Platone

PLATFORM FOR OPERATION OF DISTRIBUTION NETWORKS

Platone

PLATform for Operation of distribution NEtworks

D6.6 v1.0

Periodic report on lessons-learned (v3)

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Abstract

This deliverable reports on the lessons learned through the field trials activities of Platone during the third year of project activities. The lessons are divided into two subjects, standards, which is the major topic of WP6 and general topics, including regulatory issues.

Keyword list

lessons-learned, standards, regulation, legislation, data privacy

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 Platone project's core part is the demos that are currently developed in Italy, Greece and Germany. During the implementation of innovative projects that cover a variety of applications, a significant body of experience is gained. Such lessons are learned via the process of development and implementation and it is important to keep track of them and present them to the community. Thus, an extra value is added by projects like Platone which serve as a source of valuable information for future projects that try similar approaches. This deliverable reports the lessons-learned during the 3rd year of Platone. Reporting is split in two categories: one for general topics and a dedicated category for the applicable standards.

Areti, the leader of the Italian demo gained experience on the Local Flexibility Markets. In addition, the need for appropriate planning of installations at customer premises during the implementation phase is highlighted, due to lack of access in case of absence of the customer. Moreover, the experience of Platone forms the basis for future expansions in other projects for the partners involved in the Italian demo. With regard to standards, the Italian demo reports the value of CHAIN2 protocol, associated with second generation smart meters. Furthermore, MQTT served well to scale the solution and communications between platforms successfully. Finally, sufficiently wide and versatile data structures facilitated the power flow calculations and the flexibility mechanism.

The German demo leader, Avacon, reported successful feedback from the implementation results regarding flexibility availability, setup responsiveness, KPI targets and automation. With regard to forecasts used during the tests, AVACON reported some sensitivity of net demand to solar irradiation and that shifting to 15-min control intervals improves accuracy. On the field of standards, the German demonstrator highlights the successful use of Modbus TCP on their interface implementation for control of Households Battery Storage Systems (HBES). Although the HBES vendors offer a system that can work in combination with PV panels, smart inverters, energy management and electric meters, there are no standards specifying which data fields are readable and writeable through the vendor API.

HEDNO, the leader of the Greek demo, reported valuable experiences on the protection and anonymisation of data, PMU installation and platform integration. As far as development work is concerned, the regulatory gaps related to the implementation of flexible DUoS tariffs were highlighted.

Finally, E.DSO, the leader of WP1, highlights the value of the continuous tracking and updating of the KPIs used in the project, which is part of their activities. This task offers a formal process of improving on the KPI plans of Platone. Additionally, valuable insights were produced by coordinating with the Scalability-Replicability and Cost-Benefit Analysis tasks.

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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".

In WP6 the emphasis is mainly on the standardization and legislative side of the project. WP6 assists the demo leaders in the implementation of their field trials by analysing the applicable standardization ecosystem and the regulatory framework, and by providing suggestions and support and by recording their efforts to assist future similar projects. It is this last point in particular that the series of annual deliverables on lessons-learned wants to address.

1.1 Task 6.2.3

Task 6.2.3 aims at concentrating feedback from the Platone Demo leaders regarding their activities that are affected by standards, the standardization ecosystem in general and legislative and regulatory topics. This task delivers an annual report on the lessons learned through the demo implementations. These annual lessons-learned reports have an open format that allows for the Demo leaders to record their valuable experiences that came as a result of the project activities on the aforementioned topics.

1.2 Objectives of the Work Reported in this Deliverable

The objective of the work reported in this deliverable is to concentrate the any valuable experience and lessons obtained by partners during the 3rd year of Platone. The demo leaders are encouraged to report their experience on general topics and, if applicable, to standardisation. Apart from demo leaders, other partners are encouraged to report any valuable insights on their respective fields. The result is a record of how they encountered and handled any interesting problems or observations.

1.3 Outline of the Deliverable

Chapters 2,3 and 4 discuss the lessons-learned as were gained by the activities of the Italian, Greek and German demo respectively. Chapter 5 includes the corresponding insights from other partners, apart from the demo leaders. Chapter 6 concludes this report.

1.4 How to Read this Document

This document aims to record the experiences the demo leaders and other partners gained during the second year of the project from the work on the implementation of the demonstrations and other activities of Platone. The reader is not required to have any specific knowledge but reading some references on the previous lessons-learned reports [2], [3] might be useful.

