Multimodality for people and goods in urban areas

FP7. CP 284906

WP5.1
Instant Mobility prototype description

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Instant Mobility WP4.1
Instant Mobility global architecture

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0.1	18.06.2012	Dirk Beckmann	Initial draft
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0.3	15.10.2012	Rafael Salinas	Initial draft scenario 2

Deliverable Abstract

This document is based on "Instant Mobility Use Case scenarios functional and non-functional requirements" (D3.5) and "Instant Mobility functional & technical specifications" (D4.16) to deliver details of the definition and selection process of the prototypes that are part of the Instant Mobility Project. Those prototypes are used to demonstrate domain-specific features and interfaces with Generic Enablers.
This deliverable aims at describing especially the concrete results expected for the demonstration in the ITS World Congress in Vienna (Oct. 2012) and the Mobile World Congress in Barcelona (Feb. 2013).

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1. Introduction

1.1 Instant Mobility

The Instant Mobility (IM) project is the Use Case project in area of mobility of the Future Internet Public-Private Partnerships (FI PPP) programme. The project defines scenarios and services for multimodal travellers, drivers & passengers, passenger transport operators, goods vehicle operator’s en road operators & traffic managers. The goal of the Instant Mobility project is to define requirements for Future Internet technology tools and enablers, so that all these services will be available to any Internet-connected user, whether using a portable, vehicle-based or fixed terminal. These requirements will underpin a set of technical specifications for both domain-specific and Future Internet enablers that will in turn be created as software conceptual prototypes for a virtual demonstration.

In the Instant Mobility vision, every journey and every transport movement is part of a fully connected and self-optimising ecosystem in which travellers, goods and collective transport will benefit from personalised and real-time information delivered by next-generation Internet technologies. Future Internet technologies will offer accurate positioning, continuous connectivity and a host of personalised online mobility services. The Instant Mobility project has developed three parallel but interwoven scenarios for multimodal mobility for people and goods in urban areas with a user and business-centred focus (D3.1 and D3.3), namely: Personal travel companion; Smart city logistics; Transport infrastructure as a service. Each scenario comprises a set of applications addressing the needs of the different actors involved and describes a number of Future Internet-supported services that are likely to be used by and to benefit a particular group of stakeholders.

Functional and non-functional requirements for the three scenarios and their applications have been derived from the use case scenarios descriptions and functional analysis. The requirements have been identified following two steps. First step was to identify non-functional requirements for all applications. Then based on the common Instant Mobility non-functional requirements, specific functional and non-functional requirements for each application have been identified (D3.5).

Detailed technical specifications of the components necessary to implement these scenarios have been derived from the use case scenario descriptions and the functional and non-functional requirements (D4.2-D4.8 and D4.9-D4.15). These components can be the proposed Future Internet enablers (either generic as developed by the FI-WARE project [FI-WARE-Website][1] or domain-specific) or services build on top of these enablers.

WP5 (Realisation and prototyping) is implementing prototypes that are build using the specifications of the prior work package (WP4). These prototypes will demonstrate the key functionality of the envisioned IM system and will therefore show its capabilities. The prototypes are also used to explore potential risks in the technical realisation of the full system by

[1] FI-WARE-Website: http://www.fi-ware.eu/

implementing potentially sensitive aspects a priori. This deliverable will describe the process of WP5 to select and define these prototypes.

1.2 Development cycle and prototype approach

The project workflow follows a typical development process. WP3 is producing functional and non-functional requirements by analysing different scenarios and use-cases. This outcome will be used in WP4 to specify the key functionalities (enabler sets) of the targeted system. The specification is used in WP5. The overall workflow is sketched in Figure 1.

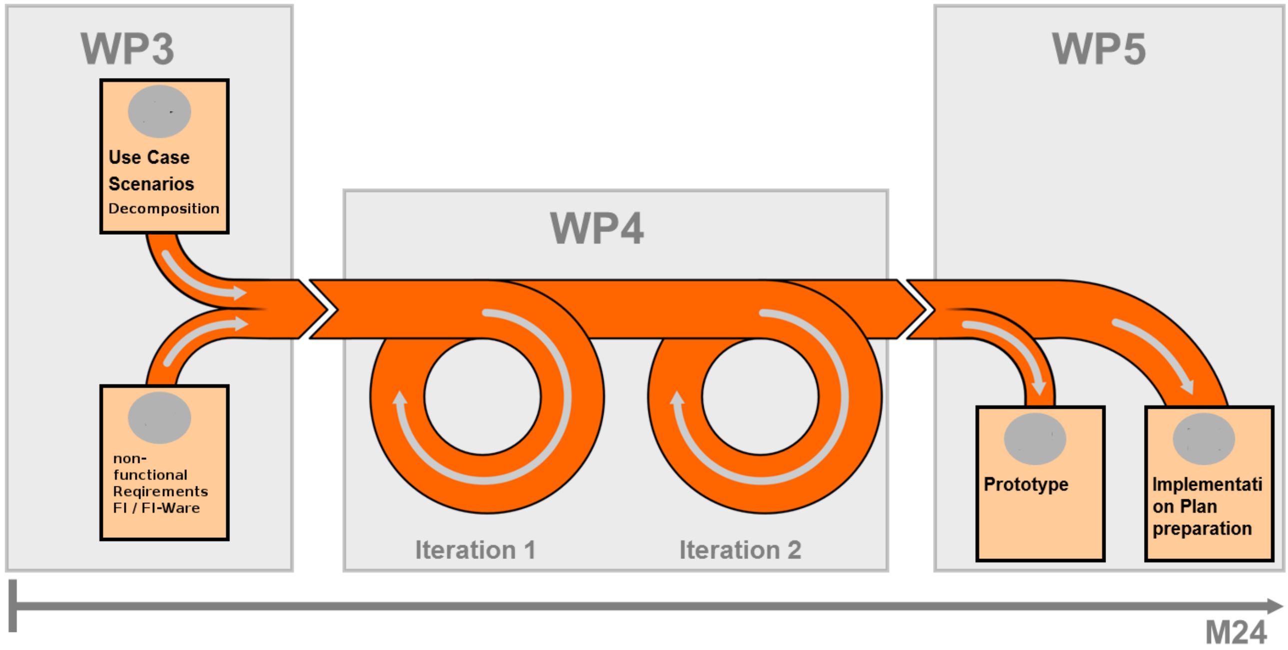


Figure 1: Instant Mobility work flow diagram

The work in WP5 is twofold: It will produce the prototypes as outlined above and it will also prepare an (implementation-) plan for the second phase of the FI-PPP program.

