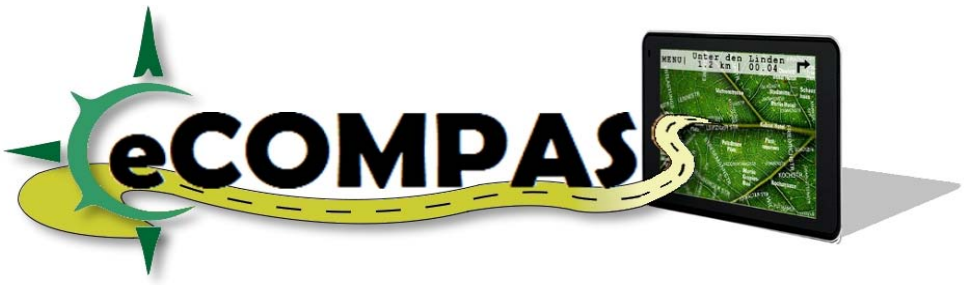

eCO-friendly urban Multi-modal route PlAnning Services for mobile uSers

FP7 - Information and Communication Technologies

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D1.2 – Use Case Analysis and Priority Application Scenarios

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☐ PP : Restricted to other programme participants (including the Commission Services)
☐ RE : Restricted to a group specified by the consortium (including the Commission Services)
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Keyword List: Use Cases, Actors, Functional Requirements Clustering, UML Notation, Use Case Prioritisation

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Summary

In this deliverable several use cases for eCOMPASS are presented and analyzed in view of their priority and applicability. The description of use cases is a very important instrument in order to simplify and organize the programming of eCOMPASS.

In the following, the presented use cases will be divided into three main groups according to the users of eCOMPASS. There will be use cases for private drivers, logistics tour planners and drivers and finally for residents or tourists who depend on multi-modal transport. Furthermore, for each use case a certain level of prioritization will be set according to the needs of the users and the final applicability.
Finally, priority application scenarios will be presented which collect the most essential use cases deployed in the pilot of eCOMPASS.

Table of Contents

1 Introduction

The aim of this deliverable is to provide precise descriptions of the eCOMPASS use cases (UCs) based on the user requirements that are reported in Deliverable D1.1. For the definition of the eCOMPASS UCs a concrete methodology is applied based on the most common software engineering practices, as well as experience from previous projects. The definition of UCs that are derived from the user functional and non-functional requirements is one of the most important phases of the project as it provides input to the design of the system architecture and the technical specifications of the eCOMPASS framework. In particular, the work described herein constitutes the foundation of the functional characteristics of the eCOMPASS system, encompassing all envisaged innovative features, precisely addressing user needs. It also provides all necessary information for the initialization of the system implementation based on the technical specifications. Moreover, the deliverable provides the basic scenarios of usage, from which the eCOMPASS pilot application scenarios will be selected after a prioritization procedure is applied to the eCOMPASS UCs.

1.1 Description of Relevant WP1

The purpose of the WP1 work that is relevant to this deliverable is to define a wide range of innovative application scenarios, through which the results of the project will be demonstrated. In order to do that, firstly the definition of all possible UCs is required for providing a fully functional description of the eCOMPASS system. Work in WP1—and Task 1.3 in particular—builds on the results of the user requirement analysis in order to specify in detail a set of eCOMPASS representative UCs and pilot scenarios. Those scenarios will be used for decomposing and refining high-level system goals into more measurable and testable requirements. The scenarios will be defined on the basis of the functional specifications and will provide the baseline for the definition of the eCOMPASS validation approach (WP6). The draft UCs will be presented to the consortium for comments and consolidation. UCs address the following application scenarios: Routing for private vehicles, routing for fleet of carrier vehicles, multimodal transportation human mobility, and tourists moving through multimodal transportation. Each one of them incorporates some of the following parameters (indicative list):

- Public transportation facilities, vehicles, cargos and roads (highway, rural, urban, inter-urban, etc).
- Other types of infrastructure elements (tunnels, bridges, etc).
- Weather and road condition.
- Time of day and traffic conditions.
- Types and specifications of sensors and subsystems required for each UC.
- Required reliability of information.
- Required accuracy (in terms of location based info) of information.
- Required update frequency of dynamic information.

The eCOMPASS UCs that are derived as a tangible result of the work that is foreseen in Task 1.3 are formally presented in this deliverable.

1.2 Scope of this Deliverable

Deliverable D1.2 documents the second phase of the work in WP1, i.e. the one that follows work done in Task 1.1, about the identification of user needs based on user surveys and the specification of the user functional and non-functional requirements. Building on the outcome of deliverable D1.1, we start by examining the user requirements with the goal to identify the various actors that are involved in the functionalities described by each requirement. This comprises the first step of an overall methodology that guides to the definition of the UCs from the previously defined user requirements. This methodology is described in detail in this deliverable.

After presenting the UC methodology all derived UCs are formally presented in tabular format. The UCs are classified into the following categories:

- Use cases for private vehicle drivers
- Use cases for vehicle fleet drivers
- Use cases for residents and tourists with smartphones
- Common use cases

As soon as the UCs are developed, a prioritization procedure is applied to the UCs that leads to the selection of the most appropriate UCs to be used as part of the pilot applications scenarios. Also, bi-lateral feedback exists between work that is done for the purpose of this deliverable and deliverable D1.3 ("eCOMPASS system architecture specification"). As the development of the UCs progresses, the eCOMPASS UCs are associated to specific parts of the eCOMPASS architecture and vice versa. For this reason these two deliverables evolve in parallel and their delivery date coincides. It is also expected that deliverable D1.2 gives feedback to workpackage WP6 for the definition of the concrete evaluation metrics for the assessment of the pilot cases. The deliverable concludes by the justified selection of the priority application scenarios.

1.3 Structure of the Document

The main body of this document consists of three parts: Section 2 describes in detail the overall methodology for deriving UCs and priority application scenarios starting from the user functional requirements; Section 3 formally presents the UCs that are derived after applying the previous methodology, presented for each application scenario, and Section 4 presents the priority application scenarios that are selected from the UCs. Finally Section 5 concludes the deliverable.

2 Methodology

2.1 Scope

This section explains the procedure that has been adopted in eCOMPASS for the definition of UCs. It is based on software engineering best practices and assumes as a basic source of information the functional requirements that have been presented in Deliverable D1.1. This section also presents a template for the formal description of UC in tabular format, including information about the UC to be described, as well as their visual representation in the form of UML UC diagrams.

It is worth mentioning here that no formal methodology for the definition of UC exists, thus the adopted "methodology" consists mainly of a set of best practices that are met in the literature, as well as similar procedures that have been successfully adopted by previous EC projects.

2.2 Best Practices and the Role of Actors

This subsection provides the most common views regarding the role and the design practices of UC in the software engineering literature. As stated in (Sommerville, 2001) "*use cases can be seen as a scenario-based technique for requirements elicitation*". In their simplest form "*use cases identify the actors involved in an interaction and names the type of interaction*". For this reason an essential step for the definition of the UC is the identification of the involved actors. The actors and their interactions are illustrated by the means of UML use case diagrams.

Sometimes confusion exists in the relevant literature about whether or not a UC is a scenario on its own (Fowler and Scott, 1997), or encapsulates a set of scenarios, where each scenario comprises a single thread within the UC. In this case there would be a scenario for the normal interaction plus interactions for each possible exception.

According to (Pressman, 2001) in order for an analyst to create a UC s/he first needs to identify the various types of people or devices that use the system under consideration. The actors usually represent roles that people or devices play as the system operates. An actor can be defined as *anything that communicates with the system and that is external to the system itself*. Based on this definition, it becomes clear that actors and users are not always the same. A typical user may have many different roles, whereas an actor represents an external-to-the-system entity that plays one specific role. On the other hand, for a particular UC a user being an actor may also have a specific role.

The actors are identified based on the functional requirements of the system. Because requirements elicitation is an iterative process, not all actors can be identified in the first iteration. It is possible to identify primary actors at the first iterations and secondary actors as more information becomes available about the system. Once actors have been identified the UC can be defined. For the precise definition of UC, Jacobson (Jacobson, 1992) suggests a number of questions to be answered:

Q1) What main tasks or functions are performed by the actor?
Q2) What system information will the actor acquire, produce or change?
Q3) Will the actor have to inform the system about changes in the external environment?
Q4) What information does the actor desire from the system?
Q5) Does the actor wish to be informed about unexpected changes?

Based on the aforementioned principles, the detailed methodology that is proposed for the definition of the eCOMPASS UCs, is described in the following subsection.

2.3 Adopted Methodology

The approach that has been adopted for the user requirements elicitation, UC definition and the production of the eCOMPASS architecture, in the context of WP1, is depicted in Figure 1 and outlined in what follows.

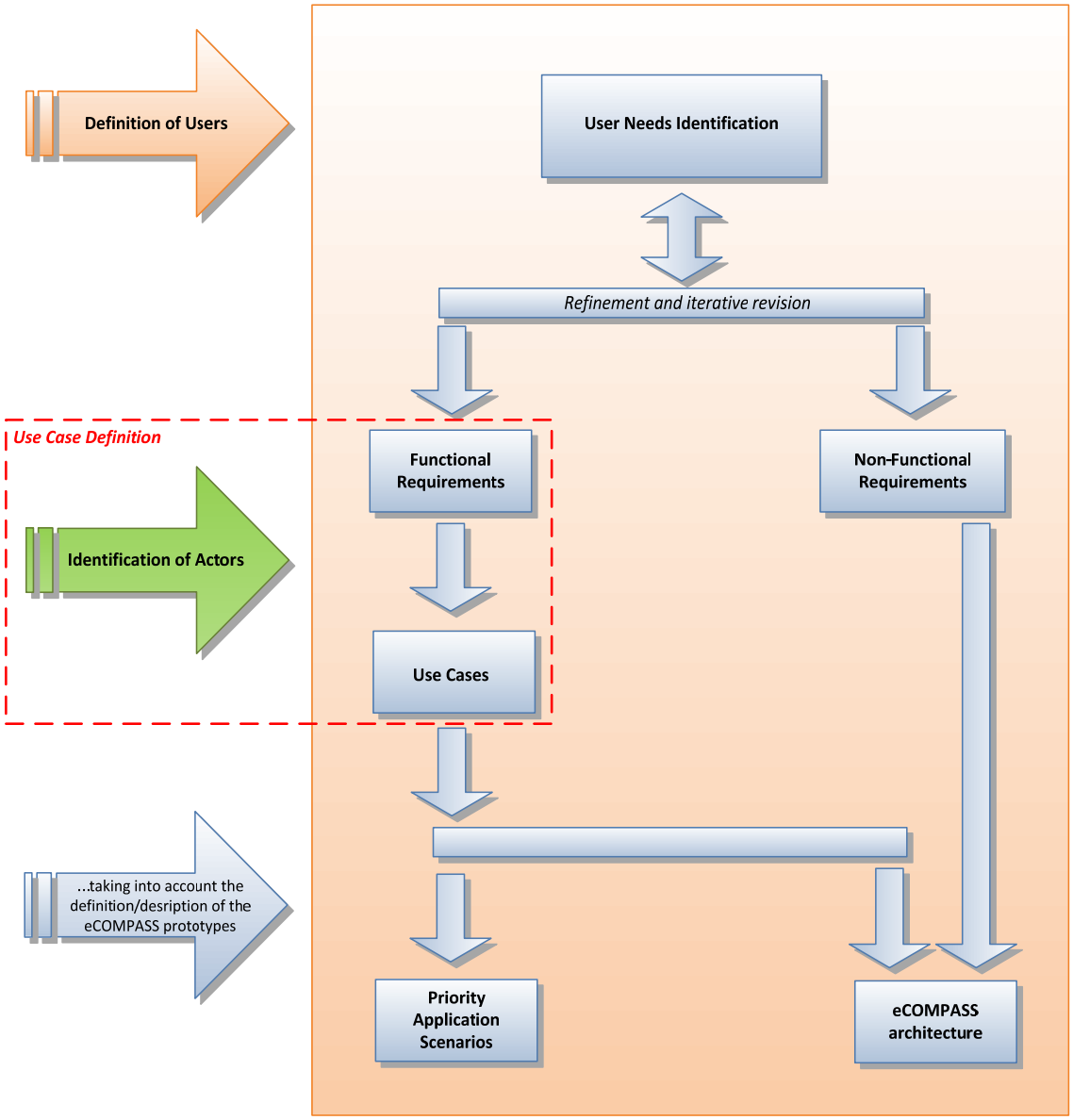

Figure 1 : Interactions of Requirements Engineering activities

As shown in the above Figure, the identification of the user needs, after defining the target user groups, leads to the production of functional and non-functional requirements. All these stages are reported in the deliverable D1.1. The identification of the actors based on the functional requirements launches the development of the UC. The overall process finally leads to the definition of the Priority Application Scenarios (PAS), which are selected from the available UC, after taking into account the available prototype descriptions (that will be developed in WP5). The PAS form the basis of the pilot application design. The overall process also results in the generation of the system architecture based on the UC, taking also into account the non-functional requirements of the eCOMPASS framework.

The procedure for the UC definition (enclosed in the red dashed box shown in Figure 1) can be summarised in the following steps:

- Review (and if necessary prioritize) functional requirements list
- Identify the actors, i.e., users or external-to-the-system entities that play a specific role
- Define UC from functional requirements, by answering the five questions Q1-Q5 in subsection 2.2.

