Background

- 2008 WenChuan earthquake
- Near 70,000 people died

Avoid this tragedy!
The response of EEWS for Lushan Mag. 7 quake

• EEW center and its camera
• Captured Video for the quake
  (2013/4/20)
The EEW on the “4.20” LuShan earthquake
The response of EEWS for the LuShan earthquake on April 20, 2013

- Gave 28 seconds of warning time for Chengdu “quake is occurring in Lushan”
- Gave 21 seconds of warning time to Chengdu “estimated seismic intensity 4.5”
- When the countdown is finished, the Chengdu is strongly shaked
- Gave 5 seconds of warning time for Ya’An
The mitigation by the EEWS

- Students and teachers evacuated according to prescribed rules
- Cell phone users evacuated as well
- People in Wenchuan received warning from TV
EEWS

1. Sensors
2. EEW Center
3. Receiver

Monitor → Analyze → Transmission → Receive → Application

Sensors monitor the earthquake → EEW Center → Transmission → Personal Receiver → People → Public

Industry Receiver → Nuclear station → Chemical industry → High-speed train → Manufacturing
EEW features

- Sudden
- Automatic
- Response in seconds

EEWS has both public welfare and commercial nature.

EEW Goal: **EEW Starts the Whole Society Earthquake Emergency synchronously**
Current status

- **Mexico**
  
  In 1991, EEWS was launched by building 12 sensors in the Gulf of Mexico, services for Mexico city point to point. 200 sensors has been installed gradually.

- **Japan**
  
  In 2001, EEWS network was started. 1000 monitoring stations has been built in 2007. During “3.11” earthquake, 27 Shinkansen train stopped after warning, as well as the Fukushima nuclear power station stopped, which though destroyed by the Tsunami.

- **China**

- **Nepal**

- **USA (volunteer tests)**
Japan Kumamoto earthquake

Apr. 16, 2016 Kumamoto quake (Mag. 7.3)
Apr. 14, 2016 Kumamoto quake (Mag. 6.5)

TV, radio, internet
Show emergency earthquake alert

Apple Inc. added EEW function in the iphone. Free services.
Current status of ICL

- **5600** sensor (marked by green dots)
- Extending to **31** provinces of China
- **2,200,000** square kilometers covered
- **90%** of China population affected by major earthquakes
- Already safely served for schools, communities, radio, television, factories, major projects, government, etc. for **over 5 years**
Current status

ICL EEWS has applied to Nepal (Aug. 2015)

Nepal EEWS supported by ICL technology went to operation (Apr. 2016)
EEW for 35 destructive quakes

- 2013 Feb.19, QiaoJia of YunNan province, Magnitude 4.9
- 2013 Apr. 20, Lushan of SiChuan province, Magnitude 7.0
- ...
- 2014 May 30, Yingjiang of Yunnan province, Magnitude 6.1
- 2014 Aug. 3, LuDian of Yunnan province, Magnitude 6.5
- ...
- 2015 Apr.15, ALaShanZuoQi of Inner Mongolia Municipality, Magnitude 5.8
- ...
- 2017 Mar. 27, YangBi of Yunnan province, Magnitude 5.1

(The above are all the destructive quakes in the area covered by ICL EEWS)

Average Response Time = 6.5 second

RMSD = 0.32

RMSD : Root mean square deviation
Many ways to send EEW messages

- Cell phones
- Television
- Microblog
- Special receivers

Only places affected by quakes will be alerted by EEW messages
Many ways to send warnings

- Cell phones
- Television
  - Small quake: Subtitle
  - Big quake: Pop-ups
- Microblog
- Special receivers

Television EEW is used in Wenchuan county
Many ways to send warnings

- Cell phones
- Television
- Microblog
- Special receivers
Many ways to send warnings

- Cell phones
- Television
- Microblog
- Special receivers

Only places affected by quakes will be alerted by EEW messages
Special receivers for schools and other places with dense population

1. Earthquake Early Warning (when there is a quake, it can automatically trigger the broadcasting system to broadcast the EEW messages)

2. Earthquake Drills (Educate how to respond)
EEW for Emergency Department

National Early Warning Center of China

National Disaster Reduction Center of China
EEW for Government

Emergency Management Office of Sichuan Province, Fire Corps of Sichuan Province, etc.
EEW for National Defense

