simpli·city

The Road User Information System Of The Future

WP7 – Use Case I:
Meeting the Increased Mobility Demand

D7.2: Use Case Implementation Report (Use Case I)

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Short Abstract (Teaser)

This deliverable reports the work carried out within task T7.2 for the implementation of the Use Cases defined in WP7 that have been used for the real-world validation process within SIMPLI-CITY.

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Executive Summary

The SIMPLI-CITY project foresaw two Use Case scenarios, which were used to test the theoretical structure and software prototypes in a real-world environment. Indeed the work package WP7, analogously to WP8, was aimed to demonstrate the effectiveness of SIMPLI-CITY to provide reliable mobility-related services and apps to be delivered to road users by means of the Personal Mobility Assistant.

Use Case I was further divided into two topics: “Routing to a Big Event” (Use Case topic I.1, defined by IBM and located in Dublin, Ireland) and “Personalised Traffic Restrictions” (Use Case topic I.2, defined by SRM and located in Bologna, Italy). Although these two Use Case topics were related to each other, each addressed a different area, e.g., while Use Case topic I.1 addressed the transportation and navigation part of a trip, Use Case topic I.2 focused on traffic analysis.

This deliverable describes how both topics of the Use Case defined in T7.1 were addressed through an app developed on top of the SIMPLI-CITY system.

Table of Contents

1 Introduction

SIMPLI-CITY – The Road User Information System of the Future – was a project funded by the Seventh Framework Programme of the European Commission under Grant Agreement No. 318201. Its results provide the technological foundation for bringing the “App Revolution” to road users by facilitating data integration, service development, and end user interaction.

Within this document, an in-depth description of the implementation of the Use Cases defined in WP7 (Use Case topic I.1 and Use Case topic I.2) is provided.

1.1 SIMPLI-CITY Project Overview

Analogously to the “App Revolution”, SIMPLI-CITY adds a “software layer” to the hardware-driven “product” mobility. SIMPLI-CITY takes advantage of the great success of mobile apps that are currently being provided for systems such as Android, iOS, or Windows Phone. These apps have created new opportunities and even business models by making it possible for developers to produce new apps on top of the mobile device infrastructure. Many of the most advanced and innovative apps have been developed by players formerly not involved in the mobile software market. Hence, SIMPLI-CITY supports third party developers to efficiently realise and sell their mobility-related service and app ideas by a range of methods and tools, including the Mobility Services and App Marketplaces.

In order to foster the wide usage of those services, a holistic framework is needed which structures and bundles potential services that could deliver data from various sources to road user information systems. SIMPLI-CITY provides such a framework by facilitating the following main project results:

- Mobility Services Framework: A next-generation European Wide Service Platform (EWSP) allowing the creation of mobility-related services as well as the creation of corresponding apps. This enables third party providers to produce a wide range of interoperable, value-added services, and apps for drivers and other road users.
- Mobility-related Data as a Service: The integration of various, heterogeneous data sources like sensors, cooperative systems, telematics, open data repositories, people-centric sensing, and media data streams, which can be modelled, accessed, and integrated in a unified way.
- Personal Mobility Assistant: An end user assistant that allows road users to make use of the information provided by apps and to interact with them in a non-distracting way – based on a speech recognition approach. New apps can be integrated into the Personal Mobility Assistant in order to extend its functionalities for individual needs.

To achieve its goals, SIMPLI-CITY conducted original research and applied technologies from the fields of Ubiquitous Computing, Big Data, Media Streaming, the Semantic Web, the Internet of Things, the Internet of Services, and Human-Computer Interaction. For more information, please refer to the project website at http://www.simpli-city.eu.

1.2 Document Purpose, Scope and Context

The overall objective of work package WP7 was to demonstrate the feasibility of SIMPLI-CITY's approach to build services and innovative mobility-related end user apps by integrating different data sources and to present them to the end user by means of the Personal Mobility Assistant. In the context of work package WP7, the purpose of this document is to show how the solutions defined for SIMPLI-CITY were converted into real apps that are applicable in a real-world environment.

Therefore this deliverable is focused on the Use Case Specification (Use Case I) defined in D7.1.2, implemented through an app developed to demonstrate the Use Case.

1.3 Document Status and Target Audience

This document is listed in the Description of Work (DoW) as "public", as it provides general information about the goals and scope of SIMPLI-CITY and can therefore be used by external parties in order to get according insight into the project activities.

