



Green eMotion

Development of a European Framework for Electromobility

Deliverable 3.2

ICT Reference Architecture

Prepared by:

**Better Place, Bosch, Enel, IBM, SAP, Siemens
under the lead of IBM**

Date: April 04, 2012

Version: 1.2

Document Information

Authors

	Name	Company
Key author	Volker Fricke	IBM
Key author	Andreas Dannhauer	IBM
Author	Chapter 3.2.2: Ruth Schilling	IBM
Author	Chapter 3.3: Dr. Thomas Stiffel	Bosch
Author	Chapter 4 + 7 Dr. Norbert Reschauer	IBM
Author	Chapter 5: Thomas Gereke	Siemens
Author	Chapter 5: Tom Kiemes	SAP
Author	Chapter 5: Bijan Rahnema	SAP
Additional author	Anders Pold	Better Place
Additional author	Giovanni Coppola	Enel
Reviewer		
	WP 3 Team Members	ALL
	Detlef Schumann	IBM, Work Package 3 Lead
	Mark Connolly	ESB, External WP3 Review
	Dr. Heike Barlag	Siemens, Project Coordination

Distribution

Dissemination level		
PU	Public	X
PP	Restricted to other program 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)	

Revision history

Version	Date	Author	Description
0.15	February 15, 2012	Volker Fricke	Final Version for external review
0.16	March 5, 2012	Volker Fricke	External review comments by ESB
1.0	March 16, 2012	Volker Fricke	Version for Project Coordinator review
1.1	March 28, 2012	Volker Fricke	Comments from Project Coordinator
1.2	April 4, 2012	Volker Fricke	Minor revisions on executive summary

Status	
For Information	
Draft Version	
Final Version (Internal document)	
Submission for Approval (deliverable)	X
Final Version (deliverable, approved on)	

Table of Contents

1	Executive Summary – ICT Reference Architecture	8
2	Introduction	10
2.1	Definition Reference Architecture	11
3	Architecture Overview.....	13
3.1	GeM EV Services Market	15
3.1.1	Architecture Overview Diagram	15
3.2	Marketplace Level.....	16
3.2.1	Conceptual View	18
3.2.2	Operational View	22
3.3	Other Marketplace Options.....	26
4	System Context	29
4.1	Business View	29
4.1.1	Diagram	29
4.1.2	Stakeholders / Business Actors	31
4.2	Technical View.....	33
4.2.1	Actor Overview	33
4.2.2	System Context Diagram – Technical View	37
4.2.3	External Entities	40
4.2.4	Information Flows	40
4.2.5	Control Flows	42
5	Security Architecture.....	45
5.1	Security Topics	45
5.2	Security Best Practices.....	46
6	Architectural Decisions	48
7	Non-Functional Requirements	49
7.1	NFR-Audit and Control	49
7.2	NFR-Availability	49
7.3	NFR-Backup and Restore.....	50
7.4	NFR-Documentation	50
7.5	NFR-Extensibility	51
7.6	NFR-Installation Procedures.....	51
7.7	NFR-Interoperability.....	51

7.8 NFR-Localization and Legal	51
7.9 NFR-Maintainability	51
7.10 NFR-Non-Reputability	52
7.11 NFR-Operability	52
7.12 NFR-Performance	52
7.13 NFR-Portability	52
7.14 NFR-Reliability	52
7.15 NFR-Robustness.....	53
7.16 NFR-Scalability	53
7.17 NFR-Security and Privacy.....	53
7.18 NFR-Usability	53
8 Glossary.....	54

List of Figures

Figure 2-1: Service Level as part of Green eMotion Project.....	10
Figure 2-2 Green eMotion Marketplace	11
Figure 3-1: Architectural Overview GeM EV Service Market.....	16
Figure 3-2: Relation between the Actors.....	17
Figure 3-3: Domain Overview	18
Figure 3-4: Architectural Overview Marketplace	19
Figure 3-5: Reference Architecture - Demonstration Focus	22
Figure 3-6: Cloud Reference Architecture	23
Figure 3-7: Architectural Overview GeM Marketplace hosted in the cloud.....	25
Figure 3-8: Option 1: Single Marketplace	26
Figure 3-8: Option 2a: One Clearing House and multiple Service Broker	27
Figure 3-9: Option 2b: Multiple Clearing Houses and multiple Service Broker.....	27
Figure 3-10: Option 3: Interconnected Marketplace.....	28
Figure 4-1: System Context - Business View.....	30
Figure 4-2: Actor Overview	33
Figure 4-3: System Context Diagram – Overview.....	37
Figure 4-4 System Context Diagram – Nonhuman Actor View.....	38
Figure 4-5 System Context Diagram – View of Business Human Actors	39
Figure 4-6 System Context Diagram – View of Technical Human Actors	40

List of Abbreviations

API	Application Programming Interface
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
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 electric vehicle
RES	Renewable energy source
RFID	Radio frequency identification
SDR	Service detail record
SECC	Supply Equipment Communication Controller
SLA	Service level agreement
TOU	Time of use
V2G	Vehicle to grid
V2H	Vehicle to home
VPP	Virtual power plant
WP	Work Package

1 Executive Summary – ICT Reference Architecture

One of the main goals of Green eMotion (GeM) is the definition and demonstration of the European Marketplace. That means the ICT needed for electric mobility processes and services, e.g. clearing house services (roaming), forwarding service detail record or basic end user services like search for charging points or value added services like reservation of charging points.

The European Marketplace will support the efficient integration of the various demo regions with their charge management systems and customer backend systems. With that all connected demo regions can use the provided Electric Vehicle (EV) services including roaming of the European Marketplace.

By the open architecture, standardized interfaces and business objects (e.g. identification of charging points and contracts) it is ensured that all market participants can develop and commercialize their own services on the Marketplace. By that a competitive approach between the different EV service providers will be boosted.

The GeM European Marketplace will also facilitate the interconnection of several Marketplaces. That enables e.g. roaming between EV service providers even if one is connected to the GeM European Marketplace and the other one is connected to a local Marketplace. That will be ensured by using standardized interfaces, business object and an open architecture.

This deliverable is about the ICT reference architecture for the GeM European Marketplace components and their relation and interaction. The ICT reference architecture will include all requirements, including security, safety and privacy concepts, components and interfaces. The specific APIs and interfaces of the ICT Reference Architecture are part of deliverable D3.5 Specification (Release 1) and D3.6 (Release 2). ICT Reference Architecture relevant standards and protocols are part of deliverable D3.9 and D3.10.

One important pillar of Green eMotion (GeM) is the design and test of the EV Services Market including the GeM Marketplace as part of the ICT system which will connect all actors of the system and facilitate the exchange of information. The Green eMotion EV Services Market including the GeM Marketplace will provide many services, not only to electric mobility and links together all involved stakeholders in the electric mobility ecosystem.

Before designing and implementing Green eMotion's EV Services Market including the GeM Marketplace system, a thorough analysis of previous electric mobility demonstrations and their IT approaches have been performed in Task 3.1 Stakeholder ICT Requirements and Business Analysis and documented in Deliverable D3.1 to leverage the lessons learned by them.

The ICT Reference Architecture is **THE** framework describing the GeM EV Services Market and GeM Marketplace components and their relation. The overall architecture has to fulfil the functional and non-functional requirements (see also deliverable D3.1 chapter 6, Requirements for the GeM WP3 Marketplace Project) and to provide a scalable, extensible, secure and open platform for handling all interactions between services and their related stakeholders. This ICT Reference Architecture will enable other companies to deploy similar Marketplaces for EV services in Europe and will ensure interoperability with the GeM Marketplace being deployed as part of the Green eMotion project.

Chapter 2 (Introduction) describes the scope of the Reference Architecture for the Green eMotion Marketplace as part of GeM EV Services Market. The Reference Architecture will be used as the basis to instantiate (realize) the architecture for the demonstration system used for the demo regions.

Chapter 3 (Architecture Overview) provides an architecture overview of the GeM EV Services Market and in specific of the GeM Marketplace. This chapter describes all stakeholders involved in electric mobility and the functional components needed from a GeM Marketplace point of view. The GeM Marketplace is a well defined sub domain/element of the ICT system of the Green eMotion EV Services Market which serves as an IT environment for offering services by Service Providers to Service Requesters. Alternative implementation options for the GeM Marketplace are discussed and a recommended option for the scope of the Green eMotion project defined.

Chapter 4 (System Context) outlines the actors and system involved from the GeM Marketplace perspective. The information and control flow between the GeM Marketplace and actors is further described in more detail.

Chapter 5 (Security Architecture) lists all relevant security topics to be considered when designing and implementing the GeM Marketplace.

Chapter 6 (Architecture Decisions) provides a table of important decisions when designing and implementing the GeM Marketplace, like Service – Oriented – Architecture (SOA). Finally chapter 7 (Non-Functional Requirements) outlines a comprehensive list of relevant requirements which are non-functional related, like availability, scalability etc.

The last chapter 8 (Glossary) summaries all terms and definitions used for the ICT Reference Architecture of the GeM EV Services Market.

2 Introduction

This deliverable is about the ICT reference architecture for electric mobility describing the ICT EV Services Market components and their relation. The ICT reference architecture will include all requirements, including security, safety and privacy concepts, components and interfaces.

ICT is seen as the key enabler for electric mobility to reduce the technological disadvantages by offering a multitude of basic and advanced services to the EV driver. Without integration efforts the usability for the end user may be regionally limited and offerings of advanced services may be decelerated due to barriers to realize economies of scale. Within Work Package 3 (WP3) the Service Level is addressed, as shown in Figure 2-1, including the ICT open platform based on a B2B marketplace concept with EV business services, operation, billing etc. provided to all stakeholders.

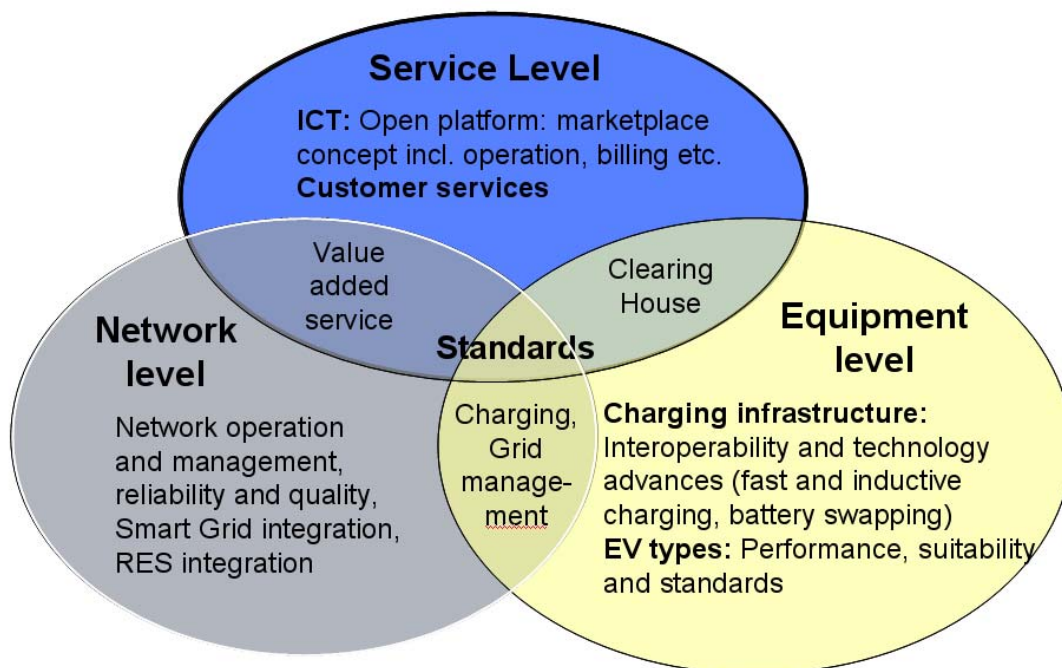


Figure 2-1: Service Level as part of Green eMotion Project¹

One important pillar of Green eMotion (GeM) project is the design and test of the GeM Marketplace as part of the complete ICT system (GeM EV Services Market) which will connect all actors of the system and facilitate the exchange of information. Figure 2-2 shows the Green eMotion Marketplace as part of the EV Services Market with the services and involved stakeholders in the electric mobility ecosystem. The GeM Marketplace should enable a high number of services for consumers, suppliers, service providers, grid operators as well as policy makers and is therefore an important prerequisite for consumer acceptance and intelligent efficient functioning of the future EV Service Market.

¹ Green eMotion DOW

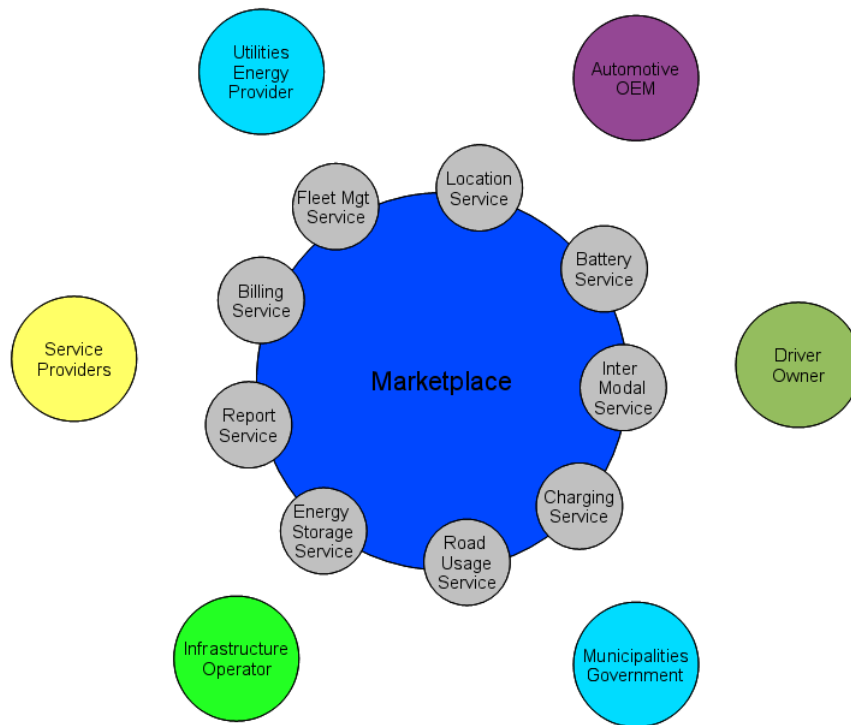


Figure 2-2 Green eMotion EV Services Market

Before designing and implementing Green eMotion’s Marketplace system, a thorough analysis of previous electric mobility demonstrations and their IT approaches have been performed in task 3.1 Stakeholder ICT Requirements and Business Analysis and documented in deliverable D3.1 to leverage the lessons learned by them. A deep survey on the expectations of internal and external stakeholders have ensured that no requirements are missed, producing a holistic goal definition on the overall system.