2.4 Use Case Priorities

The selection of the PAS from the available UC, requires the definition of a UC prioritization schema. In order to distinguish UC in terms of value or primacy for eCOMPASS stakeholders, as well as in terms of importance for the system operation, three levels of prioritization can be set:

- Essential
- Secondary
- Supportive

In this way, each UC description encloses a level of prioritization. The 'essential' and 'secondary' UC are the ones that will be considered for the formation of the PAS. Either these UC will be used 'as is', or they will provide input for the formation of more composite application scenarios to be deployed during the pilots phase in WP6. On the other hand, the UC whose priority level is labelled as '*supportive*' will be tested only if they are not covered/tested through another UC. Also another field of the UC description template which is presented in subsection 2.7, is dedicated to explain why the particular priority level is assigned to the specific UC.

It is worth highlighting here, as also easily shown in the general overview of the UC provided in the next Section 3, that most of eCOMPASS identified UC are assigned with a high ('*essential*') priority level. All fields of the UC are briefly explained in the template that is provided in subsection 2.7.

2.5 Functional Requirements Clustering (Primary vs. Secondary)

The process of identifying the actors from the functional requirements is generally a straightforward process. This holds especially for a class of functional requirements which is deemed primary in the sense that a functional requirement that belongs to this class can adequately define a unique UC. On the other hand, there are functional requirements, which can be seen as secondary, in the sense that they do not uniquely define a UC, however they provide information that is applied to more than one UC. The different ways in which mappings may occur between UC and the two classes of functional requirements, are depicted in Figure 2.

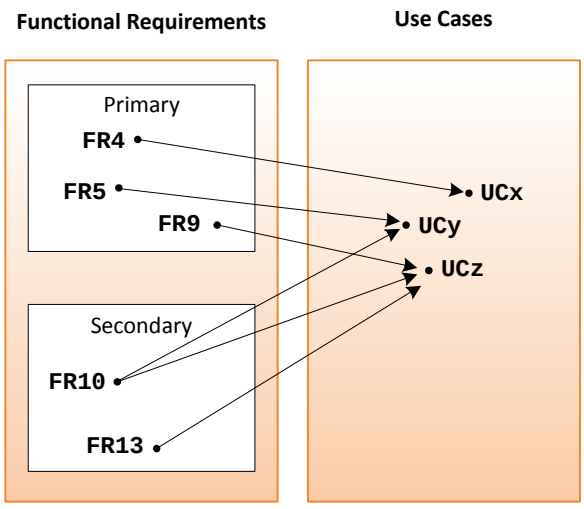

Figure 2: Mapping between primary and secondary functional requirements to use cases

Examples of primary functional requirements as they are reported in D1.1 include functional requirement FR1 "Specific Traffic information", according to which the system should be able to provide online traffic information on all roads relevant to the driver's current route and FR5 "Departure Time Advice", which suggests that the system should provide, upon request, further suggestions to the users based on the current traffic prediction, about when

to leave home in order to avoid congestion, for a given route. Both FR1 and FR5 lead to the definition of a separate UC. The first one typically includes the driver as an actor who requests to get traffic information, whereas other external entities, such as traffic data providers could be actors as well. The second UC, derived from FR5 may include the driver as an actor who requests suggestions about when to leave home. Again the traffic data provider could be another actor that interacts with the eCOMPASS framework.

An example of a secondary functional requirement taken again from D1.1 is FR13 ("Number of pre-trip routes"). This requirement suggests that when the user selects pre-route planning the system should return three routes at maximum, but it should give to the user the option to select more routes. This requirement can be applied to a number of UCs where the user requests some type of route to be returned and there are alternative routes to be displayed, such as when the user requests "robust routes" (FR15) or the most convenient and efficient in time (FR9) or multimodal routes (FR8).

2.6 UML Notation

As soon as the UC are finally defined, in addition to these textual descriptions, and in order to allow their easy digestion by the development teams in the future phases of the project, UML (Unified Modeling Language™) diagrams are prepared for each UC, showing the relationships among actors, sub-modules and activities/actions identified within each UC. A typical UC diagram in UML looks like the one depicted in Figure 3 that shows an actor who performs some action on the system, i.e. the named ellipses represent interactions between the actor and the system. Arrows may be used between actors and interaction ellipses in order to indicate the direction of communication. Different types of actors who share common characteristics can be associated with each other through a generalisation arrow as shown in Figure 4 with the white triangle on the arrow face.

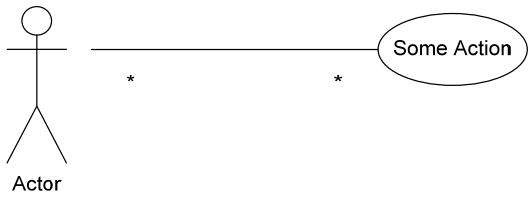

Figure 3 : Actor and actor's action in UML notation

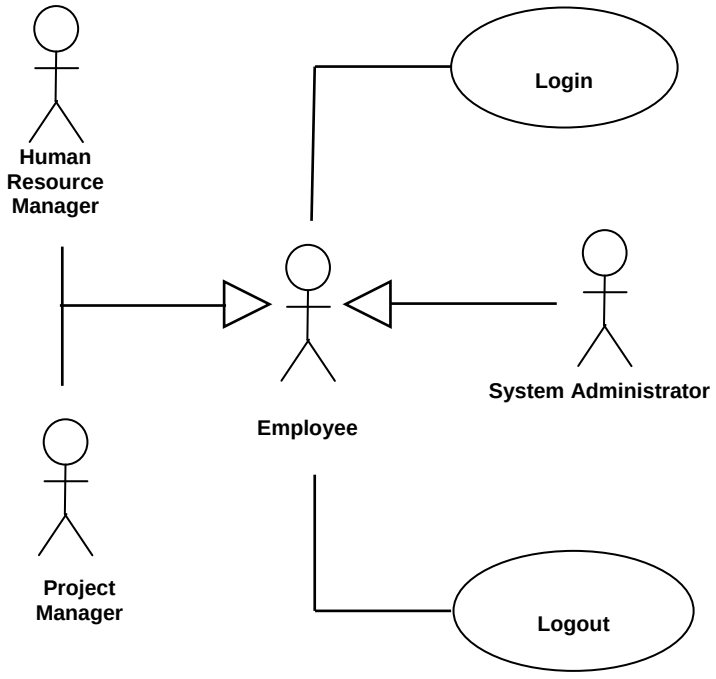

Figure 4 : Generalisation of actors

Generalizations may occur between UCs as well. The example depicted in Figure 5, which has been taken from (Si Albir, 2003), shows that a project manager may publish the status of a project in two ways: by generating a report to a printer or by generating a web site on a project web server. These two actions have a common part, which is the collection of relevant data about the status of the project to be published. The UC diagram shown in Figure 5 (a) without generalisation is equivalent to the one shown in Figure 5 (b) using generalisation.

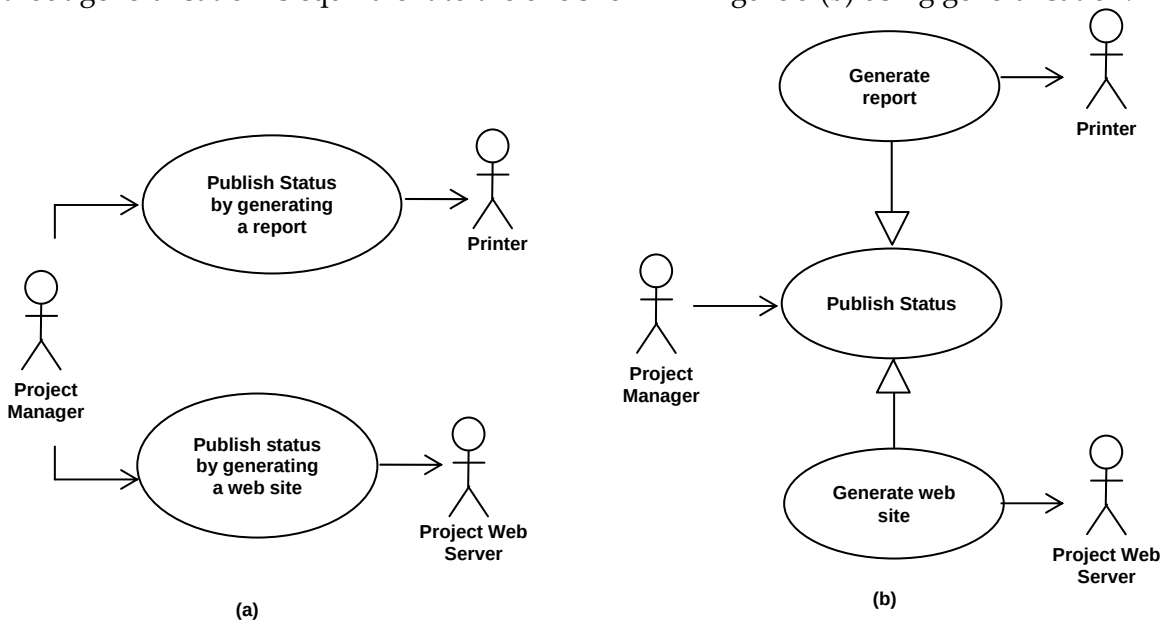

Figure 5 : (a) Similar use cases, (b) the same use cases with generalisation

Other relationships that may occur between UC include dependencies. Two forms of dependencies are supported in a UC diagram: <<include>> and <<extend>> dependencies. When an activity is part of a sequence of activities it can be separated and be associated with the other activities by the means of an <<include>> dependency. For example, Figure 6 (a) shows three activities that include the same activity. This can be presented using the notation in Figure 6 (b).

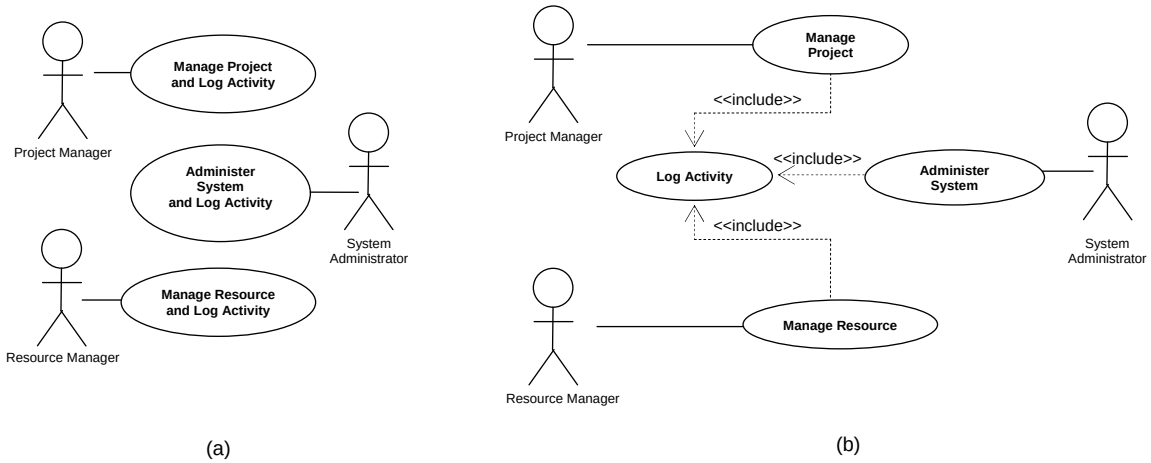

Figure 6 : (a) Use cases with common behaviour, (b) the same use cases including dependencies

Figure 7 (b) refines Figure 7 (a) using <<extend>> dependencies. The three activities *Maintain Project*, *Maintain Activity* and *Maintain Task* are options of the *Manage Project* UC, so

Manage Project is factored out and extends those three actions. It is important to understand the difference between <<include>> and <<extend>> dependencies and UC generalisation. An inclusion UC has no knowledge of the base UC that includes it, an extension UC has no knowledge of the base UC that it extends, and the *Maintain Activity* UC shown in Figure 7 has no knowledge of the UC that it extends, so they cannot involve the actors of the base UCs (i.e. the one from which the dashed lines starts) in their behaviour sequences. An inclusion UC must be developed before its base UC, an extension UC must be developed after its base UC, and a more specific UC must be developed after its more general UC.

