

SOFTWARE ENGINEERING 2 PROJECT

Requirement Analysis and Specification Document

**CLup - Customer Line-up**

**Version 1**

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7. **Introduction**
   1. **Purpose**

This document is the *Requirements Analysis and Specification Document (RASD)* of the *CLup – Customers line-up* application. It contains the main goals, the domain, and its representation through some models, in order to describe the systems in terms of functional and non-functional requirements. It also analyzes the main needs of the customers and the scenario with the most typical uses cases.

The document represents the baseline for project planning and estimation of costs and size, for software evaluation and for change controls. It is addressed both to the project managers and the developers, in order to better understand the whole application and how to develop it.

* + 1. **Description of the given problem**

CLup is an application with two main purposes: the first one is to allow store managers to regulate the influx of people in the building, and the second one is to save people from having to line up and stand outside of stores for a huge amount of time.

The application allows the user to see a map of the city on which the nearest stores are highlighted with the opening hours and the current time that approximately must be waited to enter. After choosing a store, the user has two options to enter it:

* Line up retrieving a number from his home and waiting until the number is called to approach the store. If the user selects an unavailable store, where the current queue is longer than two hours of waiting, the application suggests him the nearest store with a shorter waiting time or which is currently available.
* Book a visit to the supermarket, guaranteeing that the client will be able to enter the store in a certain time. In this case, the system will send a notification to the client a few hours before the booking as a remainder and in order to have a confirmation of the booking. If the user wants to select an unavailable slot of time, the application suggests him the nearest store where the chosen slot is still available.

In both cases the system will periodically calculate the distance of the customer from the store to send him a notification when it is time to get close to the store. In order to making this time estimation as exact as possible, the user can also indicate the means of transportation (on foot, car, public transport) through which he will go to the supermarket.

Moreover, the user must indicate if he will come alone or with another person and the amount of time he will stay in the store (15, 30 or 45 minutes). Alternatively, he can point out which categories of items he needs to buy (fruit and vegetables, meat, pasta and rice...) and the system will calculate itself an estimated permanence time. In the end, if a user already visited the same store many times, the system can automatically define this time through the statistics of his previous visits.

When the booking has been completed, the user receives a QR Code which identify its reservation (to manage his access to the store and to retrieve information about the amount of time he/she stayed in the supermarket and how often) and which must be scanned to enter and leave the store. It enables to check how many people are in each store all the time.

For the people who do not have access to the required technology, the stores hand out tickets also at the entrance. Even in this case the tickets present a QR Code that must be scanned in the same way, and the user must indicate how much time he/she will stay in the store.

* + 1. **Goals**

|  |  |
| --- | --- |
| NAME | BRIEF DESCRIPTION |
| G1.1 | Allows OnlineUser to line up |
| G1.2 | Allows OnlineUser to book a slot of time |
| G2 | Allows OnlineUser to see real-time the waiting time to enter for each store |
| G3 | Allows OnlineUser to check real-time the waiting time for his booking |
| G4 | OnlineUser can select the means of transportation |
| G5.1 | OnlineUser can point out the duration of his visit by choosing a defined period of time |
| G5.2 | OnlineUser can point out the duration of his visit by selecting which categories of items he will buy |
| G5.3 | OnlineUser can point out the duration of his visit by statistics on his previous visits |
| G6 | OnlineUser can delete a booking |
| G7 | OnlineUser can receive suggestions about alternative stores when the chosen one is not available |
| G8 | Information is retrieved to build statistics about waiting time, duration of visits and most busy times of the day |
| G9 | OnlineUser is notified when he should start coming closer to the supermarket |

* 1. **Scope**

In this section are enumerated the phenomena related to the *machine* – which is the software – and to the *world* – which is the real environment affected by the machine. A phenomenon can be shared if it is controlled by the world and observed by the machine or vice versa.

* + 1. **World phenomena**

|  |  |
| --- | --- |
| NAME | BRIEF DESCRIPTION |
| WP1 | User needs to go grocery shopping |
| WP2 | OnlineUser takes a smartphone with himself |
| WP3.1 | OnlineUser goes to the store with a booking |
| WP3.2 | PhysicalUser goes to the store without a booking |
| WP4 | Each store has a certain capacity to contain people |
| WP5 | Costumer line up out of the store |

* + 1. **Machine Phenomena**

|  |  |
| --- | --- |
| NAME | BRIEF DESCRIPTION |
| MP1 | Generation of QR Code |
| MP2 | Calculation of the estimated time to arrive to the chosen supermarket |
| MP3 | Computation of the open and currently available stores |
| MP4.1 | Esteem of the residence time inside the store for a usual OnlineUser |
| MP4.2 | Esteem of the residence time inside the store through the analysis of the type of items that the OnlineUser needs to buy |
| MP5 | Encryption of sensitive data |

* + 1. **Shared phenomena**

|  |  |
| --- | --- |
| NAME | BRIEF DESCRIPTION |
| SP1 | User shows the QR Code entering the supermarket |
| SP2 | User shows the QR Code leaving the supermarket |
| SP3 | The system sends a notification that invite him to come closer to the store |
| SP4 | The system sends a notification that remind him about his booking |
| SP5 | OnlineUser make a booking |
| SP6 | OnlineUser delete a booking |

* 1. **Definitions, Acronyms, Abbreviations**
     1. **Definitions**

|  |  |
| --- | --- |
| NAME | BRIEF DESCRIPTION |
| QR Code | It is a type of matrix barcode which contains information about a reservation |
| User | He is a generical costumer of the store |
| OnlineUser | He is a customer of the store who goes to the supermarket using CLup |
| PhysicalUser | He is a customer of the store who goes to the supermarket not using CLup |
| ToComplete | To complete |

* + 1. **Acronyms**

|  |  |
| --- | --- |
| NAME | BRIEF DESCRIPTION |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |

* + 1. **Abbreviations**

|  |  |
| --- | --- |
| NAME | BRIEF DESCRIPTION |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |

* 1. **Revision history**

To complete

* 1. **Reference documents**
* Slide of the lectures
* Specification document “R&DD Assignment A.Y. 2020-2021”
  1. **Document structure**

The document is divided in six parts.

* **INTRODUCTION**: it gives an overlooking on the purpose and scope of the document, defining the main goals and phenomena and the definitions, acronyms, and abbreviations of most used words. It also contains the revision history and the reference documents to better underline how it has been developed.
* **OVERALL DESCRIPTION**: it contains scenarios and further details on the shared phenomena given through class diagrams and state charts. Moreover, it describes the major functions of the application and their constraints. There is also information about users and their main characteristics in order to clarify their needs. Finally, are included the domain assumption that can be deducted from the assignment.
* **SPECIFIC REQUIREMENTS**: here are included more details on all the aspect in section 2 which can be useful for the development team. It represents the core of the document as it contains the functional and non-functional requirements, described through the definition of the use cases and their associated sequence/activity diagrams. There are also described the requirements on the external interfaces and the design constraints.
* **FORMAL ANALYSIS USING ALLOY**: here there is the alloy code and the corresponding metamodel generated from it, in order to describe formally the application.
* **EFFORT SPENT**: it includes information about the number of hours each group member has worked for the development of the document
* **REFERENCES**: it contains the reference documents.

