009⁶ to fulfill a request by the Telecommunications Authority of the Maldives (TAM)⁷ to investigate pre-conditions in the Maldives that would make it feasible to implement cell broadcasting within a national public warning system, and, concurrently, evaluate the use of cell broadcasting for commercial usage.

About Cell Broadcast⁸

Cell broadcast is the term given for the technological ability to send a single text or binary message to be distributed to multiple mobile phones within a "cell". Cell broadcast was originally designed to let network operators offer location-based services. It is a standard feature on GSM⁹ networks as well as IS95 CDMA. Essentially, cell broadcasting is a timely and efficient means of "pushing" out a message to participating mobile phones in an entire cell area without the lag times associated with sending messages via SMS, which are queued. Unlike one-to-one mode SMS, it is a one-to-many mode of communication.

A cell broadcast is composed of 82 octets, which equates 93 characters using a default character set. Only mobile handsets that have cell broadcast channels activated will receive the messages.

How does cell broadcasting differ from the prevalent mode of messaging, SMS? The table below gives a brief breakdown of key differences as they relate to the main subject of this report – public warning.

Table 1: SMS vs. Cell Broadcasting for Public Warning

Characteristic	Short Message Service Message (SMS)	Cell Broadcast Message (CB)
Transmission Type	Messages sent point-to-point (Messages directed to terminals; one-to-one or one-to -preset group)	Messages sent point-to-area (Messages directed to radio cells)
Mobile Number Dependency	Dependent. Requires specific phone numbers to be input.	Independent. Does not require phone number input.
Location Dependency	Independent. Only pre-registered numbers will be notified; message can be received anywhere.	Dependent. All numbers within a geographical area (cell) will be notified. The Cell Broadcast Service allows messages to be broadcast to all Mobile Stations (MS) in a given country, all MS's in a selected group of geographical locations, or all MS's in a particular cell area. ¹⁰
Message Type	Static messages will be sent to all pre-registered numbers.	Tailored messages can be sent to different areas based on the alert level for each area.
Bi-directionality	Yes. Users can both receive and respond directly to the sender via SMS.	Yes. Two-way messaging is an option that may be provided by the CB authority through embedded numbers or URLs to which the user may respond. If using 'native' software then the user must 'click' on the link. The phone will then either phone the number or open the WAP browser and go to the link. ¹¹
Congestion and delay	Subject to congestion as messages are queued. Immense numbers will cause delays.	Broadcasts are sent to a cell area on dedicated channels, eliminating congestion . Delays may only occur in poor coverage areas.
Message Length	140-160 characters in length <i>Can 'concatenate' up to 5 times, advisably. But it may not be supported by all mobile services.</i> ¹²	93 characters <i>It is possible to 'concatenate' up to 15 'pages' together to produce a single message of up to 80 * 15 = 1200 'bytes' of data.</i>
Security	Poor authenticity. No	Good security. There is no

	indication that a message is generated by a legitimate authority that cannot be emulated by typing in a text message from another phone. ¹³	way for an outsider to generate a cell broadcast message; so false emergency alerts are unlikely using this method. ¹⁴
Service Barring	No barring.	Limited. Received only if the broadcast reception status is set to “ON”.
Reception	Yes. Message received once the mobile is switched on.	Yes, but limited. No reception if broadcast is sent before mobile is switched on. However, if updates to the cell broadcast are sent, those will be received if mobile remains on.
Delivery Confirmation	Yes. Sender can request delivery confirmation.	No. No confirmation of delivery.
Repetition Rate	No repetition rate.	Yes. Can be repeated periodically within 2 second to 32-minute intervals. In a UMTS environment, the highest repetition rate is 1 s.
Language	Identical to all receivers.	Multi-language broadcasts can be broadcast to multiple channels simultaneously. ¹⁵
Message Storage [Most important for first responders and government officials re: public warning]	Yes.	No. However, the user may choose to at his/her discretion should the appropriate firmware be housed on the handset. In some cases, the message is placed in a special area of the inbox and the alarm goes off. In other cases the message is flashed straight on the screen and also placed in the inbox. ¹⁶

Why cell broadcasting?

Modern technological information dissemination tools, such as SMS are quite prevalent as are common warning technologies, such as sirens, radio/TV. So how might cell broadcasting enhance general information dissemination and public warning? From the above table, there are many obvious contrasts to SMS for public warning, making cell broadcast an ideal standalone or addition to any warning system since it is less vulnerable to congestion and can reach a broader audience with no privacy infringement. For general information dissemination, it can now be used for commercial purposes thanks to a growing number of income-generation models.

Furthermore, we live in an age of greater awareness of risks due to increased media presence. Governments play such a strong role in many societies that citizens have come to expect more services from them, akin to services provided by private entities. With rapid technological progress, it is necessary that they keep current and use the latest information technologies. Additionally, in our globalized world where people, products and ideas are moving across borders at lightning speeds, it is essential that communication methods be standardized. Cell broadcast is an easily standardized system since it is a simple technology, universally available regardless of mobile communication system, and international standardization will soon be available through the work of the ITU. Finally, alerts and warnings over current tools are insufficient because they have lesser reach and cannot provide proper, timely information. Though the table above shows how cell broadcast compares in scale to SMS within a public warning framework, it also extends to general information dissemination use as well.

