



# SUNSET

**Sustainable Social Network Services for Transport**  
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## **Deliverable D5.2** **“System integration”**

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## Summary

Deliverable D5.2 is a prototype deliverable concerning the integrated SUNSET system. This document provides a description of this prototype in its current state (M18 of the SUNSET project). The integrated system combines software from all work packages supplying software functionality – WP2, WP4, as well as WP5. Additionally, the integrated system relies on external resources and services for correct operation. This deliverable will be revised in M24, when the integrated system is ready for the full living lab operation.

The documentation page serves as a primary reference for the documentation of the architecture of the SUNSET system. While the design and development of this system is an ongoing process, the documentation can be considered a work in progress further to be perfected in the second half of 2012. This page can be accessed using the following login details:

URL: <http://www.tripzoom.eu/sps/>

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# 1. Introduction

Deliverable D5.2 is a prototype deliverable concerning the integrated SUNSET system. This document provides a *description* of this prototype in its current state (M18 of the SUNSET project). The integrated system combines software from all work packages supplying software functionality – WP2, WP4, as well as WP5. Additionally, the integrated system relies on external resources and services for correct operation. This deliverable will be revised in M24, when the integrated system is ready for the full living lab operation. A snapshot of the source code of the prototype is available on request.

## 1.1 Goals

The goals for this deliverable are (in M18):

- Provide a basic but fully integrated SUNSET system using the individual components developed in WP2 (personal mobility and platform) and WP4 (mobile applications), the integration components of WP5 (urban mobility services), and other (external) supporting components. Prepare this system for initial validation efforts (WP7) during which valuable feedback will be collected to improve the system (M18)

## 1.2 Main Results and Innovations

The main results of this document are given in

**Table 1.** This explains how the results of this deliverable contribute to the project's main innovations. In this table, "N/A" in the right column indicates that this deliverable does not contribute to a particular project innovation.

| SUNSET innovations  | Contribution of this deliverable  |
|---|---|
| Social mobility services that motivate people to travel more sustainably in urban areas                 | A social network adapter is implemented to enable social network login to the SUNSET system and prepare for further social network integration such as sharing information and inviting users to join the SUNSET community. |
| Intelligent distribution of incentives to balance system and personal goals                             | The integrated system supports issuing incentives through the city dashboard in a flexible manner, and notifying travellers of existing incentives (for their living lab) and assigned rewards on their mobile phone.       |
| Algorithms for calculating personal mobility patterns using info from mobile and infrastructure sensors | The integrated system supports monitoring of personal mobility patterns and aggregation of these patterns.  |
| Evaluation methodologies and impact analysis based on living lab evaluations                            | N/A   |

**Table 1: Contributions of this deliverable, D5.2 (M18), to the SUNSET innovations**

## 1.3 Approach

Given the complexity of the system as a whole, and the high number of dependencies between internal components, and dependencies on external resources, we have decided to build the integrated system in a highly iterative manner. Since the beginning of this year (2012) we worked with a release process in which the system is build and tested in an

iterative manner in 'releases'. This release process is used for the development of all software components, including the components from WP2 and WP4.

Each release focuses on implementing a limited number of system tasks and services. Over time, we expanded and improved the system to prepare it for living lab execution. We are using tooling to keep track of the development activities and plan for future releases (i.e., the Redmine web-based project management and bug-tracking tool <sup>1</sup>). So far, we went through 4 releases: it is expected that before the full living lab execution, we will go through 4 more releases (bringing the total number of releases to 8). As we show in this document, a considerable amount of functionality is already implemented, allowing for more focus on stability, usability, and scalability in future releases.

A cycle typically consists of 4-5 weeks of development and 1 week of evaluation. Each evaluation is considering the state of the system at a certain moment in time, and is reporting on that state (including bugs and show-stoppers). This repeated evaluation of the system as a whole allows us to keep a firm grip on the development. The system evaluation approach and a summary of the results of the first four releases are provided in section 4. Note that this evaluation summary refers to services and tasks in the Redmine system, which do not completely match with the components describe in this documents, i.e., the Redmine system handles a much higher level of detail. Nevertheless, we include section 4 here, to provide a good insight in the way we are developing the integrated SUNSET system.

The deployment of the system is done in a distributed back-end consisting of a number of servers. Additionally, the client software is deployed to the Android and iPhone phones of the users. The servers have been available from an early stage on, and receive updates as new functionality is ready (and bugs are fixed). Likewise, users of the system are asked to upgrade to newer versions as more functionality becomes available in the mobile apps.

This document is organised as follows. Section 2 provides an overview of the current state of the system by revisiting the components described earlier in the architecture and design document D5.1 [1]. Section 3 describes the deployments environment. Finally, section 4 gives a summary of the evaluation approach and the results of the evaluation of the first 4 releases.

## 1.4 Architecture and design adaptations (D5.1)

The architecture and design of the SUNSET software was delivered in D5.1 in M10. Since then, we made a number of adaptations to the system:

- The Traffic Pattern Detector (TPD) was dropped as a separate component. We now investigate the feasibility of using an external data source (such as Google Traffic) to present traffic status information to the user.
- Related to this, the Infrastructure Status Store (ISS) was not implemented, because it would only be used by the TPD.
- The end-user functionality is accessible almost exclusively through the mobile clients, i.e., for day-to-day usage, the travellers only need their mobile phones to use the SUNSET system. As a consequence, no functionality is duplicated in the web portal and the Portal Profile Visualisation is no longer necessary.
- A Context Harvester (CH) component was introduced to support the efficient gathering of information for the user's buddy list from all server-side components, such as the Relation and Identity Manager (RIM) for the user profile, the Personal Mobility Store (PMS) for the last location and trips, the Mobility Pattern Detector (MPD) for mobility patterns and the Incentive Market Place (IMP) for rewards gained with incentives.
- A Notification Dispatcher (ND) was introduced to allow all server-side components to notify the mobile clients about certain events, such as the availability of a new incentive, rewards and experience sampling questions.

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<sup>1</sup> Redmine Project management web application <http://www.redmine.org/>

- The proposed responsibilities of the Social Network Adapter (SNA) are taken over by the Relation and Identity Manager (RIM).



## 2. Component status

In deliverable D5.1 [1] the components that together form the SUNSET system were first described in terms of design and functionality. This chapter describes the relation between the system architecture and its actual implementation, highlighting the most important components and their current implementation status.

### 2.1 Mobile Client

This subsection describes the components that together form the Mobile (access device) Client used by the core stake-holder, end-user or traveller (referred to as the user for shorter). The mobile app on iOS is currently developed for version 5 and on Android OS for version 2.1. Both versions are forward compatible and have already been successfully tested on iOS 5.0, 5.1 and 6.0 beta 3 as well as Android OS 2.3 and 4. The figures illustrating the sub-components of the Mobile Client will be a selection of those platforms. For further reference to the initial design of the Mobile Client, we refer to D4.1 [7].

The end-user mobile application of the SUNSET project is called Tripzoom. Tripzoom provides the following functionality to end-users:

- It records their trips in the background (Section 2.1.7)
- It provides an overview of their mobility in terms of trips, frequent trips, places visited and a mobility footprint ((Section 2.1.3). Furthermore it provides incentives and rewards earned from their travel behavior (Section 2.1.2).
- It provides a means to invite friends and to get information about the travel behavior of friends (in terms of last trip, total costs, total CO<sub>2</sub> emission, and time and distance travelled) (Section 2.1.4)
- It will notify the end user when there is a new experience sampling question available for them to answer (Section 2.1.1), if someone invites them to become a friend, if a new incentive ('challenge') has been made available to them, or if they earned a reward based on their travel behavior (Section 2.1.5)

In terms of presentation to the user, the functionality is grouped in blocks: The 'Me' tab contains all relevant information about the travel behavior of the user, whereas all information regarding friends is placed under the 'Friends' tab.

In addition, the Mobile Client provides a means for the user to edit his personal profile information (such as name, city, gender etc.) and to control the privacy settings. This provides direct control over what information others can see of this user, when they become friends with the user.

Upon first use, the Mobile Application asks the user to register with the Tripzoom portal. During the registration process, access credentials are generated that will be used in all subsequent calls to server components.

The following subsections describe the most important components of the Mobile Client.

### 2.1.1 Mobile Experience Sampler (MES)

The Mobile Experience Sampler (MES) retrieves questions posed by system operators from the ES and ESS (Evaluation Support and Experience Sampling Store, see Section 2.7). The communication between the Mobile Client and the ESS is achieved through the use of push notifications provided by the Notification Dispatcher (Section 2.7). Figure 1: Notification of an experience sampling question and its subsequent visualisation in the application when responding to the notification. Platform: iOS. illustrates the process of receiving an experience sampling question notification and its follow up question.

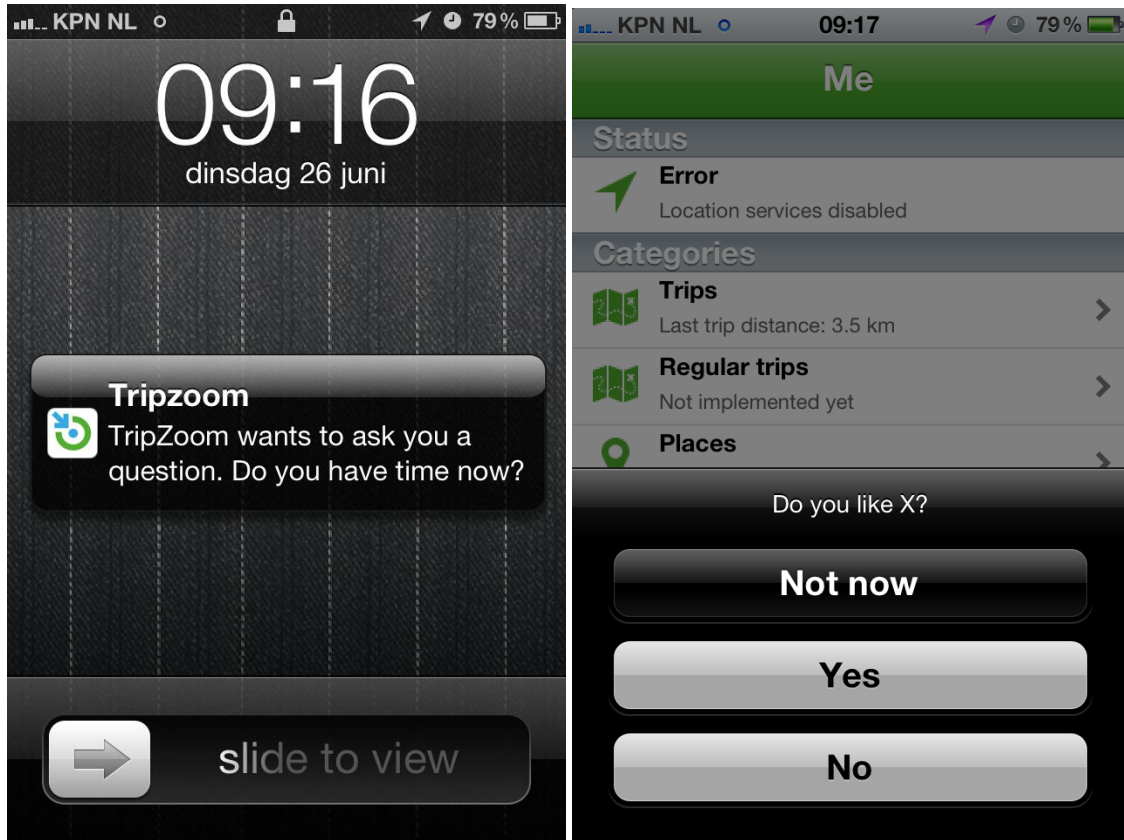


Figure 1: Notification of an experience sampling question and its subsequent visualisation in the application when responding to the notification. Platform: iOS.

