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FM Radio and RBDS--Based Emergency Alerting: Possibilities and Potholes

DeeDee M. Bennett

University of Nebraska at Omaha, dmbennett@unomaha.edu

Salimah LaForce

Georgia Institute of Technology

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FM Radio and RBDS-Based Emergency Alerting: Possibilities and Potholes Volume 2013, Number 04 – October 2013

Introduction

There is a revolution in wireless technologies that is changing how we communicate during emergencies. The Federal government agencies responsible for regulations and practices concerning the dissemination of emergency alerts, notifications, communications, and next generation distribution systems for emergency alerts have stated that redundancy and reliability are critical to ensure that alerts over “communications systems have the capacity to transmit alerts and warnings to the public as part of the public alert and warning system.”¹ Further, regulatory agencies and policymakers are taking the lead through the rulemaking process to reconcile issues concerning full access to alerts and other emergency information for people with disabilities.² However, the current national alerting solutions are relegated to either cellular networks (i.e. Wireless Emergency Alerts [WEA]) or broadcast stations and cable systems (i.e. Emergency Alert System [EAS]) and each alone (in its current form) is not optimized for accessibility. WEA regulations have prohibitions that impede accessibility and EAS is not mobile. EAS utilizes broadcast spectrum that can send large amounts of data, while WEA uses the cellular network and has instituted strict data limitations. Where one is strong the other is weak and vice versa. A synergistic relationship between the traditional broadcast industry and the wireless industry could remedy emergency alert and information access concerns held by providers (network congestion), emergency managers (timeliness of message), and by citizens (full access in the most expedient modality).

Background on WEA, SMS and RBDS

Currently, most phones have Short Message Service (SMS) capability. SMS is text message capability for mobile devices such as a phone. It utilizes space in the signaling system of cellular networks to use a path that does not interfere with regular data or voice traffic. SMS under 3G is relatively free from congestion. However, SMS requires an individual message be sent to every subscriber (one to one), and there is no verification of receipt of an SMS message.

¹ See *Executive Order*, Section 2(a)(iii). Section 3(b) (iii) of the *Executive Order* which directs the Commission to adopt rules.

² FCC (2010) FCC Implementation of the Twenty-First Century Communications and Video Accessibility Act [Pub. L. 111-260].

Available at <https://prodnet.www.neca.org/publicationsdocs/wwwpdf/113010fccpresentation.pdf>

