Platone

PLATFORM FOR OPERATION OF DISTRIBUTION NETWORKS

Platone

PLATform for Operation of distribution NEtworks

D6.5 v1.0

Periodic report on lessons-learned (v2)

The project PLATform for Operation of distribution NEtworks (Platone) receives funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no 864300.

Project name	Platone
Contractual delivery date:	31.08.2021
Actual delivery date:	27.08.2021
Main responsible:	Panagiotis Pediaditis
Work package:	WP6 – Standardisation, Interoperability and Data Handling
Security:	P = Public
Nature:	R
Version:	V1.0
Total number of pages:	21

Abstract

This deliverable reports on the lessons learned through the demo activities of Platone during the second year of project activities. The lessons are divided into two subjects, standards, which is the major topic of WP6 and other topics, including regulatory issues which is another theme of WP6.

Keyword list

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

Disclaimer

All information provided reflects the status of the Platone project at the time of writing and may be subject to change. All information reflects only the author's view and the Innovation and Networks Executive Agency (INEA) is not responsible for any use that may be made of the information contained in this deliverable.

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. The main theme of the project, which is partial or complete utilization of the Platone Open Framework, sets a stage where a variety of solutions, approaches and concepts will be implemented or invoked during the development and field trial of the use cases. 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 to projects like Platone, because they can serve as a source of valuable information for future projects that try similar approaches. In this report, special attention is given to the topic of standardisation which is the main topic of WP6 and one of the most important aspects novel projects.

The Italian demo, during the second year, focused on implementation and integration of the Platone Open Framework, hence, experiences on components, integration, and overall architecture were gained. One important lesson is that the break-up of the system architecture into 5 internal project streams contributed to the success of the overall development process. Moreover, the Italian demo goes beyond the current standards definitions to implement its own data flows and data models in order to meet its flexibility and speed requirements. In some cases, such as storage related standards, the current ecosystem was deemed immature to serve the needs of the demo.

The Greek demo focused significantly on the Low-Cost PMUs during the second year. Experience showed that the installation of equipment in areas that are serving a large number of regular customers is challenging due to the requirements on uninterrupted power supply that have to be met. Good practice on such installations involves a number of internal administrative and regulatory requirements. This effort also produced a comprehensive list of the required standards that have to be met by such installations which is a valuable source for the future.

The German demo progressed a number of demo components during the second year that provided valuable lessons-learned. First of all, the installation of the community battery storage gave the opportunity to gain experience in a number of topics such as fire prevention rules, transformers, inverters, battery cells and their standards, factory acceptance and its list of additional standards, and experience in electrical grounding, isolation and personnel training. In addition, measurement devices were installed. Highlights of that process were the use of Modbus for electrical data transfer, data visualisation via IoT, PV prognosis exploitation, low-cost PMUs and their installation, and insights into Blockchain Access Layer architecture via the PMU integration. Moreover, the ALF-C connection to physical assets provided lessons on development practices such as agile/scrum, IoT, future integration with household storage and reconsideration of KPIs. Finally, the operation of the smart secondary substation gave valuable experience on energy patterns and optimal energy management strategies for the demo area.

Beyond the topic of standards, important lessons learned from the demos include how tenders can delay project activities, user participation approaches, and personal data handling as reported by the Italian demo. For the Greek demo, experience was gained on regulatory topics via the activities of Platone, including EU directives, market structure and blockchain. For the German demo, the activity of identifying the representative community of the demo provided important lessons, such as how to contact owners of land that can be used for the project; how grid congestions can potentially be more common than expected as temporary measurement devices revealed the issue in the chosen area; how local authorities do not have experience with new technologies such as a large battery; and how one can handle customer involvement events during the COVID-19 pandemic.

Finally, two partners beyond the demos reported lessons learned. E.DSO conducted an overview of regulatory topics of relevance to Platone for many European countries and found that the EU framework changes constantly while at the same time individual countries are slow to follow changes. A common workshop between projects that were approved during the same call was conducted by the E.DSO and produced a number of valuable insights as over 75 participants contributed their experiences from project development. BAUM reported that one lesson learned during the first two years of Platone is that the initial ambitions of the planned innovation workshops are not easy to meet due to internal and framework conditions. For example, the demos rarely develop prototypes for user testing so early in the project’s lifetime. Finally, the COVID-19 pandemic seriously limited the options for customer engagement.

