INFORMATION TECHNOLOGIES FOR SHIFT TO RAIL

D7.8 – White Paper on IP4 Concepts
End-user applicability

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REPORT CONTRIBUTORS

Name	Company	Details of Contribution
Yves Amsler	UITP	reviewer
Marco Ferreira	Thales Group Portugal	reviewer
Delphine Grandsart	EPF	author
Cristina Hernandez	UITP	reviewer
Stijn Lewyllie	EPF	author
Marcelo Vieira	Thales Group Portugal	reviewer
Maria Laura Trifiletti	RINA C-BE	Quality check

EXECUTIVE SUMMARY

IT2Rail is a first step towards achieving the objectives of IP4 (*IT solutions for Attractive Railway Services*), one of the Shift2Rail Joint Undertaking's long-term Innovation Programmes. Within IP4, the objective is to create a seamless multimodal travel experience by providing travellers with smart personalised services to facilitate each stage of the journey:

- Travel shopping (dealing with planning & pricing)
- Booking & Ticketing (dealing with booking, payment, ticketing and validation)
- Trip Tracker (dealing with tracking & re-accommodation)
- Business Analytics (dealing – amongst other things – with post-sales & settlement).

The traveller can access these services through their 'Travel Companion', which functions as a 'front end' user interface. In the 'back end', the Interoperability Framework guarantees technical interoperability of multimodal services by insulating consumer applications from the task of locating, harmonising and understanding an open-ended world of data, events and service resources, which are consequently made available 'as a service'.

Travellers do not interact directly with the Interoperability Framework (IF) or its assets. That is why in this *White Paper on IP4 Concepts End-user applicability*, the focus is not on the Interoperability Framework as such but rather on the different functionalities developed within IT2Rail based on the IF. For each of these components, the added value is discussed, as well as suggestions for further developments/improvements from the point of view of the end-user: the traveller.

The main advantage of the Travel Companion approach is that it simplifies life for the traveller by shielding them from the underlying complexity of different, non-integrated, fragmented information, payment, ticketing, validation etc. systems and procedures and acts as an all-encompassing user 'front end' interface giving access to a large number of multimodal products and services. IT2Rail focuses on a number of concrete use cases – specific instances of an individual traveller's journey – that follow the traveller throughout the different stages of planning, booking and executing a multimodal journey, in order to better understand actual user needs along the way. The use case approach is important because the traveller is placed at the centre of innovative solutions.

This *White Paper* formulates general recommendations that should be taken into account in the follow-up of IT2Rail, i.e. other Shift2Rail IP4 projects, as they may ensure a better market uptake.

In the main, the results achieved in IT2Rail are promising. However, an important limitation from a traveller's point of view is that currently, the IT2Rail use cases tackle only co-modal combinations of major transport modes. Further developments that introduce additional use cases and intermodal through-ticketing possibilities, covering also a wide variety of first and last mile solutions are welcome. Regarding passenger rights, the European Commission is currently examining options to better protect passengers in the EU when using multimodal transport. The outcome of this process should also be taken into account. Finally, the involvement of the end-users, the passengers, is key in follow-up projects. The IT2Rail Travel Companion and its components are meant to cater to various user groups which may have different needs and expectations about its functionalities. Travellers should be actively engaged in subsequent IP4 projects and called upon to actually test and evaluate the products and services that are being developed.

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LIST OF ABBREVIATIONS

EC	European Commission
EDF	European Disability Forum
EPF	European Passengers' Federation
EU	European Union
GOF4R	Governance of the Interoperability Framework for Rail and Intermodal Mobility
ID	Identifier
IF	Interoperability Framework
IP	Innovation Programme
IT	Information Technology
IT2Rail	Information Technologies for Shift to Rail
ITF	International Transport Forum
ITS	Intelligent Transport Systems
NFC	Near Field Communication
PRM	Persons with Reduced Mobility
PT	Public Transport
QR	Quick Response
S2R	Shift2Rail
TC	Travel Companion
TOC	Transport Operating Carrier
TRA	Transport Research Arena
TSP	Transport Service Provider

1. INTRODUCTION

IT2Rail is a first step towards achieving the objectives of IP4 (*IT solutions for Attractive Railway Services*), one of the Shift2Rail Joint Undertaking's long-term Innovation Programmes.

The ultimate aim of the Shift2Rail (S2R) programme as a whole is to achieve a modal shift from road transport towards more sustainable transport modes such as rail. Considering rail transport, in order to make it a more attractive option for travellers, some key improvements are needed. Basically, the railway sector needs to adopt a user-centric approach to be able to empower the travellers and to respond better and faster to their needs.

Travellers are increasingly 'connected' and technology-savvy and expect to have relevant and real-time information at their fingertips in a few clicks, through a variety of channels. Within IP4, the objective is therefore to create a seamless multimodal travel experience by providing travellers with smart personalised services to facilitate each stage of the journey:

- Travel shopping (dealing with planning & pricing)
- Booking & Ticketing (dealing with booking, payment, ticketing and validation)
- Trip Tracker (dealing with tracking & re-accommodation)
- Business Analytics (dealing – amongst other things – with post-sales & settlement).

Travellers can access all these services through their 'Travel Companion' (onwards TC), which functions as a 'front end' user interface, giving users full control of their door-to-door travel experience. Travellers can use the TC (which considers personal preferences, including mobility constraints) to plan their trip, manage bookings, validate entitlements, navigate at interchanges and, in case of disruptions, find alternative solutions for re-routing and re-accommodation.

