FIWARE: the pillar of the Future Internet

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The FIWARE Public-Private Partnership (PPP)

- **Goal**: capture opportunities derived from the new wave of digitalization of life and businesses that is coming

- **Strategy**: Build an ecosystem that will work as catalyst for capturing the opportunities, engaging data providers and entrepreneurs

- **Pillars**:
  - **FIWARE**: a generic, open standard platform which serve the needs of developers in multiple domains
  - **FIWARE Lab**: a meeting point where innovation happens and data providers plus entrepreneurs can be engaged
  - **FIWARE Ops**: the suite of tools easing deployment and operation of FI-WARE instance nodes
  - **FIWARE Accelerate**: a program that funds developers and entrepreneurs, and ignites roll-out of the ecosystem
  - **FIWARE Mundus**: reach a global footprint, opening to regions that share the same vision and ambition
What does FIWARE provide as a platform?
Being “Smart” requires first being “Aware”

- Implementing a Smart Application requires gathering and managing context information.
- Context information refers to the values of attributes characterizing entities relevant to the application.

### Context Information

- **Boiler**
  - Manufacturer
  - Last revision
  - Product id
  - Temperature

- **Users**
  - Name-Surname
  - Birthday
  - Preferences
  - Location
  - ToDo list

- **Flowerpot**
  - Humidity
  - Watering plan
Being “Smart” requires first being “Aware”

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- Context information refers to the values of attributes characterizing entities relevant to the application.

**Application**

**Context Information**

**Bus**
- Location
- No. passengers
- Driver
- Licence plate

**Citizen**
- Name-Surname
- Birthday
- Preferences
- Location
- ToDo list

**Shop**
- Location
- Business name
- Franchise
- Offerings
Different sources of context need to be handled

- Context information may come from many sources:
  - Existing systems
  - Users, through mobile apps
  - Sensor networks (Internet of Things)

- Source of info for a given entity.attribute may vary over time

What’s the current temperature in place “X”?  Notify me the changes of temperature in place “X”

Place = “X”, temperature = 30º

Standard API

A sensor in a pedestrian street
A person from his smartphone
The Public Bus Transport Management system

It’s too hot!
A non-intrusive approach is required

- Capable to integrate with existing or future systems dealing with management of municipal services without impact in their architectures
- Info about attributes of one entity may come from different systems, which work either as Context Producers or Context Providers
- Applications rely on a single model adapting to systems of each city
Connecting to the Internet of Things

- Capturing data from, or Acting upon, IoT devices should be as easy as to read/change the value of attributes linked to context entities

GET <Oauth token> 
/V1/contextEntities/flowerpot-1/attributes/humidity

PUT <Oauth token> 
/V1/contextEntities/flowerpot-1/attributes/status "watering"

Issuing a get operation on the “humidity” attribute enables the application to find out whether the plant has to be watered.

Setting up the value of attribute “status” to “watering” triggers execution of a function in the IoT device that waters the plant.
Connecting to the Internet of Things

- Capturing data from, or Acting upon, IoT devices should be as easy as to read/change the value of attributes linked to context entities

GET <Oauth token> /V1/contextEntities/lamp1/attributes/presenceSensor

Setting up the value of attribute “status” to “light on” triggers execution of a function in the IoT device that switches the lamp on

PUT <Oauth token> /V1/contextEntities/lamp1/attributes/status “light on”

Issuing a get operation on the “presenceSensor” attribute enables the application to get info about presence of people near the lamp
Context Management in FIWARE

- The FIWARE Context Broker GE implements the OMA NGSI-9/10 API: a simple yet powerful standard API for managing Context information complying with the requirements of a smart city.

- The FIWARE NGSI API is Restful: any web/backend programmer gets quickly used to it.
FIWARE NGSI: Basic interaction

- **Context Producers** publish context information by invoking the `updateContext` operation on a Context Broker.

- **Context Consumers** can retrieve context information by invoking the `queryContext` operation on a Context Broker.

![Diagram showing the interaction between Context Producers, Context Consumers, and Context Broker]
**FIWARE NGSI: Subscription to notifications**

- **Context Consumers** can be subscribed to reception of context information complying with certain conditions, using the `subscribeContext` operation a ContextBroker exports. Such subscriptions may have a duration.

- The Context Broker notifies updates on context information to subscribed Context Consumers by invoking the `notifyContext` operation they export.

```plaintext
Bus = “X”, next_stop = “A”, arrived = “Yes”
```

```
Id = subscribeContext (consumer1, condition, duration)
```

```
notifyContext (id, context_info)
```

```
updateContext (context_info)
```

```
Context Consumer (consumer1)
```

```
Context Broker
```

```
Context Producer
```
FIWARE NGSI: Context Providers

- **Context Providers** can be registered to the Context Broker as “holders” of certain context information.

