PowerEnJoy Project

Integration Test Plan Document (ITPD)

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1. Introduction

1.1 Revision History

- v1.0
- v1.0.1: added reference to Design Document v1.1.1

1.2 Purpose and Scope

This project aims to provide customers within the administrative division of Milan with a car sharing service and all the associated functionalities as widely discussed in the RASD and the DD.

This document represents the Integration Test Plan Document, which outlines the organization of the integration testing activities aiming to make the different components of the system correctly interoperate and avoid any unexpected behavior.

1.3 List of Definitions and Abbreviations

In extension to the RASD and DD Definitions, acronyms, abbreviations paragraphs, below are some definitions and abbreviations used in this document:

- "J2EE" = abbreviation for Java Enterprise Edition, platform-independent Java-centric environment considered within the scope of this project as the fundamental system runtime context.
- "IDE" = acronym for Integrated Development Environment, software application that provides the comprehensive facilities for software development.

1.4 List of Reference Documents

I used for this ITPD as reference for the project assignment, the general layout and structure

- Assignments AA 2016-2017.pdf,
- RASD v1.1 Alfredo Fomitchenko.pdf,
- DD v1.1.1 Alfredo Fomitchenko.pdf,
- Integration Test Plan Example.pdf (SPINGRID example),
- Integration testing example document.pdf (MyTaxiService example);

to create the diagrams

- draw.io website;

to write the actual document

- Microsoft Word 2016;

as scheduling and time effort management tracker

- Microsoft Excel 2016.

2. Integration Strategy

2.1 Entry Criteria

Integration testing can produce meaningful results only if some conditions about the overall project progress are met.

The first fundamental criteria is that the Requirements Analysis and Specifications Document and the Design Document must be released in a fully revised way: this assures that the architecture and the interactions concerning the components has been settled and agreed upon, which gives the definitive picture of what should interact and work with what component.

The second criteria, as important as the first, is that every component that has been developed individually must be tested within its own scope, assuring that problems raised in the integration phase are not due to internal algorithmic issues.

2.2 Elements to be Integrated

As extensively illustrated in the Design Document, the system will be composed of low-level components and external gateways, which wholly constitute and provide the necessary functionalities. These are: AuthenticationManager, Router, ListAvailableCarsHandler, LoginManager, RegistrationManager, ReservationManager, RideManager, LockManager, TimerManager, ChargeManager, DiscountHelper, DataController, Cache, Database Server, LocatorHelper, GoogleMapsGateway, EmailServiceProviderGateway, BankGateway, Customer application, Car service.

For all the details about the integration testing, see the following paragraphs.

2.3 Integration Testing Strategy

The Design Document highlights two critical components:

1) Router, as every incoming request from the mobile application and every request from one component to another must be correctly interpreted and forwarded;
2) DataController, as the world model and logic regarding customers, cars, reservations and rides lies within it and every other component trying to read, write or manipulate data asks this one to do so.

The importance of these two components and their functions naturally leads to the choice of starting the whole integration testing process with a focus onto the two given by a critical-module-first approach.

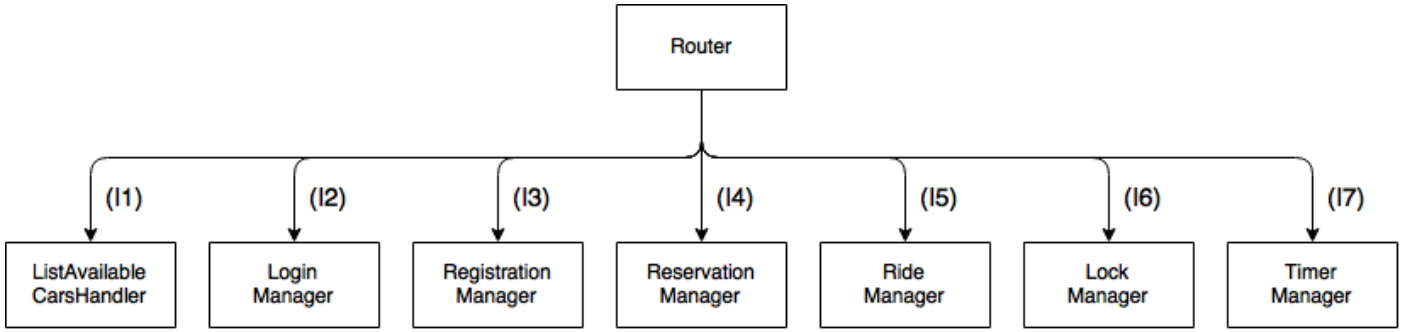
Then, given Router and DataController are fully integrated with the components they communicate directly with, a hierarchical bottom-up approach follows, for which low-level components are found developed and ready to be integrated.