The Maldives exhibits many key characteristics that demonstrate why current tools can no longer be as effective. Geographical coverage, type of coverage (use of undersea fiber optic cables, etc.), tourism and a modern communications network are some of those characteristics. For instance, sirens or loudspeakers must be placed on every island in every atoll of the Maldives in order for the general public to receive a public warning. Although TV and radio are fairly ubiquitous, the mobile phone is fast becoming the most common technology available to all classes. Moreover, the mobile

Commercial uses within the system

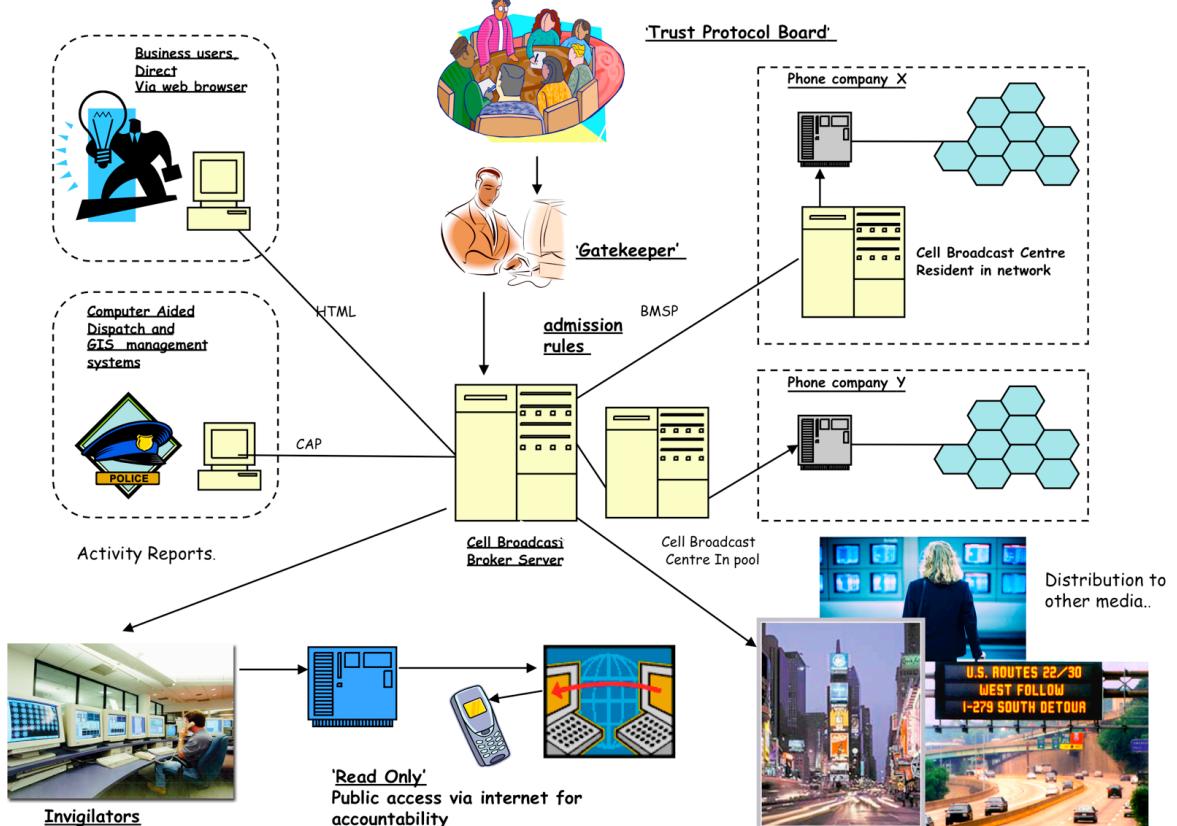


Figure 0: CellCast Technologies System for Commercial Use of Cell Broadcasting
 [Wood, Mark (2008, September). *TAM Meeting Male 29 Sept 2008: Authority to Citizen Communications for the 21st Century*. PowerPoint presentation made to the Cell Broadcasting Workshop to Maldivian stakeholders, Male, Maldives]

phone is a medium that is available and easily accessible by the majority of tourists who enter the country. Although resorts may have a public announcement system, cell broadcasts received over a mobile phone could be perceived as less intrusive (of course, intrusion is relative) and cause less panic. A mobile phone is also more accessible to provide ongoing alerts throughout an emergency rather than as an early warning alone. For example, it can notify evacuees when they might be able to return to their homes and whom they may contact for further information should they need additional help. Thus, Maldivian officials must closely examine the reasons explained herein on how cell broadcasting may enhance and build upon existing warning and information dissemination infrastructure.

Public Warning in the Maldives

The use of cell broadcasting for public warning in the Maldives has gained more attention, since its unique characteristics of the country appear to complement this technology. An island nation composed of groups of 26 atolls of about 1,192 islets of which 250 islands are inhabited, it is crucial that a public warning system is able to reach all of the inhabited islands scattered within the Maldives. The country is prone to a number of hazards including tsunamis, earthquakes [overall hazard is low, except for Seenu, Gnaviyani and Gaafu atolls¹⁷], flash floods, tidal waves, thunderstorms, tornadoes and waterspouts, strong winds, drought and cyclones [northern atolls¹⁸].

Although the GoM has already made significant strides towards instituting a public warning system through its Emergency Telecommunications Committee and mandating TETRAnet as a first responder warning system nationwide, cell broadcasting has the potential to be an inexpensive, effective, and all-purpose means of disseminating crucial warning information to the *public* – including all roaming customers, regardless of nationality – through various technologies beyond mobile phones.

