An energy marketplace dashboard as a practical example of
Future Internet enablers integration
at the Terni trial

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Pasquale Andriani, Massimiliano Nigrelli
Engineering Ingegneria Informatica S.p.A.

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SEVENTH FRAMEWORK PROGRAMME

FUTURE INTERNET PPP

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P. Andriani (ENG)
M. Nigrelli (ENG)

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Introduction

- **Context**: growing density of Renewable Energy Sources (RES) in the electrical grid
  - **Issues:** misalignment between RES production and users consumption, reverse power flows, power losses, voltage drops
- **Proposed solution:** an **energy marketplace**, fed with data coming from the **city of Terni**, built on top of **FIWARE GEs** to enable both demand response and "issue solving" actions on **MV/LV grid**
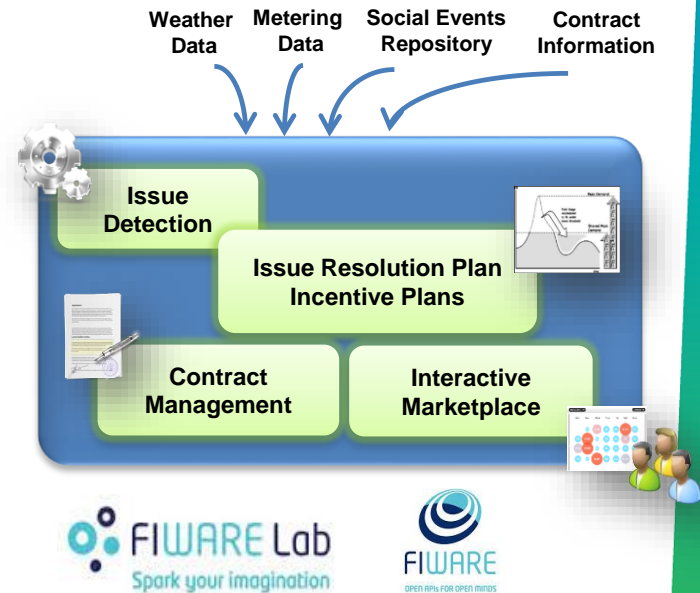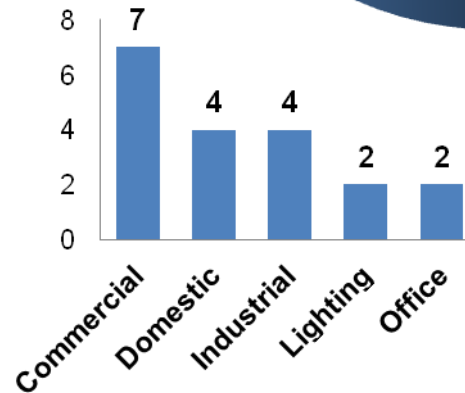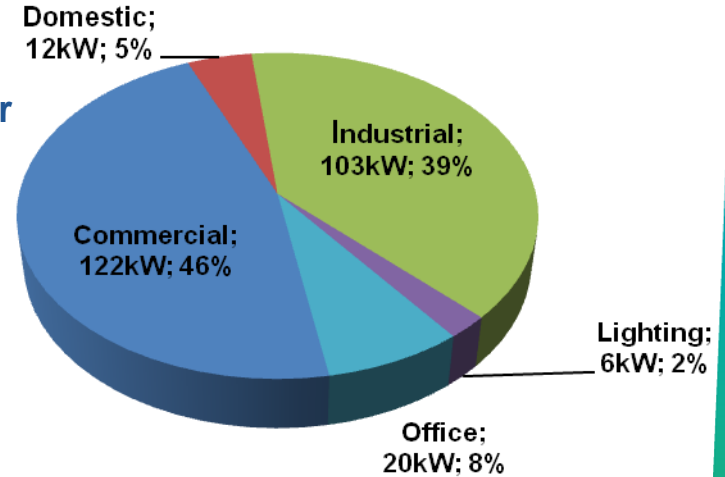
TERNI trial site

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Trial site area: Terni (Italy)

Sectors and Installed Active Power

1 ASM TERNI SPA

2 Secondary Sub. SCOV

3 WP4 Area
Area: 68,182 sq.mts

Domestic; 12kW; 5%
Industrial; 103kW; 39%
Commercial; 122kW; 46%
Lighting; 6kW; 2%
Office; 20kW; 8%