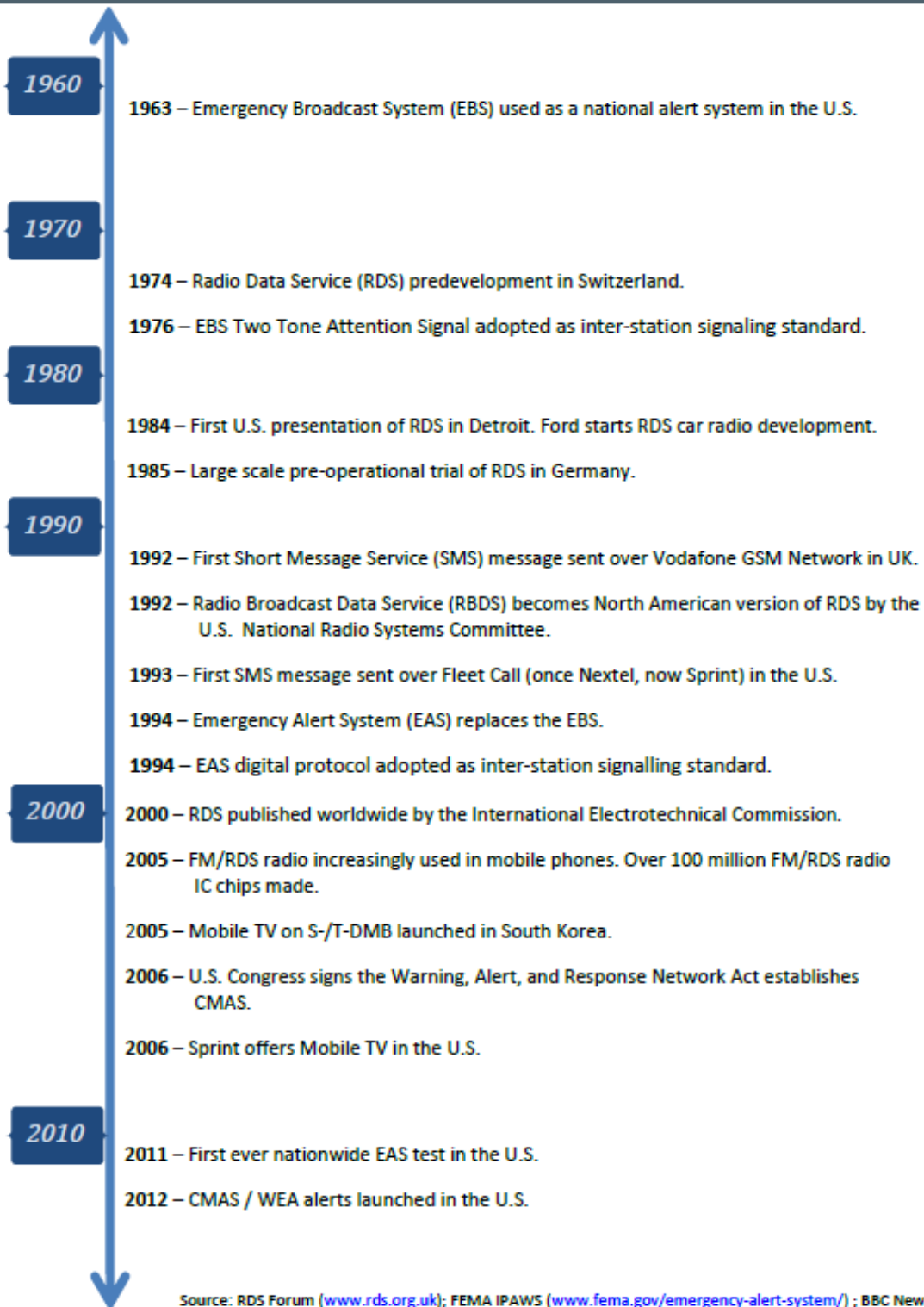
Most users of SMS have experienced times where an expected message never arrives, or arrives hours or sometimes even days later. An SMS arriving minutes, or even an hour late can be the difference between life and death during an emergency. As seen during Hurricane Katrina and the recent Super Storm Sandy in the U.S., the cellular network is frequently off-line for days in disaster-stricken areas. More importantly, for the emergency management message originator, the cost of SMS alerting is roughly 3-6 cents per text message.³ Therefore, if you have 100,000 person alert base, the cost for one alert message sent would be \$3,000 to \$6,000. The problem is you never send one SMS text alert message. It always requires 5-8 messages, which means for one incident the average cost to operate a SMS text based alert system will range from \$15k-\$30k PER INCIDENT. The result is that most municipalities can't afford to maintain and use the systems.

WEA is a more reliable and less expensive than SMS based warning systems that have proliferated across the U.S. from a combination of sources, including private companies, media outlets and local governments. WEA broadcasts each alert at least twice to ensure everyone in a given area receives the message. WEA alerts are delivered to cell phones via cell broadcast, which is a special mechanism to send a broadcast package to all phones (one-to-many) in the range of a cell tower. Cell broadcast, unlike Short Message Service (SMS), is supported on all major cellular technologies, including Long-term evolution (LTE). For cell broadcast and WEA to function, the cellular infrastructure must be operational and cell phone handsets must be equipped with special hardware and enabled software. However, the cellular network is less reliable than traditional analog wire-line phone lines and FM radio.

FM radio is free with no message fees or long-term contracts. Radio Broadcast Data Service (RBDS) is a standard for providing data-casting transmitted on the 57 kHz subcarrier of terrestrial FM radio stations in the United States. Using RBDS for emergency alerting would combine both a WEA textual message sent to a phone, as well as receiving EAS audio emergency information from an FM radio station (or even just to hear the FM station audio message). Some phones have text-to-speech (TTS) capabilities that can read a WEA or SMS message to a person who is blind or has low vision, but TTS is not a WEA message requirement. In some cases TTS is a relatively expensive piece of additional software required for purchase by the end user. RBDS integration could be an option for people with vision loss who select a phone that does not have embedded TTS or cannot afford to purchase additional software.

³ Global Security Systems determined pricing based on basic SMS text cost information from alert providers and extrapolated final figures.

