

FIESTA-IoT

Federated Interoperable
Semantic IoT/cloud Testbeds and Applications



The Challenges of the IoT Cross-Domain Integration Session

Federation and Cross Domain Interoperability

19 June 2019, Aarhus, Denmark



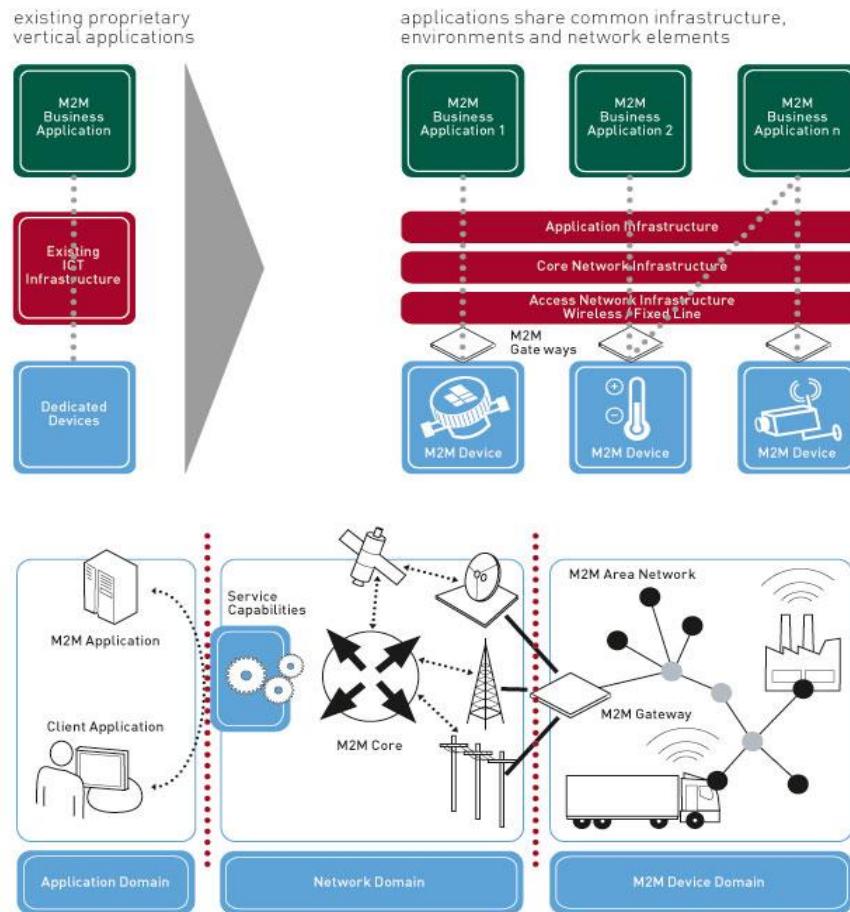
Dr. Martin Serrano

ICT/IoT Expert, Data Scientist, Head Unit Leader
Internet of Things, Stream Processing and
Intelligent Systems Research Unit
IEEE ComSoc Chair IoT Experimentation Chapter
OASC.ie Board Member



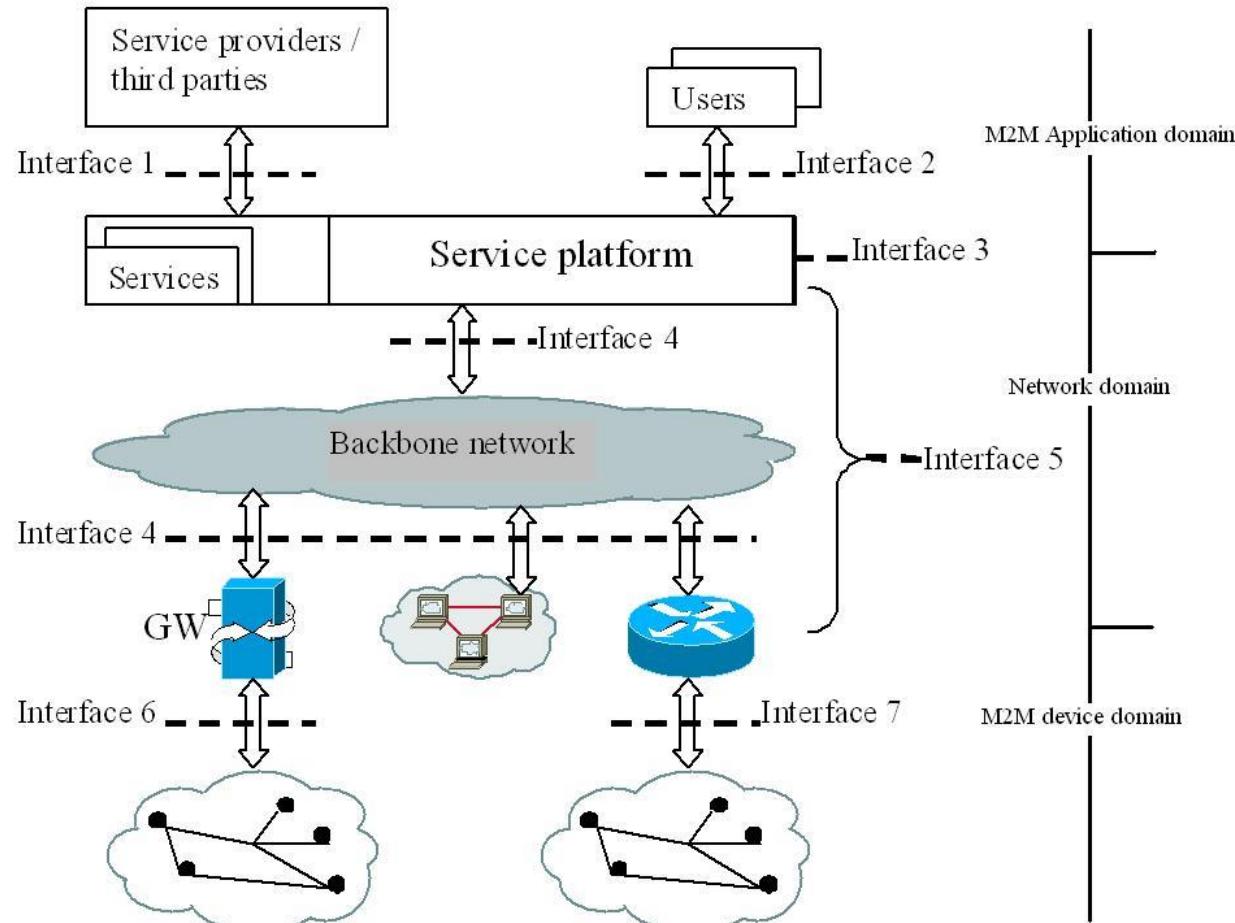
Motivations and Trends: OneM2M

Convergence Between Management and Middleware



ETSI Standardizes M2M Communications
By Joachim Koss, Vice-Chairman of ETSI TC M2M

Motivations and Trends: M2M and Core Networking Interoperability

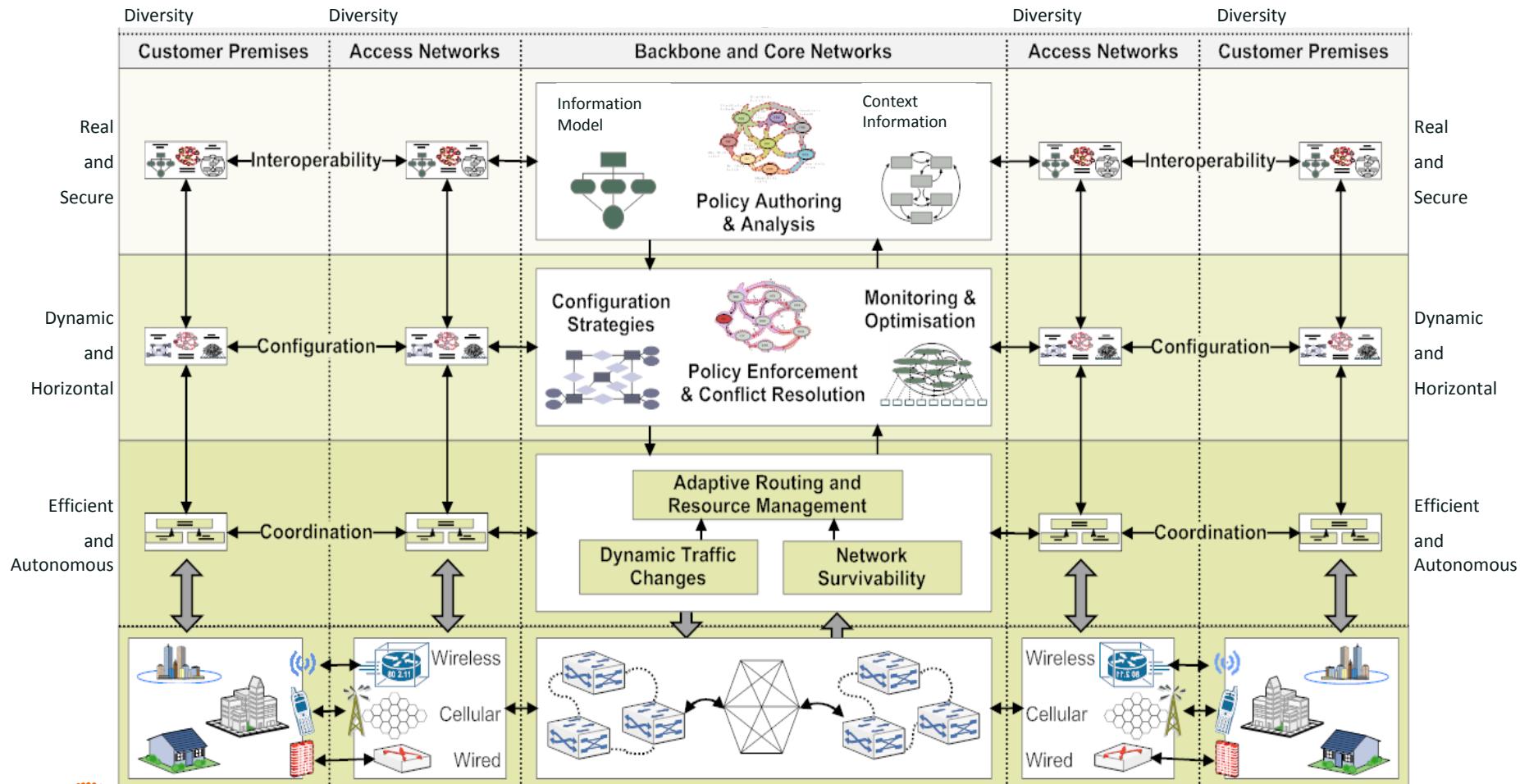


Machine-to-machine communication
European push for M2M standardisation
Eurescom Archives