Army

Military factory
EEW for State-Key Projects

Xichang Satellite Launch Center
Trigger Case:
Jan. 14, 2015
Sichuan Leshan earthquake (Mag. 5.0)
Estimated intensity: 3.7 degrees
EEW time: 11 seconds
Blue alert
EEW for State-Key Projects

Nuclear Power Station
EEW for Lifeline Projects

Chengdu Metro
EEW for Gas Lines

- With an electrical valve, a gas line in YunNan earthquake administration is controlled by EEW.
- Chengdu Gas Company
- JABIL
EEW for Chemical factories

- Developed Emergency plan based on EEW for chemical factories
- The first EEW drill for chemical factories in China (2015)
EEW for Chemical factories

Trigger Case:
Apr. 2, 2014
DuJiangYan of Sichuan, Mag. 4.0 quake
Distance between epicenter: 32km
Blue alert

The biggest chemical factory of Sichuan, China
EEW for Life-line Projects

Sichuan Electric Power Company
Dense population——Schools
Dense population——Communities
Dense population——Office

- Chengdu High-tech Park building
- Tianfu Software Park D-zone
- Science and Technology Department of Sichuan Province
- ……
Cellphone EEW case

- Apr. 20, 2013 LuShan earthquake (Mag. 7.0)
- Oct. 7, 2014 JingGu earthquake (Mag. 6.6)
TV EEW case

- Small quake: Subtitle
  - LuShan Mag.7 quake
- Big quake: Pop-ups
  - Wenchuan TV EEW alert
  - 42 seconds EEW time

Elevator EEW case

- Elevator affected by quakes
  - Wenchuan Mag.4 quake
  - Intensity: 2.4
  - Trigger the elevator EEW
- Automatically leveling
- Automatically open the door
School EEW case

Apr.17, 2014, YangBi Mag. 5.0 quake. The EEW receiver of Chengdu PaoTongShu school alerted, after warning teachers and students evacuated safely.

May 30, 2014, YingJiang Mag. 6.1 quake. The EEW receiver of LongLing school alerted, after warning teachers and students evacuated safely.
Shake Map: Evaluation of seismic Intensity in minutes

Apr. 20, 2013  Lushan Mag. 7 quake

Shake Map of ICL

Shakemap after 6 days of the LuShan quake by expert investigation
Shake Map: Evaluation of seismic Intensity in minutes

Nov. 22, 2014, KangDing Mag. 6.3 quake

Shake Map of ICL

Shakemap after 3 days of the KangDing quake by expert investigation
The whole response process after an earthquake

**Disaster reports based on human observation**

- **EEW**
  - Earthquake early warning
  - User Evacuation and disposal
  - Earthquake automatic report

- **Shakemap**
  - Automatically open the disaster collection system
  - Generate emergency assistance decisions

- Continuous reports

**Experts and Practitioners Estimate the disaster**

- **5-10s** | EEW alert. User Evacuate and disposal
- **30-60s**
- **2min** | Automatically open the disaster collection system
- **5min** | Earthquake automatic report
- **7min** | The 1st Disaster report. Blind estimated to generate disaster distribution map
- **15min**
- **30min**
- **60min**
- **120min**
Summary of key EEW parameters

- **Response Time**: 30% faster than Japan (Japan is 9s, ICL is 6.5s)
- **Reliability**: No false triggers, No miss alarm for destructive quakes until now during 5.5 years
- **Blind zone radius is smaller**: 30% smaller than Japan (Japan is 30km, ICL is 21km)
- **Cost**: about Japan’s 1/5
- Integration of on-site and front detection EEW
- Widely use of MEMS sensors
Conclusion and Outlook

1. Innovative and full solution on EEWS, and already applied in areas of 2.2 million square km, the largest EEWS in the world.
2. No false trigger, no miss alarm for actual 35 destructive quakes inside EEW zone
3. Used by both the public and lifeline projects in China and Nepal already

Up to now, without ICL, mainland China would have no EEW technologies, no EEWS, no EEW messages to the public.
Cooperation expected

- Expect more international cooperation
EEW can save lives.
EEWS is a scientific project, and a social project.

Thank you for your kind attention.

The next earthquake, the world has EEW?!