Authors and Reviewers

Main responsible		
Partner	**Name**	**E-mail**
NTUA		
	Panagiotis Pediaditis	panped@mail.ntua.gr
Author(s)/contributor(s)		
Partner	**Name**	
NTUA		
	Panagiotis Pediaditis	panped@mail.ntua.gr
AVACON		
	Navreet Dult	navreet.dult@avacon.de
	Benjamin Petters	benjamin-georg.petters@avacon.de
ARETI		
	Fabio Bastianelli	fabio.bastianelli@mail-bip.com
HEDNO		
	Froso Gralista	E.Gralista@deddie.gr
E.DSO		
	Sophia Giovanett	sophia.giovanett@edsoforsmartgrids.eu
BAUM		
	Manuel Haas	m.haas@baumgroup.de
Reviewer(s)		
Partner	**Name**	
AVACON		
	Navreet Dult	
APIO		
	Alessandro Chelli	
Approver(s)		
Partner	**Name**	
RWTH		
	Padraic McKeever	

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 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 their implementation by analysing the standardization ecosystem and the regulatory framework, provides suggestions and support and records their efforts to assist future similar projects. It is this last point 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 Demo leaders regarding their activities that are affected by standards and the standardization ecosystem in general and legislative and regulatory topics additionally. This task includes a report on lessons-learned every year. This annual lessons-learned reports have an open format that allows for the Demo leaders to record their valuable experience 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 2nd year of Platone Contrary to the 1st year, this year the report is open to all partners for contributing their lessons-learned. The demo leaders are encouraged to report their experience on standardization first. This means that any issues that come up while the development process is under-way that are related to standards are relevant for reporting. The same applies for other topics the demo leaders might have valuable experience to share including the regulatory and legislative framework. Apart from demo leaders, other partners are encouraged to report any valuable insights on the topics of standards but also on their respective fields. The goal is again to have a platform to record 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, beyond 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 focus is on standardization, the major theme of WP6, but legislation and regulation and other topics are discussed, also. The reader is not required to have any specific knowledge but reading some references on the previous lessons-learned report [2] are made.

2 Italian Demo

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

2.1 Lessons-learned on Standards

During the second year of the project activities, the Italian Demo focused on the implementation and integration of the planned platforms in which the architecture has been designed. These meant going through different issues and gaining of significant knowledge about the components, integration flows and functioning of the whole architecture.

In this phase, the partners involved in the WP3 activities were able to define the trial location of specific portions of the electricity distribution network of Rome among the areas previously detected. In this first stage, the areas that will be involved in the trial are:

EUR – Tor di Valle District

Centocelle District

Starting from the release of two important deliverables (D3.3 [3] and D3.6 [4]), the Italian Demo is operative in the field and it has started to execute its role.

In Deliverable 3.3 the Italian Demo architecture is presented by providing a detailed description of all the components that compose the System Architecture, by highlighting their roles in the process and representing the complex data flows built up by the partners to ensure interaction between them. The elaboration of the whole System Architecture was divided in different streams in order to guarantee a full definition of the functions to be implemented. Five different WP3 internal project streams and related working groups and responsible figures were identified. Only in a second step, the different streams have started to communicate among themselves and integrate their functionalities in the entire process.

Moreover, the technologies used for the implementation of the System Architecture are defined and reported in D3.3.

In D6.2 partners involved in the Italian Demo have provided a list of main standards applicable in its trial. During the second year of the project, the use of these standards has been evaluated and some of them have not been used in order to achieve less standardized protocols and to be more flexible. The System Architecture implemented ensures a very flexible and quick solution, thanks to the data model defined. In fact, for some components (e.g., energy market communications and cybersecurity algorithms), the partners decided to implement their own data flows and use a customized data model for the Italian Demo. In particular, the data model defined allows for the interaction among different platforms, thanks to the multiple communication flows. In this case, the standards are just some general and equal rules applied to each platform belonging to the System Architecture. In general, for other components, standards have been applied as guidelines but not to the extend that fully compliance with them can be considered.

Regarding the Blockchain Technology, the architecture is currently not fully implemented according to standards due to the innovative nature of the technology.

Even for standards related to Battery Storage and Energy Storage System, the products used are not certified according to traditional standards, since the standards were produced recently and therefore are “young” and “immature” compared to the required implementation.

Concerning the measurements side, with reference to the Advanced Metering Infrastructure (AMI), standards are fully applied.

In conclusion, during the second year of the project, the partnership evaluated the standards required for the implementation of the architecture and of the use cases, recognising that the standards detected at the beginning of the project would have slowed down the implementation of the architecture and would not have guaranteed the flexibility and responsiveness required by such a complex process.