- **Number of users per sector: 19**
- **2 PV ➜ 215 kW**

Trial status

- **Trial Implementation**
    - Seven P2 meters have been actively gathering data from September 2013
    - Installation of **five ZXF E350 Landis+Gyr** meters was finalized in January 2015 based on a combination of DLMS/COSEM and G3-PLC technologies
- **Benefits of DLMS/COSEM and G3-PLC technologies integration**
    - As **DLMS/COSEM** is already a standardized solution in natural gas and water metering, multi-utilities (such as ASM) are interested in consolidating its adoption
    - **G3-PLC** is based on high-speed narrow-band **power line communication** (i.e. 150 – 500 kHz) and represents a **promising trade-off** between **higher data rates** and a requirement for **reliable communication** on MV/LV network

Energy Marketplace concept

- The marketplace acts as an **energy "*information hub*" for different stakeholders**: Aggregator(s), DSO(s), Market Regulator, Energy Retailer(s), final Customer(s)

- The marketplace is equipped with a **dashboard** that an aggregator uses to publish **"issue solving" actions** that a Retailer can turn into a plan of **incentives/disincentives** which are finally translated into a contract proposal for the final customer
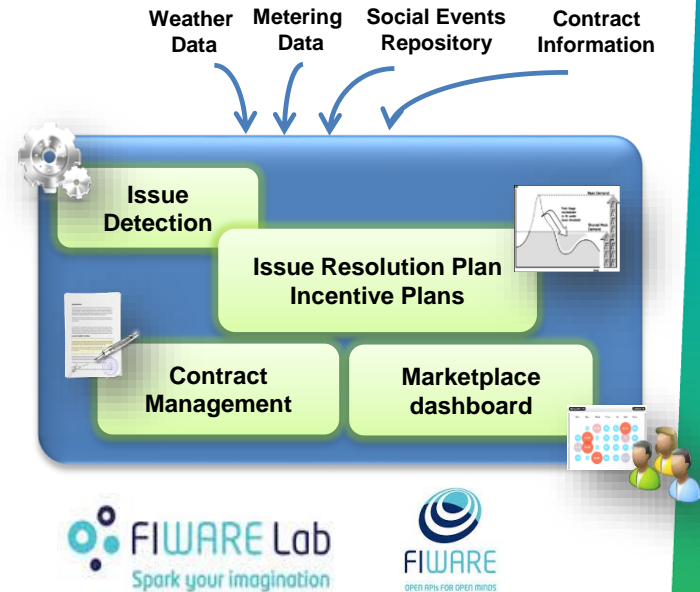
Future plans

- **Marketplace dashboard** is a tool to enable both **demand response** and **"issue solving"** actions thus improving **stakeholders operational efficiency**

- ASM as a DSO is **evaluating the usage** of the tools and the underlying implemented architecture for its **day-to-day operation** beyond FINESCE
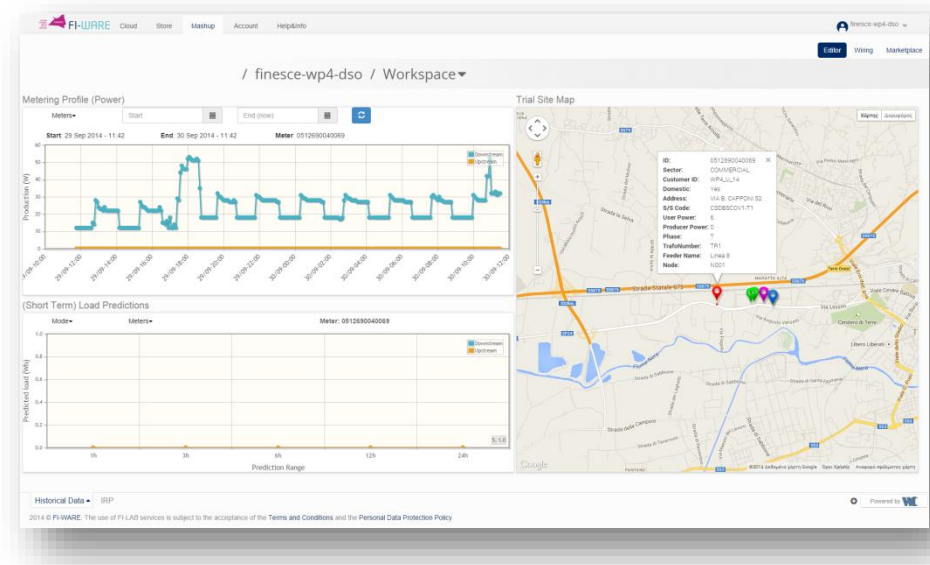
Support to SMEs and FIWARE Accelerators