2.1 Definition Reference Architecture

The ICT Reference Architecture is the framework describing the GeM EV Service Market and the Marketplace components and their relation. The overall architecture has to fulfil the functional and non-functional requirements (see also deliverable D3.1 chapter 6, Requirements for the GeM WP3 Marketplace Project) and to provide a scalable, extensible, secure and open platform for handling all interactions between services and their related stakeholders.

The Reference Architecture for the Green eMotion Marketplace and EV Services Market follows industry best practices for Reference Architectures. Within the IT Industry there is a common sense about the scope and focus of a Reference Architecture²:

² Refer to OASIS Group: Reference Architecture for SOA: <http://docs.oasis-open.org/soa-rm/soa-ra/v1.0/soa-ra-pr-01.pdf>

- A Reference Architecture in the field of software architecture or enterprise architecture provides a template solution for architecture for a particular domain. It also provides a common vocabulary with which to discuss implementations, often with the aim to stress commonality.
- A Reference Architecture is a software architecture where the structures and respective elements and relations provide templates for concrete architectures in a particular domain or in a family of software systems.
- A Reference Architecture consists of a list of functions and some indication of their interfaces (or APIs) and interactions with each other and with functions located outside of the scope of the Reference Architecture.

The Reference Architecture for the GeM Marketplace and EV Service Market is based upon these principles. A Reference Architecture contains always a superset of architectural building blocks that might be required. During the instantiation (realization) process, meaning creating and establishing the architecture for a dedicated project, a selection of the required building blocks is done based on the Reference Architecture.

The Reference Architecture will be used as basis to instantiate (realize) the architecture for the demonstration system. During or after the demonstration period of the GeM project the Reference Architecture will be used as template to instantiate any specific solution implementation for an EV Marketplace as part of an EV Service Market according to specific requirements. This Reference Architecture will enable other companies to deploy similar Marketplaces for EV Services in Europe and will ensure interoperability with the GeM Marketplace being deployed as part of the Green eMotion project.

3 Architecture Overview

The Reference Architecture considers the ICT systems to be built on two levels:

- the overall Green eMotion EV Services³ Market and
- the Green eMotion Marketplace

This chapter lays out the definition for important terms for the Reference Architecture.

In the following sub chapters the architecture will be described in detail on the above two levels. The specific APIs and interfaces are part of deliverable D3.5 Specification (Release 1) and D3.6 (Release 2).

The GeM **EV Services Market** is the Virtual Domain comprising all the services related around Electric Mobility – it describes the whole ecosystem for EV Services. The GeM EV Services Market consists of End User Service Providers, which are **Service Requesters** from a marketplace perspective - **Service Providers** and any number of GeM **Marketplaces**. The GeM EV Services Market is characterized by covering all sorts of contractual relationships across

- 1) B2B, e.g. bilateral roaming agreements between two service providers,
- 2) B2C, e.g. charging services to an end-customer and
- 3) B2G, e.g. charge management of municipality-owned charging infrastructure.

The GeM EV Services Market is open:

- Any party offering an EV related services is considered as a part of the GeM EV Services Market.
- Services offered on the GeM EV Service Market must be standardized, e.g. every Service Provider offering a “Search Charge Point Service” must use the same service interface.
- EV Services can be offered via a GeM Marketplace or directly on a bilateral basis between Service Providers and Service Requesters.

Service Provider: A Service Provider offers services to Service Requesters. Service Providers in this context are EVSE Operator or other value-add service providers, like navigation or routing providers.

³ Definition of a “Service” from Wikipedia:

The generic clear-cut and complete, concise and consistent definition of the service term reads as follows:

A service is a set of one time consumable and perishable benefits

- delivered from the accountable service provider, mostly in close coaction with his internal and external service suppliers,
- effectuated by distinct functions of technical systems and by distinct activities of individuals, respectively,
- commissioned according to the needs of his service consumers by the service customer from the accountable service provider,
- rendered individually to an authorized service consumer at his/her dedicated trigger,
- and, finally, consumed and utilized by the triggering service consumer for executing his/her upcoming business activity or private activity.

Service Requester: A Service Requester is requesting and using the services offered from a Service Provider.

Service Broker: The Service Broker links the Service Requester with the Service Provider. It is a non-human actor. Service Brokerage in this context is one of the core functionalities of the GeM Marketplace.

End User Service Provider: An End User Service Provider offers services to end customers and might use services offered by other Service Providers to fulfil these services. End User Service Providers in this context are for example EVSP.

The Green eMotion Marketplace is a well defined sub domain/element of the ICT system of the Green eMotion EV Services Market which serves as an IT environment for offering services by **Service Providers** to **Service Requesters**. It is based on a common set of standards, tools and architectures assuring new entrants can enter the GeM Marketplace without barriers. Any GeM **Marketplace** shares a set of common **Core Services**, such as (but not limited to) a Common Service Catalogue, Common Service Broker functionality and common access technologies. Beside the Core Services also **Clearing House Services** and **Value Added Services** can be running on the GeM Marketplace. Optionally also **Basic End User Services** are running on it. The GeM Marketplace acts a Service Broker for **Business to Business (B2B) EV Services** – the Clearing House Services, the Value Added Services and the Basic End User Services.

Core Services are basic services that are required to run a GeM Marketplace and these services are shared and used by the Value Added Services, Basic End User Services and Clearing House Services.

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.

Clearing House Services are business services which enable roaming processes for charging EVs by multiple EVSE operators. Two scenarios are reflected, the contractual clearing and the financial clearing. The latter can be on top of the contractual clearing.

Value Added Services (VAS) are business services around but not limited to electric mobility. They might enrich the functionality of Basic End User Services to provide more comfort. Value Added Services are designed in order to generate value for a stakeholder in the system and might be charged.

All stakeholders in the electric mobility ecosystem may offer their services on the GeM Marketplace platform. End User Service Providers (Service Requesters) can use already offered services to enrich their own services. Service can be selected based on certain criteria (e.g. “Find available Charging spot” services can be selected based on energy type (renewable)). Similar Value Added Services can be aggregated in the Marketplace (e.g. “Find available Charging spot” services are offered by several providers owning charging spots – a service requester uses this services and the Marketplace aggregates the answer of all these services).

Marketplaces can be segmented, and/or related to other Marketplaces (hierarchically or peer-to-peer). There are several models to operate Marketplaces; this document discusses the following three models:

1. **Single Marketplace:** This Marketplace is operated by one operator. This operator is also the only Service Broker acting on the Marketplace and the Marketplace is not connected to any other Marketplaces. Several types of this Marketplace can co-exist in the Market.

2. **Interconnected Marketplaces:** An interconnected Marketplace is operated by one operator. This operator is also the only Service Broker acting on the Marketplace. This type of Marketplace is connected to other Marketplaces. Several types of this Marketplace can co-exist in the Market.
3. **Multiple Service Brokers per Marketplace:** Such a Marketplace is operated by one operator, but several Services Brokers can act on this Marketplace.

The next chapters detail the understanding of the market and the three models to operate a Marketplace.

For the Green eMotion WP3 project, the demonstration systems will be the GeM EV Services Market based on regional demonstrations and a single GeM Marketplace as a starting point to reduce complexity and ease implementation. In WP3 regional demonstrations will be part of the GeM EV Services Market. This focus will be on demonstrating basic and value-added end-user services and bilateral roaming agreements between service providers and interfacing with GeM Marketplace and clearing house. What will be demonstrated is also documented as use cases in deliverable 3.3. The GeM Marketplace will be open and be built on standards. For further details refer to D3.9 Standards and Protocols. Depending on upcoming business model the other operating modes for the GeM Marketplace is used in the future. Demonstration of multiple / interconnected Marketplaces maybe be part of a second phase.

3.1 GeM EV Services Market

On the GeM EV Services Market there are many stakeholders and actors like Energy Retailer, Distribution System Operators (DSO), Transmission System Operators (TSO), Automotive OEMs, Electric Vehicle Service providers, Charging Spot Operators, Mobility Service Providers, Municipalities etc. In the end, every actor acts as Service Requester or Service Provider on the Market or as a combination of both roles. The Service Requester is offering its End User Service to the end customer, typically the driver or owner of the vehicle. To fulfil its End User Service, the requester is using services offered by Service Providers on the Market. The Service Providers can offer their services directly or via the Marketplace. If the Service Requester is accessing the offered service directly there is a bilateral relation between both players. This is also part of the GeM EV Services Market. Within the EV Services Market several Service Providers may offer the same service, e.g. searching for charge spots. The GeM Marketplace or a Service Provider on the GeM Marketplace aggregates these services allowing Service Requesters to access this service offered by several Service Providers within one request.

3.1.1 Architecture Overview Diagram

The following diagram illustrates the relation between the different actors on the EV Service Market. The diagram focuses on the EV Service Market; the Marketplace internals are described and illustrated in the following chapters. It does not illustrate the importance of certain Services running on the Marketplace.

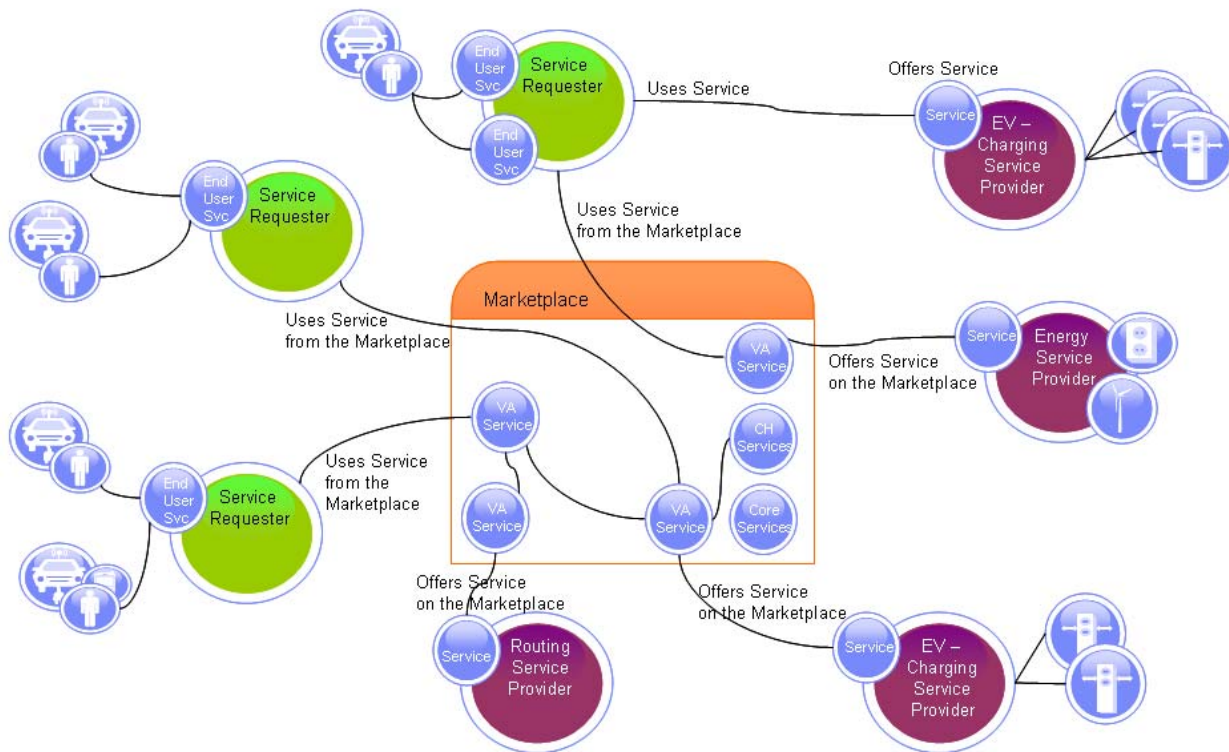


Figure 3-1: Architectural Overview GeM EV Service Market

3.2 Marketplace Level

As described above the GeM Marketplace acts as a Business-to-Business (B2B) Service Broker. The consumer has a contractual relationship with an End User Service Provider. The End User Service Provider is offering Basic End User and/or Value Added Services to consumers. The relations are depicted in Figure 3-2. (Note: The white boxes in the diagram simply reflect a certain service of the corresponding service type). To fulfil its service it acts as Service Requester and uses Core Services and/or Clearing House Services provided on the Marketplace. The End User Service Provider (B2C) might also use other Basic End User or Value Added Services offered on the Marketplace to fulfil its service. As a prerequisite a contractual relationship has to be established between the business partners clarifying the terms and conditions under which a service can be used. The Basic End User Services will most likely run in the End User Service Provider environment. In addition the Marketplace will also offer an environment to run these services, if the (End User-) Service Provider has no own capabilities to host and execute these services.