### 2.1.2 Mobile Incentive Presenter (MIP)

The Mobile Incentive Presenter (MIP) provides the mobile interface of the IMP (Incentives Market Place (Section 2.9.1)). It shows an overview of the incentives tailored to the user (Figure 2, left) which are visualised in a list, with a more detailed textual description of the incentive. Incentive rewards are implemented and visualised in a similar fashion (Figure 2, right). The user is notified of new incentives becoming available using the notifications provided by the Notification Dispatcher.

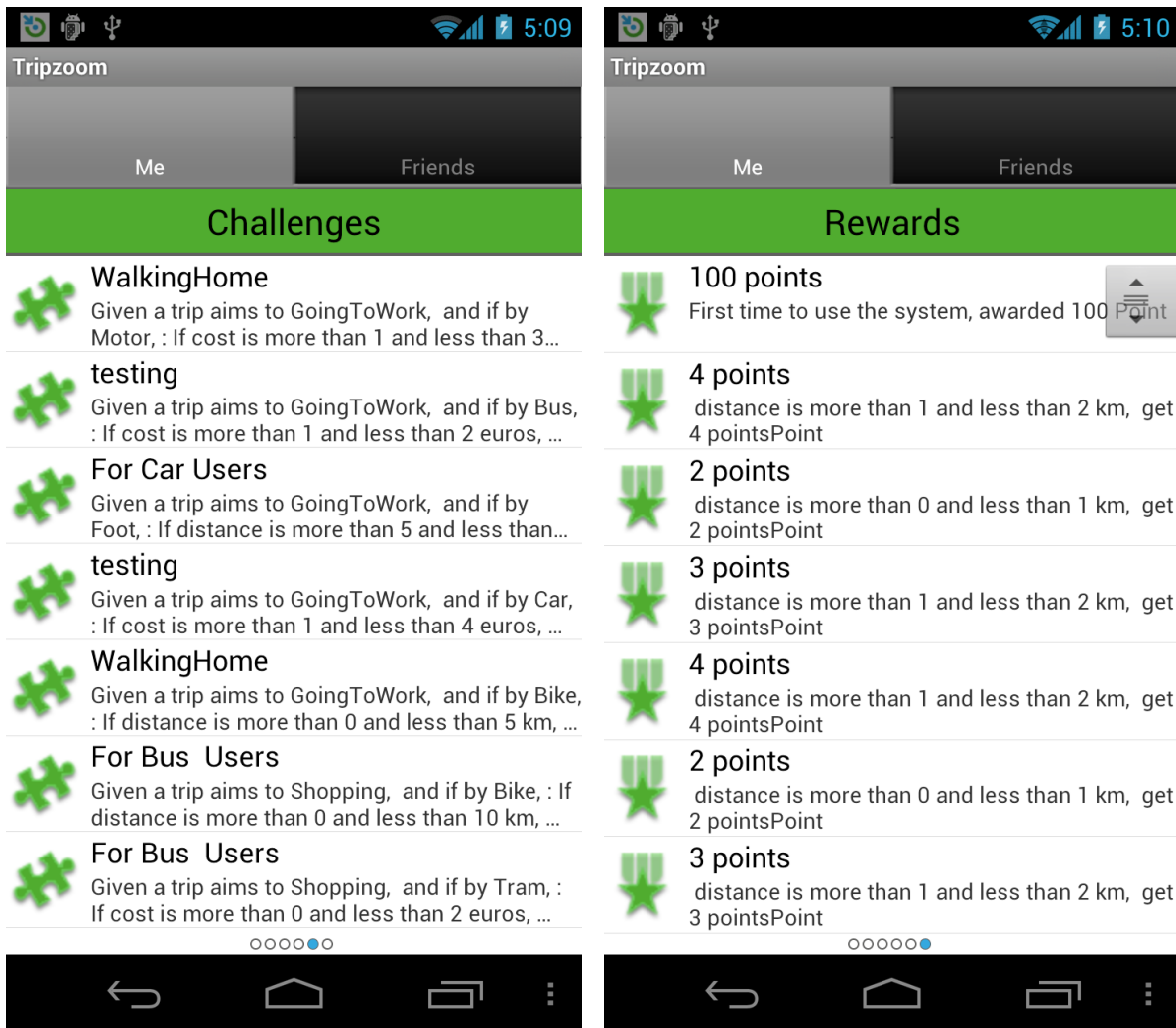


Figure 2: An overview of applicable incentives (left) and the rewards earned by a user (right). Platform: Android.

### 2.1.3 Mobile Mobility Profile Visualisation (MMPV)

The Mobile Mobility Profile Visualisation (MMPV) component provides the mobile front-end for any mobility related statistics computed by the MPD (Mobility Pattern Detector, Section 2.5.2). As such, the Mobile Client distinguishes between 3 mobility-related concepts: trips, frequent trips and places. The MMPV provides methods for retrieving detailed information on these concepts which was processed on the server by the MPD. Furthermore, the mobility profile (Figure 3) provides means to compare the modal split of a user against the total time or distance travelled, travel costs and emissions.

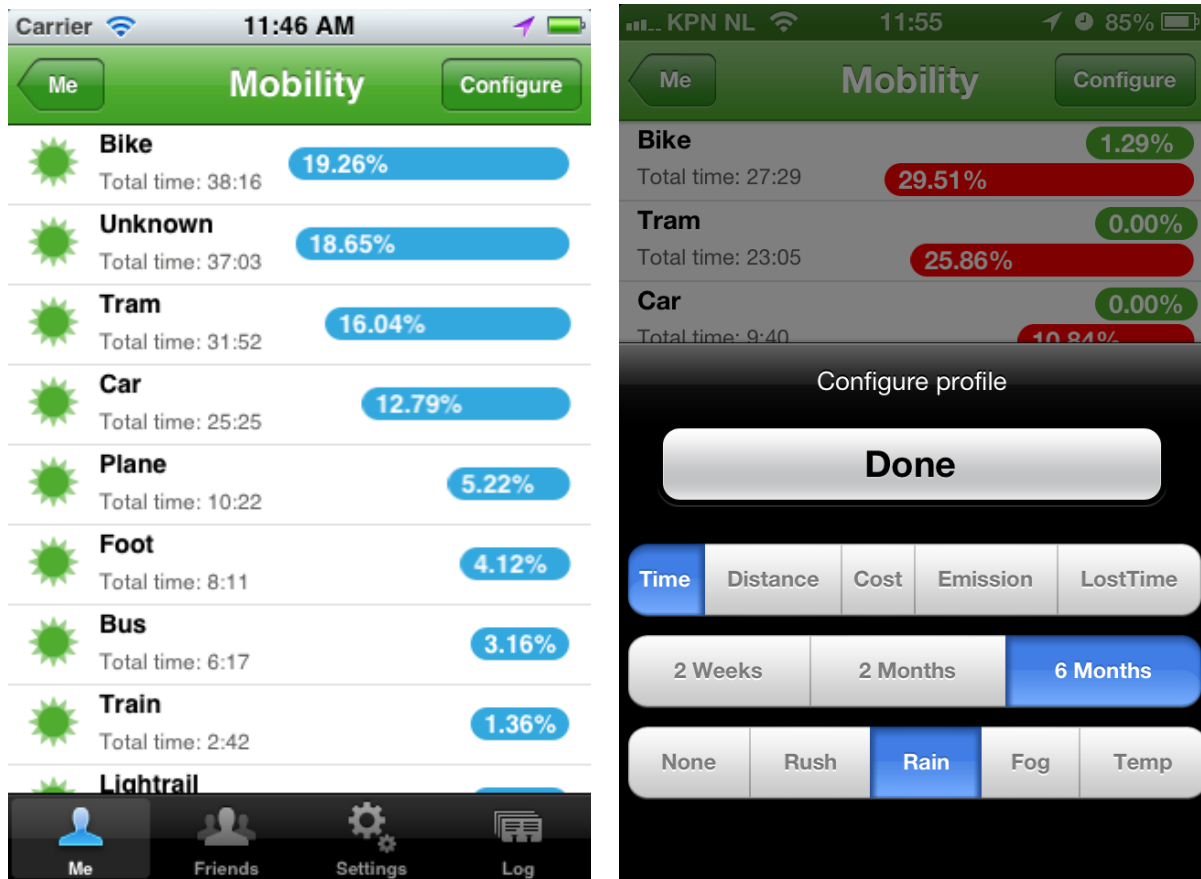
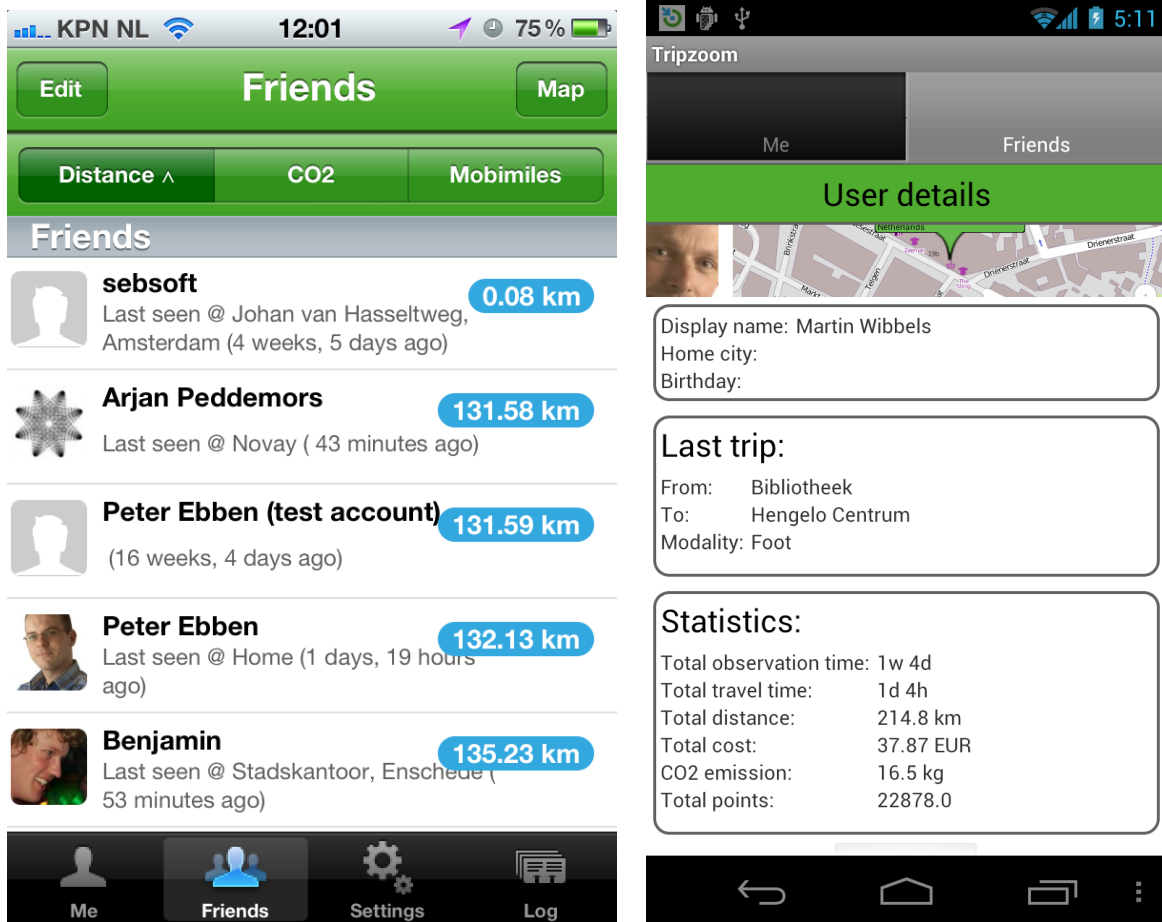


Figure 3: Left: Overview of modalities compared over time (Platform: iOS). Right: Mobility profile configuration (Platform: iOS).