- Access to the data gathered from the trial site is allowed via the FINESCE APIs

  - Marketplace APIs access is enforced by KeyRock Identity Management GE upon trial site owners authorization

- Marketplace data connectors (named "FINESCE DSEs") are available as Open source software under the Apache 2/GPLv2 license at http://finesce.github.io/

- Both a description and a link to the Marketplace dashboard for public users are available at http://www.fiware.org/finesce-terni

A deeper look into technical details

Marketplace architecture
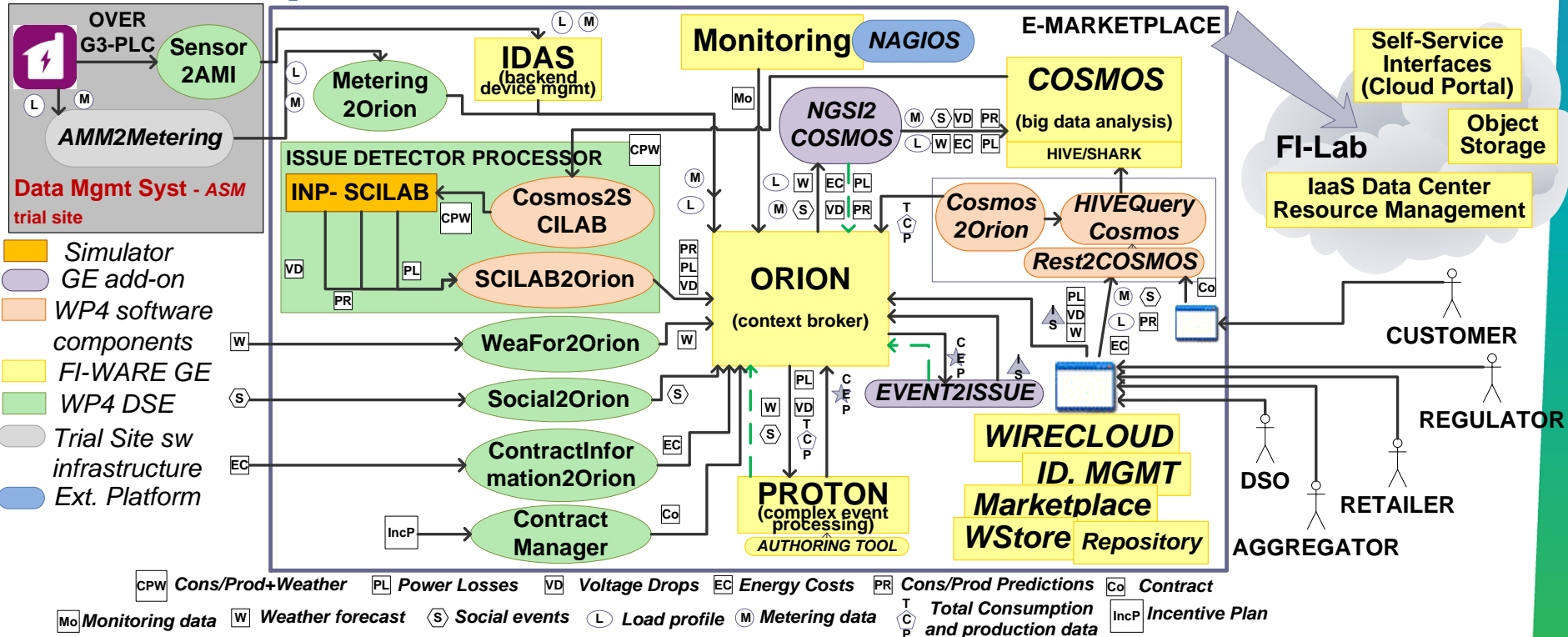
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[DEMO]

