Wireless Networks in Geophysical Monitoring

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Outline

Research areas OVSICORI - UNA

Types of Networks in Geophysical monitoring OVSICORI-UNA

Future new implementations IoT

Benefits of IoT

Limitations, recommendations, suggestions to implement IoT in Costa Rica
Research areas OVSICORI - UNA
Location of Costa Rica and our Volcanoes

Central America between Nicaragua and Panama
Area: 51100 km²
Population: 4 872 000

5 Active Volcanoes
3 Tectonic Plates

OVSICORI began in 1984.
Recent seismicity in Costa Rica 2015

4723 earthquakes, of which 4667 are located in Territory National, 162 of these were reported by Senses Population.
Largest Earthquakes in Costa Rica recent years

Since 1984 the OVSICORI, has built a database of over 200,000 earthquakes, locating major earthquakes with their aftershock.
Here some of the most important:

<table>
<thead>
<tr>
<th>Date</th>
<th>Local Time</th>
<th>Depth</th>
<th>Located</th>
<th>Mag</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 25, 1990</td>
<td>07:22</td>
<td>22 km</td>
<td>Cóbano</td>
<td>6.8</td>
</tr>
<tr>
<td>December 22, 1990</td>
<td>11:28</td>
<td>5 km</td>
<td>Puriscal</td>
<td>5.0</td>
</tr>
<tr>
<td>April 22, 1991</td>
<td>15:57</td>
<td>10 km</td>
<td>Limón</td>
<td>7.6</td>
</tr>
<tr>
<td>January 08, 2009</td>
<td>13:21</td>
<td>7 km</td>
<td>Cinchona</td>
<td>6.5</td>
</tr>
<tr>
<td>September 05, 2012</td>
<td>08:42</td>
<td>35 km</td>
<td>Nicoya</td>
<td>7.6</td>
</tr>
</tbody>
</table>
Last Eruptions of Volcanoes
Turrialba Volcano, 2013 - 2014
Irazu Volcano
March 19, 1963 (until 1965)
In 1968 the colossus of San Carlos killed 78 Costa Ricans, 6,000 had to be evacuated and caused damages worth $35 million.
Poas Volcano
2013 - 2014
Types of Networks in Geophysical monitoring OVSICORI - UNA
OVSICORI - UNA Seismic and Volcanic Network

40 permanent seismic stations.
30 GPS permanent stations
2 Multigas stations (SO2, CO2, HF)
2 MiniDoas Stations (SO2 gases)
Types of installations

POTG Station  
( Potrero Grande, Puntarenas)

COVE Station  
(Coopevega, San Carlos)

CERB Station  
( Cerbatana, Puriscal)
Types of sensors

30 Broad-Band stations real time:
- 10 Seismometer Trillium Compact + Digitizer Taurus
- 10 Seismometer CMG-3ESP Compact + Digitizer Guralp CMG-DM24S3
- 10 Seismometer STS2/Trillium 240 + Acelerometer + Q330/Q330HR

10 Broad-Band Stations (We need communication real time)
- 3 Seismometer Trillium 240 + Acelerometer Episensor FBA-EST + Digitizer Q330HRS
- 5 Seismometer Trillium 240/STST2 + Digitizer REFTEK 130
- 2 Seismometer CMG-3ESP Compact + Digitizer Guralp CMG-DM24S3-EA

**VERY EXPENSIVE EQUIPMENT**
( warranty can not be touch )
Telecommunication Network OVSICORI
Future new implementations IoT
Idea of implementation of IoT

1 - Have a WSN- IoT to monitor all parameters (Temperature, Humidity, Deformation Systems, Gases Monitoring, Seismic Monitoring, Meteorological Monitoring).

2 - Have a data storage of event history and friendly format with the users (Scientists).

3 - Try to use the current telecomunications platform trunked and include the new WSN and new IoT standards and protocols.

4 - Implement in real time early warning systems to send alerts to government institutions of prevention and mitigation of natural disasters.
Platform solution to implement of IoT in OVSICORI -UNA

Implement low consumption equipment and light to improve facilities in dangerous locations and difficult access

Use IPV6 to have a big wireless sensor network in all techniques of monitoring and have access directly to all sensors

Transition of all protocolos and 6LowPan to increase the scalability and availability of data, low power consumption to reduce the time of preventive and corrective maintenance.

High redundancy with the capacity of DTN (Delay Tolerant Network) over IPV6 and 6LowPan and recover data can be loss for a eruption or problems in Telecommunications.

Big Data storage in own institution with a Cloud Service, Docker containers are an ideal platform for the Big Data analytics use case because of their unique security and performance advantages.
Network architecture of IoT
Benefits of IoT
Benefits of IoT research areas in geophysical monitoring

Improve our monitoring systems with high resolution of coverage areas in different fields Deformation, Seismic and Volcanic events

Have a possible improvement model predictions of volcanic eruptions

Modify, change and implement our solutions with low-cost equipment

Implement a real-time correlation of all geophysical measurements and have a very fast risk assessment.

Have an early warning system for the population and emergency agencies in the country such as the National Emergency Commission, Civil Aviation, Ministry of Public Education, National Parks

Big database have a lot of monitoring techniques to be used in scientific publications and improve research areas.
Benefits of IoT to country population
Controls in agriculture close to volcanic areas

Monitoring water sources of acid rain pollution.

Early warning systems for country and the people close to volcanoes

Programs evacuation of high-risk areas.

Education programs for prevention of natural disasters.

Early warning systems for civil aviation and government
Limitations, recommendations, suggestions to implement IoT in Costa Rica
Limitations

Choose the frequency of operations (210 – 216 MHz), licensed or free frequency 5.8 GHz, 2.4 GHz, 902 GHz (noise, quality of signal, distances and coverage).

National regulations administration institutions radio spectrums.

Telecommunications infrastructure to install main communication links (National Parks and Costa Rican Electricity Institute ICE).

Knowledge in areas (IoT, WSN and maintain wireless sensor networks for many years).

Recommendations

Suggestions
Thank you for you attention.