

**Contract MOVE/C2/SER/2012 489/SI2.646722**

**AWT**  
**(All Ways Travelling)**

**Phase 2 - Proofs of Concept (POCs)**

**FINAL REPORT**

**Disclaimer**

This report was produced by the All Ways Travelling Consortium for DG Mobility and Transport (MOVE) and represents the Consortium's views on the matter.

The conclusions and recommendations are those of a consortium and do not assume to reflect in their entirety the position of the individual member organizations of the consortium.



The views expressed in the report have not been adopted or in any way approved by the Commission and should not be relied upon as a statement of the Commission or DG MOVE's views.




The European Commission does not guarantee the accuracy of the data included in the report, nor does it accept any responsibility for any use made thereof.

## Versioning and Content




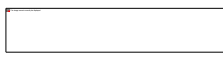
Version	Date	Author	Changes / Update
0.1	18.03.2016	Consortium	First version for EC
0.2	25.03.2016	Consortium	Conclusions and Recommendations chapters completed
0.3	07.04.216	Consortium	First update with EC feedback, add-on in Introduction chapter, inclusion of "response time issue example"  Update of "Specifications" and "Looking Forward" chapters, move demonstration chapter at the end of the report, add demonstration Q&A chapter  Additional Recommendation on dissemination / communication added to Looking Forward chapter – Recommendations section
0.4	27.05,2016	Consortium	Enrich section 1.1.5 and some ad hoc edits
0.5	13.06.2016	Consortium	Further clarification of section 1.1.5 topics and their relationships, including specific identification of topic related challenges; some minor modification to section 1.1.6, and correction of a formatting error in the Assumptions and Limitations Table in Section 2.1
1.0	06.07.2016	Consortium	Final review, grammar and typos corrections

## Contributors - Consortium Members:

Name	Company	Role
Jean-Marc Garzulino Svend Leirvaag Thomas Drexler Tom Jones Laetitia Dalmasso Edouard Bavoux		<b>Project manager</b> <ul style="list-style-type: none"> <li>✓ Overall project coordination and integration of Advisory Board</li> <li>✓ Ensure project/study goals are achieved</li> <li>✓ 2 Monthly Progress meetings with DG MOVE</li> <li>✓ On time delivery of Inception, Intermediate, and Phase 2 Final, Reports</li> <li>✓ Attendance at all meetings</li> </ul> <b>Technical Lead</b> <ul style="list-style-type: none"> <li>✓ Consolidate technical outputs</li> <li>✓ Schedule and control works</li> <li>✓ Documents technical decision making process</li> </ul> <b>Business Lead</b> <ul style="list-style-type: none"> <li>✓ Coordinate with regards the choreography of the Proofs of Concept and the messages they convey</li> </ul>
Isabelle Mancel Frederic Le Bris Xavier Letellier Laurent Laudinet Ricardo Mourão		<ul style="list-style-type: none"> <li>✓ Coordination of the POC2 (First and last miles) and POC3 (trip tracking) development and interfacing with POC1</li> <li>✓ Contribution to progress reports</li> <li>✓ Contribution to Inception, Intermediate and Final Report</li> <li>✓ Setup of POC2 and POC3 for demonstration purposes</li> </ul>

Mark Mallants		<ul style="list-style-type: none"> <li>✓ Content contributor : Rail booking/ticketing/settlement data and back end</li> <li>✓ IT contributor : POC1 Inter-modal and co-modal options</li> <li>✓ IT contributor POC3 real-time data feed for Rail and SMS engine</li> <li>✓ POC Demo Lead</li> <li>✓ Contribute to progress reports</li> <li>✓ Contribute to Inception, Intermediate and Final Report</li> </ul>
Juan Iván Martin Henry Coles		<ul style="list-style-type: none"> <li>✓ Share IATA e-Ticket and Interlining expertise</li> <li>✓ Share IATA BSP, TIESS, ICH knowledge</li> <li>✓ Validate current industry architecture potential extension to enable POC1 and final solution</li> <li>Contribution to Inception, Intermediate and Final Report</li> </ul>
Stefanos Gogos		<ul style="list-style-type: none"> <li>✓ UNIFE was part of the Phase 1 study but will kept up-to-date on progress of Phase 2.</li> <li>✓ <b>Not accountable anymore</b> but will kept up-to-date on progress and results of Phase 2.</li> </ul>

## Other contributors

Company	Contribution
	<ul style="list-style-type: none"> <li>✓ Company Logo provided on the courtesy of GVB for AWT demonstration purpose (Amsterdam urban leg)</li> <li>✓ Product catalog provided on the courtesy of GVB for AWT demonstration purpose (Amsterdam urban leg)</li> <li>✓ Business support provided on the courtesy of GVB for the AWT final report (project findings and looking forward topics)</li> </ul> <p>Following the formal agreement signed between GVB and Thales France, GVB name and logo used for the sole purpose of the AWT demo POC2 shall not be reused nor disseminated out of the AWT project.</p>
	<ul style="list-style-type: none"> <li>✓ Nokia Here's web-services for public urban transportation itineraries are used to perform the routing of the local segments, for both Amsterdam and Rome cities.</li> </ul> <p>Based on the formal agreement signed between Nokia Here and Amadeus, Nokia Here service has been used in this prototype, to demonstrate the local routing functionality.</p>
	<ul style="list-style-type: none"> <li>✓ Brussels Airlines kindly accepted to provide access to their test environment and simulate interlining with Rail and Urban Transportation entities included in this project, and to be named as external contributor</li> </ul>
	<ul style="list-style-type: none"> <li>✓ Public affairs and strategic communication support provided in preparation of the demonstration event</li> </ul>

## Abstract:

*All Ways Travelling is a consortium, responsible for a 3 year long project that was successfully awarded the tender of the European Commission (Mobility and Transport Directorate) to develop and validate a model for a multimodal pan-European passenger transport information and booking system.*

*The project is organised in two phases. The first phase (study) was finalised on July 11<sup>th</sup>, 2014. The second phase (development and validation of proofs of concepts) started on October 2014 and will last until March 2016.*

This final report covers the complete duration of the project. It comprises the following parts as described hereafter:

### **First part (Covering Phase 1 - already published)**

- The overall findings and recommendation (Executive Summary)
- The full study

### **Second part**

- A description of the 3 Proofs of Concept (POCs)
  - o Underlying methodology
  - o Project Engineering including: overall architecture, modules, components, links between the different company systems
  - o Detailed explanation of the flows
- Looking forward to complement the findings of the study and demonstrate the possibilities and benefits of multimodality.

A full version of this document is also available, describing in details how the POCs were implemented.

# TABLE OF CONTENTS

1.	INTRODUCTION .....	6
1.1.	<b>Underlying Methodology .....</b>	<b>6</b>
1.1.1.	Conceptual Framework for the POCs.....	7
1.1.2.	Evolution of the analysis for determining the POCs.....	8
1.1.3.	A customer-centric analysis of the 'As Is' and 'To Be'.....	9
1.1.4.	A 'reverse-engineering' approach to solutions .....	11
1.1.5.	Concluding remarks on POC determination.....	13
1.1.6.	Concepts being proved in the POCs .....	18
2.	PROJECT ENGINEERING .....	20
2.1	<b>Proof of Concepts summary: Three POCs to cover the full passenger experience .....</b>	<b>20</b>
2.2	<b>Engineering Management Plan.....</b>	<b>32</b>
2.2.1	Overall architecture.....	33
2.2.2	List of modules .....	34
2.2.3	Deliverables .....	36
3.	THE STORYBOARD.....	37
4.	POCS IMPLEMENTATION .....	47
	<b>Test strategy .....</b>	<b>47</b>
	<b>Integration strategy .....</b>	<b>48</b>
4.1	<b>POCs Design.....</b>	<b>48</b>
4.1.1	POC1 Design .....	48
4.1.2	POC2 Design .....	53
4.1.3	POC 3 Design .....	59
6	LOOKING FORWARD .....	62
6.2	<b>Conclusions.....</b>	<b>75</b>
6.3	<b>Recommendations.....</b>	<b>82</b>

## 1. Introduction

Following Phase 1's study on the framework conditions for a European passenger transport information and booking interface across transport modes, we have reached some key preliminary conclusions and we presented a set of recommendations for future action of the European Commission based on the academic research.

In Phase 2, we aim to implement/develop a multi-modal eco-system allowing a European citizen to purchase a trip from his home city to another European city, sending him his travel details, accompanying him during his trip, and ensuring payment and settlement.

Before describing how the project went about designing and implementing the Proofs of Concept (POCs), the obstacles that were confronted and the workarounds used, it is important to describe the underlying methodology on top of which the AWT analysis was built.

It is also noteworthy that the analysis for determining the POCs underwent some evolution between the AWT tender stage (28<sup>th</sup> September 2012) and the final POC demonstration in phase 2 (26<sup>th</sup> February 2016 – NS centre, Utrecht).

Over this period, of course, AWT phase 1 delivered the Study on the framework conditions for a *European passenger transport information and booking interface across transport modes*, which the Study referred to as 'MMITS' (multimodal information and ticketing system). Findings and recommendations from the study were instrumental in influencing the evolution of the POC approach: from an initial Tender proposition of alternative POCs from which the Commission was invited to make a choice, to a proposition to demonstrate both alternatives. This evolution also deserves some explanation, in order to ensure that the reader understands the logic for the inclusion of the different concepts deployed in the implementation and final demonstration of the POCs.

### 1.1. Underlying Methodology

The methodology used to couch the POC analysis consisted of defining:

- A conceptual framework for the POCs based upon an analysis of the contextual and specific requirements of the Commission for the contracted work.
- A customer-centric analysis of the 'as is' supply chain of travel products and services compared to the 'to be' supply chain capabilities (functions) associated to the Commission's vision as laid out in the 2011 White Paper on Transport, to construct an inventory of customer 'pain points' for the search, purchase, and execution of a multimodal travel plan, that need to be addressed.
- A 'reverse-engineering' approach to the positioning of the POCs as 'techno-conceptual' enablers to shed light on the possible steps in between the 'as is' and the 'to be' i.e. for X, or Y, function of the 'to be' vision to exist, what are the logical prerequisites in terms of supply chain capabilities which need to be facilitated? And what does the adoption of these new capabilities mean for the different supply chain links in the 'as is' environment?

### 1.1.1. Conceptual Framework for the POCs

The AWT tender outlined some 'key thematic drivers', in promotion of its bid, which were designed to answer to the perceived contextual requirements of the Commission when it took the preparatory action to publish the original Call. Some of these (as listed below), provide the conceptual framework for the POCs, from the methodology perspective.

**Focus on Traveller Experience (customer-centricity):** multimodal travel must be rendered easy and attractive if the associated benefits (Commission objectives) for the economy, social well-being and the environment are to be reaped. In other words, demand or 'market pull' at the customer end of the supply chain, has to be aligned (in terms of direction and strength) with the institutional 'push' envisaged by the Commission, for the overall operation to succeed and remain sustainable.

N.B. the concept of 'market pull' is potentially misleading: this should not be equated necessarily with what customers actually demand, but probably more with what they will accept with 'open arms'. Customers are not necessarily the best source for articulating what they would prefer to have (the 'to be') in overall functional terms, since their expectations tend to be as well conditioned by the current 'as is' (current way of how things are done or supplied) as their supply chain links normally are. This makes 'out of the box' thinking difficult: customers tend to limit themselves to identifying faults in current processes (the arrangement of the delivery of current 'as is' functions) than with articulating their need for new functions, which, in turn, would suggest what new processes may be required. The 'market-pull' concept is probably, therefore, better defined as the 'pull' of a vacuum which is experienced only once someone starts trying to fill it. Did anyone ask explicitly for the paper-clip? The hyper-market (one-stop shop)? The internet? No, but the vacuum pressure (the market-pull) to consume these phenomena, has been critical, indeed all-determining, for their success. We believe that the 'multimodalisation' of the current quasi-silo individual transport markets, essentially an exercise in macro market-engineering, falls into this category of phenomena.

**Continuity with the Past and Future:** that, despite the project being 'stand-alone' from a purely funding perspective, the POCs needed to be part of the past in terms of building on previous research/initiatives/practices, and, even more importantly, part of the future in contributing bridging concepts and inputs to relevant projects and initiatives currently anticipated. The consequences of this, cannot be underestimated: it meant that the POCs could not be designed as 'ivory-tower-conceived' technical blue prints for the White Paper vision. This would have been a methodological error. The POCs needed to be designed as extensions of technology concepts which were already 'embryonic' in today's transport market landscape, and whose accumulated and 'assisted' evolution could establish those capabilities identified as pre-requisites for the functional characteristics of the target 'to be' multimodal market.

*It is worth pointing out at this stage, that the 'assistance' required involves not only project-level funding, but a meta-level coordination of the short to medium to long term funding and call strategy around multimodality within the Commission: in short, a road-map with certain specific outcomes proposed as 'deliverables' over the long term. This theme returns in the Final Report conclusions and recommendations sections in chapter 6 below. The absence of such a road-map or, more accurately, the coordination and thinking behind it, risks a series of unlinked research/innovation efforts, which, could easily fizzle out through lack of traction.*

**Market ‘Take-up’:** this theme was more implicit, than explicit, and was carried in more than one ‘key thematic driver’ within the original tender: it combined the concepts of ‘**Quick Wins**’ and ‘**Protecting investments**’ which are ultimately about reducing the height of the investment bar for market players, and sustaining a longer term transformation.

In terms of the POCs this works hand-in-hand with the ‘Focus on Traveller Experience’ as described above. If the demand side of the equation exercised a ‘market pull’ then this would only be effective insofar as most links in the supply chains considered that the promise of additional business and revenues outweighed the costs of implementing the corresponding technology. The emphasis on ‘protection of revenues’ had, as rationale, the principle of ‘re-use where possible’, and is considered a key attribute for the methodology in designing the POCs. This translates directly into the willingness or propensity of the market to implement what research can only demonstrate, and is ultimately the yardstick by which Commission interventions could be measured.

**Conceptual Framework post-script** - although not directly linked to the determination of the POCs themselves, the original AWT tender did reference another thematic driver: ‘**Coopetition**’ as a term to describe the behavioural outlook that should probably inform industry stakeholders on the path towards multimodality : it tries to capture the idea of ‘collaborating in order to compete’ and might apply equally to participation in the steps to develop the necessary technology on equal terms with ‘competitors’ from other modes, as well as to the actual business strategies required to satisfy the end-to-end trip requirements of a customer in a multimodal / D2D market place. The importance of this point is that its prerequisite would appear, logically, to be a positive appreciation of the business opportunities that a multimodal market-place presents. Here, for example, we might imagine what business opportunity is sufficiently visible to motivate the collaboration required with other modes/operators to design ‘intermodal products/services’ as might be captured on an intermodal or integrated ticket. As the AWT Study suggests, when observing the lack of ‘visible’ data on multimodal passenger flows, this element is severely lacking, and therefore constitutes one of the non-technological barriers to success. Again, it is a theme that we shall return to in Chapter 6 – ‘Looking Forward’.

