Platone

PLATFORM FOR OPERATION
OF DISTRIBUTION NETWORKS

# Platone

## PLATform for Operation of distribution NEtworks

# D3.4

# Delivering of Technology (v2)

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**Abstract**

The Italian Demo aims to enable network users to participate in the optimized grid management through the flexibility mechanism. Thanks to the coordination of areti and the cooperation of all the partners involved in the WP3, the Italian Demo is developing an innovative system, enabling distributed resources connected in medium and low voltage grids to provide grid services through a market model approach, guaranteeing the inclusion of all the electrical sector stakeholders.

This document reports about the second version of the technologies implemented within the Italian Demo activities. As a supporting report, it accompanies the release of the updated version of the System Architecture of the Italian Demo. The document illustrates the updates made on the data exchanges, the descriptions of new functionalities implemented on the platforms and the news on the trial areas.

**Keyword list**

Low Voltage; Medium Voltage; Day Ahead; Real Time; Chain2Full; Smart Contract; Token; Light Node

## 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 users to be easily certified so that they can valorise their flexible energy use. 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 field trials and within the Canadian Distributed Energy Management Initiative (DEMI).*"*

Italian Demo partners, during the second period of the project, have kept working on the development and implementation of the technology designed within the project activities. Indeed, the updated version of the System Architecture of the Platone Italian Demo, has been enriched with further functionalities that will facilitate the implementation and the operation of the Local Flexibility Market. The new functionalities implemented in the platforms are described in this report and then will be analysed and evaluated with the Report on second integration activity in the field (D3.8).

With the first version of the technology, released in July 2021, areti already enabled distributed resources connected to its grid to provide services through the flexibility market. Indeed, the block of functionalities released with the first version already provided an innovative solution to the local energy market in the national scene, able to take advantage of a solution not previously exploited. The first block of functionalities included: day ahead session, full Medium Voltage (MV) simulation, simplified settlement, smart contract for Access Layer, full handling of MV users, handling of Low Voltage (LV) users by work-around (as MV Point of Delivery), use of smart contracts for measurements, activation commands and offer partialization.

The system architecture is now implemented with all the functionalities foreseen in the Platone Project and a very important extension of the project is already planned. Indeed, the approach developed within the Platone Italian Demo, has been proposed by areti as national pilot for the Flexibility Market to the National authority ARERA.

Thanks to the effort lavished by the partners, the updated version of the technology implements the following developments:

| | |
|---|---|
| Market Platform | • Integration and coordination of Day Ahead and Real-Time sessions<br>• Overall settlement calculation<br>• Smart Contract and Platone Token |
| Aggregator Platform | • Elaboration of Real-Time offers |
| DSO Technical Platform | • Integration and coordination of Day Ahead and Real-Time sessions<br>• Simulation of the Low Voltage network<br>• Integration and coordination of MV and LV network simulations |
| Flessibili App | • New functionalities on the "Flessibili" mobile App |

In addition, the following activities and developments have been done or are ongoing:

- Update of Baseline calculation;
- Inclusion of the areti's lab Point of Delivery (PoDs);
- Enrichment of the dataset gathered from the main meter;
- Smart Building integration;
- Gathering of storage data for the Aggregator Platform.

Not only has the work undertaken during this period led to the release of these new features, but it also focused on improving and debugging of the previous version. This software will stay operative for the last year of project with further debugging and refinements, and in June 2023 (month 46) a third version will be delivered.

Moreover, the document:

- presents the updates made on the data exchanged between the platforms presented in the previous deliverable (D3.3);
- provides descriptions concerning flexibility resources involved in the Demo during the last period;
- lists the Italian Demo project KPIs, whose monitoring is ongoing and will be treated in further WP3 deliverables.

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# Table of Contents

# 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 the removing of 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 is being tested in three European trials (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 continuous spread of renewable energy sources and the increased electric energy consumption require a radical change in the energy management process, which needs to be more flexible and inclusive. For this reason, the aim of the Italian Demo is to realise a fully functional system that enables distributed resources connected in medium and low voltage to provide grid services in different flexibility market models which include all the stakeholders (TSO, DSO, aggregators and end-users). The main goals of this WP are:

- Use of blockchain technology for an efficient, democratic and non-discriminatory market model for exploitation of local flexibility in the Rome area;
- Improve and promote the consumer access thanks to blockchain infrastructure and to the presence of Aggregators;
- Use of local flexibility to solve criticalities which can affect the distribution grid in terms of stability
- and security;
- To enable distributed resources to provide flexibility to transmission grid to contribute to guaranteeing that the whole system remains balanced and safe;
- To increase the grid observability for improving the network management.

The Italian Demo of Platone intends to develop “a complete end-to-end TSO-DSO coordinated local flexibility market”. It aims to test a system capable of enabling distributed resources connected in medium and low voltage grids to provide grid services, allowing the inclusion of all the stakeholders. In general, the DERs used in the dispatching market allow the overcoming of the traditional network management model, named “fit and forget approach”. Hence, the distribution grid may no longer be necessarily designed to guarantee the maximum power exchanged of the resources in all the conditions, but the DSO could operate the network considering the possibility that the DERs can support the network operation providing services to solve critical issues. For instance, when the peak load is concentrated in a few hours, instead of reinforcing the grid, it might be easier and more efficient to use the flexibility resources, by carrying out power modulation. In accordance with this novel philosophy, in the Platone Italian Demo, the DSO can acquire flexibility from the users connected to the grid, by means of an Aggregator. Similarly, and at the same time, the TSO can face the congestion in transmission grid by buying flexibility offered by DERs.

The System Operators use two different ways to localize the requests:

- The DSO defines the quantities for relevant grid point: Primary Substation, MV feeder or Secondary Substation, joining the PoDs list subtended to grid point.
- The TSO defines the quantities only for PoMs (Point of Measure), coincident with the Primary Substations (i.e. the connection points between Transmission and Distribution networks).

Moreover, in an active distribution grid, the voltage profile could undergo strong variations along the grid's nodes and lines. For instance, an MV power plant can reverse the energy flow along the MV feeder causing a voltage increase in the point of connection and changing the voltage profile on the whole line. To solve this issue, the DSO can acquire the flexibility for instance from the resources connected to the same line to fulfil the right voltage value. Furthermore, the TSO can use the DERs to solve the issues at the transmission level. In this case, TSO could request to some DERs to modulate their power exchange with the grid. Platone WP3 Italian Demo provides market processes to manage the above described 'active grid management'.

## 1.1 Associated Tasks

The System Architecture of the Italian Demo is in constant development and improvement. For the release of the second version of the System Architecture, five tasks have been identified, three internal tasks related to WP3, and two external tasks related to WP1 and WP6.

Task 3.2 "Development of a standard blockchain based infrastructure, implementing a Common Access Interface between all the market players" is one of the project tasks composing WP3 – Italian Demo. Task 3.2 is coordinated by areti in cooperation with Apio, Siemens, Engineering and Acea Energia. It includes the following sub-activities:

- HW/SW (Hardware and Software) development of blockchain technologies to include customers in the system, led by Apio;
- Definition of communication protocols, identification of the communication channel and development of the apparatus for meter data exchange, led by Apio;
- Development of Shared Customer Database platform led by areti.

Task 3.3 "Implementation of a technical platform for grid state estimation and flexibility requests validation" is another project task composing WP3 – Italian Demo. It is coordinated by Siemens in cooperation with areti. It includes the following sub-activities:

- Hardware and software developments related to the real time state estimation of the grid, led by Siemens;
- Definition of a telecommunication infrastructure, led by Siemens;
- Development, testing and implementation of the state estimation tool, led by Siemens.

Thanks to all the data gathered from the hardware/software implemented on field, the weather forecasts, historical data, and network topology knowledge the DSO Technical Platform performs the state estimation and indicates any forecasted network operating constraints violation.

Task 3.4 "Solutions to enable Aggregators to provide flexibility: Aggregator platform and customer involvement" is coordinated by areti in cooperation with Siemens, Engineering, Acea Energia and B.A.U.M. It includes activities aimed to test a local flexibility market in which end-users can be considered as market actors, thanks also to the role of the Aggregator.

The sub-activities composing the Task 3.4 are reported below:

- Aggregator Platform development and integration, led by Siemens;
- Solutions to enable local flexibility market, led by areti;
- Customer engagement techniques led by Acea Energia in cooperation with B.A.U.M.

The sub-task mentioned ensures an integration at every level of the Aggregator Platform and the acquisition of relevant data from the architecture regarding the flexibility analysis.

## 1.2 Objectives of the Work Reported in this Deliverable

The objective of the work reported in D3.4 is to present and describe the innovations and updates developed within the second release of technology. After the release of the D3.3 that deeply analysed and presented the structure of the Platone system architecture, this document will present the second version of the technology with all its implementation and updates. New functionalities will be presented and changes in data flows among the platforms will be described in order to detect implementation compared to the first version of the technology. The deliverable will then focus on the geographical and technical updates and the Italian Demo KPIs.

WP3 Italian Demo fully implements the Platone Reference Architecture in all its components and functionalities, both from a technological point of view and from a market structure point of view.

## 1.3 Outline of the Deliverable

The introductory chapter explains the Platone reference context, and the specific project task linked to the present deliverable, also providing indications about the objectives and characteristics of the document. Chapter 2 *Overview* summarizes the structure of the Platone system architecture and the updates regarding the data flows among the platforms. Chapter 3 *Updates and Implementations*, analyses the achievements and developments within the second release of technology, both on the technical and geographical (demo) side. Chapter 4 *KPIs* describes the ongoing status of WP3 Project KPIs. Chapter 5 *Conclusions* closes the document with the conclusions part, it is followed by the list of tables, the list of figures, the list of references, the list of abbreviations and the list of technical terms.

## 1.4 How to Read this Document

The document provides relevant information and updates based on the second release of technology of the Italian Demo. Furthermore, significant links and insights on the evolution of the technology during the project can be made through these Platone Deliverables.