2 Italian Demo

The following subchapters report the lessons learned from the Italian demo in the third year of the project.

2.1 General lessons-learned

Throughout the third year of Platone, the Italian Demo partners highlighted the importance of the coordination activities and began to identify some crucial points that have to be considered in future developments. The Local Flexibility Market, implemented as part of the project activities, brought forward very specific and local issues. Indeed, potential issues were detected thanks to the devices installed in the field and found to be localized to the working area. Addressing those issues, the location of DERs is crucial in the implementation of the Local Market. Moreover, it has to be considered that the flexibility offers can provide their volumes and prices per Point of Delivery.

Another crucial topic, which emerged during the project activities implementation, is related to the System Operators' coordination. Indeed, a coordination mechanism among the System Operators has been identified as important and it can greatly improve the impact of the flexibility products offered to solve the grid issues.

Areti, during the customer-engagement activities, realised that the installation at the individual users' premises have some criticalities:

- The customers are spread over a wide area;
- The installation of components in private spaces requires the availability of the customers during the planning of the intervention;
- Maintenance is difficult to do because any intervention on the components always requires the availability of the customer.

Moreover, areti has gained significant knowledge from the implementation phase and via the project activities and it is now able to better understand the major issues and needs of the market. Due to this, 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 ready to start, and the Platone Italian Demo solution will be used in them.

2.2 Lessons learned on standards

During the third year of project development, WP3 partners concentrated their effort on several developments and important updates that led to the release of a new version of the technology. One of the most important updates has been achieved in relation to the Light Node. The implementation was related to the upgrade of the library dedicated to decoding the CHAIN2 protocol, needed to receive and parse information from the 2nd generation smart meters. The first version of the software supported a limited version of the protocol, named "Monitoring" where only a limited set of profiles and electrical measures were available. With the upgrade of the library, in order to be fully compliant with the CHAIN2 protocol, the Italian Demo made the communication with the meter easier and enriched the data and information gathered by the Light Node. Indeed, the full CHAIN2 protocol means that each Light Node receives more information, and that more information must be processed, signed and then sent to the Blockchain Access Layer.

Thanks to the choice of the MQTT protocol and the stream processing within the Blockchain Access Layer (built on top of Apache Kafka), it has been a seamless process to scale to an increased flow of data.

Furthermore, the choice of a standard protocol as MQTT, allowed the same libraries to be used in the communication with other platforms, such as the interaction between the Light Node and the DSO Technical Platform, which uses MQTT to communicate set-point information to each Light Node.

Light Nodes are equipped with multi-band communication capabilities and the possibility to have an independent internet connection through 4G allowed the Light Nodes to achieve optimal uptime.

Regarding the certification of measurements in blockchain, the choice to apply timestamping to groups of measurements still shows benefits, in fact regardless of the increase in payload size due to the availability of new measurements and the increase in the number of Light Node deployed, it has not been necessary to increase the frequency of block creation, or the number of measures certified in each block.

Moreover, the first phase of the project the DSOTP implemented the power flow calculation and flexibility management for the medium voltage grid using a forecasting mechanism for the day ahead. In this second phase the DSOTP implemented the power flow calculation and flexibility management for the low voltage grid, and, in addition, the overall real-time intraday market has been developed. During these implementations and the integration tests, the structure of the data exchanged with other platforms didn't change. Indeed, all the necessary fields to support the management of a second type of market, and potentially further variations were already included. This was possible through the definition of a sufficiently wide and versatile data structure that included the characteristics of both levels of the grid (medium voltage and low voltage). This feature has brought the considerable advantage of requiring changes only to the backend logic and to add those new functionalities without any impact on the communication mechanisms between the platforms.

During the implementation and the integration tests, it was detected that some communication was lacking between the platforms. This lack was caused by the distributed cloud infrastructure. The retry mechanisms, already provided for the communication through APIrest and MQTT, have been very useful to overcome this problem. The number of retransmission attempts has been appropriately calibrated to the number of non-communication events based on the experience gained during the integration phase.

3 Greek Demo

The following subchapters report the lessons learned from the Greek demo in the third year of the project.