In the 'back end', the 'Interoperability Framework' (onwards IF) guarantees technical interoperability of multimodal services by insulating consumer applications from the task of locating, harmonising and understanding an open-ended world of data, events and service resources, which are consequently made available 'as a service'.[1]
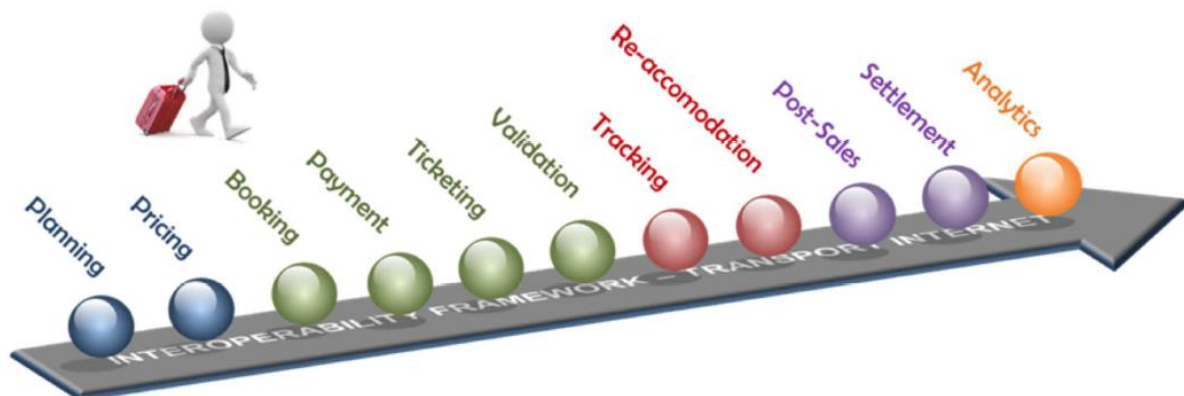

Figure 1: A large spectrum of travel services[2]

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[1] IT2Rail Grant Agreement, Annex 1: Description of the action (April 2015), p.10

[2] IT2Rail Grant Agreement, Annex 1: Description of the action (April 2015), p. 4

IT2Rail, as a lighthouse project for IP4 as a whole, basically tackles all of IP4's main concepts, albeit at a reduced scale (in terms of geographical coverage, number of transport modes, depth of functionality) and covering, for the time being, only co-modality (i.e. no 'through-ticketing').

IT2Rail focuses on a number of concrete use cases – specific instances of an individual traveller's journey – that follow the traveller throughout the different stages of planning, booking and executing a multimodal journey, in order to better understand actual user needs along the way. The use case approach is important because the traveller is placed at the centre of innovative solutions, accessing all multimodal travel services through the Travel Companion.

Travellers do not interact directly with the Interoperability Framework or its assets. They do not care about code information and IT technicalities. What interests them most is being able to enjoy the benefits of a seamless multimodal travel experience. That is why in this *White Paper on IP4 Concepts End-user applicability*, the focus will not be on the Interoperability Framework as such but rather on the different functionalities developed within IT2Rail based on or thanks to the IF.

In this report, the logical order proposed is the one applied in the IT2Rail project as a whole: Travel shopping (chapter 2), Booking & Ticketing (chapter 3), Trip Tracker (chapter 4) and Business Analytics (chapter 5). Finally, the Travel Companion (chapter 6) will also be evaluated. For each of these components, the added value (benefits) will be discussed, as well as suggestions for further developments/improvements from the point of view of the end-user: the traveller. In this context, it is important to realise that various user groups (including for example elderly people, or people with a disability) may have different needs and expectations (chapter 7).

This *White Paper on IP4 Concepts End-user applicability* formulates general recommendations addressing the further steps of the IP4 programme. These should be taken into account in the follow-up of IT2Rail, i.e. other S2R IP4 projects, as they may ensure a better market uptake.

The recommendations in this White Paper are based on a current analysis of the state of the art on user (traveller) needs as well as on EPF's own expertise and knowledge coming from its member organisations. Additional feedback from the AGE Platform (a European network of non-profit organisations of and for people aged 50+) and EDF (the European Disability Forum, an independent NGO bringing together representative organisations of persons with disabilities from across Europe) has been incorporated. Finally, the comments and suggestions of the end-user expert group within IT2Rail have also been considered. In total, there have been 4 end-user group meetings, in which external experts including passengers' representatives discussed the impact of the new IT2Rail systems on travellers, what the travellers' expectations and acceptance levels are etc.[3] A fifth end-user group meeting will take place during the TRA2018[4] final event, in order to show end-users the final achievements of the project.

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[3] The minutes of these end-user group meetings are included in D8.8 *Conclusions and Recommendations of the Experts' Groups* in IT2Rail.

[4] Transport Research Arena Conference, April 2018: www.traconference.eu

2. TRAVEL SHOPPING (PLANNING, PRICING)

The current situation

TRL's *Study on ITS Directive, Priority Action A: The Provision of EU-wide Multimodal Travel Information Services* (May 2016) provides an overview of the current status of multimodal travel information services in Europe. A total of 125 providers were found to be offering 160 services. Local services generally provide more detailed information than pan-European services and the level of modal coverage varies. In particular pan-European services currently do not cover all possible travel options. Moreover, most existing services are based on static (instead of real-time, dynamic) data. Overall, TRL's review shows that the level of service remains limited, especially concerning the 'door-to-door' element.[5]

Some advanced multimodal door-to-door journey planning applications do already exist – however, until now these are mostly limited in terms of geographic scope, centred around large transport operators or focused on long-distance travel modes without including the first and last mile.[6] These portals do not offer any booking & ticketing facilities either.