The development of the prototypes is organized in three tasks. WP5.1 selects the outline of the prototypes (e.g. the scope and coverage) and indicates potential events in which the prototypes can be demonstrated. The WP5.1 goals are described in more detail in the next section. WP5.2 uses this scope of the prototypes to select key specific enablers for realisation. WP5.3 combines the implemented Specific Enablers of WP5.2 with the implemented Generic Enablers (of FI-WARE) to build functional prototype applications.

The Phase 2 preparation activity relates to WP5.4 and will be described in D5.4.

1.3 Scope of this deliverable

This deliverable will define the scope of the prototypes demonstrators that are presented by the IM project and document the work of task WP5.1. This deliverable aims at describing especially the concrete results expected for the demonstration in the ITS World Congress in Vienna (Oct. 2012) and the Mobile World Congress in Barcelona (Feb. 2013).

It is not a technical specification of the prototypes (and demonstrations) this can be expected as an outcome of the prototype development activities in tasks WP5.2 and WP5.3.

1.4 Document contents

The content of this deliverable is structured as follows:

- Chapter 2 explains the selection process and the organisation of the prototypes as well as the trade-off that have been made.
- Chapter 3 gives an overview of the use case scenarios of WP3 that were used to derive the prototypes.
- Chapter 4 to 7 presents an overview of four Instant Mobility prototypes.
- And finally, Chapter 8 presents a summary and conclusions.

1.5 Intended audience

This deliverable will define the scope of the prototypes demonstrators that are presented by the IM project. This makes D5.1 relevant for the work teams in the tasks WP5.2 and WP5.3 as their work is essentially defined in this document.
This deliverable is also relevant for the WP7 as it outlining the prototypes that can be expected for dissemination activities through the course of the project.
WP4 has prolonged its activities by six month due to delays in core platform project (FI-WARE). So WP4 is overlapping WP5 by a few month which allows the WP4 work team to learn from the developments in WP5. Even though this deliverable is not providing résumé of the developments that will be achieved (later) in WP5, it can server as an entry point for WP4 to understand the selection of specific enablers and how they are used in WP5.

1.6 Abbreviations

API	Application Programming Interface
BPMN	Business Process Model and Notation
CAN	Controller Area Network (field bus)
CO_2	Carbon dioxide
CP	Core platform (refers to FI-WARE)
DoW	Description of Work
ECU	Electronic control unit
FCD	Floating car data
FI	Future Internet
GE	Generic enabler (of FI-WARE)
HMI	Human Machine Interface
ICT	Information and communication technology
IM	Instant Mobility
ITS	Intelligent Transportation Systems
NO_x	Nitrogen oxide
OBD	On-board device
OBU	On-board unit

RSU	Roadside unit
RTD	Research & Technical Development
RTTI	Run-time type information
SO_x	Sulfur oxide
USB	Universal Serial Bus

2. Methodology and selection process

The work of WP5.1 started in M12 (Apr. 2012) by studying the work that has been achieved by WP3 and WP4. This study showed a focus of those work packages on three main scenarios (“Personal travel companion”, “Smart city logistics” and “Traffic management in the cloud”) instead of the originally planned eight. These consolidated three scenarios have been specified in WP4.
Another constraint to the work of WP5 was given by WP7 in form of required demonstration for the ITS World congress in Vienna (Oct. 2012) and a presentation event at the Mobile World Congress in Barcelona (Feb. 2013) which will be used to show the prototypes of WP5.
The latter constraint obliged WP5.1 to consider two different development activities: One activity to develop an impressing demonstration for the dissemination activities at the ITS World congress and another activity to develop more substantial prototypes for the Mobile World Congress 2013.

2.1 Selection process of prototypes (scope)

To get an impression about the partners’ ambitions on the scope of potential prototypes and to define work teams for their development, an open call for prototype proposals was organized. To structure the feedback a template was used that asked for the key functionality of the prototype and how this prototype would promote IM’s goals. The template also asked for potential exhibitions of the prototype and the associated effort that partners expect.

WP5.1 received five submissions for different prototypes of work teams. The WP5.1 team studied the prototype proposals and verify that they are matching the projects ambitions and cover the intended scope in the DoW (Description of Work) duly.
Another aspect was to see how the prototypes can be combined into virtually appears for visitors of the event as one prototype to represent the platform ambitions of the project.
After this analysis it was clear that there will be three main prototypes that correspond with the scenarios of WP3.
The proposals were to show a multi-modal travel companion, an Eco-Driving assistance (for heavy vehicles as part of the logistics scenario), and a Traffic management in the cloud.
A fourth prototype was proposed that focuses more on the technology aspects than transport and mobility functional aspects. This “CAR-API” prototype is aims to connect mobile devices the IM platform and offer IM’s functionality on mobile device while not being focused on a specific scenario or application. This means that the scenario based prototypes will use this prototype to bring functionality to the end user (in the demonstration).
To the audience of the Mobile World Congress the three scenarios will be demonstrated in specific functions correlated to the tree scenarios. The aspects of showing functionality on mobile devices will be provided by the CAR-API prototype.
To show true interoperation between prototypes it is foreseen that the prototypes will exchange some data. This can be achieved by supplying traffic data from the Traffic Management for the

Travel algorithms and Eco-Driving assistance. Assuming that this data indicates a traffic jam, those prototypes could react by redirecting the traveller or (truck) driver to an alternative route.
Figure 2 illustrates the four prototypes and their connectivity in a possible set up.

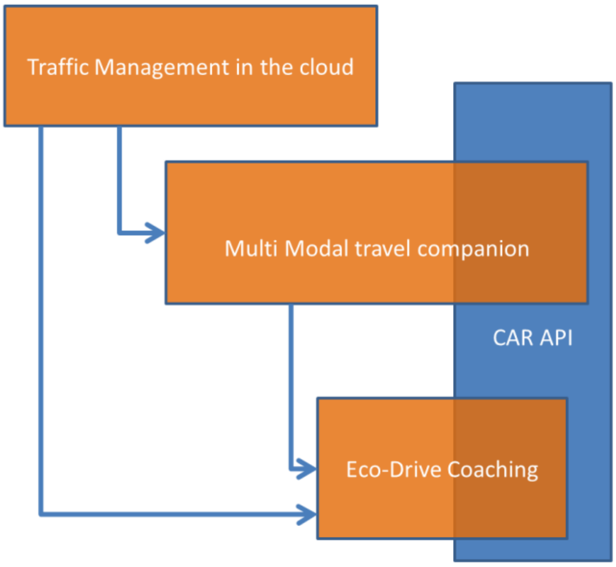


Figure 2: Four prototypes for the Mobile World Congress Barcelona

In the process of refining the ambitions of each prototype some changes have been made. The most notable is the extension in the scenario 2 prototype from a rather limited Eco-Driving assistance to multiple use cases: “Load sharing and optimizing”, “Dynamic time/place drop point”, “Itinerary booking and real time optimized route navigation” and “Eco-optimized driving, vehicle and driveline control”.

