PLATFORM FOR OPERATION OF DISTRIBUTION NETWORKS

Platone

PLATform for Operation of distribution NEtworks

D3.8

Report on second integration activity in the field

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Abstract

The goal of the Platone Italian Demo is to develop a complete “end-to-end local flexibility market” assuring a proper TSO/DSO coordination.

This document aims to explain the relevant improvements and integration activities connected to the second “Delivering of technology” of all the Italian Demo Platforms including the Market Platform, the Aggregator Platform, the DSO Technical Platform and the Access Layer (composition of Light Node, Blockchain Access Layer and Shared Customer Database).

The Deliverable mentions all the development activities spread along the different Platforms of the Italian Demo to also enable the Real Time market sessions (in addition to the already implemented Day Ahead session).

Furthermore, this document describes some relevant integration activities between the DSO Technical Platform and the LV DSO Operational Systems, important activities on the customers’ side as well as the evolution of the mobile app “Flessibili”.

On top of all those aspects, this work shows the technical/economic scenario defined with LV real network data that was used to validate the evolved overall Italian Demo Platone process. The complete up and running system allowed to test the new internal algorithms confirming definitively the flexible approach designed from the very beginning in the Platone Italian Demo.

Keyword list

Access Layer; Aggregator Platform; Blockchain Access Layer; DSO Technical Platform; Light Node; Market Platform; System Architecture; Shared Customer Database; System Integration; Field Test

Executive Summary

"Innovation for the customers, innovation for the grid" is the vision of project Platone - Platform for Operation of distribution Networks. Within the H2020 programme "A single, smart European electricity grid", Platone addresses the topic "Flexibility and retail market options for the distribution grid". Modern power grids are moving away from centralised, infrastructure-heavy transmission system operators (TSOs) towards distribution system operators (DSOs) that are flexible and more capable of managing diverse renewable energy sources. DSOs require new ways of managing the increased number of producers, end users and more volatile power distribution systems of the future.

Platone is using blockchain technology to build the Platone Open Framework to meet the needs of modern DSO power systems, including data management. The Platone Open Framework aims to create an open, flexible and secure system that enables distribution grid flexibility/congestion management mechanisms, through innovative energy market models involving all the possible actors at many levels (DSOs, TSOs, customers, aggregators). It is an open source framework based on blockchain technology that enables a secure and shared data management system, allows standard and flexible integration of external solutions (e.g. legacy solutions), and is open to integration of external services through standardized open application program interfaces (APIs). It is built with existing regulations in mind and will allow small power producers to be easily certified so that they can sell excess energy back to the grid. The Platone Open Framework will also incorporate an open-market system to link with traditional TSOs. The Platone Open Framework will be tested in three European demos and within the Canadian Distributed Energy Management Initiative (DEMI).

The objective of the Platone Italian Demo is to develop, integrate and test a complete "end-to-end local flexibility market" assuring a proper TSO/DSO coordination both on Medium and Low Voltage networks.

This Deliverable starts from the "Report on first integration activity in the field" and from the significant improvements connected to the second "Delivery of technology" of the Platforms involved in the Italian Demo (Market Platform, Aggregator Platform, DSO Technical Platform and Access Layer) showing how the overall system evolved with some new functions and how it was tested on a different real network scenario.

The functions added on the different Platforms of the Italian Demo enabled the Real Time market sessions (in addition to the already implemented Day Ahead session) addressing in detail the Low Voltage network (in addition to the activities already done for the Medium Voltage part).

This work completes one of the most important aspects of the Italian Demo that is the alignment with the real electrical network scenario; more in detail, the focus is on the integration activities between the DSO Technical Platform and the LV DSO Operational Systems concentrating both on the network data and on the measurements acquisition.

In addition, to show how the test environment and user engagement evolved furthermore, the involvement of a Collective Self Consumption entity and of the areti Smart-Park (EV fleet) are mentioned in the document as well as the new functionalities that were added to the mobile app "Flessibili".

On top of all those aspects, this Deliverable displays step by step the technical/economic scenario defined on the LV real network data used to validate one more time the evolved overall Italian Demo Platone process. The complete up and running system allowed to test the new internal algorithms leading again to some interesting results in terms of User Flexibility services exploitation and confirming definitively the flexible approach designed from the very beginning in the Platone Italian Demo.

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1 Introduction

The project "PLATform for Operation of distribution Networks – Platone" aims to develop an architecture for testing and implementing a data acquisition system based on a two-layer Blockchain approach: an "Access Layer" to connect customers to the Distribution System Operator (DSO) and a "Service Layer" to link customers and DSO to the Flexibility Market environment (Market Place, Aggregators, …). The two layers are linked by a Shared Customer Database, containing all the data certified by Blockchain and made available to all the relevant stakeholders of the two layers. This Platone Open Framework architecture allows a greater stakeholder involvement and enables an efficient and smart network management. The tools used for this purpose will be based on platforms able to receive data from different sources, such as weather forecasting systems or distributed smart devices spread all over the urban area. These platforms, by talking to each other and exchanging data, will allow collecting and elaborating information useful for DSOs, transmission system operators (TSOs), Market, customers and aggregators. In particular, the DSOs will invest in a standard, open, non-discriminatory, blockchain-based, economic dispute settlement infrastructure, to give to both the customers and to the aggregator the possibility to more easily become flexibility market players. This solution will allow the DSO to acquire a new role as a market enabler for end users and a smarter observer of the distribution network. By defining this innovative two-layer architecture, Platone strongly contributes to aims to removing technical and economic barriers to the achievement of a carbon-free society by 2050 [1], creating the ecosystem for new market mechanisms for a rapid roll out among DSOs and for a large involvement of customers in the active management of grids and in the flexibility markets. The Platone platform will be tested in three European demos (Greece, Germany and Italy) and within the Distributed Energy Management Initiative (DEMI) in Canada. The Platone consortium aims to go for a commercial exploitation of the results after the project is finished. Within the H2020 programme "A single, smart European electricity grid" Platone addresses the topic "Flexibility and retail market options for the distribution grid".

The Italian Demo, led by the Italian DSO areti, aims to realise a completely integrated system able to involve all the distributed energy resources (connected to the Medium and Low Voltage networks) in providing Flexibility Services according to specific market frameworks (Day Ahead, Real Time sessions) and including all the relevant stakeholders (TSOs, DSOs, customers, Aggregators).

All the partners involved in WP3 worked on the implementation of the second release of the System Architecture of the Italian Demo collaborating in all the necessary integration activities and getting to the second field test setup.

This second test setup is a final step on the Italian Demo roadmap because it addresses, through a complete up & running system, all the remaining aspects left form the previous test activities like the Real Time market sessions management and the extension to the areti's Low Voltage Network involving real Flexible Users.

1.1 Task 3.2, 3.3 and 3.4

This Deliverable reports on all the integration activities connected to the main development Tasks of WP3:

- Task 3.2: "Development of a standard Blockchain based infrastructure, implementing a Common Access Interface between all the market players"
- Task 3.3: "Implementation of a technical platform for grid state estimation and flexibility requests validation"
- Task 3.4: "Solutions to enable Aggregators to provide flexibility: Aggregator platform and customer involvement"

Starting from the overall design of the technical solution and delivering of technology, activities continued involving different integration steps between all the Italian Demo platforms and preparing proper data scenarios for a second field test.

1.2 Objectives of the Work Reported in this Deliverable

The objective of the work reported in this Deliverable is to describe the further evolutions and integration activities connected to the "Delivering of technology (v2)" [2] considering the general test approach and focusing on the single Italian Demo platforms. Furthermore, the Deliverable contains the description of the economical/technical scenario setup to test also on the Low Voltage network the overall Platone Italian Demo process.

1.3 Outline of the Deliverable

The document has the following structure:

- Chapter 1 is about the general introduction of the reported work
- Chapter 2 describes the adopted methodology and the integration steps for the Italian Demo architecture
- Chapter 3 is dedicated to the overall test architecture and to the improvements for each Platform of the Italian Demo
- Chapter 4 explores the data used to build the second test scenario, the description of the test process and the final results
- Chapter 5 presents the general conclusions of the activities shown in the Deliverable

1.4 How to Read this Document

This Document can be read independently from other Platone's Deliverables. Though, it is connected to other Documents of the Platone project especially to D3.4 "Delivering of technology (v2)" [2] and D3.6 "Report on first integration activity in the field". The following list summarizes all linked Platone Deliverables:

- D3.1 "Internal operational plan and WP3 roadmap" [3] released by areti on Month 3 (November 2019) as confidential detailed work plan and roadmap of WP3. Within D3.1, a first description of the Italian Demo architecture was implemented listing the main objectives and the structure of the architecture.
- D2.1 "Platone platform requirements and reference architecture (v1)" [4] released by Engineering on Month 12 (August 2020) as public detailed work on the Platone Open Framework. Within D2.1, Engineering describes the Platone Open Framework, a relevant element for Platone Demos and so for the Italian Demo.
- D1.1 "General functional requirements and specifications of joint activities in the demonstrators" [5] by E.DSO on Month 12 (August 2020) as a public report on the Use cases of the three Platone demonstrations. D1.1 sums up and compares the use cases in the different demos.
- D2.3 "Platone Market Platform (v1)" [6] released by ENG on Month 18 (February 2021) as a public report that accompanies the first software delivery of the Platone Market Platform with an architecture overview and explanation of a demonstration setup.
- D3.3 "Delivering of technology (v1)" [7] released by areti on Month 21 (May 2021) as a public report that accompanies the first software delivery of all the Italian Demo Platforms with a System Architecture overview defining the functional and technical requirements, and the communication mechanisms.
- D3.6 "Report on first integration activity in the field" [8] released by SIEMENS on Month 23 (July 2021) as a public report on the integration activities, data setup and real test scenarios connected to the first release of the Italian Demo Platforms
- D2.2 "Platone platform requirements and reference architecture (v2)" [9] released by Engineering on Month 30 (February 2022) as public detailed work on the Platone Open Framework. Within D2.2, Engineering describes the evolution of the Platone Open Framework, a relevant element for Platone Demos and so for the Italian Demo.
- D2.4 "Platone Market platform (v2)" [10] released by ENG on Month 38 (October 2022) as a public report that accompanies the second software delivery of the Platone Market Platform with an architecture overview and explanation of a demonstration setup.
- D3.4 "Delivering of technology (v2)" [2] released by areti on Month 38 (October 2022) as a public report that accompanies the second software delivery of all the Italian Demo Platforms with a System Architecture overview defining the functional and technical requirements, and the communication mechanisms.

2 Methodology

2.1 Integration approach

The Italian Demo has developed a full implementation of the common Platone Architecture introduced in the D2.1 [4] using data coming directly from the Medium Voltage and Low Voltage distribution grid and equipment in the field. The System Architecture is based on the platforms shown in Figure 1 where:

- The Blockchain Service Layer (including Market Platform) runs the cross between offers and requests. It was developed in WP2 and adapted to the Italian Demo requirements (as necessary)
- The Aggregator Platform elaborates flexibility offers and the Italian DSO Technical Platform elaborates flexibility requests and checks the offers. These platforms were developed by Siemens
- The Italian Blockchain Access Layer intermediates the customers and the market. It was developed by APIO
- The Shared Customer Database (SCD), through Blockchain Access Layer, stores all the flexibility data. It was developed by areti

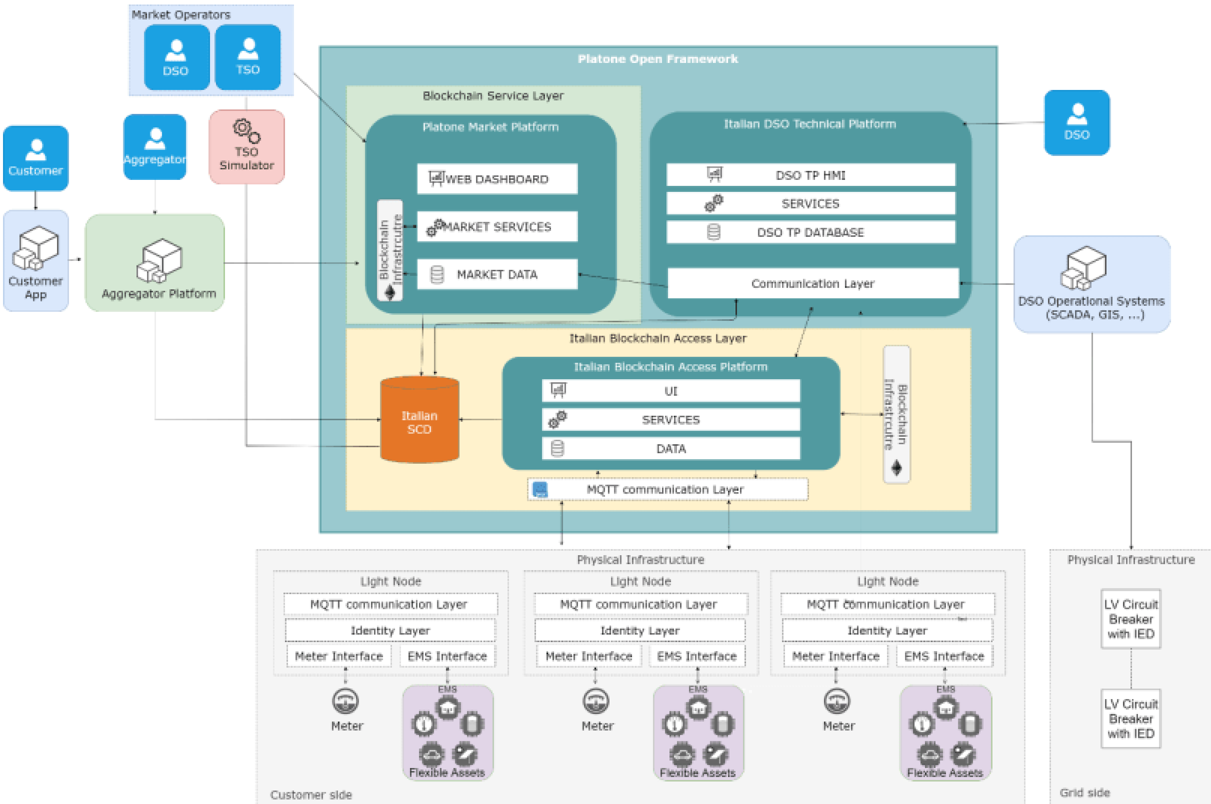

Figure 1: Italian Demo Architecture

In the second release of the technology, Italian demo partners, starting from the previous version, have focused on the implementation of new functionalities and improvements.

