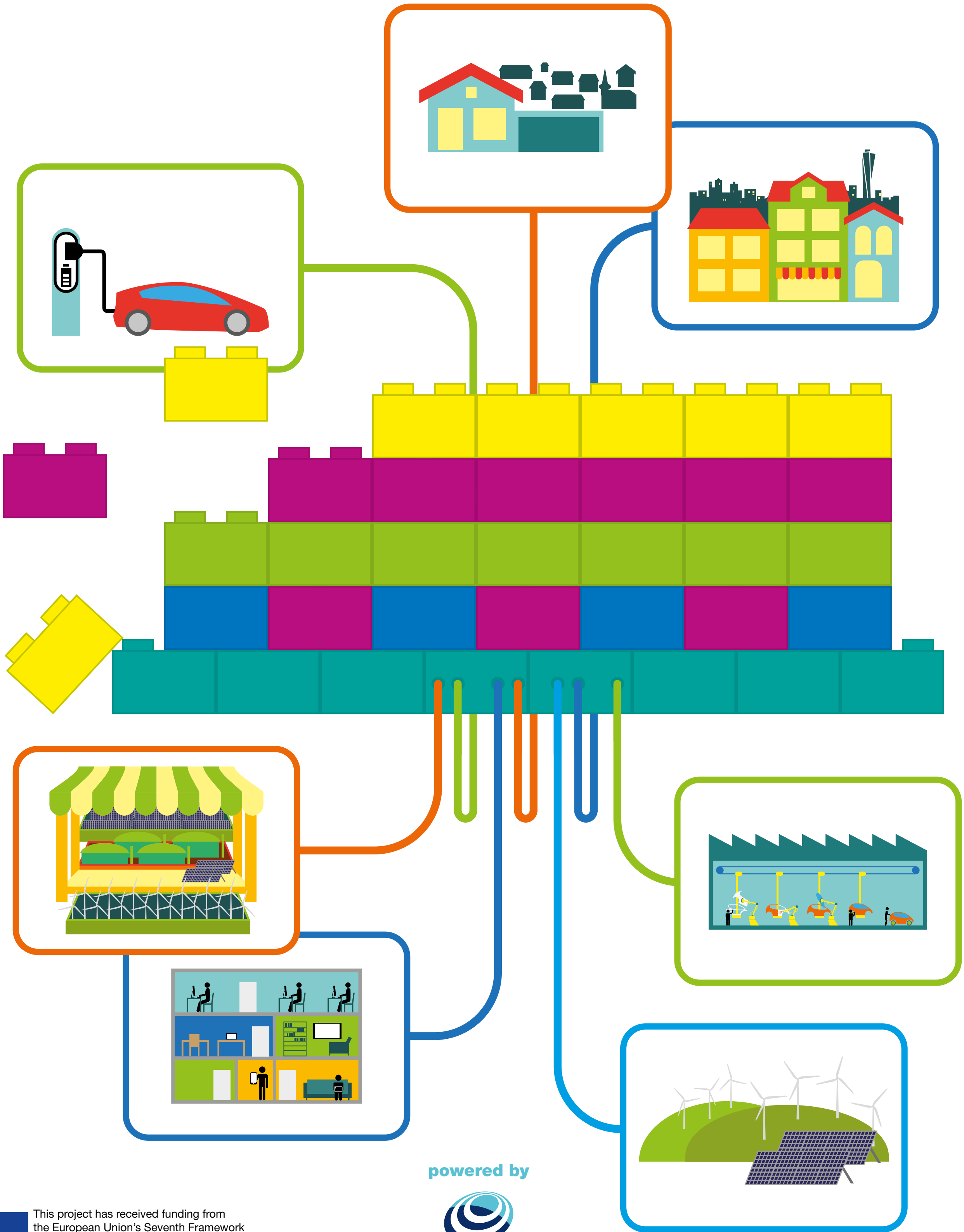
The FINESCE Smart Energy Platform

FUTURE
INTERNET
SMART
UTILITY
SERVICES

FINESCE



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FIWARE

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Authors: Alexander von Jagwitz, Helena Geißler, Dr Fiona Williams, Prof. Antonello Monti, Padraic McKeever, Adelheid Weinert, Philipp Reiß and many contributors from the FINESCE trial sites

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Lead Partner: Ericsson GmbH, Eurolab R & D.

Contact: Alexander von Jagwitz, Helena Geißler - finesce@baumgroup.de

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Content

Foreword

Now that the energy sector actors are embracing change and transitioning towards renewable energy and putting customers in the centre of an eco-system of energy services, the integration of the latest Information and Communications Technologies (ICT) into their infrastructures is becoming a priority.

ICT offers cost-effective communications and IT services, based on low latency wireless communications (e.g. LTE 4G and 4.5G), fibre optics and IT services with local edge processing in private edge clouds. The work of FINESCE in developing the FINESCE Platform has taken care of interfacing the new ICT technologies to the assets of the energy providers (sensors, meters, PMU's, actuators, etc) providing quick and easy means to set up field trials and plan large scale roll-outs.

The FINESCE field trials in 7 European countries show the technologies in operation and in this brochure, we provide you with an overview of the key learnings from the field trials.

If you would like more information or to see trial infrastructure at work, please contact us!

Dr Fiona Williams,
FINESCE Project Coordinator, Ericsson

The biggest challenge for modern utilities is the shift from a product-based to a service-based economy. In this context it is critical to offer competitive and always new services that are able to satisfy the needs of the customer, the new center of the infrastructure. To enable such a context, there is an urgent need of an ecosystem, and then a software platform, compatible with the new economic environment.

In the interest of the customer itself, it is critical that this platform is open so to have multiple players competing for the best offer and also so to have a rapid process development for innovative ideas.

In a nutshell, it is a new world based on completely new economic dynamics. FINESCE put the foundation to make this possible in Europe, on one hand creating the fundamental pieces of software that make the transition possible and on the other hand creating the conditions for a competitive market that will facilitate the penetration of renewable energy making the energy transition a reality.

The work is not over and it will require continuous improvement and, as any other software enterprise, maintenance and update. For this reason FINESCE implemented a solid plan to keep the work alive with the support of all the stakeholders.

An industry consortium coordinated by FEN GmbH, a company operating on behalf of RWTH Aachen University, is attracting industry partners in this initiative. More than 20 companies are planned to operate as founders of this initiative but the call is open to everybody anytime. We are ready to change the energy world with a pioneering approach centered in Europe and in support of European citizens and industries for a clean and green future. Come on board with us!

Prof. Antonello Monti,
FINESCE Technical Manager, RWTH Aachen

Introduction: Utility 4.0 – new energy services enabled by ICT platforms

In Europe utilities need to find ways to contribute to national climate goals, be "dynamic adopters" of fluctuating renewable energies in the grid and varying regulations without losing revenues. Addressing this challenge, an option is to offer and facilitate access to quantitative and qualitative energy data and human/user insights within a smart grid-ready setup that enables utilities to test and qualify new business models and engage in finding new customer-relationship models to be in line with the rise of new technologies, private Distributed Energy Resources (DER) and the future customers‘ needs and requirements.

Pressure on utilities regarding climate change is escalating, leading to much greater penetration of renewable energy sources, high load applications such as electric vehicles, increased prosumer activity and other complex developments, all resulting in increased risk of instability. A stream of flexible, economic solutions, to keep the grid balanced will be needed not so far into the future. Short development cycles and low cost deployment are essential requirements and this is where the Future Internet approach of reusable software components, the FIWARE Generic Enablers, and cloud based services, which can be combined to develop multiple applications, can help address these serious technical challenges.

Energy services have been static for many years, with little functional innovation occurring of the type that would benefit consumers. The gap between complex and inhomogeneous utility infrastructures and the world of software driven service development, often lead by small companies, could not be greater, and will not be bridged without the development of a standardised platform, as proposed by the FINESCE project. Such a platform will be expensive and difficult to develop unless Future Internet technologies are deployed to increase standardisation, reduce costs and product development times.

Smart Grids have been slower to roll out than originally forecasted, mainly to high cost of deployment in the distribution network. FINESCE has developed a radical solution based on low cost computing, software defined communications and systems layers by utilising Future Internet technologies to reduce software development costs.

The FINESCE project provides best-practice examples showing the importance to work with digitalised and cloud-based solutions for the energy sector getting ready for the next step: the service-based Utility 4.0.

FIWARE & FINESCE

FIWARE is an open initiative aiming to create a sustainable ecosystem to grasp the opportunities that will emerge with the new wave of digitalization caused by the integration of recent Internet technologies. The initiative is based on the following pillars:

The FIWARE platform provides a rather simple, yet powerful set of APIs (Application Programming Interfaces) that ease development of Smart Applications in multiple vertical sectors. The specifications of these APIs are public and royalty-free. Besides, an open source reference implementation of each of the **FIWARE Generic Enablers (GEs)** is publicly available so that multiple FIWARE providers can emerge faster in the market with a low-cost proposition.

FIWARE Lab is a non-commercial sandbox environment where innovation and experimentation based on FIWARE technologies take place. Entrepreneurs and individuals can test the technology as well as their applications on FIWARE Lab, exploiting Open Data published by cities and other organizations. FIWARE Lab is deployed over a geographically distributed network of federated nodes leveraging on a wide range of experimental infrastructures.

FIWARE Ops is a collection of tools that eases the deployment, setup and operation of FIWARE instances by Platform Providers. It is designed to help expand the infrastructure associated to a given FIWARE instance by means of federating additional nodes (datacentres) over time and allowing cooperation of multiple Platform Providers. FIWARE Ops is the tool used to build, operate and expand FIWARE Lab.

FIWARE Generic Enablers (GEs) are key software building blocks that are offering general-purpose functions and are thus applicable in different sectors and can be flexibly customized to be implemented in different use cases. GEs comprise sets of software components that enable the development of advanced and innovative Future Internet applications and services. It is the ability to serve a multiplicity of usage areas that characterizes GEs and distinguishes them from Domain Specific Enablers (DSEs). DSEs are common to multiple applications, but all of them specific to a very limited set of use cases. DSEs offer functions that are specific and characteristic in certain domains, In the case of FINESCE the Smart Energy domain.

The open and royalty-free nature of FIWARE GE specifications allows third parties to develop and commercialize platform products that are in compliance with FIWARE GE specifications. GE Open Specifications contain all the information required in order to build compliant products which can work as alternative implementations of GEs developed in FIWARE. Combining GEs (and DSEs) is easy to develop applications. Alternatively, GEs and DSEs can be added to already working applications to add new functions.

GEs are linked to the following main FIWARE Technical Chapters:

· Cloud Hosting

· Data/Context Management

· Applications/Services

· Internet of Things (IoT) Services Enablement –

· Interface to Networks and Devices (I2ND) –

· Security –

· Advanced WebUI

FIWARE GEs are available on www.fiware.org

Application Programming Interfaces (APIs) are specifications that allow a software programme to communicate and interact with another software programme implementing the API. Specifications of APIs and Interoperable Protocols supported by FIWARE GEs are public, royalty-free, and open source. They are already built-into the GEs and make their deployment easy. These APIs ease the development of Smart Applications in multiple vertical sectors.

FINESCE DSEs are open source, software components which are re-usable by developers in the Smart Energy domain. In order to be re-usable, code and specifications must be made available, thus allowing a developer to make his own implementation of a DSE.

FINESCE DSEs are software components that are useful to other developers in the Smart Energy domain. FINESCE DSEs consist of a reference implementation inside one of the trial sites and downloadable specifications and code. The structure of the DSE documentation follows that in the FIWARE Catalogue.

