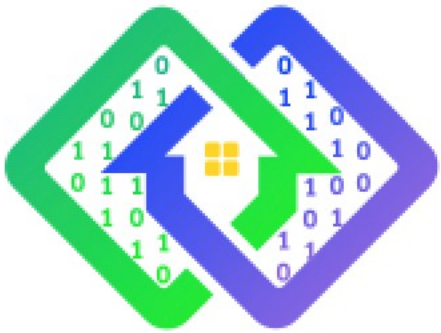
Grant Agreement N° 872592



PLATOON

Digital platform and analytic tools for energy

Deliverable D1.3

Platform Requirements

Contractual delivery date:
M01

Actual delivery date:
30th June 2020

Responsible partner:
P02: TECNALIA, Spain

Project Title	PLATOON – Digital platform and analytic tools for energy
Deliverable number	D1.3
Deliverable title	Report on platform requirements
Author(s):	Erik MAQUEDA
Responsible Partner:	P02 - TECNALIA
Date:	30.06.2020
Nature	R
Distribution level (CO, PU):	PU
Work package number	WP1 – Energy System Management Challenges

Work package leader	ENGIE, France
Abstract:	This report provides an accurate description of the captured requirements for the PLATOON platform. This report contains the requirements for the main functionalities and components of the PLATOON platform that will be developed, implemented, integrated and validated in the subsequent work packages (WP2-WP7). Especially, it focuses on the requirements for the key topics such as the PLATOON Reference Architecture and Interoperability layer, Platform Security and Privacy, Data Analytics Toolbox, Edge Computing and Marketplace. Additionally, in order to address the ecosystem building aspect and development of open calls platform collaboration requirements will also be considered.
Keyword List:	Requirements, Platform, Reference Architecture, Interoperability, Data Governance, Data Analytics Toolbox, Edge Computing, Marketplace.

The research leading to these results has received funding from the European Community's Horizon 2020 Work Programme (H2020) under grant agreement no 872592.

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Approved by:	Philippe Calvez (ENGIE)
Recommended/mandatory readers:	Mandatory readers WP2-WP7 WP and Task Leaders.

Document Description

Version	Date	Modifications Introduced	
		Modification Reason	Modified by
v0.1	10/02/2018	Table of contents added	Erik Maqueda (TECN)
v2	08/04/2020	Brief content for different sections included.	Erik Maqueda (TECN)
v2.1	28/04/2020	Detailed content for different sections included.	Erik Maqueda (TECN)
v2.2	18/05/2020	Comments from different partners included and comments from 12th May meeting amended.	Erik Maqueda (TECN)
v2.3	09/06/2020	Changes to Reference architecture (defined what we mean with compatible and compliant) and Marketplace.	Erik Maqueda (TECN)
v2.4	14/06/2020	Final refinements in different sections	Erik Maqueda (TECN)
v2.5	16/06/2020	Filled requirements summary able. Version ready for internal review.	Erik Maqueda (TECN)
V2.6	29/06/2020	Included all the comments/remarks from the internal review process.	Erik Maqueda (TECN)

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Terms and abbreviations

API	Application Programming Interface
CA	Consortium Agreement
CD	Continuous Development
CI	Continuous integration
CQ	Continuous Quality
CO	Confidential
COSMAG	Comprehensive Architecture for Smart Grids
DAPS	Dynamic Attribute Provisioning Service
DoA	Declaration of Action
DM	Dissemination Manager
DoA	Description of Action
EC	European Commission
EM	Exploitation Manager
EtB	Ethical Board
GA	Grant Agreement
IDS	International Data Spaces
IoT	Internet of Things
IM	Innovation Manager
KR	Key Result
NFV	Network Function Virtualization
MEC	Multi-access Edge Computing
PM	Project Manager
PU	Public
QA	Quality Assurance
RDF	Resource Description Framework
RE	Restricted
IA	Innovation Action
SAREF	Smart Appliances REFerence Ontology
SC	Steering Committee
SGAM	Smart Grid Architecture Model
TA	Technical Annex
TM	Technical Manager
WP	Work package
WPL	Work package Leader

Executive Summary

The objective of PLATOON project is to develop a big data platform for the energy sector to leverage data and provide new analytics tools that enable the development of new services and business models that boost the decarbonization of the energy sector in line with the European Green Deal.

PLATOON platform is presented as a breakthrough COSMAG compliant platform with flexible capabilities covering three main pillars:

- **Interoperability** to ensure multiparty data exchange and deal with a wide spectrum and heterogenous data sources, formats, interfaces.

- **Data governance** to meet data/app providers requirements regarding security, privacy and sovereignty.

- **Data Analytics Toolbox** to extract value from the data and that can be easily used by energy domain experts without deep coding skills and mathematical knowledge.

It is generally accepted that it is almost impossible to have a single big data platform that fits perfectly the necessities for all the stakeholders of the energy sector due to various reasons. Therefore, PLATOON aims to create what is known as a federated platform, a decentralized platform formed of different platforms from different companies that are able to exchange data and services with each other.

This report provides an accurate description of the requirements for the PLATOON platform. It contains the requirements for the main functionalities and components of the PLATOON platform that will be developed, implemented, integrated and validated in subsequent technical work packages (WP2-WP7). These requirements are in line with the use case, data exchange and business exchange requirements defined in tasks T1.1, T1.2 and T1.4 defined in deliverables D1.1 and D1.2.The report is structured in 9 main sections:

Section 1 sets the context and introduces the concept of the PLATOON federated platform.

Sections 2,3 and 4 gather the requirements for the PLATOON Reference Architecture, Interoperability Layer and platform security and privacy, which will serve as key inputs for WP2 and WP3.

Section 5 and 6 focus on the requirements for the Data Analytics Toolbox and Edge Computing which are key elements for the implementation and validation of algorithms on large-scale pilots in WP4 and WP6.

Section 7 covers the requirements for the PLATOON Marketplace that will be developed in WP3 and that it is key for the exploitation of the results after the project according to the potential business models and analytic services derived from WP8.

Section 8 defines the platform collaboration requirements in order to address the ecosystem building aspect and facilitate the development of new tools and services through open call innovation in WP7.

Finally, in section 9 the main conclusions of the document are listed and in section 10 there is a table that summarizes all the requirements for the different modules defined in the previous sections.

1 Introduction: PLATOON Federated Platform.

The objective of PLATOON (Digital PLAtform and analytical TOOls for eNergy) project is to develop a big data platform for the energy sector to leverage data and provide new analytics tools that enable the development of new services and business models that boost the decarbonization of the energy sector in line with the European Green Deal.

PLATOON platform is presented as a breakthrough COSMAG compliant platform with flexible capabilities covering three main pillars:

• **Interoperability** to ensure multiparty data exchange and deal with a wide spectrum and heterogenous data sources, formats, interfaces.

• **Data governance** to meet data/app providers requirements regarding security, privacy and sovereignty.

• **Data Analytics Toolbox** to extract value from the data and that can be easily used by energy domain experts without deep coding skills and mathematical knowledge.

It is generally accepted that it is almost impossible to have a single big data platform that fits perfectly the necessities for all the stakeholders of the energy sector due to various reasons:

On the one hand, most of the PLATOON partners and the companies in general already have their own (usually more than one) legacy systems, business digital platforms, expert tools, etc. that have been specifically tailored to meet their business and process requirements. Deploying new tools, or large platforms becomes difficult due to multiple specific constraints such as economic (cost), time to market and internal and external expectations, direct and indirect risks, etc. that will require time and money that companies are not willing to spend.

On the other hand, having a single platform would require the introduction of a third-party company that is responsible for managing the PLATOON platform and that would incur in further costs. In this sense, companies continuously manifest that they do not want to rely on a single platform provider due to the so-called vendor lock-in, but they want to have control over their platform and services instantiations and be able to change the platform provider if necessary.

Therefore, PLATOON aims to create what is known as a federated platform. A federated platform is a decentralized platform formed of different platforms from different companies that are able to exchange data and services with each other.

The following sections define the requirements for the main functionalities and components of the PLATOON federated platform:

- PLATOON Reference Architecture
- Interoperability Layer
- Platform Security and privacy.
- Data Analytics Toolbox
- Edge Computing
- Marketplace
- Collaboration requirements.

The requirements defined in this document are defined in line with the use case, data exchange and business exchange requirements defined in tasks T1.1, T1.2 and T1.4 defined in deliverables D1.1 and D1.2.

The requirements from this document will serve as the input for the subsequent technical work packages (WP2-WP7) to develop, implement and validated the different solutions.

2 PLATOON Reference Architecture Requirements.

As explained in the previous section PLATOON aims to create a federated platform formed of different platforms or platform components from different companies that are able to exchange data and services with each other. In order to build such a federated platform, PLATOON will define a flexible and modular lightweight reference architecture that will set the framework that the different platforms from the different stakeholders should follow to allow mutual integration and interoperability amongst them.

Figure 1 represents a high-level representation of the abovementioned concept of the PLATOON reference architecture. The reference architecture is formed of the following components:

- **Interoperability layer:** This module acts as the "translator" between the different platforms and IOT devices from different stakeholders. This module has two main functions: 1) Enable effective communication and data sharing amongst different platforms. 2) Enable the use of the PLATOON Data Analytics Toolbox that will be developed in the project.

- **Ingestion**: This is the part that allows the ingestion and integration of massive and heterogenous amounts of data coming from different data sources once have passed the interoperability layer. As there are already multiple solutions available, as part of the project no specific ingestion module will be developed. Instead already available solutions will be implemented for the specific pilots depending on the particular requirements.

- **Storage**: as in any digital platform there will be a repository for storing and managing the data. Different platforms from different stakeholders that form the PLATOON federated platform already have its own specific storage solutions based on different technologies (SQL, NoSQL, Graph Databases…). No new storage solutions will be developed in the project. Already available solutions will be implemented for the specific pilots.

- **Data Governance:** this comprises the set of components based on IDS reference architecture such as connectors, identity provider, broker, etc. which ensures data security, privacy and sovereignty (i.e. the data is shared and utilized according to the specific agreements signed by the different stakeholders).