Necessity for Public Warning

The December 2004 tsunami affected many of its islands and wrought considerable devastation to Maldivian infrastructure, particularly telecom. Although it was not widely reported in the media, on a *per capita* basis, Maldives was one of the worst affected countries.^{19,20}

Not only did the tsunami destroy telecom shelters, but it affected five major nodes, disrupted service to 13 atolls (163 islands), destroyed power systems and batteries, and damaged radio equipment. Since the tsunami caused a loss of lives and wrought considerable destruction upon the infrastructure, the need for resilient telecommunications as well as a public warning system has become more palpable in the atoll nation. Distances between atoll islands and a population scattered thinly (except the densely populated capital city of Male) require a system to help manage the possible destruction that may be wrought by natural hazards to which the country is susceptible. The Telecom Authority of the Maldives (TAM) has taken a number of steps towards implementing a public warning system in collaboration with the nation's Emergency and Telecommunications Committee. One of the initiatives that will be in full operation by the end of 2009 is TETRAnet, a system consisting of a series of sirens placed strategically in the atolls adjacent to existing cell towers.

Despite this considerable step forward, the TETRAnet solution still does not address the ways in which a fisherman would receive an alert? How might a resort speedboat carrying tourists to and from resorts be notified of impending danger? Efficient and effective public warning through durable technologies is necessary to ensure that the general public is able to take timely steps in evacuating from dangerous areas, so as to save lives and secure property.

Thus, a public warning system with an embedded cell broadcast feature would provide the optimal answer to the above questions, since it is the most versatile and far-reaching. Moreover, CB is an inexpensive technology that requires no further infrastructure beyond an existing telecommunications network. Given that the Maldives already has an existing mobile telecommunications system in place, instituting cell broadcast costs next to nothing.

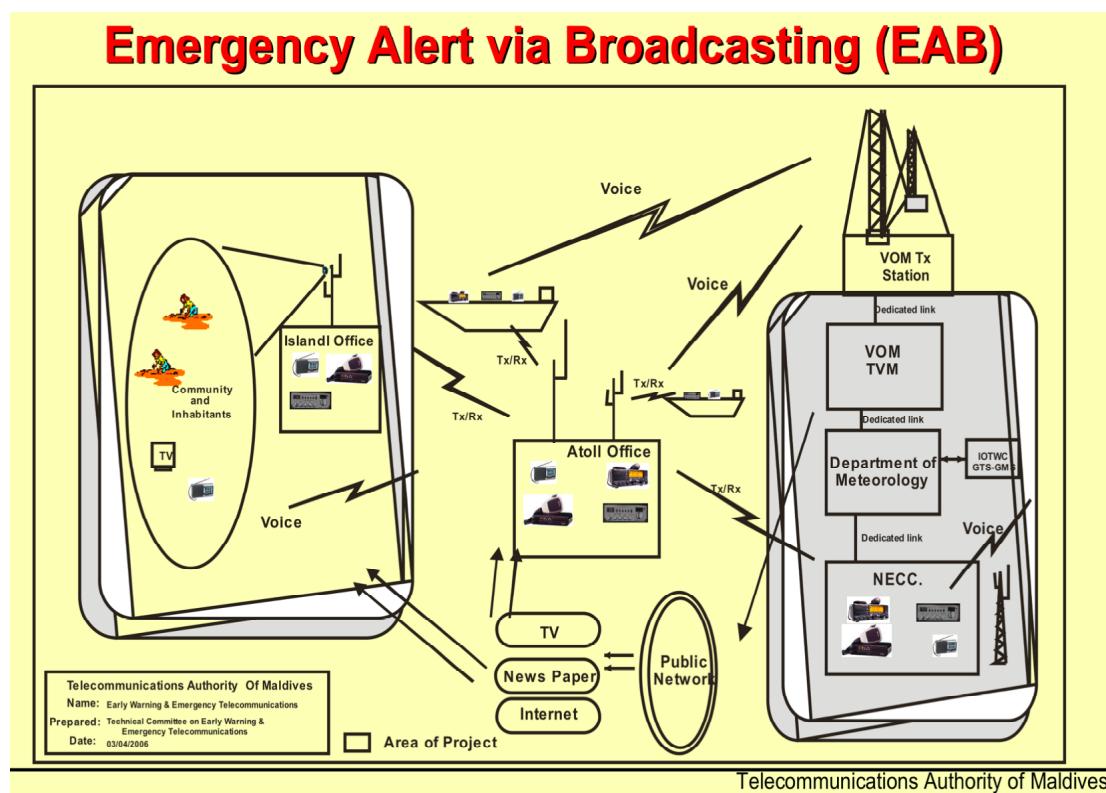


Figure 2: Emergency Alert System in the Maldives

Figure 2 depicts the current emergency alert system in the Maldives. This system is dependent upon coordination amongst the VOM and TVM (local TV stations), the Department of Meteorology and the NECC in order to send information via TV broadcast or radio. Information would be relayed through Atoll offices, to island offices and finally, to the general public. This complex relay of information leaves significant room for mistakes to occur. TETRAnet would solve some of this complexity, but cell broadcasting would eliminate it entirely and give the general public faster access to the information they need in a timely manner.