1. **Overall Description**
   1. **Product perspective**
      1. **UML Description**

[TODO]

* + 1. **State Charts**

Now we are going to analyze some critical aspects of the application, modelling their behaviors, and showing the evolution over time of their states through appropriate state diagrams, which are reported below.

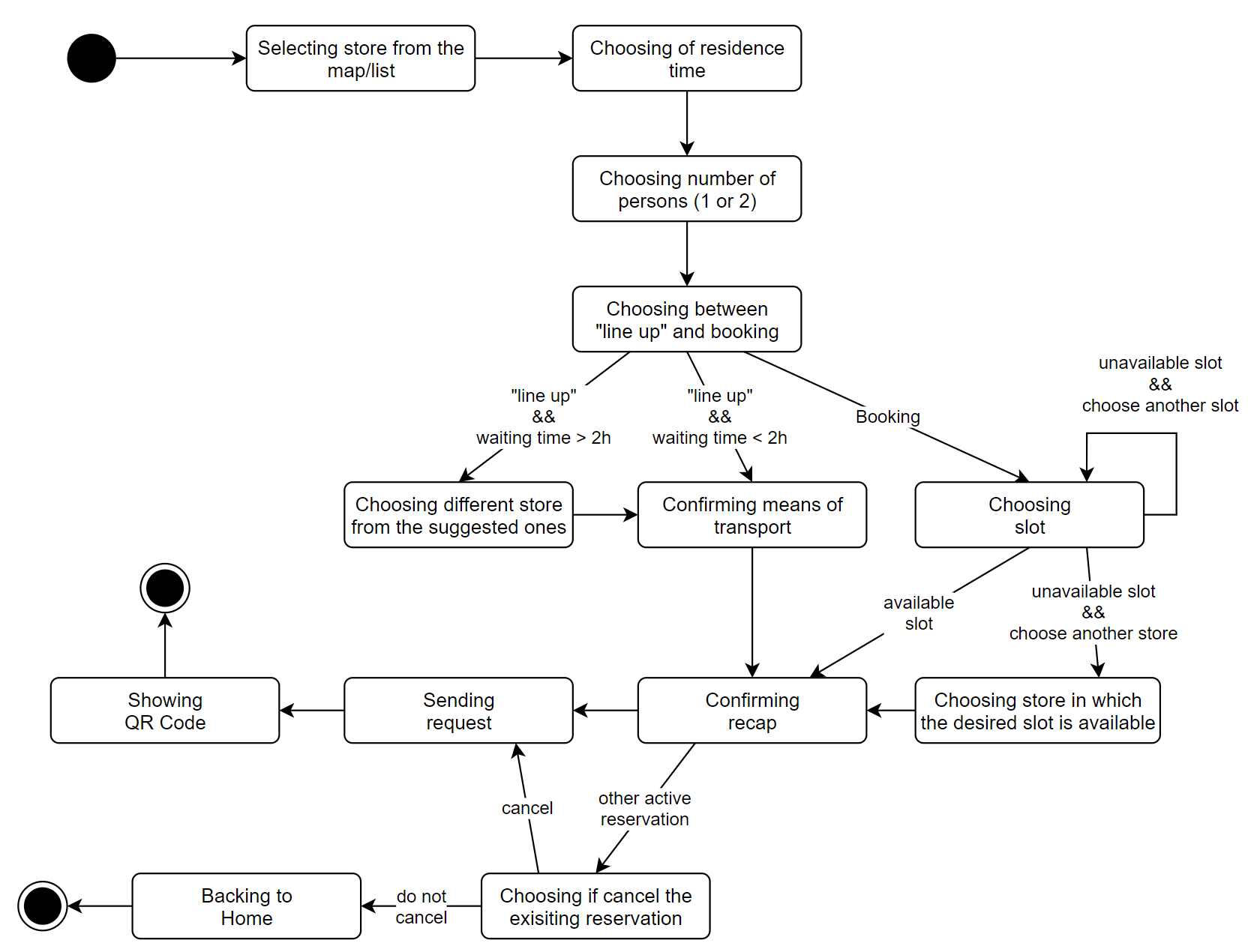


Figure 1 - State Diagram 1: creating a reservation

In the first state diagram (Figure 1), we model the creation of a reservation by the OnlineUser, showing the main actions that he has to perform.

* 1. **Product functions**

In this section are listed and explained the main functionalities of CLup.

* + 1. **Line up**

The main functionality of the app focuses on save people from having to line up and stand outside of stores for a huge amount of time. Line up represents the first alternative which is proposed to the user. Opening the app, the OnlineUser is able to visualize the map of a region and to select the store he wants to go in. At this point, after the insertion of the requested information (residence time and number of people who will come to the store), the OnlineUser can choose to line up. Through this action, he put himself in a virtual queue which has the purpose to substitute the physical one which would be created outside the store. Therefore, as it were a real one, the OnlineUser is able to check through the app how many people are in front of him and the estimated time after which he will be able to enter the store. In this way, he does not have to lose his time waiting near the store, but he can come closer only when it is time. The app will help him sending a notification when the estimated time of entrance coincide with the estimated time computed by the system to reach to the store from its current position.

* + 1. **Booking a visit**

Booking a visit represents the second alternative which is proposed to the user. It follows the same mechanism of the first one but gives to the user an additional benefit. In fact, while through the line up choice the OnlineUser is put in a virtual queue and is not able to choose the exact time it will enter the store, as it changes according to the people in the queue, through this second option the OnlineUser is able to select the specific time he wants to enter the store, choosing a slot of time that, once selected, doesn’t change anymore. However, the first available time slot could be in a few hours, so this option is not recommended to a customer who needs to go to the supermarket as soon as possible. Also, in this case, the OnlineUser will be helped by the app which will send him a notification two hours before the entrance time, to remember him about the booking and to ask him to confirm his presence.

* + 1. **Suggest alternatives when the chosen store is not available**

Selecting a store in the map, the OnlineUser can immediately see the estimated waiting time for each store. In fact, in the visualization of the city map, each sales point is differently colored (green, yellow, red) in order to highlight which one is currently available with a very low waiting time, which one is available but there is some time to wait before entering, which one is not currently available as the waiting time is longer than two hours. Nevertheless, the OnlineUser is able to select also the red ones, as the booking option doesn’t take care of the current waiting time. Then, if the chosen store is not currently available to line up, or if the chosen slot of time is not available anymore, the system suggests to the OnlineUser an alternative store, selecting the one nearest to the chosen one. This represents another helpful function of the app as it allows the user to have multiple chances and to go to a less crowded store where is easier and comfier to do grocery shopping.

