Design Document

myTaxiService

AA 2015/2016

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Summary

1 Introduction

1.1 Purpose

This document a second step into the developing of myTaxiService system, it directly follows the RASD document, which has been previously provided and approved.

The design document is intended to be a guide for developers during the implementation of myTaxiService system. We are going to show the architecture of this system by providing a high/medium level view of the system-to-be and we will to show how it is meant to be built.

Since this document it's not meant to show the effective implementation of the software, we are not going to give specific details about the protocols with which each component interact with the system neither examples of possible implementation of the code.

1.2 Scope

As already explained in the RASD, we want to build a system able to provide both a fair distribution of the work among the taxi driver located in the city both a quick and reliable service for all the customers. We want provide an intuitive way of interaction for the users and also to give all the information they need as soon as they need it. We will also show how the communication between customer and driver will happen along with how (and when) the information will be stored into the database.

1.3 Definitions, Acronyms, Abbreviations

Here is a list of all the terms we will use into this document

- *RASD: Requirement Analysis Specification Document*
- *All the terms already included in the RASD*
- *Tier logical level of the architecture.*

1.4 Reference Documents

Within this document we will refer many times to the RASD so, since the Design Document is a further step into the developing of a system, it is suggested to read the RASD in order to completely understand this document Document.

We also referred to the IEEE standard for Design Document for the structure of this document.

1.5 Document Structure

This design document is structured as follows:

- *An architectural part in which we will show and explain our main architectural decisions.*
- *A list of the critical algorithms that will take place in our system*
- *Mockups of how we mean the User Interface to be*
- *An explanation of how our architectural choices respect the requirements described in the RASD documentation.*

2 Architectural Design

2.1 Overview

In this chapter, as previously mentioned, we are going to show how the architeture of our system will be built. We will start from a high level view and we will go deep into details in order tho show the logic components that characterize our system, where they should be placed in the hardware and how they will interact with each other at runtime.

More precisely, the following topics will be discussed.

- *High level architectural view*
- *Component view*
- *Deployment view*
- *Runtime view*
- *Component interfaces*
- *Architectural styles and patterns*

2.2 High level components and their interaction

A high level view of the architecture of our system is shown in fig 2.1

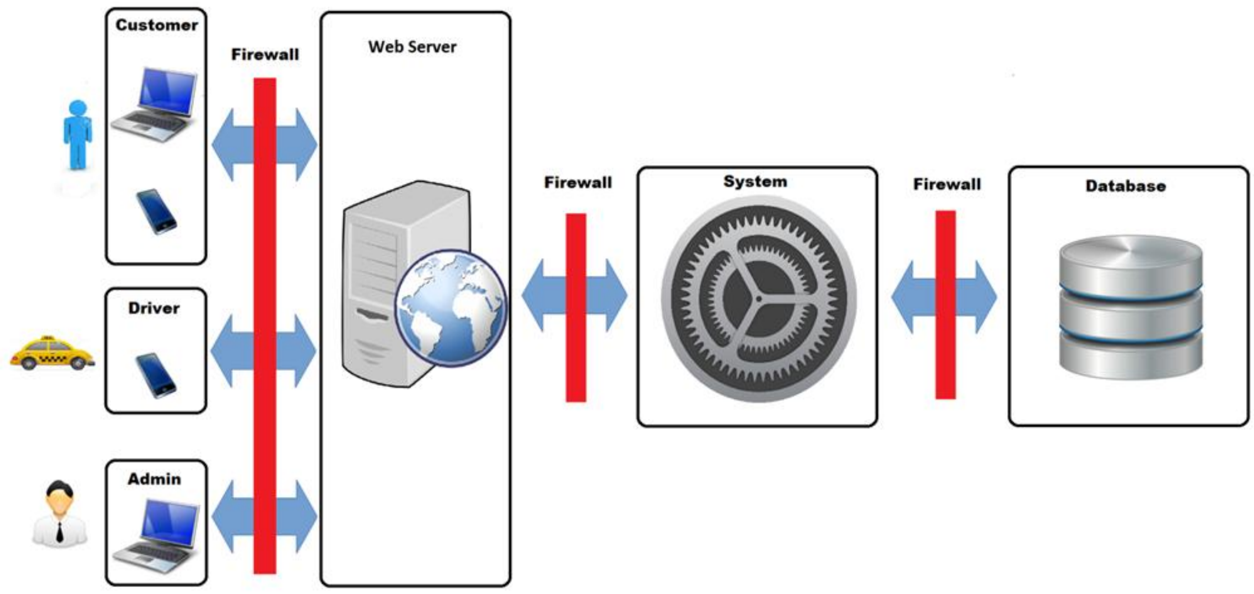


Fig 2.1

Our architecture is composed by the User Side and by a 3 Tier configuration:

***User Side**: the leftmost one, it refers to part of the software in direct contact with the user. Since Each device (mobile or PC) interacts with the system through the internet, this Tier is composed by two layers*

- *The Client layer i.e. the client application (for mobile) and the web broswer (for the access through web page)*
- *The Web layer that is made by all the software components that will receive requests from the User, will send them to the system and vice versa.*

1. ***Web Tier:** it is made by a web server, it receives messages from all the users, forward them to the system and vice versa.*
2. ***Application Tier:** this is the real core of the system. It is made of all the components that manage the request made by the users and allow a correct communication between them.*
3. ***Data Tier:** The hardware where all the information are permanently stored. It is separated by the system and it is connected with him via LAN (for example with a TCP/IP communication protocol)*

2.3 Component View

We decided to divide our system in various components in order for it to be as much cohesive as possible. Each is independent, has been created for a specific task so it has a unique set of functionalities and is able to communicate only with a few other specific ones.

A component diagram is shown in Fig 2.2

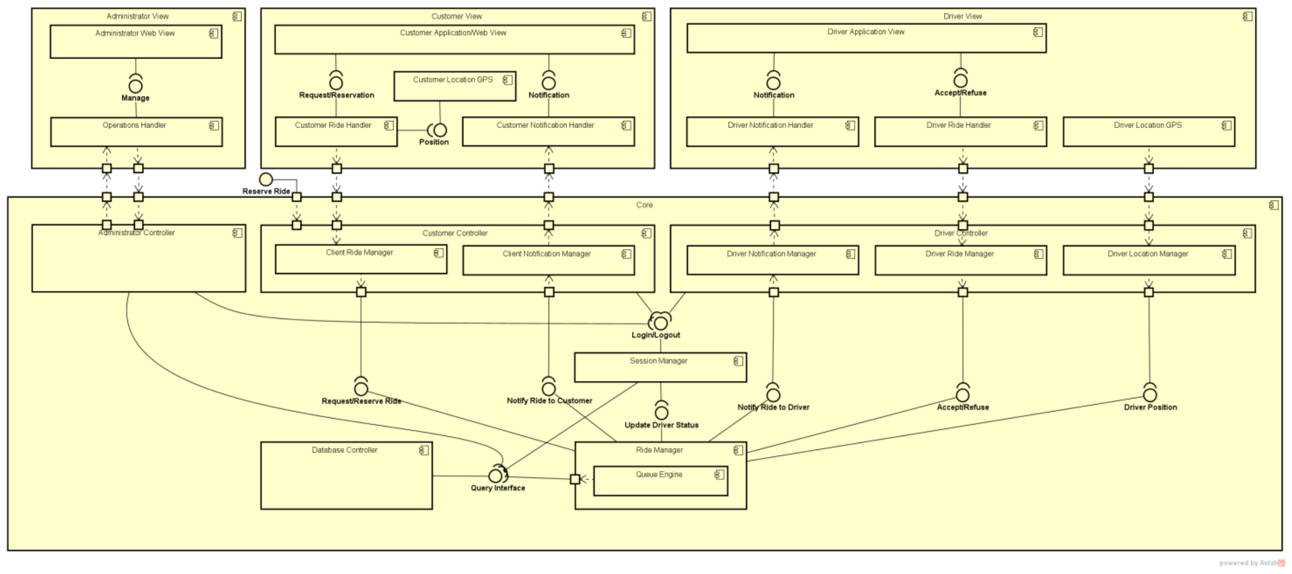


Fig 2.2

The component diagram shows that the software is divided in components and sub components, for every one of them we are going to give a brief explanation.

1. ***Customer View**: this macro component contains all the sub-components that interact directly with the Customer such as:*
    - ***Customer Application View**: it is the part of the system that generate the graphic part and manages the events generated by the Customer.*
    - ***Customer Ride Handler**: the party of the system that generate the effective request/reservation of a taxi, it is in charge of sending all the necessary information to the Customer Controller.*

- ***Customer notification Handler****: this part of the system is in charge of receiving all the information from the Customer Controller , transform them into a notification and to send them to the Customer Application View so that the customer will be able to see them.*
- ***Customer Location GPS****: this part of the system is activated when a customer request a taxi through mobile application and does not insert the adress of the meeting point, it will provide the actual position of the customer to the Ride Handler that will communicate it to the Customer Controller.*

2. ***Driver View****: this macro component contains all the sub-components that interact directly with the Driver such as:*
    - ***Driver Application View****: it is the part of the system that generate the graphic part and manages the events generated by the Driver.*
    - ***Driver Notification Handler****: this part of the system is in charge of receiving all the information from the DriverController, transform them into a notification and to send them to the Customer Application View so that the driver will be able to see them*
    - ***Driver Ride Handler****: this is the part of the system that allows the driver to queue in a certain zone.*
    - ***Driver Location GPS****: this part of the system communicates the actual position of the taxi that will be automatically*
3. ***Administrator View****: this macro component contains all the sub-components that interact directly with the Administrator such as:*
    - ***Administrator Web View****: it is the part of the system that generate the graphic part and manages the events generated by the Administrator.*
    - ***Operations Handler****: it is the part of the system that allows the Administrator to interrogate the database in order to perform read/write operations on it (the ones he is allowed to)*
4. ***System****: this is the core of myTaxiService, it manages all the Users and the interaction between them while storing and retrieving data from the Database. It is made by this macro-components.*
    - ***Administrator Controller****: this part of the system connects the Administrator with the database. It is in charge of controlling the credentials used to log in by querying the Session Manager and to send the query made by the Administrator to the Database Controller.*
    - ***Customer Controller****: this part of the system is in charge of elaborating all the messages coming from all the Customers and sending them to the inner parts of the system and viceversa. It is composed by:*
        - ***Client Ride Manager:*** *it is in charge of receiving all the request/reservation from the customers and sends the information to the Ride Manager.*
        - ***Client Notification Manager****: it is in charge of receiving messages from the Ride Manager that contain all the information that has to be provided to the customer and to send it to him.*
    - ***Driver Controller****: this part of the system is in charge of elaborating all the messages coming from all the Drivers and sending them to the inner parts of the system and vice versa. It is composed by:*
        - ***Driver Ride Manager****: it is in charge of receiving from all drivers the queue requests, their decisions about accepting/refusing a ride and sends them to the Ride manager.*
        - ***Driver Notification Manager****: it is in charge of receiving messages from the Ride Manager that contains all the request notifications and dispatches them to the single Drivers.*
        - ***Driver Location Manager****: it is in charge of periodically querying each Driver Location GPS in order to check whether a taxi is still in a zone or not, if not it the Ride Manager will be notified.*
    - ***Session Manager****: it is in charge of keeping track of the connected Users and their status. If a user accidentally disconnects from the system and reconnects after a while the Session Manager will recover the previous information.*

- ***Ride Manager**: this part of the system is in charge of assigning a driver to a pending request. and to keep.*
    - *Queue Engine: this part of the system is in charge of keeping track of the taxi queues in the various zones on the city.*
- ***Database Controller:** this part of the system is the one that directly communicates with the Data-base. It is the one that can load/store data on the Database.*