2.2 Lessons learned on other subjects

Throughout the implementation of the activities and the assignment of external activities, one important topic has arisen, the public tender mechanism and its timeline. Current legislation requires several mechanisms that can significantly lengthen tender procedures. This could lead to possible delays in project activities. For this reason, it was decided to schedule the awarding of contracts in good time to avoid any possible delays and to ensure perfect continuity with the timeline at the same time.

Moreover, the Italian Demo foresees the participation of several users to the implementation of its activities. This led to the identification of a strategy for customer-involvement since the first year of the project. This strategy identified two different clusters of users. For this reason, two distinct user-engagement workshops were planned: 1) local key-stakeholders and large commercial prosumers (held in June 2020 during the first year of project); 2) residential customers (prosumers and consumers) (held in March 2021 during the second year of project). This strategy was identified as more effective for setting the ground for starting discussions in order to understand users' needs.

The participation of several users is crucial for the implementation of the project activities and the success of the trial. For this reason, Enea - an important national agency for new technologies operating in Rome - was involved. This gave the possibility to involve a niche of people already interested in energy and environmental issues. WP3 partners were able to involve users in the trial thanks to the interaction with Enea too. In this first phase, the users involved will be few, due to the invasive installation required by the project activities at users' equipment (Micro Photovoltaic, storage system, Light Node). In a second phase, it is possible that only the Light Node will be installed, with a higher number of users involved, in order to recreate a more realistic energy environment.

The involvement of several residential customers led to the elaboration of a contractual form regulating the relationship between ARETI and users. This meant a deep study of the regulatory framework and the implementation of a free-for-loan contract that has allowed the installation of the equipment (Light Node, Micro-photovoltaic and storage system) at the users' equipment. This type of contract gives to the users the opportunity to participate to the project activities.

Moreover, ARETI defined an internal governance document to define the methods for managing users' personal data exchange during the pilot implementation and during customer-engagement activities. This document confirms that ARETI is the only partner appointed to know user's personal data (already in its availability) and to formally contact the users. Another important phase is related to the sharing of measurement data in the demo trial, without disclosing the personal data of the users involved. For this reason, ARETI has adopted a pseudonymization strategy. Therefore, customers who will freely participate in the pilot testing will have to sign a dedicated information document provided by ARETI, which illustrates project methods and purposes and the use of their consumption data, before starting the activities.

3 Greek Demo

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

3.1 Lessons-learned on Standards

In the second year of the project, the Greek demo has explored extensively the options for the installation of the Low-Cost Phasor Metering Units (LoCo PMUs) in the test grid of the Mesogeia area. The main challenge with this lies in the fact that the test grid belongs to a semi-urban area, with a multitude of loads and the uninterrupted supply of power must always be respected and guaranteed. To that effect, the Platone researchers of HEDNO reached out across the organization to gather the relevant information, in order to gain approval to install the PMUs and to do so in a safe and effective manner.

The Network Division of HEDNO has compiled comprehensive lists of standards that metering equipment connected to the grid must comply with. These include standards for:

- Electromagnetic Compatibility (EMC) requirements for measurement devices (2006/95/EC),
- Type tests (steady state, impulse power tests, e.g., IEC 60870-2-1, IEC 60870-3), environmental tests (IEC 60068-2) for power, analogue and digital outlets
- Voltage and current transformers, in order to connect any metering device to the grid (IEC 61869-2, IEC 61869-3)
- Phasor measurements in power systems (accuracy of PMUs: IEEE Std C37.118.1-2011, guide for installation: IEEE C37.242-2013, IEEE/IEC 60255-118-1-2018

The above-mentioned lists have been a valuable source of information, in order to decide how to install the PMUs in the safest and most effective way possible.

3.2 Lessons learned on other subjects

Apart from the area of Standards, the Greek demo gained significant knowledge on regulatory topics during the second year of the project. In order to fill in the 'Questionnaire on regulations concerning DSOs' which D1.3 [5] was based on, thorough research was conducted in the regulatory areas that the questionnaire was covering, including detailed study of the relevant national laws of Greece.

In the area of flexibility, the current national legal framework was examined, including the collaboration of TSO-DSO and the limitations of the current legislative framework, as well as the future transformation that will come after its harmonization with the EU directives and the Target Model, i.e., the single European market model the Agency for the Cooperation of Energy Regulators (ACER) has proposed in order to integrate European markets. Also, looking into subjects like energy storage, EVs and Energy communities was a valuable learning opportunity for the Platone researchers that spanned from reading the laws that govern their introduction to the Greek energy Market, to researching current applications. The same holds for the concept of the 'Aggregator', which is still novel for Greece. Lastly, this questionnaire was also an opportunity for the Greek demo team to find out information about data management by the DSO and energy providers and to spot the regulatory gaps concerning Blockchain and smart contracts in Greece. By reviewing the complete D1.3 document, the Greek demo researchers got a useful overview of the regulatory aspects that apply to the rest of the Demo countries as well as other countries in Europe.

