A Mobile IoT Device Simulator for IoT Cloud Systems

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Started in an STSM

- STSM titled: “Design of a Mobile IoT Simulator”
- 10 days at University of Antwerp - iMinds (Belgium), in January, 2016
- In collaboration with:
  - Steven Latré, and
  - Bart Spinnewyn
- On simulating IoT devices in IoT Clouds
IoT – Internet of Things

- New trend
  - Connection between objects
    - Things/Devices/Sensors/Actors
    - Smart Environment
  - Like the internet revolution
    - Connection between people
    - Unprecedented scale and pace

- Gartner report (2011)
  - 30 billion devices always online
  - more than 200 billion devices discontinuously online by 2020
IoT and the Cloud

Cloud
- Manage resources
- Scalability
- Handle big data
- Access from everywhere

Cloud IoT features
- Connect devices (HTTP, MQTT)
- Store and stream data
- Visualisation
- Push notification
# PaaS survey with IoT features

## TABLE 1. PaaS General features.

<table>
<thead>
<tr>
<th>Provider</th>
<th>Open source</th>
<th>Hosting</th>
<th>Server</th>
<th>Client languages</th>
<th>Mobile SDK languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluemix</td>
<td>no</td>
<td>closed</td>
<td>many</td>
<td>Java, JS</td>
<td>Android, iOS</td>
</tr>
<tr>
<td>Parse</td>
<td>yes</td>
<td>open</td>
<td>JS</td>
<td>Java, JS, C</td>
<td>Android, iOS</td>
</tr>
<tr>
<td>Google</td>
<td>no</td>
<td>closed</td>
<td>many</td>
<td>Java, Python</td>
<td>Android, iOS</td>
</tr>
<tr>
<td>Amazon</td>
<td>no</td>
<td>closed</td>
<td>many</td>
<td>C, JS</td>
<td>Android, iOS</td>
</tr>
<tr>
<td>Azure</td>
<td>no</td>
<td>closed</td>
<td>many</td>
<td>C, Java, JS</td>
<td>Android, iOS, WP</td>
</tr>
<tr>
<td>Heroku</td>
<td>no</td>
<td>closed</td>
<td>many</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CloudFoundry</td>
<td>yes</td>
<td>closed</td>
<td>many</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Kinvey</td>
<td>no</td>
<td>open</td>
<td>JS</td>
<td>JS</td>
<td>Android, iOS</td>
</tr>
<tr>
<td>DreamFactory</td>
<td>yes</td>
<td>open</td>
<td>JS</td>
<td>JS</td>
<td>Android, iOS</td>
</tr>
</tbody>
</table>

## TABLE 2. PaaS IoT features.

<table>
<thead>
<tr>
<th>Provider</th>
<th>Protocols</th>
<th>Data store</th>
<th>BLOB</th>
<th>GEO</th>
<th>Push not.</th>
<th>Trigger</th>
<th>Visualization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluemix</td>
<td>MQTT</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Parse</td>
<td>REST</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Google</td>
<td>REST</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Amazon</td>
<td>MQTT, REST</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Azure</td>
<td>MQTT, AMQP, REST</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>N/A</td>
</tr>
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<td>Heroku</td>
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Bluemix

- IBM Cloud
- Many supported devices
- MQTT broker
- History and real time data
- Visualisation example
- Simple sensor simulator (web)
Parse
- Facebook (MBaaS)
- Open-source
- User management (social networks)
- Data store, Push notification
- Server side and admin UI

Google Cloud Platform
- Google
- Many cloud service
- AppEngine, …
The need for IoT environment simulation

- Wide variety of devices
- Applicable for development and testing
- Cost effective
- Changeability
Related Work

- General network simulators
  - NetSim
  - Qualnet
  - OMNeT++
- IoT simulators
  - DPWSim
  - SimpleIoTSimulator
  - Atomiton
IoT simulator requirements