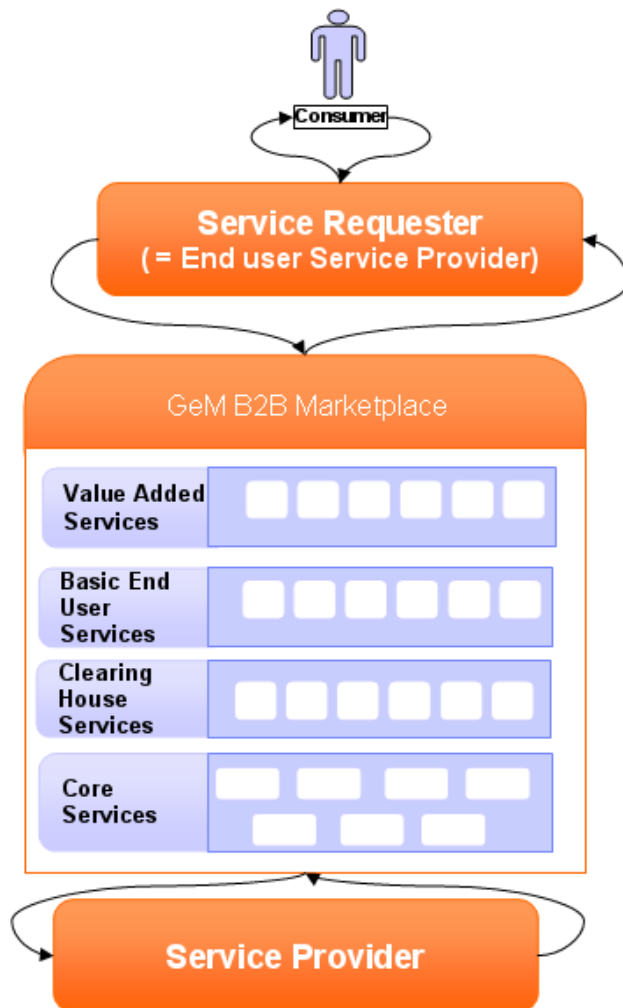


Figure 3-2: Relation between the Actors

In the following chapters, the GeM Marketplace will be described from two angles, the conceptual view and the operational view. The conceptual view describes the architectural building blocks being required to implement the Marketplace. The operational view lays out concepts how the Marketplace is operated.

3.2.1 Conceptual View

The conceptual view lays out domains and identifies architectural building blocks within these domains. Architectural building blocks will be further broken down in the Component Model into components/features.

The Marketplace is split into three main domains:

1. **Service Creation Domain**
2. **Service Execution Domain**
3. **Service Delivery Domain**

Figure 3-3 depicts the three domains (Note: white boxes reflect architectural building blocks inside this domain).

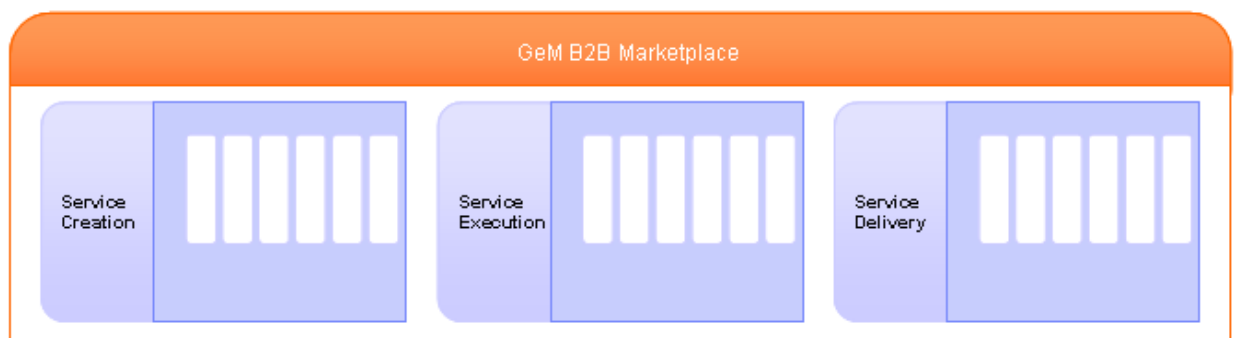


Figure 3-3: Domain Overview

The **Service Creation Domain** is intended to be used during the Service Development of Value Added or Clearing House Services. It contains processes, methods, frameworks and development and test tooling to create new services for the Marketplace. This domain is optional but recommended to operate a Marketplace.

The **Service Execution Domain** centralizes all functionality around the execution of services. It offers an environment to execute services being offered on the Marketplace. This domain is optional, but recommended to operate a Marketplace. As alternative for Service Providers, they can execute their services in their own environment and the Marketplace acts as proxy and forwards the service requests to the Service Providers own environment.

The **Service Delivery Domain** offers all functionality around the Services. It offers functionality to register services, search for services and to use services. This domain is required and provides the foundation to operate a Marketplace.

Beside these three main domains are three supportive domains containing functionality for Information Management, Analytics and Optimization, and Security and Compliance. Those three additional domains complement the architectural overview.

Figure 3-4: Architectural Overview Marketplace details the all the domains of the Marketplace. The domains colored in orange belong to the Marketplace. The domains are colored in grey do not belong to the Marketplace, they are operated by the Service Providers out site of the Marketplace.

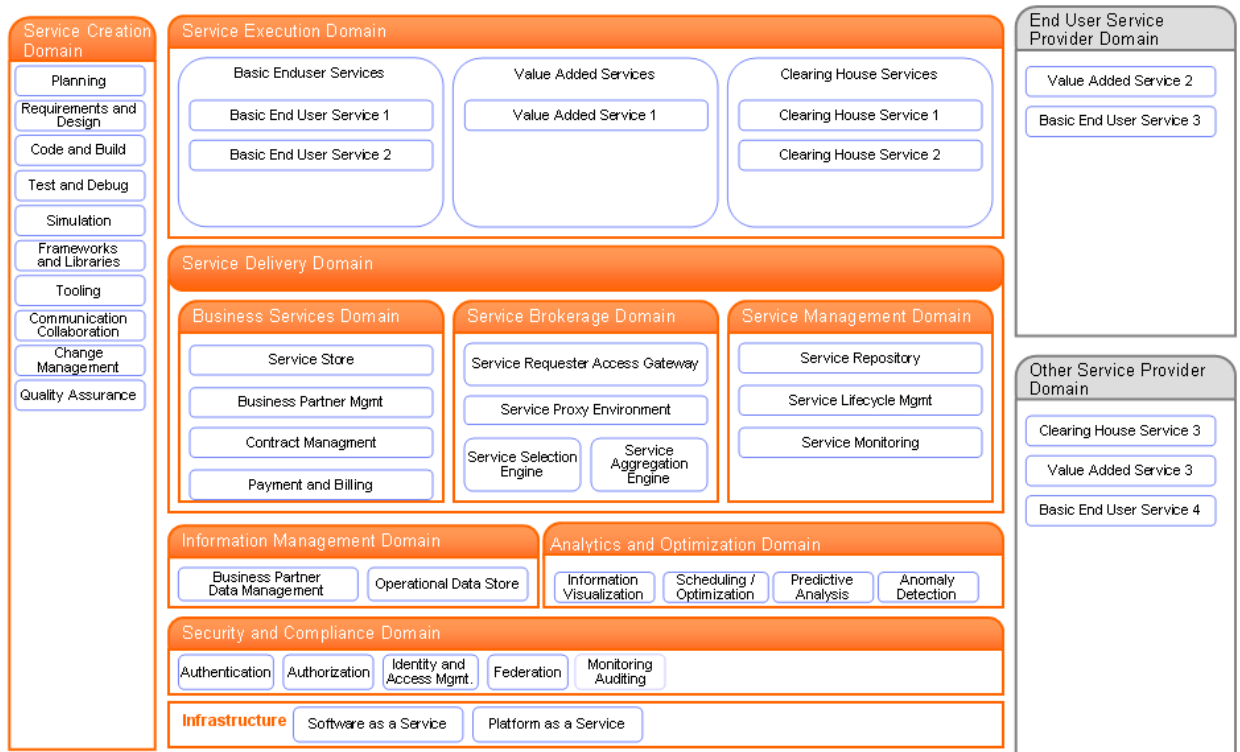


Figure 3-4: Architectural Overview Marketplace

The architectural building blocks in the **Service Creation Domain** should help stakeholders to create new Services for the Marketplace. It covers the whole service life cycle for developing and maintaining a Service.

- Planning provides tooling for project management and development planning.
- Requirements and Design provides tooling to create, document and manage requirements for services to be delivered via the Marketplace.
- Code and Build provides tooling to create/implement and build services to be delivered via the Marketplace.
- Test and Debug provides tooling to run the different types of tests, e.g., functional tests, integration tests, performance tests. Furthermore the debug facilities/tooling allows a detailed problem analysis of services to be deployed.
- Simulation provides tooling to simulate developed services.
- Framework and Libraries provide best practices, architectural framework and patterns allowing a Service Provider to reuse existing knowledge when creating a new Service.
- Communication Collaboration provides tooling to support collaboration inside and between teams during the development and maintenance phase. The tools include messaging, social networking, email etc.
- Change Management provides tooling to support a life cycle management for the developed services. This includes managing code, defects, feature requests etc.

- Quality Assurance provides tooling to implement a Quality Assurance process. This can include tooling for documenting and running test cases.

The **Service Execution Domain** provides a Service Execution Environment to run/execute Value Added Services, Clearing House Services and Basic End User Services. It depends on the operational concepts, what concrete functionality is offered in this domain. Further details on the operational concepts are described in chapter 3.2.2 . In Figure 3-4 only placeholders (Basic End User Service 1, Value Added Service 1 and Clearing House Service 1) are added for any type of Basic End User Service, Clearing House Service and Value Added Services. Details on these services are described in the corresponding deliverable.

The **Service Delivery Domain** is split up into three sub domains:

- Business Services Sub Domain
- Service Management Sub Domain
- Service Brokerage Sub Domain

The **Business Services Sub Domain** contains functionality to manage Business services, like administrating Business Partner data. This domain contains the following architectural building blocks:

- Service Store: Is used to browse and sell or buy Services. Service Requesters are using this functionality to browse through offered Services. During the purchase process a contractual relationship is established between the Business Partners. Furthermore the Service Store is used to bring in and remove services to/from the Marketplace.
- Partner Management: It offers functionality to manage “customer data” of all Marketplace participants. Customers in the Marketplace context are the Service Providers and Service Requesters.
- Contract Management: It offers functionality to administrate the relations between Marketplace participants. It maintains the information which service requester has contracted which services.
- Payment and Billing: It manages the payment and billing processes for the usage of Services. It offers measurement (service metering) functionality to document service usage and supports several payment models. It considers two aspects of payment and billing. On the one hand the payment and billing between the business partner and the Marketplace is managed, on the other hand the information about service usage (service metering) is provided to allow Service Provider to run their payment and billing processes to charge the Service Requesters.

The **Service Management Sub Domain** contains functionality to manage the Services being offered on the Marketplace. Managing in this context means bringing new Services into the Marketplace, removing Services from the Marketplace, starting and stopping these Services, versioning of Services. This domain contains the following architectural building blocks:

- Service Repository: Is a central catalogue of all Services.
- Service Monitoring: It offers functionality to monitor the status/health of the Services to see if a Service is still active and fully operational.
- Service Lifecycle Management: It offers functionality to Service Providers to register and de-register their Services. Furthermore Service can be enable/disabled.

The **Service Brokerage Sub Domain** offers functionality to access the Services offered on the Marketplace. The functionality in this domain is used during runtime when a Service request is processed. This domain contains the following architectural building blocks:

- Service Requester Access Gateway: It is the initial entry point for Service Requesters to access Services offered on the Marketplace.
- Service Proxy Environment: It manages the interactions with Services executed outside the Marketplace.
- Service Aggregation Engine: This is a service which aggregates Services of the same type to support usage of multiple similar services within one request from a Service Requester. A certain service, e.g. “Search for Charging Spots” can be offered by several Service Providers on the Marketplace. If a Service Requester wants to access this service from a choice of the providers offering these services the Service Aggregation Engine processes the service request from the Service Requester and retrieves the service responses from the chosen service providers. The answers are aggregated and provided to the Service Requester.
- Service Selection Engine: This is a service allowing Service usage based on certain criteria. Service interfaces may contain certain properties. Based on these properties, services can be selected. In this case the Service Requester requests a certain service and a certain criteria just from the Marketplace and not from a special Service Provider. The Selection Engine selects an appropriate Service based on the given criteria and the subscriptions of the Service Requester.

Open APIs assure that 3rd parties can offer some services like aggregation as part of offered services on the GeM Marketplace.

The **Security** domain offers state of the art security services like identification, authentication and authorization of Marketplace participants. **Furthermore Security and Privacy is an aspect of every service in the system.** It contains the following architectural building blocks:

- Identity and Access Management:
 - Authentication provides functionality to verify if an actor is the one he claims to be.
 - Authorization provides functionality to verify if an actor is allowed to access the Marketplace to use certain services offered via the Marketplace.
- Federation provides Identity and Access Management across several domains/companies.
- Monitoring Auditing provides functionality like access logs that are required for auditing purposes.

The **Information Management** domain offers functionality to store any operational data. It contains the following architectural building blocks:

- Business Partner Data Management is a data store holding all information about the business partners of the Marketplace.
- Operational Data Store is a data store holding operational data being created and required to operate the Marketplace.

The **End User Service Provider Domain** contains Basic End User Services and Value Added Services that are offered on the Marketplace, but being hosted and executed in the End User Service Providers environment. It is outside of the scope of the Marketplace itself, but part the overall Reference Architecture.

The **Other Service Provider Domain** contains Value Added Services and Clearing House Services that are offered on the Marketplace, but being hosted and executed in the Service Providers environment.

For the Green eMotion demonstration project, the focus will be on a subset of the identified architectural building blocks.