### 2.1.4 Mobile Buddy List (MBL)

The Mobile Buddy List (MBL) collects and displays profiles, status and performance summaries of a user's buddies (such as mobility information and performance). It provides the means to search for users and invite them to become friends, delete friends and to accept and decline friend requests. The MBL visualises other users' mobility information (i.e., a last trip and overviews of total travel distance, time, cost and emission) provided by the Mobility Pattern Detector (Section 2.5.2) and provides methods to sort and compare the list of buddies according to CO<sub>2</sub> emissions, total number of points earned (provided by the IMP, Section 2.9) and distance to the user's current location. Furthermore MBL also provides functionality to view the user's buddies on the map. Figure 4 shows an overview of a user's buddies and a detail page of one of the buddies.



**Figure 4: Left: Buddy list sorting friends by distance (platform: iOS). Right: Buddy detail page showing its personal information, last trip and mobility statistics (platform: Android)**

### 2.1.5 Mobile Notifications (MN)

The Mobile Notifications component (MN) receives notifications from the Notification Dispatcher (Section 2.7) and resolves these notifications to form actions for content presentation in the Mobile client. It will notify the end user when there is a new experience sampling question available for them to answer (Section 2.1.1), if someone invites them to become a friend, if a new incentive ('challenge') has been made available to them, or if they earned a reward based on their travel behavior (Section 2.1.5).

### 2.1.6 Mobile Authentication (MA)

The Mobile Authentication component (MA) registers the mobile application and the mobile device for the user via the Proxy & Authentication (PA, Section 2.4.3) as well as the RIM component (Relation and Identity Manager, Section 2.4.2) and authorises the application to make API calls to the platform. Upon opening the application for the first time, the user needs to register using the Web Portal (Section 2.2). After giving explicit consent to share certain pieces of personal information such as mobility and user profile related content, a set of credentials is provided which is used to sign requests to the various APIs using the OAuth protocol (for more information see Section 2.4 on Proxy & Authentication services).

### 2.1.7 Mobile Sensing (MS)

The Mobile Sensing component (MS) gathers raw measurements from built-in mobile device sensors to derive trips and static location information. These sensors include the GPS sensor,

WiFi sensor, GSM sensor, magnetometer and the accelerometer. To control and minimise battery usage while optimising trip recording quality, the MS uses algorithms to configure and switch between these sensors. The implementations of the MS may vary per platform and OS version, as the different platforms have different limitations on the use of these sensors in foreground and background and the degree to which they are configurable and the way they can be accessed, and while different OS versions offer different functionality to configure those sensors.

## 2.2 Web Portal

This section describes the SUNSET web portal which has been redesigned to focus on the Tripzoom application and on end users. The initial design of the web portal as described in D5.1 comprises two main components:

- The *Portal Profile Visualisation (PPV)* component provides the front-end of the web portal for SUNSET-users, provides visualisations of user mobility profiles and links this information to social networks. The portal and mobile clients complement each other for the visualisation of mobile profiles, focusing on their individual strengths (e.g. mobility vs. screen size).
- The *User & Application Management (UAM)* component provides a front-end for the RIM to users and developers. It allows end users to set preferences and settings while developers can use this component to register external resources and applications.

The updated design of the web portal focuses on selected aspects of these components in order to focus on end users: Like the PPV and the UAM, the updated web portal provides a front-end for end-users, allows them to manage their personal data and links to social networks. However, unlike the PPV and the UAM, it shifts the visualisation of mobility profiles to mobile clients, is not targeted at developers and only integrates a limited number of external resources, e.g. connections to social networks. Instead, the updated web portal focuses on end users and the (mobile) Tripzoom application. It also implements different social networking features that replace a single *Social Network Adapter* component. The following sections describe the main parts of the updated Tripzoom web portal (<http://tripzoom.eu/tripzoom/index.php>) in more detail.

### 2.2.1 Landing Page

One goal of the updated web portal is to advertise Tripzoom to interested visitors and potential future users. For that purpose, the landing page of the web portal (Figure 5) was redesigned to illustrate core aspects of Tripzoom such as personal mobility, sustainability or community. In order to get more information about these and other aspects of Tripzoom, users can access a more detailed information page from the landing page.

The landing page also features different connections to social networks: The most prominent social networking features are Facebook- and Twitter-boxes that link to the respective Tripzoom -pages on these social networks and provide a preview of latest updates. Additional links to Tripzoom-pages on Facebook, Twitter, Google+ and Foursquare can be found in the footer of the landing page which also includes links to terms & conditions, contact and privacy information. Finally, the landing page includes two links that allow users to download the mobile Tripzoom app for iOS and Android from the App Store, respectively from Google Play.



Figure 5: Landing page of the Tripzoom web portal

## 2.2.2 Login and Registration

From the landing page, users can either log in to an existing Tripzoom account or register to create a new one. A registration-link and a more prominent login-button at the top of the landing page link to the respective pages (Figure 6). Users can login and register with dedicated credentials or an existing Facebook-account. However, users who log in or register with Facebook automatically have access to its social networking features. Other users have to log in to Facebook later in order to use the same features. The login-page also features a link that allows registered users to retrieve forgotten passwords.

Figure 6: : Portal pages for login (left) and registration (right)

The design of these pages is deliberately simple in order to be reused for the mobile login process. In order to use the mobile Tripzoom application, users have to log in to Tripzoom. This

feature is handled by mobile-friendly versions of the login- and registration-pages of the Tripzoom portal (Figure 7).

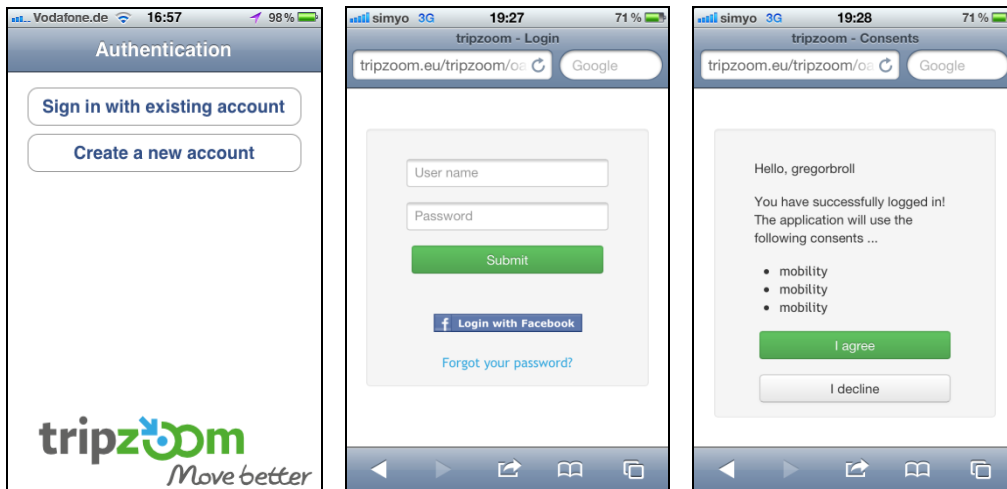


Figure 7: Login and registration in the mobile Tripzoom app (left) is handled by mobile-friendly versions of the portal pages for login (middle) and registration (right)

### 2.2.3 User Profile Management and Social Networking

After users have successfully registered or logged in, they get to the “inner” part of the portal which is based on the social network framework ELGG<sup>2</sup>. It allows users to manage their user profile (Figure 8) and settings for their Tripzoom account, to invite and manage friends, to create blogs and to post activities to an activity feed. The functionality of ELGG and thus the portal can be easily extended with additional add-ons.

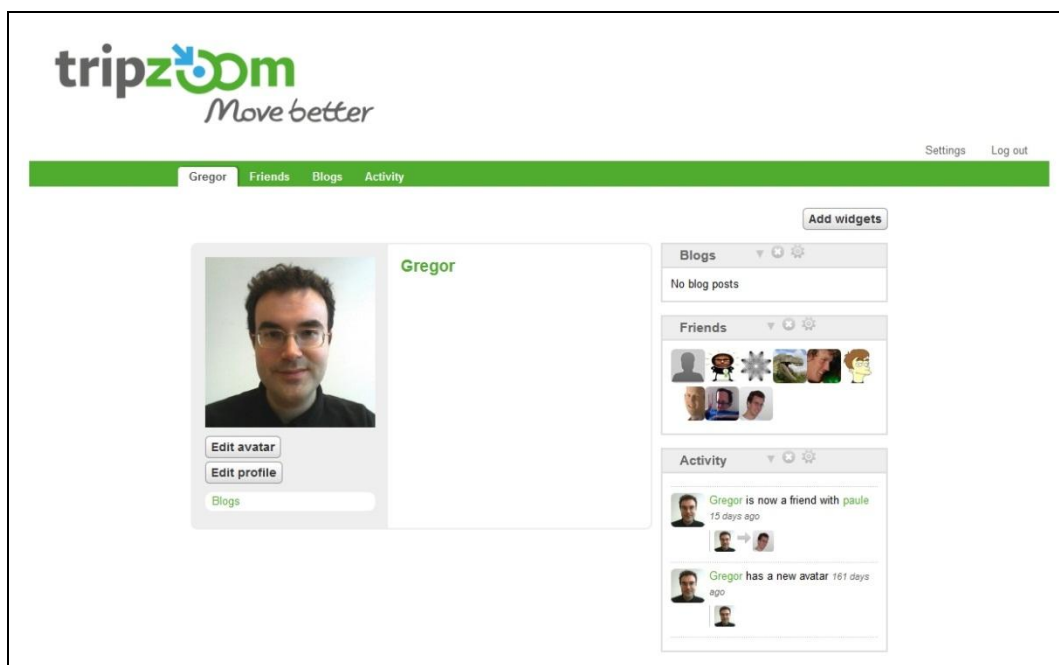


Figure 8: User profile page within the Tripzoom portal

<sup>2</sup> ELGG: Open source social networking engine <http://www.elgg.org>



This inner part of the Tripzoom web portal is a social network itself, connecting members of the Tripzoom community with each other. Apart from the Facebook login, this part of the Tripzoom portal also integrates or will integrate other social networking features that link to external social networks like Facebook or Twitter.

- **Connection to social networks:** Users will be able to connect their Tripzoom account with existing social network accounts. These connections are a prerequisite for smooth interactions between Tripzoom and social networks and other features of Tripzoom.
- **Import user information:** Users will be able to import profile information from other social network accounts to update their Tripzoom profiles.
- **Inviting friends:** Users will be able to invite their friends from other social networks into Tripzoom.
- **Posting:** A dedicated API allows different Tripzoom components, including the web portal and the mobile clients, to post different kinds of information (e.g. status updates, messages ...) to different social networks.