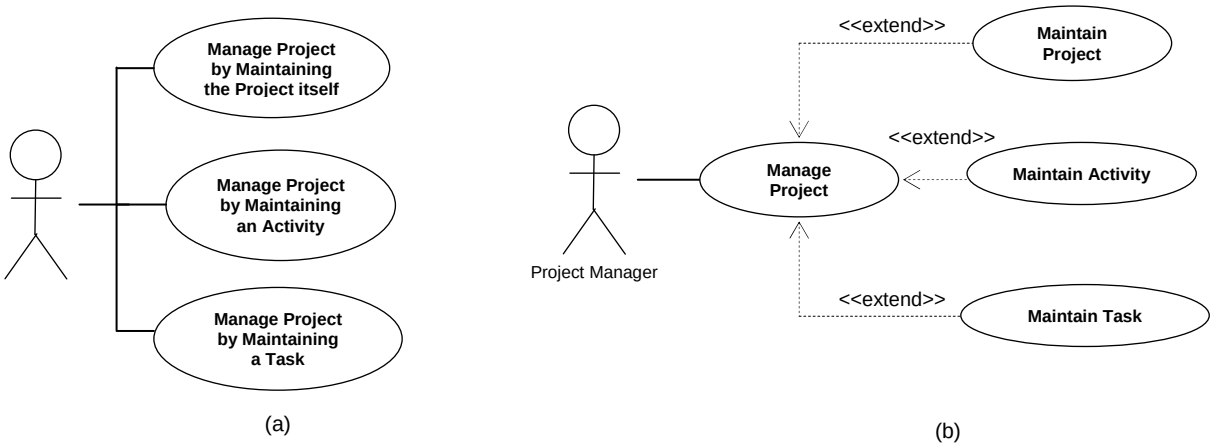

Figure 7 : (a) Use cases with optional behaviour, (b) by using <<extend>> dependencies

2.7 Use Case Detailed Description template

The following Table shows the UC info template that is used for capturing information required for the description of the UC. The template presents UC information in tabular format. For each UC the corresponding UML UC Diagram should be drawn at the space that is left after the tabular template. Each table corresponds to one UC and identifies itself in a unique manner using a unique ID in the form "UC*x.y*", where *x* is an integer number from 1 to 3, corresponding to each one of the three user categories (see also Section 3), whereas *y* is an integer number *y* = 1, 2, … corresponding to each subsequent UC. Also a title is provided that indicates in brief the goal of each UC. Each row corresponds to specific type of information required for the description of the UC. The following template provides brief explanations for each one of the contained fields.

Table 1 – Use Case Description Template

ID	**<unique id in the form UC*x.y*>**
Title	**<human readable title that indicates UC's goal>**
Summary	<a longer and more detailed statement of the goal and the related scenario of use>
Primary actor	<the actor who belongs to any eCompass user group>
Secondary actor(s)	<other external entities (persons or objects) that interact with the system>
Priority Level	<One of: *Essential*, *Supportive*, *Secondary*>

ID	**<unique id in the form UC*x.y*>**
Title	**<human readable title that indicates UC's goal>**
Background info/reason on selection and on assigning the priority level	<why is this important to be included with the specific priority>
Workflow	<Description of the interaction level in the form of steps: Step 1-the user wants to... Step 2-the system...>
System output	<i.e. what should be the system's functionality, as reaction to the user actions>
Preconditions	<which are the preconditions (if any) that should be fulfilled for the Use Case to take place>
Involved Client	<which is the eCOMPASS client that is involved in the implementation of this UC, e.g. In-Car Application (Private/Fleet), multi-modal applications, etc.>
Devices	<on which device this UC will operate properly>
Critical success parameters	<what really matters at the end>
Environmental or other restrictions	<related to the generic context of use>
Relevant Ucs	<IDs of any relevant eCompass Use Cases>
Relevant Functional Requirements	<the ID of the functional requirements (e.g. FR13) according to the notation reported in D1.1, that are used to derive this UC >
Comments	<only, if applicable>
Author	<the name of the author of this UC>
Version	<version number (for future modifications)>
Date	<the date on which this UC has been authored>

<UML UC diagram goes here>

Based on the aforementioned methodology and template, Section 3 presents in detail the eCOMPASS UCs.

3 eCOMPASS Use Cases

3.1 Private Vehicle Drivers

3.1.1 Basic Route Computation

Basic UCs of the eCOMPASS application for private vehicle drivers comprise route computations optimized for different objectives, as depicted in Figure 8. Detailed use case definitions are given in the tables below.

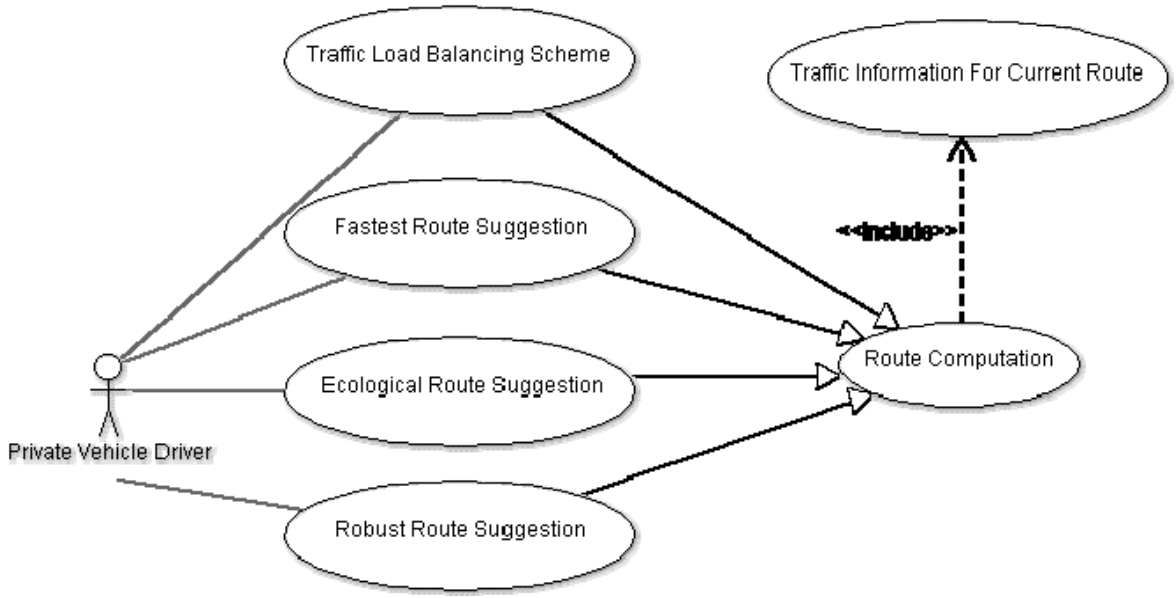

Figure 8: Use case diagram for basic route computations. Any route computation includes traffic information for this route.

UC 1. 1 - Economical Route Suggestion

ID	**1.1**
Title	**Eco-Friendly Route Suggestion**
Summary	As a driver, I want to be able to request up to three, or a small network of, especially eco-friendly routes taking into account the current traffic situation.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Eco-friendly routes are one of the most essential concepts in eCOMPASS.
Workflow	Step 1: The user enters his destination and requests an eco-friendly route.

ID	1.1
Title	**Eco-Friendly Route Suggestion**
	Step 2: The system displays up to three eco-friendly routes from the user's current location to his destination, and their characteristics.
System output	The system outputs up to three eco-friendly routes from the user's current position to the destination entered. Advanced characteristics of each route are displayed, including the current traffic situation (e.g. minutes of delay, traffic tendency), reliability of the computed ETA (e.g., on a scale 0-10), and its eco-footprint (e.g. in fuel used).
Preconditions	A server connection has been established to obtain real-time traffic information. The driver's location is known, either through a valid GPS fix, or the user having entered a location.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The routes computed shall be significantly more eco-friendly than other routes, in particular the fastest. On the other hand, they shall be competitive with other routes, in particular the fastest, in terms of travel time and distance.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	UC 1. 9
Relevant Functional Requirements	FR6, FR13
Comments	This use case occurs stand-alone, but may also occur as a sub use case of UC 1.5,where the users may receive an economical route as one of several route alternatives.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

UC 1. 2 - Robust Route Suggestion

ID	1.2
Title	**Robust Route Suggestion**
Summary	As a driver, I want to be able to request up to three, or a small

ID	1.2
Title	**Robust Route Suggestion**
	network of, especially robust routes taking into account the current traffic situation.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Also robust routes are a key concept in eCOMPASS. Moreover, in deliverable D1.1, they were identified as a feature especially desired by users.
Workflow	Step 1: The user enters his destination and requests a robust route. Step 2: The system displays up to three robust routes from the user's current location to his destination, and their characteristics.
System output	The system outputs up to three routes with a reliable ETA from the user's current position to the destination entered. Advanced characteristics of each route are displayed, including the current traffic situation (e.g. minutes of delay, traffic tendency), reliability of the computed ETA (e.g., on a scale 0-10), and its eco-footprint (e.g. in fuel used).
Preconditions	A server connection has been established to obtain real-time traffic information. The driver's location is known, either through a valid GPS fix, or the user having entered a location.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The routes computed shall be significantly more robust than other routes, in particular the fastest. On the other hand, they shall be competitive with other routes, in particular the fastest, in terms of travel time and distance.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	UC 1. 9
Relevant Functional Requirements	FR15, FR13
Comments	This use case occurs stand-alone, but may also occur as a sub use case of UC 1.5, where the users may receive a robust route as one of several route alternatives.

ID	1.2
Title	**Robust Route Suggestion**
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

UC 1. 3 - Fastest Route Suggestion

ID	1.3
Title	**Fastest Route Suggestion**
Summary	As a driver, I want to be able to request up to three, or a small network of, fastest routes taking into account the current traffic situation.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Fastest routes are a commodity in navigation and are essential as a reference points for all other route suggestions.
Workflow	Step 1: The user enters his destination and requests a fastest route. Step 2: The system displays up to three fast routes from the user's current location to his destination, and its characteristics.
System output	The system outputs up to three routes with (close to) minimum travel time from the user's current position to the destination entered. Advanced characteristics of each route are displayed, including the current traffic situation (e.g. minutes of delay, traffic tendency), reliability of the computed ETA (e.g., on a scale 0-10), and its eco-footprint (e.g. in fuel used).
Preconditions	A server connection has been established to obtain real-time traffic information. The driver's location is known, either through a valid GPS fix, or the user having entered a location.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The routes computed shall be among the fastest possible taking into account the current traffic situation.
Environmental or other	Due to the requirement for a server connection, GPRS coverage

ID	1.3
Title	**Fastest Route Suggestion**
restrictions	is needed in the area of employment.
Relevant UCs	UC 1. 9
Relevant Functional Requirements	FR15, FR13
Comments	This use case occurs stand-alone, but also as a sub use case of UC 1.5, where the users may receive a robust route as one of several route alternatives.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

UC 1. 4 - Traffic Load-Balancing Scheme

ID	1.4
Title	**Traffic Load-Balancing Scheme**
Summary	As a driver, I want to have the option to participate in a load-balanced traffic routing scheme, reducing congestion for all.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Secondary
Background info/reason on selection and on assigning the priority level	Traffic load-balancing is essentially motivated from game theory, in particular network (congestion) games, where it is a well-known fact that users selecting fastest routes selfishly leads to inferior system performance: The average travel time when (all) users act selfishly can be a multiple of the average travel time when (all) users route choices are coordinated. However, individual users may experience a longer travel time in the coordinated scenario as compared to the selfish setting. Due to the achievable reduction in average travel time, traffic load balancing could be a tool to help reduce emissions. In the research conducted for D1.1, users have indicated to be somewhat open for it. However, it is still a far open research question which load-balancing concepts would be suitable for practice, and how they could be implemented. Moreover, load-balancing models require flow-dependent travel times, in contrast to time-dependent travel times required by other eCOMPASS routing models, which places traffic load-balancing somewhat outside of the main focus of eCOMPASS. Also, it is

ID	1.4
Title	**Traffic Load-Balancing Scheme**
	unclear how realistic flow-dependent travel times could be obtained for pilot testing. Hence we deem the priority of this use case secondary to some others.
Workflow	Step 1: The user enters his destination and requests a route suggestion according to a traffic load-balancing scheme. Step 2: The system displays a route from the user's current location to his destination, and its characteristics.
System output	The system outputs a route according to a traffic load-balancing scheme. Advanced characteristics of the route are displayed, including the current traffic situation (e.g. minutes of delay, traffic tendency), reliability of the computed ETA (e.g., on a scale 0-10), and its eco-footprint (e.g. in fuel used). Optionally, an estimation of the average travel time currently saved by users through traffic load-balancing could be displayed.
Preconditions	A server connection has been established to communicate the user's current position and destination, and to receive route information. The driver's location is known, either through a valid GPS fix, or the user having entered a location.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	First, the routes computed shall be appealing enough to the user to keep using this feature. Secondly, there shall be a noticeable reduction in average travel time and/or emissions compared to uncoordinated (selfish) routing.
Environmental or other restrictions	A traffic load-balancing scheme requires routes to be computed server-side, where origin and destination information for all participating users is collected. Traffic load-balancing is only meaningful when a significant number of drivers participate. If this is not the case, the best such scheme can do is routing each of the few users individually (like no traffic load-balancing was in place). Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	
Relevant Functional Requirements	FR16
Comments	At present, many conceptual questions regarding traffic load-

ID	1.4
Title	**Traffic Load-Balancing Scheme**
	balancing remain to be answered, and it is also unclear how the necessary data on flow-dependent travel times could be obtained. Hence, this use case is considered a secondary priority, as its realization might prove out of scope for eCOMPASS.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

3.1.2 Alternative Routes

Next, we describe the various UCs related to computing alternative route suggestions. An overview is given in Figure 9, the detailed UC definitions are given in the tables below.