- D3.3 [2] “Delivering of technology V1”, released by areti on month 21 (May 2021) as a public detailed work on the release of the first version of the System Architecture. Within D3.3 areti describes Italian Demo architecture, by providing a first overview and then describing all the components of the System Architecture, by highlighting their roles in the process;
- D3.6 [3] “Report on first integration activity in the field”, released by SIEMENS on month 23 (July 2021) as a public detailed work on relevant integration activities and data setup that followed the first “Delivery of technology”. Within D3.6, SIEMENS describes the integration activities that follow the “Delivering of technology (v1)” considering the general adopted approach, focusing on the single Italian Demo platforms and on the overall necessary integration architecture. Furthermore, the Deliverable contains the description of the economical/technical scenario setup to test the overall Platone Italian Demo process;
- D2.2 [4] “Platone platform requirements and reference architecture (v2)” released by Engineering on month 30 (February 2022) as a public report detailed on the Platone Open Framework. Within D2.2, Engineering describes the Platone Open Framework, a relevant element for Platone Demos and so for the Italian Demo.

# 2 Overview

## 2.1 System Architecture

The Italian Demo has developed a full implementation of the common Platone Architecture introduced in the D2.1 [5] using data coming directly from the distribution grid and equipment in field. The D2.2 provided an overview of the upgrade undergone during the second phase of the project to the Platone Architecture. Concerning the Italian Demo, the System Architecture released during the project activities is shown below in Figure 1.

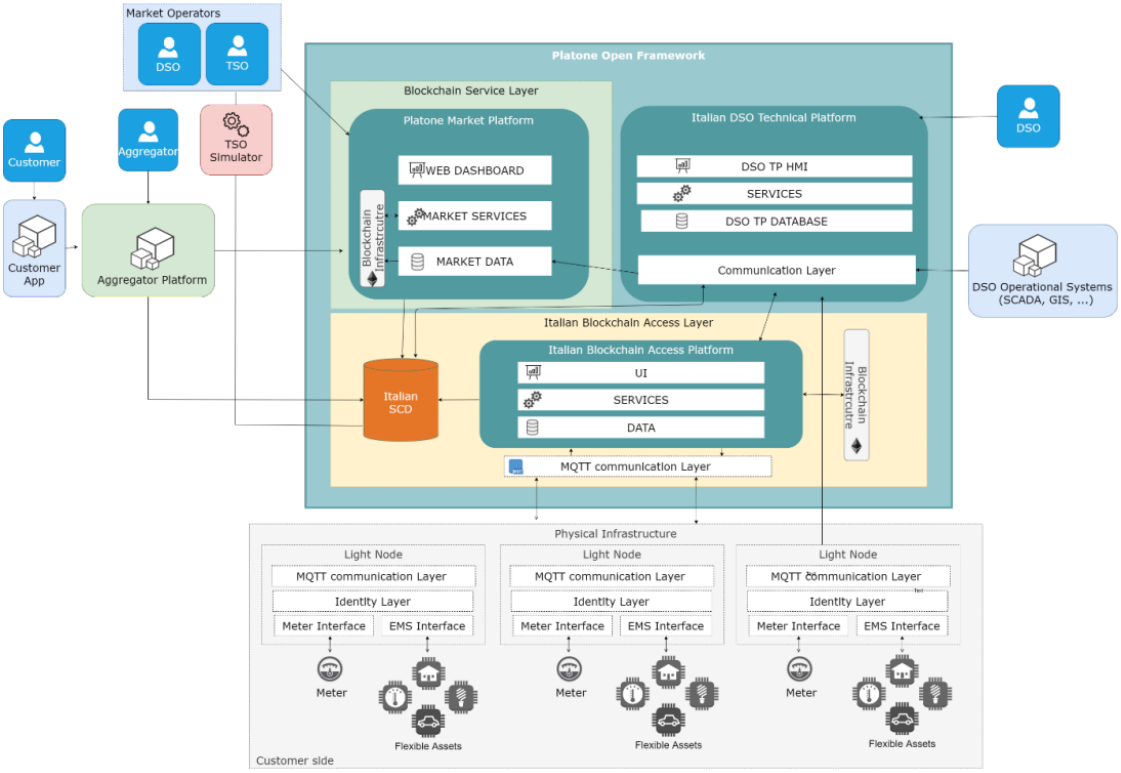


Figure 1 Italian Demo Architecture

The architecture deeply described in the D3.3 [2], is composed by five different platforms able to enable the Local Flexibility Market. These platforms are:

- The **Market Platform** is one of the core components of the Platone Open Framework and it is defined within the WP2 activities. It is a blockchain technology-based platform in which are stored the global flexibility needs coming from TSOs and the local flexibility requests coming from DSOs. The requests are matched with the offers received by the aggregators, that sell the flexibility of the resources enclose in their portfolio according to ancillary services defined by System Operators, in order to solve the grid issues occurred. These market operations are fully registered and certified thanks to the blockchain service layer;
- The **Aggregator Platform** is the platform suitable to manage the flexibility resources and runs algorithms to optimize market strategy and flexibility offers;
- The **Blockchain Access Layer** is an architectural layer that acts as level of security and trustworthiness of the framework. Indeed, it is able to certifies all the data coming from the Light Node (device used to gather data from the main meter) and runs the Smart-Contracts;
- The **Shared Customer Database** collects all the data and information in a single archive and makes them available, after an appropriate authorization, to the stakeholders involved in the

Local Flexibility Market. This database is able to arrange, store and collect the measurements, the flexibility orders and the other data related to the DERs, providing this information to the other Platone platforms to implement the functionalities for the market (and further stakeholders involved in the activities according to authorization rules);

- The **DSO Technical Platform**, in compliance with the market session timeframes, is the platform able to perform:
  - the power flows,
  - the sending of the flexibility requests to Market Platform;
  - the technical validation check of the economic market outcomes;
  - the broadcast of the set-points to flexible resources.

  Thanks to the continuous interaction with the DSO monitoring and control system, it receives all the inputs required to detect grid issues and to solve them with flexibility provided by DERs.

The architecture depicted in the Figure 1 was described in the previous version of the technology (D3.3 [2]).

Concerning data exchange between the platforms (Figure 2) has undergone some slightly updates consisting in the information included in some flows.

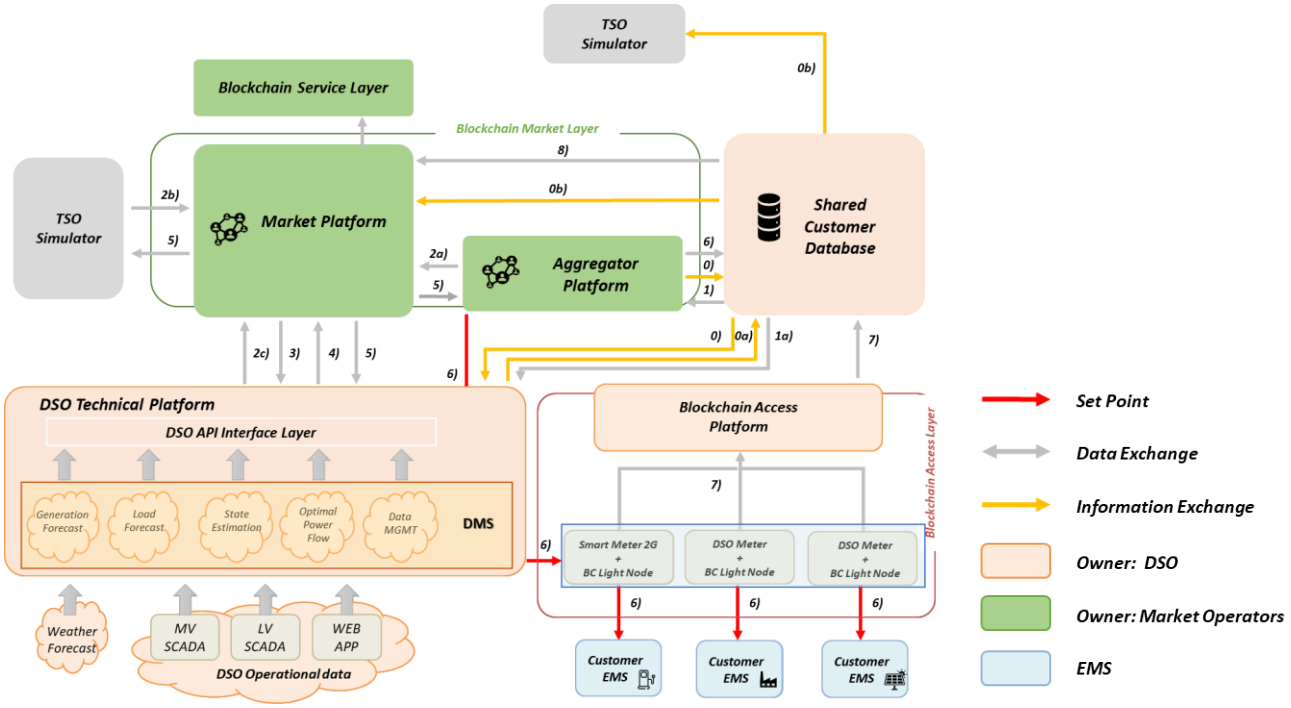


Figure 2 Italian Demo Data Flows [6]

The following table describes the data reported in the Figure 2 Italian Demo Data Flows and the related updates:

**Table 1 Communication and Data Flow specifications (highlighted in bold the updated versions)**

| Flow | Sender | Receiver | Description | Updates in this version |
|---|---|---|---|---|
| **0** | Aggregator Platform | Shared Customer Database | Flexible PoD registration: AP sends all the data to register the resource in the SCD | No Updates |
| **0** | Shared Customer Database | DSO Technical Platform | Flexible PoD registration: SCD turns the data to DSO TP to localize the resource on the distribution grid | No Updates |
| **0a** | DSO Technical Platform | Shared Customer Database | Flexible PoD - PoM association: DSO TP detects the PoM (Point of Measurement) code linked to the resource | No Updates |
| **0b** | Shared Customer Database | Market Platform (TSO Simulator service) | Flexible PoD data: The SCD sends the data of the flexibility resources to TSO Simulator | No Updates |
| **1** | Shared Customer Database | Aggregator Platform | Flexible PoD data: The SCD sends, in streaming manner, to AP the quartorary measurements | No Updates |
| **1a** | **Shared Customer Database** | **DSO Technical Platform** | **Flexible PoD data: The SCD sends, on demand, the measurements data to DSO TP** | **Implementation of the on-demand call** |
| **2a** | Aggregator Platform | Market Platform | New flexibility offers: AP sends the flexibility offers to MP | No updates |
| **2b** | TSO Simulator | Market Platform | New flexibility requests: TSO sim sends the flexibility requests to MP | No Updates |
| **2c** | **DSO Technical Platform** | **Market Platform** | **New flexibility requests: DSO sends the flexibility requests to MP** | **Implementation of the LV flexibility requests with separate flow with respect to MV requests** |
| **3** | **Market Platform** | **DSO Technical Platform** | **Market outcomes for technical validation: MP sends to DSO TP the more economics offers for the technical validation** | **Definition of a unique flow to gather the outcomes for LV and MV resources (in the previous version the flow encompasses only the MV users)** |
| **4** | **DSO Technical Platform** | **Market Platform** | **Validated market outcomes: DSO TP sends the offers in compliance with the grid limits** | **Definition of a unique flow to gather the outcomes for LV and MV resources (in the previous version the flow encompasses only the MV users)** |

| Flow | Sender | Receiver | Description | Updates in this version |
|---|---|---|---|---|
| **5** | **Market Platform** | **Aggregator Platform**<br>**Market Platform (TSO Simulator service)**<br>**DSO Technical Platform** | **Market results: MP sends the market outcomes to the stakeholders** | **Definition of a unique flow to gather the outcomes for LV and MV resources (in the previous version the flow encompasses only the MV users** |
| **6** | Aggregator Platform | Shared Customer Database | Set-point: AP sends the set-point to SCD | No Updates |
| **6** | Aggregator Platform | DSO Technical Platform | Set-point: AP sends the set-point to DSO TP | No Updates |
| **6** | DSO Technical Platform | Light Node | Set-point: DSO TP sends the set-point to Light Node | No Updates |
| **6** | Light Node | Customer Activation Systems<br>(e.g. EMS) | Set-point: Light Node makes available the set-point to Customer activation System | No Updates |
| **7** | Light Node | Blockchain Access Layer (Blockchain Platform) | Measurement data & Set-point: Light Node sends the data to BAL | No Updates |
| **7** | Blockchain Access Layer (Blockchain Platform) | Shared Customer Database | Measurement data & Set-point: BAL sends the data to SCD | No Updates |
| **8** | **Shared Customer Database** | **Market Platform** | **Measurement data & Set-point: SCD sends data to MP for the settlement phase** | **The flow is updated on demand (in the previous version there was a daily update)** |

# 3 Updates and Implementation

## 3.1 Technical updates

During the first phase of the project, the aim of the Italian Demo was to design and implement the System Architecture and all the platforms needed to develop a Local Flexibility Market able to unlock the flexibility in the distribution grid and enable users to be part of a process in which they would be crucial to solve eventual issues detected in the grid. Once this objective was achieved, the partners have focused on the implementation and the technical updates to include in the overall process, in order to make the system more reliable and easier to use both for the market operators (SOs and Aggregators) as well as for the customers. For this reason, the working group has planned several internal tests and updates of the technology to keep up to date the software and the platforms. Many steps forward have been made during the time considered and important goals have brought the exploitation of the results achieved during the implementation of the project activities.

The activities realised during the second phase of the project have led to the second delivery of the technology that involves the following developments:

**Table 2 Platforms' developments**

| | |
|---|---|
| Market Platform | • Integration and coordination Day Ahead and Real-Time sessions<br>• Overall settlement calculation<br>• Smart Contract and Platone Token |
| Aggregator Platform | • Elaboration of Real-Time offers |
| DSO Technical Platform | • Integration and coordination of Day Ahead and Real-Time sessions<br>• Simulation of the Low Voltage network<br>• Integration and coordination of MV and LV network simulations |
| Flessibili App | • New functionalities on the "Flessibili" mobile App |

In addition, the following activities and developments have been done or are ongoing:

- Update of Baseline calculation;
- Inclusion of the areti's lab PODs;
- Enrichment of the dataset gathered from the main meter;
- Smart Building integration;
- Gathering of storage data for the Aggregator Platform.

The descriptions of the developments and the activities are presented below.

### 3.1.1 Market Platform

***Integration and coordination of Day Ahead and Real-Time sessions***

The first version of the technology has been developed and tested with the Day Ahead session. With this second release, the market, already arranged to manage both timings, is now running in both Day Ahead and Real-Time sessions. The Day Ahead sessions consist of 1 session related to services to be delivered in the 24 hours of the day after, while the Real-Time consists of 6 sessions each one related to services to be delivered in the next 4 hours.

The following figure reports the market sessions showing also the related activities of the other platforms:

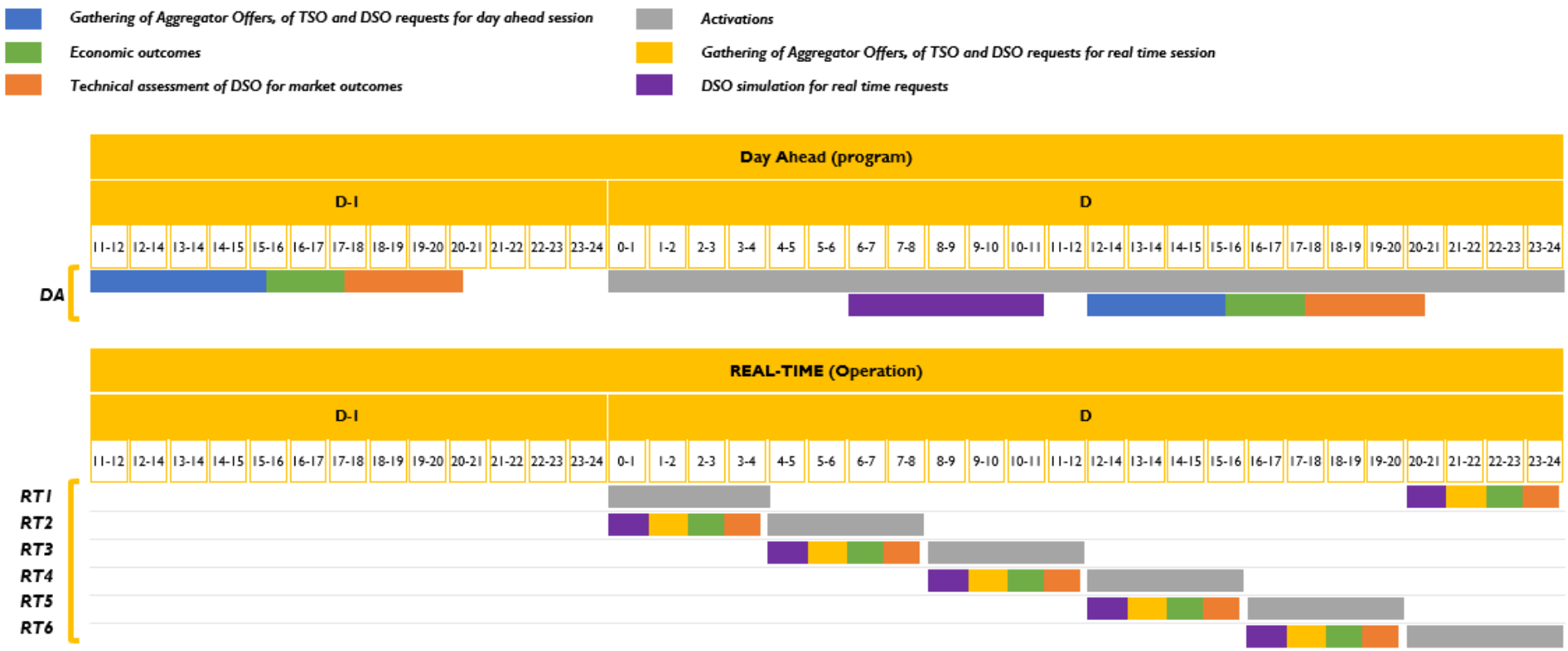


Figure 3 Market Sessions

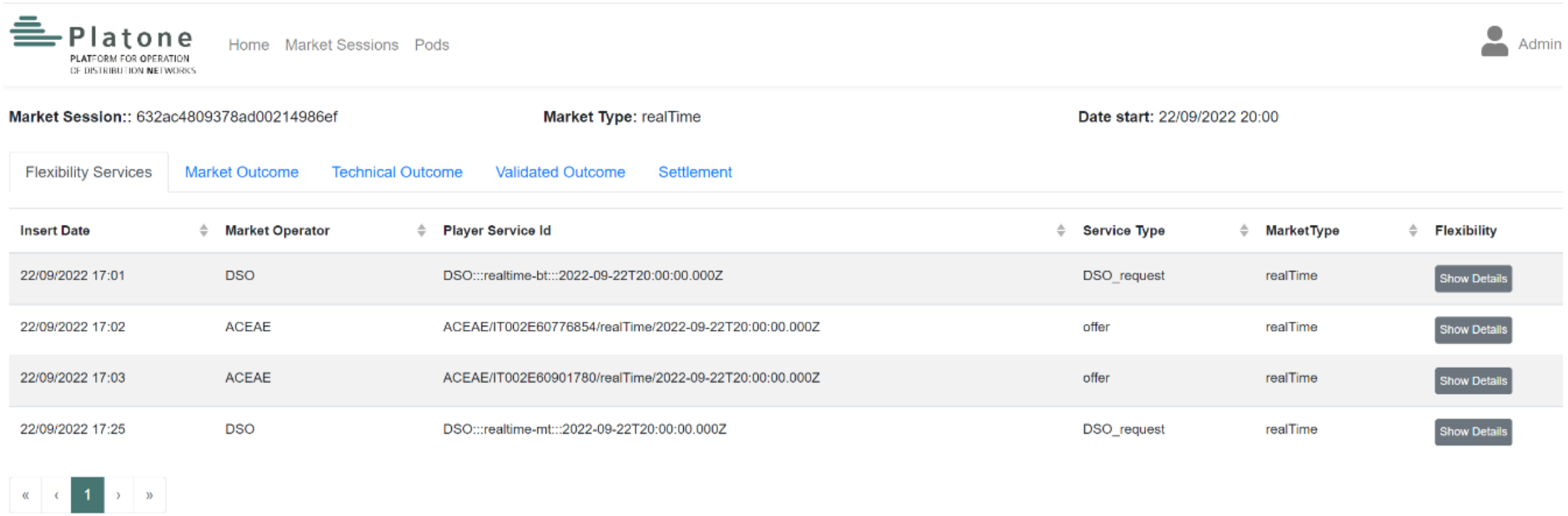


**Figure 4 Real time session offers/requests in the Market Platform**

***Overall Settlement Calculation***

To calculate the flexibility provided by the resources, the Market Platform acquires the certified measurements from the Shared Customer Database and perform the settlement for any market sessions. In detail the Market is able to calculate the settlement for each resource and to define the remuneration process through the Smart Contract and Platone tokens running on the blockchain service Layer.

***Smart Contract and Platone Token***

The new developments on the Market Platform includes the integration with the Blockchain infrastructure and the Blockchain service layer. More in detail, the Platone Market Platform implements three different Smart Contracts:

- *Certification*, the Smart Contract is able to certificate all the market results and register them into the Blockchain infrastructure
- *Settlement Agreement*, a dynamic smart contract able to manage multiple agreements between the aggregator and its own customers. This Smart Contract is used for the settlement management
- *Platone Token,* an ERC-20 based Token used for the payment of the flexibility provisioning to the end customers. Each customer has its own wallet linked to its own PoD and Platone Tokens are provided to the customer wallet at the end of the settlement phase. A dashboard showing the total tokens gained by the user and the number of tokens achieved by the customer is available on the app “Flessibili” (refer to 3.1.4).

### 3.1.2 Aggregator Platform

***Elaboration of Real-Time offers***

In the Aggregator Platform, the ongoing update activities concern the elaboration of flexibility offers for the Real-time sessions. In detail, the Aggregator Platform will define the offers for Real-time sessions with the update data from the fields and proceed to send to Market Platform before each Real-time Market Session (this is possible if the POD Registration attribute “Real-time Market Participation” is set in “True”). The updates, now in an early stage, will enable the automatic management of the Real-time offers. Hence, this update increases the liquidity of the market and guarantees more flexibility in the customer involvement.

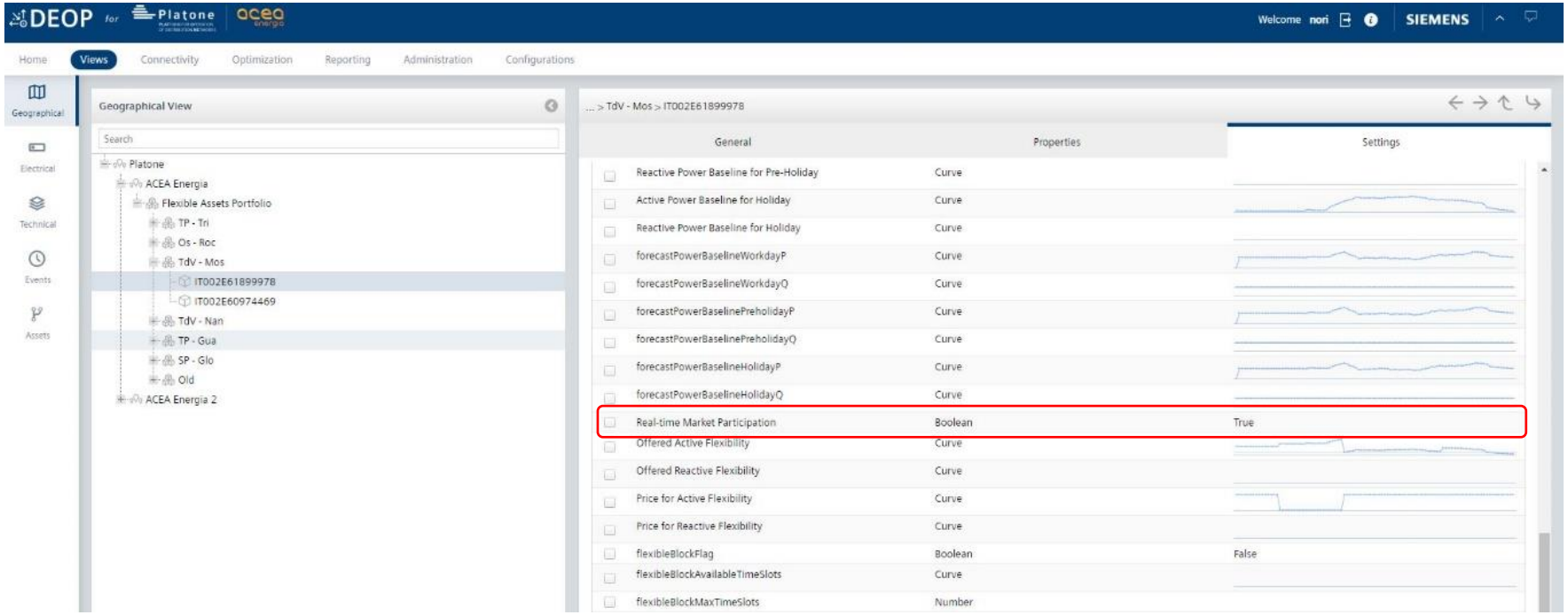


**Figure 5 Real time sessions offers in the Aggregator Platform**

### 3.1.3 DSO Technical Platform

***Integration and coordination of Day Ahead and Real-Time sessions***

In the DSO Technical Platform, the function to elaborate the flexibility requests for the Real Time sessions have been implemented. The DSO is therefore able to elaborate requests for services to be activated in the next 4 hours, allowing him to adjust the requests issued in the previous Day Ahead market session and/or solve grid issues not forecasted in the previous Day-Ahead session.
Similarly, the DSO Technical Platform now includes the function to perform the technical validation of market outcomes related to Real-Time sessions.

***Simulation of the Low Voltage network***

Thanks to the implementation of the algorithms developed into the DSO Technical Platform, the LV grid is now integrated into the Platone framework. Indeed, the platform is now able to take into account also the LV grid and therefore is able to foresee the LV congestion and request the flexibility from LV resources.

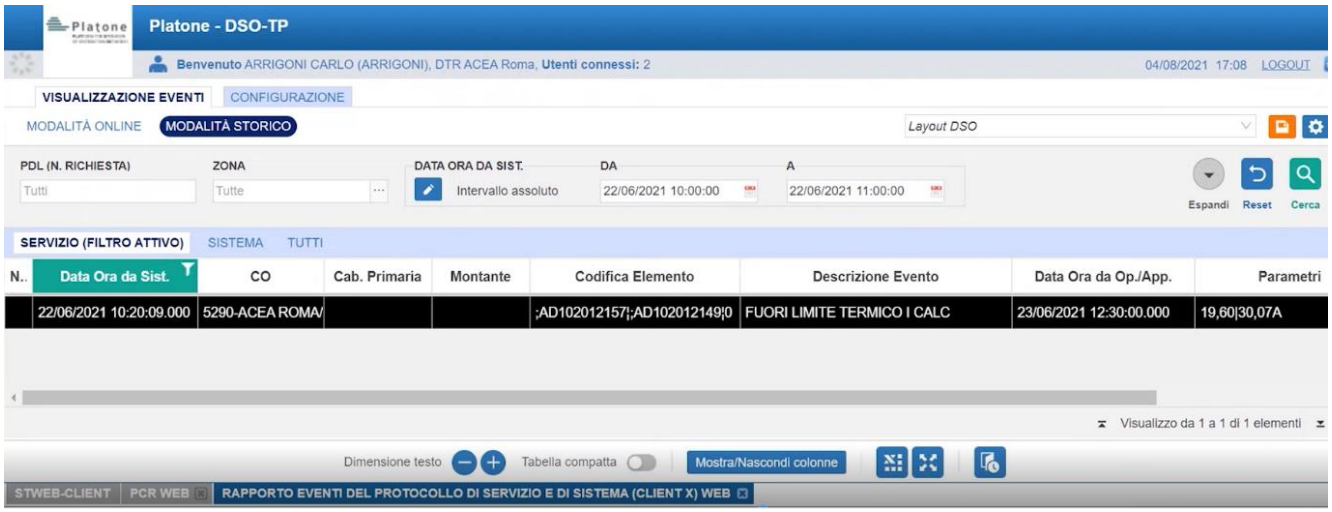


**Figure 6 Indication of LV congestion**

***Integration and coordination of MV and LV network simulations***

In this second release, the LV algorithms running on the DSO Technical Platform permit a full integration between LV and MV grids. Hence, the results of the LV power flows are used as input for the calculation of the MV power flows.