While the document primarily aims the project partners, this public deliverable can also be useful for the wider scientific and industrial community. This includes other publicly funded projects, which may be interested in collaboration activities.

1.4 Abbreviations and Glossary

A definition of common terms and roles related to the realization of SIMPLI-CITY as well as a list of abbreviations is available in the supplementary document "Supplement: Abbreviations and Glossary", which is provided in addition to this deliverable.

Further information can be found at http://www.simpli-city.eu.

1.5 Document Structure

This deliverable is broken down into the following sections:

- Section 1 provides an introduction for this deliverable, including a general overview of the project, and outlines the purpose, scope, context, status, and target audience of this deliverable.
- Section 2 provides a description of the frame of this deliverable, taking into account the relation with the SIMPLI-CITY platform.
- Section 3 describes the Use Case Topic I.1: "Routing to a Big Event".
- Section 4 describes the Use Case Topic I.2: "Personalized Traffic Restrictions".
- Section 5 provides an overview of the functionality of the single app that implements the two Use Case topics.
- Section 6 provides the final conclusions.

2 Use Case I: Meeting the Increased Mobility Demand

2.1 Introduction

The present deliverable describes the implementation of the real-world scenarios defined within work package WP7. The Use Case scenarios defined in WP7 complete those already provided within WP8 allowing a more extensive validation of the SIMPLI-CITY platform and components delivered by WP4-6.

In particular this deliverable provides an explanation of the implementation of Use Case I defined in D7.1.2 and its two topics: Topic I.1 “Routing to a Big Event” (located in Dublin), and Topic I.2 “Personalised Traffic Restrictions” (located in Bologna).

The two Use Case topics in Dublin and Bologna were strictly connected to each other; in particular the Use Case I.2 was partly based on the Use Case I.1, because data elaboration procedures from the Dublin Use Case were part of the personalised traffic restrictions elaboration conducted in Bologna.

The present deliverable D7.2 shows how the final app follows the Use Case functional definition and details about the architecture of the app in the framework of SIMPLI-CITY environment, and describes it also in detail.

2.2 Relation with the SIMPLI-CITY Platform

The specified app in this deliverable was built on top of the SIMPLI-CITY platform which was developed in the RTD WP4-6. The app is structured into backend services and a frontend app for the SIMPLI-CITY PMA.

2.2.1 Usage of the SIMPLI-CITY Platform by the Use Case App

2.2.1.1 Service Component

The service component of a Use Case app makes use of backend services hosted by the Service Runtime Environment (SRE). These services enable the Use Case functionality to be reusable in different SIMPLI-CITY apps, due to a modular separation. In this context, the implemented service components can also make use of data services, e.g., end user and device data, or data derived from different other sources can be accessed without taking care “where” they come from. Crucial data for the Use Case apps are the user’s current location for rerouting.

2.2.1.2 App Component

The Use Case app components make use of the backend services and show the resulting information to the user through the Multimodal Dialogue Interface.

2.2.2 Advantages of Using the SIMPLI-CITY Platform

In SIMPLI-CITY a variety of different data sources (realized as data services) were implemented and integrated in the RTD WP4-6. Using these data services, apps have access to a wide range of different data which can be easily aggregated and processed in order to be provided to end users. Hence, app and service developers can create complete

new apps and realize complex Use Cases upon this data. Although the WP7 app makes use only of a small subset of these services, it serves as an example showing how to “bring the RTD outcome to the real world”.

2.3 Required Equipment

Figure 1: Use Case I Architecture

The Use Case I “Meeting the Increased Mobility Demand” was designed for offering a set of services to drivers aiming at improving her/his transportation experience and perform analysis of the current traffic situation in real time.

In order to realize this Use Case, a smartphone running Android 4.4 is required for the app and the connectivity with the backend services. All the backend services are already provided by SIMPLI-CITY and deployed on a corresponding server.

3 Use Case Topic I.1: Routing to a Big Event

3.1 Topic Overview

As already stated in D7.1.2 the main objective of the first topic in this Use Case is to offer a set of services to help drivers to improve their routing by giving them real-time information about the conditions on the traffic.

In addition to inform about traffic congestions in real-time, the app is able to give traffic-related predictions about events that can cause traffic congestions or could affect the overall travel time negatively.