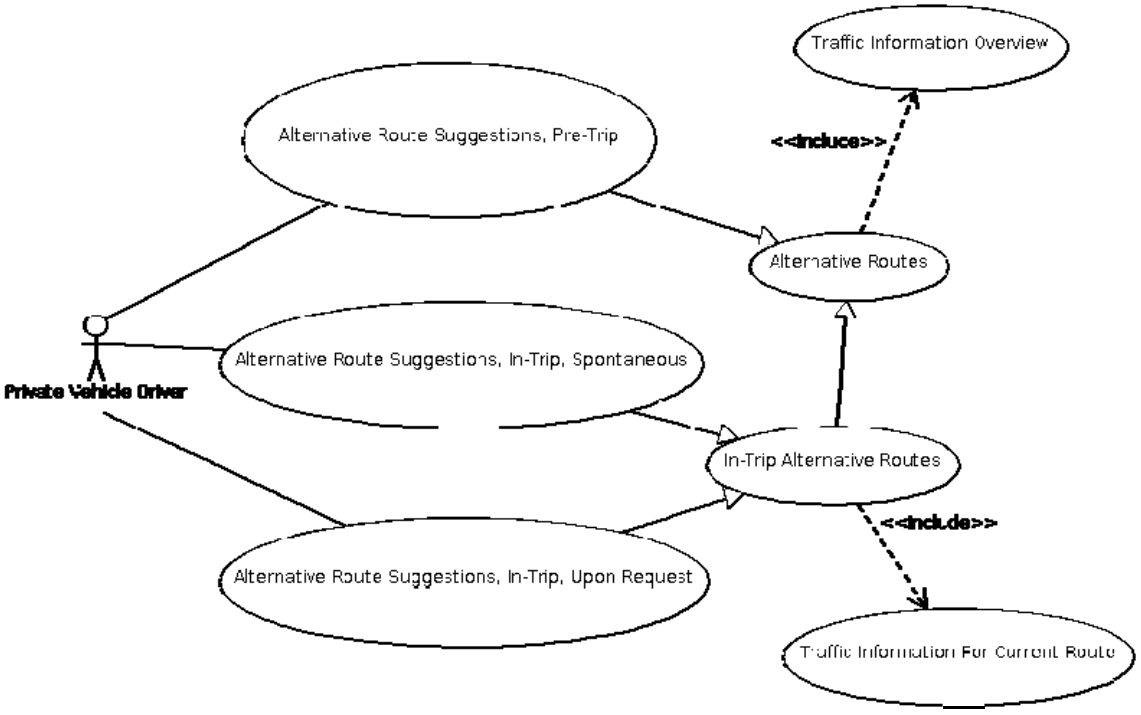

Figure 9: Use case diagram for alternative route computations. The display of several alternative routes pre-trip always includes a traffic information overview, while an alternative displayed in-trip will always refer to traffic information on the current route.

UC 1. 5 - Alternative Routes Suggestion, Pre-Trip

ID	**1.5**
Title	**Alternative Routes Suggestion, Pre-Trip**
Summary	As a driver, before I depart, I want to be presented up to three, or a small network of, different alternative routes to my destination; these alternatives shall take into account the current traffic situation. Advanced characteristics of the corresponding routes shall be provided with the alternatives, such as the current traffic situation, reliability of ETA, and eco-footprint.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Providing rich alternative route information to aid the driver in making better and more eco-friendly route decisions is a key tool in achieving the objectives of eCOMPASS.
Workflow	Step 1: The user enters his destination and requests alternative routes. Step 2: The system displays different route options from the user's current location to his destination, and their characteristics.
System output	The system outputs a number of alternative routes from the user's current position to the destination entered. Advanced characteristics of the different routes are displayed, including the current traffic situation (e.g. minutes of delay, traffic tendency), reliability of the computed ETA (e.g., on a scale 0-10), and its eco-footprint (e.g. in fuel used).
Preconditions	A server connection has been established to obtain real-time traffic information. The driver's location is known, either through a valid GPS fix, or the user having entered a location.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The alternatives returned shall all be relevant to the user, i.e. they must not contain routes considered useless. In particular, the alternatives' characteristics shall embody sensible trade-offs, e.g. a fastest, a most reliable route, and a most economical route, but also options compromising on these parameters should be present.

ID	1.5
Title	**Alternative Routes Suggestion, Pre-Trip**
	The alternatives computed shall reflect the current traffic situation. In particular, the user shall consider the feature relevant even for daily drives through familiar areas, because it conveys different options and trade-offs depending on the individual traffic situation.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	UC 1. 1, UC 1. 2, UC 1. 3, UC 1. 9, UC 1. 10, UC 1. 6
Relevant Functional Requirements	FR1, FR2, FR3, FR4, FR7, FR12
Comments	Some of the routes returned as output may be routes which would also be computed as system output of UC 1. 1 and UC 1. 2, i.e. an economical and a robust route.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

UC 1. 6 - Alternative Route Suggestions, In-Trip, Upon Request

ID	1.6
Title	**Alternative Route Suggestions, In-Trip, Upon Request**
Summary	As a driver, while I am en route, I want to request suggestions for route alternatives ahead, together with traffic information, based on the current traffic situation.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	As traffic, and also the driver's understanding of the traffic situation, keeps changing while en route, the driver may want to request route alternatives in-trip to aid him in making better and more eco-friendly route decisions. This use case plays a major role in increasing the relevance of a navigation application for daily drivers traveling in familiar areas.
Workflow	Step 1: The user requests an alternative route while driving.

ID	1.6
Title	**Alternative Route Suggestions, In-Trip, Upon Request**
	Step 2: The system informs the user about the next turn-offs for an alternative route and displays a comparison only of key characteristics like travel time and eco-footprint. Step 3 (optional): The user may request additional information on the currently suggested alternatives. Step 4 (optional): Upon user request, the system displays an alternative route (e.g. as a map overview) and its key characteristics like travel time, traffic situation, reliability of ETA, and eco-footprint, in comparison to the current route.
System output	The system outputs alternative routes turning off the user's current route ahead of his current position. Key comparison figures like travel time, traffic, and eco-footprint are displayed for the current route and the alternatives, and a comparison of more characteristics can be displayed upon user request.
Preconditions	A server connection has been established to receive real-time traffic information. The driver is driving on a planned route to his destination. The driver's location on his route is known through a valid GPS fix.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The alternatives suggested shall be relevant to the user, i.e. they shall either be truly attractive improving on the current route in at least one characteristic, or they shall embody a suitable means to disclose traffic information relevant to the user, e.g. a route would be a faster alternative without traffic, but it is congested at the moment.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	UC 1. 10
Relevant Functional Requirements	FR3, FR4
Comments	Depending on implementation, this use case might also satisfy the user requirements addressed in UC 1. 10.
Author	Felix Koenig, TomTom
Version	1.0

ID	1.6
Title	Alternative Route Suggestions, In-Trip, Upon Request
Date	10 October 2012

UC 1. 7 - Alternative Route Suggestions, In-Trip, Spontaneous

ID	1.7
Title	Alternative Route Suggestions, In-Trip, Spontaneous
Summary	As a driver, while I am en route, I want to receive an alternative route suggestion together with traffic information, based on the current traffic situation, when an interesting alternative becomes available, e.g. due to changes in traffic.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	As traffic, and also the driver's understanding of the traffic situation, keeps changing while en route, the system suggesting an alternative spontaneously can aid the driver in making better and more eco-friendly route decisions. Moreover, displaying traffic information associated with these alternatives can help the driver to understand the current overall traffic situation, which is an essential user need according to D1.1. This may either lead him to choose an alternative route, or reassure him that his current route is still the best. The frequency with which the system suggest alternatives spontaneously shall be a settable user preference, as some users might find frequent spontaneous suggestions useful and informative, while other might feel they would be annoying.
Workflow	Step 1: When the traffic situation changes significantly and/or the user approaches a point on his current route where an alternative route forks off, the system informs the user about the next turn-off for an alternative route and displays a comparison only of key characteristics like travel time and eco-footprint. Step 2 (optional): The user may request additional information on the currently suggested alternative. Step 3 (optional): Upon user request, the system displays this alternative route (e.g. as a map overview) and its key characteristics like travel time, traffic situation, reliability of ETA, and eco-footprint, in comparison to the current route.

ID	1.7
Title	**Alternative Route Suggestions, In-Trip, Spontaneous**
System output	The system outputs an alternative route turning off the user's current route ahead of his current position. Key comparison figures like travel time, traffic, and eco-footprint are displayed for the current route and the alternative, and a comparison of more characteristics can be displayed upon user request.
Preconditions	A server connection has been established to receive real-time traffic information. The driver is driving on a planned route to his destination. The driver's location on his route is known through a valid GPS fix.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The alternative suggested shall be relevant to the user, i.e. it shall either be a truly attractive alternative improving on the current route in at least one characteristic, or it shall embody a suitable means to disclose traffic information relevant to the user, e.g. the route would be a faster alternative without traffic, but it is congested at the moment.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	UC 1. 10
Relevant Functional Requirements	FR3, FR4
Comments	Depending on implementation, this use case might also satisfy the user requirements addressed in UC 1. 10.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

3.1.3 Departure Time Suggestion

The UC diagram for departure time suggestion is depicted in Figure 10. Details of the UC definition are given in the table below.

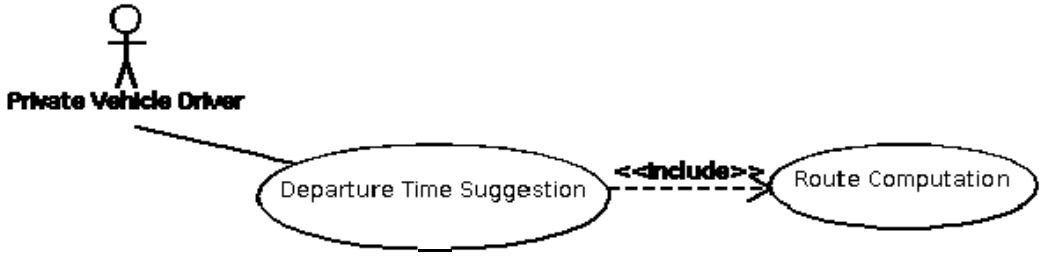

Figure 10: Diagram for UC 1. 8, departure time suggestion. This use case always includes the computation of at least one route.

UC 1. 8 - Departure Time Suggestion

ID	**1.8**
Title	**Departure Time Suggestion**
Summary	As a driver, before I depart, I want to be suggested one or several points in time for departure in order to avoid traffic most effectively. Choosing a later departure time will not get me to my destination sooner, but it might spare me inconvenience and fuel cost, in addition to reducing my transportation eco-footprint, by avoiding congestions.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Enabling drivers to choose their departure time smartly as to avoid traffic peaks can contribute significantly to reducing emission, as drivers are less likely to encounter congestion on their routes. Real-Time traffic information shall be used in combination with traffic prediction to estimate travel times for different departure times realistically.
Workflow	Step 1: The user enters his destination and a time window, and requests departure time advice. Step 2: For the departure time window specified, the system displays one (or several) travel time functions for one (or several) route types.
System output	For the departure time window specified by the user, the system outputs the travel time as a function of the departure time, and optionally also the different suggested routes within the departure time window. This can be done for one fixed route type (e.g. fastest, economical, robust), or for several (resulting in multiple travel time functions). When the departure time window lies further in the future, the use of traffic prediction may be omitted and historical speed data used instead.
Preconditions	A server connection has been established to obtain real-time traffic information to be used in traffic prediction.

ID	1.8
Title	**Departure Time Suggestion**
	The driver's location is known, either through a valid GPS fix, or the user having entered a location.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The travel time function predicted for the departure time window shall be accurate. In times of dynamically changing traffic (e.g. rush hours), travel times varying with changing departure times shall be observed.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	UC 1. 1, UC 1. 2, UC 1. 3
Relevant Functional Requirements	FR5
Comments	When a departure time suggestion is requested for a time window far in the future, the system might rely solely on historical traffic information, and not on traffic prediction, as the latter might not be available in this case.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

3.1.4 Traffic Information

The following figures and tables define UCs related to traffic information.

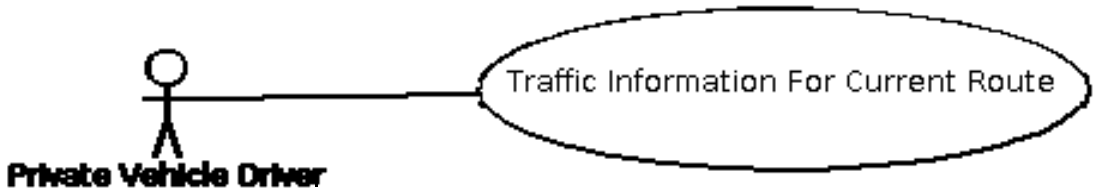

Figure 11: Diagram for UC 1. 9, traffic information for current route.

