

Green eMotion

Development of a European Framework for Electromobility

Deliverable 3.8

Implementation of demo prototype for
Release 2

Prepared by:

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Under the lead of IBM

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List of Abbreviations

API	Application Programming Interface
BC	Business Component
B2B	Business to Business
CA	Consortium Agreement
CDR	Charge Detail Record
CH	Clearinghouse
CMS	Charge Management System
DoW	Description of Work (Annex I of Grant Agreement)
DSO	Distribution System Operator
EOC	End of charge
ESB	Electricity Supply Board
EV	Electric vehicle
EVCC	Electric Vehicle Communication Controller
EVCOID	Electric Vehicle Contract ID
EVSE	Electric Vehicle Supply Equipment
EVSP	Electric Vehicle Service Provider
G4V	Grid for vehicle (EU research project)
GeM	Green eMotion
HMI	Human machine interface
ICT	Information and Communication Technologies
ICT	Information Communication Technology
IMS	Infrastructure Management System
KPI	Key Performance Indicator
MPO	Metering Point Operator
MSP	Measurement Service Provider
NFR	Non Functional Requirement
NOC	Network Operations Center
NPE	Nationale Plattform Elektromobilität (German initiative)
OEM	Original Equipment Manufacturer, i.e. Electric Vehicle manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
RES	Renewable Energy Source
RFID	Radio frequency identification
SDR	Service data record
SECC	Supply Equipment Communication Controller
SLA	Service Level Agreement
TOU	Time of use
UID	Unique Identifier
V2G	Vehicle to Grid
V2H	Vehicle to Home
VPP	Virtual Power Plant
WP	Work Package

1 Executive summary

To enable Europe-wide electromobility in practice, a marketplace was developed within the EU funded demonstration project Green eMotion. The project will demonstrate Europe-wide roaming in an interoperable electromobility system and provide access to new added value services. Via this marketplace concept users of electric vehicles will be able to access charging infrastructure anywhere in Europe in a convenient way and other related mobility services.

The Green eMotion Marketplace is a B2B platform where the business partners offer and sell services related to electromobility. The most basic service is charging. Herewith one business partner needs to operate charging infrastructure (EVSE operator) and another one has a service contract with an EV driver (EVSP). The EVSP buys the charging service from the EVSE operator and sells it to the EV driver. More advanced services are e.g. search of a charging pole with certain features or in a specified location. Other services are related to roaming, reservation or smart charging.

With the release 2 of the Green eMotion Marketplace a new set of features will become available. In the core Marketplace itself a Service Monitoring Dashboard will be implemented that allows monitoring of the actual service execution by the service provider. That will enhance the usability from the business partner perspective. Also the administration of business partner profiles will be more convenient.

With the new release business partner might specify standard interfaces for their services that will be handled by the marketplace. With that service provider gain the possibility to address a broad group of potential business partners for the usage of their service. Furthermore a new process for handling of contracts between the business partners will be implemented. The new process is a two-step-process, where a partner publishes an offer for a service. If another partner is interested he will sign in for booking of the service. In a last step the service provider can accept or decline the business relationship.

Roaming as the most important service on the marketplace will in the new release also handle a list of contract IDs (EVCOIDs) directly on the Clearing House via web service. This allows an integration of the customer relationship management (CRM) system and therefore an automated update of related roaming rights based on the customer's contractual status.

Another new feature of the Clearing House service is the so called Push Authorization service. In release 1 the authorization request had to be triggered by the EVSE operator at which the EV driver wants to charge. With the new feature the EV driver might authorize himself directly at his service provider (EVSP), e.g. via smart phone app. That means he can use always the same authentication process independent from the installed chargers or the operation system. This feature will overcome the problems with different RFID standards or different apps to be used over Europe.

New in release 2 will be the reservation service. In the selected demo region Malaga the EV driver will be able to make reservations for the installed GeM charging poles. This increases the acceptance of electromobility as the user can be sure that the needed charging pole will be available when needed.

An EV Driver portal will be developed and will use the Marketplace electromobility services from an EVSP point of view. Planned features are self managing of the drivers account data, view of charging history and graphical presentation of energy consumption.

The integration of a multimodal journey planning service is under consideration. This would extend the services from pure electromobility services, like charging and roaming to other transportation means, e.g. train.

Regarding smart charging the focus in release 2 is the end-to-end demonstration, showing real time smart charging through a smart phone interface. Additionally a service providing historical data of EVSE usage and load curves will be realized.

The prototype environment (described here in this deliverable D3.8) will enable the WP3 partners to do cross-partner integration testing of their components and will also give demo regions as part of the WP8 demonstration program the chance to validate the results of their front end adaptations in a test environment. All of this will add to the goal of delivering a solid and thoroughly tested release 2 for deliverable D3.13 that can be used to demonstrate the previously defined use cases and business scenarios in most of the Green eMotion demo regions.

The release environment (upcoming deliverable D3.13) will be used by the partners in the regions to develop and demonstrate ICT services (Clearing House and other value-added services) in end-to-end scenarios for all three functional domains. The test plan (deliverable D8.1) will outline the details about how the testing is performed, while the test report (deliverable D8.2) will document the test results for all three domains

2 Introduction

2.1 Prototype Overview

In the software engineering process a prototype in general is an early release of an IT system that is used to verify the concepts and processes that are laid out in the software design. This is a crucial step, since it helps to identify problems early in the development process. If these problems would occur in a later phase, it would involve significantly more effort to resolve the issues and might also impact the release schedule.

The following picture illustrates the Green eMotion (GeM) building blocks and highlights the scope of this deliverable (D3.8) indicated with dark grey color.