- Simulate many physical aspects
  - Battery
  - Low power wireless communication
  - Dynamic environment
  - Heterogeneous

- Basic requirements
  - ID
  - Sensor data (binary, plain text, JSON, …)
  - REST or MQTT
Proposed solution: MobIoTSim

- Android application
- Connects to the cloud
  - MQTT protocol with Eclipse PASO client
- Simulates many IoT devices
  - With authentication (ID and token)
  - Custom data generation (JSON format)
  - Custom frequency
  - Interactive start and stop of devices
MobIoTSim screenshots

Cloud settings
- Bluemix quickstart
- Organization ID: quickstart
- Connection type: TCP
- Port: 1883
- Auth token: PoMQ5uK2K?TEdZyo1F

Full URL: tcp://quickstart.messaging.internetofthings.ibmcloud.com:1883

SAVE

Devices
- MobIoT_test01
  - STOP
  - !
- MobIoT_test02
  - START

MobIoT_test01 command: warning (26)
ADD NEW DEVICE
MobIoTSim screenshots

Select a Device Type

- Custom
- Temperature
- Humidity

Device settings

Type ID: MobIoTSimType
Device ID: MobIoTSimDevice01
Token: RfoDC-zKRO_BJ^d+x8
Type: Custom
Frequency: 1.0
Min value: 0
Max value: 30

OK
CANCEL

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MobIoTSim options

- Cloud settings
  - Common part for all simulated devices
  - How to connect to the cloud
  - Cloud specific fields (generates a URL)
  - Bluemix quickstart and Bluemix apps

- Device settings
  - Specific for one device
  - Type (group devices)
  - Authentication (ID, token)
  - Frequency
  - Data generation

- Devices
  - Device list (Add / Edit / Delete)
  - Start / Stop
  - Warnings (Reactions from the cloud)
MobIoTSim with Bluemix quickstart

Quickstart
No sign-up required to see how easy it is to connect your device to Watson IoT Platform and view live sensor data.

MobIoTSimDevice01

status data

I've seen my data, what next?

1. Use your device in an application created with IBM Bluemix.
   Click here for more details.
2. Go to your Bluemix account.
   SIGN UP    LOG IN
   Note: When you sign up for a trial you may have to wait up to 24 hours to receive your log-in information.
3. Create an app using the internet of Things Starter from the Catalog.
   CREATE APP
   Note: You will have to name your app and wait for a few minutes for it to start running.
4. When your app is running, select the app URL or type it into the browser to open the Node-RED flow editor.
   http://<appname>.mybluemix.net
5. Import the flow for your device into the Node-RED flow editor.
   IMPORT FLOW
MobIoTSim with Bluemix gateway
MobIoTSim and Bluemix

- Cloud application runs on Bluemix
  - Uses the native Bluemix MQTT broker (IoT service)
- Devices can be registered to the Bluemix database (ID, token)
- Visualisation
  - Receives the data from each simulated devices
  - Visualise the data in real time
MobIoTSim and MS Azure
MobIoTSim and MS Azure
MoibIoTSim use cases

- PaaS developer
  - Create IoT applications
  - Learn the basics
  - No need to buy real devices

- Test an IoT cloud application
  - Generate different test data
  - Replay the test cases
Results and availability

Papers:


Available at GitHub since October, 2016:

- [https://github.com/sed-szeged/MobIoTSim](https://github.com/sed-szeged/MobIoTSim)
- [https://github.com/sed-szeged/MobIoTSimBluemixGateway](https://github.com/sed-szeged/MobIoTSimBluemixGateway)
Conclusions

- Identifying IoT simulation needs and requirements

- MobIoTSim:
  - General purpose IoT device simulator
  - Gateways for Bluemix, Azure
  - Available as opensourse

- Future work:
  - Generic gateway
  - More templates and network error simulation
Thank You for Your Attention!

Questions?

https://github.com/sed-szeged/MobIoTSim

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