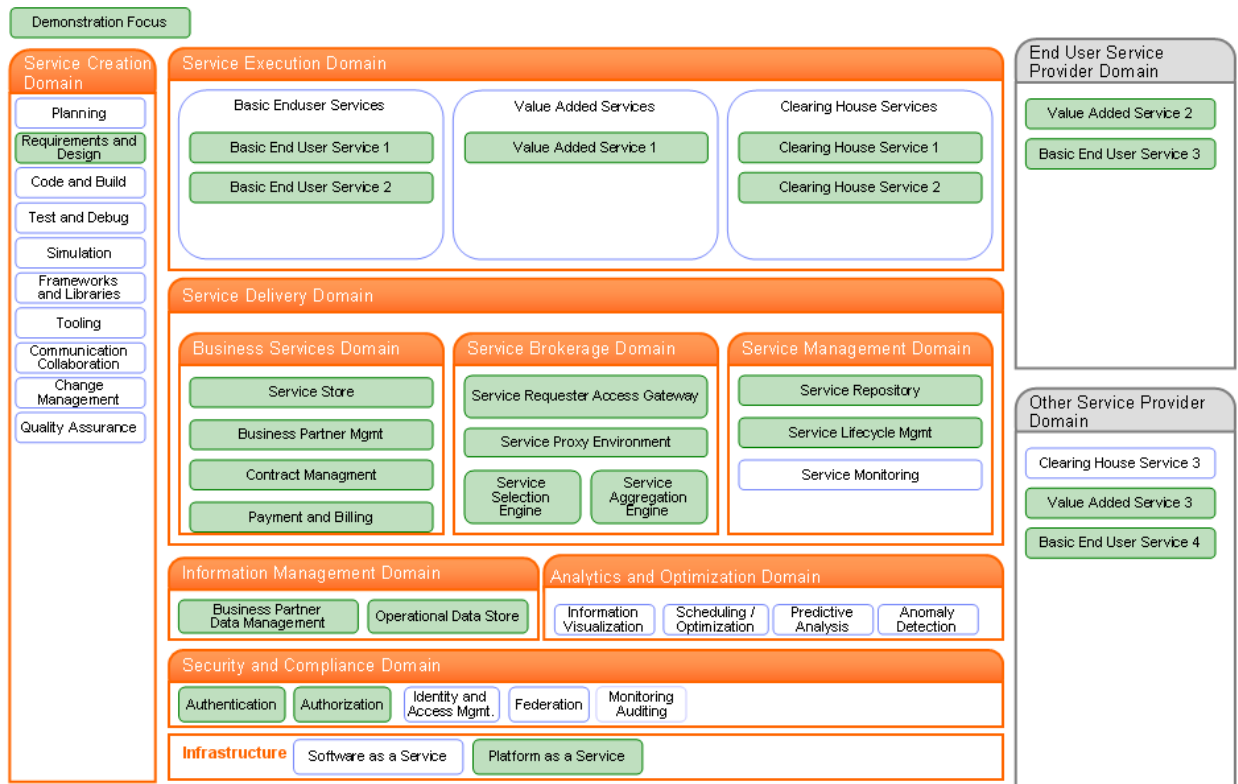


Figure 3-5: Reference Architecture - Demonstration Focus

Note: The service execution location/domain is not finalized yet. The decision if a certain Basic End User Service, a Value Added Service and a Clearing House Service is executed in Marketplace Service Execution Domain or in the Service Providers own IT Environment will be taken later.

3.2.2 Operational View

The operational view describes how the above described Reference Architecture is hosted and run in a production environment.

For the operation of the GeM Marketplace two main options were considered:

1. Conventional approach with dedicated hardware systems to host the Marketplace system
2. Cloud environment to host the Marketplace system

For the GeM Marketplace the best choice is the cloud option. The most compelling reason of the cloud approach is the flexibility of resource allocation. The Marketplace might start with only a few business services, but the cloud infrastructure enables it to scale up in an easy way, without the need of manual migration to other systems and with costs reflecting the actual usage of resources. Even for a small scale Marketplace deployment it can benefit from the high availability and fail over capabilities of an underlying cloud infrastructure to recover from hardware or software failures. Furthermore the cloud infrastructure helps separating concerns of the Marketplace operator and the IT infrastructure provider. Both roles can be accomplished by different organizations. In addition business partners of the Marketplace planning to sell services, but don't have own computing resources, can use resources on the cloud to develop, test

and run those services. Those services offered on the Marketplace, which run within the cloud, only consume resources and cause costs, if they are actually contracted by a Service Requester.

The Cloud Computing Reference Architecture (CCRA reference [1]) provides the guideline to run the GeM Marketplace in a cloud. It forms the base for a flexible infrastructure to deploy and operate the Marketplace in a cloud environment. The CCRA is submitted to the Open Group (<http://www.opengroup.org/>) for standardization.

The architectural elements of the CCRA are depicted in Figure 3-6 here:

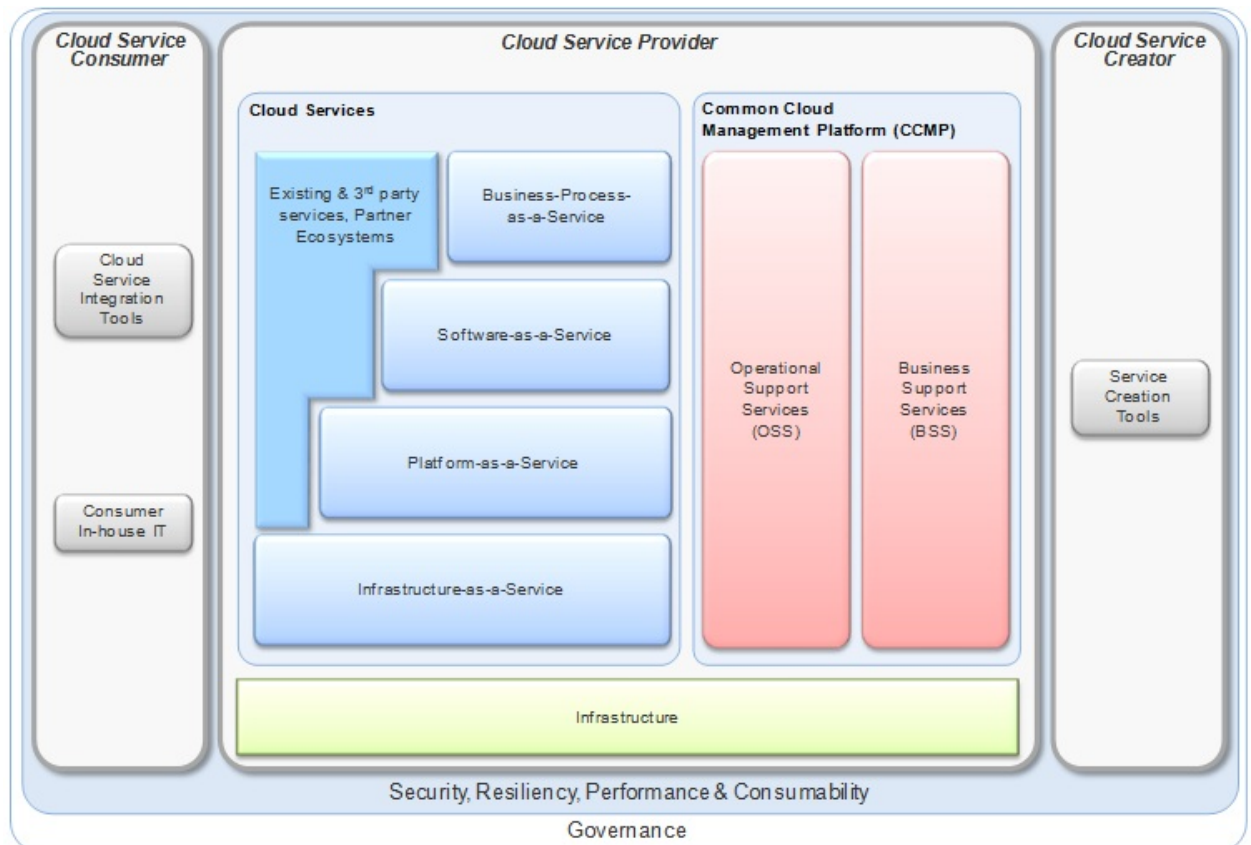


Figure 3-6: Cloud Reference Architecture

CCRA defines a spectrum of cloud service models: **Infrastructure as a Service (IaaS)**, **Platform as a Service (PaaS)**, **Software as a Service (SaaS)** and **Business Process as a Service (BPaaS)**. All service model definitions are determined by the management scope covered by the provider.

- Infrastructure-as-a-Service**
 The capability provided to the consumer is to rent processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly select networking components (e.g., firewalls, load balancers).
- Platform-as-a-Service**
 The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created applications using programming languages and tools supported by the provider (e.g.,

java, python, .Net). The consumer does not manage or control the underlying cloud infrastructure, network, servers, operating systems, or storage, but the consumer has control over the deployed applications and possibly application hosting environment configurations.

- **Software-as-a-Service**

The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure and accessible from various client devices through a thin client interface such as a Web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure, network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings. Software-as-a-Service is also referred to as Applications-as-a-Service since SaaS is essentially about providing applications as a service (vs. software in general). This also includes content services (e.g. video-on-demand) and higher value network services (e.g. VoIP) as typically encountered in communication service provider scenarios.

- **Business-Process-as-a-Service**

Business process services are any business process (horizontal or vertical) delivered through the Cloud service model (Multi-tenant, self-service provisioning, elastic scaling and usage metering or pricing) via the Internet with access via Web-centric interfaces and exploiting Web-oriented cloud architecture. The BPaaS provider is responsible for the related business function(s).

The Common Cloud Management Platform (CCMP) is defined as a general purpose cloud management platform to support the management of any category of cloud service across I/P/S/BPaaS. CCMP is split into two main elements – the Operational Support Services (OSS) and Business Support Services (BSS). OSS comprises an image catalog, service automation management, platform and virtualization management, provisioning, IT service level management etc. BSS comprise customer account management, service offering management, subscription management, pricing and billing etc.

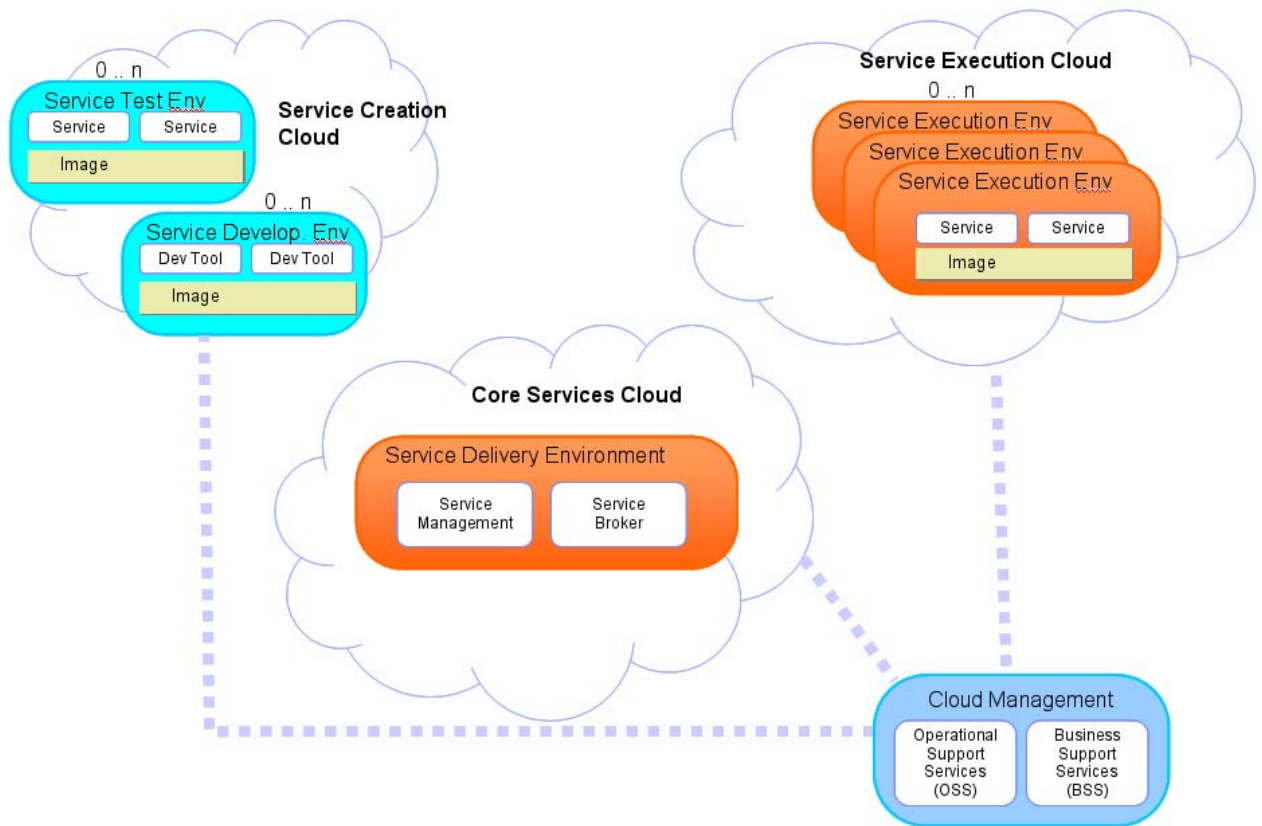


Figure 3-7: Architectural Overview GeM Marketplace hosted in the cloud

Virtualization in a cloud system is based on images which represent an instance of a virtual server. An image contains at least an operation system and optionally an arbitrary software stack.

In the context of the GeM Marketplace the core services of service brokerage and service delivery are provided on a core set of images in the cloud. This includes especially the Service Store that acts as an entry point to business partners, the Service Repository and the brokerage infrastructure.

Further images can be requested from business partners via the Service Store for service development and test in the Service Creation Cloud or service execution in the Service Execution Cloud. Those images dedicated to a business partner are delivered as IaaS or PaaS ready for a Service Provider to implement a service. After implementation the images can then be captured via the Service Store and made available for use or testing by other business partners. Service creation images as well as service execution images are not necessarily required to register a service on the Service Store. The service might be developed, tested and run outside the cloud environment. But to provide any further core services like access control or monitoring the actual service call must be routed through the service broker in the Core Service Cloud. For services hosted in the Service Execution Cloud or Service Creation Cloud this is mandatory.

The Marketplace offers also images in the Service Execution Cloud and Service Creation Cloud that can be shared between business partners. These images have a predefined software stack, e.g., application server, on which services can be deployed and which they can use. Registration of those services is also done via the Service Store and triggers the deployment on such a shared image. Routing of actual service requests to shared images through the Core Service Cloud is also mandatory.

The cloud management including image capturing, image catalogue and provisioning of images is located outside of the Marketplace cloud system. But its operations are controlled by the core Marketplace in the Core Services Cloud. So the Service Store is the only entry point for the image life cycle for business partners. No direct cloud management APIs are offered.