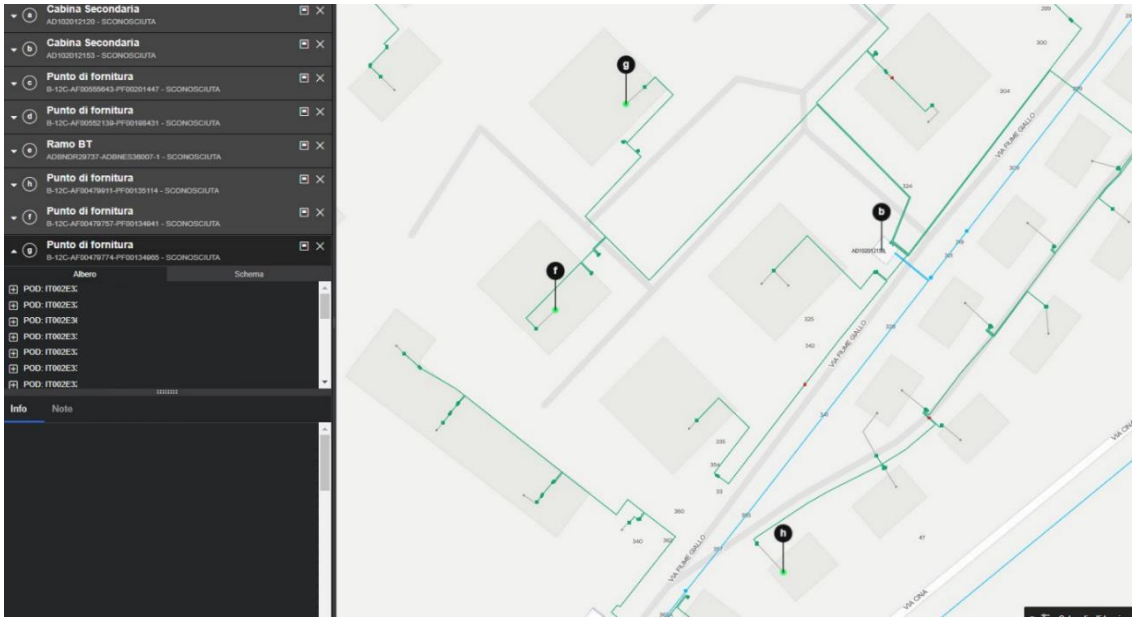


Figure 7 Representation of MV (cyan) and LV (green) network in DSO Technical Platform

### 3.1.4 Flessibili App

***New functionalities on the "Flessibili" mobile App***

The updates of the "Flessibili" App consents the users to consult their consumptions, the offers issued and the offers accepted.


Figure 8 Flessibili App interface: Consumptions

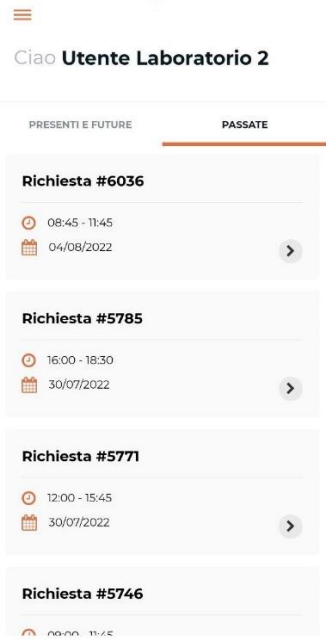


Figure 9 Flessibili App interface: Offers

By means of Flessibili, Platone users can express their preferences and availability in compliance with the real time market session and can select the availability slots to provide flexibility. The following figure reports the dashboard developed for this functionality:

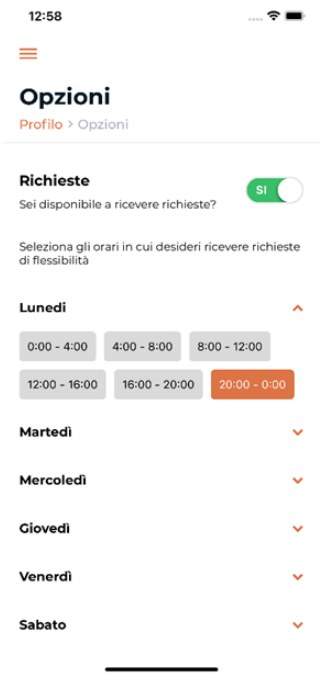


Figure 10 Flessibili App interface: Availability to provide service

Finally, Flessibili (as mentioned before in subchapter 3.1.1) implements also an electronic wallet section, where users can check their tokens acquired at the end of the settlement phase.

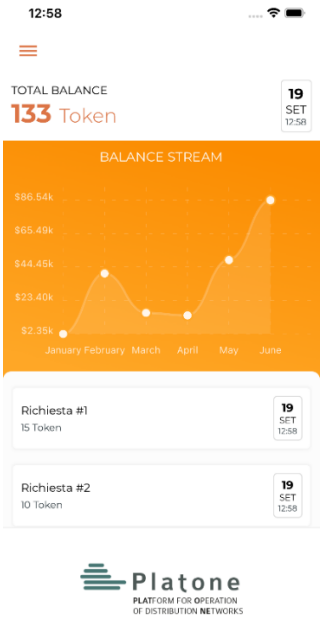


Figure 11 Platone Token (Flessibili App)[1]

All these services are implemented in the Blockchain service layer and made available through standard APIs. The Settlement Agreement Contract and the Platone Token Contract (for the balance service) are already integrated within the Aggregator Platform and the Flessibili App.

[1] Design of the App that could be subject to change

### 3.1.5 Other developments and activities

***Update of Baseline calculation***

The Baseline is used to represent the typical users' energy behaviour in normal condition (no providing flexibility services).
The partners are studying the possibility to define a Standardized Baseline. The exploiting methodology is depicted in scientific paper [7]. It is defined as:

- a baseline ex-ante (customer behaviour regardless of their participation in the Flexibility Market) equal to the average consumption/generation of 5 corresponding hours in the days with the highest daily consumption/generation and
- a baseline ex-post (how customer behaviour changes after their participation in the Flexibility Market) adjusted upward and downward by the difference between the last two hours' actual consumption and baseline. Ex-post baseline would be used to validate the settlement calculation verifying that the handlings have actually been used to achieve the target set by the Local Flexibility Market.

The Standardized Baseline calculation and publication is performed by the Shared Customer Database.

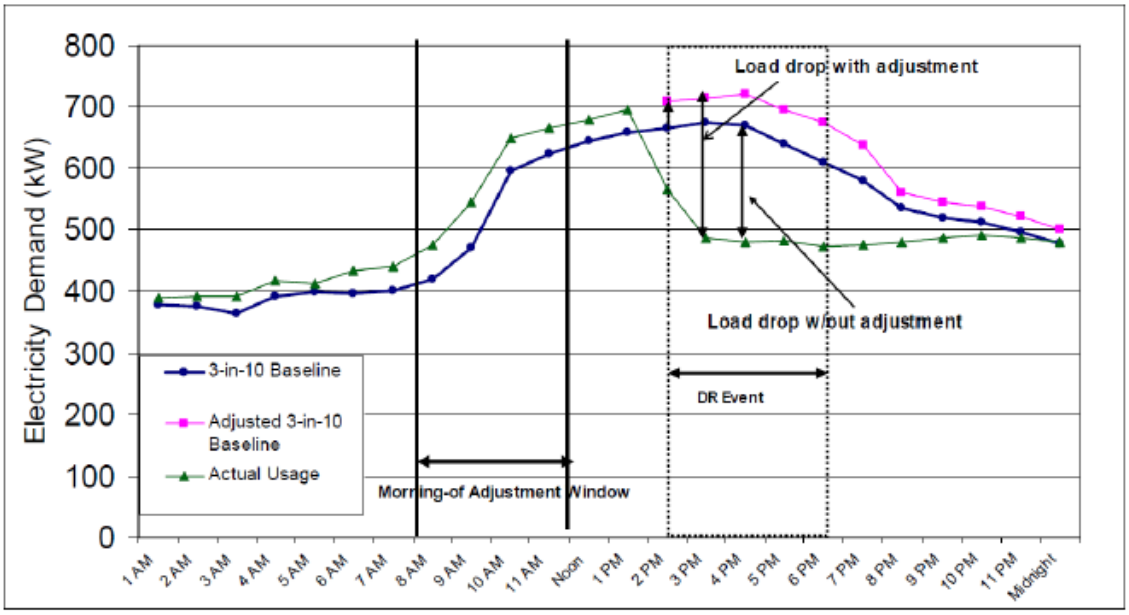


**Figure 12 Comparison of the Standardized Baselines [7]**

***Use of the areti's lab PODs***

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 Light Nodes are interconnected with the smart meters and linked to a Load Simulators able to simulate (by setting a time schedule) the energy behaviour of residential customers.
In detail, the Light Node receives the flexibility order and forwards it to the Load Simulator that simulates the flexibility service delivery. Both the measurements gathered from meters and the flexibility orders are certify by Light Node and sent to Shared Customer Database.

