CELL BROADCAST TECHNOLOGY

WHITE PAPER: MASS ALERT SERVICE

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1 INTRODUCTION

A stable government's leaders can manage their economy, legislation and law enforcement, medical standards, and the defense of borders.

But even the most well-organized, resourceful government is vulnerable when a significant natural disaster hits. Whether it be earthquake, flood, wildfire, epidemic, tsunami, heat wave or extreme cold front, managing citizen communication and action is a life-and-death challenge-not to mention the risk of long-term financial damage suffered by the individual, the community and the country as a whole.

A 2015 UN report offers horrifying statistics to illustrate the impact: In the past 20 years, natural hazards around the world have killed more than 600,000 people, left 4.1 billion injured or homeless, and cost trillions of dollars in damages.

Regardless of your view on causes of environmental global change, it's clear that we're seeing disasters strike in new, previously "safe" regions, and becoming more extreme. And not only do disasters cause suffering as they happen - they also kick off new cycles of poverty and disease that impact generationsto come.

As the central body citizens rely on for information and instruction in times of crisis, governments around the words are working swiftly: They are adopting integrated communication systems and strategies with common rules, well-defined legal mandates, and clear, real-time action plans.

Technology is the cornerstone of these efforts; government officials and emergency managers need a zero-failure, citizen-friendly system that makes it quick and easy to instantly reach millions of citizens with a warning message or instructions. They need to be able to contact smaller, remote geographic areas and to even reach them when the cellular networks are in overload. This strategy is not the responsibility of commercial cellular providers. While these companies may provide the consumer-facing infrastructure and devices to reach the consumer, the content and methodology must be centralized to assure a comprehensive, consistent solution. This whitepaper will describe the quickly-evolving cell broadcast technology that provides these critical, comprehensive tools for alerting, instructing and managing responses from the public.First, a quick review of Cell Broadcast technology and benefits. Cell Broadcast is defined by the European Telecommunications Standards Institute (ETSI) and is incorporated into the 3GPP standards. It is a location-based mobile network service that mass-delivers text or binary messages to citizens' phones within the range of the cell, group of cells, or the entire network. While to the end-user, a Cell Broadcast message resembles an SMS, the underlying technology is quite different-in ways making it a perfect fit for emergency messaging:

- Cell Broadcasts are area-centric, rather than user-centric. This means a single message is sent and received by every device in the area…even to visitors for whom the broadcaster has no individual phone number.

- Because an SMS message is sent from the broadcaster to each individual recipient, it may cause over capacity load which will result in portion of population receiving the message when it's already irrelevant.

- Cell Broadcasting does not utilize/monopolize network capacity in the way SMS does when being sent to every subscriber in the country. During a crisis, when phone usage spikes, this is often the difference between a citizen receiving a message and being blocked by the traffic on the system.

In short, Cell Broadcast was practically designed with emergency notifications in mind and is, quite logically, the choice of virtually all policy-makers looking to streamline crisis communication management.

Evolution of Implementation

Since 2006, countries around the world have been developing modernized Public Warning Systems (PWSs): a combination of strategies, regulations and equipment to disseminate emergency alerts via mobile devices. These efforts were sparked by the American Warning, Alert, and Response Network (WARN) Act passed by Congress in 2006. Shortly after this Act, in 2007 and again in 2008, The Federal Communications Commission proposed and adopted specific - though preliminary - network structures, operational procedures and technical

requirements, renaming the program Commercial Mobile Alert System (CMAS) and finally migrating to a more simply named Wireless Emergency Alerts (WEA).

The CMAS interface transitioned to the newer implementation of WEA and went live in April 2012; the National Weather Service began delivering its Wireless Emergency Alerts on June 28, 2012.

Today's WEA system allows local, federal and national agencies in the US to transmit:

- Alerts issued by the President of the United States.
- Alerts involving imminent threats to safety of life, issued in two different categories: extreme threats and severe threats
- AMBER Alerts

Participation (and some parameters of the process) are optional for cellular providers, though most mainstream companies (T-Mobile, AT&T, Sprint, Verizon) do participate. The alerts are sent to these mobile operators who then broadcast them to their customers, using area-based Cell Broadcast, rather than network-limited SMS technology. The CMAS/WEA system has involved collaboration between the Federal Emergency Management Agency, the Department of Homeland Security Science and Technology Directorate, the Alliance of Telecommunications Industry Solutions and the Telecommunications Industry Association.

