Disaster Monitoring & Management Utilizing GNSS

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Outline

• Pakistan Hazard’s Vulnerabilities
• Recent Disasters in Pakistan
• Disasters Devastations & Lessons Learned
• Global Navigation Satellite System (GNSS)
• GNSS Possibilities
• Current Trends for Disaster Management
• Summary
Pakistan Hazard’s Vulnerabilities

- Flood
- Earthquake
- Tsunami
- Land Slides
- Diseases Breakout
Pakistan Hazard’s Vulnerabilities

Seismic Zone of Pakistan

<table>
<thead>
<tr>
<th>Zones Category</th>
<th>Seismic Factor Ground Acceleration</th>
<th>Possible Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>g/5 to g/10</td>
<td>Major</td>
</tr>
<tr>
<td>II</td>
<td>g/10 to g/15</td>
<td>Moderate</td>
</tr>
<tr>
<td>III</td>
<td>g/15 to g/20</td>
<td>Minor</td>
</tr>
<tr>
<td>IV</td>
<td>g/20 or Less</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

Tsunami Vulnerability

Source: National Disaster Management Authority (NDMA)
Recent Disasters – Earthquake 2013

In September 2013, Pakistan hit by Two major earthquakes in a week

Happy to have new piece of land?
Earthquake 2005

- On 8th Oct 2005, a powerful earthquake struck the northern parts of Pakistan causing destruction to infrastructure and housing as well as severely affecting more than one million lives.
- Damaging 67% of educational institutes, 74% of Health institutes, 37% of Roads
- Most of the utilities like telecom, water supply & electricity were out of order
- 200 million tons debris to be managed

Source: National Disaster Management Authority (NDMA)
Recent Disasters - Flood Devastations

• The floods during last three monsoon seasons from 2010 to 2012 caused extensive damages in Pakistan.
• At least 2000 people killed and over a million homes destroyed

“Pakistan floods are a 'slow-motion tsunami’ - Ban Ki-moon, UN Secretary General

Disasters Devastations & Lessons Learned

GNSS based technology will serve the needs in case of disaster and provision of early warning systems.
Global Navigation Satellite System (GNSS)

- GNSS is the standard generic term used for satellite navigation systems.
  - It provides autonomous geo-spatial positioning with global coverage.
  - GNSS-based receivers can provide the location (latitude, longitude and attitude) within a few meters.

- With advancements in GNSS technology, surveying grade accuracy can be achieved by establishing CORS network as a national positioning service.
  - It will provide high accuracy, precision and integrity.
  - It can fulfill the requirements of geodesy and geosciences.
  - It can serve the needs of surveying, mapping and navigation users.
Scope of CORS in Pakistan

- Network RTK approach
- Reliable, Accurate, Robust and Economical (RARE) Positioning Service
- 80 to 100 base station across the country
- Backbone for providing common datum
GNSS Possibilities: Early Warning Systems

- GNSS based CORS network can be used to provide early warning in case of emergency.
- Studying the plate tectonic movement will help in providing notifications and warnings for earthquake, volcanic eruptions and landslides.
- Establishing seismic network support will assist in tsunami early warning systems.
- By monitoring the storm surge and streamgages can help in flood and severe weather warnings.
- Geomagnetic observations will help in storm forecast.
- Precise geospatial information obtained using CORS network will aid in carrying out response operations for wildfire and accidents.
GNSS Possibilities: Tsunami Warning System

- In 1945, an earthquake of 8.3 Richter scale near Pasni (Baluchistan) has caused tsunami with wave height of 40ft.
- Improved understanding of the potential tsunami hazard from the Makran Fault in Iran and Pakistan.
- Need of community preparedness using scientifically developed hazard maps.
- Need of Tsunami monitoring system, for detecting and generating early warning.
GNSS Possibilities: Disaster Detection by Monitoring Ionosphere

- Monitoring Ionosphere can help in predicting the earthquake and tsunamis
- Changes in ionosphere before the seismic activity, such as:
  - Total Electron Content (TEC)
  - $f_0F_2$
  - Electron temperature
  - Electric/Magnetic field
- Continuously improved earthquake-ionosphere coupling model give a strong support for the emergence of these anomalies
- Observing the ionosphere and analyzing the relationship between the disturbance information and earthquake, explores the impending earthquake prediction method
  - Observation of ionosphere TEC by GNSS
- Results can indicates few days before the event.
GNSS Possibilities: Hazard Management

In the aftermath of significant disaster event, GNSS serves as an essential enabling technology for:

– Re-Mapping
– Establishing a grid and geo-referenced incident data
– Precise Monitoring
– Immediate Response for Search & Rescue
– Organizing Debris Removal
– Planning for long term recovery
Current Trends – Social Media For Disaster Management

Top Social Media Tools

- Reaching 500M
- Over 200M blogs
- Over 800M users

Current Trends – Social Media for Disaster Management

• Social media is a current phenomena that has revolutionized the people life.

• With the incorporation of navigation features in social networking applications, it can be effectually used for:
  – Social navigation, geo-social consuming.
  – Search and rescue efforts can get great benefit.

• The increase in use of social networking applications in Pakistan, can be effectively utilized for disaster management.
Benefits of Social Media – Trends in World

Twitter Shakes It Up - August 2011

Spreading rapidly via social networking sites, phrases + hashtags like "5.8" and #earthquake dominated Twitter's trending topics list.

Source: KUSA 9 News Facebook page and Kade Dworkin
Current Trends – Cellular & Smartphone Application

• Pakistan has been one of the fastest growing mobile markets among the emerging telecom markets
  – Currently there are more than 121 million cellphone users in Pakistan.
  – The usage of Smartphones in Pakistan is increasing significantly
• Utilization of SMS text messaging service in case of emergency.
  – It reaches effectives wherever they are without internet
  – Can easily accommodate multiple languages.
• Integration of GNSS in recent smart phones
  – Mobile apps
  – Emergency response apps
Summary

- Pakistan is highly prone to disasters.
- In last few years Pakistan has faced many disasters, necessary steps are required to effectively manage any such condition in future.
- GNSS based technology can serve the needs to effectively manage disasters and provide early warnings.
- Establishment of advance GNSS technology such as CORS network will increase the accuracy of GNSS based systems.
- Continuous monitoring of GNSS performance will help in monitoring the space weather.
- Social Media can play important role in aftermath of disaster, especially in search and rescue operations.
- GNSS and mobile networks should be efficiently used for emergency response.