A Mobile Multi-Technology Gateway to Enable IoT Interoperability

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INTER-IoT Project

- EU-funded H2020 Project (Call ICT-30)
- www.inter-iot.eu
- Full-fledged solution for enabling IoT Platform "voluntary" Interoperability:
  - INTER-LAYER (D2D, N2N, Mw2Mw, AS2AS, D&S2D&S)
  - INTER-FW (Meta-models, APIs)
  - INTER-METH (Methodology and CASE) tools
  - INTER-IoT Case Studies: INTER-HEALTH, INTER-LogP
Motivations and Key contributions

- Currently many different (quasi) standards do exist in the IoT arena from several perspectives that meets sectoral needs which refer to worlds that do not talk among themselves:
  - Big fragmentation and many “ad-hoc” solutions
  - Single radio communication Vs Multi interface

- Smartphones are increasingly present in people’s pockets
  - already equipped with multi radio interfaces
  - ideal candidates to collect, process and forward DATA coming from the body and surrounding environment

- PROPOSAL → Smartphone-based gateway…
  - To put order in the current panorama
  - To interact with all major today’s technologies
  - Enough flexible to host the technological advances that will come
  - To implement the “my world in my pocket” paradigm
The integration, harmonization and interoperability of such dissimilar communication protocols and standards represents the main issue to be addressed in order to fully realize the exciting IoT vision.
Software Architecture

1st International Workshop on Interoperability, Integration, and Interconnection of Internet of Things Systems (I4T 2016)
Berlin 4 Apr 2016
Smartphone-based mobile IoT gateway: Testbed implementation

<table>
<thead>
<tr>
<th>Interfaces</th>
<th>Bluetooth</th>
<th>SD-Zigbee</th>
<th>Wi-Fi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Garmin VivoFit</td>
<td>3 Waspmote</td>
<td>1 Samsung Smart TV</td>
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<tr>
<td></td>
<td>1 Scale Beurer 74822 BF</td>
<td>XBeet ZB-Pro</td>
<td>1 Samsung Air Conditioner</td>
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<tr>
<td></td>
<td>3 Shimmer</td>
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</tbody>
</table>
Main GUI

Multiple interfaces choice and activation

Data received on a specific interface

<table>
<thead>
<tr>
<th></th>
<th>Galaxy S2</th>
<th>Galaxy S3</th>
<th>Galaxy S4</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>Dual-Core 1.2GHz</td>
<td>Quad-Core 1.4GHz</td>
<td>Quad-Core 1.9GHz</td>
</tr>
<tr>
<td>RAM</td>
<td>1GB</td>
<td>1GB</td>
<td>2GB</td>
</tr>
<tr>
<td>Battery</td>
<td>1800 mAh</td>
<td>2100 mAh</td>
<td>2600 mAh</td>
</tr>
<tr>
<td>Operating System</td>
<td>Android 2.3.3</td>
<td>Ice Cream Sandwich</td>
<td>Jelly Bean</td>
</tr>
</tbody>
</table>
System performance analysis

We repeated the test 10 times to average the system load distribution.

The average CPU load is 15% in case of the most performing smartphone.

CPU Load by activating all the interfaces
System performance analysis

The maximum amount of memory is 85MB

Memory usage by activating all the interfaces
System performance analysis

The Samsung S3 has a battery of 2100mA at 3.8V.

Energy reduction of about 12% in 30 minutes.

Smartphone lifetime of more than 4 Hours.

Energy consumption

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Conclusions & future works

- We proposed a mobile gateway solution to support IoT interoperability through a smartphone-centric application.
- We implemented a real test-bed on different common smartphones demonstrating the ability of acting as a:
  - Data collector
  - Data handler
  - No excessive use of CPU and Memory
  - Limitation on energy consumption

Future works:
- Testbed extension:
  - More IoT devices
  - Different devices with different hardware/software capabilities
  - Enhanced radio interfaces such as BLE and ANT+ and different higher level protocols (MQTT, CoAP, etc)
- Applications in Smart City, V2V, m-Health, Smart Port Logistics
THANK YOU FOR THE ATTENTION

Questions?