A Stack4Things-based platform for Mobile CrowdSensing services

Giovanni Merlino
University of Messina
gmerlino@unime.it
MDSLab

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Outline

- Scenario
- Taxonomy
- Approach
- Platform
- Use case
- Conclusions
MCS reference scenario

MCS Application
Frontend Server

Backend Aggregation
Server

Aggregate Analytics

Data Provider

Node1

Node2

Nodei

Nodej

Nodek

Noden

Owners/Contributors

MCS Sensing Network/Infrastructure

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A taxonomy of MCS applications

<table>
<thead>
<tr>
<th>MCS applications (categorized by)</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Participatory</strong></td>
</tr>
<tr>
<td><strong>Owner involvement</strong></td>
<td>Active, human-assisted sensing / tagging</td>
</tr>
<tr>
<td><strong>User benefit</strong></td>
<td>Public interest</td>
</tr>
<tr>
<td><strong>Fruition modality</strong></td>
<td>Pull / non-contextual</td>
</tr>
<tr>
<td><strong>Interaction model</strong></td>
<td>Centralized (client-server)</td>
</tr>
<tr>
<td><strong>Incentive mechanism</strong></td>
<td>Credit systems (bank)</td>
</tr>
</tbody>
</table>

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Cloud and IoT integration: data-oriented

- IoT devices send data to the Cloud
- app built on top of standard cloud facilities (VMs, storage, network)
- app makes use of stored (non-real time) IoT data
- indirect, IoT device-initiated only, retrieval of actuation commands
Cloud and IoT integration: application-specific

- app uses **ad-hoc mechanisms** to interact with IoT devices
- **no explicit interactions** between Cloud components and IoT infrastructure
- **static** infrastructure deployment

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Cloud and IoT integration: full thing “cloudification”

- IoT infrastructure as a **natural extension** of a datacenter
- well-defined Cloud **API** as a resource management interface
- **separation of concerns** between infrastructure and application (when needed)
- from Cloud to **Fog/Edge** computing
- **device computation offloading**
IoT-Cloud engine: Stack4Things

- an open source project helping administrators to manage IoT device fleets without caring about their physical location, their network configuration, their underlying hardware/software setup

- a Cloud-oriented horizontal solution providing IoT object virtualization, customization, and orchestration

http://stack4things.unime.it
A Service-Oriented MCS infrastructure

Users

OpenStack command line clients

Web browser

s4t IoTronic command line client

s4t IoTronic

s4t lightning-rod

GCM control channel

WAMP control channel

Virtual networking WS channel

Service forwarding WS channel

OS level calls

REST communication

S4T OpenStack Cloud

OpenStack services

node OS tools, services, and IoT resources

(mobile) smart device
Stack4Things node-side architecture for an MCS platform

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Stack4Things Cloud-side architecture for an MCS platform

IoTronic database

IoTronic conductor

IoTronic AMQP queues

IoTronic GCM agent

IoTronic WS tunnel agent

IoTronic command line client

Web browser

IoTronic dashboard

IoTronic APIs

IoTronic database

GCM signaling

WS communication

REST interaction

AMQP pub/sub

command/response stream (to/from smartphones)

communication with smartphone services

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Use case: MCS for Smart City services

#SmartME as crowdfunding initiative and experimental Smart City testbed

http://smartme.unime.it
Example of a S4T-powered MCS app

- **Pothole** Detection and Mapping (PDM)
  - **Android** app + **Cloud** backend
  - Web **portal**

- **MCS enhanced** by the IoT-Cloud
  - **runtime** injection of code to nodes for computation at the edge
  - (locally) querying Roads API to actually **anchor** potential sites to the road

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PDM web portal
Conclusions

- a **taxonomy** and model for MCS
- relating MCS to IoT and **edge** computing
- adapted **IaaS** framework for IoT to serve as a service-oriented **platform** for MCS
- instantiate / deploy **custom** code at runtime
- **offloading** capabilities exercised through MCS app
Credits / Question time

co-authored with

Salvatore Distefano
Antonio Puliafito
Francesco Longo
Dario Bruneo

Thanks!

gmerlino@unime.it