Deliverable D1.3

Public Innovation Concept

WP 1

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Project Summary

The objective is to establish an IT environment for the integration and analytics of data streams coming from high volume (mass) products with cyber physical features, as well from Open Data Sources, aiming to offer new cross sectorial services and focusing on the commercial confidentiality, privacy and IPR and ethical issues using a context sensitive approach. The project addresses cross-stream analysis of large data volumes from mass cyber physical products (CPP) from various industrial sectors such as automotive, and home automation. The business objective of the research is to allow for analyses of such data streams in combination to other (non-industrial, open) data streams and for the establishment of diverse enhanced sectorial and cross-sectorial services. The project will develop: (i) New models for integration and analytics of data streams coming from multi-sectorial CPP, including shared systems of entity identifiers applicable to multi-sectorial CPP (as well as the definition of agreed data models for data streams from multiple CPP aiming at defacto standard; (ii) Ecosystem, including a common Marketplace, and methodology to use such models to build multi-sectorial cloud based services, (iii) Toolbox for real-time and predictive cross-stream analytics, context modelling and extraction, and dynamically changing security policy, privacy and IPR conditions/rules and (iv) set of services such as services based on a combination of data streams from home automation and (electrical) vehicles to provide enhanced local weather forecast and predict and optimise energy consumptions in households. The project will build upon the results from past and current projects, where results from the project AutoMat, addressing services developed based on data streams from vehicles, will be used as a basis for further development aiming to extend it to integrated, cross-sectorial data streams analytics.

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- Siemens SRO (SIM), Czech Republic
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PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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100	Final version	31.01.2019

Document Summary

This document gives an overview of the key Cross-CPP project objectives and challenging requirements and provides a summary of the Cross-CPP Solution Concept. For this purpose this document is presenting the following topics:

- Motivation and Challenges driving the Cross-CPP project
- Ecosystem Workflow defining the information flow between key stakeholders and Cross-CPP system modules
- Ecosystem Architecture presenting the high level structures of the Cross-CPP system solution and functions as a blueprint for the system development
- Methodology Concept that shall serve the different stakeholders of the Cross CPP value chain as basic guidelines for participating in the overall Cross-CPP workflow

This is a public document, which presents the aforementioned aspects in an accessible way for a non-restricted audience.

Abbreviations

API	Application Programming Interface
App	Software Application
B2B	Business to Business
B2C	Business to Company
BC	Business Case
BMP	Big Data Marketplace
CAN	Controller Area Network
CB	Company Backend
CIDM	Common Industrial Data Model
CME	Context model, Modelling & Extraction
CPP	Cyber Physical Products
CPS	Cyber-Physical Systems
CPU	Central Processing Unit
CS	Cloud Service
CVIM	Common Vehicle Information Model
D	Deliverable
DH	Data Harvesting
e.g.	exempli gratia = for example
ECU	Electronic Control Unit
EU	European Union
GA	Grant Agreement
GUI	graphical user interface
i.e.	id est = that is to say
IPR	Intellectual Property Rights
MP	Marketplace
OEM	Original Equipment Manufacturer
R	Requirements
ROI	Return On Investment
SME	Small and Medium Sized Enterprise
T	Task
WP	Work Package

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1 Motivation and Challenges

Project Motivation

Key ***motivation of Cross-CPP*** project is to give cross-sectorial industries access to the great spectrum of sensor data coming from high volume products from various industrial sectors (vehicles, smart home devices, etc.). With the increasing number of connected sensors and actuators within such mass products, this number will rise in short-term. This enormous amount of data continuously generated by mass products will represent:

- ***a NEW information resource to create new value***, allowing the improvement of existing services or the establishment of diverse new cross-sectorial services, by combining data streams from various sources
- ***a major big data-driven business potential***, not only for the manufacturers of Cyber Physical Products (CPP), but in particular also for cross-sectorial industries and various organisations with interdisciplinary applications

Figure 1: The Cross-CPP Vision

However, these business potentials are currently still locked since manufacturing industry producing mass products has not established clear models and tools for such cross sectorial collaborations. Current solutions and offerings in the CPP data domain are driven by OEM specific business approaches that are almost solely focused on their own products and are realized by proprietary solutions. The resulting brand-specific solutions mostly do not provide CPP data to the outside world, hindering long-term value creation by service providers due to fragmented environments and the lack of brand-independent representation of CPP data. Due to this high level of market fragmentation, the situation today is characterized by far too complex and individual value chains resulting in economic inefficiency.

This situation is mainly characterised by the following major difficulties for both, the service providers (data customers) and for the CPP manufactures / owners (data providers):

- **No or limited access to CPP data** caused by missing or distributed access to CPP data as well as by diverse brand specific data formats. This situation is forcing service providers interested in CPP data to build up and maintain interfaces to diverse ecosystems with different data models, causing high efforts and costs for data collection and processing.
- **Limited possibilities to use cross-sectorial CPP big data streams,** due to missing functionalities for an easy access and detection of needed data, as well as of easy to use big data analytics functionalities for Service Providers with low big data expertise and knowledge.
- **Missing preconditions to establish such cross-sectorial data market**, as for e.g. the absence of an agreed common data model for CPP data coming from various industrial sectors, or mechanisms for an optimal management of commercial confidentiality, privacy, IPR and ethical aspects applicable to various cross CPP data streams.
- **Uneconomical brand-specific service platform solutions**, causing high costs for the implementation of proprietary data platforms, which have to be financed and justified by just a few CPP manufacture specific services (no single service can bear the cost for such system solution -> ROI is not achievable). Thus, today services will be often offered for high price not acceptable for the majority of customers.
- **Wasted Innovation Potentials** by thousands of external experts due to closed brand-specific data platform. Even very big CPP Manufactures will by far not have the expertise and innovation potentials of the world-wide network of service providers. By that reams of new innovative services remain closed.

In contrast to today's sporadic proprietary CPP ecosystems, which are in most cases restricted to CPP manufacture specific services and which are not open for third parties interested in these CPP data, the Cross-CPP project focuses on what CPP and their sensor data can bring to the outside world. Therefore, as key challenges, Cross-CPP has to overcome several obstacles by establishing a CPP Big Data Ecosystem, which should develop the following main characteristics:

- **Brand independent concept**, open for integration of diverse CPP data providers coming from different industrial areas, also providing a standardized cross industrial CPP data model which needs to be flexible enough to incorporate data coming from various industrial sectors.
- **CPP Big Data marketplace** providing to service providers a single CPP data access point with just one interface (one-stop-shop), as well as support functionalities for easy data mining/analytics. By these means, data customers (Service Providers) just need to set-up and maintain one interface to gather diverse CPP data from different CPP providers.
- **Controlled access to diverse CPP data streams** and optimal management of data ownership and data rights, applicable to various cross CPP data streams.
- **Win-Win value chain** for all ecosystem partners, due to the fact that the costs for the ecosystem in place can be shared by a great many data customers, which will make a single service much more economical.