Advantages and benefits of using GEs

ADVANTAGES / GENERIC ENABLERS	Cloud GEs	COSMOS Big Data Analysis GE	WIRECLOUD Application Mashup GE	ORION Context Broker GE	PROTON Complex Event Processing GE	OBJECT STORAGE GE	KEYROCK Identity Management GE	IDAS (Backend) Device Management GE
free support (contact person available via email)	■	■				■	■	
no hardware to be purchased	■	■						
free usage (no costs per hour / no licensing costs)	■	■		■		■	■	■
cloud based (available as SaaS) + no hardware to be purchased + no installation activities to be carried forward (GE Global instance)		■	■			■	■	
openness: no vendor lock in			■	■	■			
no need of extreme hardware configuration			■			■		
comes with native integration with other GEs, thus being part of an entire ecosystem			■	■	■			
cloud based: installable from image available on a catalogue (coming with a default configuration) on a cloud-based VM (GE private instance)			■	■	■			
natively integrated in the FIWARE cloud infrastructure							■	■

- Availability of a contact person (the "GE owner")
- No costs of hardware, hosting and licensing in the context of the FI-PPP programme
- Future Internet "ecosystem"
- Based on "open standards" and so GEs can easily be integrated with other products either open source or COTS

Conclusions

- The **energy marketplace dashboard** represents a tool to enable both **demand response** and **"issue solving"** actions thus improving stakeholders **operational efficiency**

- **Marketplace DSEs** (in combination with related GEs) available as open source software **allow SMEs to smooth the learning curve** when joining the FIWARE ecosystem applied to the energy domain

- **FIWARE GEs adoption** is appealing based on factors such as availability and type of **support**, **no costs** of infrastructure, **interoperability** and **open standards**, although operational issues have been risen from time to time

FINESCE GEs

	GE Name	What is "roughly" a GE?
1	Context Broker (ORION)	Message Brokers - Distributed publish-subscribe Messaging System
2	CEP (PROTON)	Event Processing Software
3	Big Data Analysis (COSMOS)	Big Data ecosystem (Hadoop)
4	Application MashUp (WIRECLOUD)	MashUp Editor
5-6	Cloud GEs	Cloud facilities (OpenStack)
7	Object Storage	Cloud storage products/services based on CDMI (Swift)
8	Identity Management (KEYROCK)	Cloud integrated framework for authentication and authorization (OAuth2)
9	(Backend) Device Management (IDAS)	IoT Device Management

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FINESCE GEs

	GE Name	Evaluation - Issues
1	Context Broker	good performance; the most updated and well documented
2	CEP	good performance; Auth Tool UI tailored on tech people
3	Big Data Analysis	works as expected; frequent problems with data retrieval performance (Shark often crashes!!)
4	Application MashUp	works as expected; high standards performance and stability
5-6	Cloud GEs	VMs and GE instances easy to be created; unexpected "crashes" affecting marketplace dashboard operation
7	Object Storage	stable and swift
8	Identity Management	integration into Application MashUp infrastructure well documented and easy to accomplish
9	(Backend) Device Management	satisfying level of support; not very detailed documentation; insert different observations in a single call is not possible!

Marketplace DSEs

Specs of FINESCE DSEs are publicly available (**GitHub**); the source code has been released as open source (under the Apache 2.0 license).

	DSE Name (module name)	Description
1	Social Events Interface (Social2Orion)	a REST service by which a social information provider sends social events data to an instance of ORION Context Broker
2	Weather Condition Interface (WeaFor2Orion)	a Timer service that collects weather forecast data from a third-party weather forecasting service and then sends them to an instance of ORION Context Broker
3	Metering (Metering2Orion)	a client/server application that accepts metering data coming from a Trial site, translates it into an NGSI10-compliant format and then publishes it onto an instance of ORION Context Broker
4	Contract Information (ContractInformation2Orion)	a REST service by which a retailer sends energy related costs to an instance of ORION Context Broker

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	DSE Name (module name)	Description
5	Contract Tailor Processor (ContractManager)	ContractManger is a REST service (developed in Java) which translates the incentives included in an IncentivePlan into a new Contract proposal that will be saved into an ORION Context Broker GE instance.
6	Protocol Adapter AMM (Sensor2AMI)	The Protocol Adapter Sensor2AMI is a software solution for reading Landis+Gyr E350 DLMS/COSEM compatible electric energy meters and publishing application-specific power and energy profiles to Device Backend Management GE.
7	Issue Detector Processor (Cosmos2SCILAB + INP-SCILAB + SCILAB2Orion)	COSMOS2SCILAB - a Java TIMER client which, every fifteen minutes, writes the last weather forecast and the last load profile information retrieved from Cosmos onto two .csv files. SCILAB2ORION - a Java TIMER client which, every fifteen minutes, reads PowerLosses/VoltageDrops and Load Prediction (from .csv files) and then writes/updates ORION Context Broker GE entities.