PNW ShakeAlert

Earthquake Early Warning for the Pacific Northwest

The PNW ShakeAlert Demonstration System
Goals of the PNW ShakeAlert Demonstration

- Overall: prepare the best EEW system for wide distribution and use (~2 years)
- Demonstrate viability and usefulness of ShakeAlert warnings
- Understand users needs and adapt ShakeAlert to meet them
Goals of the PNW ShakeAlert Demonstration

- Identify users (and uses) in your organization.
  - those for whom EEW will make their job easier
  - advocates for EEW
- Communicate user experience and ideas to us—we want feedback!
- What will it take to implement EEW in your organization?
  - who and how? challenges? technical help?
- Each organization develop an “action plan” to implement EEW, with PNSN collaboration.
• **ANSS/ PNSN/ RSN**
  seismic monitoring network.

• **EEW**
  generic Earthquake Early Warning.

• **ShakeAlert (PNW ShakeAlert)**
  A particular EEW system developed in California. We use a variant here. May use several methods.

• **ElarmS**
  A particular seismic EEW method within ShakeAlert. Processes seismic data and provides warning messages.

• **UserDisplay (PNW UserDisplay)**
  A stand-alone computer application that receives ShakeAlert messages, then calculates and displays (for humans) expected shaking levels and times.
What is Earthquake Early Warning?

- Rapidly detecting and evaluating the strength of an earthquake (within seconds)
- Estimating likely impacts
- Alerting customers before strong shaking hits them
  - There must be time to take defensive action
  - At most this will be several minutes, more commonly less than a minute
How EEW works

• Damaging seismic waves are slower than smaller “P” wave vibrations.

• The amplitude of the early P-wave grows with magnitude of earthquake.
Seismic data in real-time from ~220 stations in PacNW
ElarmS - based on first 1-4 sec. of P-wave
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Alerts sent to UserDisplay (Mag, Location, Time)

Earthquake Early Warning Basics

1. Alerts are generated when an earthquake occurs.

2. Alerts are transmitted to the user display, where they are displayed.

3. A message from the alert center is immediately transmitted to your computer or mobile phone, which calculates the expected intensity and arrival time of shaking at your location.

- Sensors positioned about 6-12 miles apart
- Earthquake alert center
- Epicenter
- Wavefront
Event PLAYBACK 2001_Nisqually_M6.8
Origin Time: Wed Feb 28 10:54:00 PST 2001
Epicenter is 6 miles (9 km) WNW of DuPont

Remaining Time

Expected Intensity: V
Estimated Magnitude: 6.8

Probability of Correct Alarm: High

Notice: Earthquake data may be preliminary and subject to change
2003: Two damaging earthquakes
- $15 million in losses
- Fire, equipment damage
- 17 and 13 days loss of productivity

Spent $600K on early warning and shear walls in basement
- Sensitive equipment set down on floor to reduce shaking and damage

Two similar earthquakes
- $200K in losses
- 4.5 and 3.5 days loss of productivity
At the time of the M9 Tohoku-oki earthquake...

- 24 trains were running in the Tohoku Shinkansen system
- 9 seismic sensors along the coast, and 44 sensors along the train track
- detected the initial tremor; automatic shutdown of power; activation of the emergency brakes
- all trains stopped without derailment
- they did not sustain any damage on bridges and tunnels, and could restore the operation very quickly

- from Asahi
Communicating the Warning

Japan

TV and radio announcements
- 124 of 127 TV stations (98%)
- 41 AM, 35 FM radio (75%)

J-Alert messages
- 226 municipalities receive the warnings
- 102 announce them with public address systems

Cell phones
- 3 companies (Docomo, AU, Softbank)
- 52 million can receive them (47%)

Dedicated providers serve
- power plants
- factories
- schools
- hospitals
- shopping malls

earthquake location and hazard
estimated shaking in your area

estimated shaking in your area

estimated shaking in your area
PNW UserDisplay Demo
Miscellaneous Points

• Please don’t share UserDisplay too widely
  – Keep track of who has it in your organization
• Consider CI SN Display (or our PNSN Webpage)
  also to gauge UserDisplay performance
• Next UserDisplay release will allow multiple sites
• We’ll send occasional “test events”
• Bill Steele will be coordinating feedback
• Computers can’t be allowed to go into “sleep” mode
• Size of largest earthquakes (~M8+) likely currently underestimated by ElarmS. New GPS methods will fix.