4 German Demo

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

4.1 Lessons-learned on Standards

Over the course of the second year of the project, the activities of the German demo were focused on implementing the main field test components into the field, the development of the Energy Management System (EMS), called Avacon Local Flex Controller (ALF-C), and its integration into the Platone framework and connection to physical assets in the grid.

As a result, the large-scaled battery energy storage system (**Community Battery Storage**) with 300 kW installed power and 777 kWh storage capacity was successfully transported to the field test region and connected to the secondary substation. In this context Avacon gained a bunch of new experiences:

- Since there is no standard process for setting up a large-scale energy battery storage system in a community, an extensive communication exchange with the manufacturer and the fire prevention authorities needed to be established, so the components of the system meet the requirements of the fire prevention authorities and our application purposes.

  The system is equipped with a transformer with 400 V grid connection and 515 V in the high voltage side. The transformer meets the standards of VDE 0532, IEC 60076 (DIN EN 60076), DIN EN ISO 9001, DIN EN ISO 14001. As an air-cooled system, it has proven to be a low-maintenance, reliable and cost-effective system.

  The inverter fulfils the EN61800-5-1 security standards. This includes an automized grid disconnection in case of overvoltage or internal short circuits, as requested by the grid code for assets connected to the low voltage network (VDE 4105).

  The battery cells and rack system are certified with the UL9540A-cetificate, which validates the suppression of thermal runaway from cell to cell. The technology and certification contribute to a safe operation of the system and reduce regulatory requirements set by local authorities for the approval of built-in operation.

  The battery storage is equipped with an automated fire suppression system that fulfils the EN 15004 standard. Fulfilling the standard is advantageous for obtaining a building approval from the local authorities.

- The factory acceptance test was successfully performed and protocolized. The functionalities of the system components were tested according to several norms and standards.

  General standards that have been regarded for the factory acceptance test are IEC 61000-6/-4/-2, VDE 0100/-410/-420/-600, VDE 0101, VDE-AR-N 4100/-4105/-4110, IEC 62485/-1/-2/-5, EN 61439/-1/-2, VDE AR 2510 /-50, IEC 62619.

  A Declaration of Conformity was gathered for: the three-phase sine filter and the three-phase transformer under the RoHS-Guideline 2011/65/EU and 2015/863/EU, the DC Bus under the security guideline EN61800-5-1 (2003), line filters, power chokes and transformers under the RoHS-Guideline 2011/65/EU and 2014/35/EU and EU 2017/2102.

  In addition, documents as installer confirmations, user manual, maintenance schedule, single line diagrams were collected.

- The connection of the battery system could be done by Avacon; however, the electrical grounding and isolation measurements were performed by a service provider and protocolled.

- The site acceptance test took place in the field test region and included a training for Avacon's electricians at on-call duty and the local fire department.

Avacon gained knowledge about the installation of **measurement devices** in the secondary substation to have real-time measurement data of the net power and energy demand of the energy community.

- A PLMulti II is a measurement device that provides data (S, P, Q, U, I Phase) from the busbar at the LV/MV-grid connection point. The provided measurement data are an important indicator for the balancing mechanism since the device provides 1-minute mean values of the net power and energy demand. The device contains a Modbus TCP/RTU interface, which turned out to be a very reliable and flexible interface standard. This protocol allows a quick implementation and data collection. It further provides high flexibility regarding the collection of single data from a large set of provided data. This allows the reduction of data traffic to a minimum required volume and therefore enables efficient smart grid applications.
- The measurement data is visualized via IoT on a dashboard to have live community measurements and the behaviour of the large-scale battery system is available. Avacon gained knowledge about the data needed from the assets (e.g., secondary substation, large-scaled community battery system) and required visualization details on the dashboard to successfully perform all use cases. Visible data on the IoT Dashboard are the power exchange between LV and MV Grid, the power of the large-scale community battery storage, state of energy and state of charge of the community battery storage, active and reactive power, voltage and current. The IoT enabled Avacon to perform fast evaluation of measurement data and contains historic data that was used to test the developed algorithms of RWTH Aachen.
- Moreover, PV prognosis data of a weather provider is visualised on the IoT dashboard. By overlapping the PV prognosis with measures power exchange between LV and MV, the prognosis data seemed appropriate in general. Further evaluation of PV prognosis data and the meaning of the power exchange between LV and MV is done during use case tests.
- The first PMU, developed by RWTH Aachen, was scaled to be placed at the secondary substation and successfully connected to it as a reference measurement device. For the current and voltage conversion, a circuit board had to be laid out and an appropriate housing was built that can fit in the secondary substation. Avacon gained knowledge about the composition and functionality of the PMU by drawing a schematic diagram for the signal converter and a PMU system structure diagram.
- First measurements could be taken. The connection of the PMU to the Blockchain Access Layer will be further examined. First architecture drafts have been designed with the help of ENG and RWTH Aachen that provided Avacon greater insight of the whole architecture.

