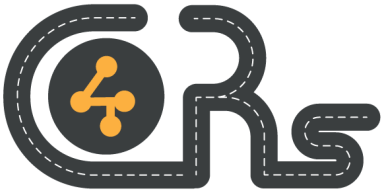

CROWD4ROADS

CROWD sensing and ride sharing FOR ROAD Sustainability

Project Number: 687959

D3.1 — Carpooling and Crowd-sensing Integration Plan

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Executive summary

This document corresponds to Deliverable 3.1 of the CROWD4ROADS (C4Rs) project and provides an overview or the integration aspects of the two main public-facing initiatives that are part of C4Rs: the *SmartRoadSense* applications and service (UNIURB), providing crowd-sensing for road quality, and *BlaBlaCar* (COMUTO), providing a carpooling platform to the public.

This document outlines how crowd-sensing and carpooling will be integrated during the course of the CROWD4ROADS project, in order to fully harness collective intelligence and to provide better contributions to sustainability issues tied to road-based passenger transport.

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1. Overview

The two main public-facing outlets of the CROWD4ROADS project are *SmartRoadSense*, the crowd-sensing road quality monitoring application and service developed by UNIURB, and *BlaBlaCar*, the carpooling platform by COMUTO.

SmartRoadSense targets a virtually unlimited amount of users, growing in utility through the voluntary contributions of drivers and passengers making use of the service. *BlaBlaCar* also addresses users in a wide array of countries, thriving as a contact point between drivers and passengers, both mutually benefiting from the service.

2. Community merging

SmartRoadSense is a road quality monitoring system created and operated by University of Urbino. The system is composed of a mobile smartphone app and an online service. The mobile app can be freely installed by any user (it is currently available for the Android and Apple iOS operating system) and will enable her or him to collect road surface data by simply anchoring the smartphone device to her or his car, through the use of the device's on-board sensors. The back-end service collects said data, aggregates it, and makes it available online.

BlaBlaCar is a carpooling platform operated by Comuto. The service provides users the means to announce trips they intend to make, to communicate with each other, to reserve free places on another user's trip, and to transfer payments in a secure manner. Today 12 million travelers per quarter are using BlaBlaCar for their trips [BBCAU].

As seen, both *SmartRoadSense* and *BlaBlaCar* depend on a community of users for their operations, that need to be engaged with the service and gain some kind of benefit from contributing their time and data.

Both communities are mainly focused on people using private vehicles for transportation, and thus can have a large interests overlap. *SmartRoadSense* and *BlaBlaCar* communities can clearly take advantage of each other and of the results of the CROWD4ROADS project.

Nevertheless, the two communities are completely different in terms of identity and trust management: while user identity and reputation play a key role in carpooling (drivers that offer and reserve trips must be clearly identified and their profiles are needed to build trust between users), this personal information is not essential for crowd sensing. While *BlaBlaCar* manages end-user data as part of its operations, *SmartRoadSense* does not, guaranteeing user anonymity as detailed in D1.3. In order to comply with the project's data protection requirements, the CROWD4ROADS project does not entail any direct interaction or integration between the data of the two platforms. In order to avoid dealing with personal data and to protect the sensitive information of BlaBlaCar users, the project will not call for any data sharing, other than data that was publicly available before the start of the project and the open data made available by SmartRoadSense.

Rather, integration of the two platforms is exclusively based on shared interests and awareness of carpooling and sustainable road transportation.

CROWD4ROADS will take specific actions to increase the overlap between the two communities by means of targeted communication campaigns, as detailed in D5.2.

3. Mobile application

In the framework of the CROWD4ROADS project, both SmartRoadSense and BlaBlaCar share the same purpose: they both aim to harness collective intelligence to contribute to the solution of sustainability issues of road passenger transport. However they contribute to CROWD4ROADS playing two quite different roles: SmartRoadSense constitutes the technological backbone on top of which the road monitoring task will be developed throughout the entire length of the project; new features will be added to the platform in order to make its usage and adoption more engaging for drivers and passengers, and to further develop the technological aspects concerning the way the data are handled, processed, stored, and shared. At the same time the large community of BlaBlaCar users is going to be leveraged in order to further increase the average car occupancy rate by means of targeted communication campaigns.

That said, the integration between the two platforms is not to be intended as two platforms merging one into another from a technical point of view, since this would not entail any significant improvement for any of the platforms and it would rather results in a misuse of time and resources that could better be used otherwise (as discussed in D2.1, Section 5).

Instead, the coöperation between the two platforms would be preferable, in order to reach the shared goals mentioned above. As mentioned in the previous section, the body of privacy preserving techniques, a keystone in the SmartRoadSense architecture, would clash with the collection and management of user details, which are fundamental features of the BlaBlaCar platform.

One of the ways to achieve a form of technical integration between the two platforms would be to implement a brand new multi-platform CROWD4ROADS mobile application, with the sole purpose of presenting an overview of the project's mission, to promote the project's objectives for end-users, and to link to the two existing platforms, in order to advocate the adoption of carpooling and crowd sensing. This option however is not advisable nor desirable for several reasons: an app like the one depicted will be hardly adopted by users, having to fight in already overcrowded environments as the mobile app stores are [MDAS]; moreover, as detailed in D2.1, the development of a new application, even if it is kept simple, entails the need to cope with all the development and maintenance issues that derives from the app living in a dynamic environment like a mobile operative system is; finally, creating a new app that

only acts as a showcase for other already existing services and apps, which are already available and have a consistent user base, would most likely disorient users, without leading to any actual benefit to the economy of the CROWD4ROADS project.