In more details the following functionalities have been implemented within this scenario:

- Routing. The user is able to define several routes, like defining a route based on a destination, defining a time interval or a transportation mode. The result will be a map shown to the user with the current selected route and information about potential anomalies.
- Anomalies consideration. The user is able to get information about traffic anomalies on the selected route and to demand more information about any specific anomaly.
- Personalized areas and routes. The user is able to save information in the app about routes and then retrieve these routes in the future.

3.2 Topic Architecture

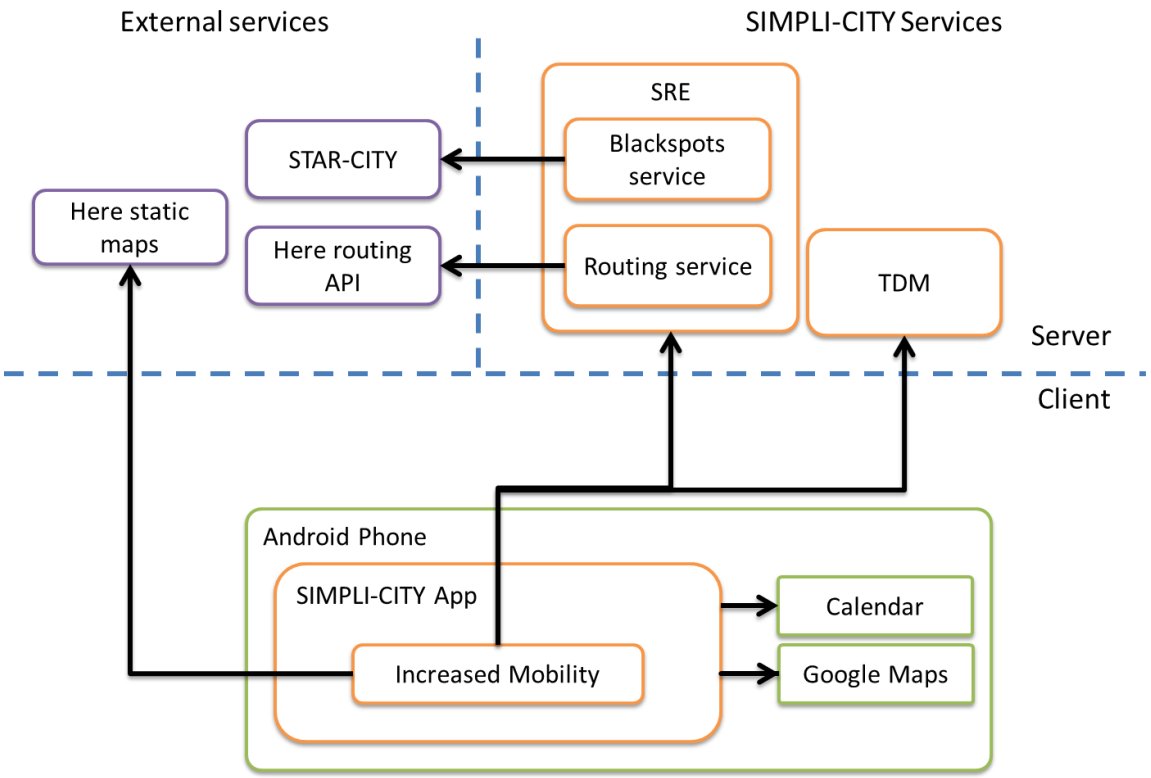

Figure 2: Architecture of the Use Case Topic I.1

As depicted in Figure 2, the architecture for the Topic I.1 “Increased Mobility” is divided into several components that in conjunction offer the functionalities defined in task T7.2, i.e., the server side with the Service Runtime Environment (SRE) and its backend services, the TDM, and third-party external services such as STAR-CITY, Here routing and Here static maps. On the client side the Android Phone and its apps is located.

This is a simplified version of the whole SIMPLI-CITY architecture, including the major components used for this Use Case topic.

3.2.1 Server Side Components

There are two types of server side components. The services part of the SIMPLI-CITY platform, and services from external sources and consumed by SIMPLI-CITY components.

The SIMPLI-CITY platform has basically two main components: The SRE and the TDM. The SRE offers a set of services integrated into the SIMPLI-CITY platform and invoked by the client apps through the SIMPLI-CITY framework, while the TDM is responsible for handling the voice interaction with the user.