* 1. **User characteristics**

**[TODO]**

**2.4 Assumption, dependencies and constraints**

**2.4.1 Domain assumptions**

|  |  |
| --- | --- |
| NAME | BRIEF DESCRIPTION |
| D1 | If the store chosen by OnlineUser is currently not available, he searches for an alternative instead of going to the supermarket pretending to enter as a PhysicalUser |
| D2 | The user stands in the store for an amount of time which deviates by a maximum of five minutes from the one that has been indicated |
| D3 | The internet connection of the OnlineUser works properly |
| D4 | The smartphone of the OnlineUser has an integrated GPS sensor |
| D5 | The GPS sensor of the smartphone of the OnlineUser is always active while using CLup and is activated in background each five minutes |
| D6 | About 80% of the customers goes to the supermarket through the use of CLup |
| D7 | OnlineUser comes to the supermarket with the means of transportation that he selected on the app |
| D8 | When OnlineUser selects the types of items that he will buy, he sticks to this indication |

1. **Specific Requirements**
   1. **External Interface Requirements**
      1. **User Interfaces**

**[TODO]**

* + 1. **Hardware Interfaces**

**[TODO]**

* + 1. **Software Interfaces**

**[TODO]**

* + 1. **Communication Interfaces**

**[TODO]**

* 1. **Functional Requirements**
     1. **List of Requirements**

**[TODO]**

* + 1. **Mapping**

**[TODO]**

* + 1. **Use Cases**
       1. **Use Cases Description**

1. **Registration of an OnlineUser**

|  |  |
| --- | --- |
|  |  |
| Name | Registration of an OnlineUser |
| Actors | Guest |
| Entry Condition | 1. Guest has downloaded the app onto the personal device 2. Guest has a working internet connectivity 3. Guest has not an account yet |
| Event Flow | 1. Guest clicks on “Sign Up” button 2. Guest fills all the mandatory fields with personal information and clicks the Confirm button 3. The system checks the validity of the input 4. The system saves the data and sends a confirmation email |
| Exit Conditions | Guest has successfully completed the registration and becomes an OnlineUser |
| Exceptions | 1. The Guest is already registered 2. The user did not fill all the mandatory fields 3. Username is already taken 4. Email is already linked to another account   All the exceptions are handled by notifying the user and taking him back to the sign-up page. |

1. **Login of an OnlineUser**

|  |  |
| --- | --- |
|  |  |
| Name | Login of an OnlineUser |
| Actors | OnlineUser |
| Entry Condition | OnlineUser has previously successfully signed up to the application service |
| Event Flow | 1. OnlineUser opens the app on the device 2. OnlineUser clicks on the “Login” button and inserts username and password 3. The system checks the validity of the input and sends back a session Token |
| Exit Conditions | OnlineUser can now access all the functionalities of the application |
| Exceptions | 1. The username inserted does not exist 2. The password inserted does not match the username   All the exceptions are handled by notifying the user and taking him back to the login page. |

1. **Booking**

|  |  |
| --- | --- |
|  |  |
| Name | Booking |
| Actors | OnlineUser |
| Entry Condition | OnlineUser has already logged in the application |
| Event Flow | 1. OnlineUser clicks on a store on the interactive map 2. OnlineUser:    1. inserts the desired residence time between predefined intervals of time    2. inserts the categories of the items he needs to buy    3. accepts the suggested residence time or goes to 2.1) or 2.2) (only for regular customers) 3. OnlineUser inserts the number of person (max 2) 4. The system calculates an estimated waiting time 5. OnlineUser chooses between “Line up” and Booking:   Line up:   1. if waiting time < 2h, OnlineUser confirms the means of transport 2. if waiting time > 2h, OnlineUser chooses a different store from the suggested ones   Booking:   1. OnlineUser chooses a time slot 2. If the time slot is not available, OnlineUser    1. chooses a different slot    2. chooses a different store from the suggested ones 3. OnlineUser confirms the recap 4. If OnlineUser already has an active reservation, the system asks him if he wants to delete it and saves the new one 5. System receives the request and generates the relative QR Code 6. OnlineUser sees the QR Code |
| Exit Conditions | OnlineUser booked successfully |
| Exceptions | 1. The internet connection is not available   The above exception is handled by notifying the user with an error message   1. In point 7), OnlineUser does not accept to overwrite the current active reservation   The above exception is handled by bringing back the OnlineUser to the Home |

1. **Load map**

|  |  |
| --- | --- |
|  |  |
| Name | Load map |
| Actors | OnlineUser |
| Entry Condition | 1. OnlineUser has already logged in the application |
| Event Flow | 1. OnlineUser opens the app 2. The system loads the map of the last known position of the OnlineUser 3. OnlineUser inserts an address or enables the GPS position 4. The system loads the map of the given position |
| Exit Conditions | OnlineUser can see the map |
| Exceptions | 1. The internet connection is not available   This exception is handled by notifying the user with an error message |

1. **Cancellation of a reservation**

|  |  |
| --- | --- |
|  |  |
| Name | Cancellation of a reservation |
| Actors | OnlineUser |
| Entry Condition | 1. OnlineUser has already logged in the application 2. OnlineUser has an active reservation |
| Event Flow | 1. OnlineUser clicks on “My Reservations” section 2. OnlineUser clicks on the active reservation 3. OnlineUser clicks on “Cancel Reservation” button 4. OnlineUser confirms the action |
| Exit Conditions | OnlineUser cancelled the reservation |
| Exceptions | 1. The internet connection is not available   This exception is handled by notifying the user with an error message |

1. **Approach to the store Notification**

|  |  |
| --- | --- |
|  |  |
| Name | Approach to the store Notification |
| Actors | System |
| Entry Condition | 1. The system detects the lineup time is about to expire |
| Event Flow | 1. The system sends a reminder notification to the OnlineUser to inform him that it is time to approach the store from its current position |
| Exit Conditions | OnlineUser receives the notification |
| Exceptions | 1. The internet connection is not available   This exception is handled showing the notification when the internet connection will be available (managed by the OS) |

1. **Scan of the QR Code at the entrance of the store**

|  |  |
| --- | --- |
|  |  |
| Name | Entrance scan of the QR code |
| Actors | OnlineUser |
| Entry Condition | 1. OnlineUser has logged in 2. OnlineUser has correctly completed the booking procedure 3. OnlineUser must have his mobile device with him |
| Event Flow | 1. OnlineUser opens the “My Reservations” section and clicks on the active reservation 2. OnlineUser positions the device in front of the scanning machine 3. QR Code is recognized 4. The system checks the validity of the code and shows the user that the code was accepted with an OK message |
| Exit Conditions | OnlineUser successfully validated its reservation and can now enter the store |
| Exceptions | 1. QR code is not recognized 2. QR code is recognized but the time slot is incorrect   All the exceptions are handled by notifying the user with an error message |