All the activities were planned and organized keeping the work streams defined in WP3 [7].

Figure 2 shows one of the main updates implemented in this period: the timeframe of the Local Flexibility Market process. In detail, the demo partners have completed the short-term market, implementing the Real Time sessions and the coordination between them and the Day Ahead session.

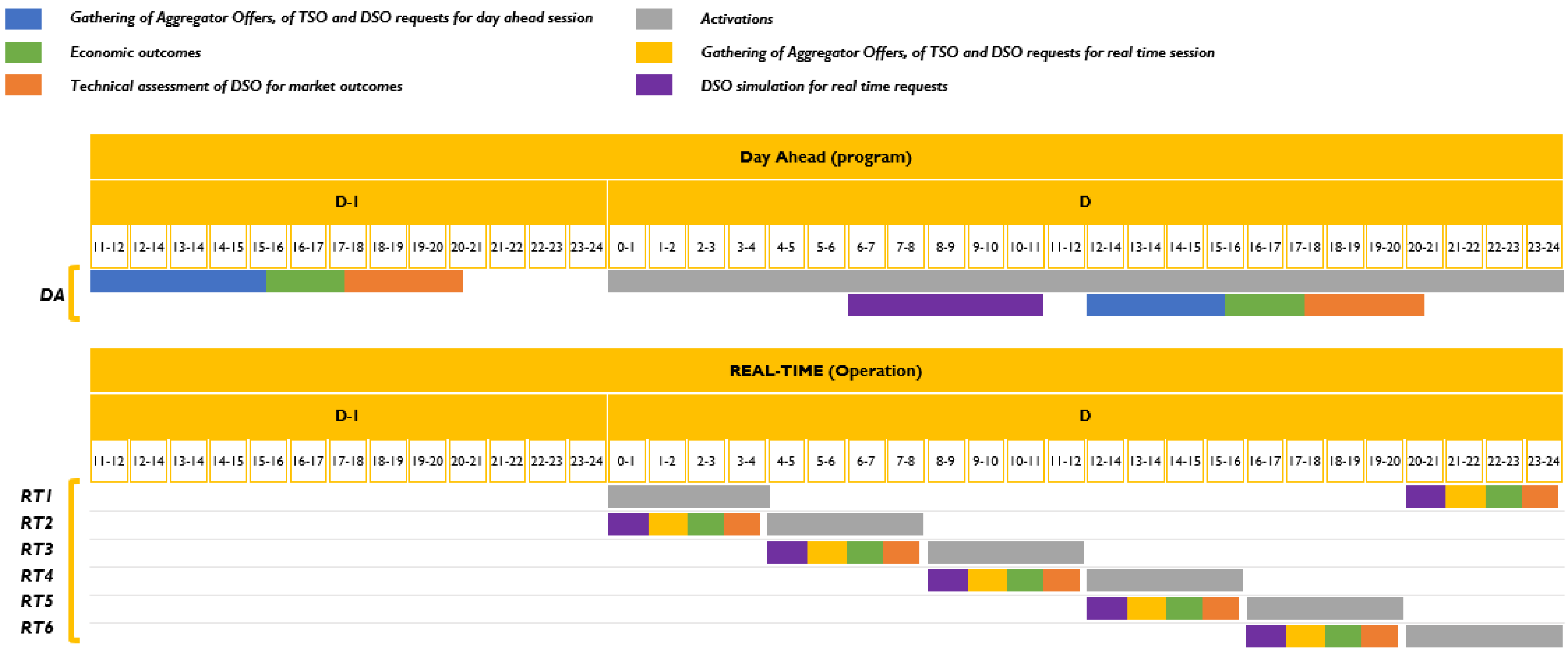

Figure 2: Timeline of the Platone Italian Demo process

2.2 Integration steps

The integration steps treated in this report have the following focus:

- Involve and inform the customers: new functionalities have been implemented on the mobile App "Flessibili" (Ch. 3.3)
- Increase the grid observability: several sensors and other devices installed in the substations, have been integrated into the DSO Technical Platform (Ch. 3.4)
- Test the market sessions: to avoid the customers discomfort, some load simulators installed into areti's lab have been involved (Ch. 3.6)
- Test the flexibility provided by EV fleet: areti smart park has been equipped with the light nodes (Ch. 3.7)
- Increase the kind of users involved in the demo: a Collective Self Consumption has been involved in the Italian Demo (Ch. 3.7)

This second release confirms the Italian Demo architecture and the content of each data flow (following list and Figure 3); moreover this release adds the implementation of Flow 1a and Flow 5 (between Market Platform and DSOTP).

- Flow 0 (AP – SCD): Flexible PoD registration
- Flow 0 (SCD – DSOTP): Flexible PoD registration
- Flow 0a (DSOTP – SCD): Flexible PoD - PoM association
- Flow 0b (SCD – MP/TSO Simulator): Flexible PoD data
- Flow 1 (SCD – AP): Flexible PoD data (15min)
- Flow 1a (SCD – DSOTP): Flexible PoD data (on demand calls)
- Flow 2a (AP – MP): Flexibility offers
- Flow 2b (TSO Simulator – MP): TSO Flexibility requests
- Flow 2c (DSOTP – MP): DSO Flexibility requests
- Flow 3 (MP – DSOTP): Market outcomes for technical validation
- Flow 4 (DSOTP – MP): Validated market outcomes
- Flow 5 (MP – AP/DSOTP/TSO Simulator): Market results
- Flow 6 (AP – SCD/DSOTP): Setpoint
- Flow 6 (DSOTP – Light Node): Setpoint (to the field)
- Flow 6 (Light Node – EMS): Setpoint (customer's plant)
- Flow 7 (Light Node – Blockchain Platform): Measurement data & Setpoint
- Flow 7 (Blockchain Platform – SCD): Measurement data & Setpoint
- Flow 8 (SCD – MP): Measurement data & Setpoint (updates on demand)

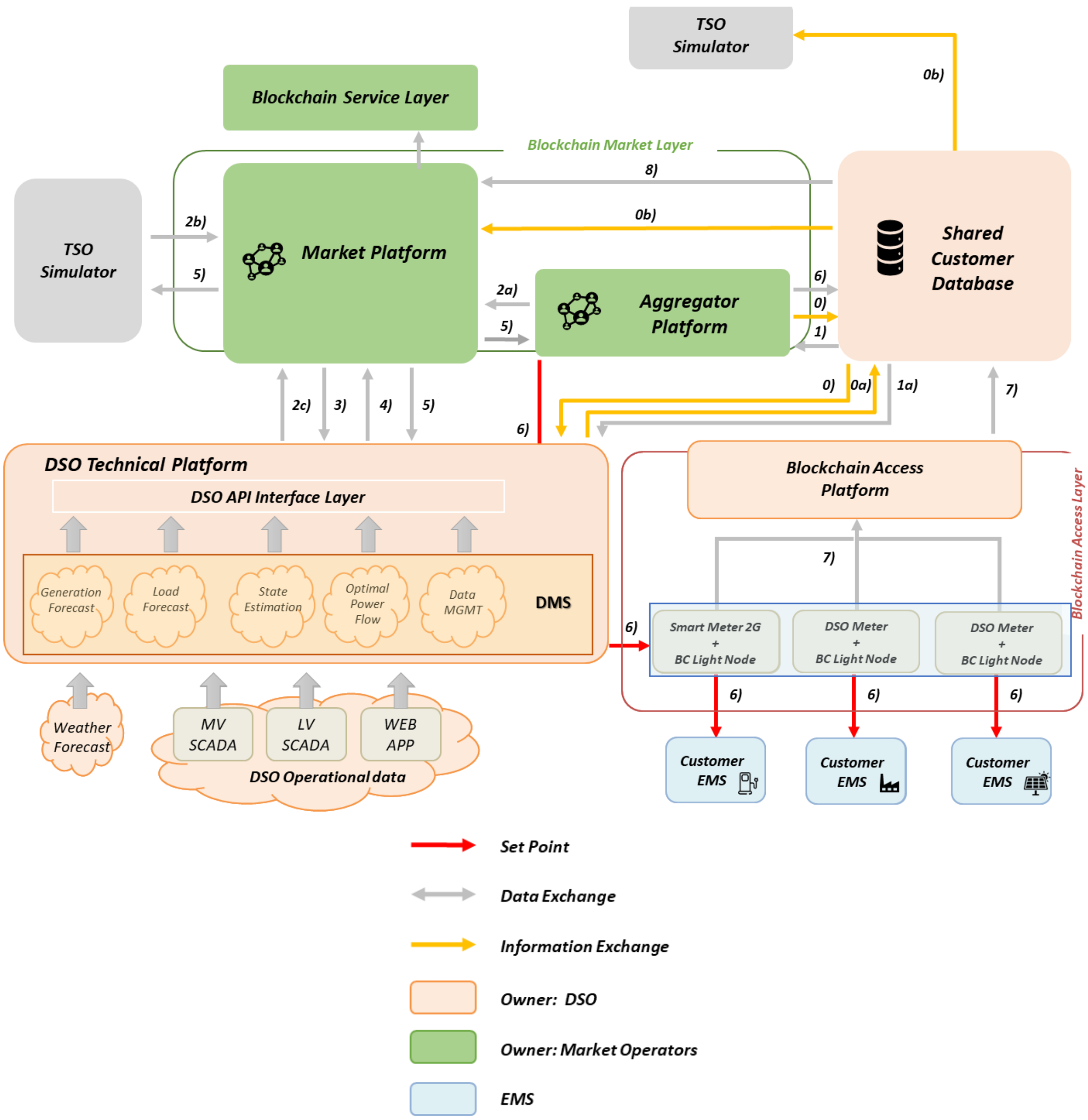

Figure 3: Data Flow for Italian Demo architecture

3 Test architecture and platforms evolution

3.1 Overview

Chapter 3 describes the main evolutions implemented in each platform of the Italian Demo architecture in the second release.

3.2 Market Platform

The Platone Market Platform is one of the core components of the Platone Open Framework (as described in D2.1 [4]). The Market Platform (MP) is a blockchain-based platform that enables the management of wide geographical area flexibility requests from TSOs and local flexibility requests from DSOs. The flexibility requests are matched with offers coming from Aggregators accordingly to pre-defined rules and dispatching priorities, in order to solve grid issues. All the market operations are registered and certified within the blockchain service layer, ensuring a high level of transparency, security and trustworthiness among all the market players.

The second prototype of the Platone Market Platform was integrated in the Italian Demo Architecture and includes additional features compared to the first one. More in detail:

- Coordinated day-Ahead and Real Time Market Flexibility Services
- Settlement Outcomes and validation on Real Time results
- Certification of market results on blockchain service layer
- Settlement and Customer Incentivisation, based on two smart contracts: flexibility agreement and Platone Token
- Updated version of the Web Dashboard for Market Participants.

For more detail about the second release of the Platone Market Platform, see D2.4 [10].

3.2.1 Integration with other platforms

In the context of the Italian Demo, the Platone Market Platform allows the integration of other platforms through a specific component: the communication layer.

As shown in Figure 4, the communication layer is part of the overall Platone Market Platform architecture and allows the integration of external components and internal communication among the different layers within the Market Platform. It provides both synchronous communication interfaces (REST APIs) and asynchronous communication interfaces (Message Broker).

