

Radio Broadcast Alerts Save Lives *Franklin W. Bell*

The most widely implemented Alerting technology on Broadcast Radio is EAS (Emergency_Alert_System). First implemented in USA in 1997 it has been adopted in a number of countries, and has saved many lives. While the Common Alert Protocol is used to the Radio Broadcaster, the EAS protocol is used over the air. This is the beginning of the desirable improvements.

- 1) Adapt EAS to be an extension of CAP with a low amount of data with;
 - A} Allow for jurisdiction code schemes for international use. E.g. UNLocode
 - B} Add polygons with limited data requirements
 - C} Extend the Event Terms to have one for every CAP ETL with spectra.
 - D} Provide for Earthquake Early Warning (EEW) with very rapid delivery, polygons and estimated countdowns to shock arrival. In areas with known seismic risk, doing exercise drills is more relevant than depending on people milling. “Drill or Mill is a decision for education”.
 - E} The implementation of polygons, EEW, language selection and perhaps more MAY require codes to trigger processing in the receiver, which is not currently provided for.
 - F} Contain other CAP Data within the EAS improved protocol.
 - G} Provide for redundancy of delivery using a Digital Daisy Mesh (DDM), including reception from digital TV with separate alert data and audio or digital radio broadcast e.g. DAB+, DRM and HD Radio.
 - H} Have a State Plan for implementation which is preferably including an automated monitoring system of alert delivery. Radio broadcast in some areas is using unmanned stations, and Engineers may be expected to maintain a significant number of stations over a wide area and so cannot manually operate EAS. A regulatory authority may audit the automated monitoring.
 - I} For the monitoring above, the audio should include the modem tones of the EAS header, even though the data is complete and includes the header.
- 2) A basic philosophy is also to provide for relevant precision of the alerting delivered to the listener. This may include an Intelligent Internet Speaker, so that Alert Fatigue Should be avoided. Actual statistics of the increase of fatalities in the Ukraine arising over longer attacks have been gathered, and the deaths were of those who remained at a higher level instead of going to a basement. Their vertical location changes are data gathered and incorporated in an academic paper. “Public response to government alerts saves lives during Russian invasion of Ukraine” David

Van Dijckea,b,1 ID , Austin L. Wrightc,1,2, and Mark Polyakb ID Edited by David Laitin, Stanford University, Stanford, CA; received December 4, 2022; accepted March 26, 2023. An estimated 8% to 15% of fatalities could have been avoided. The authors estimated by the owners of those mobiles going to the basement again.

- 3) In order that Alerts should be delivered at a suitable opportunity, dependent of importance, the different Event Terms are assigned a default Automation Priority Valus (APV) with 1 being highest, 9 being least and 0 for special cases. Receivers are by default set to deliver alerts with APV of 1 to 5 and the rest MAY be presented as texts without a loud beep. The default value of 5 could be changed by the user, perhaps varying by time of day, so as to more precisely match the appropriate alert type and the user preference.
- 4) In one conference concerning wildfires, I asked how they alerted the public of such alerts. They said they would phone the local radio station and place an advertisement to this effect. That would not work very well for unmanned radio stations. I hope that EW4All including consumer electronics implementation would improve on this in the future. The added software for consumer electronics devices is estimated to be in the range of U.S. 5c to 50c per unit.

Japan JMO Alerting, and Haiti.

The radio, TV and mobile alerting system of the Japanese JMO delivers weather, seismic, tsunami and perhaps other alerts. Comparison of the Tohoku and 2003 Indian Ocean tsunamis, which were comparable size, shows the effectiveness of such alerting in saving lives.

Another comparison between the presence and absence of alerting is the comparison between American Samoa and Samoa with the 2009 tsunami. The basic numbers are quite a contrast, but normalizing for the different population reduces that somewhat, In American Samoa, the radio DJ felt the earthquake, went to the Encoder/Decoder and manually initiated a tsunami alert. Such initiative should not be discouraged by rules, legislation, management of unsuitable software. I.e., different Event Codes should have lower limits to authority as well as jurisdiction for who can send what alerts.

By contrast, the lack of alerting in Haiti, with 300,000 fatalities, shows the results of the combination of lack of alerts and the poor seismic resistance of structures. One of the most expensive buildings, the Catholic cathedral collapsed. I offered the Government of Haiti two free EAS Encoder/Decoders to start a warning system. However, there was no interest from the Government (who made a video tape), Haitian organizations, or the

Clinton Foundation. The offer included a free spreadsheet of Rules of Order in English and French.