Starting Point and Challenges for Cross-CPP

The Cross-CPP project does not have to reinvent the wheel and can build upon the results of the past and current projects ProSEco, AutoMat, IASIS, Resilience 2050, and Juniper.

Specifically, results from the project AutoMat, which has established a novel and open Ecosystem in the form of a cross-border Vehicle Big Data Marketplace that leverages currently unused information gathered from connected vehicles, will be used as a basis for further development. The validity of the developed brand independent AutoMat concept and standardized common vehicle data model has been proven in the scope of the project for the automotive industry by three leading car manufactures (Volkswagen, Renault and FIAT).

In contrast to AutoMat project, which was focused exclusively upon automotive industry, a key mission of Cross-CPP is to analyse and extend the AutoMat concept with regard to the integration of data streams coming from other CPPs than vehicles.

Given that Cross-CPP project aims to extend the AutoMat approach to a “Cross-Sectorial Ecosystem”, first of all the project has analysed the existing AutoMat workflow and architecture from both sides, the perspective and needs of cross-sectorial CPP Data Providers (CPP manufacturers / owners) and the perspective of Data Customers (Service Providers) who intend to create new value out of that CPP data. To achieve this transition to a “Cross-Sectorial Ecosystem” the project has to face the following challenges:

1. From perspective of Data Providers (CPP manufacturers / owners)
   - Enlarge the big data pool by providing data streams from various industrial sectors such as automotive, home automation systems and other industries.
   - Extend Cross-CPP Data Model, for data streams coming from multiple sources, applicable for various industrial sectors.
   - Empower data owners to exploit their most valuable asset in the “Internet of Things” – their CPS data (vehicle data, smart home device data etc.), simultaneously ensuring that the owner can fully control which data should be provided to which Service Provider, always under consideration of their commercial confidentiality, privacy, IPR and ethical aspects.
2. From perspective of Data Customers (Service Providers)
   - To offer advanced one-stop-shopping support for Service Providers, especially for SMEs or start-ups, by providing instruments enabling an easy access, detection and selection of required data, as well as flexible cross-stream analysis tools for large data volumes.
   - Extend Cross-CPP Data Model, providing data streams coming from different industrial sectors.

According to those challenges, the envisaged major projects outcomes of Cross-CPP will be:

- **Standardized Cross Industrial Data Model**

  One of the most important objectives of this project is to come up with a standardized cross industrial data model. This model needs to be flexible enough to incorporate data coming from various

industrial sectors and to further extend it to future upcoming needs by both, Data Providers and Data Customers.

- **CPP Big Data Marketplace with Analytics Toolbox**

  The envisaged “One-Stop-Shop” CPP Big Data Marketplace will provide Service Providers a single point of access to data streams from multiple mass products. The Marketplace will also offer a data analytics toolbox, which will provide easy to use big data analytic functionalities for Service Providers, enabling an easy access, search/detection and selection of required data.

- **Cross Industrial Services**

  Cross industrial data streams represent new information resources enabling new and innovative business ideas. In the scope of the Cross-CPP project, the consortium partners will develop several innovative cross-sectorial services.

2 Cross-CPP Ecosystem Workflow

As mentioned before, key starting point for Cross-CPP is to build upon the results of the former AutoMat project. Therefore, in contrast to the AutoMat project focussing exclusively upon automotive industry, in a first step the validity and needed extensions of the AutoMat concept with regard to the integration of data streams coming from other CPP Data Providers have to be analysed. For this, the Data Harvesting and Processing at CPP Data Provider side have to be investigated. In Figure 2 the respective AutoMat configuration is presented.

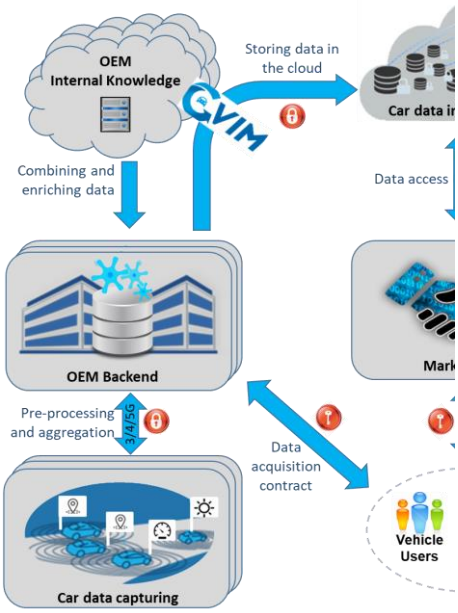

Figure 2: AutoMat configuration

In AutoMat the data harvesting process takes place in the vehicle. The various Electronic-Control-Units (ECU) like engine and brake control units, air-condition system etc. are responsible for the vehicle operation where a wide range of sensor systems provide the signals for the respective control tasks. The different ECUs hardware units are strongly interacting, where the required signal exchange takes place via bus-systems (e.g. CAN-Bus, FlexRay etc.). About 4.000 signals at a sampling interval of about 10ms are exchanged, whereat the information is just broadcasted on brand specific bus systems, which means that all data are volatile information. Without interacting with any of the ECUs responsible for the operation of the vehicle, in the AutoMat concept a configurable Data Logger is harvesting those data from the different vehicle busses, which are of interest for Service Providers. These data might be processed or aggregated on vehicle level before they are forwarded to the OEM Backend via a secure mobile communication link. At the OEM Backend the data are further processed (e.g. validation, cleansing, normalisation, further aggregation). Finally, the data are transformed into the brand independent standard data format, the so called CVIM (Common Vehicle Information Model) to be stored in a cloud storage. In case of Cross-CPP the vehicle data have to be transformed into the “Unified Cross-Industrial Data Model”. Additionally, the OEM Backend is responsible for the contract management with the data owner to agree on the vehicle data allowed to be harvested.

Analysing the second Cross-CPP scenario of the building management system a similar structure can be identified. A building management system consist of several independent operating hardware control units getting signals from respective sensor systems for e.g. building access control, heating/air conditioning, fire protection etc. These control units communicate with a Building Management Backend responsible for the monitoring and optimisation of all the systems in the building (e.g. Siemens Desigo CC software platform). This covers tasks like handling of process-data and parameter settings, archiving of process data etc. Cross-CPP targets to harvest data from the building management system in operation, which are of interest for external Service Providers without directly interacting with the building control system. Just the data logging, backend pre-processing, the transformation in the Unified Cross-Industrial Data Model and the handling of the access allowance have to be added in the Backend.

Due to the fact, that the Cross-CPP data harvesting is not directly interacting with the process operation of any CPP system, but is just collecting data from these processes via a configurable logging functionality, in conclusion it can be stated that the basic AutoMat concept is also valid for any CPP Data Provider system. Required are extensions in respect to Cross-CPP Backend functionalities concerning any necessary pre-processing of the harvested data and the transformation into the Unified Cross-Industrial Data Model. Also the handling of the contract management concerning the consent on data acquisition by the data owner must be realized. The resulting generalized Cross-CPP Ecosystem (see Figure 3) is described in the text to follow.