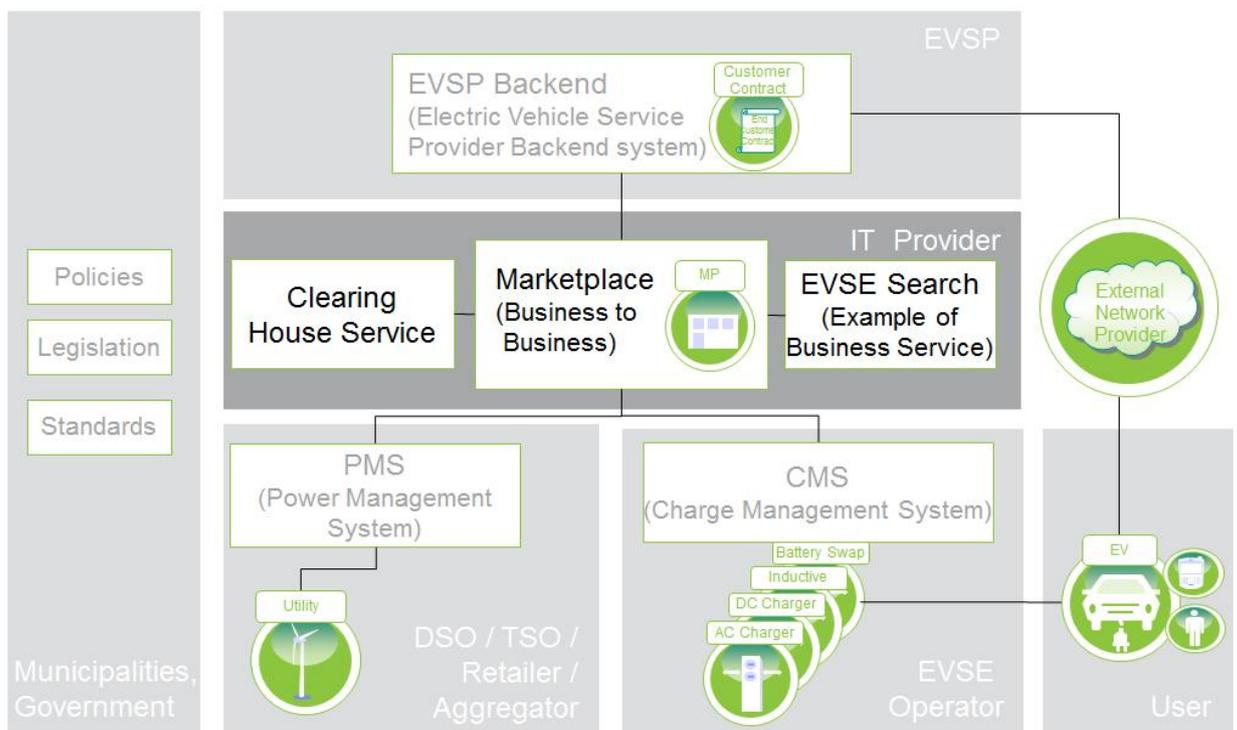


Figure 2-1: GeM Building Blocks and Scope of D3.8 Demo Prototype 2

The grey boxes represent building blocks under the control of certain roles (e.g. the highlighted dark grey building block Marketplace (Business to Business) is provided typically by IT providers). The smaller boxes inside the building blocks represent logical system components, such as the “Clearing House Service”. The lines between the logical components represent communication paths between those components. Services offered by the components and business objects exchanged between them are being described in detail in the corresponding sections.

This deliverable D3.8 Prototype 2 is based on previous deliverables (such as D3.4 and D3.6) towards Release 2 deliverable D3.13.

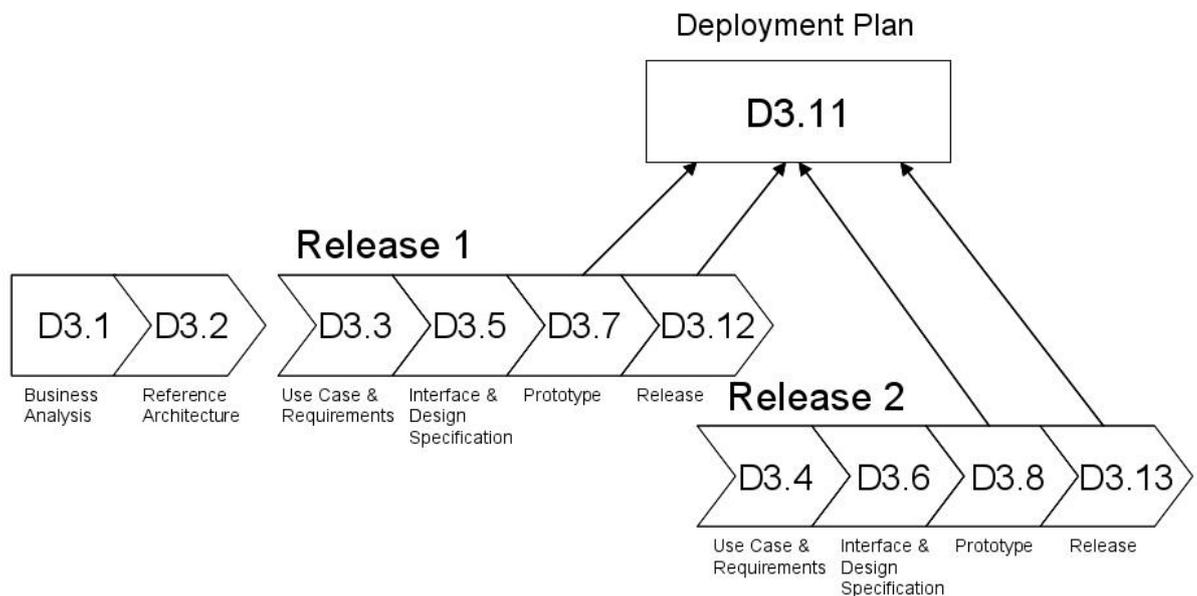


Figure 2-2: Sequence of deliverables in GeM

As D3.8, like all other release 2 documents, is designed as a full update to the preceding release 1 version, it is not required to read D3.3 & D3.5 in order to understand this deliverable. However, it is strongly recommended to read D3.4 & D3.6 before, as they contain the foundation D3.8 builds upon.

Within Green eMotion a prototype for an electromobility marketplace was defined in work package 3 to verify the functionality of the services before final release to the European demo regions. The development of this base system was finalised in February 2013 for the first release. The prototype described in this deliverable outlines the core functionality of the release 2 (D3.13 – available in February 2014). D3.8 defines the scope according to the specifications in deliverable D3.6 (Service & transaction design specification), which is required for a basic integration of the partners developing the services. New features will be added for release 2 (February 2014): e.g. reservation of charging points, energy load management.

In the end the GeM Marketplace will have the following functional domains:

Marketplace: The Service Brokerage component as base system of the marketplace will provide the Dynamic Service Gateway as central integration point for all services. The Business Services component will provide an updated look and feel of the marketplace user interface. This will be extended and integrated with the Service Brokerage component.

Roaming: The Clearing House component will provide services to authorize users across EVSE operators and EVSPs and to forward Service Detail Records for charging transactions. Integration with the marketplace is offered, in order to validate Roaming agreements between the involved parties on the marketplace (release 1).

Charging: The central Search EVSE component will offer a service interface to query charging spots and battery swap stations from different EVSE operators (release 1). Service interfaces for updates of master

data and EVSE status which allow the reservation of charging points will be part of release 2. Additional value-added services around charging, such as an “EV Driver Portal” demonstrating park, charge and ride scenarios are considered for implementation.

Energy: The Energy use cases were not in focus for release 1 as these do not require integration testing between different partners, only basic registration of the new services for Energy had been completed. Within release 2 the energy services will be implemented and demonstrated with the marketplace and partners.

The ICT services in the Energy domain (e.g. Smart charging) are based on the results from the deliverable D4.2 (Recommendation regarding requirements for communication protocols and grid-supporting opportunities).

