The FIWARE Programme (originally FI-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
Understanding FIWARE (Open Standard Platform) (advanced OpenStack-based Cloud + rich library of Generic Enablers)
Why an open standard platform is required

- Avoid vendor lock-in:
  - Standard Southbound APIs for sensor providers
  - Standard Northbound APIs offered to applications
  - Portability across platform providers
  - Interoperability of apps on top of different providers

- Larger community of developers (critical mass, economies of scale)
  - True innovation
  - More competition, leading to cost savings

- Not any standard is enough
  - Modularity
  - Allow different business models
  - Integration with standard open data platform
  - Non-intrusive (smooth integration with legacies)
Open Source. Avoid vendor lock-in
You have the control
PRESS RELEASE

ATOS, ENGINEERING, ORANGE AND TELEFÓNICA ANNOUNCE THE CREATION OF THE FIWARE FOUNDATION TO ACCELERATE THE DEVELOPMENT OF SERVICES IN THE INTERNET OF THINGS

1. The four companies are now announcing their plans to bring FIWARE to other domains like Smart Industry or Smart Agrifood beyond Smart Cities.
2. The FIWARE Accelerator program has demonstrated how innovative SMEs and startups can build IoT-enabled solutions and introduce great improvements in business processes across several sectors.
3. The FIWARE platform provides a solid technology foundation for digitizing the European Industry
FIWARE Generic Enablers (GEs)

- A FIWARE Generic Enabler (GE):
  - set of general-purpose **platform functions** available through **APIs**
  - Building with other GEs a **FIWARE Reference Architecture**

- **FIWARE GE Specifications** are open (public and royalty-free)

- **FIWARE GE implementation** (FIWARE GEi):
  - Platform product that implements a given GE Open Spec
  - There might be multiple compliant GEis of each GE Open Spec

- **One open source reference implementation** of each FIWARE GE (FIWARE GEri):
  - Well-known open source license
  - Publicly available [Technical Roadmap](#) updated in every release

- Available FIWARE GEis, GEris and incubated enablers are published on the [FIWARE Catalogue](#)
## FIWARE major differential features

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<th>Section</th>
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| Cloud       | • Federation of infrastructures (private/public regions)  
               • Automated GE deployment                                           |
| Data/Services Delivery | • Complete Context Management Platform  
               • Integration of Data and Media Content                           |
| IoT         | • Easy plug&play of devices using multiple protocols  
               • Automated Measurements/Action ↔ Context updates                 |
| Apps        | • Visualization of data (operation dashboards)  
               • Publication of data sets/services                                |
| 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                                               |
The FIWARE Catalogue includes links to other catalogues bringing information about domain-specific enablers (DSEs) to be combined with those serving general purposes (Generic Enablers - GE). They may be helpful for those who plan to develop applications in the domains of energy, creative media, smart manufacturing, health and wellbeing, and the agrifood sector.

The perfect solution to make your app focus on a specific vertical.

Please note that Domain Specific Enablers (DSEs) are different from FIWARE Generic Enablers (GEs). Some of them have been developed as part of the Future Internet PPP large scale trials as domain specific extensions which are now available to you. Their development may not have followed the FIWARE Developers' guidelines, and subsequently no quality assurance and support can be given. There may also be different regimes regarding availability of source code under well-known open source licenses, level of support and sustainability in the long term.

Some DSEs may demonstrate they are not only applicable to the specific domain for which they were originally designed but to many other application domains. Those DSEs may eventually become a FIWARE GE by going through the incubation process defined within the FIWARE Open Source Community.