- **Processing:** This comprises the set of tools and algorithms that allow processing of data to extract value from it. In particular, PLATOON project will develop a Data Analytics toolbox formed of a set of data analytics tools for energy specific applications (e.g. predictive maintenance for wind turbines, power dispatch optimisation, HVAC optimisation…) and for generic applications (e.g. graph processing tools, visualisation tools…). In order to optimise data exchange, processing and storage some of these tools will be deployed directly at the edge and some will be deployed in the cloud or on premise.

- **Marketplace:** This is a one-stop shop that integrates some of the datasets (depending on the level of data confidentiality and openness) used in the project and the tools developed as a

result of the project. The marketplace will mainly offer two types of services: 1) data (raw and process data) 2) apps (data analytics tools).

- **Security and Privacy:** This is a mandatory element of any digital platform and includes all the modules that protect the platform against external malicious attacks and avoids leakages of private data.

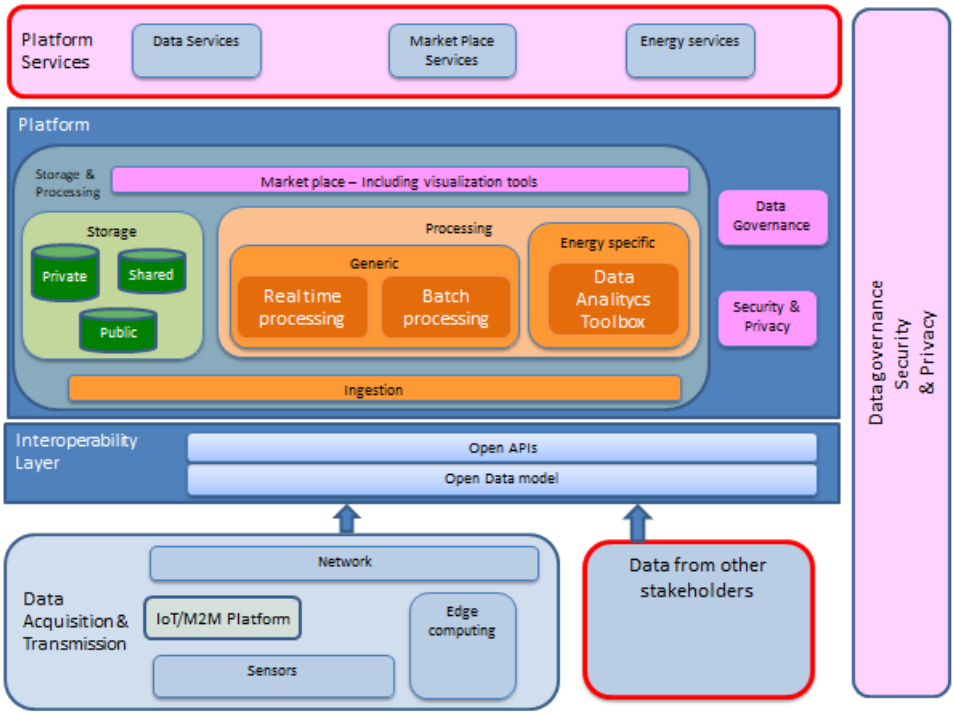

Figure 1 PLATOON reference architecture: conceptual high-level representation

PLATOON reference architecture will be further developed and defined in detail in WP2 but must comply with the following general requirements:

- Must allow integration of already existing solutions from partners legacy systems to facilitate pilot implementation and avoid rework (more detailed information about partner´s legacy systems can be found in deliverable D1.1).

- Must be technologically agnostic to avoid vendor lock-in and enhance its adoption.

- Must reuse already developed solutions and only create or improve those aspects that are not covered by the existing solutions in order to avoid unnecessary efforts and concentrate all the efforts in adding value.

- Must be compliant with the COSMAG reference architecture as stated in the call and in the DoA as one of the main objectives of the project. The COSMAG (Comprehensive Architecture for Smart Grid) is a very high-level architecture and so far, there is a single document [i] that defines a very high level architecture called Federated Data Solution Space and a set of conclusions and recommendations. In this case to be compliant means that the developed reference architecture can be mapped with the Federated Data Solution Space and that it takes into consideration the conclusions and recommendations defined in the COSMAG architecture document.

- Must be compatible with FIWARE [ii]to enhance its adoption after project completion. FIWARE is an open source international initiative defining a universal set of standards for context data management which facilitates the development of Smart Solutions for different domains such as Smart Cities, Smart Industry, Smart Agri-food and Smart Energy. The Context Broker is the core component of FIWARE which allows exchanging context (data) amongst different data sources and the different platform components such as processing and visualisation tools. Therefore, being compatible with FIWARE means that the developed reference architecture must allow the integration with the API used by the FIWARE Context Broker.

- The reference architecture should be applicable for the whole energy value chain, i.e. generation, transport/distribution and end use of energy. In fact, one of the main objectives of the project is to develop a big interoperable data platform for the energy sector and as such all the above-mentioned elements of the value chain are covered by the different pilots.

- It would be desirable to be able to map the PLATOON reference architecture to the different layers SGAM (Smart Grid Architecture Model[iii]) reference architecture as it will enable the interoperability in the smart grid area. Nevertheless, it needs to be highlighted that the SGAM reference architecture is very specific for Smart Grids, while PLATOON reference architecture aims to cover the whole energy sector as mentioned in the previous requirement. Using SGAM might compromise the mandatory requirement which is the main objective of the project. Thus, this is a desirable requirement.

- Must be compatible with IDS [iv](International Data Spaces) reference architecture in order to allow data sharing between different stakeholders while ensuring data sovereignty, security and privacy. This is one of the key objectives of the project as stated in the DoA and there is a specific work package (WP3) to develop the specific solutions for this part. Also, being compatible with the IDS reference architecture allows to access a wider TRUST data driven ecosystem composed of different organizations that will enhance the exploitation of the project results. IDS reference architecture covers many different functionalities some of which are optional and some of them are mandatory. Thus, in order to be compatible with IDS, PLATOON reference architecture must be able to integrate the main mandatory components of IDS reference architecture, i.e. the connector and the Identity provider or DAPS (Dynamic Attribute Provisioning Service).

- Must be compatible with the main widespread distributed big data storage solutions (SQL, HDFS, HBase, NoSQL databases...) and batch and real-time processing solutions (e.g. Hadoop V2.0, Spark, Flink, Kafka...). These solutions are already implemented in some of the partners platforms and will be used for some of the pilots (e.g. Sansa stack in for pilot 3a). In this case compatibility means that depending on the specific needs for the pilots, different big data storage and processing solutions can be instantiated in different platforms that follow the PLATOON reference architecture. For example, there can be a platform that uses SQL for storage and Python for processing and another one that uses HDFS and Spark.

- Must allow some of the components of the reference architecture to be hosted at the component/device level (e.g. edge computing), on premise or in the cloud for efficient data processing. Edge computing will be implemented in some of the pilots such as pilot 1a and pilot 3c.

- Must be compatible with the main Cloud platform providers: Amazon Web Services, Microsoft Azure and Google Cloud to avoid vendor lock-in and enhance its adoption. In this sense, compatibility means that the PLATOON reference architecture can be implemented in those main Cloud platform providers.

- Must enable the exploitation of digital services (both data and data analytics tools) through the PLATOON Marketplace that will be developed in WP3.

- Must comply with industry cybersecurity standards to ensure that system is immune against malicious attacks (see more details in section 4).

The following sections define in more detail the requirements for the abovementioned components of the reference architecture that will be developed in the project.

3 Interoperability Layer Requirements

Within the scope of PLATOON project, there are seven different pilots where different analytics tools for different use cases will be developed, implemented and validated using specific technologies as defined in the deliverable D1.1. In each of these pilots they will participate different partners which already have their own platforms and tools. Equally, some of these analytics tools will be directly deployed at the edge on the IOT devices. Additionally, some of the data analytics tools developed for one use case will be validated in other similar use cases. Moreover, as part of the project, external companies will be participating to the project through open call innovation, extending the scope of core technologies development and complementing the pilot activities with new data analytics tools, services and use cases.

As stated in the previous section, PLATOON won´t impose a single centralised platform that all the partners need to use. Instead, PLATOON will create a federated platform, formed of different platforms or components from the partners and external open call companies, that are able to exchange data and services with each other. In order to achieve this the abovementioned PLATOON reference architecture will be defined that will set the framework that the different platforms from the different stakeholders should follow to allow mutual integration and interoperability amongst them.

When integrating different platforms, we could make an ad-hoc one to one connection between the different platforms. This is usually the quickest and easiest way to connect a small number of platforms. However, this solution is not scalable as the required ad-hoc connections increases exponentially as the number of platforms increases.

Therefore, as part of the PLATOON reference architecture, an Interoperability Layer will be developed that will act as “translator” interface amongst the different platforms and IOT devices from different stakeholders that form the PLATOON federated platform. The interoperability layer is a key element of the reference architecture and has two main functions:

1. Enable effective communication and data sharing amongst different platforms.

2. Enable the access and use of tools from the PLATOON Data Analytics Toolbox that will be developed in the project.

This will allow federate actors, services, use cases, heterogeneous data in a common environment to meet multiple objectives both business and technical by allowing coordination and cooperation amongst them.

