ITU/WMO/UNESCO IOC Joint Task Force on SMART cables

Climate Monitoring and Disaster Warning Using Submarine Cables

Brussels, 20-21 November 2019

Hiroshi OTA, International Telecommunication Union (ITU)
SMART Cables - Basic Concepts

SMART (Scientific Monitoring And Reliable Telecommunications) cable systems for Climate Monitoring and Disaster Mitigation

SMART cables: first order addition to the ocean-earth observing system, with unique contributions that will strengthen and complement satellite and in-situ systems

- **Telecom + science, shared infrastructure, $**
- Cable repeaters host sensors, not to interfere
- Potential: global spanning, trans-ocean, 1+ Gm ~10,000+ repeaters (~100 km)
- 10-25 year refresh cycle
- Initially: **bottom pressure, temperature and seismic acceleration**; supplement later
- Share data internationally

Install routinely on new cables
Deploy by cable ship, no maintenance

---


https://www.itu.int/en/ITU-T/climatechange/task-force-sc/Pages/default.aspx
SMART Cables measure: Pressure, temperature; acceleration

Adapted from Nerem, 2016
Climate change is a remorseless threat to the world’s coasts.

Economist, August 2019
Tsunamis

Red earthquakes
Green/white cables

<table>
<thead>
<tr>
<th>Place</th>
<th>Year</th>
<th>Mag</th>
<th>H (m)</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chile</td>
<td>1960</td>
<td>9.5</td>
<td>25</td>
<td>6000</td>
</tr>
<tr>
<td>Alaska</td>
<td>1964</td>
<td>9.2</td>
<td>30</td>
<td>132</td>
</tr>
<tr>
<td>Mindinao</td>
<td>1976</td>
<td>7.9</td>
<td>9</td>
<td>7,800</td>
</tr>
<tr>
<td>Tumaco</td>
<td>1979</td>
<td>8.1</td>
<td>6</td>
<td>350</td>
</tr>
<tr>
<td>Hokkaido</td>
<td>1993</td>
<td>7.8</td>
<td>30</td>
<td>250</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>1998</td>
<td>7.1</td>
<td>15</td>
<td>2200</td>
</tr>
<tr>
<td>Sumatra</td>
<td>2004</td>
<td>9.2</td>
<td>33</td>
<td>230,000</td>
</tr>
<tr>
<td>Solomon Island</td>
<td>2007</td>
<td>8.1</td>
<td>12</td>
<td>52</td>
</tr>
<tr>
<td>Samoa</td>
<td>2009</td>
<td>8.1</td>
<td>14</td>
<td>189</td>
</tr>
<tr>
<td>Maule, Chile</td>
<td>2010</td>
<td>8.8</td>
<td>3</td>
<td>525</td>
</tr>
<tr>
<td>Tohoku</td>
<td>2011</td>
<td>9.0</td>
<td>10</td>
<td>19,000</td>
</tr>
<tr>
<td>Palu</td>
<td>2018</td>
<td>7.5</td>
<td>7</td>
<td>~2000?</td>
</tr>
</tbody>
</table>
The SMART Cable Opportunity

Better observe the ocean
Flywheel of Climate, Source of Hazards

More Sensors
A global network of ocean floor observation stations

Less Money
Harness 3rd party investment to save millions in deployment costs

Societal and environmental issues:

- **Climate change** – ocean temperature, circulation
  - direct impact, short and long term
- **Sea level rise** – hazard for coasts, island, cities
- **Disaster warning** – tsunami and earthquake monitoring throughout ocean basins and coastal margins
Existing technology components

• Dedicated cable systems
  – Existing and proven:
    • S-Net, Sanriku
    • DONET, perhaps NEPTUNE, OOI-RCA (high power, ROV)
    • N-Net – new
  – Sanriku: lower cost, close to SMART
• Or use Branch unit on commercial cable – wet demo
SMART Repeaters

Two approaches

Repeater Pressure Housing

Accelerometers (c)

End Cone
Pressure and Temperature Sensors (a)

Coupling
Bend Limiter

Sensor Pod
Pressure and Temperature Sensors (b)

10-15 m

2 m

Cable

~5 m
Costs

- Dedicated single purpose early warning systems (S-net, N-net) and plug and play science systems (NEPTUNE-Canada, US OOI-RCA, DONET) are expensive

- **SMART**
  - *Expect lower cost*
  - Share/incremental costs only, with telecom
  - Assume no wet maintenance for SMART part
  - Pick and choose which systems
  - Build up coverage over time
Ongoing projects

• National Institute of Geophysics and Volcanology (INGV, Italy): “Wet demonstration” project (Funded)

• New Caledonia – Vanuatu SMART Cable: Very modest (appropriate) scale pilot SMART system connecting New Caledonia to Vanuatu (300 km, 2 SMART repeaters) (Partially funded; work underway to obtain balance)
Proposed projects

• ANACOM (Portugal): Science/early warning + telecom system for Lisbon-Azores-Madeira-Lisbon

• Indonesia: “Cable-based tsunami warning system” based on SMART concepts
Challenges

• Reliability – SMART repeaters shall be designed to ensure that scientific sensors and telecommunication functions do not interfere with each other.

• Cost – Who pays the incremental cost due to sensors? Governments (climate, early warning), development banks (climate, disaster, connectivity)? Industry - CSR and/or a cost of doing business? Others?

• Legal issues – Telecommunication cables and marine data collection are governed by different legal regimes. If all countries involved with a system need and want the SMART capability, the deployment should be easy. If any country does not want SMART capability, we simply would not deal with that cable system.

• Starting small/modest/simple cases
Conclusion

- SMART cables provide alternative/complementary methods for climate change monitoring and tsunami early warning
- Technically feasible
- There are already ongoing (funded) and proposed projects on SMART cables
- ITU, WMO and UNESCO IOC are supporting Joint Task Force (JTF) on SMART cables.
  - Monthly e-meetings and yearly face-to-face events
  - Participation is welcome!