2.4 Sequence of Components/Function Integration

As mentioned, the first integration phase focuses onto Router and DataController which represent critical parts of the system. Then, a more hierarchical bottom-up approach follows.

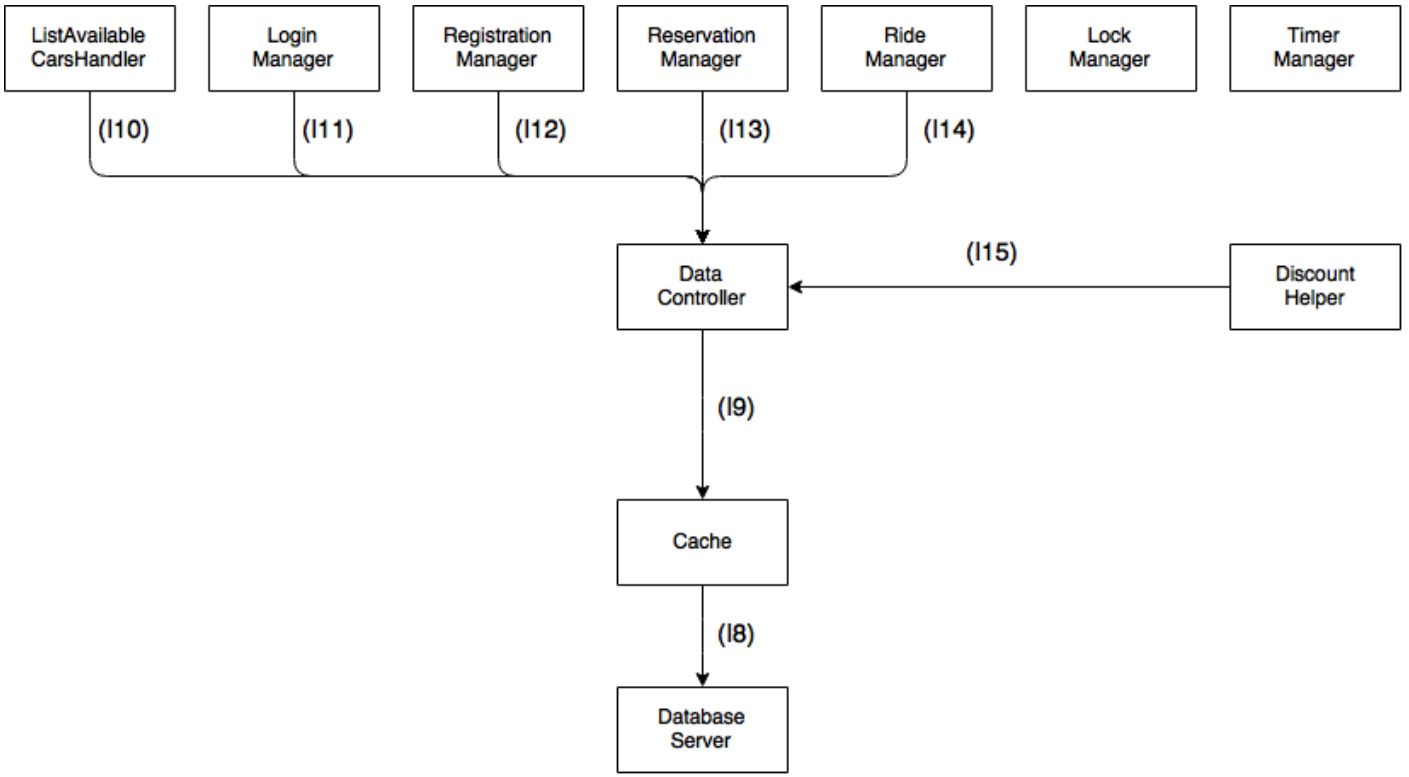
Please note that, especially regarding Router testing, diagram arrows going from A to B mean that B must have already been developed for the whole test to start, but methods are also called the other round (for further details see Individual Steps and Test Description section).