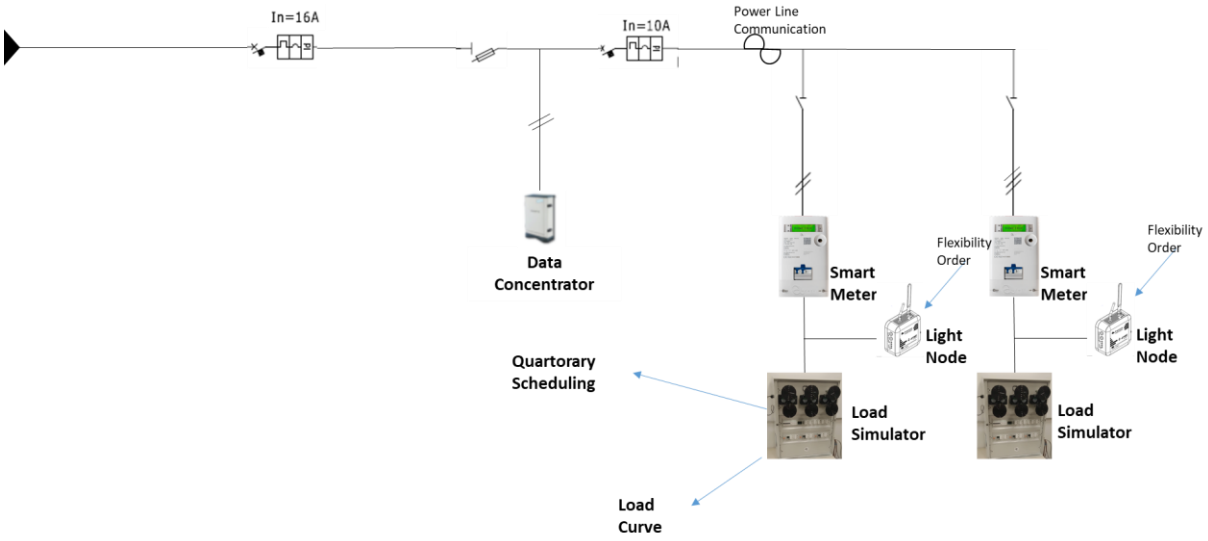


Figure 13 Single-line diagrams of the Lab PoD

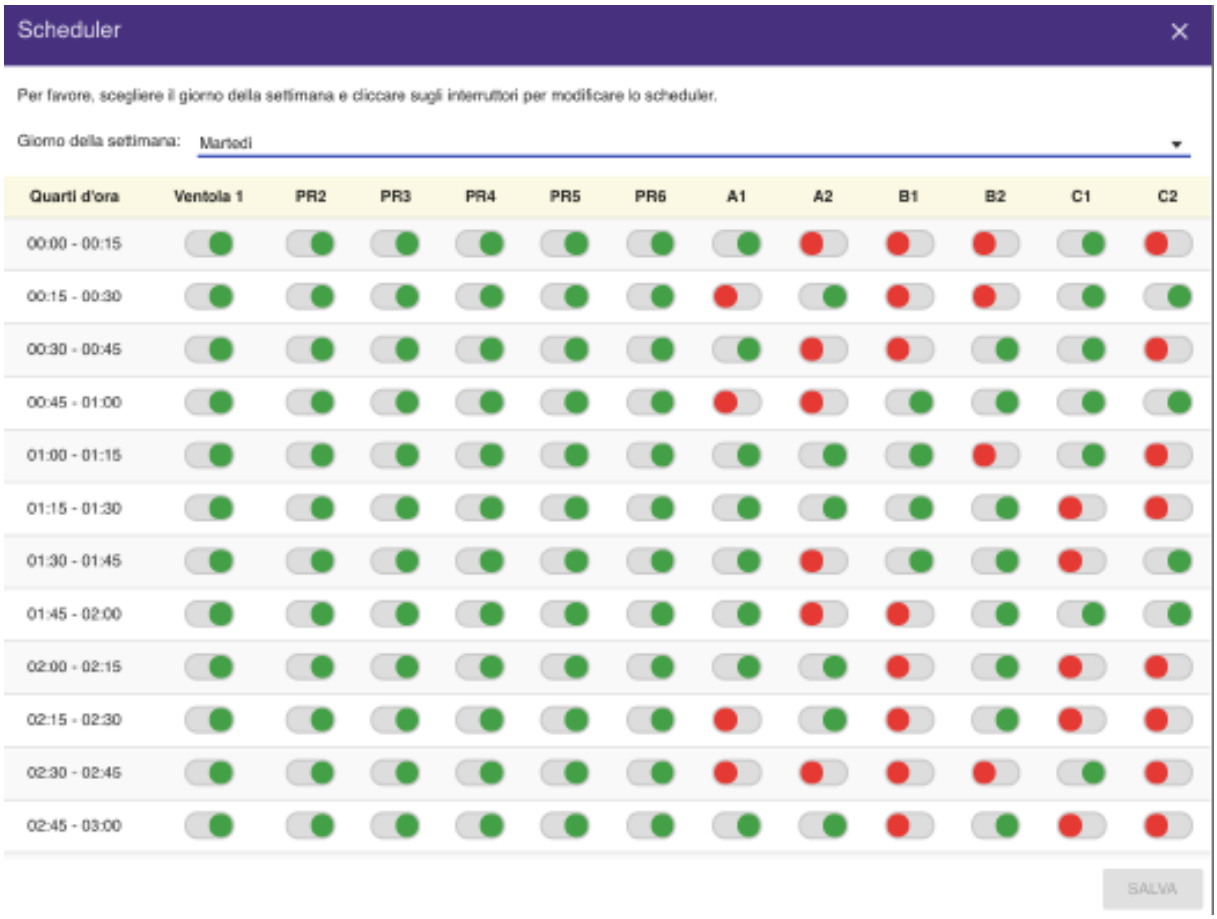


Figure 14 Quartorary Scheduling

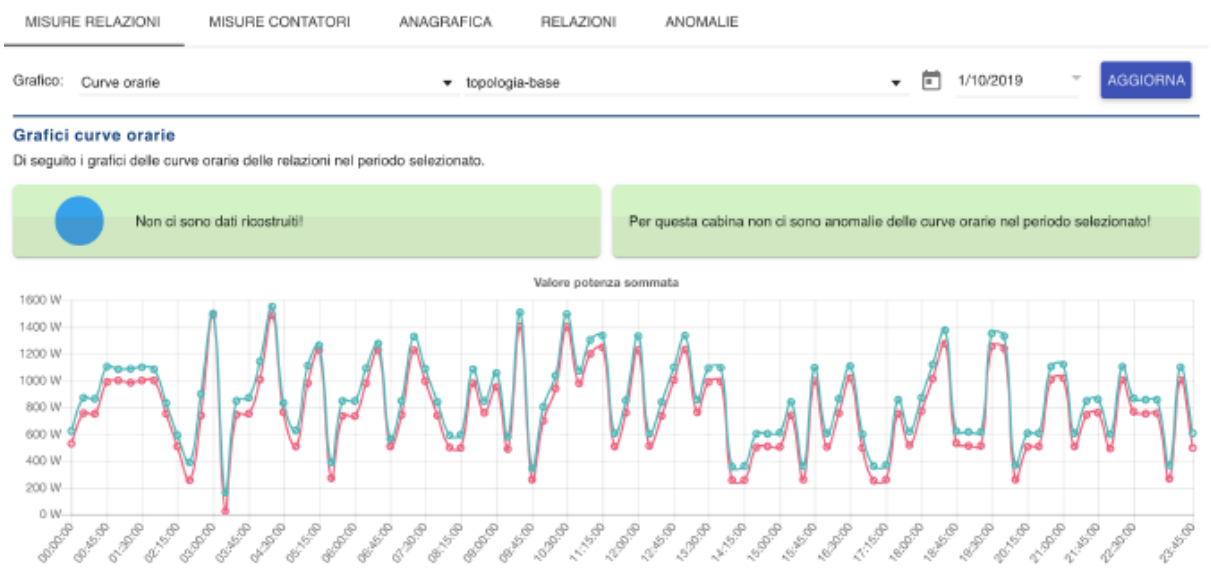


Figure 15 Load Curve


Figure 16 Light Node and smart meter in areti's lab

***Enrichment of the dataset gathered from the main meter***

An update of the data flow between smart meter and Light Node has been tested on the devices installed at the areti's lab. In detail, a new version of the data format, named Chain2Full, has been set on the lab's smart meters and the Light Node firmware has been updated to acquire the new dataset. Indeed, the old version, named Chain2, gathered few data (like the quartorary withdrawn energy) respect the new one. Instead, the Chain2Full increases the set adding the quartorary energy active absorbed/injected, instant active power absorbed/injected, the reactive energy measurements (only for 3Ph main meter) and so on. In this way the solution is able to gather more data and improve the observability and therefore the accuracy of the forecast tools. Below are described the differences between these two datasets:

Table 3 Differences between datasets Chain2 and Chain2Full

| DATA | Chain2 | Chain2Full |
|---|---|---|
| **Measurement date** | X | X |
| **Measurement time** | X | X |
| **Quarter-hour sample of active energy absorbed** | X | X |
| **Quarter-hour sample of active energy injected** | | X |
| **Quarter-hour sample of inductive reactive energy when active energy absorbed*** | | X |
| **Quarter-hour sample of capacitive reactive energy when active energy absorbed*** | | X |
| **Quarter-hour sample of inductive reactive energy when active energy injected*** | | X |
| **Quarter-hour sample of capacitive reactive energy when active energy injected*** | | X |
| **Quarter-hour average of active power exchange** | X | X |

* Only for 3Ph meters.

Such update, once performed in the smart meters and related Light Nodes of users participating in the Italian Demo, will increase the awareness of the user who can monitor more in detail his/her consumptions and productions.

***Smart Building integration***

The use case focused on the Enea smart building "Casaccia" in Rome, has been tested. Enea smart building is a replicable model of a new tertiary Smart Building, equipped with production plants, storage systems and management software systems able to monitor consumption energy levels and implement control strategies according to production from renewable sources and market requests. The building is equipped with:

- 18 kWp photovoltaic system installed on the roof;
- 12 kWh storage system;
- Energy Management System (EMS) that manages the energy flows between the photovoltaic system, storage and user loads based on flexible strategies;
- Building Energy Management System (BEMS) that collects data from IoT devices concentrators, implement local diagnostic and control strategies on the building in order to adapt dynamically the energy demand of the building.