2.4 Deployment view

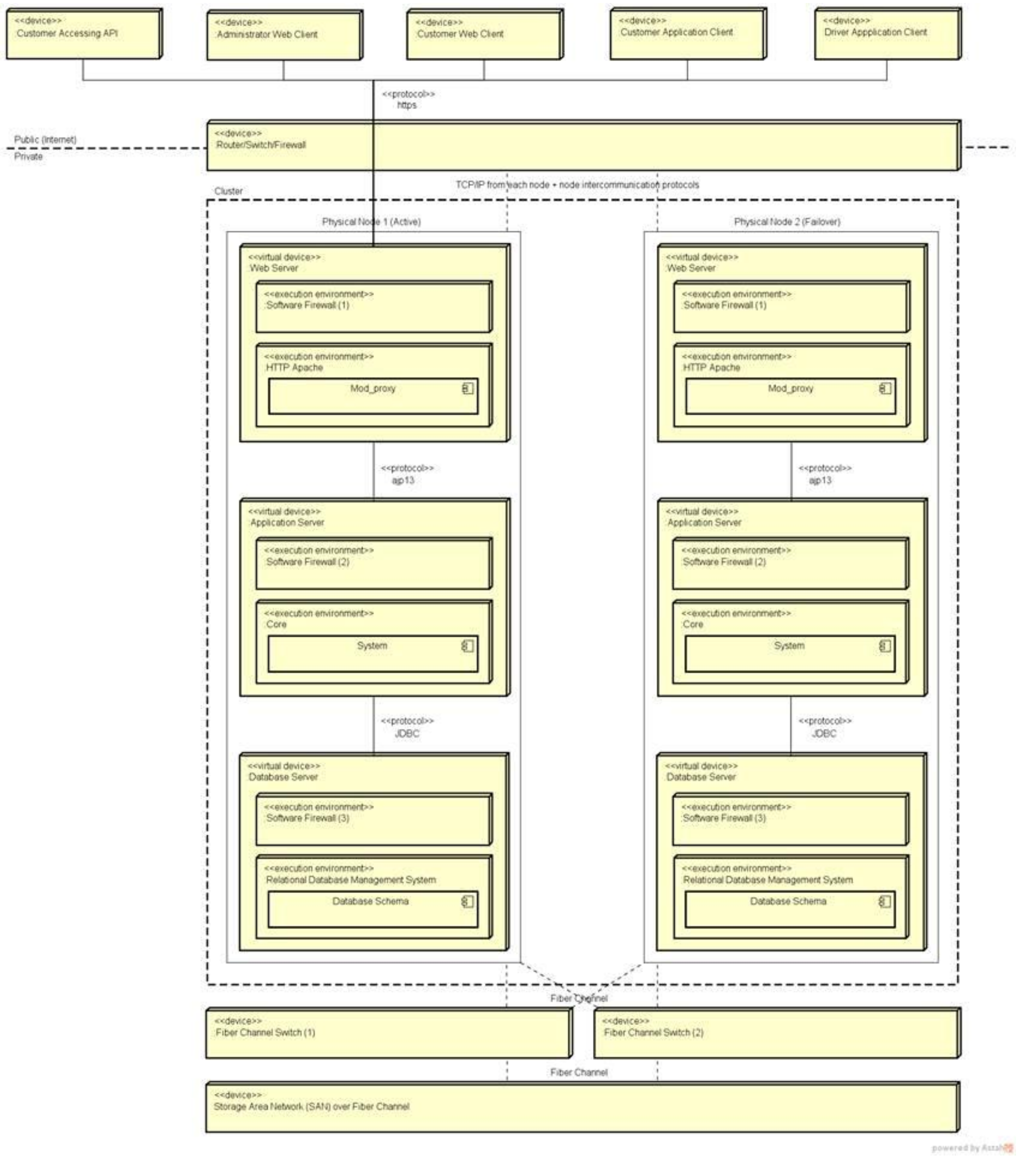


Fig 2.3

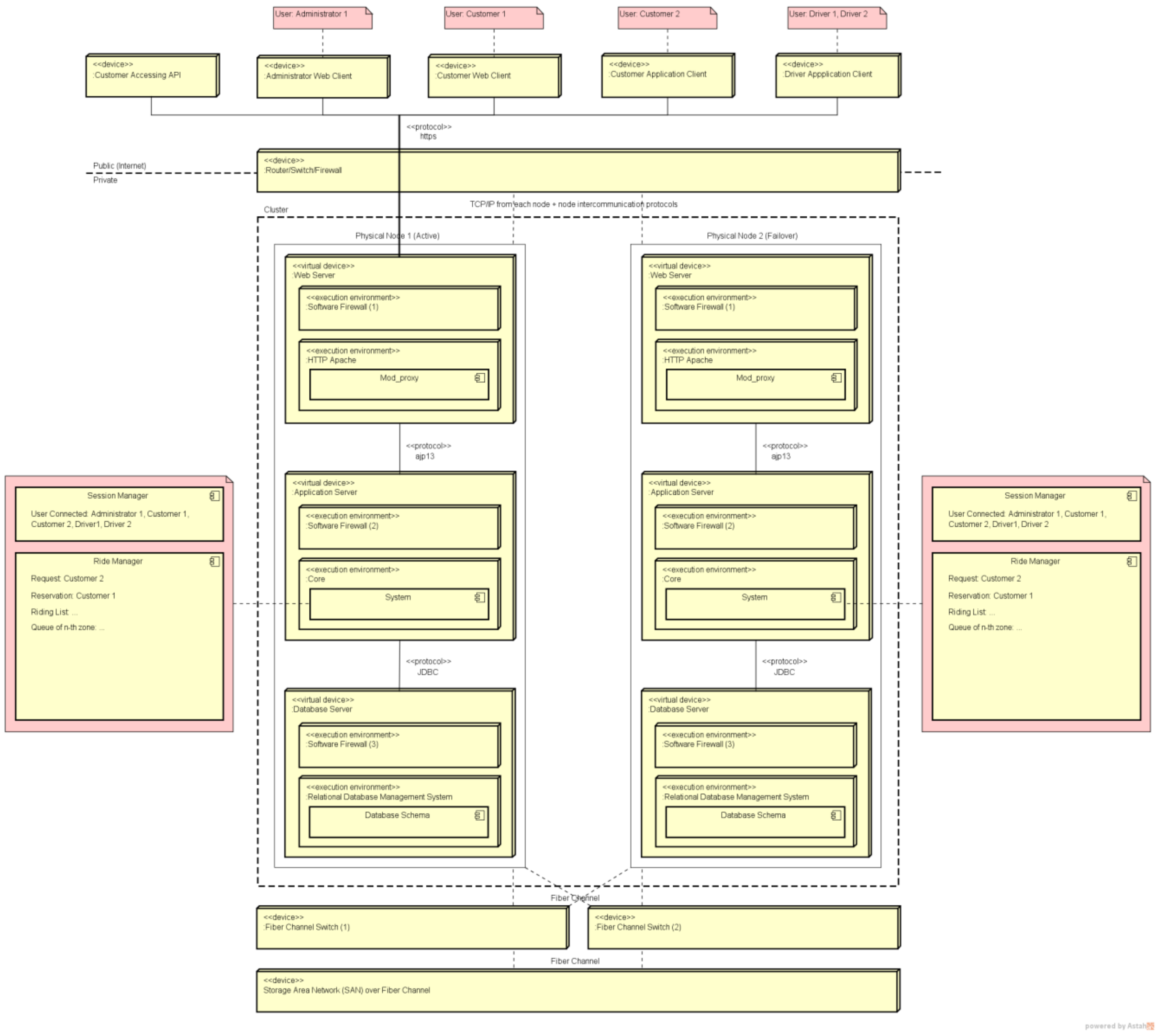
In this component diagram we can see that two physical node that are clustered. Every node runs a bare-metal hyper-visor that let us run different virtual machines on each node.

The nodes are used in this way: the first is the active node and the second the failover one.

If the active node fails, the failover node continues working without downtime, because in the this node there is a shadow copy of the virtual machines running in the active node. We can also add other failover nodes in order to increase redundancy in our system.

Every node shares the secondary storage linked to a SAN(Storage area network) thanks to a Fiber Channel link (we use 2 switches in order to make redundant the path between the SAN and the nodes). The SAN uses also redundant Fiber Channel interfaces and a RAID system to keep the data safe. The two node then can communicate between them and also with the internet by attaching them to a router/switch. Every node has the same virtual machine running (synced by the ethernet link through the router/switch). On each node there are three virtual machines: one with the DMBS, one with the Application Core and the other with the web server that allows to communicate outside permitting the remote app to run correctly and the correct working of the website.

2.5 Runtime view



User: Administrator 1
User: Customer 1
User: Customer 2
User: Driver 1, Driver 2
<<device>> :Customer Accessing API
<<device>> :Administrator Web Client
<<device>> :Customer Web Client
<<device>> :Customer Application Client
<<device>> :Driver Appplication Client
<<protocol>> https
Public (Internet)
Private
<<device>> :Router/Switch/Firewall
TCP/IP from each node + node intercommunication protocols
Cluster
Physical Node 1 (Active)
Physical Node 2 (Failover)
<<virtual device>> :Web Server
<<execution environment>> :Software Firewall (1)
<<execution environment>> :HTTP Apache
Mod_proxy
<<protocol>> ajp13
<<virtual device>> :Application Server
<<execution environment>> :Software Firewall (2)
<<execution environment>> :Core
System
<<protocol>> JDBC
<<virtual device>> :Database Server
<<execution environment>> :Software Firewall (3)
<<execution environment>> :Relational Database Management System
Database Schema
Session Manager
User Connected: Administrator 1, Customer 1, Customer 2, Driver1, Driver 2
Ride Manager
Request: Customer 2
Reservation: Customer 1
Riding List: ...
Queue of n-th zone: ...
Fiber Channel
<<device>> :Fiber Channel Switch (1)
<<device>> :Fiber Channel Switch (2)
Fiber Channel
<<device>> :Storage Area Network (SAN) over Fiber Channel
powered by Astah

2.6 Component interfaces

Here you define the interfaces of your components, that is, which operations they offer to the external world, their meaning, any input and output parameter (name, possible set of values/type)

In this section we try to explain how each component communicate with the others by describing the interfaces they offer and their meaning:

- ***Administrator View**: it communicates with **Administrator controller** with following methods:*

  getDriverList(form): will allow the Administrator to look into the list of drivers given the criteria he inserts.
  GetCustomerList(form): will allow the Administrator to look into the list of customers given the criteria he inserts.
  deleteDriver(driverID)
  deleteCustomer(customerID)
  getUserState(admin ID): will ask to restore the session if the connection fails
  login(customerID, password)
  logout(customerID)

- ***Customer View:** it communicates with **Customer Controller** controller with the following methods:*

  requestTaxi(customer ID, meetingGPSLocation, meetingTime)
  reserveTaxi(customer ID, meetingGPSLocation, meetingTime)
  managePersonalInfo(customerID, data): will forward to the system the data the customer decided to modify in his personal page (ex: profile picture, phone number, address)
  login(customerID, password)
  logout(customerID)
  getUserState(customerID):will ask to restore the session if the connection fails

- ***Driver View:** it communicates with **Driver Controller** with the following methods:*

  queue(driverID, GPSLocation) will allow the driver to queue.
  sendGPSLocation(driverID, GPSLocation) will automatically send GPS location in order to check if the driver left the zone in which he queued or no.
  getInformation(driverID) requires information about the queue so that the driver will be able to see his position in the queue and the other queues around the city.
  decide(boolean) communicate if driver Accept/Refuses a ride.
  feeCustomer(customerID, taxiID) function enabled by the system after a timeout, allow the driver to fee the Customer if he is not present at the meeting
  login(driverID, password)
  logout(driver ID)
  getUserState(driverID): will ask to restore the session if the connection fails

- ***Administrator Controller:** it will communicate with **Administrator View** with the following methods:*

  sendData(data) will send to the administrator the information he requested.
  notifyAdministrator(message) will communicate to administrator the result of his request.

