Politecnico di Milano
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Computer Science Engineering

Software Engineering 2

eMall - e-Mobility for All

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Contents

1 Introduction

1.1 Purpose

Nowadays sustainability is one of the most important and debated topics in our society. In fact, in the next few years we are going to deal with a huge green transition to limit our carbon footprint on the planet, such as in the transportation field, which finds itself as one of the main contributors of global warming. In this direction, in recent years the old motor vehicles running on gasoline are leaving space for electricity-powered vehicles, even though there are several central aspects to deal with in order to let the electric vehicles be competitive with the old vehicle generation. In this direction, the goal is to create a fully operative and diffused infrastructure for the fast charging of the batteries, which is one of the main limitations for the final customer. In fact, the batteries need to be charged often and nowadays the task of finding an available charging spot is not as easy as it seems.

With this issue in mind, *eMall* is an operating system, itself composed of two subsystems, whose goal is to offer a way to find available charging stations for electric vehicles, offering at the same time to the user the possibility to access to several features such as the reservation of a specific socket at a certain timeframe or the reception of personalised proactive suggestions by the system.

This document contains a description of the architectural design for the system, including the components involved and how they interact. Additionally mockups of the user interface are presented and a plan for the implementation, testing and integration of the system. Therefore, this document should guide the development of the system.

1.2 Scope

While there are several stakeholders to consider, this document is only concerned about two actors: Drivers and Administrators. The Driver is the final user, the one who interacts with the *eMSP* to have the possibility to book the battery recharge of his vehicles. Instead the role of the system Administrator mainly concerns to monitor the correct behaviour of the system and to take strategic decisions.

The main system is divided into two subsystems: the *eMSP* and *CPMS*. The *eMPS*

is designed to be an interface and to communicate both with the Driver and the Administrator, driving their requests. The *CPMS*, instead, is modelled on the *OCPI 2.2.1* protocol and is referred to as a specific *CPO*. The main task of the *CPMS* is to supply information about its *CPO* charging stations to the *eMSPs* it is linked to, both for the Driver and the Administrator usage.

Although *CPO* and *DSO* are mentioned in this document along with the other entities described before, we will not consider either their internal system or their decision making.

The architecture of *eMall* follows the three-tier pattern with a presentation layer, business logic layer and a data layer.

1.3 Definitions, Acronyms, Abbreviations

1.3.1 Definitions

Definitions	Description
Driver Identifier	To identify a specific driver, this could be an identification number such as her/his SSN
Car Identifier	To identify a specific car, this could be the licence plate
Station Identifier	To identify a specific charging station

1.3.2 Abbreviations

Abbreviations	Definitions
RASD	Requirements Analysis and Specification Document
API	Application Programming Interface
RX	Requirements number X
GPS	Global Positioning System
CLI	Command Line Interface
DBMS	Database Management System
DB	Database
MVC	Model View Controller
eMall	e-Mobility for All
EV	Electric Vehicle
Driver	Electric vehicle driver
Administrator	*CPO* administrator

1.4 Revision History

Version 1.1.0

1.5 Reference Documents

- The specification document "Assignment RDD AY 2022-2023_v3.pdf"
- RASD

1.6 Document Structure

This document is composed of seven sections, detailed below.
In the first section the problem is introduced together with the purpose of this specific report and a recap of the context. Additionally, some necessary information in order to read the report is given, such as definitions and abbreviations.
Section two contains the description of the architectural design of the system together with motivations and reasons that led to opting for these solutions. It starts with a high-level overview of the architecture and then breaks each part down into components. The components are described and their interdependence are shown in the component diagram. Moreover, the section contains a component interface diagram, a deployment view and sequence diagrams describing the interactions between components in the runtime view.
In section three design mockups of the user interface is presented.
Section four contains the requirement traceability matrix, where each of the components described in section two is mapped to the requirements specified in the *RASD*. The mapping is based on whether the component contributes to the fulfilment of the requirement.
Section five describes the suggested implementation order and test plan of the system.
In section six is shown the total effort spent by each of the project members.
Section seven contains the references used.