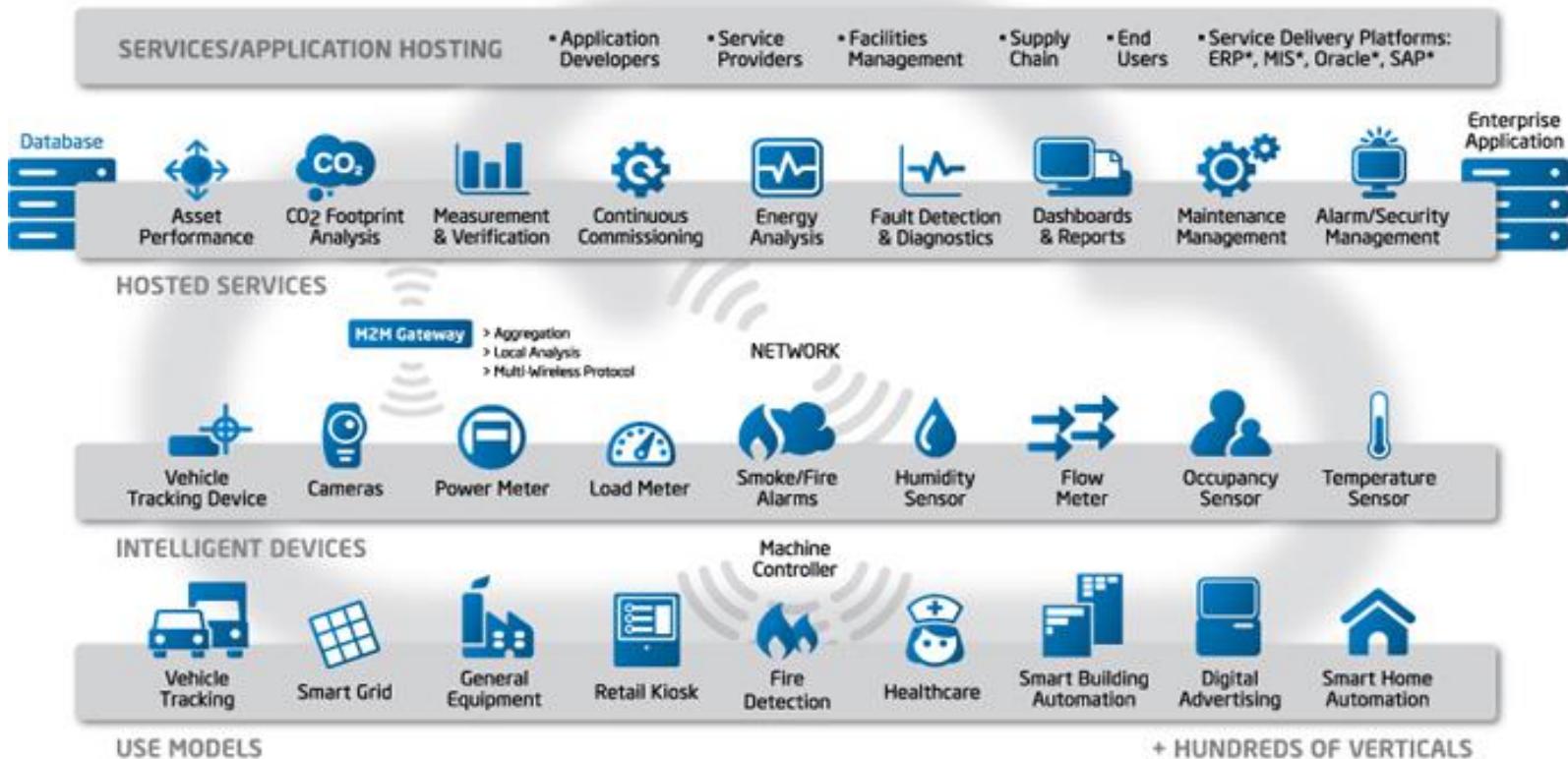
Motivations and Trends: E2E End to End Communications Interoperability



End-to-End Communications Services Broader Scope

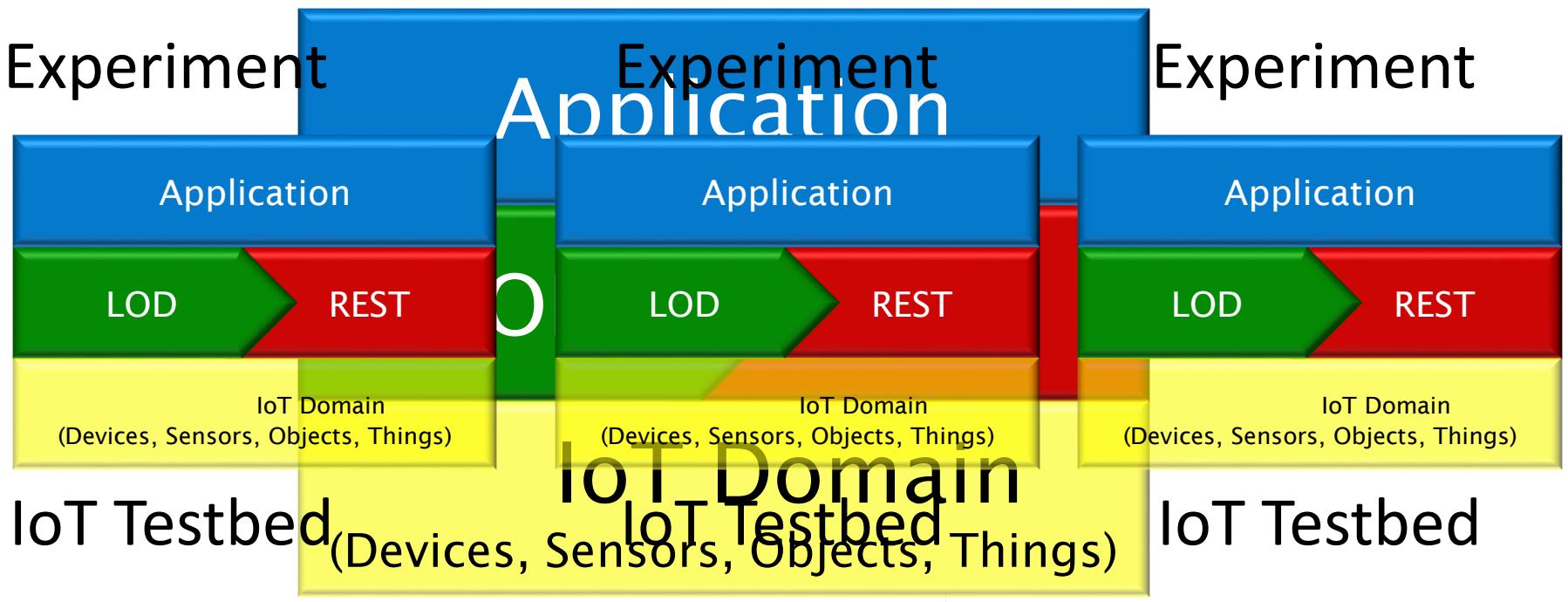


M2M Ecosystem of Smart Services



Machine-to-machine Ecosystem
<http://blog.trentonsystems.com>

IoT Applications = Sensor Data + Applications



The Future of IoT Experimentation designed today

Expansion of IoT Community

IoT Infrastructure and Experiments

Testbed Interoperability

Funding Opportunities



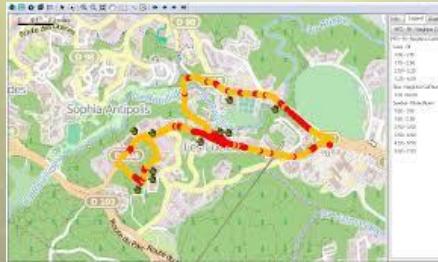
Smart City Testbed,
Santander, Spain



ICS Smart Building Tesbed,
Guilford, UK



ICT Testbed,
Sophia Antipolis, France



KETI Mobius Tesbed,
Seoul Korea



The FIESTA-IoT's Concept around IoT Testbeds and Experimentation

Fiesta Testbed & Experiments Overall



Fiesta-IoT

OC1. OC2. OC3. OC4. RC1.

Testbeds:

05

Testbed Extensions:

03

03

11

Industry Exp:

01

Experiments – SME: (Innovation)

03

09

05

01

19

Scientific Exp:

02

Scientific Excellence Exp:

03

04

09

08

09

03

13

05

01

39



Open Call 1-4 Overall Figures

13 Partners

EU-ICT 1 FIESTA-IoT Platform 41 Months

8 Tools available, 11 available Datasets

5 Testbeds, EaaS 4 IoT Participants/Experiments

4 Open Calls, 11 Testbeds

63 IoT Participants

Duration 2015-2018

EU Contribution 5,132,584.00 Euro

The Internet
of Things

Experimentation



Experimentation as a Service (EaaS)

EaaS Ecosystem by engaging Communities

- Blueprint IoT Experimental Infrastructure for EaaS.
- Testbed Agnostic Access to IoT Datasets.
- Tools and Techniques for IoT Testbeds Interoperability and Portability.
- Proof-of-Concept Integrated Experiments
- Global Market Confidence Programme (as Sustainability Vehicle).
- Stakeholders Engagement – Expansion in terms of Experiments and Testbeds – Involvement of Third Parties Towards a Global IoT Experimentation Ecosystem:
- Best Practices for IoT Interoperability and IoT Data Sharing.

