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Mapping of FINESCE Trial Site Architectures onto Smart Energy Platform Architecture

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Abstract:

This report is an analysis of how the implemented trial site systems architectures could be mapped onto a platform architecture.

Keyword list:

FIWARE, Smart Energy, Platform

Disclaimer:

All information provided reflects the current status of the trial site testbeds at the time of writing and may be subject to change.

Executive Summary

FINESCE has built seven separate vertically integrated field trials which each represents a separate FIWARE-based platform. This approach represents the prevalent silo-based thinking in the energy domain when FINESCE was started a couple of years ago. However, one of the major results of FINESCE has been that the project partners have realised that this silo-based architectural approach leads to a dead-end and is not what is needed for the future: making separate platforms for different physical sites or different use cases will not enable any economy of scale effects where existing results are re-used in new contexts. Rather, a different approach, based on a common platform, represents the way forward in Smart Energy

This report performs a functional mapping of the FINESCE trial site systems (as actually implemented) onto a platform architecture. This results in a basic understanding of what such a platform should look like and what functions it should contain. This understanding will be useful when in later projects which implement new use cases using the platform architecture.

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1. Introduction

The Future Internet Public-Private Partnership (FI-PPP) programme of the EU has sponsored the cloud-based open-source FIWARE technology as an ecosystem for the development of platforms and applications. FIWARE technologies have been field-tested in the energy domain in the FINESCE project, running from May 2013 to September 2015. In FINESCE, a set of over twenty use cases have been implemented in seven field trials where Information and Communication Technology, and specifically FIWARE, have been applied.

Each FINESCE trial site cover widely different Smart Energy use cases. Due to this diversity, FINESCE adopted a bottom-up architectural approach where each individual trial site offers Smart Energy data over an API, with the WPs' individual APIs being unified through the FINESCE API which offers a single point of access to the data available from the seven trial sites. The result is that FINESCE has implemented seven physically separate field trial infrastructures, each of which comprises the equipment (for example electricity grids, smart factory, commercial and private buildings, electric vehicles) and the FIWARE-based trial infrastructure system implementing the use cases. The trial site infrastructures are stand-alone, vertical silos, albeit incorporating FIWARE GEs and FINESCE's own DSEs. This approach has the advantage of giving the trial sites the needed independence to conduct separate experiments, based on site-specific infrastructural components. It also has the advantage of allowing several independent GE evaluation and integration activities to be performed in parallel. In this approach, each of the FINESCE trial site infrastructures is a separate, FIWARE-based, platform.

Building seven separate vertically integrated field trials represents the prevalent silo-based thinking in the energy domain when FINESCE was started a couple of years ago. However, the ongoing revolution in power grids is reversing the traditional grid layout and operation, which used to be top-down, with centralised generation and centralised system level automation. Due to the increasing penetration of distributed generation, and in particular renewable energy sources, which inject power at MV and LV levels, the power grid is turning into a bottom-up system, providing opportunities for existing and new players to develop new business models based on new customer services which target households, prosumers and other players in the energy domain. These new business services will be based on data, which carries the main value and allows services to be defined flexibly. In the case of incumbent Utilities, this enables them to adopt a business model which brings them closer to customers. The main challenge is to acquire the data from various sources and to give service providers easy access to a unified view of the data. This unified access to data from heterogeneous sources can be provided by a shared "Platform", the provision of which will enable all energy domain players to focus on what they best understand – Energy, and implementing energy services - rather than having each to concern themselves with ICT issues.

Hence, one of the major results of FINESCE has been that the project partners have realised that this silo-based architectural approach leads to a dead-end and is not what is needed for the future: making separate platforms for different physical sites or different use cases will not enable any economy of scale effects where existing results are re-used in new contexts. Rather, a different approach, based on a common platform, represents the way forward in Smart Energy. A service-oriented, open-source platform-based approach is believed to have great potential. It allows the development of valued-added business services on top of a Platform which interfaces towards field devices and enables mutually beneficial co-operation between partners from utilities, service providers, ICT companies and research organisations.

The use of such a common platform is not in itself a new idea: for example several of FINESCE's sister projects in FI-PPP Phase 2 develop such platforms. However, it is a new approach in the Smart Energy domain to develop an open-source, Smart Energy business Platform based on a cloud-computing, service-oriented model and applying ongoing developments in ICT.

This Platform will be built incrementally by projects coming after FINESCE which implement new use cases in collaboration with industry partners. Such projects will develop the Platform functionality along with the Applications. This requires having a clear concept of what functionality belongs in the Platform and what belongs in the Application, which is addressed by the architectural framework presented in this report.

This report addresses the question of how the existing FINESCE trial site systems would look in such a platform architecture, or, if we had to re-do FINESCE from scratch, how would we implement it using a Platform architecture?. To do this analysis, the components in the individual trial site systems are each mapped onto the platform architecture and a composite platform architecture extracted, as illustrated in Figure 1. This results in a basic understanding of what such a platform should look like and what functions it should contain. This understanding will be useful when in later projects which implement new use cases using the platform architecture.

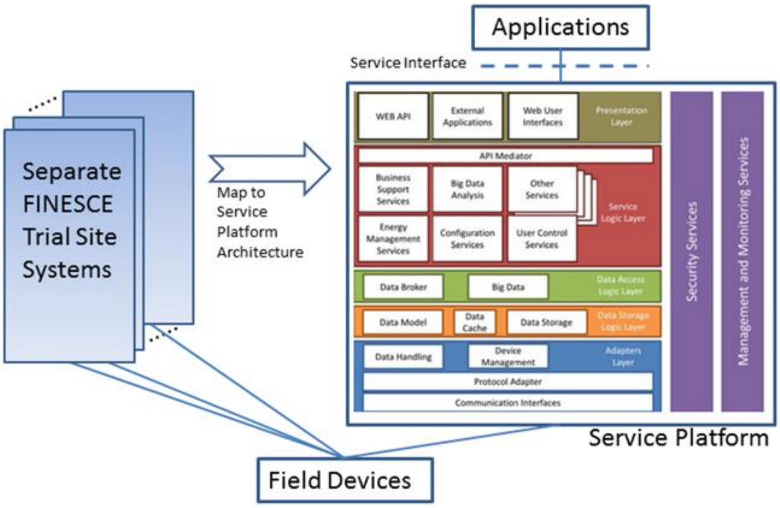

Figure 1: Mapping of Trial Site Systems to Service Platform Architecture

A further question addressed by this report is: how much can be learned from FINESCE, how much of the architecture can be extracted and re-used to tackle similar use cases, what lessons are there for people wanting to do similar things? It should be noted that the FINESCE trial site infrastructures are often built around legacy equipment (hardware and software): in the analysis performed in this report, this aspect has been bypassed and the functionality of the concerned equipment considered when mapping to a platform architecture. A limitation of this approach is that some legacy systems are large and monolithic, meaning that their functionality maps to several Platform layers and components.

