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Mobility as a Service in the Shift2MaaS Project

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Abstract

This article aims to introduce Mobility as a Service from a general point of view, but also from the point of view of its implementation in the environment of international research projects. Specifically, this is the project Shift2MaaS under Shift2Rail, as the first European rail initiative. Further, this project is described in more details, including information about the goals, the demonstration sites, pilots and current progress.

Keywords: MaaS; Shift2Rail; Shift2MaaS; Demonstration sites; Functionalities; Testers

1. Mobility as a Service

Mobility as a Service (MaaS) can be characterized as the integration of various forms of transport services into a single mobility service accessible on demand. MaaS offers, through a single application, a diverse menu of transport options, whether it is public transport, ride-, car- or bike-sharing, taxi or car rental/lease, or a combination thereof. In the centre of interest is located customer/user/traveller transport needs. Moreover, MaaS enables a single payment channel instead of multiple ticketing and payment operations. The aim of MaaS is to provide an alternative to the use of the private car that may be as convenient, more sustainable and helpful to reduce congestion and constraints in transport capacity.

Based on the above, the benefits of MaaS can be summarized in the points mentioned below:

- **Easy route planning** – real-time route planning allows users to plan their journey using multiple transport methods, based on intelligent suggestions derived from their personal preferences.
- **Simplified payments** – users can use phones, smartwatches and bank cards.
- **Personal touch** – MaaS is a fully personalized service. By using big data, two-way communication and constant user feedback, MaaS systems become the ultimate customer-focused transportation platforms.

In ten years' time, MaaS is predicted to be worth a staggering $1.76 trillion, a quarter of the entire transportation industry, and to have completely revolutionized how people live and work. With the help of MaaS, people are

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already stepping away from their own cars and into someone else's, taking advantage of the benefits that shared mobility offers without the hassle of driving, parking or maintaining a car.

Furthermore, every major city is struggling with increased urbanisation and the resulting accessibility and liveability issues. The MaaS service could contribute to improvements in the living conditions and accessibilities of cities and rural areas.

2. Shift2MaaS project

The Shift2MaaS project is one of the Shift2Rail Innovation Program 4 (IP4) projects. IP4 deals with "IT Solutions for Attractive Railway Services". The project was launched in December 2018 and its activities should be completed in June 2021.

MaaS schemes can be seen as initiatives with a great potential that provide a tailored mobility package to travellers. Shift2Rail IP4 projects are currently developing technologies and tools for Transport Service Providers and travellers that can be used in MaaS applications and should advance the uptake of these new MaaS schemes. The new technologies can play a crucial role in the large-scale uptake of MaaS schemes, and ensure a stable business operation of these schemes at a global level. Within the Shift2Rail IP4, the following technologies have been developed:

- Interoperability Framework
- Travel Shopping
- Booking and Ticketing
- Validation
- Payment
- Trip Tracking.

The aim of the Shift2MaaS project is to uptake the IP4 technologies and overcome the technical and non-technical barriers for the adoption of new and integrated MaaS platforms to enable seamless passenger experience. Another goal of this project is to support the introduction of the Shift2Rail IP4 technologies within the MaaS context by analysing the needs of the involved stakeholders. The Shift2MaaS demonstrates the benefits of IP4 technologies through pilot demonstrators, i.e. real environments of shared mobility services. Impact of the benefits of IP4 technologies will be assessed by designing an evaluation framework and also on business models and on the behaviour of passengers.

2.1. Demonstration sites

In the Shift2MaaS project, three demonstration sites have been defined: Lisbon, Málaga and Central-East corridor (Figure 1).