Telecom Providers: Dhiraagu and Wataniya

Currently there are two main GSM service providers in the Maldives. The larger and older, Dhivehi Raajjege Gulhun Private Limited (Dhiraagu), a joint venture company

55% owned by the Government of the Maldives and 45% by Cable and Wireless is the most widespread and has excellent coverage in the resort islands. Dhiraagu has a near-monopoly in the most lucrative market – tourism – in international roaming.²¹ In 2004, a license was granted to Kuwait-based Wataniya to introduce competition into the telecommunications sector. Both operators claim close to universal geographic coverage, even in the most remote atolls. On-the-ground reports rated Dhiraagu's coverage as superior to Wataniya's, particularly on the water and at all tourist resorts. In the Maldives, there is yet no substantive user interface available for SMS messaging in Dhivehi script, so the Latin script is used for transliterating when texting.

Some of the emergency alert in-roads the island nation has made include emergency alert via broadcasting (EAB), the use of bulk SMS on a mobile network, priority calling and national roaming, and the establishment of a national Emergency Operating Center. Moreover, regular communications drills, awareness programs and inclusion of emergency telecommunications in curriculum continue to inculcate a prepared environment.

Advantages/Limitations of CB for the Maldives

Advantages

Location-Based Push Service

CB offers the ability to differentiate the push messages depending on the location. It can be broadcast to areas:

- as small as a single radio cell;
- as big as an entire network;
- a cluster of areas in between.

More efficient distribution than SMS

SMS is one-to-one technology whereas CB is one-to-many. Thus, this significantly impacts the cost structure of such services allowing for easier network dimensioning. In an average network it would take 100 SMS with the same content approximately 30 seconds to reach its destination, whereas in a CB-enabled network, a similar message transmission takes 30 seconds to reach *all* end users tuned into a CB channel, up to several million at a time.

CB messages provoke other mobile phone traffic (SMS, WAP, voice)

Since a customer can opt to participate in a CB channel, he acknowledges that he will receive occasional messages. SMS can seem more intrusive as it is not generally by choice that a customer will receive such messages. Opting into a CB channel exposes the customer to various “teasers”; in the case of CB commercials, they may have the form of triggers for SMS, WAP or voice services.

Real-time communication

Unlike SMS, the time to broadcast a message over a CB channel is insensitive to the number of subscribers scheduled to receive the message. In a typical CB, a message can be sent within 30 seconds to all handsets. Efficiency of communicating the message is does not decline in peak hours and CB does not use the signaling network (IN7) to carry messages as with SMS. One CB message (with a maximum of 15 pages with 93 characters, in total 1395 characters) to a BSC carries as much data as 8 basic SMS messages. The network infrastructure to carry these CB messages is dedicated to SMS-CB and the peak traffic on SMS-CB does not collide with any other service. One can 'concatenate' up to 15 'pages' together to produce a single message of up to $80 * 15 = 1200$ 'bytes' of data. It is possible to 'concatenate' 15 'Pages' together, however the limitation is the size of the screen on the phone. Many researchers conclude that about 180 characters (2 pages) is the optimum large size for a public warning message, though the true maximum figure is closer to 1350 characters of Latin using 7-bit coding.²²

Multi-Language Push Services

On a single CB channel, messages may be broadcast in various languages. However, since mobiles are sensitive to the selected language, only messages in that language will be displayed. This kind of feature is most attractive for multi-lingual countries, or for services dedicated to roammers to encourage loyalty to a particular network.

Emergency Location Based Info Services

Governmental institutions may want to broadcast emergency messages to handsets in a particular area in the event of local emergencies. This feature is particularly useful for people on the move, listening to radio/TV, or working with the Internet. CB is the only currently existing technology for emergency services available on 2G and 3G networks.

CB can broadcast binary messages

Binary data can also be transmitted over a CB channel. In other words, encryption-decryption for subscribed services is possible as well as machine-to-machine communication using CB as a bearer.

Other features are equally possible:

- Dynamic traffic updates
- Enhanced CB, like EMS enabling ring tones or logo transmission
- Assisted GPS

Opt-in and Opt-out features

With the development of the Internet, trends in privacy protection regulation are on the upswing in the EU and in some domestic laws. Increasingly, concepts with push services targeted at mobile handset users that require permission of the end-user must be well defined. Thus, opt-in (customer wants access) and opt-out (customer does not want access) are conceptual features of CB technology. When a customer "opts in", content providers will reach him; otherwise, the content provider does not reach that customer. This allows for m-marketing campaigns to be targeted at the right mobile community.

Message streams are not stored

CB messages are display only meaning that no information is stored on the handset or the SIM, unless the user desires to archive the message. Thus, CB messages can be seen as a form of streaming content and will not overload mobile phone inboxes. It is important to note that the option of storing is solely dependent upon the type of firmware available on the handset. Thus, if a user desires to store a CB message, the following options may be available:

- A cell broadcast appears on the main screen and is stored by the user when given an on-screen option;
- A cell broadcast is stored immediately in the inbox without ringing an alarm or appearing on the main screen;
- A cell broadcast is stored immediately in the inbox and an alarm is sounded.

Broadcasts do not infringe on privacy

The content provider is broadcasting data to any mobile in a given area. It does not know which numbers it is reaching.²³ However, cell broadcasts have the potential to be disruptive to mobile phone users if they do not have the option to participate in a cell broadcast service or not (excluding emergency cell broadcasts). Therefore, the aforementioned opt-in and opt-out feature must be included.