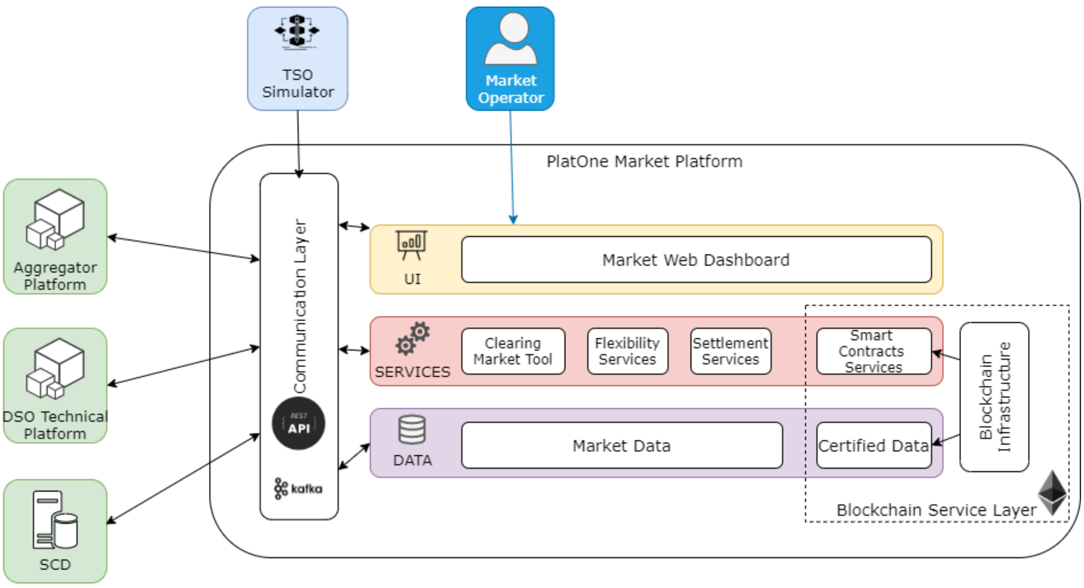

Figure 4: Market Platform Architecture

A specific architectural component dedicated to communication mechanisms provides a greater flexibility to the Market Platform, which is able to cover different solution and integrate different external systems.

Figure 5 describes the integration flows between the Platone Market Platform and the other platforms. More details about integration and communication mechanism were already provided in D3.6 [8].

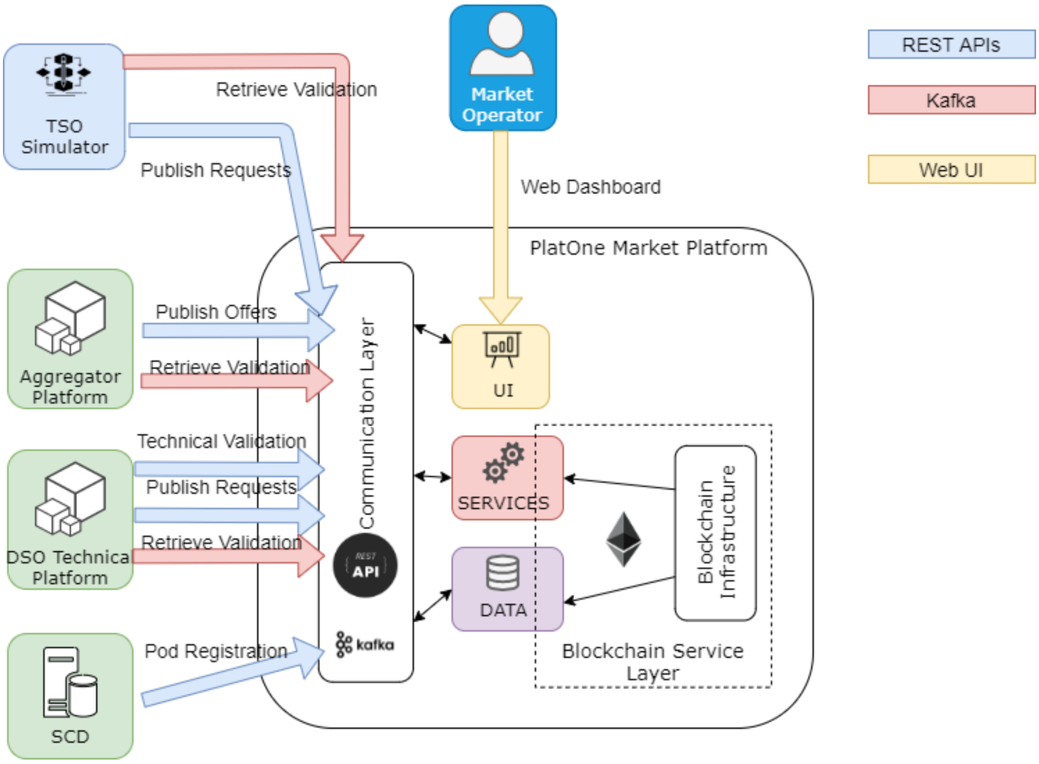

Figure 5: Integration with the Market Platform

All the REST APIs exposed by the Platone Market Platform implement an authentication mechanism based on Oauth2.0 over HTTPS connection and are documented as OpenAPI3.0 in the Deliverable D3.3 [7].

The second version of the Platone Market Platform implements a new authenticated API used by the aggregator for retrieving the wallet balance of a specific PoD. This information is directly retrieved from the blockchain service layer and is used for the visualisation of the Platone Token balance within the Customer app (App Flessibili) as described in Ch.3.3.

Table 1: Market Platform new REST API

Name	**Url**	**Method**	**Parameters**	**Responses**
Retrieve Balance	/contracts/transactions/balanceOf/:pod	GET	In request: PoD : String	Success (200) Wallet Balance Error (500) Error Message - *String*

For the exhaustive list of APIs please refer to the D2.4 [10]. All the connections to the Message Broker are secured through a mutual authentication based on TLS.

In the first version of the Market Platform, only the validated outcomes were published in the Message Broker. The Validated Outcomes are filtered for each Market Participant (DSO, TSO, and Aggregator(s)) and published in different Kafka Topics. Each consumer is authorized to read only in its own specific topic.

In the second version, a new topic was added for providing the settlement results to the aggregator. Table 2 reports the updated list of topics.

Table 2: Kafka Topics

Topic	Publisher	Subscriber	Message
validated_outcome_DSO	Market Platform	DSO Technical Platform	Validated Outcome filtered by DSO
validated_outcome_TSO	Market Platform	TSO Simulator	Validated Outcome filtered by TSO
validated_outcome_[AGG_ID]	Market Platform	Aggregator(id)	Validated Outcome filtered by Aggregator (id)
Settlement_[Agg_ID]	Market Platform	Aggregator(id)	Settlement results filtered by Aggregator(id)

3.2.2 Market Platform environment setup

The second prototype of the Platone Market Platform was released as Open Source and all the single components of the architecture are available as Dockers. Deployment aspects are already established and discussed in D2.4 [10].

3.3 Aggregator Platform

3.3.1 Introduction

The Aggregator Platform is the operational platform that facilitates flexibility asset management by gathering the required data measures, aggregating available flexibility from thousands of different (Point of Delivery) PoDs, and by providing optimal algorithms to optimize market strategy and flexibility offers. The platform named DEOP (Distributed Energy Optimizer) developed by Siemens has been already presented and deeply described in D3.6 [8].

Mainly, the Aggregator Platform has several tasks and four use-cases have been individuated which reflect four main functionalities: PoD Registration and Baseline Definition, market offers definition, PoD activation and settlement and remuneration phase.

3.3.2 Implementation in the second version

Within the second version of the technology, the Aggregator Platform has gone through several implementations and integration of functionalities implemented with the first release of the System Architecture. The Platone Italian Demo is updating the Real Time session of the market and to achieve this objective, the Aggregator Platform has worked on the communication flows with the Market Platform in order to define the offers and send them to the Market before each session. This function will guarantee the automatic management of Real Time offers.

Thanks to the update of the “Flessibili” App and the integration done within the new version, the Aggregator Platform is now receiving the storage data through the Access Layer of the App. Indeed, the Energy Management System (EMS) installed at the users’ side communicates with the Platone framework sending data about the status of the charge, power exchange, self-consumption rate, PV production, etc. to the “Flessibili” App and to the Aggregator Platform too.

Moreover, the implementation has focused on the settlement and remuneration phases. Within the second version of the technology, these two phases are now headed directly to the users. Indeed, the data coming from the Market Platform (the corresponding process deeply described in D3.3 [7]) are now managed and shared by the Aggregator with the users thanks to the "Flessibili" App.

The integration implemented between DEOP platform and the device in the field concerns the communication with the EMS installed at the users' places.

Thanks to these integrations, the aggregator monitors the active energy measurements behind the meter needed to build up the flexibility offers in addition to the trend of the users' consumptions coming from the SCD.

The measurements come into the platform with the same characteristics (timestamp and unit of measurements) that they have in the Access Layer. The visualization is guaranteed through the User Interface; an example is reported in Figure 6 where it's possible to see in red colour the baseline for the user's energy consumption (kWh), in yellow the storage system SOC (%) and in green the active power trend for the PV component (W).

The most important measures are the nominal data of the flexible and generation applications (PV and storage) and the dynamic measures of the production PV and SOC of the storage system.

The communication method is structured as follows:

- The Light Node periodically interacts with the EMS (every 60 seconds) via Modbus TCP protocol
- The measures obtained are immediately signed and sent by the Light Node to the Blockchain Access Layer
- Blockchain Access Layer sends the EMS measurements to Aggregator Platform via MQTT protocol

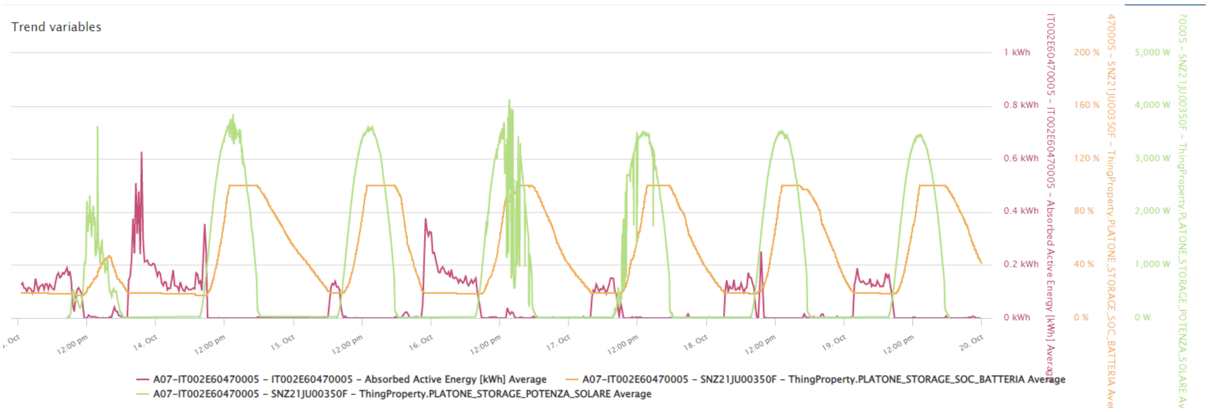

Figure 6: Energy consumption baseline, storage system SOC and PV active power

3.4 DSO Technical Platform

3.4.1 Introduction

The second release of the DSO Technical Platform (DSOTP) confirms the general functions provided in the first release (for more detail consider D3.3 [7], D3.4 [2] and D3.6 [8]) such as:

- Performing Power Flows
- Sending flexibility requests to the Market Platform
- Performing technical validation of flexibility offers
- Sending set-points to flexible resources

adding the following other features:

- Real Time Market session management
- LV network management (including LV DSO Operational System alignment, LV unbalanced power flow, LV flexibility request algorithm, LV flexibility validation algorithm)

- Evolution of power data & measurements management

3.4.2 Day Ahead and Real Time computation management

The DSO Technical Platform evolved to manage the overall Market scenario including:

- Day Ahead Market session: computed to obtain a snapshot of the network status and behaviour for the whole next day (24 hours with 15 minutes time interval)
- Real Time Market session: computed to obtain a snapshot of the network status and behaviour for the next four hours (15 minutes time interval)

These two sessions are based on power flow computation in each single reference timeslot in order to get evidence of voltage violations or current congestions, both in medium and low voltage networks. In case there are some violations or congestions in some reference timeslot, the flexibility computations are triggered to solve the network problems in those specific timestamps.

A dedicated service called "dsotp-flexy-manager" was implemented to manage all the scenarios in three main aspects:

- Orchestrate the start of computations by scheduling them at a specific time for Day Ahead and Real Time scenarios
- Process the computed results to produce all the data flows required by the Market Platform
- Receive data flows by external services and start "on demand" computations (flexibility technical validations)

The computation requests are sent from "dsotp-flexy-manager" to an adapter service called "dsotp-flexy-worker", which is in charge of managing the final call to the algorithms' execution service and the algorithm results retrieval.

For each reference timeslot, in both scenarios, the following algorithm sequence is followed:

- Power flow computation
- Flexibility algorithm (request or validation depending on the specific goal of the computation slot)

Once all reference timeslot computations terminated (16 for Real Time, 96 for Day Ahead) results are aggregated and sent to the Market Platform where they are needed to match flexibility requests and offers.

3.4.3 LV DSO Operational System alignment

3.4.3.1 Introduction

The DSOTP needs to know the topology of the LV distribution network and its real status to perform all its basic functions. This information is transmitted to the DSOTP by the DSO Operational Systems (highlighted in Figure 7, for further details please refer to Deliverable D3.6 [8]); the next paragraph will describe how the systems (master & slave) are aligned, namely how the owner of the data (master DMS-LV) shares its two databases (NGDMS and MEASURES_ARCHIVE DB) with the DSOTP (i.e. slave DMS-LV).