Today, travel shopping/planning across modes is generally quite difficult and risky. Organising complex, multimodal, European wide trips requires a lot of effort and is time-consuming. Travellers, when planning such a journey, must adjust to a variety of interfaces, devices, tools etc. developed over time by many different Transport Service Providers.

The absence of one mobility platform to cover all transport modes (including first and last mile) and all countries, is a source of frustration for travellers. There is no overview, which makes it difficult to make an informed choice on what is, overall, the best travel option.

IT2Rail's Travel Shopping: Added value

IT2Rail has developed a Travel Shopping component that allows seamless multimodal travel planning in a one-stop-shop mode, covering different transport modes, in order to answer door-to-door queries.

The Travel Shopping aggregates distributed travel shopping data and journey planning expertise, using the Interoperability Framework as a translator, producing a list of possible travel options including the first and last mile. This simplifies life for travellers and allows them to make an informed choice by easily comparing different options and combining different transport modes if necessary. Another practical advantage is the fact that events from the user's digital calendar can be used to initiate a query, which can be handy and save the user time and effort.

Moreover, Travel Shopping takes into account preferences and needs (e.g. reduced mobility and preferences with regard to carbon footprint[7]) – that are stored in the user's profile linked to the Travel Companion – to ensure an efficient search that results in a personalised list of travel options that are feasible and attractive for the traveller.

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[5] TRL (2016). *Study on ITS Directive, Priority Action A: The Provision of EU-wide Multimodal Travel Information Services*

[6] IT2Rail Grant Agreement, Annex 1: Description of the action (April 2015), p.15

[7] The latter is not yet available in the IT2Rail demonstrator, but is planned to be included in future releases.

Further steps and improvements

Trust is of the utmost importance. Firstly, the information shown by the Travel Shopping must always be correct, reliable and up-to-date. Secondly, the query results must be presented in a neutral, unbiased way, i.e. not favouring any specific Transport Service Provider (for commercial or other reasons). In other words, the Travel Shopping should be 'operator agnostic'.[8]

Travellers have to be confident that Travel Shopping will indeed show them the best options. This means that Travel Shopping ideally needs to access all, not just some, of the available transport options to calculate the best results – otherwise some interesting options might not be considered. New mobility services such as Uber, BlaBlaCar but also bike-sharing systems, taxi services etc. need to be included in the total offer if relevant.[9]

With regard to price, it is important to take into account any factors that may result in advantageous tariffs (e.g. Travel Shopping should enquire, if relevant, whether the travellers could use a family ticket, a senior discount, a three-day ticket etc.).

If the traveller has defined any preferences or specific needs in his/her profile, the Travel Shopping should take these into account and rank the results of the travel query accordingly (e.g. ecological footprint, accessibility for wheelchairs, preference for rail over bus etc.). If not, travellers should be asked how they wish to rank the search results (e.g. fastest route, cheapest route).

Travellers must be able to re-iterate their journey planning request, altering their input or overruling their preferences. In any case, Travel Shopping should always (if possible) show more than one option, so as to allow comparisons. Online flight booking systems can be regarded as a good example in this respect, e.g. they often use a matrix to show prices on different days/times, allowing to sort the search results according to different criteria.

When planning a journey, the traveller needs the following information as a minimum: travel modes, transfer points, travel & transfer time and cost. Other information could be useful as well, for ex. frequency, accessibility, availability of seats, CO_2 emission, space for pushchairs/luggage/bicycles/wheelchairs, information on regular disruptions, etc.

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[8] Lanquetot, F. (2017): *"At a fundamental level, trust is based on independence. Platform operators should be perceived as 'operator agnostic'. If there is a suspicion that the platform has a bias towards one operator's services, the platform will not succeed"*, says Laurent Kocher, Executive Director Marketing, Innovation and Services at Keolis.

[9] In practice, it will probably not be possible to have access to *all* transport options in Europe. However, the aim should be to continuously improve coverage.

The current situation

Currently a large number of different ticketing, payment and validation systems exist across transport modes and operators. For the traveller, this means having to switch between several websites in order to be able to book and pay for each leg of the journey. Most of the time, multiple tickets are needed as well. In addition, these need to be validated separately throughout the travel.

Even though lots of efforts are being put into achieving interoperability between different booking and ticketing systems at a regional or even national scale, fragmentation of fare media (e.g. different smart cards) and fare products (transport offers by different providers in the multimodal ecosystem) still remains an important issue, especially on a European scale.

IT2Rail's Booking & Ticketing: Added value

The Booking & Ticketing component developed within IT2Rail allows travellers to book and pay for their entire door-to-door journey in a 'one-click' action.

The Booking & Ticketing service, thanks to the Interoperability Framework, is able to interact with multiple booking, payment and ticketing processors to generate bookings, coordinate payments and create electronic entitlements for (each part of) the journey selected on the Travel Shopping.

This radically simplifies the traveller's life and takes away a lot of the uncertainty that is now associated with having to go through different booking, payment and ticketing processes in order to book different parts of one door-to-door journey.

The Travel Companion cloud wallet function securely stores the created electronic entitlements, which enables easy validation '*en route*' through using a smart device, e.g. a smartphone. As a back-up (in case the smartphone cannot be used), the E-passport is planned to store data on the traveller's journey (entitlements and tokens) within its NFC chip.

