



# Strategic Technology Integration for Alert Signalling and Avoidance Mechanism-Earthquake Safety

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**Disaster Resilient Infrastructure  
in Himalayas: Opportunities and  
Challenges**

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# OVERVIEW OF PRESENTATION



- Impact of Natural Imbalances and Related Issues
- Underground Activities
- Real Time Monitoring of Nature Dynamics
- Equilibrium Point and Drift Phenomenon with Dynamical Changes- Issues & Challenges
- Earthquake General Concepts



## OVERVIEW OF PRESENTATION-Contd.



- Concept of uncontrolled under Water Dynamics
- An approach for assessment of underground earth dynamics- Integrated Technology
- Determination of unequal forces responsible for equilibrium shift
- Technology Integration with Satellite Imaging
- Normal Equilibrium Point – As Reference for Analysis



The shifting masses send out shock waves that may be powerful enough to:

- ❑ alter the surface of the Earth, thrusting up cliffs and opening great cracks in the ground and
- ❑ cause great damage ... collapse of buildings and other man-made structures, broken power and gas lines (and the consequent fire), landslides, snow avalanches, tsunamis (giant sea waves) and volcanic eruptions.

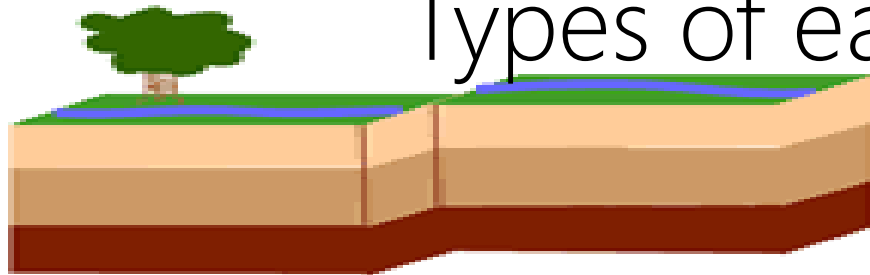


# What is an Earthquake?

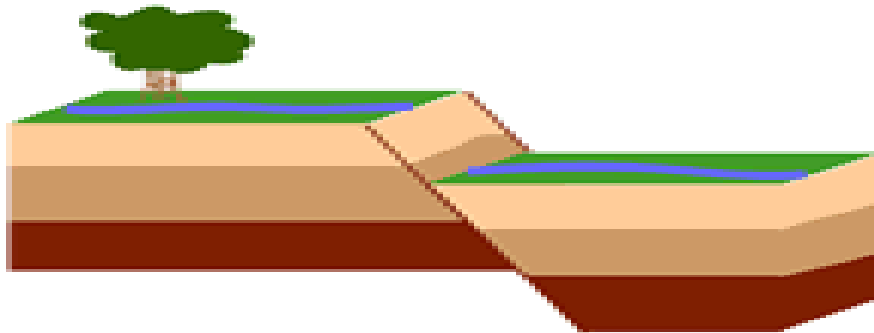
- An earthquake is a shaking of the ground caused by the sudden breaking and movement of large sections (tectonic plates) of the earth's rocky outermost crust.
- The edges of the tectonic plates are marked by faults (or fractures). Most earthquakes occur along the fault lines when the plates slide past each other or collide against each other.



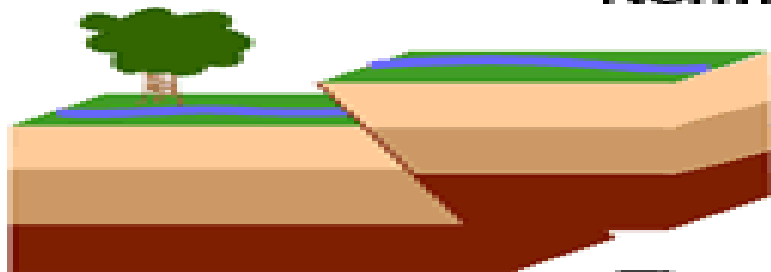
## Types of earth movement:



**Strike-slip**



**Normal**

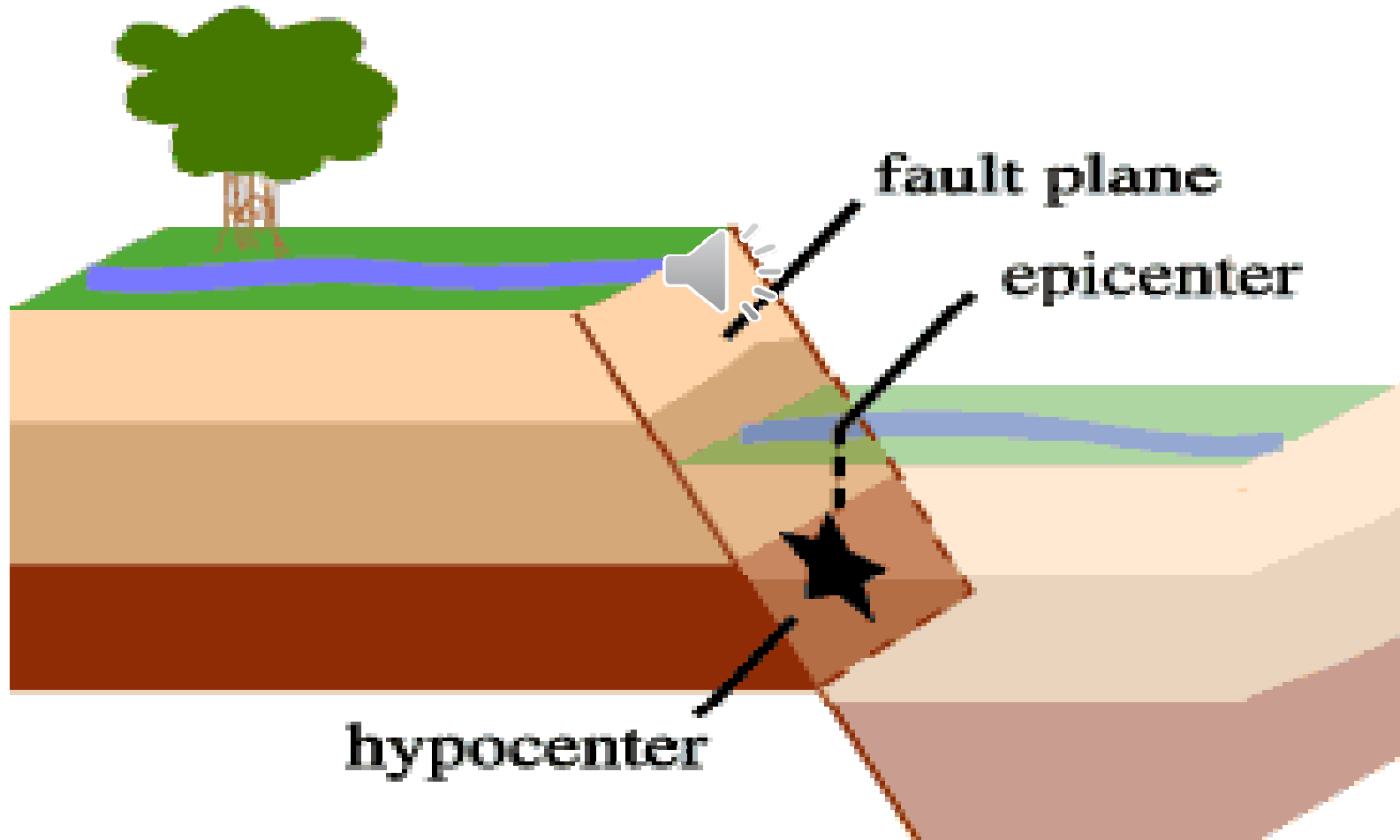


**Thrust**

- ❑ Strike Slip – the two plates rub against each other laterally
- ❑ Normal – one plate drops below the adjacent plate
- ❑ Thrust – one plate is pushed up above the adjacent plate.



## Anatomy of a fault:



## • Earthquake Management Centers (EMC)

### • At State, Regional and National /International level

- Co-located with respective Earth Monitoring/ Despatch Centres
- Coordination between the State / Regional / National/International Data Analytics Centre.

### • Integrated with real time measurement and information flow.

- Visibility of the Zonal Earth status
- Communication & IT infrastructure with adequate resilience and redundancy for assessment and alert signalling

### • Interfacing with Indian Metrological Department (IMD) at local and global level.

### • EMC may have following functions:

- Real time tracking of Zonal Earth Dynamics with Satellite Imaging
- Geo-spatial visualization
- Advanced decision-making and Alert Initiation Building Block





## • Compliance to Safety Standards and Earth Equilibrium

- Enforcement of compliance to Earth Equilibrium standards – Signalling

## • Understanding Deviation Factor and associated Measures

- Zonal Satellite Imaging and Computation of Deviation Factor

- Data Analytics Algorithm Development

- Interfacing the Deviation Factor with Data Analytics tool

- Acceptable Deviation factor and risk of Relatively larger change Condition Monitoring

- Establishing a Thumb Rule for Deviation Factor of Equilibrium Prediction and signalling

- Parallel Data Analytics for Multi Zonal Earth behaviour with Satellite imaging



# Need of Smart Devices and IoT Technology



- Expert system to supplement conventional Earth Data Flow : Visualize Earth Situational Image at Sub-Zonal level.
- Develop Tools to comprehend situational awareness and to derive corrective actions – Alert Signalling and associated impact analysis while contingencies are propagating
- Automation in Alarm Generation including recommended solutions

## Evaluation Procedure for Degree of Risk - IoT with Satellite Imaging

- Device that send field data at sub-second having global Time synchronization.
- Visualization of Degree of Risk and Tectonic Measurement information Through Decentralized mode with Centralized Mapping and despatched data flow
- India needs to adopt the technology at Regional and national level as pilot and demo projects.