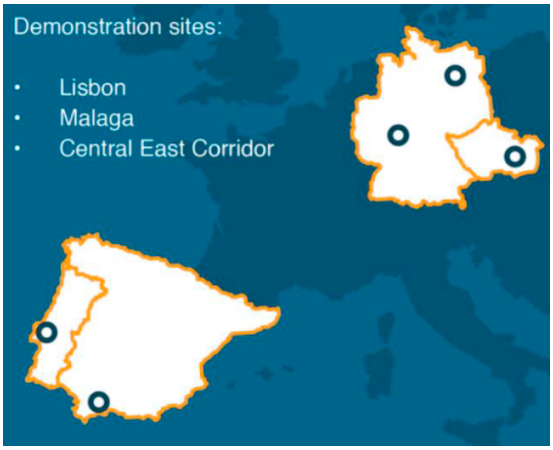

Fig. 1. Shift2MaaS demonstration sites

Given the very different nature of these demonstration sites in terms of mobility services offered, grade of maturity of legacy systems and the different Public Transport Operators and Travel Service Providers included in the service chain, each demonstration site runs only the S2R IP4 subsets which are needed. This aspect is pursued following a modular and scalable design of the scenarios and use-cases. The specification of each demonstration site is described below.

2.2. Lisbon

The Lisbon Metropolitan Area is the biggest agglomeration in Portugal, with a population of about 2,8 million people. With a motorization rate of 433 passenger cars per thousand inhabitants and a modal share of private vehicles of over 50% (and public transport below 30%), there is now a strong political commitment to reverse these numbers and promote public transport. The Lisbon Municipality is committed to transfer 150,000 daily trips from cars to sustainable forms of transport. An important element of the strategy to address this challenge is the modernization of public transport and its full integration in digital transport networks. Starting with public transport, Lisbon was amongst the first large mobility area to evolve to a fully multimodal NFC (Near Field Communication)[*]-based integrated ticketing system. For more than a decade, the paper tickets have residual used in the area and most public transport trips take place using contactless cards based on CALYPSO[†]. Public transport operators own the ticketing infrastructure, which implies that this interoperability framework is based on the application of common standards to different technology providers and integrators. With regards to passenger information, most relevant data is made available through open data platforms. The project's partner EMEL[‡] operates separate technological solutions for their services for private transport and shared transport services. However, in both cases there is already some work regarding the cooperation of these systems with those of public transport operators. For example, EMEL has developed the systems to allow NFC-based public transport cards in some of its parking meters.

The expectation of the Lisbon demonstration site is to explore how public and private transport can be integrated side-by-side within multimodal travel chains, i.e. to cover all available modes of transport. The scenario proposed is

[*] NFC is a modular technology for wireless radio communication between electronic devices at a very short distance (up to 4 cm) with the approach of the devices.
[†] Calypso cards are microprocessor based contactless and dual interface smart cards which offer both speed of transaction and a high level of security. (http://ask-contactless.com/Default.aspx?tabid=62&language=en-US)
[‡] EMEL (Empresa Municipal de Mobilidade e Estacionamento de Lisboa) – EMEL is the Lisbon Mobility and Parking Municipal Company whose main mission is managing the concession of public parking in the Lisbon Municipality.

to allow users to receive complete information about trip options, allowing them to be flexible in their travel decisions rather than to lead users to a specific mode of transport.

2.3. Málaga

Málaga is a metropolitan area of 1.2 million people, as well as one of the most famous tourism destinations worldwide. The city presents a quite complete transport infrastructure, which includes a recently renovated train station with high speed connections to major cities in Spain (Madrid, Barcelona, Zaragoza, Sevilla, Cordoba), and a public transport fleet composed of 242 buses covering 45 lines within the city. Two metro lines are under construction, whereas the roadway system includes two highway rings. The recently approved Sustainable Urban Mobility Plan (SUMP) aims at achieving several ambitious objectives by 2025, through a realistic action plan. Measures include switching the modal split from the current 42% to 14% in private vehicle use, together with a parallel increase in bicycle (9%) and public transport (27%) use. In the Shift2MaaS project, Málaga and the project's partner EMT[§] provides a testing ground for the implementation of a transport interoperability service. Urban, national (intercity) and international (cross-border) trips that start or end in this area are investigated in the Shift2MaaS project in order to assess how a MaaS service could work on different geographical levels. Furthermore, the Shift2MaaS project investigates the possibilities of a common payment system. This brings together different public and private mobility service providers including bus, metro, car-sharing, bike-sharing, rail, coaches, using the EMT smart card platform already in operation; and investigating the potential of the semantic interoperability[**] and S2R IP4 Interoperability Framework[††].