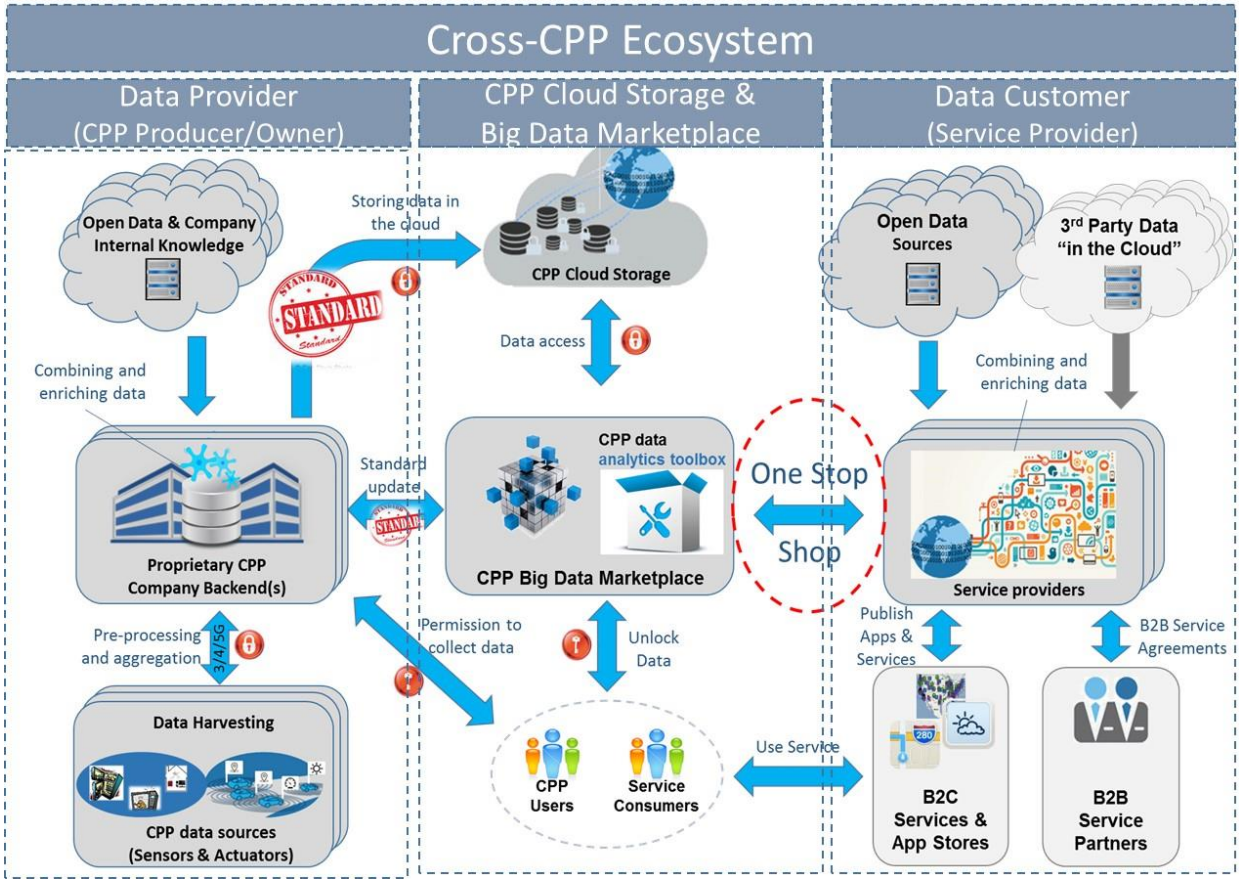

Figure 3: Cross-CPP Ecosystem

In general the ecosystem can be separated into three pillars:

1. ***Left pillar: Data Providers (CPP Manufacturers)*** -> Comprising data harvesting and making CPP data from various industrial sectors available, transfer brand specific data streams into the common CPP data model.
2. ***Middle pillar: Cross-CPP Cloud Storage & Big Data Marketplace (MP)*** -> Comprising a cloud based concept for CPP Cloud Storage. Enabling controlled access to CPP data from different sources, offering support to Service Providers in the form of an easy access and detection of needed data, as well as of flexible cross data stream analysis tools.
3. ***Right pillar: Data Customer/Service Provider*** -> Cross-sectorial industries or manufacturers of CPP using CPP data from various products to create new value out of that data ("CPP-data" has no value in itself), by improving services or establishment of diverse new cross-sectorial services.

These general Cross-Sectorial Ecosystem workflow, structured by the three pillars, is detailed in the text to follow.

Left pillar: Data Providers (CPP Manufacturers)

As written above, the CPP Manufacturers are the key for gathering and provisioning of CPP Data. According to the underlying concept the left pillar is structured into two main components, *Data Harvesting* and *CPP Company Backend*. The main functionalities required by the envisaged Cross-Sectorial Ecosystem workflow are described for both components in the following.

Data harvesting (on CPP level, e.g. on vehicle or house level)

The main role of the Proprietary CPP Data Harvesting is to acquire the data from a proprietary CPP data source and send them to CPP Company Backend (see Figure 4). To ensure that the data harvesting process is in consent with end user needs, a data acquisition configuration is downloaded from the CPP Company Backend and deployed in the CPP data logger. CPP data will be measured and stored as CPP data packages. In order to reduce the amount of information to be transmitted the CPP signals can be pre-processed and aggregated. Optionally a data masking might be applied. These CPP data will be transmit to CPP Company Backend module according to the transmission strategy defined by the CPP manufacture. To enable a flexible data acquisition process in respect to upcoming adaptations of signals and data channels, the data acquisition process on CPP level can remotely configured by the CPP Company Backend.

