POLITECNICO MILANO 1863

MSc Computer Science and Engineering

Software Engineering 2
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TRAVLENDAR

Design Document

894135
Franklin Onwu
`franklinchinedu.onwu@mail.polimi.it`

899318
Ivan Sanzeni
`ivan.sanzeni@mail.polimi.it`

884021
Matteo Vantadori
`matteo.vantadori@mail.polimi.it`

Related professor:
Prof. Matteo Giovanni Rossi

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Contents

1 | Introduction

1.1 Purpose

Section [G.0] treats all the goals related to the registration to the application:

G.0.1 The unregistered user can sign up to the *Travlendar+* services.

G.0.2 The registered user can sign in to *Travlendar+*.

G.0.3 The registered user can sign out from *Travlendar+*.

G.0.4 The registered user can delete his/her account from the *Travlendar+* services.

Section [G.1] treats all the goals related to the creation and personalization of an event:

G.1.1 The *Travlender* can schedule a new event adding name, time slot, location, type of event and (eventually) a description.

G.1.2 The *Travlender* can modify the name of the event.

G.1.3 The *Travlender* can modify the location of the event.

G.1.4 The *Travlender* can modify the description of the event.

G.1.5 The *Travlender* can modify the starting time of the event.

G.1.6 The *Travlender* can modify the ending time of the event.

G.1.7 The *Travlender* can modify his/her event from a work event to a personal event or viceversa.

G.1.8 The *Travlender* can insert the description at any later time and modify it at any moment.

G.1.9 The *Travlender* can choose how many minutes earlier arrive to his/her destination.

G.1.10 The *Travlender* can delete an existing event.

G.1.11 The *Travlender* can see all the events he/she has already scheduled.

Section [G.2] treats all the goals related to the customization of the *Travlender* preferences:

G.2.1 The *Travlender* can decide to choose the quickest way as default.

G.2.2 The *Travlender* can decide to choose the cheapest way as default.

G.2.3 The *Travlender* can decide to choose the most ecological way as default.

G.2.4 The *Travlender* can decide to reach the location choosing means that keep him/her out of adverse weather conditions.

G.2.5 The *Travlender* can add constraints on the transports range of time, restricting their use only in a chosen time slot.

G.2.6 The *Travlender* can restrict the use of transports, setting a maximum distance per travel.

G.2.7 The *Travlender* can set a maximum amount of money to spend in public, shared or non-shared transports per travel.

G.2.8 The *Travlender* can select the means he/she wants to use and deselect those he/she doesn't want to.

Section [G.3] treats all the goals related to the customization of the *Travlender*'s settings:

G.3.1 The *Travlender* can add his/her public transports tickets or passes.

G.3.2 The *Travlender* can select all his/her owned means.

G.3.3 The *Travlender* can decide to allow transports accessible by people with disabilities as the only way to travel.

Section [G.4] treats all goals related to the purchase of *non-shared transports*:

G.4.1 The *Travlender* can book in-app a taxi.

G.4.2 The *Travlender* can book in-app a limousine.

Section [G.5] treats all the goals related to the purchase of *public transports*:

G.5.1 The *Travlender* can buy in-app a ticket for the metro.

G.5.2 The *Travlender* can buy in-app a ticket for the bus.

G.5.3 The *Travlender* can buy in-app a ticket for the trolleybus.

G.5.4 The *Travlender* can buy in-app a ticket for the tram.

G.5.5 The *Travlender* can buy in-app a ticket for the train.

Section [G.6] treats all the goals related to the purchase of *shared transports*:

G.6.1 The *Travlender* can take a bike from a bike sharing service.

G.6.2 The *Travlender* can take a car from a car sharing service.

Section [G.7] treats all the goals related to the special event categories:

G.7.1 The *Travlender* can create an event with a flexible time occupation.

G.7.2 The *Travlender* can create a non-reserved time event.

G.7.3 The *Travlender* can select a location outside Milan for his event.

Section [G.8] treats all the goals related to the travel:

G.8.1 The *Travlender* can modify his/her preferences for a single travel.

G.8.2 The *Travlender* can get the route for his/her event location all over Milan.

1.2 Scope

Travlendar+ is a calendar-based application designed to schelude any kind of event, supporting the user in reaching the location of the events all across Milan, combining different sort of means in relation to the user preferences.

The application is designed to match the user needs to personalize each event in every respect. So the user can easly customize each event assigning it a category and distinguishing it between work or personal reasons, deciding means and constraints to reach it and buying tickets or booking means in-app, if necessary.

The main application goal is to lead the user to handle each kind of event with *Travlendar+*: from a lunch with friends to a job interview, from an interesting expo to an out of town meeting.

1.3 Definitions, acronyms, abbreviations

1.3.1 Definitions

Cheap = with this preference the application chooses the cheapest way to reach the location.

Eco = with this preference the application chooses the most ecological way to reach the location.

Flexible event = kind of event that provides calendar, reminder and street direction supports and can be overlapped with activities as long as exists a minimum amount of time fixed by the user.

Lasting event = kind of event that provides calendar, reminder and street direction supports and can be overlapped with activities.

Non-shared transports = limousine, taxi.

Not wet = with this preferences the application chooses only means that keeps the user out of adverse weather conditions to reach the location.

Personal event = the user specifies that the event has personal purposes.

Public transports = bus, metro, train, tram, trolleybus.

Quick = with this preference the application chooses the quickest way to reach the location.

Shared transports = bike sharing, car sharing.

Standard event = kind of event that provides calendar, reminder and street direction supports and cannot be overlapped with other activities.

Transfer event = kind of event that provides calendar and reminder supports and cannot be overlapped with other activities. It is used for events that take place outside Milan.

Travlendar+ = the name of the application.

Travlender = a registered and logged user of Travlendar+.

Work event = the user specifies that the event has work purposes.

1.3.2 Acronyms

API = Application Programming Interface.

GPS = Global Positioning System.

MMS = Mapping Managing System.

RASD = Requirements Analysis and Specification Document.

TMS = Transporting Managing System.

1.3.3 Abbreviations

A.n = Application assumption number n.

G.n.m = Goal number m in section n.

D.n = Domain assumption number n.

R.n.m = Requirement number m in section n.

T.n = Text assumption number n.

1.4 Revision history

26th November 2017
Version 1.0 - Document delivery.

1.5 Reference documents

https://standards.ieee.org/findstds/standard
IEEE standard for requirements documents.

https://developers.google.com/maps
Reference point for the third-party *MMS* considered in this project.

https://citymapper.com/milano
Reference point for the third-party *TMS* considered in this project.

1.6 Document structure

2 | Architectural design

2.1 Overview

Travlendar+ is designed to be exclusively a smartphone application, this implies that the user can have access to the application server only via his/her device.

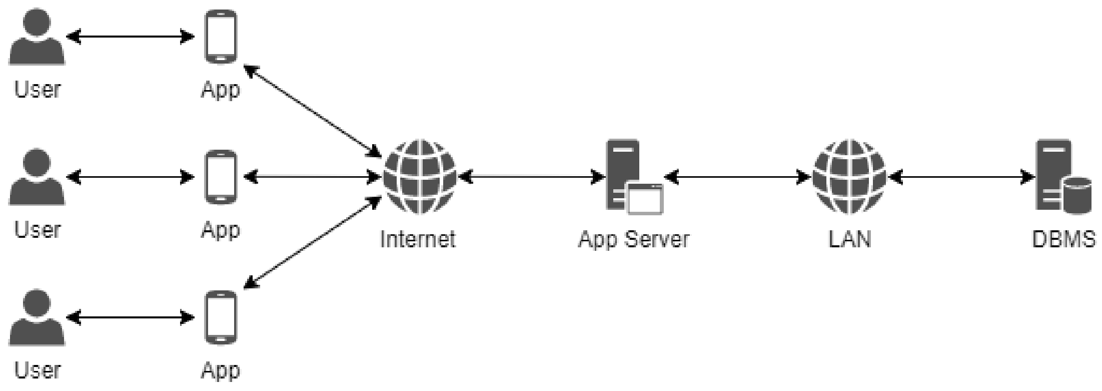


Figure 2.1: High-level architecture

For this reason, *Travlendar+* is meant to be a three-tier application, divided as follows:

Presentation tier includes the application itself on the user smartphone, it represents the means by which the user interacts with the remote system.