For the connection of physical assets to the ALF-C and the identification of suitable standards, it became clear in the first year of the project that standards being used by the vendors of battery storage systems are not unified and often contain an element of either vendor-specificity or make use of obscure protocols that are not widely used. In case of household batteries, it turned out that the *manufacturers considered do not offer any interface for a direct connection of external devices*. Instead, batteries are equipped with integrated sensors and controllers that can be accessed only by the vendor via proprietary back ends. In some cases, vendors offer an API enabling an indirect link to the batteries via the vendors cloud for measurement and controlling purposes. The standard used for the backend interface differs between vendors, see [2]. However, in the second year of the project, with the help of the Avacon's education department, a set of components for a household battery energy storage system prototype has been identified that meets the technical requirement for measurement and control and is additionally flexible to be dimensioned individually to the requirements of the households in the field test region. Avacon has gained more knowledge about **single components of a system, their communication and their compatibility**.

- The chosen set consists of a BYD HVS storage that meets high safety standards (VDE 2510-50) and is able to communicate along a CAN/RS485 interface with an external inverter. The Costal Plenticore is the ideal suiting inverter for the BYD HVS storage and all existing PV systems. The inverter provides an WLAN interface as well as a Modbus interface (Modbus TCP/RTU) for remote control grid management, query of measured values from a PV system, remote-controlled change of parameters of a PV system and remote charge and discharge control of battery. Along the interface all necessary variables can be read (SOC, SOE, P, E) and write (e.g., P for charging and discharging). The communication will take place along a

Teltonika RUT955 communicating via LTE or LAN/WLAN. A system prototype has been assembled, but not yet implemented and connected to the ALF-C for testing.

- Further community assets (e.g., wall box, heat pump) will be considered when household energy storage systems are successfully implemented into the field.

For the Energy Management System – ALF-C a usable prototype of the Avacon Local Flex Controller in its 3rd release was built and successfully implemented into the field. For this, different modules were developed in a cloud environment that enable the application of use cases UC-GE-1 and UC-GE-2 and set a base for the implementation of UC-GE-3 and UC-GE-4.

- Avacon gained deeper knowledge about *agile development* with the usage of Scrum techniques and spotted the benefits of a flexible architecture by designing apps in an Azure environment as logic apps and the implementation of customized code as function apps.
- The connection of the ALF-C to the Community Battery was realised via IoT and successfully tested by sending setpoints via the ALF-C. With a time delay of 15 min. the setpoints are visible on the dashboard and on the user interface of the Community Battery.
- The ALF-C already has the prerequisites implemented that are needed for the connection to household flexibilities from the field. The connection to household battery storage will be done in the next steps.
- During the development of the ALF-C the previous specified hardware, software, communication and IT components were further particularized and security standards regarded not only for the IT data security but also in respect to the steering mechanism of the large-scale battery system. The first use case has already been triggered; the ALF-C will be further developed to enable its full functionalities. The previously defined key performance indicators to measure the effectiveness of the architecture and strategies and describe the expected results and their impact on future operations were reconsidered. The Key Performance Indicators that are suitable for Use Case 1 were successfully applied on the first results.

After the implementation of a **smart secondary substation** with sensor (PLMulti II) and communication device, the lesson's learned after 6 months of measurement are following:

1.) The community of Abbenhausen with its large penetration of PV modules proved to be a model region for future Local Energy Communities (LEC).

2.) From February 2021 onwards the community produced more energy than it required on most days. The maximum ratio of energy export to import was about eight. The amount of energy surplus often exceeds the capacity of the currently installed battery storage by large margins. This demonstrates that a smart energy management system is required to utilise the surplus energy economically.