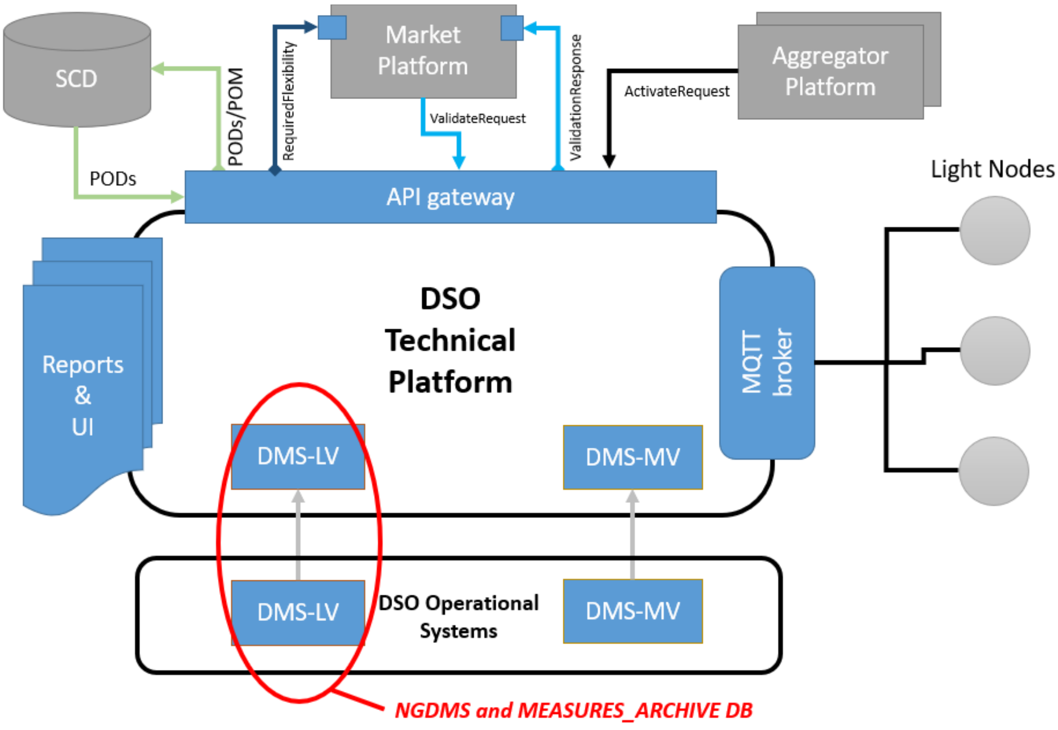

Figure 7: Internal DSOTP architecture & Operational Systems alignment

3.4.3.2 Database alignment

To avoid concurrency problems and possible slowdowns, the adopted solution is based on specific database replication mechanisms between the DMS-LV and the DSOTP. This approach enables data to be present on multiple databases almost instantly (there is only a small delay due to the communication network) and, at the same time, avoids the efficiency risks connected to the use of a shared database instance.

For the NGDMS database (electrical network data), the implemented replica is called “logical replica” where the data that is modified on the master database are sent to the slave database via a proprietary binary protocol using the so called "chunks" optimizing the data storing procedures. This database “logical replica” allows to define which elements of the database have to be replicated; for example it’s possible to replicate only certain tables of a schema reducing the generated network and still assuring the possibility of creating the needed data queries.

For the MEASURES_ARCHIVE database, since there is a large amount of data with a high updating speed, a "physical replica” of the database has been implemented. In this case, the data communication is identical to the previous one in terms of efficiency and reliability on the slave database update; the main difference is that the recipient database is a “bit-to-bit” copy of the source database both for the structure and at data level. These LV measurements are used to refine the DSOTP load profiles obtaining more accurate power flow calculations for the next day or the next 4 hours.

For both replica mechanisms (logical and physical) there are no limits on the number of recipients and, if there are communication issues between the databases, no data is lost because as soon as communication is re-established, the replication process takes care of sending the data that failed to be transmitted.

3.4.4 LV power flow & flexibility computations

The DSOTP was firstly developed for Medium Voltage grids. In the second release and considering the different network models, data, and management for Low Voltage grids, the developments have been extended to count for such differences.

As for MV, also on the LV networks running power flow computations gives to the DSO an important tool to observe the grid at a given point in time in terms of voltages, currents and power flows, thus identifying possible critical situation of voltage violations or wire congestions.

In a flexibility market perspective, the DSOTP has been developed to perform on the LV grid the following sequence of steps in each reference timeslot:

- Unbalanced power flow (specific algorithm able to consider that phases are not balanced)
- Identification of voltage violations or wire congestions
- Flexibility computation (flexibility request to solve DSO technical issues or flexibility validation to verify that market outcomes do not introduce problems onto the grid)

The basic sequence of the algorithms for the LV network is of course the same considered for the MV but the characteristics of the single computations were developed specifically to deal with the different data and network model necessary for the LV network.

As for the MV processing, "dsotp-flexi-manager" schedules the Day Ahead and Real Time computation scenario according to the timeline of the Platone Italian Demo process (see Figure 2) to obtain results inside the expected time window. Stating that the LV power flow results on the MV/LV transformer level are useful for MV power flow processing, the LV computations are scheduled before the MV computations.

For the LV computations a new service called "pcr-engine-bt" was developed to extract from the "physical grid" data model all the information required to create a set of "logical grid" models fitting the algorithms' model requirements.

The LV network is partitioned into isolated grids, each one independently processable by power flow computations or flexibility algorithms, allowing to execute them in a parallel and concurrent fashion. Then "pcr-engine-bt" sends each of these single algorithm computations to a set of pcr-workers to process them, as shown in the following schema (Figure 8):

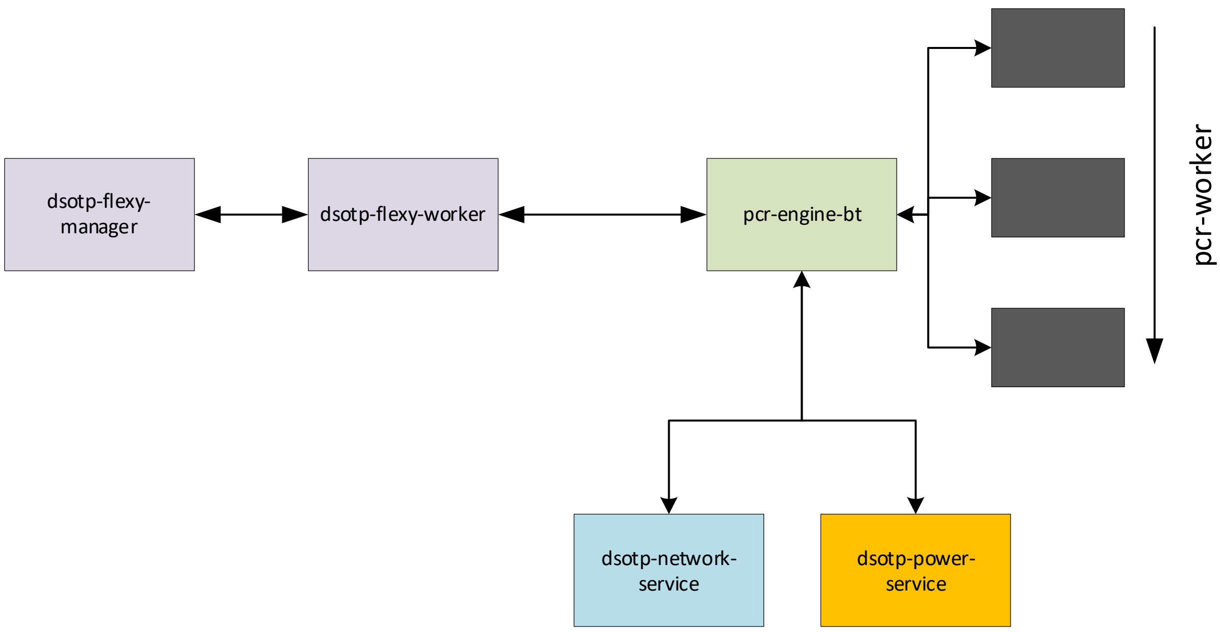

Figure 8: LV network model management & data processing

The "pcr-engine-bt" service gets the data to process for each single isolated grid by invoking:

- The "dsotp-network-service" to get the physical grid data
- The "dsotp-power-service" to get the power data (see Ch.3.4.5)
- The "dsotp-flexi-manager" to get the PoD flexibility data

3.4.5 Power data management

The second release of the DSO Technical Platform also addressed an evolution and tuning on the internal power data management (both for MV and LV network).

3.4.5.1 Load and generation data source hierarchy

All the DSO Technical Platform computations require data (active and reactive power) for each load and generation plant in the network, something usually not trivial to manage and obtain. Typically there are different "sources" of these data, each characterized by a different degree of reliability (i.e., quality of data).

This concept was formalized in the DSO Technical Platform by adding a quality index to each source of data, resulting in a hierarchical stack of sources managed by a dedicated service called "dsotp-power-service", which is responsible to offer the data with the best quality (i.e accuracy) for each network element to the algorithm computation service.

The following Figure 9 and Figure 10 show in detail the hierarchy of the power data sources from the worst (at the bottom) up to the best (at the top) for both Low Voltage and Medium Voltage networks.

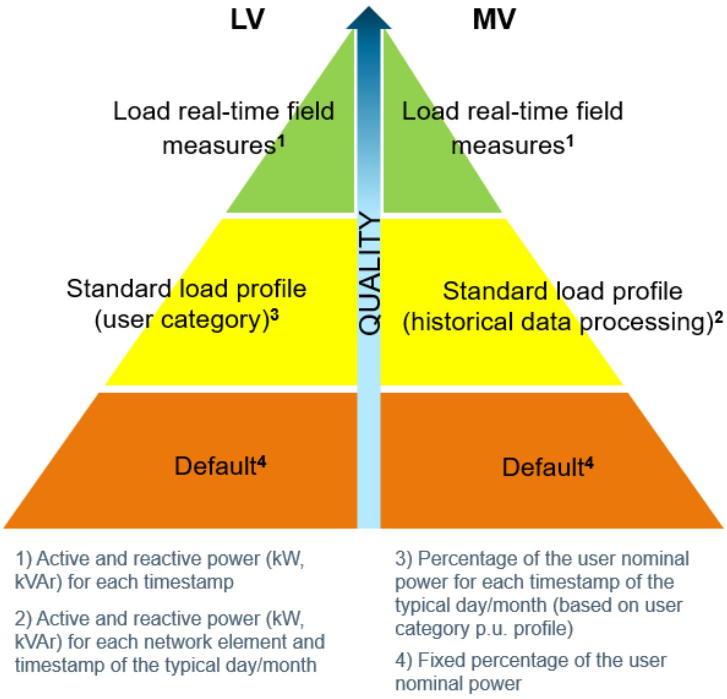

Figure 9: Load data source hierarchy

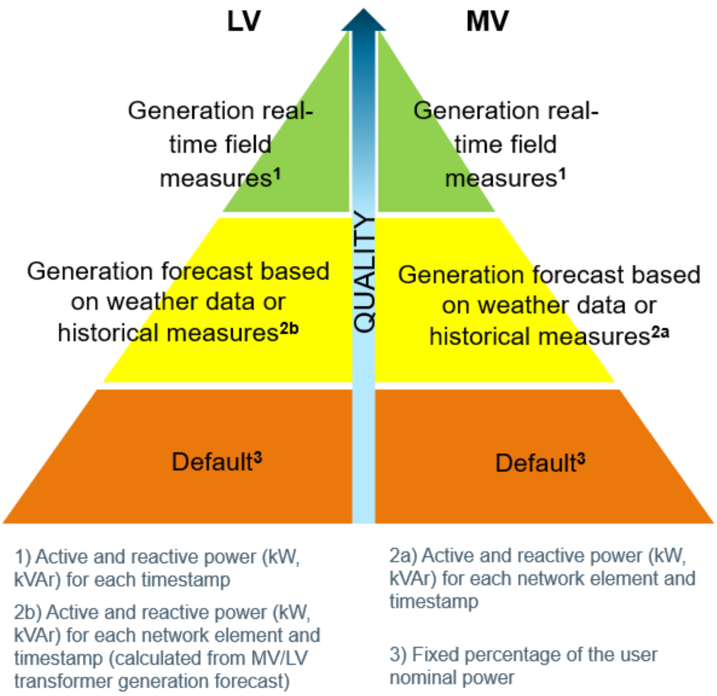

Figure 10: Generation data source hierarchy

As it is shown, both load and generation data sources can be described (starting from bottom):

- Default values based on the network element nominal power
- Historical load data and generation forecast (MV network) or "user category" historical load data and generation forecast (LV network)
- Real time load and generation measurements collected by field sensors

The generation forecast in the second layer of the hierarchy is collected from a source service called LGF (Load & Generation Forecast) that provides generation data for a reasonable future time window based also on meteorological data. Since LV elements are not directly managed by LGF, the MV/LV transformer generation forecast is used as aggregated data to be split among each LV PoD connected to the transformer.

The DSOTP platform is also able to obtain recent historical measurements for each measured PoD on the grid (i.e., flexible users with a Light Node), via the so-called 1a flow. These data are used to refine in a more precise way the power data curves of the second level on a daily basis.