2 Architectural Design

2.1 Overview: High-level components and their interaction

2.2 Component view

2.3 Deployment view

2.4 Runtime view

2.4.1 Registration Runtime

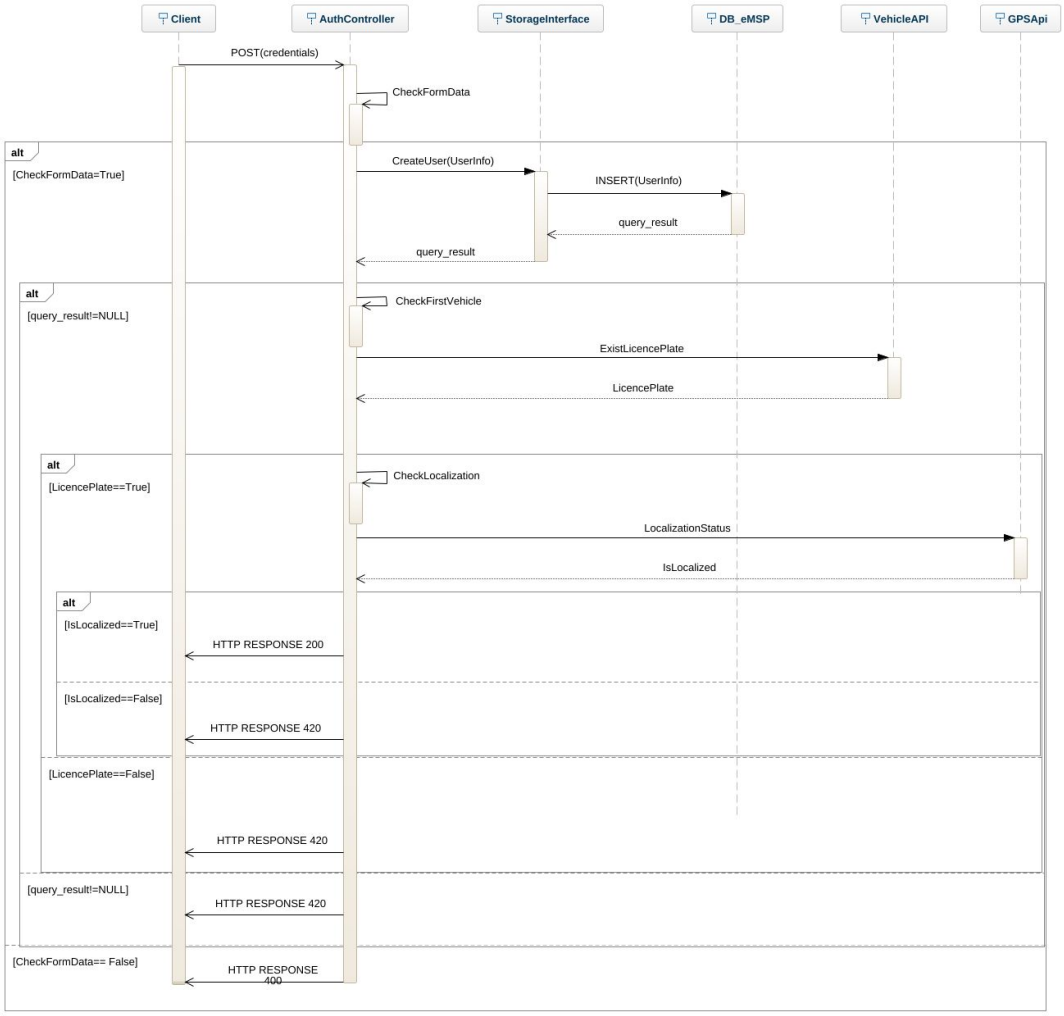

Fig. 1: *Sequence diagram of the registration process for a Driver*

2.4.2 Login Runtime

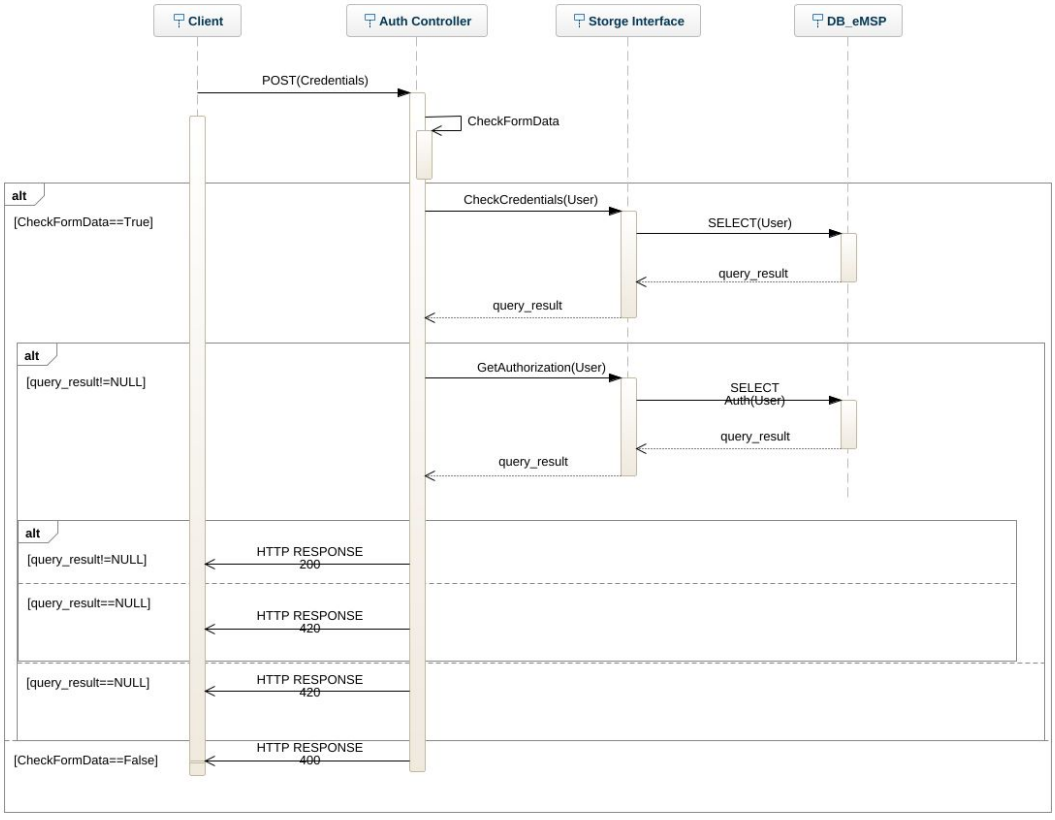

Fig. 2: *Sequence diagram of the login to eMall*

2.4.3 View Map Page

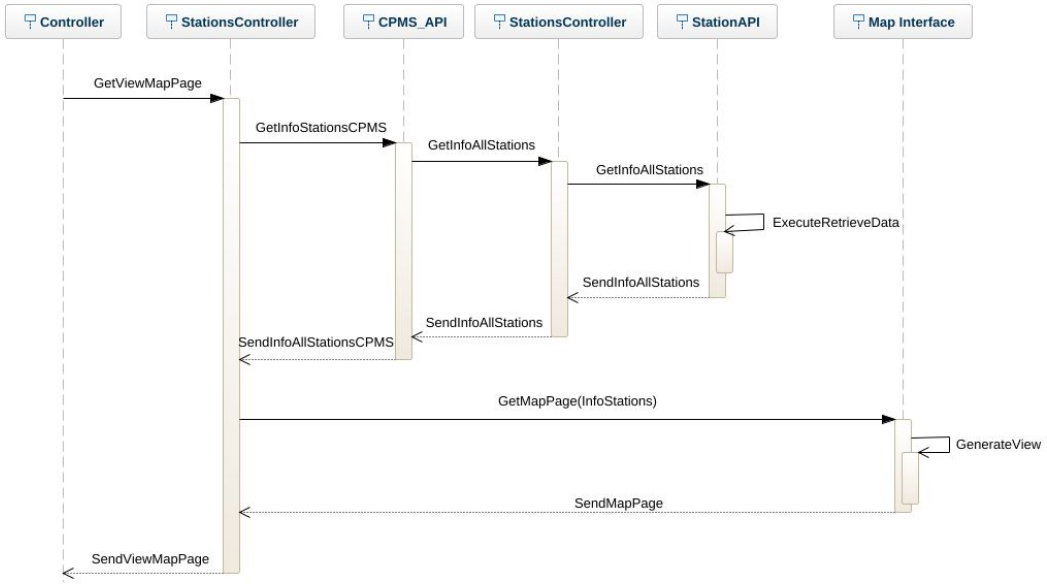

Fig. 3: *Sequence diagram of the visualization of Map Page*

2.4.4 View Stations Page