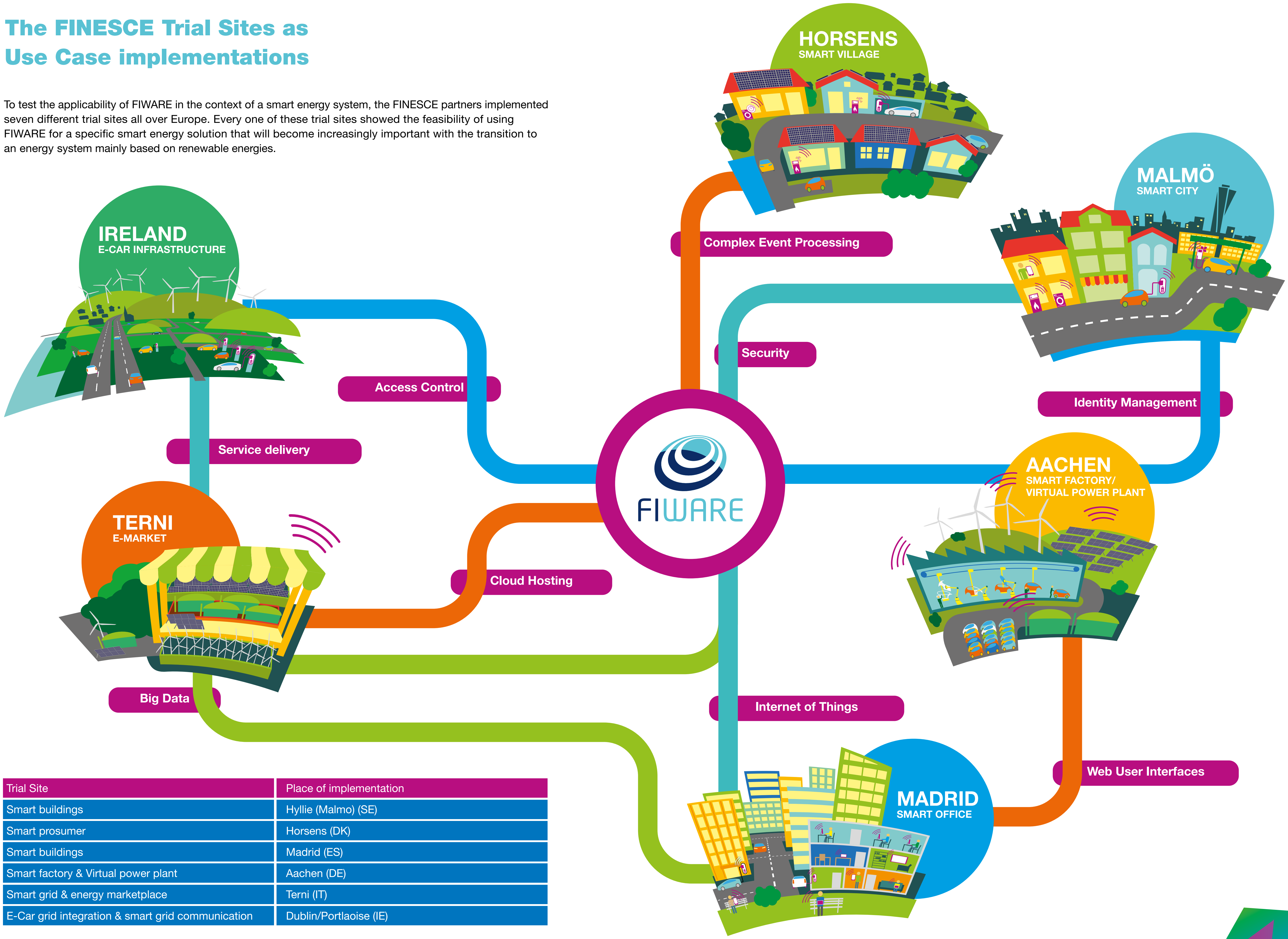
The FINESCE DSEs are Smart Energy components which have been developed in the context of the individual trials.They are individual, stand-alone components which may be of use to developers in integrating GEs and developing Smart Energy applications. They constitute a first step towards making a fuller, more complete set of such open source components.

As a special DSE FINESCE provides a unified, homogeneous Application Programming Interface (FINESCE API) to define a common format of interaction among distinct Smart Energy Systems and facilitate access of third parties to the functionality of its seven trials.

FINESCE DSEs are available on www.finesce.eu.

The FINESCE Trial Sites as Use Case implementations

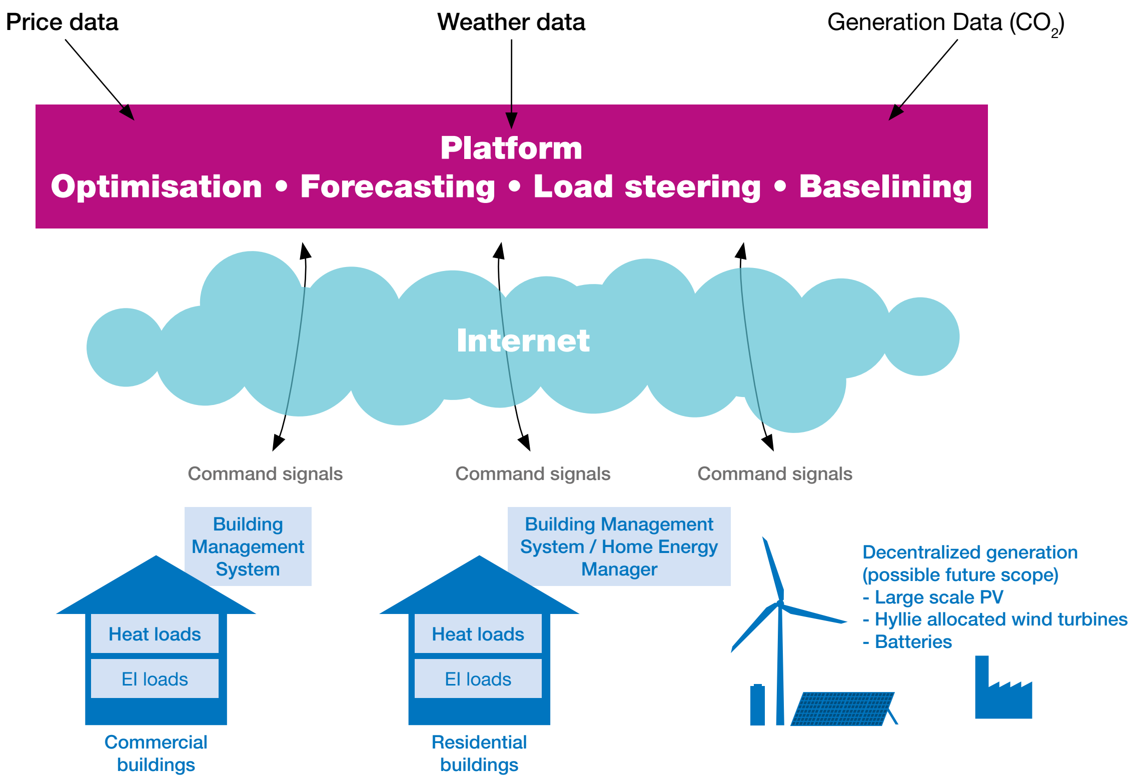
To test the applicability of FIWARE in the context of a smart energy system, the FINESCE partners implemented seven different trial sites all over Europe. Every one of these trial sites showed the feasibility of using FIWARE for a specific smart energy solution that will become increasingly important with the transition to an energy system mainly based on renewable energies.



Trial Site	Place of implementation
Smart buildings	Hyllie (Malmo) (SE)
Smart prosumer	Horsens (DK)
Smart buildings	Madrid (ES)
Smart factory & Virtual power plant	Aachen (DE)
Smart grid & energy marketplace	Terni (IT)
E-Car grid integration & smart grid communication	Dublin/Portlaoise (IE)

Malmö – Smart Buildings

The objective of the implementation with buildings in the Hyllie district in Malmo was to test Demand Side Management and Demand Side Response based on either price or share of green energy available (CO2) for both heat and electrical loads. Commercial and residential buildings were equipped with smart gateways (Energy Manager) connected to the building's building management system and in some cases also home energy management systems. Heat and electrical consumption were optimised by an energy management system according to price, energy mix (CO2) and / or weather data: the building management system adjusted consumption accordingly.

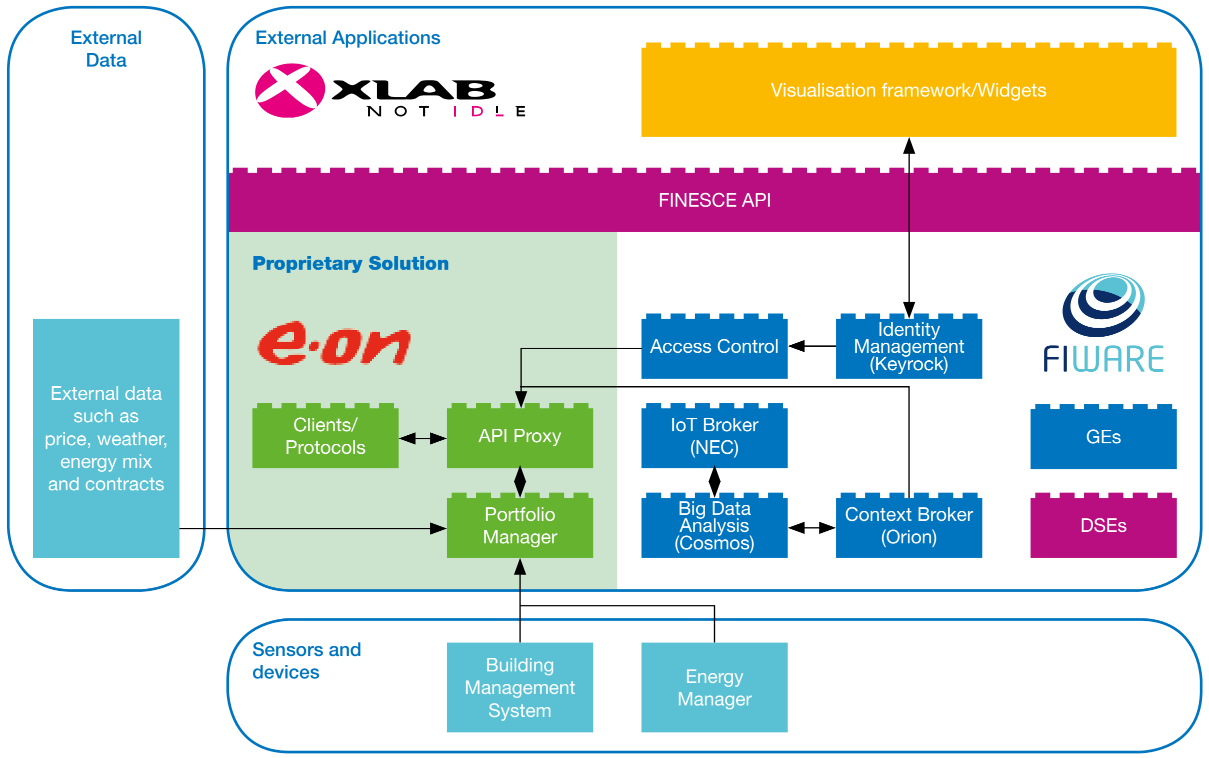


The functional architecture from a load optimization perspective is split into two distinct parts: the Portfolio Manager and the Energy Manager. The Portfolio Manager is responsible for a centralized portfolio management for clusters of buildings and the Energy Manager is responsible for a distributed energy management capability.

"Our trial site has gained a positive experience with FIWARE, mainly linked to data processing and security chapters. As for the data processing, we have integrated FIWARE Generic Enablers Orion Context Broker and Cosmos Big Data Analysis for executing Big Data related use cases. The general experience of working with Orion Context Broker and Cosmos Big Data Analysis has been very positive."