Application tier contains the application model and logic, it's the layer that makes decisions and evaluations on the best way to travel, following the user preferences.

Data tier stores all the data neccessary to the system.

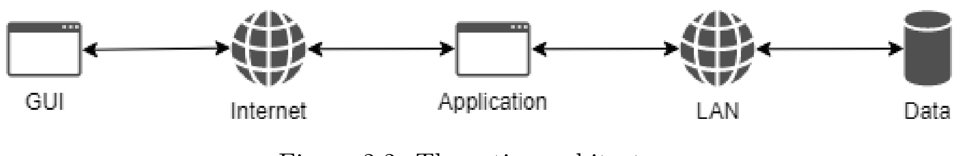


Figure 2.2: Three-tier architecture

2.2 Component view

The following diagram shows in deatil the cooperation between each component of the *Device*, the *Application Server* and the *Database Server*. The diagram also highlights the adopted patterns and the way that the application server interacts wtih the *Transporting Managing System* and the *Mapping Managing System*.

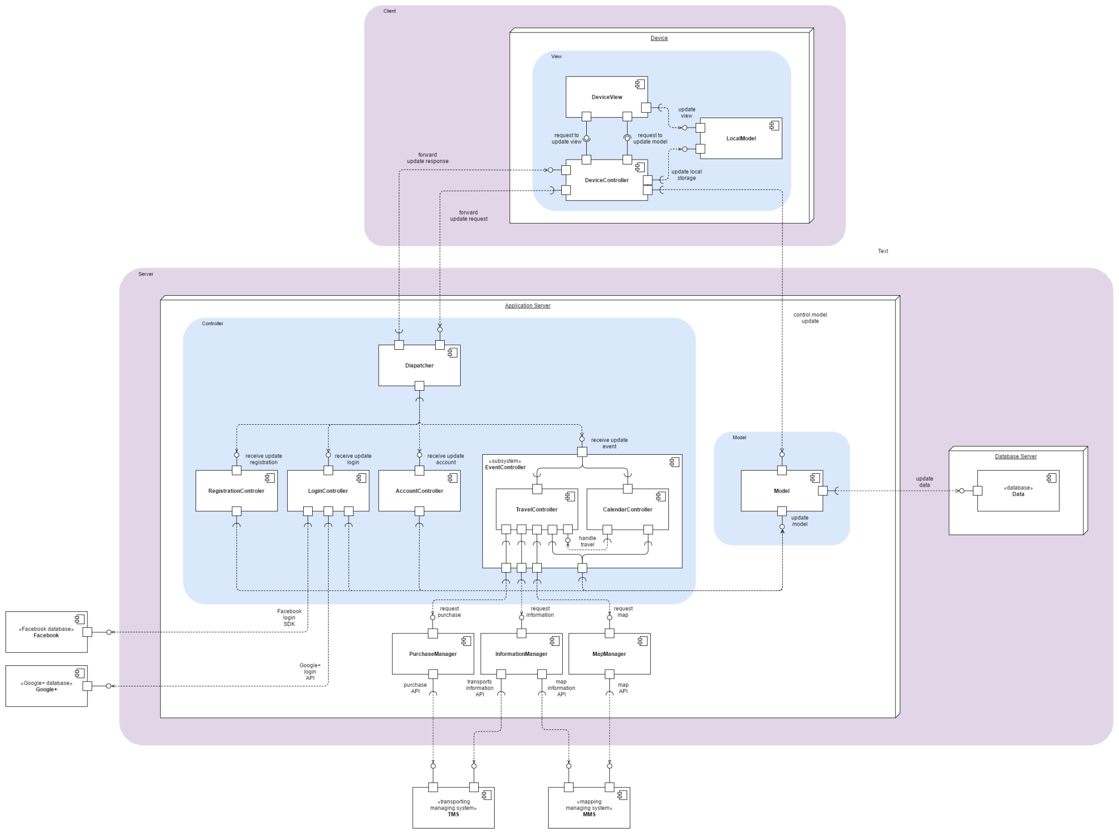


Figure 2.3: Component diagram

2.2.1 Device

The *Device* node has three components that simulate a local *MVC* pattern:

DeviceView represents the input/output application entity, it includes all the things the user can see and interact with.

DeviceController is the bridge connecting the view to the *Model*, it plays two important roles:

1. it forwards any request to update the *Model* from the *DeviceView* to the *Application Server*;
2. once the *Model* has been updated on the *Application Server*, it updates the *LocalModel* in the same way.

LocalModel is a local copy of the *Model*, its implementation allows the user to check the schedule and add a new event also if he/she is offline (it should be noticed that any update will be effective only once the user will be back online).

2.2.2 Application Server

The *Application Server* node has nine components (one of them divided into two subcomponents), it comunicates with the *Device*, the *Database Server* and the third-party applications:

Dispatcher is the *Application Server* component in charge of dispatching each request coming from the device to the relevant component.

RegistrationController handles any registration request.

LoginController handles any login request, it is also in charge of communicating with Facebook and Google+ to allow the user to log by means of them.

AccountController handles any request about user preferences (travel priority, not wet mode), constraints (maximum range of time, maximum distance, maximum amount of money, selected means, disabilities) and owned means.

EventController handles any request about the creation of a new event or the update of an existing one, it is designed as the closed cooperation between two subcomponents:

> **TravelController** is the spatial *EventController* subcomponent in charge of evaluating the best way to travel on the bases of the user preferences, constraints and owned means.
>
> **CalendarController** is the temporal *EventController* subcomponent in charge of evaluating if the event can be located in the time slot indicated by the user, taking account not only of the event duration, but also of the travel duration calculated by the *TravelController*.

PurchaseManager controls the non-shared (taxi, limousine) and shared booking (bike sharing, car sharing) and the public transports (bus, metro, train, tram, trolleybus) tickets purchase, thanks to its interaction with the *Transporting Managing System*.

InformationManager collects any information required to evaluate the best way to travel for each event, thanks to the combined interaction between:

1. the *Transporting Managing System* to know the public transports tickets cost, the fuel price, the taxi and limousine fares, the bike sharing and car sharing systems coordinates and the average cars fuel consumption.
2. the *Mapping Managing System* to know the weather conditions, the road traffic and to locate the bike sharing and car sharing systems coordinates provided by the *Transporting Managing System*.

MapManager provides the map that requests to the *Mapping Managing System*.

Model stores all the application data updated by the *Controller* components.

2.2.3 Database Server

The *Database Server* has only a single component:

Data stores all the user data updated by the *Controller* components, passing through the *Model*.

2.2.4 External Services

Transporting Managing System provides the public transports tickets cost, the fuel price, the taxi and limousine fares, the bike sharing and car sharing systems coordinates and the average cars fuel consumption.

Mapping Managing System provides the weather conditions, the road traffic and the bike sharing and car sharing systems location.