Europe's Unique Challenge

Europe faces an extra challenge in addressing these issues, which makes it more complex than the American model. According to Emergency Telecommunications (EMTEL), a committee formed by the European Telecommunications Standards Institute (ETSI): "The organization of emergency and public safety services may vary from country to country depending on how the society is structured. Citizens are increasingly mobile. They travel for business, for holidays, etc. In order to provide an optimum level of security and accessibility to these citizens in emergency situations, the emergency telecommunications services need harmonization."

As such, they are developing EU-ALERT, the standardized European emergency alerts system. When implemented, the letters EU will be replaced by characters identifying a particular country (e.g. NL-ALERT for the Netherlands and UK-ALERT for the United Kingdom). This allows each country to confi gure its own implementation matching their specific requirements while maintaining a common core technology shared by all participating countries. The process is gradual, however: The Netherlands is the first EU member state to implement EU-Alert and a number of other European countries (like France and Belgium), are investigating the possibility of deploying similar services.

Various periphery bodies have likewise been working toward Pan-European standardization: Recent resolutions in bodies such as the ITU Telecommunication Standards Advisory Group (TSAG), the Global Standards Collaboration (GSC), the Asia-Pacific Standardization Program (ASTAP) and various ETSI Technical Bodies all highlight the need for a coordinated approach to emergency communications.

Japan – Focus on Quakes

Around the time the US was formalizing its initial programs in 2007, NTT Docomo, one of Japan's leading operators, began offering the Area Mail Disaster Service. This Cell Broadcast services focused particularly on Japan's highest-risk disasters: earthquakes and tsunamis. Users on the NTT Docomo network were provided with handsets that have a specific configuration menu that allowed them opt in or out of earthquake and/or tsunami warnings. The menu also allows users to select the volume and duration of the ringtone dedicated to emergency messages. Today's next generation implementation is a two-tiered approach call the Earthquake and Tsunami Warning System (ETWS), and has been standardized in 3GPP (a global telecommunications standardization institute) and is also implemented by Japan's other phone networks, au and SoftBank Mobile. The standard specifies the delivery of emergency information in two levels. The Primary Notification contains the minimum, most urgently required information such as "An earthquake occurred/is about to occur". This information can be automatically triggered by any of the 4,235 P-wave sensors around the country, and because of its short, simple nature, it can be received by citizens near the epicenter within about 4 seconds. With this data, people may take shelter or move away from dangerous areas such as cliffs. Railway workers can use this warning to slow down bullet trains, and factory workers may use it to stop assembly lines before the violent shaking reaches them and causes an industrial damage. The Secondary Notification includes supplementary information not contained in the Primary Notification, such as epicenter, seismic intensity, and other information that may be useful, but not as critical to short term "run for cover" activity.

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The UN Gets Involved

In January 2005, the World Conference on Disaster Risk Reduction (a series of United Nations conferences focusing on disaster and climate risk management in the context of sustainable development) created the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (HFA). The HFA's first Priority for Action was to "ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation," notably through "policy, legislative and institutional frameworks for disaster risk reduction." HFA was the first initiative to explain, describe and plan the tasks that were required from various sectors and government bodies to reduce disaster damage to property and life. It was developed and agreed to by partners representing 186 countries: governments, international agencies, disaster experts and many others – creating a shared, international, coordinated system. The HFA outlines five specific priorities for action, and offers guiding principles and practical means for achieving disaster resilience:

1. Making disaster risk reduction a priority;
2. Improving risk information and early warning;
3. Building a culture of safety and resilience;
4. Reducing the risks in key sectors;
5. Strengthening preparedness for response.

Following the expiration of this plan's scope in 2015, The Third UN United Nations World Conference on Disaster Risk Reduction was held in Sendai, Japan. The resulting Sendai Framework for Disaster Risk Reduction 2015-2030, an expansion and dramatic improvement to the previous agreement, featured seven targets and four priorities for action. Among these targets: "Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030." It was endorsed by the UN General Assembly in June 2015.