David Lillienberg, E.ON

The developed trial infrastructure has been proven to be a very flexible system with regards to handling different use cases and business models. One of the infrastructure's many strengths is the ability to deliver benefits both on a local level, optimization in the building, and at the same time on a global level.

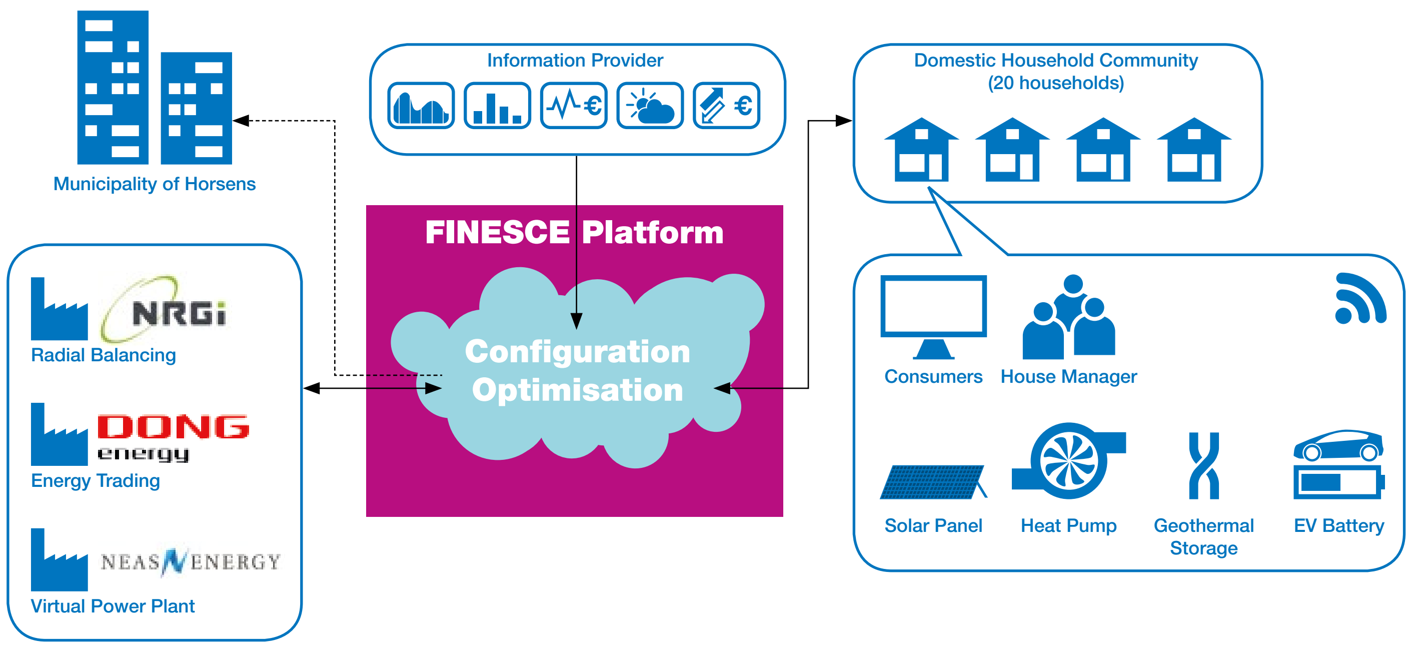


The **API Proxy** provides the external trial API and acts as a frontend integrator towards FI-Lab. As for the executing of Big Data related use cases, the **Context Broker GE (Orion)** has a very central position and interfaces to **Big Data Analysis (Cosmos). Identity Management (Keyrock)** is used for a single-sign-on to the external Visualization framework/Widgets.

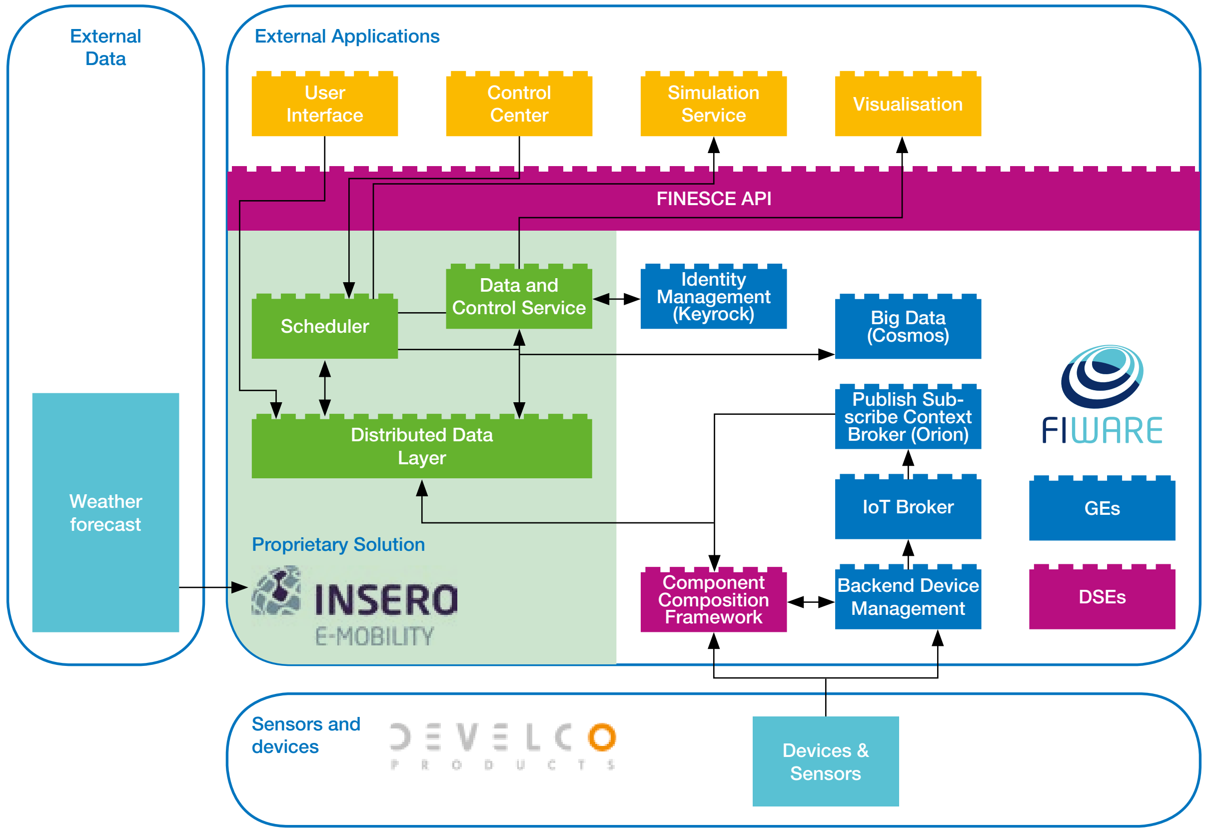
Big Data GE (Cosmos):
The GE allows you to inject historic context information records into an HDFS based storage. Big Data analysis or advanced queries can then be performed over historic data.

Horsens – Smart Prosumer

The trial site in Horsens focused on smart consumers and smart houses. In Horsens, the homes of 20 families were upgraded to intelligent homes equipped with the latest available energy and ICT technologies. The households tested not only the local interaction between the various technologies, but also the interaction with the overall energy system as a whole. Besides a Home Energy Visualisation System, the equipment included solar panels, geothermal storage, heat pumps and electric vehicles. The houses were linked together and managed via a local smart grid, and optimisation of energy consumption as well as the configuration of the different devices was enabled via cloud services. Data collected from the households was available through the FINESCE API.



The Component Composition Framework DSE mediates the different APIs exposed from the web services that gather the data from the devices. **The Scheduler** optimises the charging of EVs based on the users' preferences, measurements from the houses and prognoses from various services to optimise the way energy is used in the smart grid as a whole.



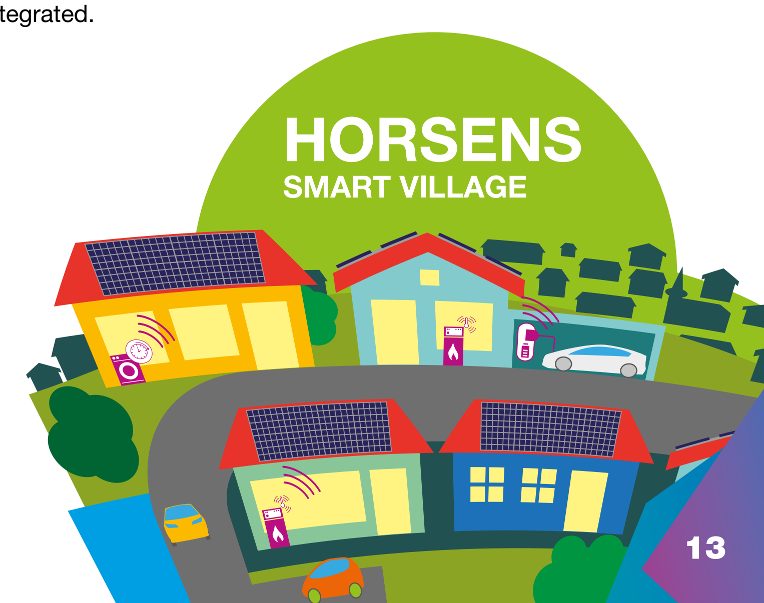
The families have access to real-time information about energy consumption. This happens via an intelligent IT cloud system, through which utility companies, energy and equipment suppliers and other third parties can also interact with the different houses. The new equipment, combined with the presentation of useful information positively influenced the families' behaviour and energy consumption.

"FIWARE and FI-LAB platform has been a valuable tool in terms of testing different types of functionality in one place in a uniform manner. In particular, aspects of security and live data streaming have been enhanced through Generic Enablers and supported the overall trial setup."

Andy Drysdale, INSERO

Control instructions for the houses are provided by the **Control Center** and executed in this component. The Distributed Data Layer provides the communication bus facilitating the exchange of measurement data, queries and control messages between the components in the system.The trial site has successfully integrated **Identity Management (Keyrock)** to authenticate trial site users (external apps and owners of houses involved in the trial). **Orion Context Broker** is integrated. A backend comprising the **Backend IoT Broker (NEC)** and **Backend Configuration Manager (Orion)** is integrated.

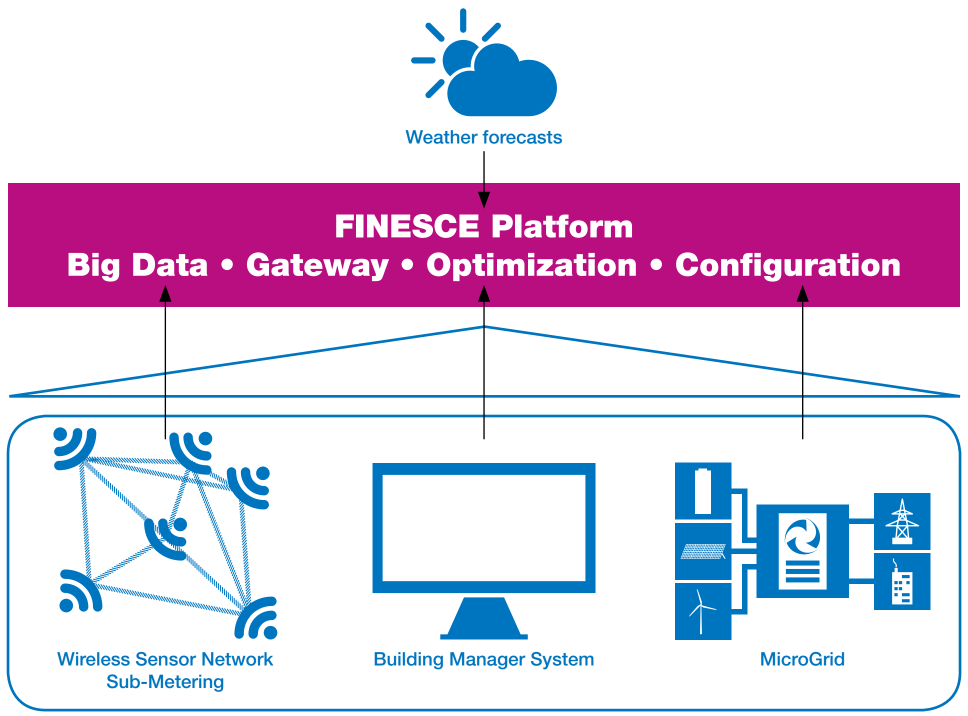
Identity Management GE (Keyrock):
Identity Management covers a number of aspects involving users' access to networks, services and applications, including secure and private authentication from users to devices, networks and services, authorization & trust management, user profile management, privacy-preserving disposition of personal data, Single Sign-On (SSO) to service domains and Identity Federation towards applications. The Identity Manager is the central component that provides a bridge between IdM systems at connectivity-level and application-level.