Note that support of DSE catalogues as well as DSEs is outside the control of FIWARE.
Platform ↔ Ecosystem

Open Standard Platform

Sustainable Open Innovation Ecosystem
A live instance of FIWARE available to developers for free experimentation

Not only platform, tools...this is powered by data!
FIWARE Lab: the “meeting point” where innovation takes place

App Customers and Data providers
- Connect to entrepreneurs
- Put their data at work
- Bring new innovative services to end users
- Be more efficient
- Social Reputation

Entrepreneurs, Developers
- Develop once for a large market
- Easily meet potential customers
- Marketing, promotion
- Ability to test with real data and end users
- Simple yet powerful APIs that accelerate product development

FIWARE Technology Providers
- “Coopetitive” approach
- Connect to entrepreneurs: jointly exploit the opportunities

★ 4,2 M€ promotion campaign
  - Campus Party events
  - Startup Weekend events
  - Chambers of Commerce
  - 870 K€ in prizes

★ 100 M€ of funding devoted to entrepreneurs in phase 3 of the FIWARE program
Extending the FIWARE Lab offering for service providers and developers

- 4,200 M€ promotion campaign
- Campus Party events
- Startup Weekend events
- Chambers of Commerce
- 870 K€ in prizes

- 100 M€ of funding devoted to entrepreneurs in phase 3 of the FIWARE program

- 12 nodes in Europe providing up to 3000+ cores, 16TB+ Ram, 750TB+ HD

- Creation of nodes in Mexico (1000+ cores) and Brazil

- Level 1 and Level 2 support for the nodes

- Showcases for developers, infrastructures, smart businesses
FIWARE Lab nodes around the world
FIWARE Instances

- Future Internet Applications run on top of “FIWARE Instances” that are built by “FIWARE Instance Providers” upon:
  - selection of FIWARE GEis (products) from the FIWARE Catalogue.
  - assembly of selected FIWARE GEis with proprietary added-value products.
Building the FIWARE ecosystem: the vision

- Creation of dedicated GE instances
- Use of Global shared GE instances

FIWARE provider A

FIWARE provider B

Applications

FIWARE Catalogue
What does FIWARE bring to Smart Cities?
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
Open and Agile Smart Cities initiative

- Launch of the Open and Agile Smart at CeBIT:
  - Denmark: Copenhagen, Aarhus and Aalborg
  - Finland: Helsinki, Espoo, Vantaa, Oulu, Tampere, Turku
  - Spain: Valencia, Santander, Málaga, Sevilla
  - Portugal: Porto, Lisbon, Fundão, Palmela, Penela and Águeda
  - Belgium: Brussels, Ghent and Antwerp
  - Italy: Milan, Palermo and Lecce
  - Brazil: Olinda (Recife), Anapólis (Goiás), Porto Alegre (Rio Grande do Sul), Vitória (Espírito Santo), Colinas de Tocantins (Tocantins) and Taquaritinga (São Paulo)
- Other countries and cities welcome to join!
- Some of them already in the pipeline

(*) Ordered by country and date of incorporation
From silos to platforms
From clusters to ecosystems: Cross-fertilization of data

- within a given environment (building, plant, city)…
- between vertical application domains (energy, transportation, logistics, etc…)
Modularity; integration with legacies
Domain-specific platforms = FIWARE + specific enablers
Example: FIWARE for Smart Energy

- FIWARE Sustainable Smart City Malmö, Sweden
- FIWARE Smart Region Horsens, Denmark & Madrid
- FIWARE X-border Virtual Utility, Aachen
- FIWARE for the Energy Marketplace in Terni, Italy
- FIWARE for Power management, Ireland

GE and DSE integration
FIWARE as a multi-sided IoT platform

IoT Applications providers

end users

developers

IoT data providers

 Networks & IoT Infrastructures operators

Data aggregators

data providers
data providers

data providers

individual data providers
Raising the level of data abstraction in IoT infrastructures

- Beyond *device* and protocol abstraction!
- Capturing the invariants in target *environment* instances
- Abstracting all relevant *physical entities* in the environment
  - rooms, places (akin to context entities in context middleware)
  - non-connected appliances and legacy systems
  - passive items
- Providing higher layers of abstraction
  - virtual entities based on properties and categories (intrinsic)
  - entity & device instance groups (extrinsic and ad hoc)
Virtual Entity Layer:
(Entity groupings according to intrinsic or extrinsic features)

Entity Abstraction Layer

Device Abstraction Layer

Physical Environment
Consolidating multiple sources of data

- Primary data may come from many types of sources:
  - peer and lower-level infrastructures
  - networked sensor systems
  - external information systems
  - crowdsourcing (individual smartphone sensors)

- They are attached by FIWARE to relevant entities

What’s the current traffic density in street “X”?

