ATIS-0700020

FEASIBILITY STUDY FOR EARTHQUAKE EARLY WARNING SYSTEM

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ATIS-0700020, *Feasibility Study for Earthquake Early Warning System*

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ATIS-0700020

ATIS Feasibility Study on

Feasibility Study for Earthquake Early Warning System

Alliance for Telecommunications Industry Solutions

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Abstract

This feasibility study evaluates the feasibility of the commercial LTE cellular networks in supporting public earthquake notifications as part of the proposed California Earthquake Early Warning System (EEWS). Although this feasibility study is initially targeted to California, it is applicable to other earthquake warning systems that may be deployed anywhere in the United States and its territories.

Foreword

The Alliance for Telecommunication Industry Solutions (ATIS) serves the public through improved understanding between carriers, customers, and manufacturers. The **Wireless Technologies and Systems Committee** develops and recommends standards and technical reports related to wireless and/or mobile services and systems, including service descriptions and wireless technologies. WTSC develops and recommends positions on related subjects under consideration in other North American, regional, and international standards bodies. WTSC coordinates and develops standards and technical reports primarily relevant to wireless/mobile telecommunications networks in the U.S. and reviews and prepares contributions on such matters for submission to the appropriate U.S. preparatory body for consideration as ITU contributions or for submission to other domestic and regional standards organizations. WTSC will maintain liaison with other ATIS Committees as well as external fora as appropriate. WTSC will coordinate closely with other standards developing organizations (e.g., TIA, IEEE, ETSI, etc.) on wireless issues to ensure that the work programs are complementary.

The mandatory requirements are designated by the word SHALL and recommendations by the word SHOULD. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages. The word MAY denotes an optional capability that could augment the document. The document is fully functional without the incorporation of this optional capability.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, **WTSC**, 1200 G Street NW, Suite 500, Washington, DC 20005.

At the time of consensus on this document, **WTSC**, which was responsible for its development, had the following leadership:

WTSC Chair: Mark Younge, T-Mobile

WTSC Vice Chair: Don Zelmer, AT&T

WTSC SN Chair: Peter Musgrove, AT&T

WTSC SN Vice Chair: Greg Schumacher, Sprint

The **Systems & Networks (SN)** Subcommittee was responsible for the development of this document.

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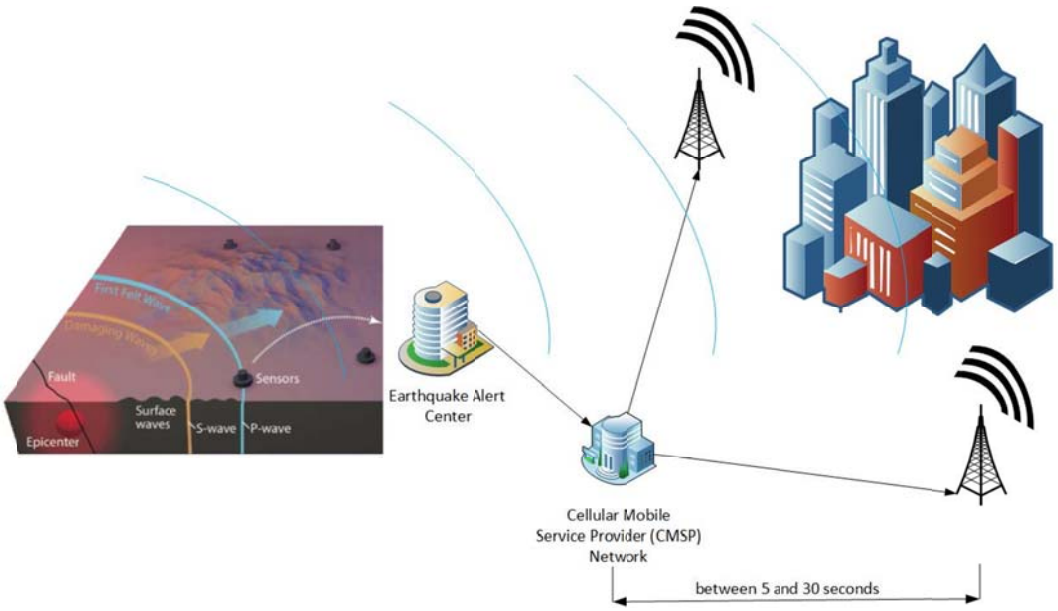
Executive Summary

ATIS completed this feasibility study to evaluate techniques to distribute Earthquake Early Warning (EEW) notifications to the general public through cell phones via the cellular network as a way to complement the California Integrated Seismic Network (CISN). An EEW system has been conceptualized for the West Coast of the United States within existing operational environments of three regional seismic networks in southern California (Southern California Seismic Network, SCSN) and northern California (Northern California Seismic System, NCSS). The Pacific Northwest (Pacific Northwest Seismic Network, PNSN) and other Advanced National Seismic System (ANSS) areas in North America (e.g., the New Madrid Seismic Zone, etc.) are beyond the scope of this study. The study took into consideration the basic EEW System service model consisting of components that are used, or planned to be used, in EEW systems around the world. This report provides a summary of this feasibility study.

As a conclusion of this study, ATIS determined that a cellular wireless broadcast EEW notification is a viable concept designed within the constraints and limitations of the cellular wireless networks. This study describes a proposed architecture for the EEW system for the distribution of time sensitive EEW notifications using capabilities in the LTE broadcast channel. This architecture uses broadcast capabilities in the cellular network. Broadcast has the potential to reach millions of users in seconds to minutes in an inherently geo-targeted fashion, whereas trying to reach the same number of users via traditional SMS or push data services ("apps") would swamp the network, slowing the delivery of EEW notifications to a crawl.

