MOBiNET – an innovative approach for a European-wide ITS service platform

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Abstract

The paper shows an innovative approach for a European-wide ITS Service platform which addresses current barriers of cooperative system-enabled service deployment such as lack of harmonised services, availability of communication means, inaccessibility and incompatibility of transport-related data, fragmentation of end user subscriptions and payment services, and proprietary technologies in user devices. Primary goal is the holistic simplification of the overall process by bringing together mobility service offerings and demand in a common market place. In this paper we present the use cases that guided the initial platform development and the resulting architecture constitute. Particularly, we describe how the platform supports cooperative systems at the example of the green-light optimal-speed advisory use case.

Keywords:

ITS platform, mobility applications, market place

Introduction

MOBiNET is a collaborative project[1] that aims at simplifying the Europe-wide deployment of transport and mobility services by creating an “Internet of Mobility” in which transport users’ requests match service providers’ offers, and promotes openness, harmonisation, interoperability and quality. During the course of the project MOBiNET will develop, deploy

[1] Funded in 7th Framework Programme of RTD of the European Union, co-funded with ca. €11M, 34 partners.

and operate the technical and organisational foundations of an open, multi-vendor platform for Europe-wide transport and mobility services.

Key objective of the project is the simplification of the overall process of bringing together mobility service offerings and demand in a common market place. The open platform will provide the required “glue” functionality to let service providers easily compose their services based on available data or other B2B services, and to deliver their services to end users. End users will be enabled to easily discover and use these services.

Key MOBiNET innovations address the barriers of cooperative system-enabled service deployment, including the lack of harmonised service interfaces, availability of communication means, inaccessibility and incompatibility of transport-related data, fragmentation of end user subscription and payment services, and proprietary technologies in end user devices.

MOBiNET will develop solutions for both business (B2B) users and end (B2C) users (e.g., drivers, travellers), including:

- a comprehensive directory of Europe-wide mobility and transport-related data and services;
- membership of the MOBiNET B2B supplier community enables providers to include third-party content and services to their own offerings;
- an e-Marketplace as an e-commerce network linking service providers;
- a platform-independent agent on end user devices, including access to an app store and an intelligent communication and connectivity manager that hosts end user services and provides connectivity;
- single sign-on and single payment account for end users.

Implementations of these components will be based on existing solutions where available, and integrated into a seamless set of platform functionalities.

This paper is structured as follows. First, we introduce the overall platform development approach and the initial use cases: green-light optimal-speed advisory (GLOSA), multimodal travel assistance (MMTA), and usage based insurance (UBI). Then we give an overview on the conceptual platform architecture and introduce the foreseen platform components. On this basis we explain specific technical challenges in context of cooperative systems and how the MOBiNET platform contributes to overcome them. The final section sums up the major points and explains the next steps.

Platform development approach and initial use cases

The MOBiNET platform is currently under active development and applies an iterative, use case driven development approach. There are three major iterations planned for the initial platform development. During each iteration the following phases are performed:

- **Development phase:** Requirement refinement, architectural, design, implementation, and testing activities are closely aligned and form the basis of every major iteration. Additionally, these development-related activities are organised in sub-iterations to ensure constant feedback and to handle requirement prioritisation.
- **Commissioning phase:** In this phase the developed platform functionalities are handed over into operation. Newly developed functionality is tested in a specific pre-production environment to make sure that non-functional and specific operational requirements are still met.
- **Validation phase:** As soon as new versions of the platform components are available on the production environment, dedicated test sites validate the platform on the basis of the use cases. The results of the validation are used to further adapt the platform requirements to better shape the platform scope.