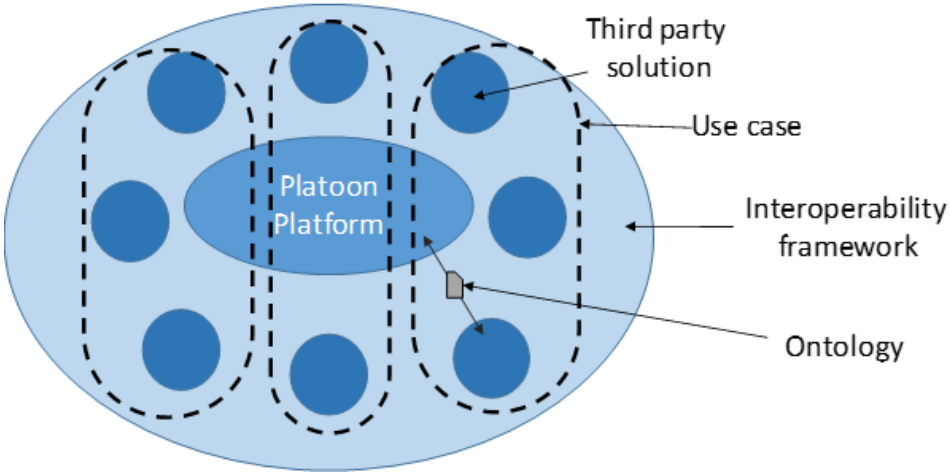

Figure 2 High Level Representation of the concept of the Interoperability Layer

The interoperability layer will be further developed in WP2, but, in summary, it will consist of a set of common data models (e.g. semantic data models such as ontologies…) and common APIs.

Regarding data models, there are different types of data models already available such as a relational database models, geographic data models, semantic data models, etc. Based on the experience from different partners in previous projects, for this specific case the semantic approach seems especially suitable. A semantic data model represents data in terms of named sets of objects, named sets of values, named sets of relationships, and constraints over these object, value, and relationship sets[v]. Apart from the semantic data model approach, in WP2 different alternatives will be reviewed and the solution that meets best the requirements will be selected and developed.

In addition, ontologies are a key paradigm to ensure the semantic interoperability. An ontology is defined as an explicit specification of a conceptualisation[vi] and its role is to ensure semantic disambiguation. An ontology consists of the definition of concepts (meaning) with an hierarchical taxonomy and sematic relations between these concepts[vii]. Due to the differences between different sectors and applications it is almost impossible to define a single ontology for all of them. In practice, different ontologies are used for different applications. An example of an ontology for the Smart Building area is SAREF [viii], but there are other examples for other applications.

Finally, apart from a set of common data models (e.g. semantic data models such as ontologies…) it is crucial to have a common API to standardise the data exchange between the different platforms.

The interoperability layer will be further developed in WP2, but it must satisfy the following requirements:

- It must define a set of common data models (e.g. semantic data models such as ontologies…)for all the pilots belonging the same pilot group (RES generation and in particular wind turbines, smart grids and smart buildings) in order to develop common generic tools and be able to validate same data analytics tools in multiple large scale pilots. If possible, it would be desirable to define a single PLATOON data model and ontology. However, due to the differences between different sectors and applications it is recognised that is very likely that it might be almost impossible to define such a single ontology for all of them.

- The developed set of common data model(s) must be open source in order to enhance its adoption and reuse already existing solutions.

- The developed set of common data model(s) must take into account and reuse as much as possible already open and widely-used ontologies and standards for the three main areas of the energy supply chain under the scope of PLATOON, i.e. RES generation (in particular wind turbines), smart grids and smart buildings in order to enhance its adoption and reuse already existing solution. For example, SAREF ontology for smart buildings and Core IEC Standards[ix] for smart grids. Nevertheless, the existing ontologies in energy sector don't cover all the domains. Thus, the developed PLATOON ontology(ies) must extend or/and to create ontological modules to represent other knowledge which is not present in the well-known ontologies

- Must allow the integration of heterogeneous data that will be used in different pilots. Specifically, it must be able to deal with the following formats as per defined in the pilot requirements in deliverable D1.1:
    - Files (e.g. csv, xml, JSON, CAD and jpeg)
    - Logs (csv and txt)
    - SQL
    - NoSQL (mat and tdms format)

- Must define common APIs in order to make scalable the integration between different platforms.

- The developed PLATOON APIs must be open source in order to enhance its adoption and reuse already existing solutions. In this sense the developed PLATOON APIs must consider existing standardisation activities related to Open API and data interoperability, such as NGSI-LD.

A more detailed description of the data exchange requirements and already available solutions regarding data models, ontologies and APIs are described in the deliverable D1.2

4 Platform Security and Privacy Requirements

Security and Privacy are two mandatory elements of any digital platform. Thus, PLATOON federated platform must comply with widespread cybersecurity and privacy standards to ensure that system is immune against malicious attacks.

As explained in previous sections PLATOON is envisaged as a federated platform formed of many individual platforms. Thus, if each of the individual platforms follows the previous principles then we only to protect the data flows between platforms at the communication level. Therefore, PLATOON will mainly focus on developing the solutions to ensure security and privacy in the data exchange between platforms. As part of the project no specific security and privacy component will be developed for protecting the individual platforms from the different partners. Instead a "Platform Security and Privacy" guideline will be defined based on already available solutions. Whenever necessary these solutions will be implemented for the specific pilots.

Regarding security, the following security requirements must be ensured at different levels, at the device, communication and user levels:

- At the device level, only those devices/sub-systems that have the required authorization can connect, for which there are security tokens that work as a key and are renewed periodically.
- At the communication level, sensitive information might be exchanged via encrypted channels to protect the confidentiality in case there may be a capture of network traffic.
- At the user level, roles and access permissions will be defined so that only the appropriate people can use the systems in the permitted functionalities.

Regarding privacy and the use of personal data, the information systems will comply with the requirements of the GDPR for which the systems must guarantee that all the rights contained in said law are fulfilled.

Security and privacy requirements are defined in more detail in the deliverables D1.2 and D1.4.

5 Data Analytic Tools Requirements

The PLATOON Data Analytics toolbox will be formed of all the data analytics tools that will be developed in the project by the different partners for the different use cases defined in the deliverable D1.1 that. These tools will allow the extraction of value from heterogenous data sources. There will be two main groups of data analytics tolls:

1. Energy specific tools for which have been specifically developed for the different applications or services (benchmarking , predictive maintenance, operation optimisation, etc.) and for the different domains of the energy value chain as per the different use cases defined in deliverable D1.1 (i.e., RES generation, smart grids and End Use of Energy).

2. Generic tools that complement the energy specific tools and that are applicable to different applications and domains (e.g. data pre-processing tools, visualisation tools, graph processing tools, etc.).

The PLATOON Data Analytics Toolbox is one of the main exploitable assets from the PLATOON project. Regarding intellectual property of the tools, in general the generic tools will be open source, whereas in the case of energy specific tools, some of the tools will be open source and free to use and some others will be proprietary and might be exploited under specific conditions.

The Data Analytics Toolbox plays a central role in the PLATOON federated platform and it is linked to the processing part of the PLATOON reference architecture introduced in Section 2. Nevertheless, it is also strongly related to the interoperability layer defined in section 3. In fact, the interoperability layer is the key element that will enable the use (and reuse) of the tools from the PLATOON Data Analytics Toolbox by the partners of the project.

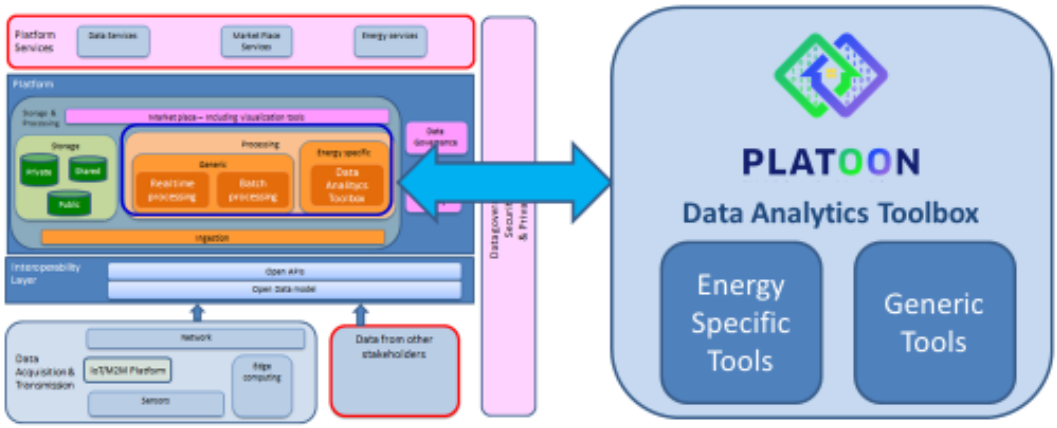

Figure 3 PLATOON Data Analytics Toolbox

The PLATOON Data Analytics Toolbox will be defined in WP4, specifically in task T4.1. However, it must comply with the following requirements.

- It must allow the development, implementation and validation of tools required for the different use cases as defined in deliverable D1.1.

- It must be able to process big volumes of heterogenous data in batches as well as in real-time. There are some pilots such as pilot 1a, 3a, 3b and 3c that due to the nature of the use cases it is not required real-time processing and batch (or micro-batch) processing is enough. However, there are other use cases such as 2a and maybe 2b where due to the frequency of the data and the type of response that is required where it is very likely that will need real time processing.

- It must allow distributed implementation of the different parts of the data analytics tools at different levels of the architecture, i.e. at the edge and on cloud/premise in order to make an efficient use of storage and processing capability.

- Must be compatible with the main widespread open-source and free to use big data batch and real time processing frameworks (Hadoop V2.0, Spark, Kafka...) and storage solutions (RDBMS, HDFS, HBase, NoSQL databases..., Cache, time series). This will speed up the development of the data analytics tools for the different use cases allowing the use of already existing and validated libraries (e.g. Spark MLib) without having to write all the code from scratch. This also enables access to a global software development community.

- Must be compatible with legacy systems and data analytics tools that the companies already have. In this sense, it must be compatible with the following programming languages:
  - Python (used in pilot 1a, 2b, 3a, 3b and 3c).
  - R (used in pilot 2a).
  - C++ (some legacy systems might use C++)
  - Java (used in pilot 3c for edge computing).
  - Scala (native language for Spark libraries)
  - MATLAB (used in pilot 1a)

- Must be compatible with main cloud providers (Amazon Web Services, Microsoft Azure and Google Cloud) in order to enhance its adoption and exploitation. It must also be compatible with the coming GAIA-X [x]European initiative. In this context, compatibility means that it must allow the implementation (at least it should have connectors to IaaS part of the clouds) into these platforms.