Limited function alerting and Consumer Electronics

There are a number of single function (e.g. flood, fire, earthquake or tsunami) systems. None of these are designed to deliver to consumer electronics devices. EAS is designed to do so, but as noted previously there are improvements that are desirable. To have such selectivity incorporated into consumer electronics, it would first be necessary to have a worldwide specification based on CAP and to be applicable to all the different technologies. With the EW4All initiative, it seems that Consumer Electronics could incorporate such software into their products as a desirable but inexpensive feature. Addressing the problem of multiple languages would also be a complementary capability.

A computer keyboard suitable for multilingual use is a specification that has been developed for inclusion into a new CAP version.

Approximately 80% of radio listeners are in vehicles. Vehicles are increasingly including navigation. Therefore, implementing selectivity of alerting by polygon is becoming practicable to include in new vehicles. Adding flood maps and altitude to escape tsunamis is another form of improvement.

Satellite Digital Audio Radio Service (SDARS) and Earthquakes

Earthquake Early Warnings need to be delivered As Soon As Possible. However SDARS not only adds a 0.7 second delay, but also adds data compression and a delay for redundant data stream. This is not the most desirable for rapid alerting. In the U.S., this is SiriusXM. They have made agreements with many vehicle manufacturers to include their system in new cars. Such cars have a stubby fin on the rear roof which is for SiriusXM, FM and AM. However, being so small, the AM sensitivity is low. For SiriusXM users, this is not a problem, BUT as the SiriusXM delay of alerting is not optimized for earthquakes, it would be desirable for the radios to be scanning for stations with EAS functioning. That could be indicated by an EAS Heartbeat message say every 6 seconds. This SHOULD enable the radio to complete a station scan every few minutes and identify the best station for Alert, and tune to that one.

DAB+

This is a wider bandwidth digital multiplexed signal of many radio stations. It is also likely to be implemented with a Single Frequency Network. That would enable a nationwide radio system with the driver only selectin the desired channel. Digital alert messages can be

provided and the audio selected IF the message is relevant. There is expected to be some latency, but EEWS should be satisfactory.

DRM

This is a single frequency digital radio system. The practicability of delivering the alert data and audio in a manner that also permits program content to continue, perhaps at a lower sample rate, appears possible but this has not been confirmed. A DRM data stream has been delivered on an ATSC3 transmission. Alerts are not needed there as ATSC3 includes A/331 Advanced Emergency Alerting.

HD Radio AM and FM

This has an analog AM or FM carrier, and also lower and upper data sideband. It is also possible to switch to an all-digital mode, but the analog receivers will not output program, only noise. AM HD Radio only provides one program. It may be possible in the future to put alerts on the AM and program on the digital with alert data. However, the specification does not allow for that, so it would depend on their being a maximum part of receivers with the capability, before getting existing receivers to have their software upgraded. That may not be a simple process.

A Large Radio Receiver Concept

This may be the size of a boom box type radio, but incorporate electronics which resembles a vehicle radio. A mobile functionality could be included as a teleconference or videoconference capability. As the radio receiver could be an SDR (Software Defined Receiver Receiver), the functionality could be quite extensive including analog and radio broadcast, scanner, shortwave, and even digital TV I(using perhaps another SDR) (if an HDMI2 output is included). With limited mixer capability and two mic/line inputs, and 20 W power, it could be an emergency PA system also that runs on 12 volt power.

The Most Dangerous Country

Nepal has had, and is expected to have in the future, earthquakes over magnitude 9. Given this, the terrain, the building technology applied and the precipitation, there have been estimates made as to the likely number of fatalities. They range from 100,000 to 1 million. Can an earthquake of Mw 9 occur in the Himalayan region?

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Given this, I attempted to raise funds for an Earthquake Early Warning System for Nepal. A Japanese geologist suggested implementing the system used in Japan. However, the Japanese system reportedly {but unconfirmed} cost \$US 500M. This could be significantly reduced for EW4All with worldwide mass production.

The geography of Nepal is one where the Indian plain becomes valleys rising in the Himalayas. Broadcasters are mostly FM stations lower in each valley. Pictures of FM broadcast stations broadcasting after an earthquake magnitude 7.8 in 2015 is below.





While the misery of this situation is apparent, what is not apparent is the potential for these Broadcasters to be able to deliver Alerts that potentially could save a lot of lives. This is not a substitute for feasible and appropriate improvements in seismic resilience of buildings and other infrastructure.