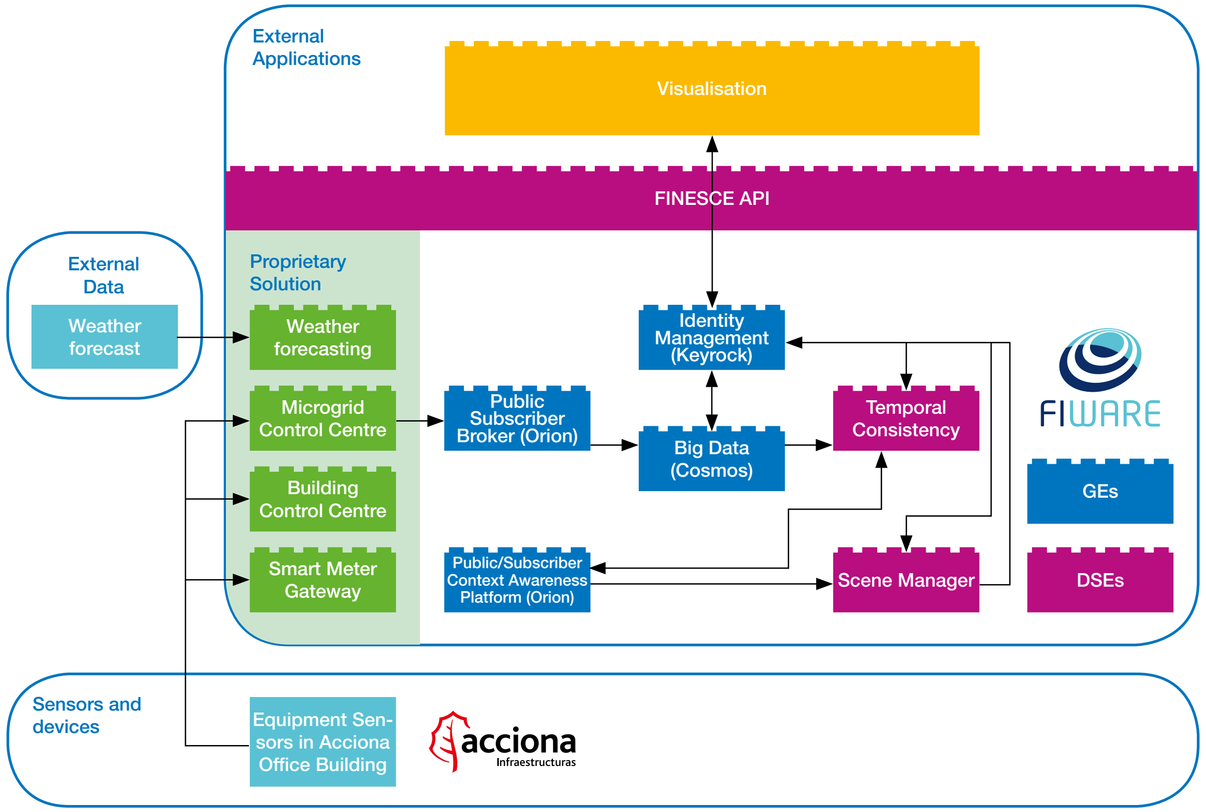


Madrid – Smart Building

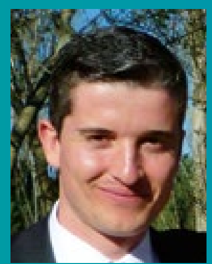
The trial site in Madrid realised an innovative integral concept for future office buildings including energy generation from renewable energies, a micro grid and a building management system with remote real-time monitoring (including weather forecast) for the micro grid. To this end, a wireless sensor network architecture connecting several modules and sensors was installed, measuring for example temperature, relative humidity, luminance in and outside the building and power production and consumption. The objective of the building's management system was to have a control system for building facilities and to achieve higher energy efficiency and improved comfort conditions.

These services encompass the optimization of day-to-day remote and secure operation of building management systems and of their integrated energy generation and storage assets, as well as auditing and monitoring services.





The office building environment involved real users, demonstrating how FI (Future Internet)-specific technology can enable a smoother integration of office building management strategies with energy production and storage capabilities in a micro-grid context.



"Use of FIWARE in the Madrid trial has facilitated and empowered the development of innovative energy services for smart tertiary and industrial sector buildings. FIWARE provides adequate components that support our services, especially for processing the huge datasets generated by buildings and for giving access to these data to complementary applications for facilities management."

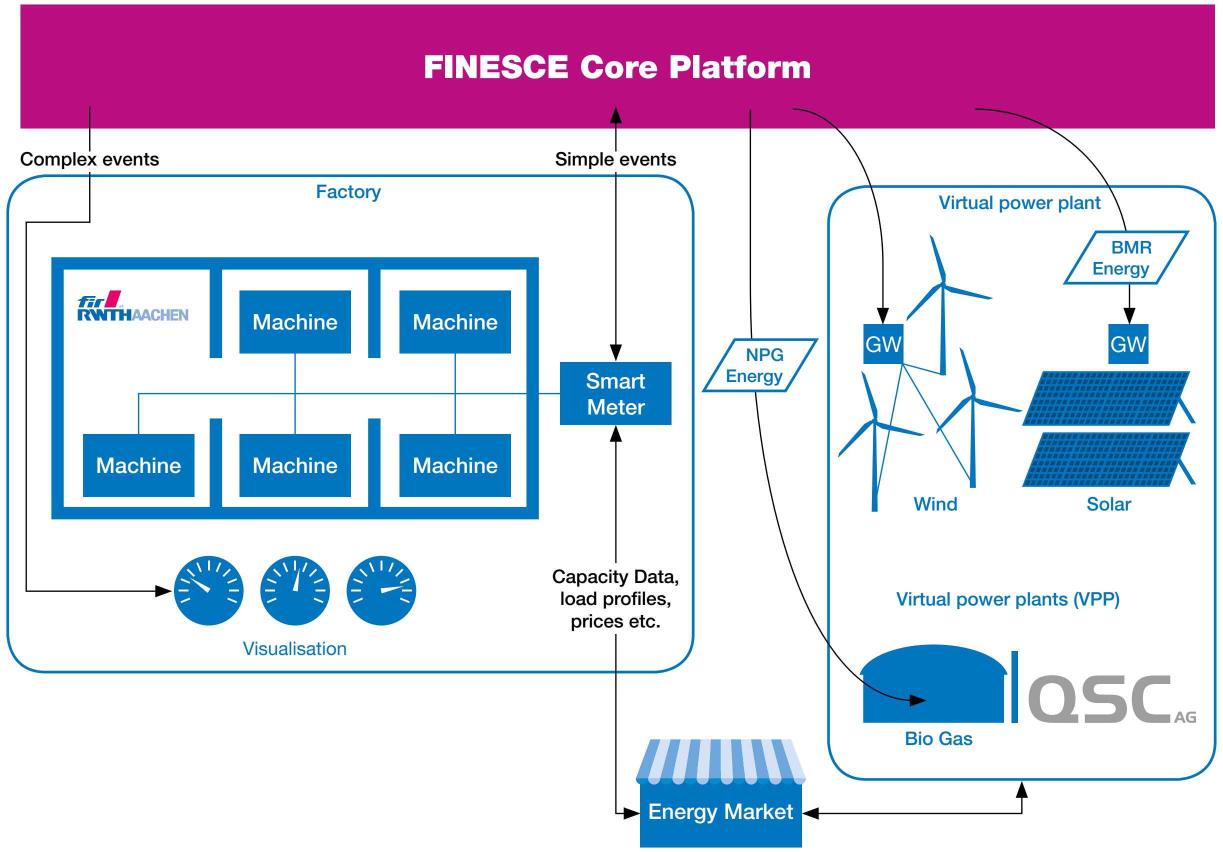
Jose Luis Buron Martinez, Acciona

Four systems at the Acciona building provide data from the building's equipment and sensors to FIWARE GEs; Web API module exposes, through appropriate security control, the API that all external services will use; **Temporal Consistency DSE** pre-processes data stored in the **Big Data GE** from any of the Madrid trial data sources: the Weather Forecasting module, the Building Control Centre, the Microgrid data concentrator, and/or the Smart Metering gateway. **Scene Manager DSE** allows configuration of a set of multiple parameters (scene), based on which different alerts can be triggered and offered to subscribed users. It works together with the **Public/Subscribe Context Broker – Context Awareness Platform GE** to perform the event configuration, receive alert notifications and manage the subscriptions to those events.

Context Broker GE (Orion):
Context information is represented through values assigned to attributes that characterize those entities relevant to your application. The Context Broker GE (Orion) is able to handle context information at large scale by implementing standard REST APIs.

Aachen – Smart Factory & Virtual Power Plant

The trial site in Aachen realised demand-side management of an intelligent scale factory. This smart factory produces real goods in small series. In combination with the virtual power plant, the focus of this trial site was balancing energy supply and demand - demand-side management as a function to stabilise the grid. In order to understand and optimize the relationship between the production process and energy usage, an energy monitoring system was installed to collect data via sensors within the factory. The sensors monitor the four main consumers of electricity regarding their status and energy consumption, which is directly sent to the local production database via Ethernet. Further, data on energy supply was used to adjust the production via demand-side management.