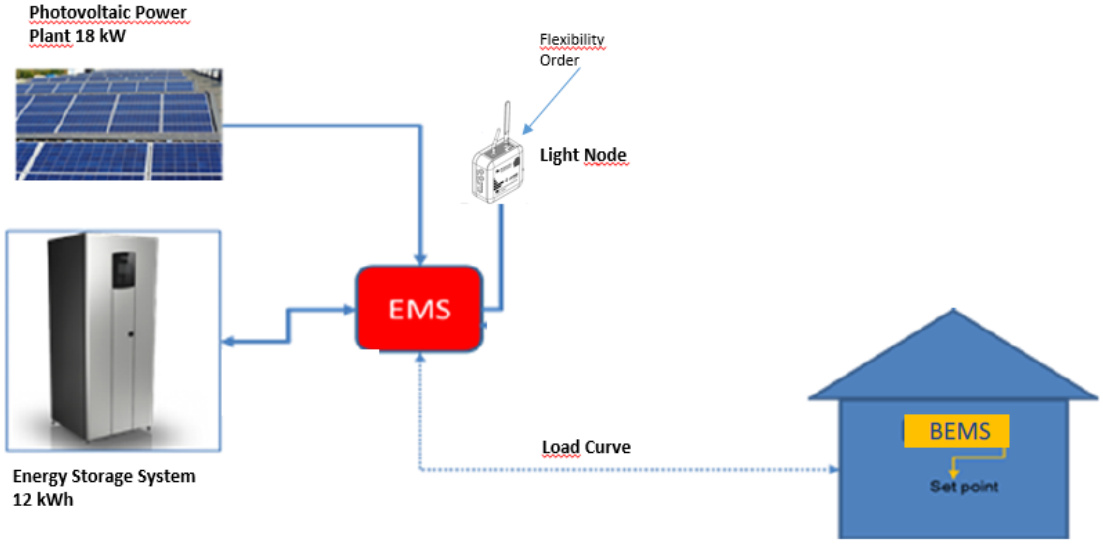


Figure 17 Communications scheme in the smart building Enea (1/2)

To include the smart building in the Platone system, a virtual Light Node[2] has been interconnected with the Energy Management System, so, during the test, the Light Node sends the Set-point to the EMS that select the right scenario and keeps the power value at point of delivery. The measures gathered by Light Node are stored on the Shared Customer Database. This experimentation is very important since it tests and analyses the flexibility available from an active building.

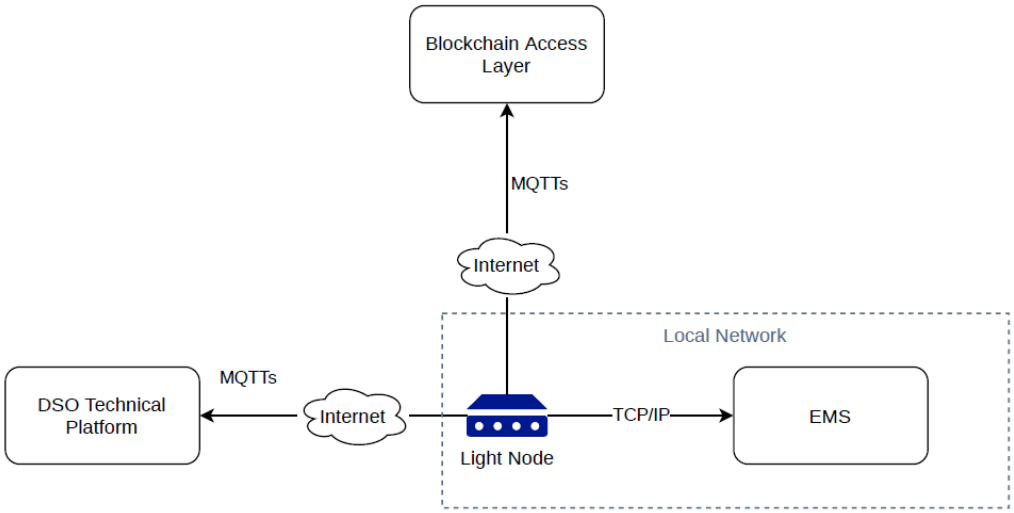


Figure 18 Communications scheme in the smart building Enea (2/2)

***Gathering of storage data for the Aggregator Platform***

The Battery Energy Management System (BEMS) embedded into storage installed in the customer premises (see the Deliverable 3.3[2]) gathers and makes available data about the status of charge, the power exchanged, the self-consumption rate, the PV production and so on. Hence, the Light Node has been interconnected with the BEMS to acquire this information every minute and send them to the Blockchain Access Layer, which forwards them to the Aggregator Platform.

[2] A software application performing the functionalities of a real Light Node.

## 3.2 Updates on the involved flexibility resources

Within the Italian Demo, from March 2021, the DSO Technical Platform started to acquire the data coming from the technical devices installed in the secondary substations, located in the area of the project activities. Indeed, the architecture built up during the first period is interfacing with areti's assets like the LV switches, RTU and Router that the DSO has already installed in the field.

Since the release of the first technology, the Italian Demo has also seen the involvement of the first users participating to the trial phase. Indeed, during the second period of the project, after the conclusion of the installation phase of technological equipment at the users' location, the 11 different residential users started to take active part in the trial and in the experimentation activities in order to test the Local Flexibility Market developed for the Platone Italian Demo.

Figure 19 Light Node Platone users' locationshows Platone Italian Demo users' location and future application of the solution proposed as the Smart Park in the Ostiense District and the Collective Self Consumption.

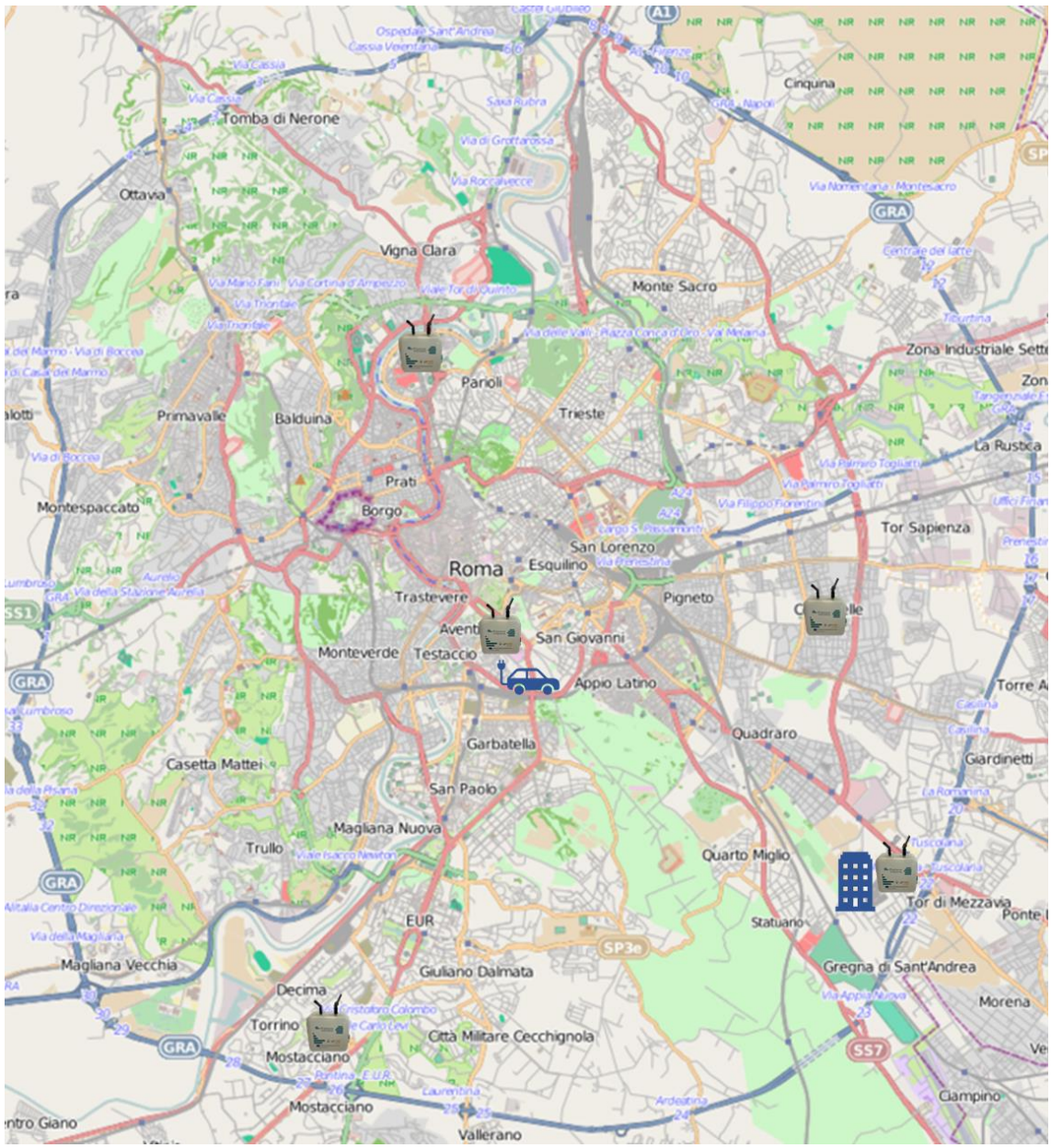


Figure 19 Light Node Platone users' location

areti is also implementing other applications to test the approach developed into the Platone Italian Demo. Indeed, areti started the installation of the Light Nodes in the area of the Ostiense district, specifically in the smart EV parking. This installation consents the monitoring and the management of the charging infrastructure to test the flexibility provided by the EV charging stations, in order to solve local congestion.