Timeline of Emergency Alerts, SMS, RDS and RBDS Worldwide



Source: RDS Forum (www.rds.org.uk/); FEMA IPAWS (www.fema.gov/emergency-alert-system/); BBC News (http://news.bbc.co.uk/2/hi/uk_news/2538083.stm); Time .com (<http://techland.time.com/2011/06/08/americas-first-ever-sms-message-burp/>)

Potential use of FM Radio and RBDS for emergency alerting

Almost all modern car radios support RBDS. It is used for the transmission of information such as broadcast station call letters/signs, song names, traffic, etc. Many home radios also support RBDS.

As part of the Federal Communications Commission's (FCC's) Report and Order in December 1994 establishing the EAS, the use of RBDS to transmit EAS messages is strongly encouraged but not required. Currently, RBDS for alerting has been working for the last six years in the State of Mississippi and to varying degrees in another 17 States through local, county and statewide alert systems. RBDS alerting allows authorized alert originators such as emergency managers, university and government officials to send geo-coded alert messages to citizens including weather information, amber alerts and imminent danger alerts. This capability provides an additional way of alerting citizens in times of emergency. More importantly, the RBDS alerting platform leverages the existing FM radio broadcast infrastructure which has overlapping signals, reliable back up power and transmitting systems.⁴

RBDS for emergency alerting on mobile devices is not a completely novel concept. In 2012, researchers noted that FM-RDS⁵ was used via DISANET to broadcast emergency communications. DISANET is a disaster communication system developed by both Indian and Japanese researchers.⁶ They found that it is both easy to deploy and well-suited for disaster areas. The European Broadcasting Union (EBU) established a broadcasting standard for the Digital Audio Broadcasting (DAB) system to be compatible with mobile devices for which they anticipated emergency communications to be a feature.⁷ Furthermore, researchers in South Korea assessed that accessible information can be transmitted through radio-based sub-channel transport (such as RDS) if a higher bit-rate is available to push the multimedia contents. Such accessibility in communications could include audio messaging for the blind, video clips related to the emergency and maps depicting the evacuation route or shelter locations.⁸

Similar to broadcasting terrestrial FM radio stations over mobile devices, other researchers are looking into emergency alerts on TV through such devices. South Korea has cellphones and vehicle navigation devices with the capability to receive satellite and terrestrial television signals through the process of

⁴ The information in this paragraph was provided by Matt Straeb, Global Security Systems, May 2013.

⁵ Radio Broadcast Data Service (RBDS) is a standard for providing digital information on FM radio broadcast stations in the U.S. similar to the Radio Data Service (RDS) in Europe.

⁶ Jalihal, D., R.D. Kolipillai, P. Khawas, Keiji Takeda, Kotaro Kataoka. (2012). A Rapidly Deployable Disaster Communications System for Developing Countries. IEEE.

⁷ Emergency Broadcasting Union-Union Europeenne de Radio-Television (EBU-UER). (2006). Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to Mobile, Portable and Fixed Receivers. ETSI EN 300-401 V1.4.1

⁸ Choi, Seong Jong. (2007). Analysis of Emergency Alert Services and Systems. *2007 International Conference on Convergence Information Technology*.

digital multimedia broadcasting (DMB).⁹ DMB can be used for emergency alerts and is an extension of DAB.¹⁰ As an extension, DMB has the capability of radio broadcasts over mobile devices and is a good starting point for background information. In 2005 Qualcomm introduced a rival technology for the U.S. market, MediaFlo¹¹. MediaFlo, however, failed to be fully adopted among carriers and consumers. In 2010 Qualcomm discontinued the product.¹²

A 2011 study on mobile digital television for U.S. emergency communications found that further research was necessary to determine the stability and suitability of the current mobile devices and public safety needs.¹³ In their study researchers suggested that public safety entities strategically assess the use of digital television as it does not limit the number of subscribers in any geographic area, the necessary infrastructure is currently in place, and it does not use the existing public safety spectrum. Other researchers contend that digital television may not be the appropriate channel for the United States, as many Americans spend much of their commute in personal vehicles (as opposed to other countries where public transportation is the norm) and States have outlawed the use of cellphones in automobiles.¹⁴

A more recent project that is currently in development by National Public Radio (NPR) Labs with funding from the Department of Homeland Security, Science and Technology Directorate, is a demonstration project to look at emergency alerting for individuals who are Deaf or hard-of-hearing living in the US Gulf Coast. It will make use of the RBDS sub-carriers with the expectation of directly delivering end-to-end, accessible emergency messaging currently afforded to hearing individuals.

