May 30, 2016

Via FCC Electronic Comment Filing System

Ms. Marlene Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Wireless Emergency Alerts (WEA) – Proceeding 15-91

Dear Ms. Dortch:

On May 23, 2016, Carnegie Mellon University (CMU) researchers met with the FCC team from the Public Safety and Homeland Security Bureau via teleconference call. The FCC team included James W. Wiley, Attorney Advisor; Gregory Cooke, Associate Division Chief, Policy and Licensing Division; Rasoul Safavian, Electronics Engineer; Behzad Ghaffari, Electronics Engineer; Lisa Passarella, Legal Intern; and Stephanie Winkler, Legal Intern. The CMU team included Dr. Hakan Erdogmus, Associated Teaching Professor of Electrical and Computer Engineering; Dr. Bob Iannucci, Distinguished Service Professor of Electrical and Computer Engineering; and Dr. Martin Griss, Principal Research Scientist, CMU Silicon Valley.

We discussed several aspects of the FCC's Notice of Proposed Rulemaking on Wireless Emergency Alerts (WEA) Proceeding 15-91. The following notes are intended to summarize the content of discussion.

<u>Context</u>

During the period spanning April 2014 through October 2015, CMU Silicon Valley researches conducted a multi-part study on improving the WEA service. The study included one-on-one interviews and an online survey with alert originators nationwide to identify gaps and elicit future WEA requirements, design and implementation of a testbed and an enhanced WEA mobile app for live testing of possible WEA improvements, and field trials of selected improvements with live subjects using the testbed. Our findings and recommendations were captured in an extensive report submitted to our sponsor, the Department of Homeland Security, Science and Technology Directorate, First Responders Group (WEA Program). Our conversation with FCC focused on these findings and recommendations.

<u>Message Length</u>

We support the proposed increase of WEA text limit from the current 90 characters to 360 characters. Our field studies suggest that increasing message length could improve public response to alerts, in particular message relevance and actionability.

More importantly, increasing message length would allow a compressed representation of the alert's geotarget, as well as other meta-data (such as a URL), to be embedded in the alert message. Such embedding would open up a wide range of possibilities through advanced capabilities of modern smartphones. These capabilities include precise geotargeting, high-information maps, and support for situational awareness, as discussed below.

Geotargeting/Geofencing and Polygon Compression/Transmission

The geotarget of a WEA message is often expressed as a polygon, however service providers map these polygons to a resolution of their own choosing. Consequently, the final mapping, as well as who gets the alerts and who doesn't, is not entirely transparent and predictable. If a representation of the geotarget can be sent with the alert to the receiving mobile device, the device, using its location/GPS capabilities, can do the filtering locally and make the delivery decision. This method necessitates only a comparison of the device location to the geotarget received, and leads to precise geotargeting with no undesirable leakage that causes irrelevant alerts being delivered to a large number of citizens. We have devised compression methods that can reduce the size of a geotarget polygon representation significantly (to 10 to 25% of its original size, or 9-61 characters, for polygons included in a corpus of over 10,000 National Weather Service WEA alerts). The compression is lossless and computationally efficient, making it feasible to embed the geotarget in the alert text at the origin and recover it without loss of any information at the device. Our experiments with the NWS corpus shows that this is possible even with the current 90-character limit, still leaving sufficient space for the message content for a majority of the NWS alerts. Our compression methods combine simple coordinate shifting heuristics with efficient large-integer-arithmetic (BIGNUM) encoding algorithms and higher base representations. These methods can be customized and applied to the message text itself and other meta-data as well. An increase to 360 characters would thus make geotarget and other meta-data embedding completely practicable, enabling a whole host of WEA features on the client side.

Inclusion of External Links in Messages

In our field studies, we tested differences in public response to WEA messages that included an external link (a URL or a Twitter hashtag that gives further information about the alert) with regular WEA messages that only included a standard alert text. We did not observe significant differences between the two groups according to most of our general outcome measures, although the majority of the test subjects who received a link, when explicitly asked, found them desirable/useful. The muted response could have been due to the fact that the emergency scenarios to which the test subjects responded were artificial. Unfortunately, there is no good way of testing this kind of WEA extension under the kind of hypothetical scenarios we employed in our testing. We note that including a clickable URL or hashtag and accessing the associated web sources via the mobile browser or another third-party app on the smartphone was very easy to do in the WEA mobile app implementation that we used during our field tests. This contradicts the claims of some wireless service providers that this very functionality would be challenging to implement.