UC 1. 9 – Traffic Information for Current Route

ID	**1.9**
Title	**Traffic Information for Current Route**
Summary	As a driver, while I am en route, I want to be presented with accurate traffic information for my current route.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Supportive
Background info/reason on selection and on assigning the priority level	Traffic in urban areas is highly dynamic, and hence likely to change while the driver is already en-route. A user's route choice may depend on what traffic is like on distant parts of his route *when he gets there* (as opposed to now). Hence, real-time traffic data shall be enhanced by traffic prediction for the duration of the route.
Workflow	Step 1: The driver requests traffic information for his current route. (Alternatively, no action is required when this information is continuously displayed, e.g. on a traffic bar) Step 2: The system displays traffic information for the users current route ahead.
System output	Traffic information is provided for the remainder of the user's current route in the form of traffic incidents, e.g. by delay information for road segments with speed significantly below free flow values. This information can be displayed in short form, e.g. on a traffic bar always visible in the user's driving view, or in detailed form (e.g. including more data on the incident) upon user request.
Preconditions	A server connection has been established to receive real-time traffic information. The driver is driving on a planned route to his destination. The driver's location on his route is known through a valid GPS fix.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The traffic information shall be accurate, i.e., reflect the situation on the route at the time the user gets there (provided he continues along his planned route normally).
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	1.8

ID	1.9
Title	**Traffic Information for Current Route**
Relevant Functional Requirements	FR1, FR4
Comments	
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

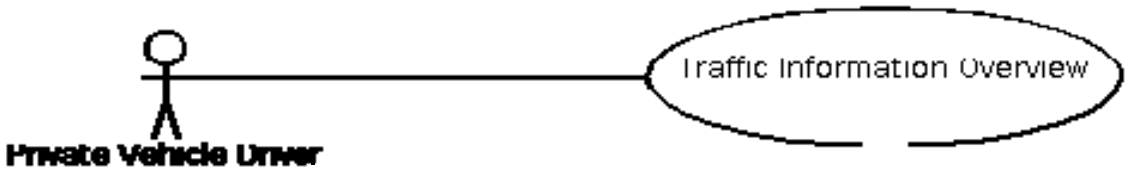

Figure 12: Diagram for UC 1.10, traffic information overview.

UC 1. 10 – Traffic Information Overview

ID	1.10
Title	**Traffic Information Overview**
Summary	As a driver, I want to be presented with traffic information for relevant roads outside of my route.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Supportive
Background info/reason on selection and on assigning the priority level	Drivers, and especially commuters driving in a familiar area, demand an overview of traffic in order to make their own routing decisions, or to better understand their navigation systems' suggestions. Besides this being a prominent outcome of the user research in D1.1, this is also key in increasing the daily relevance of eCOMPASS applications for urban drivers. A user's route choice may depend on what traffic is like on distant parts of the road network *when he gets there* (as opposed to now). Hence, real-time traffic data shall be enhanced by traffic prediction. It is key to achieve a good trade-off between the following two extremes: traffic information only along the current route is too

ID	1.10
Title	**Traffic Information Overview**
	narrow to be really informative; traffic information for an entire radius of the road network is too broad to be digestible. Likely, virtual alternative routes should be computed in order to determine for which roads traffic information should be displayed.
Workflow	Step 1: The driver requests a traffic information overview for his current destination. Step 2: The system displays an overview of traffic incidents relevant for his current destination.
System output	Traffic information is provided for roads relevant to the user's current destination (and position) in the form of traffic incidents, e.g. by delay information for road segments with speed significantly below free flow values. This information can be displayed in short form, e.g. graphically on a map, or in detailed form (e.g. including more data on the incident) for each incident separately upon user request.
Preconditions	A server connection has been established to receive real-time traffic information. The driver has entered his destination. The driver's location is known through a valid GPS fix.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	Traffic information shall be displayed exactly for the roads the user feels are relevant for his destination (and current position).[1] The traffic information shall be accurate, i.e., reflect the situation at the time the user gets there (provided he continues along his planned route normally).
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	UC 1. 6
Relevant Functional Requirements	FR2, FR4
Comments	Depending on implementation, this use case could also potentially be merged into UC 1. 6, i.e., a traffic information overview could be provided by maintaining, updating, and

[1] We refer to the user's perception in this success parameter as it is largely unclear how to phrase this more precisely: If there was a clear definition of "relevant roads" for any journey, this use case would be trivial.

ID	1.10
Title	Traffic Information Overview
	displaying different alternative routes with traffic information.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

3.1.5 Park & Ride

The UC diagram for a park & ride feature is depicted in Figure 13, details of the UC definition are given in the table below.

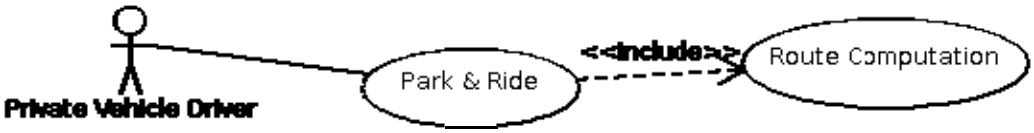

Figure 13: Diagram for UC 1. 11, park & ride. This use case includes the computation of a route from the user's location to a park & ride terminal location.

UC 1. 11 - Park & Ride

ID	1.11
Title	Park & Ride
Summary	As a driver, I want to receive suggestions to use park & ride.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Secondary
Background info/reason on selection and on assigning the priority level	In urban areas, and especially in the case of heavy traffic on roads, park & ride can become a truly attractive alternative to driving all the way to the destination. Encouraging drivers to make use of park & ride possibilities can potentially reduce their distance travelled by car, and hence their eco-footprint. However, as reported in D1.1, car drivers are only slightly interested in such feature. Hence, we consider this a secondary priority.
Workflow	Step 1: Pre-Trip, or while already en route, the user requests a park & ride route to minimize/reduce his distance traveled by car. In special cases when park & ride becomes especially attractive/competitive in terms of travel time (e.g. when an essential road to the user's destination is heavily congested or

ID	1.11
Title	**Park & Ride**
	blocked), the system might propose park & ride spontaneously, skipping Step 1. Step 2: The system displays an alternative route using park & ride, including detailed information on the public transportation part of the route.
System output	A route from the user's current position to a park & ride terminal, detailed information on how to proceed to the destination from there using public transportation, and advanced characteristics of this routing option like public transportation cost, travel time, and eco-footprint.
Preconditions	The user has entered is destination. A server connection has been established to receive public transport information. The driver's location is known, either through a valid GPS fix, or the user having entered a location.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The park & ride routes proposed shall be attractive alternatives to the respective car routes, such that they are indeed selected by drivers regularly.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	
Relevant Functional Requirements	FR18
Comments	
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

3.1.6 Eco-Coaching

The UC diagram for eco-coaching is depicted in Figure 14, details of the UC definition are given in the table below.

Figure 14: Diagram for UC 1. 12, eco-coaching.

UC 1. 12 - Eco-Coaching

ID	**1.12**
Title	**Eco-Coaching**
Summary	As a driver, I want to be coached to drive more economically.
Primary actor	Private Vehicle Driver
Secondary actor(s)	None
Priority Level	Secondary
Background info/reason on selection and on assigning the priority level	Eco-coaching aims at training drivers how to increase their fuel-efficiency by changing their driving style, and is hence another tool to reduce emissions in private vehicle traffic. This lies somewhat outside the main focus of eCOMPASS, with is mainly on advanced algorithms. Hence, we consider this a secondary priority.
Workflow	Step 1: When the feature is enabled, the system provides in-trip recommendations regarding driving style. Step 2: When arriving at the destination, the system provides extensive feedback on the user's eco-performance on this trip.
System output	The system shall provide detailed feedback on the eco-friendliness of the user's driving style, and coach him to improve on it. This is done in-trip as well as after arriving at the destination.
Preconditions	Sources of input are available which enable eco-feedback; e.g., when a GPS fix has been acquired, the signal can be used to measure acceleration and speed.
Involved Client	In-Car Application (Private Vehicle)
Devices	In-Car Device (Private Vehicle)
Critical success parameters	The user shall find the feature useful; the user's driving style shall improve measurably by using the feature for some time.
Environmental or other restrictions	None
Relevant UCs	
Relevant Functional	FR17

ID	1.12
Title	Eco-Coaching
Requirements	
Comments	Eco-coaching is a very broad field, and distinction needs to be made between in-trip and post-trip features. Further investigation on the possibilities and potential of eco-coaching is needed to improve the level of detail of this use case definition. Moreover, this use case is considered a secondary priority, as its realization might prove out of scope for eCOMPASS.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

3.2 Vehicle Fleet Drivers

3.2.1 Standard IT-based Tour Planning

The UC diagram for IT-based tour planning is depicted in Figure 15, details of the UC definition are given in the table below.

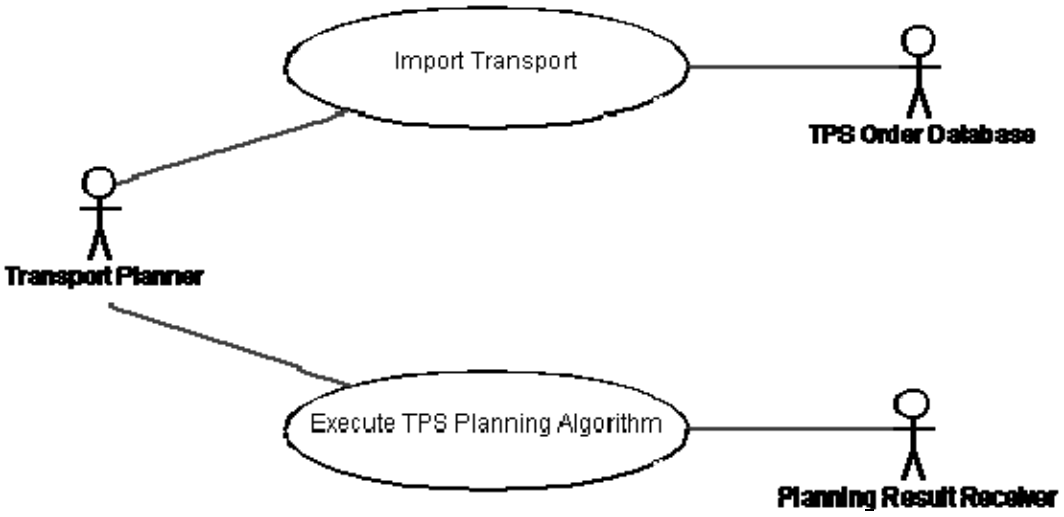

Figure 15: UML UC 2.01 diagram for standard IT-based Tour Planning

UC 2. 01 – Standard IT-based Tour Planning

ID	2.01
Title	Standard IT-based Tour Planning
Summary	As a logistics tour planner I want to plan my transport orders.
Primary actor	Commercial vehicle fleet tour planner

ID	2.01
Title	**Standard IT-based Tour Planning**
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	The logistics company planner plans tours based on: - existing transport orders, - available vehicles, -available drivers. For the planning she/he takes the available fleet, transport orders and known boundaries into account. While forming tours the planner tries to integrate all mandatory transport orders to the tours.
Workflow	Step 1: The planner imports all transport orders Step 2: The planner runs a tour planning to get a valid solution, i.e. plan transport orders and meeting all restrictions.
System output	The system shall provide a valid solution for the tour planning problem.
Preconditions	1. IT-based tour planning application is installed and configured. 2. Transport orders are imported correctly to the tour planning application.
Involved Client	Commercial logistics company - logistics tour planner
Devices	Logistics back-office system.
Critical success parameters	The user shall find the planned valid.
Environmental or other restrictions	Drive time regulations have to be respected. Green zones have to be respected.
Relevant UCs	
Relevant Functional Requirements	
Comments	This use case formulates the basic requirements for an IT-based tour planning – a pre-condition for further use cases.
Author	Florian Krietsch, PTV
Version	1.0
Date	10 October 2012

3.2.2 IT-based Tour Planning with Optimization

The UC diagram for IT-based tour planning with optimization is depicted in Figure 16, details of the UC definition are given in the table below.

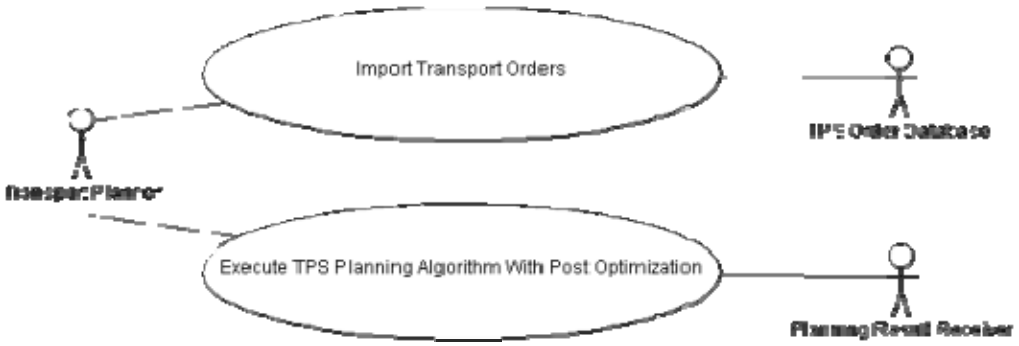

Figure 16: UML UC 2.02 diagram for IT-based Tour Planning with optimization

UC 2. 02 –IT-based Tour Planning with optimization

ID	**2.02**
Title	**IT-based Tour Planning with Optimization**
Summary	As a logistics tour planner I want to plan my transport orders more efficiently.
Primary actor	Commercial vehicle fleet tour planner
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	The logistics company planner plans tours based on: - existing transport orders, - available vehicles, -available drivers. For the planning she/he takes the available fleet, transport orders and known boundaries into account. While forming tours the planner tries to integrate all mandatory transport orders to the tours. Furthermore the planning shall provide a tour optimization to reduce KPIs: vehicle number to fulfill the tours, predicted fuel consumption, drive distance and drive time.
Workflow	Step 1: The planner imports all transport orders Step 2: The planner runs a tour planning to get a valid solution, i.e. plan transport orders and meeting all restrictions. Step 3: The planner runs the optimization process to receive an

ID	2.02
Title	IT-based Tour Planning with Optimization
	improved solution.
System output	The system shall provide a valid and improved solution for the tour planning problem.
Preconditions	1. IT-based tour planning application is installed and configured. 2. Transport orders are imported correctly to the tour planning application. 3. Traffic prediction data is available 4. A state of the art optimization algorithm is available.
Involved Client	Commercial logistics company - logistics tour planner
Devices	Logistics back-office system.
Critical success parameters	The user shall find the planned valid. The user shall experience an improvement of the provided tour planning.
Environmental or other restrictions	Drive time regulations have to be respected. Green zones have to be respected.
Relevant UCs	2.01
Relevant Functional Requirements	FR21
Comments	This use case formulates an advanced requirement for an IT-based tour planning.
Author	Florian Krietsch, PTV
Version	1.0
Date	10 October 2012

3.2.3 IT-based Tour Planning with Urban Eco-Optimization

The UC diagram for IT-based tour planning with eco-optimization is depicted in Figure 17, details of the UC definition are given in the table below.