The Americans, Europeans and Japanese are all nationalizing these systems, each with its own focus: The US spear-headed the effort a decade ago with its CMAS (Commercial Mobile Alert System) and have developed a number of new implementations to keep up with fast-moving device technology; the EU is focusing on cross-border functionality that provides emergency messaging for those moving between countries and coverage zones; the Japanese were the first to implement a system to provide virtually instant, automatic "take cover" warnings seconds ahead of an earthquake, followed by a longer message with additional details.

No matter where on the globe, these plans are especially important in rural areas where infrastructure and architecture are more primitive or limited, communications channels less dependable, and medical or rescue forces are distant.

❷ THE STANDARD SOLUTION

The mobile component in end-to-end solutions popular in many national implementations around the world today is based on a technology called Cell Broadcast. Cell Broadcast has been defined by the European Telecommunications Standards institute (ETSI) since 1997 and is incorporated into the GSM 3GPP standards. It is a location-based mobile network service that mass-delivers text or binary messages to citizens' phones within the range of the base station cell, group of base station cells, or the entire network. Repetitive paragraphrepetitive paragraph The cell broadcast service architecture is described in the 3GPP standard 23.041 and is supported over 2G, 3G and 4G networks in a similar manner, using one CBC (Cell Broadcast Center) that serves all these networks - the broadcast service's basic functionality does not change when roaming from one network technology to another.

The main CBC solution entities are:

CBE (Cell Broadcast Entity) - The originator of the Cell Broadcast message being sent. It dictates the message text, message destination and the message scheduling. The Alert Aggregator that we will discuss shortly is a **CBE.**

CBC (Cell Broadcast Center) - This entity resides in the mobile operator's core network. The CBC handles and manages the sending of a message received from the CBE; it routes it to the target cells through the RAN controllers (see on the right), and implements the interfaces connecting it to the RAN controllers.

RAN (Radio Access Network) Controller - The entity in the operator's radio network that manages a group of cells. The RAN controller distributes the Cell Broadcast message to the target cells. (BSC, RNC and MME are the RAN Controllers for 2G, 3G and 4G networks respectively.)

Cell Antenna - The component that wirelessly sends the Cell Broadcast message to mobile devices.

End-User Device - The end-user's equipment (generally a mobile phone) that responds to the Cell Broadcast protocol to receive and present the message to the user.

THE ADVANTAGE OF CB VS. SMS

While to the end-user, a Cell Broadcast message resembles an SMS, the underlying technology is quite different – in ways making it a perfect fit for emergency messaging:

- Cell Broadcast is area-centric, rather than user-centric. This means a single message is sent and received by every device in the area – even to visitors for whom the broadcaster has no individual phone number.
- Because a standard (P2P) SMS message is sent to each individual recipient, it may cause a "traffic jam" backlog in an area covering a particularly large number of targeted users. This can result in a portion of the population receiving the message beyond the relevant time. Cell broadcast, on the other hand, is a real-time, simultaneous, mass-reach technology; millions of people can receive alerts instantly.
- • Cell Broadcasting does not over-utilize/monopolize network capacity in the way SMS does when being sent to every subscriber in the country. During a crisis, when phone usage spikes, this can actually lead to network collapse.

In short, Cell Broadcast is a perfect fit for emergency notifications, and is quite logically, the choice of virtually all policy-makers looking to streamline crisis communication management.

TECHNOLOGY COMPARISON

	SMS	CELL BROADCAST
Real time target audience	Limited	Millions
Mass distribution time	Hours	Few Minutes (including repetition)
Radio impact	Severe overload	Negligible
Network impact	May cause network overload	Negligible
Availability during emergency	Very weak	High
Location based	Complex	Built-in
Infrastructure Cost	Low	Low
Additional handset cost	None	None
Resources cost	Requires a lot of network resources	Very low
Availability of handsets	All	Very high
Proven & interoperable	Yes	Yes
Bandwidth	Low	Low

A CENTRAL MASS ALERT SYSTEM

The fact that mobile operators maintain one central CBC entity to connect all cell antennas makes the integration of a Mass Alert system very simple; a nation-wide Mass Alert system need "only" to connect to each mobile operator in the country to ensure maximum reach to the total, all-inclusive mobile subscriber audience.