1. **Reminder Notification**

|  |  |
| --- | --- |
|  |  |
| Name | Reminder Notification |
| Actors | System |
| Entry Condition | 1. The system detects the reservation time is near |
| Event Flow | 1. The system sends a reminder notification to the OnlineUser   Three possibilities:   * 1. OnlineUser confirms the reservation within 1h   2. OnlineUser choose, within 1h, to do not confirm the reservation   3. OnlineUser does not reply within 1h. Therefore, the system deletes the reservation |
| Exit Conditions | OnlineUser receives the notification |
| Exceptions | 1. The internet connection is not available   This exception is handled showing the notification when the internet connection will be available (managed by the OS) |

1. **Scan of the QR Code at the exit of the store**

|  |  |
| --- | --- |
|  |  |
| Name | Exit scan of the QR code |
| Actors | OnlineUser |
| Entry Condition | 1. OnlineUser has logged in 2. OnlineUser must have his mobile device with him 3. OnlineUser must be inside the store 4. OnlineUser must have finished to grocery shopping |
| Event Flow | 1. OnlineUser opens the app which automatically shows the QR Code of the active reservation (no other action is allowed) 2. OnlineUser positions the device in front of the scanning machine 3. QR code is recognized 4. The system checks the validity of the code and shows the user that the code was accepted with an OK message 5. OnlineUser clicks on the screen to go on 6. The system shows to the OnlineUser the real amount of time he spent inside the store 7. OnlineUser clicks on the end button 8. The reservation ends successfully |
| Exit Conditions | OnlineUser ended its reservation and can now leave the store |
| Exceptions | 1. QR Code is not recognized   This exception is handled by notifying the user with an error message and the assistance of a clerk is required |

1. **Choice of means of transport**

|  |  |
| --- | --- |
|  |  |
| Name | Choice of means of transport |
| Actors | OnlineUser |
| Entry Condition | 1. OnlineUser has logged in 2. OnlineUser is not currently inside the store with an active reservation |
| Event Flow | 1. OnlineUser opens the app 2. OnlineUser sees the home page with the map of the stores and the icons of the types of transports 3. OnlineUser clicks on the chosen type 4. The system computes the travel times to the stores 5. The new chosen means of transport becomes highlighted |
| Exit Conditions | OnlineUser has successfully changed his transportation |
| Exceptions | 1. OnlineUser clicks on the already selected means of transport   This exception does not lead to any change in the means of transport |

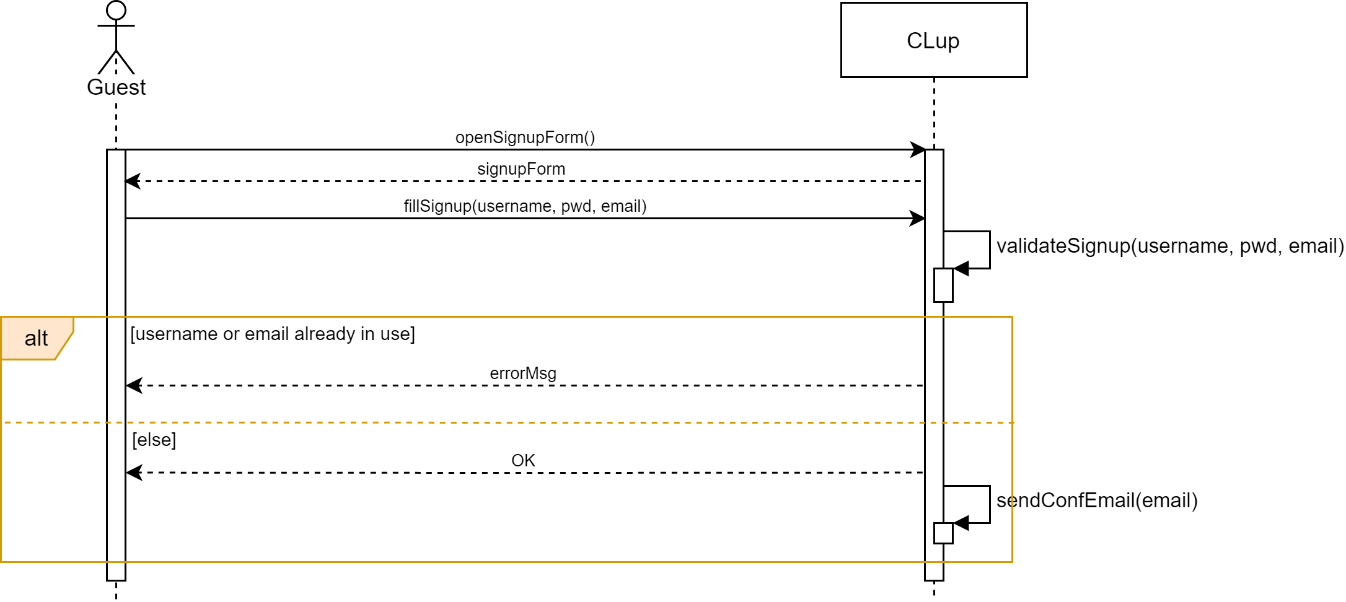
1. **Check the state of an active reservation**

|  |  |
| --- | --- |
|  |  |
| Name | Check the state of an active reservation |
| Actors | OnlineUser |
| Entry Condition | 1. OnlineUser has already logged in the application 2. OnlineUser has an active reservation |
| Event Flow | 1. OnlineUser clicks on “My Reservations” section 2. OnlineUser clicks on the active reservation 3. OnlineUser can see how many people are currently in front of him in the queue and the approximate time he will be able to enter the store |
| Exit Conditions | OnlineUser has read all the requested information |
| Exceptions | 1. The internet connection is not available   This exception is handled by notifying the user with an error message |