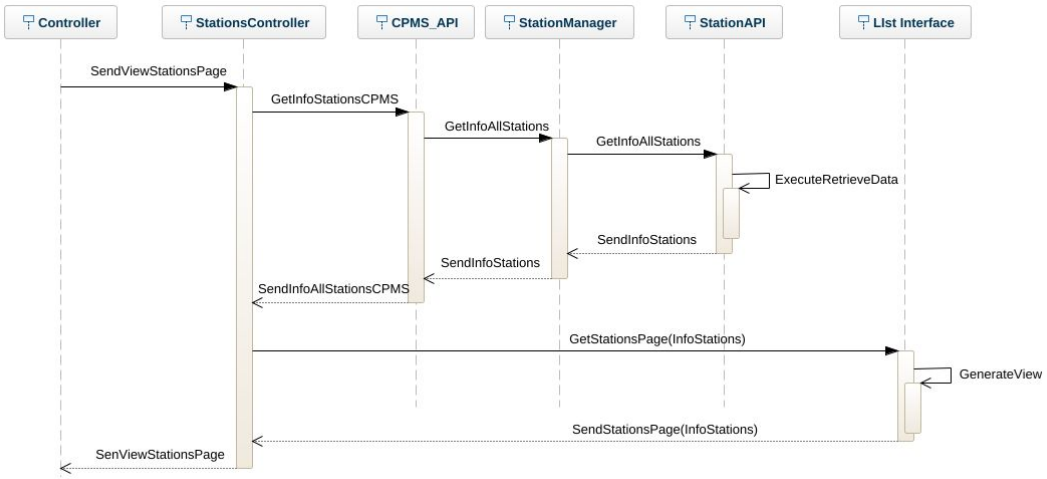

Fig. 4: *Sequence diagram of the visualization of the list in Stations Page*

2.4.5 Make a reservation

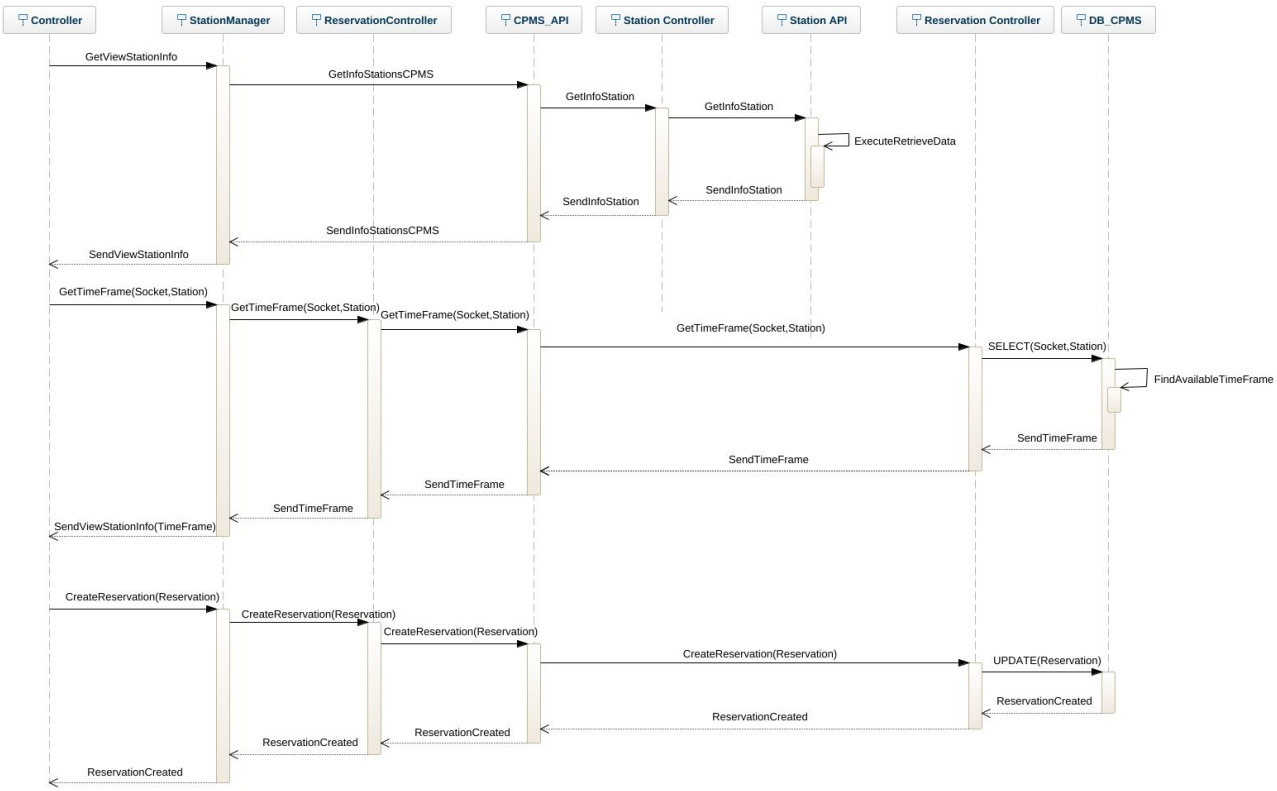

Fig. 5: *Sequence diagram for making a reservation*

2.4.6 Monitor the charge

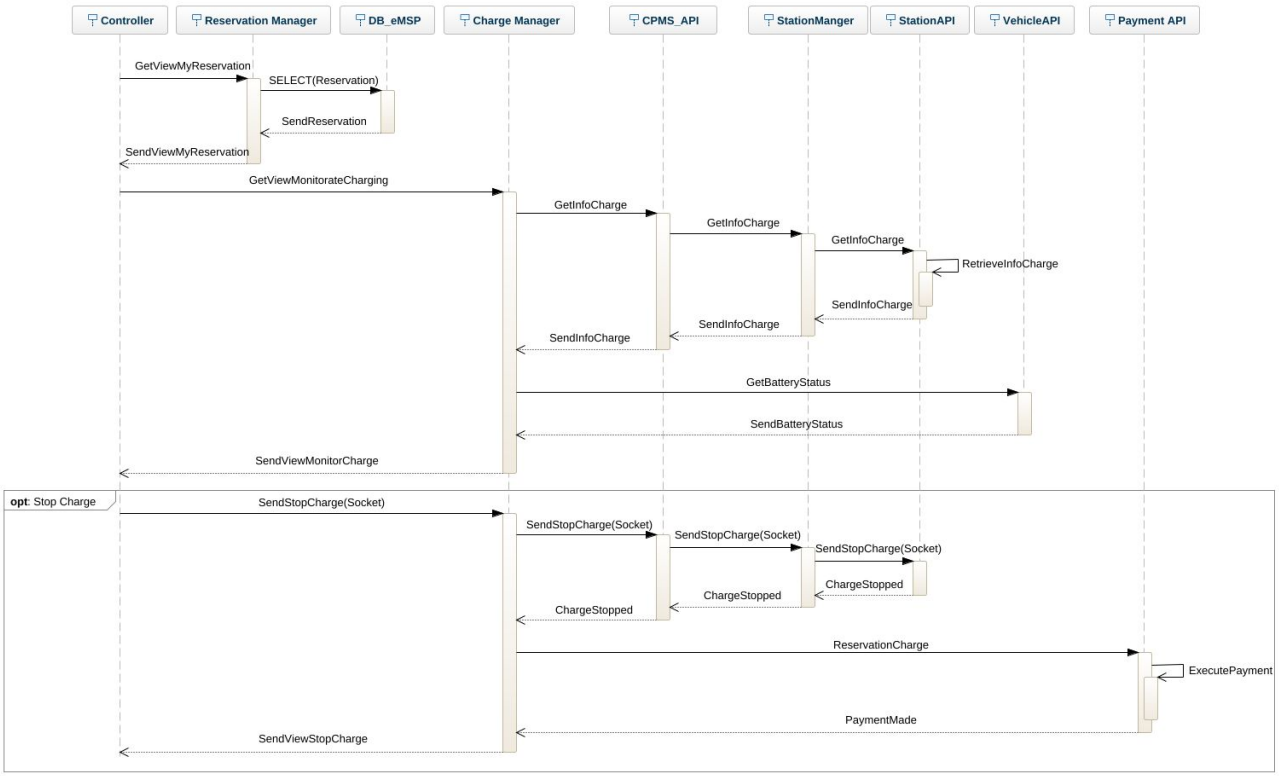

Fig. 6: *Sequence diagram for monitoring the charge*

2.4.7 Start the charge

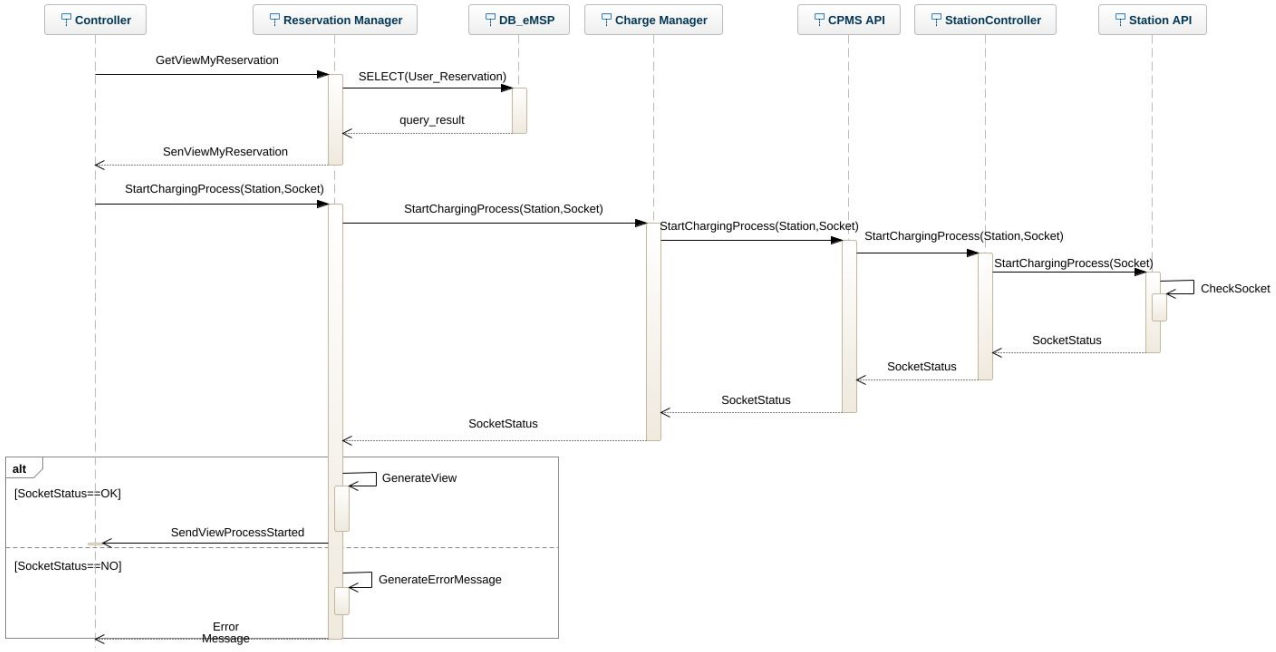

Fig. 7: *Sequence diagram for starting the charge*

2.4.8 Change Energy Mix

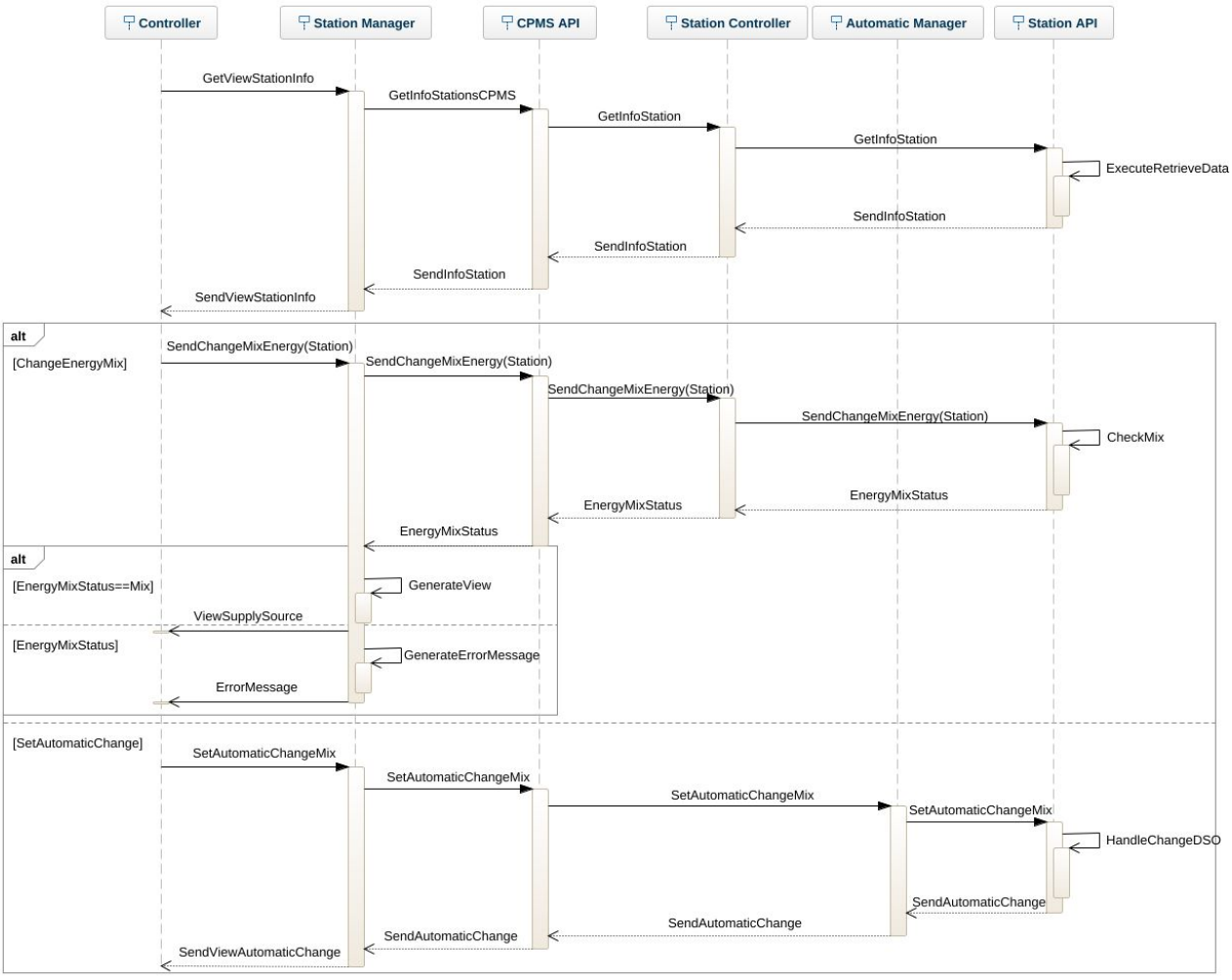