Facebook allows the user to sign in to *Travlendar+* using the Facebook login.

Google+ allows the user to sign in to *Travlendar+* using the Google+ login.

2.3 Deployment view

The following diagram shows in deatil the physical deployment of the *Device*, the *Application Server* and the *Database Server*. The diagram also highlights the adopted patterns and the way that the application server interacts with the *Transporting Managing System* and the *Mapping Managing System*. The diagram also highlights the three-tier system architecture.

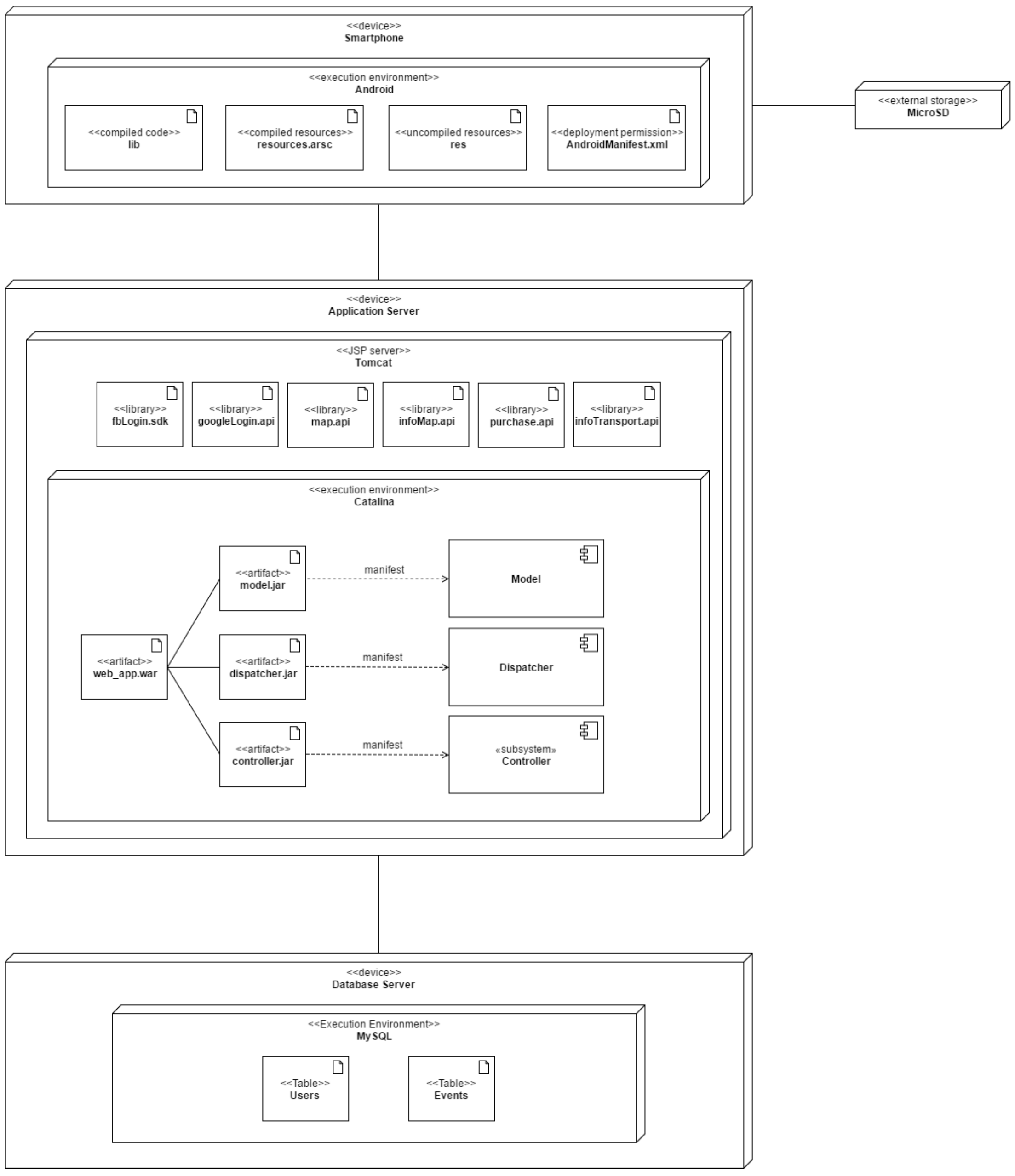


Figure 2.4: Deployment diagram

2.3.1 Device

The *Device* execution environment is *Android*, so the application has to be an *APK file*. The block shows the most significant files or directories:

lib contains the compiled code.

resourches.arsc contains the precompiled resources.

res contains the resources not compiled into *resources.arsc*.

AndroidManifest.xml describes the name, the version, the access rights and the referenced library files for the application.

2.3.2 Application Server

The *Application Server* execution environment is *Catalina*, with *Tomcat* as the JSP server. The block shows the most important libraries and archives:

fbLogin.sdk allows the Facebook login.

googleLogin.api allows the Google+ login.

map.api provides the map.

infoMap.api provides the weather conditions, the road traffic and the bike sharing and car sharing services location.

infoTransport.api provides the public transports tickets cost, the fuel price, the taxi and limousine fares, the bike sharing and car sharing services coordinates and the average cars fuel consumption.

web app.war is a collection of *JAR file* that contains:

- **model.jar** is the artifact that manifests the *Model* component.
- **dispatcher.jar** is the artifact that manifests the *Dispatcher* component.
- **controller.jar** is the artifact that manifests all the *Controller* components.

2.3.3 Database Server

The *Database Server* execution environment is *MySQL*. The block shows the most important tables:

Users in which are gathered the user preferences, constraints and owned means.

Events in which are gathered all the user events information.

2.4 Runtime view

2.4.1 Creation of a standard event or a flexible event

The sequence starts when the *Travlender* taps the + button to create a new event, choosing a standard event or a flexible one. In the Device, the *DeviceView* sends a request to the *DeviceController*, passing to it the event information. Then, the *DeviceController* dispatches the request to the Application Server *Dispatcher*, that requests a new event creation to the *EventController*, that in turn requests an event list to the *Model*. Now, the *EventController* takes the first test to check whether there is at least an overlap between the new event and an old one. If the test comes back negative, the *EventController* requests the map to the *MapManager* and a set of necessary information to the *InformationManager*, then it takes the second test to check whether there is at least an overlap between the travel time evaluated by the algorithm and the previous saved event. Worst-case scenario, if the algorithm doesn't find any acceptable travel, the application warns the *Travlender* and suggests him/her to modify the event time slot. On the contrary, if the test comes back negative, the *EventController* updates the *Model*, that also forwards the update to the *Data*. Now, the *DeviceController* can finally update the *LocalModel* and send to the *DeviceView* the request to update the view.