### 1.1.2. Evolution of the analysis for determining the POCs

In sequential terms, of course, the methodology was not fully deployed until more detailed planning of the POC phase was undertaken, and the findings of the Study were known. The conceptual framework for the POCs was already in place at time of tender but the POCs, as conceived at that time, were proposed as a choice between two alternatives: a POC set devoted to ‘comodality’<sup>1</sup> versus a POC set devoted to ‘intermodality’<sup>2</sup>. The tender suggested that the Commission should make a choice at the end of Phase 1 of the project when the findings of the AWT study were known.

---

<sup>1</sup> Comodality represents one form of ‘multimodality’ where the distribution or retailing link in the supply chain concatenates separate Transport Service Provider (TSP) segments in order to construct a travel solution for the customer. It is characterised by multiple tickets/transport contracts and, normally, multiple payments. None of the participating TSPs are aware of the involvement of the others.

<sup>2</sup> Intermodality represents the other form of ‘multimodality’ where the Transport Service Providers agree to combine their services into a single offering and single transport contract. It is characterized by a single



It is apparent that at the time of the tender, discussions often turned around which approach to multimodality (co-modal or inter-modal) was ‘preferable’, as if this was simply a matter of choice (possibly also influenced by budget available for the 2<sup>nd</sup> phase).

As a result of the Study and deeper analysis, still based upon the conceptual framework for the POCs, the consortium came to see that the market place (even today) exhibited both ‘comodality’ and ‘intermodality’ and that rather than representing two alternative or mutually exclusive approaches to multimodality, they represented, more accurately, the competitive and collaborative elements of a single marketing strategy which might contain them in different proportions depending on the overall business strategy of any individual Transport Service Provider. As such, the consortium’s recommendation to the Commission was that both should feature in the POC demonstration.

### 1.1.3. A customer-centric analysis of the ‘As Is’ and ‘To Be’

This piece of the analysis, a critical piece of the methodology, is based upon a comparison of the functions belonging to the ‘to be’ vision with the ‘as is’, from a customer perspective, in order to produce a high level inventory of customer ‘pain points’. The exercise is conducted by comparing how a customer might satisfy their end-to-end trip requirements (from shopping-thru-purchase-thru-travel) using the ‘as is’ processes with how the equivalent would be achieved using the ‘to be’ processes as implicit in the White Paper vision.

The resulting inventory provides a ‘check-list’ of pain points which are theoretically solved (by the ‘to be’) and which therefore produces a more detailed list of ‘to be’ solutions. This then provides the input for a second step analysis (as we shall see) identifying the nature of the ‘to be’ solutions: i.e. whether such solutions are completely technology-based, completely non-technology based, or whether they demand complementary technology and non-technology solutions.

It was clear that for the objectives of the Commission to be met, the analysis behind the POC design should be informed by reference to today’s customer experience of shopping, purchasing, and executing, a resulting multimodal travel plan. Solutions, technology-based or otherwise, that did not directly address the customer pain points, would have little chance of long-term sustainability, and therefore little chance of attracting the engagement of stakeholders in the varied transport supply chains.

The following table summarises this first step analysis:

---

Intermodal or Integrated Ticket and one ‘thru-fare’ payment. The TSPs are aware of each other’s participation and communicate (interoperate) the consumption of their individual segments to the lead Intermodal partner who carries financial responsibility for the entire travel solution itinerary.

Area	Shopping reality of today	Effort - Pain Point	Risk - pain point	Solution
Search	I have to visit several sites in order to plan my trip from door to door.	I have to imagine what possibilities may be available in terms of different modes and routes. I have to guess or research how long it takes to make the transfer between different modes in order that my plan is 'feasible'.	I risk not being aware of potential solutions which may be cheaper, quicker or otherwise superior with regards to trip attributes which are important for me. I risk underestimating or overestimating the connection times between modes, meaning that I may either put myself in difficulty during the trip or I miss perfectly feasible combinations leading to a far longer trip duration than was otherwise necessary.	Provide a comprehensive multimodal D2D journey planning service which delivers a comprehensive choice of feasible Travel Solutions tailored to the traveler's personal preferences.
Purchase	Even if I can access a one-stop shop for travel planning purposes, I am redirected to several sites in order to effect booking and payment.	I have to navigate several sites, which is very time-consuming, and I have to reenter payment information and personal details multiple times.	Due to the time taken to make each individual purchase, one of the component parts of my travel plan may no longer be available once I try to purchase it. This is particularly risky from a financial perspective if I have just purchased cheap fares pertaining to other parts of my trip which are, consequentially, non-refundable or carry a cancellation penalty.	Provide a one-stop shop for the booking and purchase of any feasible Travel Solution offer selected, which ensures the traveler does not end up with a partially purchased trip.
Urban Ticket Delivery considerations at Purchase Time	After purchasing the Urban Transit segment I might receive, at best, multiple tickets to print, but also, sometimes, multiple smart cards or fare media corresponding to the different urban transport operators involved in my trip: which I will have to keep, store, remember to take, and not lose! Also, I prefer that I have the flexibility to use these tickets beyond the entitlement purchased when using the city transport system at my destination.	It is still my responsibility to provide the transport operators with the proper ticket and fare media in use within the operator ticketing system  It's an inconvenience to have to receive, keep, store, remember to take with me, and travel with multiple 'tickets', making sure not to lose any of them.  I really need full flexibility of using the city transport system when I arrive: not to have the effort of queueing up for additional tickets during my stay: otherwise I might as well buy everything I need as and when I want it once I arrive.	Should I forget, misplace or lose one of the fare media used (smart card or smart paper ticket for example), I am at best delaying the rest of my trip in order to acquire another support for my travel entitlement, or worse: I am unable to use the transport network of the operator putting at risk my overall trip.  The risk in pre-purchasing urban tickets is that I cannot accurately forecast my usage: it may have been a waste of my time to buy something up front, only to find I could get a better deal once my plans involving city transport are more defined when I arrive. On the other hand I don't want to pay additionally up front for entitlements which ultimately I might not use. Either circumstance risks a small financial loss.	Provide a common architecture enabling "open loop" ticketing. In an open loop ticketing system, the transport operator ticketing system is no longer the fare media issuer but relies on an external issuer. Such system allows the traveler to reuse a fare media from one operator to another. Incorporate a fare media which will allow travel in excess of prepaid entitlement.
In-trip considerations at Purchase Time	In the main, apart from urban transit where services are frequent and intermodal flexibility is optimised due to comparatively lower fares and no advance booking requirements, I am obliged to purchase my travel entitlements under individual and separate transport contracts.	Once I am travelling, should one of the planned services be delayed or cancelled, I will either have to calculate if a subsequent service will still get me to my next connection on time and/or research alternatives. These circumstances involve me in a lot of additional work making new calculations, researching and purchasing alternative travel arrangements, as well as pursuing complex or time-consuming refund procedures to be reimbursed for any tickets which I can no longer use.	If my trip is split in multiple transport contracts, it means no one entity (apart from myself) is responsible for guaranteeing arrival at my final destination. If I am a victim of a disruption in the planned services, then in addition to the effort and stress which I risk, I also risk overall financial loss if tickets I have purchased, but which I can no longer use, are non-refundable. Furthermore, re-arranging the travel myself, risks to be less than optimal, carrying the further risk that my final arrival time may be too late to satisfy my trip's original purpose: as such I may have to abandon the trip, incurring potential further expense to return to my origin as well as not having achieved the purpose of my trip.	Provide a common architecture to support Intermodal* Travel services (responsibility for arrival offered under a single transport contract). For co-modally* purchased services (and in any case) boost confidence by providing a Trip-Tracking service to automatically analyse the impact of any service disruption on the traveler's full multimodal itinerary and provide an appropriate Travel Insurance service at time of purchase.

\* See Glossary on Terminology for definitions of Intermodal and Comodal.

#### 1.1.4. A 'reverse-engineering' approach to solutions

In this second-step analysis, the 'outcome' defined solutions from the first step are analysed in reverse, to identify different pre-requisite technology choices, together with their pros and cons, in order to feed a decision on what to include in the POCs.

N.B. of course, it is important to distinguish between choices made for the AWT POCs (which are governed by different constraints) from choices made for the completion, for example, of a meta-Road Map to facilitate the production of a short-to-long-term funding and call strategy, although clearly the former ought to be designed with 'usefulness' for the latter in mind.

This second step analysis is illustrated in the following table, using the list of solutions from the previous step as input.

Solution	Technology choices	Challenges : Pros and Cons	POC choice
Provide a comprehensive multimodal D2D journey planning service which delivers a comprehensive choice of feasible Travel Solutions tailored to the traveler's personal preferences.	(1) Acquire / Build a concentrated repository of Travel Data accessed by a centralised multimodal journey planner (2) Manage distributed Travel Data and distributed journey planning expertise via real-time calls to Travel Experts (3) Use a combination of the centralized and distributed data access choices with a cache mechanism to improve performance on distributed data access	(1) Appropriate 'middle-ware' required to master different data formats; reluctance or cost-constraints for some Travel Service providers to provide data feeds; inappropriate for certain types of data such as prices which may be calculated dynamically by some Travel Service providers; performance in time-response, however, is guaranteed due to 'preparation' of Travel Data in a coherent format and being locally accessible. (2) Appropriate 'middle-ware' required to master different data formats; Performance issues for returning results in acceptable time frame if handling everything via external calls AND invoking specialized 'middle-ware' to handle different data formats in real-time; (3) Appropriate 'middle-ware' required to master different data formats; a cache (fed periodically and opportunistically from external calls) to optimize local data accessibility and format translation, whilst minimizing external calls : to guarantee both comprehensive Travel Data and acceptable response times.	Option (3) without cache  (cache too expensive for small amount of distributed data to be used for the POC demo...but should apply to a production equivalent)
Provide a one-stop shop for the booking and purchase of any feasible Travel Solution offer selected, which ensures the traveler does not end up with a partially purchased trip.	(1) Provide a booking, payment and ticketing orchestration service to handle multiple and parallel transactions with the relevant Travel Service Providers: the service automatically rolls back any successful transactions should one transaction fail. (2) For Intermodally offered services, treat all Travel Service Providers as if they were single mode, from shopping through to settlement.	(1) For the aggregator/distributor - very heavy managing the full range of Interoperability issues: substantial effort required to master all modes, and, for certain modes, all operators or cities (urban transit) within that mode. There remains the difficulty of infrastructural settlement arrangements for transport operators being sold outside their domestic market. Furthermore, this choice cannot deal with Intermodal Travel products, where operators must be connected to manage Travel Entitlements. (2) Eliminates all Interoperability issues : Global standards exist for Airlines, and many examples exist of Air-Rail, Air-Bus, which effectively use those global standards, but it effectively puts up far too heavy cost-barriers for most operators belonging to long distance modes (requiring booking as well as ticketing). Similar arrangements exist today between Rail and Bus / Urban Transit but tend to be based on proprietary solutions belonging to the dominant Rail provider.	Option (1) to deal with a co-modal example; and (2) to demonstrate the 'principle' of a common Entitlements Management architecture for an Intermodal example.
Provide a common architecture enabling "open loop" ticketing. In an open loop ticketing system, the transport operator ticketing system is no longer the fare media issuer but relies on an external issuer. Such system allows the traveler to reuse a fare media from one operator to another. Incorporate a fare media which will allow travel in excess of prepaid entitlement.	(1) Provide an unified fare media with multiple transport application (2) Enable the use of an external card (EMV bank card) as a fare media within the urban ticketing system. Implement a ticketing scheme based on read only fare media holding only an identifier (3) Provide a post processing ticketing process supporting Pay As You Go transport usage.	(1) This limits the number of fare media a user carries at a given time. (2) The Post-Paid type of product allows the traveler to seamlessly use the transport network outside the planned trip. (3) Such technologies (EMV and "Pay As You Go ") induce a financial risk for the transport operator that needs to be mitigated by an agreement with the banking actors of the EMV eco-system to have the EMV actors support part of the financial risk.	Option (2) and (3) with the use of an EMV bank card as a fare media and Pay As You Go usage on top of a regular pre-paid transport product.
Provide a common architecture to support Intermodal* Travel services (responsibility for arrival offered under a single transport contract). For co-modally* purchased services (and in any case) boost confidence by providing a Trip-Tracking service to automatically analyse the impact of any service disruption on the traveler's full multimodal itinerary and provide an appropriate Travel Insurance service at time of purchase.	(1) Provide a 'thin' but common architecture at the level of Travel Entitlement Management only (leaving current shopping, booking, payment and ticketing processes in tact) to encourage creation and distribution of Intermodal Travel. (2) Provide a Trip Tracker Service capable of merging realtime travel service information from different modes in order to analyse and notify impacts on the traveler's multimodal itinerary (3) Include in the purchase of co-modal travel products, a Travel Insurance scheme, to protect the traveller against financial loss.	(1) This optimizes choices (1) and (2) from the one-stop-shop (above) in terms of tackling interoperability issues (an obligation for aggregators with regards to co-modally offered services) whilst it would significantly lower the cost-barrier for Transport Service Providers to participate in creating and distributing Intermodal Travel solutions. (2) The challenge is to match real-time info with the affected traveler itineraries, and manage connection time analysis between different modes in the itinerary. (3) An insurance policy purchased for protection against financial loss for comodal services disrupted during travel, should additionally increase the confidence of the traveler to make this type of purchase prior to travel	Within the allowable budget choice (1) was adopted for urban, but was too costly to apply equally to Rail (full legacy version deployed) AND choice (2) will be provided, whilst choice (3) remains a possibility, budget and time permitting.

### 1.1.5. Concluding remarks on POC determination

The application of the AWT methodology achieved the following results:

1. A target set of technology choices to implement in order to deliver and demonstrate the POCs
2. A list of key topics and related challenges that eventual implementations of the solutions, or their equivalents, in the market place, would need to take care of, or which would require resolution by non-technology means.
  - **Interoperability Challenge:** that the business applications of a critical mass of European travel and transport industry players are able to interoperate so as to provide the customer with comprehensive information on available transport options and the corresponding processes for their booking, payment, ticketing, consumption, modification, and, more exclusively for the business partners (e.g. transport providers, retailers, distributors), their financial settlement.