Further steps and improvements

Again, trust is probably the most important issue. Travellers need to trust not only the transport provider(s) responsible for the different parts of the journey, but also the application itself. Travellers need to feel confident and protected against cyber security threats. Payment transaction should be perceived as safe. Final prices to be paid should be the same as those shown by the Travel Shopping in the planning phase.

Ease of payment is also a factor to consider. Preferred payment methods vary from country to country and also from one person to another. Different options should be provided e.g. bank card, credit card, virtual payment services,… including the choice between pre-paid and post-paid.[10] Some people do not wish to pay online or are not able to. Therefore, it should be possible to pay in another

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[10] Mobility as a Service apps summarise the costs of all used transportation means on a single invoice (post-paid), whereas other systems are pre-paid, such as the OV-chipkaart in the Netherlands. IT2Rail deals only with pre-paid.

way as well, e.g. by bank transfer or even in cash (in that case, an intermediary is needed, for ex. a travel agent or a counter clerk in a railway station).

It is important that the Travel Shopping and the Booking & Ticketing module can be used separately, i.e. planning does not automatically lead to buying.

Tickets (entitlements and tokens) are linked to a specific traveller's account (Travel Companion – Cloud Wallet). This should not exclude the possibility to buy tickets for other people (e.g. partner, friends, family, group tickets, etc.).

In general, one ticket for the whole journey is preferable to several tickets – on the condition that it is possible to change or cancel any part of it when necessary e.g. rebook part of the journey in case of disruption or due to unforeseen personal circumstances.

There should definitely be a back-up plan for storing entitlements/tickets. If the traveller's smart device does not work or is not available, storing them on the traveller's E-passport could be an option. However, carrying a passport is not obligatory everywhere. Other alternatives for back-ups could include a contactless (payment) card, a QR-code that can be printed, or even biometric identification (face recognition, fingerprints). It would be a good idea to let travellers decide for themselves which option(s) they prefer.

Introducing schemes similar to existing 'frequent-flyer' programmes (or OV-miles[11] for using Public Transport), to encourage users to accumulate points (miles, kilometres, …) which they can redeem to get discounts, prizes or other rewards could be also attractive. It should be possible to incorporate existing loyalty schemes linked to specific transport operators in the Booking & Ticketing application.

The current Booking & Ticketing component developed within IT2Rail only tackles co-modal combinations of major transport modes. In the future, it is very important from a traveller's point of view that *intermodal* 'through-ticketing'[12], i.e. grouping of different travel segments under a single transport contract is introduced because this gives the traveller additional security and guarantees. IT2Rail for now only takes into account major transport modes (air, rail, regional and urban transport). It is important that in a later stage, also (*other) first and last mile solutions* are included in the overall offer, such as bike-sharing and car-sharing, Uber etc.

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[11] https://www.ovmiles.nl/

[12] **Comodality** is where the passenger's selected travel solution consists of an aggregation of Transport Service Provider (TSP) products/services, performed in the distribution link of the supply chain. None of the contributing TSPs are aware of the contribution of the others: multiple 'tickets' (transport contracts) are established between the passenger and each contributing TSP, each guaranteeing arrival only at the destination of the service provided by each TSP. **Intermodality** is where the passenger's selected travel solution consists of an aggregation of TSP products/services performed by the contributing TSPs themselves at the start of the supply chain: commercial agreements between contributing TSPs define a single 'thru-fare' and the apportionment of ticket revenues between them: a single 'ticket' or transport contract is established which guarantees arrival of the passenger at the final destination. (IT2Rail newsletter, Sept. 2016)

4. TRIP TRACKER (TRACKING, RE-ACCOMMODATION)

The current situation

Lack of assistance, especially when confronted with reduced mobility issues or other problems such as disruptions of the journey, is a crucial issue for travellers.

Existing journey planners are based mainly on static timetable data. If something happens or changes, this causes travellers to feel insecure if they have to deviate from their original plan – especially because they cannot be confident that they will find an adequate solution or alternative.

IT2Rail's Trip Tracker: Added value

IT2Rail's Trip Tracker keeps track of and monitors – in real-time – any events, incidents and irregularities that may affect the traveller's planned journey. It alerts and informs the travellers and, if necessary, proposes alternative solutions for re-routing or re-accommodation.

Trip Tracker cooperates with both the Travel Shopping and Booking & Ticketing component to plan and book alternative itineraries, while at the same time taking into account user preferences stored in the Travel Companion.

Trip Tracking is a very valuable functionality from a traveller's point of view because it minimises the stress and inconvenience linked to any kind of disruption. Travellers feel confident and reassured, because thanks to the help of the Trip Tracker, they will be able to make the best possible decision in a given situation, and feel relatively at ease despite unforeseen changes to their original plans.

Further steps and improvements

As mentioned before, currently IT2Rail only tackles *co-modal* combinations of transport modes, i.e. multiple tickets/transport contracts are established between the traveller and each Transport Service Provider within the multimodal transport chain. In the future, it is very important from a traveller's point of view that *intermodal* 'through-ticketing', i.e. grouping of different travel segments under a single transport contract is introduced. This gives travellers additional security and guarantees their arrival at the final destination – which is what ultimately matters.

In case of disruptions and without possessing a 'through-ticket' for the whole journey, at this point, the Trip Tracker is able to look up and suggest alternative travel options, but this will come at an additional cost for the travellers as they will most probably have to buy a whole new ticket.