Other Context-Aware Features (High-Information Maps / Location History)

We combined precise geotargeting/geofencing (via embedded geotarget and client-side message filtering) with high-information maps and location history on the client's device. High-information map refers to a map of the area where a recipient is located, overlaid with the geotarget of the alert (a polygon) and the recipient's location. Next generation of mobile devices are expected to ship with built-in/cached maps, making it possible to augment the alert context visually with a map, without relying on a data connection. Of course, the client device would need to know the geotarget, which can be embedded in the alert as discussed above. We found that alerts delivered with high-information maps significantly improved public response to alerts, especially alert relevance, compared to pure-text alerts. Test subjects also found the maps to be highly desirable feature: this was a highly statistically significant result. Similarly we observed statistically significantly positive outcomes when alerts were delivered to test subjects who were outside the alert area, but whose location history stored on their phones suggested that they visited the area recently and/or frequently. This is a form of interest targeting that we think is worthwhile to consider in future WEA service in conjunction with client-side precise geotargeting and high-information maps.

Situational Awareness

Another feature that was tested during our research was a digest view that combined information from a stream of related alerts during an ongoing emergency. In a complex, continuing emergency situation, such as a wide-scale natural disaster, multiple incidents with frequent updates may be interleaved. This may cause recipients to incorrectly assimilate the information or assess the current situation, and confuse them. If alert messages can carry the right meta-data (already available in the Common Alerting Protocol -- CAP -- format), the client device can separate the different alert streams, order them properly, overlay the changing information, and only present an up-to-date digest view of each alert stream. This concept is what we call situational awareness. We have tested the digest view capability in a field trial using a customized WEA app that could switch between the regular WEA view (a steam of pure text alert received individually) and the said digest view. Test subjects were randomly divided into two groups: while the app presented the regular WEA view to one group, it presented the digest view to the other group. We observed that the digest view group performed statistically significantly better in interpreting the alerts for complex emergency situations. The digest group subjects also fared significantly better in perceived value of the alerts. Our position is that future WEA service should have means to support situational awareness to better deal with complex emergency scenarios. The digest view that we propose in our research can be implemented while staying loyal to the existing WEA network architecture.

Testing

Public testing of WEA service was of prime importance according to the interviews and the online survey conducted with alert originators. Our experience further suggests the development of a more general-purpose environment in which alert originators, government agencies and emergency organizations can safely pre-test WEA concepts, features or enhancements with volunteers before these improvements are deployed. This can be highly beneficial and avoid wasting resources on features and improvements that are not likely to produce good results. Such pre-testing, with instrumentation capability, would precede and complement wider-scale regular public testing. It has been proven feasible by our research (as demonstrated by our testbed).

Third-Party WEA Applications

We do not believe that WEA delivery and presentation should remain the responsibility of the mobile OS (via a built-in app). The OS should define an API that would allow third-party applications to take advantage of additional meta-data embedded in the alert messages, including the geotarget, and chose the best presentation method. Third party applications are much better positioned to innovate and leverage modern smartphone capabilities. They are also better positioned to give users more advanced configuration options and flexibility. We have tested several such enhancements during field trials (including precise geotargeting, use of high-information maps with precise geotargeting, and use of receiving device's location history to affect message delivery to persons currently outside the specified alert region, but with an interest in the specified alert region), and observed significantly improved public response to such enhanced alerts compared to normal WEA alerts. The built-in OS app can still provide the basic, default functionality. Mobile service providers are generally unwilling to accommodate even very simple and technically extremely feasible changes such as handling an alert message containing a URL. We therefore do not believe that much WEA innovation is realistically possible with exclusive reliance on service providers and mobile platform/OS developers.

Regards,

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References/Attachments

- Hakan Erdogmus, Martin Griss, Bob Iannucci, Sumeet Kumar, João Diogo Falcão, Abhinav Jauhri, Maxim Kovalev. *Opportunities, Options, and Enhancements for Wireless Emergency Alerting Service*. Department of Homeland Security, Science and Technology Group, First Responders Group. December 2015. Available at: http://www.firstresponder.gov/SitePages/Technology/Documents.aspx?s=Technology%20Documents
- Bob Iannucci, João Diogo Falcão, Sumeet Kumar, Hakan Erdogmus, Martin Griss. *From Alerting to Awareness*. Presented at: IEEE International Symposium on Technologies for Homeland Security, 10-12 May, 2016, Waltham, MA.
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