- Must allow a modular implementation of the tools allowing the combination of different generic tools that can be shared amongst use cases (signal processing, outlier removal, visualisation…) and use case specific tools (digital twin, soft sensor…) to avoid effort duplication and to focus on developing value adding modules.

- Must allow a seamless integration with different data sources to be able to connect the tools to the data from users. In order to facilitate the integration with the data source, the tools within the PLATOON Data Analytics platform must follow the common ontologies developed for the PLATOON interoperability layer.

- Must allow the semantification of data to produce Knowledge Graphs. The most common and standardized Semantic Linked Data format is RDF (Resource Description Framework). RDF makes interoperability of several Knowledge Bases possible. It would be desirable that the General Data Analytic Tools could perform analytics natively on these RDF representations of data. It is desirable that the provided analytics makes use of the semantic linked data.

- It must be compatible with existing widely used open source Data Analytics frameworks (e.g. Databricks, Knime, etc.) that allow the development, implementation and validation of tools in order to enhance its adoption. This type of Data Analytics frameworks has user friendly interfaces that make it easy to deploy and use the data analytics tools by energy experts without a deep knowledge in coding. It would be desirable that the compatible Data Analytics frameworks allow easy implementation and validation of the data analytics tools following the drag & drop concept. Similar to the MATLAB Machine Learning suite [xi] but based on open-source software and libraries. Additionally, these types of frameworks already have some generic built-in tools that could be used as part of the project such as pre-processing functions to be able to prepare the data before feeding it to the tools (e.g. change parameter types, remove Nan values, remove columns).

- It must allow conducting and tracking different experiments with different hyperparameters to be able to test the tools before implementing them in the production system.

- Must allow fine tuning the hyperparameters of the data analytics tool (weights, thresholds…) to adapt it for the specific dataset.

- Must allow the representation of the results in a user-friendly interface using specific KPIs for the specific application so that energy experts without a deep knowledge in data analytics can understand them.

- It must enable implementation of the tools using containers and/or microservice concept in order to facilitate its implementation according to the required specific business model for the specific tools (e.g. pay per license / pay per use).

- It would be desirable to enable automatic “productification” process according to DevOps principles.

- Must have version control using solutions like GIT or similar in order to meet the quality assurance requirements and be able to track any change to the code.

- It would be desirable to have monitoring tools that automatically generate internal alarms when the tools are down, or they have been receiving bad data for a long time.

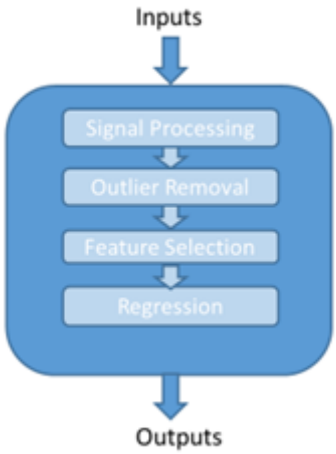

Figure 4 Data Analytics toolbox high level representation of the modular approach

6 Edge Computing Requirements

The Edge Computing is linked to the data Acquisition and transmission and processing part of the PLATOON reference architecture introduced in Section 2. The foundation of edge computing focuses on specific deployment models that aim at balancing among data processing workload, communication channel bandwidth, and guaranteed responsiveness of critical applications.

Basically, Edge Computing is a distributed topology where the information processing is placed closer to the systems that produce and / or consume the information (e.g. IOT devices, sensors, controllers…) for a fast service delivery.

The traditional models of processing and storing data in a centralized way either on premise or in the cloud is no longer valid for certain applications due to three main factors:

1. High volume of exchanged information.
2. Low latency for automatic decision making.
3. Security and privacy issues.

According with the first problem, the amount of information produced by an IoT system grows exponentially, however, the need for computing capacity to process that information also grows exponentially, but much faster, causing data to be left untreated. Additionally, the bandwidth of the installations and sites is always finite and although we can increase it (with its corresponding increase in cost), we will never have the capacity to make it grow as much as the total volume of information. At the same time, as the companies are getting more mature in the digitalisation process, they are

starting to realise that not all data adds value and that actually having too much non-value-added data can create internal data governance problems. Thus, only valuable data needs to be stored and processed. Also, in many applications, such as in predictive maintenance, where specific tools will be developed for different use cases in the project, there is no need to store and process data in a centralised system with a constant frequency but it makes more sense to apply an on-demand approach. In fact, when the asset is working under normal operation it is usually enough to work with aggregated data and process and store the data in a centralised manner every few minutes to analyse long term degradation. However, if suddenly an anomaly happens then it is useful to store and process high granularity data to be able to understand what caused the anomaly.

The second problem is based on the physical fact according to which moving information always takes time which is proportional to the distance between sender and receiver. In the new scenarios of use envisaged by the extension of the 5G network, the capacity of management in mission critical or self-controlled systems such as smart grids with latencies below seconds, require a nearby computing that cannot delay calculations to be performed in a distant infrastructure which is usually several kilometres away from where the final action should be implemented.

Finally, both public and private organisations are very reluctant to share data and must be kept as private due to its personal/legal sensitivity or due to the importance to the business. A good way to protect this type of private information and minimize potential data leakages is to reduce as much as possible data exchange. This can be efficiently achieved if it is processed locally where the data is generated using edge processing solutions. Unfortunately, as edge devices proliferate (including mobile handsets and IoT sensors) new attack vectors are emerging that take advantage of the proliferation of endpoints. Thus, edge computing solutions should implement solutions for permission-based access control, secure encrypted communication, certificate management and integration into existing security solutions. The state-of-the-art encryption and authentication protocols are based on cryptographic suites such as Advanced Encryption Standard (AES) for confidential data transport, Rivest-Shamir-Adleman (RSA) for digital signatures and key transport, and Diffie-Hellman (DH) for key negotiations and management. While these protocols are battle-proven in deployments, they suffer from two shortcomings when it comes to applying them to IoT. The first shortcoming is that these protocols are resource hungry and generally demand high-capability compute platforms. Appropriate reengineering is required to accommodate constrained devices. The second shortcoming is that the authentication and authorization protocols are high touch, requiring user input for provisioning and configuration. In many IoT deployments, access to the devices will be limited or impractical, thereby requiring that the initial configuration be tamper-proof throughout the usable lifespan of the devices, and such lifespan could extend to many years. In order to address these shortcomings, new lightweight authentication and authorization protocols are required which leverage the experience of today's strong encryption/authentication algorithms but can run on constrained devices[xii]. With respect to privacy, some IoT applications even involve highly sensitive personal information. For these types of applications, it is imperative to decouple the device from the owner's identity while still providing robust mechanisms for device ownership verification and device identity authentication.

Edge Computing architectures focus on solving these problems, minimizing the information that is moved among the components, optimizing the use of expensive resources such as communication and distributing the processing capacity in a coordinated manner. The main benefits of Edge Computing technology are the following:

- Overcome the limitations of communication channel bandwidth and end-to-end delay, which is especially important for real-time applications requiring the exchange of vast amounts of data. Only the processed information that is truly relevant to the business is centralized, and

those applications or services that must interact quickly with assets or people are deployed closely in the field.

- Allow for the centralized platform to store and process smaller data sets by deploying pre-processing and site-dependent analytics algorithms (e.g. event detection, feature extraction) on the edge infrastructure. These can be dedicated gateways or telco operator provided infrastructure (i.e. multi-access edge computing, MEC).

- Increased safety and reliability of sub-system operation provided by autonomous data storage and processing capability in the edge even in the case of communication network failure.

- Enhancement of security, privacy and management frameworks due to the reduced number of sensor and actuator devices connected to the internet and consequently reduced number of attack vectors.

- Optimization of costs associated data transmission, storage and processing.

- Mitigating bandwidth limits. The ability to move workloads closer to the end users or data collection points reduces the effect of limited bandwidth at a site. This is especially useful if the service on the edge node reduces the need to transmit large amounts of data to the core for processing as is often the case with IoT and NFV workloads. Data reduction and local processing can be translated into both more responsive applications and reduces the cost of transporting terabytes of data over long distances[xiii].

However, Edge Computing architectures are not the solutions to all the problems that deployment of IoT systems entails, in fact, their management and governance are much more complicated that IoT cloud first approach.

Additionally, there are various hardware and software associated requirements for the edge computing to introduce beneficial features and capabilities. Hereby the focus is on general software and protocols solution requirements, while the specific hardware requirements will be further elaborated within task T4.2 for specific use cases and deployment scenarios:

- Must be based on industry protocols that can be adopted for specific purposes. Apart providing local storage and processing capabilities the main function of edge gateway is to enable wide area connectivity to the cloud and local area connectivity to sensor and actuator devices, where there is a plethora of industry protocols that can be adopted for specific purposes (e.g. Modbus, BACnet, etc.).

- Must allow to execute locally microservices and applications. The ability to execute locally microservices and applications is the key to enable distributed and autonomous data processing. Depending on the use case, applications might include data cleaning, data compression, feature extraction, event detection with threshold-based notifications and alarms, analytics algorithms, remote monitoring and diagnostics, and any other custom software.

- Must allow local data storage on the edge devices. This is a crucial requirement for autonomous operation in case it is disconnected from the network.

- With respect to security, the edge computing solution should allow for permission-based access control, secure encrypted communication, certificate management and integration into existing security solutions.

- With respect to privacy, must allow the implementation of anonymisation solutions to decouple the device from the owner's identity while still providing robust mechanisms for device ownership verification and device identity authentication.

- It must allow the remote management of individual edge computing instances via run, halt, configure, and update procedures so that I can enable/disable and control the different edge computing devices remotely. Must allow orchestration tools that manage and coordinate many edge sites and workloads, potentially leading toward a peering control plane or "self-organizing edge. It would be desirable to allow automated data and workload relocations for load balancing across geographically distributed hardware. In this sense the developed solutions must have an open API that allows remote applications to communicate with the edge computing infrastructure via REST, WebSockets, or JSON-RPC.