These two components, SRE and TDM, were widely explained in the Technical Specification deliverable (D3.2.2).

External components utilised within Use Case Topic I.1 are offered by different providers:

- STAR-CITY. This is a service developed by IBM that offers anomalies prediction based on user context (location, time frame, etc).
- Here Routing API. Here services are used in order to calculate the appropriate route.

- Here Static API. This service allows retrieving a static map image of the current route based on a set of parameters (source, destination, waypoints, etc).

In the SRE, two services are consumed by the Increased Mobility app.

The Routing Service is used in order to get the route to follow from source to destination points. This service uses Here Routing API as external service to calculate the routes. Other considerations, like traffic restrictions due to vehicle information, are also evaluated by this service. However, this is part of Use Case Topic I.2 (see Section 4).

The Blackspots Service receives information extracted from the current user route (route bounding box, time, etc), and uses this information to retrieve the list of traffic anomalies that could affect the driving from the STAR-CITY system.

3.2.2 Client Components

The main client components are the PMA application and the Increased Mobility app that runs on top of it.

The Increased Mobility app performs all communications to other components through the PMA and provides answers to the TDM when needed as result of the business rules defined by the app and the answer received from SRE services.

The phone calendar is used to retrieve information about events that the user plans to attend.

Finally, Google Maps is used as navigation tool to perform the live routing once all the aspects of the route have been decided by the user.

3.3 Backend Services

In the SRE, two services are consumed by the Increased Mobility app.

The Routing Service is used in order to get the route to follow from source to destination points. This service uses Here Routing API as an external service to calculate the routes. The route request is performed through the method getDirections. This method takes as input parameters the current latitude and longitude of the vehicle, collected through the PMA sensors, and the destination address (also information from vehicle and driving license, but as stated before, this is not used for this Use Case Topic but for the next Use Case Topic in Section 4). The output is the different data which is needed to create a route, which is then shown on a map to the user (using the Here Static API).

The Blackspots Service receives information from the user route (source, target, time, etc), and uses this information to retrieve the list of traffic anomalies that could affect the driving from the STAR-CITY system. The method getAnomalies gets as input the user coordinates and the radius in meters. Within this area, the service searches for traffic anomalies. The output is a list of anomalies including a description, a location, a severity, etc. This information is also shown to the user.

4 Use Case Topic I.2: Personalised Traffic Restrictions

4.1 Topic Overview

The main objective of the second Topic in this Use Case is to being able to offer a personalized route to the user, according to traffic restrictions based on the user information, and specifically, based on the vehicle characteristics. This Topic uses Bologna city as reference, where some areas of the city centre have specific circulatory restrictions.

The following functionalities have been implemented within this scenario:

- Routing prediction considering restricted areas. The Increased Mobility app is able to offer personalized routes to the user that allows the vehicle to drive on several areas or to avoid them if the user vehicle is not allowed.
- Anomalies consideration. Similar to the previous Topic, anomalies will be shown to improve the ability of the driver to take a different route based on anomalies prediction combined with the ability to drive through restricted areas or the need to avoid them.
- Personalized areas and routes. The Increased Mobility app will allow the user to store personalized routes and retrieve them in the future as stated in Section 3 with the addition of adding potential restricted areas according to the user's profile.

For a more detailed description of this second Topic in this Use Case, please see deliverable D7.1.2.