2.4.1 Critical-module-first Integration Testing: Router



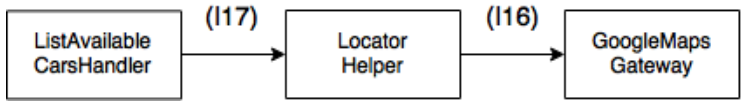
ID	Integration Test	Description paragraph
I1	Router → ListAvailableCarsHandler	3.1
I2	Router → LoginManager	3.2
I3	Router → RegistrationManager	3.3
I4	Router → ReservationManager	3.4
I5	Router → RideManager	3.5
I6	Router → LockManager	3.6
I7	Router → TimerManager	3.7

2.4.2 Critical-module-first Integration Testing: DataController



ID	Integration Test	Description paragraph
I8	Cache → Database Server	3.8
I9	DataController → Cache	3.9
I10	ListAvailableCarsHandler → DataController	3.10
I11	LoginManager → DataController	3.11
I12	RegistrationManager → DataController	3.12
I13	ReservationManager → DataController	3.13
I14	RideManager → DataController	3.14
I15	DiscountHelper → DataController	3.15

2.4.3 Bottom-up Integration Testing: ListAvailableCarsHandler

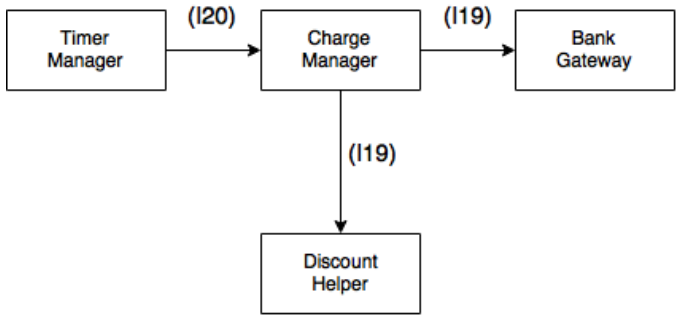


ID	Integration Test	Description paragraph
I16	LocatorHelper → GoogleMapsGateway	3.16
I17	ListAvailableCarsHandler→ LocatorHelper	3.17

2.4.4 Bottom-up Integration Testing: RegistrationManager

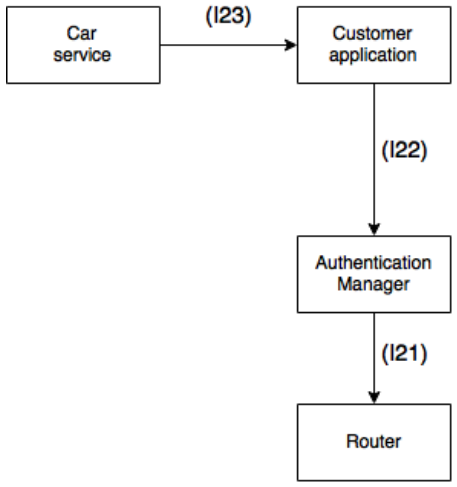
ID	Integration Test	Description paragraph
I18	RegistrationManager → EmailServiceProviderGateway	3.18

2.4.5 Bottom-up Integration Testing: ChargeManager



ID	Integration Test	Description paragraph
I19	ChargeManager → DiscountHelper, BankGateway	3.19
I20	TimerManager → ChargeManager	3.20

2.4.6 Bottom-up Integration Testing: Front End



ID	Integration Test	Description paragraph
I21	AuthenticationManager → Router	3.21
I22	Customer application → AuthenticationManager	3.22
I23	Car service → Customer application	3.23

3. Individual Steps and Test Description

3.1 Integration test case I1

Test case identifier	I1T1
Integration test items	Router → ListAvailableCarsHandler
Input specification	Create the Router request triggered by the customer to retrieve the available cars from the customer's position given as either an address or a GPS position
Output specification	Check if the correct ListAvailableCarsHandler methods are called
Environmental needs	AuthenticationManager driver