In the FCC rulemakings to modernize EAS, inclusion of mobile technologies for receiving emergency alerts is addressed and encouraged. RBDS could bridge the gap between traditional EAS and WEA. This was reinforced by a letter from the FCC Commissioners to the U. S. Congress on March 18, 2010 which stated that the FCC would ... “not require or prohibit the use of Alert-FM ... or similar systems as the basis of the CMAS. CMAS participants, then, are free to adopt FM-based technologies as they

⁹ Shim, J.P., Kyungmo Ahn, and Julie M. Shim. (2006). Empirical Findings on the Perceived Use of Digital Multimedia Broadcasting Mobile Phone Services. *Industrial Management & Data Systems* 106(2):155-171.

¹⁰ Choi, Seong Jong. (2007). Analysis of Emergency Alert Services and Systems. *2007 International Conference on Convergence Information Technology*.

¹¹ Shim, J.P., Kyungmo Ahn, and Julie M. Shim. (2006). Empirical Findings on the Perceived Use of Digital Multimedia Broadcasting Mobile Phone Services. *Industrial Management & Data Systems* 106(2):155-171.

¹² Carew, Sinead. (2010). Qualcomm Suspends Flo TV sales. *Reuters*. October 5, 2010. Retrieved from <http://www.reuters.com/article/2010/10/05/us-qualcomm-flo-idUSTRE6945AO20101005>

¹³ Desourdis, Jr., Robert I., Kevin Vest, Mark O'Brien, and David J. Mulholland. (2011). Digital Television for Homeland Security: Broadband Datacast for Situational Awareness and Command Coordination. IEEE

¹⁴ Shim, J.P., Kyungmo Ahn, and Julie M. Shim. (2006). Empirical Findings on the Perceived Use of Digital Multimedia Broadcasting Mobile Phone Services. *Industrial Management & Data Systems* 106(2):155-171.

desire.”¹⁵ In 2011, the FCC noted that “FM chips in mobile devices ... could enhance the value of Public Localized Alerting Networks (PLAN) during disasters.”¹⁶ They also mention that the reach of emergency alerts may increase due to the significantly high adoption of FM radio and mobile phones among the more vulnerable including ethnic minorities and people with disabilities populations.¹⁷

Some cellular phones have FM radio capability (most HTC models for example), but currently no cellular phones in production in the U.S. provide a public Application Programmer’s Interface (API) to access RBDS capabilities. Thus, external projects cannot develop and evaluate new uses for the technology. RBDS capabilities are extremely limited in phones with FM radios. In addition, some carriers disable the FM radio functionality to push users to listen to streaming audio instead of free FM radio (AT&T for example disables the FM Radio on their HTC One phones). So while there is great potential for RBDS and FM Radio integration into the emergency alerting environment, moving beyond theoretical deliberations to development and testing on commercially available phone models is constrained by the conflicting interests of markets and social good.

New ways to provide access to emergency alerts

Widespread adoption of FM radio in cell phones would provide a couple of potential ways to improve access to emergency alerts and information today. In response to the FCC’s Second Further Notice of Proposed Rulemaking regarding EAS, the Wireless RERC recommended¹⁸ that the FCC require broadcast stations using RBDS subcarriers to deploy that technology to distribute real-time notifications of national, state and local emergency situations, weather warnings, homeland security notices, and evacuation instructions with targeted information to persons with disabilities.

WEA (formerly the Commercial Mobile Alert System [CMAS]) provides the same basic functionality as the proposed FM radio in cell phones, but as we will see, it is not as robust. WEA alerts can be provided via text on the cell phone screen; in 64 character blocks (multiple blocks can be transmitted). Cell phone users that are Deaf or hard-of-hearing can use this as a primary source of emergency information and can then consult alternate information sources for additional details. For example, a Deaf or hard-of-hearing user first receives a WEA tornado warning on his/her cell phone, but then in lieu of visiting a website and further congesting an already taxed network, they could manually use the cell phone FM capability to receive additional details. Indeed, many WEA messages direct the

¹⁵ March 18, 2010, Letter to Honorable Stephanie Herseth Sandlin, U.S. House of Representatives, 331 Canon House Office Building, Washington, D.C.