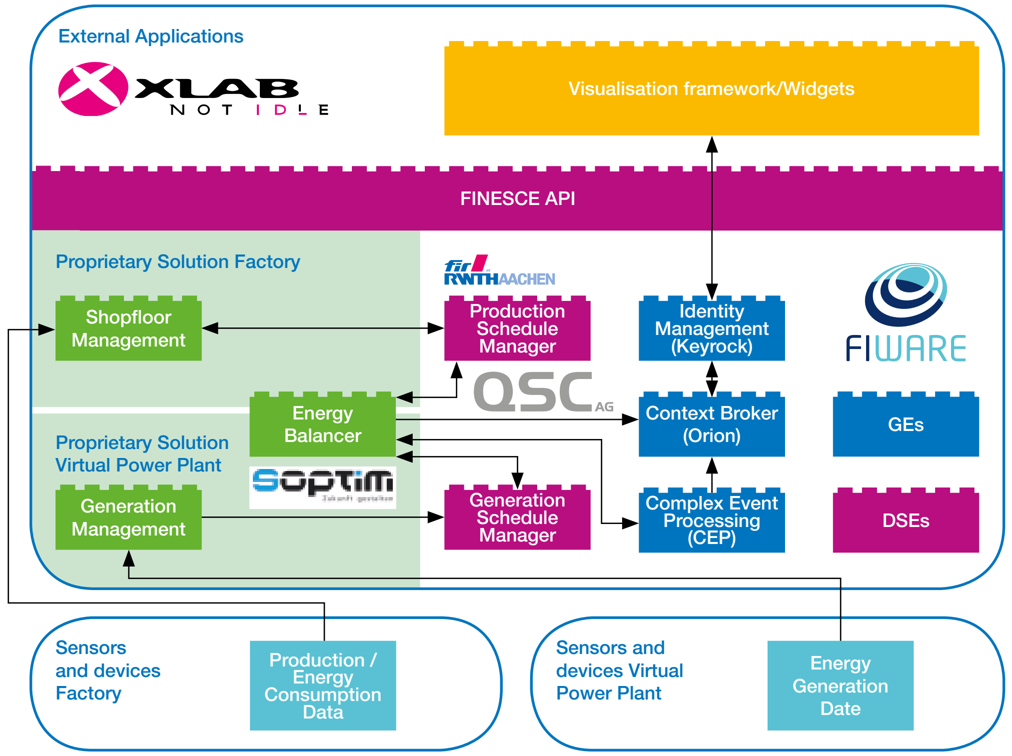


In Aachen and Cologne a cross border (Germany and Belgium) virtual power plant was set up combining supply units based on different renewable energy sources such as wind power, solar power and biomass into one supply unit. Each of the distributed renewable energy plants provides its production data which is collected through meters connected to a gateway. The virtual power plant is used to supply energy to the smart factory with the objective of balancing supply and demand optimally. By means of intelligent data processing and automated aggregation of the producer and consumer data an anonymous utilization is possible.

"The B2B energy ecosystem interlinks industrial demand-side management and a cross-border Virtual Power Plant (VPP) combining renewable energy resources. Using FIWARE led to a faster development providing the building blocks for underlying services and infrastructure. It proved to be a solid basis for a fast integration of the trial."

Ulrich Hacker, QSC

The virtual power plant and the smart factory are connected via a common cloud-based infrastructure.



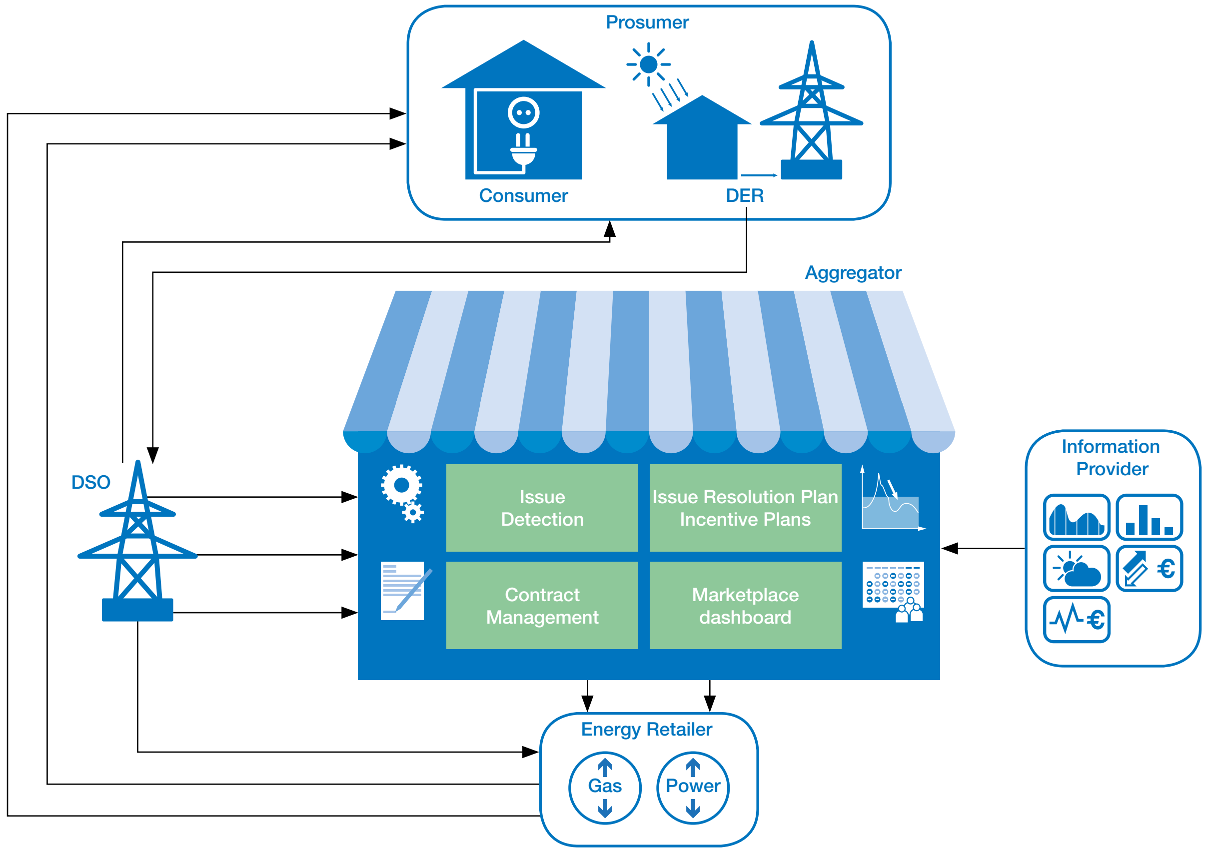
The Generation Schedule Manager DSE provides information about the VPP's energy generation. **The Production Schedule Manager DSE** provides the 3 production plans based on the energy requirement. The **Energy Balancer** takes the output of these 2 DSEs to plan how to balance the energy production and consumption. Data to identify deviations from the plan during the production is sent to the **Complex Event Processing GE.**

"Our goal was to bring a sophisticated, scalable and flexible IT infrastructure to the shop floor of our factory to monitor production progress and KPIs. Thanks to FIWARE, we were able to deploy the application in two months, and iteratively improve from there. FIWARE builds a sound but nonetheless flexible foundation for our IT architecture."

Julian Krenge, FIR

Terni – Smart Grid & Energy Marketplace

The trial site in Terni was set up in a small part of Terni's power grid characterized by a high feed-in of renewable energy, namely photovoltaic and hydro-electric power plants. This high density of RES is highlighting more and more grid issues, as introduced in the premise (i.e. instability, reverse power flows and power losses) mainly due to energy consumption not aligned with respect to production from PV plants.

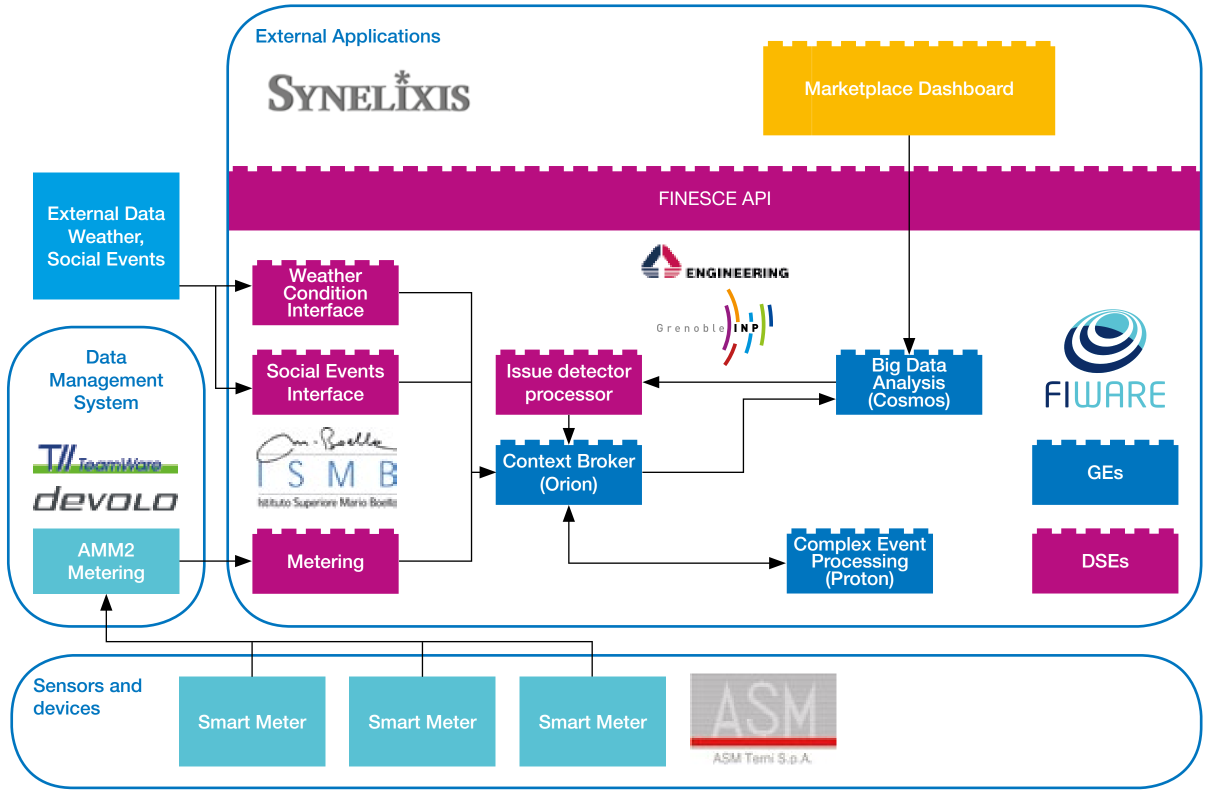


The implementation involved Demand Side Management with new market-mechanisms for a better involvement of consumers and other actors within the energy market by collecting and assessing smart meter data. An aggregator can propose an issue issue resolution plan for imbalances in electricity supply and demand based on this assessment. Thus grid stability can be optimised. Further, an Energy Retailer transforms the resolution plans to specific incentives tailored to the Consumer. This results in the minimization of the risk of grid instability and the maximization of income and benefits.

"The cloud-based energy marketplace, which gathers data from the Terni Trial site, entirely relies on FIWARE GEs as well as on FIWARE Lab cloud hosting capabilities. The FIWARE GEs represent a Future Internet ecosystem through which the marketplace acquires, stores, processes/analyses energy data and, finally, exposes trial site information via either a UI or APIs."