3.2 Integration test case I2

Test case identifier	I2T1
Integration test items	Router → LoginManager
Input specification	Create the Router request triggered by the customer to log into the system
Output specification	Check if the correct LoginManager methods are called
Environmental needs	AuthenticationManager driver

3.3 Integration test case I3

Test case identifier	I3T1
Integration test items	Router → RegistrationManager
Input specification	Create the Router request triggered by the customer to register a new account for logging into the system
Output specification	Check if the correct RegistrationManager methods are called
Environmental needs	AuthenticationManager driver

3.4 Integration test case I4

Test case identifier	I4T1
Integration test items	Router → ReservationManager
Input specification	Create the Router request triggered by the customer to check if he is able to reserve a car given that he has not previously reserved another one
Output specification	Check if the correct ReservationManager methods are called
Environmental needs	AuthenticationManager driver

Test case identifier	I4T2
Integration test items	ReservationManager → Router
Input specification	Create the ReservationManager request intended for TimerManager to start a timer associated to a new reservation
Output specification	Check if the correct Router methods are called
Environmental needs	None

Test case identifier	I4T3
Integration test items	Router → ReservationManager
Input specification	Create the Router request triggered by LockManager to check whether the customer requesting a car unlock is the one that reserved the car
Output specification	Check if the correct ReservationManager methods are called
Environmental needs	AuthenticationManager driver

Test case identifier	I4T4
Integration test items	ReservationManager → Router
Input specification	Create the ReservationManager request intended for TimerManager to stop a timer associated to a reservation
Output specification	Check if the correct Router methods are called
Environmental needs	None

3.5 Integration test case I5

Test case identifier	I5T1
Integration test items	Router → RideManager
Input specification	Create the Router request triggered by the customer to start a ride
Output specification	Check if the correct RideManager methods are called
Environmental needs	AuthenticationManager driver

Test case identifier	I5T2
Integration test items	RideManager → Router
Input specification	Create the RideManager request intended for TimerManager to start a timer associated to a new ride
Output specification	Check if the correct Router methods are called
Environmental needs	None

Test case identifier	I5T3
Integration test items	RideManager → Router
Input specification	Create the RideManager request intended for TimerManager to stop a timer associated to a ride
Output specification	Check if the correct Router methods are called
Environmental needs	None

Test case identifier	I5T4
Integration test items	RideManager → Router
Input specification	Create the RideManager request intended for LockManager to lock the car
Output specification	Check if the correct Router methods are called
Environmental needs	None

3.6 Integration test case I6

Test case identifier	I6T1
Integration test items	LockManager → Router
Input specification	Create the LockManager request intended for ReservationManager to check whether the customer requesting a car unlock is the one that reserved the car
Output specification	Check if the correct Router methods are called
Environmental needs	None

Test case identifier	I6T2
Integration test items	LockManager → Router
Input specification	Create the LockManager request intended for the car service to lock the car
Output specification	Check if the correct Router methods are called
Environmental needs	None

3.7 Integration test case I7

Test case identifier	I7T1
Integration test items	Router → TimerManager
Input specification	Create the Router request triggered by ReservationManager to start a reservation timer
Output specification	Check if the correct TimerManager methods are called
Environmental needs	AuthenticationManager driver

Test case identifier	I7T2
Integration test items	Router → TimerManager
Input specification	Create the Router request triggered by ReservationManager to stop a reservation timer
Output specification	Check if the correct TimerManager methods are called
Environmental needs	AuthenticationManager driver

Test case identifier	I7T3
Integration test items	Router → TimerManager
Input specification	Create the Router request triggered by RideManager to start a ride timer
Output specification	Check if the correct TimerManager methods are called
Environmental needs	AuthenticationManager driver

Test case identifier	I7T4
Integration test items	Router → TimerManager
Input specification	Create the Router request triggered by RideManager to stop a ride timer
Output specification	Check if the correct TimerManager methods are called
Environmental needs	AuthenticationManager driver

3.8 Integration test case I8

Test case identifier	I8T1
Integration test items	Cache → Database Server
Input specification	Create the Cache request triggered by DataController to retrieve the appropriate data necessary for DataController to fulfill the call
Output specification	Check if Database Server correctly handles the call
Environmental needs	Cache and Database Server are intended to be fully integrated as parts of an Oracle DBMS component of the Red Hat OpenShift cloud infrastructure

