Oregon Hazards Lab: Science for Public Safety

UNIVERSITY OF OREGON

Prof. Douglas R. Toomey
University of Oregon, Earth Sciences
Director, Oregon Hazards Lab

The Really Big One

Earthquake & Tsunami, Japan

The Really Frequent Ones

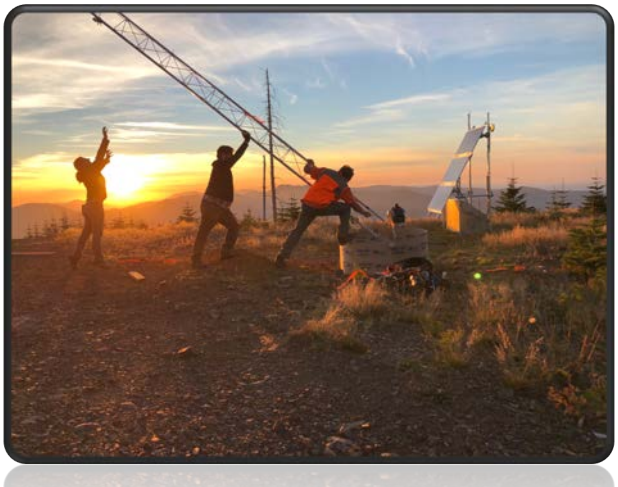
Eagle Creek Wildfire, Cascades Locks, OR

Oregon Hazards Lab

UNIVERSITY OF OREGON

O-HAZ uses science, technology, and education to understand, monitor, and mitigate multi-hazards within the PNW

- Pacific Northwest Seismic Network
- ShakeAlert
- AlertWildfire
- Oregon Research Platform



PNSN
Pacific Northwest Seismic Network

- To monitor earthquake and volcanic activity across the Pacific Northwest, the University of Washington and the University of Oregon cooperatively operate the Pacific Northwest Seismic Network (PNSN).
- The PNSN is sponsored by the U.S. Geological Survey (USGS), the U.S. Department of Energy, the State of Washington, and the State of Oregon.
- Beginning in 1969 with five seismometers, the PNSN has grown to more than 300 seismograph stations distributed across the region and become the second largest seismic network in the United States.
- The PNSN is an organization dedicated to reducing impacts of earthquakes and volcanic eruptions in the states of Washington and Oregon by providing accurate and fast information about earthquakes and ground motions to scientists, engineers, planners, and the public.

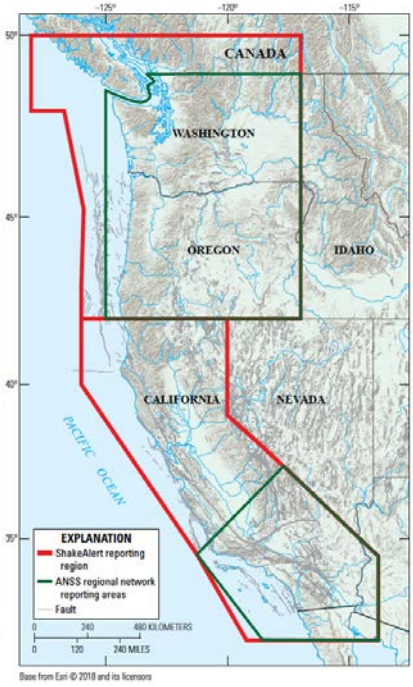


Figure 2.1. Map of the ShakeAlert reporting region (outlined in red) and Advanced National Seismic System (ANSS) regional network reporting areas (outlined in green) in the western United States and Canada.

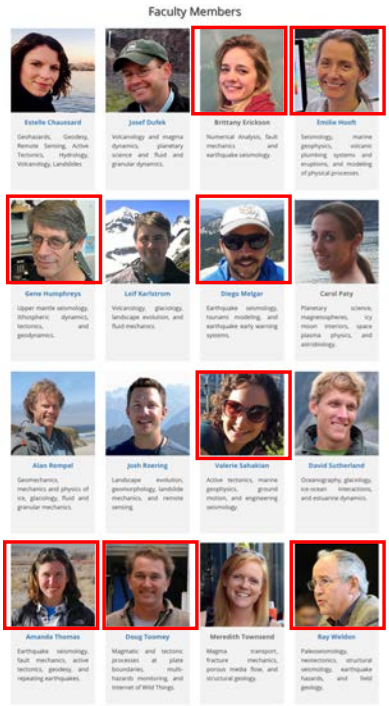
PNSN
Pacific Northwest Seismic Network

UO and PNSN

- For nearly 30 years the UO has participated in PNSN
- Prior to 2014, participation was limited to field support
- Since 2014 — and catalyzed by ShakeAlert and State contributions — UO participation has expanded