Should something go wrong, travellers may be reimbursed for part of the journey or – depending on the contract – compensated and/or re-routed at the cost of the Travel Service Provider (or of the Transport Operating Carrier, depending on the case and if the TSP and the TOC are not the same company). Therefore, in case of disruption, it would be useful to point out to travellers what their traveller rights are, preferably with concrete information on how to file a complaint and/or ask for compensation and/or re-routing.

Unfortunately, passenger rights currently apply independently to each individual transport mode (air, rail, maritime and inland waterways, bus and coach) and only if there is a single contract of carriage. Existing EU Passenger Rights Regulations do not tackle the issue of disruptions in a multimodal

context.[13] For example, if a passenger misses a flight because of a delay of the train to the airport, air passenger rights (compensation, assistance, reimbursement) do not apply and the traveller can only – in certain cases – ask for a reimbursement of (part of) the price of the train ticket. This is why the European Commission is conducting an impact assessment to explore the scale and scope of the issue, in order to draw conclusions regarding a possible EU (legislative or other) initiative to improve and guarantee an adequate level of protection to passengers when using combinations of different transport modes. It should be noted though that urban and local transport (first and last mile) are not covered by this initiative.[14]

In case there is no suitable travel alternative, it would be a good idea at this point to provide the traveller with non-transport related information as well e.g. on accommodation (hotels, …), possibilities to buy food and drink, entertainment, …

Even when nothing goes wrong, some travellers may wish to be kept informed by the Trip Tracker that everything is going according to plan, as this might reassure them. However, this probably applies mainly to non-frequent travellers and it should not be assumed that everyone wants this. Tracking should be optional: It needs to be activated by the traveller.

Travellers shall be reassured that, when using the Trip Tracker, they are not *personally* 'tracked' or followed. Instead, the *journey* is tracked – based on the bookings and travel entitlements stored in the Travel Companion's wallet. Evidently, personal data stored in the TC shall be managed in accordance with the legally required protection of privacy and individual rights.[15]

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[13] Which is acknowledged by the EC in its *Communication on passenger rights in all transport modes* (2011)

[14] *Rights of passengers in multimodal transport: Inception Impact assessment* (2016)

[15] Another IT2Rail White Paper on Security and Privacy aspects of SHIFT2RAIL IP4 will deal with these issues.

The current situation

In the current situation, during all the different stages of planning, booking and executing a multimodal journey – especially a long-distance, international one –, travellers are confronted with a complex variety of different and often unfamiliar systems. There is no single application or website where they can plan and book a multimodal European wide trip from door-to-door, which is not a user-friendly situation. In addition, the traveller's personal, travel and payment data are stored by each retailer and operator separately, with varying levels of security.

IT2Rail's Travel Companion: Added value

The main advantage of the Travel Companion is that it shields the traveller from the underlying complexity of different and perhaps unfamiliar non-integrated, fragmented information, payment, ticketing, validation etc. protocols and procedures, and acts as an all-encompassing 'front end' interface giving access to a large number of multimodal products and services.

Three unique concepts have been developed:

- the unique traveller identifier will let the user create a personal profile including preferences (e.g. preferred transport modes, environmental preferences, seating preferences, etc.) and PRM status;
- the personal application will function as the traveller's companion, giving access to all of the other IT2Rail functionalities: shopping, booking and payment, assistance during the journey (interchange navigation and alerts in case of disruption), ticket validation and data provided by business analytics components;
- the virtualised data store is a secure vault that stores all the user's data (preferences, travel entitlements and tokens, payment means).

The Travel Companion also helps travellers with (indoor) navigation at interchanges. For example, it provides a better understanding of where and when to enter, leave or change vehicles, it shows the traveller's position on a map, displays suggested routes and provides guidance, recognizes deviations, ….

Further steps and improvements

In order to be able to use the Travel Companion, users will need to register and create an account. They will also be asked to provide some personal information. The aim is that the Travel Companion will thus be able to provide the user with customized assistance and information. However, we should consider that registration, in certain cases (to use basic functions of the Travel Companion, e.g. only planning a journey without actually buying a ticket, or consulting travel statistics), may not be necessary and should therefore not be compulsory.

The user will be able to customise their Travel Companion and a variety of (additional) applications, tailored to specific user groups' needs, could be developed. On the other hand, providing personal information and preferences could also prove to be a barrier: It takes time to create a profile and enter personal data, and there may be concerns regarding security (where are my data being stored?) and privacy (who has access to my data?). Transparency is important: It should be clear

how the system works, which data are being used by whom and for which purposes. In any case, the Travel Companion will have to ask for permission of treatment of personal data according to the EU General Data Protection Regulation[16].

Configuring preferences should preferably be done on a voluntary basis (and not be obligatory). It may be a good idea to have the Travel Companion 'remember' preferences from previous choices the user has made, i.e. act as a self-learning or smart-learning system.

However, for each new travel query, it should be possible to change these preferences, as some preferences are 'stable' (e.g. PRM status), while others may depend on the context (e.g. work-related versus leisure travel, travelling alone versus with a family).

Considering that the Travel Companion will be used for international journeys and that the number of international, cross-border journeys is growing, the language issue is a key one. It would be helpful if the Travel Companion could offer a (fully reliable) built-in translation module for travellers.