4.2 Topic Architecture

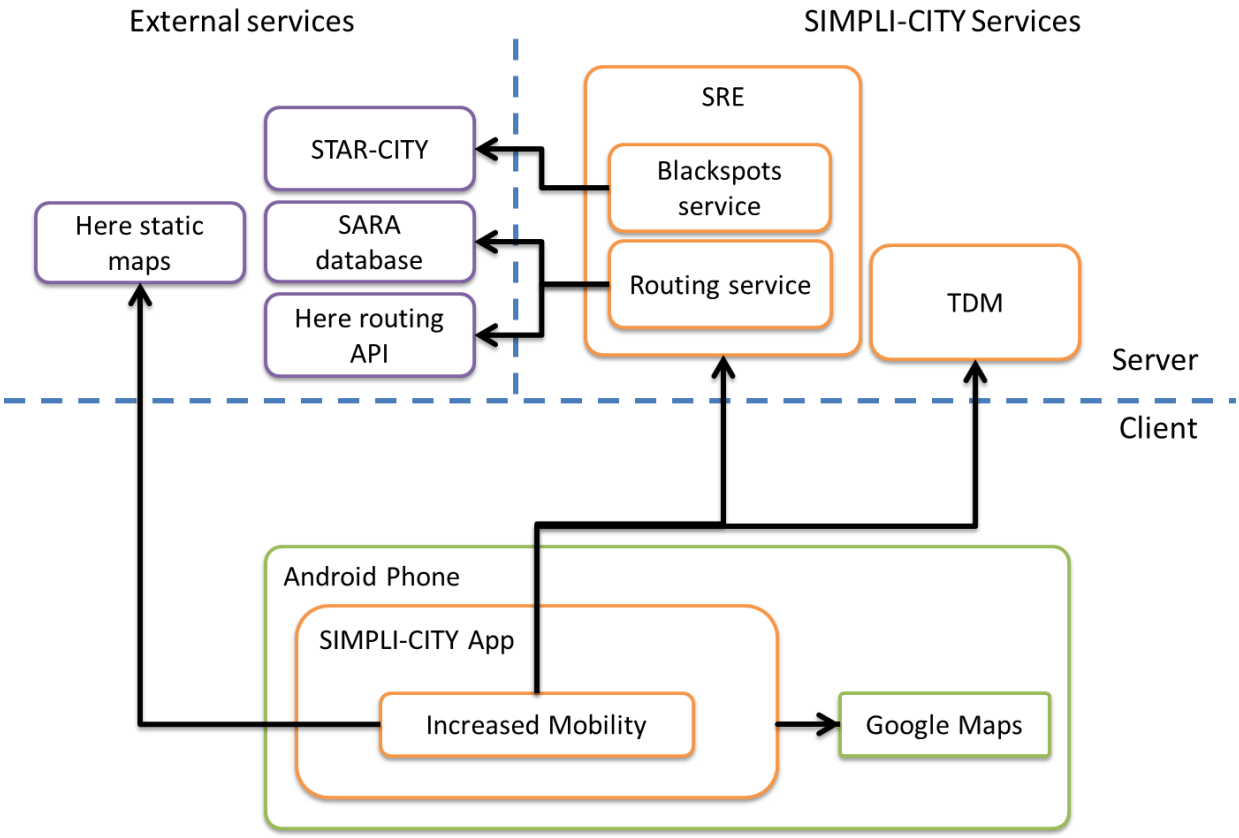

Figure 3: Architecture of the Use Case Topic I.2

As in the Topic I.1, the Increased Mobility architecture for the Topic I.2 is divided into several components that in combination offer the functionalities defined in task T7.2.

As can be seen from Figure 3, for the Topic I.2, the components that allow the app to offer extended functionalities to fulfil the needs requested by Topic I.2 are added to the architecture of Topic I.1, which was shown in Figure 2.

4.2.1 Server Side Components

The server components for this Topic I.2 are similar to those explained in Section 3.2.1 but the use of the SARA database is added to this Use Case Topic.

The SARA database provides information about the restricted areas the current user is allowed to drive through. This information is requested by the Routing Service based on the current user profile. If the user has provided the required information about the vehicle, this information will be send to the Routing Service, which, after querying the SARA database, will use the Here Routing API to request a route avoiding certain areas (if needed). In case the user does not provide the required information, and thus, it is not provided to the Routing Service, the whole restricted area will be considered as forbidden during the route generation.

4.2.2 Client Components

The client components for this Topic I.2 are the same as for Topic I.1, since the login about the restricted areas is handled by the backend services deployed on the SRE. The only addition is the ability to specify the needed information about the vehicle to retrieve the correct restrictions for user's vehicle from the SARA database.

4.3 Backend Services

The backend services used by the app are the same as used for Topic I.1, which are described in Section 3.3.

The only difference is the use of the SARA database by the Routing service in order to get the current restricted areas for the user's vehicle.

5 App Implementation Review

5.1 Introduction

For both Use Case Topics (“Routing to a Big Event” and “Personalised Traffic Restrictions”) a single app has been created. This is a review of this app’s functionality.

Due to final changes or restrictions on the development platform, it was not possible to exactly follow what was specified for Use Case I in the deliverable D.7.1.2 Functional Specifications. In Section 5.4 these changes are described and the reasons are analysed.

5.2 App Structure

Figure 4 shows the navigation flow of the Increased Mobility app, following the way in which it has been implemented.

