



Deliverable 7.10

EV integration in Smart Grids - Glossary

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1 Executive Summary

Interoperability of hardware and software within the electromobility environment is a mandatory prerequisite for an open and convenient access of EV drivers to public charging infrastructure. Not only that the plug of his EV must fit into the charging station's socket, first the driver needs to find an available charging station (Electric Vehicle Supply Equipment: EVSE) at an appropriate driving distance. Then he needs to authorize himself to gain access, meaning that he can plug in and start a charging session.

To achieve this is not trivial as we need both, a “physical” connection between the car and the charging station, and the ICT-based connection among all the other actors involved. In both cases there is the need for standardized solutions and for common choices/regulations. Interoperability becomes a central topic and while the physical plug/socket aspects are becoming less problematic, the communication interfaces still remain quite an open issue.

While these topics are treated in detail in report D7.8¹, this document provides a collection of the main terms and definitions used in this context as a work of reference.

2 Abbreviations

B2B	Business to business
CDR	Charge detail record
CH	Clearinghouse
CMS	Charge management system
DSO	Distribution system operator
EV	Electric vehicle
EVMS	EV management system
EVSE	Electric vehicle supply equipment
EVSEID	Electric vehicle supply equipment identifier
EVSEO	Electric vehicle supply equipment operator
EVSP	Electric vehicle service provider
GeM	Green eMotion
GUID	Global unique identifier
ICT	Information and Communication Technologies
IEC	International Electrotechnical Commission – international standardization body
ISO	International Organization for Standardization – international standardization body
OEM	Original Equipment Manufacturer, i.e. Electric Vehicle manufacturer
PMS	Power management system
PoD	Point of delivery
PV	Photovoltaic
RES	Renewable energy source
RFID	Radio frequency identification
SDR	Service detail record
TSO	Transmission System Operator
VAS	Value added service

3 Introduction

EV Integration into Smart Grids will be a vital approach for the future use of EVs. Although this seems to be a topic coming from the electrical engineering perspective, the most vital parts have to be done by ICT solutions. To get a common understanding, the Green eMotion architecture has been described in building blocks.