3.) The largest energy generation is realised on clear and sunny days. The challenge on such days is that the surplus energy often exceeds the storage capacity. Thus, algorithms that determine when to charge, e.g., peak generation at noon, are essential.

4.) On partly cloudy days a large energy surplus is possible. However, unsteady cloud cover produces steep gradients in generation which need to be managed.

5.) Very low energy generation was realised on overcast days without direct solar radiation. This presents a trade-off between storing energy in the preceding days or simply importing energy from the MV-grid.

6.) Meteorological models do not have sufficient temporal and spatial resolution for an accurate prediction of local solar radiation, i.e., cloud cover, especially partly clouded days. The resulting steep gradients in energy generation cannot be managed with the currently implemented algorithms. A possible solution could be the installation of a weather station in the field-test region to improve local measurement by tracking of solar radiation and cloud convection that provide immediate data for the algorithms.

4.2 Lessons learned on other subjects

In the second year, project activities were not only focused on the technical implementation of the IT architecture, but also on the involvement of customers and local municipality.

Since Avacon will implement a field test trial in a village with private customer households participating in the project, a **representative community** had to be identified. The process turned out to be more complex and extensive as expected. A list of requirements had to be defined. The most important requirements set were:

1.) The aggregated installed generation power of local PV connected to the LV-grid had to be 120 kW minimum.

2.) A lot for the Community Battery Energy Storage System (CBES) must be available, located not further than 150 meters away from the MV/LV-feeder.

3.) The community should not be located in industrial districts.

In the first step, the LV-grid grid section was identified. In the next step, undeveloped land was identified, address data of landowners were identified via the land registry office and letters with request for land use were sent. During this process the mayor of the municipality was introduced to the project, which turned out to be very advantageous and is recommended as the right approach for the implementation of any field test project. The municipality supported the identification of possible sites. However, the direct contact to customers and negotiation with land owner had to be made by the project team. Furthermore, the experience has shown to be advantageous to contact as many landowners at the same time as possible, since many do not reply to sent letters.

After Abbenhausen has been selected as a suitable region and local landowners confirmed the use of their land for the CBES by Avacon, a temporary measurement device has been implemented into the field. The measurement data from June 2020 indicated, that the large number of PV-systems in the community generated a surplus of energy. The export power flow at the MV-feeder regularly exceeded the technical limit of the transformer. Consequently, in order to install a local 300 kW CBES the substation and local grid had to be reinforced. This example shows that lower voltage networks already today are at their limits. In order to make use of the positive effect of smart grid solution, it has to be implemented now.

After Identification of the field test region and the acceptance of use of land the major hurdle for the success of the implementation of the trial was to get the building approval from local authorities. It turned out to be very positive for the process of approval to involve the authority at an early stage at which the CBES tender was in the final steps. The local building authority do not have much experience with the approval process for the construction and implementation of a battery storage system in a container system. Establishing a direct and regular contact at the early stage helps to address question directly and build understanding. Thus, the approval process can be simplified and accelerated.

In order to have interested participants in the field test region, Avacon has organized an information day for households and gained new experience about events in COVID-19 times. An Open Day has been carried out together with households of the field test region to inform about the project and to present the chosen household energy storage system. Here, Avacon gained new insight by writing a hygiene concept that was permitted by local authorities. The standard customer involvement process was partly changed with advanced reservations, free Corona tests, health/safety regulations. The used communication strategy by Avacon made this event attractive for the households in the field test region and Avacon managed to make participation in the event as uncomplicated as possible for households. The components that were presented to the households will be installed in the next steps. Also, the connection to the ALF-C is planned in near future.

During the second year of implementation, the first preparation for SRA und CBA has been performed and in preparing inputs for D1.3 [5] the European and given national regulation has been examined in order to identify and evaluate legal and regulative gaps. It has turned out that in many areas the solution Avacon targets to implement, such as Battery usage and ownership by a DSO or regulation towards citizen energy communities/renewable energy communities, the EU guidelines yet has not been put into national law. As consequence Avacon will closely follow developments in legislation and take action in due course.

5 Beyond demo activities

In this Chapter lessons-learned from other activities are reported.

5.1 E.DSO

This subchapter can include any reporting of lessons-learned from the E.DSO.

The operational objectives of WP 1 “DSO Operation Strategies and Harmonization” are the definition of the DSO operation specifications for the aggregator/customer flexibility market handling system, to ensure the harmonization between the demonstration sites and the methodology applied for the analysis of their results, thirdly, the definition of KPIs and ensure the uniqueness of the project, fourthly, the harmonization of project work into the general European regulatory framework and with other projects responding to the same call.