The interoperability topic and challenge is essentially comprised of a number of sub-topics and related challenges:

- **Standardisation Challenge:** that the distribution mechanisms within both Transport Undertaking and Third Party retailing channels are able to handle the implementation of the necessary standards in a reasonable time-frame, and at reasonable cost, for the Interoperability challenge to be met. Distribution mechanisms feeding Third Party retailing channels have a comparatively far tougher challenge than Transport Undertaking distribution mechanisms feeding their own retailing operations, since customers expect comprehensive coverage / content from a Third Party retailer, whilst a Transport Undertaking retailer is unlikely to offer transport products/services which are in direct competition with its own (even if retailing complementary transport services provided by its business partners). The current proliferation of standards (industry, open, proprietary) both across and within transport modes, makes this challenge somewhat unsurmountable without the introduction of either new, and more universally accepted, standards, or the introduction of meta-standards e.g. as offered by semantic web technologies via which currently different standards for similar processes may be mapped/resolved. It may be observed that new standards, such as may emerge from transport sector initiatives such as TAPTSI and Full Service Model (FSM) for Rail, or the Smart Ticketing Alliance (STA) for the urban public transport sector, are complementary to meta-standard efforts such as currently pursued in Shift2Rail IP4, since they reduce / converge the number of standards requiring to be mapped by the meta-standard. Opportunities also present themselves for the introduction of new standards to cover intermodal business processes where no such standard exists. In particular, the issuance of a single integrated multimodal ticket, and the interoperability required between the relevant transport undertaking partners to manage the exchange of passenger consumption data for its composite travel entitlements, is an obvious shortfall which needs addressing. But equally, a standard for the third party retailing of public transport services is another.

Within the scope of the All Ways Travelling Proofs of concept, the standardisation challenge was contained due to the very small number of implicated transport providers: one public transport content aggregator (Thales) representing 2 public transport authorities (Amsterdam and Rome), two content aggregators (AccesRail for intermodal, and BeneRail for comodal) representing one Rail Operator (SNCB) and one content aggregator (Amadeus) representing one Airline (Brussels Airlines). Nevertheless, the efforts to implement missing interfaces between the shopping and booking engine (Amadeus) and Public Transport (Thales) and comodally retailed Rail (BeneRail) took a major share of the available budget. Otherwise, existing interfaces were used, whilst the IATA e-ticketing interline standard (nominally for interline air travel) was used and adapted as the Integrated Ticket standard and associated travel entitlement consumption management.

The Standardisation Challenge is clearly a technology challenge in one sense, but also one requiring a high degree of collaboration between industry players both within and across sectors. Whilst there are reasons for optimism at transport sector level without direct intervention by the Commission (e.g. FSM and STA) it is difficult to imagine similar efforts across transport sectors without it. Hence, significant funding intervention such as the IP4 multimodal passenger services component of the Shift2Rail Joint Undertaking, bringing together industry players from the different sectors, is critical.

The Standardisation Challenge is, itself, composed of sub-topics and related challenges:

- **Accessibility<sup>3</sup> of Travel Data and Processing Challenge: that travel data (timetables, tariffs, service availability, real-time schedule change, PRM (persons with reduced mobility) facilities, and carbon footprint indicators) relating to all European transport operations, as well as corresponding booking, payment and ticketing processes, are 'accessible' on a non-discriminatory basis i.e. there exists an access method / defined service, for third parties. Note that, as recommended in the All Ways Travelling study (phase 1), the scope for Commission intervention should distinguish between travel data and processes concerning publicly owned or contracted transport services, on the one hand, and travel data and processes concerning purely private transport services, on the other. The latter is recommended to be left to the market-place and the individual business/distribution strategies of those private concerns.**

---

<sup>3</sup> Accessibility in this context means that a data or processing resource has a service or access method defined for data retrieval or process invocation.

In-scope intervention may address technical advice, guidance and direction and/or funding where financial obstacles exist. However, the Accessibility Challenge also incorporates the Data Availability topic:

- **Availability<sup>4</sup> of Travel Data and Processes Challenge:** that all relevant European travel data and processes are ‘available’ meaning that data is stored in a structured manner, related processes defined, and that there is a willingness to share with third parties. Obstacles in this area relate to data which is not stored in a structured manner (and therefore incapable of being made accessible) – examples could be PRM facilities or carbon footprint data in the urban Public Transport sector. Equally, travel data and processes which are restricted to the relevant transport undertaking retail operations only, mean that for the purposes of the white paper vision on transport, these resources are effectively unavailable. Once again, the scope for intervention by the Commission should be limited to travel data and processing concerning publicly owned or contracted transport services.

The type of intervention may be regulatory, but can contain suitable support in the form of technical advice and funding for structured data collection and storage, and the adoption of a Third Party retailing policy by relevant public transport authorities.

- **Shopping Response Time Challenge:** that the customer experience of a single integrated multimodal travel market-place should not be compromised by unacceptable response times when shopping for travel solutions which draw upon a vastly augmented pool of European Transport services.

This ‘issue’ is revealed in the discussion of the architectural choices behind the ‘comprehensive multimodal D2D journey planning service’: a centralised architecture vs. a distributed one (and any hybrids in between) underpinning the potential ‘to be’ supply chain configurations. Clearly, and at first glance, a centralised architecture where the objects to be searched are centralised locally (to the search engine) makes for a far more efficient performance in terms of response time. But this is not necessarily consistent with the conceptual framework of the POCs in terms of principles of re-use identified in the ‘Market Take-Up’ theme/driver. Different historical factors playing across the different sectors of the industry have bequeathed an overall uneven patchwork of resources (data and data

---

<sup>4</sup> Availability in this context refers to the fact that data exists (i.e. it is stored in a structured manner), its related processes are defined, and that the owner of both data and related processes is willing to share them with third parties.

processing expertise) which, in its imperfect ensemble, is a de facto hybrid of centralised and distributed architectures: suggesting that pragmatic hybrid solutions, for addressing multimodality in total, have a far greater chance of success for the long-term, since they will be future-proofed against factors which may push the market, or its component sectors, towards further centralisation, or, on the contrary, towards the further distributed nature of these key resources. The management of response times across the supply chains is something which has to be de facto handled, whatever the architectural configuration, and there are multiple technologies that can be deployed to assist. As such, response time, is not so much an issue, as a 'factor to be handled' in all cases, knowing that the digital market-place will be the best arbitrator of successful solutions, rather than any prescriptive top-down architectural imposition which could be dreamed up. Nevertheless, this report tracks the reflections and choices made through the POC specifications steps, considerations looking forward, and conclusions.

- **Comodal 'roll-back' capability Challenge:** that the customer experience of the one-stop shop capability is not compromised, in the case of comodal retailing of transport services, by partially purchased travel solutions.

As part of the solution to ensure that the one-stop shop capability does not leave customers with partially purchased travel solutions when creating the possibility for the advanced purchase of all comodal itinerary segments, the consortium paid attention to the problem of contextual processing during the booking-payment-ticketing (contract establishment) step. If advance purchase (see 3. Principal hypothesis behind the POCs, below) versus purchase 'on the fly' is considered a key factor in the choice of more environmentally friendly modes of transport, then this aspect is critical for consumer uptake (alongside other important considerations regarding the risk of service disruptions during the trip : see 'Passenger Rights' in this current list of topics). If parallelisation of booking-payment-ticketing step dialogues with multiple travel service providers is a way to optimise performance in terms of response time, a technical strategy to avoid a mixed bag of 'results' (in terms of success / failure) needs to implement the equivalent of an UNDO function. Whilst this conjures up some complexity in terms of the 'commit' part of the dialogues supported by different transport providers, it was also apparent that Customer Preferences may also play a key role: a customer may not want to UNDO longer distance bookings, if the only failures are occurring within first or last mile purchases, for example.

- **Multimodal Passenger Rights Challenge:** that both comodality and intermodality are supported in the market-place so that customer perception of the respective risks is reduced to a level which does not mitigate against the advance purchase of multimodal travel in general.

It looked much more likely that a minimum set of multimodal Passenger Rights, at a regulatory framework level, could be defined to support the passenger in the face of intermodal products and services, where intermodal partners normally market a guarantee



for arrival at final destination with appropriate compensatory features for delays, missed connections and involuntary re-routing. However, the multiplicity of customer transport contracts characterising comodally retailed transport segments, presents a far greater difficulty on the legal front, since each contract only guarantees arrival at destination of the current itinerary leg: likewise, rights to compensation for delays due to missed connections are difficult to assign when the transport provider has no knowledge of subsequent connecting transport arrangements, which any service disruption may threaten. Should legal research into the possibilities confront a dead-end, it might make sense for the Commission to pro-actively encourage new Travel Insurance products, designed to compensate for missed connections, whilst passenger access to a Trip Tracking service ought to take care of invoking the process of alternative travel planning where a service disruption is identified as breaking the overall passenger itinerary.

- **Complexity of the urban transport network Challenge: that the integration of urban public transport, with long distance transport segments, does not exponentially increase the number of possible Travel Solutions available to the customer.**

When analysing the integration of urban transport with longer distance modes, the consortium had to confront the fact that attempting to treat each 1<sup>st</sup>, middle, or last mile, in the same way as long distance (Air or Rail) was handled, would be problematic: the simple fact that the combined number of bus-stops, metro stations, tram-stops, or urban rail stations in any single city probably outnumbered the global number of airports, and probably the number of mainline rail stations within any one country, risked to raise the overall complexity of returning valid travel solutions to unmanageable proportions, simply in terms of the exponentially increased number of journey plans that could be output. In terms of the number of potential urban products that would cover any point-to-point urban itinerary, when placed within an already complex longer distance mobility query involving multiple long distance modes, the choice was too great. The consortium considered that one solution to this was to minimise the choice of urban products/services to the zonal level of travel passes that would entitle the passenger to travel anyway they liked, and which would be valid for the length of time of their stay in that city before departing. This encourages the concept of urban products and services which are designed for the intermodal-intercity passenger (although these could easily overlap with products and services currently existing for city dwellers, at the level of zonal travel passes of differing periods of validity). The consortium decided that where door-to-door addresses were supplied in any mobility query, it would be sufficient for the urban transport provider to identify the zones required to cover any point-to-point urban itinerary, and to propose an appropriate 'Pass' type product. This would not prevent journey-planning proposals to be supplied, for example by Nokia HERE, to the passenger as an information on how to optimise best usage of such a product, without multiplying the number of actual travel solutions presented to the customer for selection for purchase.

- **Geolocations Challenge: that multiple sectoral references/codes for the same 'location' plus dynamic network topographies at urban public transport level, do not prevent the**

### **effective combination of different sector journey planning, when resolving customers' mobility queries.**

Linked to the previous topic of urban transport network, the consortium took on board the general problematic that in a multimodal scenario, the number of references used for any one particular infrastructural 'stop-point' were multiple (at least one per intersecting transport mode). The capability of mapping between these references needed to be guaranteed if solutions from sectoral journey planning experts were to be combined effectively. However, it was clear that whilst airports, main stations (rail or bus) or metro references would remain fairly static, urban networks could be fairly dynamic with routes and intermediate bus-stops for example changing comparatively regularly, as de facto physical topographies evolved with the ebb and flow of urban planning, road-works, one-off events, diversions etc. The consortium considered that geo-coordinates therefore should remain dynamically derived by the 'experts' mastering them from real-time information today, whilst a mapping between the static references for more permanent infrastructural constructions, could be relied upon to ensure that modally different journey-planning experts could be combined to produce multimodal itineraries.

Despite this general approach, the consortium, as the reader will see, ran into some difficulties sticking to this principle: including the need to hard-code some geo-coordinates (identified as a specific problem associated with the specific architectural infrastructure of one of the partners, rather than a generic issue for the industry) as well as the need to create dummy location codes and corresponding operator codes in order for the Air-based booking and settlement engines to manage the inclusion of urban public transport. Neither aspect was regarded as a show-stopper, although it meant adaptations for Amadeus and IATA for the POCs, but it does highlight the need for a more systematic approach for a longer term and production-level implementation.

### 3. [Principal hypothesis behind the POCs:](#)

AWT's overall objective in the POC phase of the contract is to demonstrate a number of technology concepts which would facilitate the transformation of today's fragmented transport systems into the single, integrated and seamless European Transport System envisaged in the 2011 white paper on Transport.

The principal hypothesis behind our POCs is that, insofar as the shopping and purchase of multimodal travel can be made comprehensive, seamless, effortless, and risk-free, then the proportion of multimodal travel which is planned and purchased 'in advance', rather than 'on the fly', will increase significantly. We further believe that such an increase in 'prepaid' multimodal travel will naturally contribute to a significant modal shift towards more environmentally friendly combinations of transport mode than currently occurs with 'on-the-fly' purchase, today

### 1.1.6 Concepts being proved in the POCs

**Interoperability** – can be achieved without necessarily requiring the willingness or capacity of travel service providers to migrate to a new standard (indeed, meta-standards may be more fruitful, although this was not specifically implemented for proof in the POCs) : however, adoption (rather than migration) of a new standard may be necessary where previously no standard was available. (see POC 1 and POC 3)

**One-Stop Shop** – that it is possible to provide for any D2D European itinerary without obliging the customer to consult multiple sites for shopping purposes, and without redirecting or referring them to other sites for booking, purchasing for ticketing processes (see POC 1)

**Advance purchase of all Travel Entitlements** - that using technology to render the customer's comodal experience as close as possible to an intermodal one is essential for encouraging pre-trip purchase of all comodally retailed travel entitlements

**Distributed vs. Centralised** – that you don't need to depend upon acquiring and centralizing all travel data nor centralize all shopping processes (e.g. expert journey planning) into one super centralized database or processing platform in order to provide comprehensive and multimodal travel planning and ticketing services (see POC 1 and POC 3).

**Business model agnosticism** – that travel provider products and services can be distributed equally whether they are stand-alone (composing part of a comodal travel solution) or combined through commercial agreements with other travel providers, in joint-products and service offerings (as would underpin an Intermodal travel solution, or as part of a larger comodal travel solution) (see POC 1).

**Single Identifier linked to passenger** (new concept in Urban Transit) – is introduced across transport modes being particularly innovative for the urban transit sector by the demonstration of either comodal or intermodal Ticketing incorporating urban transit trip 'segments' (see POC 1 and 2).

**Entitlement – Token split** (new concept in Urban Transit) – is introduced systematically across modes, including urban transit, enabling flexible Token management to deal with non-convergent smart city ticketing schemes in the same itinerary (see POC 2).

**Back-Office-centric vs. Card-centric** (pertaining to Urban Transit) – is promoted, as largely a consequence of Entitlement-Token split (see POC 2).

**Combining Pre-paid (long distance travel) and Post-paid (urban transit) mechanisms** – is perfectly possible and works equally well for comodal and intermodal business models (see POC 1). In the same context it is perfectly possible to combine urban travel entitlements from pre-paid and post-paid schemes within the same integrated / intermodal ticket (POC2).

**The value of Conceptual Enablement** through multimodal projects – finally, the design of this POC demonstration has obliged all participants to compare, contrast and find the generic 'concept drivers' behind terminology which may be used equally in different transport modes but with subtly

different meanings.

