2: ShakeAlert

Distributing Alerts

Earthquake Early Warning

Doug Given

USGS

Earthquake Early Warning Coordinator

WSSPC/NEPM Meeting
May 22, 2014

Principal EEW Collaborators

- ***USGS***
  Given, D., Cochran, E., Oppenheimer, D.
- ***Caltech***
  Heaton, T., Hauksson, E., Böse, M.
- ***UC Berkeley***
  Allen, R., Hellweg, P., Neuhauser, D.
- ***Swiss Seismological Service, ETH***
  Clinton, J., Behr, Y.
- ***U. of Washington***
  Vidale, J., Bodin, P.
- ***Moore Foundation***
  Chandler, V., Biggs, G.

CISN ShakeAlert

Users today…

Transportation

Personal Safety

Process Safety

Receiving alerts:

- ~50 scientists
- Google.org
- BART
- Amgen
- Metrolink
- So Cal Edison
- CalEMA
- City of Los Angeles
- UC Berkeley OEP
- Caltech Security
- *more in the works*

Applications

Using seconds to tens of seconds warning for…

1. Personal safety
   - – moving to safety

2. Automated control
   - – slowing/stopping/isolating sensitive systems

3. Situation awareness
   - – initiating response before shaking

Two Major User Categories

Public

- Drop, cover, hold on
- Distributed via TV, radio, Internet, cell
- Requires education

Institutions (automated)

- Rail transit
- Factories
- Refineries
- Port facilities
- Hospitals
- Pipelines

Derailed Shinkansen 2004.

Getting the message to users

Many users, little time requires mass notification

- Too slow or unreliable:
  - E-mail
  - Instant messaging
  - RSS
  - SMS (text messages)
  - IP clients
  - Reverse 911

Japan:
Communicating the Warning

PUBLIC ALERTS

TV and radio

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

J-Alert messages (satellite)

- 226 municipalities
- 102 public address systems

Cell phones

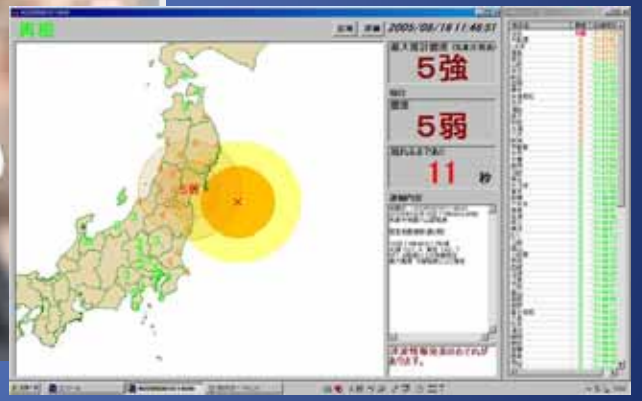
- 3 companies (Docomo, AU, Softbank)
- 52 million can receive them (47%)

COMMERCIAL USERS

- power plants
- factories
- construction sites
- hospitals

earthquake location and hazard

estimated shaking in your area




参院決算委
国会中継

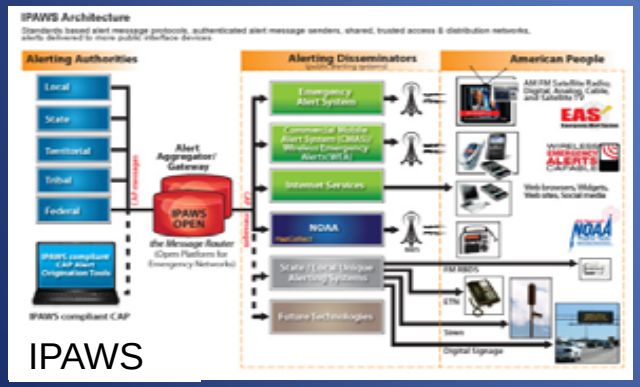
ShakeAlert Delivery

ShakeAlert will:

- Create and send:
  - Alerts
  - Parameter data streams
- Via data stream services (servers, cloud, social media)
- FEMA-IPAWS (TV, radio, WEA) "alert authority"

Partners will:

- Alert redistribution
- Mass notification integration
- Direct radio, VSAT, etc.
- App development
- Social media applications



