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Public Safety Messaging System:

Telecommunications Emergency Alerting Capabilities

Summary:
This paper describes an emergency warning and notification system, the Public Safety Messaging Solution (PSM) that offers significant advantage over current technologies.

The PSM uses the Public Switched Telephone Network (PSTN) to deliver a short coded message from a messaging server to a specialized messaging terminal located at the customer premises. The PSTN offers advantages over other messaging and notification technologies due to broad local bandwidth, always-on status, ubiquitous availability, provides for geographically specific individual addressing, and supports high load-demand messaging applications. The network's redundancy and long-term stability make it suitable for mission-critical applications such as public safety messaging. Other communications systems, such as wireless networks, do not support the localized capacity necessary for large-scale real-time message delivery at this time. However, the PSM will support applications across a variety of platforms, including wireless, paging, email, and instant messaging.

The summary will present the fundamental characteristics for effective notification from the citizen's viewpoint, compare current technologies and systems, and evaluate the tradeoffs inherent in each, then describe in detail the PSM and its advantages.

Emergency Notification System Requirements:

The mission for any emergency warning and notification system is to deliver information that will be usable by the citizens to enhance their safety and security.

Effective emergency warning and notification systems need to meet a variety of objectives. They must meet the needs of both the Emergency Management Organization (EMO) and of the citizens. In most cases, the needs of both groups coincide. An emergency warning system designed to be easily useable by the EMO personnel, but too complex or too vague for the citizens to use, would not be sufficient.

Following are criteria for evaluation of message transmission systems and strategies.

Safety:
Delivery of the message should not involve added risk to people, particularly emergency responders. Systems that deliver the messages to the home along with capability of acknowledgment that the message has been received are most effective.

Understandable:
The nature of the threat must be readily identified to the citizen. Sufficient information must be included to allow informed response to threats, and serve as a primary source for notification regardless of time of day.

Universal accessibility/Easy to access:
The system should be easy to use and be designed for use by individuals with limited ability, sight, mobility or literacy. Access for the elderly and children is imperative.

Rapid transmission:
Reduction of the time required for the transmission of the message leaves more time for threat analysis and decision-making by the EMO and for threat response by the citizens.

Accurate:
A system that results in a high percentage of false warnings is likely to be ignored by the public.

Specific:
Ability to direct the message to a specific geographic area makes the message more useful and increases the accuracy of the threat prediction for the citizen.

Reliable:
The methods of message generation, transmission and receipt must be reliable or citizens or EMO personnel will not use them.

Available:
The system should be immediately available; the optimum solution would always be operating, requiring no specific action to enable it during a threat. Optimally, the system would be used for other purposes so that continual operation would validate its availability for emergency use.

Easy to use:
The system must be useable by both the EMO personnel as well as average citizens. In the case of the citizen, the system should not require detailed training in order to be understood or used. The system should be easily accessible.

Current Emergency Notification Systems:
Current technologies are designed to deal with a variety of natural (storms, tornadoes, floods, tsunamis, fires, etc.) and man-made threats (chemical spills, gas leaks, train wrecks, civil disturbances, etc.).

Emergency notification systems deal with the gathering of information, decision-making regarding the appropriate responses and dissemination of the information on threats or directed action. For this analysis, the method of disseminating information is the main issue. For most technologies, the initial information gathering and decision-making is somewhat independent of the method of disseminating the information. An exception is that if the speed of the transmission is greatly increased, the options for gathering information and decision-making are increased because they are somewhat less time critical, and the potential response from the public is greatly enhanced.

Notification systems serve two distinct groups. The first is the Emergency Response organizations (Police, Fire, EMO, Hazmat groups, National Guard, etc.) that need specific information to allow the marshaling of personnel and equipment, as well as tactical decision-making in the field. Emergency Responders are highly trained (initial and recurrent) and consequently can manage more complex notification systems and devices. Notifications to such groups are typically through radio, phone or pager links.

The second group is the community, whose citizens need information that enables them to take shelter or other actions to minimize the risk of life or property. This group is typically minimally trained in specific notifications, terminology and equipment, and consequently is unlikely to evaluate the notification systems from any standpoint other than the accuracy of threat notification and the ease of use. In summary, if the public is provided with a high percentage of false warnings (warnings that are premature or not followed by a discernible threat) it will respond by discounting the validity of future warnings, which increases risk by minimizing the validity and value of future warnings.

Because of their minimal training and greater number (versus emergency responders), the citizens must rely on notification technologies including sirens, broadcast radio and television, National Weather radio, emergency personnel making public announcements over loudspeakers, and automated phone message delivery. A common feature is that (with the exception of sirens) the emergency messages involve spoken words or specific tones to gain the citizen' attention.

Comparison of Current Emergency Notification Systems:
Following comments use the criteria above to compare current systems in current use:

Sirens:
Sirens are non-specific regarding a particular geographic location, with sound radiation pattern depending on field interference, weather, time of year (windows open or closed) and provide minimal threat information. Since the sirens are seldom used except for testing, the citizens are likely not to be readily able to determine whether the siren signals a test or a threat. There is no ready method of determining whom has received and responded to the threat notice.

Broadcast radio or television:
These devices can provide rich text or voice messages regarding emergency notifications, but they are not always "on" and therefore are not capable of providing a

reliable initial notification. There is no ready method of determining whom has received and responded to the threat notice.

Nationalized Weather Radio Broadcasts:
This system is limited to broad geographic areas, with no ready method of determining whom has received and responded to the threat. The devices can be set to respond automatically to a threat notification, but the feature often provides warning alerts when the threat is not imminent or close. Since emergency notices are sent infrequently, the system is not in continuous use and is not likely to be kept at a high state of readiness by the homeowner. There is no ready method of determining whom has received and responded to the threat notice.