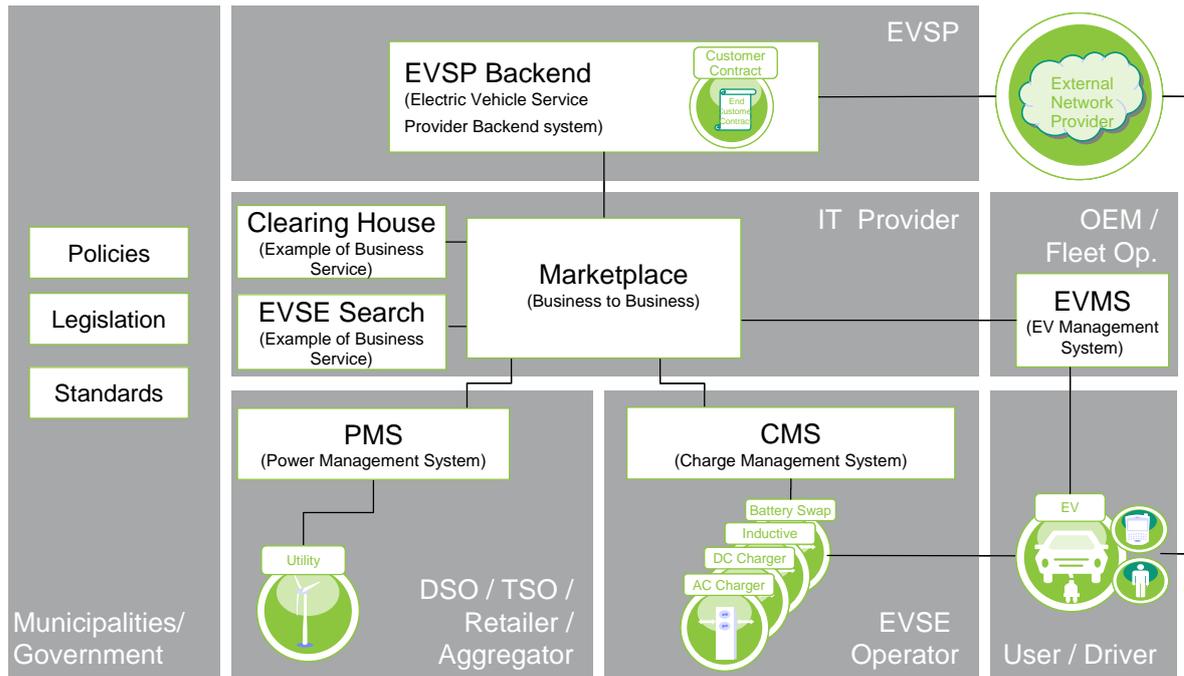


Figure 3-1 Green eMotion Building Blocks, evidencing roles and interactions

The grey boxes represent building blocks under the control of certain roles (e.g. the grey building block Marketplace (Business to Business) is provided typically by IT providers). The smaller boxes inside the building blocks represent logical system components, such as the “Clearing House Service”. The lines between the logical components represent communication paths between those components.

The main actors involved and their interactions are:

- User/Driver;
- Original Equipment Manufacturer (OEM)/ Fleet Operator;
- Electric Vehicle Supply Equipment (EVSE) Operator;
- Information Technology (IT) Provider;
- Distribution System Operator/Transmission System Operator/Retailer/Aggregator;
- Electric Vehicle Service Provider (EVSP);
- Municipalities/Government.

With these building blocks the use cases within the electromobility system can be described. Before realizing any service a detailed analysis and description of the included services, the sequence diagrams and



business components is necessary. Green eMotion has done this already for the main use cases, see report D3.6¹.

A major issue is that the defined processes must be compatible at least within Europe independent from the system they are implemented in or by whom. That means we need a common basic architecture and a common understanding about the notation in this system.

This document lists Terms and definitions for the main components and services in chapter 4. The main actors and their roles are listed in chapter 5.

¹ <http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php>

4 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".

ISO/IEC 15118 - Vehicle to grid communication interface

ISO/IEC 15118 is an international standard for the communication between an EV and EVSE. Besides pure charge control mechanisms it offers a wide amount of features like automatic identification of the contract ID without the need of an extra RFID card (Plug&Charge), charge schedules, energy forecasts, and load management (features for smart grid integration), pricing information, metering etc.

Load Area

All sub-station in a geographical area is located to a local area grid connection. This connection point can be identified with the load area ID.

Note:

Today no standard for the identification of the load area grid point is established

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.

Point of Delivery (PoD)

The PoD is the grid connection point for the EVSE. The PoD is the substation (transformer station) where the power from the low voltage grid will be distributed to the EVSE.

Note:

Today no standard for the identification of the load area grid point is established

Reference Architecture

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 Architecture :

- 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.

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.

5 System interplay of the GeM architecture

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.

5.1 Business View

5.1.1 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.