2.4. Central-East corridor

This demonstration site involves Germany and Czech Republic and in particular the cities of Berlin and Brno. Berlin has a population of some 3.4 million inhabitants and covers an area of almost 900 km². Berlin possesses an outstanding local public transportation network. The network of regional trains, S-Bahn (city train), U-Bahn (subway), trams and buses has a total length of around 1,900 km. Passengers can get on or off at over 3,100 stations and stops. In addition, several other mobility services such as vehicle-sharing (free-floating and fixed), bike-sharing, taxis, etc. is available for the citizens. One of the partners in this corridor (for the German side) is rms[‡‡] located in the Rhein-Main Area in Hessia (Germany).

Brno is the second largest city of the Czech Republic with a population of nearly 400,000 and an area of 230.19 km². Brno has very well-developed public transport infrastructure. The tram and trolleybus, an electric bus that draws electricity from overhead wires, are its low-polluting backbone. Brno has the largest trolleybus network in Europe consisting of 140 vehicles that cover routes of 94 kilometers and transport 45 million passengers a year. KORDIS[§§] is responsible for Integrated Public Transport in Brno and also throughout the South Moravian Region.

In particular, within the Shift2MaaS project, the demonstration explores a door-to-door European corridor between Germany and Czech Republic, for the reason that the passenger rail transport is currently facing substantial changes. One of the main changes is that there are new rail operators in the previously monopoly sector. All the operators have their own tariffs and systems. It results in the fact that the passengers have to buy different tickets if they want to use different operators. This is even more crucial in cross-border situations.

[§] EMT (Empresa Malagueña de Transportes) – the transport operator that operates the urban public bus network in Málaga.

[**] Semantic interoperability can be characterized as the ability of computer systems to exchange data with unambiguous, shared meaning.

[††] Interoperability Framework is one of technologies developed within Shift2Rail IP4 to meet the technical challenges associated with open-data policies establishment (to reduce data access costs), and data exchange standardisation (to reduce data exchange costs).

[‡‡] rms (Rhein-Main-Verkehrsverbund Servicegesellschaft) – a 100% subsidiary company of Rhein-Main-Verkehrsverbund (RMV), one the biggest Regional Public Transport Authorities in Germany).

[§§] KORDIS is responsible for managing, developing and maintaining regional and city public transport, including local and regional buses and trains.

2.5. Demonstration functionalities

The functionalities that Public Transport Operators and Travel Service Providers provide for the demonstrations depend on the legacy systems and the identified business logic. Overall, the list of the main functionalities (following the terminology used by S2R IP4) that are provided by the Shift2MaaS Travel Service Providers summarizes the following table.

Table 1. Demonstration functionalities

Functionality		Description
Travel Shopping	Itinerary Items Calculation (Planning)	The Offer Provider system can provide the Traveller with offers (itinerary items) matching the Traveller's mobility request
	Offer Items Calculation (Itinerary offers with fares)	The Travel Expert can provide the Offer Provider system (shopper) with Offer Items (itinerary items enhanced by fares)
Booking	Request Inventory Lock	This function concerns the locking of capacity requested in the Offer for a particular Travel Episode. This is not a mandatory function; it depends on the business model of each Travel Service Provider.
	Price booking offer items	This function is involved in the booking scenario as, depending on the Travel Service Provider considered, the price computed before the booking may only be informative and may evolve between shopping time and booking time.
Ticketing	Generate Entitlements and Tokens	This function concerns the issuing of a valid Entitlement and/or Token for the customer. This function is part of the Travel Service Provider business.
	Cancel Entitlements and Tokens	This function involves revoking the validity of an Entitlement and/or Token for the customer. This function is part of the Travel Service Provider business.
Validation	Validate & Compute consumption	The function identifies the token and processes its associated payload based on the token embodiment presented by the Traveller.
	Notify consumption	This function notifies the Ticket Controlling Organization that a token has been validated and used.
	Update Tokens	This function updates the token with the updated payload and interacts with the travel companion to propagate the token update to the travel companion's tokens wallet.
Payment	Request CC (Credit Card) Authorization	This function issues a credit card authorization request to the Merchant.
	Request Clearing-Request Refund	This function issues a request for refund to the Merchant.
Trip Tracking		This component provides Travellers with assistance when navigating transport modes. It also provides personalised information (related to predefined preferences) and up-to-date status reports on subsequent legs of the journey (e.g. service delays, cancellations, re-routing, etc.).