2.2 Focus of the Prototype Environment

The Green eMotion marketplace eco-system is a complex ICT system of interconnected components¹ offering EV Services which are operated by many different partners. The following figure gives a simplified overview of the involved components, partners and connections in order to show the focus of the prototype.

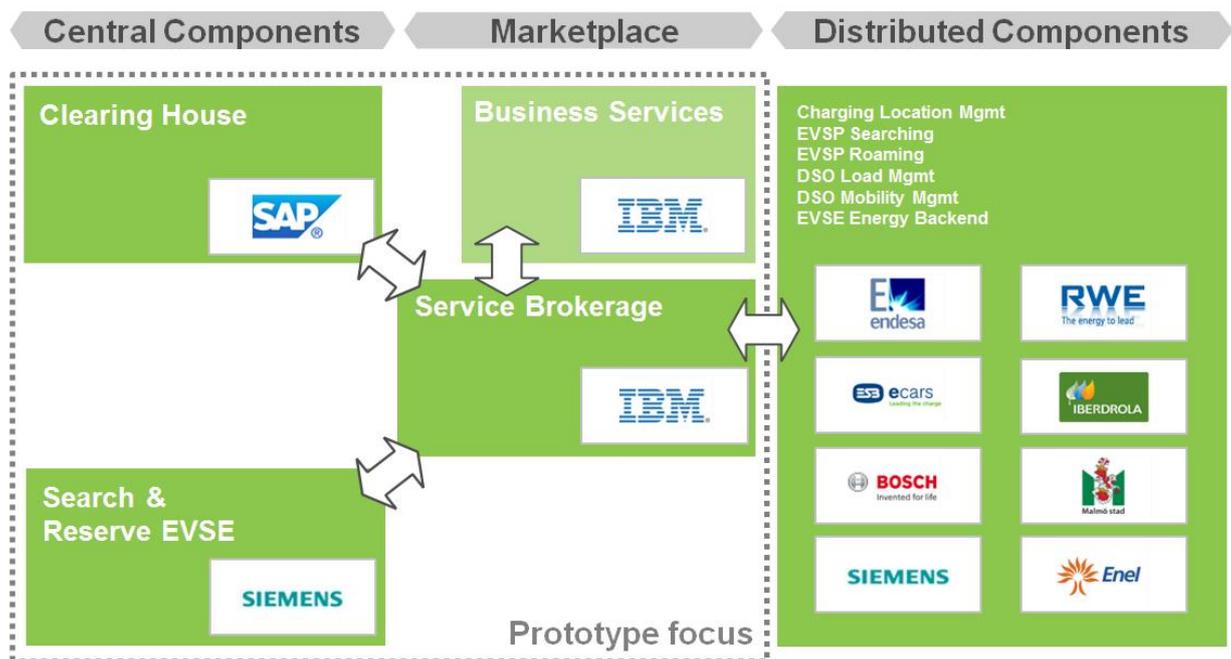


Figure 2-3: Overview of business components and partners

The components that make up the Green eMotion marketplace eco-system can be separated in three groups:

¹ Component: An IT subsystem with defined interfaces providing specific functionalities and features.

- **Central components:** Provide functionality that is used by many different partners and is not specific to a particular region. Usually only one instance would exist for one specific component.
- **Distributed components:** Components that are operated by many different partners and/or regions. These can be components that are used to integrate with a central component (e.g. Clearing House) or components that only integrate with other distributed components (e.g. Energy BCs).
- **Marketplace:** The required components that make up the marketplace act as the central hub for integrating all other components. They provide generic functionality for offering, contracting and using services provided by other components; both central and distributed components.

The focus of the prototype 2 is the deployment of updates to the central and marketplace components. These are required to go forward with the development and integration of the distributed components. The goal of the prototype is therefore to provide a platform for integration and testing, so that a solid IT system for demonstration purposes can be delivered by the WP3 partners for release 2 (February 2014).

Release 2 will be built on the functionality from release 1 and enhanced by new or changed features defined by updated use cases (refer to D3.4) and interface specification (D3.6). In the first release only the core functionality that was required for integration of regions and partners had been provided. This functionality will be extended in this consecutive prototype 2 time frame leading up to release 2.

2.3 Prototype Development and Test Schedule

As stated before the prototype development and test phase provides a platform for integration and testing, so that a solid IT system for demonstration purposes can be delivered by the WP3 partners for release 2 (February 2014).

Since the prototype will not provide all of the defined functionality from day 1, it is required to have an aligned development schedule for WP3 partners, so that involved partners outside of WP3 can adapt their development schedules and plan the testing activities.

The following table offers a quick overview of the planned versions for each component. More details on the scope of each prototype versions are provided in the next chapters.

	Nov13	Dec13	Jan14	Feb14	April14
Marketplace				V1	
Roaming	V1			V2	
Charging / Reservation				V1	
Energy				V1 ²	
EV Driver Portal				V1	
Multimodal Planner					V1

Table 1: Development and Test Schedule for Prototype 2

Note: Each version is made available at the end of the month listed in the table.

² This is not a new release but an update on the Release 1 Energy Services. Refer to chapter Prototype 26.2.

3 Marketplace Domain

In the Green eMotion Reference Architecture that was defined in deliverable D3.2 the GeM Marketplace was divided into 3 domains, which are shown in the figure below.