3.1 General lessons-learned

In the third year of the project, the focus has been on the implementation of the Platone concept in the Greek demo, the installation of the PMUs, the submission of D4.3 and D4.4 and the deployment of the BAL and DSOTP. Furthermore, the Greek Demo hosted the Platone Open Day in November 2021. There are several experiences worth reporting in this deliverable.

At the Platone Open Day, which took place on 24/11/2021, along with Platone, four other H2020 projects were presented (x-flex, Parity, Smart4RES, SYNERGY). From the discussions of the day, the key lessons learned concerned the regulatory changes required in Greece for the implementation of variable tariffs, in order to facilitate flexibility services and markets. The concepts of social justice in the access of consumers to flexibility services was also pointed out. Additionally, the need for data protection and data anonymization was also highlighted, along with the need for efficient utilization of the data acquired.

The issue of data anonymization was an important lesson learned, that also came up concerning the uploading of open data sets to the Zenodo platform. The Greek Demo uploaded the first data sets concerning PV generation, taking care to anonymize the data, according to the GDPR directive.

An important part of this past reporting period has been laying the groundwork for the installation of the PMUs in selected nodes of the Greek demo. Extensive research was conducted concerning the installation of the PMUs that included internal HEDNO regulations. So, the regulatory framework of the DSO was an area where lessons were learned, in terms of procuring and installing new components in the grid, in this case the PMUs and required hardware (power outlets, voltage and current sensors, SIM cards, spacers, cabling). Especially for the current and voltage sensors, which are required for signal acquisition, a lot of options were considered until the final selection was made. The input requirement of the PMU (V AC) complicated the search, because most commercially available current sensors have a current output and voltage sensors a DC voltage output, making the choices available very limited.

The lessons learned from the deployment of the Platone solution concern the software and hardware required, i.e., open-source software like Octave for the deployment of the State Estimation Tool, Docker container and Kubernetes to host the platforms, communication protocols and encoding, e.g., xml etc.

Concerning the submission of D4.3 and D4.4 the main lesson learned is the regulatory gap concerning variable DUoS tariffs and provision of flexibility services to the DSO. The current tariff structure is set by the NRA in cooperation with the DSO but currently does not allow for variable tariffs. Another important lesson is how limited the literature is with regards to a realistic modelling of the interaction between humans and pricing signals of all kinds. This question was an important one during the development of the variable tariff tools. Another important lesson from the development of the tools described in the deliverables was the limitations of availability of field data, especially when applying machine learning techniques.

3.2 Lessons learned on standards

Extensive research was conducted concerning standards in the areas of EMC requirements, type tests, environmental tests for power, analog and digital outlets, voltage and current transformers and accuracy of PMUs, building on the research conducted in the previous year of the project.

4 German Demo

The following subchapters report the lessons learned from the German demo in the third year of the project.

4.1 General lessons-learned

This chapter described the lessons-learned for the German demo regarding all topics.

4.1.1 Lessons-learned from UC 2 “Coordination of Flexibility Requests” demonstration.

Following lessons learned have been concluded from the UC 2 evaluation based on KPI:

- An achieved 99% of flexibility availability (KPI_PR_03) indicate that the implemented field-test setup, which consists of a CBES, communication infrastructure, sensors, controllers and a local balancing scheme implemented by the ALF-C, provides a high availability. The KPI thus confirms that the implemented field-test setup is sufficient for the evaluation of use case algorithms;
- The KPI_DE_05 has shown that the responsiveness of the ALF-C balancing scheme in combination with the field-test setup has a short latency and meets the requirements of the initially targeted 5 minutes for response. The dispatching of flexibility request into a measurable power flow value at the MV/LV grid connecting feeder, confirming the execution, takes places in under 2 minutes. The quick responsiveness meets the requirements for prequalification for the participation on secondary control power markets;
- The main difference between requested setpoint and achieved setpoint of 5.3 kW (8%) measured with KPI_DE_06 shows that the balancing scheme based on a 15-minute control cycle is sufficient for the use case application. However, deviation between requested and measured load exchange at MV/LV grid connecting point during UC 2 application is the result of stochastic and highly dynamic changes of the community load demand and PV generation, especially during daytime. The performance of the ALF-C balancing scheme might be increased through a shorter duration of the control-cycle;
- The KPI target values for all KPI have been achieved and prove the success of the implementation of the ALF-C balancing scheme and the field-test setup. In addition, it has been shown that the set KPI target values were realistic and appropriate.
- Automation of UC2 test runs can save a significant number of resources and time and improve repeatability. For UC2 testing, the ALF-C interface for triggering requests from external market participants (DSO, TSO, aggregators) was simulated and automated by implementing a so-called runbook. As result, the testing of the ALF-C prioritization algorithm was considerably simplified and less error-prone than manual input via an GUI;
- Incoming flexibility requests can only be executed when there is sufficient flexibility storage capacity in the community/LV-grid. When flexibility requests from higher grid management instances (DSO, TSO, market) cannot be fulfilled due to a lack of available flexibility, it would be efficient when a second level (regional) EMS would manage these requests and dispatch them to other energy communities on the same MV feeder;