Finally, since the LV power flow calculation results also contain the MV/LV transformer power balance (on the LV side of the transformer), these data are used as an additional input for that transformer when executing the MV power flow computation.

3.4.5.2 Installed powers and generation forecast management

For each generation plant of the grid, it is necessary to know the nominal installed power; the DSOTP internally retrieves this data from the LGF application via SOAP (Simple Object Access Protocol) endpoints. As LGF is also a provider of generation forecast data, the DSOTP interacts on a daily-basis with LGF using a "dsotp-importer" service to cache a future time window of generation forecast data and the installed power for each generation plant.

All the data coming from LGF are stored in a persistent Database and used by NCS module (Network Calculation System) through the "dsotp-power-service" that manages the level of quality that LGF is supposed to have inside the power sources hierarchy (see the following schema in Figure 11).

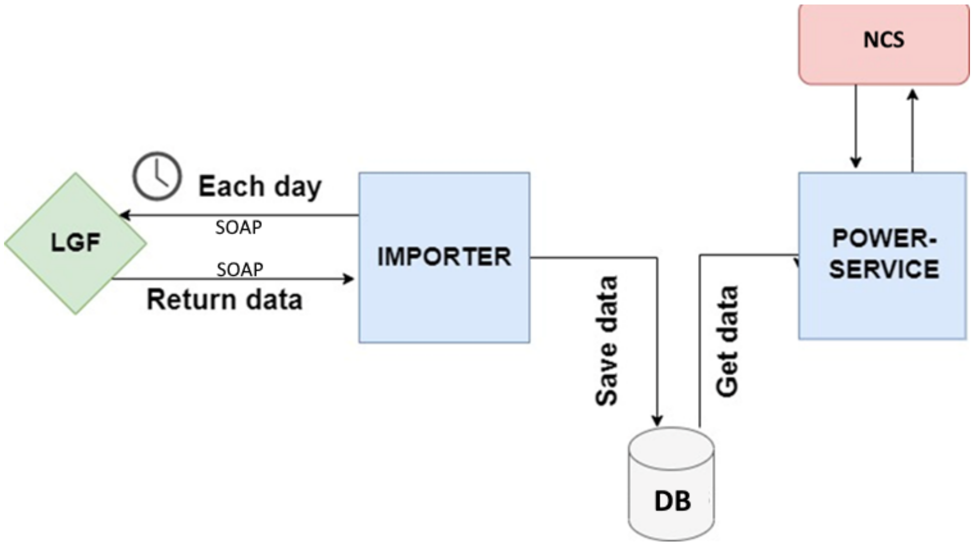

Figure 11: Generation forecast management

LGF is not able to give data for each single LV generation plant but it can provide generation forecast data for each MV/LV transformer that has generation plants below it. This situation is managed by the "dsotp-power-service" by disaggregating the transformer forecast proportionally to all PoDs connected to it; the result of this elaboration has a higher quality than the default data.

3.4.5.3 Flow 1a

The Flow 1a was implemented in the second release to be used by the DSOTP to collect measurement from SCD (Shared Customer Database). These data come from customer-bound instruments (Light Node) and are stored at SCD level and form a valuable set of timeseries data representing the real power behaviour of individual PoDs in recent times.

The DSOTP, towards "dsotp-power-service", retrieves these data (balance of active and reactive power for each timestamp for all the measured PoDs) once a day and stores them as shown in the following Figure 12.

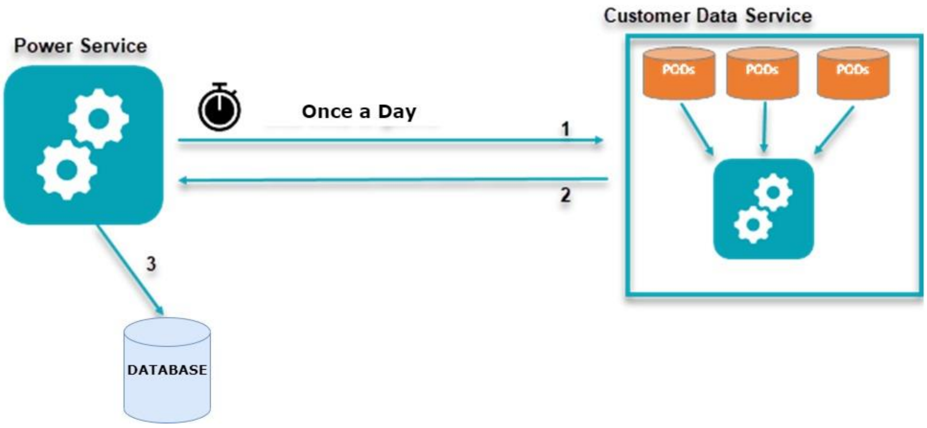

Figure 12: PoD measurements retrieval (Flow 1a)

Here (Figure 13) a sample of data format received from SCD and stored in the local DSOTP Database is shown:

```
{
    "dataTimeStart": "2022-10-11T22:01:12.233Z",
    "dataTimeEnd": "2022-10-12T22:01:12.233Z",
    "quarterHourFlows":
    [
        {
            "pod": "LN02bad68d9a27",
            "dataTime": "2022-10-12T21:45:00.000Z",
            "measures":
            {
                "power":
                {
                    "reactivePower":
                    {
                        "value": 0,
                        "quality": "n.g."
                    },
                    "activePower":
                    {
                        "value": 0.008,
                        "quality": "ok"
                    }
                }
            }
        },
```


Figure 13: Data sample received from SCD

Apart from storing them, the received data are used to refine the PoD historical data curves that are part of the inputs necessary to perform the power flow computations; the refined data preserves the separation between the different "type of the day" which they refer to:

- Working day
- Pre-holiday
- Holiday

As soon as time goes on, the day type curves for these PoDs are supposed to be quite close to the real behaviour of the plants, giving better results in estimating the power flows of the grid.

3.5 Shared Customer Database

The Shared Customer Database is a repository system where all Blockchain certified data related to flexible PoD are stored and made available to the Platone Italian Demo platforms and stakeholders; moreover, SCD represents the link between the two Blockchain Layers of the Platone architecture (for more details please refer to D3.6 [8]).

SCD didn't implement any relevant new features in the second release since it was already flexible enough to enable all the uses cases introduced with the new developments in the other Italian Demo Platforms.

3.6 Access Layer

The Blockchain Access Layer and the Light Node form the Access Layer, a data exchange infrastructure among flexible DERs, platforms and stakeholders within the Italian Demo architecture (for more details consider D3.6 [8]).

The following paragraphs describe the activities connected to the second release and test of the Italian Demo architecture.

3.6.1 Light Node Software Simulator

To test the whole Italian Demo process involving all the platforms and actors, without disrupting the service in place for the 11 users (refer to Deliverable D3.6 [8]), a software simulator for the Light Node was implemented.

The Light Node simulator is a software able to recreate the same set of outputs generated by the real Light Node; it implements the same algorithms and the same interfaces to the other Platone components (e.g. the DSO Technical Platform) as the real Light Node, except for the Open Meter and the EMS since Simulated Light Nodes (SLNs) only generate quarter-hourly measurements and not real time ones.

The Light Node Simulator main roles are:

- Receive setpoints from the DSO Technical Platform
- Generate and cryptographically sign simulated measurements
- Send signed measurements to the Blockchain Access Layer

Measurements of each simulated Light Node are generated using a baseline dataset provided by the Aggregator Platform (see Figure 14).

Setpoints are received by the SLN using the same channel as the real Light Nodes, a MQTTS (Secure Message Queuing Telemetry Transport) connection.
When an SLN receives a Setpoint, it cannot propagate it to an EMS, but it will simply adjust the generated measurements by “following” (sending the requested values of active power) the requested Setpoint.

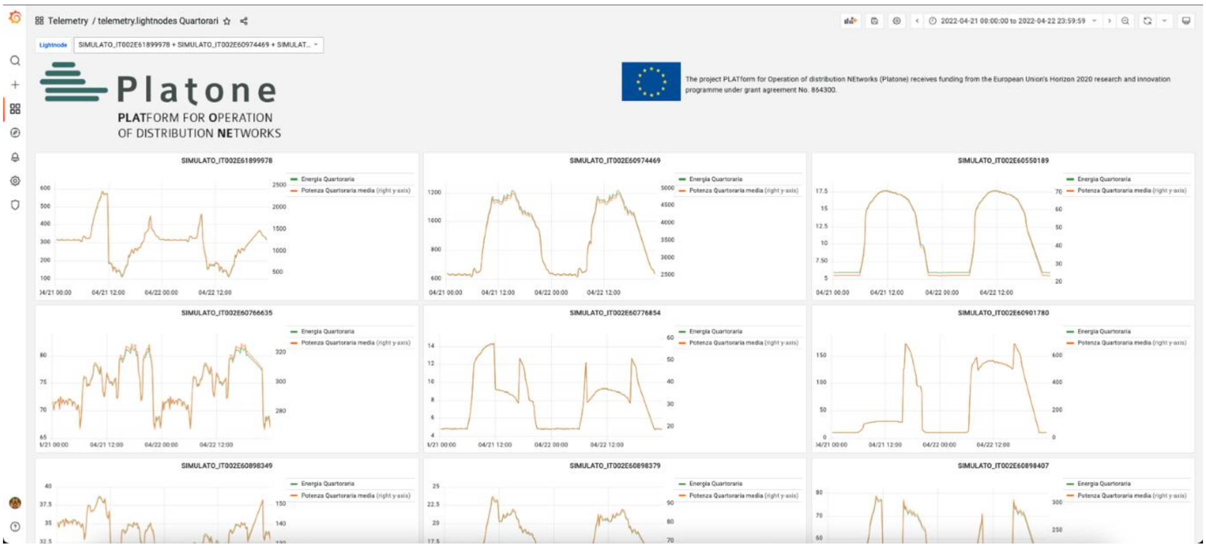

Figure 14: Simulated Measurements

There are many benefits in using the simulator for testing purposes:

- Simulate Setpoint reception and actuation without interfering with real users
- Easily scale from a few connected Light Nodes to thousands without provisioning hardware
- Have custom measurements without providing load to the Open Meter

3.6.2 Load Simulator

The first batch of Light Nodes installed on customers’ premises only received a subset of electrical quantities from the Open Meter, because the CHAIN2 protocol (see [11]) was not enabled in the full version.

Before upgrading to the full CHAIN2 protocol the 11 Light Nodes of the experimentation, some lab tests were conducted with dedicated hardware; this allowed to perform tests on whole Italian Demo process involving all the platforms and actors, without disrupting the service in place for the 11 users.

For the required tests, an electrical cabinet equipped with an edge device and 6 heating lamps acting as electrical load were used (see Figure 15).

The Edge Device mounts a Linux based operative system and runs containerized applications, among which there is a NodeJS application which listens for MQTT messages to receive manual load actuations.

The Edge Device obtains internet connectivity through a 4G router and an ethernet connection.

The scheduler also periodically refreshes an internal representation of the load scheduling.

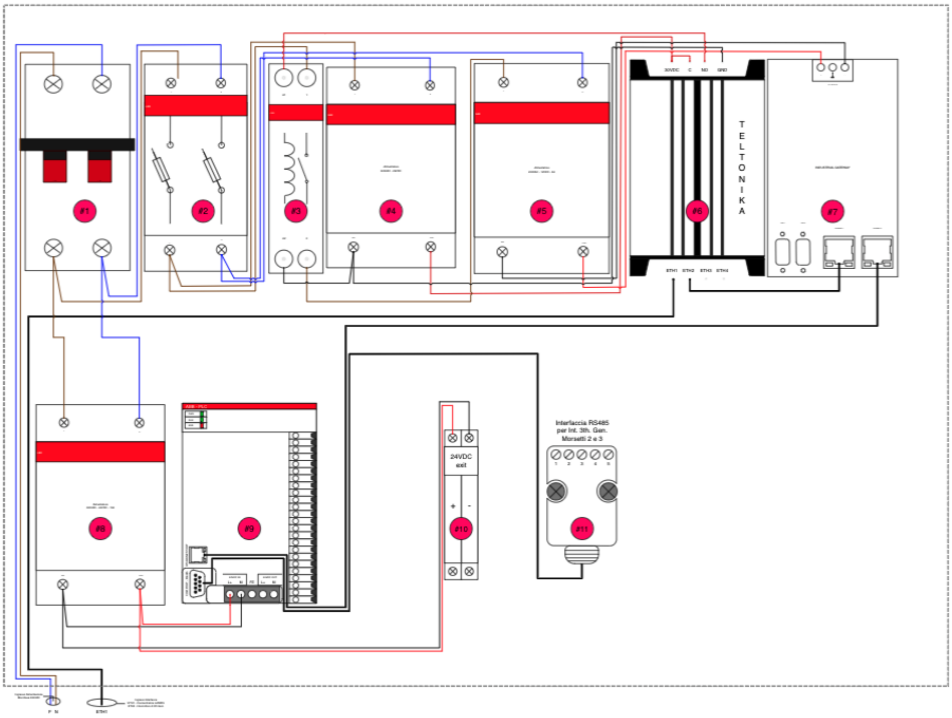

Figure 15: Wiring diagram of the test cabinet

The Edge Device runs with a remote-controlled software that can schedule (and program the scheduling) the electrical loads by selecting for each day of the week which load should be active in which 15-minutes slot (see Figure 16).