3.3 Other Marketplace Options

The described architecture focuses so far on the Marketplace approach with:

1. One Marketplace Core Services providing the foundation to run and operate services
2. multiple Clearing House Services from multiple Service Providers
3. multiple Value Add Services from multiple Service Providers
4. multiple End User Services from multiple Service Providers

This model and approach is open with regard to most of the offered business services by many Service Providers but limits the flexibility in the domain of core services. Additionally legal constraints e.g. anti trust aspects must be considered. Even if the risk is small, the dependency on this single player with regard to cost, flexibility and to further development (enhancements, etc.) may slightly remain (see Figure 3-8: Option 1: Single Marketplace.

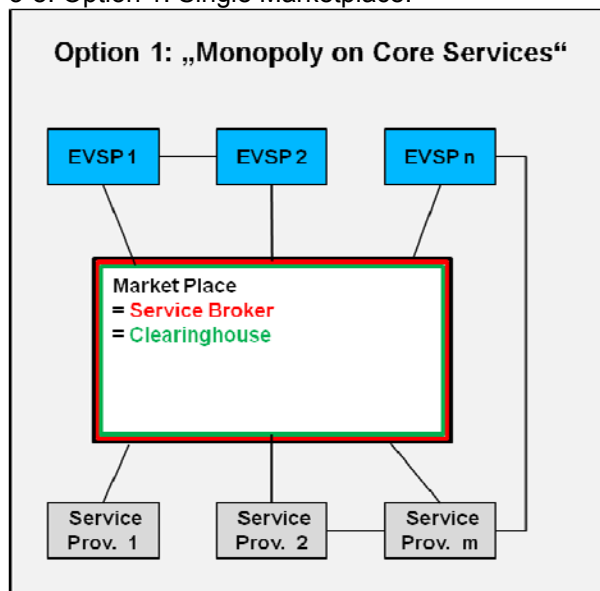


Figure 3-8: Option 1: Single Marketplace

An alternative is if there is more than one player offering such a marketplace (see figure Option3). In other words different market places would act in competition, however, this would reduce the multiplier effect for service providers and requesters (create once & sell to multiple requestors). A self-evident solution would be to connect the market places. This would allow for example on marketplace A a service provider can offer services to service requestors on marketplace B and vice versa. Unfortunately this increases the coordination between the market places as well as the complexity of the supported processes. Influencing factors are thus number of involved partners and number of services offered on connected marketplaces.

So it is likely to expect both forms:

- 1) There are services which are offered only on one marketplace and
- 2) other service which can be offered on both marketplaces at the same time.

Nonetheless with regard to the aim of openness a definition of this interface between the marketplaces would be a necessity.

A variation of this approach would be a hierarchical organization of the marketplaces in, e.g., national or regional clusters. An additional advantage of this approach is to allow regional/ national specific developments.

Another approach would be to set the arena of competition on the marketplace itself. This means all beside a minimum amount of services on the marketplace face competition. No player or provider is excluded or discriminated. Option 2a and Option 2b show two other examples of those approaches. Explicitly competition would be defined for the brokering role as well as the clearing house. In other words multiple players would offer brokering or clearing house services.

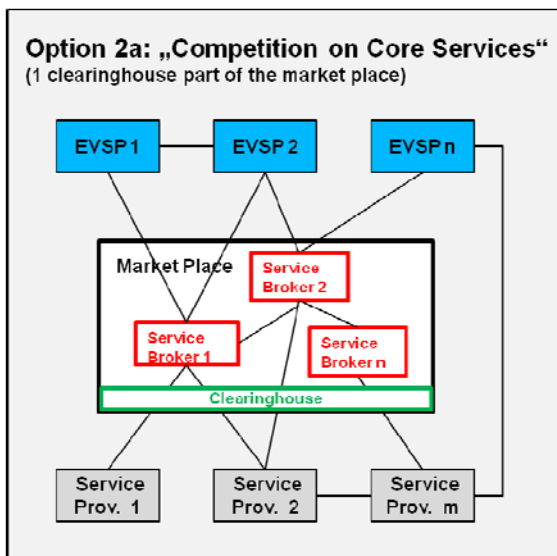


Figure 3-8: Option 2a: One Clearing House and multiple Service Broker

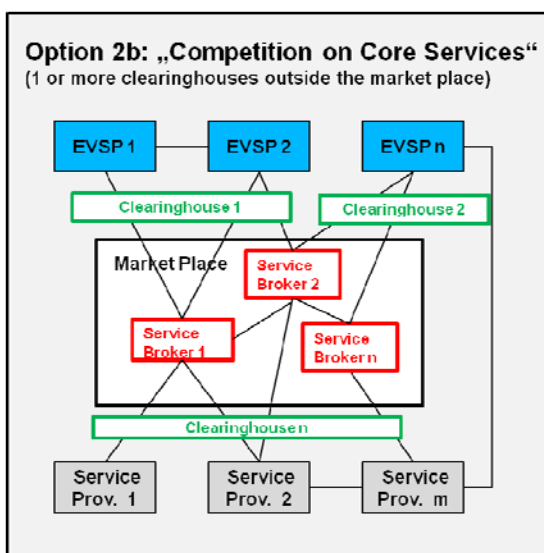


Figure 3-9: Option 2b: Multiple Clearing Houses and multiple Service Broker

The downside of the approach is an even higher degree of coordination and complexity between the players on the market; however the benefits are “more” flexibility, “higher” competition for all players on the market which will in turn enable more innovations and faster cost effective structures.

There are a lot of more possible combinations for this type of marketplace operational model, but the basic principle is the same: Competition on the marketplace instead of competition between marketplaces. In contrast to the before mentioned approach agreements (Interfaces, processes etc.) and rules of the marketplace are defined on a common level for all players of the marketplace.

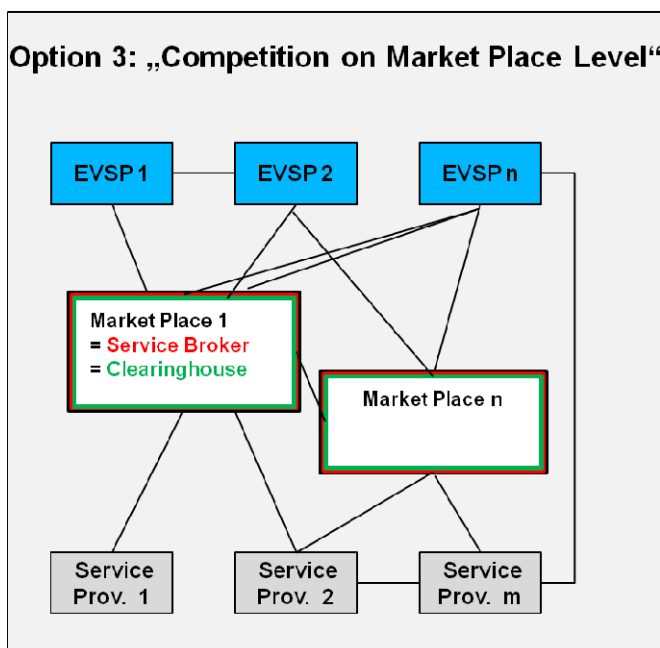


Figure 3-10: Option 3: Interconnected Marketplace

This approach might be another possible architecture of the marketplace, however due to time and limits of resources as well as the high degree of complexity and the high numbers of involved partners, the overall aim can only be reached step by step.

To conclude the following basic assumption should be considered:

- Allow bilateral business outside the marketplace
- Standardized and open interfaces for linkage of all actors within one or between multiple marketplaces (Option 3)
- The marketplace should allow competition to allow fast mass market adoption. This would convince also major players outside of Green eMotion to participate and to foster the rise of the European marketplace.
- Any company or organization may participate and contribute to support a wide acceptance of the proposed solution. Nonetheless there may be a small set of rules and services which must be defined to reduce the complexity and support the adoption responsible the participation at the marketplace.

4 System Context

The System Context initially represents the entire system as a single object or process and identifies the interfaces between the system and external entities. Usually shown as a diagram, this representation defines the system and identifies the information and control flows that cross the system boundary. The System Context highlights several important characteristics of the system: users, external systems, batch inputs and outputs, and external devices.

This chapter describes the context of the B2B Marketplace of Green eMotion WP 3 project. To provide a common understanding, the system context is presented in two different views:

- The Business View shows the Marketplace system in the context of its stakeholders.
- The Technical View shows the Marketplace system in the context of roles of the acting stakeholders.

4.1 Business View

4.1.1 Diagram

The system context diagram shows the entire system represented as a single object or and identifies its interfaces with external entities of the system.

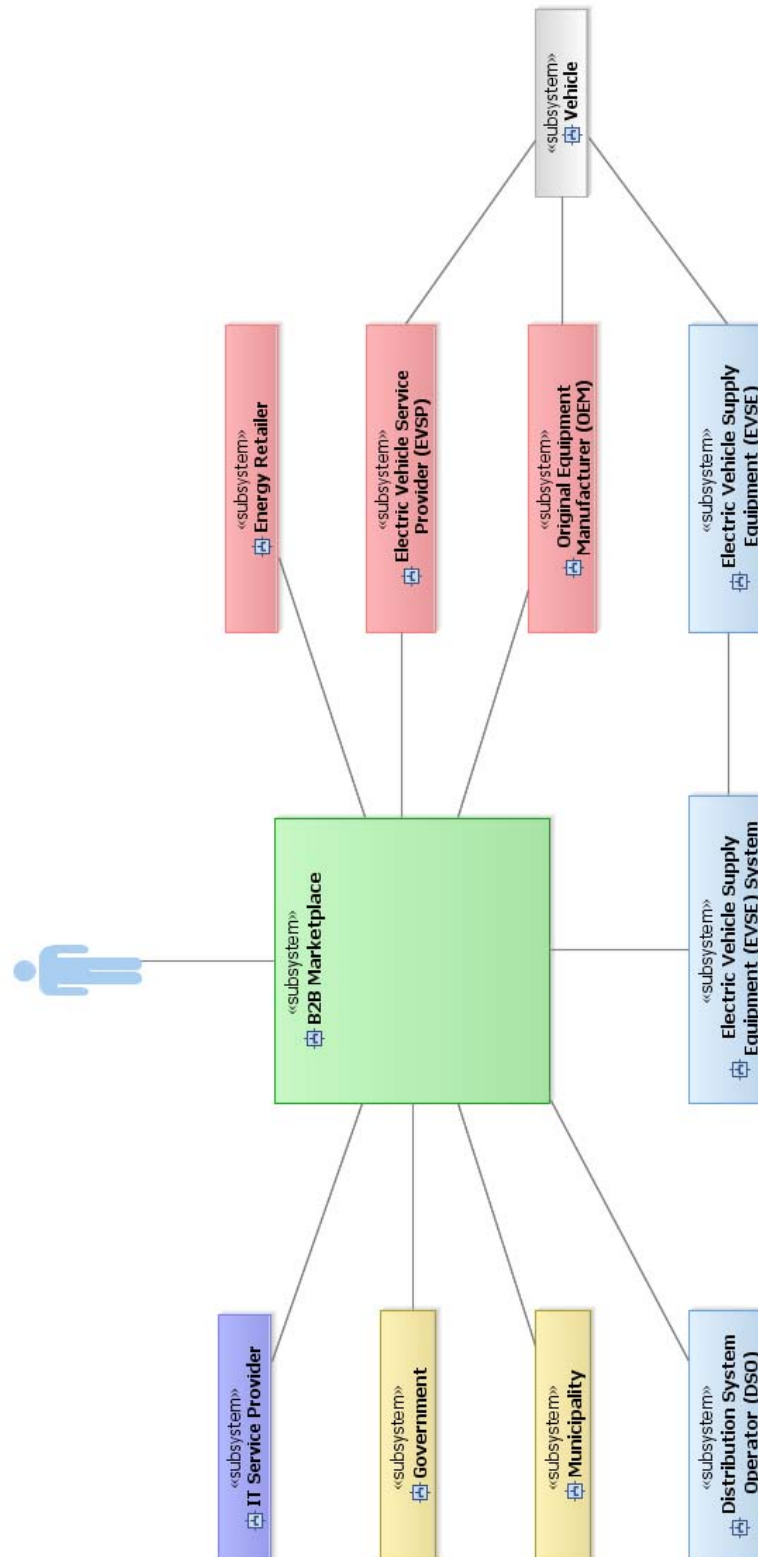


Figure 4-1: System Context - Business View

4.1.2 Stakeholders / Business Actors

Most of the stakeholder can act as Service Provider as well as Service Requester. This means that a physical entity is not restricted to play one single role, i.e., an energy retailer can act as an EVSE operator as well.

For a detailed description of the stakeholders refer to the Business Analysis Document [1].

The following section describes the Stakeholders / Business Actors in alphabetical order as shown in Figure 4-1: System Context - Business View. The actors described below are in the same colour as shown in the figure before.

4.1.2.1 ACT – Marketplace Operator

Description	Role representing all administration activities performed by the marketplace. The role can be divided in a Marketplace Business Operator and Marketplace Technical Operator role.
Type	Human Actor

4.1.2.2 IT Service Provider

Description	Entity acting as placeholder for business partners that offers services to the marketplace.
Type	Nonhuman Actor

4.1.2.3 Distribution System Operator (DSO)

Description	Entity responsible for the distribution grid
Type	Nonhuman Actor

4.1.2.4 Electric Vehicle

Description	A vehicle, which is powered by electricity. The entity will provide the link to the vehicle driver. The electric vehicle can act by itself based on its state.
Type	Nonhuman Actor

4.1.2.5 Electric Vehicle Supply Equipment (EVSE)

Description	Physical entity that plugs directly to the electric vehicle to deliver the energy.
Type	Nonhuman Actor

4.1.2.6 Electric Vehicle Supply Equipment (EVSE) Operator System

Description	Role that delivers and manages physical equipment to supply the charging process of the vehicle
Type	Nonhuman Actor

4.1.2.7 Energy Retailer

Description	Entity that sells electrical energy to customers
Type	Nonhuman Actor

4.1.2.8 Government

Description	Role representing public authorities
Type	Nonhuman Actor

4.1.2.9 Municipality

Description	Role representing cities and regions that provide EV services
Type	Nonhuman Actor

4.1.2.10 Original Equipment Manufacturer (OEM) System

Description	An entity that produces electric vehicles and provides EV services related to their own build electric vehicles.
Type	Nonhuman Actor

4.1.2.11 Electric Vehicle Service Provider (EVSP) System

Description	An entity that offers electric vehicles and provides EV services related to any electric vehicles from different OEMs.
Type	Nonhuman Actor

4.2 Technical View

4.2.1 Actor Overview

The following diagram shows the hierarchical structure of the actors. The description of the actors can be found in the following subsections.