Little to no additional physical infrastructure required

Since all that is required for cell broadcasting is a CBC, broker and a mobile user, its use will require little additional physical infrastructure in between the aforementioned components as it uses mobile communications over terrestrial cables and wires so often found in other systems (i.e. TETRAnet).

Limitations

CB Compatible Handsets

The user must have a CB enabled handset switched on and set to receive the appropriate CBs.

Lack of Standardization and use across networks

All the mobile networks must carry the message to ensure maximum people coverage.

Complex Geographical Areas

Determination of the geographical area for a CB message is complex and varies between networks due to the use of separate transmitter sites. The superb coverage of the two telecommunications providers in the Maldives would overcome this limitation to a large extent.

Not a stand-alone public warning system

The extent to which such a service is complimentary to, or can replace, other warning mechanisms²⁴

Not infallible to hazardous events

In the event of extreme weather, such as cyclones, if cell towers come down cellular communications of any sort will not function. Any hazardous event that disrupts the cellular system would impede optimal functioning of the cell broadcast system.

Considerations for a Public Warning System

When planning a public warning system, certain characteristics must be considered according to the ITU's study group on cell broadcasting. These characteristics include:

- **Inter-jurisdictional, national, and regional cooperation.** A public warning network in the Maldives must reach *at least* all inhabited islands within the nation. It may also be prudent if the Maldives network were linked in some way to the Sri Lankan cell broadcasting system, this would not require a loss of autonomous decision-making on the part of the Maldives. Cooperation with the Sri Lankan telecom networks would enhance implementation of cell broadcasting since the Sri Lankans have more experience with the initiation of cell broadcasting as a public warning system in January 2009. Levels of cooperation should be decided by the relevant authorities on both sides.
- **Involvement of the user community in identifying requirements and ascertaining value; need for support of multiple languages in message delivery.** The Emergency Telecommunications Committee, or the appropriate body, would involve all stakeholders within the public warning community so as to determine the public warning needs of the Maldives. Concurrently, it would decide in which language(s) CB messages would be sent.
- **Involvement of vendors.** Inclusion of commercial vendors will help strengthen the general public's interest and buy-in to the system. For instance, if Villa Resorts decided use cell broadcasting to notify tourists at its resorts of not only changing climate conditions, but also entertainment options, promotion of these choices to the Maldivian general public would enhance the likelihood that the technology would become more accepted as more than just a public warning mechanism.
- **Aiming for low-tech solutions to ensure relevance for people without access to sophisticated receiving devices (so-called “last-mile” community solution).** The mobile phone has become quite ubiquitous in the last few years, so much so that those in the “last-mile” have access. A public warning system that uses cell broadcast has the capability of reaching everyone – from first responders, to tourists, to communities in the “last-mile”.
- **Systems to be designed up-front with security in mind to retain public trust in alerts and warning.** The use of cell broadcast for public warning ensures

top-notch security since only authorized personnel, or agencies, may produce and disseminate warnings.

- **Interoperability to be enhanced by common elements and open, international standards.²⁵** Since cell broadcasting can be sent via more than one technology (i.e., message boards, radios, etc.), it has the potential of being highly interoperable and easily standardized nationally, regionally and internationally. Nevertheless, absent standardization, no guarantees can be given that tourists roaming in the Maldives, or in any country for that matter, will receive the necessary notifications. Thus, it is important that all stakeholders interested in cell broadcasting stress standardization.

Beyond Public Warning: General and Commercial Applications of Cell Broadcasting

Although the primary focus here is upon cell broadcasting for public warning, this report will explore the uses of cell broadcasting for other general information dissemination purposes of which there are several.

Its general characteristics make it ideal for use in public warning. However, it can be used for a variety of information dissemination messages. Such messages may include: news alerts, traffic notifications, service announcements, advertising, event information, and much more. To date, no optimal business model available to sanction appropriate billing for commercial use. However, several burgeoning cell broadcast companies have created models that address income generation schemes for cell broadcast. Below are some commercial applications of cell broadcast:

Cell Information

Possibly the most widespread usage of cell broadcast is of cell information. This includes location information, i.e. the name of the cell area will be “broadcast” on the screen of the mobile phone. Currently, neither Dhiraagu nor Wataniya have this service activated. This may be due to the fact that the service was not originally provided in their respective agreements or the operators are not fully aware of the benefits that the service may provide. By contrast, most operators in neighboring Sri Lanka have this feature activated within their networks for both commercial and, as of early 2009, public warning use.

Advertising

Cell broadcast is suitable for advertising and is probably the best way to generate revenue for the service provider. For advertising usage, subscription options must be made available to the user. Individual companies might have the option of having their own dedicated channel explicitly for their company advertising. However, it is advisable that there be a balance between advertising and “useful” information, otherwise it is possible that the handset user may unsubscribe from the channel. “Useful” information might be weather information, stock-exchange rates, product discounts, local news, etc. The user may opt into advertising that is most relevant and opt out of advertising that is not.

Mobile Banking

The Maldives Monetary Authority (MMA) is in the process of improving the financial infrastructure of the country. The first step towards an interoperable payment system in the country is to connect the banks' ATM population and reconcile all Points of Sale acquired through a shared EFTPOS Switching System.²⁶ M-banking is the optimal solution for an accessible banking system for an atoll nation, as banks are not easily reachable like in other nations. Since both operators in the Maldives are participating in this initiative, it may be useful to collectively explore the possibility of covering the minimal costs of activating cell broadcast channels. Other cost-sharing activities may be brokered with the banks themselves.