**3.2.4 Use Cases Diagram**

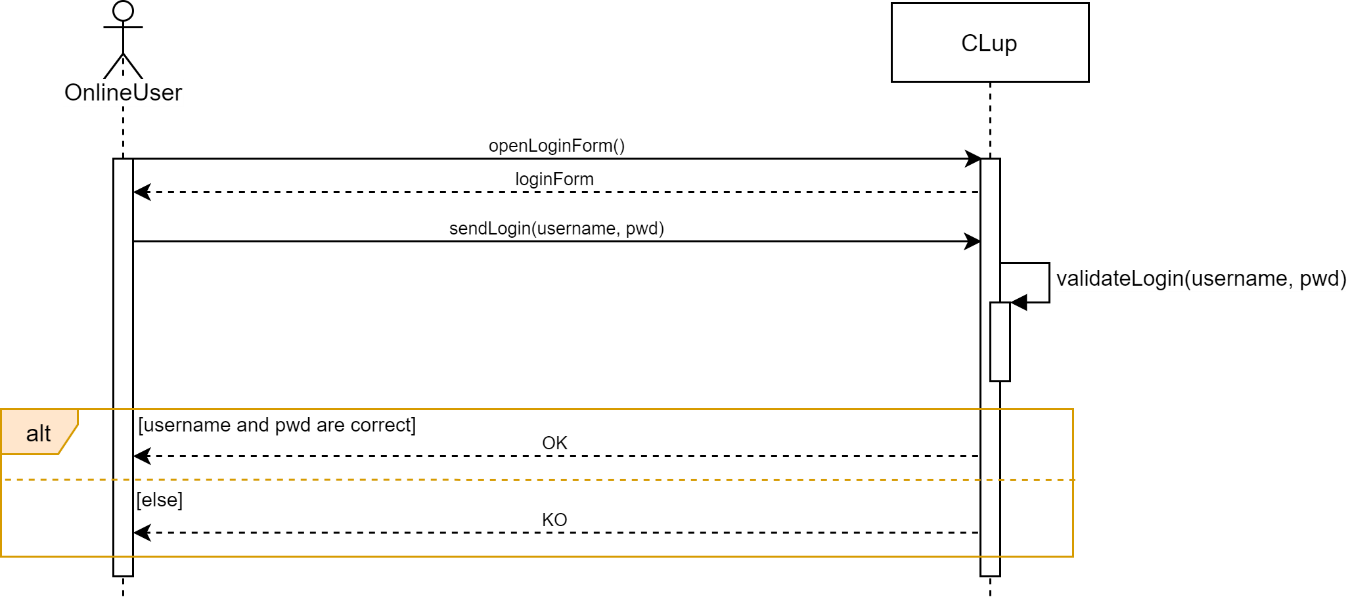
1. **Registration of an OnlineUser**

Figure 2 - Sequence Diagram: registration of an OnlineUser



1. **Login of an OnlineUser**

Figure 3 - Sequence Diagram: login of an OnlineUser



1. **Booking**

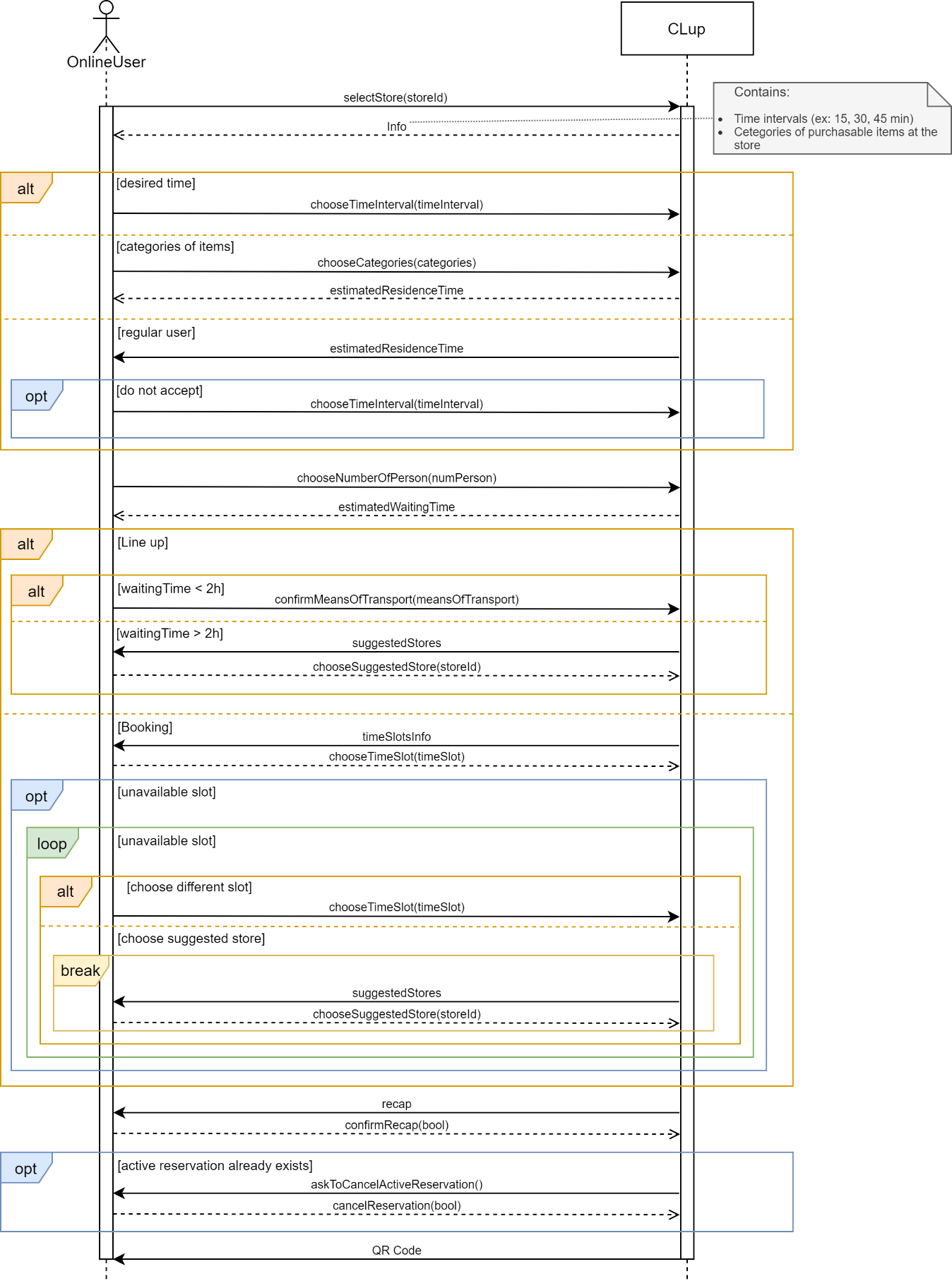
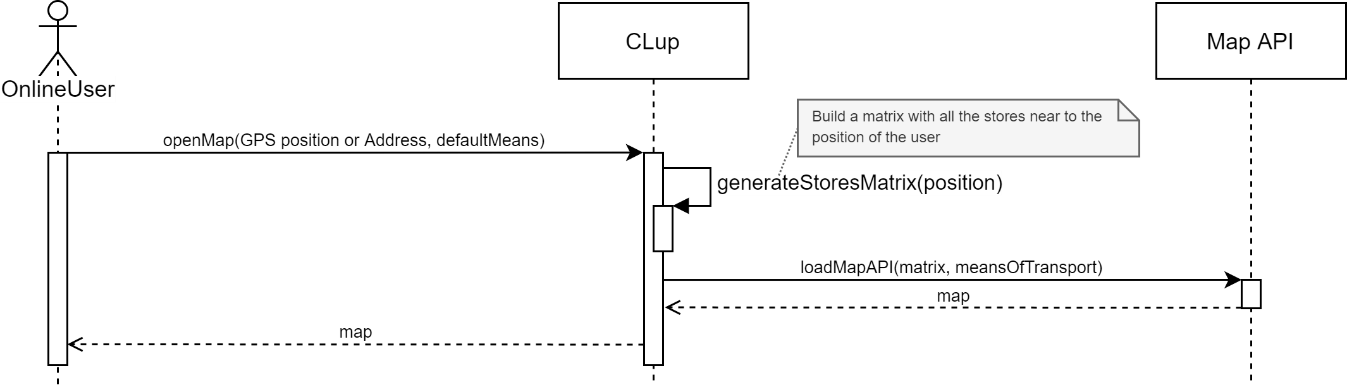