This approach provides early, constant feedback on developed platform functionality, allows proper requirement adaption, and ensures overall quality of the platform.
To support the first iteration in context of requirements elicitation and platform validation, the following use cases have been selected:

- **Green-light optimal-speed advisory:**
  To optimize traffic flow, improve comfort and reduce fuel consumption, drivers get an in-car speed advise which is determined by a traffic light controller at one or more intersections. This use case is a typical use case implemented based on cooperative systems. MOBiNET enables road operators to provide this service to a much larger group of drivers by also enabling personal mobile devices. At the same time, service providers are enabled to include this function as part of their service offering, by e.g. integrating this speed advice in a navigation application.
- **Multimodal travel assistance:**
  This use case represents a popular example of a mobility service and is widely studied in several projects. Existing journey planners and other travel assistance services often lack spatial coverage or have limited coverage of transportation modalities. In this context, MOBiNET enables transport operators and other data providers to provide their data in a common market place. On this basis, service providers are able to build comprehensive multimodal journey planners for the city or to extend their service coverage by obtaining data from different content providers without further negotiations.
- **Usage based insurance:**
  Nowadays, usage based insurance is offered in a closed value chain where a telematics service provider installs a telematics device in the car of an individual on behalf of an insurance company. In this way, the insurance company can offer insurance to the end user based on his driving behaviour. MOBiNET will allow opening up this value chain

by creating a market where telematics service providers are decoupled from the insurance providers. This enables end users to switch more easily between insurance companies and it allows telematics service providers to offer additional services. In return, insurance companies get easier access to a larger customer base.

Architecture overview

Figure 1 shows the conceptual architecture of the MOBiNET platform. The platform consists of two main components: the MOBiCENTRE, containing all central functionality to support service providers and other business stakeholders, and the MOBiAGENT, containing all functionality on end user devices.

MOBICENTRE is designed as a modular and scalable distributed system. It provides commonly required infrastructure functionalities to support the whole service provider chain including service management, billing, communication, and identity management. In this context, the MOBiCENTRE acts primarily as a mediation platform that provides the necessary infrastructure to allow service providers to make their services available to a broader audience without major changes.

Additionally, the MOBICENTRE provides a dedicated service provider Web portal which essentially functions as a B2B service market place. It allows service provides to maintain the whole lifecycle of their services and to monitor their usage. It enables them to create completely new, innovative services on the basis of the published services. In this context, the platform handles technical aspects of service composition as well as business and contract-relevant aspects like pricing or service level agreements.

The infrastructure functionalities can be integrated with existing services via dedicated APIs. To ease migration of existing services and to build new ones, service developer support is provided, e.g. in terms of development tools, tutorials, or test infrastructure.

In addition, it is planned to host core mobility services in the MOBiCENTRE in case these services are either useful in the context of a wide range of use cases or are completely missing. Such services are directly integrated with the infrastructure functionalities and are provided with the same quality of service.

MOBiAGENT supports apps on the end user device to use the MOBiNET functionality as provided by MOBiCENTRE. In this context, it enables access to transparent communication services (including V2X communication) and provides access to an end user market to let end users discover and use mobility services. Particularly, MOBiAGENT is designed to support a wide range of mobile devices (e.g., Android, iOS, Windows Phone) and app technologies (e.g., Web app, OSGi-based apps) to simplify the integration of existing apps.