Fig. 8: *Sequence diagram for energy mix settings*

2.4.9 Change the DSO

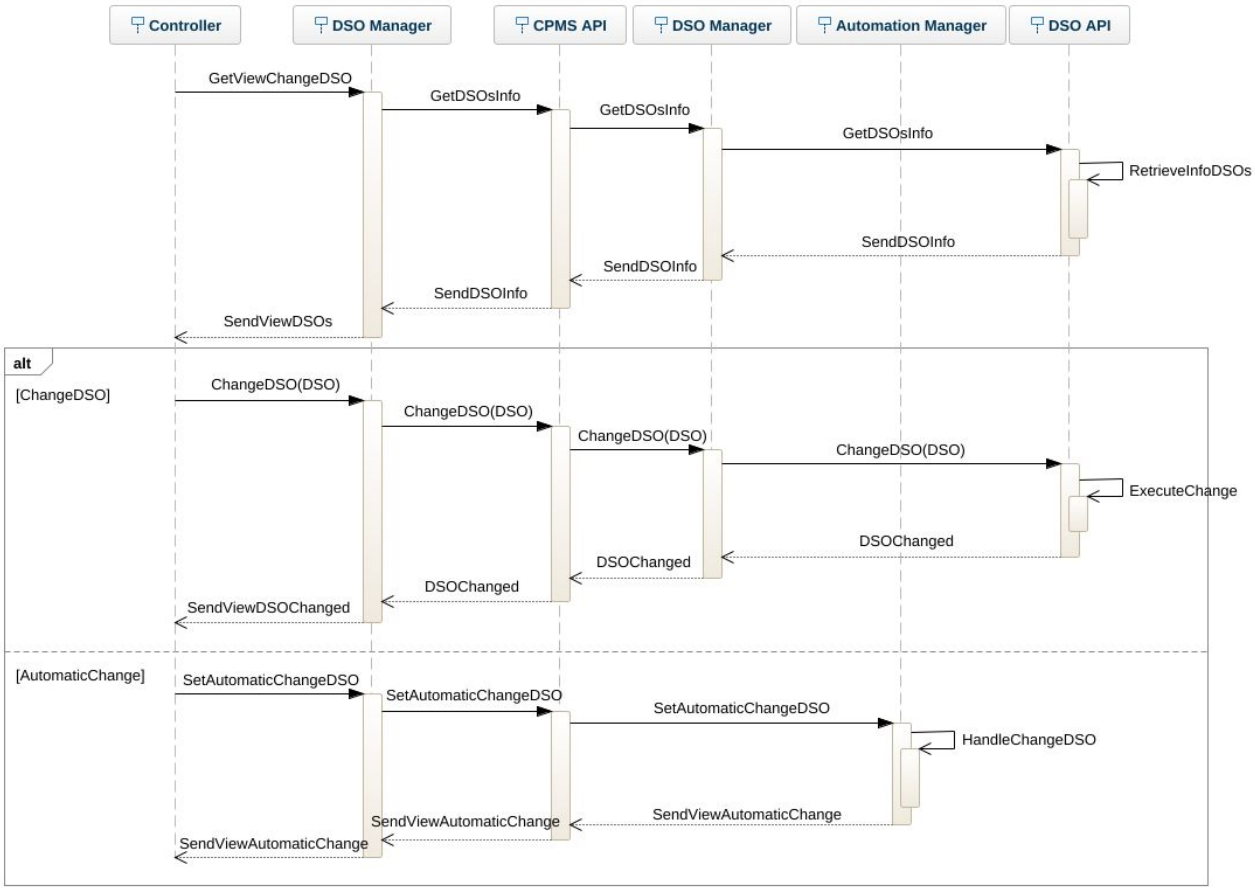

Fig. 9: *Sequence diagram for DSO settings*

2.4.10 Accept a recommendation

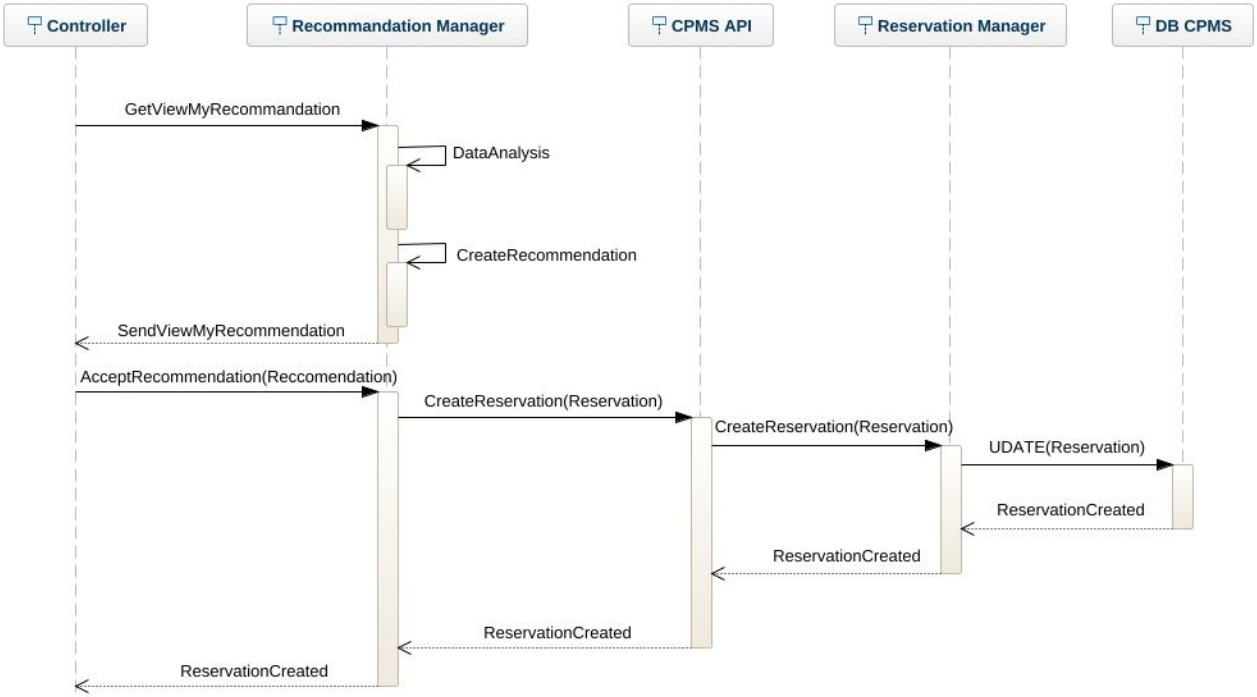

Fig. 10: *Sequence diagram of the acceptance of a recommendation*

2.5 Component interfaces

2.6 Selected architectural styles and patterns

2.7 Other design decisions

3 User Interface Design

3.1 Driver

3.2 Administrator

4 Requirements traceability

This section contains a table explaining what components, according to their abbreviations