The Travel Companion is a protected, secure data store in the cloud that is uniquely associated with the traveller and his/her secured ID (unique traveller identifier). This should give travellers a sense of reliability and security when using the Travel Companion, on two conditions: The traveller must be confident that first, their personal data will be treated in accordance with the existing laws protecting privacy and individual rights; and second, all due care has been taken to protect the Travel Companion from any access attempts by unwanted or denied sources, from falsification, cyber security attacks etc.

Finally, it should be noted that there will probably not be 'one' Travel Companion encompassing all of the possibilities listed above. Rather, it is more realistic to expect that several Travel Companions will be on the market, each offering a number of functionalities, and travellers will be able to choose one that fits their needs best.

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[16] Regulation (EU) 2016/679 of the European Parliament and of the Council 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

6. BUSINESS ANALYTICS (POST-SALES, SETTLEMENT)

The current situation

Lots of 'big data' from different sources – social, mobile, structured, unstructured – is there 'in the cloud' but in order to obtain valuable insights on travel behaviour these data need to be leveraged and monitored. Information needs to become knowledge.

In addition, Transport Service Providers generally keep their own statistics but travellers (and third parties) can often not access this information.

IT2Rail's Business Analytics: Added value

The Business Analytics component focuses on leveraging social, mobile, structured and unstructured data to obtain insights that will allow operators and Transport Service Providers to increase their quality of service and better satisfy the travellers' needs. It combines data from various sources (internal and external to the system) in order to provide meaningful information for all IT2Rail ecosystem users: Transport Service Providers, but also end-users.

Supported by the Interoperability Framework, the Business Analytics function uses 'big data' technologies to access the 'web of transportation' and thus to generate analytical insights on travellers' satisfaction and performance of the transport system (trends, deviations, …), based on the one hand on historical business data (e.g. service disruptions risk) and on the other hand on travellers' feedback.

Travellers' feedback on completed travel is collected by means of questionnaires. Integration with social networks will be an additional source of travellers' feedback. By listening to the travellers, transport operators will be able to adapt and improve their services, which will at the same time enhance the travellers' experience and customer loyalty.

Selected analytics can be accessed by the traveller through their Travel Companion (for example: average duration, risk of disruption, level of crowdedness e.g. at peak hours, chronic delays, etc.). Additional information from the internet (e.g. notifications from social networks, geo-referenced information for services, advice on particular events, weather data etc.) associated with a planned journey can also be used to allow the traveller to make an informed decision and also to enrich the traveller's experience.

Social reputation and travellers' reviews/ratings are especially important with regard to new transport options that work on a peer-to-peer basis such as BlaBlaCar, Uber and carpooling schemes. Other Business Analytics include for example operators' punctuality reports, general travellers' satisfaction scores etc. All these statistics may contribute to an overall sense of trust and reliability from the travellers' side.

Further steps and improvements

Thanks to the Business Analytics platform, travellers will be able to give feedback on the completed trip. It would be useful if user feedback could also be given *during* the journey.[17]

Giving feedback should be as easy as possible. A simple yes/no question, choosing a smiley face or a sad face, thumbs up or thumbs down, … are preferable over long questionnaires. Gamification and rewards could help to incentivise travellers to give feedback on the services.

In addition, it would be useful to provide the traveller with relevant information *after* the journey has finished, e.g. on lost property, how to file a complaint, how to claim a reimbursement, where to find extra information on passenger rights etc.

The after sales service must be improved and made more reliable. When buying a ticket for multiple legs of a multimodal journey, it should be clear who is responsible and whom the traveller should contact for a claim, e.g. in case of disruptions.

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[17] For example, Helsinki Regional Transport Authority has recently launched a pilot customer service based on instant feedback. The results are promising.

The IT2Rail Travel Companion and its components are meant to cater to various user groups that may have different needs and expectations about its functionalities. The (public) transport market can be segmented (i.e. carved up into user groups that have different needs and respond differently to proposed changed in the marketing mix) in many different ways, based on geographic, demographic, socio-economic, behavioural and/or psychographic variables.

Taking into account **gender** in transport is a fairly recent development. Statistics generally do not differentiate between men and women, which makes it hard to draw any conclusions on differences between men and women regarding their mobility needs. The ITF Discussion Paper *Gender and Transport* (Duchène, 2011) confirms that women are still more often than men engaged in domestic chores and taking care of others ("double working day") and that as a result, they make more trips (especially non-work related trips), in chains that are more complex and with a greater variety of routes, but within a more restricted geographical area than men. Women are generally also more dependent on public transport modes than men, as fewer women than men own or use a car. Finally, in their choice of transport mode, women seem to be more sensitive to environmental issues than men. Safety (on public transport and also at stops) is a more important issue for women, as well as accessibility (avoiding stairs, sufficiently wide doors etc., as women are often loaded with packs or have children with them, possibly in a pushchair).[18]

Considering differences based on **age**, mobility rates are lowest for children (12 and younger) and the elderly (even though also within the 65+ group, there are enormous differences from one person to another). Both are important target groups with a large share of 'captive' users. If young people are happy with their public transport experience, they are more likely to keep on using it as adults. Elderly people nowadays are often accustomed to car use and need to be attracted to public transport by familiarizing them with using their services and by adapting them to their needs and expectations.[19]

Children today are digital natives that will take up the Travel Companion as something taken for granted. The Travel Companion might be able to offer parents the option of 'tracking' their children while they are travelling alone, so that they can feel confident that everything is okay.

For elderly people, ease of use is crucial. In addition, comfort (available seating and toilets for example) and accessibility (low-floor vehicles, elevators in stations, but also for ex. information on walking distances at interchanges) are important issues and the Travel Companion could be of assistance here by providing information and filtering query results based on these needs.