  *It will communicate with **Session Manager** with the following methods:*

loginAdmin(driverID, password)
logout(adminID)
getUserState(adminID): will restore the session if the connection fails

It will also communicate with the ***Database Controller*** *with the following methods:*

forwardQuery(query): will convert the request sent by the administrator into a query and forward it to the system

- ***Customer Controller:*** *it will communicate with the* ***Customer View*** *with the following methods:*

  notifyUser(customerID, data): will update the customer about his requests/reservation

  It will communicate with ***Session Manager*** *with the following methods:*

  getUserState(customerID): will restore the session if the connection fails
  loginUser(customerID, password): will forward the request of login
  logoutUser(customerID)

  It will communicate with ***Ride Manager*** *with the following methods:*

  sendTaxiRequest(customer ID, zone, meetingTime) will forward the customer request to the system after converting GPS location into a zone known to the system.
  sendTaxiReservation(customer ID, zone, meetingTime, date) will forward the customer reservation to the system after converting GPS location into a zone known to the system.

- ***Driver Controller:*** *it will communicate with the* ***Session manager*** *with the following methods:*

  getUserState(driverID): will restore the session if the connection fails
  loginUser(driverID, password): will forward the request of login
  logoutUser(driverID)

  It will communicate with ***Ride Manager*** *with the following methods:*

  sendQueueRequest(driverID, zone) that will forward to it the queue request of the driver after converting the GPS location into the proper zone of the city.
  updateDriverPosition(driverID, parameter) this function is used to manage the refusal of a driver.
  deleteDriverFromQueue(driverID): will tell the system to eliminate a driver from the queue (for example if he left the zone or he logged out) It will communicate with the ***Driver View*** *with sendNotification that will contain all the information that needs to be provided to the driver while periodically sending a getGPSPosition request that will return the actual position of the driver to check if he got out of the zone or not.*
  feeCustomer(customerID, taxiID) report the fact that the driver reported a customer

  It will communicate with ***Driver View*** *with the following methods:*

  notifyUser(driverID, data) will update the driver with the information he needs to have.
  sendQueueInfo(driverID, data) will send the list of the queue around the city.

- ***Session Manager:*** *it communicates with the* ***DB Manager*** *with the following method:*

  getUserInforation(query) in order to retrieve User Credentials

  Will communicate with both ***3 controllers*** *with the following methods:*

notifyController(UserID, message): which will communicate them the result of the login/logout requests deliverUserStatus(UserID, data): that will allow the controllers to retrieve the status of a user once he logged out because the connection failed.

- ***Ride Manager:** it communicates with the **Session Manager** with the following methods:*

  updateUserStatus(UserID, data) to update drivers and customers status (such as if they are in a ride or not and so on).

  *It communicates with **Customer Controller** with the following method:*

  sendRideInformation(customerID, driverID, time) that will contain the estimated time of arrival and the Taxi ID once his request has been accepted.

  *It will communicate with **Driver Controller** with the following method:*

  *sendRideNotification(customerID, meeting location) that will notify the first driver in the queue, retrieved by requesting it to the **Queue Manager**. This is used also for the reservations (see algorithms).*

  *It communicates also with **Database Controller** with the following method:*

  storeInformation(query): will save data into DB
  getInformaton (query) will retrieve data from DB

- ***Database Controller**: just offers:*

  provideInformation(data): to all who can interface to it.

2.7 Selected architectural styles and patterns

1. ***Three Tier Architecture:** as easily visible from Fig 2.1 our main architectural choice is a 3 tier architecture which components have been already described in 2.2. This brings to us the following advantages:*
    - ***Locations:** We divided our system in three different devices that can be placed in different locations if needed.*
    - ***Scalability:** Since each tier can scale horizontally we can augment the number of machines in order to sustain an incrementing amount of load if needed.*
    - ***Availability:** If one of the device goes down it can be replaced with another one so the system will not crash.*
    - ***Security:** as shown in fig 2.1 our system is protected from malicious attacks thanks to the utilization of firewalls that are placed between each tier. This mean that sensible data will be difficult to access from unauthorized users.*
2. ***Client-Server:** The other main architectural choice is to implement a Client-Server system. This brings us the following advantages:*
    - ***Centralisation:** in this architecture there is a centralized control. Servers help in administering the whole set-up. Access rights and resource allocation is not in charge of the Client.*
    - ***Proper Management:** All the files are stored at the same place. In this way, management of files and their recovery becomes easier.*

- ***Back-up:*** *as all the data is stored on server its easy to make a back-up of it. Also, in case of some break-down if data is lost, it can be recovered easily and efficiently*
- ***Accessibility:*** *from various platforms in the network, server can be accessed remotely.*
- ***Memory:*** *as new information is uploaded in database, each device need not have its own storage capacities increased. All the changes are made only in central computer on which server database exists.*

3. ***SOA (Software Oriented Architecture):*** *This architectural styles brings us the following advantages:*
    - ***Indepedency:*** *each component is independent and they communicate by offering interfaces one to the other. This will allow to change the internal behavior of a component without compromising the entire system.*
    - ***API:*** *the API that are exposed by the system can be seen as a separated set of services offered to the external. Also, this style gives us also the possibility to increment the number of the offered services by developing other functionalities.*
    - ***Information flow:*** *this style grants an organized flow between the component of our system, diminishing the number of messages sent and saving cost.*
    - ***Mediator:*** *this is the pattern that we used to plan all our system. Basically there is a central component, indicated as System in the component diagram, that puts in communication the components of the Application Tier. In this way we can increase the cohesion of our system lowering the number of messages sent.*

3 Algorithm Design

In this chapter we are are going to show the fundamental algorithms that will take place during the execution of our system. We decided to represent the principal logical components of our system and to show how every algorithm will involve each one of them.

The following algorithms will be explaned:

- *Customer request a taxi*
- *Driver's Queue*
    - *Drivers accepts ride*
        - *Customer is not present at a ride*
    - *Drivers refuses rife*
- *Customer reserves a taxi*
- *No driver is present in the zone when a request arrives*

3.1 Request a Taxi

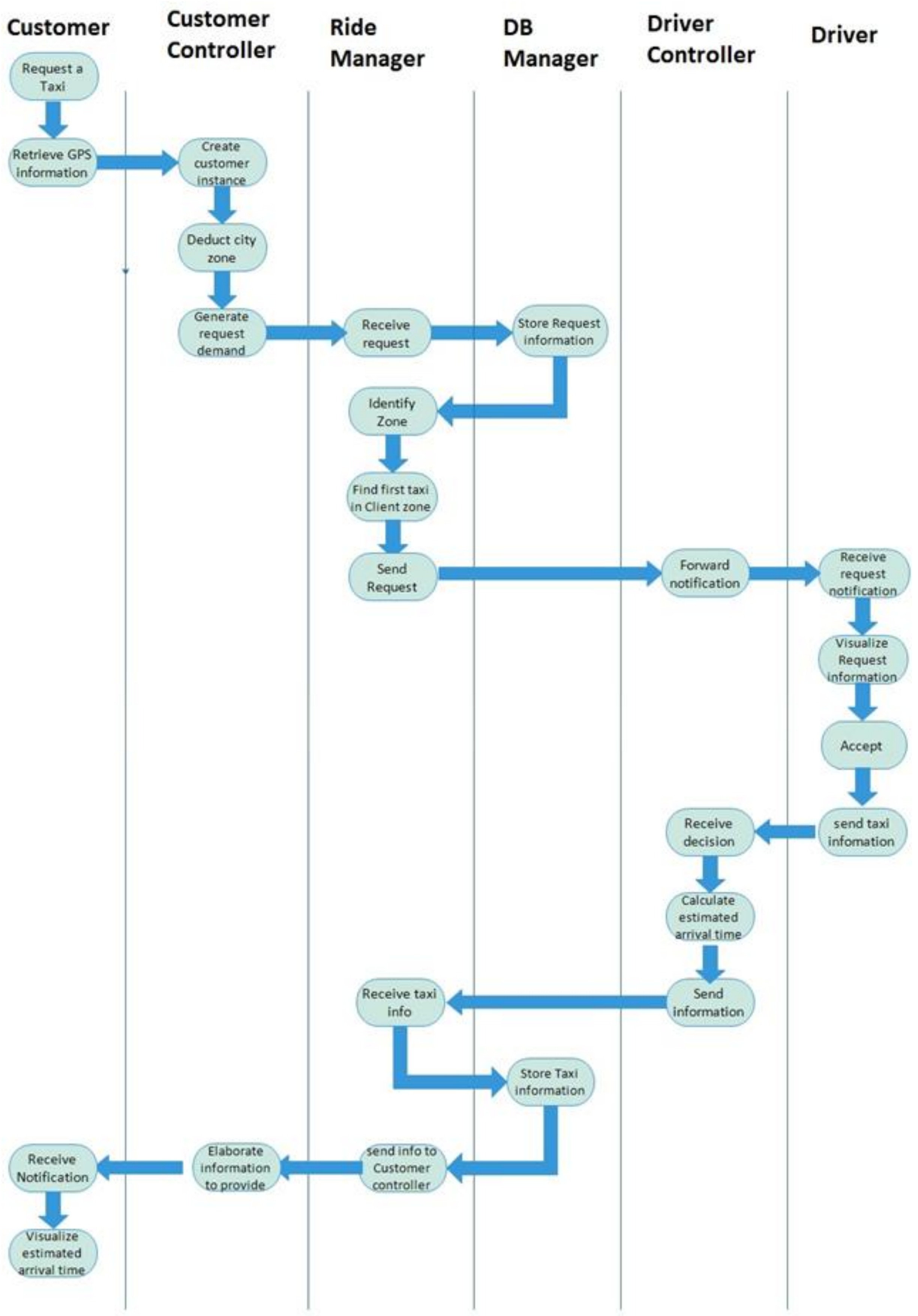


Fig 5.1

Fig 5.1 shows the flow of events that occurs when a customer requests a taxi. For complexity reasons and in order to underline the request we supposed that the customer was already logged in and that the first driver accepts the request.

For completeness, we are now going to explain briefly what happens after the customer gets on the taxi and they arrive at the designated location:

4. *As soon as the customer pays, the driver confirms that the ride ended via mobile app.*
5. *Ride details (Customer, driver, route, cost) are saved into the database.*
6. *Driver Controller allows the driver to queue again.*

As shown in the picture, data are saved in the Database only when there is a confirmation by one of the User (Customer and Driver) that they will participate to the request and when the ride is concluded. The former happens because of security reasons (for example, if a person disappears it could be useful to know what his last location was) while the latter is done mainly because of business motivations.