- A Context Broker will invoke the queryContext or updateContext operations exported by Context Providers whenever they are queried for, or asked to update, context information they hold.

```
Bus = “X”, location = (x, y)
```

```
registerContext (provider-x, registration_data, duration, id)
```

```
queryContext / updateContext
```

```
Context Consumer
```

```
Context Broker
```

```
Context Provider (provider-x)
```

```
Context Consumer
```

```
Context Broker
```

```
Context Provider (provider-x)
```
Integration with existing systems

- Context adapters will be developed to interface with existing systems (e.g., municipal services management systems in a smart city) acting as Context Providers, Context Producers, or both.

- Some attributes from a given entity may be linked to a Context Provider while other attributes may be linked to Context Producers.

```
queryContext(e1, attr1, attr2)
```

```
updateContext(e1, attr2)
```

```
queryContext(e1, attr1)
```

```
Context Broker
```

```
Application
```

```
System A (e.g. GIS, POIs)
```

```
System B (e.g. Transport system)
```

```
Context Provider
```

```
Context Consumer
```
Integration with sensor networks

- The FIWARE backend IoT Device Management GE enables creation and configuration of NGSI IoT Agents that connect to sensor networks.
- Each NGSI IoT Agent can behave as Context Consumers or Context Providers, or both.
Once context information is gathered, a lot of useful complementary FIWARE enablers can be used

- Advanced Web-based UI (AR, 3D)
- Open data publication
- Data/Apps visualization
- Context Broker
- Complex Event Processing
- Multimedia processing
- Big Data Analysis
Context Processing and Analysis

Applications

NGSI-9/10

Programming of rules

Simple Processing
(aggregation, averages, …)
Sensor2Things

Complex Event Processing
(CEP)

Context Broker

Context Management
Processing and Analysis

BigData Analysis
(Hadoop-based)
FIWARE IoT & Context/Management altogether

- Applications
  - CEP
  - BigData Analysis
  - ContextBroker
  - Simple processing
  - IoT-enabled Context Management

- Backend
  - Native NGSI IoT Agent
  - Native NGSI IoT Agent
  - Gateway/Device Platform GEs

- Other sources

- NGSI IoT Agents
  - IoT Backend Device Management

FIWARE NGSI-9/10

- Backend
  - Gateway/Device Platform GEs
  - Gateway/Device Platform GEs
  - Gateway/Device Platform GEs
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  - Gateway/Device Platform GEs
  - Gateway/Device Platform GEs
Data analytics

Context Sources

Context Broker

Extract Transform Load

Analysis

Query/Reporting

Data mining
Open Data publication

Context Source

NGSI

Context Broker

BigData Analysis

ckan
FIWARE = advanced OpenStack-based Cloud capabilities + library of APIs that ease development of applications
## FIWARE major differential features

<table>
<thead>
<tr>
<th>Section</th>
<th>Features</th>
</tr>
</thead>
</table>
| **Cloud**                | - Federation of infrastructures (private/public regions)  
                          | - Automated GE deployment                                                |
| **Data/Media Context Mgmt** | - Complete Context Management Platform  
                          | - Integration of Data and Media Content                                  |
| **IoT Services Enablement** | - Easy plug&play of devices using multiple protocols  
                          | - Automated Measurements/Action ↔ Context updates                       |
| **Data/Services Delivery** | - Visualization of data (operation dashboards)  
                          | - Publication of data sets/services                                      |
| **Advanced Web UI**      | - Easy incorporation of advanced 3D and AR features  
                          | - Visual representation of context information                           |
| **Security**             | - Security Monitoring  
                          | - Built-in Identity/Access/Privacy Management                            |
| **I2ND**                 | - Advanced networking (SDN) and middleware  
                          | - Interface to robots                                                    |
Why FIWARE?
Building a successful ecosystem requires …

Creating a **vibrant community of active contributors** who commit a sustainable investment over time

**FACTS**

- 24 partners from 9 different countries
- 7430+ PMs devoted to development activities in 5 years (5165 PMs in the first 3 years)
- 122/76 M€ of budget/funding (37/23 M€ in the next 2 years)
- Each FIWARE component is considered strategic in the portfolio of contributing partner
Building a successful ecosystem requires ...