It should be noted that, in spite of all the advantages of automatized digital services such as those developed within IT2Rail, there is still a share of travellers that prefer human interaction to machine-based systems. Especially in case of disturbances, or for planning a really complex trip, some travellers may prefer to speak with an informed staff member rather than to rely solely on an app. This is especially true for elderly people, partly because they value social contacts more, partly

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[18] Duchène, C. (2011). *Gender and Transport*.

[19] Fiedler, M. (2007). *Older People and Public Transport – Challenges and Chances of an Ageing Society*.

because of concerns with regard to safety and security (being alone in a station might cause discomfort) and also partly due to a lack of experience with electronic devices and ticketing.

Travel Companion functions, while relevant for all types of users, can be even more useful for **people with a disability**. It is important to realise that these people actually constitute a large and very heterogeneous group and that their requirements are very diverse.[20]

The needs of people with reduced mobility (onwards PRM) somewhat overlap with the needs of elderly people (in terms of accessibility), but on an increased level. People using a wheelchair or rollator, for example, need step-free access, dedicated wheelchair spaces, elevators to reach the platform, accessible toilets on board etc. With regard to navigation, the Travel Companion could give valuable assistance, especially to PRM, because it could inform about the availability and location of escalators, stairs, heightened platforms etc. It could also point out specific seating (e.g. dedicated spaces for wheelchairs). People with a visual impairment also need help to find the right platform and vehicle, for example by means of guiding lines, assistance by a staff member or – why not – the indoor navigation module of a Travel Companion. Finally, for both of these groups, information about temporary obstacles either indoor (e.g. stalls in the station blocking the way) or outdoor (e.g. construction works in front of the entrance to the station) is very relevant as well.

It is important to bear in mind that the tool or application providing this information has to be accessible as well[21] and that information should always be offered according to the 'two senses' principle. Deaf people or people with a hearing disability for example need visual or written information, whereas blind people and people with a visual impairment need information provided either in Braille (which not every blind person can read!) or audible format. Similarly, it should always be possible to contact a helpdesk or provide feedback in at least two different ways e.g. by phone or by chat.

People with a speech impairment or cognitive disabilities (e.g. intellectual disabilities, brain injury or autism) can also benefit from the TC services. For some of these people, it may be difficult to ask for information, to buy a ticket, to identify the right stop to get off, to find their way around in an unfamiliar station etc. It is therefore especially important that they are provided with information and instructions (e.g. for navigation at interchanges) that are easy to understand.

When providing personal information on PRM status and possibly assistance needed throughout the journey, passengers with a disability should be reassured that such information cannot be used to discriminate against them. People with reduced mobility have the right to travel like anyone else and can, in principle, not be denied boarding.[22] They are also entitled to assistance. The Travel Shopping could make this easier because currently, assistance has to be arranged separately for each leg of the journey which is quite complicated and time-consuming. Real-time information about the assistance (for ex. the next agent will be available in 10 minutes) could be reassuring for the person in question, needing this assistance.

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[20] IbGM (n.d.). *Survey on information for people with reduced mobility in the field of public transport – Final report.*

[21] Cf. https://www.w3.org/WAI/intro/wcag for an overview of Web Content Accessibility Guidelines (WCAG)

[22] Unless this is technically not possible or there are security concerns. For an overview on different transport modes: http://europa.eu/youreurope/citizens/travel/transport-disability/reduced-mobility/index_en.htm

People with **low incomes** on average travel less, and if they travel, the trip length is relatively short, which makes sense as there is little money to spend on transportation. Some people from the lowest income groups do own a car through necessity but struggle to afford it. At the same time, those on low incomes may be unable to obtain the biggest discounts on public transport fares as it is often necessary to pay large amounts in advance to purchase season tickets.[23] Low cost (public) transport options are necessary and an application such as the Travel Shopper could assist in finding the most attractive options, perhaps preferably post-paid. It is important to realise that a large share of people in poverty have access to a smartphone, because to them it is a lifeline to a new job, training, contact with family, access to services etc. Having no data plan in many cases, they rely on free Wi-Fi to access the internet.[24] This is one of the reasons that the Travel Companion should also be able to function in an offline mode (even though of course, real-time updates are then not possible).

Within Europe, **cultural differences** exist with regard to preferences and expectations that have to do with (public) transport. It is important to take into account these differences, on the one hand because immigration is an important development within Europe, and on the other hand because the number of cross-border, international journeys is continuously increasing. Actually, (recent) immigrants and tourists have some things in common, such as an increased need for understandable travel information and a comprehensive explanation of how the transport system works. In both cases, the Travel Companion could offer customised assistance, including translation services perhaps.

Finally, user needs may also vary according to **frequency of travel** and **purpose of travel**. Frequent travellers, for example commuters who do the same journey to work every day, will obviously not need to go through the same phase of planning their journey each day. They know the route and even if there is a delay or disruption, this will not be a major cause for concern – even though they still want to be informed about what's going on and when they will arrive at their final destination. The functionalities offered by the Travel Companion are much more important to occasional travellers who need help throughout all the stages of planning and booking their journey, buying and validating tickets. Also, for infrequent travellers, the need for assistance in case of disruptions is higher as they find themselves in an unfamiliar place not knowing what to do.