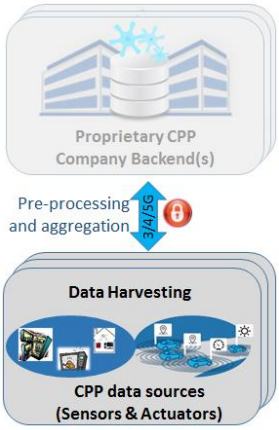

Figure 4: CPP Data Harvesting

CPP data infrastructure and CPP Company Backend:

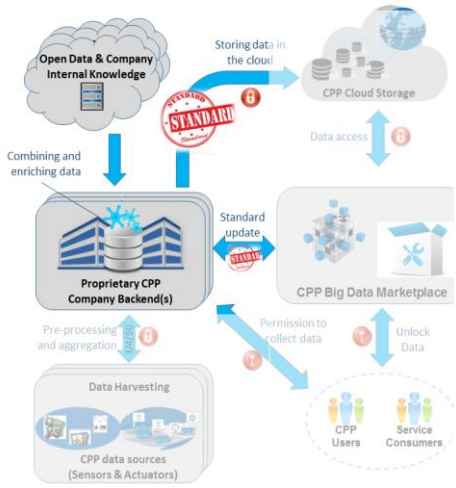

Figure 5: CPP Company Backend

In Cross-CPP, the CPP Company Backend represents the central data access point to the CPPs for thousands to millions of CPPs of a brand. The CPP Company Backend (see Figure 5) will be based on proprietary brand specific solution, interpreting and transforming proprietary CPP manufacture specific CPP data into physical information in reference to agreed owner permissions. Furthermore, the information will be validated and can be masked to enforce privacy. Finally, the information is converted into the required quasi standard information representation, the Unified Cross-Industrial Data Model format and is published to the owner's CPP Cloud Storage. The CPP Company Backend will also manage the configuration procedures for the data mining at CPP level, by providing CPP specific data logger configurations. In this context the CPP Company Backend has to handle also the consent of the data owner for data harvesting as well as with a cloud storage provider. Therefore, the data owner selects data to be harvested from CPP and may define data masking features w.r.t. privacy requirements. The CPP data owner can also terminate these contracts.

Middle pillar: Cross-CPP Cloud Storage & Big Data MP

As written above, the Cross-CPP Cloud Storage & Big Data Marketplace consist of a cloud based concept for CPP Cloud Storage and a Marketplace enabling controlled access to CPP data from different sources, also offering support to Service Providers in the form of an easy access and detection of needed data. According to the underlying concept the middle pillar is structured into two main components, 'CPP data in the cloud' and 'CPP Big Data Marketplace. The main functionalities required by the envisaged Cross-Sectorial Ecosystem workflow are described for both components in the following text.

CPP data in the cloud:

Cross-CPP targets a cloud based concept for the storage of CPP Big Data. Therefore, a storage provider needs to setup and offer a certified data storage infrastructure. In general it is assumed that various providers offer “data vaults”. The storage infrastructure has also to provide an application programming interface (API) to enable data reception from the CPP Manufacture Backend, as well as data access by the CPP Big Data Marketplace. Furthermore, storage providers have to prevent data from unauthorized manipulation, to ensure data completeness, as well as the trustworthiness of the data sources and the protection of the privacy of data owners, etc.

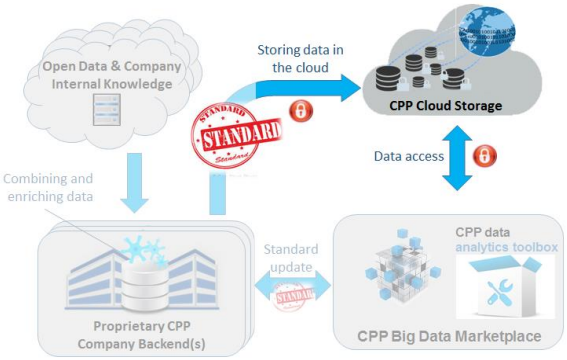

Figure 6: Cloud based concept

The data are stored in a brand-independent, open and transparent data model represented by the Common CPP Data Model. However, the CPP Data Model will not be a rigid, rather representing a living data structure, where in reference to the needs of the service provider community the amount of signals to be recorded, as well as the type of measurement channels can be modified or extended. Therefore, the storage management must be able to handle an update of the CPP Data Model.

CPP Big Data Marketplace:

The CPP Big Data Marketplace (see Figure 7) is the central element of the Cross-CPP Ecosystem Concept representing the mediator for all the actors involved in the flow of the data.

For the data customer (service provider) side the CPP Big Data Marketplace (CPP-BMP) represents a “One-Stop-Shop” Marketplace provide a single point of access to data streams from multiple mass products. Therefore, the marketplace will also offer instruments enabling an easy access and detection of needed data, as well as a data analytics toolbox, which will provide easy to use big data analytic functionalities for Service Providers with low big data expertise and knowledge.

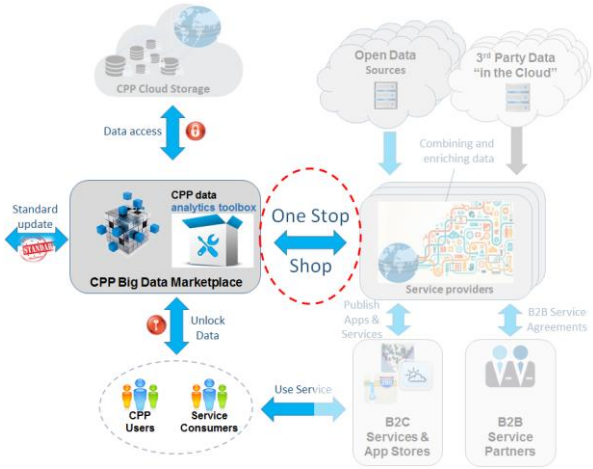

Figure 7: CPP Big Data Marketplace

On the other hand, in respect to a service provider request to access specific CPP information sets the CPP Big Data Marketplace has to identify the relevant data owners and manage their permission for the data access by the service provider.

The data provision to the service providers can take place in a pull or push mode. In the pull mode in case of a data request the access authorisation will be checked and the relevant data storages identified. The retrieved CPP information from the storage cloud will be decrypted, verified, anonymised where needed and delivered to the service provider. In the scope of these activities also an accounting of the data access will be realised as reference for any billing process. In case of the push mode, the CPP-BMP will have to manage the push data subscription and change notification. All other activities to be realised by the CPP-BMP are the same as for the pull mode.

The CPP Big Data Marketplace has also to handle the certification of cloud vaults offered by the various storage providers according to specified requirements, as well as to administrate the certified CPP Cloud Storage catalogue.

Right pillar: Data Customer/Service Provider

Once all contractual agreements for the data access by service providers have been arranged, for the service run-time phase the service providers have to enable to bring brand-independent cross-sectorial data stream content to their worlds. Therefore, the marketplace offers a quick and easy access to the CPP data from various products, including flexible cross-stream analysis tools for large data volumes, covering features such as data cleaning, filtering, etc., transforming the CPP information into service relevant input information. On service provider side an integration of other big data information sources and the CPP information forwarded by the CPP Big Data Marketplace will happen and big data analytics concepts applied. Based on specialized algorithms for the various services, the final service products are generated. These services may be offered at already existing portals (e.g. Apple App Store, Google Play Store, etc.) in order to distribute their services and applications.