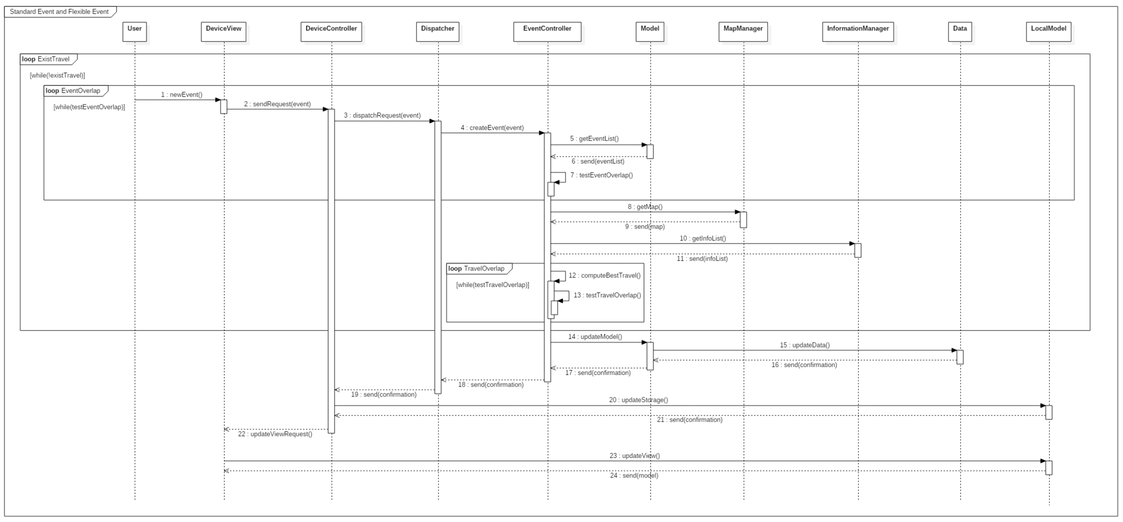


Figure 2.5: Standard event or flexible event

2.4.2 Creation of a lasting event

In this case too, the sequence starts when the *Travlender* taps the + button to create a new event, choosing this time to create a lasting event. In the Device, the *DeviceView* sends a request to the *DeviceController*, passing to it the event information. Then, the *DeviceController* dispatches the request to the Application Server *Dispatcher*, that requests a new event creation to the *EventController*, that in turn requests an event list to the *Model*, as in the previous case. However, this time the *EventController* doesn't take any test on the event time slot, because a flexible event allows its creation regardless of the overlap with other events. So, the *EventController* requests immediately the map to the *MapManager* and a set of necessary information to the *InformationManager* and updates the *Model*, that forwards the update to the *Data*. As before, the *DeviceController* can finally update the *LocalModel* and send to the *DeviceView* the request to update the view.

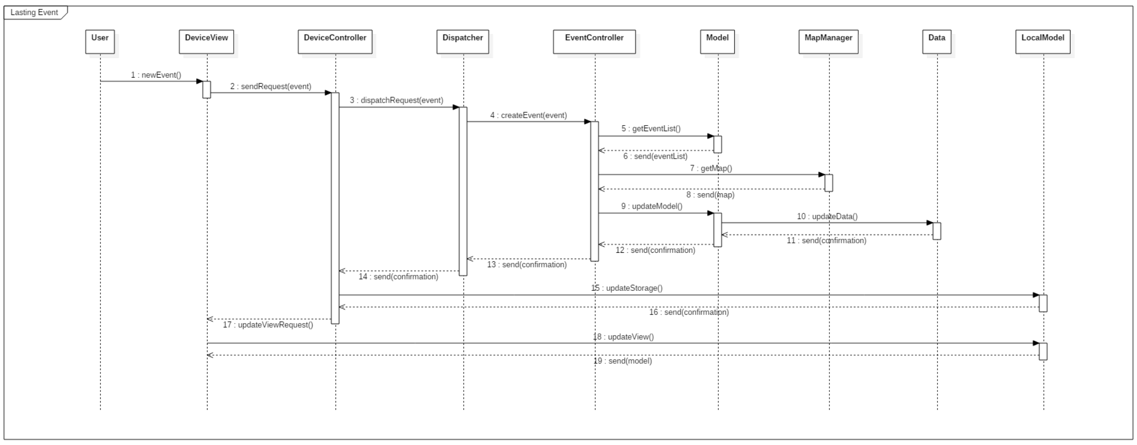


Figure 2.6: Lasting event

2.4.3 Creation of a transfer event

As the two previous cases, the sequence starts when the *Travlender* taps the + button to create a new event, choosing to create a transfer event. In the Device, the *DeviceView* sends a request to the *DeviceController*, passing to it the event information. Then, the *DeviceController* dispatches the request to the Application Server *Dispatcher*, that requests a new event creation to the *Event-Controller*, that in turn requests an event list to the *Model*. Since the transfer event is designed only for events outside Milan, the *EventController* takes only one test, to check whether there is at least an overlap between the new transfer event and an old transfer, standard or flexible event (in the third case, it's important to be careful about its constraints). If the test comes back negative, the *EventController* requests the map to the *MapManager* and a set of necessary information to the *InformationManager*. Then, the *EventController* updates the *Model*, that also forwards the update to the *Data*. Now, the *DeviceController* can finally update the *LocalModel* and send to the *DeviceView* the request to update the view.

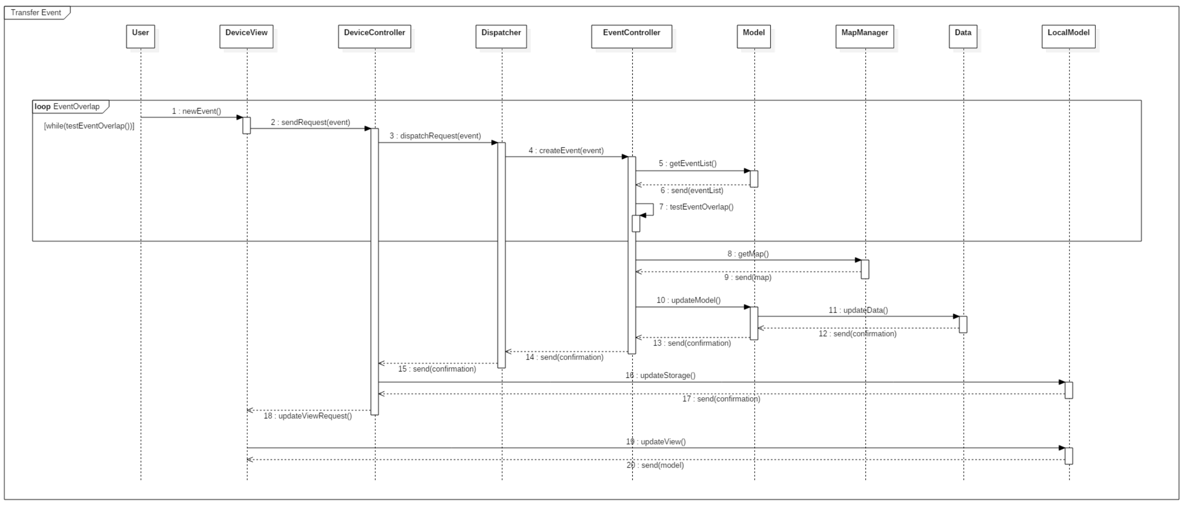


Figure 2.7: Transfer event

2.4.4 Start a travel and purchase a ticket

The sequence starts when the *Travlender* taps the *Go* to reach an existing event. In the Device, the *DeviceView* sends a request to the *DeviceController*, passing the information on the upcoming event that the *Travlender* wants to reach. The *DeviceController* dispatches the request to the Application Server *Dispatcher*, that requests to start the travel to the *EventController*, that in turn requests the map to the *MapManager*, a set of necessary information to the *InformationManager* and all the user preferences, owned vehicles and constraints to the *Model*, that forwards the request to the *Data*. Now, the *EventController* evaluates the best way to reach the event, taking account of all the acquired information, and checks whether the travel time overlaps part of the event (on the off chance that, for any reason, a way to reach in time the event doesn't exist anymore, the application will warn the user of the delay time). Then, the *EventController* updates the *Model*, that also forwards the update to the *Data*. Now, the *DeviceController* can update the *LocalModel* and send to the *DeviceView* the request to update the view.
Once the *Travlender* starts the travel, he/she can decide to buy in-app a public transport ticket, if required. In the event that the *Travlender* decides to do that, the *DeviceView* sends a request to the *DeviceController*, passing all the user purchase information. The *DeviceController* dispatches the request to the Application Server *Dispatcher*, that requests to purchase a ticket to the*EventController*. The *EventController* forwards the purchase request to the *PurchaseManager*, that sends on success a confirmation message. So, the *EventController* can update the *Model*, that also forwards the update to the *Data*. In this case too, the *DeviceController* updates the *LocalModel* and sends to the *DeviceView* the request to update the view.