4.1.2 Lessons Learned from UC 1.2 and Generation and Load Forecasts

In Deliverable 5.4 Avacon has evaluated UC 1 “Virtual Islanding”. The UC has been implemented based on a 15-minutes measurement-control cycle. In the period from December 2021 to June 2022 another balancing approach, a forecast-based and optimized scheduled control (UC 1.2), has been implemented, applied and evaluated. The principle of the balancing scheme of UC 1.2 is based on a day-ahead generation forecast for the community, which is based on solar radiation forecast, and a consumption forecast for the community, which is based on standard load profiles and a scaling factor. The forecast of the net load demand of the community is determined based on both forecasts. The control schedule for the charge or discharge of batteries is determined in such a way that the peaks at the secondary substation are minimized. The minimization is performed by an optimization service from RWTH Aachen that respects the state of charge of the battery, its capacity and other variables. The lessons learned after the application of UC 1.2 are:

- The net load demand of a communities or LV grid (power exchange at the MV/LV grid connection point) has a high sensitivity to solar radiation.
- The solar radiation forecast provided by the selected service provider for the German demonstrator provides reliable and suitable prediction for the application of a forecast-based and optimized schedule control of batteries (UC 1.2) on sunny and not clouded days.
- On cloudy days, the solar forecast is not suitable at all days of investigation to minimize load peaks measured at the secondary substation. In a few cases, the application of UC1.2 even leads to higher power peaks.
- The evaluation of results pointed out, that the shift from a 1-hour interval forecast to a 15-minutes interval forecast has potential to improve the accuracy of generation prediction. Additionally, parameters of the forecast model could be tweaked further, e.g., standard load profile scaling.
- The application of UC 1.2 reduced peak load at the secondary substation significantly.

4.2 Lessons learned on standards

This chapter described the lessons-learned for the German demo with a focus on standards during the third year of Platone.

Households Battery Storage System (Gateway IoT) Modbus TCP

Since the last report Avacon has equipped 5 households with smart inverters, household battery energy storage systems (HBES) and IoT communication devices. Additionally, a prototype of the system has been implemented at Avacon's education department in Laatzen, close to Hannover. For the measurement and control of the HBES an interface had to be implemented. Following lessons learned have been collected during the implementation of the interface to the HBES:

- HBES systems are mostly operated in combination with roof-top photovoltaic systems
- Vendors offer systems in combination with PV panels, smart inverters which include the energy management, e.g., for PV self-consumption, HBES, electric meter.
- The inverters from different vendors provide interfaces which make use of standardised protocols to enable measurement and control from external devices.
- There are no standards regarding which data fields are readable and writeable through the vendor API.
- The datapoint allocation in standardized protocols is different between vendors. This requires high effort for the implementation (parameterization) of routers.
- Instructions for parameterization of interfaces are only partly publicly available by the vendors.

5 Beyond demo activities

This chapter reports on the lessons-learned from other activities.

5.1 E.DSO

During the course of the third year of implementation of the Platone project, E.DSO continued leading the activities of WP1 “DSO Operation Strategies and Harmonization”, whose operational objectives include the harmonisation between the demonstration sites and the methodology applied for the analysis of their results, the definition and calculation of Key Performance Indicators (KPIs) and the harmonisation of the project work into the general European regulatory framework and with other projects responding to the same call.