The generic solution architecture involves several authorities and entities as described in the figure below:

Alert Initiator - The "supplier" of the information to be shared with the population: Police, fire department, weather service, etc.

Alert Aggregator - The Cell Broadcast Entity mentioned earlier that receives and handles the event, spreading it among mobile phone users as well as other modes of alert systems that reach the target population: Sirens, radio, TV, social networks, etc.

Mobile operator - As described above, the commercial entity that owns the cellular infrastructure - in particular, the Cell Broadcast Center.

End User - The audience receiving the alert.

Deployment of a Mass Alert system involves prerequisites that governments must impose on all mobile operators, as well as on the handset manufacturers who wish to sell phones to citizens, in order to ensure standardization across all operators and handsets.

❸ THE CELLTICK MASS ALERT SOLUTION

Our solution is for a National Mass Alert system that enables comprehensive delivery of text messages to end user devices over 2G/3G/4G cellular network infrastructure. The solution includes a national central system that aggregates alerts from a number of authorities spread across the country, and manages the transmission of these alerts to the relevant geographical areas.

The solution is powered by Celltick's interactive messaging platform that runs over the Cell Broadcast infrastructure and enables the mass distribution of content to entire populations in the coverage broadcast area, enabling individuals to interact with the service using P2P SMS.

The national center is to be designed as fully redundant (active standby architecture) to ensure service continuity in the event of either planned or unplanned service shutdown

The National Mass Alert system would connect to all mobile operators in the country to allow them to deliver messages over their Cell Broadcast and/or SMS infrastructure, to the specific location relevant to the message goals and content.

As a way to ensure reliability of the overall solution offered herein, the Cell Broadcast and SMS infrastructure that reside on the mobile operator's premises should also be redundant and with high availability in the event of infrastructure failures; they would achieve this by including two CBC servers in active-standby architecture, and assuring that the connecti on to the radio network ele ments (BSC/RNC/MMEs) has more than one available route.

The solution is illustrated in the following diagram, where the Central Alert Aggregator sends commands to the CBC of the mobile operator, specifying the following variables:

- Area – the target area described with polygons, circles or pre-define names
- Channels-broadcast channels set the type of the message:
  - Regular Cell Broadcast
  - CMAS messages
  - Interactive messages
- Message content
- Start time
- End time

Alert editor can designate the way he wants to distribute the alert (perhaps even with all three options); with the option to decide whether he'd like the n message to be interactive. These interaction options may also include voice calls and/or SMSs.

❹ CASE STUDIES

As discussed, the Cell Broadcast model above is clearly a perfect method for transmitting urgent, life-saving instructions and updates in a crisis. A few examples illustrate its effectiveness:

- In 2003, authorities in Mumbai reacted to a twin car bombing by instantly and efficiently issuing mass communications through Celltick's system, over the Hutch network. With telecom networks and news websites overwhelmed and out of commission, messages still went out non-stop, offering updates, traffic reports, instructions for blood donations and listing hospital helplines.

- In the Asian tsunami of 2004, Sri-Lanka's Dialog GSM mobile service used Celltick's system to send over 100,000 interactive alerts to citizens, including warnings, news updates, and information on collection centers and donation instructions. These messages were specifically sent in a forwardable format to help spread the word beyond the initial population of recipients.

- When Chile experienced a devastating 8.2-magnitude earthquake in 2014, authorities managed to keep citizens up-to-date throughout the crisis, no matter where they were or what devices they used. The implementation used emergency mobile channels and a geo-redundant configuration to prevent complete failure due to earthquake damage.

❺ SUMMARY

Countries around the globe recognizes the need for a unified, dependable method to reach its citizens. While each system varies slightly in its implementation – based on the country's specific priorities and risk factors – the common elements are dependability and speed of delivery, and minimal risk or complications introduced to infrastructure. When lives and property are at stake, a CB-based mass alert system is an endeavor that cannot be responsibly ignored, underfunded or delayed.