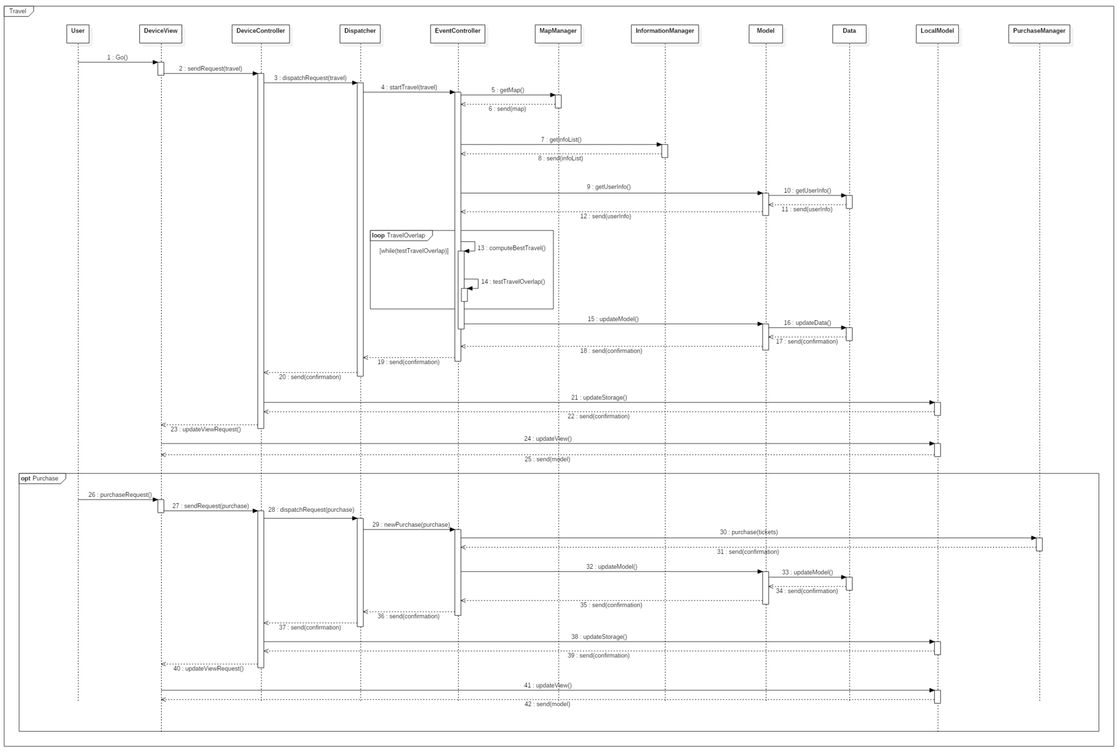


Figure 2.8: Travel start and ticket purchase

2.5 Component interfaces

2.6 Selected architectural styles and patterns

2.6.1 Architectural styles

Travlendar+ is designed to use one architectural style:

Client-Server

As highlighted in purple in the component diagram [Figure 2.3], the applitication relies on a close communication beetwen two different hardwares:

1. the Device on which *Travlendar+* is installed (the *client*);
2. the Application Server and the Database Server, that provide the *Travlendar+* services (the *server*).

2.6.2 Patterns

Travlendar+ also is designed to use three different patterns:

Model-View-Controller

As highlighted in cyan in the component diagram [Figure 2.3], the application is divided into three sections:

1. a *view*, that corresponds to the device and sends all the update requests to the *Dispatcher* and displays the *Model*;
2. a *controller*, that groups the *Dispatcher*, the *Registration Controller*, the *LoginController*, the *AccountController* and the *EventController*, recieves the *DeviceController* requests and manipulates the *Model*;
3. a *model*, represented by the namesake component.

Local Model-View-Controller

The device is also divided into three components, that simulate a local *MVC* pattern, through which the *Travlender* can use some application services also if he/she is offline (obviously, any update will be effective only once he/she will be back online):

1. a *local view*, represented by the *DeviceView*, that displays the *LocalModel*.
2. a *local controller*, represented by the *DeviceController*, that recieves the requests from the *DeviceView* and manipulates the *LocalModel* after the *Model* and *Data* update.
3. a *local model*, represented by the namesake component, that is a local storage of the Application Server *Model*.

Dispatcher

The addition of the *Dispatcher* component permits to carefully monitor all the controllers. The *Dispatcher* is responsible for the request dispatching to the concerned controllers. Obviously, the *Dispatcher* needs a list of all of them.

3 | Algorithm design

3.1 Cheapest travel algorithm

This Java-code method convey a sense of how the cheapest travel algorithm will be implemented in the application:

Input: a set of travels.

Output: the cheapset travel from the set.

```
//cheapest way method
public Travel minimizeCost (Arraylist<Travel> travels){

   travels[0] = min;

   for(i = 1; i <= travels.size(); i++){
      if(travels[i].totalCost < min.totalCost){
         min = travels.get(i);
      }
   }

   return min;

}
```

3.2 Most ecological travel algorithm

This Java-code method convey a sense of how the most ecological travel algorithm will be implemented in the application:

Input: a set of travels.

Output: the most ecological travel from the set.

```
//most ecological way method
public Travel minimizeCFP (Arraylist<Travel> travels){

   travels[0] = min;

   for(i = 1; i <= travels.size(); i++){
      if(travels[i].totalCFP < min.totalCFP){
         min = travels.get(i);
      }
   }

   return min;

}
```

3.3 Quickest travel algorithm

This Java-code method convey a sense of how the quickest travel algorithm will be implemented in the application:

Input: a set of travels.

Output: the quickest travel from the set.

```
//quickest way method
public Travel minimizeTime (Arraylist<Travel> travels){

   travels[0] = min;

   for(i = 1; i <= travels.size(); i++) {
      if(travels[i].totalDistance < min.totalDistance) {
         min = travels.get(i);
      }
   }

   return min;

}
```

4 | User interface design

4.1 User interface

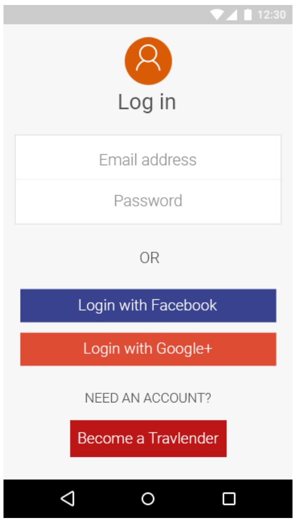


Figure 4.1: Login

The unregistered or unlogged user can log in to his/her account (if he/she has already got one) or create a new one. The application allows to log in with his/her own Facebook or Google+ account.

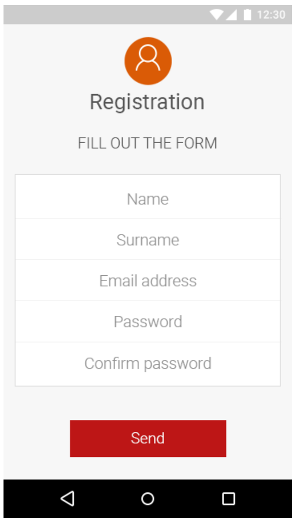


Figure 4.2: Registration

Tapping *Become a Travlender* an unregistered user can sign in to *Travlendar+*. A registration form appears and the user can fill out the form and tap *Send* to complete his/her registration.

