FINAL TECHNICAL REPORT

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ASAP: Automated Seismic Alert Project
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Summary

Recent upgrades in seismic network data processing in the Central US through the Advanced National Seismic System (ANSS) and the Center for Earthquake Research and Information (CERI) at the University of Memphis have made active earthquake notification systems for 24-7 emergency management control rooms in the New Madrid seismic zone (NMSZ) a reality. Originally (2000) ASAP was a pager-based notification system for earthquakes utilizing CUBE software (Cal-tech/USGS Broadcast of Earthquakes) modified and configured for the Central US (Figure 1). Through the course of this project CISN (California Integrated Seismic Network) Display was developed based on internet protocols and replaced CUBE as the state of the art method for earthquake notification in the San Andreas and Cascadia seismic zones. ASAP pager-based stations (ASAP 1) were distributed in 2002-04 to emergency management agencies in the Central US. These systems were brought back to CERI in 2004 in order to upgrade to internet-based CISN Display (Figure 1) and are now identified as ASAP 2 systems.

Several significant problems were encountered in the deployment of ASAP 1 stations. The specialized Create-a-link Motorolla pagers that were the heart of the CUBE system were no longer produced after 2001 because of their low transmission rate (9600 baud) and the increasing use of internet based systems for remotely operated applications. The low transmission rate, the need to interact with many page service providers over a 7-state area caused the need for near constant troubleshootin. Additional problems were encountered related to the need for emergency managers to be reliably notified about earthquakes in secondary seismic zones. Although seismic hazard is lower in the Central US than in the West, multiple seismic sources (New Madrid, Wabash, Southern Illinois,

and East Tennessee seismic zones) requires different ASAP 2 configurations for each state. USGS deaggregations of seismic hazard from the National Seismic Hazard Mapping Project demonstrate that although the seismic potential of some Central US source zones is lower than New Madrid, lesser proximal sources can drive most of the hazard for important Central US urban areas and should be considered based on the needs of each state. For ASAP 1, the possibility of poor quality locations and magnitude estimates for these lesser source zones in 2001 greatly impacted our confidence in providing rapid and reliable notification services to some Central US states and stalled the process of distributing ASAP 1 systems to KY, IL, and IN. The recent focus on provision of nationally standardized and uniform seismic monitoring through the Advanced National Seismic System and the US National Seismic Network now add a higher level of confidence in the speed and accuracy of time-critical earthquake information for the entire Eastern US since 2002. ASAP 2 systems are now online in Tennessee and Arkansas state emergency management control rooms utilizing CISN Display modified with Central US GIS attributes and configured according to the specific needs of each user. For instance, the Arkansas Dept. of Emergency Management does not want to be alerted for M 3.5 earthquake in the East TN seismic zone, but the Tennessee Emergency Management Agency does. Although emergency managers in the Central US could install and operate CISN Display, configuration for their specific needs requires some knowledge of seismic source zones, seismic networks of interest, and warning thresholds. As the knowledge base for these products increases, future implementations of ASAP 2 (CISN Display) could be handled directly by the users.