Pasquale Andriani, Engineering

AMM2Metering retrieves "raw" consumption and production data from the smart meters installed at the trial site and passes them over IP to **Metering** DSE; this DSE translates metering data coming from AMM-2Metering into an NGSI10-compliant format (ORION context events) and finally publishes them on the **ORION Context Broker GE**



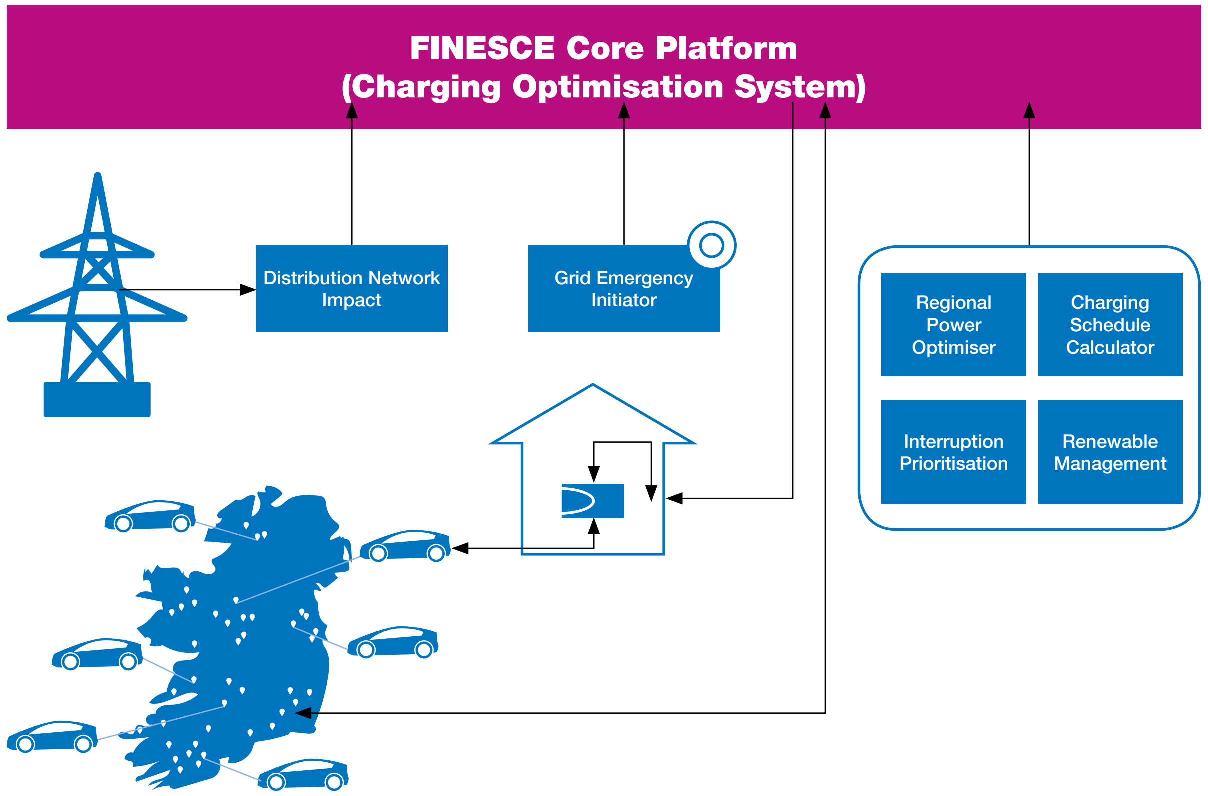
Weather Condition Interface DSE collects data from a weather forecasting service every five minutes and sends them to ORION Context Broker. **Social Events Interface DSE** is a REST-based client that exposes an aPost method via which an external provider can send data on social events (such as concerts, football matches, etc.) that can affect consumption/production in the trial site area. **Big Data GE (COSMOS), Context Broker GE (ORION)** and **Complex Event Processing GE (PROTON)** are integrated as the central part of the Marketplace architecture.

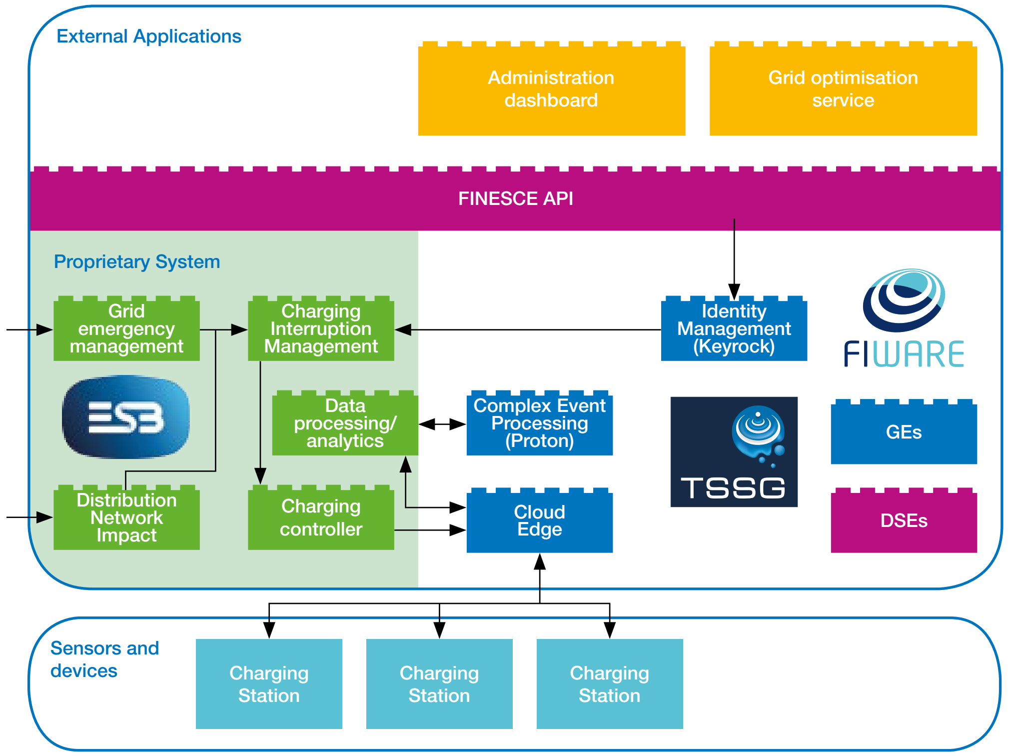
COMPLEX Event Processing GE (Proton):
Complex Event Processing (CEP) analyses events, e.g. updates on context, in real-time to detect scenarios where actions have to be triggered or new events are created.

Dublin – E-Car Grid Integration

In Ireland, an electric vehicle charging system was built including vehicles, charging points communication networks and a control system. The trial aimed at setting up a charging optimisation system for domestic home charging taking into account several criteria such as customer experience, grid friendliness and renewable energy usage. To this end, a central database was established which was fed with all the data collected during the project. The database provided data to the the charging optimisation algorithm. Apart from the optimisation of charging, a mechanism to interrupt the EV charging process in the event of a grid emergency has been developed in the trial.

The Charge Controller (Electrical Vehicle Supply Equipment) charges electrical vehicles parked at the houses;
The Cloud Edge GE at the houses supports COS – Charge Controller communication;





The heart of the charging optimization contains all data collected during the trial as well as configuration data to be taken into account by the charging optimisation algorithm. The management and control software of the Electric Vehicle Supply Equipment are being developed and hosted by WIT. Additionally an API is provided allowing access to trial data for internal partners and also SMEs or other third parties that want to use these data.

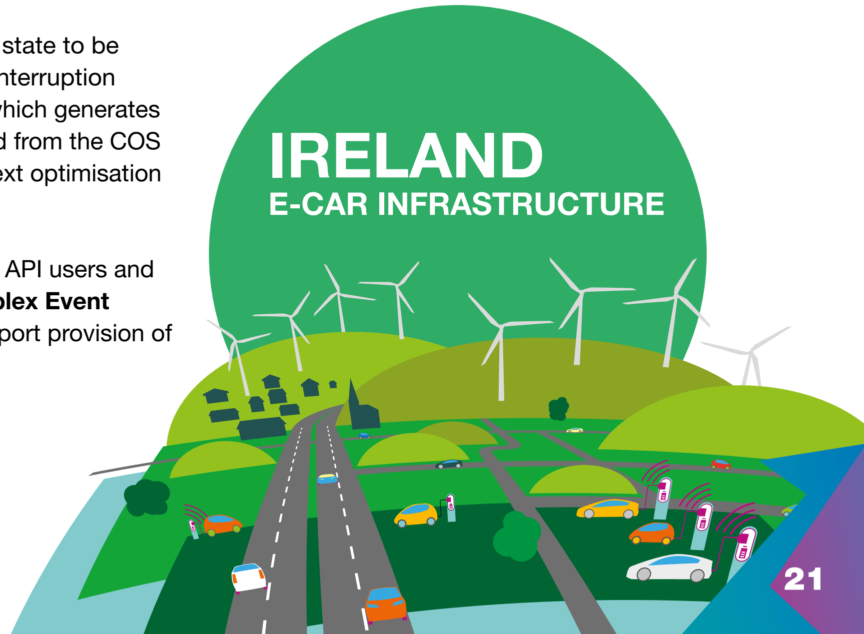
"Utilities are facing major challenges from renewable integration, new services development and ever more stringent regulatory demands; meeting these challenges requires speed and flexibility in testing of new systems. FIWARE answers these requirements, in terms of development costs and time to deployment. "

John Howard, ESB

The **Distribution Impact,** provided by an external DSO system authorises the EV charging based on its knowledge of the effect that a given EV charging schedule has on the LV and MV grid conditions;

The **Grid Emergency Initiator** allows a grid emergency state to be defined and communicated encrypted to the Charging Interruption Management. The Optimisation Service is an algorithm which generates an EV charging schedule using state information retrieved from the COS and sends it to the COS for implementation during the next optimisation cycle (15 minutes);

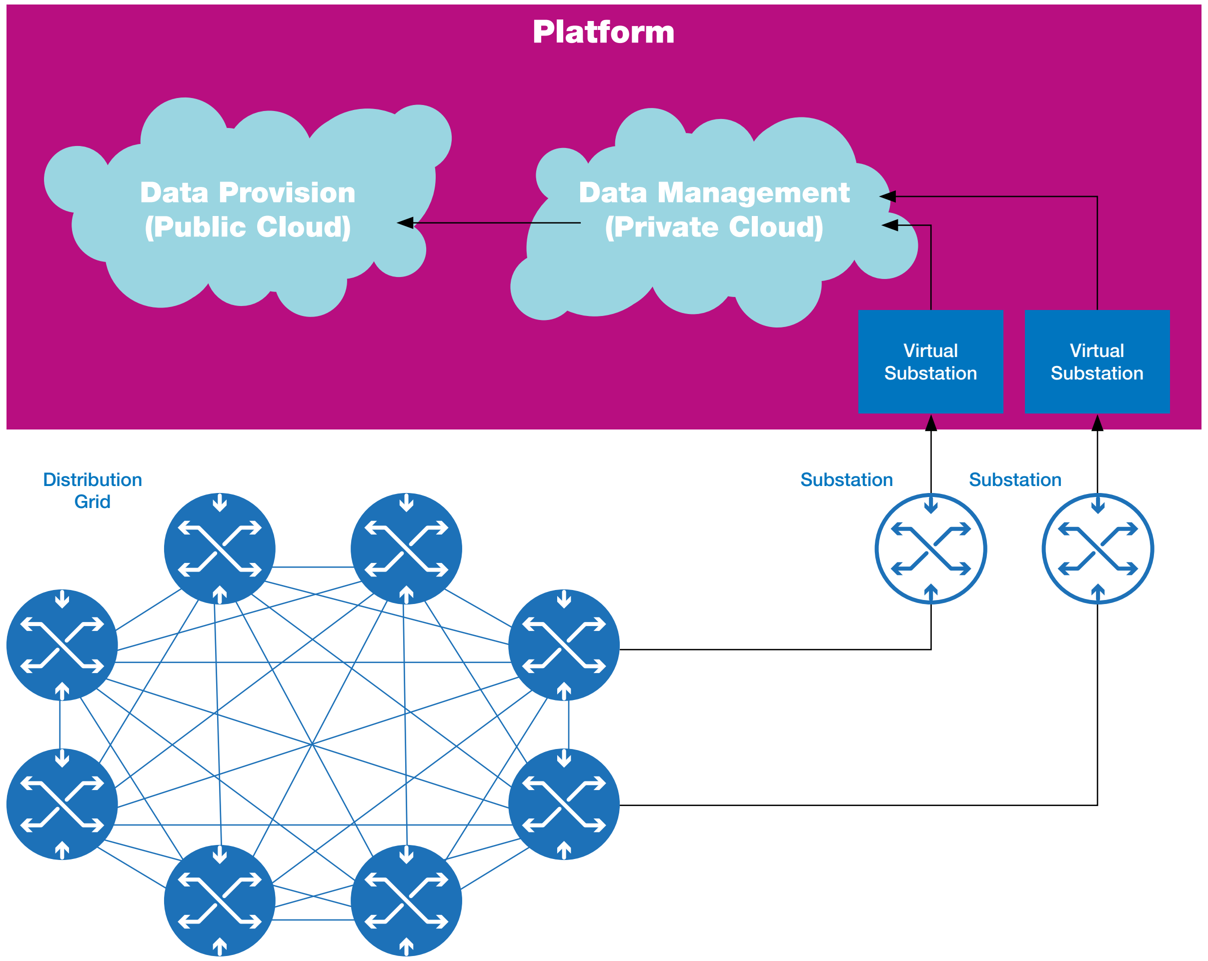
Identity Manager GE (KeyRock) is used to authenticate API users and Data Handling to enforce privacy of charging data. **Complex Event Processing GE (Proton)** is included in the design to support provision of historical charging data.