¹⁶ Waldman, Steven. (2011). The Information needs of Communities: the Changing Media Landscape in a Broadband Age. FCC. Retrieved from www.fcc.gov/info-needs-communities#download , p. 309

¹⁷ Ibid.

¹⁸ Mitchell, H., Yancey, L., Baker, P. (2007). Comments submitted to the FCC in response to *Review of the Emergency Alert System, Second Report and Order and Further Notice of Proposed Rulemaking* (2nd R&O and FNPRM), [EB Docket No. 04-296]. Federal Communications Commission: Washington, DC, December 3, 2007.

individual to check local media. Doing so on the same device, utilizing a method that doesn't tax the data load, would streamline the effort in a way that is efficient for both the user and the network. A cell phone with FM radio and/or RBDS text capability provides another method for all citizens to receive emergency information in the event cell service is unavailable.

Additionally, the Blind and low vision user could listen to the EAS message via the FM radio chip. If this capability were available on WEA capable handsets, it would work around WEA limitations such as the 90 character limit and the prohibition of URLs and 1-800 numbers. EAS messages allow for up to two minutes of audio, and often include websites and or phone numbers where more information can be obtained. Also, future use of the FM radio chip with RBDS could add functionality to turn on the phone automatically and present the alert information. We propose that these features would increase the likelihood of timely alert receipt that compels the end-user to take appropriate protective actions.

Another potential accessibility enhancement would use the RBDS feature on a cell phone to access emergency information from an FM station. This would occur when a local FM station transmitted an RBDS alert signal that is received on an RBDS capable cell phone. It would then automatically notify a person who is Blind or low-vision that there is an emergency. The FM station can then transmit a text of the alert which could drive/activate a bed shaker, a text-to-speech audio message, potentially an American Sign Language interpretation and even additional audio information. In fact, RBDS capable cell phones could be programmed to monitor the local FM Primary EAS station and automatically provide additional information in an emergency.

Further possibility would be to allow the user to choose a local FM station that provides EAS alerts and program their cell phone to monitor for that station's EAS digital or Two-Tone Attention Signal. The monitoring feature would be triggered by the phone's receipt of a WEA alert. Therefore, the phone would not need continuous active monitoring for the EAS signals; thereby reducing the demand on the battery to run the program/app.

Obstacles to RBDS use

Perhaps the largest obstacle to RBDS use is the lack of programming APIs to access the RBDS functionality of the FM radios. This obstacle can be overcome just like other technical obstacles such as cell phone power consumption and internal antenna designs. CTIA, the trade association representing the cellular industry, has openly opposed the mandated use of FM radio in phone handsets.¹⁹ The National Association of Broadcasters (NAB) supports the voluntary inclusion of FM radios in handsets but also opposes a government mandate requiring such implementation.²⁰

¹⁹ CTIA Release, February 2012, WIRELESS EMERGENCY ALERTS: WHY RADIO TUNERS ARE UNNECESSARY

²⁰ February 3, 2012, NAB For Immediate Release, NAB Statement on Voluntary Inclusion of FM Chips in Cellphones.
<http://www.nab.org/documents/newsRoom/pressRelease.asp?id=2684>

However, they also acknowledge the usefulness of FM radio in mobile devices for emergency alerting.²¹ Various trade organizations have been arguing over the inclusion of FM radio for at least three years. In the meantime, the limited access to RBDS has all but vanished as it is absent in newer versions of phones and phone operating systems. For example, Nokia had an API to access the RBDS functionality in their Symbian phones, but now that they have shifted to Windows Phone 8, this functionality has been lost. Microsoft also had an API in an earlier version of Windows Phone (for internal use only), but this too seems to have been removed. Samsung removed the functionality in a firmware upgrade to its phones in 2012.

Market solutions

The market could decide to fix this problem. Many cell phones currently have FM radios. In addition, many other phones have the FM functionality embedded in them in off-the-shelf chipsets, including chipsets from market-leader Qualcomm that just requires some simple work by the handset manufacturer to enable. This problem could be quickly solved with a combination of cellular handset manufacturers supporting FM radio and building out any needed functionality in low-level software, as well as operating system level support. If a concerted industry effort were made, a majority of new products shipping in 18 months could have this functionality. This would provide a bridge solution for people with disabilities until all handsets are fully accessible during emergencies.