## 2.3 Dashboard (Manager Web Portal)

The City Dashboard (CD) provides an operation platform for the Living Lab controller (LLc) to coordinate Tripzoom system applications. Currently, the core functions in the CD are listed below. More functions will be added in by the on-going development.

- User Administration
- User Living Lab Assignment
- Incentive Management
- Experience Sampling Management

This section explains the functionality of the CD and describes the relationship between the CD and other components (RIP, IMP, ESS) with respect to each of the core functions. These relationships are fundamentally defined in the SUNSET wide component and API overview.

The CD can be accessed using the following URL: <http://www.tripzoom.eu/portal>

### 2.3.1 User Administration

The User Administration component in the CD supports the following functionality:

- User login
- User privilege setting

The CD implements these tasks by calling RIM (section 2.4.1) and all the user information is stored in RIM. The CD can retrieve and modify user information from and to RIM.

The CD distinguishes users between different roles (i.e., the traveller and the living lab controller), yielding different functionality after a successful login. The CD provides extended functionality to the living lab controller by enabling this functionality to insert and edit incentives and to use the mechanisms to post and retrieve questions using experience sampling.

To access all the CD functions, a user needs to have another LLc to assign privilege to his/herself to become LLc. If a LLc changes a user's privilege, this change will be sent and stored in the RIM.

## 2.3.2 User Living Lab Assignment

There are three living labs planned in the Tripzoom system, i.e. Enschede, Leeds and Gothenburg (CD has a temporary “Testing” living lab for development testing). A user can only belong to one of the living lab. In different living lab, users will receive different incentives and experience sampling questions. In the current implementation, assigning users to a specific living lab is done manually. Therefore, assigning users into the right living lab is an importation task for the LLc which is supported by the CD. Figure 10 shows the page for assigning users into different living lab. To facilitate this operation, LLc can page, sort, filter and search through the user list. The possibility of automatic living lab assignment is still being investigated.

Welcome!  
Login as: matrix

English SET

Identity relations  
Mobility footprint  
User Administration  
LLUserAdmin  
Incentives administration  
ESQ administration  
[Log Out](#)

### Administrate Users

| Username         | Email address                    | Living Lab   | Option             |
|------------------|----------------------------------|--------------|--------------------|
| JingHTC          | jbie31+HTC@gmail.com             | Enschede     | Enschede Update    |
| matti2015        | matthias.wgnr@gmail.com          | Leeds        | Leeds Update       |
| JingAndroid2     | jbie31+Android2@gmail.com        | Leeds        | Leeds Update       |
| Jing_iOS         | jbie31+iOS@gmail.com             | Testing      | Testing Update     |
| MarcelMeeuwissen | M.meeuwissen@enschede.nl         | Leeds        | Leeds Update       |
| newpaul4         | paulholleis+newpaul4@gmail.com   | Gothenburg   | Gothenburg Update  |
| temp11           | paulholleis+temp11@gmail.com     | Leeds        | Leeds Update       |
| temp10           | temp10@paul-holleis.de           | Not assigned | Not assigne Update |
| Camilla          | camilla.stalstad@viktoria.se     | Leeds        | Leeds Update       |
| ebben_test       | Peter.Ebben+test@novay.nl        | Not assigned | Not assigne Update |
| ebben_iphone     | Peter.Ebben+iphone@novay.nl      | Leeds        | Leeds Update       |
| Ynze             | ynze.vanhouten@novay.nl          | Testing      | Testing Update     |
| rmartens         | chenyan153@gmail.com             | Leeds        | Leeds Update       |
| marth            | marth@docomolab-euro.com         | Leeds        | Leeds Update       |
| medium           | tripzoom_medium@paul-holleis.de  | Gothenburg   | Gothenburg Update  |
| billwione        | googleroto@yahoo.com             | Leeds        | Leeds Update       |
| wangmei163       | zhubaobao_726@163.com            | Gothenburg   | Gothenburg Update  |
| wangmei1983      | 182443145@qq.com                 | Leeds        | Leeds Update       |
| jbie1            | jbie31+test1@gmail.com           | Testing      | Testing Update     |
| sgmuller         | s.m.grant-muller@its.leeds.ac.uk | Gothenburg   | Gothenburg Update  |

Sunset server can provide users incentives to encourage effective and healthy transportations.

Car  
Bus  
Bike  
Foot  
Train  
Taxi  
Plane  
Ferry...

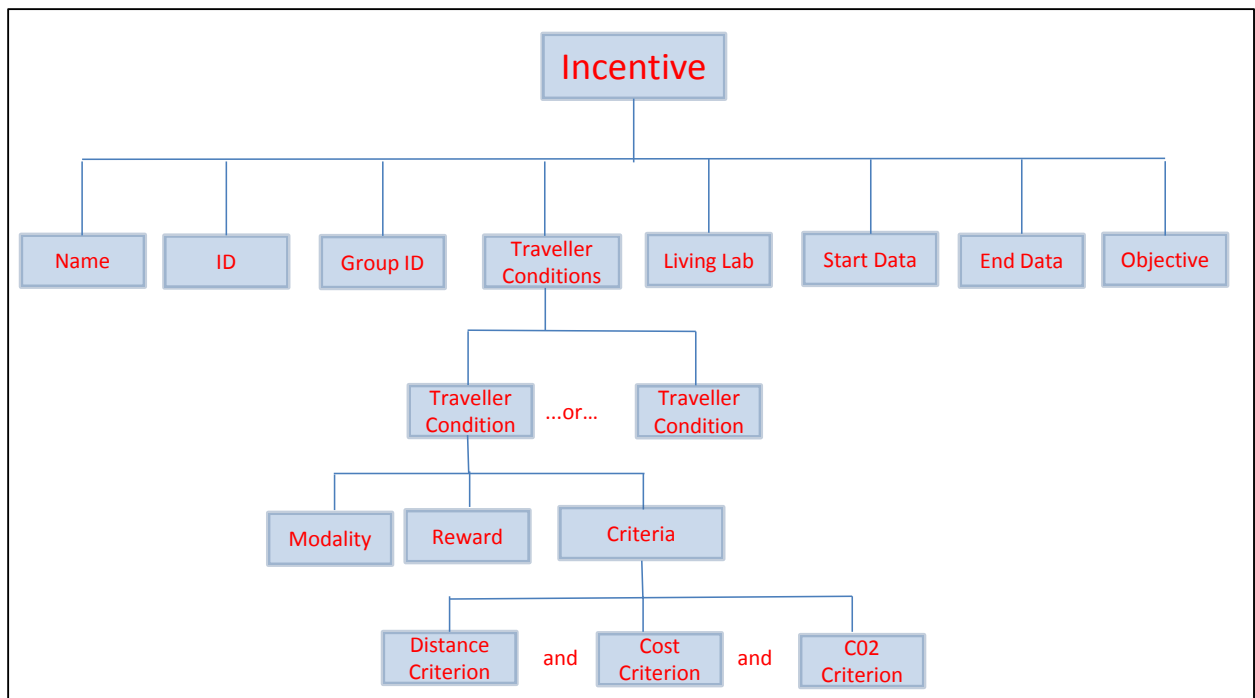
Figure 9: LLc Assign users into different living lab

## 2.3.3 Incentive Management

To manage incentives, the CD retrieves and sends incentive data to and from the IMP(section 2.9.1). LLc should be able to register, retrieve, and modify incentives in IMP database. In addition, the CD should support LLc monitoring and incentive issuing to users, for example how many users received a new incentive notification. In total, there are 2 main tasks on incentive management now in the CD:

- Registration and modification of incentives
- Monitoring Incentives

IMP currently implements “Target and Challenge” incentives. These incentives are manually registered by a LLC through the CD. The structure of an incentive is displayed in Figure 11 below.



**Figure 10: Structure of a “Target and Challenge” Incentive**

As shown in Figure 11, each incentive has several Traveller Conditions. In practice, if a user satisfies any one of the Traveller Conditions when finishing his/her trip, he/she will get the related reward. To reward a user, each Traveller Condition asks the user for a specific modality (foot, bike, bus, etc...) and if satisfies part or all of 3 criteria: Distance Criterion, Cost Criterion and CO<sub>2</sub> Emission Criterion.

For example, 3 Traveller Conditions for an incentive might be:

- If you go by foot and travel more than 5 km, you will receive 100 points as a reward;
- If you take a bus and it costs less than 2 Euros and emits CO<sub>2</sub> less than 5 mg, you will receive 50 points as a reward;
- If you take a car and travel less than 8 km and it costs less than 5 Euros and emit CO<sub>2</sub> less than 10 mg, you will receive 20 points as reward.

According to the 3 Traveller Conditions, if a user walks 6 km in a trip, he/she will receive 100 points. At another time, if the user takes a bus and spends 1 Euro and emits CO<sub>2</sub> 4 mg in a trip, he/she will receive 50 points. Another example, if a user drives a car and travels 10 km in a trip, he/she will receive no points from this incentive even though he/she does spend less than 5 Euros and emits CO<sub>2</sub> less than 10 mg.

welcome!  
Login as: matrix

**Register An Incentive**

English ▾ SET

Identity relations ▸  
Mobility footprint ▸  
User Administration ▸  
LLUserAdmin ▸  
Incentives administration ▸  
ESQ administration ▸

[Log Out](#)

sunset server can provide incentives to encourage effective and healthy transportations.

Car  
Bus  
Bike  
Foot  
Train  
Taxi  
Plane  
Ferry...

**Incentive Name:**  
The name of this incentive is: For Car Users

**Objective:**  
The objective of this incentive is: GoingToWor ▾

**Living lab:**  
This incentive belongs to Livinglab: Enschede ▾

**Duration:**  
This incentive starts on: 02-Jun-2012  
This incentive ends on: 30-Jun-2012

**Traveller Condition:**

Select modality: Unknown ▾ Update criteria: Distance  Cost  CO2  Update Criteria

Add

| Condition Preview |                |                    |               |                          |        |
|-------------------|----------------|--------------------|---------------|--------------------------|--------|
| Modality          | Distance Range | Cost Range         | CO2 Range     | Reward of this Condition | Option |
| Foot              | 5 km to 10 km  | 0 Euros to 0 Euros | 0 mg to 0 mg  | 100                      | Delete |
| Bus               | 0 km to 0 km   | 0 Euros to 2 Euros | 0 mg to 5 mg  | 50                       | Delete |
| Car               | 0 km to 8 km   | 0 Euros to 5 Euros | 0 mg to 10 mg | 20                       | Delete |

Register

**Figure 11: Incentive registration**

Incentive registered in the CD follows the incentive structure shown in Figure 11 which shows the incentive registration page. The process of incentive registration is also supported by a help page explaining the steps to be taken. After registration, an incentive can also be modified by a LLC.

A LLC can go to the incentive monitoring page to see all the incentives from the IMP including the ones created by other LLCs. Each incentive in the list is organised following the incentive structure given in Figure 11. To facilitate the operation, LLC can page, sort, filter and search the incentive list. To monitor incentive issuing to users, there is a "Check" button to check how many users are notified by each incentive. The feedback page is provided once a user clicks an appropriate button. To monitor users' response after they have been notified of a new incentive becoming available, the CD provides functionality to check how many users confirm each incentive after notifications are received. The feedback page is provided once the feedback button is clicked.

### 2.3.4 Experience Sampling Question Management

Experience Sampling Question (ESQ) is defined in ESS (section 2.8.1). To support ESS usability, the CD retrieves and sends ESQ data from and to ESS. A LLC should be able to register, retrieve, and modify part or all the ESQs in ESS database. In addition, the CD should support LLC monitoring users' answers to the questions. For example, a LLC would like to know how many users select "Yes" to the question: "Would like to walk home after work?". In total, there are 2 main tasks for ESQ management in the CD:

- Registration and modification of experience sampling questions;
- Monitor an experience sampling question.