8. CONCLUSIONS

Seamless door-to-door mobility across Europe is one of the initiatives included in the 2011 Transport White Paper *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system* (2011). It is the core objective of IP4 (Innovation Programme 4) within Shift2Rail. "Smart mobility and services" is also identified as one of 7 priority areas in the EC's recent Commission Staff Working Document *Towards clean, competitive and connected mobility* (May 2017).

The speed at which some technologies such as the IF can be deployed, will to a large degree depend on the level of social acceptance. In order to achieve a modal shift and convince more people to use rail and public transport, the travellers must be re-located at the centre of the travel experience.

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[23] Titheridge, H. et al. (2014). *Transport and Poverty: A review of the evidence*

[24] https://www.gottabemobile.com/smartphones-poverty-welfare-truth/

Understanding their needs and expectations should be a central and continuous point of attention for all stakeholders within the transport industry.

Travellers' needs are evolving fast. They are increasingly 'connected' (especially, but not only, the so-called millennials[25]) and expect real-time information at their fingertips in just a few clicks: not just transport-related information but also other relevant information on 'ancillary services' e.g. events, social network notifications, journey statistics etc. Based on this increased connectivity, new 'platform-based' business models are emerging (Uber, BlaBlaCar etc.) that are putting end-users directly in contact with mobility service providers on a peer-to-peer basis – which in turn changes users' expectations with regard to (their interaction with) more 'traditional' transport operators such as railway companies as well.[26]

In existing literature, different models exist that aim to identify factors that are able to influence (positively or negatively) the adoption of new digital technologies[27], including, amongst other things: (perceived) usefulness and (perceived) ease of use, perceived risk, monetary value, habit, hedonic motivation and social influence. All of these factors will also play a role in the market uptake of the Travel Companion approach and, consequently, in the deployment and success of the "Web of Transportation".

The main advantage of the Travel Companion is its (perceived) usefulness: It simplifies life for the traveller by shielding them from the underlying complexity of different, non-integrated, fragmented information, payment, ticketing, validation etc. systems and procedures and it acts as an all-encompassing user 'front end' interface giving access to a large number of multimodal products and services. These services are not all strictly transport-related: The Travel Companion also includes external connectivity functions (i.e. it could be linked with other existing applications such as social networks, calendar and e-mail tools as well as additional information from the internet such as weather data, information on particular events etc.), which is relevant when considering that transport could be seen as a 'network' product: It doesn't exist as a purpose in itself, but gains (additional) value because of its connections to other products and/or services.

The most important factor that may influence market uptake of the Travel Companion approach is trust. Consumers will need to feel confident that they will really receive an overview of the best travel solutions, taking into account their preferences and needs. Reliability (of data, information) and transparency (e.g. how will the user's personal data be stored and processed) are the two main aspects that will determine whether a traveller will use the TC. The functionality of the Trip Tracker,

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[25] The term Millennials (sociology concept) is usually considered to apply to individuals who reached adulthood around the turn of the 21st century. The precise delineation varies from one source to another, however. Overall, the earliest proposed birthdate for Millennials is 1976 and the latest 2004. Millennials grew up in an electronics-filled and increasingly online and socially-networked world. Based on: http://whatis.techtarget.com/definition/millennials-millennial-generation

[26] The EC describes this evolution in the working document "Towards clean, competitive and connected mobility: the contribution of Transport Research and Innovation to the Mobility package": *"Younger generations are currently opting for reduced motorisation rates and modal shift away from daily use of the automobile and towards multi-modal shared, public and active travel modes. Overall, transport users are embracing digitalisation and the use of smart phones, mobile web applications and social media. These behavioural shifts are supporting new shared mobility and transport business models, services and markets, which collectively open new pathways to sustainable mobility"* (chapter 6).

[27] E.g. Davis (1989); Venkatesh, et al. (2003); Venkatesh, et al. (2012); Wang, et al, (2013); Pura, (2005); Slade et al. (2015)

by offering help and assistance during the travel – especially in case of disruptions – could also help to lower the perceived risk of embarking on a long distance multimodal journey.

In the main, the results achieved in IT2Rail are promising. However, an important limitation from a traveller's point of view is that currently, the IT2Rail use cases tackle only co-modal combinations of major transport modes. Further developments that introduce additional use cases and intermodal through-ticketing possibilities, covering also a wide variety of first and last mile solutions are welcome. Regarding passenger rights, the European Commission is currently examining options to better protect passengers in the EU when using multimodal transport. The outcome of this process should also be taken into account.

Finally, the involvement of the end-users, the passengers, is very important. IT2Rail has adopted a user centric methodology: It has based its engineering approach on a number of specific use cases, following the traveller throughout all the stages of a multimodal journey – in order to better understand the needs along the way and take them as a starting point. Involving the end-users, the passengers, is key in follow-up projects as well.[28] The Travel Companion and its components are meant to cater to various user groups (including for ex. elderly people, people with a disability, people with a low income) that may have different needs and expectations about its functionalities. In particular, such smart mobility services should also serve the social inclusion of those who are currently limited in their mobility.[29] Co-creation processes together with travellers are a good way of understanding their needs and expectations. Travellers should therefore be actively engaged in subsequent IP4 projects and called upon to actually test and evaluate the products and services that are being developed.

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[28] For example, in GOF4R (Governance of the Interoperability Framework for Rail and Intermodal Mobility), passengers (through EPF, the European Passengers' Federation) are highly involved to better understand the Users' Demand.

[29] SWD (2017) 223 final. *Commission Staff Working Document Towards clean, competitive and connected mobility: the contribution of Transport Research and Innovation to the Mobility Package*

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