In other words, the very exercise of developing a proto-type or pilot implementation for multimodal travel, imposes a search for generic (shared) travel concepts between modes, which can be abstracted from sometimes different usages of the same transport term/concept. This in itself is both a prerequisite for multimodal technology development and proof of the value of funding such exercises which encourages this type of valuable conceptual work.

## 2. Project Engineering

### 2.1 Proof of Concepts summary: Three POCs to cover the full passenger experience

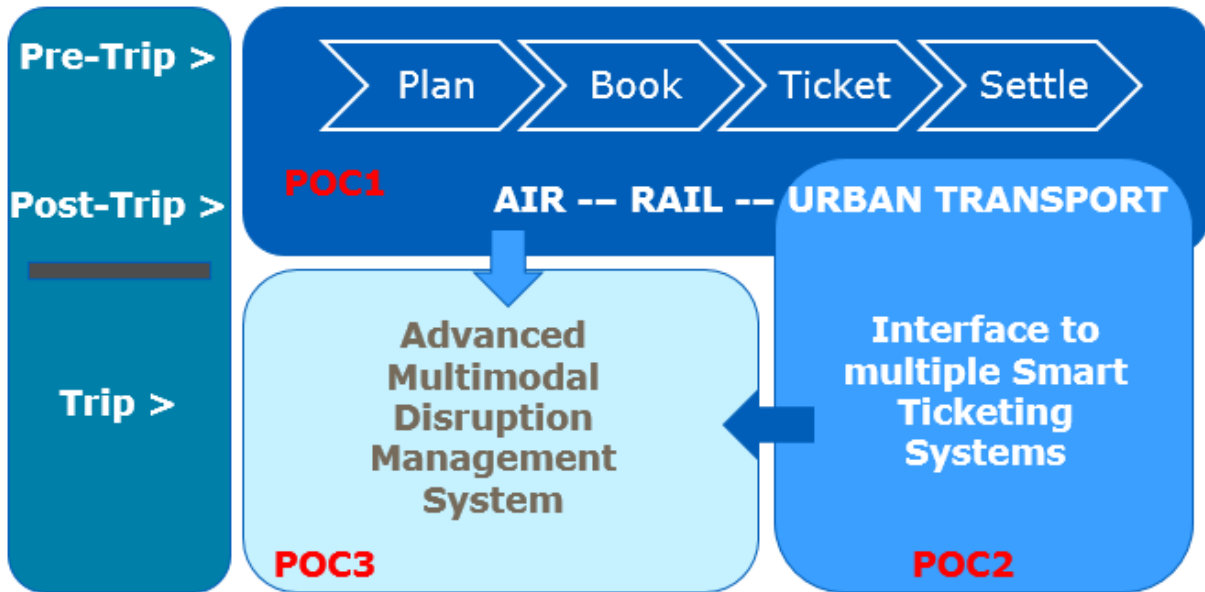
We identified **3 POCs** to cover the full passenger experience from shopping to delivery across the three modes: Air, Rail and Urban Transit Transport in accordance with the expertise harnessed by the AWT consortium.

Additionally, we considered that these POCs should address the different challenges presented by both 'comodal' and 'intermodal' travel product retailing, since these are so different with respect to the end-user view and experience: i.e. multiple transport contracts, multiple payments, multiple tickets and no guarantee that someone takes care to ensure arrival at the final destination (comodal) versus a single transport contract (offering assurance of arrival at final destination), a single payment, and a single 'ticket' (intermodal).

The intermodal case, in particular, also presented the occasion to deal with the challenges of settlement, since it requires settlement with not only the retailer of the intermodal product, but also, subsequently, between the intermodal partners themselves.

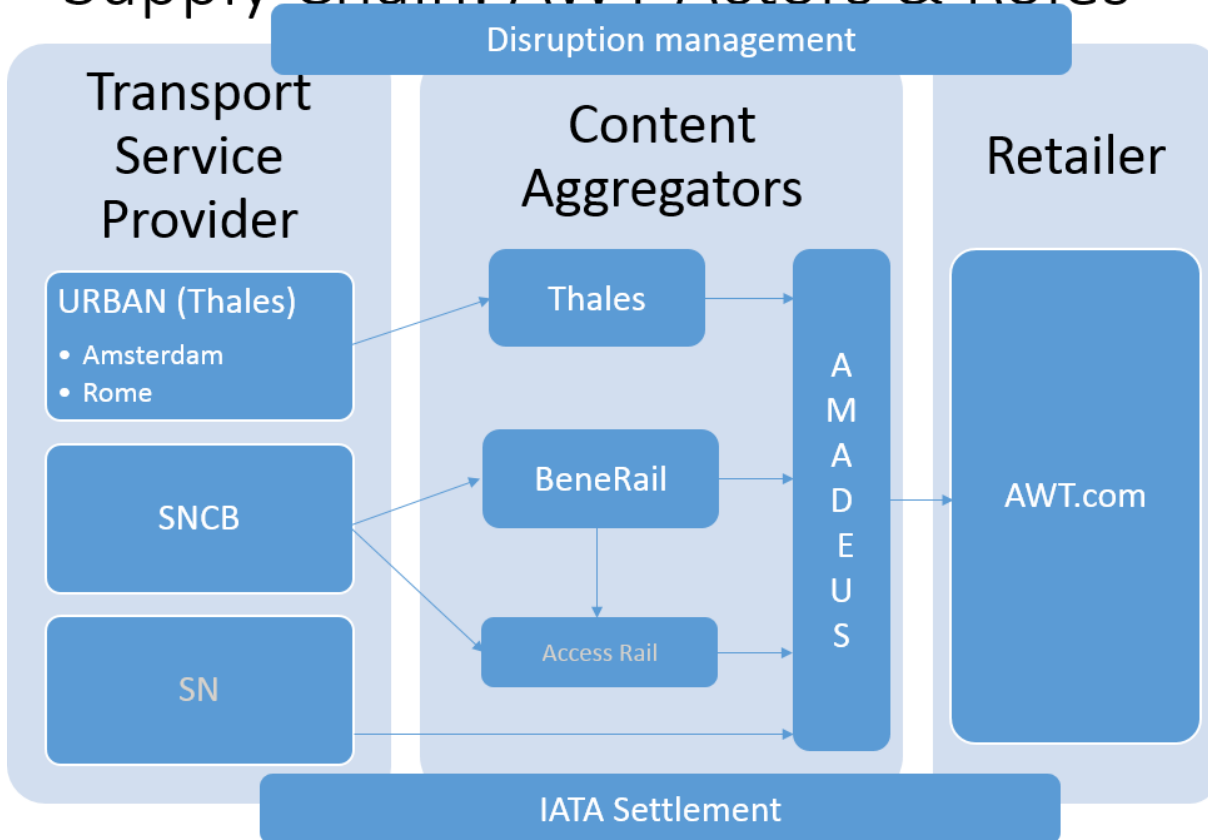
Consequently, the POCs had to deal with the integration of '1<sup>st</sup>' and 'last' miles with the longer distance modes, as well as a multimodal Trip Tracking facility to assist the passenger prior to, or during, travel when facing service disruptions on any segment of the passenger's itinerary.

Schematic overview of POC interconnection



The following diagram shows the roles of the consortium members in the POCs supply chain and the different transversal functionality we implemented.

## Supply Chain: AWT Actors & Roles



- **Proof of Concept no. 1 – One stop shop web site (& intermodal settlement)**

We knew from the study conducted during phase 1 that the marketplace today comprises opportunities (however limited) for the traveler to purchase both individual travel products (in comodal fashion) and intermodal travel products. By logical extension, a mix of the two, is also possible which suggested that our POCs should also, therefore, cover these, effectively, three options.

The one-stop shop challenge implies that the distribution link in the supply chain must be able to provide search and journey planning functions corresponding to these three options, which promised to consume a considerable portion of the assigned budget:

- The purely co-modal option is more expensive for the distribution link, since it implies implementing two or more different interfaces (formats & protocols) at each step of the overall shopping-to-settlement process: in reality, this could mean implementing a minimum of 12 different interchange messages: covering timetable, fares, availability, booking, payment and ticketing for each of at least two travel service providers. After-sales transactions increase this significantly where TSP (Transport Service Providers) products are cancellable or refundable. Additionally, due to the risk for the traveller of purchasing an incomplete and potentially non-refundable itinerary during the booking/payment/ticketing step(s) the distribution link has to provide some 'overall trip' intelligence / context and be capable of 'undoing' the successful transactions if it perceives that one or more of the parallel travel provider dialogues it must manage, fails. Conversely, there is no additional expense for the Travel Service Providers incurred by being part of a co-modal itinerary as opposed to being the sole provider of a travel segment(s) for a travel shopping query and purchase.
- The purely intermodal product tends to be more expensive at the Travel Provider link in the supply chain since either: one or more travel providers have to adopt/imitate the dialogues appropriate to the mode of one of their travel provider business partners; or, one of the travel providers has to incorporate and structure the services of its travel provider partners within its own inventory system, so that the product can be processed at each step with a single standard dialogue. Conversely, there is no additional expense for the distributor, provided that the adopted dialogue/standard for the product is capable of supporting 'through ticketing'. For the Distributor, less effort is incurred since the product or service may be processed at each step using just a single set of interfaces belonging to single industry or proprietary standard.
- A customer's mobility query may of course be met by a combination of comodal and intermodal products. With the risks associated to comodality and the dependence of Intermodality on commercial agreements, an effective distributor in a single multimodal travel market, will need to master both types of product offering.

For the AWT POC1 – our consortium had advantages with regards to the purely intermodal option: both BeneRail and any Amadeus distributed full service carrier airline can be shopped and ticketed using IATA standard messaging. In today's marketplace, AccesRail provides an IATA 'airline'

designator code, together with a message interface supported by a number of Railway Undertakings, allowing each one to be shopped, booked and ticketed as if they were an airline participating carrier on an IATA standard interline (intermodal) e-Ticket.

This meant that Air-Rail products (intermodal products) in our POC could be relatively easily distributed. Conversely, budget had to be assigned to integrating Urban Transit 'as an airline' into this same scenario in order to achieve issuance of an Integrated Ticket covering all three modes. Atypically, however, urban transport in our POC was integrated 'as an airline' only within the ticketing issuance process and subsequent travel entitlement management (service/product consumption) process. For mass public transport covering an entire city/agglomeration, notions of shopping, booking and availability have little sense once access to fare-products and timetables is secured. Indeed, our POC had even little need for urban timetables, since the fare-product being sold provided general travel entitlements on any mode within the urban transport system, limited by only zone or date-validity. This suggests that public transport authorities will never need to 'mimic' airline or rail standard shopping, availability, booking, or payment dialogues.

Likewise, our consortium included IATA which could bring the settlement infrastructure to the table at relatively lower cost, so that an Intermodal product could be settled with both the retailer (BSP processing) and between intermodal partners (IATA Clearing House (ICH)) with, nevertheless, an expense to be incurred for integrating an Urban Transit provider for the settlement with the selected Airline partner.

Both ticketing and settlement of the urban segment were achieved by identifying the Public Transport Authority as an Airline: This meant : assigning an IATA airline designator code for the PTA (Public Transport Authority); establishing a convention for coding origin and destination locations differently (even though urban origin and destination normally share the same IATA 'city' code); and, creating an electronic intermodal agreement between the PTA 'airline' and the validating carrier for the intermodal ticket, in order for IATA Clearing House process to settle between validating carrier and participating carriers included in the ticket covering the customer's itinerary.

On the co-modal side, an evaluation had to be made regarding how we could implement Rail. BeNeRail, our consortium partner for rail and system provider for NS (Dutch Railways) and SNCB (Belgian railways) international rail distribution has access to multiple inventory systems (SNCF, DB, ...) and sources rail content based on commercial distribution agreements of NS and SNCB. This content covers different railway pricing regimes:

- Non Reservation Tickets (NRT), used on a large number of Intercity and Eurocity train services;
- IRT (Integrated Reservation Tickets) e.g Eurostar and Thalys;
- and TLT (Train Linked Tickets) e.g DB ICE services

Each with specificities on shopping, booking and ticketing processes.

This rail content is exposed by BeneRail through a proprietary 'Distribution Webservice' interface and integrated into the POC1. For the different services (e.g. shopping, booking cancellation), the operations (e.g. booking, confirm booking, manage fulfilment) are the same but they need to have different or even additional values (optional fields becoming compulsory) depending on the type of product: NRT, IRT & TLT.

POC 1 dealt with only one of these price-category products. The co-modal use case we planned to demonstrate was based on an intercity rail service between Brussels Airport and Amsterdam Central station, subject to an NRT pricing regime, without seat reservation.

Focusing on this specific use case, a slightly simplified interface protocol of the BeNeRail 'Distribution Webservice' interface was proposed for integration into the POC 1, combining the manage fulfilment and send confirmation operations within the booking service.

For the same reason, only a limited mapping was made between POC1 Multi-Modal Journey Planner, shopping and booking orchestrators on Amadeus side and BeneRail reference data e.g. on station codes and rail products.

Some budget had to be allocated to develop at least a minimum of co-modal context handling, if we wanted to demonstrate an improvement over co-modal retailing in today's market-place, whilst, again, urban transit is a less costly sector (relative to a long-distance mode) to manage from the Distributor's angle. So far as settlement for co-modally retailed products is concerned, it is generally the pattern for non-Air travel providers to manage retailer settlement individually. Invoicing and settlement of the comodal Rail and Air segments was therefore not planned to be demonstrated, since for POC 1, today's solutions were considered adequate: however, we did plan to show the settlement of the comodal PTA urban product, since the airline codification we used also enabled the PTA to take advantage of IATA's non-air international settlement process/capability: TIESS.

- **Proof of Concept no.2 – First and Last Mile – Urban Ticketing**

In order to integrate the first and last miles within a multimodal journey, it was necessary to address the specificities of urban transportation relative to the pan-European traveller.

The main specificities addressed in the context of AWT were the following:

- Travellers' actual urban itinerary cannot be verified prior to its travel: at the time a traveller enters an urban network, it is not possible to determine where he will exit, since, by definition, multiple exit options are available to him. In other words, most/all urban segments are "multipoint" whereas long-distance rail or air segments are pre-defined point-to-point segments or segments with stopover. As a consequence, the consumption of the urban fare product can be managed only once the traveler has completed his segment and left the urban network.
- Specificities for booking and cancellation processes: in urban transport, booking services are different from those offered by long-distance rail or air providers. At urban segment booking time, there is indeed no actual seat booked. Symmetrically, cancellation mechanisms are also



different since there is no inventory-based booking to rollback and due to the fact that fare product consumption may be asynchronous due to lack of connectivity in buses. In AWT, urban cancellation services were adapted to fit the Air process (see FLOWN interface) with a near real-time strategy.