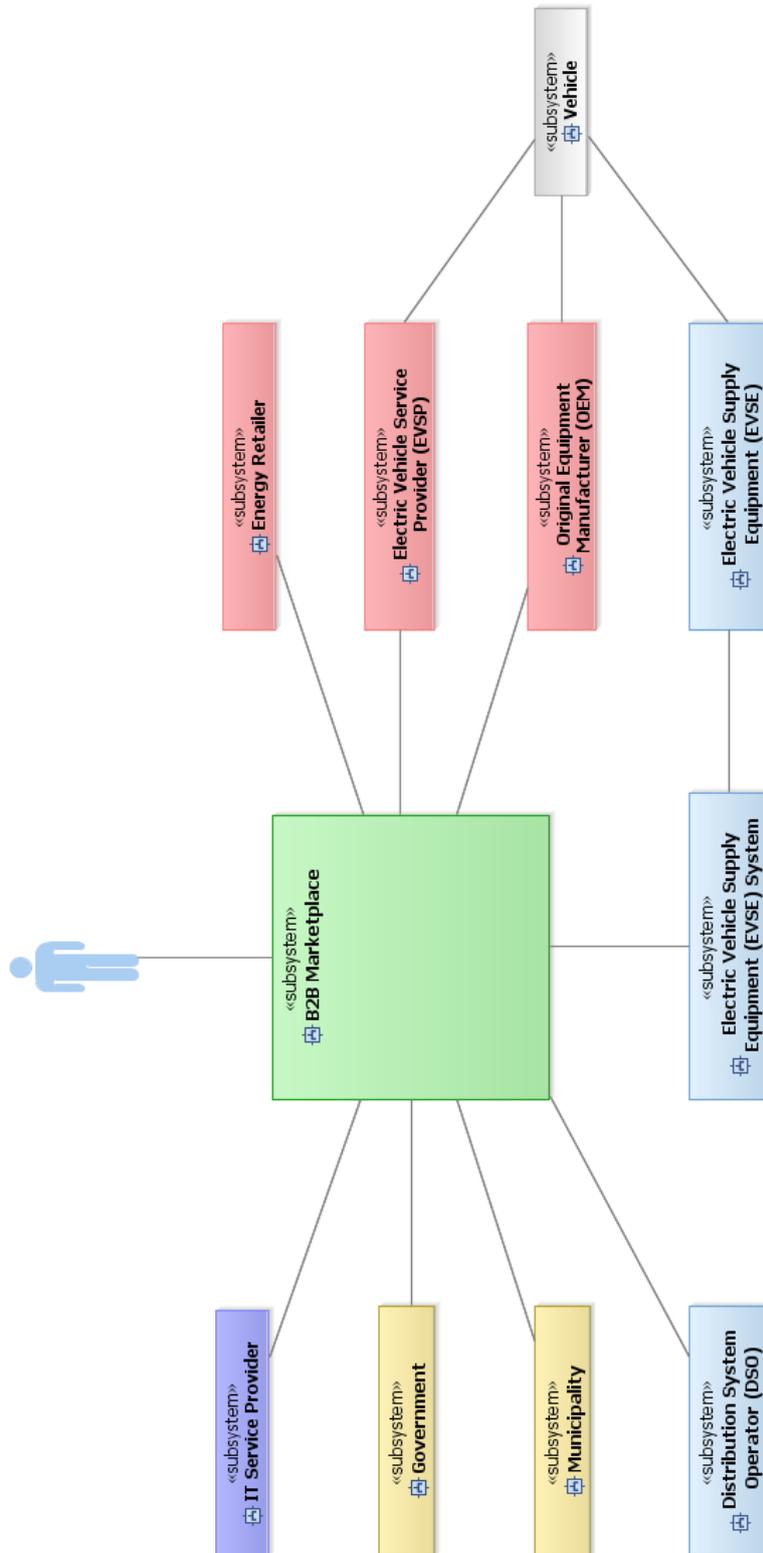


Figure 5-1: System Context - Business View

5.1.2 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 D3.1².

The following section describes the Stakeholders / Business Actors in alphabetical order as shown in Figure 5-1: System Context - Business View. The actors described below are in the same colour as shown in the figure before.

5.1.2.1 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

5.1.2.2 IT Service Provider

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

5.1.2.3 Distribution System Operator (DSO)

Description	Entity responsible for the distribution grid
Type	Nonhuman Actor

5.1.2.4 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

5.1.2.5 Electric Vehicle Supply Equipment (EVSE)

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

5.1.2.6 Electric Vehicle Supply Equipment (EVSE) Operator System

Description	Role that delivers and manages physical equipment to supply the
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² <http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php>