Regulatory solutions

For the purpose of enhancing access to emergency information, the FCC could mandate the inclusion of FM radio with RBDS capability in all new handsets, or in a certain percentage of handsets/number of handsets or encourage voluntary inclusion until all handsets are accessible to people with disabilities. This would require support from key players in government, such as the Department of Homeland Security (DHS) and the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS), as well as support and cooperation from both the wireless and broadcast industries. Even with this, it could be an uphill battle to get FCC approval to require inclusion of FM radio with RBDS capability in cell phones. The voluntary market fix would be preferable. However, the FCC might also consider releasing a Public Notice to request an update concerning FM cell phone technology.

Research and Development propositions

FCC regulations require that the Attention Signal used for WEA alerts by cell phone carriers be identical to the Attention Signal used for EAS alerts by broadcast stations and cable systems. Therefore, the Attention Signal could be one way to monitor for an FM station EAS alert. Also, the public is very familiar with the sound of the Attention Signal as it is received on both WEA and EAS alerts.

²¹ Smulyan, Jeff. (2012) Statement of Jeff Smulyan, Emmis Communications Corporation Hearing on “The Future of Audio,” before the United States House of Representatives Committee on Energy and Commerce, Subcommittee on Communications and Technology. June 6, 2012.

Additionally, a mobile application (app) can be developed that would operate as follows; (1) a WEA alert is received on a cell phone that has FM receipt capability, (2) the app is activated on the cell phone and it begins monitoring for a local FM station's EAS digital or Attention Signal, (3) an FM station transmits the EAS signal followed by audio emergency information and, (4) the cell phone receives the EAS signal and emergency information from the FM station. In this scenario the app only goes into action after receiving a WEA alert. The cell phone user receives both the WEA text alert and the FM station's EAS audio emergency information. The time that the app is actively searching for an FM station's EAS signal could be limited as well.

Global Security Systems (GSS) has proposals to demonstrate FM cell phone applications that can provide emergency information following receipt of a WEA alert. These proposals would utilize GSS assets. They would demonstrate how users who are vision impaired or hearing impaired would receive additional emergency information.

Conclusion

Communications during emergencies are changing. Often traditional SMS is slow during disasters in critical areas, with messages taking up to several hours to reach the intended population. WEA alerts are more reliable, however they are restricted to 90 character blocks even though multiple blocks can be transmitted. Additional details could be provided via terrestrial radio.

A robust relationship between the traditional broadcast industry and the wireless industry which respects both sides of the issues could remedy emergency alert and information access concerns held by providers (network congestion), emergency managers (timeliness of message) and by citizens (full access in the most expedient modality). The potential uses for RBDS are great and in some locations, such as in rural areas where broadcast signals are readily available, or areas where RBDS is already being developed and researched. Such a synergistic relationship between FM radio and wireless industries could greatly benefit underserved minority and disability populations during emergencies. The NPR labs project hopes to use RBDS to provide accessible alerts to individuals who are Deaf or hard-of-hearing. Blind and low vision users can also be alerted to EAS messages via RBDS over mobile devices.

Accessory software development would allow RBDS in conjunction with mobile devices to interpret ASL, provide text-to-speech, or drive a bed shaker. Furthermore, vulnerable populations, including ethnic minorities and people with disabilities, both with high adoption of FM radio and mobile phones, are likely to be increasingly more aware of emergency communications during disasters. Key support from NWS, NOAA, and DHS could improve the functionality of RBDS over mobile devices.

Recommended Options

1. It is important to create an interim solution until WEA is more robust. Particularly because people with disabilities must be enabled to receive emergency alerts in as many formats as needed on their device of choice.
2. A cell phone user should have the capability to receive any and all emergency information concerning an alert. One way to accomplish this is to link EAS and WEA emergency information on the cell phone.
3. Development of WEA and EAS links through cell phone FM and/or RBDS capability should be a priority of government and industry. The resulting capability can be implemented by industry on a voluntary basis. Future enhancements to WEA such as providing URL's or other links in a WEA alert will help.
4. There are some EAS activations originated by local officials that are distributed through local broadcast stations. These may not go through FEMA IPAWS and consequently WEA, especially if the local officials; (1) are not authorized to connect to IPAWS, (2) do not have the software and equipment to connect to IPAWS, (3) do not have Internet connectivity or (4) know that the cell towers in the affected area are inoperable. Therefore, those local EAS activations would be missed by cell phone users unless there is a capability in the cell phone to receive the local EAS activation via FM radio.

About the Wireless RERC

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