2. Smart Energy Platform

The focus of the Platform discussed here is “Smart Energy”, which refers to energy services and their realisation in the composite domain comprising Smart Grids, Smart Cities and Smart Buildings.

The creation of this Platform cannot be done by one Smart Energy player alone but rather consensus and support must be built among all of them. Players can create their own competitive advantage through the services they build on top of the Platform. Also, it is critical that the Platform organisation supports fast developing solutions such as the ones Small and Medium-sized Enterprises (SMEs) can provide.

The Smart Energy Platform (SEP) is a service-oriented, open-source cloud-based middleware. The basic ideas are to minimise development costs by using standardised SW building blocks, interfaces and APIs. The business model of SEP is similar to e.g. Linux: an open source version as a common background and a supported version for commercial application. The Platform's open source approach, coupled with its business focus and the participation of partners from utilities, service providers, ICT companies and research organisations will foster active, dynamic and sustainable development.

A 5-layer platform architecture [1,2,3] is adopted, as shown in Figure 2, comprising an Adapters Layer, a Data Storage Logic Layer, a Data Access Logic Layer, a Service Logic Layer and a Presentation Layer. It uses a service-oriented architecture (SOA) where each layer offers simple, extensible APIs to its users, which can be other layers or, for the Presentation Layer, Platform-external applications. SOA hides underlying complexity and so it is suitable for implementation in a distributed cloud computing environment [4].

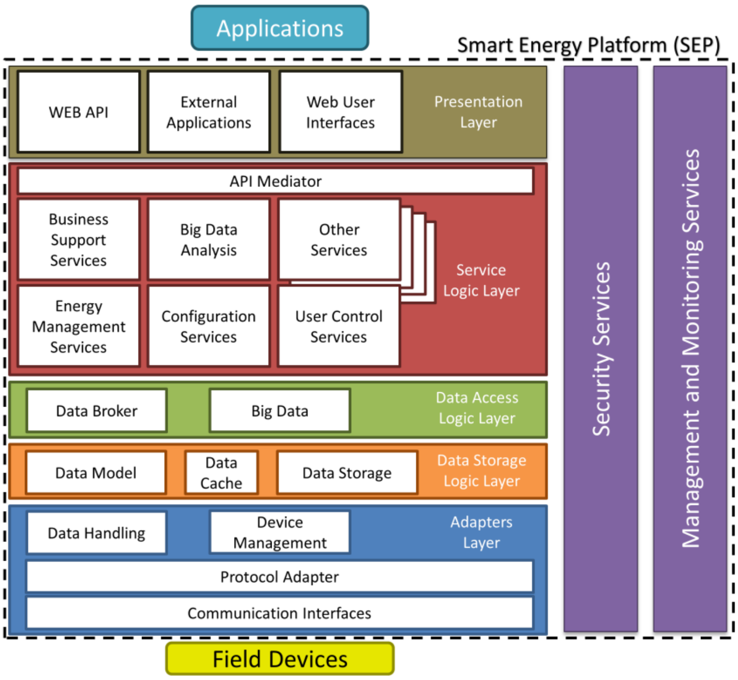

Figure 2. Smart Energy Platform Structure

The Adapters Layer (AL) supports miscellaneous communication interfaces, for data exchange and acquisition, towards the various Smart Energy devices (in electricity grids, buildings etc.). This layer provides the connection between the field devices and the Platform and interprets the different protocols used by these devices, whether they are standardised protocols (e.g. Automation architecture IEC 61850, IEC61599, Open-ADR etc.) or custom protocols, used by particular devices. This means that SEP, through its south-bound interface, is able to deal with a number of different data syntaxes and semantics. Therefore, the Protocol Adapter is flexible and extensible, in order to be compatible with present and future protocols used by field devices. Internally, SEP maps these protocols onto its own unified data model, upon which its northbound services are based. The core asset of the SEP is, therefore, this unified data model, that resides in the Data Storage Logic Layer (DSLL).

Data coming from the Adapters Layer is mapped by the DSLL onto the unified data model and then stored. The Platform incorporates two data storage systems, one short-term data cache, meant to contain those data that are requested more frequently or to access live data coming from the field devices, thus speeding up their retrieval, and a long-term data database, that retains all data passing through the Platform. The unified data model unifies the underlying device data models based on a common semantic model.

The Data Access Logic Layer (DALL) receives requests from the services on the upper layer and provides them the data they need. It can also push data to the devices, like configuration data or commands coming from the services running on the Platform. DALL’s main component is the Data Broker FIWARE Generic Enablers (GE) [10], the service that controls the data flow in the Platform. The DALL also includes a Big Data access block to manage Big Data storage.

The Service Logic Layer (SLL) offers a set of services to Smart Energy actors, supporting them in their roles and hiding the underlying complexity involved in implementing the services. Services are implemented using FIWARE GEs or Domain Specific Enablers (DSE). The set of GEs is a library of software components which offer a number of general-purpose functions, easing development of smart applications. DSEs are domain-oriented software components, which cover functionalities that are specific for a particular domain and help accelerating development of applications.

The last level is the Presentation Layer, which represents the entrance door to the Platform. External applications connect to this layer in order to communicate with the Platform. Alternatively, applications may be located directly here in the Presentation Layer and use the lower-level Platform layers from here. This means that every application makes use of the Presentation Layer in different ways, according to their architectures (e.g. thin or thick client).

In Figure 2, the two right-hand side vertical layers identify those services needed at every level of the Platform, and hence go through all the other layers. These services provide security for the Platform and for its own management and monitoring. The security services cover a number of aspects involving Users' access to networks, services and applications [11], including identity management, used for authorising external services to access personal data stored in a secure environment.

3. Mapping of Integration Architectures of FINESCE Trial Sites to Smart Energy Platform Architecture

In this chapter a mapping of functions contained in the integration architectures of FINESCE trial sites to a Smart Energy Platform Architecture is performed. The trial site architectures are taken from the D7.5 deliverable. The Platform functional entities and layers are taken from Chapter 2 above.

A separate mapping is performed for each FINESCE WP in the sub-chapters below.