To implement a seismometer network, connectivity and alert origination, dissemination to broadcasters and Encoder/Decoders is feasible. A chinese solution uses Tiktok, which is not advisable. I obtained information regarding the stations from the two broadcasters associations. Rather than use a fiber network that can be damaged by ground movement, a

UHF ruggedly built network that is a mesh is recommended. This should be TCP/IP or UDP/IP and carry television also.

In addition, there is the earthquake – landslide – river damming – lake forming – dam breaching – large flash flood process that few people think about. In the flood plain during colonial days, a British Army unit was located there, and some reinforcements were going to meet them. The flash flood made the army unit completely disappear. All that was left was the headquarters record. A comparable disaster in New Zealand was the destruction of a rail bridge by a lahar at Tangiwai which resulted in the drowning of most of the passengers.

Tsunami Preparations

While Japan has implemented tall seawalls to mitigate tsunamis, this is often beyond financial resources. A less expensive measure is to put colored coding on power or phone poles. This can use a code known as the resistor code starting at less than 1 meter above high tide with a black band and proceeding as below;

Brown 1m

Red 2m

Orange 3m

Yellow 4m

Green 5m

Blue 6m

Violet 7m

Gray 8m

White 9m

Brown-Black 10m

Brown-Brown 11m

Brown-Red 12m

Brown-Orange 13m

Brown-Yellow 14m

Brown-Green 15m

Brown-Blue	16m
Brown-Violet	17m
Brown=Gray	18m
Brown-White	19m
Red-Black	20m
Red-Brown	21m
Red-Red	22m
Red-Orange	23m
Red-Yellow	24m
Red-Green	25m
Red-Blue	26m
Red-Violet	27m
Red-Gray	28m
Red-White	29m
Orange-Black	30m
Orange-Brown	31m
Orange-Red	32m
Orange-Orange	33m
Orange-Yellow	34m
Orange-Green	35m
Orange-Blue	36m
Orange-Violet	37m
Orange-Gray	38m
Orange-White	39m
Yellow-Black	40m
Yellow-Brown	41m

Yellow-Red	42m
Yellow-Orange	43m
Yellow-Yellow-	44m
Yellow-Green	45m
Yellow-Blue	46m
Yellow-Violet	47m
Yellow-Gray	48m
Yellow-White	49m
Green-White	50m

Few terrestrial originated tsunamis exceed this, and those are in mountainous areas with landslides into water. The largest tsunami in historical times was the one in the southern Indian Ocean, which caused the Burkle crater which is 29 km diameter. The tsunami sand deposits at the West Coast of Australia go up to 1.5 km high. This occurred about 2900 BCE. Now that meteorites are being tracked, it is likely that people can evacuate to safe areas in sufficient time, though major coastal cities are at risk with limited road, rail and fuel capacity. Alerts can inform people of the anticipated tsunami height based on Pacific Tsunami Warning Center or other information, and also calculate map warning areas to be transmitted for use on suitable receivers.

Radio Streaming Broadcast

Many radio stations are now delivering their content via internet streaming. This may reach cars via mobile internet. The delivery of alerts is not included, but should be available via WEA or SMS Broadcast as is sent to mobile phones.

Also, people are buying Smart Speakers (SS, which may include a conventional radio also). The TCP/IP protocol provides a broadcast mode in subnets. Currently this is not being discussed for delivery of Alerts. The message type of CAP needs to have a port assigned by IANA and for this to be included in the next version of CAP. Internet Service Providers could select alerts for the jurisdiction according to CAP and deliver such messages to such customers via fiber or coax. SS devices may listen to voice commands. Therefore, they should also be able to demodulate the FSK modem tones of EAS from whichever alert source and ascertain if the message is the same as one that is being received from the ISP. If so, then to avoid alert fatigue, the new message can be muted.

Social Cohesion

Societies vary in many ways. To accomplish this project is aided by effective decision-making. A relevant capability for this is the usage of Rules of Order for effective decision-making. I have suggested that Haiti and Palestine learn and apply such methods to improve their governance processes, without any appreciation being expressed. The U.S. has room for improvements as loudspeaker systems are more effective by being able to deliver messages, unlike sirens, and Lahaina in Hawaii for fire and Texas river flash flood are examples. Mobiles alone cannot be depended on. Broadcast is a component.

An important aspect related to social cohesion is the use of different languages. This can be aided by having Message Templates that are pre-translated into the desired languages. Also, that phonetic characters are included in the text to aid for the pronunciation of Text-To-Speech. There needs to be a specification for multilingual keyboards in the expanded CAP standard.