FIWARE high-level API

```
{« street X » :
  « hasState » : [
    « TrafficDensity »
    ....
  ]
}
```

Notify me in case of congestion of street “X”

- inductive-loop vehicle detector
- surveillance cameras
- driver smartphones
Acting upon entities through devices

- IoT devices are acted upon through changes in the state of entities

**Backend IoT Applications**

GET <Oauth token> /cityEntities/street1/presenceState

PUT <Oauth token> /cityEntities/street1/lamps/"OnState"

**Backend platform**

**Edge IoT Applications**

**Edge platforms**

**FIWARE API**

![Diagram of IoT device interaction](image-url)
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.

![Diagram showing integration with sensor networks](image-url)
FIWARE IoT & overall Data Management

Applications

Other data sources

CEP

BigData Analysis

ContextBroker

Simple processing

IoT-enabled Context Management

NGSI IoT Agents

IoT Backend Device Management

Backend

Native IoT Agent

Gateway/Device Platform GEs

Native IoT Agent

Gateway/Device Platform GEs

Gateway/Device Platform GEs

Gateway/Device Platform GEs

Backend
Example: Smart City platform

- Smart city platform as a Data/Knowledge Hub
- Non-intrusive, open to third parties
Relationship with other IoT protocols

Context Information Management Layer

Context IoT translation Management Layer

IoT connectivity and management layer

Applications

Context Entities Mgmt

IoT resources Mgmt
FIWARE IoT architecture

IoT Backend
- IoT Device Management
- IoT Discovery
- IoT Broker

IoT Edge
- IoT Gateway
- IoT NGSI Gateway

UL2.0/HTTP, MQTT, LWM2M/CoAP, etc.

Data Context Broker
NGSI9, NGSI10

GW Logic
GW2GW API
Device API
Device

NGSI9

GW Logic
Protocol Adapter
Device API
Device
NGSI10

NGSI9
NGSI10
NGSI Device

NGSI9
NGSI10
Open Data publication

![Diagram showing the relationship between Context, Broker, BigData Analysis, and CKAN.](image-url)
Bringing IoT to the next level with Linked Data

- IoT systems no longer isolated islands
- They become part of the larger linked data archipelago
Evolution of FIWARE APIs towards Linked Data & Web of Things

- abiding by linked data principles
  - use URIs as names
  - use HTTP URIs, so that people can look up those names
  - when someone looks up a URI, provide useful information
  - include links to other URIs, so that they can discover more things

- Naming and identifying devices
  - URI of network interface (HTTP or CoAP) or proxy

- Naming and identifying physical things
  - physical things are interfaced or represented through dereferenceable URIs of their own
  - device resources may allow to monitor or control things, either directly or indirectly
Federating IoT infrastructures with Linked Data
Linked data from the Web of Things

- Narrow waist = REST identifiers shared by different infrastructures and abstraction layers
  - entities are resources, states are subresources, instant values are representations
  - devices are resources, reading from sensors and actuator controls are representations
  - HTTP or CoAP URIs for all resources and subresources
  - JSON-LD for semantic mapping of identifiers
    - resource descriptions are hyperlinks → «follow your nose»
    - no declarative descriptions à la WSDL!

REST = HTTP/CoAP URIs + CRUD + hyperlinks
Join us!

http://fiware.org

http://lab.fiware.org

Follow @Fiware on Twitter!