The scope and functions of each prototype are displayed in more in the sections 4 to 7. To explain how they relate and correspond to the scenarios section 3 explains IM’s scenarios in brief.

2.2 Observations

There are three main observations in the context of prototypes:

The definition of the scope of the Vienna demonstration, the selection of involved partners and the amount of resources to be dedicated to this development have been taken place outside WP5. This was organized by the project’s coordinator to prepare early for the Vienna demo. So the definitions in this document regarding the Scenario 1 demonstration just summarize what has been decided there apart from the intended selection process.

This deliverable reflects a snapshot of the definition process that is still on-going. Due to the changes in WP3 (reduction of to three main scenarios) and the lessons learned from WP4 a critical reflection of the prototype orientations as indicated in the DoW took place. The description in the DoW (see section 9.2) is lacking a representation of the traffic management aspects of the Scenario 3. This led to a re-alignment of demonstrations. The real-time multi-modal navigation and planning is demonstrated as essential part of Scenario 1 and will therefore form the core of the Personal travel companion Demo & Prototype (see section). The Multi-modal automated electronic payment system for mobile users will also be demonstrated in this prototype.

The Multi-modal freight information subsystem for urban areas is demonstrated in the Smart city logistics prototype. The Open portable Mobile framework is shown as a “horizontal” prototype “CAR API”. In summary the intended scope promised in the DoW is well covered and an additional scenario 3 prototype will be demonstrated in the Mobile World Congress 2013.

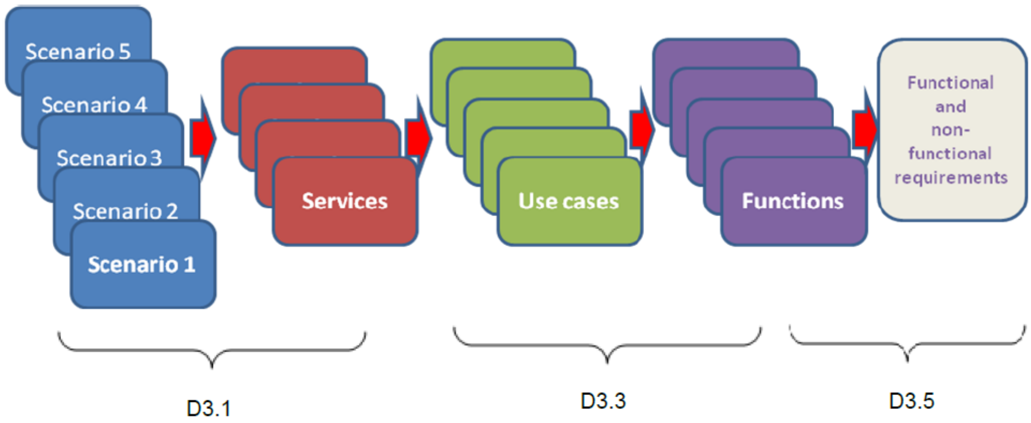
It was planned to explicitly use FI-WARE GEs in the demonstrations in Vienna. This ambition could not be fulfilled due to the tight timing. For example the FI-WARE test bed was released in August 2012. This would have forced the developments for the Vienna demonstrations into a two month time frame and put a demonstration at this point at risk.
This means that the demonstrations in Vienna will use conventional technologies to cover aspects that were planned to fill with GEs from FI-WARE. In contrast to that, the prototypes that are presented in Barcelona will make use of FI-WARE.

3. Short functional IM Scenarios

This document, like the other WP5 deliverables, is derived from WP3 and WP4 activities.

IM project was working in the definition and analysis for different use case scenarios and services in the WP3 to be develop in WP4 and implementation in WP5.

The main deliverables to take into account in this section from WP3 are the “D3.1 – Instant Mobility Use Case scenarios definition & analysis – preliminary report” where he results included here as the definition of a set of scenarios and services.



“D3.3 – Instant Mobility Use Case scenarios definition & analysis – final report” and “D3.5 Instant Mobility Use Case Scenarios Functional and non-Functional Requirements” that links the scenarios with the services, use cases and functions.

Scenarios	List of Applications
Personal travel companion	Dynamic multi-modal journey
	Dynamic ride-sharing
	Optimized public transport usage
Smart city logistics	Load sharing and optimizing
	Dynamic time/place drop point
	Itinerary booking and real time optimized route navigation
	Eco-optimised driving, vehicle and driveline control
Transport infrastructure as a service	Real-time traffic and route information
	Floating passenger data collection
	Virtualized intersection intelligence
	Cooperative traffic signal control
	Area wide optimization strategies

In WP4 the purpose of the different deliverables per application is to identify and describe both the generic enablers and the domain specific enablers on mobiles or nomadic devices necessary to implement the scenarios using the BPMN notation and the architecture defined in D4.1 to generate the decomposition of the main applications define in WP3.

The following list of deliverables, are focus on enablers hardware needs to implement in WP5:

- D4.1 Global architecture definition & requirements
- D4.2 Multimodal Journey optimisation enablers specifications -iteration 1
- D4.3 Drivers & Traveller enablers specification – Iteration 1
- D4.4 Vehicle & handheld devices enablers specifications - iteration 1
- D4.5 Public transport operators' enablers specification – iteration 1
- D4.6 Goods transport operators' enablers specifications -iteration 1
- D4.7 Traffic management enablers specifications -iteration 1
- D4.8 Mobile Payment enablers specifications - iteration 1

3.1 Personal travel companion

The Personal Travel Companion scenario aims to demonstrate the capabilities provided by the future Internet technologies for multi-modal travel, mainly in urban and inter-urban areas (long distances journey are also taken into account but as a more straightforward case).

More precisely, this scenario intends to provide to travellers, surface vehicle drivers and transports operators the benefits of dynamic planning and follow-up during multimodal journeys;

- To travellers, it will help them to plan and adjust in real time a multi-modal journey from door to door
- To vehicle drivers, it will allow them to easily book and execute ride sharing on their way to their own destination
- To transport operators, it will provide them with the complete information necessary to initiate demand driven transportation

3.2 Smart city logistics

It is well known that city goods distribution contributes to problems such as pollution, noise, congestions and unsafe environments within cities. However, if distribution vehicles would be used more efficiently it would theoretically be possible to reduce the amount of vehicles in city centers, thus at the same time reducing the magnitude of the problems caused. Better resource utilization also implies lower cost of transports or improved profit margins for the transport operators.