- Must allow to virtualize the hardware function using the "software defined hardware" scheme, allowing to change the behaviour of the devices updating the deployed software instead of the more traditional approach that requires the replacement of the embedded firmware. It would be desirable to have automated edge commission/decommission operations, including initial software deployment and upgrades of the resource management system's components.

- Must guarantee the latencies required for each scenario deployed especially among those with low and unreliable bandwidths.

- It would be desirable to have a fault-tolerant design both from a software and hardware perspective. In fact, some of the developed edge computing solutions will potentially be used for critical applications where no failure is permitted. Nevertheless, it must be highlighted that developing a completely fault tolerant design is a complicated task that requires vast amounts of resources and time. This type of development will probably not be possible given the time and resources allocated for the Edge Computing development task for this project.

7 Market Place Requirements

Data is a valuable resource in any digital, data-driven business and it is necessary to enable participants to leverage the potential of their data and tools within a secure and trusted business ecosystem.

The PLATOON federated platform will enable the exploitation of digital services (both data and data analytics tools) amongst different stakeholders through the PLATOON Marketplace.

The PLATOON Marketplace will be a one-stop shop that integrates some of the datasets used in the project and the tools developed as a result of the project. Equally, all the services developed as part of the open calls will be available through the marketplace. Moreover, additional services from previous projects can also be made available in the PLATOON Marketplace.

The marketplace will mainly offer two types of services:

1. Data services: exchange and monetisation of raw and processed data. This includes contract for 'bulk' ad hoc transfers or unlimited pay-per-use.

2. App services: Data analytics tools that can be implemented in two ways:
    a. The tools (code) are downloaded and implemented directly in the app consumer´s platform.
    b. The tools are implemented as a microservice. In this case the tool is implemented in the app provider infrastructure and the code is not shared. Instead there is an exchange of raw and processed data between the app provider and app consumer.

Regarding the monetisation of the different datasets and tools used and developed in the project, a "freemium" approach will be followed. In fact, there will be a basic free account that allows access to free datasets and tools. On top of that basic free account, there will be additional premium datasets and tools that are proprietary and that the user will have to pay to have access to them.

The PLATOON Marketplace will be defined in detail in WP3, specifically in task T3.4. However, the developed solution must satisfy the following requirements:

First of all, depending on the chosen business model different requirements need to be taken into account. In particular, at this stage of the project two types of potential business models have been considered: pay per license and pay per use. Each of the business models have their corresponding requirements regarding the marketplace:

1. **<u>Pay-per-license:</u>**
    - Must enable to download the code from the marketplace as self-contained integrated solution following the container technology.
    - Must ensure that the downloaded tools are used only under specific conditions (e.g. cannot be shared with third parties, cannot be exploited with third parties).

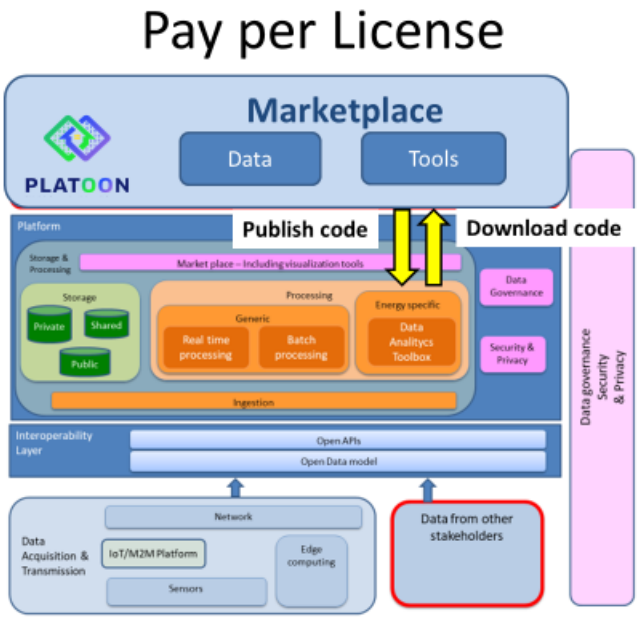

Figure 5 PLATOON Marketplace - Pay per License

2. **Pay-per-use:**
    1. It must follow the microservice concept, i.e., in this case the tool is implemented in the app provider infrastructure and the code is not shared. Instead the Data Owner sends the raw data to the App Provider and the App Provider process the data running the data analytics tool in its infrastructure and sends back the data processed to the Data Owner.
    2. It must guarantee that the tool trained with the data owner data can only be used under specific conditions agreed between the data owner and app provider (e.g. it can only be used with data owner, it can be shared with others without showing the raw data and paying a fee to the data owner, etc.).

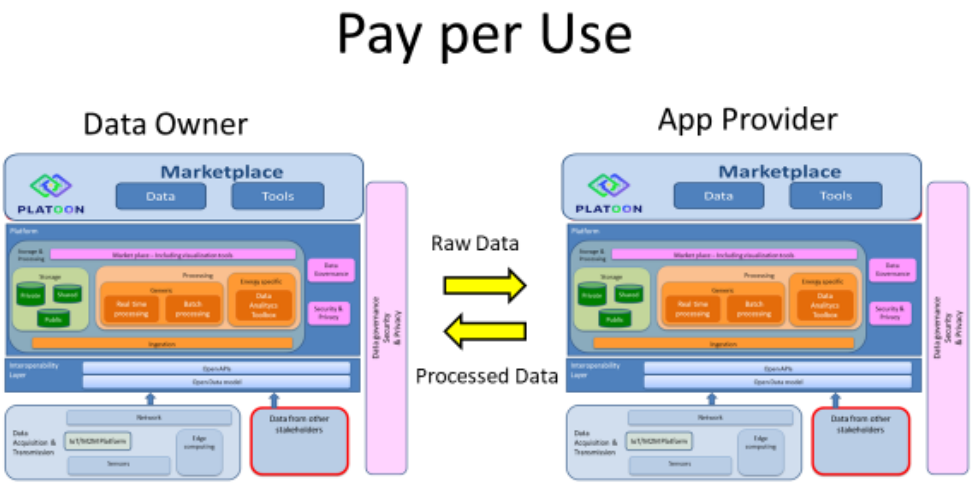

Figure 6: PLATOON Marketplace - Pay per Use

Apart from the specific requirements regarding business models, in essence, the PLATOON Marketplace is a meeting point for offer and demand, and therefore, must satisfy both the data/app providers´ (offer) requirements and the data/app consumers (demand) requirements. In fact, a well-designed marketplace for the providers but that doesn´t consider consumers 'requirements, or vice versa, will inevitably fail. Thus, the PLATOON Marketplace must satisfy the following offer and demand requirements:

Demand requirements:

- It must centralize all the different providers that own the products in one single one-stop shop and must contain a complete and easy to find catalogue of all of the products and services offered by the different providers. In this way consumers can compare the different services offered by the different providers and choose the alternative that suits best their requirements.

- It must contain a detailed description of the offered datasets and tools (metadata). In this way consumers can better understand the applicability and limitations of the of the offered datasets and tools.

- All the products and services must pass a quality and authenticity check before they are offered in the PLATOON Marketplace. In fact, consumers must trust that the products and services meet the specifications defined in the description and that including them in their business will bring them a benefit. In the case of the datasets and tools that will be used and developed as part of the project, they will follow a quality control process as part of the Large-Scale Pilot Validation processed that will be conducted in WP6. Equally, the tools and services developed by external companies through open call innovation, they will follow a quality control process ensured by PLATOON Partners as part of the Technology Transfer Programme in WP7. As part of the exploitation plan for future exploitation after the project completion an existing or new certification authority should be named in order to check the quality and authenticity of the data and tools being advertised in the marketplace.

Offer requirements:

- PLATOON Marketplace must be easily findable and accessible through the main media channels (magazines, social media, etc.) in order to reach as much potential customers as possible. Consumers must know that PLATOON marketplace exists where they can find valuable services for their business. Project Communication and Dissemination activities in WP9 are essential in this aspect.

- It would be desirable that data/app providers could define usage policies for data and app services and publish metadata including these usage policies directly on the marketplace. Having the whole process automated would make it much faster and efficient. Nevertheless, it is acknowledged that this can be difficult to implement, and it is not business critical. This can still be done indirectly defining and setting up the usage policies on the backend.

- It would be desirable to allow automatic transfer of data and tools with the associated usage constraints as soon as the product or service has been purchased directly on the marketplace. Having the whole process automated will make it much faster and efficient. Nevertheless, it is acknowledged that this can be difficult to implement, and it is not business critical. This can still be done indirectly defining and setting up the specific data and app connections on the backend.

- It would be desirable to track information about data and apps transaction in order to facilitate the billing and auditing process. Having the whole process automated will make it much faster and efficient. Nevertheless, it is acknowledged that this can be difficult to implement, and it is not business critical. This can still be done tracking the data and apps transactions on the backend.

Finally, apart from the previous requirements listed above, there are some general requirements that need to be satisfied for the PLATOON Marketplace:

- The PLATOON marketplace must be based on existing open source solutions in order to avoid rework and focus on value added tasks.

- The PLATOON marketplace must follow a decentralized approach in line with the federated platform concept explained in the previous sections. In fact, having a centralized marketplace will require a centralized repository and a company that will play the role of the marketplace

administrator reducing the exploitation costs beyond the project lifetime. In this sense, the PLATOON marketplace should follow a similar approach to the CKAN open source solution but allowing the exploitation of tools as well as data. Apart from CKAN, there are other marketplace options already available that have been created within the scope of different initiatives. Reusing them strengthens demand-side requirements as they are already known to the public but may not be optimal for offer-side requirements as they may not be tailored to the needs of asset providers. Therefore, as part of task T4.3 a benchmarking is required to choose the most appropriate option considering the commercial exploitation of the results as the final goal.

- It must have an external interface where external organizations that are not part of the PLATOON federated platform can see and purchase the different available services.