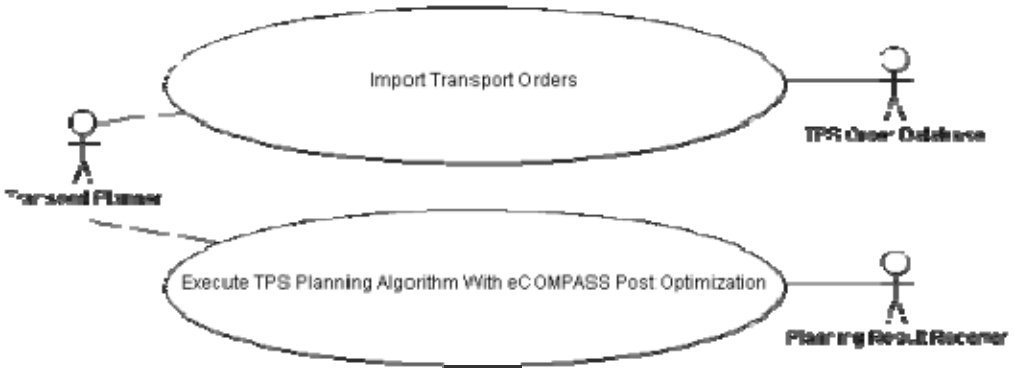

Figure 17: UML UC 2.03 diagram for IT-based Tour Planning with urban eco-optimization

UC 2.03 – Standard IT-based Tour Planning

ID	**2.03**
Title	**Standard IT-based Tour Planning with Urban Eco-Optimization**
Summary	As a logistics tour planner I want to plan my urban transport orders more efficient and more robust
Primary actor	Commercial vehicle fleet tour planner
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	The logistics company planner plans tours based on: - existing transport orders, - available vehicles, -available drivers. For the planning she/he takes the available fleet, transport orders and known boundaries into account. While forming tours the planner tries to integrate all mandatory transport orders to the tours.
Workflow	Step 1: The planner imports all transport orders Step 2: The planner runs a tour planning to get a valid solution, i.e. plan transport orders and meeting all restrictions. Step 3: The planner runs the eCOMPASS
System output	The system shall provide a valid solution for the tour planning problem. The solution shall be optimized. The solution shall be balanced and compact.
Preconditions	1. IT-based tour planning application is installed and configured. 2. Transport orders are imported correctly to the tour planning application. 3. An innovative optimization algorithm set from eCOMPASS is available, respecting balancing and

ID	2.03
Title	Standard IT-based Tour Planning with Urban Eco-Optimization
	compactness.
Involved Client	Commercial logistics company - logistics tour planner
Devices	Logistics back-office system.
Critical success parameters	The user shall find the planned valid. The user shall experience an improvement of the provided tour planning. The user shall experience balanced and compact tours.
Environmental or other restrictions	Drive time regulations have to be respected. Green zones have to be respected.
Relevant UCs	2.01, 2.02
Relevant Functional Requirements	FR16; FR21
Comments	This use case formulates an advanced requirement for an IT-based tour planning which will extend the state of the art significantly.
Author	Florian Krietsch, PTV
Version	1.0
Date	10 October 2012

3.2.4 Fleet Communication

UCs related to fleet communication are defined and illustrated in the figures and tables below.

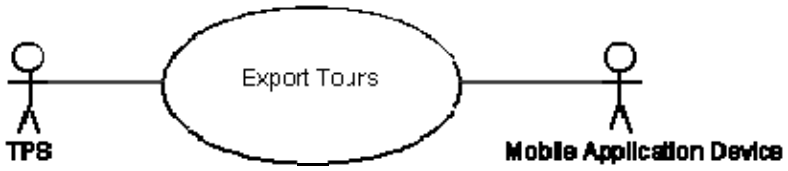

Figure 18: UML UC 2.04 diagram for IT-based Tour Planning Fleet communication

UC 2.04 –IT-based Tour Planning – Fleet communication

ID	2.04
Title	IT-based Tour Planning – Fleet Communication
Summary	As a logistics tour planner I want to communicate with my vehicles

ID	2.04
Title	**IT-based Tour Planning – Fleet Communication**
Primary actor	Commercial vehicle fleet tour planner, commercial vehicle driver
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	The logistics company planner plans tours. The planner sends planned tours from the back office to the mobile navigation devices.
Workflow	Step 1: The planner plans his transport orders and creates a tour plan. Step 2: The planner transfers tour plans from the back office system to the mobile device.
System output	The back office system shall have a working interface to communicate with external devices
Preconditions	1. IT-based tour planning application is installed and configured. 2. The data interface connectivity to mobile application is configured
Involved Client	Commercial logistics company - logistics tour planner
Devices	Logistics back-office system, mobile application device
Critical success parameters	The user shall find the feature useful; the planner shall be enabled via the data interface to transfer tour plans to the mobile device.
Environmental or other restrictions	None
Relevant UCs	
Relevant Functional Requirements	FR22
Comments	Communication is a core aspect for advanced integrated fleet planning systems.
Author	Florian Krietsch, PTV
Version	1.0
Date	10 October 2012

3.2.5 Fleet Communication Monitoring

The UC diagram for fleet communication monitoring is depicted in Figure 19, details of the UC definition are given in the table below.

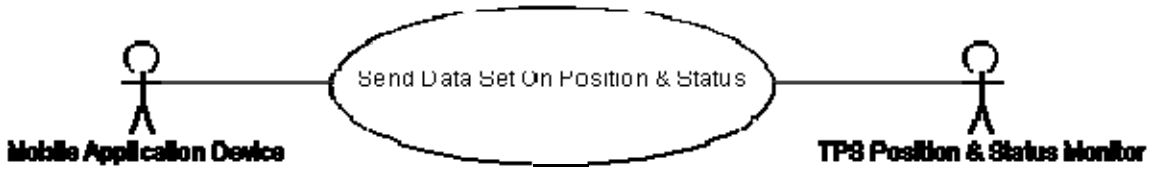

Figure 19: UML UC 2.05 diagram for IT-based Tour Planning Fleet communication monitoring

UC 2.05 –IT-based Tour Planning – Fleet communication

ID	**2.05**
Title	**IT-based Tour Planning – Fleet Communication Monitoring**
Summary	As a logistics tour planner I want to know the position and the status of my vehicles
Primary actor	Commercial vehicle fleet tour planner
Secondary actor(s)	Commercial vehicle driver
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	The logistics company planner needs to have knowledge of the position and the mission status of the vehicles she / he is in charge of.
Workflow	Step 1: The planner runs the IT-based tour planning software Step 2: The planner uses the fleet monitor feature
System output	The back office system shall display vehicle positions and status messages on a map
Preconditions	1. IT-based tour planning application is installed and configured. 2. The data interface connectivity to mobile application is configured
Involved Client	Commercial logistics company - logistics tour planner
Devices	Logistics back-office system, mobile application device
Critical success parameters	The user shall find the feature useful; the planner shall get a clear overview of the vehicle status and position
Environmental or other restrictions	None
Relevant UCs	2.04

ID	2.05
Title	IT-based Tour Planning – Fleet Communication Monitoring
Relevant Functional Requirements	FR22
Comments	This use case describes fleet monitoring, a key enabler for fleet dispatching.
Author	Florian Krietsch, PTV
Version	1.0
Date	10 October 2012

3.2.6 Fleet Communication Update

The UC diagram for fleet communication update is depicted in Figure 20, details of the UC definition are given in the table below.

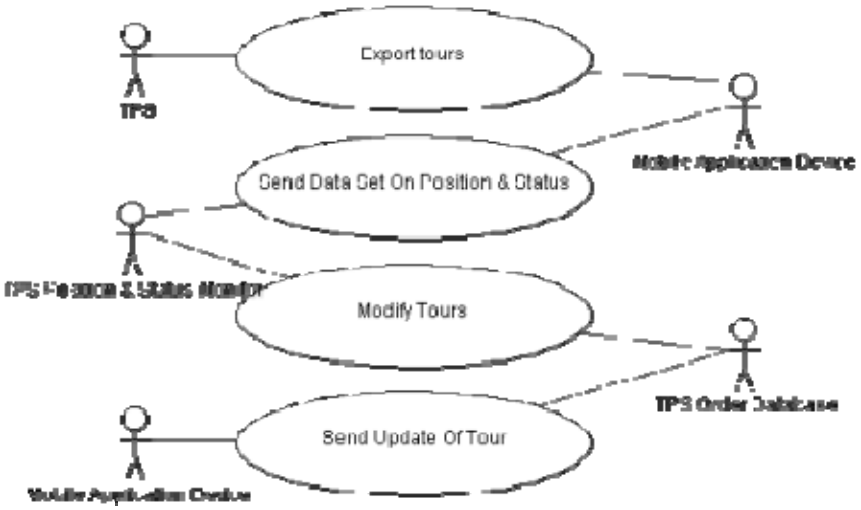

Figure 20: UML UC 2.06 diagram for IT-based Tour Planning Fleet communication update

UC 2.06 –IT-based Tour Planning – Fleet communication

ID	2.06
Title	IT-based Tour Planning – Fleet Communication Update
Summary	As a logistics tour planner I want to send and receive tour updates from my vehicle
Primary actor	Commercial vehicle fleet tour planner
Secondary actor(s)	Commercial vehicle driver
Priority Level	Secondary

ID	2.06
Title	**IT-based Tour Planning – Fleet Communication Update**
Background info/reason on selection and on assigning the priority level	The logistics company planner needs to dispatch the vehicles she / he is in charge of. Therefore the planner needs to have a bi-directional communication interface.
Workflow	Step 1: The planner runs the IT-based tour planning software Step 2: The planner uses the fleet monitor feature Step 3: The planner checks vehicle status Step 4: The planner reacts to a transport order change and changes the tour structure Step 5: The planner sends a tour update to the vehicle
System output	The back office system shall interface with the mobile application in the vehicle. A tour update can be sent.
Preconditions	1. IT-based tour planning application is installed and configured. 2. The data interface connectivity to mobile application is configured
Involved Client	Commercial logistics company - logistics tour planner
Devices	Logistics back-office system, mobile application device
Critical success parameters	The user shall find the feature useful; the planner shall have the possibility to send updates of an existing tour to the mobile application in the vehicle.
Environmental or other restrictions	None
Relevant UCs	2.04, 2.05
Relevant Functional Requirements	FR22
Comments	This use case describes a typical dispatching operation for a fleet
Author	Florian Krietsch, PTV
Version	1.0
Date	10 October 2012

3.3 Residents and Tourists with Smartphones

3.3.1 Multi-Modal Route Computation

The different UCs for computing multi-modal routes are illustrated in Figure 21. Details for the individual UCs are specified in the tables below.

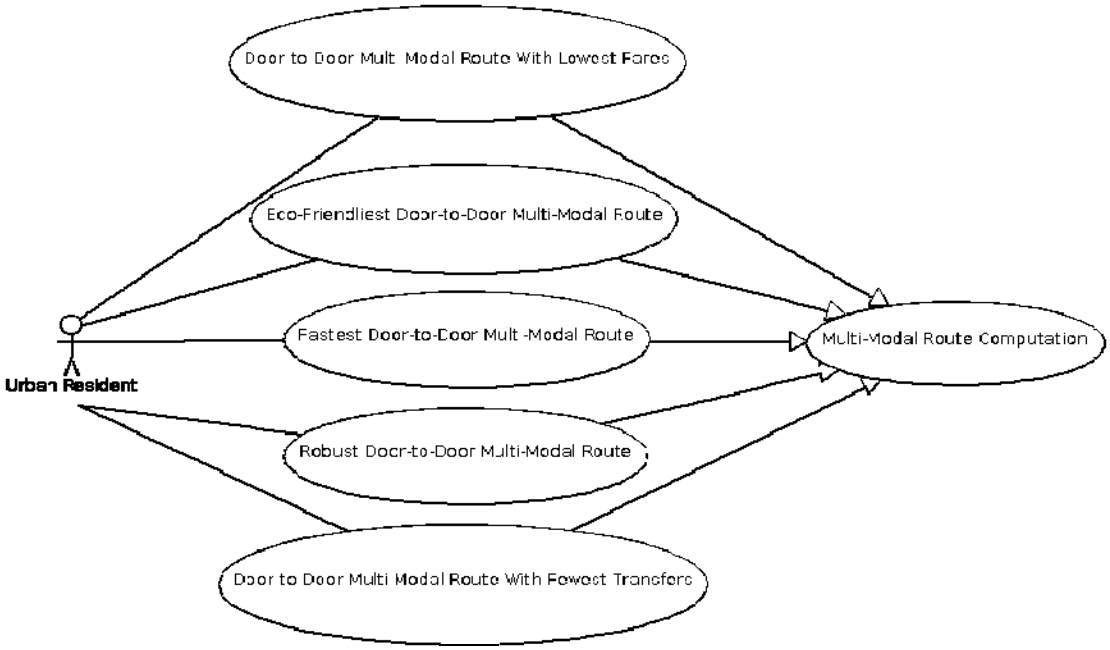

Figure 21: Use case diagram for multi-modal route computations.