- Populations of travellers targeted by urban transport generally concern greater numbers of local daily commuters than international pan-European passengers. As a result, the sales process that was demonstrated in AWT to address multimodal pan-European passengers was by construction less suited to local daily commuters. This particularity was kept in mind for assessing whether or not the processes and services provided in AWT would be applicable and usable for urban travellers without excessive costs for PTAs and PTOs.

For Urban public transport authorities and operators, the 'daily commuter' traveller category is, by its sheer mass, the prime actor of any urban ticketing system. This traveller is usually well known (often registered within the system), owns a fare media such as a contactless smart card and benefits from adapted fare products that provide low revenue per use to the operators with minimum financial risk.

The Scope of this Proof of Concept was to assess and adapt existing Urban back offices to cater for foreign travellers, using multimodal travel products, in co-existence with the daily commuter base.

This was accomplished through:

- Assessment of new technologies, such as NFC-capable smart phone and smart card emulation, was promoted with POC2 as they were perceived as potential (to be assessed) technical solutions against the fragmentation of fare media whilst allowing the integration of existing systems.
- Assessment of technologies aiming to limit the exposure to financial risk for urban operators/authorities when introducing a new category of travellers within their existing environment and systems. Indeed, when the traveller is already known to the system, the financial risk of the transport operator/authority is minimal. In pan-European multimodal travel, the traveller may not be known to the transport operator and the traveller may not possess (or wish to acquire) the operator/authority fare media. In order for the transport operator/authority to be assured of payment for the provided transportation service, the traveller must declare a means of payment before entering the transportation network in order that major financial risks of not being able to retrieve revenue for a consumed service, are avoided. A common result of this is that the price of pre-paid products delivered to unregistered travellers is higher than might be anticipated, in order to cover the loss of revenue generated by the misuse of such fare products. In this context, POC2 promoted the introduction of EMV technologies as an alternative solution for the transport operator/authority. As EMV can be considered as both a fare media and a means of payment, the transport operator/authority may rely on this technology to mitigate the risk of revenue loss whilst offering the pan-European traveller with fair and more standard pricing.

- On top of the technical feasibility and interoperability issues to be explored at urban transit level, POC2 aimed to demonstrate how the combination of the two technologies (NFC with card emulation and EMV) may contribute to a sustainable solution for transport operators/authorities to provide the complete coverage for both registered and unregistered travellers at minimum risk.

This assessment considered the two main categories of urban ticketing systems currently deployed: the Card Centric systems (where the ticketing infrastructure is decentralized and the system “intelligence” hosted on the field equipment) and the Back office centric systems (where the system “intelligence” is centralized in a global back-office orchestrating the ticketing functions.)

- **Proof of Concept no.3 – Trip Tracking**

POC3 aimed to address the complexities of trip tracking: in this case a multimodal European trip. Trip tracking is a complex subject with many variations: this is due to the particularities of each travel mode and the privacy issues of the traveller. The AWT approach was to focus on the following topics:

- Include the first and last mile: in this processing urban transportation conveyed no notion of individual because urban transport is mass transport by definition.
- It’s the trip that is tracked and not the traveller: this meant that we monitored all the relevant real-time information of the trip segments and processed it to determine whether or not it affected any other part of the entire itinerary..
- Minimize the requirements on the communications channel of the passenger, and use simple SMS for feedback, this would allow to surpass the data roaming issues still existing in Europe.
- In case of trip complete disruption the traveller is informed and has to re-plan the trip using the one stop shopping from POC1.

This approach offloads the travellers’ chore of tracking their journey segments, one by one, and handling connection times between nodes.

The AWT trip tracking relied on a Master Tracker component of APIS (Advanced Passenger Information System) from Thales, which was then responsible to correlate all the events related to a trip and notify the traveller when there is the need: in order to adapt to the AWT requirements the Master Tracker had to be adapted and tweaked.

This was accomplished by:

- Acquiring the full trip, and traveller contact, details from the one-stop-shop dialogue: to achieve this it was necessary to develop a standard communication interface that would enable both communications and scalability (for dialogues with several one stop shops if desired).

- Definition of a standard interface so that Master Tracker could communicate with multiple transport modes, determining all the information requirements from mass transportation modes to a unique mode like Air.
- Definition of an interface for the notification engine.
- Designing a solution that could be scalable and agile.

The Master trip tracker was able to consolidate events related to an individual multimodal trip on all of its segments and to provide an analysis which identifies the impact of the service disruption on the ticketed itinerary of the customer.

- **POCs overall**

The modal scope that was determined for the 3 POCs was guided by the following logic:

- Include Urban Transit for integration of first and last miles.
- Include Rail – since this is the strategic sector being promoted by the EC to spearhead the drive towards the multimodal vision of the EC white paper on transport
- Include Air in order to capture travel into or out of Europe (a growing passenger flow which clearly contributes to the anticipated growth of intra-European travel where origin or destination are non-European)

Indeed, the AWT consortium was itself put together with this logic in mind. The exclusion of other modes was due partially to that particular logic combined with the budget constraints we had to meet: not all modes could be represented.

Nevertheless, it was anticipated that it would be worth evaluating whether AWT solutions for an integrated Rail sector could inform approaches to other long distance modes such as Coach and Ferry, as might be taken up in other large-scale projects. The 'Air-like' solution used in the POCs is unlikely to be a fully sustainable solution, without complementary technology to enhance interoperability within the distribution link which could then unburden non-air providers of the cost of adapting all upstream services (timetables, fares, availability, booking and payment) to compliancy with IATA air standards.

Also, by delivering a city pass at reasonable cost for such multimodal trips, where the traveler is likely to use the urban transportation system during his stay, reduces the fare calculation and post-sales complexity and makes this solution again very scalable.

The full complexity of all possible combinations demands an enormous effort in time, people and money: this fact, combined with the existing content capabilities of the consortium members, was instrumental in limiting the consequent options and use case scope as follows:

- The variety of itineraries: we limited to two fixed origin / destination city locations, with the possibility to include some variety of mid-points but which did not require a middle mile (e.g. airport hubs with a Rail terminal)
- The variety of transport operators: was reduced to one airline, one railway and 2 urban operators.

- In this way we reduced the number of travel provider data accesses that was required that were built upon different modes/standards N.B. it is important to note that the budget required to develop new interfaces between long-distance modes (Air and Rail in this case) simply exceeded the funding offered by the EC for the POC phase .
- The extent to which reliance on tweaking legacy systems/standards is enforced
- The richness and full extent of functionalities deployed / demonstrated: no re-accommodation and very few, or limited usage of 'after sales' transactions. We'll explain how those can be addressed with the same concept in our final report, but could not be implemented in the POC as the cost would have increased dramatically for those advanced and complex functionalities

Some additional points on the middle point(s) and the middle mile(s):

- One or more middle points would have made the itinerary search way more complex for reasons explained in the Assumptions and Limitations Table (see below). Here, the journey planner experts in route-solving, are the entities to be developed to address that complexity. The large scale solution could perfectly sit on our POC and call those efficient experts  
Solving the middle mile(s), is, in one sense, strictly the same as solving the first and last mile, i.e. delivering an urban transportation trip. However, performance issues multiply since there is a greater variety of possible start and end times, imposed by the preceding and subsequent longer distance travel segments, than is confronted for 1<sup>st</sup> and last miles. Therefore for cost and time efficiency we didn't include it in the POCs for the demonstration.

REF	Functional or Business?	Area	Issue faced	Hypothesis / Simplifications	Comment
1	Business	POC1 POC2	The rollback procedure in urban transportation is not always available, it can depend on many criteria and there might be cancelation fees.	Rail segment fall back was not implemented in the scope of AWT. As a result of the uncertainty with regards the availability of UT the consortium limited the scope of the roll-back scenario: we will just demonstrate the ordering and rollback mechanism on AIR segments. An AIR segment is booked, then a UT segment sale fails. The AIR segment is ignored.	This is a complex area which needs to deal with a variety of scenarios: and may arise during the booking orchestration, the payment orchestration or the ticket issuance orchestration. Apart from the capacity of the Travel Service Providers to roll back transactions, there is also the capacity of Issuing Banks to roll-back credit card authorisation and account-blocking transactions, and the issue of dealing with non-refundable segments (which have actually been paid and ticketed) as well as refundable segments but carrying cancellation penalties. There are clearly a number of traveler options or preferences which may also need to be considered and interacted with (e.g. if the Urban Segment fails, do NOT roll-back my longer distance bookings/entitlements).
2	Business	POC2	The "Change to flown" action is not immediate in case of urban transportation. The PTA system can acknowledge a flown status two month after the actual consumption (Since some equipment are not connected).	In the demo, the urban ticketing equipment are connected to the urban back office. As a result, the first usage of the urban transportation product will be notified in near-real time to the PTA, which will trigger the events associated with this change of consumption status also in near-real time. In field, this will not always be possible (connectivity and quantity of consumption messages requires asynchronous processing). However, multiple strategy may be enforced to mitigate the risk linked to the flown message not being sent on time to comply with the standard. Such message could be send at the end of the validity of the fare product or even at the delivery of the fare product if this fare product is non-refundable.	There is a general Refund strategy deployed in Urban smart ticketing schemes: refund based on consumption - so whilst the POC represents the implementation of a solution which complies with this, we can see that practically this may not function properly in a production environment (even if it works in the POC). One solution would be for PTAs to adopt another refund policy such as eligibility based on validity date. This could ensure functional compatibility with the Intermodal requirements for consumption, notification, combatting fraud and inter-partner settlement, but it would mean a change of PTA policy on Refunds with regards these type of products

REF	Functional or Business?	Area	Issue faced	Hypothesis / Simplifications	Comment
3	Functional	POC 1	Local urban transportation itineraries are dependent on the long distance segments timings. Potentially, for each long distance solution we will need a local itinerary at different times during the day. But it would not be scalable to send one different request for local solving, per long distance solution. Indeed, knowing that there could be hundreds of long distance solutions, and local segment solving take time, it would represent a huge traffic (if the requests are sent in parallel) and huge response time (if the requests are sent in series).	For AWT POCs, the timing of the long distance itineraries will not be sent in the local solver request. Or a fake timing if needed. So we assume that the daily service of the public transportation operations do not vary sufficiently to make a significant difference to the end result.	This can be an issue in the future, for example with the night vs day bus frequencies. One idea could be to solve urban itineraries by providing a time range for the long distance segments to at least distinguish between day and night.
4	Business	POC1 POC2	CO2 for urban transportation: The data is not provided by the PTA, as the pricing product are not entirely correlated to a given journey, and a given mean of transportation (With the same ticket, you could travel several different itineraries in bus, tramway, or whatever). The information should be retrieved with the routing, however it is not available today.	For AWT POCs, the urban transportation segment will have no carbon footprint information displayed. CO2 consumption per passenger cannot be computed in a standard way nor is it provided to the partner knowledge for urban segment. Only the long distance segments (AIR or Rail) will have this information available.	In general, although it seems the POC does not deal with this: it can be that this is not even required in the market-place or by the EC since public transport is deemed 'more environmentally friendly' than other urban transport modes (car, taxi etc.) and it seems impossible to derive a carbon footprint at traveler level. Need to watch out for any evolution of this position in the overall carbon emissions issue with regards multimodal travel

REF	Functional or Business?	Area	Issue faced	Hypothesis / Simplifications	Comment
5	Business	POC1 POC2	PRM (Passengers with Reduced Mobility) / blind people for UT: Information is missing for Urban transportation - and no standard for transmitting it if it did exist.	For AWT POCs, the urban transportation segment have no standard supporting PRM information consolidation to the partner knowledge. As a result urban transportation segments will have no PRM information displayed. Only the long distance segments (AIR or Rail) will have this information available.	This looks like a limitation that was impossible for All Ways Travelling and possibly even better funded projects to address, without some movement / evolution at PTA policy level with regards PRM.
6	Business	POC1 POC2	PRM (Passenger with reduced mobility) / blind people for UT: Information is missing for Rail segments.	For AWT POCs, we will only rely on the train equipment types, and assume that the railway stations are correctly equipped.	Railway Undertakings (RU's) indicate in their planned timetables if (types of) rolling stock is equipped with facilities for passengers with reduced mobility. Station accessibility is typically information that RU's propose on their websites? In order for passengers to know if stations are equipped and staff can be organised in time, dedicated availability and booking procedures are foreseen, typically managed by centralised services at RU's. On European level, UIC leaflet xxx describes the interaction between RU's to organise assistance for international railtravel. This leaflet also foresees standardised XML interfaces (optional) between RU's. This leaflet is translated in TAP-TSI Technical Document B.10
7	Business	POC1 POC2	Urban Transportation Content in Roma: ATAC did not finally participate in the project.	In the scenario demonstrated, the Roma urban transport segment is covered by multiple non-integrated operators. AWT partners assume that the rail segments that can be found through Nokia Here is covered by the urban transport service provider involved in the demonstration scenario, so that the selected fare product grants the traveller access to the transportation network.	This is not a problem for the industry as such: we have had to fake the ATAC coverage of this transport service due to their final non-participation.

REF	Functional or Business?	Area	Issue faced	Hypothesis / Simplifications	Comment
8	Business	POC 1	Intermodal Rail segment: Using the AccesRail solution, the GDS e-ticket does not grant the right to travel the train segments by itself. The access Rail solution demands that the passenger exchanges his GDS ticket for a standard train ticket during a "check-in" process. This is not necessarily a process that has to apply to future intermodality involving rail. (Depending on future CIV rules)	A check-in is required, to have the Rail document provided to the user, in addition to the e-ticket. Indeed, only this document will allow the traveller to have the train access granted.	Railway Undertakings (RU's) will transport international passengers based on CIV rules, as referenced on all international rail tickets. Following this principle, Airline (e-) tickets are not accepted as valid travel entitlements on board of a train. In intermodal agreements between airlines and railway operators an 'operating carrier agreement' will indicate which procedures will be put in place in order to deliver valid travel entitlements for passengers, e.g through an airline style 'check-in' procedure.
9	Functional	POC 1	In the shopping orchestrator, the current infrastructure configuration make external calls to geolocation resolvers unusually complex	As AWT scenario is quite simple, translation between free text address and geo-coordinates is hardcoded (Van Gogh museum for the start point, and so on).	Not a general issue for the industry. Just difficult to implement with our budget combined with the particular infrastructure design of the shopping orchestrator. Indeed, Nokia Here offer these geolocation resolution services, and some other component of the AWT solution send calls to Nokia Here at different steps of the process.
10	Functional	POC 1	Complexity of pricing for AIR segments, and as well as for Rail or UT is depending on the number and types of passengers. For example, the limit in terms of age can depend on the providers, or the different level of services.	Choice has been made to handle only mono passenger request, for an adult, in leisure category (no business traveler).	An issue of complexity to be addressed towards larger projects
11	Functional	POC 1	The Multi Modal journey planning complexity increases with the local segments resolving. Local segments can be the first miles of a trip, last miles, or middle miles.	First miles and last miles will be solved for the door to door request, but there will be no change of airport / railway station in the middle of the journey with related middle mile solving, in the scope of AWT POC.	Contrarily to first and last mile solving, the middle mile solving can impact directly the long distance solutions to be promoted. However, for performance issue, it is not possible to perform a real middle mile solving in the middle of the route exploration for long distance journey planning.