specified in the list below, are required in order to fulfil each of the requirements specified in the *RASD*.

- **MC** - Mobile Client
- **WC** - Web Client
- **ACC** - Authentication Controller
- **SI** - Storage Interface eMSP
- **SI*** - Storage Interface CPMS
- **DB** - Database eMSP
- **DB*** - Database CPMS
- **PM** - Profile Manager
- **SM** - Station Manager eMSP
- **SM*** - Station Manager CPMS
- **RSM** - Reservation Manager eMSP
- **RSM*** - Reservation Manager CPMS
- **RCM** - Recharge Manager
- **REM** - Recommendation Manager
- **DM** - DSO Manager eMSP
- **DM*** - DSO Manager CPMS
- **NM** - Notification Manager
- **AM** - Automation Manager
- **EAI** - External API Interfaces eMSP
- **EAI*** - External API Interfaces CPMS

R	MC	WC	ACC	SI	SI*	DB	DB*	PM	SM	SM*	RSM	RSM*	RCM	REM	DM	DM*	NM	AM	EAI	EAI*
R1	X		X	X		X													X	
R2	X			X		X		X											X	
R3	X			X		X		X											X	
R4	X								X	X									X	X
R5	X								X	X									X	X
R6	X								X	X									X	X
R7	X				X		X		X	X	X	X							X	X
R8	X				X		X		X	X	X	X							X	X
R9	X			X		X					X									
R10	X			X		X			X	X	X								X	X