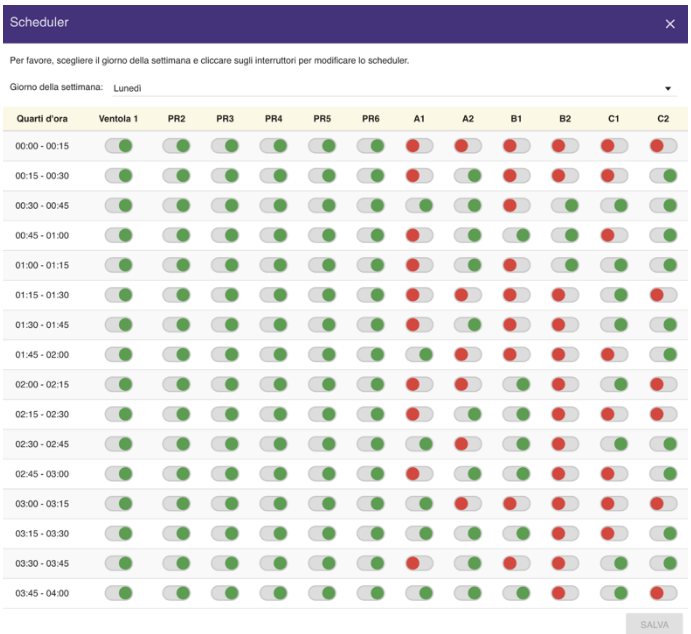

Figure 16: Load scheduler User Interface

Thanks to this device it was possible to simulate 3 “lines” where each one is connected to a dynamic load of 0W, 250W or 500W depending on the number of active loads (two loads per line).

Then, each line was connected to one Open Meter, and one Light Node to each Open Meter, simulating three distinct PoDs with different CHAIN2 profiles (see Figure 17).

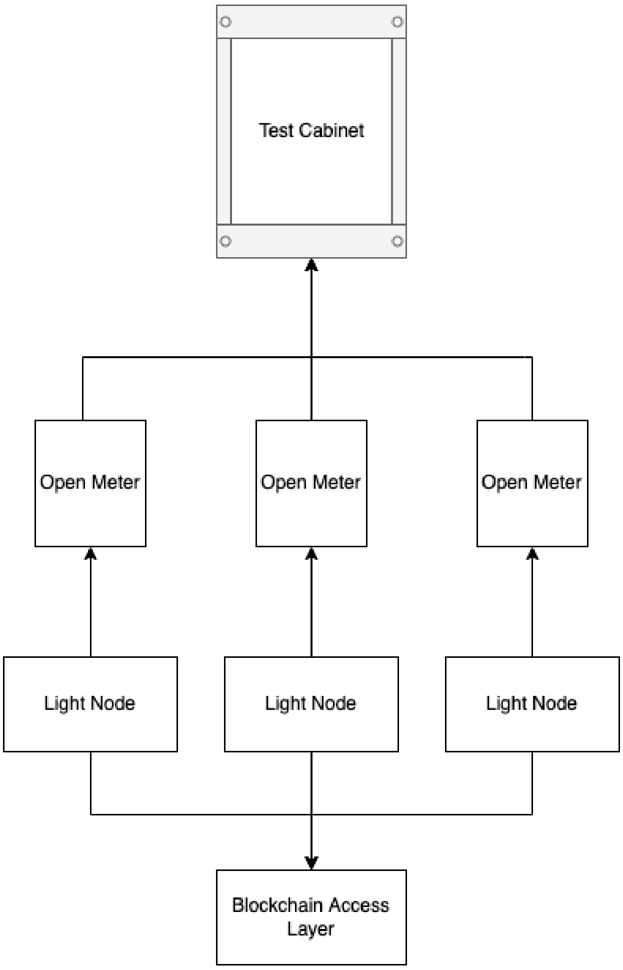

Figure 17: Test topology

At this point the 3 connected Light Nodes were able to receive CHAIN2 (full) messages from the Open Meter, obtaining measurements of both production and consumption as well as reactive components (see Figure 18).

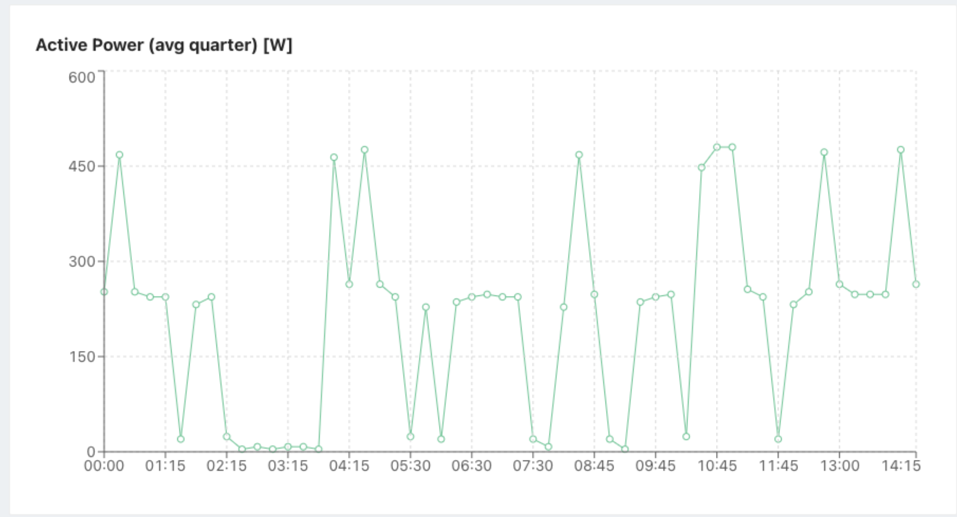

Figure 18: Active Power profile generated by the simulator

3.7 Components at customer side

3.7.1 Flexible Customer Assets

Customer engagement activities have been held in this phase to increase the number and the kind of users involved in the Italian Demo.

A condominium has been involved to test the flexibility that it can offer as Collective Self-Consumption (CSC): a group of users who are located in the same building that aim to self-consume the renewable energy produced by a plant, usually photovoltaic, located in the same building area.

Moreover, areti's smart park, already engaged in the first phase, has been equipped with a Light Node to be enabled the park to provide flexibility services to the grid.

The use case on the Smart Building ENEA in "Casaccia" has been tested to estimate the flexibility that a tertiary building equipped with a PV power plant and storage can offer to the grid.

In order to test and fine tune the flexibility orders sent by the DSO, avoiding the customers' discomfort, areti installed two Light Nodes in its lab; these devices are interconnected with the smart meters and linked to a Load Simulator able to simulate (by setting a time schedule) the energy behaviour of residential customers and the provided flexibility services.

In Table 3, are reported the details of the new additional assets involved in this second integration period.

Table 3: Customer category and the available flexible assets

No. of customers	Category	PV plant	Energy Storage System	EV Charging Station	Other (i.e., manual activation of flexible assets like dishwasher, HVAC, etc.)
1	e-Mobility	-	-	X	-
1	Smart Building	X	X	-	-
2	Lab PoDs	-	-	-	X

1	CSC	X[1]	X[1]	-	X

With respect to the CSC, areti provided the following assets:

PV plant

The CSC is equipped with a photovoltaic plant of 5 kWp, installed on the ground near the building, on ballast fixing structure (Figure 19). This solution helps obtaining in short time all the necessary permits.

Figure 19: Design of the photovoltaic plant on the ballast fixing structure

Energy Storage System

The CSC has an Energy Storage System (ESS) to increase the flexibility provided to the grid.

The technical data are presented in Table 4 and the Energy Storage System is shown in Figure 20.

Table 4: Energy storage system's technical data

Installation	**Power** [kVA]	**Power Factor** [p.u.]	**Capacity** [kWh]	**Supply**	**Dimensions WxDxH** [mm]	**Weight** [kg]
Wall-mounted	2x3	-0,8 to 0.8	4.8	1Ph+N 230Vac	2x 600x250x1810	2x up to 98

Figure 20: Energy Storage System wall-mounted

[1] Assets will be provided and installed by areti

3.7.2 Installation and integration activities

As described, the Italian Demo architecture foresees availability of particular devices installed at customer side. Some of these are owned by customers while others are owned by DSO (see Table 5).

Table 5: Device and Owner

Device	Functions	Already installed (regardless of the project)	Communication methods with Light Node	Owner
Smart Meter (SM)	• Measures electrical quantities at PoD	Yes[2]	• Chain2 • Modbus	DSO
Light Node (LN)	• Acquires data from SM • Receives Set-point and forwards it to customer activation systems (e.g. ESS or EMS) • Acquires data from ESS	Yes/No[3]	-	DSO
PV plant	• Produces electrical energy for user consumptions	No	-	Customer
Energy Storage System (ESS)	• Stores electrical energy produced by PV or withdrawn by the grid • Modulates power flow at PoD to optimize user self-consumption • Acquires Set-point and manages itself to provide flexible service to the grid • Shares collected data to LN	No	• Ethernet	Customer
EMS of Smart-Park	• Acquires Set-point and manages all connected customer systems to provides flexible service to the grid	No	• Ethernet	Customer
Other (Flexible) Electrical loads (i.e., dish washer, HVAC, etc.)	• Electrical loads that can be switched-on/off or modulated manually by the customer to modify power flows at PoD to provide flexible service to the grid	Yes	-	Customer

[2] Additional SMs could be needed to measure generation or storage quantities.
[3] No for CSC

Concerning devices installed for project purpose, the following list describes the activities performed on the customer side.

Light Node (Smart-Park and Lab PoDs)

1. Power supply of device from the plug
2. Set and activate communication data exchange between Smart Meter and Light Node (by chain2 for 2nd Generation SM)
3. Perform and set Ethernet connection between Light Node and Energy Storage System (where applicable)

Energy Storage System

1. Adapt customer's electrical system with additional connections dedicated to Storage
2. Install the Storage and connect it to the dedicated circuit
3. Install current sensor to measure current at PoD
4. Install current sensor to measure PV generation
5. Connect current sensors to the Storage System
6. Set Ethernet connection between ESS and Light Node
7. Set ESS with customer electrical system/generation plant data (contractual power, supply type and voltage, PV power, etc.)

4 Second field test

4.1 Overview

As already mentioned in the previous chapters, the main goal of this second field test was to test again the whole Italian Demo process involving all the platforms and actors focusing on the LV network.

For the preparation of the field test, the first step is the definition of the whole test scenario and input data needed to run a consistent technical/economical process along the whole Italian Demo Platone architecture; this preliminary activity will be described in Ch.4.2.

It is important to underline that during this second field test all phases of the Italian Demo process were involved resulting in a real activation of flexibility services for three LV customers connected to the areti LV network.

4.2 Test scenario and input data

The second field test considered the LV distribution network connected to two Secondary Substations focusing on three Flexible Users. Moreover, the whole process was tested considering the Real Time market session on timeslot number 74 and 75 (that corresponds to 18:30 and 18:45).

The following Table 6 shows the main data for the selected Flexible Customers including the Point of Measurement (PoM) association.

Table 6: Main Data for selected Flexible Customers

LV Feeder	Secondary Substation	Absorbed P [kW]	Generated P [kW]	PoM	PoD	Aggregator
Feeder #4	12153	6,6	2,0	CP-IRLANDESE	IT002E60470005	ACEAE
Feeder #4	12153	3,3	0,25	CP-IRLANDESE	IT002E60677916	ACEAE
Feeder #6	6394	3,3	0,25	CP-IRLANDESE	IT002E60349346	ACEAE

In Figure 21, the “12153” Secondary Substation, some of the connected LV Feeders and the position of the Flexible Customers can be seen.

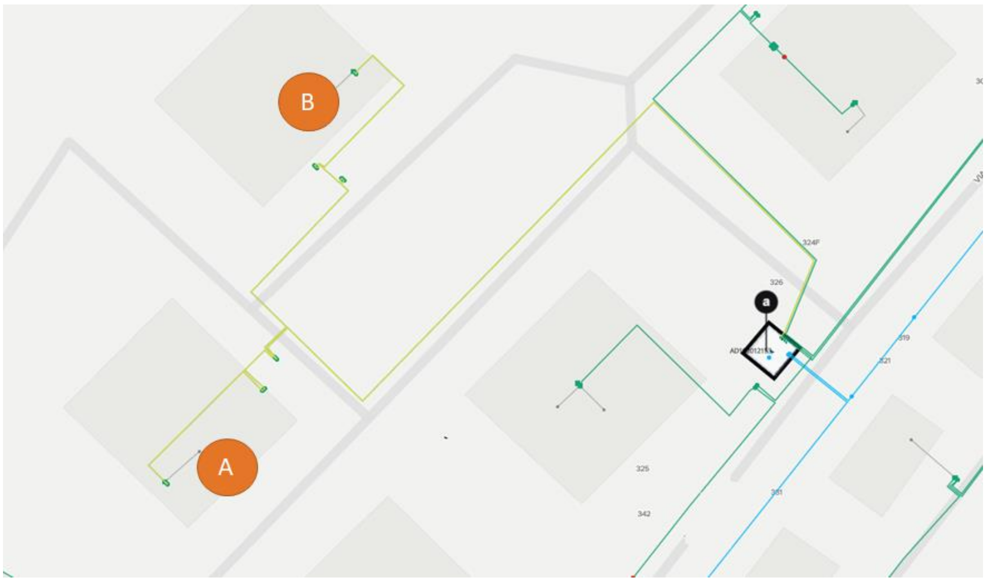

Figure 21: “12153” Secondary Substation - Position of the Flexible Customers

The next Figure 22 shows the position of the other Flexible Customer (IT002E60349346) on the LV network.