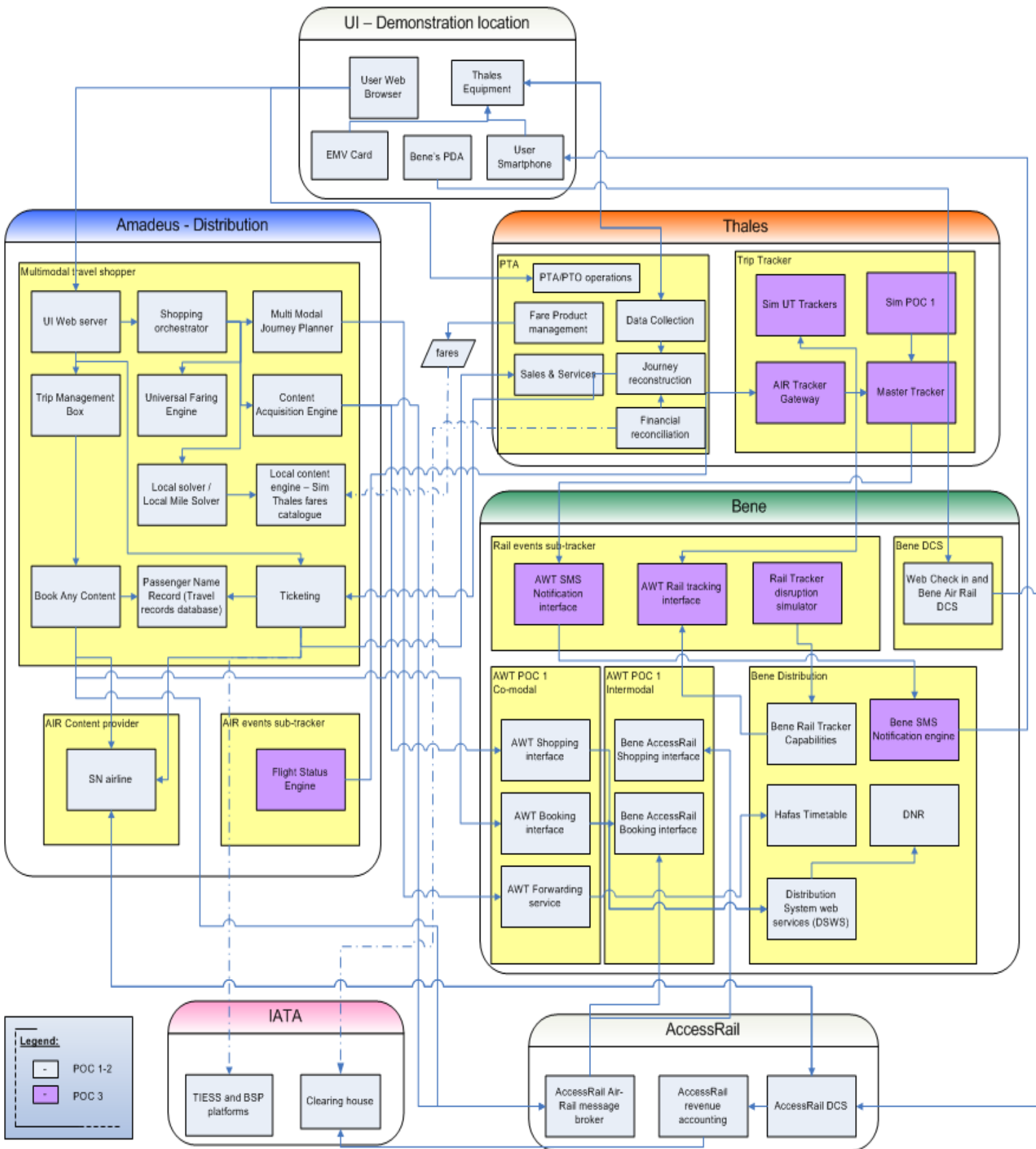
## 2.2 Engineering Management Plan

The Engineering Management Plan aims at describing the organisation of the engineering activities for the AWT project.

It contains the following information:

- The overall architecture
- The list of modules
- The deliverables

### 2.2.1 Overall architecture



### 2.2.2 List of modules

POC	Component Name	Brief description (main roles)
1	UI Webserver	The webserver manages and calls central web services to feed the demo UI, each time an action is triggered: Shopping, booking, issuance requests.
1	Shopping Orchestrator	This component receives the shopping request. It orchestrate the several shopping web services amongst central components. MMJP, CAE, local solver, as described in the specifications. The output is a list of priced recommendations. Shopping context is also stored on SO side.
1	Universal Faring Engine (UFE)	It prices the AIR itineraries, services and distributes the solutions as per shopping strategies
1	Multi-Modal Journey Planner (MMJP)	This component builds the long distance itineraries. It mixes Air and Rail travel solutions from sub-journey planners in order to build multi-modal itineraries.
1	Content Acquisition Engine (CAE)	Retrieve availability and available prices for the long distance travel solutions
1	Last Mile Solver (LMS) / Local Solver	Component called to solve local itineraries. It provides routing and pricing information.
1	Local Content Engine (LCE)	Component involved in the pricing of local itineraries, as well as in the local shopping context storage.
1	Booking orchestrator	Coordinate and aggregate different services, in order to create a temporary reservation, corresponding to the shopping recommendation selected by the user
1	Ticketing Orchestrator	Coordinate and aggregate different services, in order to confirm a temporary reservation, and establish the related contracts with other entities.
1	Electronic Ticketing Server (ETS)	Store Amadeus e-tickets
3	Flight Status Engine (FSE)	Publish flight notifications to subscriber applications (delays, cancelations,...)
3	APIS SW platform	Federate multimodal PI data sources; Data fusion of PI; Manage and Publish PI through several channels.
3	Sim UT tracker ROM	Simulator for Rome UT
3	Sim UT tracker AMS	Simulator for Amsterdam UT
3	Sim POC1	Simulator of POC1 events
3	Master Tracker	Core POC3 functionality
3	Air Tracker Gateway	Interface between existing Air events platform and POC 3 Master Tracker
2	Mobile Phone libraries	Create contract Check-in
3	BeNe SMS Notification Engine	BeNe component allowing to notify passengers by SMS on AWT real-time information updates.

POC	Component Name	Brief description (main roles)
2	Urban Back-office	Register AWT Product / Export Product Catalog / Get Contracts / Create Order / Create Payment / Get Orders / Register Tap / Get Transactions
2	Urban Back-office	Contract Establishment / Create Transit Account / Generate Flown Message / Generate Settlement Request
2	Urban operator Back Office Website	Display Transaction Display Order
2	Urban operator Customer Website	Customer account management (Order , Transaction and Fare media management)
2	Ticketing Device libraries	Update Action List Check Action List Detect Media
1	Comodal : AWT Shopping Interface	Webservice providing access to Rail Shopping services (DSWS) to Amadeus' CAE service
1	Comodal: AWT Forwarding Service	Webservice providing access to HAFAS Railway timetable engine for Amadeus MMJP , incl enhanced functionalities like ECO checker
1	Comodal: AWT Booking Interface	Webservice providing access to Rail Booking and ticketing services (DSWS) to Amadeus' BAC service
1	Comodal: Distribution System Webservice (DSWS)	DSWS allows external rail distribution partners like online travel agents to shop, book & ticket train products using an API, accessing BeNe Rail underlying distribution system business logic
1	Comodal: HAFAS Timetable / Eco	HAFAS is a European timetable, route and eco information search engine for rail, licensed by HACON Ingenieurgesellschaft GmbH
1	Intermodal: AccesRail Air-Rail message broker	Air-Rail component translating IATA airline shopping, booking messages in railway shopping, booking messages, and allowing railways to be represented in airline systems as an airline carrier. Component licensed by AccesRail.
1	Intermodal: BeNe AccesRail Shopping interface	Interface by which AccesRail can check for availability of rail products in the BeNe distribution system
1	Intermodal: BeNe AccesRail Booking interface	Interface by which AccesRail can book rail-related products in the BeNe distribution system
1	Intermodal: AccesRail Departure Control System	Air-Rail component, connecting airline Departure Control systems with railway ticketing and boarding processes. Component licensed by AccesRail.
1	Intermodal: BeN Air Rail Departure Control System	BeNe component managing ticketing and boarding of airrail passengers.
1	DNR (Travel dossier database)	The DNR database contains all information related to rail bookings, tickets, payments made through all distribution channels
1	BeNe Back Office	Back office components that manage settlement of rail sales with distribution partners (e.g agents) and carrier interline partners
3	AWT Rail Tracking Interface	Webservice providing real-time rail information to Thales AWT Master Tracker
3	BeNe Rail Tracker Capabilities	BeNe component tracking real-time information for rail, partly based on licensed HAFAS component
3	AWT SMS Notification Interface	Webservice enabling ThalesAWT Master Tracker to forward all real-time notifications to the BeNe SMS gateway

### 2.2.3 Deliverables

Deliverable Name	Content description
<b>Project Plan and Status</b>	A plan that indicated the key deliverables and milestones and give the percentage of completion for key tasks and activities
<b>Development and Integration roadmap</b>	A plan that indicates the technical tasks, sequence of work and milestones to achieve the implementation of the POC solution
<b>Pre-existing component list</b>	A document listing the main component that will be part of the POCs solution, describing what was pre-existing and what was developed in the scope of the project.
<b>Proof-of-Concept Design Solution</b>	This deliverable provides an overview of the overall solution architecture
<b>High level functional specifications</b>	A document describing the high level functional specifications for the entire solution, with a specific focus on the elements developed in the scope of AWT project
<b>Choice, Assumptions, and limitations list</b>	A document containing the constraints and limitations identified as well as the adaptation options chosen accordingly
<b>Risk Matrix</b>	A document acting as a central repository for all risks identified by the Consortium, including information such as description, impact and mitigation option
<b>Story Board</b>	A document describing the end-to-end user experience for the several scenarios of the demonstration This exercise is traveller centric, and also taking into account all impacting parameters (commercial, technical, functional, legal,...), in order to explain fully the challenges POCs are addressing
<b>Demonstration</b>	A live and taped physical demonstration in a test lab environment to present the integration of POC1, POC2 and POC3 applied on specific use cases
<b>Dissemination Results</b>	A document which aims at presenting the dissemination activities carried out by the project team over the period. Specifically, it provides a complete list of events as well as conferences made at various events and workshops and related to the project. Furthermore, any additional coverage of the project by the press releases and online media is also presented
<b>Inception Report</b>	A report that give clear definition of the project focus and details of intended outputs and activities : - Preparation of a revised work plan and timelines - Provision of further details on each individual activities and specific tasks
<b>Intermediate Report</b>	A report that gives an update of the progress in relation to planned activities for the first half of the Phase 2 project period
<b>Final Report</b>	A report including the results of both the study and the POCs, consolidating the outcomes of the All Ways Travelling project Phase 1 and Phase 2, outlining the key findings and recommendations to be promoted to the transportation ecosystem



### 3. The storyboard

A 'storyboard' is a way of capturing the flow and sequence of events, linking the traveller's perspective or 'story' with the various use-cases and related background IT processing. It is a very useful way of merging all the elements that will make up the POC demo. The objective of this document was first to have a global view of the wide and complex scope of the demonstration. It was also helpful to describe precisely what should be shown whenever several options were possible, so that the AWT developments focus on the scenario that will be demonstrated. Any difficulty that should have been left aside, according to this focus, has been listed in the section of this report, describing the assumptions / limitations for AWT. The Storyboard document, as produced prior to the POC demo in the development phase of the project, is included here below:

#### Who is Mr Smith?

Mr Smith is an Amsterdam citizen, who is registered with Amsterdam Public Transport Authority. He owns a NFC smartphone with a travel application delivered by Amsterdam Urban Back Office. However, he has no travel product loaded in his card.

He needs to travel to Rome on 16<sup>th</sup> of November; he did not sign up with the Rome Public Transport Authority for Urban Travel (i.e. he does not own any personal account in the destination Urban Back Office)

He is a customer of AWT.com, a Netherlands Online Travel Agency (OTA), and identified as such in their system. (His personal contact information is known in the AWT.com user profile).

#### Pre-Trip: Search

It is February 26<sup>th</sup> 2016. Mr Smith wants to book his mono passenger February Rome trip online. He connects to AWT.com website. In the search panel, he enters his departure and return dates (March 1<sup>st</sup> and 2<sup>nd</sup>), as well as board/off points and preferences:

- 1) First he'd like that only flights are returned between AMSTERDAM and ROME airports looking for both direct and connecting flights. He selects in the interface the "AIR content" option. Flights are displayed, for several airlines.
- 2) Secondly he thinks that Rail could be convenient as stations are in downtown, and he will enjoy looking at the landscape whilst travelling. He selects "Rail only" and changes the board and off points to Amsterdam Central station and Rome Termini station. As it is a rail station then only trains are returned. In the demo, only trains are returned distributed by SNCB/NS (NS intercity trains and possibly Thalys connection – To be confirmed).
- 3) Finally, he decides to enter his home and destination addresses for a Door-to-Door solution regardless of transport mode. He selects no specific "type of content" option, and door-to-door multimodal solutions are returned.

**a. Home address:**

Van Gogh Museum, Paulus Potterstraat 7 1071 CX Amsterdam, Pays-Bas  
(52.358416, 4.881036)

**b. Destination address:**

Piazza Navona, 1620 00186 Roma, Italia  
(41.8979, 12.4735)

In the input form for the travel search, there is no option to trigger a search for the fastest / shortest



/cheapest solutions. However, in output of the search, the results can be sorted by several criteria, as described below. In AWT, the main criteria used in the main back end processes is the price, as the passenger to be considered in the scenario is a leisure passenger.

As a result of such requests, recommendations are displayed. A recommendation is a list of travel solutions covering the requested itinerary, with associated price and conditions.

The default behavior will be to display the list of recommendations sorted based on a value defined by AWT.com (The value could depend on the profile of the traveller business / leisure), taking into account – at least – CO2 emission, the price, the travel time and the number of tickets / the model (co- or inter-modal).

However, the user can decide to sort all these solutions specifically by one of these criteria. What is important to consider is that it is just a post-sorting. Once again: The criteria used in the main back end processes is the price.

In a more advanced solution, it would be then possible to include those parameters as criteria for the search.