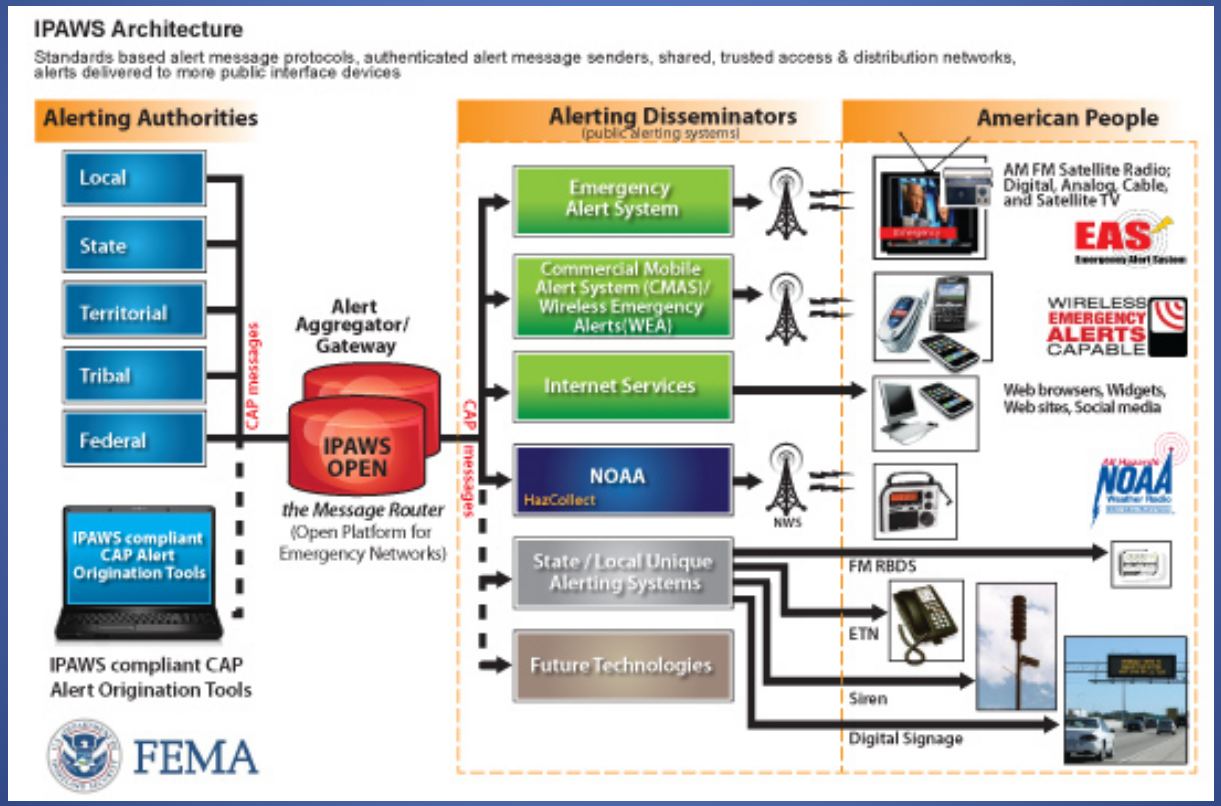
IPAWS

Sensor Networks → Field telemetry → Processing Alert Creation → Alert Delivery → User Actions

Reliable mass notification

USGS “alert authority” for FEMA / IPAWS

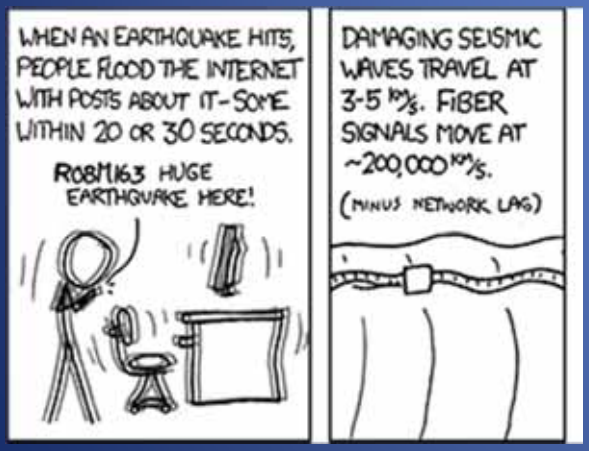
(Integrated Public Alert Warning System)

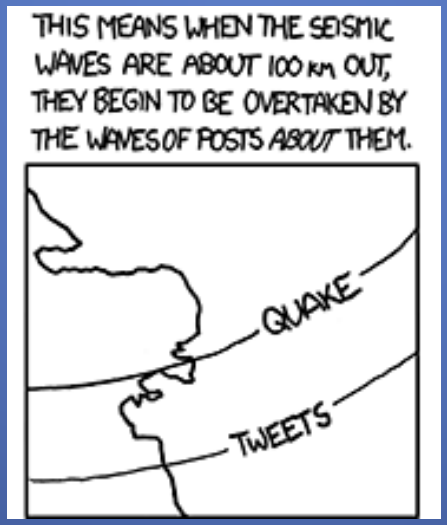


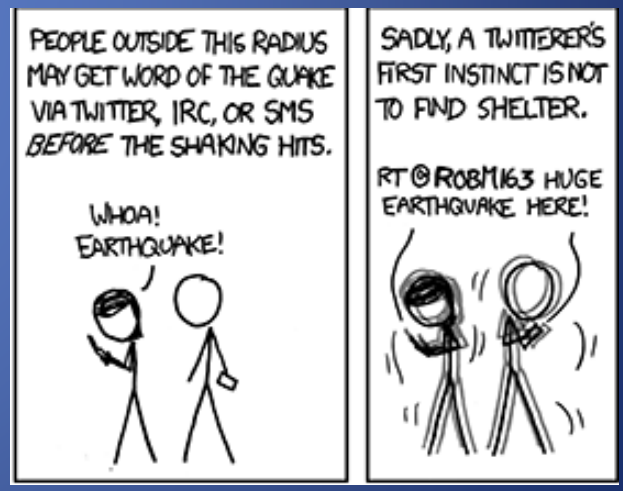
Sensors → Field telemetry → Processing → Notifications → Users