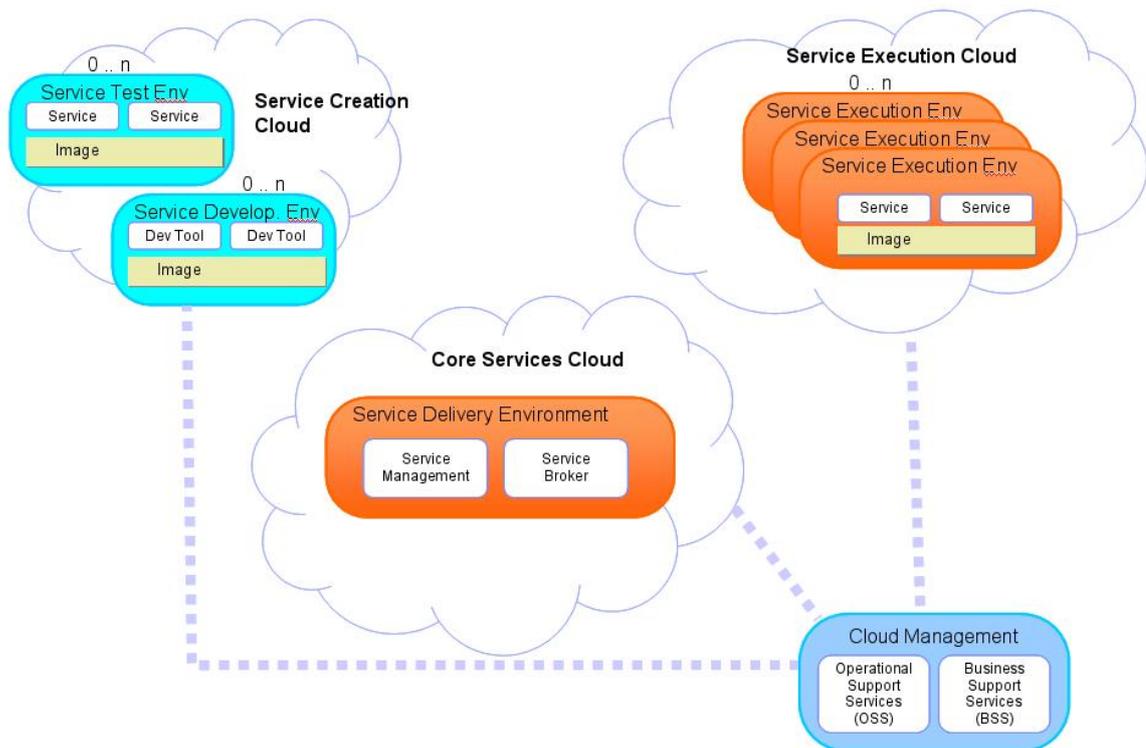


Figure 3-1: Overview of marketplace domains

In the next chapters first the functionality from release 1 will be described and afterwards the new features being implemented during prototype 2 phase towards release 2.

3.1 Release 1

The release 1 focused on the Service Delivery Environment (or Core Services Cloud), which provides the functionality that is required for the demonstration of the Green eMotion marketplace eco-system and was deployed in the IBM Cloud environment (IBM SmartCloud).

Of course also other partners are able and invited to deploy their services in the IBM Cloud environment, following the approach outlined in the Reference Architecture (see Deliverable D3.2, chapter 3.2 Marketplace Level) with the Service Execution Cloud. This allows them to use the same Cloud management tools that are also used for the management of the marketplace itself. An integration of these tools with the Service Management of the Service Delivery Environment was not planned for Release 1.

A Service Test Environment (part of the Service Creation Cloud) could also be instantiated easily in the IBM Cloud environment, so that new versions of services can be tested without impacting the existing services. However, this has not been realized in Release 1.

Additional details on the deployment of the marketplace can be found in deliverable D3.11 Deployment Plan.

The Service Delivery Environment is made up of two components: Service Brokerage (BC 1965^{*}) and Business Services (BC 1966^{*}; also “Service Management” in the Reference Architecture; Deliverable D3.2, chapter 3.2 Marketplace Level and D3.6).

The Service Brokerage component does provide the Dynamic Service Gateway (SRV 1968^{*}) which allows services to be called via the marketplace and is therefore the most crucial part for integration of partner systems. The Dynamic Service Gateway does validate contracts between Business Partners on the marketplace and will forward only those requests for validated services.

The Business Services component does provide the user interface required to buy, sell and manage services on the marketplace. The initial version has only offered a preview of the look and feel of the user interface. It was possible to register new Business Partners and to browse a catalogue of predefined services. In the second version Business Partners are able to create contracts. This has allowed the integration with the Service Brokerage component in order to validate these contracts during service calls. Additionally this version has offered the Contract Validation service interface (SRV 1967^{*}) that was used by the Clearing House to check for Roaming Agreements between EVSPs and EVSE operators on the marketplace.

3.2 Prototype 2

The release 1 features already provided rich functionalities based on partner’s needs to deploy and use the marketplace for offering and using EV services. In prototype 2 time-frame further enhancements will be implemented on core marketplace platform. Those new functions will include:

1. Change-requests from Release 1
2. Release 2 use-cases and features
3. Usability enhancements using the Marketplace by business partners

In detail the new functions are:

- 1 The change request (CR) from Release 1 does include the general usage of the service providers offering (CR38). This CR does also relate to Release 2 features (FTR 2292 and 2293) providing a generic approach on the provider and consumer roles in service offering.
- 2 Feature FTR 2294 is about a Service Monitoring Dashboard that will be implemented on the marketplace core services. The Service Monitoring Dashboard allows monitoring of the actual service execution through the Dynamic Service Gateway. See deliverable D3.4 chapter 2.
- 3 Additional release 2 use cases including partner & account management will be implemented and demonstrated. In detail the features are FTR 1376 to 1380.

* Refers to numbering scheme from deliverable D3.6 (BC: Business Component, SRV: Service Interface)

- 4 Standard interface proposed by partners will also be implemented. The features ID include FTR 1257 and 1493. See deliverable D3.4 chapter 2.
- 5 A change request to contracting services feature FTR 1447 will be implemented. This change request does provide a two-step-process of the approval step by the business partner offering and selling the service.

It is planned that all modified and new features will be deployed in one drop/version. Refer to chapter 2.3, Prototype Development and Test

4 Roaming Domain

4.1 Release 1

The Clearing House enables roaming in the electric mobility domain. For that Green eMotion partner SAP provided two service interfaces in prototype 1. The first service interface handles the authorization requests from EVSE Operators which have to deal with an unknown customer, so that the operator can decide if he allows the unknown customer to charge or not. The second service interface forwards the service data record to the responsible EVSP after charging took place, so he can bill his customer in the end.

The validation of roaming agreements between Business Partners uses the Business Services component of the Marketplace to store these agreements. This component returns the contractual status of two business partners.

In order to do the B2C contract validation, which means that the Clearing House checks if the customer has a valid contract with his provider, the Clearing House offers the storage of a list of customers from each provider directly, or asks the EVSP each time his customer wants to charge at a foreign EVSE Operator. For the latter one, the EVSP has to implement the authorization interface as well.