UO Earth Sciences has also expanded, particularly in geophysics and volcanology

- Seismology
  - PNSN@UO staff and students
  - 8 tenure track faculty in seismology or earthquake mechanics
- Volcanology Cluster
  - $10M gift resulted in Oregon Volcanology Center
  - Over 10 tenure track faculty in volcanology

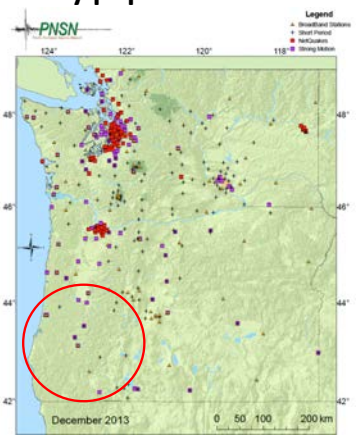


What have we accomplished since Oregon joined ShakeAlert in 2014?

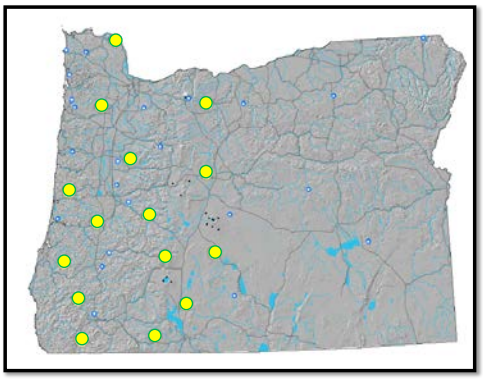
Dodson Butte, Douglas Co.

Previous State actions accelerated network growth

2013: Seismic Network in Oregon is sparsely populated

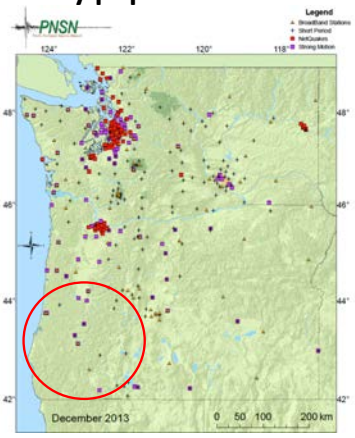


2014: State of Oregon purchased 30 high-quality sensors at 15 sites

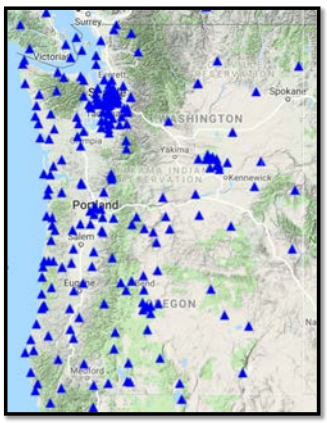


2014-2018: UO leverages state investment

2013: Seismic Network in Oregon is sparsely populated



2018: Seismic Network in State growing toward ShakeAlert requirements



Given capital investments by the State of Oregon, the USGS then supports installation, operation and maintenance

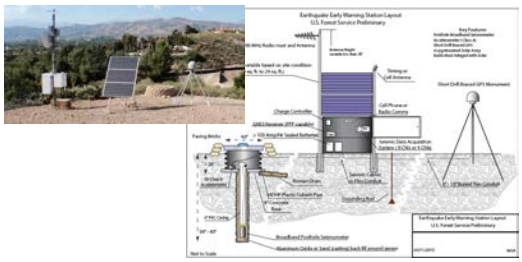
This **multiplies state investments** since USGS takes on recurring costs

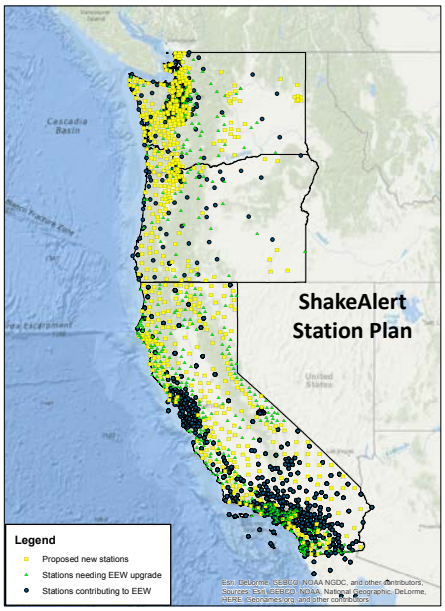
Network buildout in Oregon still below threshold for public alerting

Scotts Mills, Marion Co.