An integral part of the work in WP1, especially task 1.2, during the second year was the preparation and composition of the Deliverable 1.3 [5], a public report that gives an “Overview of regulatory aspects that impact the solutions tested in the demos in European countries”. A questionnaire was developed to gather information about the regulatory aspects that can impact the scalability and replicability potential of the solutions tested in the demos in other European countries. This questionnaire was distributed among E.DSO members and the demonstration leaders and the results are an integral part of the report that covers eight thematic topics namely: flexibility, customers connected to the DSO network, Energy Storage and EVs, aggregation, energy communities, DSO revenue regulation, Blockchain and smart contracts in the energy sector and data management, protection, and cybersecurity. It was found that the legislative framework is changing constantly on the European level, however the transposition into national legislation takes a lot of time and inhibits the process and progress. Furthermore, as Member States have discretionary room regarding the forms and methods for achieving the goals set in a directive, hence, whether the provisions were specified in the Directive or Regulation has an impact on their applicability as well as in the form in which they are implemented.

The report is a continuation and extension of two previous Deliverables 6.8 [6] and 6.9 [7] and will be used as an input for the scalability, replicability, and cost benefit analysis in WP7, as well as for the standardization and interoperability. The report was developed in close collaboration with all demo partners who provided valuable input. In addition to a lot of theoretical knowledge that was acquired in the process that highlights lack of regulation in key areas and causes obstacles in the implementation to innovation, some key lessons could be drawn from the report: Platone’s targets and vision aim not only at facilitating the energy goals of the Clean Energy Package but to combine various areas and produce innovative solutions in currently developing the use of areas such as blockchain or the storage. However, there is a huge gap between the legislative framework of the EU and different member states and the solution proposed by Platone.

The energy transition will require great investment into the DSOs’ grids to integrate the new technologies, deploy EV charging infrastructure, roll out smart meters where they are not already present and enhance the observability of the grid. The Platone Open Framework is one solution that may help DSOs but cannot defer all other investments. To keep up with the technological innovation on demand and supply side, as well safeguarding the infrastructure which, with digitalisation, also becomes more vulnerable to cyber-attacks, the investment need will be significant in the coming years. Thus some amendments to DSO revenue regulation may be necessary to enable the DSOs to keep their grids up with these trends. It shall therefore be interesting to see, if the project can bring insights to different stakeholders on the necessities that arise with the technological developments in the future.

In Task 1.4 about the coordination with other H2020 projects responding to the same call, a workshop was organised in April 2021, where all projects that responded to the ES-1 call, as well as the Platone partner in Canada, were invited to present their approach to responding to the challenges posed by the call. The workshop was divided into two parts: during the first session all project coordinators gave a presentation on how their project responds to the challenges of the call. In the second part of the workshop, the 75 participants from the various consortia were divided into five breakout sessions and discussed questions in four areas that are of interest for the Platone project partners. The breakout sessions were chaired by E.DSO and some of the partners of the Platone project. Among other topics, regulatory obstacles to innovation were identified and categorized in European countries as well as Canada. Furthermore, the influence of EU and national legislation regarding the harmonization, scalability and replicability of the solutions that are developed by demos of the various projects was discussed. The output from the discussions could be used as valuable input for the individual work of the project. It can be concluded that through exchange of best practices with the other projects, the aim to ensure that Platone builds on rather than replicates previous H2020 projects, can be achieved.

Finally, since the very beginning of the Platone project E.DSO has organized a monthly call involving all project partners. During this call the demo leaders give an update about their progress which leads frequently to a fruitful exchange between the demo partners and is a starting point for more in-depth discussions, including standardization and developments regarding the regulatory situation in the demo countries. Furthermore, E.DSO presents the updates on the progress of the different tasks and working streams in WP1 to guarantee that all partners are up to date. The monthly call is a useful platform for a project with the size of Platone because the project partners become more familiar with each other and it enhances the collaboration, the conversation between the project partners and leads to excellent project results.