3.1 Mapping of WP1 Integration Architecture

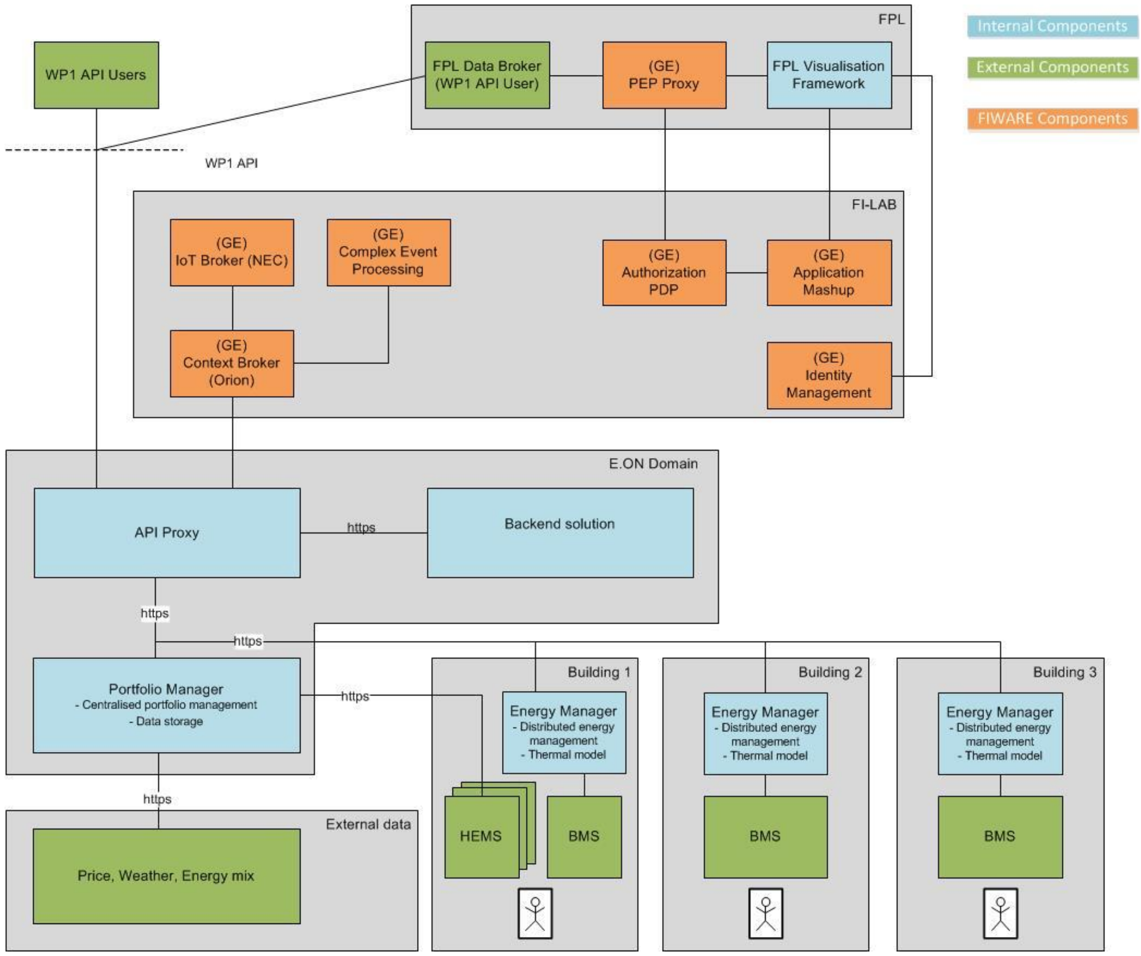

Figure 3: - WP1 Integration Architecture

WP1's functional architecture is shown in Figure 3. Table 1 below shows the mapping of the functional components for equivalent Platform layers and functions.

Component	Description	Platform Equivalent
Backend solution	Handles WP1 API user access rights and roles towards E.ON IT systems	Security Services
API Proxy	Provides the WP1 API, acting as a frontend integrator towards FI-Lab and E.ON systems	SLL, API Mediator
Portfolio Manager	back-end server platform for centralised portfolio management	Application
Energy Manager	present in each building in WP1, performs distributed energy management	Field Device
Building Management System (BMS)	present in each building in WP1, computer based control system monitoring and steering the heating supply and ventilation	Field Device
Home Energy Management System (HEMS)	present in all apartments in the first building in WP1 (Roth Fastigheter), computer based control system monitoring and steering the	Field Device

	heat usage	
FINESCE Presentation Layer (FPL)	cloud-based visualisation app working towards WP1 and WP3 trial systems. It interworks with a graphical web app which FPL users run in their browsers.	Application
Identity Management (Keyrock),Authorization PDP (AuthZForce) and PEP Proxy (Wilma)	used for a single-sign-on to the FPL	Security Services
Big Data Analysis (Cosmos) GE		DALL, Big Data
Publish/Subscribe Context Broker (Orion) GE		DALL, Data Broker
Backend IoT Broker (NEC) GE	IoT backend based on the to enable handling larger numbers of Energy Managers	SLL, Energy Management Services
Application Mashup GE	Prototyping, testing FPL	Application