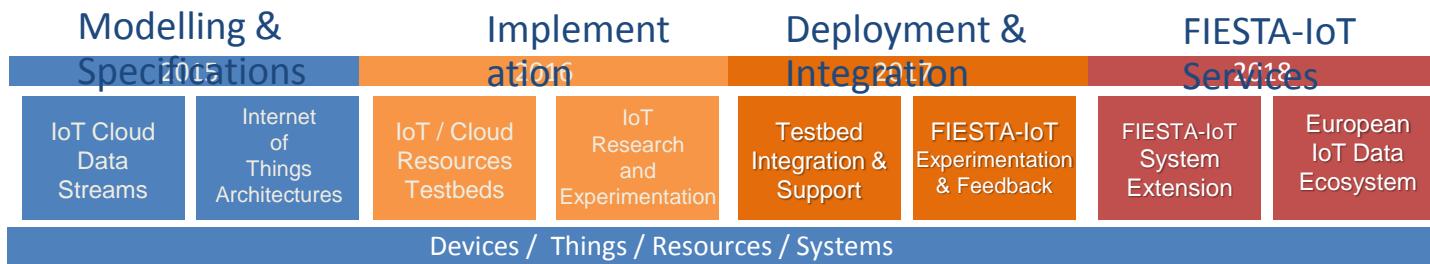


FIESTA-IoT

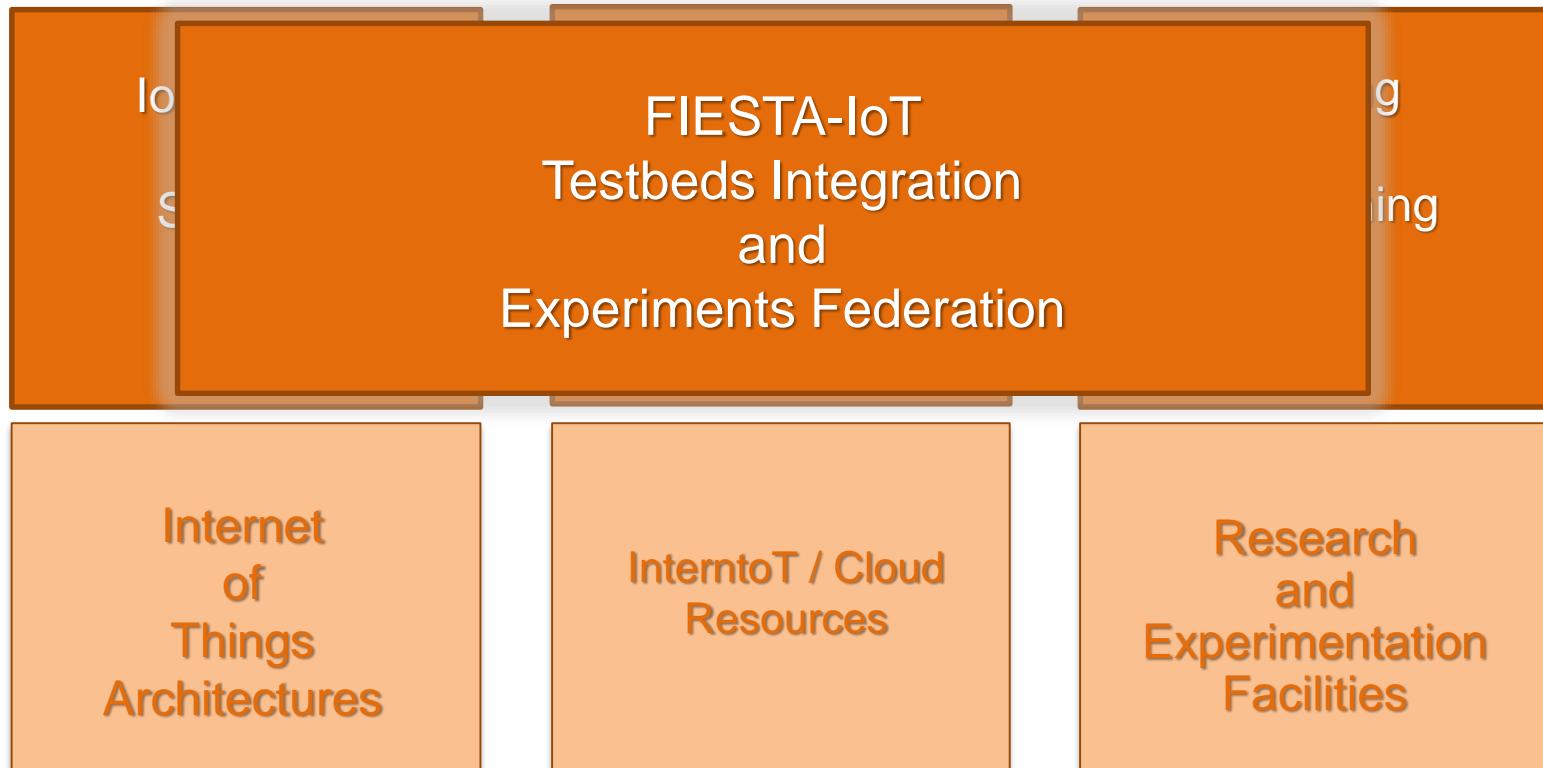
Federated Interoperable
Semantic IoT/cloud
Testbeds and Applications



Portal for European IoT Federated Data Services,



Fiesta-IoT aims to provide a **blueprint experimental infrastructure, tools, techniques, processes and best practices** enabling IoT testbed/platforms operators to **interconnect their facilities** in an interoperable way.



Experiments as a Service Model

(EaaS FIESTA-IoT Model Representation from DoA)

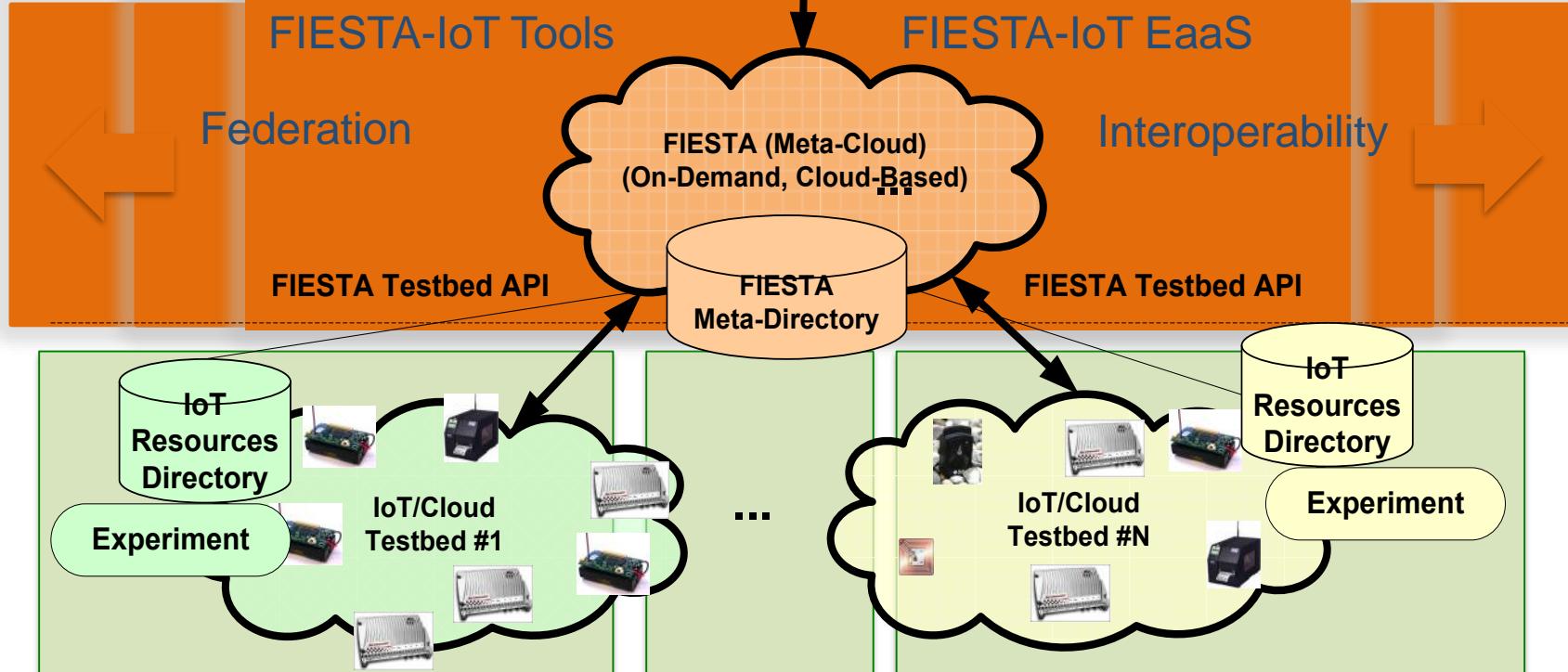


- EaaS Experiments
- Testbeds (IoT/Cloud)
- IoT Resource Directories
- IoT Experiments

FIESTA EaaS API

- Single EaaS API
- Access Datasets & Resources from Multiple Testbeds
- Portable Experiments (across multiple testbeds)

Experiment



Experiments as a Service Model

(EaaS FIESTA-IoT Model Representation from DoA Simplified)