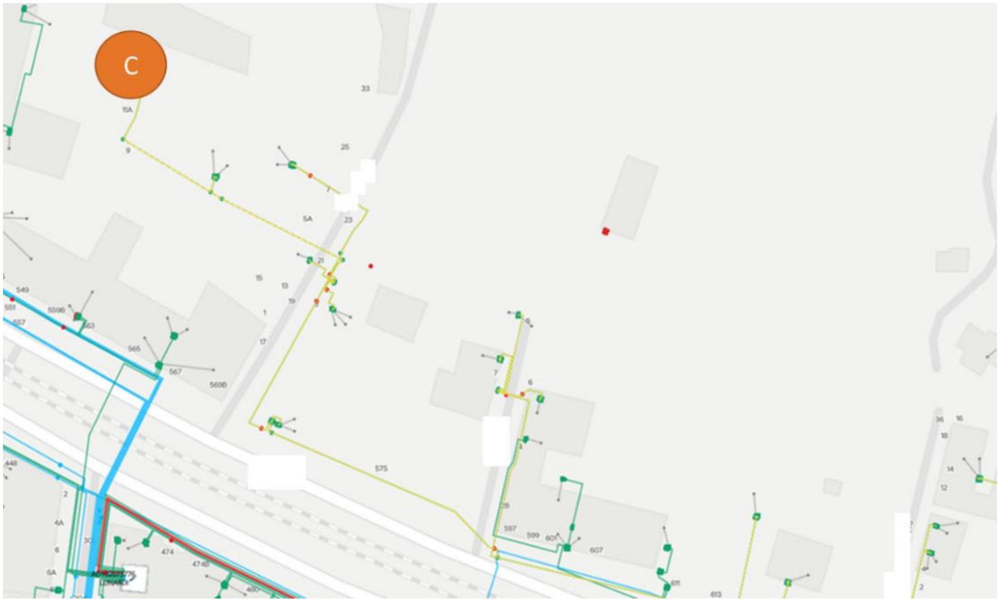

Figure 22: “6394” Secondary Substation - Position of the Flexible Customer

Table 7 shows some more detailed data chosen for the Flexible Users in the test scenario; the hypothesized Flexibility Services considered in this stage only the active power (no reactive power flexibility).

Table 7: Detailed data chosen for the Flexible Users

Index	PoD	Max Flex P up [kW]	Max Flex P down [kW]	Baseline P [kW]	Offered Flex P [kW]	Total Flex Service [kW]	Price [€/kW]
74	IT002E60470005	1,0	2,0	0	-1,0	-1,0	0,4
75	IT002E60470005	1,0	2,0	0	-1,0	-1,0	0,4
74	IT002E60677916	0,25	1,0	0,06	-0,36	-0,30	0,4
75	IT002E60677916	0,25	1,0	0,06	-0,36	-0,30	0,4
74	IT002E60349346	0,60	1,0	0,083	0,517	0,60	0,1
75	IT002E60349346	0,60	1,0	0,045	0,555	0,60	0,1

4.3 Test process and results

The next Chapters will show the complete test process step by step.

4.3.1 PoD registration

In the first step, all the relevant data for the Flexible Customers (PoD) is registered in the Aggregator Platform (Figure 23). This information about the Flexible Customers is then sent from the Aggregator Platform to the Shared Customer Database that stores all the data.

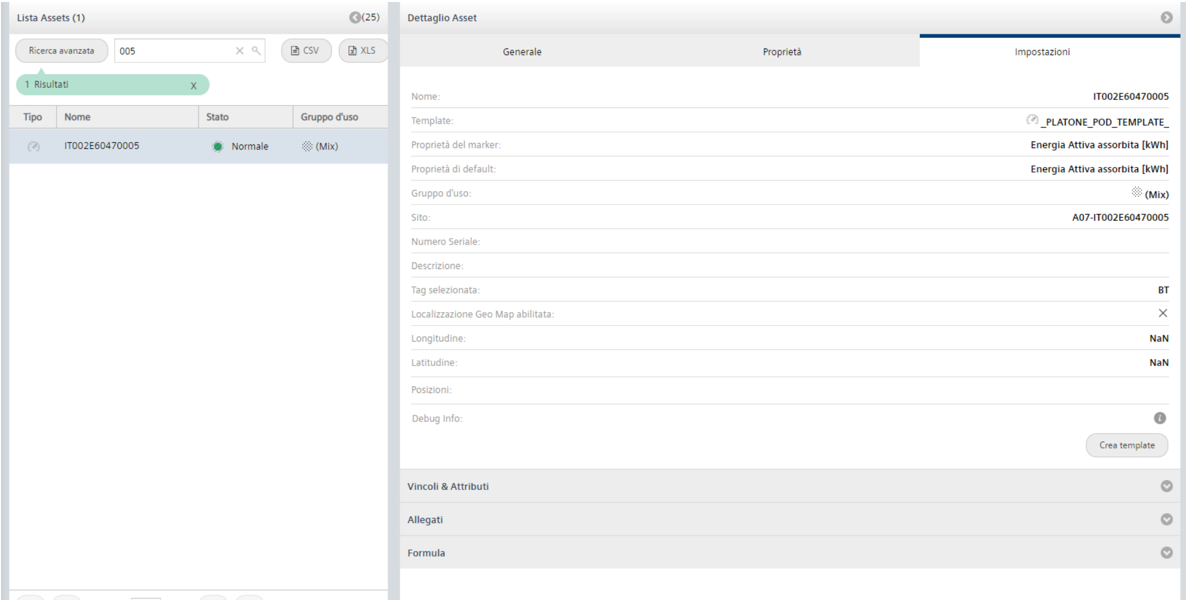

Figure 23: Platone Aggregator Platform

Then the Shared Customer Database forwards these data also to the DSOTP and receives back the PoD-PoM association; this link will be important in the next steps because the TSO requires Flexibility on an aggregated base (i.e., PoM "CP-IRLANDESE").

This data about the Flexible Customers is then finally transmitted by the Shared Customer Database to the Market Platform too, so all the Platforms are aligned.

4.3.2 Power Flow & DSO, TSO Flexibility Requests

At this step of the process, the DSOTP runs a Power Flow on the LV networks to detect some possible technical issues (voltage violations or branch congestions). Figure 24 displays an extract of some results calculated for the LV Feeder#4 of the "12153" Secondary Substation.


```
"branchId": "ADBNES130076-AD102012153 - 4-1",
"startNode":
{
   "nodeId": "ADBNES130076",
   "lineId": "AD10201215304",
   "phaseCurrents":
   {
      "maxThermalLimit_A": 15.4,
      "phaseCurrent":
      [
         22.741,
         18.744,
         15.321,
         "NaN"
      ],
      "phaseAlarm":
```

```
            [
                true,
                true,
                false,
                false
            ]
        },
        "phasePowers":
        {
            "activePower":
            [
                -4.715,
                -3.888,
                -3.179,
                0.0
            ],
            "reactivePower":
            [
                -2.282,
                -1.882,
                -1.539,
                0.0
            ]
        }
    },
    "endNode":
     …
        {
            "userId": "IT002E60677916",
            "realPowers":
            {
                "activePower":
                [
                    0.0,
                    0.0,
                    0.06,
                    0.0
                ],
                "reactivePower":
```

[
0.0,
0.0,
0.029,
0.0
]
}

Figure 24: Results calculated for the LV Feeder#4 of "12153" Secondary Substation

Figure 25 shows the alarms available on the DSOTP about the detected current overloads on a branch of the LV Feeder#4 of the "12153" Secondary Substation.

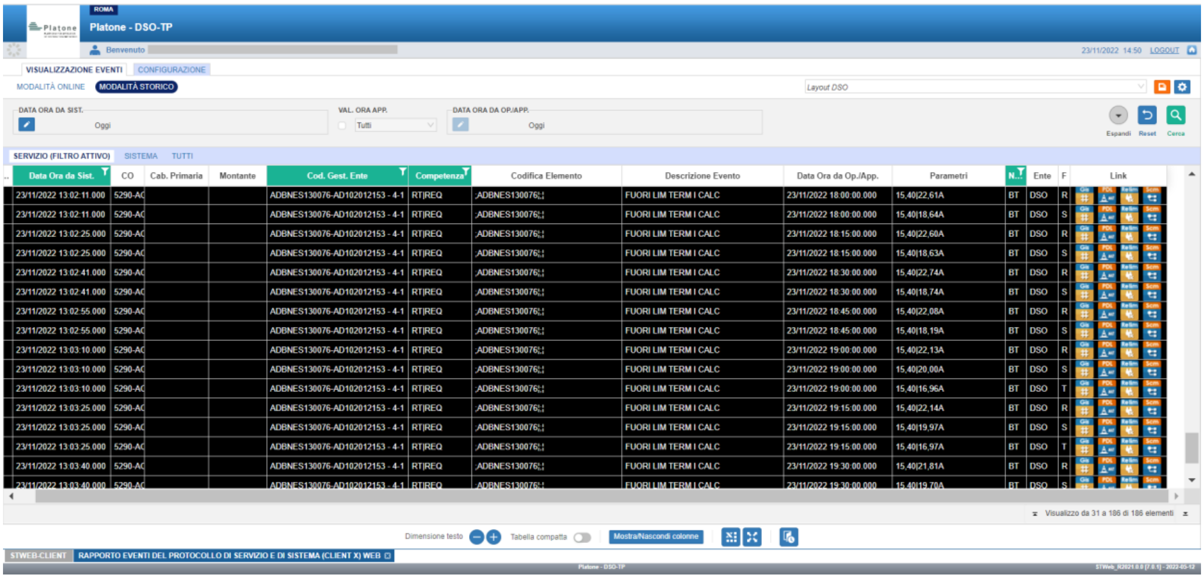

Figure 25: Alarms available on the DSOTP

Starting from this estimated grid state, the DSOTP runs the Flexibility Request algorithm that is able to deal with the current overloads requiring some Flexibility for the LV Feeder (i.e., requested Feeder power profile: 4,21 kW for timeslot 74 and 4,34 kW for timeslot 75).

Furthermore, a TSO Flexibility Request (on PoM "CP-IRLANDESE") is simulated and registered into the Real Time session of the Market Platform (Figure 26).

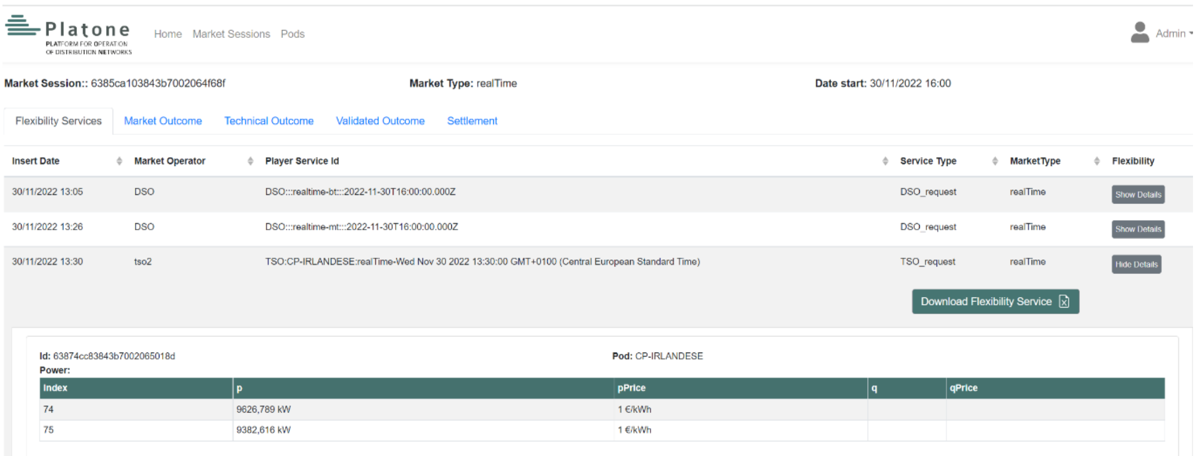

Figure 26: Simulation of a TSO Flexibility Request

4.3.3 Aggregator Flexibility Offers

In the meanwhile, on the Aggregator Platform, the Flexibility Offers for the selected PoDs are put in place (Figure 27 and Figure 28); all these data are sent to the Market Platform.