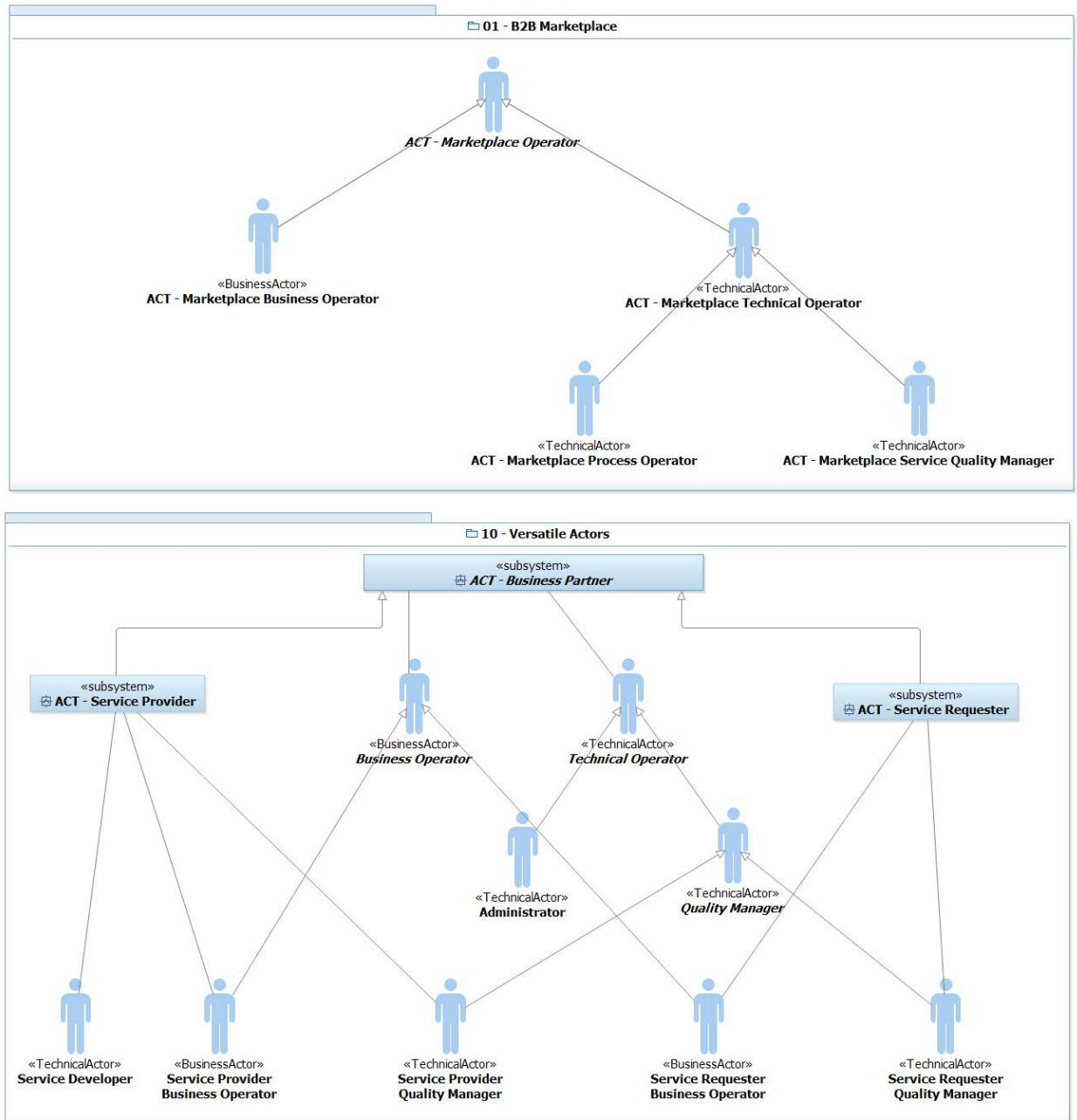


Figure 4-2: Actor Overview

4.2.1.1 Marketplace Actors

4.2.1.1.1 ACT – Marketplace Operator

Description	Abstract Role that is divided in Marketplace Business Operator and Marketplace Technical Operator roles.
Type	Human Actor

4.2.1.1.2 ACT – Marketplace Business Operator

Description	Role that manages the marketplace operations from the business perspective
Type	Human Actor

4.2.1.1.3 ACT – Marketplace Technical Operator

Description	Role that manages the marketplace operations from the technical perspective, e.g., administrator
Type	Human Actor

4.2.1.1.4 ACT – Marketplace Process Operator

Description	Special kind of the Marketplace Technical Operator that manages processes like linking and aggregating services
Type	Human Actor

4.2.1.1.5 ACT – Marketplace Service Quality Manager

Description	Special kind of the Marketplace Technical Operator that is responsible for the quality of the provided services.
Type	Human Actor

4.2.1.2 Business Partner Actors

4.2.1.2.1 ACT – Business Partner

Description	Role that is fulfilled by all entities that are registered at the marketplace. A Business Partner can act as Service Provider and/or Service Requester. The human actor roles of a Business Partner can be divided in Business Operator and Technical Operator roles.
Type	Nonhuman Actor

4.2.1.2.2 ACT – Service Provider

Description	Entity that provides EV services to the marketplace
Type	Nonhuman actor

4.2.1.2.3 ACT – Service Requester

Description	Entity that uses EV services from the marketplace
Type	Nonhuman actor

4.2.1.2.4 Business Operator

Description	Abstract Role that manages the operations of the Business Partner from the business perspective. It is divided in roles for the Service Provider and the Service Requester.
Type	Human Actor

4.2.1.2.5 Technical Operator

Description	Abstract Role that manages the operations of the Business Partner from the technical perspective. It is divided in roles for the Service Provider and the Service Requester.
Type	Human Actor

4.2.1.2.6 Administrator

Description	Technical Role of a Business Partner
Type	Human Actor

4.2.1.2.7 Quality Manager

Description	Technical Role of a Business Partner, that is responsible for the offered or used services. It is divided in roles for the Service Provider and the Service Requester.
Type	Human Actor

4.2.1.2.8 Service Developer

Description	Technical Role of a Business Partner, that is responsible for the offered or used services. It is divided in roles for the Service Provider and the Service Requester.
Type	Human Actor

4.2.1.2.9 Service Provider Business Operator

Description	Abstract Role that manages the operations of the Service Provider from the business perspective. It is a child of the Business Operator role.
Type	Human Actor

4.2.1.2.10 Service Requester Business Operator

Description	Abstract Role that manages the operations of the Service Requester
--------------------	--

	from the business perspective. It is a child of the Business Operator role.
Type	Human Actor

4.2.1.2.11 Service Provider Quality Manager

Description	Technical Role of the Service Provider, that is responsible for the offered services. It is a child of the Quality Manager role.
Type	Human Actor

4.2.1.2.12 Service Requester Quality Manager

Description	Technical Role of Service Requester, that is responsible for the used services. It is a child of the Quality Manager role.
Type	Human Actor

4.2.2 System Context Diagram – Technical View

The context diagram shows the entire system represented as a single object or process, and identifies its interfaces with external entities of the system.

To provide a better overview the system context diagram is divided in four single diagrams:

- Figure 4-3: System Context Diagram – Overview
- Figure 4-4: System Context Diagram – Nonhuman Actor View
- Figure 4-5: System Context Diagram – View of Business Human Actors
- Figure 4-6: System Context Diagram – View of Technical Human Actors **Fehler! Verweisquelle konnte nicht gefunden werden.**

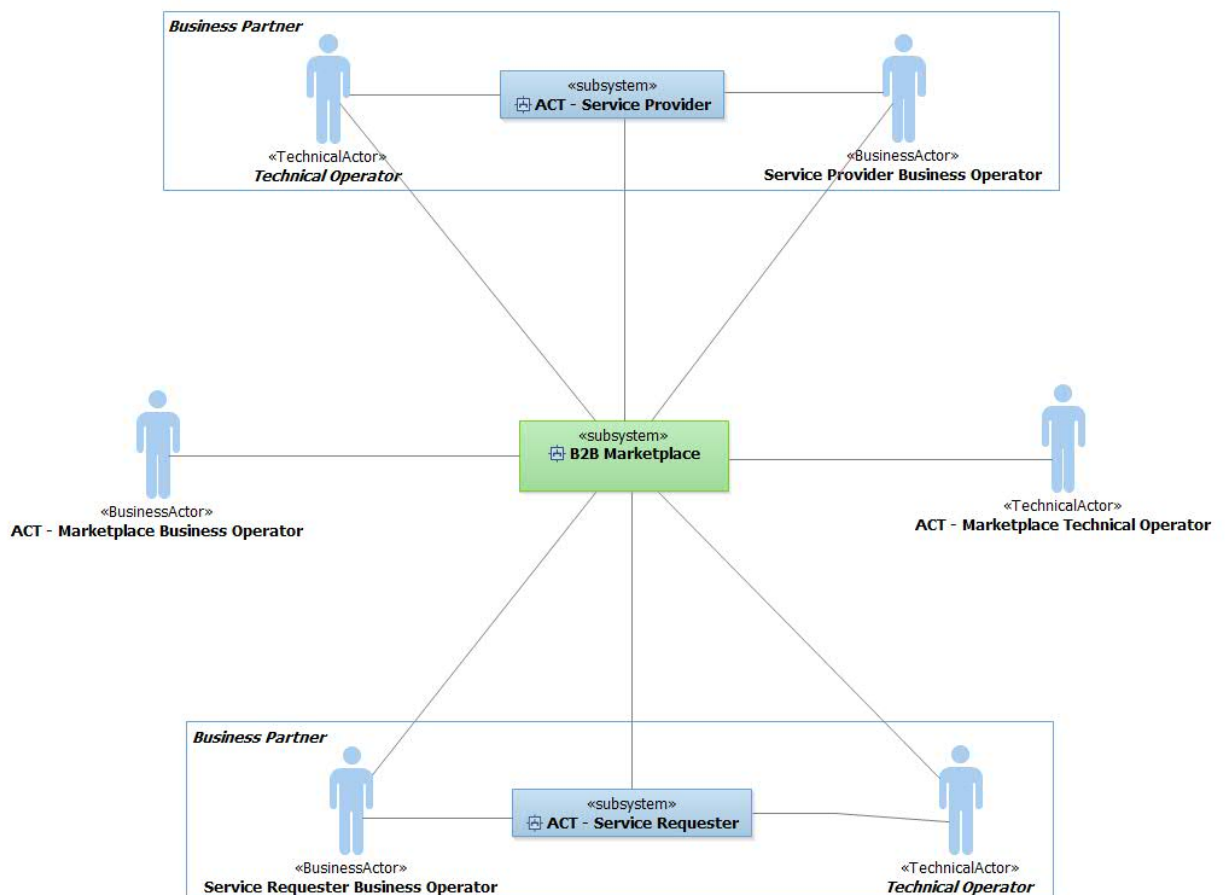


Figure 4-3: System Context Diagram – Overview

Note: The references BS-Sx belong to the business scenarios identified in the Business Analysis Document [1]; e.g. BS-S1 “Business Scenario – Service 1 – Marketplace: buying, selling, routing”.

Category	Business scenario	Priority
S1	Marketplace: buying, selling, routing	1
S2	Service detail records for accounting and billing	1
S3	B2B contract management	1
S4	Service provisioning/registration/life cycle management	1
S5	Standardization of interfaces, messages (for remote customer service)	1
S6	B2B partner management	1