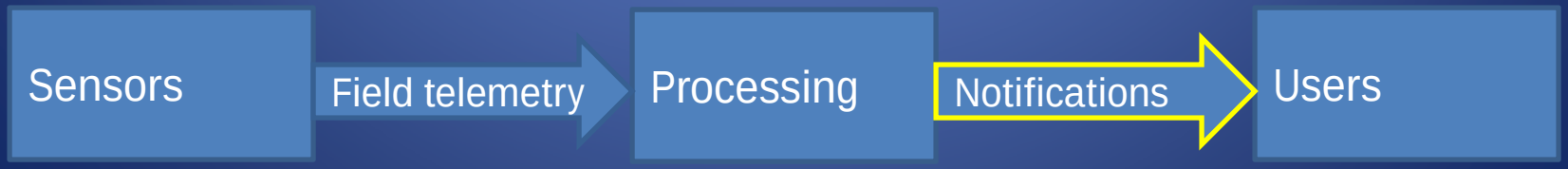
Social media: mass notification

- V 0.1 smartphone app (Google Cloud)
- Several companies interested in developing apps
- Twitter, Google, ??
- Vulnerable to infrastructure damage









GSSNet Satellite to FM Radio Alert Delivery Network

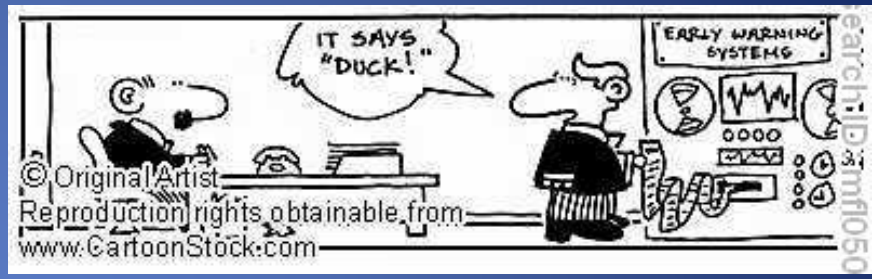
SkyAlert – Private Company, Mx

- Redistribute SASMEX alerts
- Desk top device
- Free phone app
- 221k Twitter followers
- USB/keychain receives satellite alerts

http://skyalert.com.mx/

Automated Response

- Simple alerts
  - EEW system decides thresholds
  - Public alert



- Sophisticated data stream
  Info evolves, end user makes decisions based on...
  - How long until strong shaking?
  - How strong will shaking be?
  - How certainty is the information (likelihood)?
  - Knowledge of their infrastructure & processes

  - Actions have costs (cost/benefit)
    - Low cost responses –Open fire house doors, stop elevators, slow or stop trains, etc.
    - High cost responses – Stop production lines, shut off power, scram reactor

ePAD: earthquake Probability-based Automated Decision-making

- Pre-analyze structural model and loss model for specific EEW application (PBEE method)
- Ability to include value of future information into decision-making (value-of-information)
- Visualize decision as a function of uncertainties (decision map/decision contour)

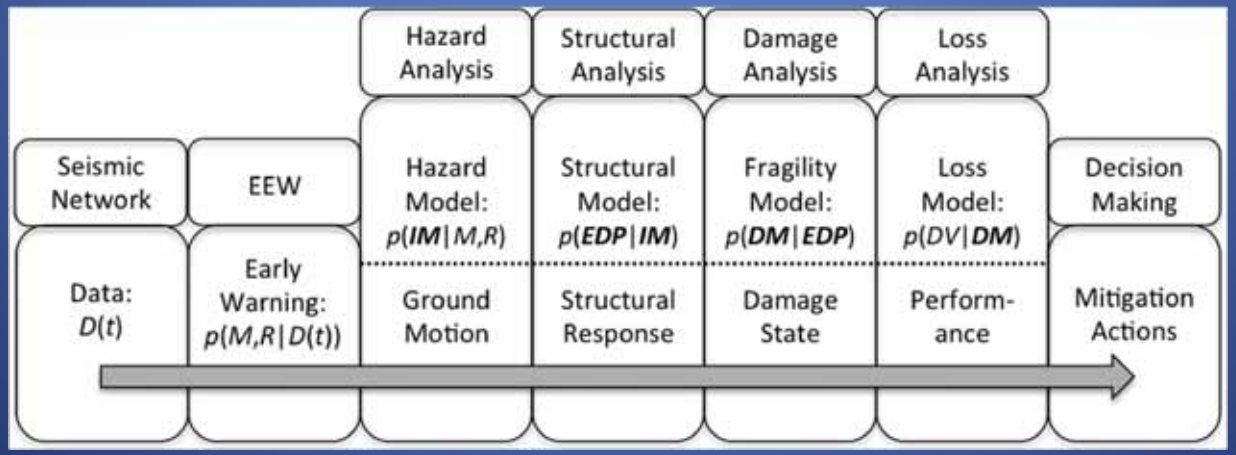
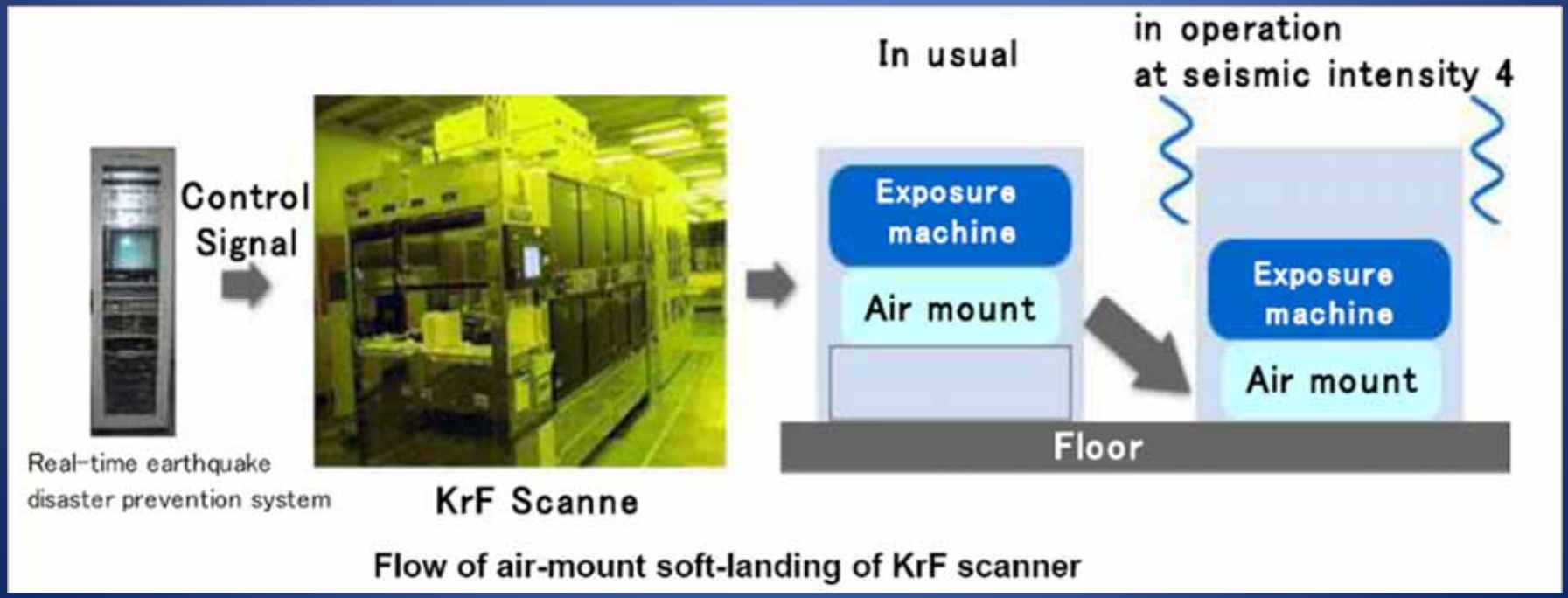