Table 1: WP1 Components Mapping to Platform Architecture

3.2 Mapping of WP2 Integration Architecture

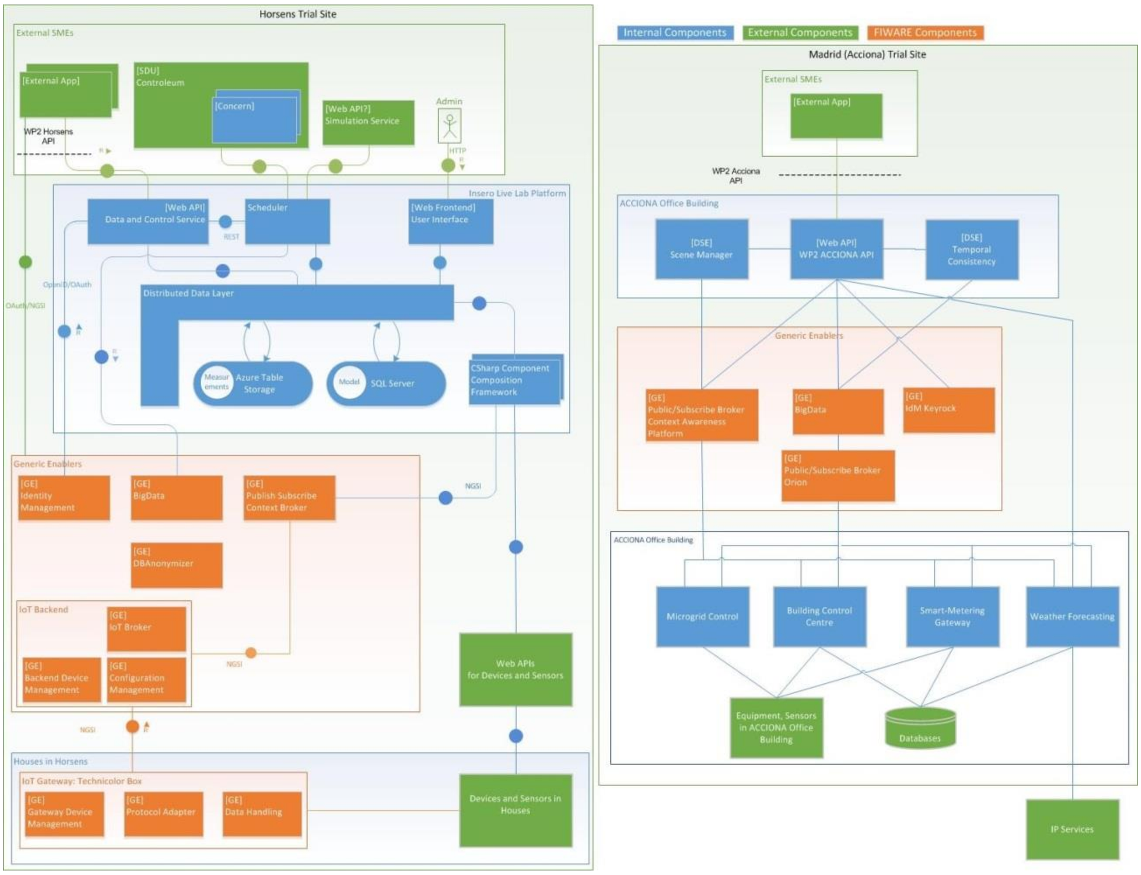

Figure 4 –WP2 Integration Architecture

WP2's functional architecture is shown in Figure 4. Table 2 and Table 3 below show the mapping of the functional components for equivalent Platform layers and functions.

Component	Description	Platform Equivalent
User Interface (web service):	administrator's system management portal, used to manage everything that can be configured in the system and visualise some of the data that is being collected.	PL, Web User Interface
Data and Control Service	exposes the API that all external services will use. Provides the historic data services to get raw measurements and aggregate measurements. Includes OData querying syntax for retrieving the sources of the measurements and the different types of measurements that exist. Provides API for the control services for the devices in the houses.	SLL, API Mediator
Component Composition Framework DSE	mediates the different APIs exposed from the web services that gather the data from the devices. • it allows NGSI clients to retrieve information through the Publish	AL, Protocol Adapter DSLL, Data Storage SLL, Other Services

	Subscribe Broker; • it stores all measurements from the houses into a NoSQL store for later retrieval and analysis; • it stores external data from weather and energy services into a NoSQL store for later usage in the Scheduler and Controleum; • it performs monitoring on all equipment in the houses, so causes of errors can easily be identified and eliminated.	
SQL Server	has a model of the physical configuration of equipment and the software deployment	DSLL, Data Model
Scheduler	uses the measurements from the houses, simulation of heat loss for the individual houses and weather and electricity production/usage prognosis from various services in order to optimise the way energy is used in the smart grid as a whole. Control instructions for the houses are provided by Controleum and executed in this component	SLL, Energy Management Services
Distributed Data Layer	provides the communication bus facilitating the exchange of measurement data, queries and control messages between the components in the system. It features a distributed platform providing location-transparent communication between components.	DALL, Data Broker
Controleum	framework for multi-objective control problems where each objective represents a concern in the control domain, like maintaining the air quality within a comfort-band, or reducing electricity consumption by extending the comfort-band in case of a demand-response event. It is the responsibility of Controleum to find a Pareto optimal solution and to identify conflicts between objectives.	SLL, Energy Management Services
Azure Table Storage	used for storing measurements	DSLL, Data Storage
IoT Gateway GEs	GEs in the Technicolor hardware box in the houses participating in the trial	AL: Device Management, Data Handling, Protocol Adapter
IoT Backend	backend comprising the Backend IoT Broker (NEC) and Backend Configuration Manager (Orion) GEs	AL: Device Management, Data Handling
Publish/Subscribe Context Broker (Orion) GE		DALL, Data Broker
Big Data Analysis (Cosmos) GE		DALL, Big Data
DB Anonymizer GE		SLL, Other Services

Identity Management GE		Security Services

Table 2: WP2 Horsens Components Mapping to Platform Architecture

Component	Description	Platform Equivalent
Microgrid Control, Building Control Centre, Smart Metering Gateway, Weather Forecasting	the four systems at the Acciona building which provide data from the building's equipment and sensors to FIWARE GEs.	Field Equipment
Web API	exposes, through appropriate security control, the the API that all external services will use;.	PL, Web API
Temporal Consistency DSE	pre-processes data stored in the Big Data GE by 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. It detects inconsistencies and removes non-valid values. It uses HiveQL Client (Backend) to interface to Big Data GE	SLL, Energy Management Services
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 in order to perform the event configuration, receive alert notifications and manage the subscriptions to those events	SLL, Energy Management Services
Publish/Subscribe Context Broker (Orion) GE		DALL, Data Broker
Big Data Analysis (Cosmos) GE		DALL, Big Data
Identity Management GE		Security Services