FIESTA-IoT
Federation Layer

End-Users

Experimenters

Service Requirements

Service Offers

Ontologies

Certification

Security

Meta-Cloud
Infrastructure

FIESTA-IoT Data Tools

FIESTA-IoT EaaS

Federation

Meta-Cloud

Interoperability

Data Models & Schemas

Common Interfaces

Middleware
Adaptor Layer

Testbeds
Requirements

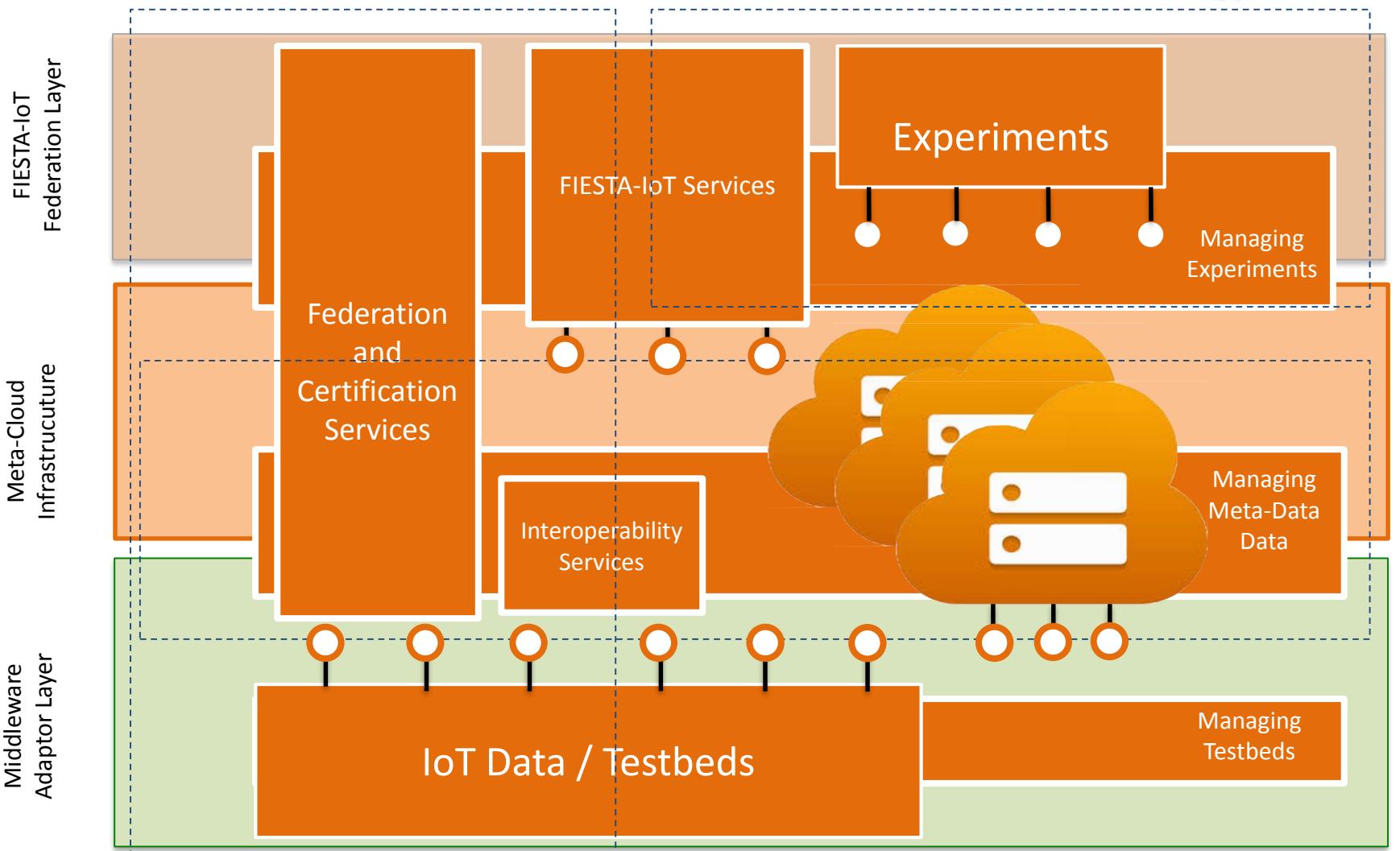
Data
Schema

Data
Model

Experimenter
Requirements

FIESTA-IoT Activities Distribution

(FIESTA-IoT Federated Services View)



Fiesta-IoT EaaS Infrastructure

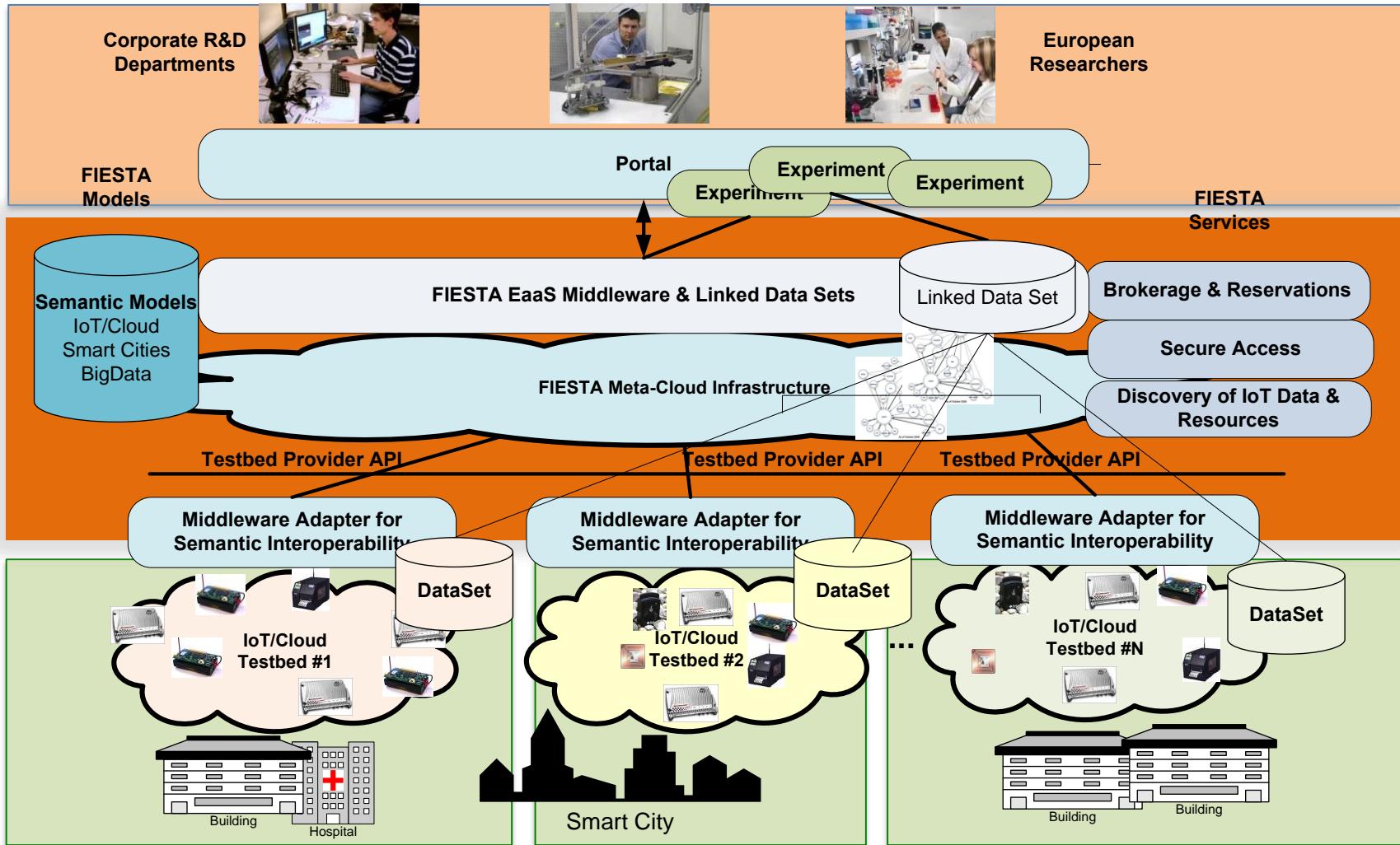
(EaaS Experimental Infrastructure Overview from DoA)



FIESTA-IoT
Federation Layer

Meta-Cloud
Infrastructure

Middleware
Adaptor Layer



Fiesta Challenges

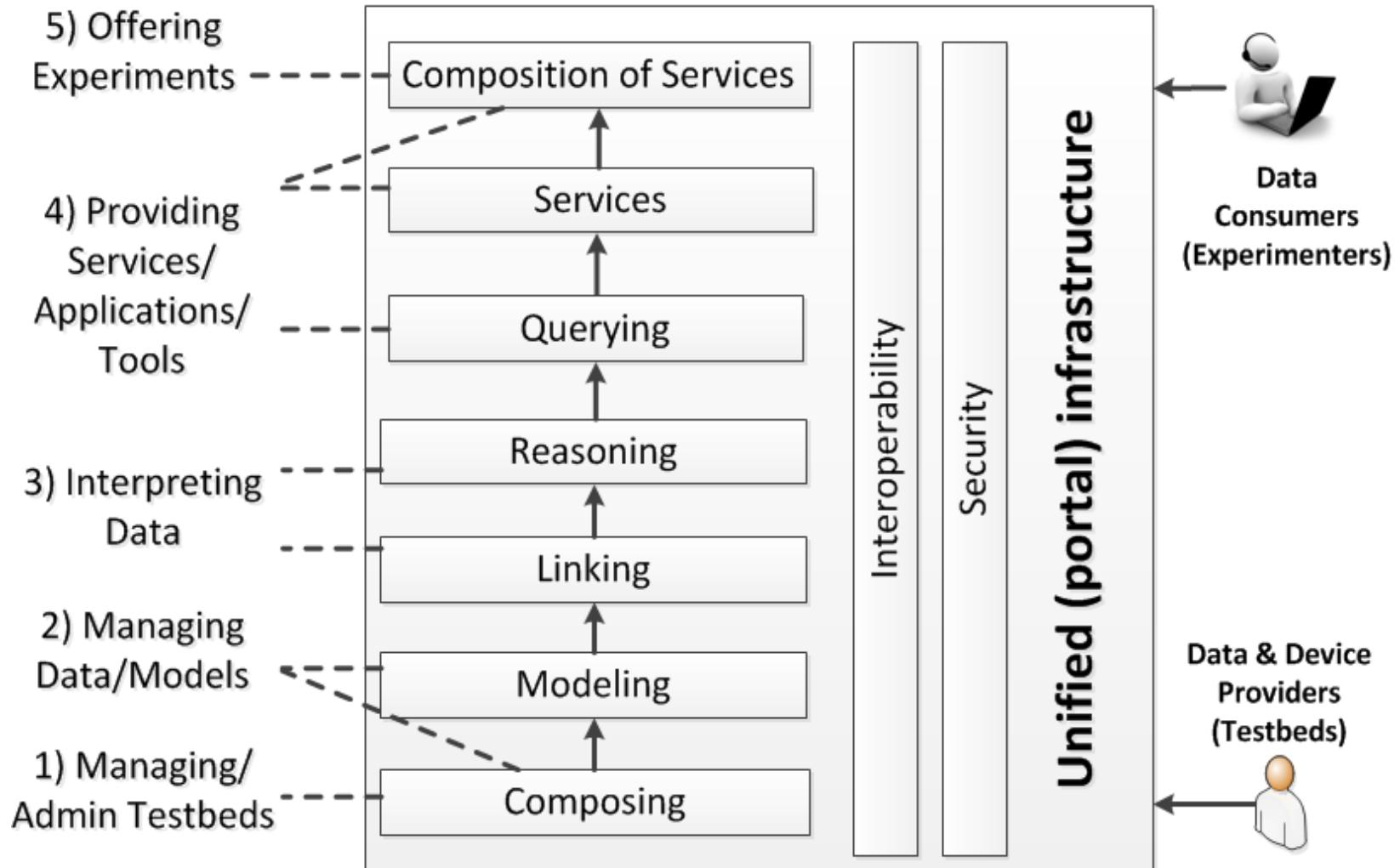
- Designing and deploying IoT interoperable tools
- Enable large scale integrated applications (experiments)
- Transcend the IoT Data (silo) boundaries
- Integrates individual IoT platforms or testbeds.