3.9 Integration test case I9

Test case identifier	I9T1
Integration test items	DataController → Cache
Input specification	Create all DataController requests intended for Database Server to retrieve the appropriate data
Output specification	Check if Cache correctly handles the calls
Environmental needs	Cache and Database Server are intended to be fully integrated as parts of an Oracle DBMS component of the Red Hat OpenShift cloud infrastructure

3.10 Integration test case I10

Test case identifier	I10T1
Integration test items	ListAvailableCarsHandler → DataController
Input specification	Create the ListAvailableCarsHandler request to extract the available cars given the customer's position
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver

Test case identifier	I10T2
Integration test items	ListAvailableCarsHandler → DataController
Input specification	Create the ListAvailableCarsHandler request to extract the available cars passing as arguments a not correctly formatted latitude and longitude pair
Output specification	Check if DataController correctly returns a Null cars list
Environmental needs	Cache stub

3.11 Integration test case I11

Test case identifier	I11T1
Integration test items	LoginManager → DataController
Input specification	Create the LoginManager request to retrieve the password associated to the customer email address
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver

Test case identifier	I11T2
Integration test items	LoginManager → DataController
Input specification	Create the LoginManager request to retrieve the password associated to the customer email address providing an email address no database record corresponds to
Output specification	Check if DataController correctly returns a Null *pwd* string variable
Environmental needs	Cache stub

Test case identifier	I11T3
Integration test items	LoginManager → DataController
Input specification	Create the LoginManager request to cache the customer data
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver

3.12 Integration test case I12

Test case identifier	I12T1
Integration test items	RegistrationManager → DataController
Input specification	Create the RegistrationManager request to check whether the customer has already registered to the system
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver

Test case identifier	I12T2
Integration test items	RegistrationManager → DataController
Input specification	Create the RegistrationManager request to check whether the customer has already registered to the system passing as argument a customer who has already registered
Output specification	Check if DataController correctly throws an error
Environmental needs	Cache stub

Test case identifier	I12T3
Integration test items	RegistrationManager → DataController
Input specification	Create the RegistrationManager request to generate a new customer's record into the database
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver

3.13 Integration test case I13

Test case identifier	I13T1
Integration test items	ReservationManager → DataController
Input specification	Create the ReservationManager request to check whether the customer either has already reserved a car or is currently riding a car
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver
Comments	ReservationManager unit testing checks whether the component correctly throws an error when either a ride or a reservation associated to the customer has been found

Test case identifier	I13T2
Integration test items	ReservationManager → DataController
Input specification	Create the ReservationManager request to generate a new reservation associating customer and car
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver

Test case identifier	I13T3
Integration test items	ReservationManager → DataController
Input specification	Create the ReservationManager request to generate a new reservation associating customer and car when the car is not available anymore
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver
Comments	The input specification occurs when the customer had correctly retrieve the car when it was available, but meanwhile he was deciding to reserve it another customer reserved it

3.14 Integration test case I14

Test case identifier	I14T1
Integration test items	RideManager → DataController
Input specification	Create the RideManager request to generate a new ride associating customer and car
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver

Test case identifier	I14T2
Integration test items	RideManager → DataController
Input specification	Create the RideManager request to insert among the ride information the battery percentage charge
Output specification	Check if the correct DataController methods are called
Environmental needs	Router driver

Test case identifier	I14T3
Integration test items	RideManager → DataController
Input specification	Create the RideManager request to set a car available again after a ride has been terminated
Output specification	Check if the correct DataController methods are called
Environmental needs	None

3.15 Integration test case I15

Test case identifier	I15T1
Integration test items	DiscountHelper → DataController
Input specification	Create the DiscountHelper request to retrieve the information associated to the terminated ride
Output specification	Check if the correct DataController methods are called
Environmental needs	ChargeManager driver

3.16 Integration test case I16

Test case identifier	I16T1
Integration test items	LocatorHelper → GoogleMapsGateway
Input specification	Create the LocatorHelper request to convert an address into a pair of latitude and longitude coordinates via GeoCoding API
Output specification	Check if GoogleMapsGateway correctly handles the call
Environmental needs	ListAvailableCarsHandler driver