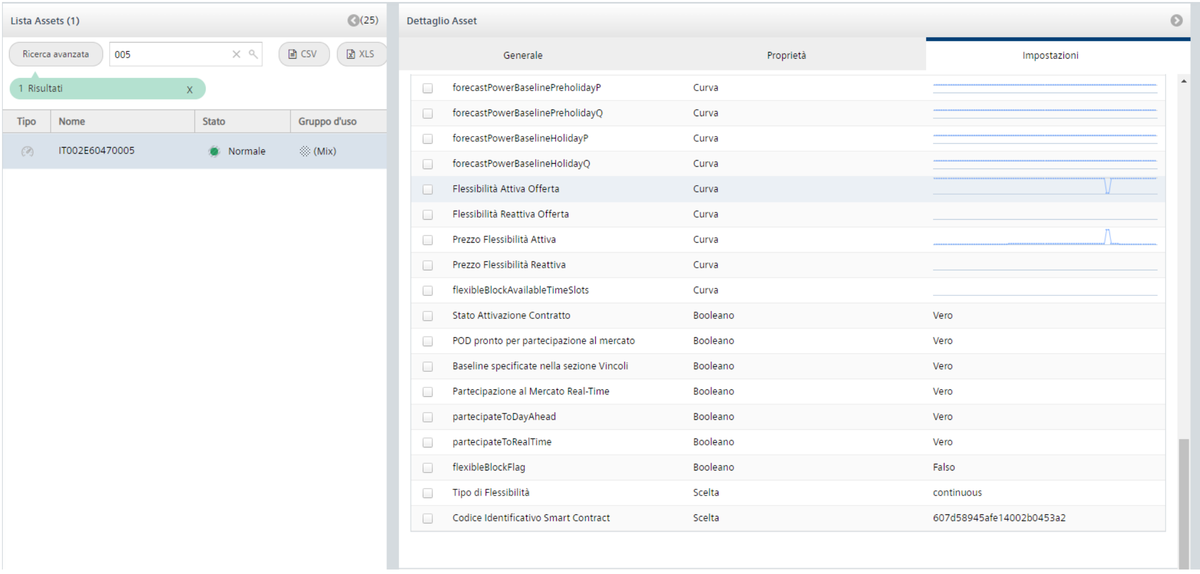

Figure 27: Flexibility Offers on Aggregator Platform

Figure 28: Flexibility Offer for PoD IT002E60470005

4.3.4 Market Platform economical outcomes

Figure 29 shows the economical result of the Market Platform for the Real Time session matching the Aggregator's Flexibility Offers with the DSO & TSO Requests. The LV Flexible Customer IT002E60470005 is accepted for -1 kW, IT002E60677916 for -0,3 kW and IT002E60349346 for 0,6 kW.

It is worth mentioning that the activation of the first two users is related to the DSO Flexibility Request while the last one is related to the TSO Flexibility Request.

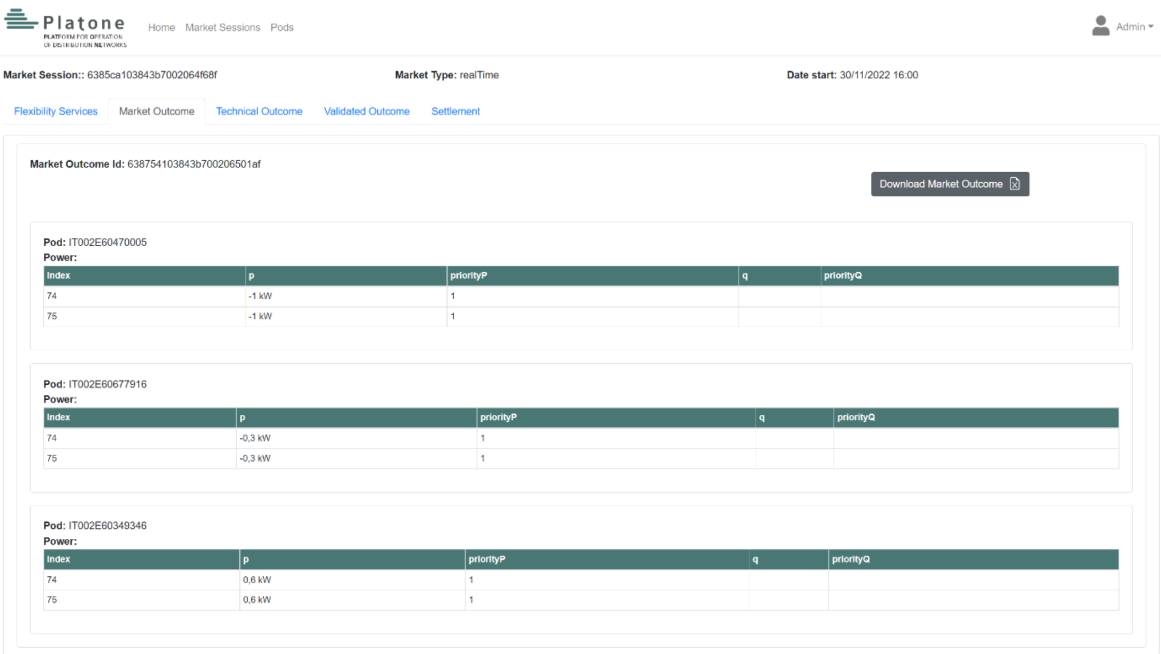

Figure 29: Economical outcome for the Real Time session

All these market outcomes are then sent from the Market Platform to the DSOTP for the final technical validation.

4.3.5 DSO Flexibility Validation & final Market Platform outcomes

The DSOTP runs again a Power Flow analysis on the LV network applying the Flexibility Services received from the Market Platform. The goal is again to detect whether this new network scenario can lead to some technical issues; since no new alarms are detected by the DSOTP, all the Flexibility Services receive a "green light". Figure 30 shows the final results on the Market Platform, which include the technical and economical outcomes of the process. These results are sent to the Aggregator Platform in order to start the activation phase.

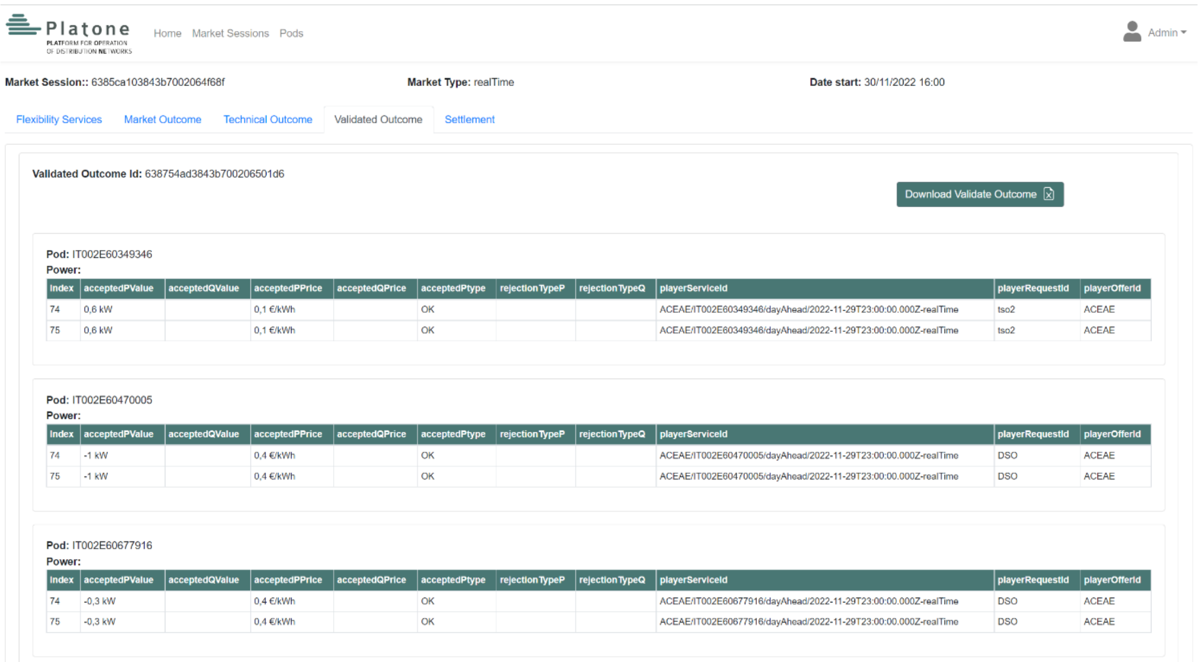

Figure 30: Final Market Platform outcomes

4.3.6 Flexibility Service activation & measurements

The final market outcome is acquired and managed by the Aggregator Platform that performs the activation of the Flexibility Service for the considered timeslots (Figure 31).

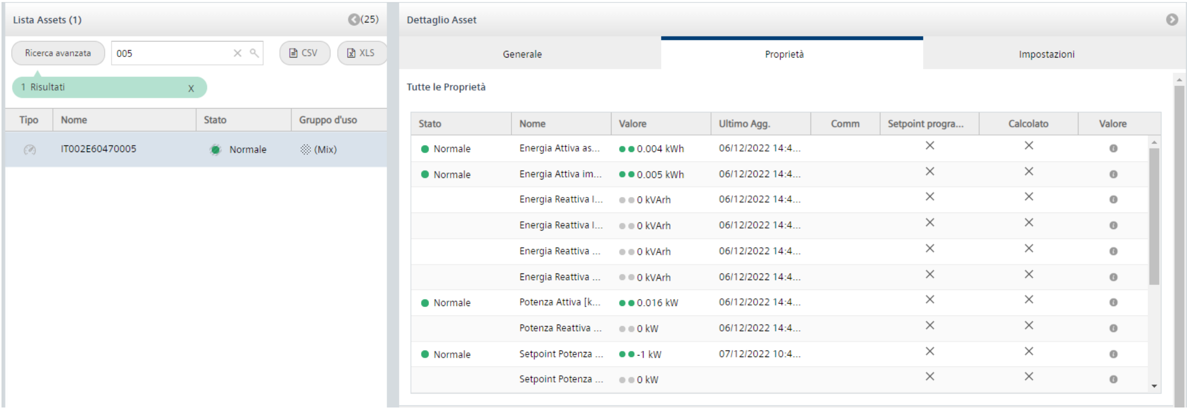

Figure 31: Aggregator Platform - Flexibility Services activation

Figure 32 shows some graphs about the Flexibility Services activation for the three considered PoDs; to be noted that these graphs stick to an opposite power convention compared to that one chosen for the Italian Demo Architecture (i.e., in Figure 32 a positive active power is injected by the plant to the DSO grid).

More in detail, looking at the "Power Grid" data (i.e., power exchanged between the PoD and the DSO network) on the reference timeslots 18:30 and 18:45, it's possible to see that basically PoD IT002E60470005 and IT002E60349346 were able to follow the requested setpoint while PoD IT002E60677916 was able to fulfil the requested Flexibility Service only at the beginning of the two timeslots deviating then its behaviour; this performance can be explained considering that for PoD IT002E60677916 some specific limitations on the local plant management intervened (combination of Storage charge processes, consumption of the user).

Figure 32: Access Layer - Flexibility Services activation

5 Conclusion

This second completely integrated field test involved again all the Platforms of the Italian Demo validating the correct interaction between them; all the tested phases didn't show any specific issues and the Platforms (Market Platform, Aggregator Platform, DSO Technical Platform, Shared Customer Database, Access Layer) were able to run properly all the necessary internal algorithms and data flows.

It is relevant to mention that the tests confirmed that all the basic data flow designed and implemented in the first release didn't need any relevant modifications and that the data model was already flexible enough to accommodate all the functional evolutions introduced in the second release. All this allowed the WP3 partners to concentrate even better on the refinement of the new functions and on the quality of the input/output data of the process.

The second integrated field test focused on the extension of the Market sessions (also adding the Real Time) and on the Low Voltage network completing properly the first results obtained during the previous field test scenario for the Day Ahead Market session on the Medium Voltage network; the TSO/DSO coordination and the growing Flexible Users participation were again the main drivers. The involvement of LV users also for dealing with the TSO requests (for global flexibility services), in addition to the DSO requests (for local flexibility services), is an interesting point to mention (especially looking at the future evolutions of these topics).

Regarding activities at customer premises, more installations and tests were performed including assets like a PV Plant and Energy Storage System to increase the flexibility provided to the grid. In addition, to test even more deeply and fine tune the whole Platone Flexibility Services management process avoiding potential real customers discomfort, areti installed in its laboratories two Light Nodes interconnected with the smart meters and linked to a Load Simulator.

All these activities, in addition to the evolution of the Market Platform and the "Flessibili" App with respect to the settlement and remuneration phases, represent a proper second consistent step in the Platone Project including progressively more different kinds of Flexible Users and involving them actively in the market processes defined in the Italian Demo.

6 List of Tables

7 List of Figures

8 List of References

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9 List of Abbreviations

Abbreviation	Term
AP	Aggregator Platform
BAL	Blockchain Access Layer
DEOP	Distributed Energy Optimizer
DMS-LV	Low Voltage Distribution Management System
DSO	Distribution System Operators
DSOTP	DSO Technical Platform
EMS	Energy Management System
ESS	Energy Storage System
EV	Electric Vehicle
LGF	Load & Generation Forecast
LV	Low Voltage
MP	Market Platform
MV	Medium Voltage
NCS	Network Calculation System
PoD	Point of Delivery
PoM	Point of Measurement
SCD	Shared Customer Database
SOAP	Simple Object Access Protocol
TSO	Transmission System Operator
WP	Work Package