Welcome!  
Login as: matrix


English ▾ SET

- Identity relations ▸
- Mobility footprint ▸
- User Administration ▸
- LLUserAdmin ▸
- Incentives administration ▸
- ESQ administration ▸


[Log Out](#)

### Register An Experience Sampling Question


Sunset server can provide users incentives to encourage effective and healthy transportations.




Car




Bus




Bike




Foot




Train



Taxi



Plane



Ferry...

**Question:**

Would like to walk home

**Possible Answers to This Question:**

| Answer       | Option                                |
|--------------|---------------------------------------|
| Yes          | <input type="button" value="Delete"/> |
| No           | <input type="button" value="Delete"/> |
| I don't know | <input type="button" value="Delete"/> |

**Active To Travellers?**

Yes  No

**How Frequently This Question Sent to Travellers:**

▾

**The Condition Deciding The Group of Travellers This Question Targets to:**

▾ Eq ▾

| Name                   | ComparisonOperator | Value | Option                                |
|------------------------|--------------------|-------|---------------------------------------|
| user\profile\livinglab | Eq                 | Leeds | <input type="button" value="Delete"/> |

**Issue Condition of This Question:**

▾ Eq ▾

| Name           | ComparisonOperator | Value | Option                                |
|----------------|--------------------|-------|---------------------------------------|
| time\dayofweek | Eq                 | 3     | <input type="button" value="Delete"/> |

**Figure 12: Experience sampling question registration**

ESQ registering in the CD, follows the ESQ structure. Figure 13 shows the ESQ registration page. The process of ESQ registration is also supported by a help page explaining the steps to be taken. After registration, an ESQ can also be modified by LLC.

After registering ESQ, LLC can go to ESQ monitor page to see all the ESQs from ESS including the ones created by other LLCs. To facilitate the operation, LLC can page, sort, filter and search the incentive list. To monitor users' answers to an ESQ, there is a "Check" button to check the answer statistics for each ESQ. The feedback page is provided once clicking the button.

## 2.4 Proxy & Security Services

The Identity and Relation Manager (IRM), the Privacy Manager (PM), and the Proxy components form the authentication and security backend of the SUNSET platform. The IRM manages users, their profiles and their interrelations, while the PM is responsible to handle the privacy policies of the users, which are grouped by type of the friendship between requester and data-owner, and to make privacy access decisions based on the established rules. Finally, the Proxy is responsible to ensure that the data access from external components is limited to those approved by the individual user. A detailed technical description of the IRM and the PM is given in D2.3 [5].

## 2.4.1 Relation and Identity Manager (RIM)

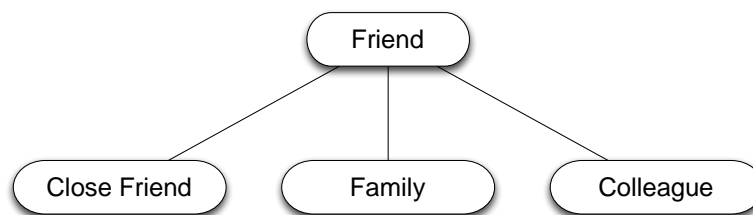
The RIM maps unique numeric identities to credentials, names, icons and further user profile information as well as to classified friend relations and system defined groups. The RIM also manages external Social Network credentials of users such as their Facebook or Twitter account data and access tokens. Its API allows for the usual CRUD (Create, Read, Update, Delete) operations on the user objects and additionally provides functionality to verify credentials and to search for a user based on a specific search term.

The identity of a user contains the following elements:

- id (unique number assigned by the system, not visible to the user)
- displayName (external visible name, configurable by the user)
- userName, email (used to register this account)
- firstName, lastName, icon, birthday, sex, homeCity (as set by the user)
- userInformation (list of extensible settings like "shareWithFacebook")
- roles (list of roles assigned to this user; one of "user", "developer", "admin", "LL coordinator")
- externalIdentities (external service account information and delegate credentials).

Only the displayName and the icon are considered public and thus are not protected by any authentication or privacy mechanism.

Relations between users can be established by defining additional Connection elements. Again the RIM provides all standard CRUD methods to manage Connections. A Connection specifies the users to be connected as well the type of connection (Figure 13).



**Figure 13: Connection types**

By default all Connections are of type "Friend". However, the user can assign a friend a more specific connection type that supports different access rights (see next section). The status of a Connection can be one of (for active Connections), invited (for friend invitations by the user) or unconfirmed (for friend invitations by another user).

The RIM also offers APIs to post to external Social Network services on the user's behalf (e.g. A users Facebook wall) using the delegations and configurations established by the users or to a general page about an external Social Network like the Tripzoom's Twitter page.

Finally, the RIP exposes a Web interface within the Tripzoom Web portal that allows the configuration of a user's account (Figure 14), revision of friendships (Figure 15) and the visualisation of community activities (Figure 16).

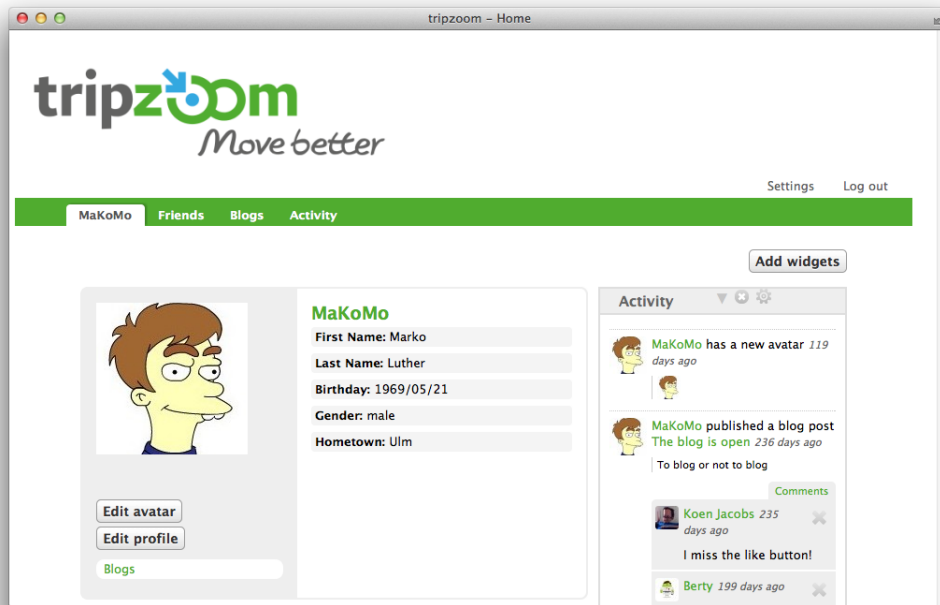


Figure 14: RIM Web interface - user profile

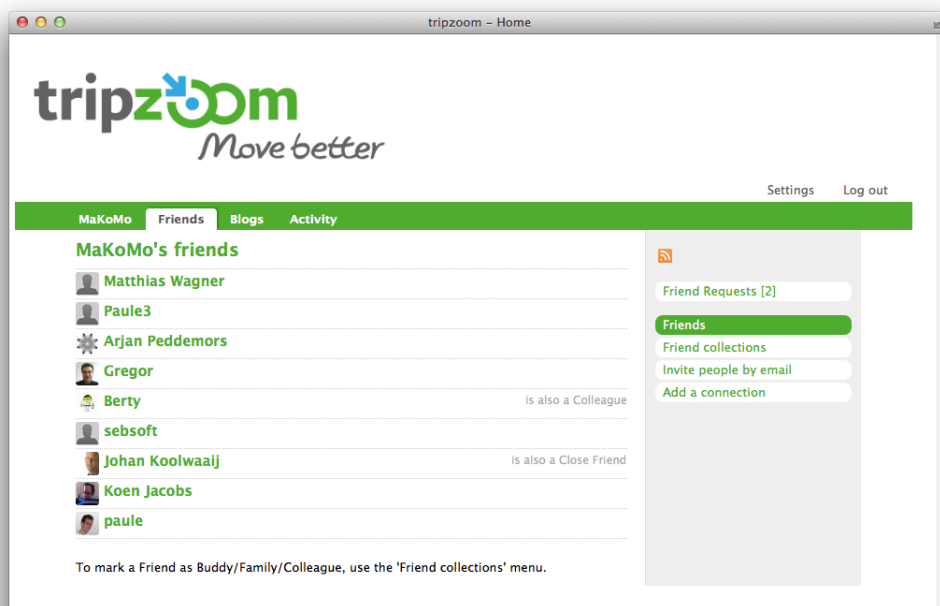
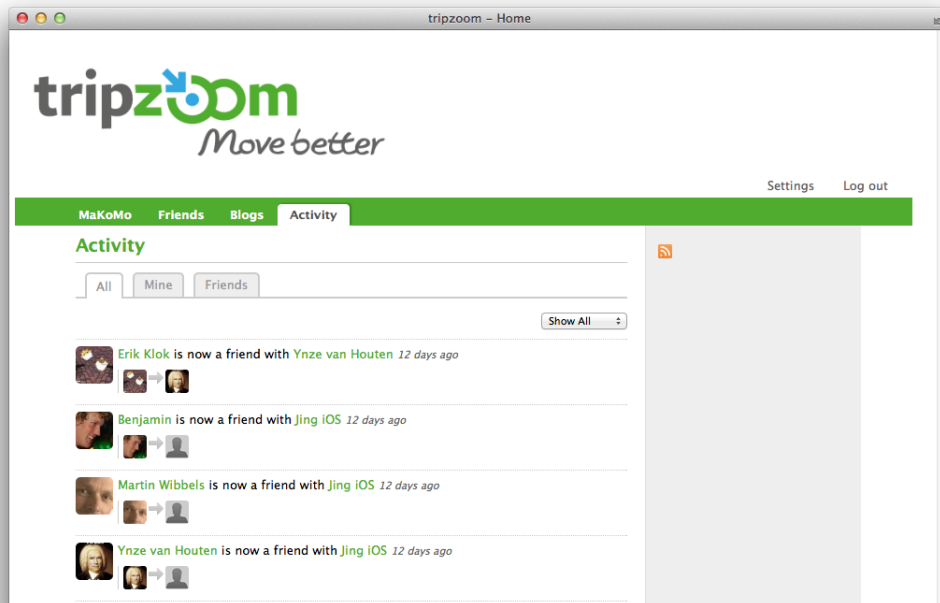


Figure 15: RIM Web interface – friends



**Figure 16: RIM Web interface – community**

## 2.4.2 Privacy Manager (PM)

The PM manages the privacy directives of users and provides the system's unique privacy decision point. The privacy enforcement point is implemented, distributed and realized in each component that manages user data (such as the PMS described below). Privacy directives can be established per context category (such as Location, Trip, ...) and type (such as Live, History, ...) For each combination of category and type, a user can specify if a certain group of buddies (such as family or colleagues) will have access to the collected data or not. The user can change these privacy directives at any time, but the effect of the change will be reflected only after a certain caching period. Additionally to those relation specific directives a user can specify if his data should be taken into account in anonymous community statistics, or not. This feature allows users with a unique data trace, easily to be recognized in certain anonymous statistics, to protect his identity also in those cases. Each privacy directive has an appropriate default that "does not disclose anything if not specified differently by the user". Those defaults can be configured via the PM's API. This API allows also introduces new privacy categories and types as well as to request a privacy decision. Also all CRUD methods are provided to handle privacy directives, which allows the system to define user interfaces to manipulate those instances. Figure 17 below shows the privacy interface of the mobile Tripzoom client.