Table 3: WP2 Madrid Components Mapping to Platform Architecture

3.3 Mapping of WP3 Integration Architecture

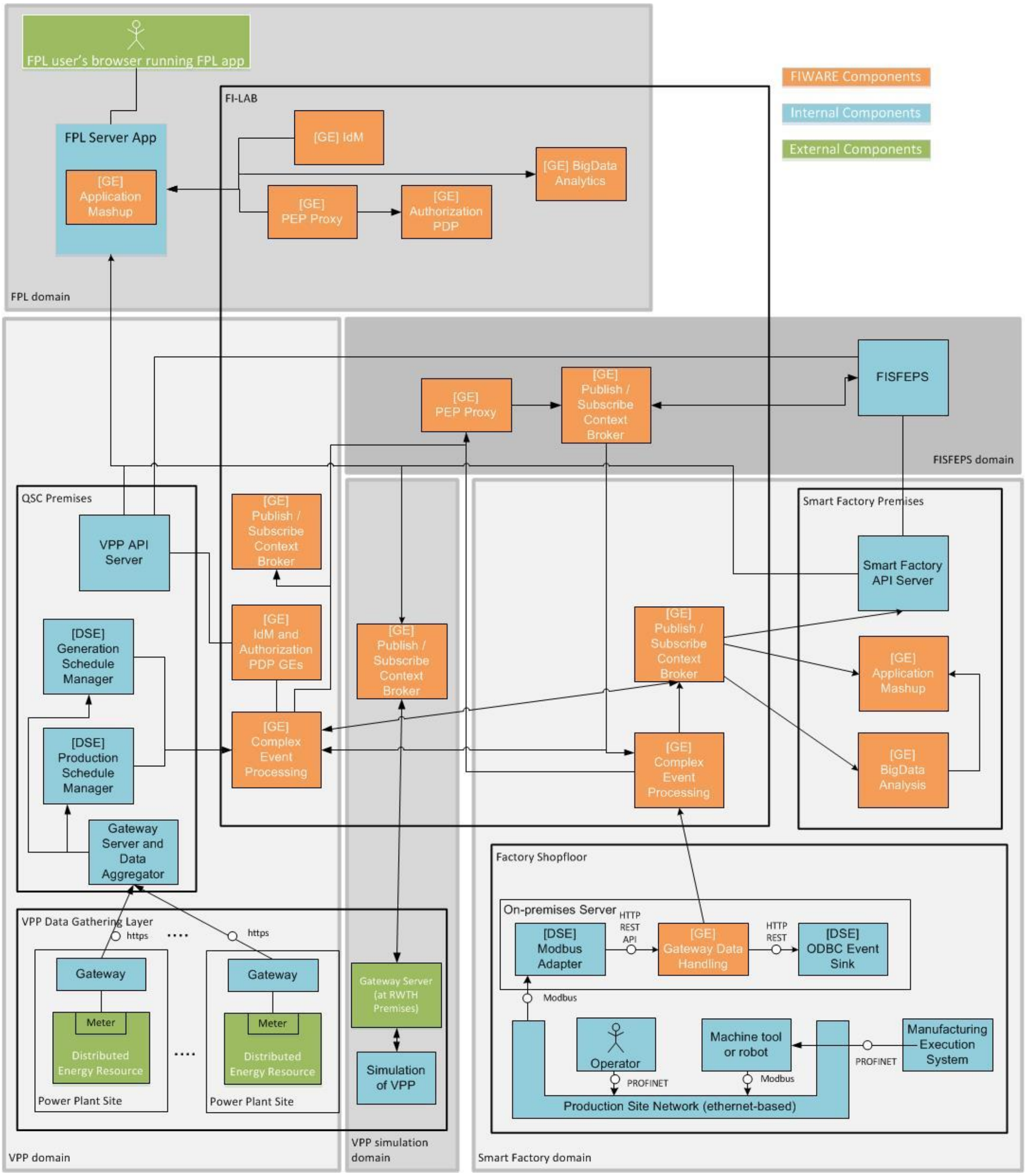

Figure 5: - WP3 Integration Architecture

WP3's functional architecture is shown in Figure 5. Table 4 below shows the mapping of the functional components for equivalent Platform layers and functions.

Component	Description	Platform Equivalent
VPP Power Plant sites (windmills, PV plants and biogas plants)	here, proprietary Gateways collect energy data from the DERs' meters and send it in encrypted form to a central proprietary QSC *Gateway Server*	Field Devices
Gateway Server	decrypts and stores the data locally and forwards it to the Complex Event	AL: Data Handing, Device Management

	Processing GE.	DSLL, Data Storage
Generation Schedule Manager DSE	provides information about the VPP's energy generation.	SLL, Energy Management Services
Production Schedule Manager DSE	processes the factory's production steps (including the associated power requirement) into a production plan.	SLL, Energy Management Services
Complex Event Processing GE	takes the output of these two DSEs to plan how to balance the energy production and consumption	SLL, Energy Management Services
Modbus Connector	supports the connection of the Factory shopfloor infrastructure to the Gateway Data Handling GE	AL, Protocol Adapter
Event Sink DSE	provides local storage of data	DSLL, Data Storage
Gateway Data Handling GE.	gateway between the factory and the cloud	AL, Data Handling
Application Mashup GE	In Factory, allows integration of the factory-related events into existing factory production management systems	PL, Web User Interfaces
Publish/Subscribe Context Broker (Orion) GE		DALL, Data Broker
PEP Proxy, Identity Management, Authorizazion PDP GEs		Security Services
FISFEPS	find the best match of the power which is generated by the VPP and the production plans which are provided by the Smart Factory	Application
FPL	web application framework for visualizing data on distributed renewable energy generation and its consumption in an industrial environment	Application