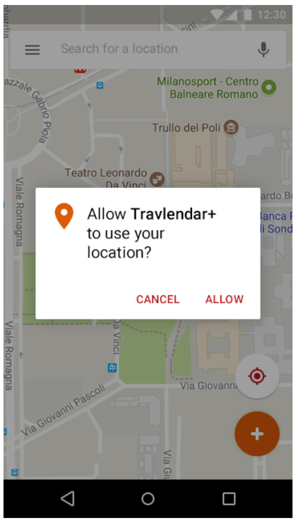


Figure 4.3: Alert

The first time the *Travlender* starts the application a pop-up appears, in which *Travlendar+* asks for the permission to use the user location. The user can tap on *allow* to give it, or *cancel* to refuse. In the second case, many application functions won't be accessible.

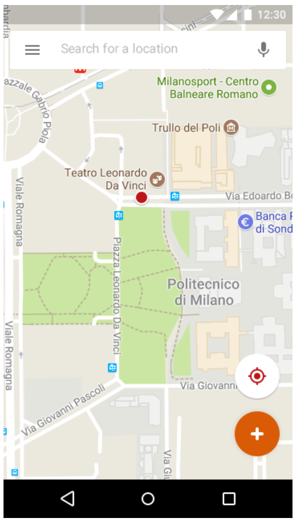


Figure 4.4: Map

If the *Travlender* decides to use the map view, he can see two buttons on the right. The first one centers the map on his/her position, the second one allows him/her to schedule a new event.

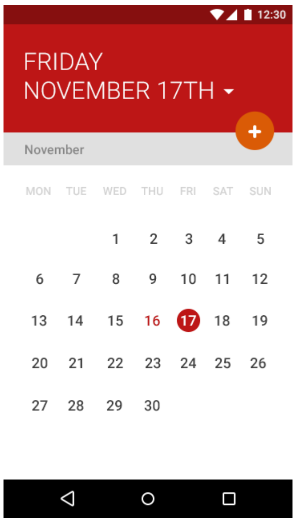
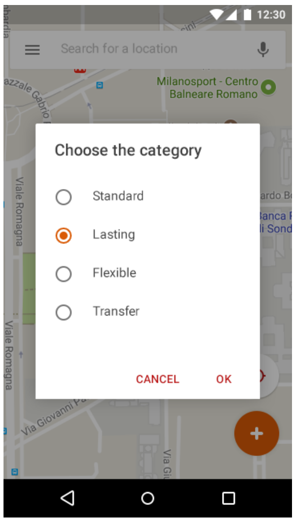


Figure 4.5: Calendar

If the *Travlender* decides to use the calendar view instead, he can see only one button on the right that allows him/her to schedule a new event. The *Travlender* can go to the previous or next month swiping on the left or on the right, respectively.

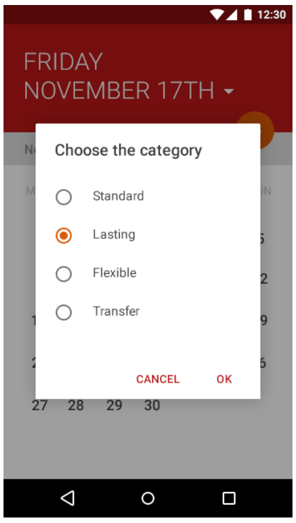
When the *Travlender* decides to create a new event, he/she can tap the + button on the map and a pop-up appears, in which *Travlendar+* asks for the event category.



Choose the category

[ ] Standard
[✓ Lasting]
[ ] Flexible
[ ] Transfer

Figure 4.6: Choise from the map



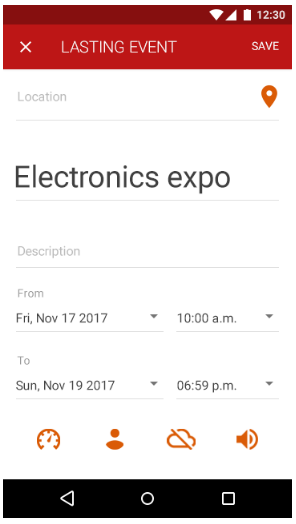
Choose the category

[ ] Standard
[✓ Lasting]
[ ] Flexible
[ ] Transfer

Figure 4.7: Choise from the calendar

The *Travlender* can also tap the same button from the calendar. Also in this case the same pop-up appears.

Now a new screen appears, in which the user can insert the location of the event, its name, a description, the starting and ending date and time and can modify the default settings, tapping the four buttons on the bottom.



LASTING EVENT

Location

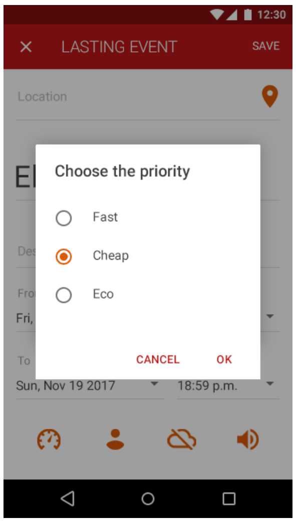
Electronics expo

Description

From: Fri, Nov 17 2017 10:00 a.m.

To: Sun, Nov 19 2017 06:59 p.m.

Figure 4.8: Creation of a new event

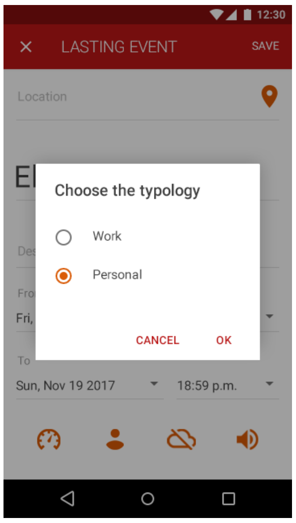


Choose the priority

Fast [✓ Cheap] Eco

Figure 4.9: Priority choise

The first one permits to change the travel preference from *quick* to *cheap*, or *eco*.

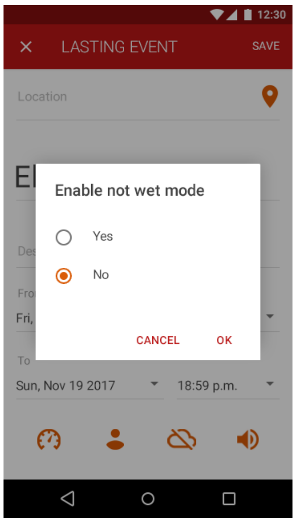


Choose the typology

Work [✓ Personal]

Figure 4.10: Typology choise

The second one permits to change the event type from *work* to *personal*.



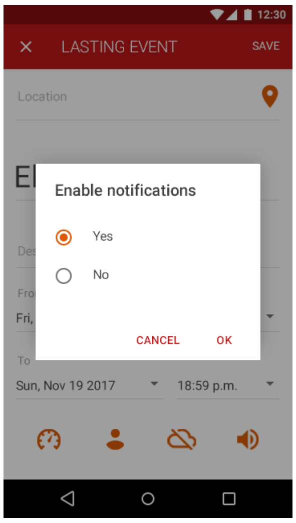
Enable not wet mode

Yes [✓ No]

Figure 4.11: Not wet mode status

The third one enables (or disables) the *not wet* travel.