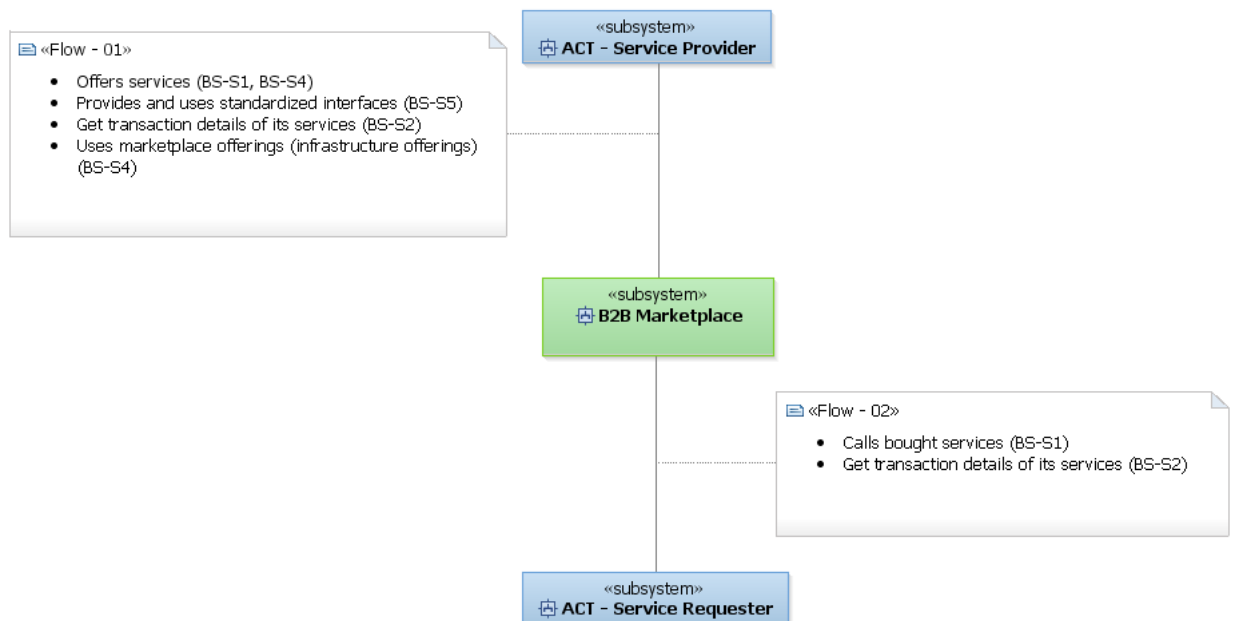


Figure 4-4: System Context Diagram – Nonhuman Actor View

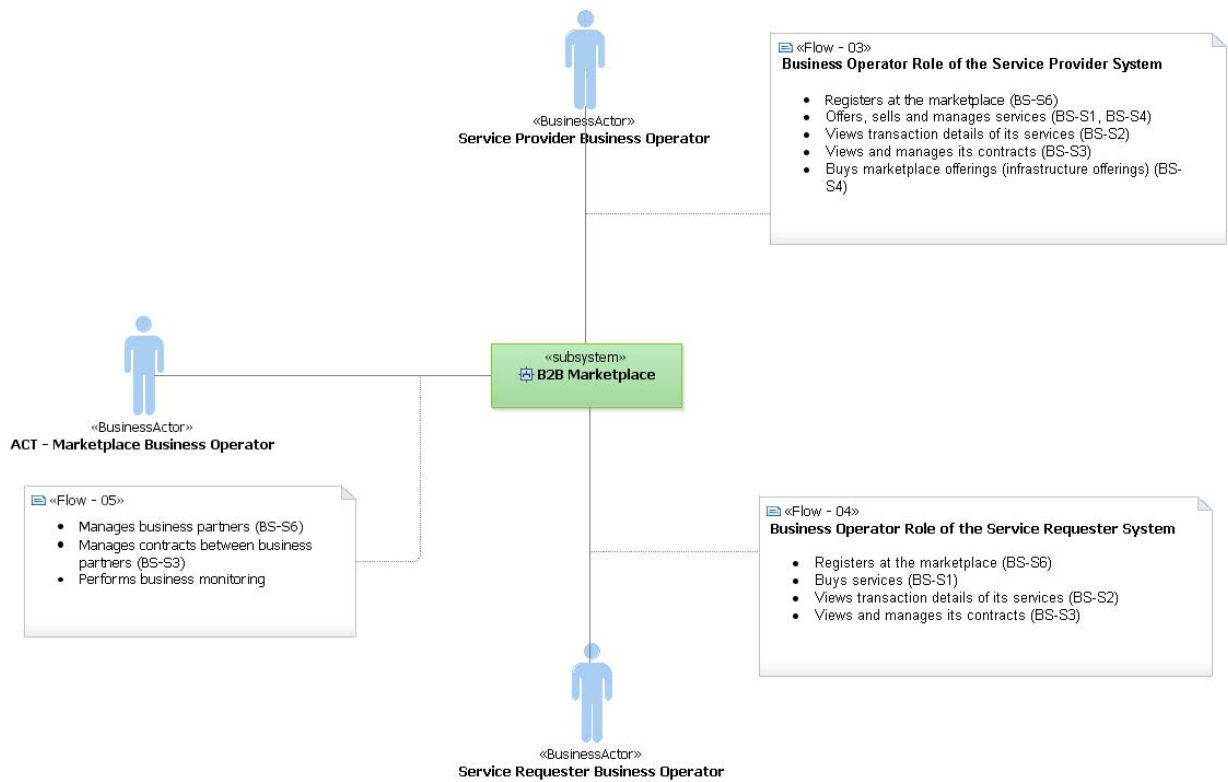


Figure 4-5: System Context Diagram – View of Business Human Actors

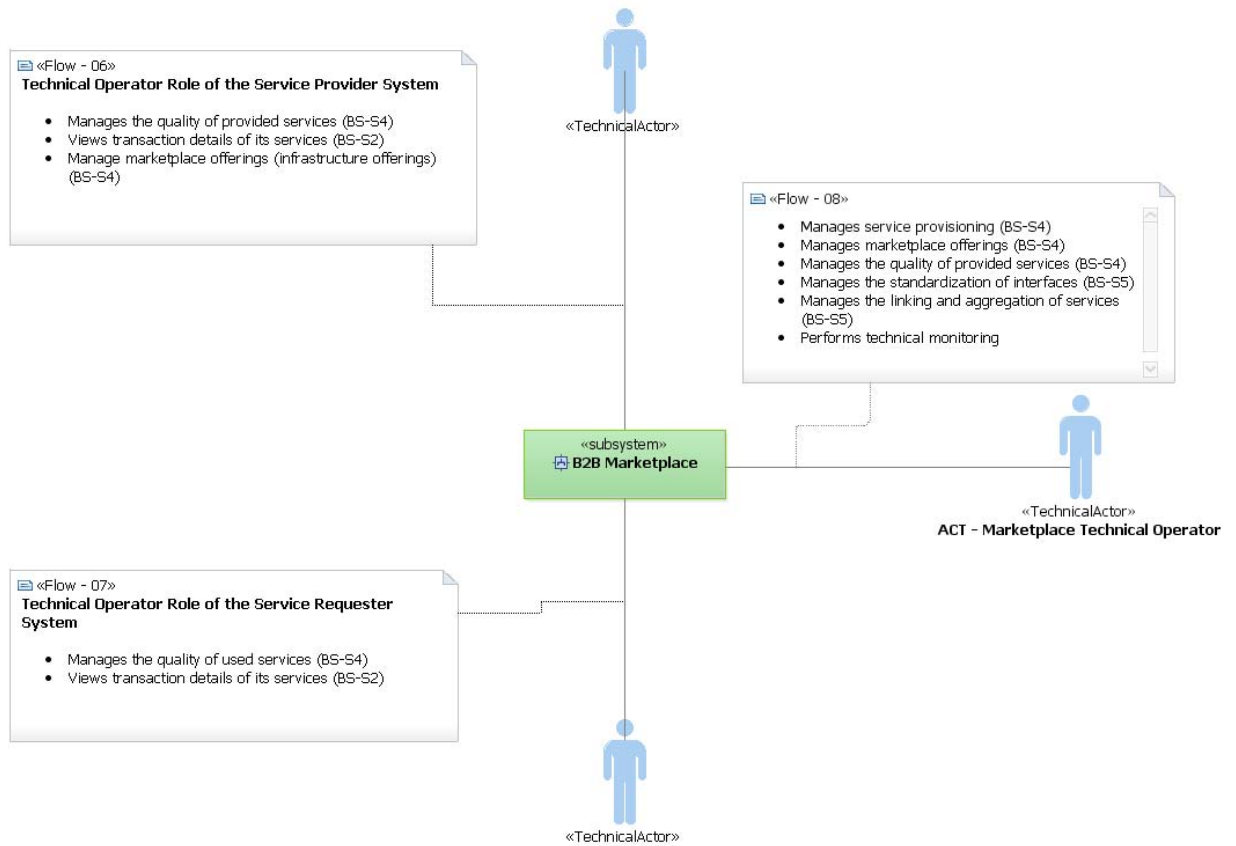


Figure 4-6: System Context Diagram – View of Technical Human Actors

4.2.3 External Entities

Most of the stakeholder can act as Service Provider as well as Service Requester. This means that a physical entity is not restricted to play one single role, i.e., an energy retailer can act as an EVSE operator as well.

The external entities are described in the actor overview section 4.2.1.

4.2.4 Information Flows

This paragraph documents the characteristics of each information flow that crosses the system boundary in numeric sequence. The numbers of the information flows corresponds with the flow numbers in the diagrams.

4.2.4.1 Information Flow - 01

Description	<ul style="list-style-type: none"> • Business Partner Data • Service Interface Description and Service Detail Description (BS-1, BS-4) <ul style="list-style-type: none"> ▪ Service Transaction Detail Records (BS-2)
--------------------	---

Number of users	
Number of transactions	High
Frequency of transactions	High
Volume of data	

4.2.4.2 Information Flow - 02

Description	<ul style="list-style-type: none"> ▪ Service Interface Description (BS-1) ▪ Service Transaction Detail Records (BS-2)
Number of users	
Number of transactions	High
Frequency of transactions	High
Volume of data	

4.2.4.3 Information Flow - 03

Description	<ul style="list-style-type: none"> ▪ Business Partner Data (BS-6) ▪ Service Interface Description and Service Detail Description (BS-1, BS-4) ▪ Service Transaction Detail Records (BS-2) ▪ Contract Data (BS-3)
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.4.4 Information Flow - 04

Description	<ul style="list-style-type: none"> ▪ Business Partner Data (BS-6) ▪ Service Interface Description and Service Detail Description (BS-1, BS-4) ▪ Service Transaction Detail Records (BS-2) ▪ Contract Data (BS-3)
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.4.5 Information Flow - 05

Description	<ul style="list-style-type: none"> ▪ Business Partner Data (BS-6) ▪ Service Transaction Detail Records (BS-2) ▪ Contract Data (BS-3)
Number of users	
Number of transactions	Low

Frequency of transactions	Low
Volume of data	

4.2.4.6 Information Flow - 06

Description	<ul style="list-style-type: none"> ▪ Service Interface Description and Service Detail Description (BS-1, BS-4) ▪ Marketplace Offering Details
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.4.7 Information Flow - 07

Description	<ul style="list-style-type: none"> ▪ Business Partner Data (BS-6) ▪ Service Transaction Detail Records (BS-2)
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.4.8 Information Flow - 08

Description	<ul style="list-style-type: none"> ▪ Service Interface Description and Service Detail Description (BS-1, BS-4, BS-5) ▪ Marketplace Offering Details
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.5 Control Flows

This paragraph documents the characteristics of each control flow that crosses the system boundary in numeric sequence. The numbers of the control flows corresponds with the flow numbers in the diagrams.

4.2.5.1 Control Flow - 01

Description	<ul style="list-style-type: none"> ▪ Offers, sells and manages services (BS-S1, BS-S4) ▪ Provides and uses standardized interfaces (BS-S5) ▪ Get transaction details of its services (BS-S2) ▪ Buys and uses marketplace offerings (infrastructure)
--------------------	---

	offerings) (BS-S4)
Number of users	
Number of transactions	High
Frequency of transactions	High
Volume of data	

4.2.5.2 Control Flow - 02

Description	<ul style="list-style-type: none"> ▪ Bought and uses services (BS-S1) ▪ Get transaction details of its services (BS-S2)
Number of users	
Number of transactions	High
Frequency of transactions	High
Volume of data	

4.2.5.3 Control Flow - 03

Description	<ul style="list-style-type: none"> ▪ Registers at the marketplace (BS-S6) ▪ Offers, sells and manages services (BS-S1, BS-S4) ▪ Views transaction details of its services (BS-S2) ▪ Views and manages its contracts (BS-S3) ▪ Buys marketplace offerings (infrastructure offerings) (BS-S4)
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.5.4 Control Flow - 04

Description	<ul style="list-style-type: none"> ▪ Registers at the marketplace (BS-S6) ▪ Buys services (BS-S1) ▪ Views transaction details of its services (BS-S2) ▪ Views and manages its contracts (BS-S3)
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.5.5 Control Flow - 05

Description	<ul style="list-style-type: none"> ▪ Manages business partners (BS-S6) ▪ Manages contracts between business partners (BS-S3) ▪ Performs business monitoring
Number of users	

Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.5.6 Control Flow - 06

Description	<ul style="list-style-type: none"> ▪ Manages the quality of provided services (BS-S4) ▪ Views transaction details of its services (BS-S2) ▪ Manage marketplace offerings (infrastructure offerings) (BS-S4)
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.5.7 Control Flow - 07

Description	<ul style="list-style-type: none"> ▪ Manages the quality of used services (BS-S4) ▪ Views transaction details of its services (BS-S2)
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

4.2.5.8 Control Flow - 08

Description	<ul style="list-style-type: none"> ▪ Manages service provisioning (BS-S4) ▪ Manages marketplace offerings (BS-S4) ▪ Manages the quality of provided services (BS-S4) ▪ Manages the standardization of interfaces (BS-S5) ▪ Manages the linking and aggregation of services (BS-S5) ▪ Performs technical monitoring
Number of users	
Number of transactions	Low
Frequency of transactions	Low
Volume of data	

5 Security Architecture

The transactions via the GeM Marketplace need to be secure – both to satisfy legislation as well as to satisfy confidence in the overall system. Security is most effectively implemented if it has been designed into the system end-to-end via the GeM Marketplace.

5.1 Security Topics

Following topics should be addressed⁴:

Authenticity (Accountability)

The authenticity of the data created, stored, transferred or otherwise processed must be ensured, i.e. who generated data and who triggered or is responsible for a processing step must be clearly identifiable at all times. The type and method of data generation can also be important.

Determination of Use

The use and scope of processing must be determined for all data generated. The data arising may only be processed with the express consent/approval of the business partner. This is with the exception of billing-relevant data and pseudonymised / anonymised data which are not traceable.

Confidentiality

Confidentiality is protection against unauthorized disclosure of information. Confidential data and information can be accessed only by authorized persons in the permitted way⁵.

Integrity

Integrity refers to the securing of correctness (intactness) of data and the correct functioning of systems. When the term integrity is applied to "data", it expresses the fact that the data is complete and unmodified. In information technology, it is generally interpreted more broadly to mean "information". The term "information" is used to denote "data" to which, depending on the circumstances, certain attributes like author or time of creation can be assigned. A loss of information integrity can therefore mean that it was changed without permission, author information was falsified or information on the time it was created was manipulated.

Authentication

Authentication refers to proof from a communication partner that he or she is truly the person they claim to be. [BSI - <http://www.bsi.de/gshb/deutsch/allg/04.htm>]

Non-Reputability of Data Transfers

The non-reputability of the sender and receiver of data must be ensured, i.e. it must be ensured that the sender can be sure that the data reached its recipient and likewise that he or she cannot deny having sent this precise data to this precise recipient. Conversely, the recipient must be sure that it has received this precise data from a certain sender and it must not be able to repudiate having received this precise data from a certain sender. Non-reputability is a prerequisite for audit-readiness.

Audit-Readiness

Audit-readiness of the collected, stored, transferred or otherwise processed data must be ensured, i.e. it must be possible to trace the processes by which data was processed without gaps and it must be

⁴ Source: Study E-Energy MoMa Security

⁵ BSI - <http://www.bsi.de/gshb/deutsch/allg/04.htm>

possible to establish who processed which data and how and when they did so. A necessary condition for ensuring audit-readiness is the assurance of authenticity and non-reputability.