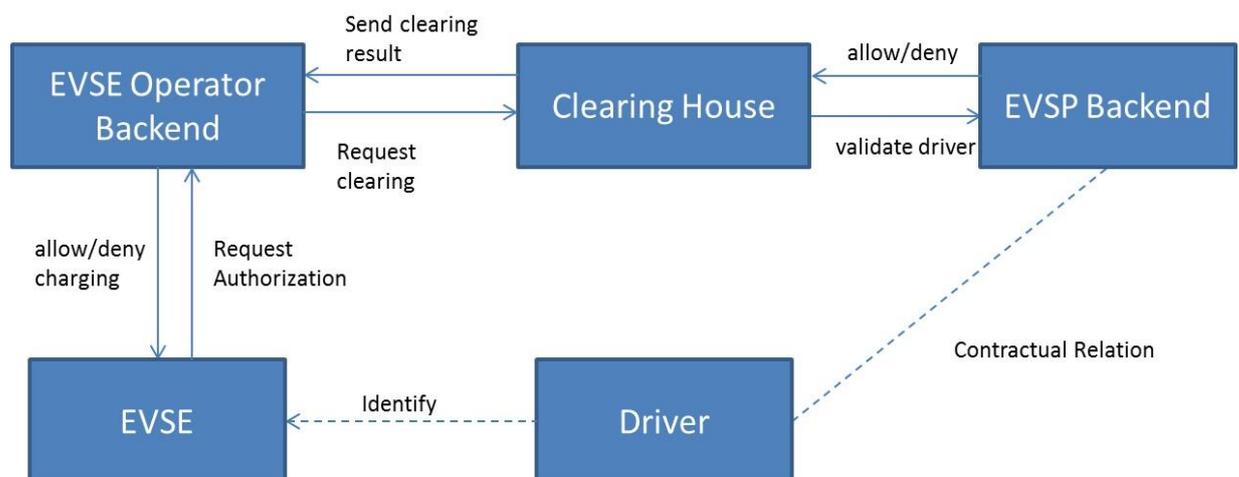


Figure 4-1: Authorization at EVSE

4.2 Prototype 2

In prototype 2 of the Clearing House, two additional services will be provided by SAP. The B2C contract maintenance service allows the EVSPs registered at the marketplace to maintain a list of EVCOIDs directly on the Clearing House via web services. In the first release this was done manually by the Clearing House operator based on emails from the EVSPs. The new web service based approach allows for integration into the CRM system of the EVSP or other customer data managing systems and an automated update of related roaming rights based on the customer's contractual status.

The second new service provided by the Clearing House is the Push Authorization service. In release one the authorization request had to be triggered by the EVSE operator at which the customer of an EVSP wanted to charge. The new service allows for an EVSP being the one telling the corresponding EVSE operator to charge his customer. It has the nature of an order instead of a question. Using this approach, the EVSP can offer a means of authentication to its customers, i.e. a smartphone app. This app would directly interact with the EVSP backend system which can determine the B2C validation on its own without sending customer related data to a third party system such as the Clearing House. Message flow B of Figure 4-2 would be used.

Green eMotion is going to provide a smartphone application which can be used by any Green eMotion customer regardless of his EVSP. The message flow A of Figure 4-2 would be used with an optional B2C check in the EVSP backend if the B2C information doesn't reside in the Clearing House.

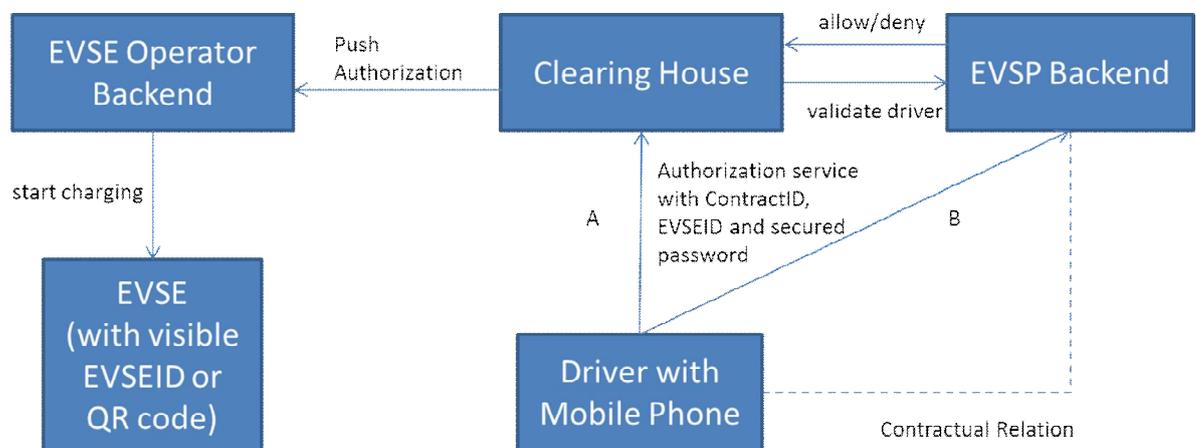


Figure 4-2: Push Authorization

Both approaches, the standard authorization and the push authorization, can exist and be used in parallel.

Regardless of the authorization interface used, the charging data is sent from the EVSE operator via the Clearing House to the EVSP using the SDR forwarding service from release one.

Implementing partner based on interface and role:

Partner	Authorization	SDR Forwarding	Push Authorization	B2C Contract Management
Bosch	EVSEO/EVSP	EVSEO/EVSP	-	-
Endesa	EVSEO/EVSP	EVSEO/EVSP	EVSEO/EVSP 2 nd priority	-
Enel	EVSEO/EVSP	EVSEO/EVSP	EVSEO/EVSP 2 nd priority	-
ESB ecars ³	EVSEO/EVSP	EVSEO/EVSP	-	-
RWE	EVSEO/EVSP	EVSEO/EVSP	EVSEO	-
Siemens	-	-	EVSP	EVSP

Table 2: Roaming partners

³ With IBM as implementing sub-contractor

5 Charging Domain

5.1 Release 1

The central Search EVSE component has offered a service interface to query charging spots and battery swap stations from different EVSE operators.

The requesting business partner can combine several search criteria, which can be grouped roughly into the following sections:

1. Technical equipment
2. EVSE operator
3. Management
4. Address
5. Proximity search

In the initial version of the Search EVSE service only EVSE master data added manually into the search component was available. None information about the current operational status of an EVSE has been provided.

By the end of November 2012 (v2) the search component was able to request EVSE master data from Charging Location Management systems, if these systems provide the specified service ProvideEVSEMasterData.

By the end of December 2012 (v3) the search component was able to request Operational status data from Charging Location Management systems, if these systems provide the specified service ProvideEVSEStatusData.

5.2 Prototype 2

Reservation of Charging Points (EVSE) / Siemens

Within prototype 2 phase Siemens is planning to implement and realize a business service “Reservation of Charging Points”. Reservation of EVSE is a value added service designed to support the EV driver to book a charging points in advance.

This value added service can be implemented by EVSPs in order to increase the confidence of the EV-driver and increase the customer-relationship to the EVSP and also increase the degree of capacity of the charging infrastructure of the EVSE-operator. This service enables extended-range journeys with increased confidence.

The service will provide a user friendly graphical user interface, including map, for integration in web-pages.