- It must allow managing the access rights of to the PLATOON marketplace in order to ensure that these companies that can offer and purchase services through the marketplace meet certain minimum requirements regarding security, privacy and sovereignty. During the project initially only PLATOON project partners will have access to the marketplace. The access right for any additional external company that might require access to the marketplace (e.g. selected companies in the open calls) will be approved in the Steering Committee.

- It must be compatible with the IDS reference architecture. This is very important for future exploitation beyond the project lifetime, it will allow ecosystem of trusted companies that meet certain minimum requirements regarding security, privacy and sovereignty. In addition, this will avoid having a specific certification authority as the access rights of companies will be granted by the IDS certification authority.

- It would be desirable to have a payment gateway. Having the whole process automated will make it much faster and efficient. Nevertheless, it is acknowledged that this can be difficult to implement, and it is not business critical. This can still be done indirectly making bank transfers between the service provider and consumer.

- It would be desirable to allow a negotiation step whereby a consumer can identify datasets (or apps) then request a price from the provider. The provider can then assign a specific price depending on the consumer (using 'unit prices' as a base pricing scheme).

- Regarding security, it must implement generic data security mechanisms (secure communication, identity management), data access (authorization management) control and data usage control aspects.

- Regarding privacy, it must be compliant with GDPR in order to avoid data privacy issues with any personal data that might be stored, provided or shared through the PLATOON Marketplace (e.g. personal contact details, bank account details, etc.).

8 Collaboration Requirements

Apart from the budget allocated to the PLATOON partners, the project includes 2 million euros of budget to fund external companies to develop building blocks for of the reference architecture, new data analytics tools for the toolbox, new services and new use cases through open call innovation. In total there will be 13 bottom-up projects, each of them with an allocated budget of 150 kEUR, organised in two round of open calls. The first open call round will be focused on developing building

blocks for of the reference architecture, new data analytics tools for the toolbox. The second open call will focus on developing the new services for existing use cases and developing new use cases within the energy sector that complement the existing use cases defined as part of deliverable D1.1.

A robust open call management process has been defined to define, evaluate and choose the best proposals as part of WP7. Also, a Technology Transfer Programme has been defined lead by PLATOON partners, in order to provide technical support to the selected companies and validate the developed solutions.

The PLATOON federated platform requirements explained in the previous sections already considers such a collaboration amongst different companies, both amongst PLATOON partners and external companies including the selected companies for open calls in WP7. Specifically, these type of collaboration requirements are considered for the PLATOON reference architecture and for the Interoperability layer that enables effective communication and data sharing amongst different platforms from different companies and allows the access and use of tools from the PLATOON Data Analytics Toolbox developed by different partners, both PLATOON partners and external companies including the selected companies for open calls.

Thus, in order to allow collaboration with external companies, these external companies must follow the following three key requirements:

- They must follow the PLATOON reference architecture defined in WP2. Specifically, they must use the set of common data models (e.g. semantic data models such as ontologies…) and APIs defined as part of the PLATOON Interoperability Layer. This will enable to share data with the rest of the companies and will allow to use existing tools and share the developed new tools with the rest of the companies enhancing the PLATOON Data Analytics Toolbox.

- They must follow the security, privacy and sovereignty solutions developed in WP3. On the one hand this will ensure that the platform from the external company does not suppose a cybersecurity risk to the rest of the platforms that form the PLATOON federated platform. On the other hand, this will ensure when the data is exchange with these external companies the data security, privacy and sovereignty requirements are maintained.

- When developing new tools and/or Edge Computing solutions they must use the Data Analytics Toolbox and Edge Computing solutions defined in in tasks T4.1 and T4.2, respectively, that will meet the corresponding requirements defined in sections 5 and 6 of this document.

9 Conclusions

PLATOON platform is presented as a breakthrough COSMAG compliant platform with flexible capabilities covering three main pillars: Interoperability, Data governance and Data Analytics Toolbox.

PLATOON aims to create what is known as a federated platform, a decentralized platform formed of different platforms from different companies that are able to exchange data and services with each other.

In order to build such a federated platform, PLATOON will define a flexible and modular lightweight reference architecture that will set the framework that the different platforms from the different stakeholders should follow to allow mutual integration and interoperability amongst them.

As part of the PLATOON reference architecture, an Interoperability Layer will be developed that will act as "translator" interface amongst the different platforms and IOT devices from different stakeholders that form the PLATOON federated platform. The interoperability layer is a key element of the reference architecture and has two main functions: 1) enable effective communication and data sharing amongst different platforms and 2) enable the access and use of tools from the PLATOON Data Analytics Toolbox that will be developed in the project.

Regarding security and privacy, PLATOON will mainly focus on developing the solutions to ensure security and privacy in the data exchange between platforms. As part of the project no specific security and privacy component will be developed for protecting the individual platforms from the different partners. Instead a "Platform Security and Privacy" guideline will be defined based on already available solutions.

The PLATOON Data Analytics Toolbox is one of the main exploitable assets of the project and will be formed of all the data analytics tools that will be developed in the project by the different partners for the different use cases. These tools will allow the extraction of value from heterogenous data sources. There will be two main groups of data analytics tolls: energy specific tools and generic tools. The Data Analytics Toolbox plays a central role in the PLATOON federated platform and it is linked to the processing part of the PLATOON reference architecture. Nevertheless, it is also strongly related to the interoperability layer. In fact, the interoperability layer is the key element that will enable the use (and reuse) of the tools from the PLATOON Data Analytics Toolbox by the partners of the project.

The Edge Computing is linked to the data acquisition and transmission and processing part of the PLATOON reference architecture. Edge computing focuses on specific deployment models that aim at balancing among data processing workload, communication channel bandwidth, and guaranteed responsiveness of critical applications. There are various hardware and software associated requirements for the edge computing. In this document the focus is on general software and protocols solution requirements, while the specific hardware requirements will be further elaborated within task T4.2 for specific use cases and deployment scenarios.

In addition, the PLATOON federated platform will enable the exploitation of digital services (both data and data analytics tools) amongst different stakeholders through the PLATOON Marketplace. The PLATOON Marketplace will be a one-stop shop that integrates some of the datasets used in the project and the tools developed as a result of the project. Equally, all the services developed as part of the open calls will be available through the marketplace. Moreover, additional services from previous projects can also be made available in the PLATOON Marketplace.

Finally, apart from the budget allocated to the PLATOON partners, the project includes 2 million euros of budget to fund external companies to develop building blocks for of the reference architecture, new data analytics tools for the toolbox, new services and new use cases through open call innovation. The PLATOON federated platform requirements already consider such a collaboration amongst different companies. Specifically, these type of collaboration requirements are considered for the PLATOON reference architecture and for the Interoperability layer that enables effective communication and data sharing amongst different platforms from different companies and allows the access and use of tools from the PLATOON Data Analytics Toolbox developed by different partners, both PLATOON partners and external companies including the selected companies for open calls.

All the defined modules of the PLATOON federated platform will be further developed and defined in in WP2-WP4 but must comply with the requirements explained in the previous sections and that are summarised in the next section.

10 Requirement Summary

The table below summarises the requirements for the different modules that form the PLATOON platform that have been explained in the previous sections. The requirements have been listed following the user stories format where the following actors have been considered:

- PLATOON platform user: In the context of PLATOON project, the term PLATOON platform user comprises all the project partners (pilot owners and solution providers) and also external companies (included selected companies in open calls) that will potentially use the PLATOON platform.

- PLATOON solution provider: In the context of PLATOON project, the term PLATOON solution provider comprises all the project partners that will develop the technical solutions (i.e. Reference Architecture, Interoperability Layer, Data Governance Framework and Data Analytics Toolbox) that will be implemented and validated in the pilots.

- PLATOON project partner: In the context of PLATOON project, the term PLATOON project partner comprises all organisations that form the PLATOON consortium an that were present during the proposal elaboration.

- Data/app provider: In the context of PLATOON project, the term data/app provider comprises all the organizations (both project partners and external organizations) that have the legal right to provide or share certain open/proprietary datasets/apps(tools).

- Data/app user/consumer: In the context of PLATOON project, the term data/app user/consumer comprises all the organizations (both project partners and external organizations) that use/consume the provided data/tools.

Table 1 Platform Requirements Summary Table

Requirement ID	Description	Requirement Group	Requirement type	Applicable WPs	Mandatory/ Optional	Pilot Specific/ General	Specified in the DoA
13001	As a PLATOON platform user, I want the PLATOON Reference Architecture to allow integration of already existing solutions that I have and my legacy systems so that I can avoid rework and I can concentrate on value added tasks.	Platform-Reference Architecture	Functional	WP2	Mandatory	General	Yes
13002	As a PLATOON platform user, I want the PLATOON reference architecture to be technologically agnostic to avoid vendor lock-in.	Platform-Reference Architecture	Non-Functional	WP2	Mandatory	General	Yes
13003	As a PLATOON solution provider, I want the PLATOON reference architecture to reuse already available open source solutions and only create or improve those aspects that are not covered by the existing solutions o that I	Platform-Reference Architecture	Non-Functional	WP2	Mandatory	General	No