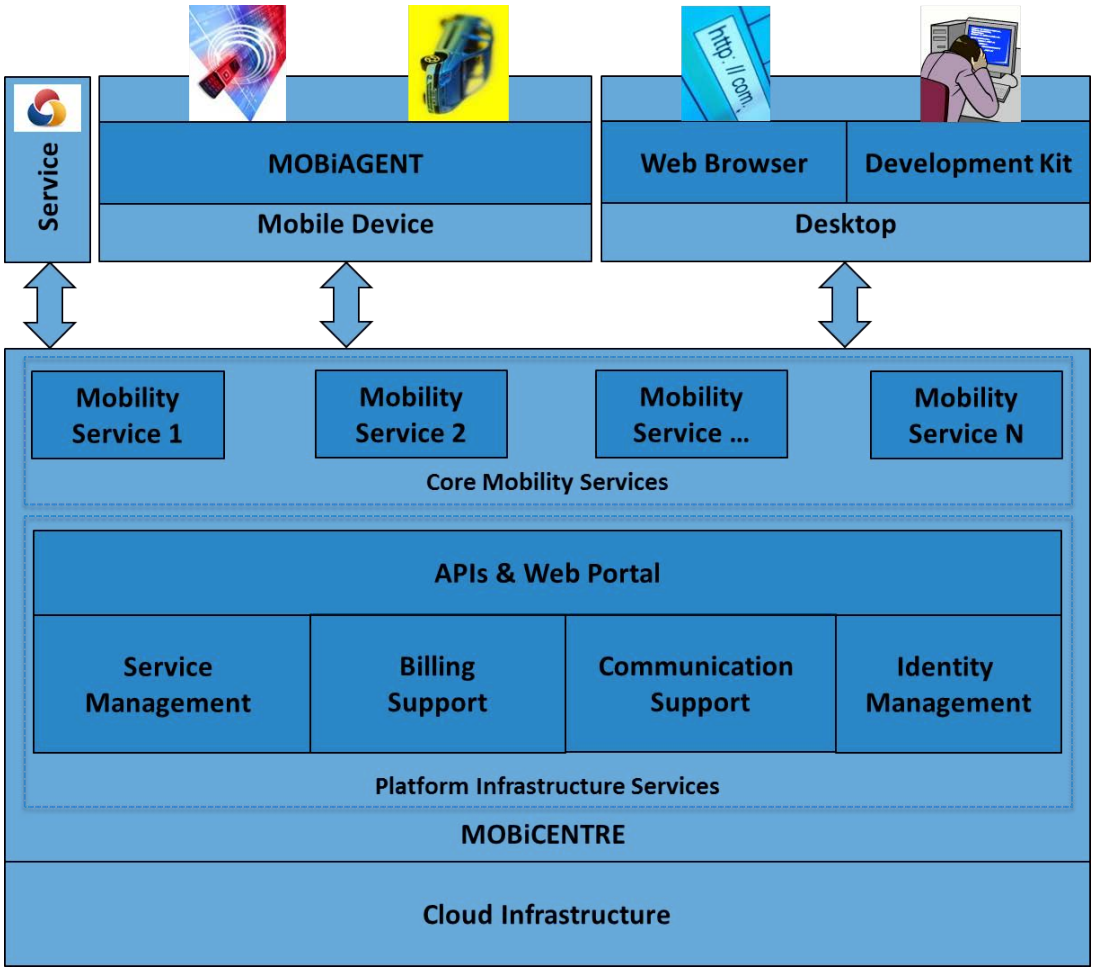

Figure 1 - Conceptual architecture of MOBiNET

Service management

The platform provides support for B2B and B2C services. To handle corresponding B2B services (e.g., Web Services) the Service Directory (SD) component is introduced. The SD provides a common service description structure to describe B2B services, supports management of those descriptions, and provides search and discovery mechanisms.
Similar functionalities are provided by the App Directory (AD) which handles these aspects in the context of B2C services (e.g., mobile apps), and provides end users with an app store functionality. In general, the App Directory is not aimed at competing with existing app stores but instead – depending on the concrete app technology – it makes use of them. However, in some cases (e.g., OSGi-based apps) established store functionalities are not available and therefore in that case the AD supports basic deployment and lifecycle management as well.
The functionalities of both basic assets are available via dedicated APIs and user interfaces through the Web portal. However, the two entities differ in their APIs. While the API for the SD is compliant with M2M communications, enabling automated service discovery, the AD API is used by the MOBiAGENT to allow end users to find services.

As a first stage, we focus on management of basic technical information of services in the service description. In the next release, non-functional and business-related aspects of published B2B and B2C services are taken into account. For that purpose, it is planned to make use of the Unified Service Description Language (USDL) [1]. USDL allows describing a wide range of services – from end user services, business services and software services up to infrastructure services – and, particularly, addresses non-technical information like pricing schemes or service level agreements. On this basis future additions would include means for service monitoring for usage based billing purposes, service composition and creation of service mashups.