Station Buildout

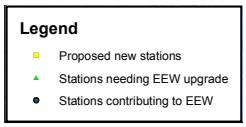
- 1,600 stations planned in CA/OR/WA
- ~650 currently contributing
- Priority on metro areas (CA)
- Buildout in Oregon depends on investment

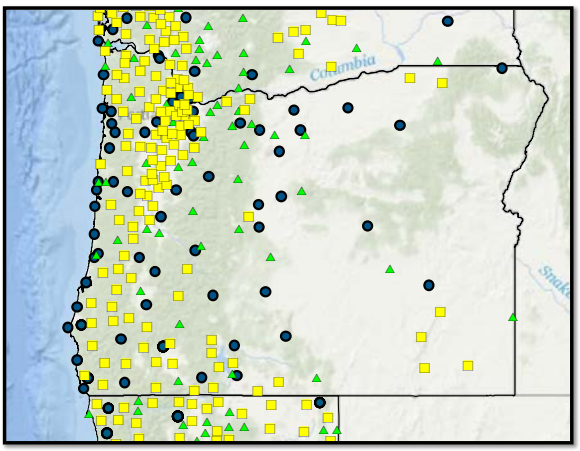




Building out the ShakeAlert Network in Oregon

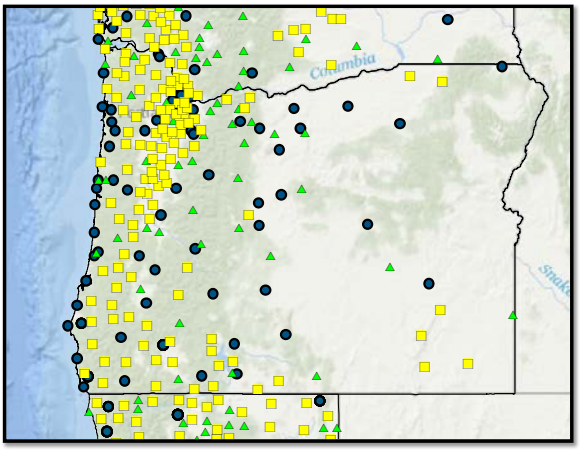
- There are currently 110 seismic stations in Oregon contributing to ShakeAlert
- 125 additional stations are needed to be 100% operational for earthquake early warning
- Oregon is currently at ~50% of buildout
- 75% minimum required for public alerting





DOGAMI Contributions to PNSN

- Prior to 2014
  - Only 2 pre-2014 DOGAMI-funded sites currently contribute data to PNSN. Others have been retired due to age or not compliant with ShakeAlert
  - These actions were implemented between UW and DOGAMI
- Since 2014
  - DOGAMI has contributed $297K to capital investments since 2014
  - These actions were implemented between UO and DOGAMI resulting in 17 sites that currently contribute to PNSN and ShakeAlert; 16 more to be installed.
  - Investments were limited to capital; UO covered costs of installation
  - USGS assumes ongoing operations and maintenance



What does it take to get a site operational?

Much more than equipment

1. Project manager
2. Site identification personnel
3. Station permitting personnel
4. Environmental review personnel
5. Equipment installation personnel
6. Equipment calibration and testing personnel
7. Telemetry and data integration personnel
8. Station construction supervision personnel
9. Data quality review personnel
10. Travel costs
11. Contracts manager (land use, purchasing, telemetry, etc.)

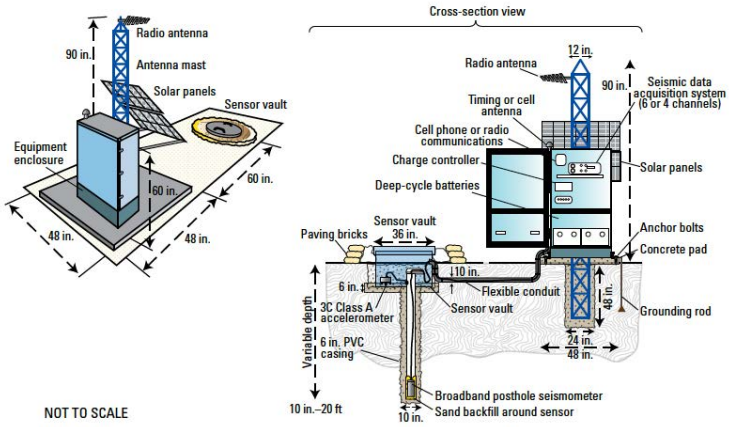


Figure 3. Schematic drawing of a typical seismic station used by the ShakeAlert system. Solar panels are on the enclosure that houses electrical and communications components. Seismic sensors are deployed in a shallow borehole. In some cases, a Global Navigation Satellite System (GNSS) receiver may be colocated at the site (not shown). All distances given are in inches (in.) or feet (ft).