UC 3. 1 – Fastest Door-to-Door Multi-Modal Route

ID	**3.1**
Title	**Fastest Door-to-Door Multi-Modal Route**
Summary	As an urban resident, I want to be presented with a sensible door-to-door multi-modal route suggestion for given origin and destination, optimized for short travel time, and taking into account real-time incidents.
Primary actor	Urban Resident
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Providing multi-modal door-to-door route suggestions is a key ingredient of the eCOMPASS mobility concept. Optimizing for fastest travel time is a typical user objective.
Workflow	Step 1: The user requests a door-to-door multi-modal route suggestion with minimal travel time. Step 2: The system displays a fastest door-to-door multi-modal

ID	3.1
Title	**Fastest Door-to-Door Multi-Modal Route**
	route and its key characteristics, e.g. travel time and number of transfers with transfer times.
System output	The system shall output a multi-modal door-to-door route optimized for short travel time, together with the route's key characteristics.
Preconditions	A server connection has been established to communicate with the routing server.
Involved Client	Multi-Modal Application
Devices	Smartphone
Critical success parameters	The route returned shall have minimum total travel time. The presentation of the route, i.e. the display of its key characteristics, shall provide a clear picture to the user of what to expect from this route.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	
Relevant Functional Requirements	FR8, FR20
Comments	Instead of entering the origin for the route query, the user's location may be used if it is available, e.g. through a valid GPS fix. The route suggestion will be planned according to user preferences, see UC 3. , or default preferences if none were entered by the user.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

UC 3. 2 – Door-to-Door Multi-Modal Route with Fewest Transfers

ID	3.2
Title	**Door-to-Door Multi-Modal Route with Fewest Transfers**
Summary	As an urban resident, I want to be presented with a sensible door-to-door multi-modal route suggestion for given origin and destination with the fewest transfers, taking into account real-time incidents.

ID	3.2
Title	**Door-to-Door Multi-Modal Route with Fewest Transfers**
Primary actor	Urban Resident
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Providing multi-modal door-to-door route suggestions is a key ingredient of the eCOMPASS mobility concept. Optimizing for fewest transfers is a typical user objective.
Workflow	Step 1: The user requests a door-to-door multi-modal route suggestion with fewest transfers. Step 2: The system displays a door-to-door multi-modal route with fewest transfers and its key characteristics, e.g. travel time and number of transfers with transfer times.
System output	The system shall output a multi-modal door-to-door route optimized for few transfers, together with the route's key characteristics.
Preconditions	A server connection has been established to communicate with the routing server.
Involved Client	Multi-Modal Application
Devices	Smartphone
Critical success parameters	The route returned shall have a minimum number of transfers. The presentation of the route, i.e. the display of its key characteristics, shall provide a clear picture to the user of what to expect from this route.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	
Relevant Functional Requirements	FR8, FR20
Comments	Instead of entering the origin for the route query, the user's location may be used if it is available, e.g. through a valid GPS fix. The route suggestion will be planned according to user preferences, see UC 3. , or default preferences if none were entered by the user.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

UC 3. 3 – Door-to-Door Multi-Modal Route with Lowest Fare

ID	**3.3**
Title	**Door-to-Door Multi-Modal Route with Lowest Fare**
Summary	As an urban resident, I want to be presented with a sensible door-to-door multi-modal route suggestion for given origin and destination, optimized for low fare, and taking into account real-time incidents.
Primary actor	Urban Resident
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Providing multi-modal door-to-door route suggestions is a key ingredient of the eCOMPASS mobility concept. Optimizing for lowest fare is a typical user objective.
Workflow	Step 1: The user requests a door-to-door multi-modal route suggestion with lowest fare. Step 2: The system displays a door-to-door multi-modal route with lowest fare and its key characteristics, e.g. fare, travel time, and number of transfers with transfer times.
System output	The system shall output a multi-modal door-to-door route optimized for low fare, together with the route's key characteristics.
Preconditions	A server connection has been established to communicate with the routing server.
Involved Client	Multi-Modal Application
Devices	Smartphone
Critical success parameters	The route returned shall have minimum total fare. The presentation of the route, i.e. the display of its key characteristics, shall provide a clear picture to the user of what to expect from this route.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	
Relevant Functional Requirements	FR8, FR20

ID	3.3
Title	**Door-to-Door Multi-Modal Route with Lowest Fare**
Comments	Instead of entering the origin for the route query, the user's location may be used if it is available, e.g. through a valid GPS fix. The route suggestion will be planned according to user preferences, see UC 3. , or default preferences if none were entered by the user.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

UC 3. 4 – Eco-Friendliest Door-to-Door Multi-Modal Route

ID	3.4
Title	**Eco-Friendliest Door-to-Door Multi-Modal Route**
Summary	As an urban resident, I want to be presented with a sensible door-to-door multi-modal route suggestion for given origin and destination, optimized for eco-friendliness, and taking into account real-time incidents.
Primary actor	Urban Resident
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Providing multi-modal door-to-door route suggestions is a key ingredient of the eCOMPASS mobility concept. Optimization for eco-friendliness lies at the heart of the project.
Workflow	Step 1: The user requests an eco-friendliest door-to-door multi-modal route suggestion. Step 2: The system displays an eco-friendliest door-to-door multi-modal route and its key characteristics, e.g. eco-footprint, travel time, and number of transfers with transfer times.
System output	The system shall output a multi-modal door-to-door route optimized for eco-friendliness, together with the route's key characteristics.
Preconditions	A server connection has been established to communicate with the routing server.

ID	3.4
Title	**Eco-Friendliest Door-to-Door Multi-Modal Route**
Involved Client	Multi-Modal Application
Devices	Smartphone
Critical success parameters	The route returned shall be particularly eco-friendly. The presentation of the route, i.e. the display of its key characteristics, shall provide a clear picture to the user of what to expect from this route.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	
Relevant Functional Requirements	FR8, FR20
Comments	Instead of entering the origin for the route query, the user's location may be used if it is available, e.g. through a valid GPS fix. The route suggestion will be planned according to user preferences, see UC 3. , or default preferences if none were entered by the user.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

UC 3. 5 – Robust Door-to-Door Multi-Modal Route

ID	3.5
Title	**Robust Door-to-Door Multi-Modal Route**
Summary	As an urban resident, I want to be presented with a sensible door-to-door multi-modal route suggestion for given origin and destination, optimized for reliability of ETA, and taking into account real-time incidents.
Primary actor	Urban Resident
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Providing multi-modal door-to-door route suggestions is a key ingredient of the eCOMPASS mobility concept. Optimization for reliability is a natural user objective.

ID	3.5
Title	**Robust Door-to-Door Multi-Modal Route**
Workflow	Step 1: The user requests a robust door-to-door multi-modal route suggestion. Step 2: The system displays a robust door-to-door multi-modal route and its key characteristics, e.g. reliability, travel time, and number of transfers with transfer times.
System output	The system shall output a multi-modal door-to-door route optimized for a reliable ETA, together with the route's key characteristics.
Preconditions	A server connection has been established to communicate with the routing server.
Involved Client	Multi-Modal Application
Devices	Smartphone
Critical success parameters	The route returned shall be particularly robust. The presentation of the route, i.e. the display of its key characteristics, shall provide a clear picture to the user of what to expect from this route.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	
Relevant Functional Requirements	FR8, FR20
Comments	Instead of entering the origin for the route query, the user's location may be used if it is available, e.g. through a valid GPS fix. The route suggestion will be planned according to user preferences, see UC 3. , or default preferences if none were entered by the user.
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

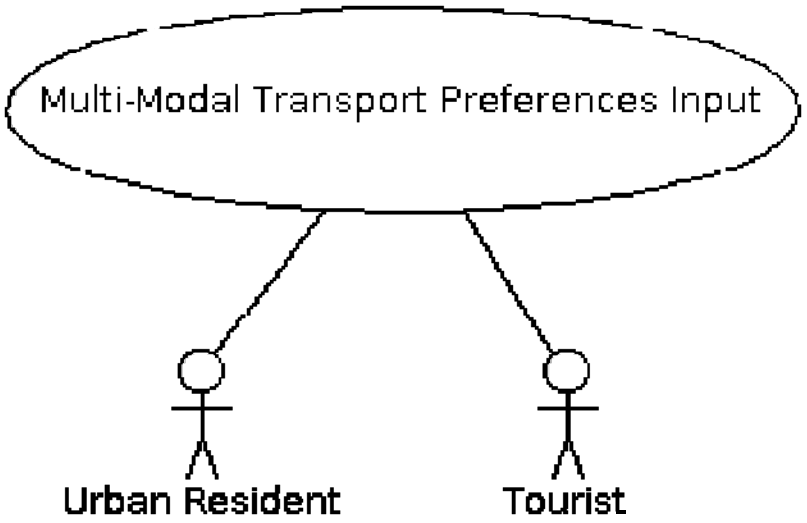

Figure 22: Diagram for UC 3.6, multi-modal transport preferences input. This use case caters to both urban residents and tourists.

UC 3. 6 – Multi-Modal Transport Preferences Input

ID	**3.6**
Title	**Multi-Modal Transport Preferences Input**
Summary	As an urban resident or tourist, I want to specify my personal multi-modal transport preferences, including e.g. which means of transport to include or exclude, and which minimum transfer time to include at transfer points.
Primary actor	Urban Resident or Tourist
Secondary actor(s)	None
Priority Level	Supportive
Background info/reason on selection and on assigning the priority level	Multi-modal route suggestions can only be appealing to the user if they cater to his preferences. Hence, this use case is essential.
Workflow	Step 1: The user enters his preferences into a form provided by the application. Step 2: The system applies these preferences to subsequent calls to the multi-modal route planner.
System output	None.
Preconditions	None.
Involved Client	Multi-Modal and Tourist Applications
Devices	Smartphone

ID	3.6
Title	**Multi-Modal Transport Preferences Input**
Critical success parameters	The form for entering preferences shall meet the user's essential expectations regarding configurability of the itinerary planner.
Environmental or other restrictions	None.
Relevant UCs	3.1-3.6
Relevant Functional Requirements	FR8
Comments	
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

3.3.2 Multi-Modal Route Alternatives

UCs related to multi-modal route alternatives are defined and illustrated in the figures and tables below.

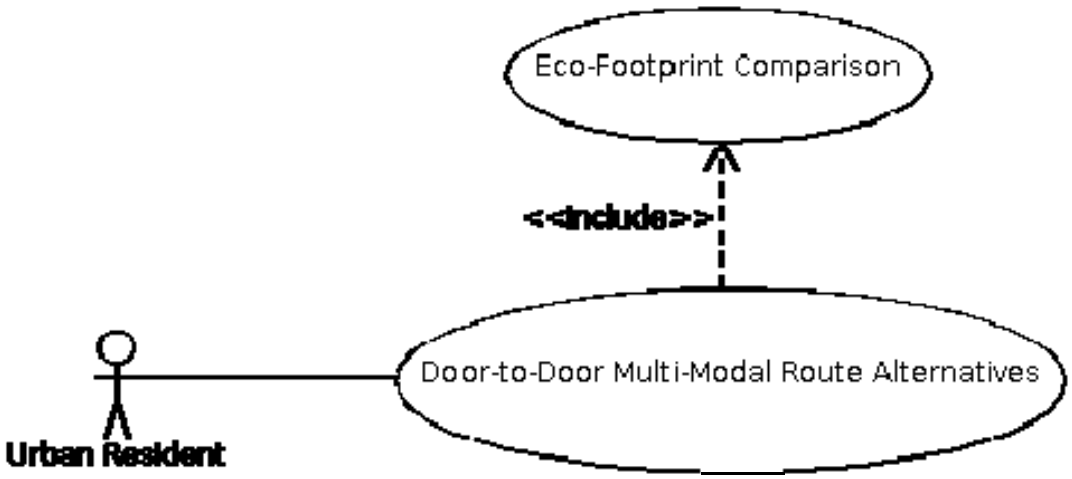

Figure 23: Diagram for UC 3. 7, door-to-door multi-modal route alternatives. When alternatives are displayed, also their eco-footprints are compared.

UC 3. 7– Door-to-Door Multi-Modal Route Alternatives

ID	3.7
Title	**Door-to-Door Multi-Modal Route Alternatives**
Summary	As an urban resident, I want to be presented different options for a door-to-door multi-modal route for given origin and destination, taking into account real-time incidents.