Identity management

The Identity Management (IdM) framework establishes a common identity for MOBiNET actors (e.g., platform administrator, party administrator, developer, end user). This approach offers end users a single subscription to all MOBiNET services and enables service providers to offer services to end users who have no prior affiliation but are accredited through MOBiNET.
To solve related interoperability issues on information and technology level, the IdM defines identity management ontology and provides corresponding components to manage identities and related identity attributes. In this context the IdM also handles privacy related aspects to ensure that corresponding actors have full control over their personal data. On this basis the IdM framework establishes support for single sign-on, standard-based authentication (e.g., OpenID), and authorisation mechanisms (e.g., OAuth, SAML). As a first stage, a MOBiNET-specific OpenID identity provider is implemented in order to internally manage MOBiNET actors.

Billing support

The Billing Support provides utilities to handle all aspects of the financial transactions in the background of a service, including management of the whole financial transaction compensation process. This is done by providing the bridge to external payment systems, monitoring of all financial transactions of registered services, as well as completion of financial transactions by providing receipt documents to involved actors. In addition, it has been planned to support issuing of virtual tickets to grant use to different transportation means using different service providers. A service provider can therefore rely on these utilities to consistently handle end user payments and compensation from other service providers.

Communication support

To support real-time and location-based ITS services, the platform provides the components Communication Agent (CA) and Communication Manager (CM). The CA is a centralized component that resides in the MOBiCENTRE. It is responsible for periodically receiving and processing information from end user devices (e.g., on-board unit, smartphone, tablets) equipped with the CM which is part of the MOBiAGENT.
The periodic updates from the CM can contain information about the current position of the device, its speed, heading, applications installed, and its communication capabilities. Depending on the specific use case, the CA might request additional information by issuing requests to the CM. The CA has interfaces towards roadside unit operators and mobile network operators and maintains information about coverage and service availability in a geographical area. It is able to resolve reliable ways to disseminate information coming from service providers using multi-technological communication. Because of its centralized nature, the CA can provide advanced features (e.g., geo-fencing and real-time statistics). It exposes APIs which can be used by service providers to disseminate information using different communication technologies in a transparent way.
The CM takes care of transparently combining the various network channels towards applications active on the end user device. Additionally, it ensures that periodic updates are sent to the CA, and combines the information flows from the different networks if multiple networks are supported by the hardware. Applications can deliver their messages for further distribution with the CM, and can choose to have full control over the communication channels used, or have the CM decide on the optimum way of communicating these messages.
Integration of CA and CM with the Billing Support and IdM components will allow the support of a wide range of business models for real-time location based information dissemination.

Support for cooperative systems at the example of the GLOSA use case

The combination of vehicular ad-hoc use cases and cellular networks has been an ongoing activity in the ITS community [2], [3]. ITS services nowadays are moving fast forward towards real-time services, where the desire is to deliver information to its destination with the least possible delay, and location-based services, where the desire is to provide most accurate and appropriate information, based on the location of the recipient. Examples of such services are GLOSA, road work warnings and traffic information in general. One set of systems nowadays, which could enable such services, are cooperative systems. They are an excellent example of providing low-delay real-time location based services. A disadvantage, however, is that they are not yet commercially available and are expected to have a rather

slow market uptake due to the average lifetime of vehicles. Another set of systems are the cellular-based systems like UMTS and LTE. Even though they have been constantly evolving towards higher bandwidth and lower latency, they are not optimized for providing ITS services. Broadcast features such as MBMS and eMBMS have been standardized, but are not commercially available on a large scale.

GLOSA supported by MOBiNET

GLOSA is a typical cooperative application demonstrated in several projects before [4]. With this use case, drivers get speed advices that support the optimum way of passing an upcoming intersection equipped with traffic lights. Optimisation can take place based on throughput, comfort, and/or environmental impact. Figure 2 shows an overview of the GLOSA use case setup in MOBiNET.