Fig.1: Performance-Based Earthquake Engineering (PBEE) method

Stephen Wu

EEW Example from Japan

- Miyagi Oki Electric Semiconductor Plant
  - "soft landing" of chip laser etching machines
  - Combines JMA EEW system + on-site sensors
  - Saved ~$15M in loss & down-time in two quakes



Flow of air-mount soft-landing of KrF scanner

Kenichi Takamatsu, 2009

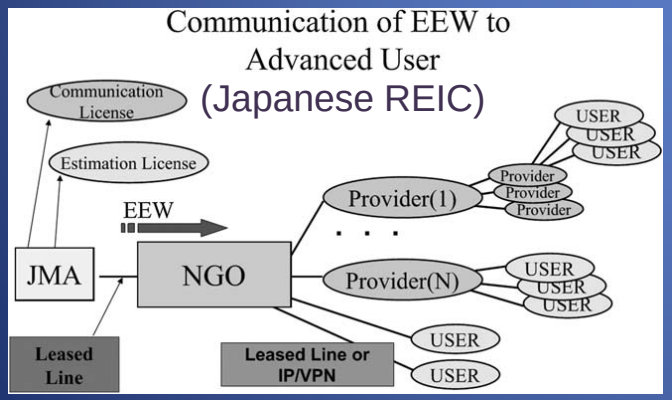
Education = User Actions

ShakeAlert will:

- Coordinate outreach
- Social science on:
  - Effective messaging
  - Alert content, sounds
  - Best actions
- Create a non-profit? (Japan REIC)

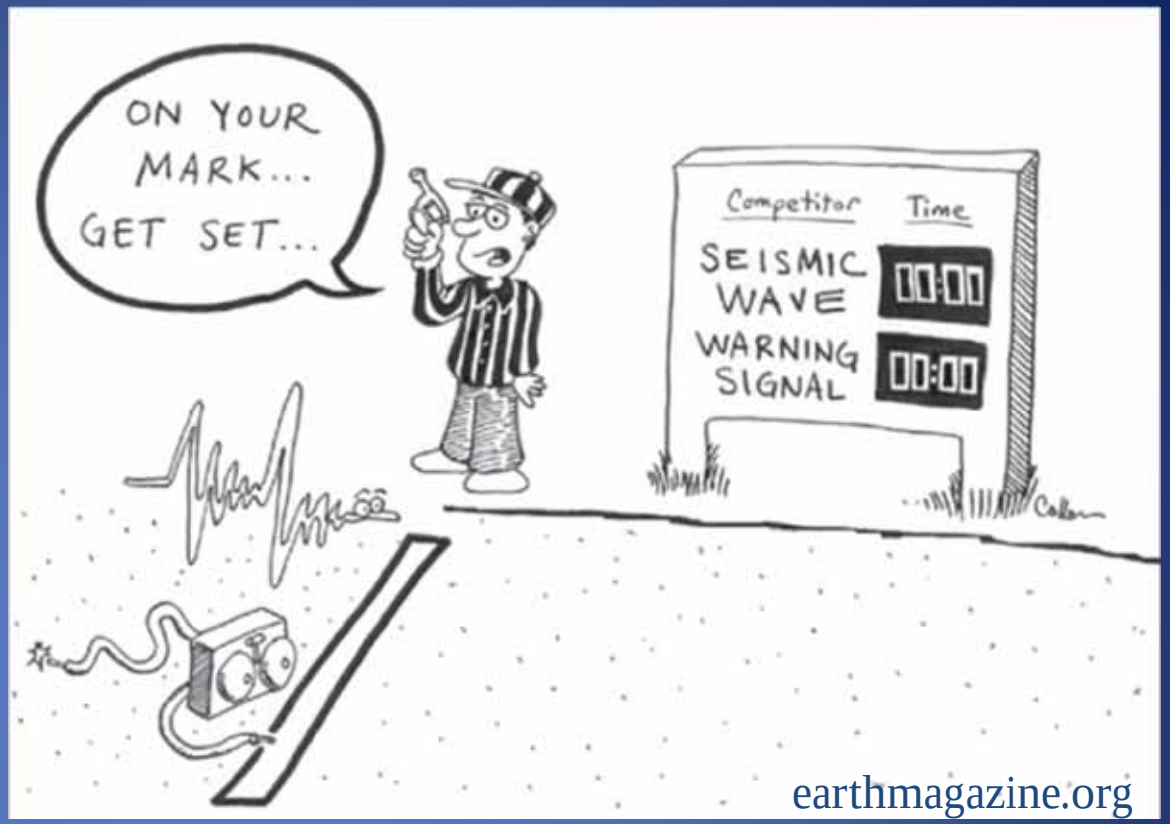
Partners will:

- Make, install & service receivers, actuators, etc.
- Consult on business plans for use of EEW
- Integrate with current hazard messaging



Sensor Networks → Field telemetry → Processing (Alert Creation) → Alert Delivery → User Actions

Questions?



CISN California Integrated Seismic Network

California's Partner to the Advanced National Seismic System

ANSS

CGS USGS OES Caltech UC Berkeley

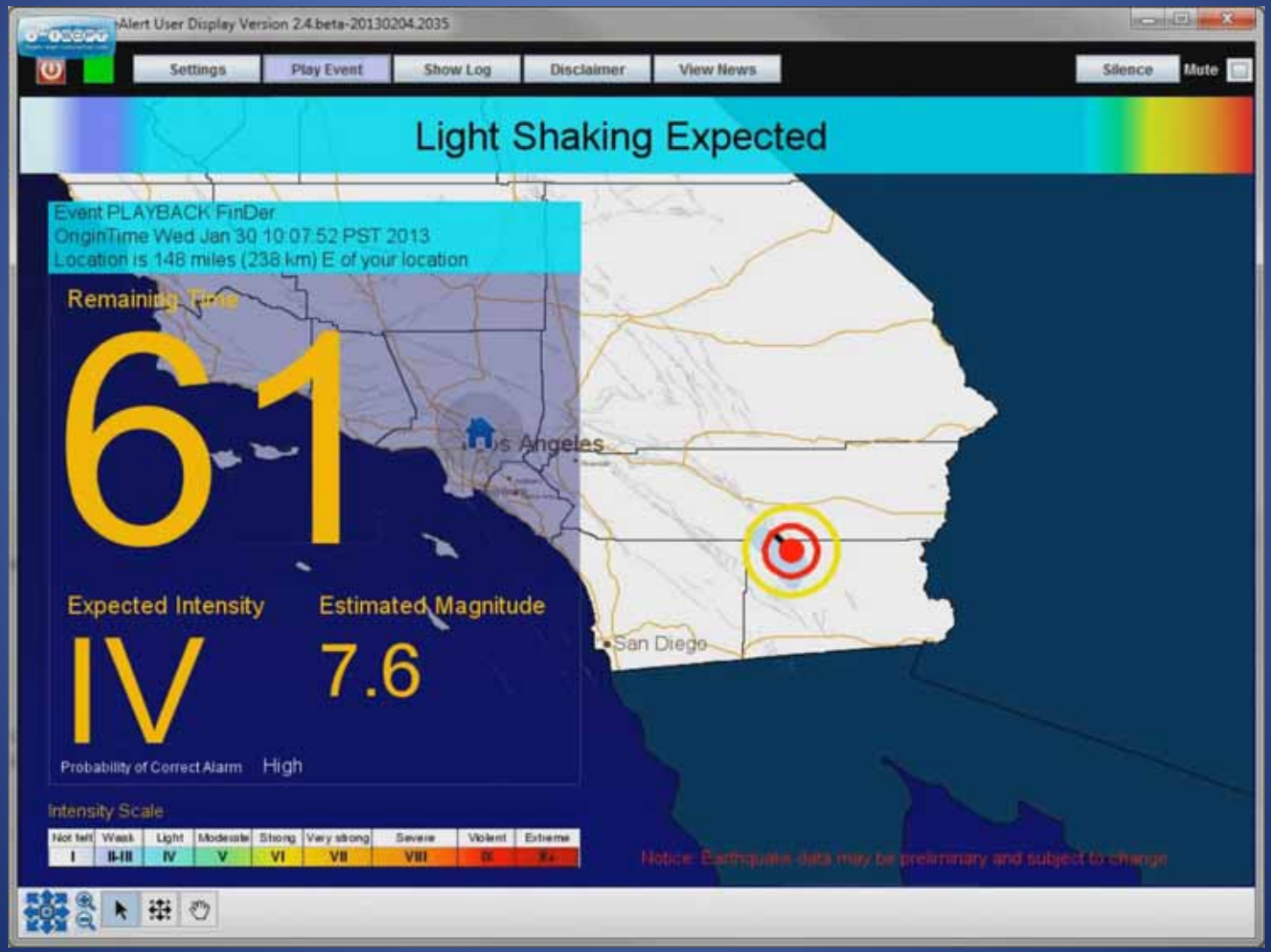
Doug Given –

Earthquake Early Warning Coordinator,

USGS Earthquake Hazards Program