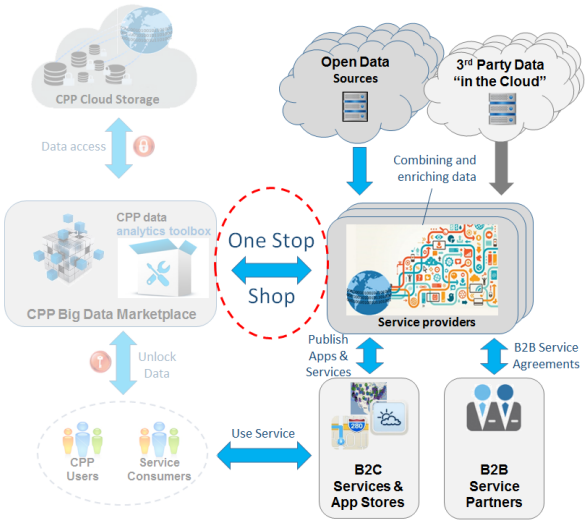

Figure 8: Service Providers

3 Cross-CPP Ecosystem Architecture

As already state above, the Cross-CPP project builds upon the results of the past and current projects ProSEco, AutoMat, IASIS, Resilience 2050, SAFIRE, and Juniper. Specifically, results from the project AutoMat will be used as reference for the Cross-CPP system development.

In the following the results of the developed concept for the general Cross-CPP Ecosystem Architecture is presented. Therefore, the following overview of general Cross-CPP Ecosystem Architecture Concept presents the plans and strategies on how to reuse and significantly enhance the results of the past project w.r.t. Cross-CPP project needs and objectives.

The resulting overview on the Cross-CPP Ecosystem Architecture Concept in Figure 9, is presenting the high level structures of the Cross-CPP system solution and functions as a blueprint for the system development. The architecture concept in Figure 9 summarise the Cross-CPP modules and its key software components and how they correlate in Cross-CPP. This figure has been derived from the workflow concept shown in Figure 3 and is composed of the main Cross-CPP modules:

- *CPP Data Harvesting*,
- *CPP Company Backend*,
- *CPP Big Data Marketplace & Data analytics toolbox* and
- *Cloud Storage*.

Furthermore, the ecosystem is completed by the cross-cutting modules:

- *Context model, modelling & extraction (CME)* and
- *Security*.

And the model by which the Cloud Storage is made, the *Common Industrial Data Model (CIDM)*.

The following Figure 9 is showing the overall Cross-CPP system solution, representing a general layered architecture view on the system concept, focusing on the components which carry the main functionality and showing the basic interaction between these components. In short:

- The bottom, the Cyber Physical Products (CPP) layer consists of vehicles and smart home devices. The Data Harvesting module acts as intermediate layer between the CPPs and the Company Backend module. The connection will be realised using 3/4/5G mobile web technologies in the case of vehicles and wired connection in the case of smart home devices.
- The Company Backend module holds the Cross-CPP company data processing chain, which receives data from the Data Harvesting Module and after processing, enrichment with company internal knowledge, formatting and transformation, stores the processed data into CIDM format (in the CPP Cloud Storage. The Company Backend module holds bidirectional connections to the CPP Cloud Storage as well as to the CPP Big data Marketplace for transferring the data and updates of the CIDM format.
- The CPP Cloud Storage holds the CPP data in the CIDM format and provides interfaces both to the CPP Company Backend as well as to the CPP Big data Marketplace for the CPP data access.
- The Big Data Marketplace module includes the CPP Data Analytics toolbox and the Software Development kit. It ensures secure data access to the CPP Cloud storage and can optionally be accessed via a GUI. The GUI is mainly used by Service Providers to select and configure the access to the cross-sectorial CPP big data pool offered by the Cross-CPP data providers via the CPP Cloud Storage.

All these modules will be accompanied by the CPP Security layer which assures the secure, context sensitive access to the CPP Cloud Storage and the Context monitoring and extraction layer that extract context from the CPP and services use to support security and improve services.

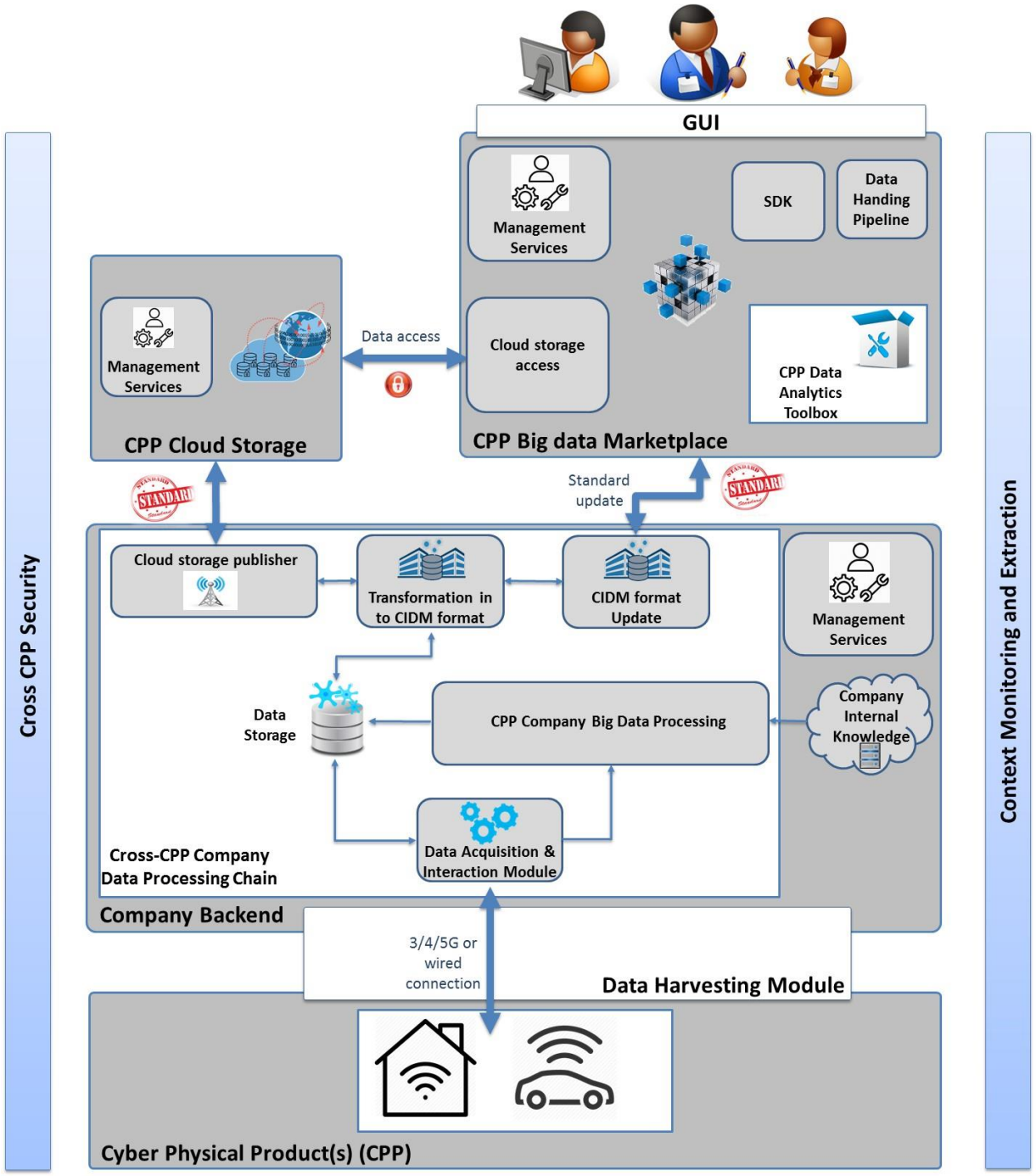

Figure 9: Overall Cross-CPP System Architecture

4 Cross-CPP Methodology Concept

Beside the specification and implementation of the Cross-CPP ecosystem, the project will also develop and provide a methodology concept that shall serve the different stakeholders of the Cross CPP value chain as basic guidelines for participating in the overall Cross-CPP workflow (see Figure 3).