	can avoid rework and concentrate on value added tasks.						
13004	As a PLATOON project partner, I want the PLATOON reference architecture to be compliant with the COSMAG reference architecture so that I comply with what it was asked in the call and what it was stated in the DoA. In this case being compliant means that the developed reference architecture can be mapped with the Federated Data Solution Space and that it takes into consideration the conclusions and recommendations defined in the COSMAG architecture document.	Platform-Reference Architecture	Non-Functional	WP2	Mandatory	General	Yes
13005	As a PLATOON solution provider, I want the PLATOON reference architecture to be compatible with FIWARE to enhance its adoption after project completion. In this case being compatible with FIWARE means that the developed reference architecture must allow the integration with the API used by the FIWARE Context Broker.	Platform-Reference Architecture	Functional	WP2	Mandatory	General	No
13006	As a PLATOON platform user, I want the PLATOON reference architecture to be applicable for the whole energy value chain (i.e. generation, transport/distribution and end use of energy) so that it can be implemented in all the use cases defined in D1.1that comprise the whole energy value chain.	Platform-Reference Architecture	Non-Functional	WP2	Mandatory	General	Yes
13007	As a PLATOON platform user, I want the PLATOON reference architecture to be mappable to the different layers of SGAM reference architecture so that it enables the interoperability in the smart grid area.	Platform-Reference Architecture	Non-Functional	WP2	Optional	General	No
13008	As a PLATOON platform user, I want the PLATOON reference architecture to be compatible with IDS reference architecture so that it ensures data sovereignty, security and privacy when sharing my data/tools with other platform users. In order to be compatible with IDS, PLATOON reference architecture must be able to integrate the main mandatory components of IDS reference architecture, i.e. the connector and the identity provider (a.k.a DAPS).	Platform-Reference Architecture	Functional	WP2	Mandatory	General	Yes
13009	As a PLATOON solution provider, I want the PLATOON reference architecture to be compatible with the main opensource big data storage solutions (SQL, HDFS, HBase, NoSQL databases...) and batch and real-time processing solutions (e.g. Hadoop V2.0, Spark, Flink, Kafka...) so that I can reuse already existing solutions and focus on value added tasks.	Platform-Reference Architecture	Functional	WP2	Mandatory	General	No
13010	As a PLATOON solution provider, I want the PLATOON reference architecture to allow some of the components of the reference architecture to be hosted at the component level (e.g. edge computing), on premise and in the cloud so that I can optimise my	Platform-Reference Architecture	Functional	WP2	Mandatory	General	Yes

	solutions regarding data exchange, storage and processing.						
13011	As a PLATOON platform user, I want the PLATOON reference architecture to be implementable in the main cloud platform providers (i.e. Amazon Web Services, Microsoft Azure and Google Cloud) so that I can avoid vendor lock-in, enhance its adoption and reduce infrastructure costs.	Platform-Reference Architecture	Functional	WP2	Mandatory	General	No
13012	As a data/app provider, I want the PLATOON reference architecture to enable the exploitation of digital services (both data and data analytics tools) through the PLATOON Marketplace to enhance the exploitation of my data and tools.	Platform-Reference Architecture	Functional	WP2	Mandatory	General	Yes
13014	As a app provider, I want all the pilots belonging the same pilot group (RES generation and in particular wind turbines, smart grids and smart buildings) to use common data models and ontologies so that I can develop common generic tools and be able to validate them in different large scale pilots to prove its generalization capacity. If possible, it would be desirable to define a single PLATOON data model and ontology. However, due to the differences between different sectors and applications it is recognised that is very likely that it might be almost impossible to define such a single ontology for all of them.	Platform-Interoperability	Non-Functional	WP2	Mandatory	General	Yes
13015	As an app provider, I want the defined PLATOON data model(s) to be open source so that it enhances the adoption of the developed tools and I can reuse already existing solutions.	Platform-Interoperability	Non-Functional	WP2	Mandatory	General	Yes
13016	As a app provider, I want the defined PLATOON ontology(es) to take into account and reuse as much as possible already open source and widely-used ontologies and standards for the three main areas of the energy supply chain under the scope of PLATOON so that it enhances the adoption of developed tools and I can reuse already existing solutions. For instance, SAREF ontology for smart buildings and Core IEC Standards for smart grids. Nevertheless, the existing ontologies in energy sector don't cover all the domains. Thus, the developed PLATOON ontology(es) must extend or/and to create ontological modules to represent other knowledge which is not present in the well-known ontologies	Platform-Interoperability	Non-Functional	WP2	Mandatory	General	Yes
13017	As PLATOON platform user, I want the PLATOON Interoperability layer to allow the integration of heterogeneous data that will be used in different pilots. In particular must be able to deal with the following formats as per defined in the pilot requirements in deliverable D1.1: Files (csv, xml, JSON, CAD	Platform-Interoperability	Functional	WP2	Mandatory	General	Yes

	and jpeg), Logs (csv and txt), SQL and NoSQL (mat and tdms format).						
13018	As a PLATOON solution provider, I want the PLATOON Interoperability Layer to define common APIs so that the integration between different platforms is replicable and scalable.	Platform-Interoperability	Functional	WP2	Mandatory	General	Yes
13019	As a PLATOON solution provider, I want the developed common APIs to be open source so that it enhances its adoption and I can reuse already existing solutions. In this sense the developed PLATOON APIs must consider existing standardisation activities related to Open API and data interoperability, such as NGSI-LD.	Platform-Interoperability	Non-Functional	WP2	Mandatory	General	Yes
13020	As PLATOON platform user, I want that a common "Security and Privacy" guideline is defined so I am sure that any platform that forms part of the PLATOON federated platform meets certain minimum requirements regarding security and privacy.	Platform - Security and Privacy	Non-Functional	WP2, WP3	Mandatory	General	Yes
13021	As a PLATOON platform user, I want the Data Analytics Toolbox to allow the development, implementation and validation of tools required for the different use cases so that I can meet the use case requirements defined in deliverable D1.1.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	Yes
13022	As PLATOON platform user, I want the PLATOON Data Analytics to be able to process big volumes of heterogenous data in batches as well as in real-time so that I can meet use case requirements defined in deliverable D1.1. There are some pilots such as pilot 1a, 3a, 3b and 3c that due to the nature of the use cases it is not required real-time processing, thus, batch or micro-batch processing is enough. However, there are other use cases such as 2a and maybe 2b, that due to the frequency of the data and the type of response that is required, they will need real time processing.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	Yes
13023	As an app provider, I want the PLATOON Data Analytics Toolbox to allow distributed implementation of the different parts of the data analytics tools at different levels of the architecture (i.e. at the edge and on cloud/premise) so that the developed tools make an efficient use of the available storage and processing capability.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	Yes
13024	As an app provider, I want the PLATOON Data Analytics Toolbox to be compatible with the main widespread open-source and free to use big data batch and real time processing frameworks (Hadoop V2.0, Spark, Kafka...) and storage solutions (RDBMS, HDFS, HBase, NoSQL databases..., Cache, time series) so that I can use of already existing and validated libraries (e.g. Spark MLib, Spark ML, etc.) without having to write all the code from	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	No

	scratch. Also, by using these open source solutions I can benefit from a global software development community.						
13025	As an app provider, I want the PLATOON Data Analytics Toolbox to be compatible with the following programming languages Python , R, C++, Java ,Scala and MATLAB so that I can use the legacy systems and data analytics tools that I already have.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	No
13026	As an app provider, I want the PLATOON Data Analytics Toolbox to be compatible with main cloud providers (Amazon Web Services, Microsoft Azure and Google Cloud) so that I can offer my tools to a wide range of app consumers. It must also be compatible with the coming GAIA-X European initiative. In this context, compatibility means that it must allow the implementation (at least it should have connectors to IaaS part of the clouds) into these platforms.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	No
13027	As an app provider, I want the PLATOON Data Analytics Toolbox to allow a modular implementation of the tools allowing the combination of different generic tools that can be shared amongst use cases (signal processing, outlier removal, visualisation…) and use case specific tools (digital twin, soft sensor…) so that we can use and share already existing generic solutions and focus on developing value adding modules.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	No
13028	As an app provider, I want the PLATOON Data Analytics Toolbox to allow a seamless integration with different data sources so that I can easily connect my tools to the data from different data providers so I can build better models and offer my tools to a wide range of consumers. In order to facilitate the integration with the data source, the tools within the PLATOON Data Analytics platform must follow the common ontologies developed for the PLATOON interoperability layer.	Platform-Data Analytics Toolbox	Non-Functional	WP4	Mandatory	General	No
13029	As an app user, I want the PLATOON Data Analytics Platform to allow the semantification of data producing Knowledge Graphs in RDF Semantic Linked Data format so that I can perform analytics natively on the RDF representations of data.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	No

13030	As an app user, I want the PLATOON Data Analytics Toolbox to be compatible with existing widely used open source Data Analytics frameworks (e.g. Databricks, Knime, etc.) that allow the development, implementation and validation of tools that have user friendly interfaces that make it easy to deploy and use the data analytics tools by energy experts without a deep knowledge in coding. It would be desirable that the compatible Data Analytics frameworks allow easy implementation and validation of the data analytics tools following the drag & drop concept similar to the MATLAB Machine Learning suite but based on open-source software and libraries. Additionally, these types of frameworks already have some generic built-in tools that could be used as part of the project such as pre-processing functions to be able to prepare the data before feeding it to the tools (e.g. change parameter types, remove Nan values, remove columns).	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	Yes
13031	As an app user, I want the PLATOON Data Analytics Toolbox to allow fine tuning the hyperparameters of the data analytics tool (weights, thresholds…) so that I can adapt the tool for my specific dataset.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	No
13032	As an app user, I want the PLATOON Data Analytics Toolbox to allow conducting and tracking different experiments with different hyperparameters so that I can validate the tools before implementing them in the production system.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	No
13033	As an app user, I want the PLATOON Data Analytics Toolbox to allow the representation of the results in a user-friendly interface using specific KPIs for the specific application so that energy experts without a deep knowledge in data analytics can understand them.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	No
13034	As an app provider, I want the PLATOON Data Analytics Toolbox to allow the implementation of the tools using containers and/or microservice concept so that they can be easily implemented according to the required specific business model (e.g. pay per license / pay per use).	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	Yes
13035	As an app user, I want that the PLATOON Data Analytics Toolbox to enable the automatic productification of tools following the DevOps principles so the deployment process is faster and more efficient.	Platform-Data Analytics Toolbox	Functional	WP4	Optional	General	Yes
13036	As an app provider, I want the PLATOON Data Analytics toolbox to have version control using solutions like GIT or similar so that I can track code changes in my tools.	Platform-Data Analytics Toolbox	Functional	WP4	Mandatory	General	Yes