Bringing incentives for entrepreneurs and developers

**FACTS**

- 80 M€ in grants to startups/SMEs in the next 2 years (FIWARE Acceleration Programme)
- 20 M€ to support involvement of 16 accelerators across Europe
- 3100+ startups/SMEs applied to 1st Open Call of the FIWARE Acceleration programme
- 1300 startups/SMEs to be funded (~400 as result of 1st Open Call)
- Selected startup/SMEs working as evangelists
- Free FIWARE Lab environment for experimentation
Building a successful ecosystem requires ...

- **engaging domain stakeholders**

**Facts**

- 25+ relevant domain stakeholders involved in Use Cases and FIWARE Accelerator programme
- 95/66 M€ of budget/funding devoted to Use Cases in verticals
- 16+ cities have published their open data on FIWARE Lab
- 14+ cities launch the Open and Agile Smart Cities initiative where they commit to adopt FIWARE APIs (NGSI, CKAN)
- New stakeholders triggered by awareness have approached us (e.g., Ferrovial, Bosch, …)
Building a successful ecosystem requires …

Creating a **meeting point** where demand connects to offering and innovation takes place.

**FACTS**

FIWARE Lab environment with 3000+ Cores, 16+ TB RAM, 750+ TB HD

1900 open datasets from cities published and growing fast!

17 nodes across Europe

1st node in LATAM deployed in Mexico. New nodes being setup: Brazil and Chile.
Building a successful ecosystem requires …

Raising awareness (which means an investment in marketing) and creating a brand

FACTS

- 6,5 M€ in marketing activities (4 M€ so far)
- 450K€ just in sponsorship of events during 2015-16
- Lead by reputed on-line marketing partner (Ogilvy)
Building a successful ecosystem requires ...

Scale and go global

21 Innovation Hubs in Europe

First FIWARE Lab nodes in Mexico and Brazil

1,4 M€ funding assigned to FIWARE mundus activities targeted to build links with Mexico, Brazil, Chile, Japan, Canada, Korea, BRIC countries ...
**FIWARE PPP: main figures**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIWARE budget (phases 1-2 + phase 3)</td>
<td>122 = 85 + 37 M€</td>
</tr>
<tr>
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</tr>
<tr>
<td>FIWARE Lab nodes</td>
<td>18 = 17 + 1</td>
</tr>
<tr>
<td>For startups/SMEs</td>
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<tr>
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</tr>
<tr>
<td>Startups/SMEs</td>
<td>1300</td>
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<tr>
<td>Partners</td>
<td>24</td>
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<tr>
<td>Countries</td>
<td>9</td>
</tr>
<tr>
<td>Cities</td>
<td>16+</td>
</tr>
<tr>
<td>Budget/Funding of Vertical Use Cases</td>
<td>95/66 M€</td>
</tr>
<tr>
<td>Marketing</td>
<td>6.5 M€</td>
</tr>
<tr>
<td>Sponsorshipals next 2 years</td>
<td>450 K€</td>
</tr>
</tbody>
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**Note:**
- 122 = 85 + 37 M€ refers to the total FIWARE budget.
- 99 = 76 + 23 M€ refers to the total FIWARE funding.
- 18 = 17 + 1 refers to the number of FIWARE Lab nodes.
- 80 + 20 M€ refers to the funding for startups/SMEs.
- 21 refers to the number of Innovation Hubs.
- 1300 refers to the number of Startups/SMEs.
- 24 refers to the number of partners.
- 9 refers to the number of countries.
- 16+ refers to the number of cities.
- 95/66 M€ refers to the budget/funding of Vertical Use Cases.
What does FIWARE bring to Smart Cities?
Smart Cities can be engines of growth

- Cities are where daily life and businesses actually happen …

- Smart Cities are not simply about more efficient municipality services but transforming Cities into ICT platforms enabling development of smart applications

- This way, cities would transform into engines of economy growth and improvement in the well-being of citizens
Why standards are relevant for Smart Cities

- The current lack of standards means an impediment for the development of Smart Cities
  - The target market for solution and services is not large enough to attract investment
  - Solutions and services become tailor made, therefore expensive.
  - Cities get locked-in to solution/application providers

- Pillars of the FIWARE programme support the creation of a sustainable ecosystem:
  - The FIWARE platform brings the necessary standards
  - The FIWARE Lab becomes the meeting point where cities meet entrepreneurs and innovation takes place
  - The FIWARE Acceleration programme helps to attract a first wave of developers (startups/SMEs)
  - The FIWARE mundus programme helps to expand globally
  - The FIWARE Ops suite of tools ease the task to deploy FIWARE instances
Target Smart City platform

- Smart city platform as a Data/Knowledge Hub
- Non-intrusive, open to third parties
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Thanks!

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