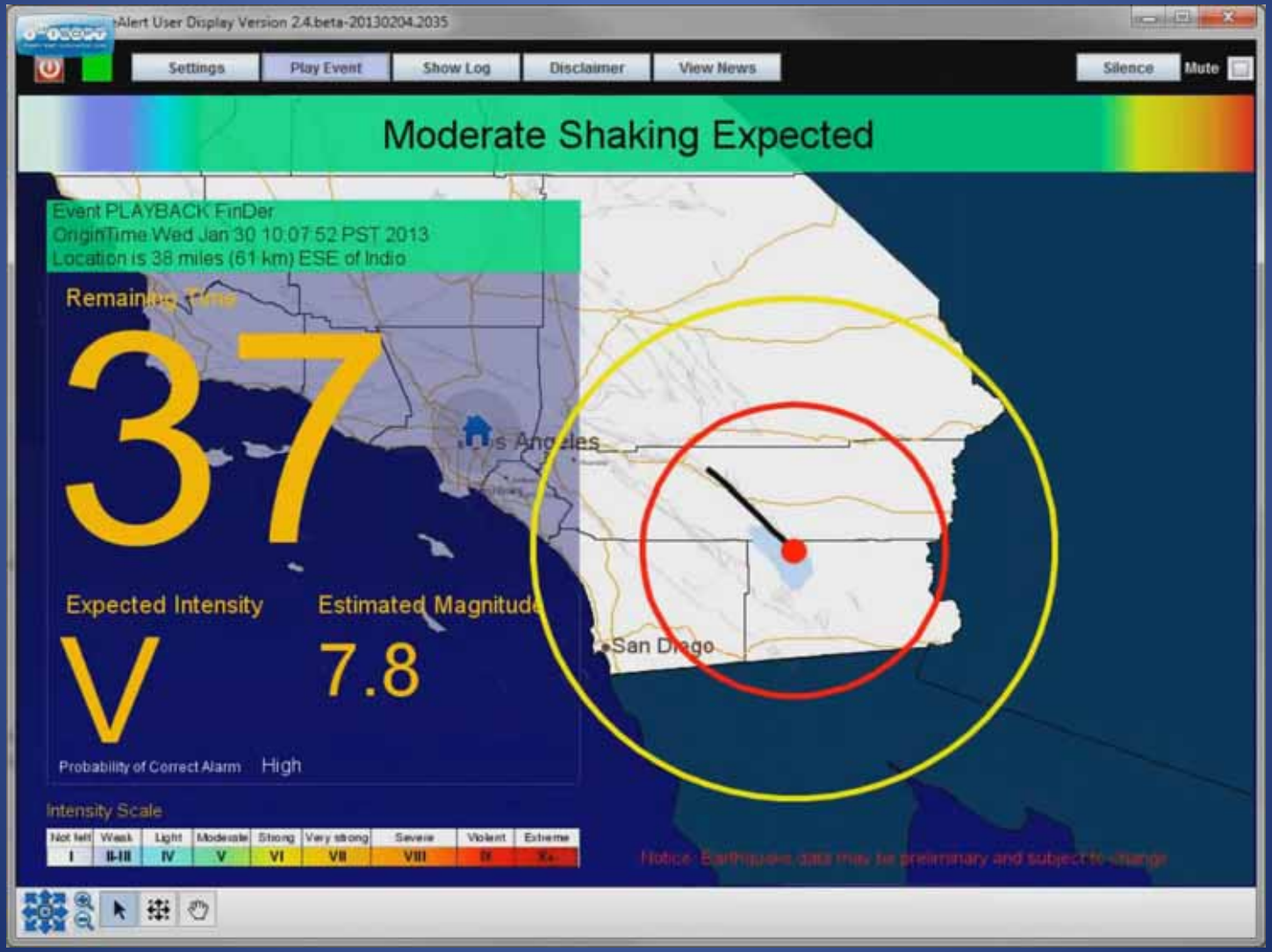
UserDisplay – ShakeOut M7.8

Real-time Finite Fault Solution



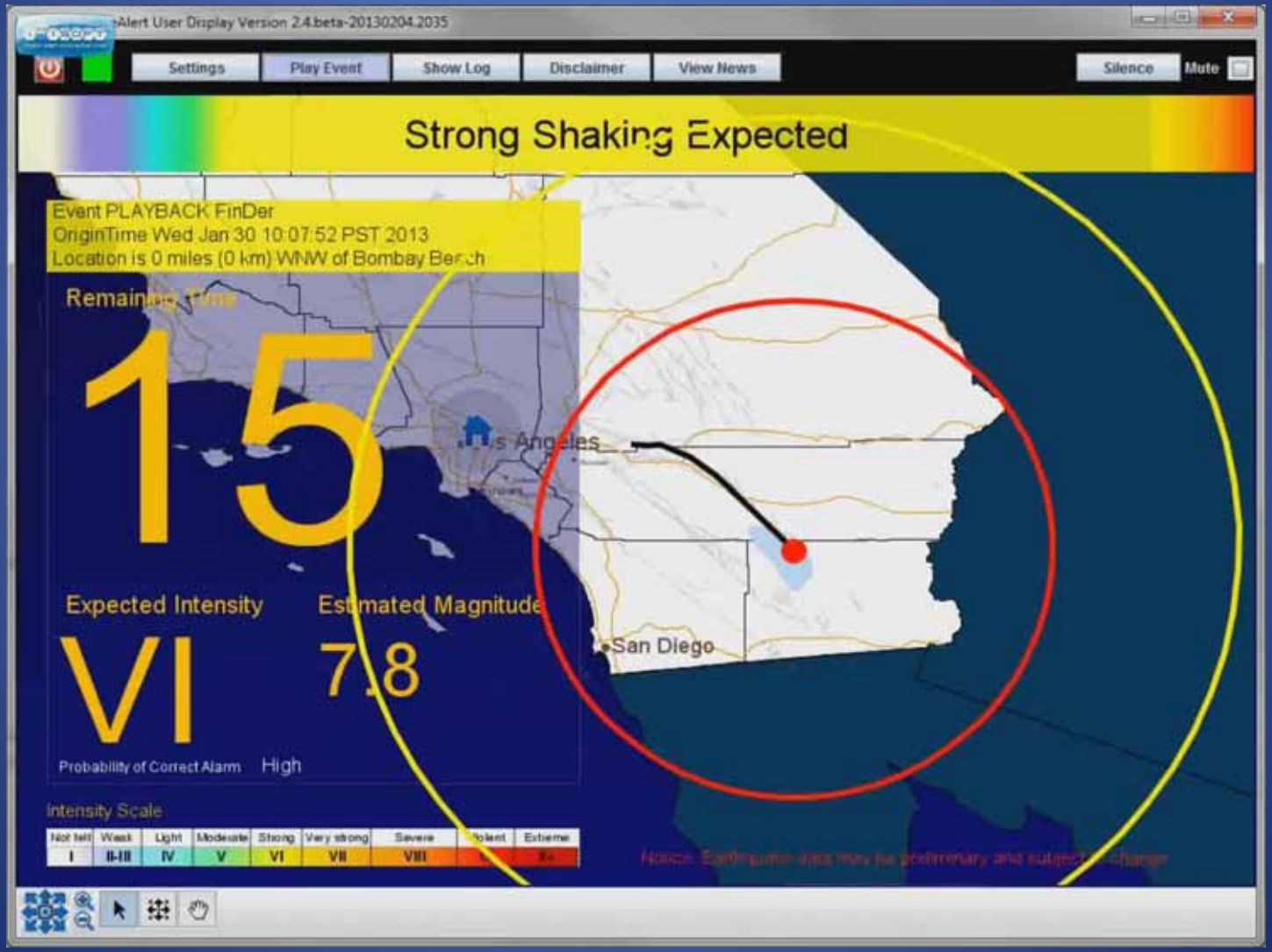
UserDisplay – ShakeOut M7.8

Real-time Finite Fault Solution



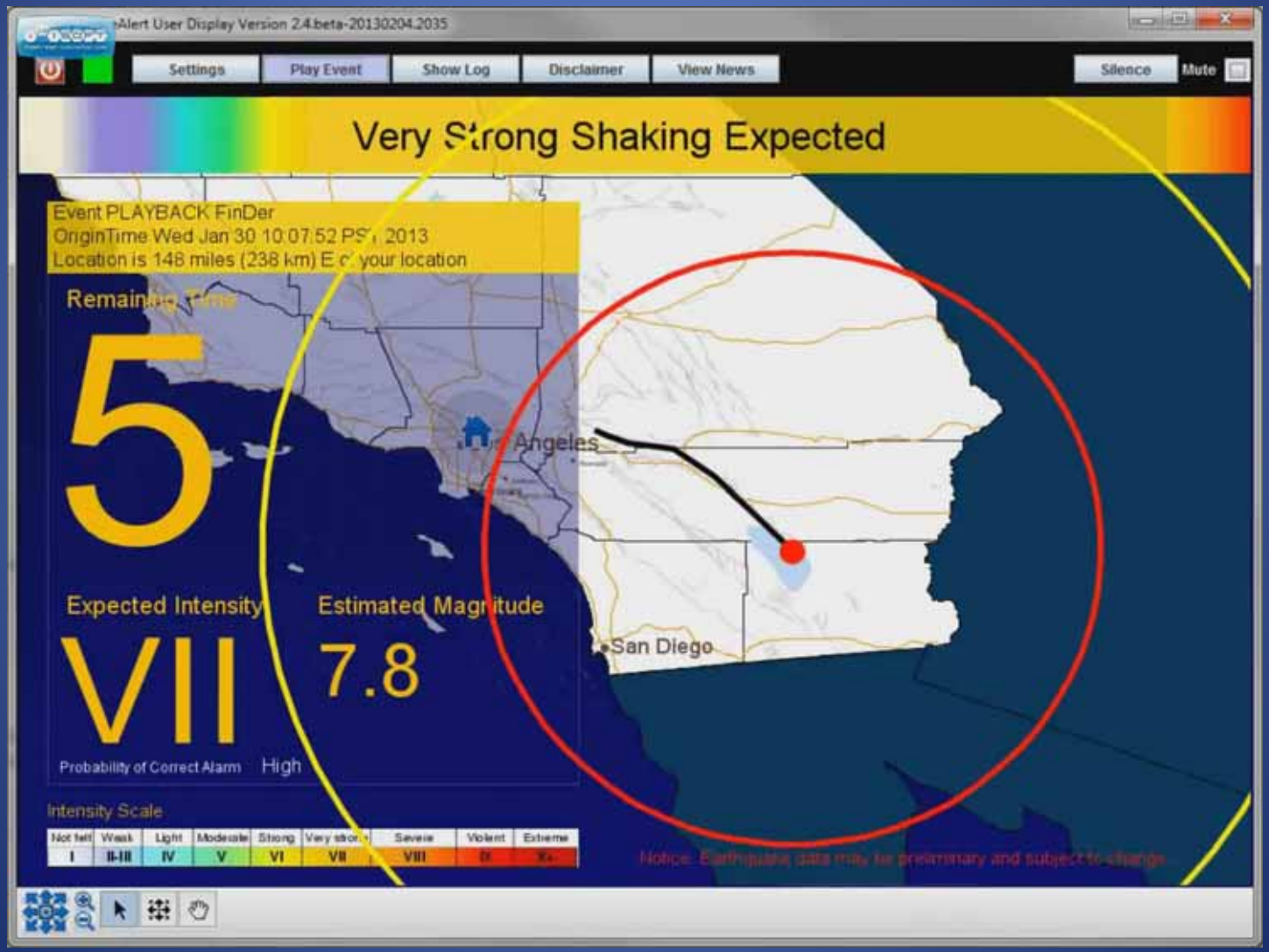