13037	As an app user, I want the PLATOON Data Analytics Toolbox to have monitoring tools that automatically generate internal alarms when the tools are down or they have been receiving bad data for a long time so that I can quickly identify issues with the tools or with the data quality and quickly solve them.	Platform-Data Analytics Toolbox	Functional	WP4	Optional	General	Yes
13038	As a PLATOON partner, I want the developed Edge Computing solutions to be based on industry protocols (e.g. Modbus, BACnet, etc.) so that I can implement them in the different use cases defined in D1.1	Platform-Edge Computing	Functional	WP4	Mandatory	General	No
13039	As an app provider, I want the developed Edge Computing solutions to allow to execute locally microservices and applications so that it enables distributed and autonomous data processing. Depending on the use case, applications might include data cleaning, data compression, feature extraction, event detection with threshold-based notifications and alarms, analytics algorithms, remote monitoring and diagnostics, and any other custom software.	Platform-Edge Computing	Functional	WP4	Mandatory	General	No
13040	As a data/app provider, I want the developed Edge Computing solutions to allow local data storage so that allows autonomous operation and no data is lost in case it is disconnected from the network.	Platform-Edge Computing	Functional	WP4	Mandatory	General	No
13041	As a PLATOON platform user, I want the developed Edge Computing solutions to allow for permission-based access control, secure encrypted communication, certificate management and integration into existing security solutions so that the security of my system is not compromised by the installation of edge computing devices.	Platform-Edge Computing	Security	WP4	Mandatory	General	No
13042	As a data provider, I want the developed Edge Computing solutions to allow the implementation of anonymisation solutions so that I can decouple the device from the owner's identity and comply with legal and ethics requirements (e.g. GDPR) defined in deliverable D1.5.	Platform-Edge Computing	Privacy	WP4	Mandatory	General	No
13043	As PLATOON platform user, I want the developed Edge Computing solutions to allow the remote management of individual edge computing instances via run, halt, configure, and update procedures so that I can enable/disable and control the different edge computing devices remotely. It would be desirable to allow orchestration tools that manage and coordinate many edge sites and workloads, potentially leading toward a peering control plane or "self-organizing edge. In this sense the developed solutions must have an open API that allows remote applications to communicate with the edge computing infrastructure via REST, WebSockets, or JSON-RPC. It would also be desirable to allow automated data and	Platform-Edge Computing	Functional	WP4	Optional	General	No

	workload relocations for load balancing across geographically distributed hardware.						
13044	As a PLATOON platform user, I want the developed Edge Computing solutions to allow to virtualize the hardware function using the "software defined hardware" scheme so that I can change the behaviour of the devices updating the deployed software, instead of a more traditional approach that requires the replacement of the embedded firmware. It would be desirable to have automated edge commission/decommission operations, including initial software deployment and upgrades of the resource management system's components.	Platform-Edge Computing	Functional	WP4	Optional	General	No
13045	As a PLATOON platform user, I want the developed Edge Computing solutions to guarantee the latencies required for each scenario deployed especially among those with low and unreliable bandwidths.	Platform-Edge Computing	Functional	WP4	Mandatory	General	No
13046	As a PLATOON platform user, I want the developed Edge Computing solutions to have a fault-tolerant design both from a software and hardware perspective so that I can use them for critical applications where no failure is permitted. Nevertheless, it must be highlighted that developing a completely fault tolerant design is a complicated task that requires vast amounts of resources and time. Thus, thus type of development will probably not be possible given the time and resources allocated for the Edge Computing development task for this project.	Platform-Edge Computing	Functional	WP4	Optional	General	No
13047	As an app provider, I want the PLATOON Marketplace to allow to download the code from the marketplace as self-contained integrated solution following the container technology so that I can sell my apps according to the pay per license business model.	Platform-Marketplace	Functional	WP3	Mandatory	General	No
13048	As an data/app provider, I want the PLATOON Marketplace to ensure that the provided datasets and tools are used by the app consumers under the specific agreed conditions (e.g. cannot be shared with third parties, cannot be exploited with third parties) so that I maintain the IPR of my data/tools.	Platform-Marketplace	Functional	WP3	Mandatory	General	No
13049	As an app provider, I want the PLATOON Marketplace to allow the implementation and exploitation of tools as a microservice so that so that I can sell my apps according to the pay per use business model.	Platform-Marketplace	Functional	WP3	Mandatory	General	No

13050	As a data/app provider, I want the PLATOON Marketplace to ensure that the tools that have been trained with the data owner data can only be used under specific conditions agreed between the data owner and app provider (e.g. it can only be used with data owner, it can be shared with others without showing the raw data and paying a fee to the data owner, etc.) so that I maintain the IPR of my data/tools.	Platform-Marketplace	Functional	WP3	Mandatory	General	No
13051	As a data/app consumer, I want the PLATOON Marketplace to centralize all the different providers in one single one-stop shop including a complete and easy to find catalogue of all of the products and services offered by the different providers so that I can compare the different services offered by the different providers and choose the alternative that suits best my requirements.	Platform-Marketplace	Functional	WP3	Mandatory	General	No
13052	As a data/app consumer, I want the PLATOON Marketplace to contain a detailed description of the offered datasets and tools (metadata) so that I can better understand the applicability and limitations of the of the offered datasets and tools.	Platform-Marketplace	Functional	WP3	Mandatory	General	No
13053	As a data/app consumer, I want that all the products and services offered in the PLATOON Marketplace pass a quality and authenticity check so that I can be sure that the products and services meet the specifications defined in the description and that including them in my business will bring a benefit.	Platform-Marketplace	Process	WP3, WP4, WP6, WP7	Mandatory	General	No
13054	As a data/app provider, I want the PLATOON Marketplace to be easily findable and accessible through the main media channels (magazines, social media, etc.) so that I can reach as much potential consumers as possible.	Platform-Marketplace	Marketing	WP9	Mandatory	General	No
13055	As a data/app provider, I want the PLATOON Marketplace to allow defining usage policies for data and app services and publish metadata including these usage policies directly on the marketplace so that the whole exploitation process is much faster and efficient.	Platform-Marketplace	Functional	WP3	Optional	General	No
13056	As a data/app provider, I want the PLATOON Marketplace to allow automatic transfer of data and tools with the associated usage constraints as soon as the product or service has been purchased on the marketplace so that the whole exploitation process is much faster and efficient.	Platform-Marketplace	Functional	WP3	Optional	General	No
13057	As a data/app provider, I want the PLATOON Marketplace to allow tracking information about data and apps transaction automatically so that it facilitates the billing and auditing process.	Platform-Marketplace	Functional	WP3	Optional	General	No

13058	As PLATOON solution provider, I want the PLATOON marketplace to be based on existing open source solutions so that I avoid rework and I can focus on value added tasks.	Platform-Marketplace	Non-Functional	WP3	Mandatory	General	No
13059	As a PLATOON platform user, I want the PLATOON marketplace to follow a decentralized approach in line with the PLATOON federated platform concept so that I can avoid having a centralized repository and a company that will play the role of the marketplace administrator reducing the exploitation costs beyond the project lifetime. In this sense, the PLATOON marketplace should follow a similar approach to the CKAN open source solution but allowing the exploitation of tools as well as data. Apart from CKAN, there are other already available marketplace solutions that have been created within the scope of different initiatives that should be considered.	Platform-Marketplace	Functional	WP3	Mandatory	General	No
13060	As a data/app provider, I want the PLATOON marketplace to have an external interface where external organizations that are not part of the PLATOON federated platform can see and purchase the different available services so that I can reach a wider public of potential consumers.	Platform-Marketplace	Functional	WP3	Optional	General	No
13061	As a data/app provider/consumer, I want that all the companies that can offer and purchase services through the PLATOON marketplace follow a checking process that I can be sure that they meet certain minimum requirements regarding security, privacy and sovereignty.	Platform-Marketplace	Process	WP3	Mandatory	General	No
13062	As a data/app provider/consumer, I want that the PLATOON Marketplace to be compatible with the IDS reference architecture so that I can access an ecosystem of trusted companies that meet certain minimum requirements regarding security, privacy and sovereignty. In addition, this will avoid having a specific certification authority as the the access rights of companies will be granted by the IDS certification authority.	Platform-Marketplace	Process	WP3	Mandatory	General	No
13063	As a data/app provider/consumer, I want the PLATOON Marketplace to have a payment gateway so that the paying process is faster and more efficient.	Platform-Marketplace	Functional	WP3	Optional	General	No
13064	As a data/app provider/consumer, I want the PLATOON Marketplace to allow a negotiation step so that a consumer can identify datasets or apps then request a price from the provider and the provider can then assign a specific price depending on the consumer (using 'unit prices' as a base pricing scheme).	Platform-Marketplace	Functional	WP3	Optional	General	No

13065	As a data/app provider/consumer, I want that the PLATOON Marketplace to implement generic data security mechanisms (secure communication, identity management), data access (authorization management) control and data usage control aspects so that the security of my system is not compromised.	Platform-Marketplace	Security	WP3	Mandatory	General	No
13066	As a data/app provider/consumer, I want that the PLATOON Marketplace to be compliant with GDPR so that I avoid data privacy issues with any personal data that might be stored, provided or shared through the PLATOON Marketplace (e.g. personal contact details, bank account details, etc.).	Platform-Marketplace	Privacy	WP3	Mandatory	General	No
13067	As a PLATOON project partner, I want that external companies including the selected companies for open calls follow the PLATOON reference architecture and the common data models, ontologies and APIs defined so that I can share data with them and I can use the tools developed by the external companies.	Platform-Collaboration	Non-Functional	WP7	Mandatory	General	No
13068	As a PLATOON project partner, I want that external companies including the selected companies for open calls follow the security, privacy and sovereignty solutions defined in WP3 so that I can ensure that the platforms from the external company does not suppose a cybersecurity risk to the rest of the platforms that form the PLATOON federated platform and that I can be sure that when I exchange data with these external companies the data security, privacy and sovereignty requirements are maintained.	Platform-Collaboration	Security and Privacy	WP7	Mandatory	General	No
13069	As a PLATOON project partner, I want that external companies including the selected companies for open calls follow the Data Analytics Toolbox and Edge Computing solutions defined in in tasks T4.1 and T4.2, respectively, so that they meet the corresponding requirements defined in this document.	Platform-Collaboration	Non-Functional	WP7	Mandatory	General	No

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