3.2 Reserve a Taxi

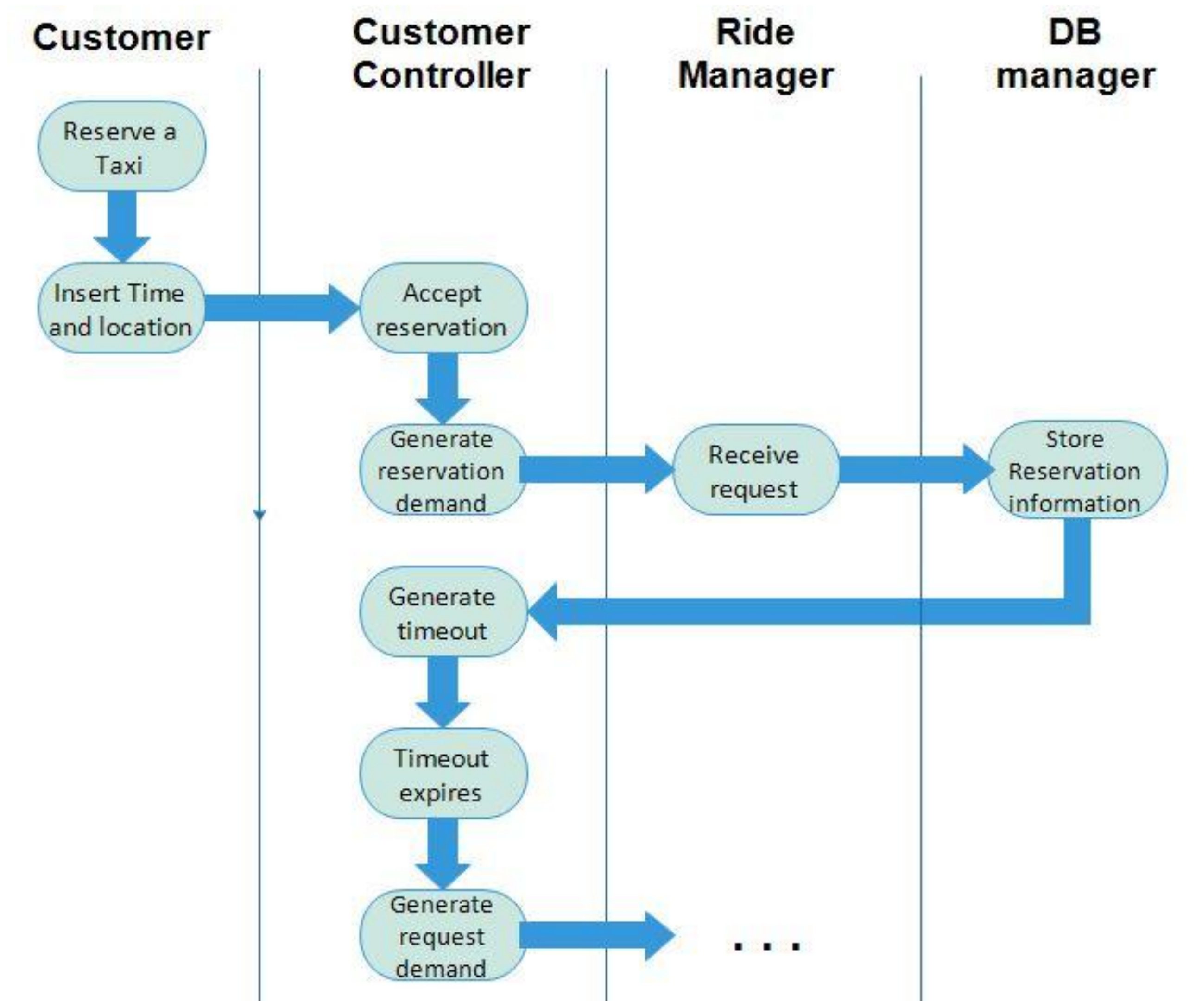


Fig 5.2

Fig 3.1 shows the flow of events that occurs when a customer reserves a taxi.

Basically, the reservation is treated just like a request but it is generated at a specific time before the meeting time. In this way, since we supposed that there are enough taxis to cover all requests, there is no pre-assigned driver. When the Customer controller generates the request, it will communicate to Ride Manager that this request corresponds to the previously made reservations and so the driver who will accept the Ride will be notified that he will have to wait for the customer for 10 minutes.

Please note that the reservation request is stored in the Database.

3.3 Queuing

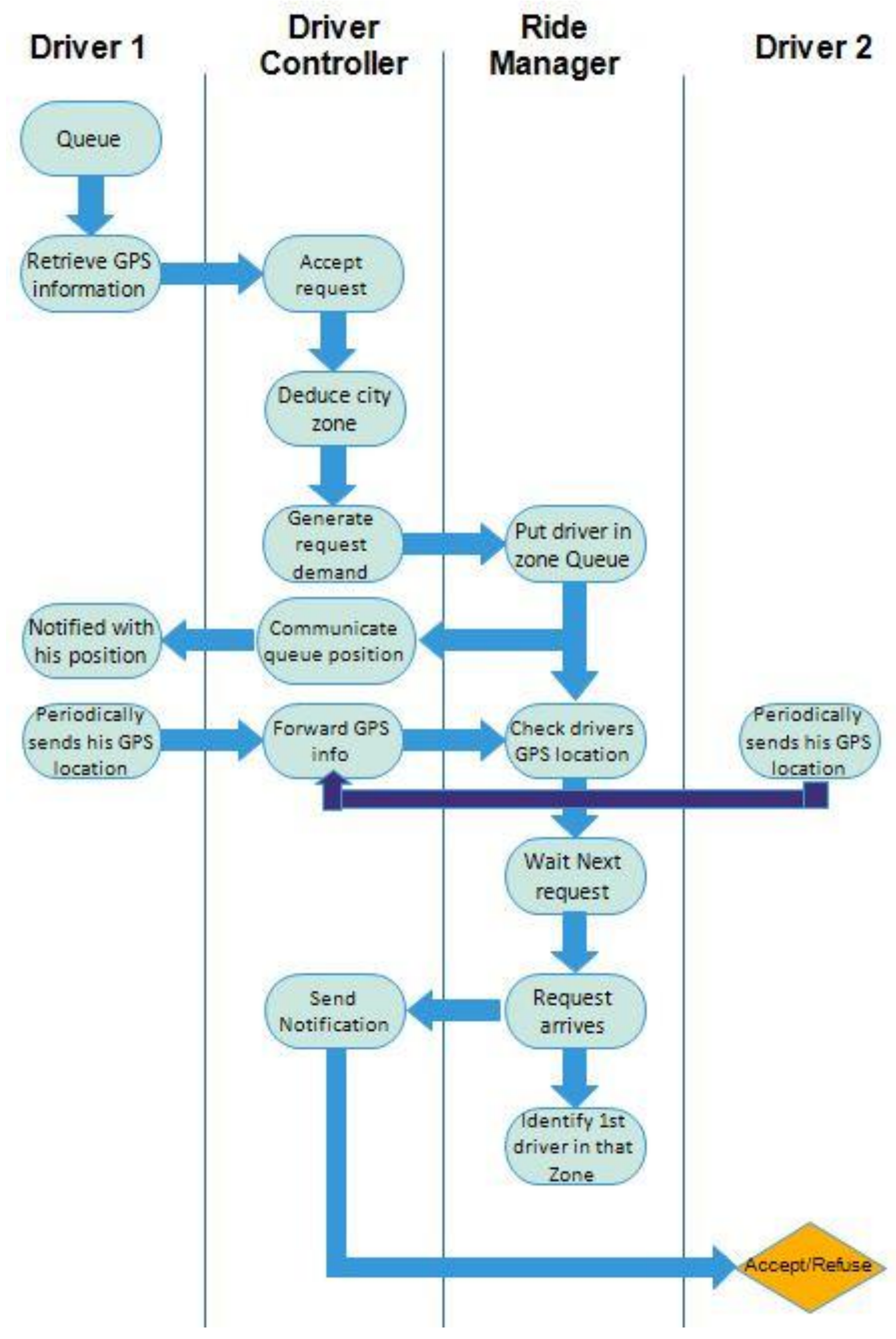


Fig 3.2

Figure 3.2 shows what happens when a driver decides to queue in a certain zone.

In this situation we supposed to have an additional driver, named Driver 2, that is the first driver of that queue. As soon as a request arrives to the Ride manager, the first driver is notified and he can decide to Accept or to Refuse, the explanation of what happens after depends on what Driver 2 decides.

Please note that, since only taxis that are in a certain zone can queue for that specific zone, the position of each driver is updated automatically and periodically. If the Ride Manager finds out that a driver has exited the zone he was queuing in, it will remove it from the queue.

3.3.1 Accept

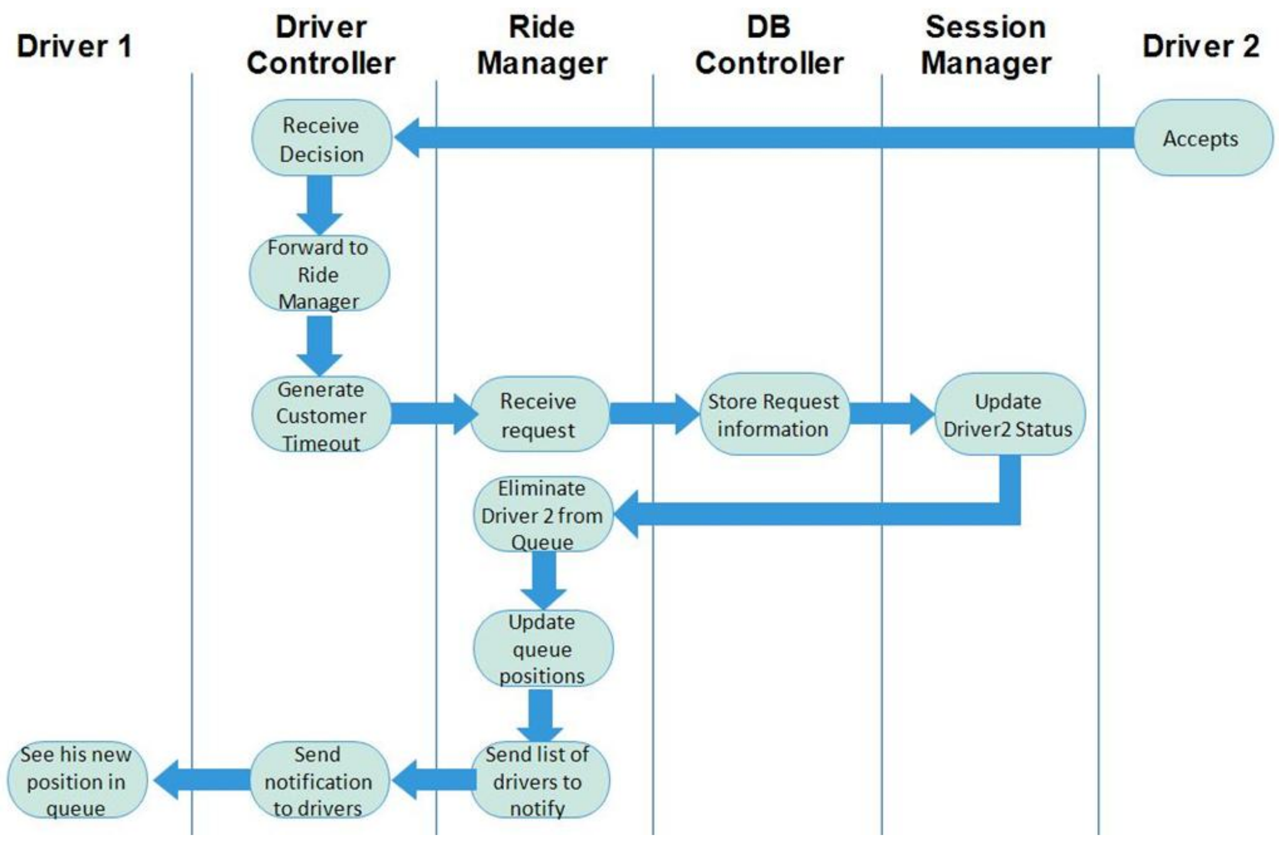


Fig 5.3

Fig 3.3 shows the flow of events that takes place if Driver 2 accepts.