For each solution, CO2 emission and facilities for Persons with Reduced Mobility (PRM) are returned when available:

- CO2:
  - AIR segments: ICAO tables checked on the UI (User Interface) side
  - RAIL segments: Calculation methods exist based on mileage / equipment (SNCF). However, for AWT the values corresponding to the scenarios are hardcoded in the UI instead of relying on such calculator
  - URBAN segments : data are unavailable and CO2 emission is not addressed in AWT
  
- PRM:
  - AIR: Flights / airport always PRM compliant (UI display only)
  - RAIL: based on equipment types (hard-coded at UI level as not all rail carriers have integrated PRM data in schedule data. This is foreseen under TAP/TSI but not yet fully implemented)
  - URBAN: data required are currently not available. They are heterogeneous and complex to manage since it requires collection and computation of information which model entry and exit layouts (gates dimensions and locations), transport vehicle access (stairs, elevators...), transport vehicle layout (PMR areas). In AWT, this aspect is not addressed

The Door-to-door recommendations (displayed on 1 readable page) are mixing flights & urban segments or flights & trains & urban segments, and connect through different European multi-modal hubs (e.g. via Brussels). Since the additional content (rail and urban) anticipated to be used in the Amadeus shopping process for the demo is nowhere near as much as the quantity of already accessible air solutions it was decided to artificially limit the air solutions so as to ensure a more equal balance of final proposed offers between air only and multimodal alternatives: so shopping would return only SN (Brussels Airlines) flights in addition to SNCB/NS rail content and urban transit content.

Each recommendation includes available prices and fare conditions. Some are flagged as co-modal (Text displayed: Connection unsecured - he would have to handle himself the risk of misconnection), whereas some others are flagged as inter-modal (Text displayed: Connection is secured - there is an



interline agreement amongst the carriers), and some other are mixed (e.g. inter-modal outbound and co-modal inbound)

NB: this servicing option (co-modal or inter-modal or mix) is at recommendation level.

In the UI Mr Smith has the possibility to select sorting criteria on the basis of duration time, price, and number of stops. For each solution, he'll see corresponding carbon footprint and PRM friendly trips.

#### Pre-Trip: Selection, Purchase of a co-modal trip (Trip1)

Among all the recommendations offered, Mr Smith selects a co-modal recommendation. This case is the most complex case we could imagine, based on the original scenario described in the tender. Indeed, it covers the complete door-to-door multimodal journey, in full co-modal. The journey is composed of:

- Urban services in Amsterdam city on the day of departure (1 ride ticket), to go from the home address (Van Gogh museum) to the Amsterdam Central Station
- SNCB/NS train between Amsterdam Central station and Brussels Airport station
- Brussels Airlines flight between Brussels airport and Roma Fiumicino airport
- Urban services in Roma neighborhood (travel pass) to go from Fiumicino airport to the final destination (Piazza Navona), and be able to use the public urban transportation inside Rome during the whole duration of the trip. It allows the passenger to go back to Fiumicino airport on the day of departure of the inbound trip to Amsterdam
- Brussels Airlines flight from Roma Fiumicino to Brussels airport
- SNCB/NS train from Brussels Airport station to Amsterdam Central Station
- Urban services in Amsterdam city on the day of arrival (1 ride ticket), to go back from the airport to the home address (Van Gogh museum)

The complete journey is a juxtaposition of Brussels Airlines flights, SNCB/NS trains, and Urban transits in Amsterdam and Rome, purchased in a co-modal way.

Mr Smith books and pays with his EMV credit card (or at least, he declares it – it will be used to identify and allow his trip for urban services at destination).

Mr Smith receives his booking confirmation, with the following documents:

Co-modal:

- 1 email with a complete trip summary is sent to the user, with a warning that there is a different booking reference per segment and that the associated travel documents or receipts should have been sent by emails. No global E-ticket or common travel reference.
- 1 email with an E-ticket is sent by Amadeus ticketing for the AIR segments only.
  - i. There is no boarding pass for SN, just the E-ticket.
- One email is sent by Bene, with the electronic ticket for SNCB.NS Rail segment.
- Two emails sent by Thales, for the purchase of products from both Amsterdam and Roma PTAs.

#### Combatting the risk in comodal product purchase

N.B. in the booking of co-modal solutions, it can happen that the booking (or payment or ticketing) with respect to one of the travel service providers, fails. For example, for a multi leg booking, we





could receive positive answers and solutions at shopping time, but moving to booking, one of the legs may no longer be available, meaning that the customer could be left with a partially purchased itinerary which is no longer valid. For the purposes of our POC we will simply UNDO the successful transactions, so that the customers itinerary is not compromised; however, this is handled in the future in every case may ultimately vary considerably: for example, in the case where it is the urban 1<sup>st</sup> or last mile which 'fails' the customer may not want that the successfully purchased longer distance segments are cancelled, since alternative solutions for 1<sup>st</sup> and last mile may be easier for him/her to secure than for the longer distance segments if their availability is limited. There are clearly many different types of scenarios – an urban middle mile connecting two long distance segments may actually be crucial and may require that the longer distance segments be UNDONE if their connection cannot be secured. This is a topic worth greater research to analyse the optimisation of the interaction of customer preferences with orchestration technology transaction failures.

For our POC demonstration, we will simulate after shopping a disruption of the rail service. In that case, Rail booking cannot be made, and the system will return an error. This causes the full reservation process to be stopped. The user is then driven to the shopping page (context is kept, destination and dates are still filled) to start his search again.

#### Pre-Trip: Selection, Purchase of an intermodal trip (Trip2)

Mr Smith selects an intermodal recommendation whose content is similar to the co-modal recommendation booked previously. The complete journey is an integrated solution with Brussels Airlines as the validating carrier, Access Rail (acting as 'marketing' carrier on behalf of SNCB/NS railway operators), and Urban transits in Amsterdam and Rome. This means that although the segments in the trip are similar to the co-modal option, Mr Smith will have a single transport contract with a guarantee of reaching his final destination, despite any service disruptions encountered 'en route'; will make only one payment to the lead partner (the 'validating carrier' – in this case Brussels Airlines (SN)); and will have all issued tokens (boarding pass etc.) linked to a single integrated airline-standard interline (intermodal) e-ticket covering his end-to-end travel entitlement(s).

Mr Smith books and pays with his EMV credit card (or at least, he declares it – it will be used to identify and allow his trip for urban services at destination). The validating carrier is SN (Brussels Airlines) for the whole transaction.

Mr Smith receives his booking confirmation:

Inter-modal:

- 1 global booking confirmation / with a complete trip summary is sent to the user.
- **An E-ticket containing all the segments is also sent to the user via email.**
  - i. Brussel Airline Segments
  - ii. AccesRail segments covering SNCB/NS rail segmentFor both, a Check-in will be required before boarding.
- Two emails sent by Thales, for the purchase of products from both Amsterdam and Rome PTAs confirming for each PTA the status of the fare product delivery within each system. The delivery of the fare product may vary from one system to another and from one product to another (e.g. in a card centric scheme a multi-ride product will be delivered to the fare media of the customer by the mean of an action list. As a



---

result the user will not see its fare product on his/her fare media before this delivery is performed few days before the trip takes place).

#### Pre-Trip: Trip Tracker initiation

The system assumes, by default, that Mr. Smith wants both journeys (trips) to be tracked for him. The scope of AWT covers the tracking, but not the re-accommodation process, which would consist in re-allocating seats to the user for another travel option when his itinerary is broken. The tracking process is strictly similar whether it is a Co-modal or an Intermodal trip. With tracking active, Mr. Smith will be notified by SMS of all disruptions that may affect his travel in real-time.

For the demo, Master Tracker (MT) receives a request to track a trip (journey) from the POC1 simulator. The pre-agreed itinerary, similar to the one described before is sent to the MT by the POC1 simulator.

The MT then tracks the outbound journey and sends the track requests to the sub-trackers.

#### On-Trip (just demonstrated for one of the two Trips)

##### Outbound trip

The next step of the demonstration is to show the interactions on the very day of the trip. The next parts of the demonstration will be achieved on a pre-booked trip strictly similar to the one we just booked: On March 1st, M Smith travels from Amsterdam to Rome, for a business trip he booked one week in advance.

- 1) Within the hour before departure, the urban sub-tracker in Amsterdam notifies the MT that a metro service got cancelled due to reason X. MT receives the notification and checks if it impacts the connection times with the next leg. It does not, there are still metro services on the line that will meet the departure time for the next transport. Mr Smith is notified accordingly.
- 2) At his departure point in Amsterdam he identifies himself with his urban transport pass (simulated via mobile). The product that he booked previously is delivered to his smartphone, and the access to the transit network at origin is granted.
- 3) Arriving in Amsterdam Central Station, he takes a train to Brussels airport. His electronic ticket, as a home printed ticket, is validated with a hand-held mobile device.
- 4) During his journey, Bene sub-tracker notifies MT that there is a train delay affecting the rail booking (leg). MT pushes a SMS to the passenger to inform and reassure him the trip is still valid. He is notified that the outbound train he is currently on board should arrive 10min later at the airport. Nevertheless, his connection at Brussels is still guaranteed.
- 5) Finally, he arrives in Brussels airport, and flies to Rome airport. The boarding of the flight will not be specifically demonstrated.
- 6) At Rome airport, Mr Smith identifies himself to the local urban transport network (UT) with his EMV credit card, and reaches downtown Rome thanks to public transportation.

##### At Destination

At this point the traveller will receive any possible disruption on the network that affects his trip or segment of trip.

- 1) During his stay in Rome, Flight tracker notifies MT that the inbound flight has been delayed by one hour, and therefore his inbound itinerary is broken. The SMS text message that Mr Smith receives indicates that he needs to log in to AWT.com in order to re-plan and rebook



his trip back. The corresponding URL link is provided. The re-accommodation process is not part of the demonstration. But it could be further implemented by sending a new query to the multimodal journey planner to solve the rest of the journey.

- 2) MT stops tracking this trip since it is broken. The cancelation of the tracking is sent to all the sub-trackers. No more notifications for this trip.  
(The MT is prepared to receive updates and changes to a given trip. The limitation comes from the other POCs).
- 3) New events are triggered for Urban transport (UT), but nothing is sent to the Master Tracker.
- 4) POCs don't address re-accommodation. Mr Smith could book a new trip in AWT.com, and MT would receive a new trip plan (pre-agreed journey) for the re-planned trip home from the simulator as if POC1 had sent it after the passenger re-planned and rebooked his trip. Or he could just contact the support desk for AWT.com.

### Inbound trip

This is similar to the outbound journey, so no need to demonstrate twice the same thing.

### Background settlement process

Whatever the model (inter- or co-modal), relevant reporting and settlement information have to be exchanged amongst the legal entities, the distributors and the providers of any mode of transportation (air, rail or urban transit). This is to ensure that the right revenues are distributed amongst the travel providers at the right time, in line with tickets consumption.

- ➔ Reporting and settlement is always a batch process, which is not triggered by the transactions themselves, but on regular basis, following billing cycles. Consequently, this part of the demonstration will not be done "live". The consortium will show reports/files that have been exported/processed a few days before, for a pre-booked and flown journey. This will allow to extract and highlight the relevant information in these reporting files.

### Co-modal journey (Trip1):

- For all the co-modal settlement, the sending of ticket sales reports to the necessary settlement entity is a batch process (i.e. offline) which will report all the sales of the day. The 'ticket sale' transaction itself is sufficient for its inclusion in the sale reporting process: there is no need for any of the entitlements to have been consumed by the traveler for the sale to be reported.
- For the demonstration specifically, the travel agency is the party to be billed. N.B. some stakeholders may refer to the travel agency as the 'merchant' in this case, but we should be aware of different usages of this term: in one, perhaps more narrow sense, the concept of merchant is strictly linked to credit card payments and the fact that the payee is the 'merchant of record', against whose 'merchant ID' the credit card approval is sought and subsequent billing initiated under a 'Merchant Service Agreement' with an 'Acquiring Bank' as contracted by the merchant. In this sense, a cash payment does not really impose any need to identify 'the merchant'. In this respect, also, we encounter the term 'Agency Merchant Model' where a travel agency may take credit card payment against its OWN merchant ID, instead of using the merchant ID of the airline (for example)



meaning that the travel service provider will bill the travel agency for the full amount regardless of whether the customer paid with cash or by credit card. Note that in the traditional 'agency model' in the airline industry, customer credit card payments are made against the merchant ID of the validating airline, so that settlement with the agency consists (where the customer has paid with credit card) of crediting the agency with any commission due and NOT billing the agency for the cost of the ticket sale. Payment from the customer can be cash or credit card – and it has become a habit to refer to the travel agency, especially in the Rail Sector as 'the merchant' when the traveler payment is cash as well as with credit card, since in both cases the travel agency is billed for the full ticket revenue (minus commission) by the Railway Undertaking. Note that the issue of liability and responsibility is also complex and distinctions are to be made in legal terms between an agency selling on behalf of a travel service provider versus a Tour Operator who packages an entire product (hotel, travel, insurance) and who is at least responsible financially (in a primary sense of responsibility towards the customer).

- **AIR:** Classic BSP processing of RET file, with AIR content – BSP stands for Billing and Settlement Plan, which is the market level Management organization for the airline-agency settlement process established by IATA in all markets where IATA designated airlines operate: actual processing (rather than settlement policy management) is consolidated in two major global settlement centers, in Madrid and Beijing (historically a BSP data processing center had been attached locally to every BSP market management organization in the world). RET stands for Reporting File and is a simple reference to the IATA standardized format of the ticket sales reporting data interchange file which is submitted by IATA accredited distributors (e.g. GDSs) to the BSPs.
- **RAIL:** Bene will export invoice based on the contracts (tickets) established via AWT.com, and send them directly to the "AWT" travel agency
- **UT:** Amadeus creates the TIESS ticket sales file and sends it to IATA TIESS system (BSP-like, but designed specifically for non-AIR travel service provider ticket sales) for agency/retailer settlement processing.

→ **The files sent to IATA:**

- 1 RET file from Amadeus incorporating the Brussels Airlines sale
- 1 TIESS file from Amadeus on behalf of Thales (urban public transport sales) for Amsterdam and Rome Public Transport authorities.

→ **The files generated by IATA**

- 1 HOT file to SN Revenue accounting and to Thales (on behalf of both Amsterdam and Rome public transport authorities).  
N.B. no reporting file is necessary for BeneRail which has all the information of its stand-alone ticket sales internally and which runs its own agency/retailer settlement system.

*Intermodal journey (Trip2):*

- Travel agency settlement (Triggered by an offline batch BSP file submission on behalf of the validating carrier (Brussels Airline) but covering the full value of all



integrated travel service products, from BeneRail AND Amsterdam / Rome public transport authorities).

The validating carrier is SN airline. The sale will be with SN as a merchant. Amadeus sends a RET file to the BSP for classic BSP processing. Indeed, all the segments in the ticket are AIR-like content (Rail and UT content are simplified so that they fit in the AIR model: Dedicated airline codes for the PTAs, and fictitious location codes are used in the report for urban transportation segments).