## Real Time Earth Equilibrium Shift Monitoring with Smart Sensors Through IoT - An Ideal Framework for Earthquake Prediction

- Real Time Earth Equilibrium Shift Monitoring facilitates efficient and reliable end-to-end intelligent multi-way delivery system for Earthquake Prediction
- IoT will be able to facilitate and coordinate various zones for understanding the earth dynamics in real time
  - It can help in least loss with in time alarm and update the information monitoring system,

# Need of Multi-Group for Earth Equilibrium Prediction

## Earth Science Expert

Knowledge Sharing

Process to Integrate Detailed Equilibrium Point at Multi-Zonal Level

Facilitate in Developing Algorithm of Data Analytics

Brain Storming Analysis with Satellite Images

Suggesting Remedial Solutions to Avoid Earth Quake

## Satellite Imaging /Data Analytics

Improved Visibility of appropriate Zone based on Deviation Factor

Real time Risk Assessment and Alert Signalling

Effective Monitoring and Alert Signal Generation

Improved Earth Understanding

Coordinated Zonal Earthquake Prediction Mechanism

## Algorithm Development and Meteorological Linkage

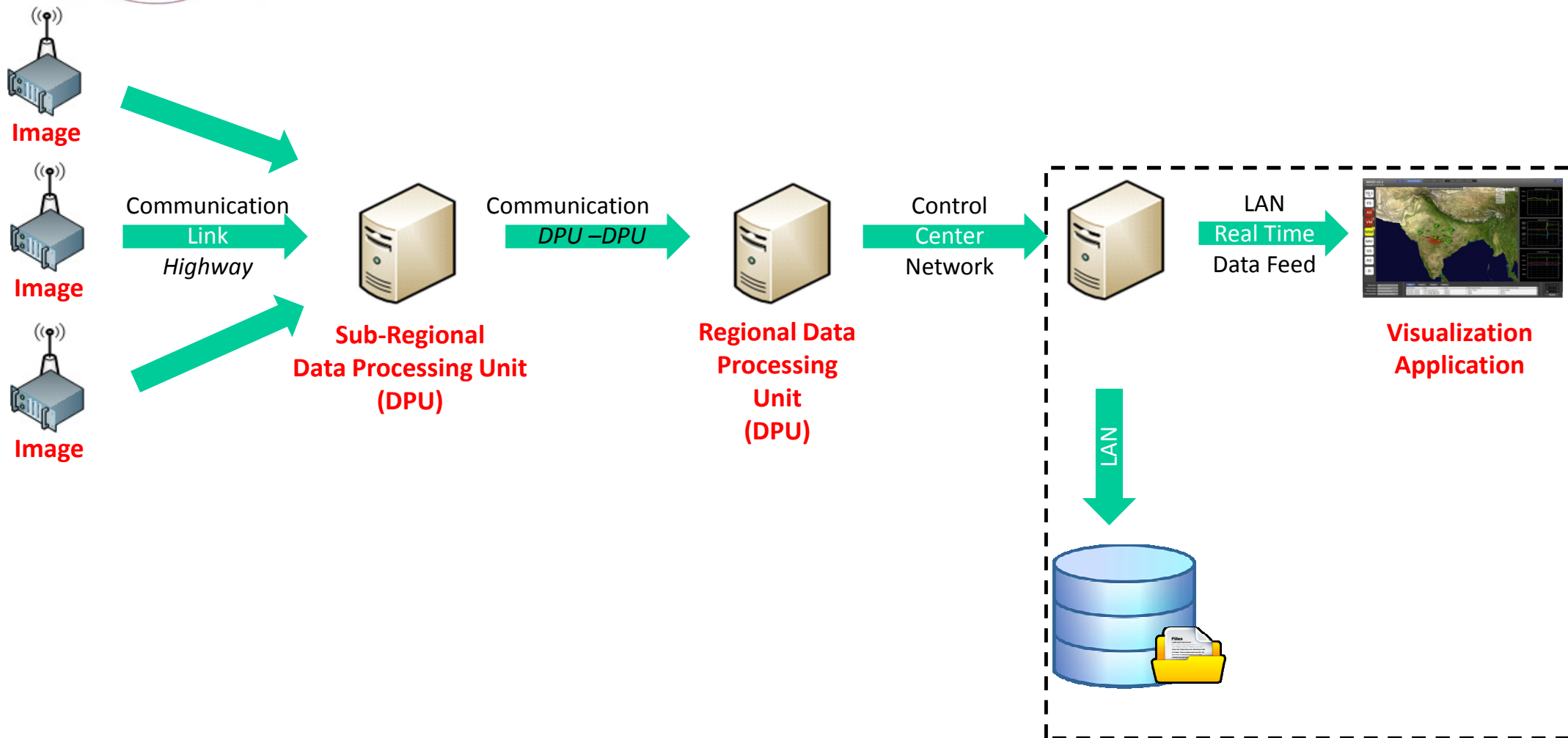
The data interface in algorithm and fast computational formulation

Closest Coordination and Assessment Enhancement

Risk Factor for Earthquake reduction



# Integrated Information Highway for Satellite Imaging and Data Processing Synchronasor Network Data Flow





# THANKS