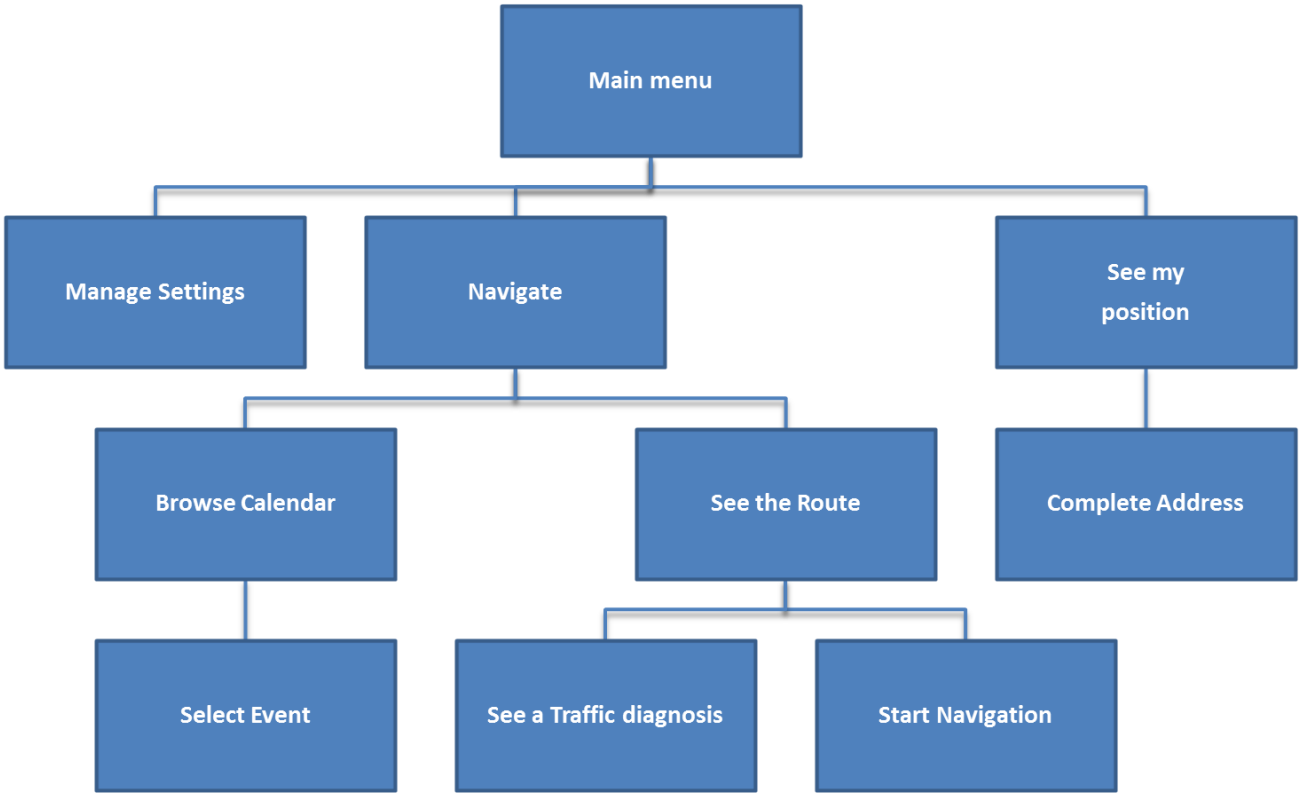

Figure 4: App Structure

The app has three main sections: “Manage Settings”, “Navigate” and “See my position”.

“Manage Settings” allows the user to setup its current vehicle information in order to receive routes tailored to the vehicle restricted areas according to Topic I.2.

The “Navigate” section is the main part of this app. It allows the user to create a route, both from a location related to device calendar events or a destination specified by the user. It also allows the user to see the information related to the anomalies in the route and start navigation using a navigation app (specifically Google Maps).

5.3 App Workflow

When the app is started, the main menu offers the options shown in Figure 5.