To fulfill the EV driver reservations the EVSPs have the possibilities to choose between the following reservation models:

- Time period reservation
- Point in time reservation

The following picture illustrates the process steps for the business service reservation charging points (EVSE):

Reservation of charging points (EVSE) business process steps

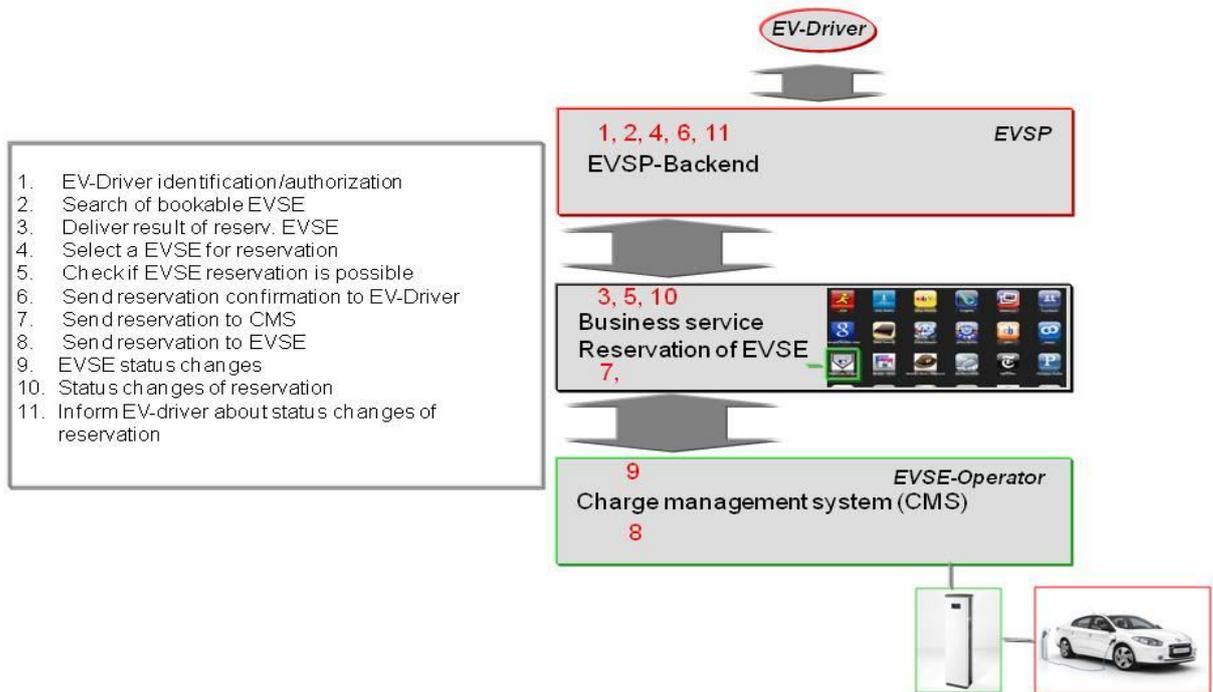


Figure 5-1: Reservation of charging points (EVSE)

The following EV driver interactions will be supported:

- Search of bookable charging points
- Reservation (booking) of charging points
- Changes of active reservations
- Deletion of active reservations
- Overview “my reservations”

The EVSP administrator can configure the general reservation functionality and the EV driver UI. For the reservation of charging points it is necessary that the service placed on the marketplace will get the actual EVSE master-data, actual status data and charging-session data from the EVSE-operator backend system (CMS).

With demonstration of this value-added service it is planned to integrate the reservation UI via the marketplace in the GeM-web-page. The reservation service will be tested with the charge management system operating the GeM chargers in Malaga provided by Siemens.

Availability of the prototype is planned for end of February 2014.

Enhancement of Search of Charging Points (EVSE) / Siemens

In prototype 2 Siemens is planning to enhance the already existing search functionality.

This basic-end user services can be implemented by EVSPs for searching of charging points (EVSE). The EVSE-operator has to implement the interface for integration of charging point master-data and dynamically EVSE data (e.g. actual EVSE status).

To support the integration in existing EVSP portals or web-pages, the search of charging points will support a user friendly graphical user interface including a map.

The optimized search result-interface will also deliver the EVSE-ID.

Within the enhanced service the search criteria for "Battery Switch Station" is not cleared. Additionally the search-criteria Plug-type "inductive" is added.

Some minor technical enhancements (e.g. Input validation of all values; regular expression defined in XSD), resulting of the demonstration phase I, will be implemented.

Availability of the prototype is planned for end of February 2014.

EV Driver Portal / IBM

Within prototype 2 phase IBM is planning to implement and realize an "EV Driver Portal". Use of EV has to be enabled to the end users through a user friendly manner. The user front-end application will enable EV drivers to easily interact with their service provider (EVSP). This EV Driver Portal would be operated by an EVSP and used by the driver. The EV driver portal could have the form of a website or a mobile application. For further details please refer to page 54 in deliverable D3.4 (Use Cases and Requirements Release 2).

Availability of the prototype is planned for end of February 2014.

Multimodality Journey Planning Service / IBM

Multimodality or also known as Intermodality journey planning is one of the important requirements for EV drivers. Given the limited range of today's EVs and the traffic situation in megacities the need for integrated transportation services around electric mobility is of high interest for end-users. Multimodality journey planning is an important value added service designed to provide a traveller with an itinerary for an intermodal passenger transport journey including different means of transport (e.g., EV, bus, train, taxi, and bike). In the context of Green eMotion the EV driver is considered to be central part of the eco system and should be supported with means to determine the best transportation routes based on the end-user's travel request and his or her personal preferences.

IBM is considering to implement a generic B2B Multimodal Journey Planning service and which could be integrated extending the EV Driver Portal application described before to demonstrate a "Park, Charge & Ride" scenario. Demonstration is highly depended on transportation partners willing to contribute providing real-time data for journey planning. As a first-and-only realization demo region it is considered to

demonstrate this in only one demo region in Europe. Please refer to page 57 - 58 in deliverable D3.4 (Use Cases and Requirements Release 2) for further details.

Availability of the B2B Multimodality Journey Planner prototype is planned for end of April 2014 / after release 2.

Partner	Search Frontend	Reservation	Provide EVSE Data
Bosch	EVSP ⁴	-	-
Enel	EVSP	EVSEO/EVSP	EVSEO/EVSP 2 nd priority
ESB ecars ⁵	EVSP	-	EVSEO
RWE	-	-	-
Siemens	EVSP*	EVSP*/EVSEO**	EVSEO**

Figure 5-2: EVSE Search & Reservation Partners

*) using GeM – webpage

**) with Demo-Region Partner Endesa

⁴ With EDF

⁵ With IBM as implementation partner

6 Energy Domain

The energy domain is in charge of demonstrating B2B services that enable value creation and value transfer among stakeholders with regards to the integration of EVs in to the LV/MV grid.

The aim of these services is to demonstrate a Large Scale Load Management (LSLM) scenario, as stated in D4.2 of Green eMotion, through the use of a dedicated set of features implemented by EVSP, EVSE Operator and DSO. The LSLM scenario shows off load management requests published on the marketplace from the DSO to multiple stakeholders, either EVSP or EVSE Operators according to the specific business / regulatory framework. This load management requests are made up of load curves that should be followed by each EVSE Operator in a specific load area, in order to achieve remuneration targets. The fulfillment of load management requests causes a power modulation forwarded to a set of charging points whose points of delivery do belong to the targeted load area.

The usage of load management practices according to the DSO needs might help the DSO in achieving high quality of service and avoiding penalties to RENs distributed producers, thus leading to a “Charge For Free” use case, where the EV driver might receive a warning on his own EVSP smartphone application that he could charge his EV for free in a certain timeslot, thanks to the B2B services infrastructure that enables value transfer between DSO, EVSE Op, EVSP and EV driver all along the chain of load management business process.