In this context, one of the key objectives of the Cross-CPP Methodology is to attract and win new ecosystem users/partners by provision of tailored support material for the key ecosystem stakeholders to empower them too easily:

- implement specified and developed procedures and tools
- understand offered functions and tools

Therefore, the Methodology will address organisational, administrative and contractual measures concerning the interaction of the various stakeholders with the Cross-CPP Ecosystem. Taking the overall Cross-CPP workflow with its three main pillars as a baseline, the key stakeholders can be mapped to this workflow as presented in Figure 10.

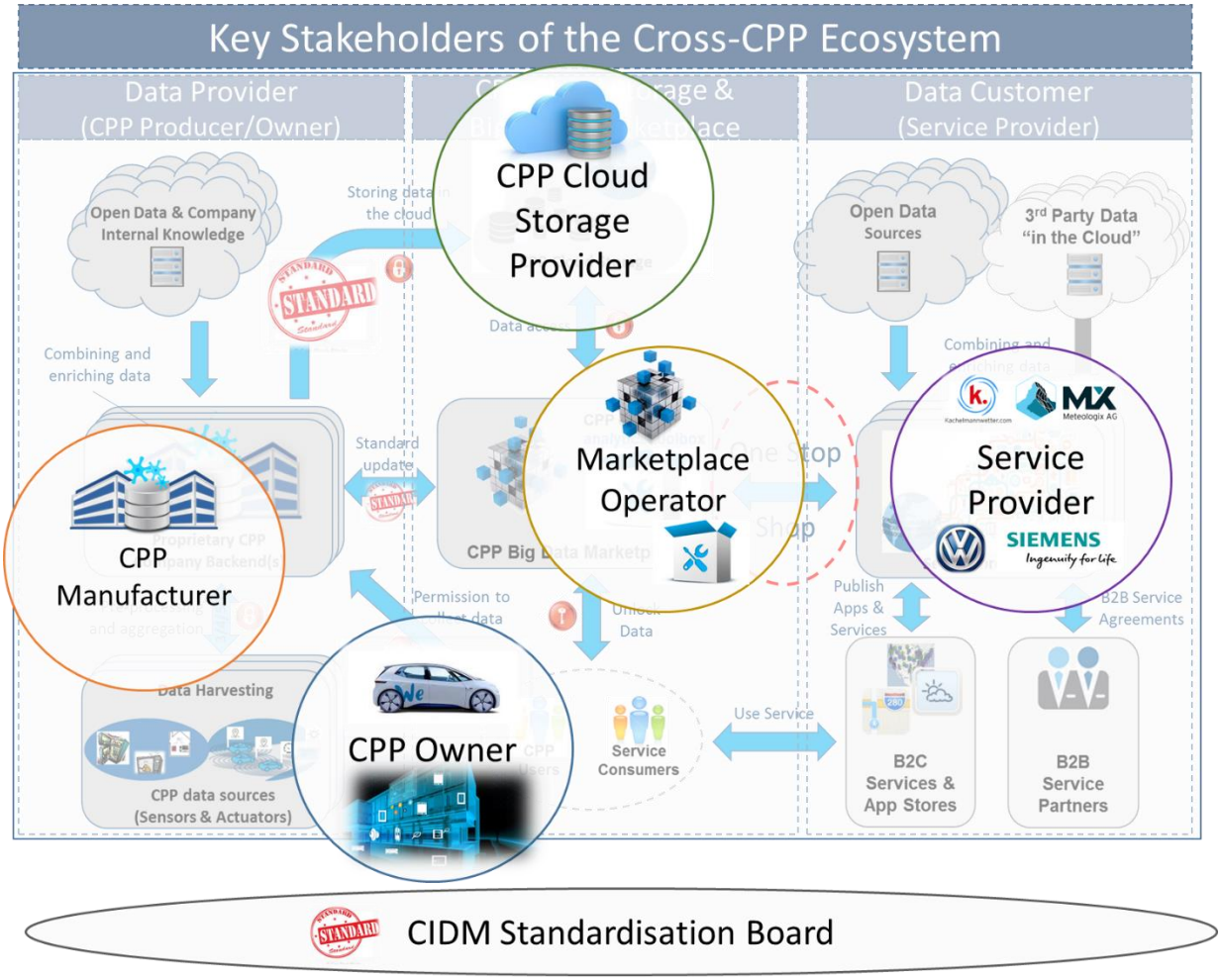

Figure 10: Key Stakeholder of the Cross CPP Ecosystem

To achieve such envisaged Methodology Concept and to identify required tailored support material to be developed, the specific view and needs for each of the Cross-CPP ecosystem stakeholder has to be taken into account. For this reason, this chapter is structured according to the Key Stakeholder of the Cross CPP Ecosystem in Figure 10:

- 4.1 CPP owner/user (Service customer)
- 4.2 CPP manufacturer (Data provider)
- 4.3 Cloud storage provider
- 4.4 Marketplace operator
- 4.5 Service Provider (Data and service customer)
- 4.6 CIDM Standardisation Board

Each stakeholder-specific section begins with a short description of the stakeholder's role and their respective activities as well as their specific methodological needs, using among other things the expertise of different stakeholders involved in the Cross-CPP project. This description is accompanied by a table, covering the methodology issues to be addressed, i.e. required tailored support material for the addressed ecosystem stakeholder. These topics represent the reference for the development of the Cross-CPP methodology.

The development of required methodological support material will be realised within the scope of the development related work packages WP200 –WP600. The documentation of the resulting methodological material will be provided in deliverable D6.5. Finally, in D6.5 a complete description of the Cross-CPP methodology will be presented and made publicly available.

In the scope of the Cross-CPP project the methodology will be validated for Car Industry and Home Automation use cases and should serve well for different cross domain CPP manufacturers as well.

4.1 CPP Data Owner

Of vital importance for the Cross-CPP project is the assumption that data acquired from a CPP belong to the owner/user of the CPP. Furthermore, these Data Owners must retain full and transparent control over which data of the CPP are harvested, where the data are stored, and by which services these data are used. This concept was explicitly formulated and applied for the first time in the AutoMat project.