Multi-Hazard Monitoring Installations

Solar powered sites:

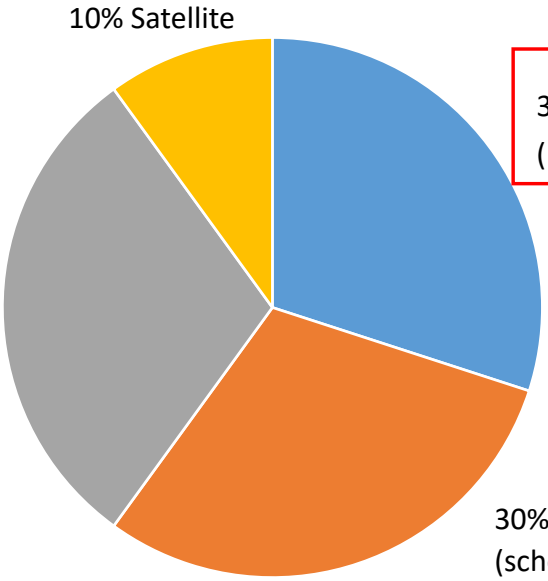
- 2-3 days for install
- Requires bedrock for seismic data, clear line of sight for telemetry and fire monitoring cameras

Urban sites:

- 1 day for install
- Requires host to provide robust power and communications

Building a Robust Telemetry Model

(Example Numbers)



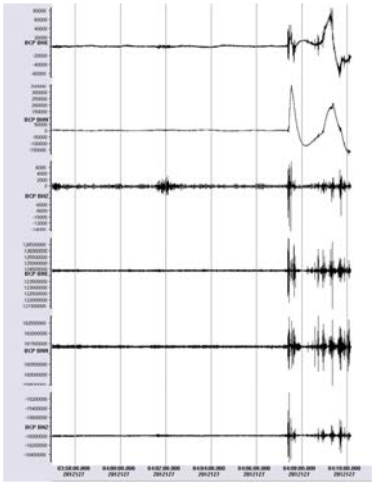

The Solar Eclipse Might Mess With Your Cell Phone Service

You might have to put your cell phone down during the upcoming total solar eclipse, but don't blame the moon for these service interruptions.

August 8, 2017 by R.J. Wilson

Multi-Hazard Monitoring Maintenance

Environmental Damage

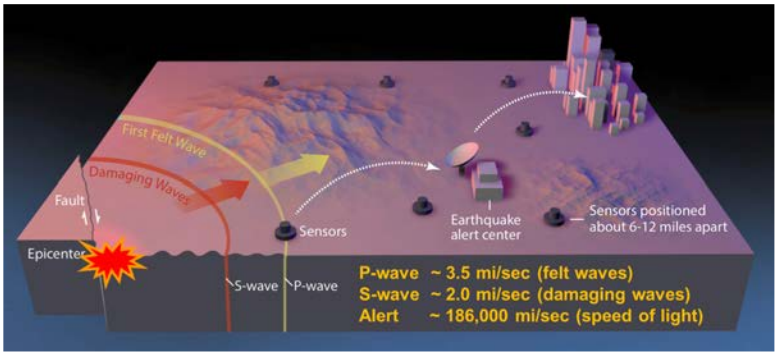


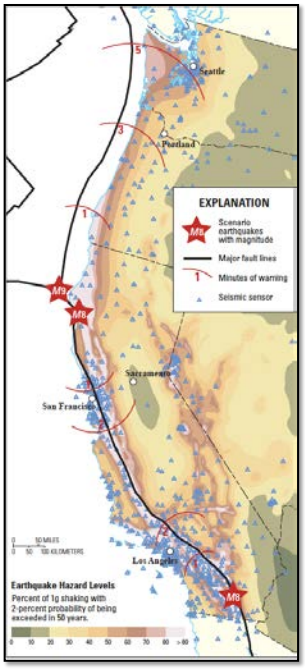
Bear Attacking Site!

Multi-Hazard Monitoring Maintenance

ShakeAlert – What is it?