Fiesta project is looking at International level

- To open new horizons for IoT solutions at the EU (and global) scale
- Internationalization of development and deployment of IoT solutions
- Promotion of Applications and experiments
- Integration of diverse IoT platforms and testbeds
based on the interconnection and interoperability.

- Basic **description frameworks**,
- **Alignment** between different models and frameworks.
- **Semantic Annotation** are the starting point,
- **Information Interchange** between data/services from different frameworks and providers.
- **Reasoning** and **interpretation** of data is required for automated processes.
- **Automation** for federated IoT systems intervention.

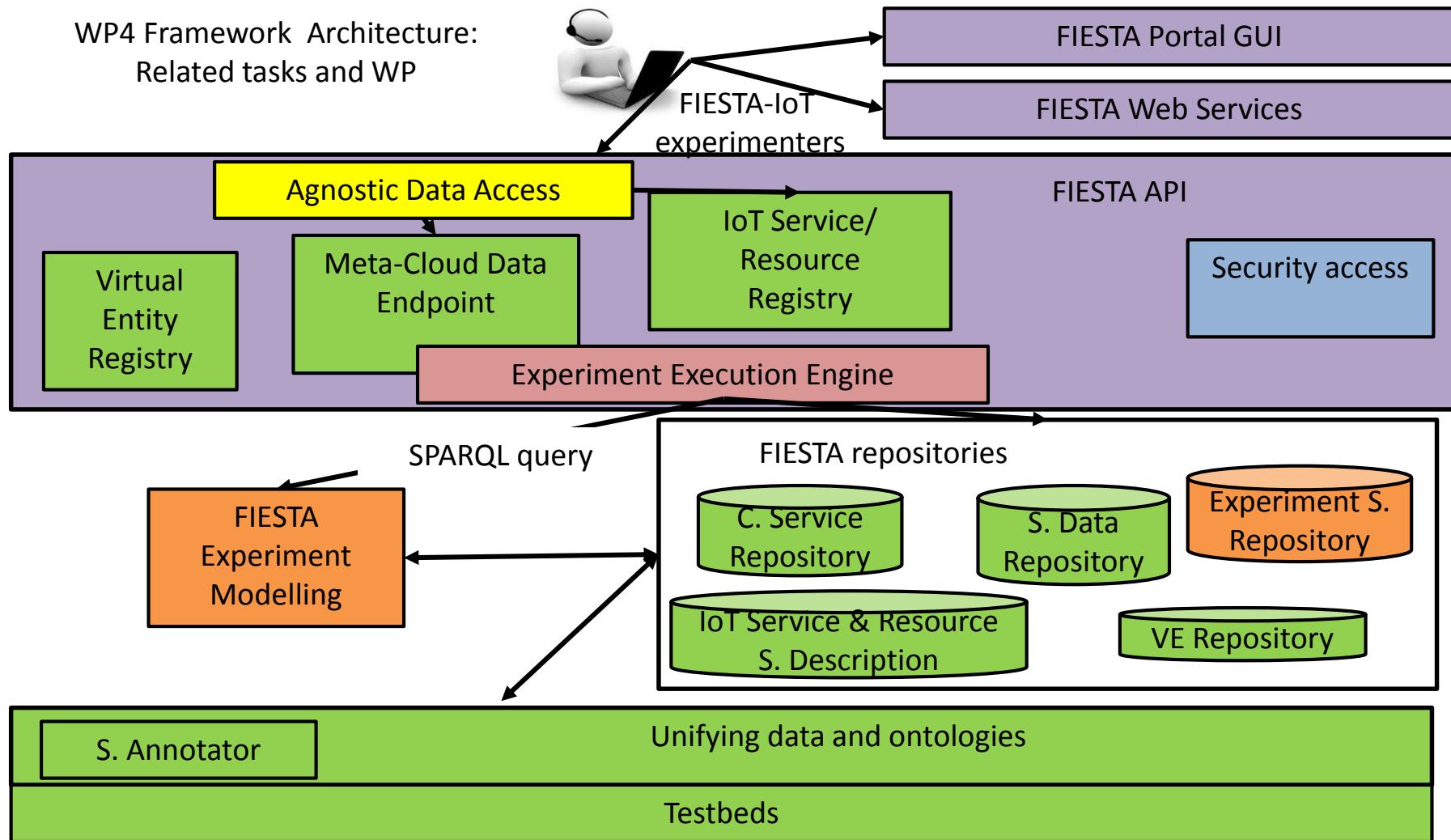
Semantic Interoperability Process (FIESTA-IoT Data Lifecycle)



Semantic Interoperability ARCHITECTURE (FIESTA-IoT Data Management Components)



WP4 Framework Architecture: Related tasks and WP



Semantic Interoperability ARCHITECTURE (FIESTA-IoT Data Management Components)



To achieve the challenges we are using the semantic enhance as way...



Semantic web layers – Agent-based Computing.



Fact 1.

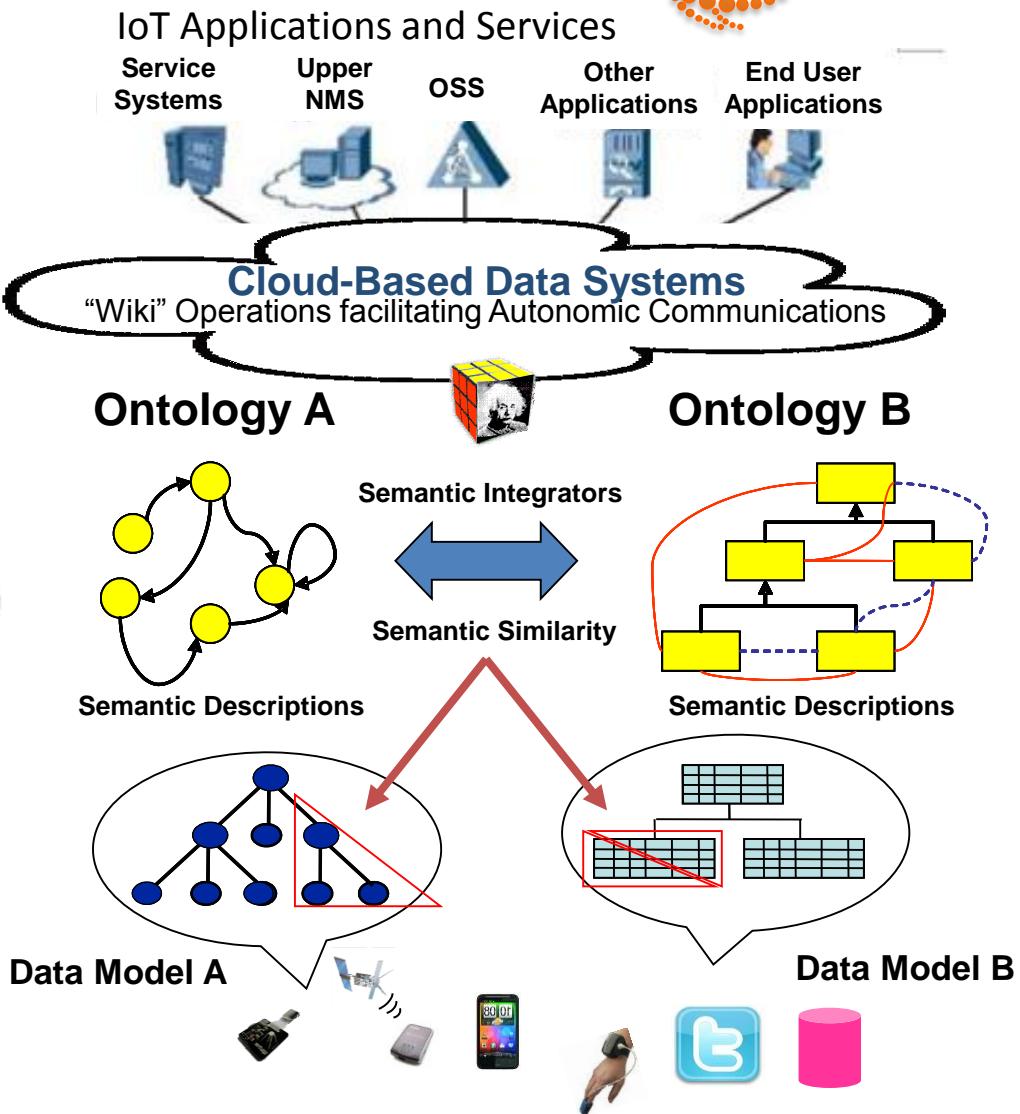
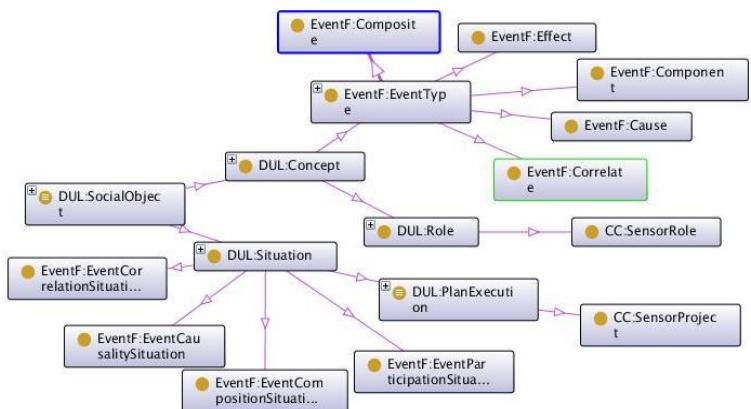
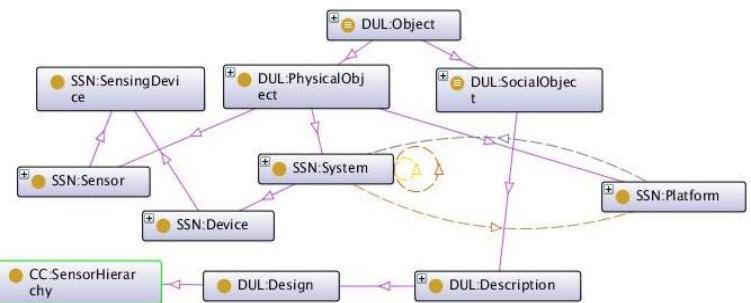
The integration of the information in sensor and applications constitutes a real challenge.



Fact 2.

It is highly desirable the sensor-collected data be distributed all over the services and users in a cross-layered panorama.