Cell broadcast may enhance the use of m-banking in the following ways:

- It is an existing feature of UMTS, the proposed system for the MMA's m-banking system.
- Cell broadcast would allow banks to send service notifications to subscribers through designated channels for individual banks. [i.e., HSBC could notify its customers through the HSBC CB channel that banking services will be unavailable on Eid al-Fitr.]
- Security and privacy of each customer is ensured since broadcasts would reach only those who subscribe to a banking channel. [Numbers of messages may be reduced by allowing options to the subscriber for types of notifications, enhancing privacy in its other sense.]
- Cell broadcast is default "ON" on most handsets. Otherwise, operators may educate users on how to switch on CB.
- An operator can verify whether a user received a CB by having a number embedded within a message. [This depends on the firmware available on the handsets available through each operator.]
- When a phone is switched off and then switched on again, the most up-to-date information will always be relayed since CB is not a "store and forward" service.
- MMA could have the option of addressing all subscribers; whereas banks would be able to address their respective customers.
- The Trust Protocol Board (a group of stakeholders assembled to provide guidelines for the use of CB in a country), or its equivalent, can set standards of use.

Events

During events, such as the 2008 SAARC Championships co-hosted by the Maldives and Sri Lanka, CB may be used to inform visitors of the start of matches, special offers, etc. Along routes to event locations, event information could be broadcast with directions and other relevant information to keep people

aware of changes, promotions, etc. Income may be generated using commercial income generating schemes such as CellCast Technologies' commercial uses of the system (as described earlier in Figure 1). The ITU is currently in the process of developing designated channels for commercial broadcasts that will better enable event management broadcasting (i.e. broadcasts may be charged to specific clients).

Service Information

The Maldives has a large tourist industry. Generally, the country may want to provide tourists with basic information when arriving. Information about the nearest hospitals, banks, travel agencies, supermarkets, pharmacists, weather, WiFi hot spots could be broadcast via CB to enhance the tourist experience in the Maldives. Nuisance broadcasts may be curtailed by awareness campaigns in airports and other public areas giving instructions on how to opt-in and opt-out of available cell broadcast services. Service information itself may also be used to notify potential cell broadcast recipients on how to opt-in and opt-out.

Airport Information

Cell broadcast may be used to inform travelers about arrivals, departures, cancellations, delays and other related information. In the Maldives, it could also provide ferry schedules to and from Male, where to find resort information and speedboat ferries, and the location of currency exchange facilities.

Tourist Information

Tourists to the Maldives may be interested in accessing resort information, such as beach information (i.e. water temperature, sea conditions, beach events). Resorts themselves may be interested in using it as a means of getting pertinent resort-related information to its customers, like entertainment options, promotions, activities, etc.

Possible Business Scheme: MMA Interoperable Mobile Banking²⁷

The Maldives Monetary Authority, the country's central bank, has embarked on an ambitious project in partnership with CGAP and the World Bank. The objectives of this project are to significantly reduce the levels of cash in the economy and to provide universal access to formal financial services through the introduction of a mobile phone-based banking system. It will involve shaping an appropriate regulatory

framework for branchless banking, developing an interoperable retail payments system with sufficient volume to be viable, and introducing retail banking competition and greater access to banking through mobile phones and a network of banking agents on the islands.²⁸

Taking Action: Cell Broadcasting for M-Banking

The MMA, mobile operators and other relevant stakeholders, with the information available herein, can use the cell broadcasting solution for the Maldivian m-banking scheme. By integrating cell broadcasting into m-banking, a stronger argument for cell broadcasting use for both commercial and public warning will exist. The commercial application of CB for this interoperable m-banking scheme will provide a sound sustainable option.

To ensure sustainability, it will be important to consider the following steps towards successful integration of an m-banking commercial application of cell broadcasting for the Maldivian market:

1. **Making the case.** Convince operators of CB's commercial application, particularly within the context of banking.
2. **Becoming involved in standard setting groups.** [If using the CellCast commercial model] Engage MMA within the "Trust Protocol Board".
3. **Developing a revenue generation scheme.** MMA must request operators to provide a certain percentage for funding of channels OR ask each bank to pay for their own channels. [Revenue on channels may be earned through mobile bankers themselves. For example, charging a fee by embedding a number within a CB so that a user may make a bank transaction.]
4. **Choosing/Designing an interface.** Choose an m-banking applet to interface via cell broadcasting. [Numerous options are available through CB vendors.]
5. **Designating channels.** Under the auspices of the "Trust Protocol Board", allocate specific commercial closed user group channels for each bank involved in the m-banking scheme. MMA should also have a designated commercial channel OR have space to broadcast on the Dhivehi and/or English civic message channel.

Figure 3: Cell Broadcasting for M-banking

Other Uses of Cell Broadcasting

Since its advent in 1988, cell broadcasting has increasingly been used for both public warning and general information dissemination purposes by several nations. In China it is used for advertising. South Korea has been using cell broadcasting for public warning since 2003. In May 2005, South Korea became the first to switch on nationwide cellular-based emergency system, paying wireless operators to equip network for broadcasts.²⁹

The Mobile Democracy Platform in Turkey allows local governments to broadcast information on a variety of issues concerning their administrative zones such as time-critical issues, plans or activities of the municipality concerning the area or residents, as well as information about roads, buildings, water supply interruption, traffic, health, cultural and social activities. All a resident needs to do to receive cell broadcast messages from their local administration is to activate the '888' cell broadcast channel on their mobile phones. The service also allows municipalities to conduct public

surveys where questions are transmitted through cell broadcast and residents respond through an SMS shortcode.