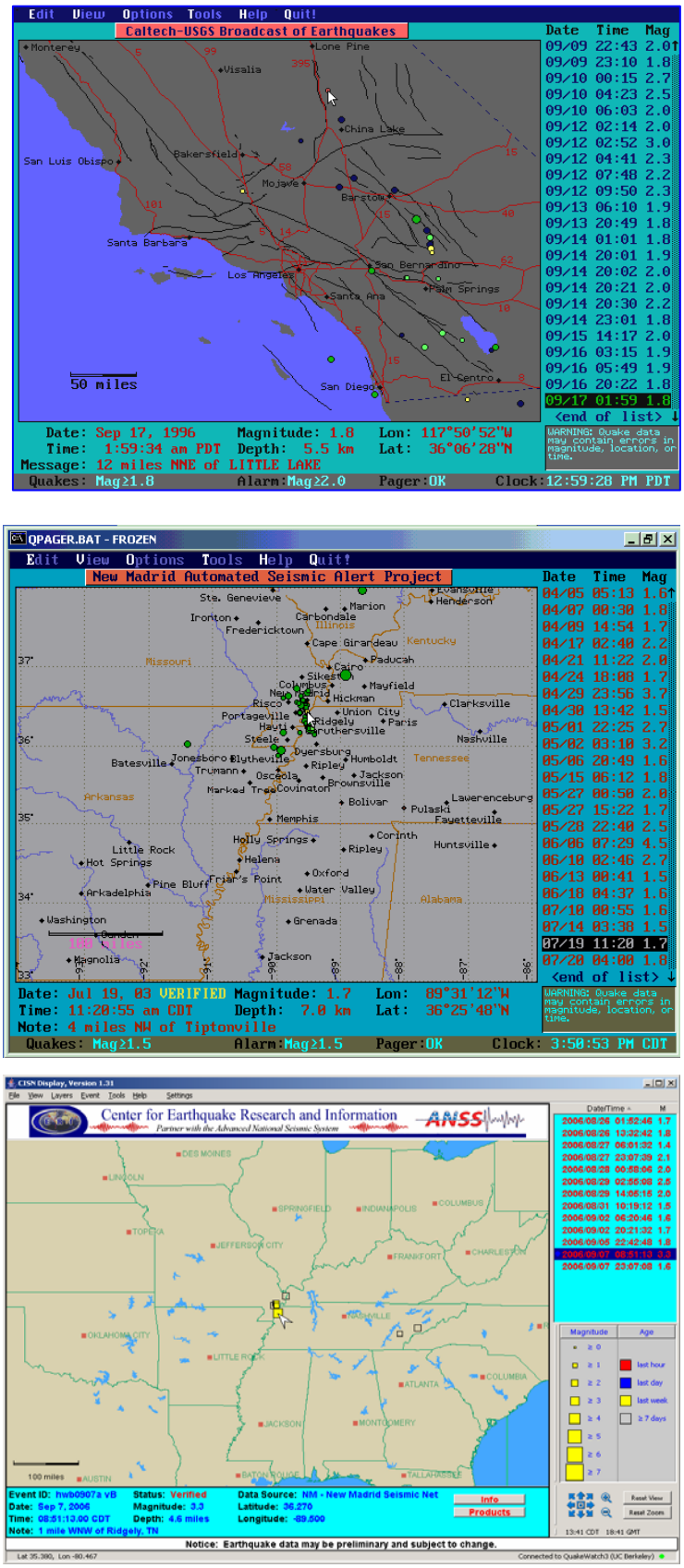

Figure 1. CUBE (upper), ASAP 1 (middle), and ASAP 2 (bottom) monitor displays.

Methodology

ASAP is a system that relies on a community of users and developers to provide continuous improvement and technical support. It provides a practical method to bring a new level of inter-regional and nationwide seismic network cooperation by combining networks into a more cohesive system (Figure 2).

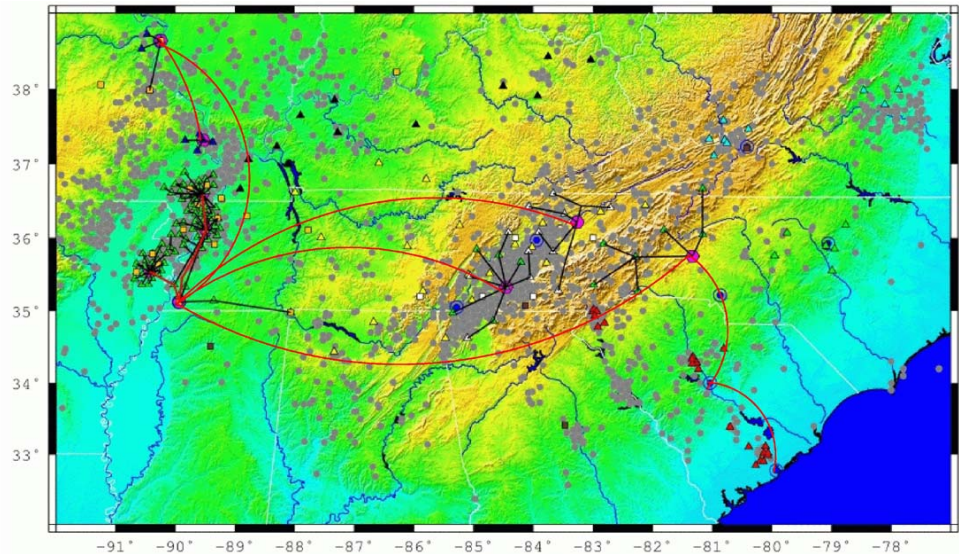

Figure 2. Internet connectivity between components of the ANSS-supported seismic networks in the southeastern US (Mitch Withers, CERI, 2003).

ASAP 1, the original focus of this project, was developed a set of 6 PC-based computers running CUBE software for implementation in emergency management control rooms in the CUSEC (Central US Earthquake Consortium) states, Tennessee, Mississippi, Arkansas, Missouri, Kentucky, Illinois, Indiana, and Alabama. ASAP 1 consisted of a Dell OptiPlex PC hardwired to a 9600-baud Motorolla Create-a-link pager (Figure 3). A 12-volt power converter was also required.