Table 4: WP3 Components Mapping to Platform Architecture

3.4 Mapping of WP4 Integration Architecture

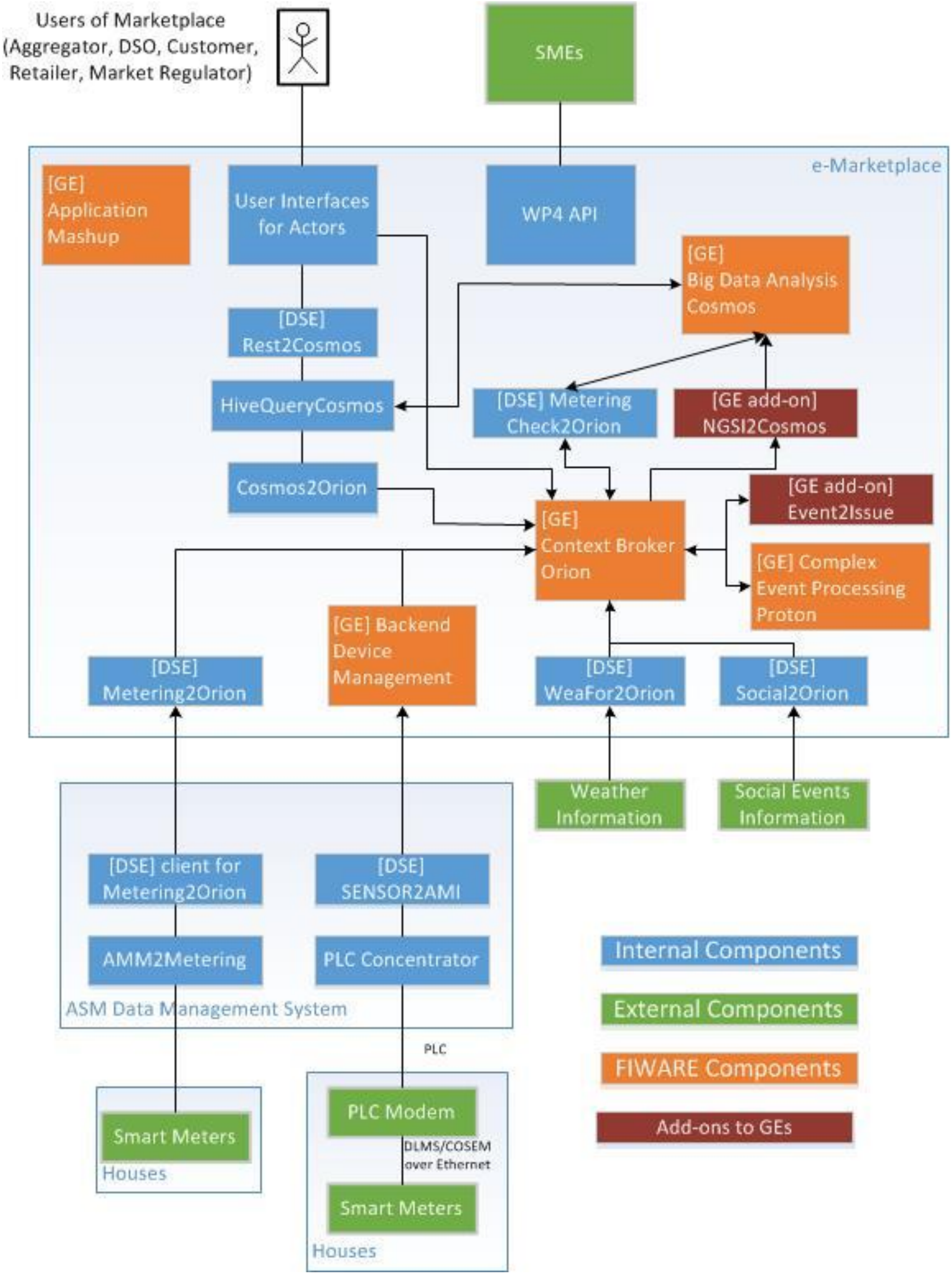

Figure 6–WP4 Integration Architecture

WP4's functional architecture is shown in Figure 6. Table 5 below shows the mapping of the functional components for equivalent Platform layers and functions.

Component	Description	Platform Equivalent

AMM2Metering	retrieves "raw" consumption and production data from the smart meters installed at the trial site and passes them over IP to Metering2Orion	AL, Protocol Adapter
Metering2Orion DSE	translates metering data coming from AMM2Metering into an NGSI10-compliant format (ORION context events) and finally publishes them on the ORION Context Broker GE.	DSLL, Data Storage, Data Model
WeaFor2Orion DSE	collects data from a weather forecasting service every five minutes and sends them to ORION Context Broker	AL, Protocol Adapter DSLL, Data Storage, Data Model
Social2Orion DSE	REST-based client that exposes an @POST 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.	AL, Protocol Adapter DSLL, Data Storage, Data Model
NGSI2Cosmos	special data injector connecting ORION to COSMOS. It subscribes to the data to be persisted) and when their values change, it automatically appends the new value in a COSMOS file (located within its HDFS file system);	DALL
Cosmos2Orion	Timer service which retrieves aggregated information on total consumption and production for the trial site area and sends it to ORION Context Broker GE;	SLL, Energy Management Services
HiveQueryCosmos	analyses and retrieves data from COSMOS GE via HIVE, It establishes the connection to the HIVE Data Warehouse, executes the Hive Query in HQL language, retrieves aggregated data and sends them to Rest2Cosmos;	SLL, Energy Management Services
Rest2Cosmos	REST-based client that exposes methods (GET) to retrieve the aggregated data from COSMOS GE via the HiveQueryCosmos module.	SLL, Energy Management Services
ContractInformation2Orion DSE	REST-based client that exposes methods (POST) whereby an external provider can send data on the cost of energy, the cost of energy produced by DERs and the cost of system transmission power plants	AL, Protocol Adapter DSLL Data Model, Data Storage
Issue Detector Processor DSE	Detects issues related to power losses and voltage drops (in the lines of a smart LV grid) and then sends it to an instance of ORION Context Broker GE	SLL, Energy Management Services
Application Mashup GE		PL, Web User Interfaces
Publish/Subscribe Context Broker (Orion) GE		DALL, Data Broker

Big Data Analysis GEs		DALL, Big Data
AMR2AMI	“alternative” metering capture system which has been implemented at the trial site: the Smart Meters, which are of a different type to those communicating with AMM2Metering, communicate using the DLMS/COSEM protocol over Ethernet to a PLC modem. A PLC concentrator at the substation terminates the PLC and communicates over Ethernet to the SENSOR2AMI DSE	Field Devices
SENSOR2AMI DSE	Comprises IAM-Reader, IAM-Server Relay, IAM2IDAS	Application
IAM-Reader	collects real time metering data, converting it to the DLMS/COSEM protocol if needed	AL Protocol Adapter
IAM-Server Relay	a middleware server which receives DLMS/COSEM metering objects from IAM-Readers and posts them to IAM2IDAS	DSLL, Data Model, Data Storage
IAM2IDAS	converts the DLMS objects to the format required the (Backend) Device Management (IDAS) GE	DSLL, Data Model, Data Storage
(Backend) Device Management (IDAS) GE		AL, Device Management
WP4 API	external interface to marketplace application	PL, Web API
Identity Management (Keyrock)	authorise users and give them a single sign-on to FI-Lab and Wirecloud	Security Services