- ShakeAlert is the name of the West Coast Earthquake Early Warning System (EEW)
- Developed by USGS, Caltech, UC Berkeley, University of Washington, University of Oregon
- Warning times from seconds to minutes





September 19, 2017, Mexico City
M7.1 deep focus earthquake

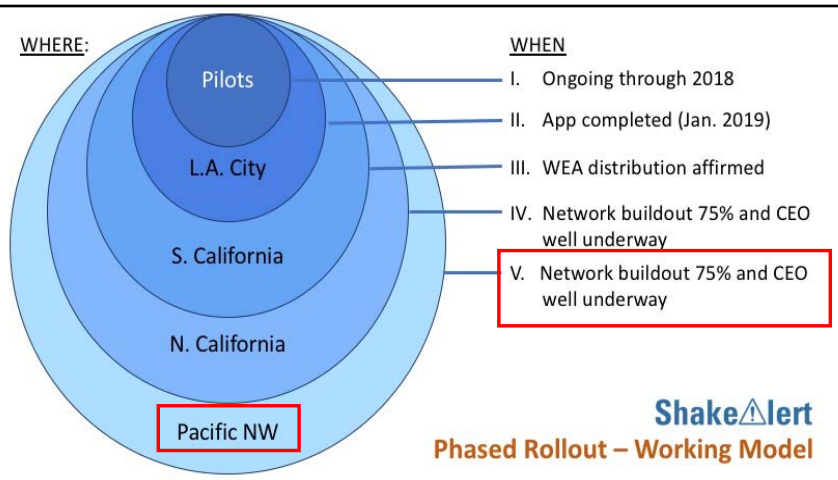
Applications

Valuable seconds to tens of seconds warning for…

- People
  - move to safety
    drop, cover, hold-on
  - mental preparation
- Things
  - automated controls
  - slow, stop transportation
  - isolate sensitive systems and processes
- Situation awareness
  - Real-time operational picture
  - Take actions before infrastructure is affected

When will ShakeAlerts be available to public?

Leaburg Canal, Lane Co.



- **Phase 1 (2018)** will be for pilots only. A media plan will be carried out leading up to the Oct announcement of Phase 1, and a public education and training campaign will begin.
- **Subsequent Phases begin when technical/CEO milestones** are reached. Timing depends on advances in WEA and cell phone apps (various developers), and is beyond USGS control.
- **Public alerting to L.A. City** would begin in Phase 2, with thresholds of M ≥ 5 and MMI ≥ 4
- This would most likely involve a **cell phone app** scalability test, starting with 50,000 L.A. City employees and – if that works – **scale up to the 4M residents of the City of LA**.

Why will public alerts come to Los Angeles, San Francisco, and Seattle first?

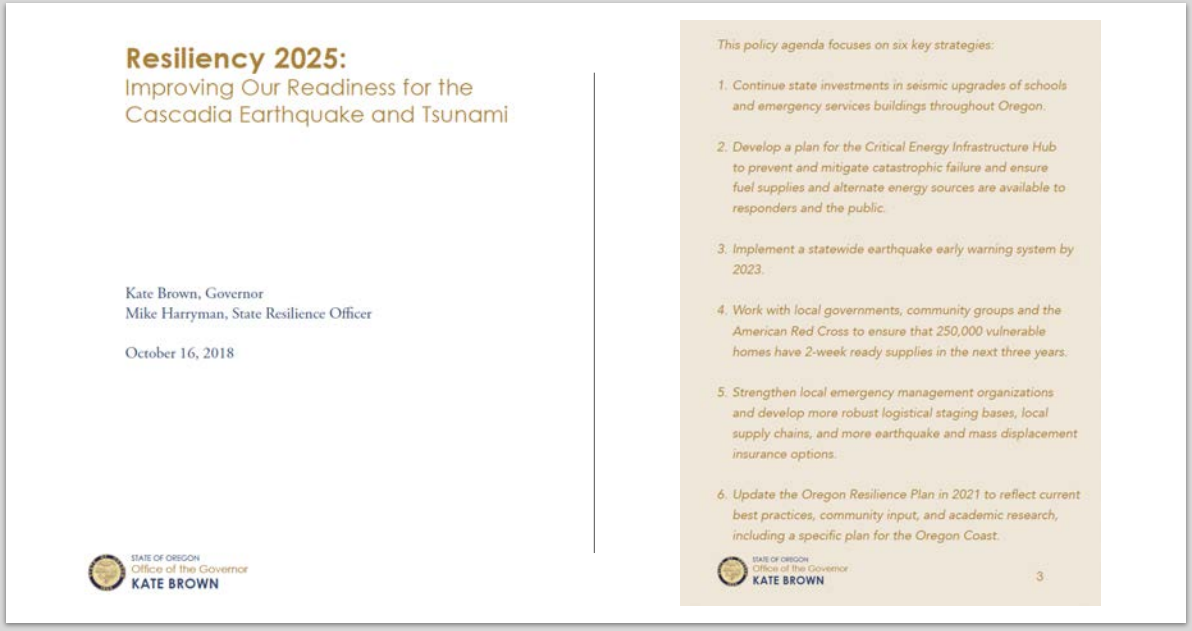
- **CA contributed $10M in 2017** ($6.4M for 183 seismic stations, $2M stayed with CalOES for their outreach work).
- **CA Governor's 2018-2019 budget includes $15.75M** in general fund support to complete station build-out. CalOES also allocated state funds in 2018 as follows:
  - **$40,000** for outreach to science teachers
  - **$45,000** for communications equipment for PIO office for outreach
  - **$38,000** for CSU Fullerton to identify gaps in research and outreach.
- CISN funding is **$1.5M per year** to USGS, CGS, UC Berkeley, and Caltech.
- **WA provides $600,000/year** to their university-operated seismic network

State-wide coordination will lead the way to ShakeAlerts!