As an integral part of the work in WP1, Task 1.3 “Key Performance Indicators” aims to define Project KPIs, common for more than one different demonstration sites, and demo-specific KPIs to enable the assessment of Platone’s performance in achieving its overall technical objectives. The first phase of Task 1.3, concluded at the end of the first year of the project, resulted in the identification of a total of 5 Project KPIs and 26 demo-specific KPIs, which were defined with the use of the common template describing basic KPI information, the calculation methodology, the data collection process and the details of the KPI’s baseline. During the third year of the project, Task 1.3 was reopened to carry out an assessment of the relevance of the previously defined KPIs following the advancements in the demonstration and project activities. To this end, a methodology was established to assess the KPIs and the associated proposed data collection processes and calculation methodologies, as reported in Deliverable 1.4. A set of criteria was defined to evaluate the KPIs’ relevance against the Use Cases (UCs) tested in the demos and their quantitative targets, the overall Platone objectives, and the scalability and replicability goals of the project. Under this framework, the demonstration leaders analysed the insights derived from the experience of their implementation and testing activities, producing an evaluation of the selected metrics.

The outcomes of the analysis facilitated the identification of eventual needs for the amendment of the KPIs’ definitions or calculation methodologies, the addition of new KPIs or the disregard of KPIs that were no longer relevant in light of the new project findings. The lesson learned during this process is the importance of revisiting the KPIs and maintaining their relevance in cooperation with the demo leaders. As the development processes of the demos proceed, new information come to light and the KPIs have to reflect the new status.

Overall, the proposed KPI assessment framework allowed to consolidate the link between the Platone KPIs and the support they provide to the achievement of the goals put forward for the UCs tested in the three demos and the project objectives, both in the technical social domain. Moreover, the assessment and update of Platone KPIs remarked the close interrelation between the KPIs and the activities of WP7 of Platone “Scalability, Replicability, CBA”, by contributing to the fulfilment of one of the project milestones, “Identification of benefits related to MCA/CBA”, together with the validation of SRA simulation scenarios and the formulation of the Platone Cost-Benefit Analysis (CBA) methodology. This close cooperation with the SRA and CBA provided lessons on how they can help to decide on the best KPI list since the different scopes these two analyses provide puts the KPIs in a different, in most cases broader perspective.

6 Conclusion

Areti reported for the Italian demo lessons-learned on the Local Flexibility Markets and how location, volume and prices are important to market design. With regards to implementation, they highlighted the difficulties in performing installation on customer premises due to lack of entrance rights. Furthermore, protocols CHAIN2 and MQTT were singled out for their importance to second generation smart meter related applications and the blockchain access layer, respectively.

The German demonstrator, Avacon, reported from the field that their solution achieved its goals on issues like flexibility availability, setup responsiveness, KPI targets and automation. Gaps were identified with regards to the standards on data fields that are readable and writeable through the HBES vendor API.

The Greek demonstrator gained valuable insights on data protection and anonymisation via the Workshop organised this year. With regard to development work, the regulatory gaps related to the implementation of flexible DUoS tariffs were identified thanks to the implementation process.

Finally, the leader of WP1, E.DSO, learned how revisiting the KPIs used in the project, in this latter stage, improves upon them and how this process is aided by coordinating with the Scalability-Replicability and Cost-Benefit Analysis tasks.

7 List of References

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

[2] D6.4 Periodic report on lessons-learned (v1), Platone EU Horizon 2020 Project

[3] D6.5 Periodic report on lessons-learned (v2), Platone EU Horizon 2020 Project

8 List of Abbreviations

Abbreviation	Term
ALF-C	Avacon Local Flex Controller
API	Application Program Interface
BAL	Blockchain Access Layer
CBA	Cost Benefit Analysis
CBES	Community Battery Energy Storage System
DEMI	Canadian Distributed Energy Management Initiative
DER	Distributed Energy Resources
DSO	Distribution System Operator
DSOTP	DSO Technical Platform
DUoS	Distribution Use-of-System
EMC	Electromagnetic Compatibility
EMS	Energy Management System
HBES	Household Battery Energy Storage
IoT	Internet of Things
KPI	Key Performance Indicator
MCA	Multi-Criteria Analyses
MQTT	Message Queue Telemetry Transport[
NRA	National Regulatory Authority
PMU	Phasor Measurement Unit
PV	Photovoltaic
SRA	Scalability and Replicability Analysis
TCP	Transmission Control Protocol
TSO	Transmission System Operator