Figure 17: Tripzoom privacy interface (platform: iOS)

### 2.4.3 Proxy & Authentication (PA)

External access to components in the SUNSET portal is controlled using OAuth. The OAuth protocol<sup>3</sup> is realized by an Apache OAuth proxy module. The proxy determines if the OAuth signature on incoming requests is valid. If so, the request is forwarded to the actual component. Otherwise the request is rejected.

The proxy adds two headers to forwarded requests:

- an OAuth-Consent header, containing a comma separated list of consents granted by the user to the requesting application;
- an iZone-OAuth-User header, containing the id (which is a number) of the user on whose behalf the request is executed.

All SUNSET components are responsible for enforcing the consents that are required for their operations. Internal interactions between SUNSET components may however be executed without consent enforcement.

The Apache OAuth module consults the Proxy component to verify the received OAuth tokens. This Proxy component manages all OAuth token and provides the standard OAuth protocol methods to request and access tokens as well as the authorisation of the corresponding delegations by the user. On top of the standard OAuth protocol the Proxy allows to assign consents to components in the system, which the user can use to restrict the access from a client to a subset of platform components. The Proxy manages all underlying data types (like Consent, Application, RequestToken, AccessToken, ...) and provides the corresponding CRUD methods to the platform.

<sup>3</sup> OAuth 1.0 Revision A Protocol Specification <http://oauth.net/core/1.0a/>

## 2.5 Mobility Services

### 2.5.1 Personal Mobility Store (PMS)

The PMS is responsible to collect all sensed mobility information from the mobile phones of the travellers, and to clean, smooth and enrich this data, so that it can be used to derive personal and community mobility patterns by the mobility pattern detector (MPD).

The personal mobility store (PMS) has three main tasks:

- To collect sensed mobility information from the mobile phone
- To clean, smooth and enrich this data
- To provide this data to other components, such as the mobility pattern detector (MPD, to detect personal and community patterns), the incentive marketplace (IMP, to monitor the applicability of incentives given the user's context), or the experience sample store (ESS, again to monitor the applicability of a micro-questionnaire based on the target user's context)

To this end it collects measurements that represent the sensed and enriched data, which include:

- Bike and Footpod measurements with accelerometer-based data
- Error measurements with data on user and system errors
- Location measurements with location data combining inputs from GPS, Wi-Fi and 3G.
- Power measurements with information on the battery status
- Trip measurements with information on single-modality trips.








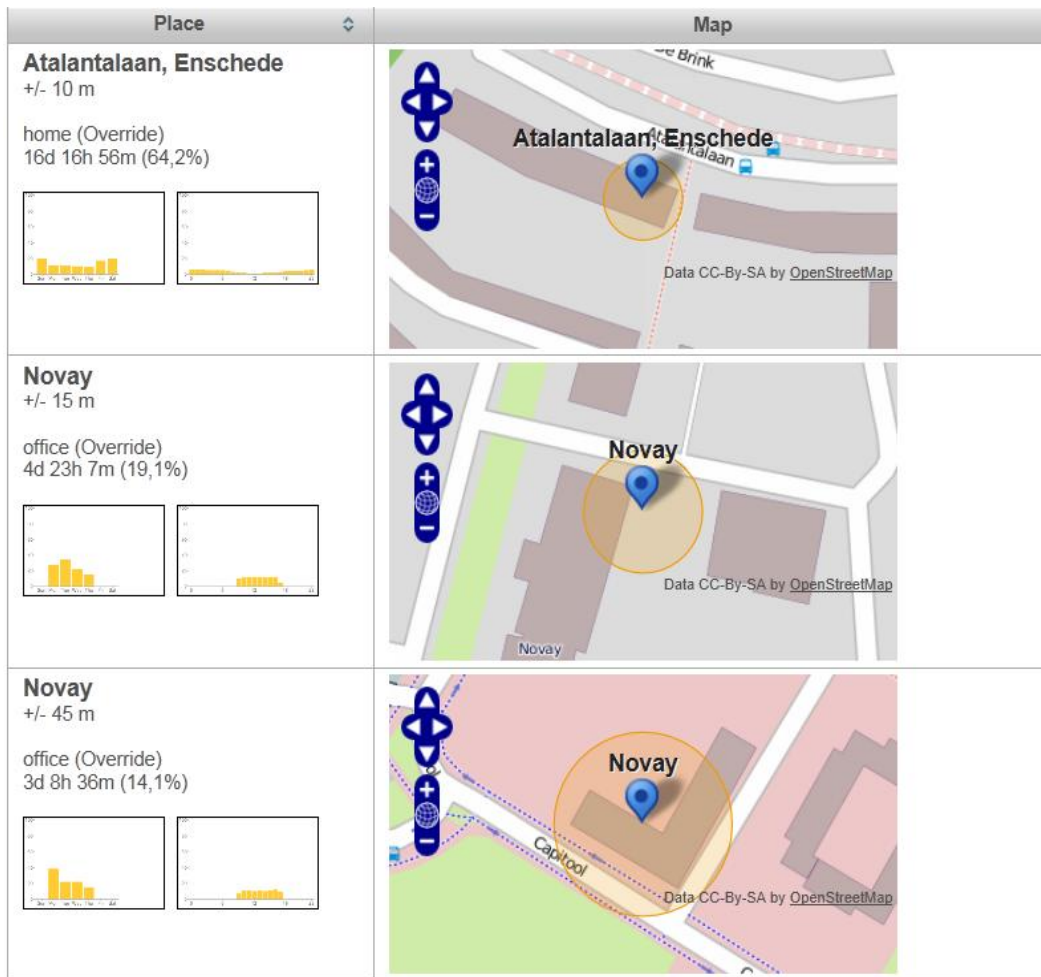
|                    |                           |                            |  |
|--------------------|---------------------------|----------------------------|--|
| 17 mrt 2012, 14:30 | Leemkoel                  | ter Huurne<br>Hollandmarkt |   |
| 17 mrt 2012, 11:33 | Atalantalaan, Enschede    | Leemkoel                   |   |
| 16 mrt 2012, 08:06 | Atalantalaan, Enschede    | CBS Drakensteyn            |   |
| 15 mrt 2012, 19:06 | Treinstation Apeldoorn    | Atalantalaan, Enschede     |   |
| 15 mrt 2012, 18:37 | Stationsplein, Amersfoort | Treinstation Apeldoorn     |   |
| 15 mrt 2012, 17:27 | Stationssingel, Rotterdam | Stationsplein, Amersfoort  |   |
| 15 mrt 2012, 16:07 | de Bavaylei, Vilvoorde    | Stationssingel, Rotterdam  |  |

Figure 18: Trip overview

Several algorithms are in place to enrich these measurements, with a natural focus on location and trips:

- To perform outlier detection and smoothing for location measurements
- To cut and stitch trips
- To assign modality to trips (as shown in the example trip list on the right)
- To map the trip route on the infrastructure network
- To look-up weather information during the trips
- To detect frequently visited places, and attach those to trips as origin and destination.

An example of a personal top 3 of frequently visited places is shown below, with obviously 1 home location and 2 separate office locations in the top 3, with detailed information such as visitation statistics and geo-location and accuracy of the place.



**Figure 19: Overview of places**

The PMS is described in detail (with data models, API descriptions and message examples) in D2.1 [6].

### 2.5.2 Mobility Pattern Detector (MPD)

The MPD is responsible for deriving longer-term personal mobility patterns from all the mobility information gathered by the PMS.

The MPD computes a personal mobility profile over different periods of time, ranging from 2 weeks to 1 year. This mobility profile consists of the modality statistics and the regular trips. The modality statistics show how much time (or distance or costs or CO<sub>2</sub>) a user spent in the different modalities, such as car, bike, bus or train. The statistic can also show which percentage of the underlying trips was during rush hour, rain, fog, or very extreme temperatures using data gathered by the Weather Information Adapter (Section 2.10). An example is shown below.

Data:  Distance  Time  CO2

Values:  Absolute  Percentage

Comparison:  None  Rush hour  Rain  Fog  Temperature

Period:  All  2 weeks  3 weeks  4 weeks  2 months  3 months  6 months  Year



**Figure 20: Mobility profile comparison**

The regular trips are those routes that a user frequently takes for a given origin-destination pair, such as home-office or office-supermarket. The example below shows all regular trips for a specific user from home to office. All regular trips have detailed information about the used modality, usage statistics, average and shortest travel time, et cetera. The MPD can also provide functionality to map a new trip on the existing regular trips, so that the PMS can decide on more optimal sensing strategies when a user takes one of these frequent routes for the 27<sup>th</sup> time.



**Figure 21: Regular trip visualisation**

The MPD is described in detail (with data models, API descriptions and message examples) in D2.2.

### 2.5.3 Mobility Pattern Visualiser (MPV)

As a result of the decision to show all mobility information in-app using native controls, and no longer in the web portal, the need for the MPV was reduced to the task of harvesting all buddy information for server-side components to be provided to the mobile buddy list (MBL) in one request. To this end, we have renamed the MPV to be the Context Harvester (CH).

The CH is responsible to harvest all information required to populate the user's buddy list from all server-side components, such as the IM for the user profile, the PMS for the last location and trips, the MPD for mobility patterns and the IMP for rewards gained with incentives.

The CH is described in detail (with data models, API descriptions and message examples) in D2.2.

## 2.6 Infrastructure network manager (INM)

The Infrastructure Network Manager (INM) provides a collection of services allowing access to road networks and their characteristics, transport routing services and other geographical data, such that personal mobility information can be mapped to these information sources. The INM uses OpenStreetMap (OSM) data <sup>4</sup> and stores this in a PostgreSQL databases for the living lab areas and the cities of the SUNSET partners.

<sup>4</sup> OpenStreetMap: Free geographic data and mapping project <http://www.openstreetmap.org>

The INM implements a mapping service, for mapping GPS traces to the infrastructure network. These mappings are used for modality detection and personal mobility analysis. The figure below show an example of location measurements being mapped (the green line) to the road infrastructure.