ID	3.7
Title	**Door-to-Door Multi-Modal Route Alternatives**
Primary actor	Urban Resident
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Providing multi-modal door-to-door route suggestions is a key ingredient of the eCOMPASS mobility concept. Presenting the user with several options increases user-friendliness as well as daily relevance.
Workflow	Step 1: The user requests door-to-door multi-modal route options. Step 2: The system outputs a number of sensible pareto-optimal door-to-door multi-modal routes, e.g. a fast, a robust, and an eco-friendly pareto-optimal route, plus one with few transfers and one with low fare. Key characteristics like travel time, number of transfers with transfer times, reliability, eco-friendliness, and fare are presented with the different options.
System output	The system shall output a number of pareto-optimal multi-modal door-to-door route options optimized for different objectives, together with the routes' key characteristics.
Preconditions	A server connection has been established to communicate with the routing server.
Involved Client	Multi-Modal Application
Devices	Smartphone
Critical success parameters	The routes returned shall all be interesting to the user, and the user shall derive a benefit from seeing all options, as opposed to just one optimized route. The presentation of each option, i.e. the display of its key characteristics, shall provide a clear picture to the user of what to expect from each route.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	
Relevant Functional Requirements	FR8, FR20
Comments	Instead of entering the origin for the route query, the user's location may be used if it is available, e.g. through a valid GPS fix. The route suggestion will be planned according to user preferences, see UC 3. , or default preferences if none were entered by the user.

ID	3.7
Title	Door-to-Door Multi-Modal Route Alternatives
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

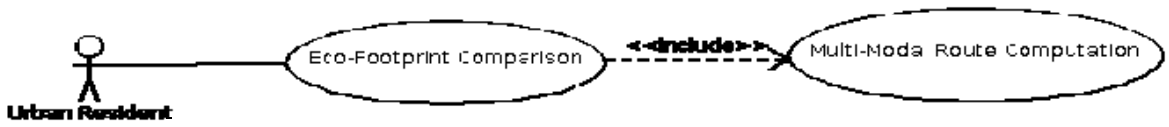

Figure 24: Diagram for UC 3. 8, eco-footprint comparison. Each such comparison includes at least one multi-modal route computation.

UC 3. 8– Eco-Footprint Comparison

ID	3.8
Title	Eco-Footprint Comparison
Summary	As an urban resident, I want to be able to compare the eco-footprint of different route options, possibly employing different means of transportation. This can be the eco-footprint of driving a car compared to using public transportation, but also a comparison of different modes of public transport, or merely different public transport routes.
Primary actor	Urban Resident
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Comparing the eco-footprint of a public transportation route to that of driving a car can effectively reassure the user that taking public transport is a good choice. Also, comparing different modes or route options in public transport can enable informed decisions and may well have a long-term effect of the utilization of different public transport lines and modes.
Workflow	Step 1: The user requests an eco-footprint comparison for different multi-modal routes currently suggested by the system. Step 2: The system returns a comparison of the eco-footprints of the currently suggested multi-modal routes, plus the eco-footprint of a corresponding car route for reference.
System output	The system shall output a graphic comparison of the eco-footprints of the currently suggested multi-modal routes, plus

ID	3.8
Title	**Eco-Footprint Comparison**
	that of a corresponding car route.
Preconditions	At least two different route suggestions have been planned and are currently available for display on the device. A server connection has been established to communicate with the routing server.
Involved Client	Multi-Modal Application
Devices	Smartphone
Critical success parameters	The eco-footprints of the compared multi-modal routes differ to a degree that the information is meaningful to the user. The difference to the eco-footprint for the car route is significant enough to be reassuring the user in his use o public transport.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	UC 3. , UC 3. , UC 3. , UC 3. , UC 3. , UC 3.
Relevant Functional Requirements	FR19
Comments	
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

3.3.3 Tourist Itinerary Planning

UCs for tourists are illustrated and defined in detail in the figures and tables below.

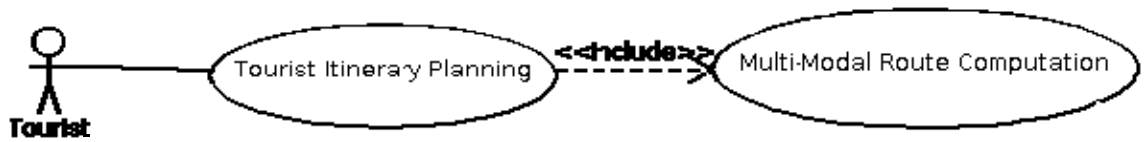

Figure 25: Diagram for UC 3.9, tourist itinerary planning. This use case always includes a multi-modal route computation.

UC 3. 9- Tourist Itinerary Planning

ID	**3.9**
Title	**Tourist Itinerary Planning**
Summary	As a tourist, I want to be presented a one or several day itinerary from my hotel, visiting sights fitting my preferences and the current circumstances (e.g. weather, day of the week, time of day), including multi-modal route suggestions.
Primary actor	Tourist
Secondary actor(s)	None
Priority Level	Essential
Background info/reason on selection and on assigning the priority level	Planning tourist itineraries, employing multi-modal transport routes, is a key focus of eCOMPASS.
Workflow	Step 1: The user enters one or several time windows on one or several days, and requests corresponding tourist itinerary. Step 2: The system displays an itinerary suggestion including multi-modal routes in between the itinerary stops and the key characteristics of the itinerary, e.g. number of stops and budget needed.
System output	The system shall output a tourist itinerary with corresponding multi-modal routes according to user preferences, together with the itinerary's key characteristics.
Preconditions	A server connection has been established to communicate with the routing server. The user has entered his itinerary preferences.
Involved Client	Tourist Application
Devices	Smartphone
Critical success parameters	The itinerary returned shall be feasible (e.g., it shall respect opening hours and sufficient time between stops for multi-modal transport), and fit the user's preferences.
Environmental or other restrictions	Due to the requirement for a server connection, GPRS coverage is needed in the area of employment.
Relevant UCs	3.9
Relevant Functional Requirements	FR8
Comments	
Author	Felix Koenig, TomTom

ID	3.9
Title	Tourist Itinerary Planning
Version	1.0
Date	10 October 2012

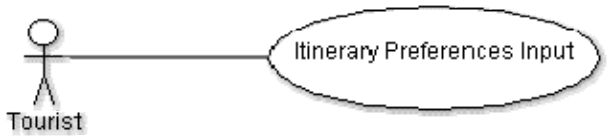

Figure 26: Diagram for UC 3. 10, itinerary preferences input.

UC 3. 10 – Itinerary Preferences Input

ID	3.10
Title	Itinerary Preferences Input
Summary	As a tourist, I want to be able to enter itinerary preferences, including e.g. start and end points for the itinerary, and which sights are most interesting for me personally.
Primary actor	Tourist
Secondary actor(s)	None
Priority Level	Supportive
Background info/reason on selection and on assigning the priority level	Planned tourist itineraries can only be appealing to the user if they cater to his preferences. Hence, this use case is essential.
Workflow	Step 1: The user enters his preferences into a form provided by the application. Step 2: The system applies these preferences to subsequent calls to the itinerary planner.
System output	None.
Preconditions	None.
Involved Client	Tourist Application
Devices	Smartphone
Critical success parameters	The form for entering preferences shall meet the user's essential expectations regarding configurability of the itinerary planner.
Environmental or other restrictions	None.
Relevant UCs	3.8

ID	3.10
Title	**Itinerary Preferences Input**
Relevant Functional Requirements	FR8
Comments	
Author	Felix Koenig, TomTom
Version	1.0
Date	10 October 2012

4 Priority Application Scenarios

4.1 Private Vehicle Drivers

Based on the various UCs defined above, their priorities, the anticipated results of algorithm development, and also the envisioned design of the eCOMPASS applications to be deployed in the pilot, we define the following priority application scenarios:

Scenario ID	**1.1**
Title	**Basic Route Computation**
Description	This scenario encompasses basic route computations, where a user requests a route of a certain type to his specific destination. Depending on the precise use case, the route type may be eco, robust, or fastest. Any route computation includes delivering traffic information for the planned route, and live traffic and possibly traffic predictions are to be regarded in route computation.
Contains Use Cases	UC 1. 1, UC 1. 2, UC 1. 3, UC 1. 9

Scenario ID	**1.2**
Title	**Alternative Routes**
Description	The alternative route application scenario comprises use cases where the actor is presented with a choice of routes. Depending on the specific use case, this may be the display of alternative routes per-trip, or the spontaneous or requested computation of an alternative to the current route while en route. For any alternative, traffic information for that specific route is presented, and when a set of alternative is displayed, a corresponding traffic information overview may be given.
Contains Use Cases	UC 1.5, UC 1.6, UC 1.7, UC 1.9, UC 1.10

Scenario ID	**1.3**
Title	**Departure Time Suggestion**
Description	This application scenario represents the use case where an actor requests a departure time suggestion based on historical and/or real-time traffic information, and possibly traffic prediction.
Contains Use Cases	UC 1. 8

4.1.1 Excluded Use Cases

The above priority application scenarios do not contain use cases UC 1. 4 - Traffic Load-Balancing Scheme, UC 1. 11 - Park & Ride, and UC 1. 12 - Eco-Coaching. These UCs had to be assigned a lower priority, since at this time, there is an uncertainty regarding their feasibility with respect to models and algorithms developed in the scope of eCOMPASS, and/or the availability of the necessary data in the pilot.

For traffic load balancing, it is not sufficiently researched how to model global traffic behavior, define appropriate models for user behavior, and which models and approaches to employ in computing the needed coordinated route suggestions. In particular, models needed to implement traffic load-balancing schemes require *flow-dependent* travel times for roads in the network, while for all other models considered in eCOMPASS, we rely on *time-dependent* travel times. This incompatibility places traffic load-balancing somewhat outside of the main scope of eCOMPASS. Moreover, it is unclear today how to obtain realistic data on flow-dependent travel times for any road network.

For park & ride, it is uncertain whether this feature will be included in the scope of WP 2 and WP 3, i.e. whether progress in research and algorithm design will be substantial enough to support it. Also it is not certain whether sufficient data on the existence and dynamic availability of park & ride terminals can be obtained for the test site. Finally, for eco-coaching, it is unclear how to feed the necessary vehicle data to the eCOMPASS system, which will be based on mobile devices.

We would like to stress that these UCs may still be included in the pilot should developments allow for it. In this case, the present deliverable would be updated accordingly.

4.2 Vehicle Fleet Drivers

Scenario ID	**2.1**
Title	**IT-based Tour Planning with optimization**
Description	This scenario includes the main problem solution for a logistical planning problem. The result shall be optimized following ecological targets.
Contains Use Cases	UC 2.01, UC 2.02, UC 2.03

Scenario ID	**2.2**
Title	**IT-based Tour Planning – Fleet communication**
Description	This scenario comprises the interface and planning support services between back-office and fleet vehicles.
Contains Use Cases	UC 2.04, UC 2.05, UC 2.06

4.3 Residents and Tourists with Smartphones

Scenario ID	**3.1**
Title	**Multi-Modal Route Computation**
Description	This scenario encompasses all basic door-to-door multi-modal route computations, which might be optimized for travel time, fewest transfers, lowest fare, eco-friendliness, or robustness, depending on the specific use case. System output in this scenario may depend on personal preferences entered by the user in a corresponding use case.
Contains Use Cases	UC 3.1, UC 3. 2, UC 3. 3, UC 3. 4, UC 3. 5, UC 3. 6

Scenario ID	**3.2**
Title	**Multi-Modal Route Alternatives**
Description	Use cases where the user is presented with a choice of multi-modal door-to-door route alternatives are collected in this scenario. Upon request, different route options can be compared by eco-footprint. The routes computed may depend on personal preferences entered by the user in a corresponding use case.
Contains Use Cases	UC 3.6, UC 3.7, UC 3.8

Scenario ID	**3.3**
Title	**Tourist Itinerary Planning**
Description	This scenario comprises tourist-specific use cases. The system returns a personalized itinerary suggestion for one or several days according to the location and time frame entered by the user, taking into account his personal itinerary preferences, which can be entered in a dedicated corresponding use case.
Contains Use Cases	UC 3.9, UC 3.10

5 Summary & Conclusions

Having used the methodology presented in Section 2 several UCs have been defined and formally described by tabular templates and UML diagrams. The described UCs can be divided into three main groups: UCs for private vehicle drivers, for vehicle fleet drivers and for residents and tourists with smartphones.

Concerning private vehicle drivers the essential UCs presented in this deliverable mainly deal with suggesting the eco-friendliest, fastest or most robust routes. Furthermore, the suggestion of alternative routes (either Pre- or In-Trip) and optimal departure times are essential UCs as well. However, features such as Traffic Load-Balancing Scheme, Park&Ride or Eco-Coaching are considered to have lower priority so far. The essential UCs for vehicle fleet drivers deal with the optimization and urban eco-optimization of IT-based tour planning as well as the communication and monitoring between tour planner and tour driver. For residents and tourists, the suggestions for the fastest, cheapest, eco-friendliest or most robust multi-modal routes as well as routes with fewest transfers or alternative routes are the most essential UCs. Moreover, the possibility of comparing the eco-footprints of different routes might lead the user into using public transport. The final essential feature plans tourist itineraries according to the users preferences.

Together, the mentioned essential UCs yield the so-called priority application scenarios. These scenarios will finally represent the main applications in the pilot of eCOMPASS.

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