Public announcements over loudspeakers:
In the absence of specific systems to notify citizens of threats, a common practice is to send emergency response personnel (Police and Fire fighters) into specific areas to make public announcements over loudspeakers. The most serious drawback to this practice is that it places the emergency response personnel in additional danger, and diverts their time and resources from the primary goal of managing the particular threat and assisting the citizens. Typically, this notification does not allow time for acknowledgment by the citizen without further delaying the notification. Depending upon the time of year and the distance of homes from the street, the announcements may not even be heard.

Automated phone message delivery:
These systems automate the delivery of voice messages using automated dialing and taped message delivery. The systems can be geographically specific based upon information regarding the location of each telephone number. The message delivery can be rich in information. The time required to set-up the call, ring and answer the phone and deliver the message averages 90 seconds per message. Busy phone lines are recalled later. The long delivery time combined with the need to notify many citizens immediately leads to problems with phone network congestion, with the potential to frustrate or delay the completion of calls between public safety officials.

Summary:
The current systems all have serious shortcomings in reliability and accuracy of the message delivery, lack of ability to acknowledge receipt of the message, increased threats to emergency personnel, or delays in delivery timing.

Public Safety Messaging Solution

Events of September 11, 2001 and since have put a greatly heightened focus on the process of threat identification, response selection and public notification, particularly in the area of terror, sabotage and public disturbance. A major objective is to decrease the time required for message distribution and to provide specific geographic targets for the messages. The Public Safety Messaging Solution (PSM), which has been under development for three years, is responsive to the new challenges of today's environment and sensitivities.

The PSM uses a centrally located messaging server to send short coded messages over the public switched telephone network (PSTN) to low cost PSM terminals located at the customer premises, such as a home or office. It allows emergency management officials to rapidly notify the public in case of an emergency.

- Public safety officials use list and/or GIS capabilities of the server to overlap geographic threat projection areas with the locations of individual houses and businesses and their telephone numbers in order to build a target list of telephone numbers that will receive the alert data message
- Officials create (or select from a pre-defined list) an alert data message of up to 60 characters, along with characteristics of the message including standard EAS alarm tone, EAS alert codes, and message acknowledgment request
- Server sends messages over PSTN by calling each target telephone number and transmitting the short (approximately 750ms) data burst. Message throughput is approximately 10 notifications/min for each single line or channel. Several data transmission formats can be used as described in Telcordia technical memoranda.
- PSM terminals at the customer premises decode and expand the messages into audible announcements such as “Tornado Warning” as well as display text on an LCD. The terminals can “ACK” positive message receipt back to the server.
- The public, regardless of age or ability, can then take deliberate steps to protect themselves and their families and secure their property before disaster strikes.

As discussed above, existing systems are not adequate for providing timely notification in the event of a public emergency due to slow speed of message delivery, the fact that home equipment is not always on, and their inability to target upon very specific areas. The PSM was designed to reduce message delivery time, target messages to specific areas, increase public safety, and accommodate special needs.

Specific features of the PSM for the Emergency Management Organization:
The PSM Administrator with secure access can configure user lists, add/change/delete information messages and customize for individual EMO clients. From the website, the EMO client can create and issue outbound messages. The message-create capability uses a database to store pre-loaded lists of individuals that can then be used as notification targets.

In other cases a Geographical Interface System (GIS) can be used for defining the specific geographic areas to which the messages will be directed, enhancing the ability to deal with weather threats or those that are affected by the wind field around the event (fires, chemical spills, gas leaks, etc.) The system can be used to initially target those areas that will be affected first, followed by announcements for areas further from the event.

The accuracy of the threat warning is enhanced because it can be modified in concert with changes in the weather or wind patterns. This is an improvement over sirens or systems such as weather radio, where the threat announcements cover relatively large geographic areas that may not be coincident with the specific location of the greatest threats.

The message send capability is triggered through the message create screens or by the receipt of the GIS file. Using predetermined listings of telephone numbers and their locations, the system will then begin its calling process, delivering the messages in coded format to the PSM terminals located in the home or place of business.

The system will then pass back through the list attempting to reach the numbers that were not successful during the first notification attempt. The EMO client defines the number of iterations. Finally, the system will use any back-up contact method specified in the user's profile, including cellular or other telephones, pagers, faxes or email. In the case of delivery of messages to locations that are not equipped with the PSM device, speed of message delivery will be decreased.

Specific features of the PSM for the Citizen:
PSM is designed for efficient notification and ease of comprehension and of use. The spoken announcement makes the nature of the emergency condition easy to understand. No call back is required if telephone not answered since the message is displayed and plays until acknowledged. The device includes an event log for review of messages.

PSM with Voice Announcement accommodates special needs since it does not require going to the phone to receive a message, and is accessible by those with limited mobility, vision or literacy, including children and the elderly. The devices have support for multiple languages that can be selected by the user. For those with hearing difficulties, the device also has a series of LEDs that signal the presence of incoming messages. The messaging terminals meet the requirements for universal accessibility as specified in Section 255 of the Telecommunications Act.

PSM provides opportunities and a platform for additional services, an important consideration since systems that are used stay installed due to their increased benefit for the user. The PSM terminal can provide Caller ID, Community Notifications, VoiceMail, Voice Portal, Personal Information Services and other real-time messaging applications including utility power-outage monitoring, telephone line quality-of-service testing, notifications of school closings, weather advisories, email, and community events. Because of the added functions possible, the unit will be able to be used on a continual basis by the citizen, ensuring that it is maintained and ready in the case of an emergency.