The last one enables (or disables) *notifications.*



Enable notifications

[✓ Yes] No

To: Sun, Nov 19 2017 18:59 p.m.

Figure 4.12: Notifications status

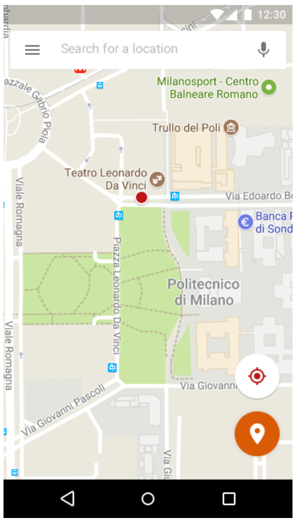
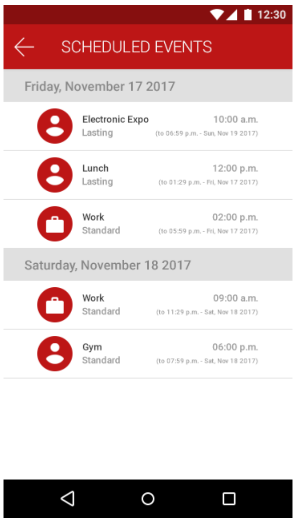


Figure 4.13: Location edit

Tapping the top-right button, the map appears and the *Travlender* can choose the location straight from it.

With the left swipe, the *Travlender* can access the scheduled events view, from the menu.



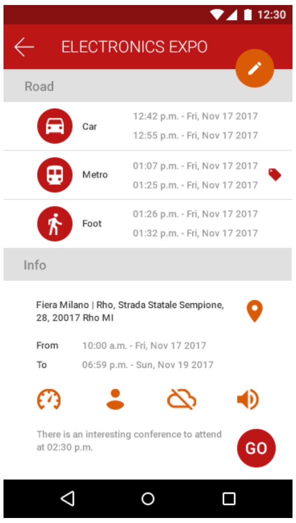
Friday, November 17 2017

Electronic Expo Lasting	10:00 a.m. (to 06:59 p.m. - Sun, Nov 19 2017)
Lunch Lasting	12:00 p.m. (to 01:29 p.m. - Fri, Nov 17 2017)
Work Standard	02:00 p.m. (to 05:59 p.m. - Fri, Nov 17 2017)

Saturday, November 18 2017

Work Standard	09:00 a.m. (to 11:29 p.m. - Sat, Nov 18 2017)
Gym Standard	06:00 p.m. (to 07:59 p.m. - Sat, Nov 18 2017)

Figure 4.14: List of scheduled events


12:30

ELECTRONICS EXPO

Road

Car	12:42 p.m. - Fri, Nov 17 2017	12:55 p.m. - Fri, Nov 17 2017
Metro	01:07 p.m. - Fri, Nov 17 2017	01:25 p.m. - Fri, Nov 17 2017
Foot	01:26 p.m. - Fri, Nov 17 2017	01:32 p.m. - Fri, Nov 17 2017

Info

Fiera Milano | Rho, Strada Statale Sempione, 28, 20017 Rho MI

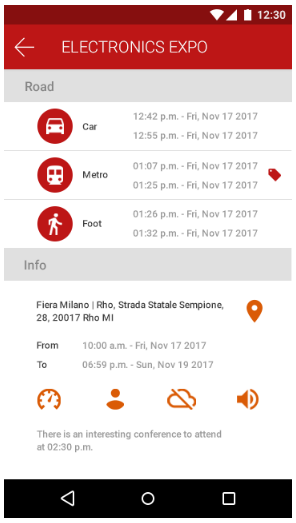
From 10:00 a.m. - Fri, Nov 17 2017

To 06:59 p.m. - Sun, Nov 19 2017

There is an interesting conference to attend at 02:30 p.m.

Figure 4.15: Summary of the event

The summary permits to modify the event information with the top-right button. The button on the right permits to change the location. Also, the *Travlender* can modify the default settings, tapping on the four buttons on the bottom. The first one is the *quick/cheap/eco* button. The second one is the *work/personal* button. The last but one is the *not wet* travel button. The last one is the *notifications* button. The bottom-right button is the *Go* button, tapping that the travel starts.


12:30

ELECTRONICS EXPO

Road

Car	12:42 p.m. - Fri, Nov 17 2017	12:55 p.m. - Fri, Nov 17 2017
Metro	01:07 p.m. - Fri, Nov 17 2017	01:25 p.m. - Fri, Nov 17 2017
Foot	01:26 p.m. - Fri, Nov 17 2017	01:32 p.m. - Fri, Nov 17 2017

Info

Fiera Milano | Rho, Strada Statale Sempione, 28, 20017 Rho MI

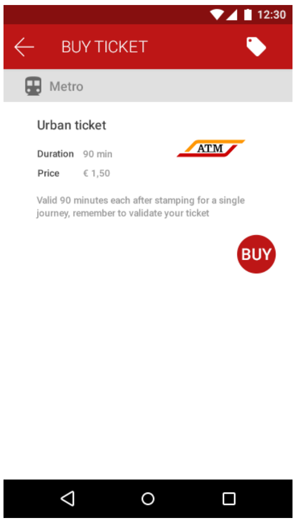
From 10:00 a.m. - Fri, Nov 17 2017

To 06:59 p.m. - Sun, Nov 19 2017

There is an interesting conference to attend at 02:30 p.m.

Figure 4.16: Started event

Once the *Travlender* taps on the *Go* button, he/she can't modify the travel settings anymore. From now, the *Travlender* can buy in-app all the required tickets, if he/she wants.


12:30

BUY TICKET

Metro

Urban ticket

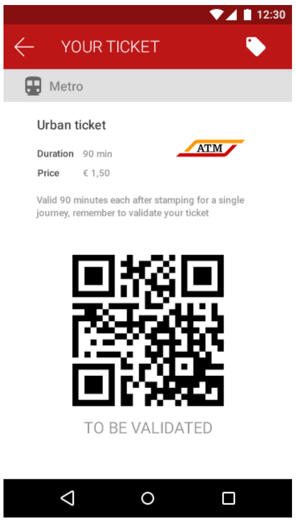
Duration 90 min

Price € 1,50

Valid 90 minutes each after stamping for a single journey, remember to validate your ticket

Figure 4.17: Ticket to be purchased

Tapping the ticket icon, the *Travlender* can see all the ticket details. The *Buy* button permits the user to buy the ticket.



Urban ticket

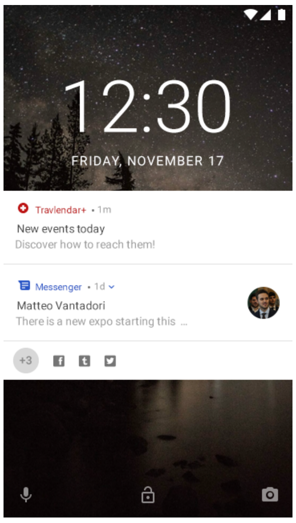
Duration 90 min

Price € 1,50

Valid 90 minutes each after stamping for a single journey, remember to validate your ticket

Figure 4.18: Purchased ticket

Tapping on the ticket icon once the *Travlender* bought the ticket, he/she can see a summary of the ticket details.



Travlendar+ • 1m

New events today

Discover how to reach them!

Messenger • 1d

Matteo Vantadori

There is a new expo starting this ...

Figure 4.19: Lock screen

If there is at least a lasting event, a low-priority notification appears on the lock screen once a day.