As you can see, as soon as the driver accepts, three main things happen:

- *A timeout is started so that if a customer does not arrive to the location point the driver can fee him*
- *his status is updated so that he can not queue for a ride until he finishes the one he is assigned to.*
- *Queue's positions are updated and every driver in that queue, for example Driver 1, receives a notification that communicate his new position in the queue.*

3.3.1.1 Customer does not arrive in time

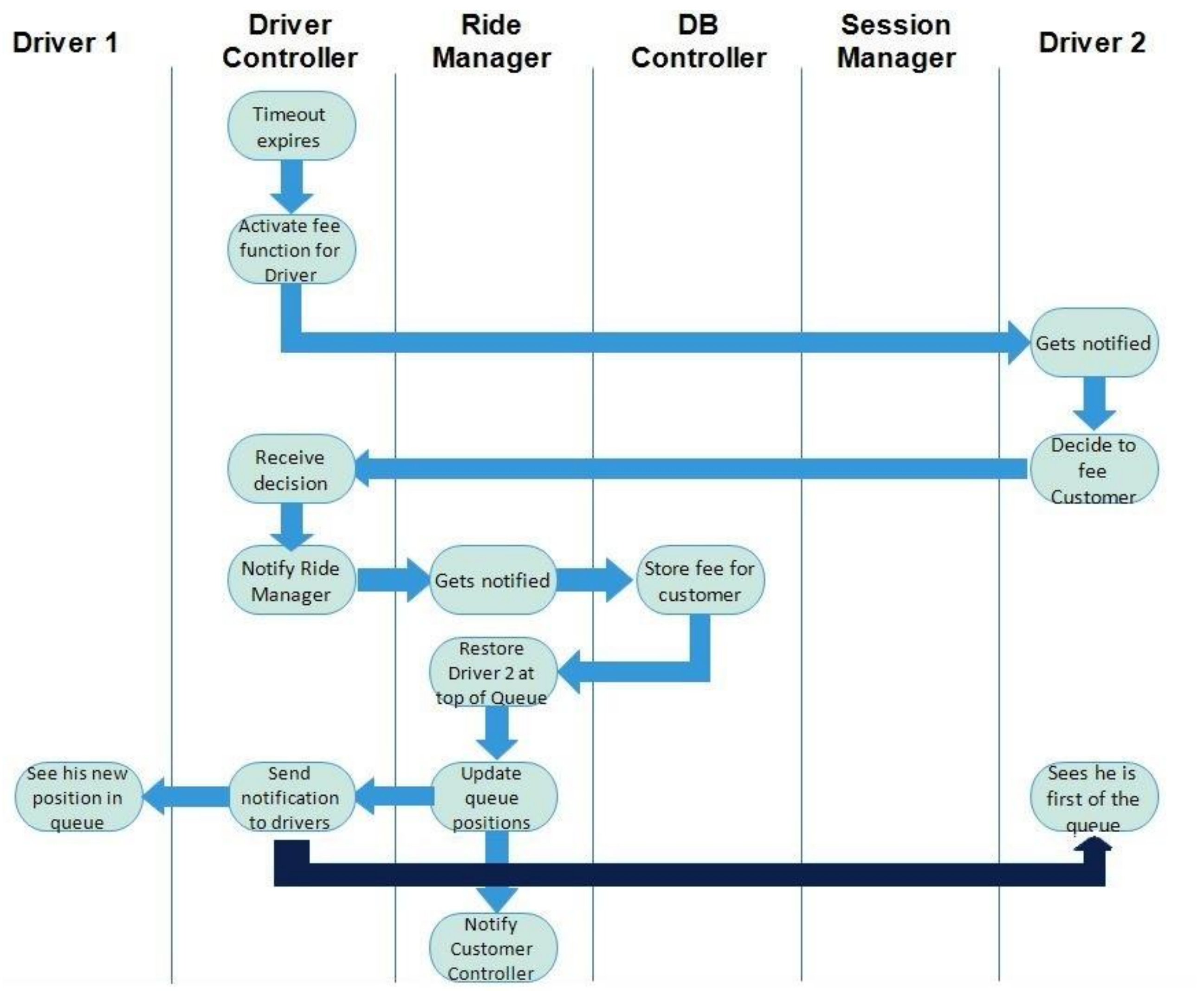


Fig 5.4

Fig 5.4 shows the flow of events that takes place if Driver 2 accepts but the customer does not arrive.

As you can see, as soon as the timeout expires, three main things happen:

- *Driver is notified that he can now apply a fee to the customer*
- *If he does it he come back in the queue again at the first positions*
- *The position of the other drivers is shifted back by 1*

3.3.2 Refuse

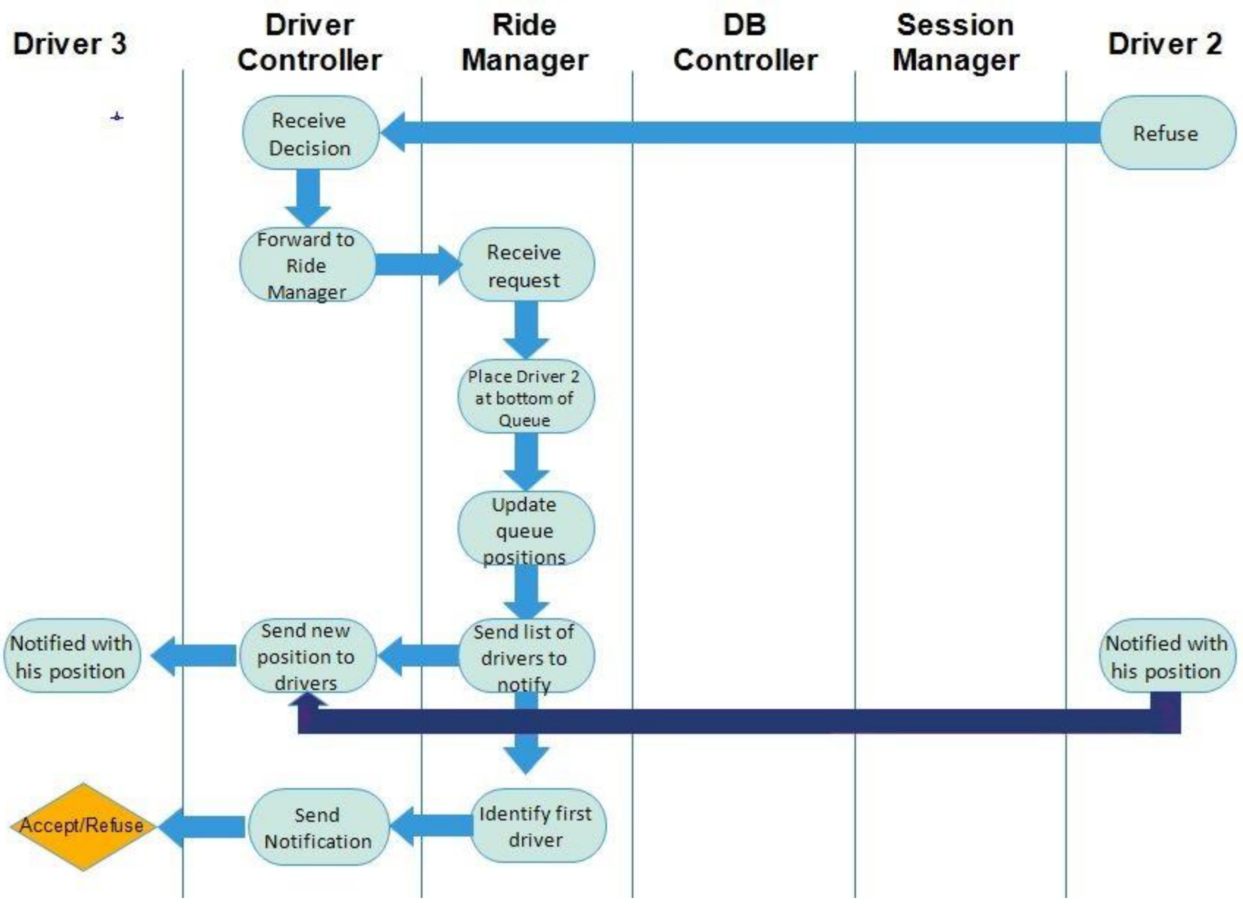


Fig 5.5

Fig 5.5 shows the flow of events that takes place if Driver 2 refuses.

As you can see, as soon as Driver 2 refuses, three things happen:

- *Driver 2 is sent to the bottom of the queue*
- *Queue's positions are updated and drivers notified*
- *Driver 3, who now is the first one in the queue receives the notification for the same request Driver 2 refused.*

3.4 Retrieving a driver outside the queue

When a request rises into a zone with no driver the following thing happen:

1. *Ride Manager identifies the first driver in one of the surroundings zones, this can be done for example giving a number as a name for the zones and by sorting them in ascending order.*
2. *First Driver is notified with this request, he is also notified that this request does not come from his area.*
3. *He can Accept or refuse, if he refuses there will be no penalty for him.*
4. *If Driver refuses the systems asks for the first driver of another area and so on*
5. *If no one of there drivers accepts the search expands to the driver in the second position of the queue of the surrounding areas.*
6. *This system keeps going until a driver accepts or until a driver queue for the zone in which the request started.*

4. User Interface Design

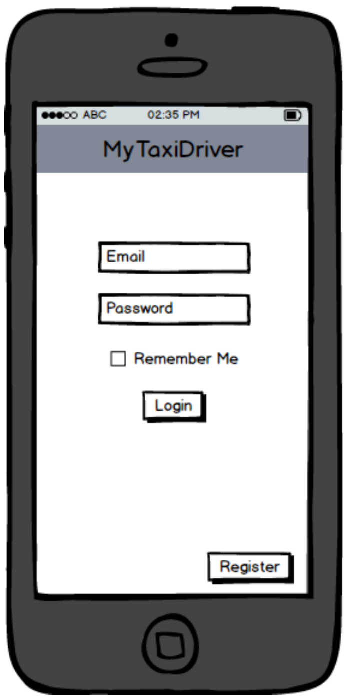
In this chapter we are going to show some mockups of the user interfaces. These will not look exaclty like the final GUI but they can be useful to give an idea on how our system will look like.

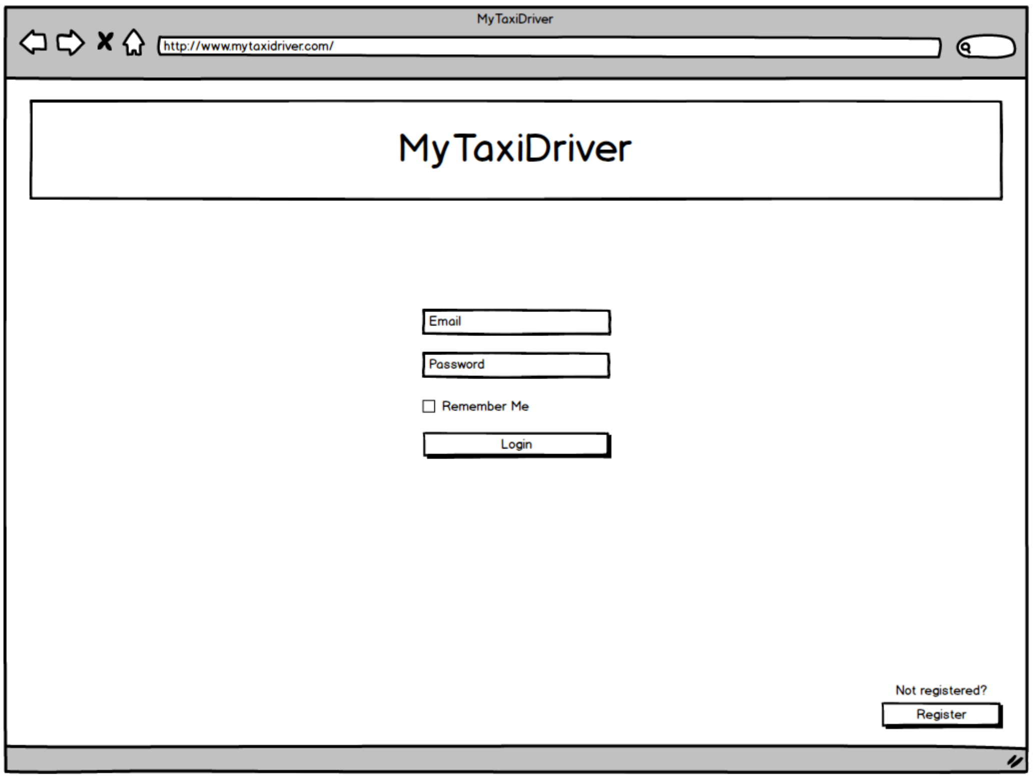
4.1 Customer GUI

In this section we will give a preview of the customer interface:

4.1.1 Login

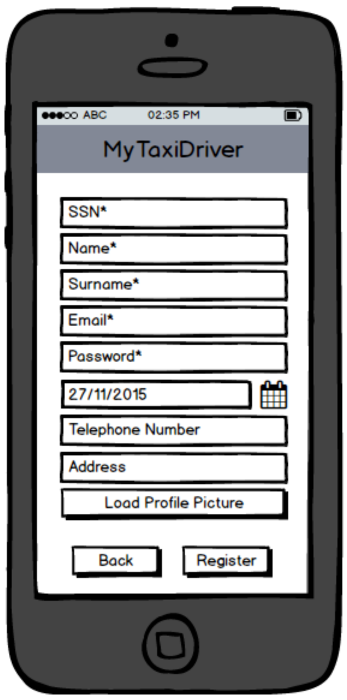
This is how the login page will look like, both on mobile app and web browser:

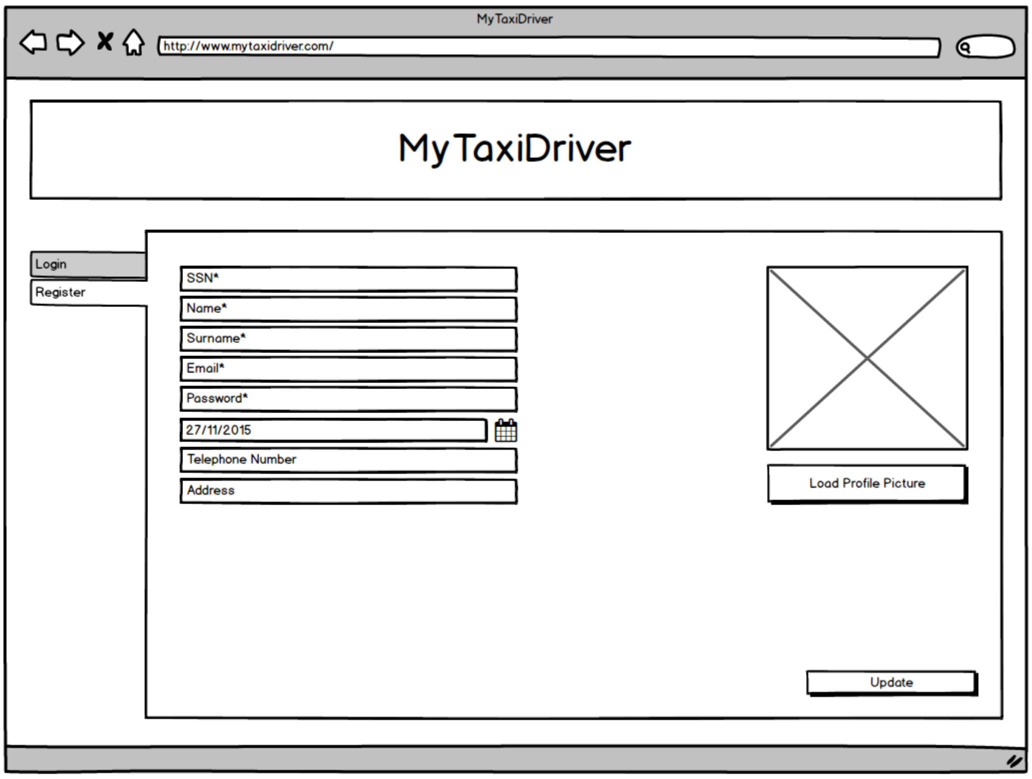




4.1.2 Register

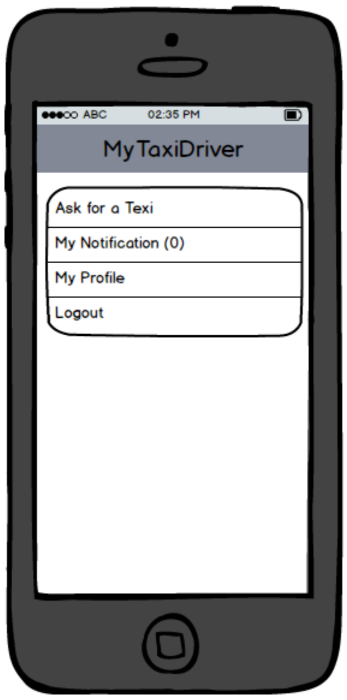
This is how the register page will look like, both on mobile app and web browser:





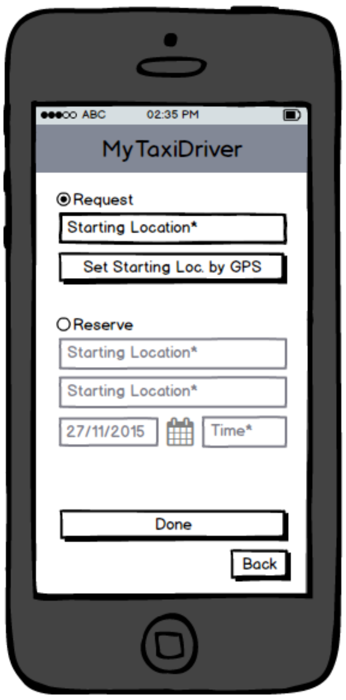
4.1.3 Main page

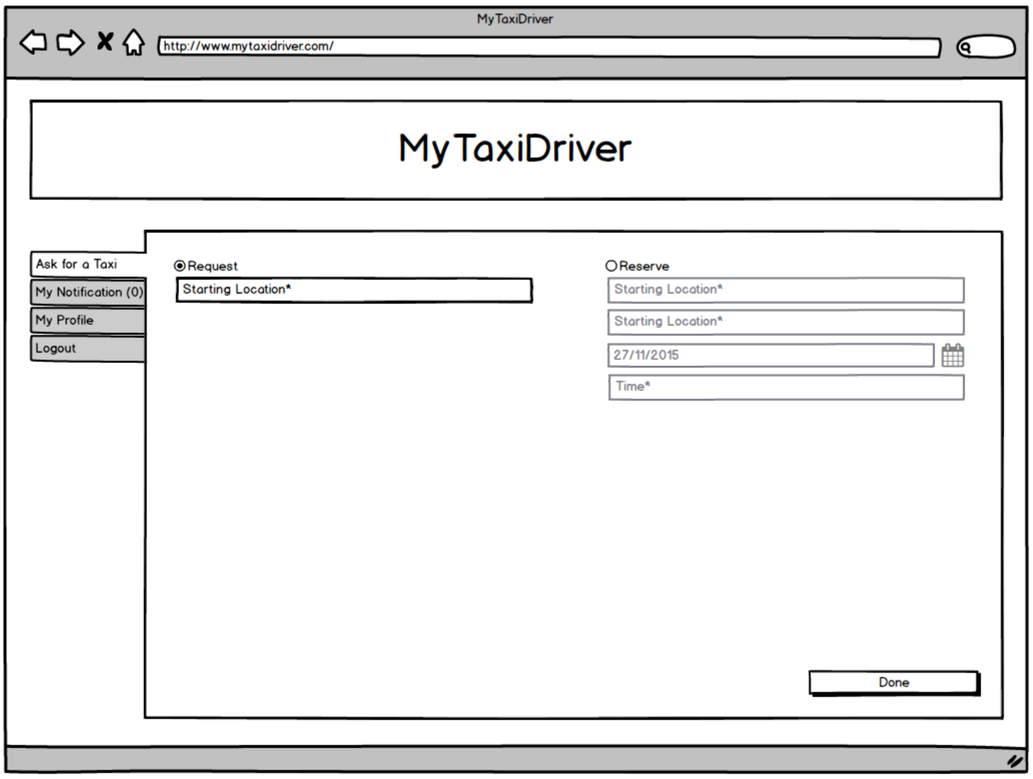
This is how the main page will look like on mobile app :



4.1.4 Ask For a Taxi

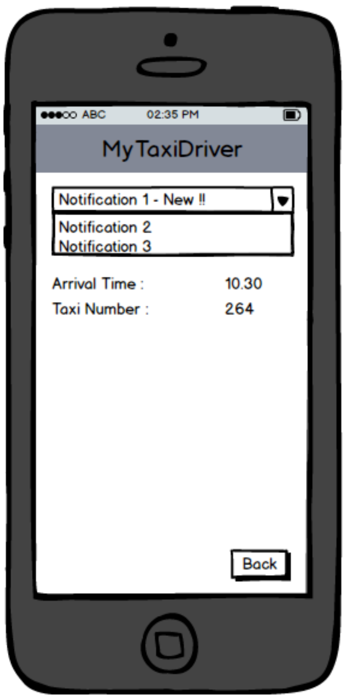
This is how the page for requesting/reserving a taxi will look like, and mobile app and on web browser:





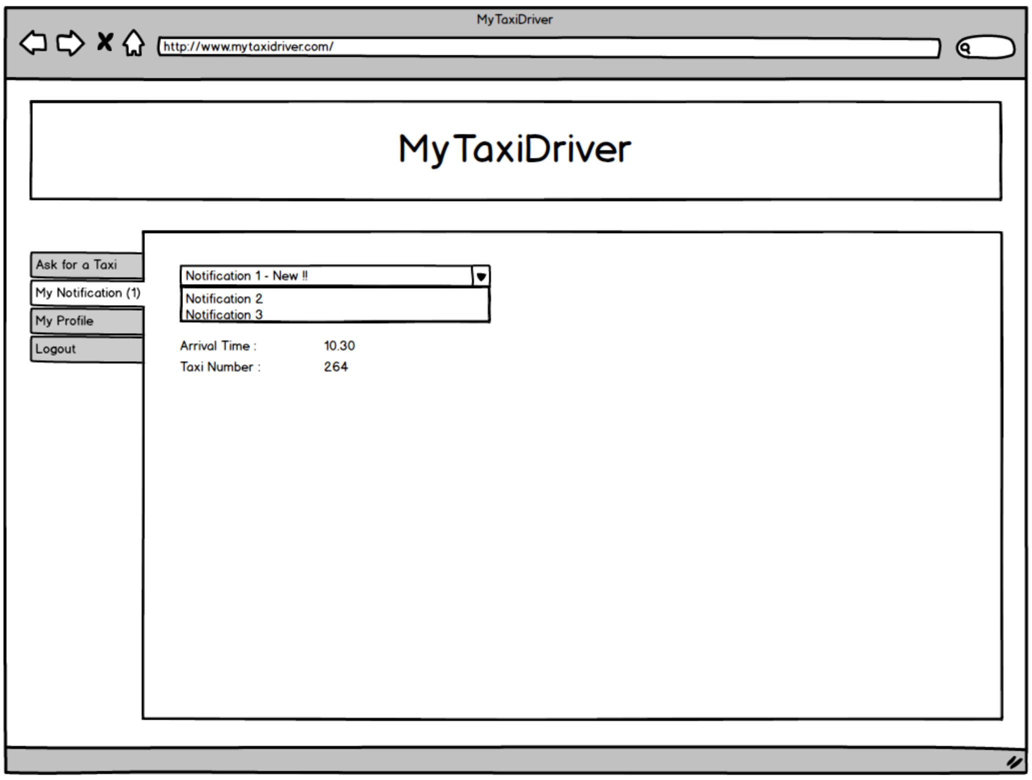
4.1.5 Notification

This is how a notification page will look like, both on mobile app both on web browser:



Arrival Time : 10.30

Taxi Number : 264

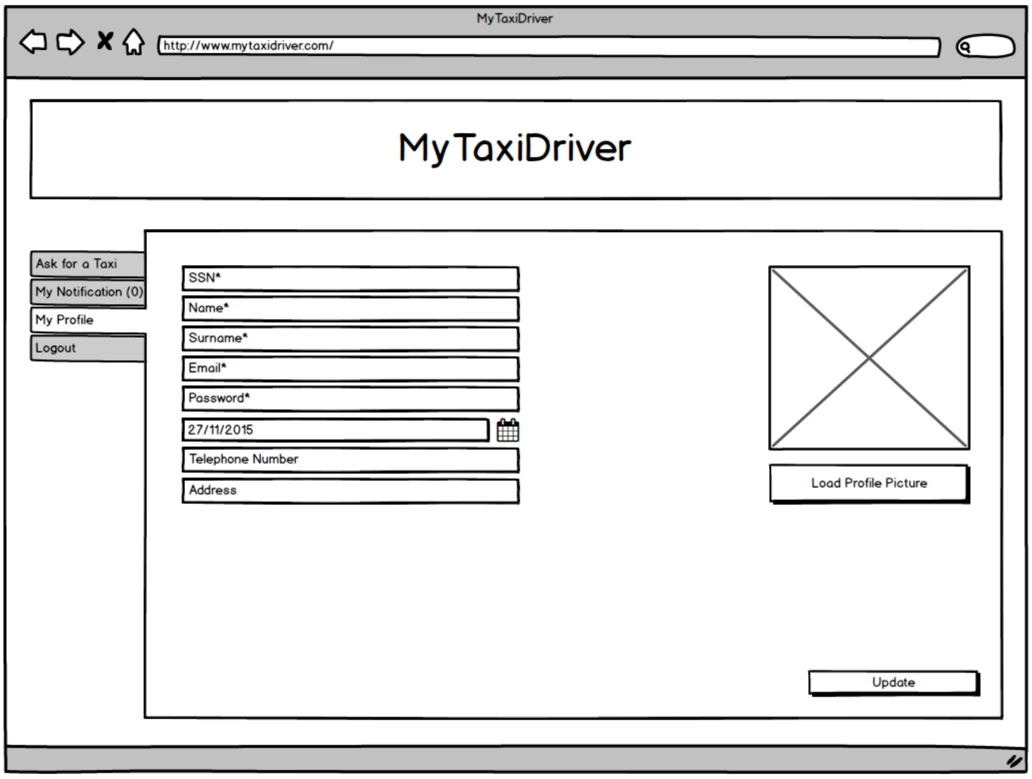


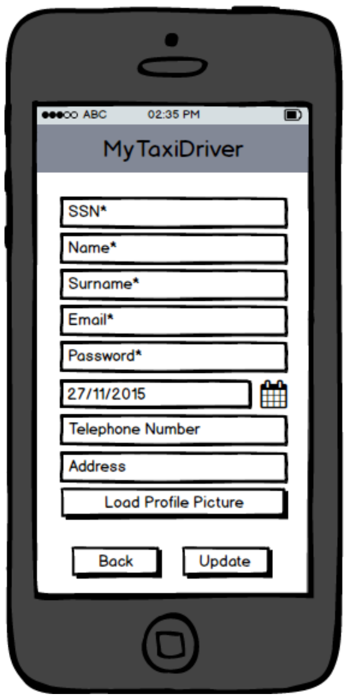
Arrival Time : 10.30

Taxi Number : 264

4.1.6 Profile

This is how the profile page will look like, both on mobile app both on web browser:



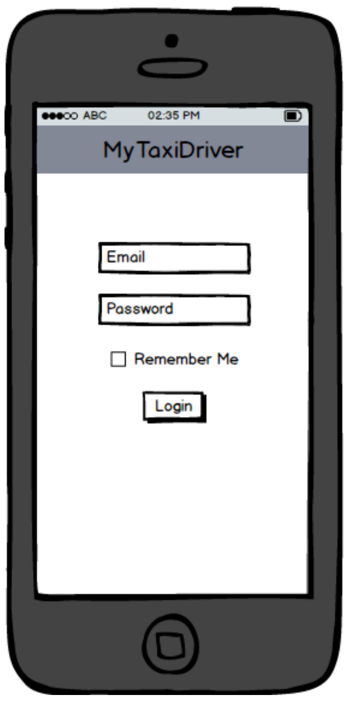


4.2 Driver GUI

In this section we will give a preview of the driver interface, notice that they can only access through mobile applica-tion:

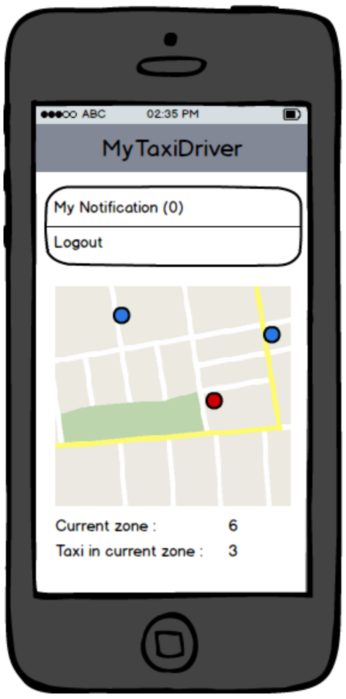
4.2.1 Login

This is how the login page will look like:



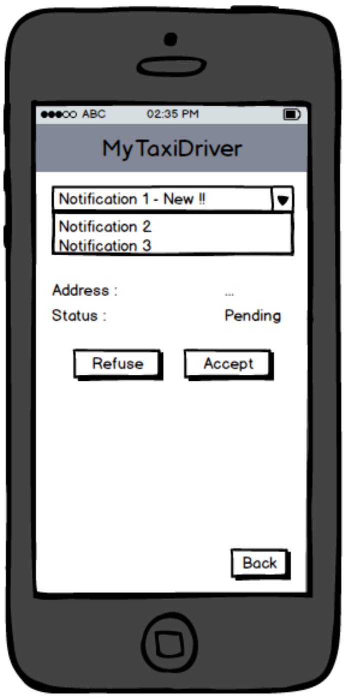
4.2.2 Main page

This is how the main page will look like:



4.2.3 Notification

This is how the a notification will look like:

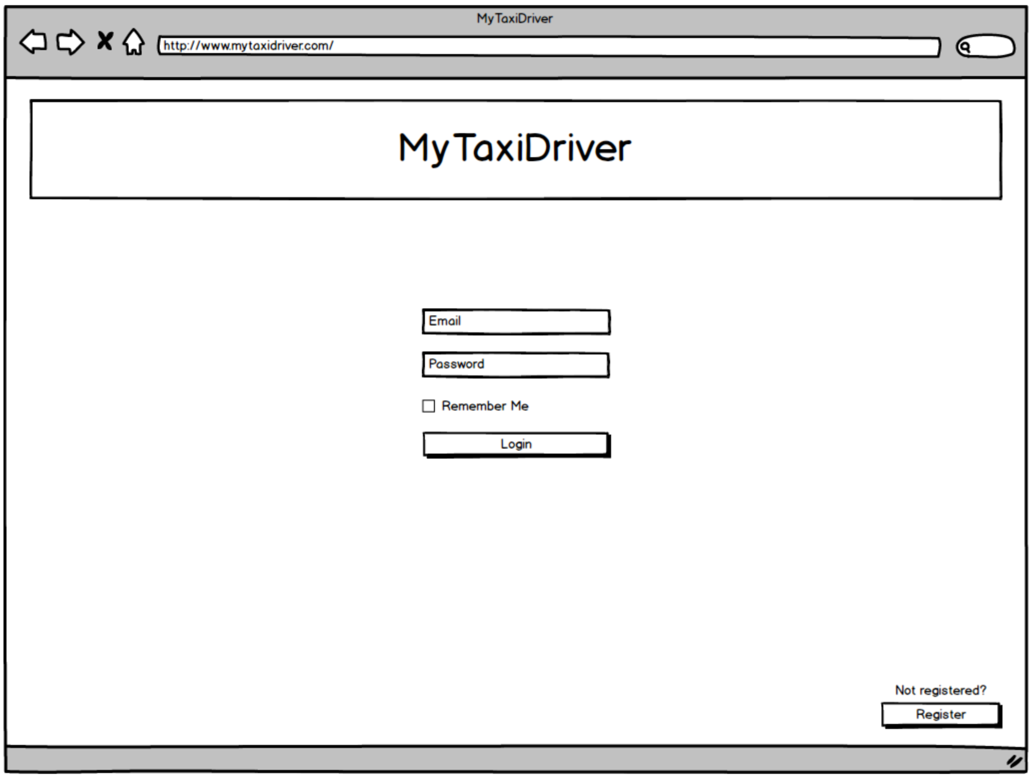


4.3 Administrator GUI

In this section we will give a preview of the driver interface, notice that he can only access through web broswer:

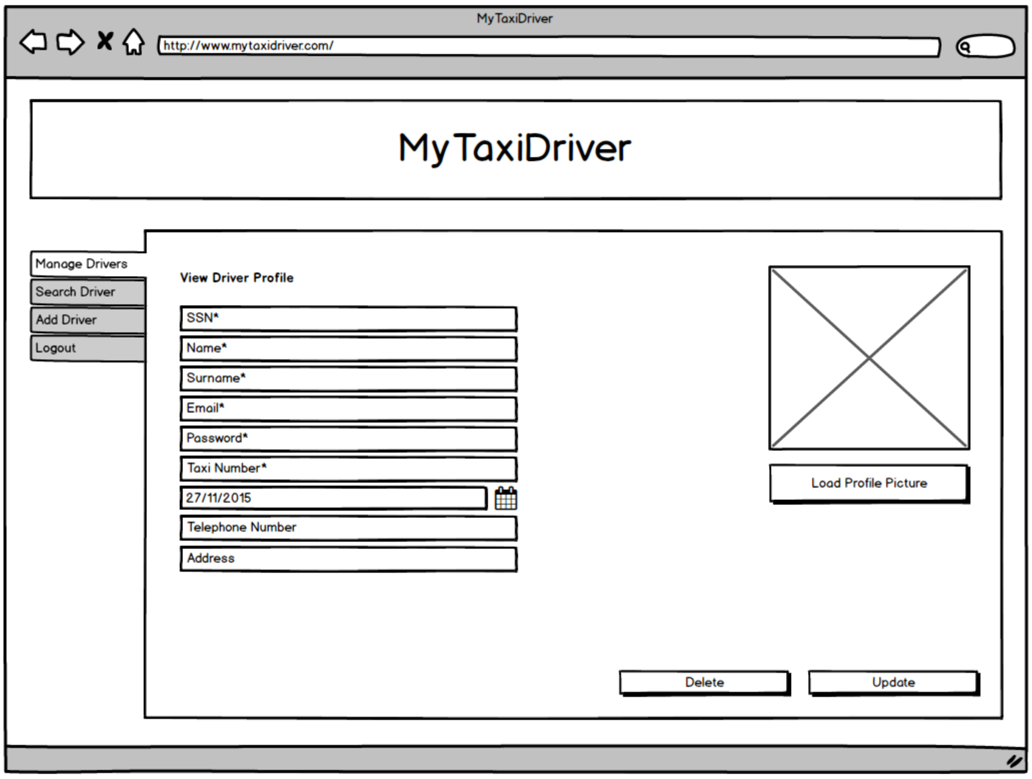
4.3.1 Login

This is what the administrator will see when he tries to log in, notice that is the same page of the customer.