Figure 4 - Sequence Diagram: booking

1. **Load map**

Figure 5 - Sequence Diagram: load map



1. **Cancellation of a reservation**

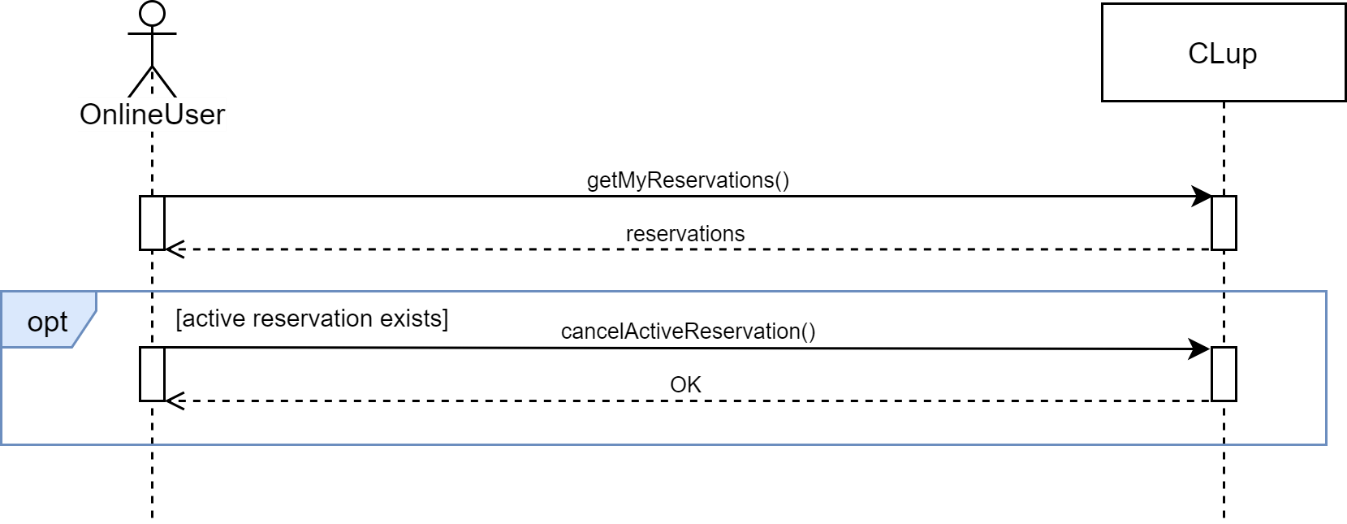


Figure 6 - Sequence Diagram: cancellation of a reservation

1. **Approach to the store Notification**

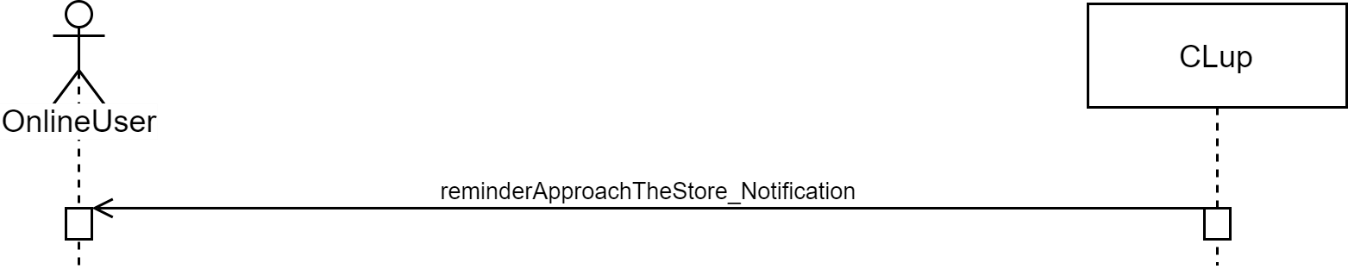


Figure 7 - Sequence Diagram: approach to the store Notification

1. **Scan of the QR Code at the entrance of the store**

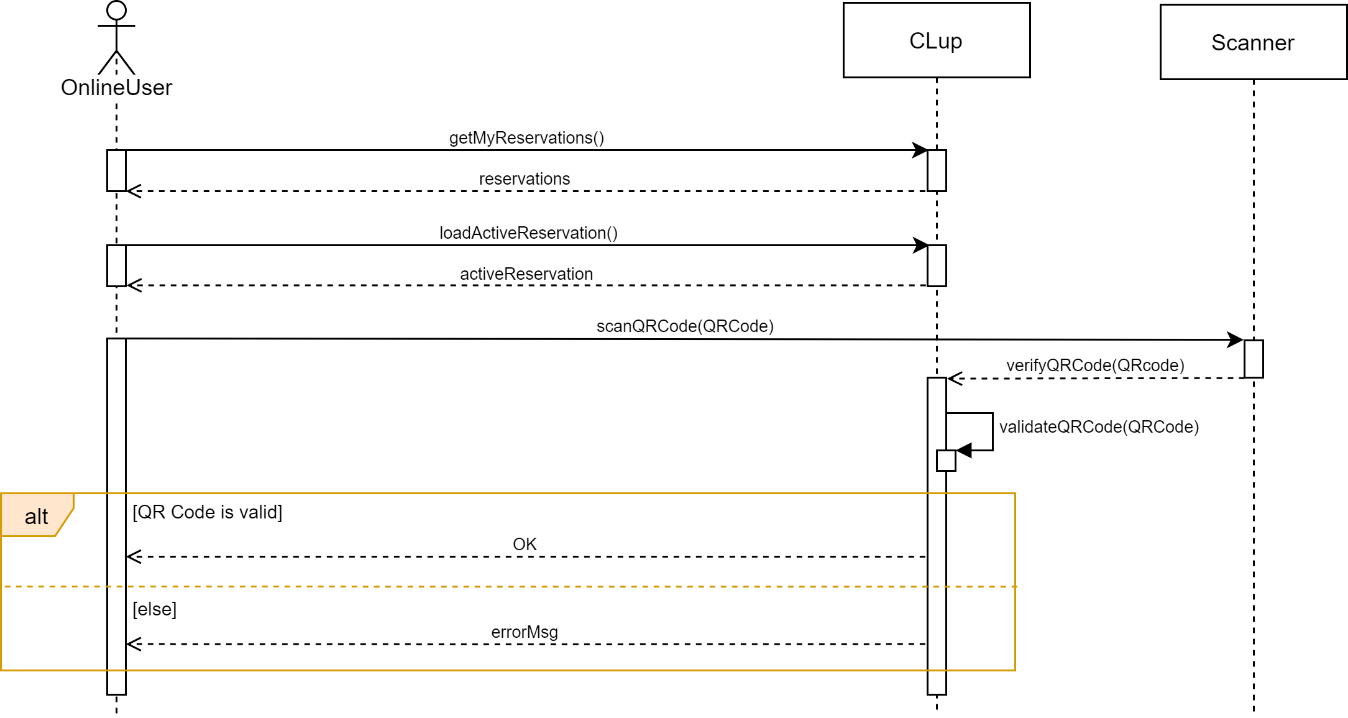


Figure 8 - Sequence Diagram: scan of the QR Code at the entrance of the store

1. **Reminder Notification**

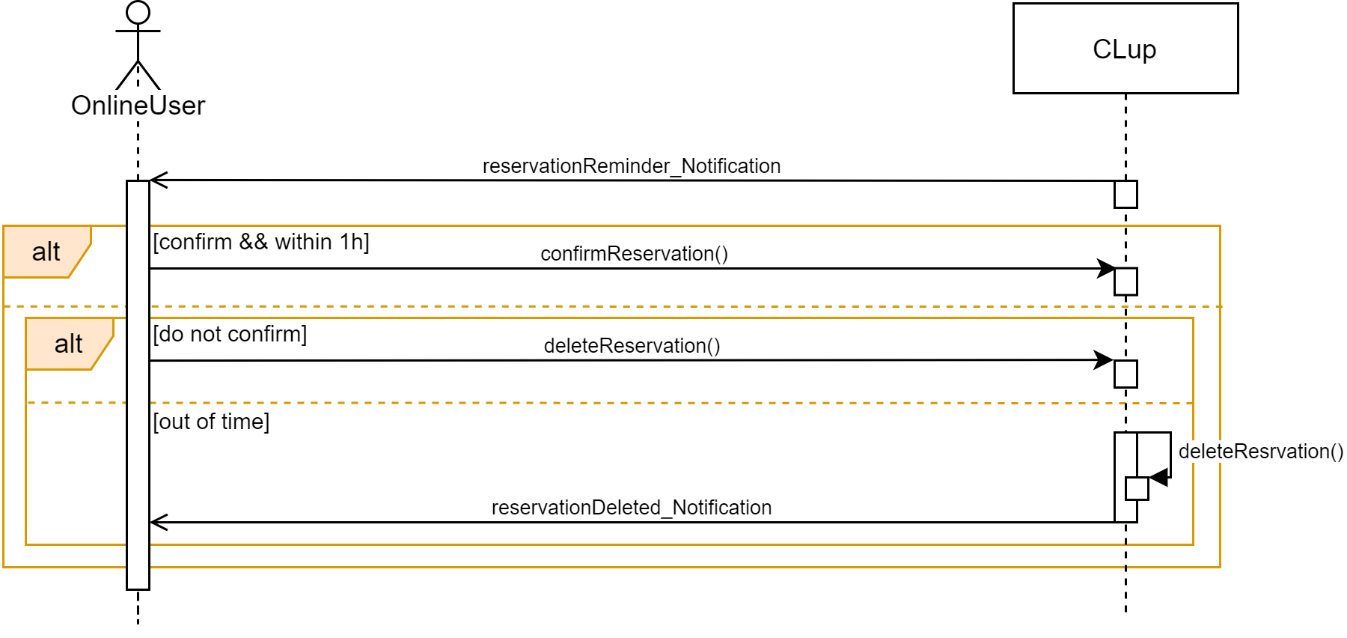


Figure 9 - Sequence Diagram: reminder Notification

1. **Scan of the QR Code at the exit of the store**

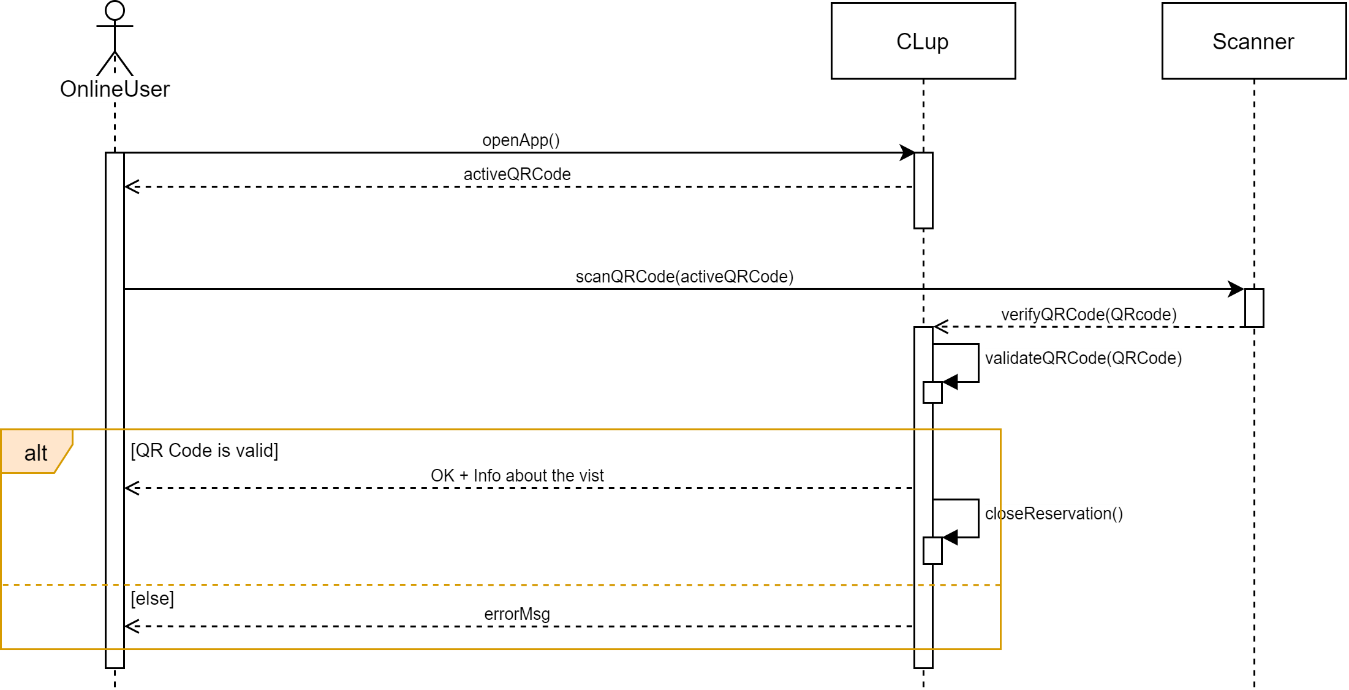


Figure 10 - Sequence Diagram: scan of the QR Code at the exit of the store

1. **Choice of means of transport**

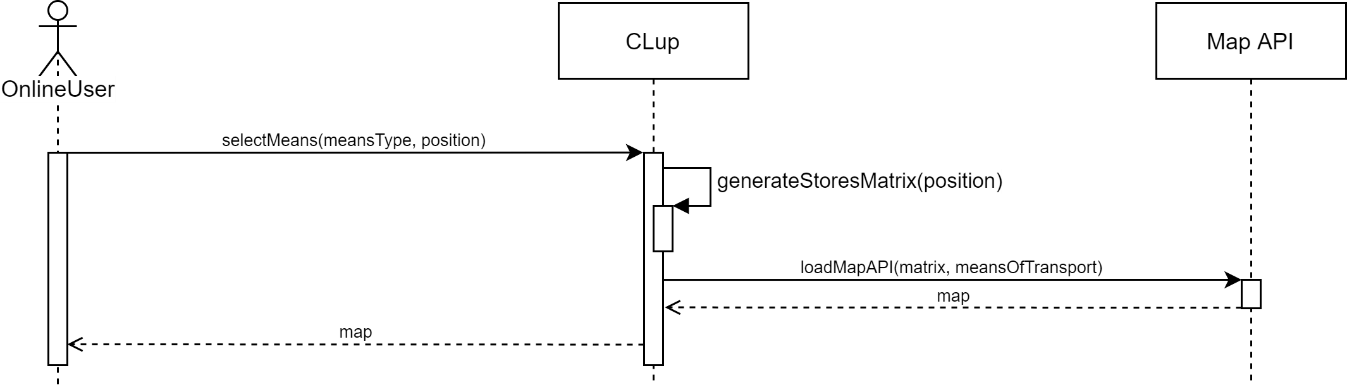


Figure 11 - Sequence Diagram: choice of means of transport

1. **Check the state of an active reservation**

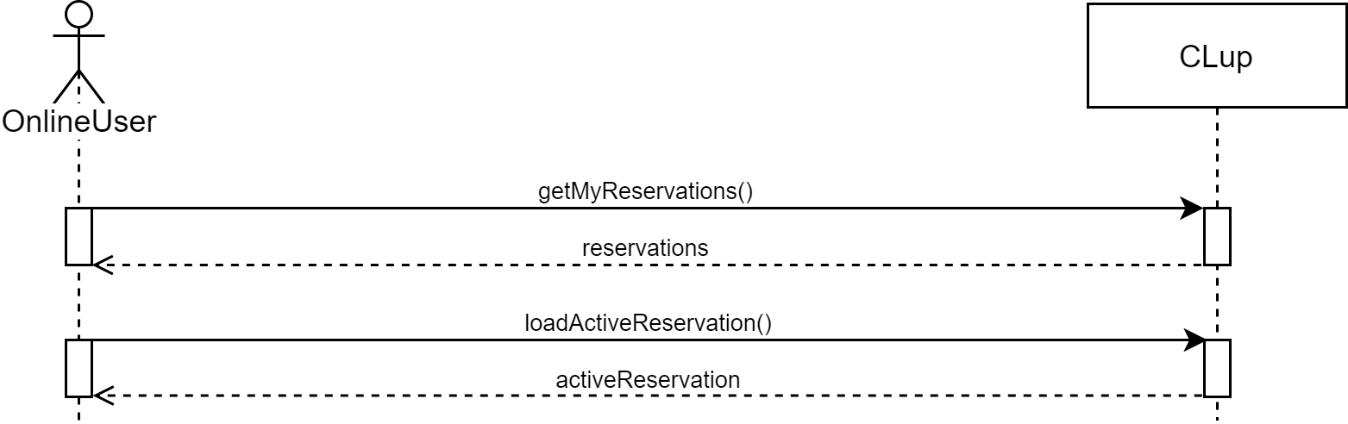


Figure 12 - Sequence Diagram: check the state of active reservation

* + 1. **Scenarios**
* **Scenario 1: BOOKING A SLOT**