The Smart city logistics operations scenario describes how transport operations can be improved with respect to safety, efficiency, environmental performance and quality of service. It considers pick-up and distribution operations mainly relying on the use of trucks, delivery vans or cero emissions solutions for last mile delivery (small trucks, electric van, cycle, tricycle or walking) taking into account the new constrains with this kind of transport.

The main problems addressed are outlined below and often influence each other: Traffic congestions within the city centres, air (NO_x, SO_x, CO_2, etc.) and noise (dB) pollution, consignees of online orders are not at home, etc.

The scenario in essence aims to:

- Contribute to sustainability in urban transport operations, not only from an environmental perspective but also from a social and financial perspective
- Reduce congestions, noise and environmental pollution caused by urban transportation
- Enhance the end-customer quality of service through transport flexibility and adaptability
- Improve the competitiveness and profitability of scenario application users (cargo owners, transporters, 3PL, cargo receivers, etc.) through enhanced efficiency
- Enhance the mobility and quality of life for urban dwellers and society

3.3 Traffic management (in the cloud)

The main objective of the Traffic Management scenario is how to use Future Internet technologies such as cloud data storage, Cloud computing virtualization or services-in-the-cloud for dynamic traffic & integrated urban space management.

These are the following advantages:

  - For the Traffic Operator: Reduce the cost of local hardware installation.
  - Reduce maintenance costs (local hardware currently resides in a hostile environment, so less hardware will result in less maintenance).
  - In the case of faults, easy intervention in a comfortable environment (server-farm).
  - Seamless configuration, installation and upgrade possibilities.
  - More scalable and modular systems for traffic control centre.

- For the User:
  - Improved safety and fewer accidents at controlled signalized interactions.
  - Reduced delays and congestion, improving the mobility of users.

- Improved energy efficiency by optimizing traffic demand.

This scenario will allow the rapid deployment of a new generation of traffic management services. These will result in an improvement in the levels of mobility on the roads by acting as B2B services, for instance by providing accurate RTTI for mobility services such as routing information, personalized route guidance, eco-driving support. The traffic management centres will be able to create the most suitable strategic action plans only by using available high quality data. The actuation services will run optimal policies which take into account the specific requirements of each zone, region or city.

4. Personal travel companion Demo & Prototype

4.1 Scope

The prototype aims at showing the global effect of ride sharing over a whole city. It will show a large number of realistically simulated Instant Mobility travellers and drivers moving over the map of a city, along with statistics. It will be possible to get information on any particular traveller's or driver's journey by clicking on it. The visitor will be able to block or release any route and observe the dynamic adaptation of users' journeys to this change.

This prototype will in particular demonstrate the ability to find common ride solutions with a large number of travellers, individual cars and public transport. This problem does not have any known solution to our knowledge.

The prototype will cover:

- De-risking of multimodal journey computation issues, and in particular car sharing
- Drivers and travellers monitoring along their journey, and in particular dynamic adaptation to unexpected changes (road becoming blocked).
- Stability of the solutions found to ensure minimum rerouting of the vehicles in case of incidents and to avoid causing further traffic jams issues.

4.2 Components

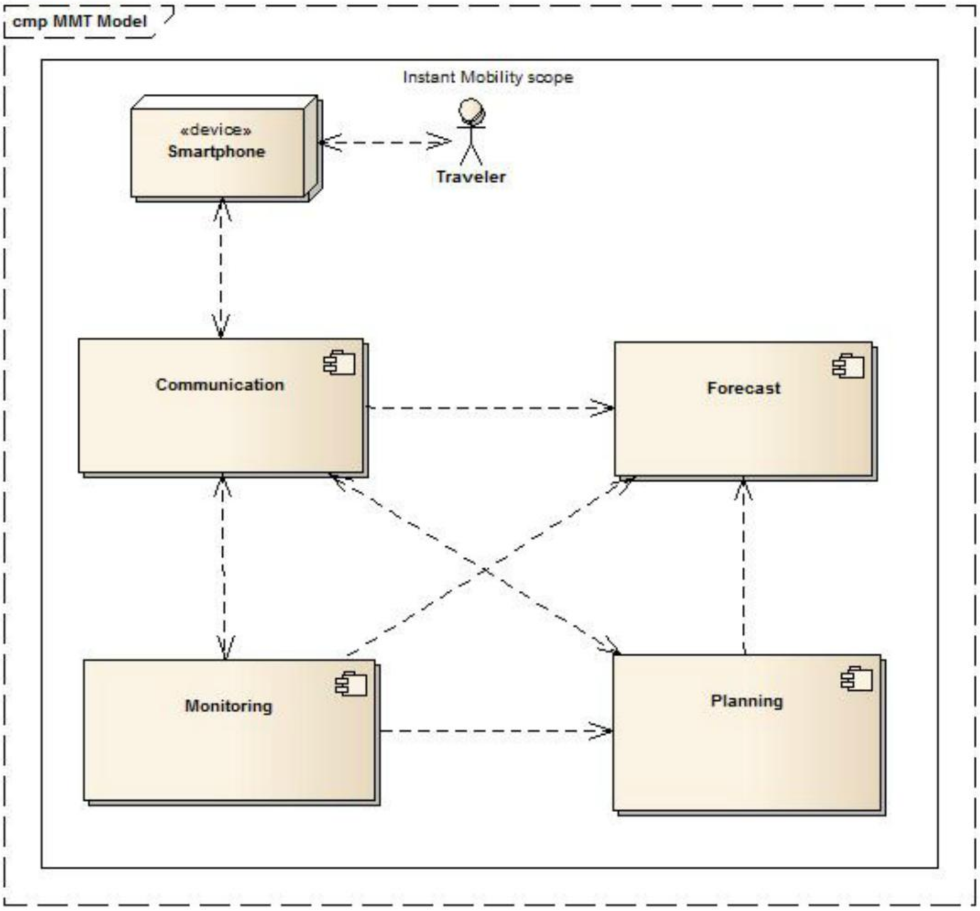
Domain specific enablers

The following components from WP4 Multi-Modal Mobility sub-system will be fully or partially implemented:

- Communication
- Planning
- Monitoring

The following components from Personnal Travel Companion sub-system will be implemented:

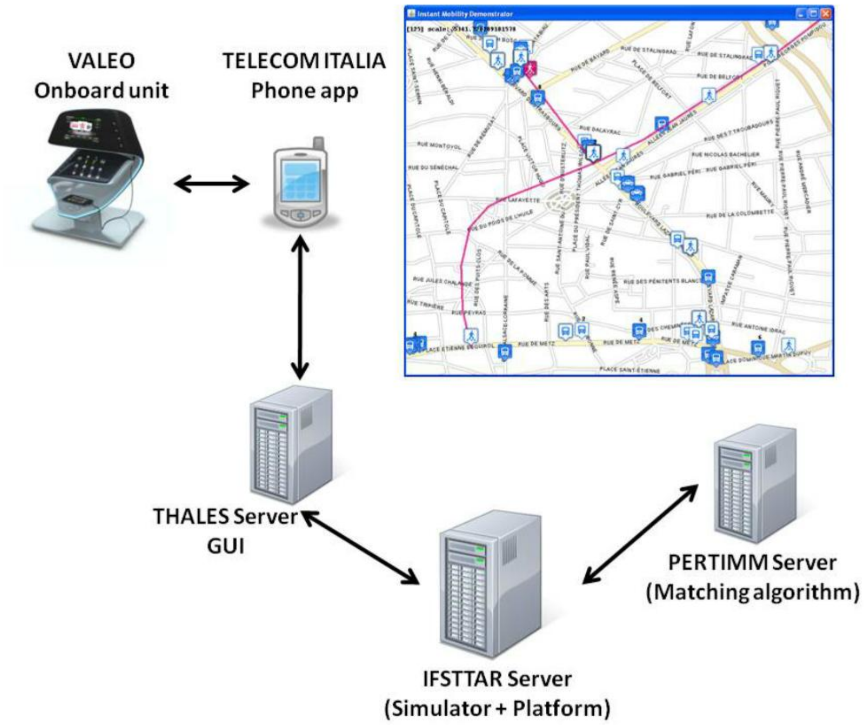
- Mobile application (driver and traveller)



Generic enablers
Due to time constraints the FI-Ware enablers will not be used in the first version of the prototype demonstrated in Vienna. After the Vienna release, available FI-Ware enablers will be validated and possibly integrated in the second version of the prototype.

4.3 System overview and contributors

Thales, IFSTTAR and Pertimm will work together to build the server-based prototype.
Telecom Italia and Valeo will work on the mobile device/on-board unit prototype.



A live demo of the first partially implemented version of the prototype will be presented at ITS Vienna (Oct 22-26, 2012).

5. Smart city logistics Prototype

This prototype aims at implementing the functionality of the use cases of “Smart City Logistics” and parts of use cases “Real-time traffic and route information” and “Virtualized intersection intelligence” with a demonstration of the whole goods transport chain, starting with load sensing and pick up planning until dynamic drop point and driver coaching.

The “Smart City Logistics” use cases included in the prototype are: “Load sharing and optimizing”, “Dynamic time/place drop point”, “Itinerary booking and real time optimized route navigation” and “Eco-optimized driving, vehicle and driveline control”.

Example of use-case

1) New goods arrival (back office)
   The transportation company receives a pick up request in the back office system and accepts the assignment.

2) Message for the consignee to choose where to pick up the goods (smartphone consignee)
   The consignee decides where to collect the goods.

3) Based on pick-up and delivery places, and load sharing, choose vehicle (back office)
   Based on the current fleet load and location, the fleet manager decides which vehicle is optimal for picking up and delivering the goods.

4) Give information to driver (in-vehicle HMI)

The driver of the chosen vehicle receives instructions of where and when to collect the goods, as well as where and when to deliver.

5) Coach driver throughout the journey (in-vehicle HMI)
   Based on the traffic, the route is optimized in real time and the driver is coached during the whole journey. The vehicle is also controlled to achieve an eco-friendly trip.

6) Monitoring of driver activity (back office)
   The fleet manager is able to follow the trip on-line and the system also logs the data and can playback the journey.

7) Successful delivery
   The consignee acknowledges receiving the goods.

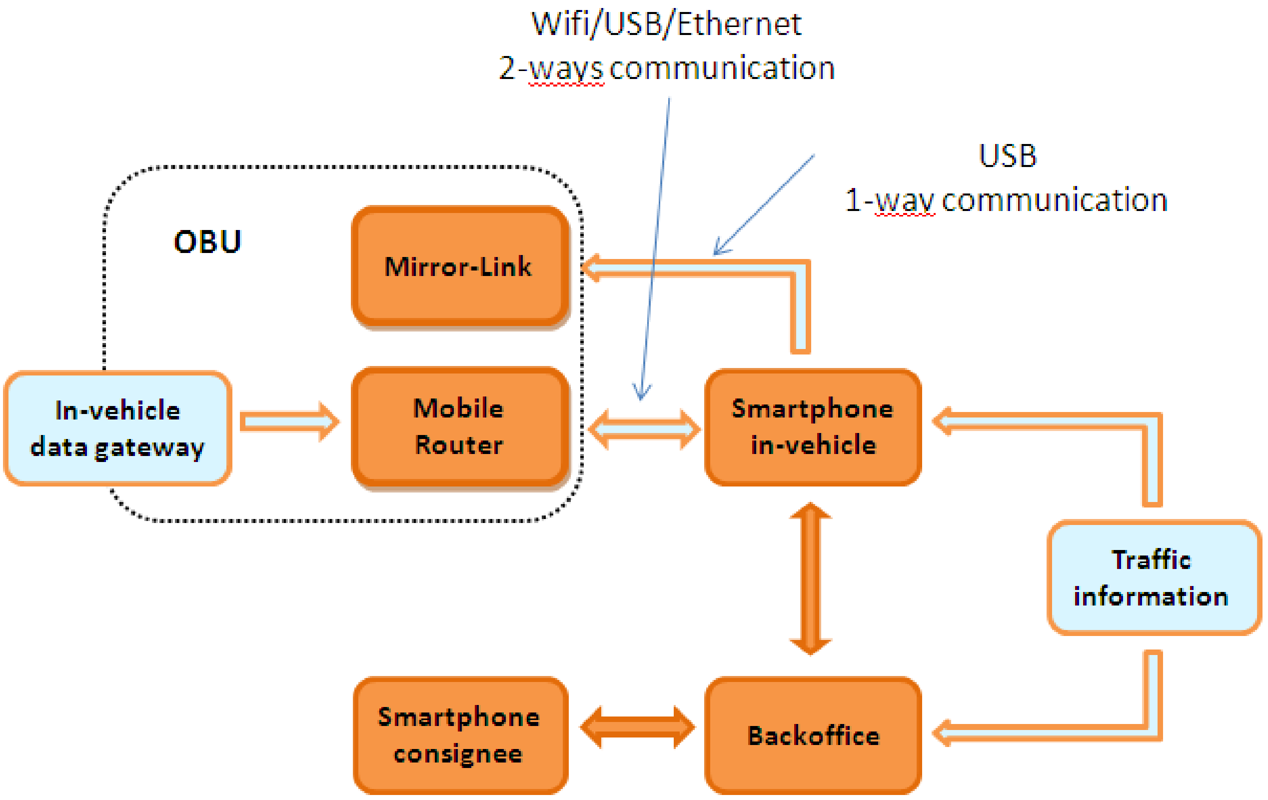
During the trip, the driver will also receive eco-driving coaching, derived from various sources of information (e.g. traffic signals, other vehicles, traffic management center, fleet manager). The system will recommend the speed and route for the driver to follow, according to directions from the back office.