5.2 BAUM

During the first two years, BAUM has led the Dissemination & Exploitation process of the project. Next to these WP8 activities, BAUM has a main task in harmonization with customers and partners needs and expectations (Task 1.5). Therefore, the customer engagement process was initialised with a kick-off workshop with all project partners to introduce user centric designs like design thinking and prepare specific innovation activities. Moreover, specific innovation and interactive customer engagement activities were prepared by BAUM to address the importance for developing solutions, which will be accepted by the users as being developed together with them. The partners agreed to apply these described methods in a row of stakeholder and customer engagement workshops, always in coordination with BAUM

The project foresees two kinds of workshop series, which should take place regularly:

1. innovation workshop with representatives of consumer associations to identify their concerns, catch their expectations and develop them as partners for communication and dissemination, so basically with stakeholder groups next to the potential (private) end consumers
2. innovation workshop in preparation of the PlatOne Field Trials to identify user needs and expectations, so basically with potential (private) end consumers

One core experience (lesson learned) during the first two years was that the initial roadmap for these workshops was too ambitious. the idea of early-stage user interactive workshops to test prototypes could not be realized, due to internal and framework conditions.

Internally, trial site demos did not have prototypes or similar solutions/products ready for being tested at that early stage. Furthermore, feedback from the system-relevant parties had to be collected first, in order to define the framework and engagement options (active/passive) and their possible extents. Thus, the first engagement workshops (Italian and Greek trials) took place with system relevant stakeholders like trials site integrated parties (DSO, Aggregator, municipality operators, commercial prosumers). Accordingly, the following workshops took place with potential private and commercial end users, to discuss their options to participate in the specific Demo and Platone. The German trial, with Avacon leading the customer engagement process, started their engagement with by informing possible households about the project and possible chances to participate.

The changing framework conditions due to the COVID-19-pandemic limited the options for costumer engagement. It was planned to create events, where stakeholder groups, esp. potential users of Platone outcomes, can test and discuss functionalities of selected results. Interviews and constructive feedbacks would have helped to adapt the presented results in order to foster an increased exploitation level. Because of the COVID-19 pandemic, physical contacts were limited or prohibited and the planning and conduction of physical workshops were not possible from March 2020 on. In detail, regulation of companies in Italy and Greece prohibited physical events. According to discussions with the consortium (especially trial sites responsible partners), virtual events cannot replace physical events, in terms of the engagement process.

6 Conclusion

This deliverable reported on the lesson learned by the Platone project demos in the second year of the project. The issues raised were divided in two broad categories, standards-related lessons and lessons on other topics, such as regulation and legislation.

On the topic of standards, the insights gained by the demos included integration of different components and how standards facilitate or come short on this issue. Another issue is the compliance with standards, guidelines and common practices when it comes to installation of components in the field. Experience shows that unexpected complications occur often and, usually, compliance involves a number of different standards. Finally, application of the project plans often provides valuable understanding on the finer details of different aspects of the project that results in a better understanding between partners and more productive cooperation.

As regards other topics, lessons were learned regarding regulatory topics that relate to tenders, user participation, data handling and markets. Moreover, experience showed that land usage can be more complicated than planned and local authorities might not be experienced in handling innovative smart grid assets. In addition, it is more practical for projects to plan hands-on testing of prototypes by users later in the timeline as the development process might not be able to catch up. Finally, the regulatory framework on EU level might be changing faster than national systems can adapt.

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, 2020

[3] D3.3 Delivering of technology (v1), Platone EU Horizon 2020 Project, 2021

[4] D3.6 Report on first integration activity in the field, Platone EU Horizon 2020 Project, 2021

[5] D1.3 Overview of regulatory aspects that impact the solutions tested in European countries, Platone EU Horizon 2020 Project, 2021

[6] D6.8 Report on the analysis of the regulatory and legislative framework, Platone EU Horizon 2020 Project, 2020

[7] D6.9 Report on solutions and recommendations for the roll-out of the designed solutions, Platone EU Horizon 2020 Project, 2020

8 List of Abbreviations

Abbreviation	Term
ACER	Agency for the Cooperation of Energy Regulators
ALF-C	Avacon Local Flex Controller
AMI	Advanced Metering Infrastructure
API	Application Program Interface
CBA	Cost Benefit Analysis
CBES	Community Battery Energy Storage System
DEMI	Canadian Distributed Energy Management Initiative
DSO	Distribution System Operator
EMC	Electromagnetic Compatibility
EMS	Energy Management System
EU	European Union
EV	Electric Vehicle
IEC	International and Electrotechnical Commission
IoT	Internet of Things
IT	Information Technology
KPI	Key Performance Indicator
LEC	Local Energy Communities
LTE	Long Term Evolution (4^{th} generation mobile communication system
PMU	Phasor Measurement Unit
PV	Photovoltaic
RoHS	Restriction of Hazardous Substances
RTU	Remote Terminal Unit
SRA	Scalability and Replicability Analysis
TCP	Transmission Control Protocol
TSO	Transmission System Operator
WLAN	Wireless Local Area Network