2.6. First pilot

In August this year, the tests of two important functionalities, that should ease and advance the uptake of new MaaS platforms, have completed. In particular, the functionalities were tested within demonstration sites Lisbon and Málaga. These tests were performed in cooperation with the project SPRINT (Semantics for PerfoRmant and scalable INteroperability of multimodal Transport). This project makes steps towards the uptake of the IP4 multimodal transport ecosystem by addressing the following specific challenges arising from TD4.1's (Interoperability Framework) objectives:

- Improve Interoperability Framework performance and scalability to sustain a large deployment,
- Simplify/automate all the necessary steps needed to integrate new services and sub-systems in the IP4 ecosystem.

In particular, the Contractual Management Market Place and the Asset Manager were tested.

The Contractual Management Market Place is a tool aiming to ease the process for Travel Service Providers to set up MaaS agreements among them (e.g. discounts for travellers) and to create Mobility packages that include services offered by different Travel Service Providers, for multiple modes. This tool wants to enable Travel Service Providers to manage products that they offer to travellers, such as a monthly travel pass, or a senior ticket. The Contractual Management Market Place has been developed by the Shift2Rail project MaaSive.

The Asset Manager has been provided by the SPRINT project. This tool lets Travel Service Providers manage their data and publish it as metadata, and aims to ease the data-exchange between different Travel Service Providers. This tool aims to avoid any standardisation, but instead lets Travel Service Providers choose the way they wish to publish the data, in any format.

The tests were executed virtually, by letting Travel Service Providers using the functionalities and giving them the chance to provide feedback.

2.7. Second pilot and impact of COVID-19

The second phase of pilots will take place during the autumn of this year. The second phase will be implemented in all demonstration sites. The goal of all pilots is to test IP4 functionalities in real environment with testers who will be travel according to the defined scenarios and use-cases. When it comes to the tested functionalities, these functionalities will be tested in each demonstration site:

- **Lisbon demonstration site** – Journey Planning, Offer Building, Issuing, Navigation, Trip Tracking (under discussion), Validation, Trip Sharing, Location-based experiences (under discussion), Inspection
- **Málaga demonstration site** – Journey Planning, Offer Building, Trip Tracking, Re-accommodation, Location-based experiences
- **Central-East corridor demonstration site** – Journey Planning, Offer Building, Issuing, Validation, Cancellation & Refund

The main problem that all demonstration sites face is related to COVID-19. This disease has the greatest impact on Central-East corridor demonstration site and cross-border travelling between Germany and the Czech Republic. For this reason, the relevant demonstration team has decided to organize the separate pilots. One of them will take place in Germany and in particular Rhine-Main region with the centre of Frankfurt am Main when the testers will travel by regional transport (trains and buses). The second pilot will take place in the Czech Republic. In this case, two subpilot will be merged. Specifically, it is the long-distance travelling (buses) between Prague and Brno and regional transport within South-Moravian region, in particular the travelling between Brno and Lednice. The aim is as much as possible to follow up the original scenario when farther wants to travel with his family from Frankfurt am Main to Lednice to visit gardens and parks in Lednice. For all demonstration sites apply that the targeted number of testers is up to 50.

As it is mentioned above, all demonstration sites face to the current situation with COVID-19. So, it is necessary to take into account the possibility that the testers will not be able to travel. For this reason, all project's partners are exploring ways to deal with this eventuality if it really happens. It means, which functionalities that are mentioned above, could be tested in a laboratory environment or which not, i.e. online and offline. Hopefully, it will be possible to organize all pilots according to the original scope, it means according to the original scenarios and use-cases.

3. Conclusion

As mentioned in this article, every major city today faces increased urbanization and the problems associated with them. MaaS can help cope with this challenge and in its further development also in the future because by the middle of the century, 66% of the population is expected to live in urban areas, compared to 30% in 1970. Mainly due to the fact that MaaS represents an alternative to the use of private vehicles. The research area of the international projects is aware of the importance, significance and potential of the future use of MaaS in the transport area. Specifically, in the case of Shift2Rail projects, they are trying to integrate MaaS with their own intentions and goals.

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