Test case identifier	I16T2
Integration test items	LocatorHelper → GoogleMapsGateway
Input specification	Create the LocatorHelper request to retrieve the customer's position via GeoLocation API
Output specification	Check if GoogleMapsGateway correctly handles the call
Environmental needs	ListAvailableCarsHandler driver

Integration test case I17

Test case identifier	I17T1
Integration test items	ListAvailableCarsHandler → LocatorHelper
Input specification	Create the ListAvailableCarsHandler request to convert an address into a pair of latitude and longitude coordinates via GeoCoding API
Output specification	Check if the correct LocatorHelper methods are called
Environmental needs	Router driver
Comments	LocatorHelper unit testing checks whether the component returns a false *found* variable if a not valid address has been provided

Test case identifier	I17T2
Integration test items	ListAvailableCarsHandler → LocatorHelper
Input specification	Create the ListAvailableCarsHandler request to retrieve the customer's position via GeoLocation API
Output specification	Check if the correct LocatorHelper methods are called
Environmental needs	Router driver

3.17 Integration test case I18

Test case identifier	I18T1
Integration test items	RegistrationManager → EmailServiceProviderGateway
Input specification	Create the RegistrationManager request to check whether the email address provided by the customer is a valid one
Output specification	Check if EmailServiceProviderGateway correctly handles the call
Environmental needs	Router driver

Test case identifier	I18T2
Integration test items	RegistrationManager → EmailServiceProviderGateway
Input specification	Create the RegistrationManager request to check whether the email address provided by the customer is a valid one passing as argument a not valid email address
Output specification	Check if EmailServiceProviderGateway correctly returns an error
Environmental needs	Router driver

Test case identifier	I18T3
Integration test items	RegistrationManager → EmailServiceProviderGateway
Input specification	Create the RegistrationManager request to send the email containing the customer's associated password
Output specification	Check if EmailServiceProviderGateway correctly handles the call
Environmental needs	Router driver

3.18 Integration test case I19

Test case Identifier	I19T1
Integration test items	ChargeManager → DiscountHelper, BankGateway
Input Specification	Create the ChargeManager request to retrieve the discount applicable to the customer's ride charge thanks to his virtuous behaviors
Output specification	Check if the correct DiscountHelper methods are called
Environmental needs	TimerManager driver

Test case identifier	I19T2
Integration test items	ChargeManager → DiscountHelper, BankGateway
Input specification	Create the ChargeManager request to charge the customer of the ride charge amount after any applicable discount
Output specification	Check if BankGateway correctly handles the call
Environmental needs	TimerManager driver, Cache stub

3.19 Integration test case I20

Test case Identifier	I20T1
Integration test items	TimerManager → ChargeManager
Input Specification	Create the TimerManager request to charge the customer after an associated ride timer has been stopped
Output specification	Check if the correct ChargeManager methods are called
Environmental needs	I19 succeeded

3.20 Integration test case I21

Test case Identifier	I21T1
Integration test items	AuthenticationManager → Router
Input Specification	Create the AuthenticationManager validated forwarding request to Router
Output specification	Check if the correct Router methods are called
Environmental needs	Customer application driver

3.21 Integration test case I22

Test case Identifier	I22T1
Integration test items	Customer application → AuthenticationManager
Input Specification	Create any Customer application request shown in the Design Document sequence diagrams
Output specification	Check if AuthenticationManager validates correctly the calls
Environmental needs	None

Test case identifier	I22T2
Integration test items	Customer application → AuthenticationManager
Input specification	Create fraudulent customer requests sent by unofficial mobile applications or mobile application emulators
Output specification	Check if AuthenticationManager does not correctly authorize the communication to Router
Environmental needs	None
Comments	The typical scenarios which this aims to test are calls emulating a car request to be unlocked performed by a customer which is not the legit customer that reserved the car

3.22 Integration test case I23

Test case Identifier	I23T1
Integration test items	Customer application → Car service
Input Specification	Create the Customer application request to establish a Bluetooth connection
Output specification	Check if Car service correctly activates the necessary Bluetooth interface capabilities
Environmental needs	I22 succeeded

Test case identifier	I23T2
Integration test items	Customer application → Car service
Input specification	Create the Customer application request to unlock the car
Output specification	Check if the correct Car service methods are called
Environmental needs	None