R11	X									X			X						X	X
R12	X									X			X						X	X
R13	X									X			X				X		X	X
R14	X													X			X		X	X
R15	X													X			X		X	X
R16	X				X		X		X	X	X	X							X	X
R17		X		X	X	X	X		X	X									X	X
R18		X		X	X	X	X		X	X									X	X
R19		X		X	X	X	X		X	X									X	X
R20		X		X	X	X	X		X	X									X	X
R21		X		X	X	X	X		X	X					X	X		X	X	X
R22		X		X	X	X	X		X	X					X	X			X	X
R23		X		X		X			X											
R24																	X		X	
R25																	X		X	
R26				X	X	X	X												X	X
R27	X	X	X		X		X													
R28	X	X	X		X		X													

5 Implementation, Integration and test Plan

5.1 Implementation

5.2 Integration & Test plan

6 Effort Spent

6.0.1 Roberto Cialini

Section	**Time spent**
Introduction	
Overall description	
Specific requirements	
Formal analysis	
Reasoning	
Total time	

6.0.2 Umberto Colangelo

Section	**Time spent**
Introduction	
Overall description	
Specific requirements	
Formal analysis	
Reasoning	
Total time	

6.0.3 Vittorio La Ferla

Section	**Time spent**
Introduction	
Overall description	
Specific requirements	
Formal analysis	
Reasoning	
Total time	

7 References