Using Semantic Interoperability





FIESTA-IoT is a flagship European Project infrastructure with tools and techniques integrating IoT testbed/platforms and Interconnect facilities and Federate Resources/Devices Federated Model

Experimenter / Service Providers



FIESTA-IoT EaaS API



EaaS Tools/Enablers

FIESTA-IoT Meta-Directory

Semantic Resource Directory

Semantic Observations Directory

FIESTA-IoT Meta-Platform
(Cloud-based)

FIESTA-IoT Testbed API

Semantic IoT Resource's and IoT Services' descriptions

Semantic Observations

Semantic Annotator

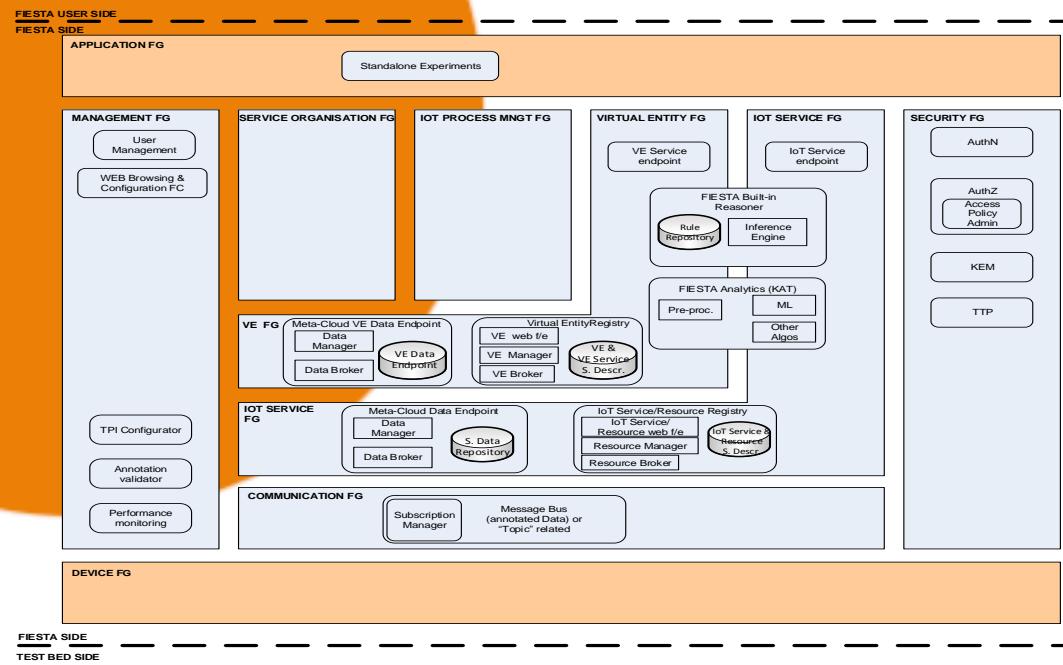
Resource Directory

IoT testbed #1

...

IoT testbed #N

IoT-Reference Architecture

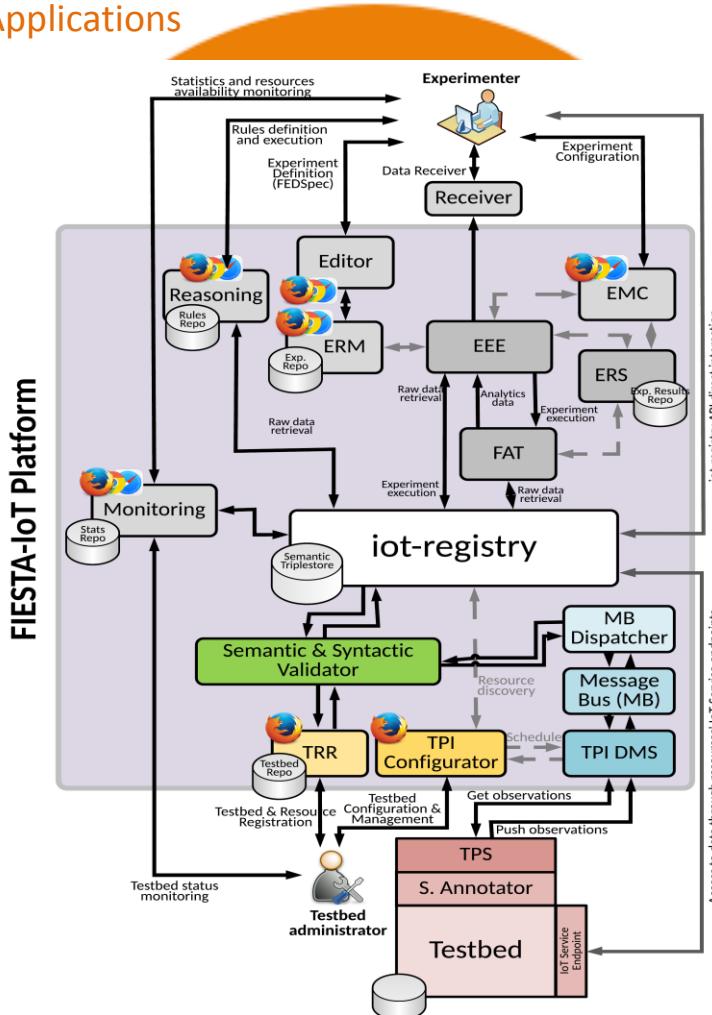


The Portal for European IoT

Federated Data Services
© 2019 FIESTA-IoT Consortium



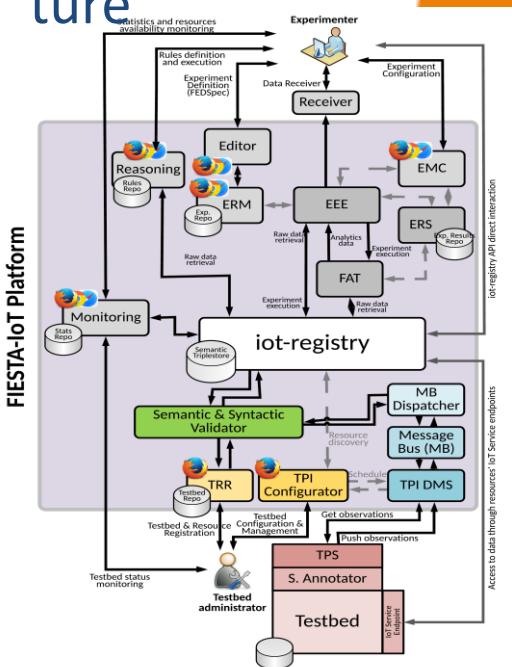
FIESTA-IoT Reference Implementation



The Portal for European IoT Federated Data
Services, Integration
© 2019 FIESTA-IoT Consortium



FIESTA- Reference Architec- ture



The Portal for European IoT Federated Data Services,
Integration and Access © 2019 FIESTA-IoT Consortium



FIESTA-IoT

Federated Interoperable
Semantic IoT/cloud
Testbeds and Applications



OpenAM

https://platform.fiesta-iot.eu/portalui/

Inria

.....

Remember my username

[Forgot Username?](#) | [Forgot Password?](#)

[LOG IN](#)

New here? [Create an account](#)

FIESTA IoT

Inria Paris Online

- Home
- Experimenter
- Testbed Provider
- Tools
- Demo
- Help
- Create Ticket

Welcome to the platform portal of FIESTA-IoT

What is FIESTA-IoT ?

FIESTA-IoT is project that provides a Blueprint Experimental Infrastructure for Heterogeneous IoT Technologies. FIESTA-IoT provides tools, techniques, processes and best practices enabling IoT testbed/platforms operators to interconnect their facilities in an interoperable way based upon cutting edge semantics-based solutions.

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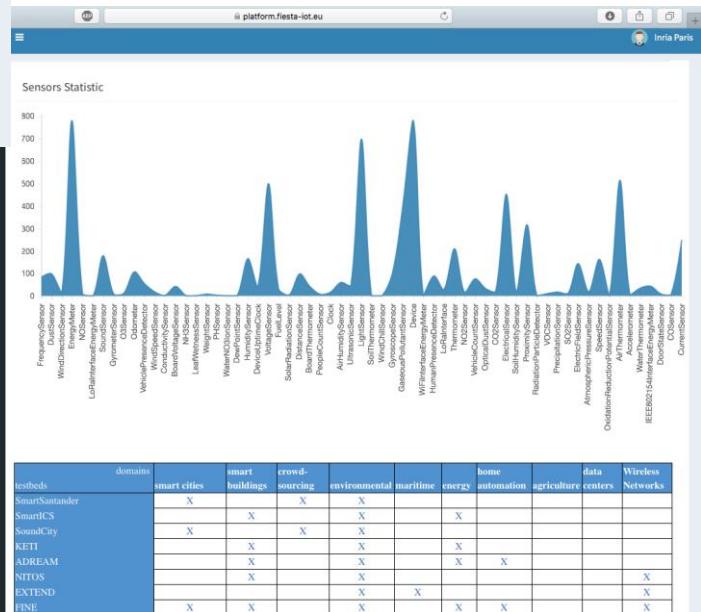
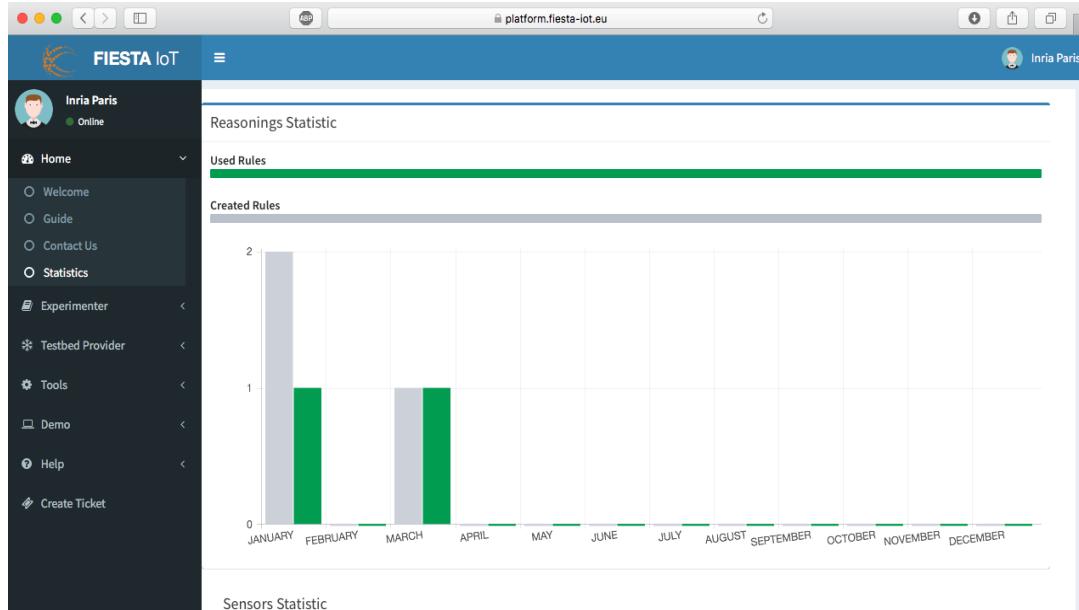
FIESTA-IoT
www.fiesta-iot.eu

Testbeds & Experiments

The FIESTA-IoT platform federates 10 IoT [testbeds](#) providing access to a wealth of heterogeneous IoT data. These ten [testbeds](#) are geographically distributed, and have distinct data offerings that can be combined to develop innovative IoT [experiments](#).