UserDisplay – ShakeOut M7.8

Real-time Finite Fault Solution

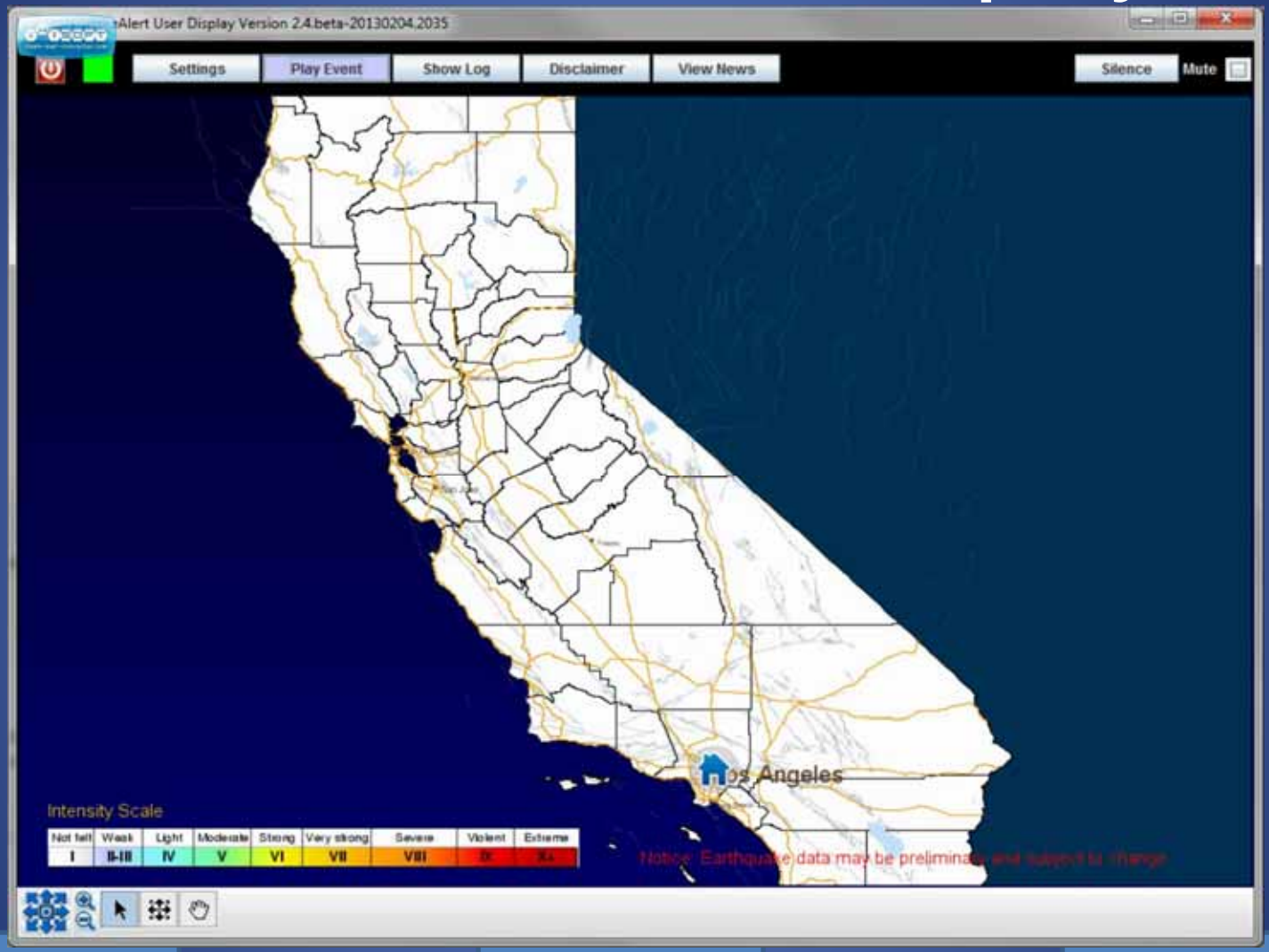


UserDisplay – ShakeOut M7.8

Real-time Finite Fault Solution



ShakeAlert User Display



Sensors → Field telemetry → Processing → Notifications → Users