The main benefits of this system are to reduce emissions and fuel consumption, to improve traffic flow, and to improve meeting schedules for goods transportation.

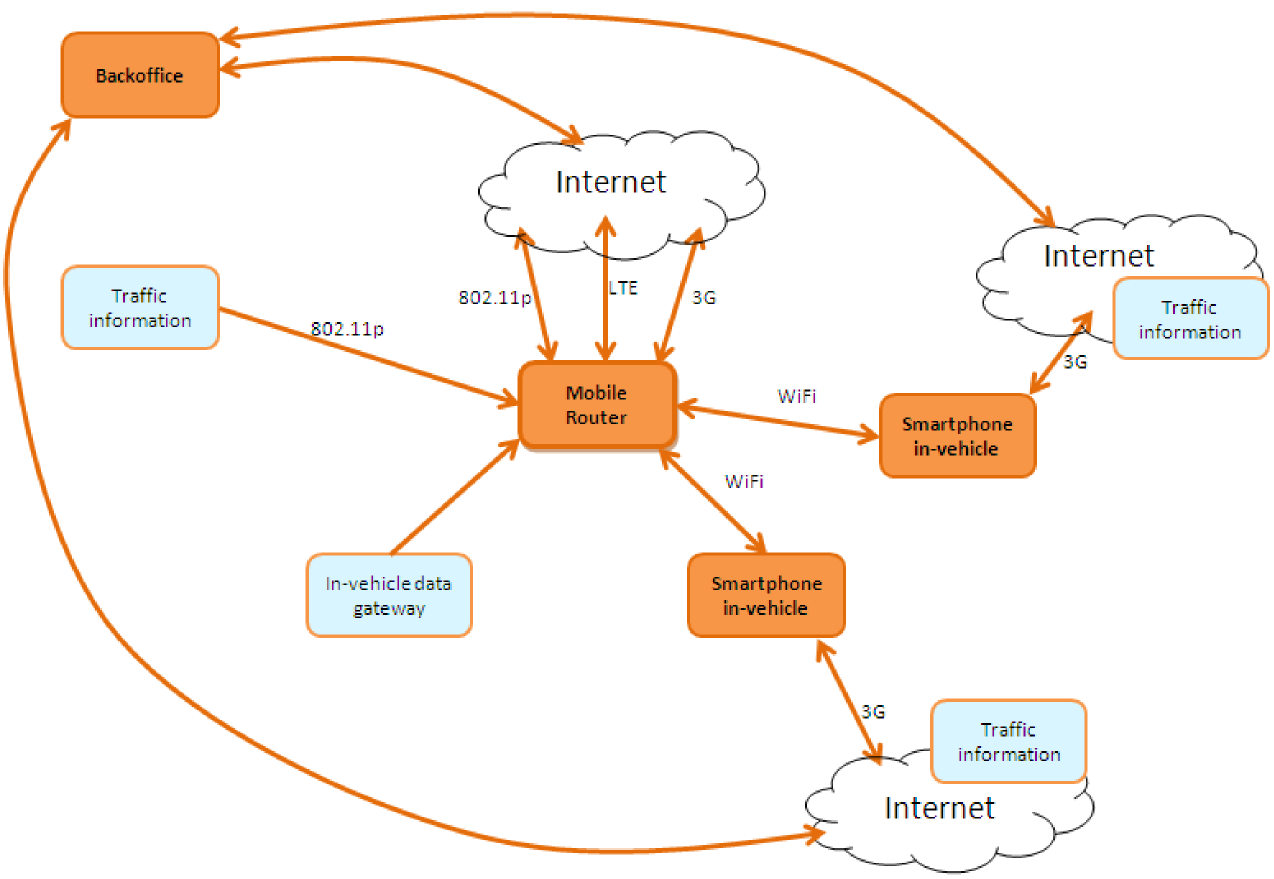
This approach connects all sources of information available, which is not done in any system know at this time.

The outcome will be a live demo. There will be parts of the system completely implemented as prototypes, as the consignee application, and parts of the system that will be simulated, as the vehicle data. The back office system will be partially implemented and partially simulated.

5.1 System overview



5.2 Communication interfaces



5.3 In-vehicle data gateway

5.3.1 Main functionalities

- Reads data from vehicle, package and send to mirror-link

5.3.2 Activities

- Specify physical connection with mirror-link (USB/Ethernet)
- Specify communication protocol (ASN1)
    - Position, Speed, Load capacity etc
- Define how to simulate vehicles for demonstration
    - Playback of pre-recorded itineraries (following driver coaching)
- Implement packaging data and broadcasting to mirror-link

5.4 In-vehicle mirror-link

5.4.1 Main functionalities

- Displays an HMI when not connected to the in-vehicle smartphone application
- Receives vehicle data from in-vehicle data gateway
- Sends vehicle data to in-vehicle smartphone application
- Receives HMI information from in-vehicle smartphone application

5.5 In-vehicle smartphone application

5.5.1 Main functionalities

- Receives vehicle data
    - Position, Speed, Load capacity, etc
- Sends vehicle data to the back office continuously
- Receives a transport request from back office
- Driver accepts/rejects transport request and system informs back office
- Receives itinerary from back office
- Receives real time traffic information from traffic management interface
- Based on itinerary and traffic information, displays navigation information for the driver
- Adapts the route in real time based on traffic information
- Gives driver coaching information based on traffic information
    - Green Light Optimal Speed Advisor
    - Traffic Jams
    - Accidents