Diamond Lake, Douglas Co.

Examples of state-wide coordination

- State of Oregon: Purchased 30 high-quality sensors at 15 sites from NSF
- Governor's Office: ensuring alignment of messaging and goals across ShakeAlert, PNSN@UO, state agencies and regional stakeholders
- ODOT: Intergovernmental agreement that allows UO & PNSN to operate on ODOT property and utilize ODOT telemetry
- DOGAMI provided UO funds from strong motion program to support station buildout; *leverages USGS support for installation, operations and maintenance*
- OEM, UO and others working together to develop communication, education, and outreach (CEO) program for our state
- EWEB provided UO funds for station buildout
- Pilot Projects developed with UO include EWEB, ODOT, UO, RH2 Engineering, RVCOG, Syn Apps, K-16 (UO, PSU, Linfield College, Beaverton School District)
- Oregon Committee on CEO, ~30 stakeholders from across all sectors



Resiliency 2025:
Improving Our Readiness for the Cascadia Earthquake and Tsunami

Kate Brown, Governor
Mike Harryman, State Resilience Officer

October 16, 2018

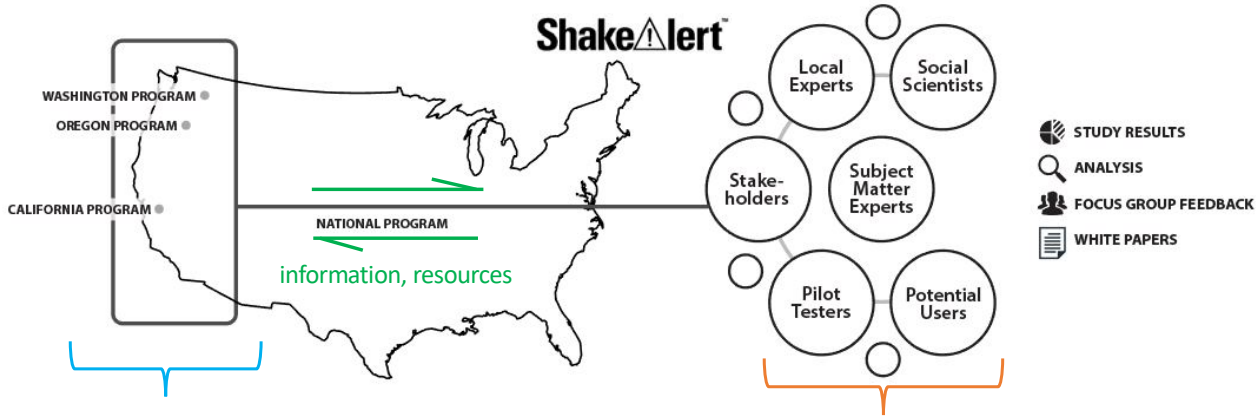
STATE OF OREGON
Office of the Governor
KATE BROWN

This policy agenda focuses on six key strategies:

1. *Continue state investments in seismic upgrades of schools and emergency services buildings throughout Oregon.*
2. *Develop a plan for the Critical Energy Infrastructure Hub to prevent and mitigate catastrophic failure and ensure fuel supplies and alternate energy sources are available to responders and the public.*
3. *Implement a statewide earthquake early warning system by 2023.*
4. *Work with local governments, community groups and the American Red Cross to ensure that 250,000 vulnerable homes have 2-week ready supplies in the next three years.*
5. *Strengthen local emergency management organizations and develop more robust logistical staging bases, local supply chains, and more earthquake and mass displacement insurance options.*
6. *Update the Oregon Resilience Plan in 2021 to reflect current best practices, community input, and academic research, including a specific plan for the Oregon Coast.*

STATE OF OREGON
Office of the Governor
KATE BROWN

3



"Oregon ShakeAlert Committee "

Public, Private, Tribal, and non-profit stakeholders driving implementation and advocacy in Oregon

"USGS Joint Committee for Communication, Education, & Outreach"

Working Groups on:
Technical User Engagement
Emergency Management Resources
K-12 Resources
Social Science Research
Community Resources
Media and Public Affairs

ShakeAlert Technical Partnerships

1. Pilot

   Development of novel and transferable technology solutions for early warning alerts that enable protective actions in advance of strong ground motion
   - protect critical infrastructure
   - mass alert dissemination

Why Are Partners Needed?