The EEW notification area is assumed to be a circle specified by the estimated surface location of the epicenter and an associated radius where the EEW notification should be broadcast. The cellular networks operators will make the best approximation to map the EEW notification area to the associated set of cell sites which are to broadcast the EEW notification.



Earthquake Early Warning System (EEWS)

Based on the completed study, ATIS is confident that North American standards can be specified to enable LTE cellular network broadcast of EEW notifications originated by an earthquake alert center. 3G networks have technology limitations and are infeasible for supporting EEW notifications; non-cellular (e.g., Wi-Fi) networks are

out of scope of this study. Specifically, Early Warning notifications to machine-to-machine (M2M) devices, Internet of Things (IoT) devices, and non-human recipients (e.g., elevators, trains, planes, bridges) are out of scope for this feasibility study.

In the course of this study, ATIS also evaluated other technologies and determined they are not feasible to meet EEW notification requirements. For example, Wireless Emergency Alerts (WEA) is designed to provide imminent threat alerts, however the WEA system is not designed for or capable of distributing time-sensitive EEW notifications. An EEW system must support time-sensitive delivery requirements that are beyond the ability of WEA, where delivery time may be measured in minutes. WEA is appropriate for less-time sensitive alerts providing authorized alerting authorities a means to provide information to citizens, for example in the aftermath of an earthquake. The U.S. Geological Survey (USGS) and ATIS must collaborate to understand the limitations and latencies in the IPAWS/WEA system.

Upon agreement to proceed into the standardization phase by all stakeholders, the proposed ATIS standards will specify all the relevant interfaces and protocols for an end-to-end system starting from the earthquake alert center all the way to broadcast to the cell phone that will notify the users of an imminent earthquake. It is recommended ATIS standardize cellular network aspects of system security and engineering, alert messages and distribution, and overall system performance for the EEWS. The EEWS solution proposed by ATIS will take several years to develop and deploy, starting with developing the new ATIS standards, updating cellular operators' networks, designing new cell phones that can receive EEW notifications, educating the public on the new service, and deploying the interfaces to the earthquake alert center. To that end, close collaboration between USGS, CISN, ATIS, cellular network operators, and other relevant parties will be required to ensure a successful and timely standardization, planning, development, testing, and deployment of an EEW system. ATIS should be involved in the development of ANSS and CEEWS standards to identify impacts to the CMSP and EEWS. It is also assumed ATIS will collaborate in the development of standards for the maximum allowable telemetry latency and minimum quality of service for data sources so an end-to-end latency budget can be determined, as well as defining the end-user perspective for an EEWS. There are public education and public outreach activities that must accompany these efforts.

Deployed cellular networks and cell phones (at the time of this study) do not support EEW capabilities. The recommended architecture and solution must be developed, standardized, tested, and deployed prior to supporting EEW.

It is estimated that it will take a minimum of 3-4 years to complete standards and fully deploy EEW capabilities in wireless networks, and begin introducing new cell phones which support EEW alerting. This duration starts once the deployment plan and budget for the sensor network and automated decision making framework of the EEW system has been approved.

Accordingly, all stakeholders should understand that it will be approximately 5-7 years from the date of this report, assuming its recommended actions are implemented immediately, before a substantial number of cellular network users (e.g., > 25%) will have EEW capabilities in their devices. Consumer adoption of EEWS will be via normal market behavior.

Using the approach of normal market driven cell phone replacement cycles for providing the penetration of EEW capable cell phones among consumers, it is estimated it will take an additional 2-3 years for EEW capable cell phones to represent 80% or more of all cell phones in use.

In summary, the wireless industry looks forward to working with the USGS, the CISN, and other states and stakeholders looking to deploy an EEW system.

1 Scope, Purpose, & Application

1.1 Scope

The scope of this feasibility study is limited to earthquake early warning notifications to cell phones used by human subscribers on LTE networks. Early warning notifications to machine-to-machine (M2M) devices, Internet of Things (IoT) devices, and non-human recipients (e.g., elevators, trains, planes, bridges) are out of scope for this feasibility study.

Also, the scope of this feasibility study is limited to Commercial Mobile Service Provider (CMSP) solutions. Other solutions such as Over-The-Top (OTT) applications, Wi-Fi only devices, and radio and TV broadcast warnings are outside the scope of this feasibility study.

1.2 Purpose

The purpose of this feasibility study is to evaluate the feasibility of the commercial LTE cellular networks in supporting public earthquake notifications as part of the proposed California Earthquake Early Warning System (EEWS). Although this feasibility study is initially targeted to California, it is applicable to other earthquake warning systems that may be deployed anywhere in the United States and its territories. Specifically, this feasibility study will:

- Provide a survey of the global earthquake warning systems for cell phones.
- Define the ATIS understanding and assumptions for the EEW system.
- Describe the ATIS recommended overall end-to-end solution for EEW notifications to cell phones.
- Define the ATIS recommended solution for EEW notifications to cell phones for LTE networks.
- Provide a high-level summary of technologies that are not suitable for EEW solution.
- Provide conclusions and recommendations.
- Define the next steps with general timelines for topics such as standards development, solution implementation, solution deployment, and cell phone development.
- Identify a parking lot of open issues that need to be addressed before the next steps can be completed. These open issues could be questions regarding the EEWS functionality or questions that need further detailed analysis in the standards development organizations.

1.3 Application

This feasibility study is applicable to cellular network operators, the USGS, CISN, CalOES and other governmental stakeholders, and to the members of the project team developing the EEWS proposal.

2 References

2.1 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

[Ref 1] 3GPP TS 23.041, *3rd Generation Partnership Project; Technical Specification Group Terminals; Technical realization of Cell Broadcast Service (CBS)*.[1]

[1] This document is available from the 3rd Generation Partnership Project (3GPP) < http://www.3gpp.org/ >.