Table 5: WP4 Components Mapping to Platform Architecture

3.5 Mapping of WP5 Integration Architecture

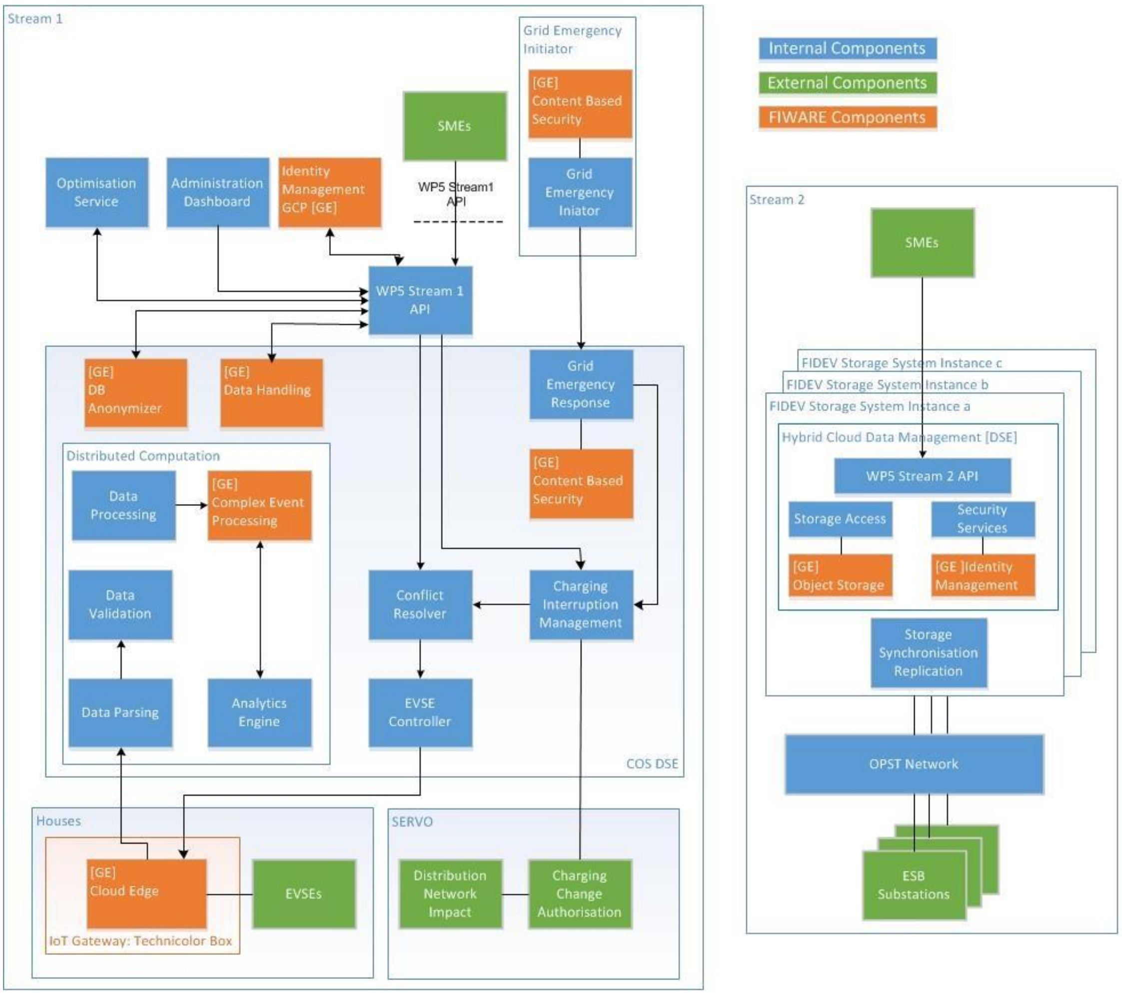

Figure 7–WP5 Integration Architecture

WP5's functional architecture is shown in Figure 7. Table 6 below shows the mapping of the functional components for equivalent Platform layers and functions.

Component	Description	Platform Equivalent
Electrical Vehicle Supply Equipment (EVSE)	charge electrical vehicles parked at the houses	Field Device
Cloud Edge GE	at the houses supporting COS – EVSE communication.	AL, Protocol Adapter
Charging Optimisation System (COS)	controls EVSE charging	Monolithic application, maps to all platform layers
SERVO	external DSO system which authorises EVSE charging based on its knowledge of the effect that a given EVSE's charging has on the LV and MV grid conditions	Application
Grid Emergency Initiator	allows a grid emergency state to be defined and communicated encrypted to COS	Field Device

Optimisation Service	algorithm which generates an EV charging schedule using EVSE state information retrieved from the COS and sends it to the COS for implementation during the next optimisation cycle (15 minutes)	SLL, Energy Management Services
WP5 Stream 1 API	provides an API for both internal WP usage and for external usage;	PL, Web API
Optical Packet Switch and Transport Network	connecting several MV substations via optical switches and optical fibre.	Field Device
FIDEV Storage System	distributed, cloud-based data storage system	Application. Could be DSLL, Data Storage.
Hybrid Cloud Data Management DSE	containing the parts of FIDEV Storage System which provide access to the local and distributed storage.	DSLL, Data Storage
Security GEs		Security Services
Object Storage GE		DALL, Data Storage
Complex Event Processing GE	support provision of historical EVSE data.	SLL, Energy Management Services

Table 6: WP5 Components Mapping to Platform Architecture

4. Southbound Protocols

4.1 WP1 Interfaces

4.1.1 Portfolio Manager / Energy Manager

There is an HTTPS server in the Energy Manager to which the Portfolio Manager connects. This server exposes a RESTful web service for the parts of the Energy Manager that the Portfolio Manager needs. The communication is secured by authentication and encryption through TLS 1.0.

4.1.2 Energy Manager / BMS

The Modbus protocol is used to communicate over the serial connection. There is a building specific set of signals that are exchanged, including control and data signals. The BMS is Modbus master and the Energy Manager is Modbus slave.

4.2 WP2 Horsens Interfaces

4.2.1 Communication (High level)

Each house is equipped with devices and sensors as listed in Table 7. To communicate with the equipment, and to retrieve data measured from the individual devices/sensors, five main interfaces are utilized in each house.

- IC Meter - Indoor Climate Meter from http://www.ic-meter.eu
- LIAB Controller Box from http://www.styrdinvarmepumpe.dk
- Develco ZigBee Gateway from http://www.develcoproducts.com
- EverGreen Domus EV Charger from http://www.vikingegaarden.dk
- VikMote EV DataLogger from http://www.vikingegaarden.dk

Please note that the names of the above devices and sensors are vendor specific. These names are used internally to ensure understanding between local partners and therefore not changed in the formal documents.

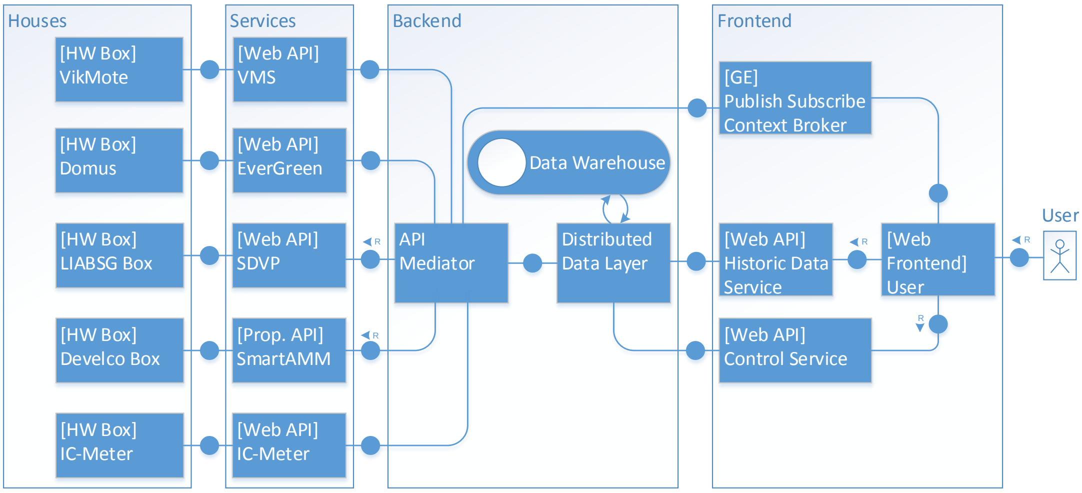

Figure 8: Data Flow

Each device aggregates measurements from a wide range of sub-sensors and devices installed throughout the house, and in the immediate vicinity.