Elisa and Gianmarco, a young nurse and a doctor, are a family with two little children and live in the center of Milan. Due to the Coronavirus emergency, their turns became longer and now they have not so much time to go grocery shopping. Trying to find a solution, they discover that CLup gives the possibility to book a slot of time to go shopping. This made them so much happy, because it finally provided them to go to the supermarket without any waste of time. In fact, through the reservation modality, they are now able to do the shopping while going back home, avoiding having to queue, in order to be back home to their children as soon as possible.

* **Scenario 2: AN INTERESTING SUGGESTION**

Marianna is a matricula of Politecnico di Milano who has just started her Master of Science. She has never lived in a big city before and, due to the Coronavirus emergency, she doesn’t have the possibility to visit her new district. However, through CLup she became able to discover all the nearest supermarkets in order to find the less crowded one, as she is very careful and tries to meet as few people as possible until the emergency won’t be over.

* **Scenario 3: THE VANTAGE OF A PHYSICAL USER**

Melania is an old lady who lives alone in her house in Florence. Due to the Coronavirus emergency, her family is not able to visit her anymore and is very concerned about the health of their lovely grandma. For the lady, even go grocery shopping has become difficult because of the huge amount of time she is forced to stand in line. Nevertheless, thanks to CLup now she is able to go to the store, get her ticket and go back home waiting for her turn, if the queue is very long. However, as a percentage of spaces is dedicated to the customers that don’t have access to the CLup’s required technology, the waiting time is always very short, and she is able to enter immediately the supermarket.

1. **Effort spent**
   1. **Galzerano Arianna**

|  |  |
| --- | --- |
| HOURS | TASK |
| 2 | Initial discussion on first part |
| 1.30 | Use cases |
| 1 | Sequence diagrams |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |

* 1. **Lampis Andrea**

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| HOURS | TASK |
| 2 | Initial discussion on first part |
| 2 | State chart |
| 2 | Use cases |
| 2.30 | Sequence diagram |
| 1.30 | Brainstorming |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |

* 1. **Leone Monica**

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| HOURS | TASK |
| 2 | Initial discussion on first part |
| 3 | Development of introduction |
| 1 | Use cases and domain assumptions |
| 1.30 | Brainstorming |
| 0.30 | Sequence diagrams |
| 1 | Product functions |
| 0.30 | Scenarios |
| ToComplete | To complete |
| ToComplete | To complete |
| ToComplete | To complete |