6.1 Release 1

Within Release 1 time span, which ended in Q1 2013, a comprehensive set of use cases within the energy domain has been described and declined into business components and service interfaces between the DSO and the EVSE operator following the WP3 specifications methodology. A subset of such business components and eight service interfaces lead to the definition of a first demo prototype with decentralized energy components. Within release 1, the prototype was equivalent to the system deployment, given that Enel has been the only partner testing the B2B interactions of the energy stakeholders acting both in the role of the DSO and the EVSE operator. The Enel system (EMM) was enhanced with new functionalities to expose web services on behalf of EVSE operator and DSO on the Marketplace. The demonstrations for the energy domain involve the Marketplace in order to have an open and scalable platform for large scale load management.

The services that will be provided for Release 1 do embed basic functionalities (see D3.5) and they will serve as proofs of concept for future advanced services to be published for Release 2, including V2G and RES integration related services.

6.2 Prototype 2

Within Release 2 time span, the energy use case and their specifications have been confirmed to be comprehensive and preliminary for more advanced energy use cases, such as vehicle to grid and RES integration. However, Release 2 B2B demonstrations will still focus on grid to vehicle smart charging and no vehicle to grid smart charging, as great effort will be invested in end-to-end demonstrations, showing real time smart charging happening at an EVSE through a smart phone interface. In the grid to vehicle

smart charging process, the EVSE operator controls the EV by modulating their loads based on load targets provided by the DSO for specific load areas. The service interfaces implemented within WP3 enable such process.

The demo prototype for release 2 will be a debugging of release 1 machine-to-machine prototype for the load management target and tracking services as well as the services providing historical data of EVSE usage and load curves. Currently all the business components within the Enel system, namely EMM, and energy services are deployed and able to interact with the GeM Marketplace. After a debugging phase, release 2 prototype will be ready to support end-to-end demonstrations to be conducted in GeM WP8 demo regions.

7 Glossary

Authentication

Authentication is the validation of an Identity on a predefined level.

Levels may be differentiated to provide different security gradations for different functions, or a system may be designed to use one single Authentication level.

Examples of authentication means are:

- *Automatically readable Certificates*
- *Passwords*
- *Iris-scans, fingerprints, etc.*
- *Dynamic challenge/response algorithms*
- *Pre-existence of a GUID*

Authorization

Authorization determines if a specific authenticated identity is given access to a specific function or resource.

Examples: Authorization can be based on many principles, e.g.:

- *Validate the combination of Identity and Requested Function (existing contract)*
- *allow, unless explicitly listed*
- *Deny, unless explicitly listed*
- *Calculate access based on Identity Properties (Providers only)*
- *Calculate access dynamically, based on system properties (max concurrent users)*
- *Include validation of time-window, connection type, multiple access, and any number or combination of aspects*

Basic End User Service

A Basic End User Service is a business service that will have to be supported discrimination free to every involved actor. Basic End User Services are a “MUST” in order to provide the minimum functionality for electric mobility.

Business Partner

Any party that is registered at the GeM Marketplace acts as Business Partner. They can act as Service Provider and/or as Service Requester.

Buying

The term Buying refers to a complex process. In the context of the GeM Marketplace the term Buying includes the following independent actions:

- Acceptance of the Service Contract Offering of the EV Service by the Service Requester
- Call of the EV Service by the Service Requester.

Call of a Service

A call occurs when a Service Requester "consumes" the EV Service based on the conditions of a Service Contract.

Note:

Selling and Buying includes the whole commercial process.

Clearing House

A Clearing House within the Green eMotion context of electric mobility provides a couple of services which enable roaming. Two scenarios are reflected, the contractual clearing and the financial clearing, which can be on top of the contractual clearing. Clearing services can be consumed by EVSE operators when asking for validation of customers (contract clearing) and forwarding SDRs. EVSPs can register, update and delete new contracts of their customers via the Clearing House or Marketplace.

The B2B contract information can be stored in the Clearing House directly or in the Marketplace.

The B2C contract information can be stored in the Clearing House directly, in the Marketplace or can be requested each time from the corresponding EVSP.

Congestion Management

This is about the efficient use and allocation of Power Transmission capacity.

This is a task of Distribution System Operators (DSO's) for the Mid/Low Voltage domain, and Transmission System Operators (TSO's) for the High Voltage Domain.

Recent developments such as local generation from windmills and large scale PV have complicated this task. EV complicates this even more, for several reasons:

EV generates significant additional E-usage

EV power usage is discontinuous because it draws power from the Grid during battery charging, not while in use.

Grid Operators have limited experience in predicting the Power Usage of EV

EV deployment through society is unpredictable, and different regions may show different usage patterns

In addition to this, technology to use EV batteries to feed power into the Grid is expected to be deployable in the near future.

This provides a valuable tool for Congestion Management and Load Balancing, but it increases the complexity of the task.

Connection Window

A connection window is a continuous period that an EV is connected to the e-Grid. The Connection Window may contain any sequence of

- charging, drawing power from the grid
- discharging, supplying power to the grid
- passivity

The Connection Window is different from the Minimum Charging Period.

The assumption is that for Home Charging, the common Connection Window is much larger than the Minimum Charging Period, since most of the EV will be connected upon homecoming in the afternoon / evening, and will only be disconnected upon departure for work in the morning.

For on-the-road charging, the connection window is defined by incidental circumstances.

Contracting

A Business Partner can accept a Service Contract Offering from a Service Provider, which generates a Service Contract.

This contract will then be the basis for usage of the EV Service.

Contractual Clearing

1. Validation of customer

a) Authentication on a charge point triggered by an EV driver or their EV

- The EVSE operator forwards the identification information to the Clearing House. The information consists at least of EVSEID (Electric Vehicle Supply Equipment ID) and Contract ID (EVCOID).
- The Clearing House first checks if the EVSE operator and the EVSP of the customer have an agreement. Therefore the Clearing House can check its own database or retrieve information from the marketplace.
- The Clearing House additionally checks if the customer is entitled to charge at that charge point. Therefore the customer data can be checked in the Clearing House database or can be retrieved from the customer's EVSP.
- The result of the check is delivered back to the EVSE operator so that he can react accordingly (start charging or deny charging).

b) Validation of customer and its purchased services

- Any EVSE operator can check the services which a currently connected customer is entitled to consume.

2. Routing of charge data (SDRs) between roaming partners

- The roaming partner EVSE operator sends the SDR to the Clearing House after the charging process is finished.
- The Clearing House forwards the SDR to the "Home" EVSP (directly, daily, weekly, monthly etc.).

Note:

Both processes are triggered only if the EV driver is not a direct customer of the EVSP which also acts as EVSE operator of the used charge point.

Core Service

A Core Service is a basic service that is required to run the GeM Marketplace and a service that is shared and used by the Value Added Services, Clearing House Service and End User Services.