Ireland – Smart Grid Communication in Portlaoise

In Portlaoise a new utility communications architecture is deployed and evaluated primarily for teleprotection purposes but also for other utility operational applications.The ultimate utility communications network is a single communications network, which can simultaneously support a utility's primary function of providing a reliable energy network, using high voltage teleprotection, and its secondary objective of enabling energy efficiency via load balancing, distributed generation, AMI and other advanced systems.

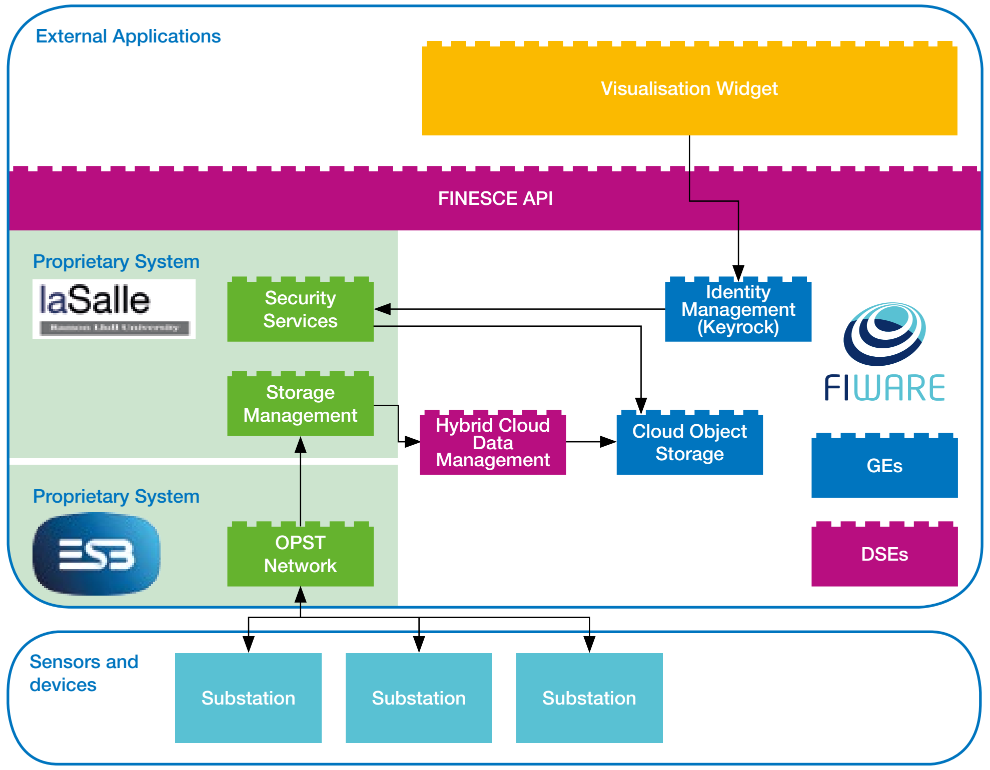
OPST (Optical Packet Switch and Transport) is a new emerging communications architecture, which has the potential to solve Utilities' stringent communications requirements.



It provides all of the circuit-switched features of SDH and all of the flexibility and economics of packet-switched architectures such as MPLS. OPST supports both a distributed switched meshed topology for teleprotection applications and a centrally-switched tree topology for Energy Efficiency applications such as Load Balancing and distributed generation applications.

Furthermore a flexible software infrastructure was implemented, focusing the trial on the demonstration of a secure and distributed storage system that can easily migrate data from private infrastructure of the utility/DSO, to public cloud, in order to easily sell or offer this data to external stakeholders. This also provided a platform to manage distributed data among different substations, automatically

replicating it in the different locations, which can help to evaluate the substitution of some very expensive electrical network devices by software platforms, low-cost sensors and high-speed communications underneath. The results of the trial have been used by ESB to evaluate a novel "Software Defined Utility" approach, which consists on high-speed physical communications and flexible software infrastructure over them.



Hybrid Cloud Data Management DSE contains the parts of the Storage System which provide access to the local and distributed storage. The API for controlling the DSE is offered as part of the FINESCE API.

Object Storage GE:
Object Storage facility (based on OpenStack Swift) can be used to store and retrieve 'blob' objects and associated metadata.

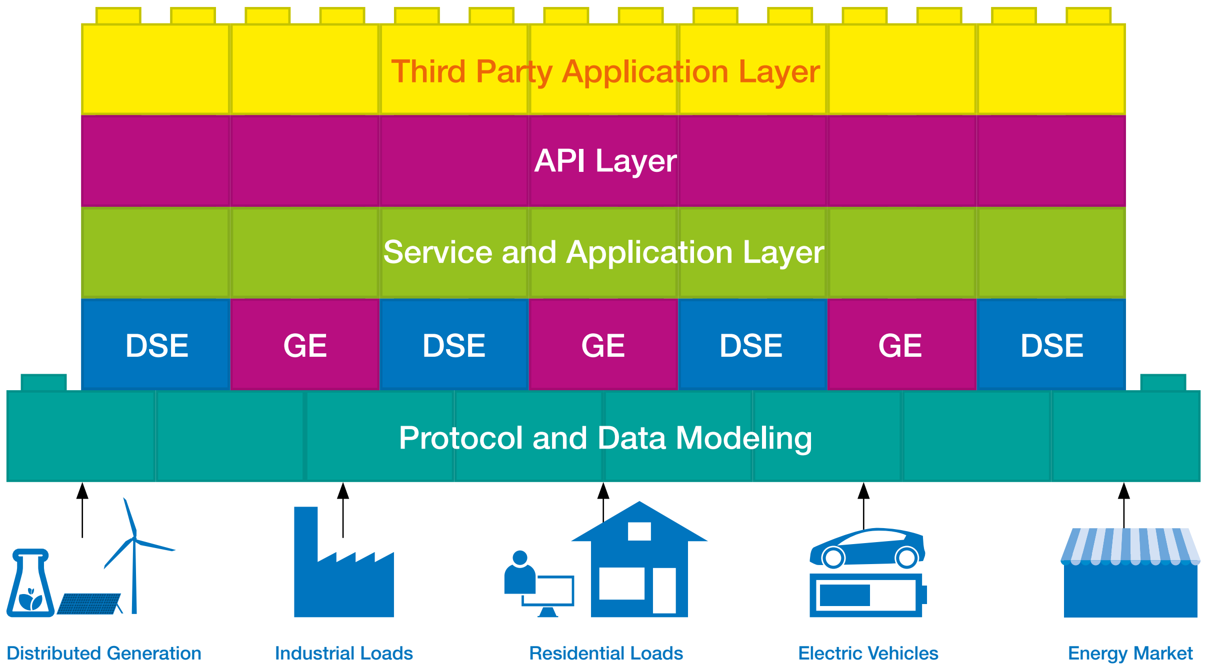
The FINESCE Smart Energy Platform

Each of the FINESCE trial site systems implements particular Smart Energy use cases on separate, FIWARE-based, vertically integrated, trial specific platform infrastructures. This approach has the merit of allowing each trial site system to independently select and integrate its own set of GEs into the trial infrastructure so that several GE have been instantiated in more than one FINESCE trial site, resulting in FINESCE performing quite extensive and deep testing of the GEs.

However, this approach does not promote re-usability of the trial infrastructures. The ability to re-use existing systems and solutions both reduces implementation costs and reduces the level of ICT expertise needed to implement new Smart Energy use cases. For example, if an existing authentication and authorisation solution can be re-used for a new use case, then the team implementing the new use case will not need the same level of security expertise as the team which originally developed the solution that is being re-used.

FINESCE has recognised that making solution re-use affordable and convenient is key to the introduction of ICT into the energy domain. Furthermore, a major outcome of FINESCE is the recognition, both within the project but also by large utilities, that the way to achieve re-use is to develop Smart Energy solutions using an open-source Smart Energy Platform (SEP), whose components and services can be optimised for re-use in new developments and which also allows proprietary added-value commercial services to be developed on top of common, open-source, components.

The Smart Energy Platform is conceived as a business-class platform based on an open-source approach using FIWARE technology. It is a cloud-based, service-oriented, open-source middleware platform that is capable of supporting the business models of the different Smart Energy actors. The term “Smart Energy” means making electricity grids, buildings and cities “smart” through the introduction of ICT and automated control, i.e. it covers Smart Grids, Smart Cities and Smart Buildings.



Actors can carry out their business by means of offering services through the SEP and using the services offered by other actors including, for example, Utilities, TSOs, DSOs, equipment providers, electricity retailers, electricity aggregators, energy service providers, electricity market regulators, electricity prosumers, electricity end-customers, building management firms and ICT companies. Hence, the SEP is envisaged as a hub for Smart Energy business, and must be built to be powerful, robust and secure enough to support real business use cases.

SEP is based on the following technical concepts:

· use of open source software, to create a dynamic development community;

· development as a cloud-based platform, to achieve scalability (in terms of geography and size) at reasonable cost;

· use of a service-oriented architecture, allows simple, extensible APIs between the various actors, which hide underlying complexity;

· use of a 3-layer platform model (integration of various data sources, middleware and API layer) to allow SEP’s services to address multiple miscellaneous data sources.

In order to support the open source approach, FIWARE open source Generic Enablers will be used as building blocks for the SEP, and it will be hosted in the FIWARE cloud.

Components developed within the Smart Energy Platform will be made available under open source licensing agreements as DSEs, thus contributing to the FIWARE offering to developers.

The vertically integrated FINESCE trial site architectures have been mapped onto the platform architecture, thereby addressing the question: how would we implement the FINESCE use cases if we were to start the project from scratch and implement them on the Smart Energy Platform? Two main aspects have been considered: data modelling and the functional architecture. The results of this work form a conceptual basis for the implementation of further Smart Energy use cases on the Smart Energy Platform in future projects.

In addition to its business application, SEP is also meant as a test environment for new standards, interfaces and devices in the energy industry. Development in this direction is already ongoing: work is ongoing to connect laboratory equipment to a FIWARE cloud platform to make a cloud-based Smart Energy testbed. This will provide the opportunity to test new services and components at different levels, ranging from pure software testing to hardware and Power-Hardware-in the-Loop testing. The pure software testing is suitable for testing cloud-based algorithms, services and the interfaces between them. Involving real Smart Home Gateways and Control Units in the tests, known as Hardware-in-the-Loop, enables the user to analyse the integration and interaction of real hardware with the cloud. A further step, the incorporation of the Smart Home test bed, allows for testing entire Smart Home systems.

RWTH has been selected by the German government to drive the Industry/University relations for the next 15 years in the field of electrical networks. In this context, RWTH created an external company FEN GmbH that is based on Industry participation. FEN develops joined research activities driven by Industry. The organisation is oriented towards direct exploitation and innovation, rather than being focused on research.

The long-term intention is to run the FINESCE Smart Energy Platform using a foundation model. However, in order to get the initial projects organised it is intended to start running it using the Flexible Electrical Networks (FEN) GmbH to organise the work.