4.2 User interface diagram

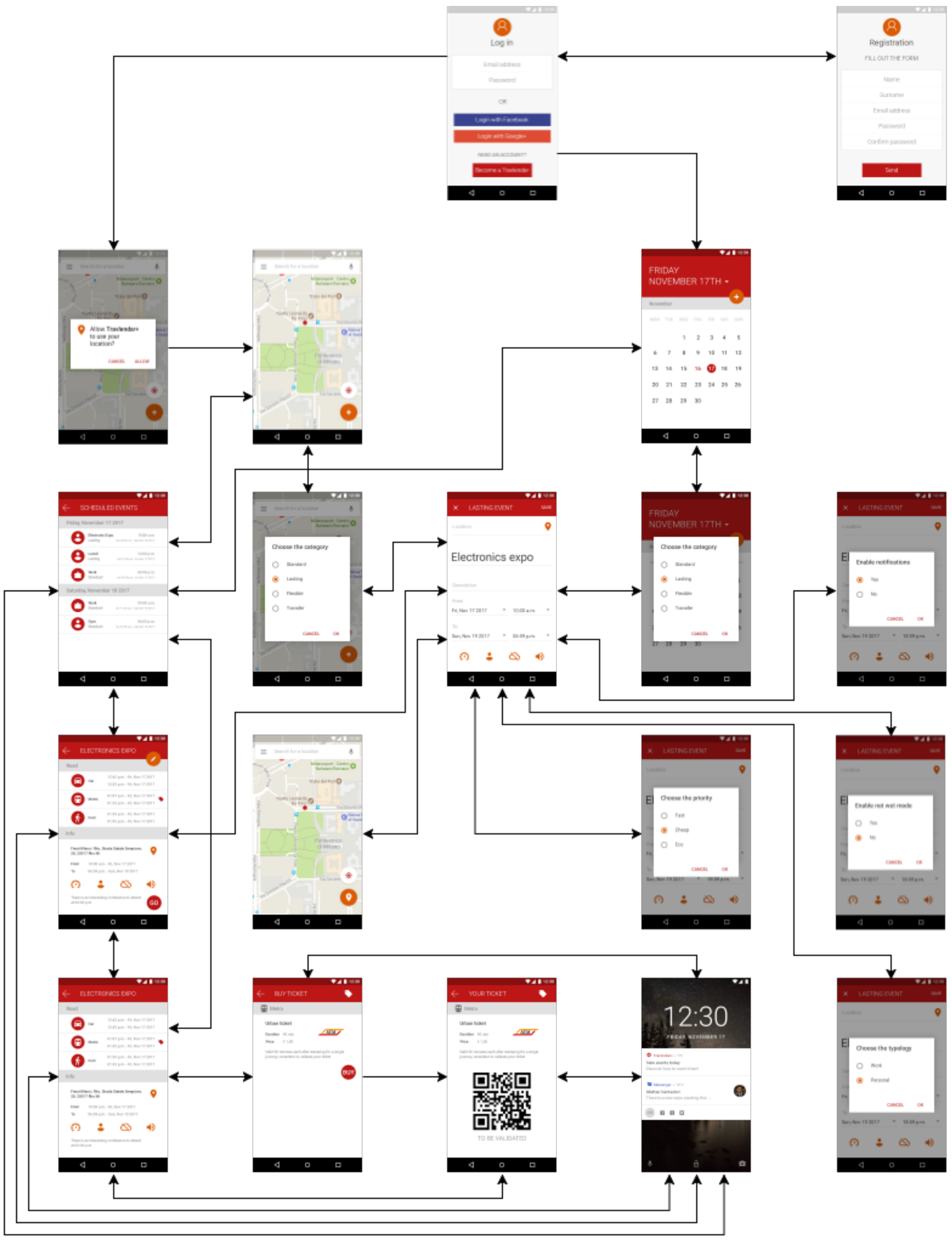


Figure 4.20: User interface diagram

5 | Requirements Traceability

Section [R.1] treats the requirements related to the event scheduling:

R.1.1 The system must keep track of the user commitments.

Section [R.2] treats all the requirements related to the creation or modification of an event:

R.2.1 The system must verify that the Travlender is free during all the event time slot.

R.2.2 The system must verify that the Travlender is free during all the travel time slot.

R.2.3 The system must guarantee that the new event doesn't overlap the previous event time slot.

R.2.4 The system must avoid that the new event compromizes the reachability of the upcoming event.

R.2.5 The system must inform the Travlender when it's not possible to schedule the new event in the chosen time slot.

R.2.6 The system must insert the new event after having checked whether it's possible to do it.
â

R.2.7 The system must suggest possible solutions to arrange any overlap, either postponing the starting time of the upcoming event or anticipating the ending time of the previous one.

Section [R.3] treats all the requirements related to the public, shared and non-shared transports:

R.3.1 The system must locate all the bike sharing system in Milan on the map.

R.3.2 The system must locate all the car sharing system in Milan on the map.

R.3.3 The system must locate all the public transports stops in Milan on the map.

R.3.4 The system must unlock a shared car when required.

R.3.5 The system must unlock a shared bike when required.

R.3.6 The system must let the Travlender book a taxi via-app.

R.3.7 The system must let the Travlender book a limousine via-app.

Section [R.4] treats all the requirements related to the travel:

R.4.1 The system must control if the (eventually) required tickets are already owned by the Travlender.

R.4.2 The system must evaluate the best way to travel for the Travlender, according to his/her preferences, constraints and owned means.

R.4.3 The system must not suggest the Travlender to use the owned car and bike for a travel starting from a location where they aren't placed.

R.4.4 The system must allow the Travlender to purchase tickets via-app.

R.5.1 The system must allow the Travlender to create an overlappable event.

R.5.2 The system must allow the Travlender to create an event with a specified reservation time slot.

R.6.1 The system must keep track of the Travlender public transports passes and tickets.

R.6.2 If asked, the system must notify the user if a scheduled event takes place on an adverse weather conditions day.

R.6.3 The system must allow a Travlender with disabilities to reach the event evaluating a way according to his/her needs.

R.6.4 The system must keep track of the means owned by the Travlender.

R.6.5 The system must keep track of the means selected by the Travlender.

R.6.6 The system must be able to evaluate the fastest way to reach the event, according to the Travlender preferences, constraints, owned means, tickets and passes.

R.6.7 The system must be able to evaluate the cheapest way to reach the event, according to the Travlender preferences, constraints, owned means, tickets and passes..

R.6.8 The system must be able to evaluate the most ecological way to reach the event, according to the Travlender preferences, constraints, owned means, tickets and passes.

6 | Implementation, integration and test plan

6.1 Device

6.2 Application Server

6.3 Database Server

7 | Effort spent

14-oct	15:00-21:00 00:00-02:00	8 hours
15-oct	16:00-18:00 00:00-01:00	3 hours
16-oct	10:00-12:00 22:00-01:00	5 hours
17-oct	16:00-18:00 22:00-02:00	6 hours
18-oct	15:00-18:00 00:00-02:00	5 hours
19-oct	22:00-01:00	3 hours
20-oct	22:00-02:00	4 hours
21-oct	16:00-19:00 22:00-02:00	7 hours
22-oct	22:00-02:00	4 hours
23-oct	22:00-03:00	5 hours
24-oct	17:00-19:00 00:00-02:00	4 hours
25-oct	16:00-18:00 00:00-03:00	5 hours
26-oct	16:00-19:00 22:00-04:00	9 hours
27-oct	16:00-19:00 00:00-03:00	6 hours
28-oct	16:00-19:00 20:00-00:00	7 hours
29-oct	10:00-13:00 15:00-23:00	11 hours