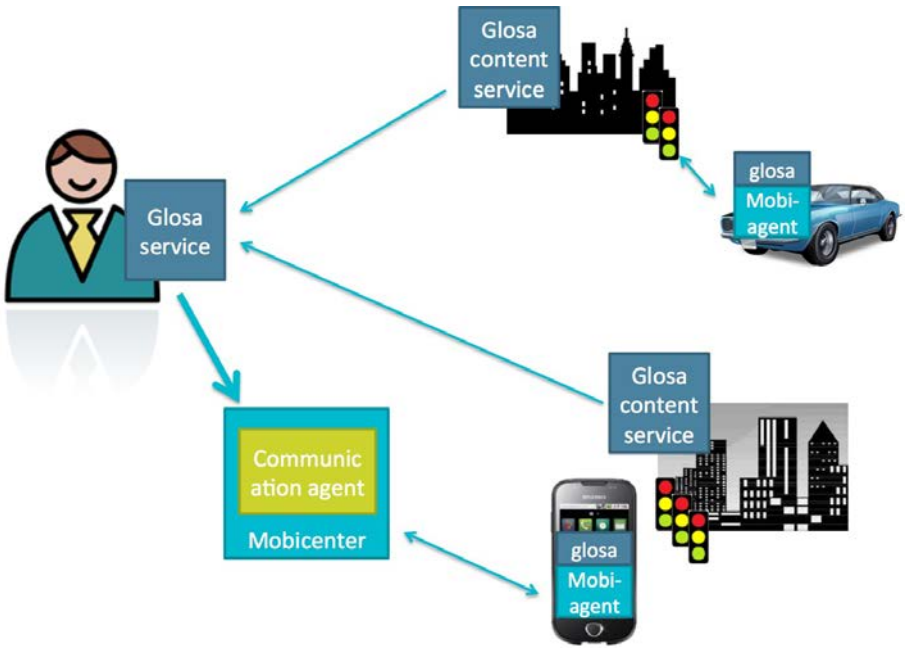

Figure 2 - Overview of the GLOSA use case setup

By using the MOBiNET Communication Support, this application can also be provided by intersections that are not equipped with cooperative communication means, and/or to drivers in vehicles without cooperative communication. This will significantly lower the barriers for a large scale deployment of such services. However, the performance of the application can depend on the type of communication available, as delays and reliability of the different communication channels can differ.

Additionally, the use of the platform enables road side operators to provide their road side information as content services in a B2B market to other service providers via the SD. This alleviates the provision of end user services. In context of the GLOSA use case, we have worked out this approach by implementing a GLOSA app offered by a GLOSA service

provider running on the MOBiAGENT. When the MOBiNET platform will be opened to a larger user base, other road operators will be able to register their GLOSA content service which will be included automatically in the GLOSA app. Other mobility end user service providers (e.g., navigation providers) will be able to find GLOSA content providers as well, and can include them in their service offerings.

Summary

First, we introduced the initial use cases green-light optimal-speed advisory, usage based insurance and multimodal travel assistance. In this context, we highlighted expected benefits through use of the platform like extension of service coverage, creation of more comprehensive, optimised applications, or opening closed business value chains. Then, we presented an overview of the conceptual platform architecture which provides the required infrastructure functionality to let service providers easily compose their services based on available data or other B2B services, and to deliver their services to end users. Finally, we described the specific benefits for cooperative systems at the example of the green-light optimal-speed advisory use case in which the platform helps to significantly lower the barriers for a large scale deployment of such services.
Currently, the first platform release is prepared and provided to the involved test sites. The release focuses on technical base functionality to allow a first end-to-end evaluation of the platform. In the course of the project, further use cases are added step-by-step to better shape the platform scope and to explore new, innovative usage scenarios.

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