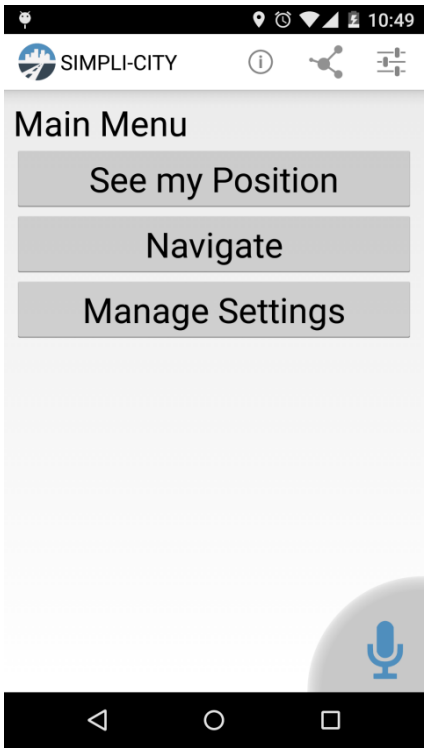

Figure 5: Main Menu

These options are presented in two ways. First the app reads them aloud asking the user which option she/he wants to choose, and second, it shows buttons related to that same options. The user has two ways of selecting any of those options, by tapping the microphone button (Push-To-Talk (PTT) button) and telling the system what option to choose, or by tapping the corresponding menu button.

This user interface approach is offered during all the app session, except for those questions made to the user where the answer is not reduced to a small number of options (like asking the user for destination address). In these cases, only voice answers are allowed. This was done in order to avoid touch interactions during critical situations, i.e., that the user does not get distracted during driving.

From this screen, the user can select three options related to the three main areas of the app, “See my Position” (Section 5.3.1), “Navigate” (Section 5.3.2), or “Manage Settings”.

5.3.1 See my Position

If the user selects “See my Position”, a map and a short description of the position are shown (see Figure 6). An extra option allows the user to get a detailed description of the current position by selecting the option “The complete address” located under the short description of the address (see Figure 7).

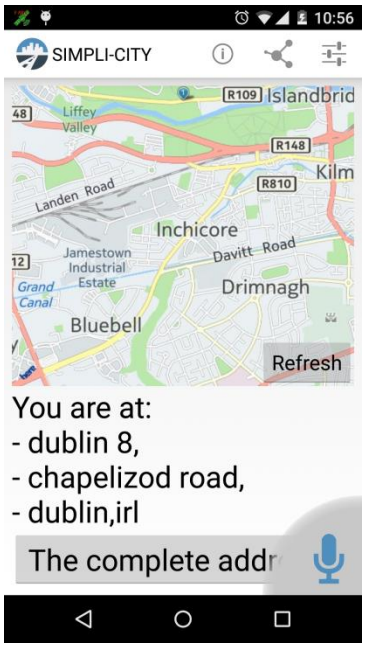

Figure 6: See my Position Menu

Figure 7: Complete Address

5.3.2 Navigate

In the Navigate screen, several options are offered to the user (see Figure 8), which are explained in the following sections:

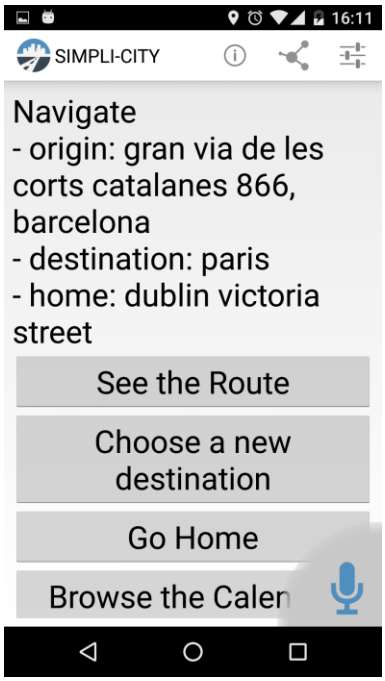

Figure 8: Navigate Screen

5.3.2.1 See the Route

In this screen a map with the route to the user destination is shown, together with the origin and destination and the following options: Start Navigation, which opens Google Maps ready to navigate, or See Traffic Diagnosis, which shows the closest traffic anomalies to the user.