Examples:

- *Business Partner Registration*
- *Service Contract Offering Creation*
- *Service Contract Creation*
- *Service Registration*

- *Service Monitoring*
- *Service Lifecycle Management*
- *Service Deregistration*
- *Service Billing*

Delivery

Service Provider provides an EV Service based on an existing Service Contract.

EV Marketplace

EV Marketplace is a marketplace within the EV Service Market which serves as a semi-open environment for offering services by Service Providers to Service Requesters.

The GeM Marketplace is an instance of an EV Marketplace.

EV Roaming

Roaming of EV related services will occur when a service is contracted between consumer A and provider B (EVSP), but is delivered to consumer A by provider C, based on a roaming contract between provider B and provider C.

Roaming both between EVSE operators and between countries/regions:

EV driver can use the EVSE infrastructure of those EVSE operators that his EV Service Provider (EVSP) has signed a roaming contract/agreement with. The Marketplace provides the service of providing a record of all roaming agreements so that it can be verified which EVSE infrastructure an EV driver is allowed to use and also which services he is allowed to consume. The Marketplace facilitates the data exchange between the roaming partners. The most common type of roaming is the international travel. When contract party from the “home” EVSP does not have any facilities abroad, he can enable his clients to use local facilities based on a Roaming Contract with a local provider. Since terms and conditions will usually be different, any Roaming Service will most likely result in a surcharge to the Roaming consumer.

Roaming of EV within the EV Marketplace considers the following information tasks:
Authentication, validation of contracts, Service indication, Generation and routing of Service Detail Records (SDR)

EV Service

EV Services (Business Services) are all the service related to Electric Mobility.

Examples:

- *Find Charging Point*
- *Reserve Charging Point*
- *Reduce grid load from charging vehicles (Congestion Management)*
- *CO2 Reporting*

EV Service Market

The EV Service Market is a virtual domain comprising all the services related to Electric Mobility. It describes the whole ecosystem for EV Services. The EV Service Market consists of End User Service Providers (Service Requesters), Service Providers and any number of Marketplaces. If there are several marketplaces, they can be completely independent or interconnected and can be organized in any type of structure.

The EV Service Market is open:

- Any party offering an EV related services is considered as a part of the EV Service Market.
- EV Services can be offered via a Marketplace or directly on a bilateral basis between Service Providers

Financial Clearing (not demonstrated within Green eMotion Project Scope)

Financial clearing is the process of balancing debts between different parties, in this case companies which act as EVSE operator and EVSP. EVSPs let their customers charge at other EVSE operators which lead to a debt to be paid by the EVSP to the EVSE operator. In case both companies act as EVSE operator and EVSP at the same time, both can have debts at the other company.

We can imagine two different clearing strategies. For both strategies, the clearing house has to know which company owes which company which amount of money. Based on the strategy of the companies, they can either send their price planes to the clearing house which would do the pricing or the companies could do the pricing on their own and send the results to the clearing house. For example, one EVSE operator could price each kWh consumed by a customer from another company with a specific amount. In that case, the clearing house only needs to know the price for the kWh. With the already available information of the SDR and the additional price information, the clearing house can calculate the debts on its own. If the EVSE operator does not want to give any price plan information to the clearing house, the EVSE operator would have to send the information about the companies which owe which amount of money to the clearing house.

Regardless of the information and pricing strategy of each company, the information has to reside in the clearing house in the end to continue with the financial clearing.

The first clearing strategy calculates the total amount over a specified time frame, i.e. a week or a month, which represents the debt an EVSP has at an EVSE operator. The total amount and the information to which the money has to be paid are then transferred to the EVSP.

The second clearing strategy does additional calculations. In that case the total amount is not sent to the debtor. After the calculation of all total amounts which have to be paid between the different companies, the difference of the debts, which two companies have among each other, is calculated. Only the company which has the higher debt gets informed by the clearing house with the information to whom the difference has to be paid.

As soon as financial clearing is in place, the business partners have to publish more contract details.

GeM Marketplace

The GeM Marketplace is semi-open B2B Marketplace within the EV Service Market. All Business Partner in the eco system may offer their EV Services on the GeM Marketplace that can be bought by any Business Partner. The EV Services may be created and hosted at the GeM Marketplace (Service Creation and Service Execution).

It consists of 4 service categories:

- Core Services
- Clearing House Services
- Basic End User Services
- Value Added Services

The GeM Marketplace (Core Services) will offer additional functionality, such as:

- Authentication and Authorization
- Linking and Aggregation of EV Services
- Collect Transaction Data
- Monitoring and Reporting
- Business Analytics

for all EV Services routed through the GeM Marketplace. EV Services, that offer well defined, preferably standardized service interfaces, can be embedded in higher level services to provide additional functionality.

Identification

Identification is the basic step of connecting a Business Object, Actor, Event and Service with a technically valid Unique Identifier.

Identification can be the result of human or automated action, such as reading an RF-TAG, reading a vehicle license-plate, or typing in a user ID.

In GeM we are using EVCO-ID, EVSP-ID and EVSE-ID for identification.

Note:

Identification does not include validation of the identity: "Authentication".

Minimum Charging Period

The Minimum Charging Period is the time required to achieve a specified battery charging level. This period is never defined explicitly; it is the result of a calculation which includes:

- available charging speed, defined by the Charging Point
- required charge level, as defined by the EV Operator (driver or Fleet-Manager)
- initial charge level, which is not final until the moment of connection to the Grid

When the Minimum Charging Period is smaller than the expected Connection Window, the opportunity exists to use the EV for congestion management, either by time-of-use control or even by supplying power to the Grid (Provided by EV / OEM).

Selling

The term Selling refers to a complex process. In the context of the GeM Marketplace the term selling includes the following independent actions:

- Provide a Service Contract Offering of an EV Service by the Service Provider
- Acceptance of the Service Contract Offering of the EV Service by the Service Requester
- Call of the EV Service by the Service Requester

Service Broker

A Service Broker is a software infrastructure component that connects Service Requester (e.g. EVSP) and Service Providers by:

- routing messages,
- transforming message protocol,
- transforming message content,
- providing publish/subscribe mechanisms,
- securing message transfer.

Service Contract

A Service Contract is bilateral contract between the Service Provider and the Service Requester. It is created if a Service Requester accepts the Service Contract Offering of a Service Provider.

Service Contract Offering

A Service Contract Offering is created by the Service Provider during a service registration process. The provider chooses all the required modules and additional optional modules from the service contract framework. The service contract offering is the base for a Service Contract between Service Provider and Service Requester.

Service Provider

Any Business Partner of the EV Marketplace that offers and sells EV Services on the EV Marketplace.

Service Requester

A Business Partner of the EV Marketplace that consumes EV Services on the EV Marketplace.

Value Added Service

Value Added Service (VAS) is not absolutely necessary in order to realize electric mobility, but they will make life easier. Value Added Services are designed in order to generate value for a stakeholder in the system and might be charged.