	charging process of the vehicle
Type	Nonhuman Actor

5.1.2.7 Energy Retailer

Description	Entity that sells electrical energy to customers
Type	Nonhuman Actor

5.1.2.8 Government

Description	Role representing public authorities
Type	Nonhuman Actor

5.1.2.9 Municipality

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

5.1.2.10 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

5.1.2.11 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

5.2 Technical View

5.2.1 Actor Overview

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

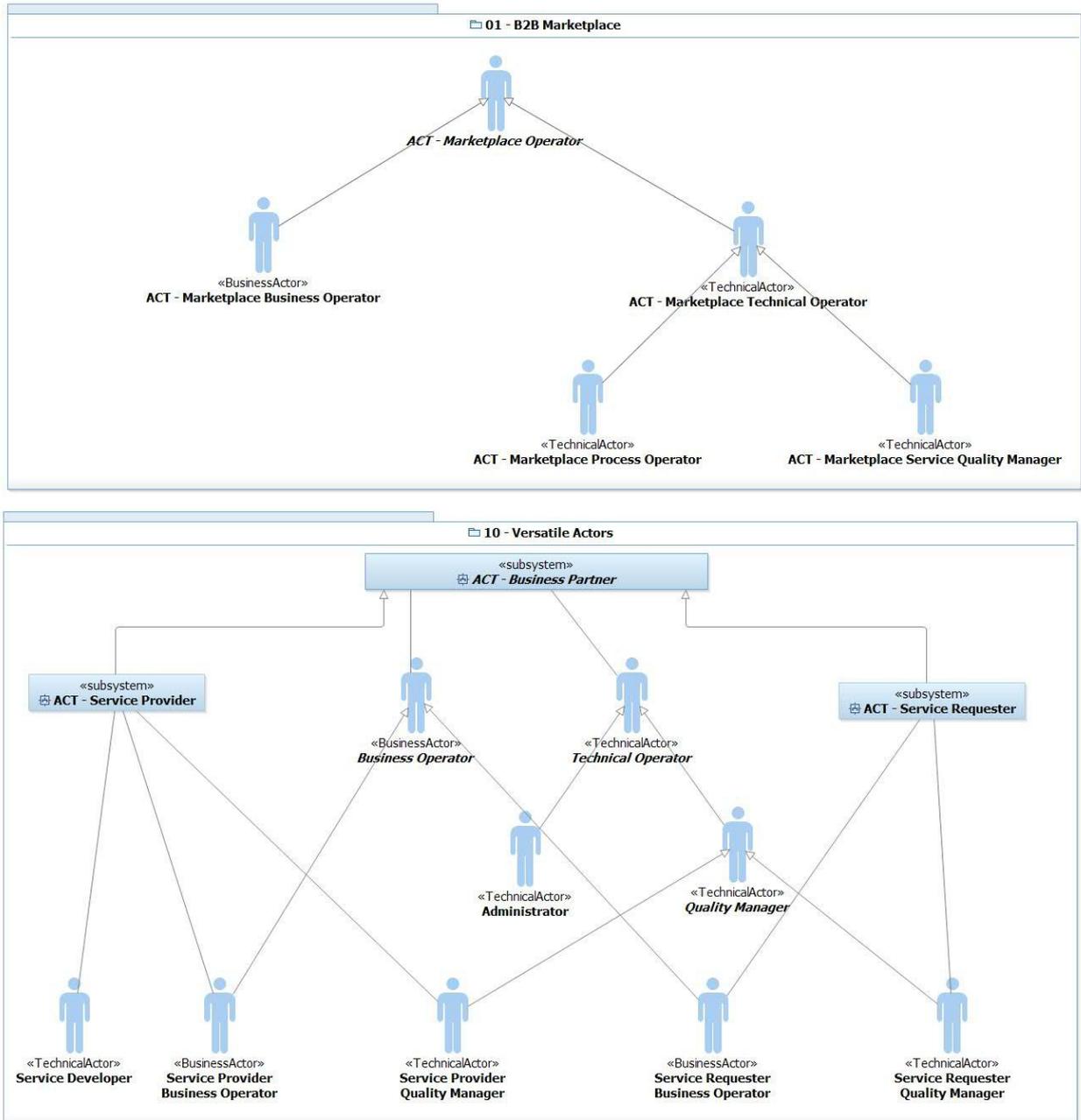


Figure 5-2: Actor Overview

5.2.1.1 Marketplace Actors

5.2.1.1.1 ACT – Marketplace Operator

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

5.2.1.1.2 ACT – Marketplace Business Operator

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

5.2.1.1.3 ACT – Marketplace Technical Operator

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

5.2.1.1.4 ACT – Marketplace Process Operator

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

5.2.1.1.5 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

5.2.1.2 Business Partner Actors

5.2.1.2.1 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

5.2.1.2.2 ACT – Service Provider

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

5.2.1.2.3 ACT – Service Requester

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

5.2.1.2.4 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

5.2.1.2.5 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

5.2.1.2.6 Administrator

Description	Technical Role of a Business Partner
Type	Human Actor

5.2.1.2.7 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

5.2.1.2.8 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

5.2.1.2.9 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

5.2.1.2.10 Service Requester Business Operator

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

5.2.1.2.11 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

5.2.1.2.12 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