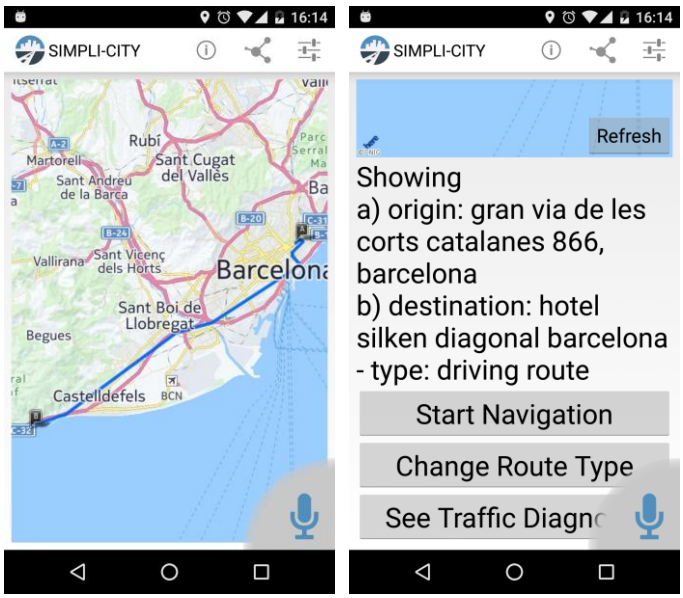

Figure 9: See the Route Menu

5.3.2.2 Browse Calendar

If the user clicks on the “Browse calendar” button from the Navigate section, an overview of upcoming calendar events is offered to the user to select (as shown in Figure 10). The data is taken from the user’s private calendar. Only events which include location information are

displayed. The user can now select one of the events in order to start the navigation to this event.

Figure 10: Browse Calendar

5.3.2.3 See Traffic Diagnosis

The “See a Traffic Diagnosis” option of the Navigation section shows to the user a list of anomalies around the selected route. The user can see the anomalies in the map and can select one of the anomalies in order to retrieve more information about the anomaly (as shown in Figure 11.

Figure 11: Anomaly Description

5.4 List of Changes from Use Case Definition

Use Case I was the first full app developed on top of the SIMPLI-CITY application. For this reason some limitations of the platform became apparent only during the development work for this Use Case I. In order to avoid these limitations, some of the options requested in the Functional Specification were implemented differently, thus adapting them to the best approach to improve the user experience:

- The menus were redesigned and simplified.
  After implementing the original navigation as proposed by deliverable D7.1.2 Functional Specification, the resulting navigation was too complex to be stated by voice in a comfortable way for the user. Thus, menus were simplified and several options were rephrased to make the conversational interface more natural, getting a user experience more similar to a natural conversation. Since the options used for voice interaction and for screen interaction are the same, in some cases the screen navigation did not look like the standard phrasing used in the majority of mobile apps. Also, several screens confirming what the user said were introduced, in order to give more confidence to the user that the right option was selected or the right data was introduced.
- The way addresses are introduced was modified.
  A specific case is the way addresses are introduced. In the original specification, the request was to ask the user for the street address, then ask for the city and finally, ask for the country. This conversation was too slow for the user, and the possibility of error due to misinterpretations of the voice were quite high. The final implementation requests the whole address in a single question. This method allows using reverse geocoding to verify the address in a single operation.

6 Conclusions

The aim of this deliverable D7.2 is to present the final implementation of the Use Case I: “Meeting the Increased Mobility Demand”, that was used to test the SIMPLI-CITY platform and solutions and the reliability of the PMA prototype in a real world setting.

Two Use Case topics were tested dealing with the provision of services and apps that support the whole trip from the preparation to the arrival at the destination.

The two topics, Use Case Topic I.1 and Use Case Topic I.2, cover two different aspects in which a driver is interested: The transportation comfort and the traffic analysis information.

The first Use Case Topic addresses how to navigate to a destination using a better calculated route to reach the place faster by avoiding possible traffic anomalies along the user’s route. For this also future anomalies with a high level of probability are taken into account. The second Use Case Topic addresses the needs or creating a route under the consideration of restricted areas, i.e., areas the user’s vehicle is allowed or forbidden to drive through, and how to get an alternative route around if needed.

Both Use Case topics are used to evaluate at what level SIMPLI-CITY’s PMA could be suitable to help users to plan and execute their routes through cities, potentially becoming the “Road User Information System of the Future”.

Implementation of this Use Case I was one of the first utilisations of the SIMPLI-CITY platform from a development perspective. According to the lessons learnt from usability evaluation, during this development some of the screens/menu points defined in deliverable D7.1.2 Functional Specification were changed in order to give to the user the same functionalities with a more comfortable and better usable voice-based interface.