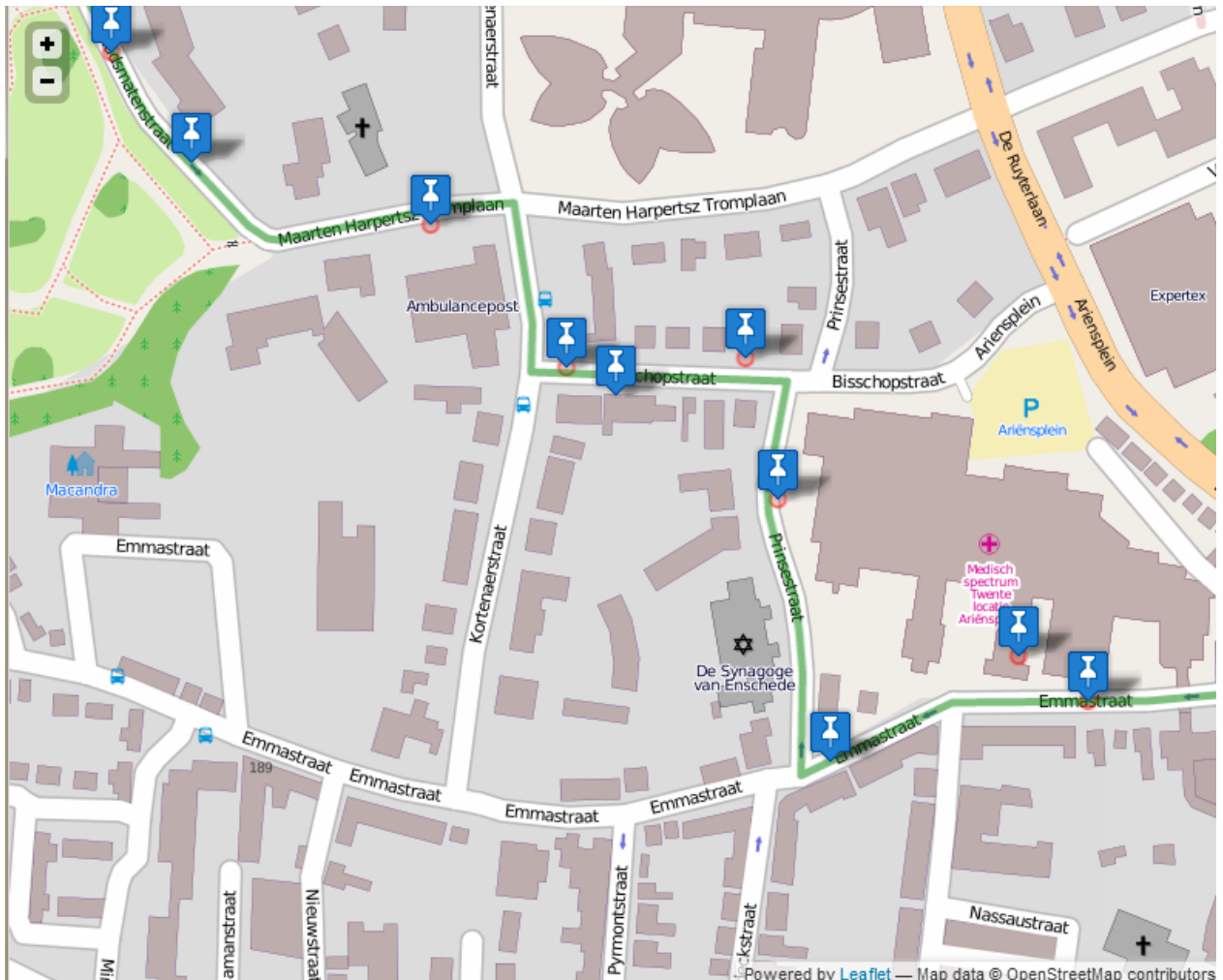


Figure 22: Mapping GPS traces to the infrastructure network

## 2.7 Notification Dispatcher (ND)

Data push notification is a core enabling technology in SUNSET to inform smartphone users that a new event requiring their attention (e.g. a new friendship request) or new data (e.g. a new experience sampling question has been issued to the user) are available on the server. The Notification Dispatcher receives push messages from server side components and forwards these messages to iOS and Android devices. Its task is therefore to ensure that the messages received from server side components are correctly formatted, maintain the list of registered devices and handle the communication to Apple / Google notification servers.

## 2.8 LL Evaluation Support

### 2.8.1 Experience Sampling Store (ESS)

Experience Sampling Question mainly includes question to users, possible answers to that question, how frequent this question will send to users(Repeat Pattern), Activeness, Conditions deciding the target users of this question(Target Condition) and Conditions deciding the question issuing(Issue condition). The structure of an ESQ is displayed in the Figure 30 below. Target Conditions or Issue Conditions have flexible numbers. Each condition could have different criteria.

The City Dashboard has 3 main tasks to manage Experience Sampling Question (ESQ) as explained in section 2.2 in including Register ESQ, Monitor ESQ, Modify ESQ.

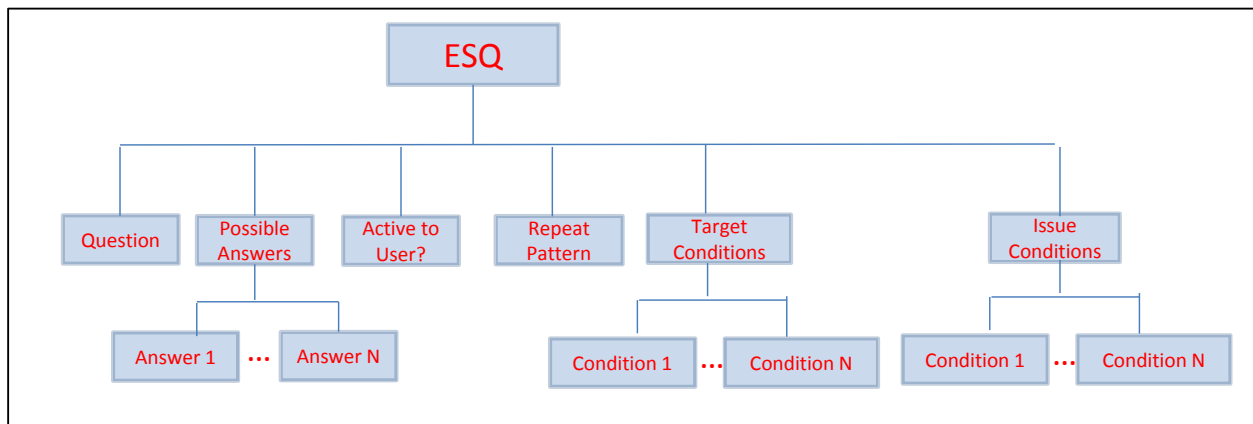


Figure 23: Structure of Experience Sampling Question

### 2.8.2 Evaluation Support (ES)

The Evaluation Support (ES) component collects and collates information from other system components for the preparation of performance evaluation of the overall system. It processes the gathered data according to pre-defined indicators and formats, to be presented via the Living Lab Control (LLC) to the operators. Due to the total dependency nature of this component, it is implemented as a parasite on other components in order to avoid extra communication overhead.

Evaluation support (ES) has three main tasks:

- To retrieve incentive stats in terms of number of receivers, awarded travellers and profile of receivers. (on the IMP);
- To retrieve traveller's trip profiles including trip date/time, trip modality, and trip route. (on the MPV);
- To retrieve experience sampling answers (on the ESS).

For the first task (incentive stats), the IMP offers a REST-style API which is described in Section 2.9.1. The second task is handled via the MPS which sends the trip profiles to the LLC and the third task is handled within ESS whose APIs are described in D2.1 [6].

## 2.9 Incentive Services

### 2.9.1 Incentives Market Place (IMP)

The Incentives Market Place (IMP) provides a platform to offer incentives in a form of a traveller's related tasks to users to encourage travellers to improve their travel behaviour with respect to the system's and an individual's travel objectives (e.g., the incentives created in the City Dashboard, Section 2.3.3). The IMP implements algorithms that match available incentives with mobility information from the MPD (Section 2.5.2), with individual user preferences and with general transport information. It identifies candidate users whose travel behaviour should be changed and the segments of the journey that could be optimised as well as users who are likely to react more positively on being offered incentives and thus are more likely to change their behaviour. It is responsible for offering the most appropriate incentive at the most appropriate moment to users via a mobile client. The IMP also records a users' response to the incentive offers and calculates the overall participation rates. Via APIs, incentive providers can register and publish incentives via the IMP. IMP has four main tasks:

1. To manage incentives
  - To register new incentives
  - To update existing incentives
  - To delete existing incentives
  - To send new incentive notifications.
2. To monitor travellers:
  - o To monitor historical trips status including travelling cost, CO<sub>2</sub> emission, travelling distance and travelling modality
  - o To monitor travellers' incentive execution status
  - o To monitor travellers' reward status
3. To award travellers:
  - o To match traveller's behaviour in terms of trip measurement to reward condition
  - o To send award notifications to mobile terminals
4. Several algorithms are implemented to ensure the validity of incentives sent to target travellers:
  - o To generate potential incentives for target travellers
  - o To cluster target traveller groups in terms of preferences of travelling behaviours
  - o To tailor incentives to target travellers according to their travelling behaviours.

The traveller's behaviours can be defined as:

- Travelling mode
- Travelling cost
- Travelling CO<sub>2</sub> emission
- Travelling distance.

### 2.9.2 Incentive Simulation Environment (ISE)

The Incentive Simulation Environment (ISE) provides an environment to test the effectiveness of incentives on historic data in the SUNSET system. In such a way, both stakeholders and developers can investigate how the conditions defining an incentive can be optimised to target the users they wish to address without introducing them to the system just yet.



In the latest system, part of the city dashboard supports the living lab controller to view the status of issued incentives in terms of notified users, aware users and awarded users (see Section 2.3).

Some of the interfaces according to descriptions above are recently getting developed in R5 within the IMP (Section 2.9.1). The IMP will start to collect expected data including numbers of awarded users regarding an incentive and the total number of users receiving an incentive in R5 Evaluation. Additional information such as ratings of each incentive are going to be collected from the mobile client. The results including approaches and analysis will be mainly contributed to deliverable D3.4.

## **2.10 Weather Information Adaptor (WIA)**

The weather information adaptor provides the PMS with current weather data, which it attaches to recorded trips: whether it rained or not, the temperature and general weather conditions.

For the Netherlands the WIA uses data periodically imported from the Buienradar feed <sup>5</sup> which contains the weather information from around fifty weather stations spread across the country. For the rest of the world data is requested on demand from the "Local Weather API" of WorldWeatherOnline <sup>6</sup>. The difference in strategies is for historical reasons, but is maintained because the quality of the information coming from the Buienradar feed is higher.

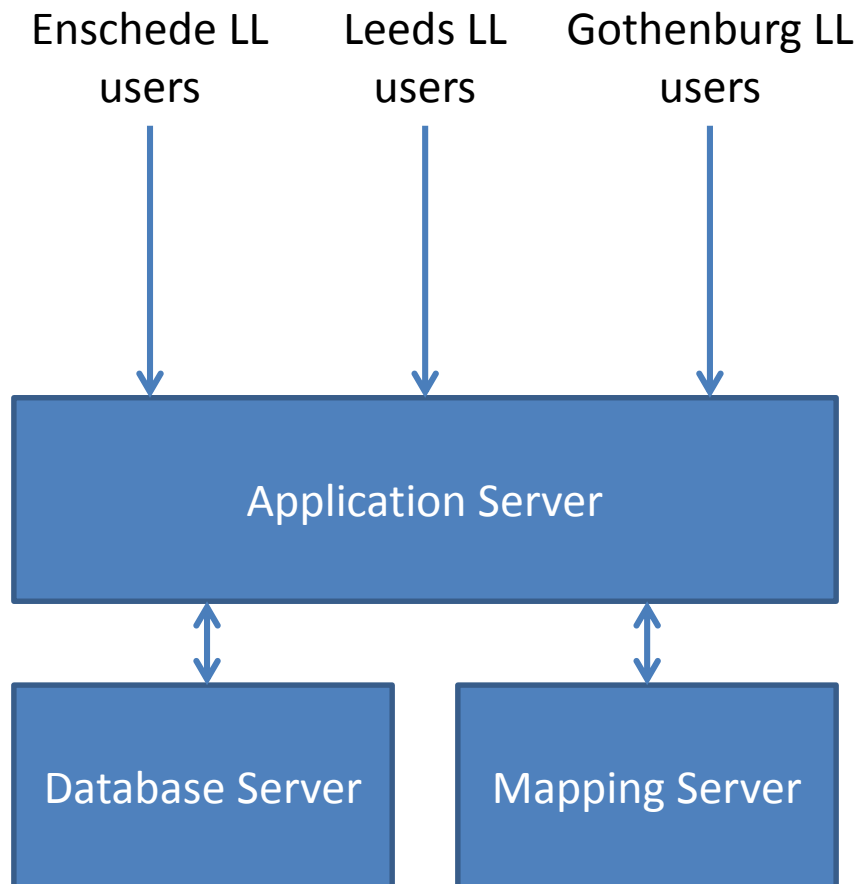
---

<sup>5</sup> Buienradar: Dutch weather XML feed <http://xml.buienradar.nl/>

<sup>6</sup> WorldWeatherOnline: Worldwide accurate and reliable weather forecast and weather content provider <http://www.worldweatheronline.com/>

### 3. Deployment status

As indicated in the D5.1, all living labs will use the same server environment. The SUNSET backend functionality now runs on a number of servers located in a secured data centre in Amsterdam, the Netherlands. The servers are interconnected by a high-speed local network; developers from the SUNSET partners have access to these servers through the Internet.