The suggested option in terms of mobile application integration is to keep the existing apps as they currently are, independent, with well distinguished identities, and an existing user base. In the course of the project references and pointers (intra-app links or links to the online resources) can possibly be added to both, in order to inform the existing user base of the project's objectives and of the other platform.

4. Incentives and rewards

Coöperation incentives are essential to motivate users to share services and resources (including their car, time, and effort, in addition to bandwidth, computational power, and storage space in the case of SmartRoadSense) and to broaden the community of users that are the basis of collaborative platforms that constitute CROWD4ROADS.

Virtual currency and reputation mechanisms are commonly adopted in online communities to boost participation. For instance, *BlaBlaCar* already makes use of a reputation mechanism in order to lead its users to behave well (eg.: arriving on time at the meeting point) during the trips they share thanks to the platform.

The *SmartRoadSense* system has been designed with strong privacy preserving mechanisms that don't allow the system to access, store, or collect any personal data tied to the user of the mobile app. The system thus only collects raw data of motion and position sensors, including all information useful to identify the quality of a particular road in a particular position, but these data are completely unrelated to the user who provides them. *SmartRoadSense* not only abstains from collecting sensible data about users, it does not perform any kind of user management.

Online reputation systems inherently require a user management framework. Therefore reputation mechanisms are clearly not applicable to SmartRoadSense and the platform needs to make use of other kind of incentives to stimulate the adoption and the usage of its mobile app for data collection.

Within the CROWD4ROADS project three different strategies will be applied in order to broaden the audience and the adoption rate of *SmartRoadSense*, engaging end-users, i.e., car drivers and passengers, in making road transport more sustainable.

1. Leveraging the large BlaBlaCar community, which in part will be sensitive about the issues SmartRoadSense and CROWD4ROADS at a large try to address. D5.2 contains a thorough description of how this strategy will be implemented in detail.
2. Let user get benefits as rewards for their usage of SmartRoadSense app. In order to motivate users to contribute to the road surface mapping process they will earn virtual currency in exchange of their efforts. See Section 4.1.
3. The development of a gamification layer on top of the current SmartRoadSense system. See Section 4.2.

4.1. Virtual currency

Virtual currency was first introduced in online games and social networks as a mean to buy and sell virtual goods without making use of real money, thus avoiding security issues, taxation, and mistrust. With the pervasive success of social media and the loss of clear boundaries between real and virtual worlds, virtual currency has become one of the key revenue driver of the Internet [SGVG]. Virtual currency systems are subject to many requirements (including transferability, anonymity, usability, and scalability) and exposed to many issues (including forgery, double spending, cheating, and speculation) which make them hard to implement.

Within the CROWD4ROADS project, a brand-new virtual currency system, whose tentative name is "GeoCoins", will be implemented in order to comply with the above mentioned requirements. "GeoCoins" are going to be designed as a light virtual currency system in which each coin includes information about where it has been earned, while also guaranteeing the privacy of the user who has earned coins and the one who spends them. GeoCoins earned by users will be used to pay services provided by third-party entities.

4.2. Gamification

As already described, a significant increase in the carpooling adoption would be valuable not only because of the implied environmental aspects, but also for both the *BlaBlaCar* and the *SmartRoadSense* platforms and, consequently, for the entire CROWD4ROADS project. To obtain such outcome, a gamification layer will be developed on top of the existing SmartRoadSense backbone.

The main purpose of the gamification infrastructure will be to further motivate people to use CROWD4ROADS while driving. The current design of the *SmartRoadSense* app was developed in order to be as minimal as possible and to require as little interactions with the user as possible. In particular, the app requires the user attention only just before and immediately after a driving session.

The design of the game elements associated to the existent platform will follow the same principles, as it will let users collect game rewards while driving but it will only permit interactions with them after the journey ends, in order not to distract the driver from his main activity.

The gamification aspects will also be leveraged to encourage the carpooling phenomenon, as users shall be able to connect their smartphones while travelling in the same car and play as a team. In doing so they will benefit by gaining increased bonuses during the game, which should increased adoption of this multiplayer mode.

In terms of data quality, having multiple devices running *SmartRoadSense* in the same car could possibly allow the platform to reach better data accuracy and quality. Algorithms to perform onboard corrections and evaluations will be developed in order to exploit the great potential of having data describing the same context from different instances of the *SmartRoadSense* app.

As a final remark, the multiplayer version of the gamified *SmartRoadSense* app could also be a way to effectively collect statistics about how many passengers are sharing the same vehicle for a particular journey, and in this way have insight and reliable data on the carpooling phenomenon.

5. Referenced documents

[SGVG] S. Greengard, “Social Games, Virtual Goods”, Communications of the ACM, Vol. 54, No. 4, pp. 19-22, 2011.

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