The municipalities can broadcast their desired information to the targeted area via cell broadcast (CBC) technology over Turkcell GSM BTSs (Base Transceiver Stations). These CBC messages reach mobile phone screens of Turkcell subscribers who have activated the 888 cell broadcast channel code in their mobile phones. This service is completely free of charge to all subscribers, and customers are able to respond to the broadcast messages using an SMS shortcode.

In October 2005, the Netherlands became the first country in Europe to *require* all operators to transmit government text warnings via cell broadcasts. The government of Netherlands paid approximately 2.5m euro/US\$3m to three operators – Vodafone, KPN and Telfort – to equip their networks for cell broadcast.³⁰

Since November 2007, NTT Docomo in Japan offers Alert Mail. It is a CB service that provides warnings for earthquake and tsunamis. Additionally, NTT Docomo supplies mobile handsets to their customers that have a specific configuration menu where the user can choose to receive earthquake warnings and/or tsunami warnings. Furthermore, the volume and duration of the dedicated alert tone can be set in this menu. The Earthquake and Tsunami Warning System (ETWS) is currently being standardized in 3GPP (a global telecommunications standardization institute). Once that has completed other tsunami and earthquake prone countries, mostly in Asia, may deploy the same service.

The USA is developing a Commercial Mobile Alert Service (CMAS) in ATIS (GSM and UMTS standardization) and TIA (CDMA standardization). Operators may elect to participate in the service and when they do, they shall follow the specifications that are currently being developed by ATIS and TIA. Both ATIS and TIA are developing a CMAS via CB specification, since CB is considered the only viable technology for CMAS. At the end of 2009, testing of CMAS will start so as to be operational in 2010.³¹

As of January 30, 2009, Sri Lanka's Dialog Telekom in collaboration with its partners Dialog University of Moratuwa Mobile Communications Research Laboratory and MicroImage Technologies together with the Disaster Management Centre (DMC) of Sri Lanka launched Sri Lanka's first ever mass alert warning system; the 'Disaster and Emergency Warning Network' (DEWN). DEWN is a system being tested by the DMC for issuing alerts via cell broadcasting. Users need only to configure area information reception settings on their Dialog mobiles to receive the alerts issued. Although emergency cell broadcasts to the general public will initially be done over the default Channel 50, eventually a dedicated emergency cell broadcast channel will be in place so that trilingual messages (Sinhala, Tamil and English) can be sent.³²

Recommended Uses for the Maldives

With consideration to the results of the informal surveys and the uses of cell broadcasting, it would be ideal for the Maldives to adopt cell broadcasting for public warning. Adoption of cell broadcasting for public warning is fundamental, yet it will be necessary to ensure that it complements planned warning infrastructure such as TETRANet as well as basic warning tools like sirens and loudspeakers.

Further, the adoption of cell broadcast for public warning is suitably complemented by its capability for commercial information dissemination. Maldivian authorities should consider the adoption of cell broadcasting for advertising, Islamic information, event information, and tourist information. Given that the Maldives Monetary Authority is in the process of instituting an m-banking system in the country, it is recommended that authorities explore the compatibilities of m-banking with the cell broadcast technology. If common ground is found, it may be useful to bring the MMA into the stakeholders committee to decide upon the implementation of cell broadcasting. This would allow for a certain degree of standardization to occur enabling a more marketable use of cell broadcasting for commercial and general information dissemination purposes.

Conclusions

Essentially, cell broadcast is an integrated open system that has the potential to allow emergency officials one-touch notification to cell phones with guarantee of covering all carriers. This technology enables a government entity to securely transmit an emergency alert of natural or human-caused disasters to mobile phones in an affected area anywhere between 5 seconds to 2 minutes, regardless of the size of the area and the subscriber's carrier.

Although cell broadcasting requires minimal to no expenditure, all stakeholders still maintain that a profit scheme would greatly enhance the desirability of cell broadcasting. Cell broadcasting is on the precipice of becoming one of the most versatile and most effective means of transmitting information. Therefore, several income-generating schemes are now available from cell broadcasting vendors. Maldivian authorities should select appropriate vendors and discuss suitable income generation schemes accordingly. Further, thought should be given to inclusion of cell broadcasting into certain aspects of m-banking as described earlier. Annex B gives a proposed schedule of activities discussed with Maldivian stakeholders during the research phase and recommended for full implementation of cell broadcasting.

Once the GoM and other stakeholders have acknowledged that there is a use of CB within the Maldives, they must obtain more information from CB vendors on any costs of operations, security features, and possibly, income-generating scheme they will adopt. Since TETRAnet is a warning standard that the Maldives has adopted, further investigation should go into ways in which TETRAnet may complement cell broadcasting, and vice versa. It may also be useful to learn more about the various uses of cell broadcasting around the world – the Netherlands, South Korea, and Turkey may be able to help Maldivians determine whether cell broadcast is a good fit. The Maldives should pay special attention to the use of cell broadcasting in transmitting information in multiple languages and ensure that Dhivehi is an option. Once these steps are taken, cell broadcast may prove to be an affordable all-purpose information disseminating technology with crucial life-saving characteristics.