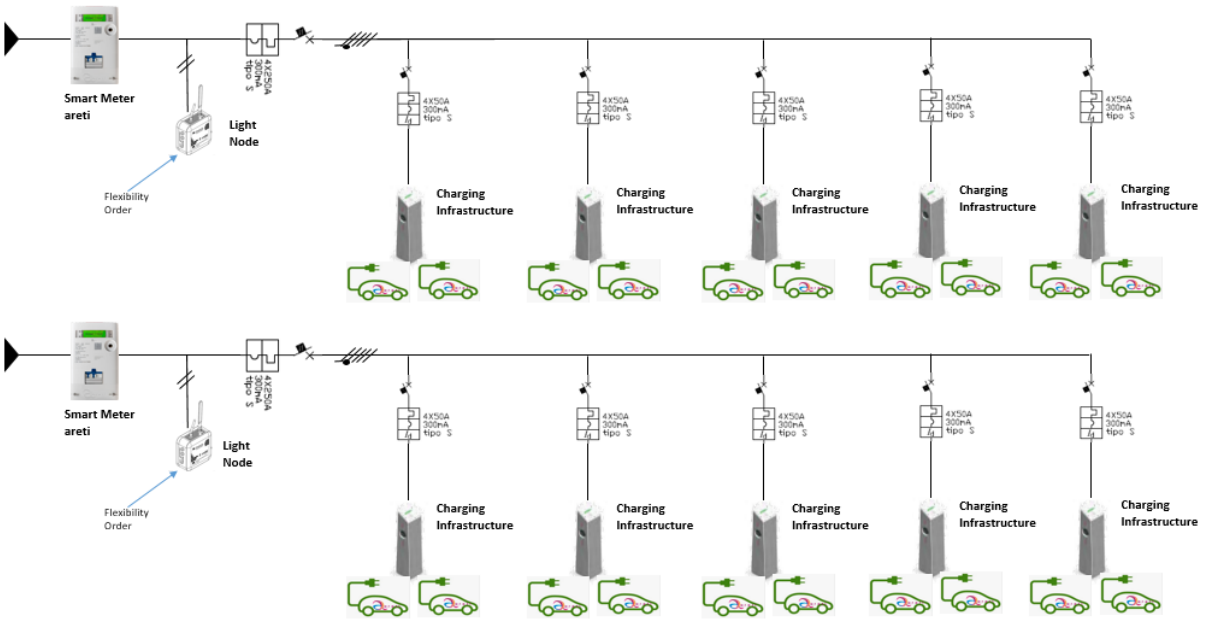


Figure 20 Areti's smart park

Moreover, WP3 partners are working to enlarge the kind of customer involved in the pilot. In this regard, areti has identified in the Capannelle neighborhood (Rome), a residential building (highlighted in the figure below) available to test the flexibility that a Collective Self-Consumption (CSC) can provide to the grid.

Figure 21 Capannelle condominium

According to the European Directive RED-II 2018/2001, CSC is a group of at least two jointly acting renewables self-consumers who are located in the same building or multi-apartment block. The Italian NRA adopts a "Virtual Model" to implement this configuration, so the CSC can use the distribution grid to aggregate consumption units, production units and energy storage located in the same building.

At the Capannelle building, areti will install a 5 kW PV power plant and 5 kWh of storage linked to the building meter, and a Light Node on the same building meter to gather the real time measurements and to receive the flexibility orders.

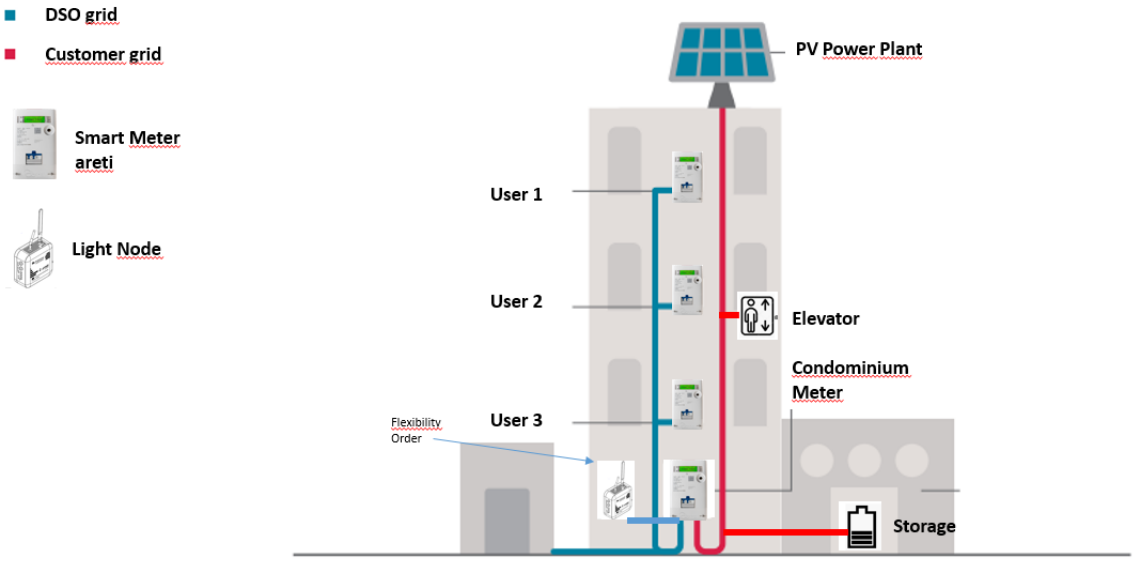


Figure 22 Collective Self-Consumption process

The community maximises the self-consumption sharing the energy among its members. The energy sharing is calculated on an hourly basis as the minimum of aggregate production and aggregate consumption. However, a part of the storage capacity not used for the self-consumption, will be provided to fulfil the flexibility requests sent by Platone ecosystem.

CSC configuration is a very important tool to encourage the active involvement of citizens in the national's energy transition process and it could be quite widespread in urban areas in the future.

# 4 KPIs

The algorithms that will be used for KPIs calculation has been developed and some of them are running directly on the platforms. In details, Shared Customer Database and Market Platform are the first platforms of the Italian Demo that implement the automatic calculation of KPI.

Concerning Social KPI *Active Participant* WP3 partners agreed to use customer's information gathered by means of the Flessibili App. In this regard, the definition of "Active Participant" will be defined based on the customer availability to provide flexibility services which is declared by him/her in the App.

**Table 4 Italian Demo KPIs**

| No. | KPI ID | KPI Name | KPI Domain | Calculation Algorithms Available |
|---|---|---|---|---|
| 1 | KPI_PR_01 | Participants' recruitment | Social | Yes |
| 2 | KPI_PR_02 | Active participation | Social | Yes |
| 3 | KPI_PR_03 | Flexibility availability | Technical | Yes |
| 4 | KPI_PR_04 | Flexibility effectiveness | Technical | Yes |
| 5 | KPI_IT_01 | Market liquidity | Technical | Yes |
| 6 | KPI_IT_02 | Forecast reliability – customer profile | Technical | Yes |
| 7 | KPI_IT_03 | Forecast reliability – grid profile | Technical | Yes |

Thanks to the technical updates developed after the first release of the technology, the Italian Demo partners were able to start gathering of the data for the calculations of Projects and Demo KPIs. After the release of the second version of the technology, the algorithms implemented will be able to perform the calculation and provide results of the KPIs processes. Moreover, the WP3 partners will perform periodic monitoring on the KPIs results until the end of the project.

# 5 Conclusion

With the work carried out in the second period of the project, WP3 partners achieved the complete version of the system architecture of the Italian Demo.

This version of the architecture will be operative from October 2022 and its integration with the activities in the field will be described and analysed in the report (D3.8). This version represents another fundamental step towards the Local Flexibility Market approach developed into the Italian Demo. Indeed, the solution implemented within the Platone Italian Demo has been proposed to the National Regulation Authority (ARERA) as pilot for the flexibility market. The approach and the platforms developed within the Platone project will be re-purposed within this regulatory framework in order to enable the DSO to acquire local flexibility services and implement a complete end-to-end TSO/DSO coordination. An important role is played by the Shared Customer Database, that in this new solution will be known as Flexibility Register and will act as a unique storage of the customers' personal and energy data for all the stakeholders involved.

Moreover, thanks to the significant knowledge gained by the project partners through the project activities on the field trials, it is now easier to understand the major issues and needs. It is for this reason that the solution developed in the Platone project will be applied to different environments in order to reuse the significant knowledge gained through the implementation of the Italian demo. Different projects are started (Flow and BeFlex, Horizon Europe projects), where the Platone Italian Demo solution will be used.

# 6 List of Tables

# 7 List of Figures

# 8 List of References


[1] European Commission, “2050 long-term strategy”, [Online]. Available: https://ec.europa.eu/clima/policies/strategies/2050_en

[2] Platone Deliverable D3.3 “Delivering of Technology v1” [Online] Available: https://www.platone-h2020.eu/Ressources/Deliverables

[3] Platone Deliverable D3.6 “Report on first integration activity in the field” [Online] Available: https://www.platone-h2020.eu/Ressources/Deliverables

[4] Platone Deliverable D2.2 “Platone platform requirements and reference architecture (v2)” [Online] Available soon: https://www.platone-h2020.eu/Ressources/Deliverables

[5] Platone Deliverable D2.1 “Platone platform requirements and reference architecture (v1)” [Online] Available: https://www.platone-h2020.eu/Ressources/Deliverables

[6] Platone Italian Demo Architecture Video [Online] Available: https://www.platone-h2020.eu/Ressources/Media_content

[7] DNV GL, Energy Networks Association, Baseline Methodology Assessment, [Online] Available: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2020-ws1a-p7-baselining-assessment-report.pdf

# 9 List of Abbreviations

| Abbreviation | Term |
|---|---|
| ARERA | Autorità di regolazione per energia reti e ambiente (Italian National Regulatory) |
| BEMS | Building Energy Management System |
| CSC | Collective Self-Consumption |
| DER | Distributed Energy Resources |
| DSO | Distribution System Operator |
| DSO TP | DSO Technical Platform |
| EMS | Energy Management System |
| LV | Low Voltage |
| MV | Medium Voltage |
| NRA | National Regulatory Authority |
| PoD | Point of Delivery |
| PoM | Point of Measurements |
| RTU | Remote Terminal Unit |
| TSO | Transmission System Operator |