- The USGS does not have the mission nor the infrastructure and expertise to deliver mass alerts directly to the public or provide site-specific technology to take automatic actions.

- The USGS strategy for alert distribution and use is to enlist partners with the necessary mission, technical ability, and resources to deliver alerts and perform end-user implementations.

Revised Technical Implementation Plan for the ShakeAlert System, USGS, 2018

ShakeAlert Partnerships & Impacts

EWEB

Provides water and electricity to 200,000 customers, has 800 miles of water pipes, 9 power generating facilities, 16,000 power poles and transmission towers, and 13,000 miles of power lines.

Oregon Department of Transportation

Maintains road infrastructure for 3.2 million passenger vehicles and critical, heavy trafficked Oregon bridges not designed for seismic loads.

Syn-Apps Notification. Unified.

Provides alerting software to 46 companies across 27 cities in Oregon and to wherever those businesses install the Syn-Apps software, including 270 customers in California, 55 customers in Washington, and 35+ countries.

University of Oregon

Providing electrical power, heating steam, and chilled water to over 80 large buildings on the UO campus through 5 miles of concrete tunnels, servicing 29,500 students and staff on campus.

Linfield College

Approximately 2,600 enrolled students across a campus of 60 academic and residential buildings

RH2 Engineers, Planners, Scientists

Provides automated solutions for water and wastewater facilities - City of Grants Pass, City of Albany, City of Gresham, South Fork Water Board. Combined Oregon impact – 260,000+ customers, 4 treatment plants, 24 reservoirs, 29 pumps, and over 500 mi of distribution mains.

ShakeAlert Partnerships & Impacts

Automated dewatering of the canal protecting several hundred residential properties between the canal and the McKenzie River; Automatic closure of turbine preventing heavy damage to critical power generating facility returning power to customers.

Automatic triggering of warning lights bridges and signaling to take alternate routes to prevent life safety hazards for pedestrians and motor vehicles.

Automated alerts to indoor IP speakers, outdoor loud horns, digital signs, mobile phones, desktop computers, strobes / beacons, IP desk phones, etc.

Automatic alert signals integrated into the control systems can prevent life threatening conditions, minimize steam ruptures or flooding, as well as minimize the time and cost of restoring critical systems.

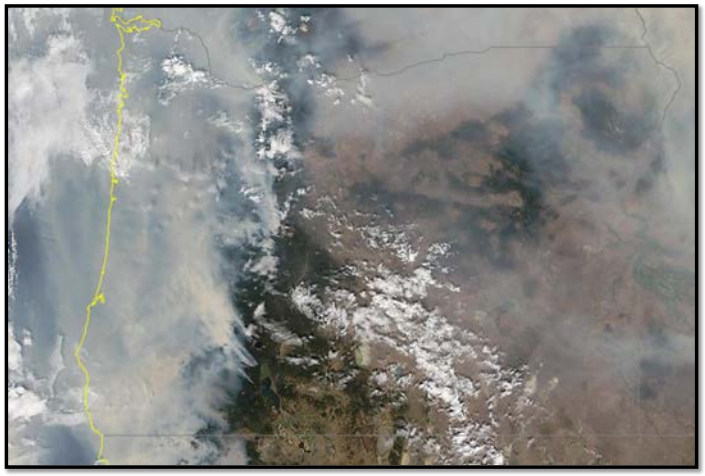
Automatic alert triggers electronic “unlocking” of doors throughout the campus, providing critical access through the doors for rescue efforts.

Automatic isolation of water reservoirs, shutdown of pump stations, chemical and motorized equipment to preserve water and distribution channels for recovery.

AlertWildfire and ShakeAlert:

A multi-hazards platform that increases state resilience

Satellite image of smoke blanketing Oregon

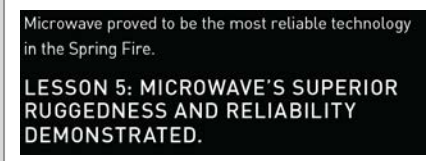


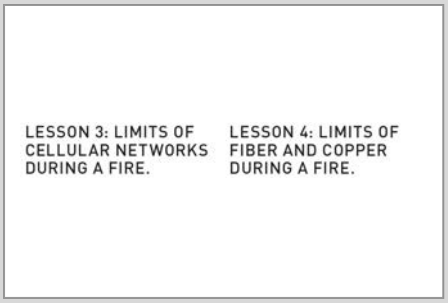
September 5, 2017

Benefits of linking ShakeAlert and AlertWildfire programs

- **Hardens** telemetry of **ShakeAlert**, improving state resiliency
- Wireless, IP-based high-speed backbone **supports a multi-hazards system**; not a one-off alerting/detection system
- **Leverages funding sources** that can save state tax dollars
- Pulls together technical and human resources within the state to improve coordination and response.