¹ “Developing a Disaster Risk Profile for Maldives”. *RMSI: United Nations Development Programme Maldives*. Volume 1: Main Report, May 2006.

² “Maldives Post-Tsunami Environmental Assessment”, United Nations Environment Programme (UNEP),

³ “Maldives: Paradise Soon to be Lost”, BBC News Online, 28 July 2004. Online: http://news.bbc.co.uk/2/hi/south_asia/3930765.stm

⁴ “Developing a Disaster Risk Profile for Maldives”. *RMSI: United Nations Development Programme Maldives*. Volume 1: Main Report, May 2006.

⁵ LIRNEasia - www.lirne.net.

⁶ “Cell Broadcast”. *Wikipedia*. Online: http://en.wikipedia.org/wiki/Cell_Broadcast

⁷ As of early 2009, TAM will be reorganized into the Communications Authority. See <http://lirneasia.net/2009/01/new-communications-act-in-maldives/>.

⁸ “Cell Broadcast”. *Wikipedia*. Online: http://en.wikipedia.org/wiki/Cell_Broadcast

⁹ “Global System for Mobile Communication (GSM)”. The International Engineering Consortium. Online: <http://www.burnsidetelecom.com/whitepapers/gsm.pdf>.

¹⁰ “Analysis of the Short Message Service (SMS) and Cell Broadcast Service (CBS) for Emergency Messaging applications; Emergency Messaging; SMS and CBS”. ETSI TR 102 444 V1.1.1 (2006-02). Online: <http://www.etsi.org>.

¹¹ Obviously, this is more suitable for commercial applications than for emergency alerts as the demand for further information through such message back features would overwhelm a system during a disaster.

¹² “Analysis of the Short Message Service (SMS) and Cell Broadcast Service (CBS) for Emergency Messaging applications; Emergency Messaging; SMS and CBS”. ETSI TR 102 444 V1.1.1 (2006-02). Online: <http://www.etsi.org>.

¹³ Crowe, David. “Wireless Telecom – EAS – Q3 2006”. Online: <http://www.cnp-wireless.com/ArticleArchive/Wireless%20Telecom/2006Q4-EAS.html>. Accessed: 15 June 2008.

¹⁴ Ibid.

¹⁵ 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. Online: <http://ro.uow.edu.au/infopapers/562>.

¹⁶ Wood, Mark (2008, September). *TAM Meeting Male 29 Sept 2008: Authority to Citizen Communications for the 21st Century*. PowerPoint presentation made to the Cell Broadcasting Workshop to Maldivian stakeholders, Male, Maldives

¹⁷ “Developing a Disaster Risk Profile for Maldives”. *RMSI: United Nations Development Programme Maldives*. Volume 1: Main Report, May 2006. p. 15.

¹⁸ Ibid., p.15.

¹⁹ “National Rapid Environmental Assessment – The Maldives”. United Nations Environment Programme. 2004, p. 78. Online: http://www.unep.org/tsunami/reports/TSUNAMI_MALDIVES_LAYOUT.pdf.

²⁰ “Maldives - Tsunami: Impact and Recovery Joint Needs Assessment by World Bank-ADB-UN System”. Asian Development Bank (ADB), the United Nations Development Programme (UNDP), and the World Bank. Annex 15, 8 February 2005. <http://www.adb.org/Documents/Reports/Tsunami/joint-needs-annex15.pdf>

²¹ From Galpaya, Helani “TRE Study” LIRNEasia. 9/19/2008. Online: <http://lirneasia.net/2008/09/colloquium-maldives-tre-study-2008/>.

²² Mark Wood (personal communication, June 23, 2008)

²³ Shillingford, Joia. "Shot on Target". *The Guardian*. May 2, 2002. Online: www.guardian.co.uk/technology/2002/may/02/internetnews.onlinesupplement1.

²⁴ From www.ukresilience.gov.uk/nscwip/publications/interimreport/technology.aspx

²⁵ "Cell Broadcast Message Identifiers". *International Telecommunications Union (ITU)*: Study Group 2. TD 70 Rev.5 (PLEN/2). Geneva, Switzerland. 30 January - 8 February 2007. Online: <http://www.google.com/url?sa=X&q=http://markmail.org/download.xqy%3Fid%3D534e4c4bbkkjtebf%26number%3D1&ct=ga&cd=ZYBwEZTqb6Y&usg=AFQjCNF9qK-daPx-MQjqnPbnHXmmWKS3aQ>.

²⁷ For more information on this project see: <http://www.mma.gov.mv/news/mobile%20eng.pdf>.

²⁸ "Maldives Case Study Policy and Regulation for the World's First 'Universal Access' Branchless Banking System." Online: http://www.cgap.org/p/site/c/template_rc?gbl-searchKeywords=Maldives+Interoperable+Payment+Systems&type=Search+Vignette&Submit.x=0&Submit.y=0&Submit=Search. Accessed: 14 July 2008.

²⁹ From <http://shelbinator.com/2007/04/17/emergency-cellular-broadcasting/>

³⁰ Ibid.

³¹ One2Many. "Cell Broadcast System: FAQ for CB in Public Warning". January 2009. Online: <http://www.one2many.eu>.

³² Antonio, Jithendra. "Dialog Aids Disaster Management". *Daily Mirror*. January 31, 2009. Online: http://www.dailymirror.lk/DM_BLOG/Sections/frmNewsDetailView.aspx?ARTID=39321.