5.5.2 Activities

- Define communication protocol with back office
- Define communication protocol for vehicle data
- Define communication protocol with traffic management
- Implement communication with back office
- Implement transport booker and itinerary

- Implement driver coaching

5.6 Consignee smart phone application

5.6.1 Main functionalities

- Receives package notification from back office
- Chooses from a list of drop-points, from back office, but with a suggestion based on current location / preferred locations / schedule
- Chooses the time to pick-up, following constraints from back office
- Sends place and time information to the back office
- Receives confirmation

5.6.2 Activities

- Define communication protocol with back office
- Implement application

5.7 Back office application

5.7.1 Main functionalities

- Simulate a number of vehicles in the map with available load capacity
- Interface for adding a new transport request, with origin, destination and capacity needed
- Request drop-point from consignee, with constraints of time and drop-point
- Receives real-time traffic information from traffic management
- Based on vehicle position, itineraries, load capacity and traffic information, chooses the best vehicle for a transport request
- Sends request to the in-vehicle application and receives the confirmation
- Sends new itinerary information to the in-vehicle application
- Receives vehicle data from vehicle continuously

5.7.2 Activities

- Define how to simulate vehicles and convert to received itinerary
- Define communication protocol with in-vehicle application
- Define communication protocol with consignee application
- Define communication protocol with traffic management
- Implement interface for new transport request
- Implement functionality for dynamic drop point request
- Implement optimal vehicle choice for transport request
- Implement itinerary calculation
- Implement real time vehicle monitoring
- Implement multiple vehicles simulation

5.8 Traffic management interface

5.8.1 Main functionalities

- Make traffic information available to the back office and in-vehicle application
    - Traffic lights
    - Traffic jams
    - Accidents
- Simulate traffic information

5.8.2 Activities

- Define communication protocol
- Implement traffic management system
- Implement simulations

5.9 In-Vehicle Mobile router

5.9.1 Main functionalities

- Ensure data exchange reliability
- Detect smartphones and possible remote modems
- Bridge between in-car sensors and users (smartphones)
- Increase data throughput
    - By using multiple interfaces towards the Internet
    - By using smartphone as a mean to get access to the Internet
    - Scheduling algorithm

5.9.2 Activities

- Specify service discovery protocol
- Specify scheduling algorithm
- System Implementation and prototyping

6. Traffic management in the cloud Prototype

In order to achieve efficient urban traffic management and control, cities need to deploy not only the technologies for traffic monitoring, but also dedicated traffic control devices and management platforms, which can integrate all the data coming from the different monitoring technologies so as to calculate strategies either for their own purpose as operators or for end users. All this has an enormous cost for cities. Here, the innovation proposed by Instant Mobility is to use the cloud capabilities of the Future Internet to create innovative services that reside in the cloud or that use the core platform capabilities. These emerging hybrids of proprietary and cloud applications will result in a new class of distributed applications, and reduce costs by eliminating the need to buy specific platforms. Transport agencies will be able to use existing infrastructure-based technologies, such as inductive loops, wireless sensor networks, DSRC beacon-based technologies and ANPR for data collection. Alongside this data, they will also have access to information from other sources (Bluetooth and Wi-Fi devices, crowdsourcing, mobile apps, …), as all of this data will be available in-the-cloud in an open data common infrastructure. According to this model, traffic operators and agencies will be able to give innovative services to logistic operators (goods delivery optimisation), public transport operators (advanced fleet management) and to the whole T&M community.

“Traffic management in-the-cloud” prototype is related to “Development scenario 3: Transport infrastructure as a service” [D3.3], which allows the rapid deployment of a new generation of traffic management systems by exploiting, among others, Future Internet technologies such as cloud data storage, cloud computing and virtualisation.

6.1 Prototype description

Functionality

Unlike current approaches, traffic control operations will be hosted in the Internet in secure virtual traffic signal controllers and a virtual traffic centre. This will leave local systems the task of providing safety control and communications. Virtual components and data are accessible anywhere to authorised personnel and give to the system high scalability and cost-effective configuration, maintenance and upgrading possibilities. At the intersections absolute or selective prioritization policies can be applied, e.g. to give priority to special vehicles such as buses, trams, emergency vehicles, commercial vehicles (HGV), etc. Furthermore, the system will be able to automatically detect critical traffic conditions and to activate dynamic green waves, to always keep the network under equilibrium conditions.

Components

The simulator will be located in the city of Trondheim and will be based on a micro approach. This kind of approach can be distinguished from other types of computer modelling in that it looks at the interaction of individual "units" such as people or vehicles. Each unit is treated as an autonomous entity and the interaction of the units is allowed vary depending on stochastic (randomized) parameters. These parameters are intended to represent individual preferences and tendencies. The area of the city involved in the prototype will be comparable with a larger quarter of the city, and up to 20 intersections will be included in the simulator. Virtual road side units will control all the intersections of the model, giving the services listed in previous section and using data coming from traditional road sensors and innovative sources and could data providers.

This prototype makes use of virtualisation to connect a high number of devices with a traffic simulator. This means that no complicate connections are required, just a software configuration. The effective interfaces between the model and the virtual road side units will allow to have a consistent real-time simulation of the real world and of real dynamic traffic conditions.

Domain specific and generic enablers

Looking at the Component Diagram of Development Scenario 3 [D3.3], the main Specific Enablers covered come from Task 4.7 and will be Intersection virtual controller and Data collector, with reference to the high quality of data given by the system, which allow to run effective control strategies.

By using the cloud computing solutions provided by the Core Platform in the PPP program we will be able to access a pool of configurable computing resources (e.g. networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Within the available service models, Cloud Infrastructure as a Service (IaaS) and Cloud Platform as a Service (PaaS) are the ones that will be used. More specifically, this is the list of generic enablers that are being monitored and which feasibility is being investigated:

- BigData Analysis: A platform to assist in the analysis of large amounts of previously stored data and incoming real-time data streams is available at FI-WARE testbed. It uses MapReduce techniques to provide low-latency analysis in near real-time giving insights in to new and existing data. It is interesting for prototype as regards the application to analyse large amounts of data coming from FCD, Crowd sourcing, etc. The plan is testing them and depending on the results, integrating them as part of the prototype.
- Complex Event Processing: the analysis and processing of discrete event data received in real time, generating new events as a result and the graphical user interface and API-based

programming of pattern/condition/action rules for analysis and processing of events of any type is also interesting for this prototype. The plan is testing them and depending on the results, integrating them as part of the prototype.