**Figure 24: SUNSET servers**

Most of the back-end components, as described in the previous section, are deployed on the application server. In case such a component uses database functionality, it uses one of the databases running on the database server (MySQL or PostgreSQL). The mapping service, which is part of the Infrastructure Network Manager, uses a dedicated server machine because of substantial RAM memory requirements.

The SUNSET back-end services are available on a continuous basis, and are regularly updated as new functionality becomes ready. A mechanism is in place to securely backup the data in the databases.

## 4. Evaluation

Usability evaluations are applied to each release in order to test the usability of the SUNSET services, including the TripZoom app (on both Android and iOS platforms), the web portal and the city dashboard. For Release 1 up to Release 4, evaluators are recruited from the non-technical project members; for later releases, end-users and usability experts will also be involved. For each release, an evaluation report is prepared and submitted to the PMT; all identified usability issues are fed back to the development team to further enhance the SUNSET service.

### 4.1 Methodology

Based on the release description, an evaluation method is selected by the evaluation team. For Release 1 up to Release 4, the method selected for the evaluation is a hybrid of heuristic evaluation and cognitive walkthrough. Both are commonly used usability inspection methods.

#### 4.1.1 Heuristic Evaluation

Heuristic evaluation [2] is a usability engineering method for finding the usability problems in a user interface design so that they can be attended to as part of an iterative design process. Heuristic evaluation involves having a small set of evaluators examine the interface and judge its compliance with recognised usability principles: the "heuristics" (they are called "heuristics" because they are more in the nature of rules of thumb than specific usability guidelines).

Based on a factor analysis of a large number of usability problems to derive a set of heuristics with maximum explanatory power, the following set of heuristics was established:

- Visibility of system status

The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

- Match between the system and the real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

- User control and freedom

Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Undo and redo should be supported.

- Consistency and standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

- Error prevention

Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

- Recognition rather than recall

Minimise the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

- Flexibility and efficiency of use

Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

- Aesthetic and minimalist design

Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

- Help users recognise, diagnose, and recover from errors

Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

- Help and documentation

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

It is recommended to use three to five evaluators since one does not gain that much additional information by using larger numbers. Heuristic evaluation is performed by having each individual evaluator inspect the interface alone. During the evaluation session, the evaluator goes through the interface several times and inspects the various dialogue elements and compares them with the heuristics. Only after all evaluations have been completed are the evaluators allowed to communicate and have their findings aggregated.

#### **4.1.2 Cognitive Walkthrough**

The cognitive walkthrough method [4] is a usability inspection method used to identify usability issues in a piece of software or web site, focusing on how easy it is for new users to accomplish tasks with the system. Cognitive walkthrough uses an explicitly detailed procedure to simulate a user's problem-solving process at each step through the dialogue, checking if the simulated user's goals and memory content can be assumed to lead to the next correct action. The method is prized for its ability to generate results quickly with low cost, especially when compared to usability testing, as well as the ability to apply the method early in the design phases, before coding has even begun.

A cognitive walkthrough starts with a task analysis that specifies the sequence of steps or actions required by a user to accomplish a task, and the system responses to those actions. The evaluator then walks through the steps, asking his-/herself a set of questions at each step. Typically four questions are asked [4]:

- Will the user try to achieve the effect that the subtask has? Does the user understand that this subtask is needed to reach the user's goal?
- Will the user notice that the correct action is available? E.g. is the button visible?
- Will the user understand that the wanted subtask can be achieved by the action? E.g. the right button is visible but the user does not understand the text and will therefore not click on it.
- Does the user get feedback? Will the user know that they have done the right thing after performing the action?

Spencer [3] proposed a Streamlined Cognitive Walkthrough technique in which you ask only two questions at each user action:

- Will the user know what to do at this step?

- If the user does the right thing, will they know that they did the right thing, and are making progress towards their goal?

By answering the questions for each subtask usability problems will be noticed, and afterwards a report of potential issues is compiled.

Whereas cognitive walkthrough is task-specific, heuristic evaluation takes a holistic view to catch problems not caught by this and other usability inspection methods. In a hybrid approach, task scenarios are combined with heuristics. So, when walking through the tasks step-by-step through the lens of the user (what terms they use, the things they'd look for and the likely paths they'd take), the evaluator looks for and identifies problems based on the set of heuristics.

### 4.1.3 Method requirements & materials

Bases on the characteristics of the current release and the chosen method, the following choices are made regarding the practical issues of the evaluation process:

#### People involved

- Any project member
- Project members who are not part of the development team
- Colleagues of project members who are not part of the project
- End-users representative of the population the project aims at

#### Evaluation location

- Desktop
- Laboratory setting
- Field setting

The following are made available to the evaluators before the evaluation starts:

#### Software

- SUNSET App release #

#### Where/how available?

- Android: via <http://tripzoom.eu/releases/>
- iOS: via TestFlight

#### Platform

The current release is tested on:

- Android platforms
  - At least two different Android smartphones
- iOS platforms
  - At least two iPhones

### 4.1.4 Procedure

For each release, an evaluation script is prepared which details the steps each evaluator has to follow in order to evaluate the release. For instance, the cognitive walkthrough method requires a detailed description of all the actions the user has to perform to reach his/her goals.

The evaluator follows the task/action list, and at each step asks him-/herself the following questions

- Will the user know what to do at this step?
- If the user does the right thing, will they know that they did the right thing, and are making progress towards their goal?

The answers to these questions are written down and explained (so no simple "yes" or "no", only in very obvious cases).

When walking through the tasks step-by-step through the lens of the user, the evaluator looks for and identifies problems based on the set of heuristics (see above).

The results from all evaluators are put together, and a list of issues is fed back to the development team.

## 4.2 Results so far

So far Release 1 to Release 4 have been evaluated using the above mentioned methodology. The results are summarised in this section.

### 4.2.1 Release 1 evaluation results

Release 1 is found to fulfil the following basic services:

- Allow to register new users
- Allow to verify the email address
- Allow user to download mobile application and provide consent

The evaluation of Release 1 identifies the following usability issues:

- Severe battery drainage due to the app;
- Low trip detection accuracy, esp. on modality.

### 4.2.2 Release 2 evaluation results

Overall Release 2 is capable of fulfilling the following services via three different platforms (web portal, Android app, iOS app):

- Travellers can change their privacy preferences and profile;
- Travellers can get an overview of all the trips they have made, and zoom in on details of a trip;
- Travellers can get an impression of their personal mobility pattern.

It should be noted that not all functions are supported on all platforms; however, this has been clearly communicated to the evaluation team in advance and did not hinder the evaluation process.

However, there are some usability issues that impair the user experience. The main usability issues as identified in the evaluation relate to

- **User help and documentation:** users often do not understand what a function does and/or what the presented information represents. Although minimalistic design is a good principle to follow, providing sufficient information for guiding the user is crucial for the success of the application.
- **Intuitive and consistent terminology:** the terms used in the app and on the portal are often not intuitive to the end users, e.g. 'identity relations'. This makes it difficult to navigate through the menus. Besides, some terms are mixed and can easily confuse the users, e.g. 'buddies' vs. 'friends'. It is recommended to only use intuitive terms (e.g. learn from other applications) and standardise them.
- **Trip and modality detection:** the current detection accuracy is too low to be trustworthy for the end user.
- **Synchronisation between app and portal:** similarity is lacking between the app and the portal. Also, it is not clear how data and changes in settings are synchronised between the app and the portal. Sometimes contradicting information is shown on the app against the portal.

### 4.2.3 Release 3 evaluation results

Overall, Release 3 is found to be not fully capable of fulfilling the intended main services.

Evaluators are able to set up incentives and receive incentive notifications but no evaluator has succeeded in accepting the incentives or receiving the rewards, even though they have met the conditions required for earning the incentives. Furthermore, it is not possible yet for the LLC to monitor how an incentive has been received by the end users.

Evaluators, acting as LLC, have difficulties in entering experience sampling questions, as they do not understand the user interface, which differs from that of the incentive administration and provides no explanation or help documents. Nonetheless, it is still technically possible to enter experience sampling questions. However, no evaluator has received the questions they have created for themselves. Furthermore, it is not possible yet for the LLC to monitor how an experience sampling question has been answered by the end users.

Besides the technical limitations, Release 3 also suffers from some usability issues, including some non-intuitive design features, and the use of terms that are confusing or too technical.

The evaluation further recommends: (a) the creation of a pool of well-defined incentive templates, where the LLC can readily select and refine an incentive to their needs; and (b) to allow trendy and innovative labelling/naming of incentives, which greatly helps the end user to remember and recognise an incentive.

#### **4.2.4 Release 4 evaluation results**

Overall, Release 4 is found to fulfil the following services:

- *Language localisation*: users can choose between languages on the app, the web portal, and the City Dashboard. Some of the platforms do not support all the languages (that will be needed for the LL's) yet, while for those supported languages, more checks are necessary to remove remaining translation mistakes /inadequacies.
- *Web portal*: the design and functionalities are found to be sufficient for the intended purpose.
- *Incentives*: incentives can be registered and rewards can be received. This works fine in general but it is noted that sometimes users receive rewards that are not due.

Release 4 is found to fail on the following services:

- *Mobility overview*: the app, especially on the iOS platform, failed to generate (useful) mobility profiles for the user.
- *External social networks*: it is currently not supported to log-in the app with external social network credentials.
- *Experience sampling*: the TripZoom service failed to deliver the experience sampling questions. As a result, no answers have been registered for the LLC to monitor, even though the monitoring functionality is provided.

### **4.3 Planning for future releases**

Five future releases will be made before the start of the Living Lab operations:

- R5: Social Incentives & LL Control
- R6: Trip Tagging & Social Network Communication
- R7: Scalability & Stability
- R8: User Experience
- R9: Finalization

For Release 5 and Release 6, the evaluation will be conducted by the non-technical members of the project, who may act as either end users or Living Lab coordinators. This will follow the same procedures as Release 1~4.

For Release 7 and Release 8, the evaluation will follow a similar but slightly different approach. Instead of project members, end users will be recruited as evaluators. The end user will be provided with a user manual and asked to perform certain tasks (corresponding to the

TripZoom functionalities). They will report their general experience (corresponding to the heuristics) as well as provide answers to specific questions (similar to the cognitive walkthrough).

For Release 9, no evaluation will take place as this release provides no new functionalities. Instead, a review will be conducted which examines the status of the usability issues reported in the previous releases, to ensure that all issues have been properly addressed in this final release.



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