Map showing the geographical distribution of FIESTA-IoT testbeds across Europe and Asia.

FIESTA-IoT Platform – Live Statistic



Portal - Document



FIESTA-IoT

- ?
- Help
- >About FIESTA-IoT
- Support
- Documentation
- Moodle
- Deliverables
- EEE API
- IoT Registry API
- Annotator API
- Testbed & Resource API
- Reasoning API
- Experiment Storage API
- FAT API
- Validation API
- FIESTA-IoT Ontology
- M3-Lite Taxonomy
- Social Media Resources


FIESTA IoT


Inria Paris
Online

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FIESTA-IoT
www.fiesta-iot.eu

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for other case, use:

```
InputStream input = urlConn.getInputStream();
StringWriter buffer = new StringWriter();
byte[] b = new byte[1024];
int readBytes = 0;
while (true) {
    readBytes = input.read(b);
    if (readBytes < 0) break;
    buffer.append(new String(b, 0, readBytes));
}
input.close();
JSONObject json = new JSONObject(buffer.toString());
```

Created by Experiment Execution Engine API support
[Contact the developer](#)

Accounting REST API	Show/Hide	List Operations	Expand Operations
Monitoring REST API	Show/Hide	List Operations	Expand Operations
Polling REST API	Show/Hide	List Operations	Expand Operations
Scheduling REST API			
POST	/scheduler/scheduleFISMOExecution	Scheduling a FISMO	
GET	/scheduler/getJobIdFromFISMOIDUserIdAndFEMOID	Get job ID from a FISMO ID and userID	
GET	/scheduler/getJobIDDetails	Get Job details	
POST	/scheduler/stopJobExecution	Pause a job from further execution	
POST	/scheduler/resumeJobExecution	Resume a paused job from further execution	
POST	/scheduler/rescheduleJob	Reschedule a job	
POST	/scheduler/deleteScheduledJob	delete a job	
Subscription REST API			
POST	/subscription/subscribe	Subscribe to a resource	
POST	/subscription/unsubscribe	Unsubscribe from a resource	

FIESTA IoT © Copyright 2017 - Federated Interoperable Semantic IoT Testbeds and Applications

Federated Interoperable Semantic IoT/cloud Testbeds and Applications. © Copyright 2019 FIESTA-IoT Consortium 29

FIESTA-IoT Experiments



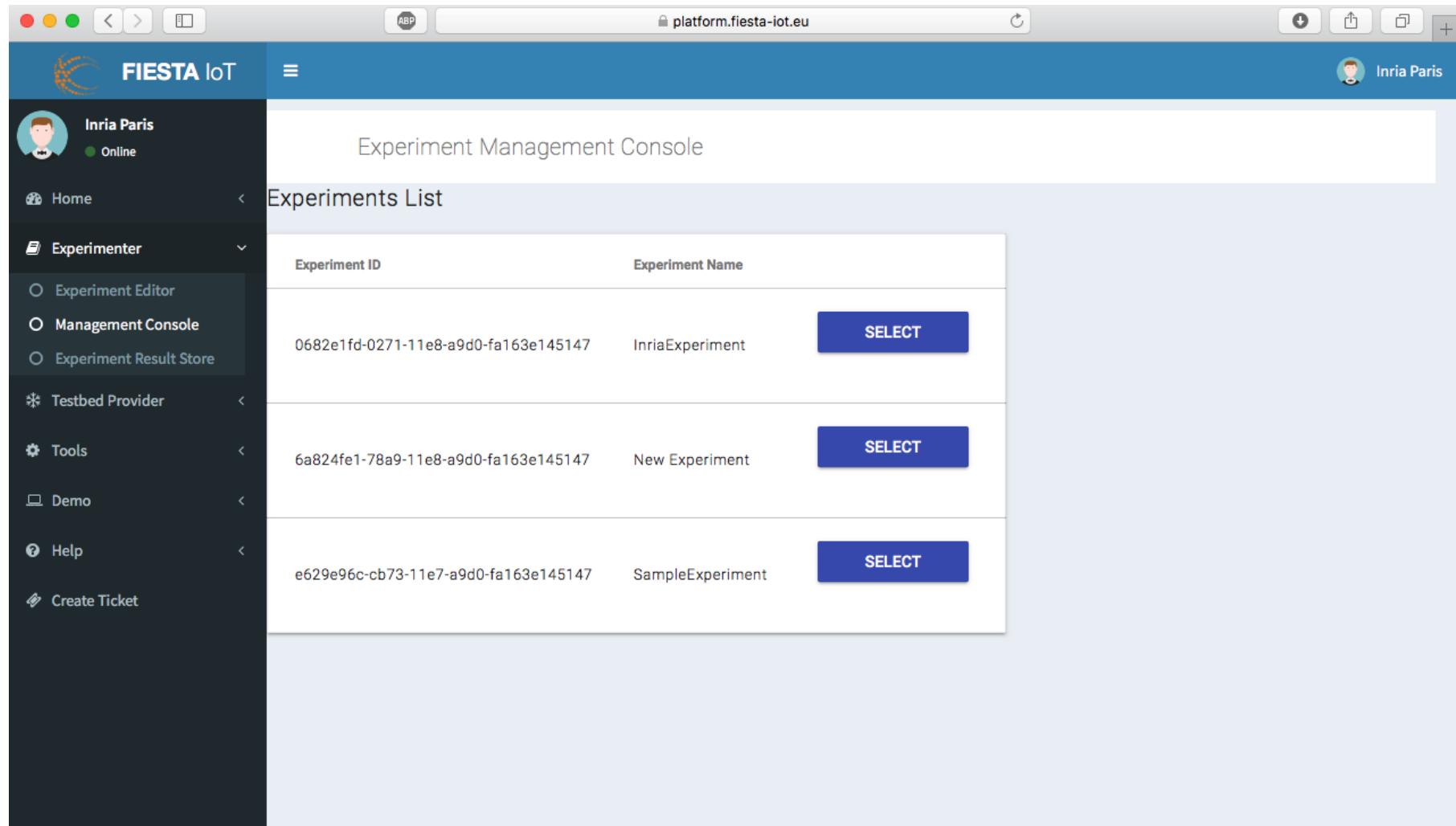
The screenshot shows the FIESTA-IoT Experiment Platform interface. On the left is a sidebar with the following navigation items:

- Inria Paris (Online)
- Home
- Experimenter
- Experiment Editor (selected, highlighted with a yellow arrow)
- Management Console
- Experiment Result Store
- Testbed Provider
- Tools
- Demo
- Help
- Create Ticket

The main content area has the following sections:

- Import Experiments XML:** A form to upload an XML file named "femo.xml" (0.01 MB). It includes a "Drop Experiment XML file here" input field, a file selection button ("파일 선택"), and "Upload", "Cancel", and "Remove" buttons.
- New Experiment:** A card showing 2 fismos and a "DomainOfInterest" button.
- TemplateExample:** A card showing 1 fismos and categories: Transportation (red), Environment (green), City (yellow), and Health (light green).
- Experiment cards:** Several cards for "New Experiment", "New Experiment", "New Experiment22", and "New Experiment". Each card shows the number of fismos (1 or 0), a "DomainOfInterest" button, and edit/delete icons.
- Bottom controls:** Arrows pointing down from the experiment cards to "Create new Experiment" and "Delete Experiment" buttons.

Experiment Management and Execution



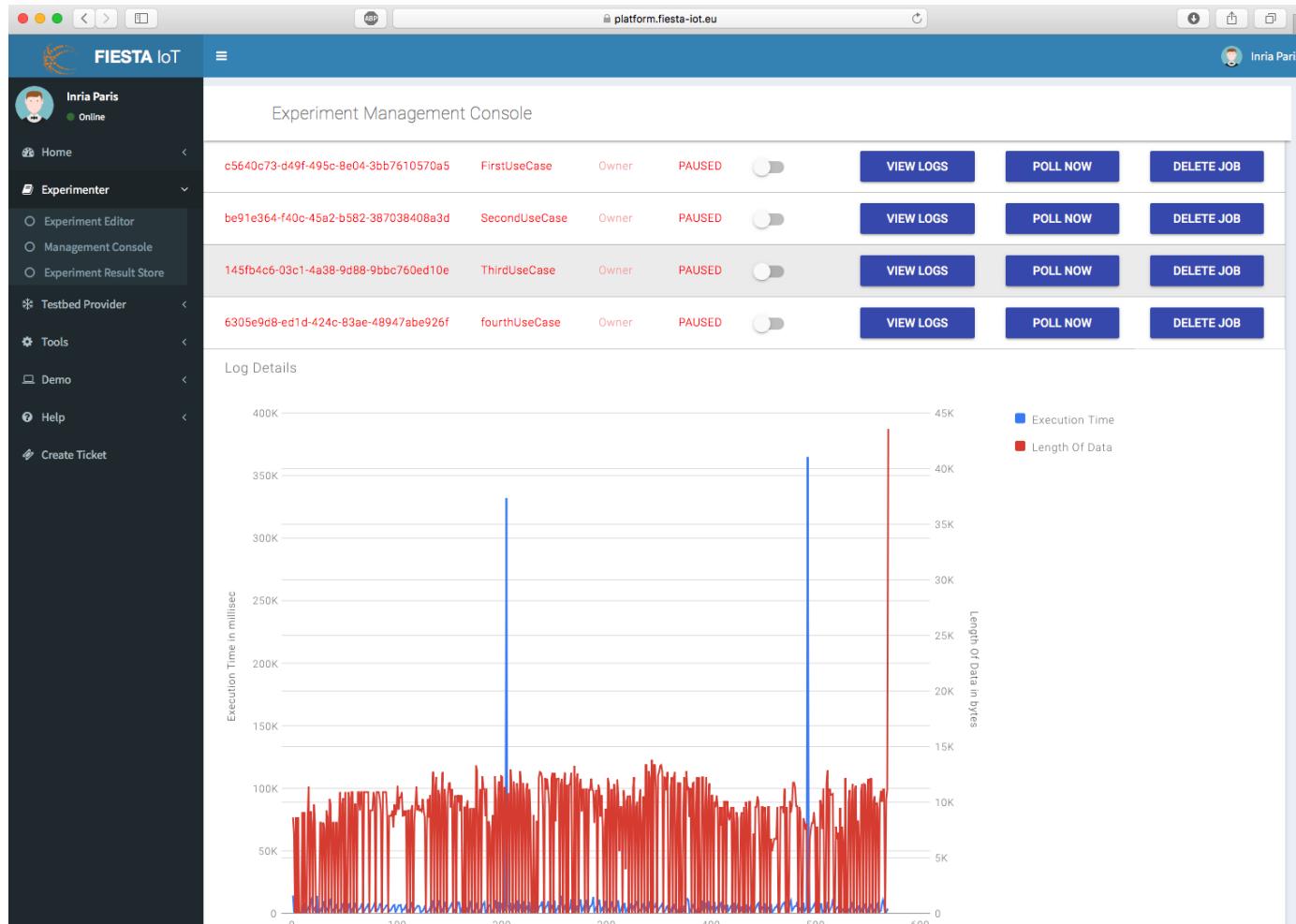
A screenshot of the FIESTA-IoT Experiment Management Console. The interface has a dark sidebar on the left with a user profile for "Inria Paris" (Online), and a navigation menu with options like Home, Experimenter (selected), Experiment Editor, Management Console, Experiment Result Store, Testbed Provider, Tools, Demo, Help, and Create Ticket. The main area shows the "Experiment Management Console" title and "Experiments List". A modal dialog is open over the list, showing three experiments:

Experiment ID	Experiment Name	Action
0682e1fd-0271-11e8-a9d0-fa163e145147	InriaExperiment	SELECT
6a824fe1-78a9-11e8-a9d0-fa163e145147	New Experiment	SELECT
e629e96c-cb73-11e7-a9d0-fa163e145147	SampleExperiment	SELECT

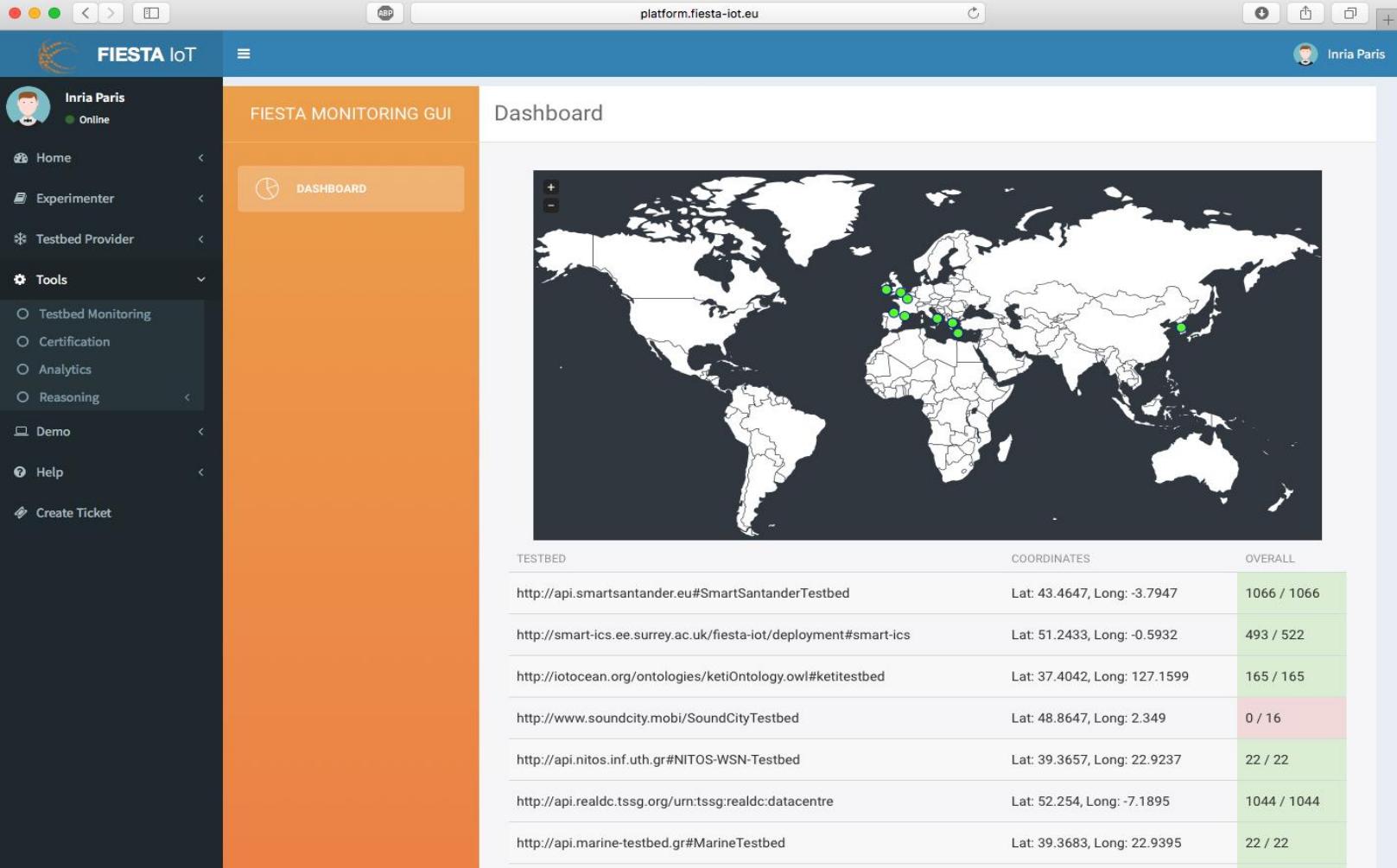
Experiment Management and Execution



Service status



Portal - Testbed Monitoring



The screenshot shows the FIESTA-IoT Monitoring GUI Dashboard. The left sidebar has a dark theme with orange highlights for the active 'Testbed Monitoring' tool. The main area has a light orange header with the title 'FIESTA MONITORING GUI' and a 'DASHBOARD' button. The dashboard itself features a world map with green dots indicating active testbed locations, primarily concentrated in Europe. Below the map is a table with data for seven testbeds:

TESTBED	COORDINATES	OVERALL
http://api.smartsantander.eu#SmartSantanderTestbed	Lat: 43.4647, Long: -3.7947	1066 / 1066
http://smart-ics.ee.surrey.ac.uk/fiesta-iot/deployment#smart-ics	Lat: 51.2433, Long: -0.5932	493 / 522
http://iotocean.org/ontologies/ketiOntology.owl#ketitestbed	Lat: 37.4042, Long: 127.1599	165 / 165
http://www.soundcity.mobi/SoundCityTestbed	Lat: 48.8647, Long: 2.349	0 / 16
http://api.nitos.inf.uth.gr#NITOS-WSN-Testbed	Lat: 39.3657, Long: 22.9237	22 / 22
http://api.realdc.tssg.org/urn:tssg:realdc:datacentre	Lat: 52.254, Long: -7.1895	1044 / 1044
http://api.marine-testbed.gr#MarineTestbed	Lat: 39.3683, Long: 22.9395	22 / 22

Expected Collaborations



European Research Cluster on the Internet of Things
(www.internet-of-things-research.eu)

IERC AC1 on Architecture approaches and open platforms
IERC AC2 on Naming, addressing, means of discovery
IERC CA4 on Service Openness and Semantic Interoperability
IERC AC5 on Governance, Privacy and Security



2013 "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems"
2011 - Internet of Things Technological and Societal Trends.
2010 - Vision and Challenges for Realising the Internet of Things.
SRA Strategic Research Agenda (SRA) IoT
IERC Strategic Research and innovation Agenda (SRIA)



FIESTA-IoT

Federated Interoperable
Semantic IoT/cloud
Testbeds and Applications



Horizons 2020-ICT-2014-1 / ICT-11-2014(RIA-IA)
FIRE+ (Future Internet Research & Experimentation)

14 Partners

EU-ICT FIESTA **36** Months

2 Open Calls

Experiments **10-20** IoT participants

EU Contribution **5,132,584.00** Euro

2015-2017

Coordinator: Dr. Martin Serrano
National University of Galway (INSIGHT)
E-mail: martin.serrano@insight-centre.org



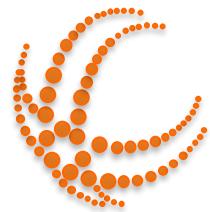
FIESTA-IoT
www.fiesta-iot.eu

FIESTA Consortium Participants



Participant No.	Participant Organisation Name	Part. Short Name	Country
1	INSIGHT@National University of Galway	NUIG-Insight	Ireland
2	University of Southampton IT Innovation Centre	ITINNOV	UK
3	Institut National de Recherche en Informatique & Automatique	INRIA	France
4	University of Surrey	UNIS	UK
5	Unparallel Innovation, Ltd.	UNINNOVA	Portugal
6	Easy Global Market	EGM	France
7	NEC Europe Ltd.	NEC	UK
8	University of Cantabria	UNICAN	Spain
9	Association Plate-forme Telecom	Com4innov	France
10	Research and Education Laboratory in Information Technologies Athens Information Technology	AIT	Greece
11	Sociedad para el Desarrollo Regional de Cantabria	SODERCAN	Spain
12	Ayuntamiento de Santander	SDR	Spain
13	Korea Electronics Technology Institute	KETI	Korea
14	Fraunhofer Institute for Open Communication Systems	FOKUS	Germany





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Semantic IoT/cloud Testbeds and Applications



The Challenges of the IoT Cross-Domain Integration Session

Federation and Cross Domain Interoperability

19 June 2018, Aarhus, Denmark



Dr. Martin Serrano
ICT/IoT Expert, Data Scientist, Head Unit Leader
Internet of Things, Stream Processing and
Intelligent Systems Research Unit
IEEE ComSoc Chair IoT Experimentation Chapter
OASC.ie Board Member



Thanks