Blue Mountain, Malheur Co.





AlertWildfire: What can it do?

- discover/locate/confirm fire ignition
- quickly scale fire resources up or down appropriately
- monitor fire behavior through containment
- during firestorms, help evacuations through enhanced situational awareness
- ensure contained fires are monitored appropriately through their demise.

www.alertwildfire.org/oregon/

www.alertwildfire.org

AlertWildfire: What can it do?

2018 Holy Fire, Santiago Peak, Orange S. Cal.
Helping to protect communications infrastructure

UC San Diego

UNIVERSITY OF OREGON

AlertWildfire: Sponsors and Partners are diverse

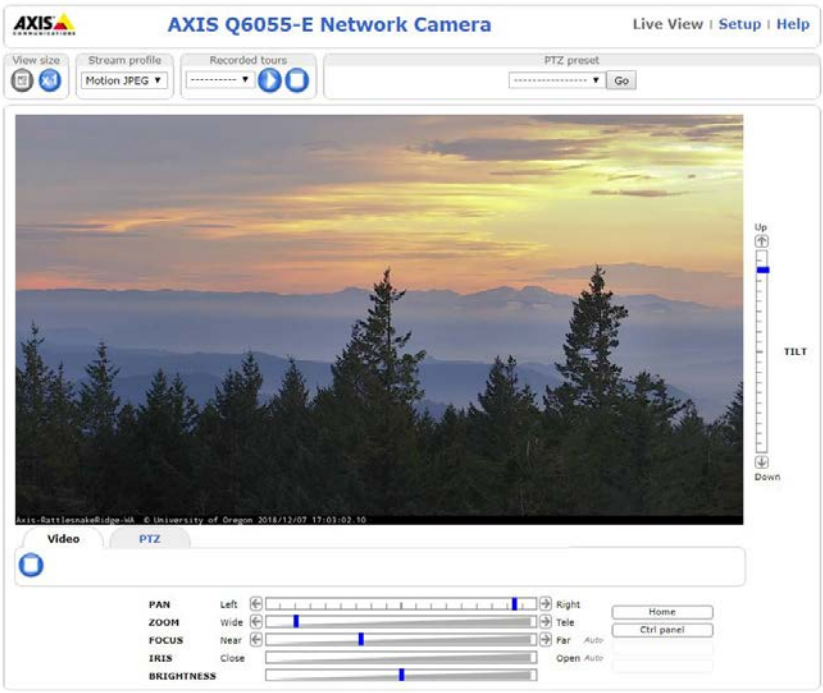
- **Federal agencies** (BLM, National Forest Service, National Science Foundation)
- **Utilities**; >500 existing or soon to be installed cameras by private sector funding
  - **SDGE** cameras installed Sep 2017
  - **SoCal Edison** (Pilot project**: $10-15M**, 160 cameras and support)
  - **PG&E** recently announced support
  - **Central Lincoln County PUD** (pilot project)
- **Counties**, adopting or replacing existing systems with AlertWildfire
  - Sonoma, Marin, Napa, Lane Co.
- Private stakeholders and communities

Steens/Wildhorse Mountain, Harney Co.

AlertWildfire & ShakeAlert provide an opportunity for statewide cooperation

- Examples of **OR stakeholders** we have engaged recently
  - Central Lincoln County PUD
  - Harney County Wildfire Collaborative
  - Lane County Sheriffs Office
  - **Douglas Forest Protection Association**
  - **Coos Forest Protection Association**
  - **Oregon Department of Forestry**
  - Eugene Water & Electric Board
  - Oregon Department of Transportation
  - Oregon Office of Emergency Management
  - Department of Oregon Geology and Mineral Industries

Blue Mountain, Malheur Co.



Summary

- PNSN@UO & ShakeAlert
  - Good progress since 2014
  - State investments accelerated network growth
  - UO facilitating state-wide coordination
  - ShakeAlerts will be available in Oregon when:
    - Network is at least 75% complete
    - Communication, Education, and Outreach is well underway
- AlertWildfire
  - Hardens telemetry of ShakeAlert
  - Diversify sources of funding for hazards detection and monitoring
  - Benefit to other stakeholders (ODF, DFPA, CFPA, counties, utilities)

Pine Mountain, Deschutes Co.