The Automat approach is in line with principles of data protection such as formulated by the European Automobile Manufacturers Association (ACEA), supplementing existing laws and regulations governing personal data protection and privacy in the European Union. These principles intend that the customers can choose whether or not to share their own data with third parties for commercial purposes according to a contract. Moreover, the data owner must be able to disallow specific data accesses and otherwise have control over how the data is used. All these principles require that the data owner always must be aware of what entity is using which data and for what purpose, even for the usage of anonymised data by a service provider.

This concept has essential consequences on the operation of the overall Cross-CPP Ecosystem. To guarantee this full control by the Data Owner, from a methodology point of view, contractual relations have to be defined between the Data Owners and respective shareholders of the Cross-CPP Ecosystem. Furthermore, there must be technical measures capable of enforcing data controls corresponding to the nuances specified by the contracts. The required operational interactions between the data owner and respective shareholders of the overall Cross-CPP Ecosystem are part of the solution concept of the sub-systems of the Cross-CPP Ecosystem.

In Deliverable D6.5 regulation for the following aspects should have to be put in place for the CPP Data Owner:

Methodology issues to be addressed in D6.5 of Cross CPP Project	WP/Task
Handling of the agreements between data owner and CPP Manufacturer concerning the harvesting of CPP Data required for the data access control	WP200/T220 WP200/T230
Handling of the agreements between data owner and cloud storage provider concerning the storage of CPP Data required for the data access control	WP200/T230
Handling of the agreements between data owner and service provider concerning the usage of CPP Data required for the data access control	WP600/T610 WP200/T230
Data privacy and security issues from data owner point of view	WP500/T520

4.2 CPP Manufacturer (Data Provider)

The data provider, which is displayed as left column in the Figure 3, can be any CPP manufacturer that might have proprietary systems in place for gathering data from various CPPs. However, it is interesting to note that in general the CPP manufacturer is neither the data owner nor the owner of the CPP.

As a first step, the Cross-CPP methodology has to provide guidelines and rules concerning how a CPP manufacturer may join the Cross-CPP Ecosystem. With respect to Cross-CPP methodology there are key requirements that need to be fulfilled by CPP data providers, to empower them to participate in Cross-CPP

workflow. The CPP manufacturer has to provide a proprietary infrastructure to first collect and then transfer data from the CPP to a company backend. For the purpose of data harvesting, a data provider needs CPPs that can provide data as well as context information on data with a certain level of reliability. Furthermore, respective data security issues have to be resolved. Data needs to be provided in the agreed CIDM format to the data storage in the Cloud. In this regard the methodology should provide guidance to CPP manufacturers enabling them to participate in the overall Cross-CPP workflow.

Furthermore, a regulation is required to govern the data acquisition agreement between the CPP manufacturer with the Data Owner also taking into account context information as well as respective data privacy and security requirements. Obtaining the Data Owner's consent should be the responsibility of the CPP manufacturer, which can be achieved by different methods. However, to find the right solution to this challenge, the selection and specification of a proper methodology really depends upon the particular domain and proprietary manufacturer solution.

In addition and as mentioned before, the CPP manufacturers have to provide data in the agreed CIDM format to the data storage in the Cloud. In this context, the CIDM format represents an evolving standard in respect to both the changing requirements by the service provider community and continuously enhanced availability of new CPP sensor data. The methodology has to provide rules concerning how CPP manufacturers (i) are involved in this adjustment and validation process and (ii) how CIDM format modifications have to be handled by the CPP manufacturers.

In Deliverable D6.5 regulation for the following aspects should have to be put in place for the CPP Data Provider:

Methodology issues to be addressed in D6.5 of Cross CPP Project	WP/Task
Participation of CPP manufacturers in the Cross-CPP Ecosystem	WP200/T220
Data acquisition agreement between CPP manufacturer with the Data Owner	WP200/T220
Handling of the adjustment of the CIDM by the CPP manufacturer	WP200/T220 WP200/T230
Context sensitivity issues from CPP manufacturer point of view	WP500/T510 WP200/T220
Data privacy and security issues from CPP manufacturer point of view	WP500/T520 WP200/T220

4.3 Cloud Storage Provider

Cross-CPP targets a cloud-based concept for the storage of CPP Data (see Figure 3). Therefore, any storage provider that wants to participate in the Cross-CPP Ecosystem needs to establish and offer a certified data storage infrastructure. In general it is assumed that various providers offer "data vaults". Even stakeholders of the Cross-CPP Ecosystem such as the CPP manufacturer or the marketplace may take the role of a storage provider.

The storage infrastructure has to enable data reception from the CPP Backend as well as data access by the CPP Big Data Marketplace. The storage management must be able to handle CPP data and related context information in the standard CIDM format and must be able to treat updates of the CIDM format initiated by the market place. Furthermore, storage providers have to prevent data from unauthorized manipulation, to ensure data completeness, as well as the trustworthiness of the data sources and the protection of the privacy of data owners, etc., according to the contractually agreed policies.

From a methodology point of view the mandatory requirements for cloud storage provides intending to participate in the Cross-CPP Ecosystem have to be documented. The fulfilment of those requirements must be validated by the marketplace to earn the status of a certified cloud storage provider, which will then be eligible to be selected by any data owner for their cloud storage.

Therefore, from a methodology point of view governance must be defined for the certification process of cloud storage providers as well as contractual provisions between a data owner and a certified cloud storage provider for the storage of the owner's CPP data.

In Deliverable D6.5 regulation for the following aspects should have to be put in place for the Cloud Storage Provider:

Methodology issues to be addressed in D6.5 of Cross CPP Project	WP/Task
Regulations for cloud storage providers to participate in the Cross-CPP Ecosystem	WP200/T230
Regulations for the certification of potential cloud storage providers by the marketplace	WP200/T230
Agreement between Data Owner and cloud storage providers in respect to the storage of CPP data	WP200/T230
Data privacy and security issues from cloud storage provider point of view	WP500/T520 WP200/T230

4.4 Marketplace and Toolbox Operator

The Marketplace is the central element of the Cross-CPP Ecosystem acting as the mediator for all the actors involved in the overall data flow of the Cross-CPP System. The marketplace will also offer instruments enabling easy detection of and access to needed data by any service provider, as well as a data analytics toolbox, which will make available easy-to-use big data analytic functionalities for Service Providers. However, service providers will have to fulfil a set of requirements to become part of Cross-CPP Ecosystem.

The data provided through the Marketplace will be brand-independent and formatted according to the standardized CIDM format and managed subject to the Data owner's stated access and privacy policies with respect to data harvesting process as well as usage of the data by service providers. This implies the handling of context information as well as Data privacy and security issues.

The Marketplace will be aware of certified storage providers, to handle and to have access to the user's storage locations. It will be also responsible for the process of certification to become a Cross-CPP storage provider.