For more information visit
www.fen.rwth-aachen.de

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FI-PPP, FIWARE & FINESCE – an overview

In 2011, the European Commission (EC) launched the Future Internet Public-Private Partnership Programme (FI-PPP) for inducing internet-enabled innovations. It is part of the European Union's (EU) Seventh Framework Programme (FP7) and it is co-funded by the European Commission. The objective of FI-PPP is to bring forth a common vision for harmonised Europe-an-wide technology platforms and their implementation. Further, FI-PPP was designed to advance the integration and harmonisation of regulations, laws and policies as one mean to realise a European Digital Single Market (DSM) and an inclusive knowledge society.

The programme aims to increase the effectiveness of business processes and bringing forth the European market for smart infrastructures in different areas. It strengthens Europe's competitiveness in the ICT sector by accelerating the development and adoption of Future Internet technologies and developing new business models. To this end, FI-PPP follows an industry-driven, holistic approach encompassing R&D on network and communication infrastructures, devices, software, service and media technologies. At the same time, it promotes their experimentation and validation in real application contexts, bringing together demand and supply and involving users early in the research lifecycle.

The FI-PPP Programme runs from 2011 to 2016. It is based on a technology foundation created and further developed by the FIWARE/FICORE project throughout the duration of the programme. The vision of the FIWARE project is to become the core platform of the future internet establishing an innovative infrastructure for cost-effective creation and delivery of varied digital services, providing high QoS and security guarantees. The FIWARE platform is open, based upon components called Generic Enablers (GEs) offering reusable and commonly shared functions serving a multiplicity of Usage Areas across various sectors.

The FI-PPP programme is split into three phases: phase one lasted from 2011 to 2013 and had as its goals, the development of the FIWARE architecture, the FIWARE GEs, the DSEs and the evaluation of the test infrastructure. Phase two started in April 2013 and is coming to an end in 2015. It had as objectives the development of the core platform and use-case specific functionalities as well as the preparation and implementation of first trials (like FINESCE). The third phase started in 2014 and aims at the provision of a stable infrastructure. It creates a sustainable ecosystem for SME-driven innovation by providing funding for over 2000 start-ups and web entrepreneurs. FI-PPP fostered public and private investments of 500 million Euros. In phase one and two 283 partner organisations from 23 countries took part in the programme.

One of the application areas of FI-PPP project is smart energy. In phase one, the project from the energy sector was Future INternet for Smart ENergY (FINSENY). It identified ICT requirements for smart energy systems that are necessary to integrate the growing share of electricity from renewable and distributed sources into the grid as well as to cope with other developments on consumer side such as the increasing usage of Electric Vehicles or the fact that consumers increasingly become prosumers. The identification of these requirements leads to the definition of new solutions and standards which were verified in a large-scale pan-European smart energy trial in phase two, in the project Future INtErnet Smart Utility ServiCEs (FINESCE). To this end, FINESCE organized a series of field trials of Future Internet technologies in the usage area of Smart Energy. It took the results of FINSENY to practical realisation and extended them to include energy forms other than electrical power in order to realise sustainable real time smart energy services.

The FINESCE consortium is comprised of 29 partners from all over Europe. The partnership includes relevant stakeholders involved in shaping the development of the future energy system. The consortium is composed of:

· ICT companies,

· energy operators,

· manufacturers,

· service providers,

· research organisations, and

· SMEs.

Project Partners	Contact information
Ericsson GmbH (Coordinator)	Fiona Williams: fiona.williams@ericsson.com
Acciona Infraestructuras S.A.	Jose Luis Buron Martinez: joseluis.buron.martinez@acciona.com
Alcatel-Lucent Deutschland AG	enterprise.solutions@alcatel-lucent.com
Alstom Grid UK	Dr. Luís Miguel Costa: luis.costa@alstom.com
ASM Terni S.p.A.	Massimo Cresta: massimo.cresta@asmterni.it
B.A.U.M. Consult GmbH	Alexander von Jagwitz: a.jagwitz@baumgroup.de
Develco Products	Dorthe Gaardbo-Pedersen: dgp@develcoproducts.com
devolo AG	Anil Mengi: anil.mengi@devolo.de
DunavNET	Srdjan Krco: srdjan.krco@dunavnet.eu
EC Network	Kaj Leonhart Petersen: klp@ecnetwork.dk
Electricity Supply Board	John Howard: john.howard2@esb.ie
Engineering Ingegneria Informatica SPA	Pasquale Andriani: pasquale.andriani@eng.it
E.ON Sverige AB	David Lillienberg: david.lillienberg@eon.se
Grenoble Institute of Technology	Raphael Caire: Raphael.Caire@G2Elab.grenoble-inp.fr
Insero Horsens	Andy Drysdale: adr@insero.com
Insero Software A/S	Thomas Hune: tsh@inserosoftware.dk
Institute for Industrial Management at RWTH Aachen University (FIR)	Marco Roscher: marco.roscher@fir.rwth-aachen.de
ISMB - Instituto Superiore Mario Boella	Mikhail Simonov: simonov@ismb.it
laSalle Research & Development	Ramon Martín de Pozuelo: ramonmdp@salleurl.edu
QSC AG	Adelheid Weinert: adelheid.weinert@qsc.de:
RWTH Aachen University	Prof Antonello Monti: amonti@eonerc.rwth-aachen.de
SEnerCon GmbH	Elmer Stöwer: elmer.stoewer@senercon.de
SOPTIM AG	Frank Fiedler: frank.fiedler@soptim.de
Synelixis	Theodore Zahariadis: zahariad@synelixis.com
Orange Polska S.A.	Rafal Artych: Rafal.Artych@orange.com
TW-TeamWare S.r.l.	Gianlucca Zanetto: gianluca.zanetto@teamware.it
Waterford Institute of Technology	Miguel Ponce de Leon: miguelpdl@tssg.org
XLAB d.o.o.	Matej Artac: matej.artac@xlab.si
Yucca Studios	Pedro Fernandes: pedro.fernandes@yuccastudios.com

FAQs – Frequently Asked Questions

What is FIWARE?

FIWARE is a software platform that provides a rather simple yet powerful set of APIs (Application Programming Interfaces) easing the development of Smart Applications in multiple vertical sectors. The specifications of these APIs are public and royalty-free. In addition, FIWARE provides software components called Generic Enablers (GEs) that are also publicly available. An open source reference implementation of each of the FIWARE components is freely accessible so that multiple FIWARE providers can emerge faster in the market with a low-cost proposition.

What is a GE?

Generic Enablers (GEs) are key software building blocks that are offering general-purpose functions and are thus applicable in different sectors and can be flexibly customized to be implemented in different use cases. GEs comprise sets of software components that enable the development of advanced and innovative Future Internet applications and services.

The FI-WARE Generic Enablers are linked to the following main FI-WARE technical chapters:

· Cloud Hosting

· Data/ Context Management

· Architecture of Applications / Services Ecosystem and Delivery Framework

· Internet of Things (IoT) Services Enablement

· Security

· Interface to Network and Devices (I2ND)

What is the difference between a DSE and a GE?

It is the ability to serve a multiplicity of Usage Areas that characterizes GEs and distinguishes them from Domain Specific Enablers (DSEs). DSEs are common to multiple applications, but all of them specific to a very limited set of use cases. DSE offer functions that are specific and characteristic in certain domains, in the case of FINESCE the Smart Energy domain.

To what ends can I use FIWARE?

The open and royalty-free nature of FIWARE GE specifications allows third parties to develop and commercialize platform products that are in compliance with FIWARE GE specifications. GE Open Specifications contain all the information required in order to build compliant products which can work as alternative implementations of GEs developed in FIWARE. Combining GEs (and DSEs) it is easy to develop applications. Alternatively, GEs and DSEs can be added to already working applications to add new functions.

What are the benefits of working with FIWARE?

Advantages of using FIWARE in the energy sector: the ready-to-use software components are easy-to-implement, an integration into other software system is easily possible, and investment costs are low. They are further easily applicable in different scenarios and use cases through the FINESCE API. In the area of energy applications this concept is rather revolutionary, currently closed proprietary software systems dominate the market for utilities.

My company already uses other software – is FIWARE compatible?

FIWARE is an open platform with open APIs. The FIWARE GEs can be used as software components that can be downloaded or used as a service from one of the FIWARE nodes.

Either way the FIWARE“ GEs are meant to be integrated in existing software environments.

What are the advantages of FIWARE compared to other software?

FIWARE provides simple APIs that are nonetheless very powerful making complex processes become simple. Further, GEs and DSEs as well as most of their reference implementations are available publicly, royalty-free and open-source. By this, complex functionalities can be programmed easily speeding up the development of new applications and services. As an open-source project, FIWARE is a meeting point where entrepreneurs and developers can come together to boost innovation enabling an open and lively community.

How can I find the right GEs / DSEs and how can I access them?

In the FIWARE catalogue (http://catalogue.fiware.org/) you can find all GEs. Additionally, there is an explanation of every GE and instructions on how to add them to already working applications. The FINESCE DSEs are accessible in the FINESCE catalogue (http://finesce.github.io/). They are grouped into functionality categories. All of the DSEs can be downloaded together with an explanation on how they are implemented.

How secure is the use of FIWARE?

FIWARE provides a powerful framework that will allow **you to setup Authorization and Access Control** policies based on widely adopted Security standards (OAuth, XACML).

E.g. FIWARE offers some services and tools to allow you to manage authentication and authorization in your applications and backend services. If you want **to manage identity in your application without** developing your own mechanisms, you can offer your users the possibility to log in to your app using their FIWARE Accounts.

Who can help me to implement FIWARE solutions?

FIWARE hosts many events where people can get in touch with the FIWARE experts (https://www.fiware.org/events/). Further, there are several thematic contact channels (http://www.fiware.org/contact-us/). Non-trivial technical questions are answered at StackOverflow.com and contact persons are listed within every GE and DSE description in the catalogues. In addition, FIWARE has different social media channels (Twitter, facebook, Google+, Linked in, YouTube, flickr) where questions are answered directly.

Apart from this, you have the social channels where our community managers should be able to provide answers or redirect you to the right channel. They are linked from our home page (www.fiware.org) - on the top right corner.

FAQs – Frequently Asked Questions

Which licensing model does FIWARE have?

GEs and DSEs are published under different licensing models – in the FIWARE and FINESCE catalogue you can find the respective licensing models under “Terms and Conditions” within the enabler descriptions.

Who owns FIWARE?

FIWARE is an Open Source Community, the FIWARE GEs are contributed by many companies. The FIWARE OS Community Governance Model has been designed with the following principles:

· Openness: it should be open to those who have something to contribute (following well established procedures)

· Based on meritocracy: active contributors should be recognized and only active contributors to technology would be able to govern decisions on the technology

· Transparency: there should be well-defined, documented and publicly available procedures

· Market oriented approach: those organizations committed to invest significant resources in supporting FIWARE adoption in the market will have a prominent role in the community

Can I test FIWARE implementations at trial sites or with real user data?

Yes, you can access the implementations and the real data of the FINESCE trial sites via the FINESCE API (http://docs.fam.apiary.io/#). There, you can test your own applications with real data from the trial sites.

What is the advantage of the Smart Energy Platform?

The FINESCE Smart Energy Platform offers

· a test environment for new standards and components

· a toolbox for easy and cheap implementation for new apps

· real infrastructure, real users, real data for test purposes

· an open ICT infrastructure and Open Source software that will be improved and extended by many stakeholders.

How can I access the Smart Energy Platform?

The individual FINESCE trial platforms and the stored trial data are accessible via the FINESCE API (http://docs.fam.apiary.io/# and https://130.206.82.22/finesce/api/docs/).

The consolidated Smart Energy Platform is hosted by the FEN consortium. Please contact Christian Haag (chaag@fenaachen.net) for further information.

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