Inside the houses that make up this trial site the different components and equipment communicate with the trial test bed through multiple gateways as described above. The gateways communicate with proprietary cloud services, which in turn are interfaced through the API Mediator Service in the Insero Live Lab platform.

	Internal (House / Electrical Vehicle)	Cloud / Internet

Manufacturer	Sensor / Actuator	Internal Protocol / Media	Gateway (Service)	Media / Connection	API Mediator Endpoint
Develco	Echelon MEP	ZigBee	Develco ZigBee Gateway (SmartAMM)	Wired Ethernet	Proprietary Service
Kamstrup / Develco	MULTICAL 602 with Develco ZigBee Module*	ZigBee	Develco ZigBee Gateway (SmartAMM)	Wired Ethernet	Proprietary Service
Develco	PIR Sensor	ZigBee	Develco ZigBee Gateway (SmartAMM)	Wired Ethernet	Proprietary Service
Kamstrup	MULTICAL 602*	S0 / Pulse Converter	LiabSG Controller (SDVP)	Wired Ethernet	Rest Based Web Service
Vikingegaarden	Build in EV charger power meas.	N/A	Domus (VMS)	GSM	Rest Based Web Service
Vikingegaarden	EV DataLogger	N/A	VikMote (EverGreen)	GSM	Rest Based Web Service
Liab ApS	Temperature Sensor Board	RS-485 modbus	LiabSG Controller (SDVP)	Wired Ethernet	Rest Based Web Service
IC-Meter	Indoor Climate Meter	N/A WIFI	IC-Meter (IC-Meter)	Wired Ethernet	Rest Based Web Service
Danfoss	DLX PV Inverter	S0 / Pulse Converter	LiabSG (SDVP)	Wired Ethernet	Rest Based Web Service

Table 7: Devices and sensors installed in each house

*) The Kamstrup MULTICAL 602 Heat Meter is interfaced by the LIABSG box as well as the Develco ZigBee gateway for testing purposes.

4.3 WP2 Madrid Interfaces

4.3.1 Building Control Centre

Please refer to Figure 8 in Ch. 4.2.1 of D7.2 for an illustration of the BCC layout.

Due to the integration of analyzers and meters with different communication protocols (Mbus, Modbus, BACnet) it has been mandatory the use of some gateways (Intesis Box) through which the data is forwarded to a data collector (also Intesis box). The data collector converts BACnet to DCX1, which is input to the BCC.

4.3.2 Wireless Sensor Network

Please refer to Figure 9 in Ch. 4.2.2 of D7.2 for an illustration of the WSN layout.

Environmental sensors and power consumption meters are connected via serial port to wireless nodes. Their measurements are sent via radio fulfilling IEEE 802.15.4 wireless protocol to the root node, and from there via UART port to the gateway, which processes it, stores it in a local data base, and once consistency is assured, this information is sent to the cloud, where is stored on a database.

4.3.3 Microgrid

Please refer to Figure 10 in Ch. 4.2.3 of D7.2 for an illustration of the WSN layout.

Modbus (RS485) is used for communication from PV panels and Microgrid Battery & Controllers towards a database.

4.4 WP3 Interfaces

Within the factory, the data from the different machines is aggregated and provided to the cloud to be stored via a specific interface (MODBUS RS485).

For the VPP, the gateway (located at the DER site) use the Internet technology available at the DER, e.g. cellular, to communicate with the dedicated gateway server.

4.5 WP4 Interfaces

The interface from the Smart Meters is DLMS/COSEM. This specification is standardised in:

- IEC 62056-42: DLMS physical layer
- IEC 62056-46: DLMS link layer (HDLC definitions)
- IEC 62056-53: DLMS application layer (COSEM)

4.6 WP5 Interfaces

In Stream 1, the interface between the COS and EVSE is a proprietary protocol transported over standard communication protocols (WiMAX and LTE for the final wireless access to the EVSEs).

In Stream 2, tnfrastructure Client Interfaces include,

- OPST = 10GE Optical
- Firewall = 10GE Optical & 1GE Copper
- TDM Router = 10GE Optical, 1GE Copper, G703, X.21, V.24
- Relay 61850 = Fast Ethernet Copper
- Relay Differential = X.21
- SCADA = V.24

5. Conclusion

The Smart Energy domain is currently on the cusp of a revolutionary development away from the traditional model where power is centrally generated and distributed to passive loads towards a scenario where large penetration of distributed renewable energy resources changes the game and will result in the emergence of new players, new business models and a much strengthened customer focus. The key enabler will be to have a service-oriented approach and this requires the development of a Smart Energy Platform which can interface between field devices and allow unique business services to be developed. The core of such a Platform is to have a unified data model which unifies the various data models of the field devices, so that service logic can be developed which can address these various devices.

This report has presented a mapping of the FINESCE trial site infrastructures onto a Smart Energy Platform architecture, thus defining needed Platform functionality and resulting in a basic understanding of what such a platform should look like and what functions it should contain. This understanding will be useful when in later projects which implement new use cases using the platform architecture.

Aspects that need to be considered when defining a single, unified platform architecture are:

- Analysis of existing unifying mappings between the protocols used between the FINESCE trial systems towards the field devices (not attempted here, although the protocols are listed in Chapter 4);
- Creation of a unified data model in the Platform for the FINESCE trial system data (see deliverable D7.13);
- Categorisation of the FINESCE use cases into groups with similar requirements and design characteristics (not attempted here);
- Derivation of needed platform functionality and structures to support the FINESCE use cases. This has been attempted in this report in Chapter 3. The result of the mappings in Tables 1 to 6 show that all of the SEP layers and most of the SEP functions proposed in Chapter 2 would be needed to implement the FINESCE trial sites' use cases in the SEP architecture.

6. References

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