In this context the Marketplace will have the role of a contract handler defined by business case contracts with involved stakeholders – data owners, OEMs, storage and service providers and also acts as a mediator for the accounting and payments from service providers to OEMs or users - in those cases where users might be rewarded. Such topics have to be addressed by the Cross-CPP Methodology.

In Deliverable D6.5 regulation for the following aspects should have to be put in place for the Marketplace and Toolbox Provider:

Methodology issues to be addressed in D6.5 of Cross CPP Project	WP/Deliverable Scope
Regulations for cloud storage providers to participate in the Cross-CPP Ecosystem	WP200/T230
Handling of the agreement between data owner and CPP Manufacturer concerning the harvesting of CPP Data	WP200/T220 WP200/T230
Handling of the agreement between data owner and cloud storage provider concerning the storage of CPP Data	WP200/T230
Handling of the agreement between data owner and Marketplace provider concerning allowed provision of data to service providers	WP200/T230
Handling of the agreement between data owner and service provider concerning the usage of CPP Data	WP600/T610 WP200/T230
Certification of cloud storage providers	WP200/T230
Handling of the CIDM update	WP200/T230
Context sensitivity issues from CPP marketplace point of view	WP500/T510 WP200/T230
Data privacy and security issues from CPP marketplace point of view	WP500/T520 WP200/T230

4.5 Service Provider (Data and Service Customer)

The third and last pillar in Cross-CPP Ecosystem in Figure 3 cover the service provider representing the customer of the CPP Data. These Data customer can be any service provider who wants to build any innovative cross sectorial service based on CPP data provided by the marketplace as a single CPP data access point (one-stop-shop). Service providers must fulfil a set of requirements (i.e.: personnel data treatment regulation) to become a service provider allowed to have access to the Cross-CPP data.

Service providers can get informed by the Marketplace about available data sources, about toolbox features for a pre-processing support of CPP data, and about context information that might help service providers to effectively filter data and use it to their advantage. Based on these data, the service provider will develop a specific service and arrange a contract with the marketplace regulating the access for the service runtime phase. From a methodology point of view regulations for this access will be required.

Furthermore, a type of contractual agreement has to be arranged between service provider and data owner to offer transparent control by the Data Owner over which services may use his data and what benefits he will get,. The Data Owner's consent should be the responsibility of the service provider, which can be achieved by different methods. However, it really depends upon the particular domain and service provider to find the right answer for this challenge.

In Deliverable D6.5 regulation for the following aspects should have to be put in place for the Service Provider:

Methodology issues to be addressed in D6.5 of Cross CPP Project	WP/Deliverable Scope
Regulations for service providers to participate in the Cross-CPP Ecosystem	WP600/T610 WP200/T230
Agreement between data owner and service provider concerning the usage of CPP Data	WP600/T610 WP200/T230
Regulations for the usage of the Toolbox by service providers	WP400/T410
Context sensitivity issues from service provider point of view	WP500/T510 WP600/T610
Data privacy and security issues from service provider point of view	WP600/T610

4.6 CIDM Standardisation Board

Of vital importance for the Cross-CPP project is the concept of a brand independent standardized Cross Industrial CPP Data Model (CIDM) enabling the integration of diverse CPP data providers from different industrial sectors to make CPP data available to a wide community of cross-sectorial service providers.

This CIDM standard, to be developed within the scope of the Cross-CPP project, represents a living standard. In the scope of the project an initial version of the CIDM will be developed and tested. This will be realised in cooperation between CPP manufacturers (Siemens and VW), the marketplace operator (ATOS) and the service providers (Meteologix, Siemens and VW). However, triggered by requests of Service Providers it will be necessary that the CPP manufacturer should provide additional data not covered by the current CIDM. This approach represents a key measure to enlarge significantly the number of data customers.

From a methodology point of view, this requires a regulation concerning how to proceed to reach an agreement for an extension/modification of the CIDM, also defining the parties that should be involved in this decision process and how the updated CIDM is implemented in the overall Cross-CPP Ecosystem.

The basic concepts for such a regulation are outlined in the AutoMat project. There it is assumed that a committee is made up by representatives of the Marketplace and the CPP manufactures. In reference to the extension requests by the service providers this committee will agree on the extent of the CVIM update. Furthermore, for the CVIM extensions the Data Owners need to update their permission status with respect to the harvesting and usage of the extended data set. Finally, all stakeholders must implement the updated CVIM version, beginning with the reconfiguration of the data harvesting on the CPP level up to the marketplace. A similar procedure has to be defined in the scope of the Cross-CPP methodology.

In Deliverable D6.5 regulation for the following aspects should have to be put in place for the Standardisation Board:

Methodology issues to be addressed in D6.5 of Cross CPP Project	WP/Task
Regulation for the participation in the Standardisation committee for CIDM updates	WP2/T220 WP2/T230 WP3/T320
Procedure for the handling of the CDIM extension based on request of the service provider community	WP2/T220 WP2/T230 WP3/T320
Regulations for the permission of the data owners in respect to extended CDIM data harvesting and usage	WP2/T220 WP2/T230 WP3/T320

5 Conclusion

In reference to the motivation and challenges driving the Cross-CPP project, the summary of the Cross-CPP Solution Concept was presented in this document. The developed CPP Ecosystem Architecture was outlined starting from an initial draft of the CPP Ecosystem Workflow, which defines the information flow between key stakeholders and Cross-CPP system modules.

The pictured architecture concept summarises the Cross-CPP modules and its key software components and how they correlate in Cross-CPP. The document outlines an overview on the Cross-CPP Ecosystem Architecture, presenting the high level structures of the Cross-CPP system solution and functions as a blueprint for the specification and development of the Early and Full Prototype of the CPP system to be realised in the next project phases.

Furthermore, in reference to the development of the Cross-CPP Methodology addressing organisational, administrative and contractual issue concerning the interaction of the various stakeholders with the Cross-CPP Ecosystem, the specific view and needs for each of the Cross-CPP ecosystem stakeholder has been analysed. The methodology to be developed shall provide the different stakeholders of the Cross CPP value chain with basic guidelines and support material for participating in the overall Cross-CPP workflow.

The overall Cross-CPP system concept clearly indicates the enormous business potentials of the Cross-CPP approach. A big chance to new business models opens up, where initial solutions will be validated and monitored in the scope of the Cross-CPP project, before scaling up for a large spectrum of new products for millions of users. The Cross-CPP project clearly shows that the brand independent and standardised data provision and access approach enables a cost efficient operation of the entire Cross-CPP value chain out of reach for a single CPP Data Provider. From business point of view, the participation for CPP manufacturers in the CPP-Ecosystem seems very attractive. On the one hand they have the role of the data Provider. On the other hand they can also take the opportunity to carry the role of a service provider offering innovative B2B/B2C services to customers as any other service provider of the huge service provider community.

CROSS-**CPP**