Test case identifier	I23T3
Integration test items	Car service → Customer application
Input specification	Create the Car service request to check whether the car can be unlocked by the customer
Output specification	Check if the correct Customer application methods are called
Environmental needs	None

Test case identifier	I23T4
Integration test items	Car service → Customer application
Input specification	Create the Car service request to provide to the system the current ride passengers number
Output specification	Check if the correct Customer application methods are called
Environmental needs	None

Test case identifier	I23T5
Integration test items	Car service → Customer application
Input specification	Create the Car service request to provide to the system the current battery charge at the end of a ride
Output specification	Check if the correct Customer application methods are called
Environmental needs	None

Test case identifier	I23T6
Integration test items	Customer application → Car service
Input specification	Create the Customer application request to perform an automated lock after the customer closes the driver door
Output specification	Check if the correct Car service methods are called
Environmental needs	None

4. Tools and Test Equipment Required

4.1 Tools

Alongside with manual operations and test data planning and writing, testing activities on the Java Enterprise Edition environment will take advantage of automated tools.

The JUnit framework will clearly take an important part of the unit testing activities for each component, but can also be involved in integration checks regarding for example objects returned by methods, errors thrown among components, etc.

However, Arquillian will be the main tool for in-container integration testing. The Arquillian framework allows the execution of the test cases extensively illustrated in this document against the Java runtime container, checking whether the interaction between a component and the surrounding environment works correctly.
Also, when dependency injection and the interaction with the database server are concerned, Arquillian represents a very powerful and widely used tool.

A significant portion of the testing activities will also focus onto the Android mobile application to be developed as fundamental part for providing the car sharing service to the customers.
Android Studio, the official IDE for Android app development and testing, industry standard officially supported by Google itself, will be the main support tool for the Android environment. Moreover, within and in extension to the IDE, the widely testing features involved in the process will be UI Automator (to build UI tests simulating user touchscreen interactions) and AndroidJUnitRunner (a class used to specifically run JUnit tests against an Android package).

4.2 Test Equipment

The cloud infrastructure chosen for the application final deployment is the Red Hat OpenShift one. Clearly the test environment where components will be tested has to be as close to the mentioned as possible, for example a scaled down version of the mentioned infrastructure.

For what concerns the mobile application testing, Android Studio provides a very reliable tool called Android Emulator which simulates different devices onto which prototype, develop and test applications. However, physical devices will be required to deliver a comprehensive testing activity, so at least one Android smartphone for each display size from three to six inches at steps of half an inch will be used.

5. Program Stubs and Test Data Required

Stubs needed will be

- Cache stub, that will simulate the response for database data requests coming from DataController, and
- DataController stub, that in particular will play a fundamental role within the integration testing of the components involved in the customer charge process (see I19).

Moreover, following are the drivers to be developed, which will invoke methods on the components to perform the integrations indicated below:

Driver	to perform integration testing between
AuthenticationManager driver	Router → ListAvailableCarsHandler Router → RegistrationManager Router → LoginManager Router → ReservationManager Router → RideManager Router → LockManager Router → TimerManager
Router driver	ListAvailableCarsHandler → DataController RegistrationManager → DataController LoginManager → DataController ReservationManager → DataController RideManager → DataController
ChargeManager driver	DiscountHelper → DataController
ListAvailableCarsHandler driver	LocatorHelper → GoogleMapsGateway
TimerManager driver	ChargeManager → BankGateway
Customer application driver	AuthenticationManager → Router

For what concerns about the test data, every test case input specification provides the information necessary to the planning and writing of it.

In particular, test case I22T2 concerning the development of unofficial mobile applications or mobile application emulators to simulate fraudulent customer requests (for example to ask for a car unlock) will definitely require more effort and the expertise of security specialists.

6. Effort

-	18 December 2016:	**2,2 h**
-	20 December 2016:	**1 h**
-	23 December 2016:	**1 h**
-	26 December 2016:	**2,5 h**
-	27 December 2016:	**2,6 h**
-	28 December 2016:	**3,4 h**
-	29 December 2016:	**3 h**
-	5 January 2016:	**1,3 h**
-	6 January 2016:	**0,5 h**
-	7 January 2016:	**3,3 h**
-	8 January 2016:	**1 h**
-	10 January 2016:	**1 h**
-	12 January 2016:	**1,1 h**
		23,9 h