Legal Certainty

For every processing step and its results the party that initiated the process and/or the party responsible are under obligation to provide conclusive proof. The necessary condition for guaranteeing legal certainty is the guarantee of audit-readiness. However audit-readiness does not in itself guarantee the conclusive verifiability of processing steps in judicial proceedings.

Data Protection

Data protection is designed to protect an individual's right to privacy from being compromised or infringed when his or her personal data is handled. Data protection therefore refers to the protection of personal data against possible misuse by third parties (not to be confused with information security).

Whereas "data protection" is a legal term, "privacy" refers more to the protection of an individual's private sphere in society and is mainly used in American English but also increasingly within the EU.

Information Security

Information security is understood to mean the state of an information system in which the unauthorized use of resources is made difficult and, where possible, identified. Unauthorized usage occurs whenever a user to whom the relevant rights have not been assigned accesses or changes information or, at a general level, does not use the system as the operator anticipated. An authorized person also acts in an unauthorized way when he or she does not use the system in accordance with the responsibilities and rights assigned to him/her or not exclusively so - for example if he or she creates access rights to which they are not entitled. Information security comprises the entire area of information processing, including the storage and transfer of data and programs. Information security also covers personal and physical security. Information may exist on paper, on computing systems or in other forms.

Legitimacy

Legitimacy implies that information and operating resources cannot be used by unauthorized persons or that measures are in place to ensure that they can only be used in the authorized way.

Validity

The validity and actuality of the collected, stored, transferred or otherwise processed data must be ensured, i.e. personal data must be processed in the quality appropriate to the purpose.

Availability

The availability of services, functions of an IT system, IT applications or IT networks or also of information is in place, if they can always be used as planned by the users.

5.2 Security Best Practices

To achieve a high security level based on best practices, the following guidelines should be realized by the entities which apply the reference architecture. The Green eMotion consortium will not provide all the documents which are mentioned in the best practices below such as 'instructional documentation' or 'security policy'. The implementing entities have to define that for themselves. Thereby each entity can decide for themselves if and how secure their implementation will be:

- Build and maintain a secure network and regularly monitor it.
- Maintain instructional documentation and training programs for users, service providers and integrators.
- Maintain a marketplace-wide information security policy and make sure that users read, understand and accept it.

- Access to the marketplace needs to be regulated. A service-provider handling sensitive data needs to be certificated. His compliance to the security-policy must be audited by an external auditor on a regular basis.
- Implement strong access control measures. Information is only distributed within users that need to deal with it. Implementation of a role-based security- and access-model.
- Provide secure authentication features. Whenever a service-provider registers at the marketplace, his identity needs to be checked by an external entity (e.g., "postident").
- Facilitate secure network implementation. It must be ensured that the system, communicating with the marketplace is the system it pretends to be (e.g. server certificate).
- Identify and protect sensitive data and store only if necessary.
- Financial and operational penalties are in place whenever the information security policy is violated and/or sensitive data is compromised.
- Protect wireless transmissions (e.g. EV to EVSP) like Wi-Fi or mobile connections.
- Facilitate secure remote software updates.
- Keep systems and software components up to date (apply security updates regularly).
- Encrypt traffic over networks.
- Use digital signatures to prevent data manipulation (billing, metering values).
- Use secure certificate stores, e.g. for ISO/IEC 15118 certificates.
- Apply domain-specific security best practices and consider known issues in those domains.
- Establish risk management.

6 Architectural Decisions

The Architectural Decisions documents here are the most important ones about the major aspects of the architecture including the structure of the system, the provision and allocation of function, the contextual fitness of the system and adherence to standards.

Architecture is understood partly through the record of the important decisions made during its later development. A well-documented architecture includes its own justification and evaluation criteria.

Note: The IDs are defined as ARCDEC-xx and numbered in a continuous manner.

Subject Area	OPERATIONAL CONCEPT	Date	Jan-2012
Decision	Cloud hosting is used to operate the Marketplace	ID	ARCDEC-01
Issue or Problem Statement	Operational concept to run the Marketplace		
Motivation/ Justification	<ul style="list-style-type: none"> • Allow easy scale up without the need of manual migration to other systems and with costs reflecting the actual usage of resources. • Benefit from high availability and fail over capabilities • Help to separate concerns between Marketplace operator and IT infrastructure provider • Allows business partners without own computing resources to easily leverage an existing development, test and execution environment 		
Alternatives	Conventional approach with dedicated hardware		

Subject Area	ENTERPRISE ARCHITECTURE	Date	Jan-2012
Decision	SOA as the architecture guiding principle.	ID	ARCDEC-02
Issue or Problem Statement	Sub-system business integration across enterprises		
Motivation/ Justification	<ul style="list-style-type: none"> • Well established enterprise architecture across many enterprises • Loosely coupling of many interconnected sub-systems 		
Alternatives	NA		

7 Non-Functional Requirements

The non-functional requirements (NFR) for the Marketplace system address those aspects of the system that, whilst not directly affecting the functionality of the Marketplace system as seen by the users, can have a profound effect on how that Marketplace system is accepted by both the users and the people responsible for supporting that system.

The non-functional aspects of a business system cover a broad range of themes. Together with the functional requirements, they define the baseline against which the Marketplace system must be developed and designed. Both sets of requirements must be captured during the initial stages of a realization project for a Marketplace implementation.

For convenience, it also includes constraints the Marketplace system must conform to or satisfy as listed here:

1. Service Level Requirements (SLRs)
2. Non Run-Time Requirements
3. System Constraints

The next chapters will describe all relevant non-functional requirements relevant to the Marketplace system. Those relevant NFRs have to be used as a template guideline and checked against a realization project of the Marketplace system.

7.1 NFR-Audit and Control

The Audit and Control requirements category addresses the need of the Marketplace to be auditable and controllable.

These requirements answer the following questions:

- Who will perform audits?
- How often are the audits conducted?
- How non-compliance issues will be handled?
- How non-compliance issues are recorded and tracked?

Furthermore these requirements describe what type of information need to be traced or logged while the marketplace system is used. They may consider or specify:

- Who accessed which service?
- What type of operations was performed?
- Which type of information/data was accessed?

7.2 NFR-Availability

These requirements cover the availability of the marketplace and the services running through it.

Typically, the marketplace systems have to be a high availability (24/7), so that human to machine and machine to machine interaction is ensured. For that reason, the systems have to be designed as redundant systems with fail-over mechanisms.

The different services may be prioritized in order to distinguish a group of services which have to be available at any time. Other groups of services may not be so important and can have a lower availability. Examples for services with the highest priority are the services needed in order to start a charging process (could also include roaming services).

Moreover the following points have to be considered:

- Definition of maintenance windows
- Dependency on other systems
- Disaster recovery
- Fail-over plans and alternative processes

7.3 NFR-Backup and Restore

The backup and restore category summarizes requirements addressing plans and provisions for backup and restores operations.

These requirements may consider or specify:

- Identification and categorization of hardware, software and data (e.g. mission critical etc.)
- Backup operation tooling
- Responsibility definitions
- Frequency and timing of Backup operations
- Backup processes descriptions
- Restore processes descriptions
- Volume definitions for backup
- Recovery strategies and Fail over plans depending on error scenarios (High Availability, Hot Standby etc.)
- Definition of Mean time to recovery (MTTR) and mean time between failures (MTBF)
- Penalty documentation for failure to recover in acceptable time

7.4 NFR-Documentation

The Documentation category address specific documentation provided as a project deliverable.

The following documentation types have to be considered or specified:

- Technical manuals
- On-line help
- Instruction manuals, operational manuals
- Installation procedures
- System overview and architecture diagrams
- Data models
- Developer Guides
- etc.

The documentation need to consider the target audience.

The services being offered on the Marketplace need to comply with a certain level of documentation to allow other business partners problem-free usage of the service.

7.5 NFR-Extensibility

The Extensibility category addresses the system design principle to implement a solution considering future growth of the system. It is a measure how easy an existing system can be extended. The impact on existing functionality should be minimized when extending the functionality. Architecture-wise, extensibility means, the system is designed to easily include mechanisms for expanding the functionality of the system without major architecture and design changes. Comprehensive Extensibility principles are necessary to assure Maintainability.

7.6 NFR-Installation Procedures

An installation process has to be established to ensure a smooth deployment:

- Deployment Request
- Definition of initial, update and patch deployments
- Format and structure of a deployment package
- Installation documentation

7.7 NFR-Interoperability

The Interoperability category addresses the need for the Marketplace to interface with other Marketplaces, other Stakeholders applications or systems without interfering with the operation of those other applications or systems.

They may consider or specify:

- List of application or systems the marketplace system is interfacing with
- Data conversion requirements
- Used standards and protocols

7.8 NFR-Localization and Legal

Localization requirements address the support different languages and different countries. Especially, different countries may have legal constraints that have to be covered, e.g.:

- Laws
- Government regulations
- Protection of intellectual capital
- Copyrights
- Export regulations

7.9 NFR-Maintainability

The Maintainability category addresses the ease with which the marketplace system accepts repairs or adapts to new functionality. These requirements address the process by which problems are reported and resolved.

They may consider or specify:

- Defined maintenance window
- How to handle Maintenance across time zones?

- How emergency fixes are handled?
- Meantime to repair/fix a problem
- Support logistics (on-site, remote help desk)
- Procedure for logging and tracking defects
- Ease of problem analysis and root cause determination
- Ease of extending functionality

7.10 NFR-Non-Reputability

The non-reputability of the sender and receiver of data must be ensured, i.e., it must be ensured that the sender can be sure that the data reached its recipient and likewise that he or she cannot deny having sent this precise data to this precise recipient. Conversely, the recipient must be sure that it has received this precise data from a certain sender and it must not be able to repudiate having received this precise data from a certain sender.

7.11 NFR-Operability

The Operability category addresses the ability to keep the marketplace system and its services in a safe and reliable functioning condition, according to pre-defined operational requirements.

7.12 NFR-Performance

These requirements address system performance of the marketplace as well as the execution environments of the services.

The marketplace and potential service providers have to consider or specify the following:

- Response time for transactions (should not exceed 1.0 second)
- Data throughput
- Data volume
- Data load (average / peak)
- System capacity
- Network routing

7.13 NFR-Portability

These requirements cover the independency of platforms or operating systems:

Implementations have to consider the following:

- Platform-independent languages
- Ability of migration to other platforms
- Existing client platforms

7.14 NFR-Reliability

These requirements cover acceptable defect or failure rates of the system that have to be considered or specified:

- Definition of fault classes

- Frequency of defects or failures
- Response time on defects and failures
- Recovery time of defects and failures
- Monitoring and tracking of defects and failures

7.15 NFR-Robustness

All services, especially the marketplace services, have to be robust, so that the execution will continue after some errors have occurred. The errors should not stop the systems or prevent the users to continue their work by using other services or process other tasks.

7.16 NFR-Scalability

Due to the fact, that nobody can assume a number of users on the marketplace and not to mention the number of electric vehicles which will be on the roads of Europe in the next years, it is highly important to not fix the system to a specific number. A small number could save some money, but would prevent the mass-roll-out of electric mobility. A large number would allow that, but would drive the cost up with no need for it if there are only some cars and users in the marketplace ecosystem. A highly flexible system with regards to scalability is needed.

7.17 NFR-Security and Privacy

The category Security and Privacy addresses the requirements of data security and data privacy as well as access restrictions:

Data Security:

- **Authentication**
Data creation and change of data needs an authenticated entity.
- **Data Integrity**
It has to be guaranteed that no data are changed without permission
- **Data Confidentiality**
It has to be ensured that no data can be accessed unauthorized.

Data Privacy:

- Confidential or sensitive data (e.g. personal data) are not accessible and must not be stored without need; otherwise an agreement of the collection of sensitive data is needed.
- A data export policy has to be established.

Access Restrictions:

- Access of services needs an appropriate access mechanism (e.g. by certificates)
- Access control by role based authorization model has to be implemented.
- A password policy has to be established

7.18 NFR-Usability

Usability is related to ease-of-use of the access and presentation for the Marketplace system. As this NFR is relevant for the acceptance of the system, the requirements are documented in D3.1 Requirements deliverable and specified further in D3.5 Specification document.

8 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 CDRs. EVSPs can register, update and delete new contracts of their customers via the Marketplace.

In case of Green eMotion's demonstration prototype the services of one Clearing House will be deployed in the Service Execution Domain of the 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.

Note:

The availability, traceability and access security of this service must be implemented at a very high quality level.

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 little 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 its 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.
 - 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 particular 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 (CDRs) between roaming partners
 - The foreign EVSE operator sends the CDR to the Clearing House after the charging process is finished.
 - The Clearing House forwards the CDR 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, but is delivered to consumer A by provider C, based on a 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 has signed a roaming agreement with. The Marketplace provides the service of providing a record of all roaming agreements so that it can be verified what 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 homeland will 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 Charge Detail Records (CDR)

EV Service

EV 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

We can imagine of two different clearing strategies. For both strategies the EVSPs have to reveal more contractual details to the Clearing House than in the Contractual Clearing. To be concrete, the EVSPs have to send the applied price plan for each customer to the Clearing House, so that the later can calculate a weekly or monthly amount for the charging at one particular EVSP. Alternatively, the EVSPs built up bilateral contracts which define the amount which has to be paid if a customer of one EVSP charges at the other EVSP. The result is the same in the end. The Clearing House has to know how much one EVSP charges for the foreign charging of another EVSP's customer.

The first strategy calculates the total amount of a specified time frame, which one EVSP, the debtor, has to pay another EVSP, the creditor. The total amount and the information to which the money has to be paid are then transferred to the EVSP who is the debtor.

The second 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 EVSPs, the difference of the debts, which two EVSPs have among each other, is calculated. Only the one EVSP which still has a debt by the other EVSP gets informed by the Clearing House with the information to whom the difference has to be paid.

The second strategy produces less data flow and less effort for the EVSPs, because two financial transactions are reduced to one. It has to be checked, if that kind of information flow is still enough to fulfill all legal requirements. For example, it could be that for administrative accounting all individual items have to be accounted. If that is the case, all foreign chargings are already in the EVSPs system and they can do the calculation with their own accounting system.

As soon as financial clearing is in place, the EVSPs have to publish more contract details. At the moment it is not clear if the EVSPs want that.

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 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.

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.

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 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.