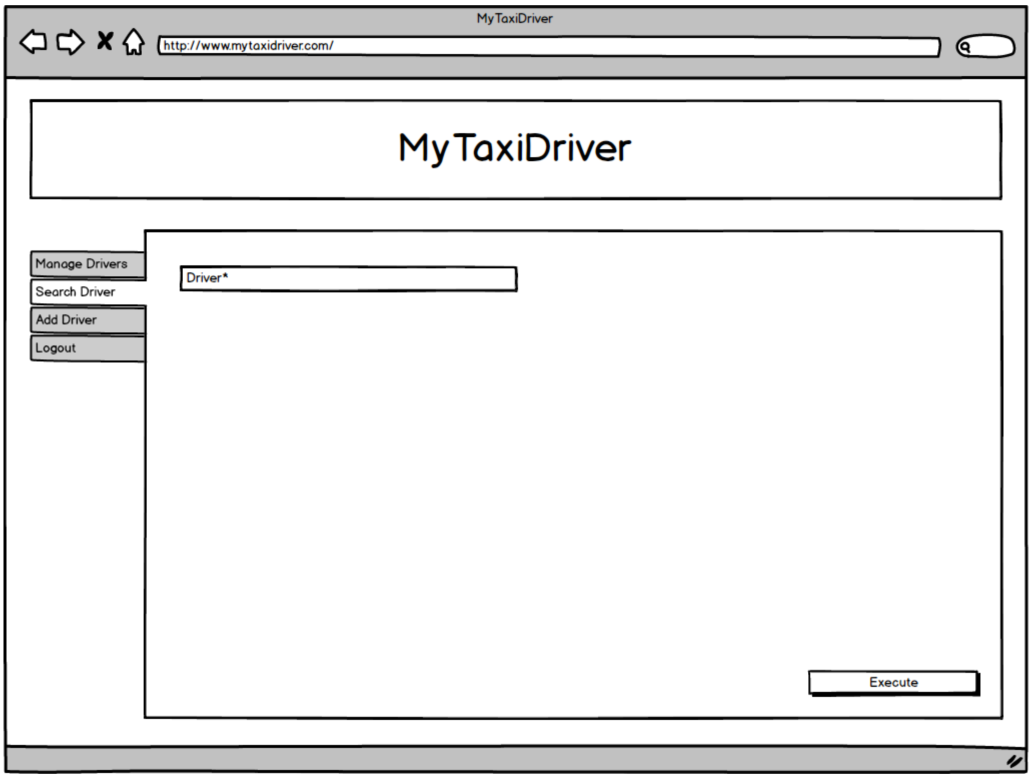
4.3.2 View Driver

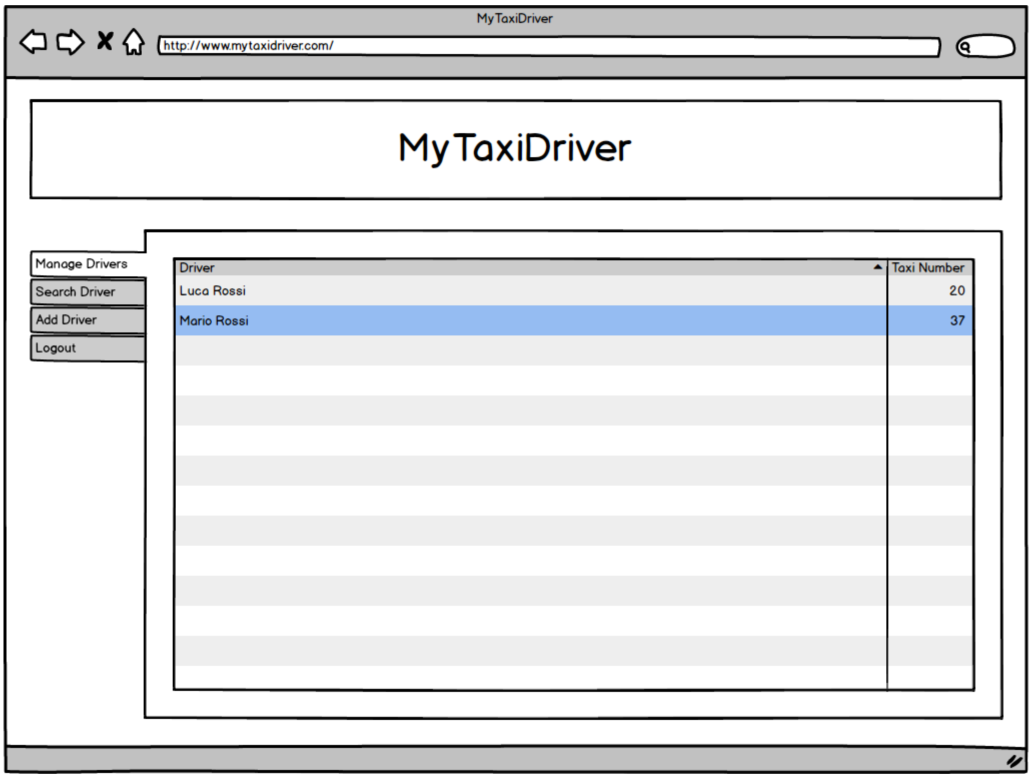
This is what the administrator will see when looking for a driver:



4.3.3 Search Driver

This is what the administrator will see when looking for a driver:

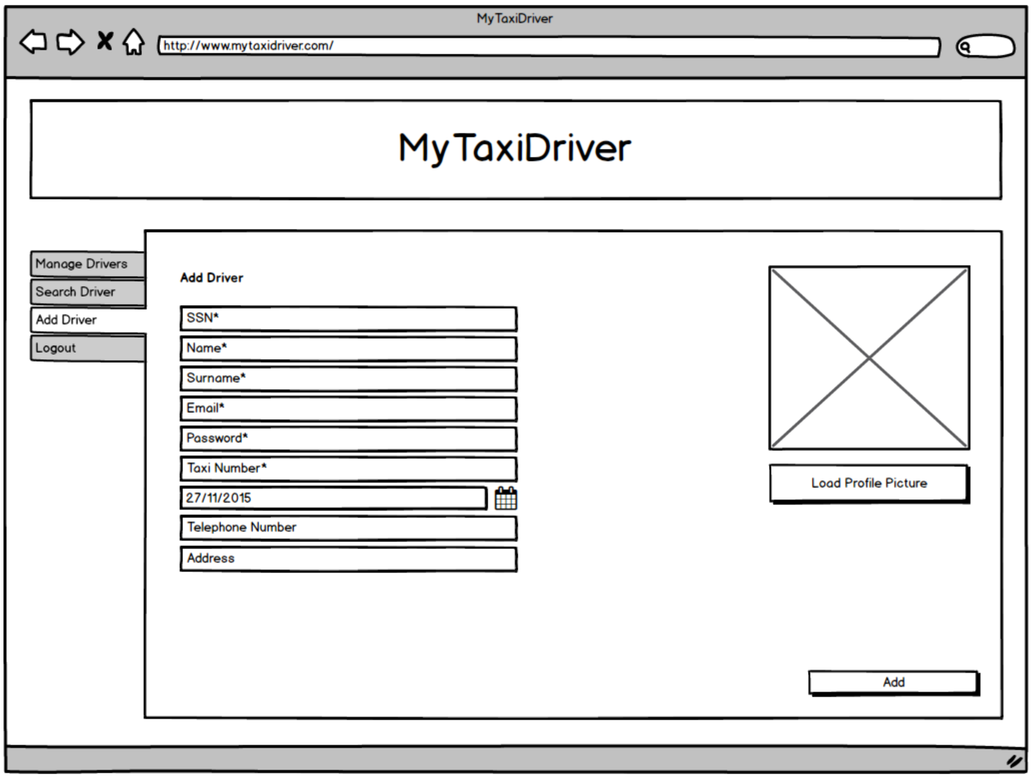




Driver	Taxi Number
Luca Rossi	20
Mario Rossi	37

4.3.4 Add Driver

This is what the administrator will see when adding a driver:



5 Requirements Traceability

In this last session we will describe how the requirements we have expressed in the RASD are traced and respected in the design element we previously identified.

In order to do so, we are going to provide the list of the main requirement, both functional and non functional, and we will explain for each of them how they are satisfied.

5.1 Functional Requirements

- ***Login and Sign up:** for both driver and customer we required to have a login (also for Administrator) and a Sign up Function . This has been provided, as the GUI mockups show, and the component who is in charge of this is the **Session Manager.** It must assure that the rules we have described for these functions are respected (i.e if credentials are correct and so on…) by directly interfacing with the **DB Manager** who retrieves data rom the Database.*
- ***Customer functionalities:** such as what we defined in the RASD as "Personal Page", "Request a Taxi" , "Reserve a Taxi" and the notifications. Those functions are provided by the **Web Layer** that allows the communication between the customer and the system. It creates a message that is sent to the **Customer Controller:** each customer request and every message that the system wants to deliver to the customer pass through it, which is connected to all the logged Customer and that checks and manage those messages.*
- ***Driver functionalities:** such as what we defined in the RASD as "Queue", "Accept/Refuse", "Check Queues", "Fee Customer" and the notifications. Everything goes exactly as for the Customer functionalities except for the fact that every logged driver is now connected to the **Driver Controller** that has the same responsibilities of Customer Controller but regarding the drivers.*
- ***Queues:** in the RASD we specifically said that only the first driver of a zone can receive a request and that drivers can only queue in a zone they are in. This is managed by the **Queue Engine** that is in charge of keeping track of the various queue of the drivers. This component is a sub-component of the **Ride Manager** that, together with the queue engine is able to assign the right driver to the right request. **The Driver Location GPS** is the one that assure that all the rules related to Queue and location (i.e "A driver can queue only in the zone he is in" and "if a driver leaves a zone it will be removed from the queue") by communicating periodically driver's position to the **Customer Controller** that will pack all these data coming from all the taxi and will forward them to the **Queue Manager** for a check.*

5.2 Non functional requirements

- ***Availability:** The parallel structure of our system will assure that it will be available for a satisfactory amount of time. Putting our machines in a **cluster**, in fact, will allow to lower the mean time between failure as much as needed.*
  Each node can be downtime for 1 hour/month maximum (12 hour/year each).

$$A\ of\ each\ node = \frac{8760 - 12}{8760} = \frac{8748}{8760} = 0.99863$$
$$A\ total\ (parallel) = 1 - (1 - 0.99863)(1 - 0.99863) = 0.999998$$

Only 5 minutes/year of downtime considering only hardware failure!!!

- ***Security:*** *In the triple tier architecture of our structure each section is separated from the others through* ***firewalls****, this will help decreasing the risk of malicious attempt of accessing sensible data.*
- ***Robustness:*** *We want our system not to crush if one of the component fails. This is achieved through the use of a cluster. Every component of a physical device is replicated into others identical devices and all of them are connecter to the same, shared, replicated storage. This way, if a device fails the others will immediately take care of its load so that the system can keep functioning.*
- ***Accesses and User Interfaces:*** *according to the RASD, every user can access to the system using a specific page according to what kind of user they are. The login system, including the checking of the credentials, is managed by the* ***Session Manager*** *which receives. User interfaces are provided by the* ***User Side*** *previously descrived.*
- ***API:*** *as already mentioned before, thanks to the SOA style the system will be able to offer APIs to external clients.*

6 References

Within this document we will refer many times to the RASD so, since the Design Document is a further step into the developing of a system, it is suggested to read the RASD in order to completely understand this document Document.

We also referred to the IEEE standard for Design Document for the structure of this document.

For redacting and writing this document we spent more or less 35 hours per person