# 1. INTRODUCTION

## 1.1. Purpose

In the past, humans have been highly dependent on fossil fuels. With the advancement of science and technology, today mankind has been able to use renewable energy in various ways, including as fuel for cars. As a result, it prevents the warming of the earth and the rise of the water level, which is one of the causes of the carbon dioxide gas released from cars due to the consumption of fossil fuels.

Electric mobility (e-Mobility) is proposed to reduce carbon dioxide. Regarding to e-Mobility, several charging stations have been created so that cars can be charged according to their battery capacity. There are several charging sockets in each charging station. There may be different types of charging sockets so that different cars can be charged. Finally, drivers pay an amount of money for charging their cars.

This document focuses on the Requirements Analysis and Specification Document (RASD) of the system and describes the main goals, the domain assumptions, the scenarios which may happen, the uses cases, the list of functional and non-functional requirements which system should fulfill, and finally the diagrams to visualize the interactions between components and performance of the system.

### 1.1.1 Goals

Table 1 Goals

|  |  |
| --- | --- |
| Goals | Description |
| G1 | eMPS allows end users to know about the charging stations nearby, their cost, any special offer they have |
| G2 | eMPS allows end users to book a charge in a specific charging station for a certain timeframe |
| G3 | eMPS allows end users to start the charging process at a certain station |
| G4 | eMPS allows end users to be notified when the charging process is finished |
| G5 | eMPS allows end users to pay for the obtained service |
| G6 | eMPS allows end users to sort the available stations |
| G7 | eMPS allows end users to go and charge the vehicle |
| G8 | CPMS allows CPOs to know the location of a charging station |
| G9 | CPMS allows CPOs to know the “external” status of a charging station |
| G10 | CPMS allows CPOs to decide from which DSO to acquire energy |
| G11 | CPMS informs CPOs to dynamically decide where to get energy for charging |
| G12 | CPMS allows CPOs to acquire by the DSOs information about the current price of energy |
| G13 | CPMS allows CPOs to know the “internal” status of a charging station |
| G14 | CPMS allows CPOs monitoring the charging process to infer when the battery is full |
| G15 | CPMS allows CPOs to know the time to start charging a vehicle according to the amount of power supplied by the socket |
| G16 | CPO sets current price of energy for paying of services |

## 1.2 Scope

To charge electric cars, an application has been defined through which the end user can do the following:

* First, the user must log in to her/his account. Then activate the GPS of her/his smartphone to find the nearest charging station.
* After selecting the nearest charging station suggested by the application, the user books a time.
* Through the notification of the user's smartphone, the end of the charging process will be shown to her/him.
* Through the application, the amount to be paid and the time when the battery was charged is shown to the user.
* Finally, the user connects to the banking portal through the application and pays the cost of charging the electric car.

Also, there are CPOs installing and maintaining charge stations in charging stations so drivers can charge their electric vehicles. CPOs can either own and operate a set of charging stations or use them for third parties. For managing charge stations, they install and use CPMSs.

### 1.2.1 World Phenomena

Table 2 World Phenomena

|  |  |
| --- | --- |
| World Phenomena | Description |
| WP1 | The end user comes to charge station with her/his car |
| WP2 | The end user finds out that her/his car needs charging |
| WP3 | The end user plugs in her/his car to the charger socket |
| WP4 | The end user leaves the charging station after payment is successful |

### 1.2.2 Shared Phenomena

Table 3 Shared Phenomena

|  |  |  |
| --- | --- | --- |
| Shared phenomena | Description | Control |
| SP1 | End user searches for nearby charging stations | World |
| SP2 | eMSP shows the nearby stations by default | System |
| SP3 | End user sorts the available charging stations | World |
| SP4 | End user books a charge in a specific charging station | World |
| SP5 | End user pays the money for services | World |
| SP6 | End user will be notified when the charging process is finished by eMSP | System |
| SP7 | User can see any special offer in eMSP | System |
| SP8 | Charging stations will be suggested by eMSP to user | System |
| SP9 | CPO knows the location of charging station through CPMS | System |
| SP10 | CPO knows the "external" status of charging station through CPMS | System |
| SP11 | CPO know the “internal” status of a charging station through CPMS | System |
| SP12 | CPO acquire by the DSOs information about the current price of energy through CPMS | System |
| SP13 | CPO decides from which DSO to acquire energy | World |
| SP14 | CPMS will dynamically decide where to get energy for charging | System |
| SP15 | eMSP provides a QR code for booking conformation | System |
| SP16 | End user can check charging process of her/his car | World |

## 1.3 Definitions, Acronyms, Abbreviations

### 1.3.1 Definitions

Table 4 Definitions

|  |  |
| --- | --- |
| Definition | Description |
| Notification | A message shown to the user by system when he/she must be notified about something (ex: the end of the charging process will be shown to him/her). |
| External Status | Number of charging sockets available, their type such as slow/fast/rapid, their cost, if all sockets of a certain type are occupied, the estimated amount of time until the first socket of that type is freed |
| Internal Status | Amount of energy available in its batteries, if any, number of vehicles being charged and, for each charging vehicle, amount of power absorbed and time left to the end of the charge |
| Time Frame | A specified period of time in which something occurs or is planned to take place |
| Valid QR code | A QR code is defined valid in the 5 minutes after end user wants to pay for the services |

### 1.3.2 Acronyms

Table 5 Acronyms

|  |  |
| --- | --- |
| Acronyms | Description |
| CPO | Charging Point Operator |
| CPMS | Charge point Management System |
| DSO | Distribution System Operator |
| eMSP | e-Mobility Service Provider |
| eMall | e-Mobility for All |
| GPS | Global Positioning System |
| API | Application Programming Interface |

### 1.3.3 Abbreviations

Table 6 Abbreviations

|  |  |
| --- | --- |
| Abbreviations | Description |
| G | Goal |
| R | Requirement |
| C | Component |
| WP | World phenomena |
| SP | Shared phenomena |

## 1.4 Revision History

Table 7 Revision History

|  |  |  |
| --- | --- | --- |
| Version | Date | Modification |
| 1.0 | 11/02/2022 | First version |
| 2.0 | 19/02/2022 | Update all sections |
| 3.0 | 22/02/2022 |  |
|  |  |  |

## 1.5 Reference Documents

* Specification Document: “Assignment RDD AY 2022-2023.pdf”
* Course slides
* <https://evroaming.org/app/uploads/2021/11/OCPI-2.2.1.pdf>

## 1.6 Document Structure

* Section 1

Overview of the purpose of the project and defining the scope of the system. Describe the specifications such as the definitions, acronyms, abbreviations, revision history, and references. As well as introducing the goals, world and shared phenomena of the software.

* Section 2

Defining the main scenarios and then explaining the main features in the software by class diagram and state charts. In user characteristics, the types of actors that use the application are explained. The product function subsection defined the functionalities of the application. In the end, the domain assumptions are defined.

* Section 3

The main part of the project which introduces interface requirements such as user interface, hardware interface, software interface, and communication interfaces. Presenting the functional requirements that are shown by use case diagrams and sequence diagrams. Then requirements are mapped to use cases.

* Section 4

Using Alloy language for analyzing the system and brief comments for clarifying the Alloy codes.

* Section 5

Shows how much time is spent by each member of the group.

* Section 6

Contains the references