Public Safety and Fast Post-Earthquake Situational-Awareness: Deploying NetQuakes in Puget Sound and Cascadia

Rapid and reliable distribution of earthquake information immediately after an earthquake is one of the main goals of the United States Geological Survey (USGS) Advanced National Seismic System (ANSS). To address this goal the ANSS has deployed a backbone of seismic stations across America to provide systematic earthquake detection and location capability. In addition, the ANSS has installed strong motion stations in Seattle, San Francisco, Los Angeles, Anchorage, Salt Lake City, and Memphis that transmit data in real-time to seismic processing centers where the data is folded into earthquake locations, magnitude estimates, and ShakeMaps. Across the United States, the new ANSS efforts have greatly improved the timeliness and accuracy of near-real time earthquake information.

A new system designed to be quickly and more cheaply installed than instruments is now ready for widespread deployment. This new system is NetQuakes and was engineered to allow a dense array of seismic stations to be relatively easily deployed in urban environments. The NetQuakes system consists of a recorder and accelerometers mounted in a weather-tight case (Figure 1). The system runs on AC power with days of backup battery, is easily bolted to a concrete floor, and transmits data to a seismic data center using high-speed internet access. Each recorder unit processes seismic signals in real-time as they are received, and after an earthquake transmits the data to the seismic processing center. In case of transmission problems, the unit has sufficient memory, allowing the critical earthquake data to be stored until retrieval is possible.

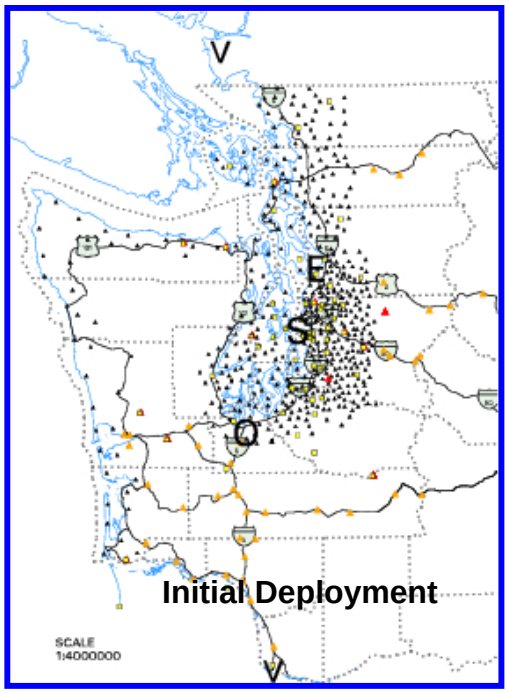
The primary use of NetQuakes is for rapid post-earthquake assessments. Several studies indicate that California needs about 7000 instruments to adequately record earthquake strong motion anywhere in the state. Unfortunately, only 1500 sites are currently operational, and at the current rate, it will take 70 years to approach the optimal deployment. The situation in Washington is no different. Although the cost of quality instruments is a factor, the difficulty in siting these instruments, establishing telemetry, and on-going costs for telemetry and equipment maintenance all hinder rapid deployment of conventional strong motion stations.

NetQuakes solves this deployment problem on several fronts. The units cost under $3000 due to new generations of inexpensive sensors and computer hardware. Installation is as simple as inserting a single bolt into concrete and plugging the unit into AC power. The units are designed to connect to the Internet using Ethernet or wireless to eliminate telemetry expenses. Finally, incase of unit failure (easily diagnosed through state-of-health messages reported hourly), the USGS sends the host a replacement unit, and the host simply unbolts and unplugs the unit, then returns the defective unit to the USGS.

Initial Deployment: Puget Sound and the Washington Coast.

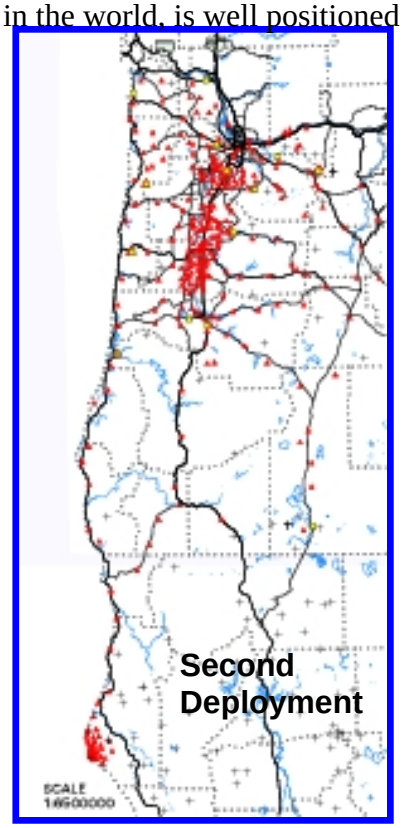
Puget Sound and northwestern Washington are earthquake country. The high earthquake hazard is due to the potential for magnitude 9 earthquakes offshore along the Cascadia subduction zone, deep events like the 2001 Nisqually earthquake, and potentially disastrous earthquakes on the Seattle fault and other crustal faults located near urban population centers. This is also a region of complex geology causing ground shaking to vary widely across the region. Recent ANSS deployments have greatly improved the overall seismic monitoring capability of the Pacific

Northwest Seismic Network operated by the University of Washington in partnership with the USGS. The number of stations, however, remains well below that needed for the fast, reliable situational analysis needed to meet Washington State's emergency response needs and provide data for designing earthquake resistant structures.



A 500-station initial deployment of NetQuakes, shown in the map, will meet the State's need for rapid situational awareness to guide the immediate post-earthquake response in Puget Sound and along the coast. This dense array could include stations at critical highway and railway bridges, public schools, hospitals, and other key buildings and structures. The densest deployment is in the Puget Sound urban corridor, with the array becoming less dense northward to the Canadian border and west toward Hood Canal. A ring of stations is included from the mouth of the Columbia River to Port Townsend to improve the immediate understanding of a Cascadia earthquake. Key transportation routes are also instrumented.

Northwestern Washington and the Pacific Coast is an excellent site for the first major deployment of the ANSS NetQuakes system. The University of Washington, one of the leading seismic centers in the world, is well positioned to oversee the installation, operation and maintenance of the improved network. In Seattle, the UW, the USGS, Washington Emergency Management, Washington Department of Natural Resources, FEMA, and the City of Seattle are now testing USGS ShakeMap software. The data generated by the state-of-the art network of NetQuakes devices could greatly improve situational awareness in Northwestern Washington during 2010 Winter Olympics in Vancouver, British Columbia when the eyes of the world are watching the region.



A second deployment of about 400 NetQuakes stations, from the Portland area south to Eugene and the I-5 corridor to California as well as along the Oregon coast south to Eureka would provide full situational awareness of a Cascadia earthquake. The resulting network 900-station network would be similar to networks operating in the Japanese subduction zone.

Information Contact:
Craig Weaver
U.S. Geological Survey206-553-0627 office;
craig@ess.washington.edu

Figure 1: Netquakes recording system in weatherproof case and simple mounting plate. The units connect into AC power and the internet using standard connections.