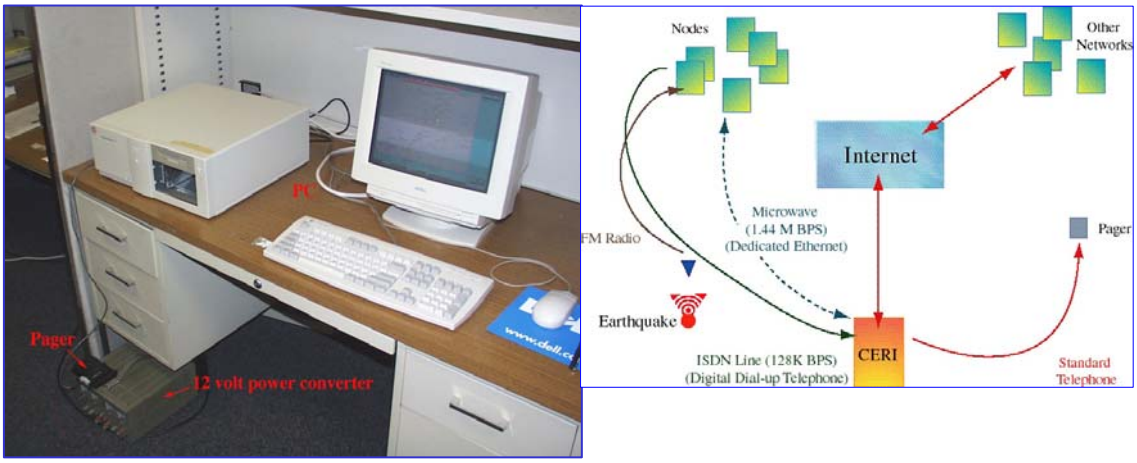

Figure 3. ASAP 1 components and message processing flow chart.

The pager from the CERI seismic network received pager notifications for earthquakes. CUBE software processed the text message into a map interface on the PC with an active alarm based on configured magnitude and location thresholds (Figure 3).
However, CISN technology (2002-2003) caused a major shift in the goal of this project and eliminated the need for problematic, low baud-rate pager systems and dependence on the operational problems that were consistently encountered with several page service providers. These changes required significant additional resources and input from CERI and the Mid America Earthquake Center in order to recall ASAP stations and reconfigure the system with internet-based CISN as the core (ASAP 2), and created the need for 2 extension requests on the original proposal.

Project Status

This project has evolved to fit the needs of widely distributed state emergency management agencies in the CUSEC states based on the availability of more dependable and accurate internet protocols that can provide active system of notification of significant earthquakes. ASAP 2 notification systems are presently implemented in Tennessee and Arkansas. Other stations, requested on numerous occasions by state emergency management agencies, will be implemented in 2006 in Missouri and Kentucky through the support of CERI and the Mid America Earthquake Center.

Additional requests from various private and public sector agencies for ASAP 2 systems will be addressed following the conclusion of this effort utilizing the most recent version of CISN Display.

Results and Conclusions

Pager-based systems for rapid earthquake notifications in 24-7 emergency management control rooms in the 7 CUSEC states proved to be an unmanageable task, as it required regular troubleshooting with numerous page services providers in different jurisdictional areas. The original ASAP pager based system (CUBE) was a 9600-baud system, which is so out-dated it is often physically limited at transmission tower switches by technicians. Few if any systems currently transmit through modern page service providers at such a low rate. This makes pager based notification systems that must utilize a specific type of pager, a high maintenance product when addressing such a large area. The availability of the internet-based CISN Display since 2003-04, and its ability to be modified for specific users in the Central United States, forced the modification of the original ASAP system and caused the need for two extension requests on this project. Adaptation continues to the present as new versions of CISN display are being tested.

ASAP 2 stations also benefit greatly from recent upgrades and increased station density that increase the quality of rapid magnitude and location solutions for secondary seismic sources in the Central US. Uncertainties in rapidly locating events accurately in the Wabash, Southern Illinois and East Tennessee seismic zones in 2001-02 caused the project to delay rapid notification services for these areas until 2005-06.

Acknowledgements

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The Tennessee Emergency Management Agency

Related Publications

Patterson, G., M. Withers, and P. Bodin (2001). New Madrid Rapid Earthquake Information System, CUSEC Journal, v6 n1, 10-12.