- Cloud Edge(/Proxy): could be interesting for its functions of “super gateway” and for the possibility to use dedicated hardware.
- Location Platform: good to get mobile devices and vehicles positioning info. It has been considered in scenario 3 specification and Bluetooth integration needs to be investigated. However, it will not be integrated in the proof of concepts.
- Pub/Sub: FI-WARE testbed will make available a limited Pub/Sub broker which enables to publish incoming events for consumption by interested application. The API uses a subset of the FI-WARE NGSI Restful API, enabling applications to provide updates about context information related to entities, support registration of context providers that are able to be queried about the value of attributes of certain entities, subscribe to context information about entities whose ids match certain conditions, which will be received as callback notifications, and query for context information that has occurred in the system for entities that match certain conditions. From the point of view of the Traffic management in the cloud prototype it is interesting for the possibility to publish (traffic, weather, …) events for interested consumers. That is why it has been taken into account in the architectural design but it will not be included in the proof of concept.
- IaaS (IaaS) service manager: key component to provide automated control solutions of Virtual machines (e.g. virtual intersection controllers).

Development process

The main development activities will regard:

- The creation of a virtual road side unit for simulated traffic control;
- The creation and calibration of a model representing the city of Trondheim;
- The configuration of an interface between the virtual road-side-unit and the micro-simulator;
- The configuration of an interface between the driving simulator and the virtual environment.

6.2 Demo description

Since this prototype will be based on traffic micro-simulation, by the end of the project (March 2012) it will be possible to use the 3D simulated environment as a virtual city, where the user can move, fly, or even drive a car, jumping from an area to another one of the city in a second. Specifically, the prototype will make use of a dedicated advanced driving simulator, able to put hardware and driver in the same loop (DHIL approach) and to make him able to actively interact with the virtual 3D environment. The model will also be used to produce a number of demonstration videos, describing the user experience while driving or travelling in the virtual city. Furthermore, the user will be able to see the working of a virtual road side unit running in-the-cloud, through a dedicated transport manager interface, running in parallel with the micro-simulator.

Since all the components all virtualised, a last generation PC (either desktop or laptop) is required. A wide-screen display will increase the impact of the demonstration and could be easily connected to the PC. If necessary, a specific driving simulator cockpit could be provided by the proposers.

7. CAR API Prototype

This prototype aims at defining open standard CAR API that may be provided on any vehicle and for any mobile phone and third party applications. Today such solutions are done through OBD devices or through closed dedicated solutions.

7.1 Prototype description

Functionality

This prototype is part of the overall Smartphone-Vehicle integration topic that is addressed in Instant Mobility development scenario 1 [D3.3] and that is examined in Task 4.3, driver and traveller enabler set. This solution is complementary to mirrorlink and it may be used to collect data relevant for some IM scenarios including for instance dynamic ride sharing and eco-optimized driving, vehicle driveline control. Furthermore information owned by the vehicle about the vehicle itself and the external environment (retrieved from on board sensors or calculated through data fusion mechanisms) can be sent to the cloud and thus enable the development as well as enrich the offer of Automotive-oriented mobility services based on the Future Internet.

Components

This prototype will use a smartphone and an On Board Unit. The prototype will work in a lab environment with the On Board Unit connected to a device emulating car ECUs and CAN bus (for instance a PC or a dedicated board). We will use also remote servers to provide cloud data.

Domain specific and generic enablers

This prototype covers the following domain specific enabler sets:

- Driver and traveller enabler set.
- Vehicle and handheld devices.

7.2 Demo description

The demo is based on the interaction between a real OBU and a Smartphone to share data arriving from the vehicle. The user will experience an application on smartphone that will exploit some data arriving from the car. This can also be used in conjunction with web data in order to provide advanced services

8. Summary

Section 2 explains in brief the process that has been taken to define the prototypes that are outlined in brief in sections 4 to 7.

The prototypes reflect well the DoW and even extend their scope over a Traffic management scenario.

The prototype descriptions capture a snapshot of the current prototype drafts. These are currently refined in the course of the developments in WP5. This means that definitions in this document are translated in to more concrete specifications that are used to implement the prototypes.

Some of the prototypes descriptions (e.g. CAR API) need to improve significantly to make clean transition from the concept to a usable and distributable specification. In the case of the CAR-API this is done on specification level to interface between the prototypes. Therefore this process is not explained in high detail.

At the time of writing the scenario 1 prototype for Vienna is finalised. There has not been the time yet to capture the lessons learned from the development to improve the orientation of the other prototypes.

9. Appendix

9.1 Open Call Template

Key prototype functionality (abstract)
Please explain • the basic functionality of the prototype that you envision. (What does a visitor/user experience?) • Outline what will be the full scope (e.g. for an intersection assistance you'll use a RSU, OBU and some backend services) • How this prototype peaks out of current state-of-the-art • What is the tangible outcome of the prototype (e.g. software, a video or a live demo) Max 1 page

IM goals
Please explain • How this prototype covers the most critical and innovative aspects of the IM (both technical and T&M functional) • What specific enablers you will cover Max ½ page

Adequate Event
One or more events that can be used to demonstrate the prototype and what will be shown there (e.g. a video or a true live demo)

Costs
Please indicate 1. all effort that you foresee for the development for the functionality explained in section one. 2. What existing background is needed (e.g. hardware) and who is providing this 3. potential partners of WP5 that are willing and capable to realize the prototypes Max ½ page

9.2 Scope of task WP5.1 and contributions according to the DoW

This task will define functionality of the conceptual prototype to be realized in task 5.3 and select the domain-specific enablers needed to demonstrate the Instant Mobility approach and feasibility. By prioritizing the most critical and innovative aspects and functions of the Instant mobility, the prototype will reflect a subset of the specifications that is necessary to validate. The definition of the prototype will orchestrate components from the Core Platform and domain specific enablers (task 5.2) to implement. These critical functions will be grouped in the following four key categories of the Instant Mobility vision

- Real-time multi-modal navigation and planning
- Open portable Mobile framework
- Multi-modal automated electronic payment system for mobile users
- Multi-modal freight information subsystem for urban areas.

A virtual prototype will be shown for each of these key categories (including a hardware platform implementation for the Open Mobile Framework)

Partners' activity:

- DLR will drive and contribute to the definition of the four prototypes
- DHL will mostly contribute to the definition of the multi-modal freight prototype
- FT Based on the scenarios described in WP3 and the technical specifications of specific enablers and available generic enablers will identify the main innovative features to demonstrate Instant Mobility services.
- TID Identification of functionality to be implemented in T5.3 and selection of Instant Mobility domain-specific