➔ **The files sent to IATA:**

- 1 RET file from Amadeus

➔ **The files generated by IATA**

- 1 HOT file to SN Revenue accounting.

○ **Interline settlement (Triggered offline, after coupons consumption):**

In addition to the travel agency settlement, the coupons usage is tracked, so that interline ('intermodal') settlement can occur:

▪ SN flight consumption:

- After a SN flight status is changed to flown, SN E-Ticket server (ETS) sends a LIFT file (a file with all flight coupons in final status: FLOWN, CANCELLED, REFUND etc.) with the SN flown coupons to SN revenue accounting system.

▪ AccesRail (9B) rail segment consumption:

- After an AccesRail (9B) "flight" is consumed, AccesRail Departure Control System (DCS) sends a change of status message to AccesRail Electronic Ticket Server (ETS), AccesRail ETS, in turn, forwards this to the validating carrier's ETS (SN ETS, hosted by Amadeus) which will return a 'Settlement Approval Code' (SAC). Finally, AccesRail ETS sends a LIFT file with 9B consumed coupons and their SAC codes to AccesRail revenue accounting system for BeNe on behalf of SNCB/NS. The SN LIFT file includes the AccesRail used coupons so that SN revenue accounting system has a record of the partner flight coupons for which it will be billed.
- AccesRail revenue accounting then produces and sends the used coupons in an IS-IDEC to IATA Clearing House, in order to bill SN for AccesRail share of the ticket revenues which SN holds.

▪ Urban transportation segment consumption:

- No LIFT needed by Thales because their Back-Office system functions as both 'Electronic Ticket Server' and 'Departure Control System' for the Public Transport Authority.
- At first usage of the product, Thales sends the "flown" notification through the consumption tracking service to Amadeus Ticketing Gateway, which will interact with the validating carrier ETS (SN ETS, hosted by Amadeus) just as AccesRail ETS had done. Hence, Thales retrieves the SAC codes in return, and is able to generate the IS-IDEC files, and send them



to IATA Clearing House (ICH) to bill SN for the public transport used segment.

- Following the notification from Thales, Amadeus' hosted SN E-ticket server sends the consumed urban transportation coupons to SN revenue accounting in a LIFT file (exactly has it had done for the AccesRail (BeneRail) used segment).

→ **The files sent to IATA Clearing House (ICH):**

- 1 IS-IDEC sent by AccesRail revenue accounting
- 2 IS-IDEC sent by Thales (One for each PTA, 2D and 2Z, representing Amsterdam and Rome 'airline' Public Transport Authorities)
- ICH then performs the net-settlement processing captured in the following output files :

→ **The files generated by IATA Clearing House (ICH)**

- One validation report for each IS-IDEC in input
- One output IS-IDEC, to be sent to ICH clearing bank to actually effect the electronic fund transfers from SN to AccesRail and PTA bank accounts.\*

*\*Note: The SIS files are therefore produced only when, and if, the travel service segment is consumed (not booked). There is no impact if one leg is rebooked, it will only ever be populated on this file once it is eventually consumed.*

### Background: Travel Entitlement Consumption Management for Intermodal

Travel entitlement management is an essential feature of any intermodal travel product which combines the services of different modal-transport operators: under a commercial agreement between the travel services providers themselves, on the one hand, and under a single transport contract with regards the customer, on the other.

Typically, there is a lead partner (validating carrier), who takes financial responsibility for the Intermodal Travel Entitlement purchase including the authorization for any post-sale transacted financial changes (cancellations, refunds, exchanges). As we have seen in the above description of the background settlement processes, the logic for this financial responsibility stems from the fact that the lead partner (validating carrier) sits on the full trip 'ticket revenues' (following settlement with the retailer) until billed by their intermodal partners, and therefore holds the power to refund the trip, for example, if no part of it has been travelled.

As such, the same 'coupon usage' message exchange mechanism which triggers intermodal billing (see previous section), is used by the lead partner to authorize/reject post sale transactions on an analysis of the status of the 'coupons' (segments of the journey) for the entire trip.

Coupon control starts with the validating carrier in 'Open' status, and each coupon is either pulled by, or pushed to, the relevant partner Travel Service Providers (TSP) as a function of when that partner needs to have operational control of their segment's coupon (or travel entitlement): e.g. an airline requires operational control (local access) to the coupon in order to assist check-in operations at an airport and this normally occurs 48 hours prior to departure time : local control means a working copy of the coupon is actually downloaded to the departure control system so that airport check-in operations can continue even if there is a problem with external connectivity which would otherwise prevent access to the coupon : this is essential for key operations such as validating



---

passenger travel entitlements, checking-in, boarding, and, of course, for allowing the TSP to stamp the status as 'flown' after the passenger has travelled.

Intermediary statuses may be, consequently, assigned by each of the Travel Service Providers: e.g. these include intermediary statuses such as 'Airport Control', 'Checked-In' or 'Boarded' (to take some Air sector examples) as well as the final status 'Flown' (Used).

Other non-used final statuses, such as 'Cancelled', 'Refunded', 'Exchanged' are set by the validating carrier itself (since they have financial repercussions) and communicated to the partner Travel Service Providers.

In short, if the validating carrier receives a Ticket Cancellation request (for example), their job is to check that the status of all 'coupons' (segments) are 'OPEN' (initial status for each segment). If this is the case, they will authorize the transaction, since they can be confident that no travel has been consumed. Should any final status (e.g. Flown, Cancelled, Exchanged, and Refunded) be identified, the validating carrier would reject this transaction. Should any intermediary status be identified (such as 'airport control', for example, a request is sent to the relevant TSP's Electronic Ticketing Server, to retrieve control of the coupon from local control. Sometimes this is possible e.g. the coupon has been downloaded to local control, but the passenger is not yet checked-in: so the coupon can be returned, and it assumes its original status as 'Open' and the cancellation may then be authorized. On the other hand, if the locally assigned status shows that the coupon is already checked-in or boarded, the authorisation for the cancellation will be refused, because by that stage it is too late to stop the passenger consuming the entitlement and the status changing to 'Flown' (used).

This entire mechanism, based on interoperability between the partner TSPs, is essential for combatting fraud (submission of a passenger cancellation or refund request, during or after the entitlement consumption).

In the demonstration, we should give the above explanation verbally since it cannot be demonstrated in our POCs (post-sales transactions out of scope).



---

## 4. POCs implementation

In the tender, the consortium proposed a set of POCs based on a common architecture ensuring interoperability between the shopping, booking, payment, ticketing, settlement and trip tracking systems of the consortium members.

Our implementation approach to link those different entities and ensure efficient operations between them was to set a series of workshops to start understanding mechanisms and deliveries of each system, which data type they are managing, what are the processes and particularities for each transport mode, and start to elaborate potential solutions to address multimodality.

We had around 10 iterations of 1 to 2 days face-to-face workshop, starting during phase 1 in anticipation of phase 2 kick off. It allowed the group to draw in details the final architecture and the different existing functional blocks involved plus the interfaces we needed to develop. This design exercise was based on strong collaboration, knowledge sharing, and merging expertise. We found it the most efficient way to achieve our goal.

We produced not only the POCs overall design, but also a stronger structure of our project organisation. We created different streams, with leaders to manage the POCs implementation, all of them managed by our project manager. Streams and leaders are:

- Technical stream: led by Amadeus, responsible for all technical aspects. Each company named also a technical responsible to liaise with the Technical Leader and formed the technical group
- Business stream: Led by Amadeus, in charge of all business related topics and their interactions with the POCs and of the choreography of the POCs
- Demonstration stream: Led by BeneRail, responsible for organising the live demonstration

Based on the same approach, the technical group had several regular and calls meetings (weekly, bi-weekly, and monthly depending on the period of the project) to create the structure and design of each POC.

Once the solutions have been designed for each of the POCs, the tasks of development, specifications, testing and integration have been divided into several releases. This has been achieved in waterfall methodology.

It is important to focus on the testing and integration steps, which were a challenge, knowing the number of people involved in the development activities.

### Test strategy

Several levels of tests have been used to split testing phase into logical phases and to set clear boundaries for each level of testing.

First, each development were covered by unit tests under the developer's responsibility.

In addition, each module and associated functionality was validated by functional tests (please refer to the list of modules in section 3.2.2), still under the responsibility of the development teams. In case the feature relied on a service provided by another team, mocked answer were used to reduce dependencies, before the integration.

In the meantime, links connectivity tests were handled by the teams responsible of the applications that called services exposed by other modules.





---

Then, we entered the integration phase.

### Integration strategy

The internal functional validations, the integration test plans, and the link connectivity were ready before the beginning of integration tests.

As the first release did not contain all the modules, it was not feasible to have global integration testing, from a customer point of view. However, there were several interactions between modules, or between systems that could already be tested, by simulating requests in input of the calling module.

Consequently, integration tests for the first release were under the responsibility of each “Calling application” (For example, Amadeus ticketing gateway was responsible of testing the integration, including the call to Thales Back office).

In the specific case of the file export (The settlement files exported by Amadeus to Thales, for instance), the validation of the file was handled by the Application that receives and decodes the file (In our case, IATA).

For the second and third releases, most of the modules and the UI were ready for testing, so there were some end-to-end testing, under the POC owner responsibility:

- Amadeus handled the integration testing for POC1.
- Thales France handled the integration testing for POC2. (Knowing that a part of POC1 and POC2 are merged, so the tests were done collaboratively, to complement each other and cover the whole scope)
- Thales Portugal handled the integration testing for POC3.

A demo test plan described all the end-to-end tests required to covers the features that were to be demonstrated during the demonstration to the European commission.

## 4.1 POCs Design

### 4.1.1 POC1 Design

The aim of POC1 is to demonstrate a system of reservation for door-to-door multimodal journeys, including the steps of search, booking and confirmation through a One-stop shop web site, and the reporting and settlement features related to this reservation.

The POC1 covers an important part of the distribution activity. It can be divided into several steps:

- Steps covered by the user interface:  
*These several steps are triggered through the UI of the shop web site, and the action is visible from the traveller point of view.*
  1. Login (Customer identification)
  2. Shopping (The search of priced available journeys)
  3. Booking (The selection of a solution)
  4. Contract establishment and payment (With the Travel providers)
- Step not covered by the user interface:



---

*These several steps are back office processes, which are not directly visible from the UI of the shop web site. Indeed, it would make no sense to view the settlement processes between the different travel actors from the traveller point of view, for instance.*

5. Ticket issuance (For relevant contents. Output visible through email)
6. Travel Agency Reporting and settlement (Report of the sales of a given period)
7. Intermodal Reporting and settlement (Report of the consumed coupons)

The complete solution for both co-modal and inter-modal flows uses several new external interfaces:

- Amadeus – Bene: Journey planning service through forwarding service
  - Used in order to find rail travel solutions, for the part of the journey where rail transport mode is a relevant option.
- Amadeus – Bene: Shopping service
  - Used to retrieve the available fare for selected rail segments
- BeNe – AccesRail: Shopping Interface
  - Used to distribute Bene content through AccesRail solution for intermodal
- Amadeus – Bene: Contract establishment
  - Used to purchase rail segments through Bene, with 1-step booking flow (One transaction to book and confirm)
- BeNe – AccesRail: Booking Interface
  - Used to distribute Bene content through AccesRail solution for intermodal
- Amadeus – Thales: Product catalogue (Simulated link with POC2)
  - Used to retrieve the Fare product catalogue of each PTA.
- Amadeus – Thales: Contract establishment (link with POC2)
  - Used to purchase public transportation fare products from one of the PTAs.
- Thales – Amadeus: Flown interface (link with POC2)
  - Used by the PTA to notify the validating carrier (Brussels Airlines) that the public transportation fare product has been consumed.
- Thales – IATA: Settlement interface (simulated link with POC2, intermodal only)
  - Used for the reporting and settlement.

Please refer to the overall architecture diagram (section 3.2.1) to have a better view on the interactions, and internal components.

The following sequence diagrams provide in detail the way and the sequence of these interface invocations.

### [Journey planning](#)

The use case below illustrates the journey planning is being executed in POC1.

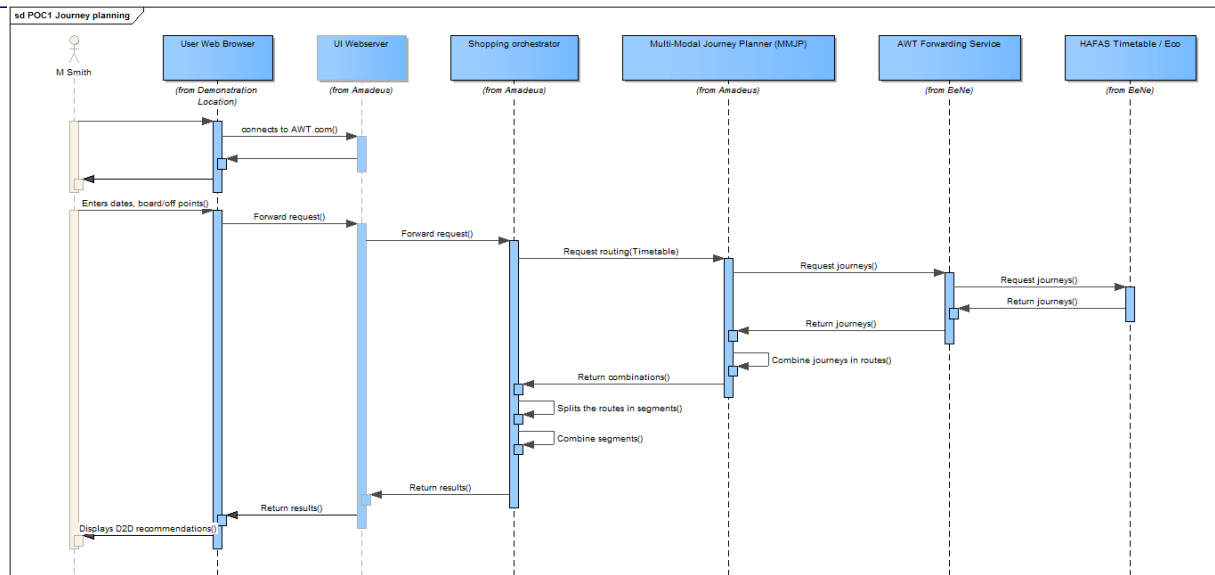


Figure 1 – POC1 Journey planning

### Shopping

Mr Smith wants to book his mono passenger Rome trip online. He connects to AWT.com website. In the search panel, he enters his departure and return dates, as well as board/off points and preferences. The default behaviour is to display the list of recommendations sorted based on a value defined by AWT.com. The Door-to-door recommendations (displayed on 1 readable page) are mixing flights & urban segments or flights & trains & urban segments, and connect through different European multi-modal hubs (e.g. via Brussels). Each recommendation includes available prices and fare conditions. Some are flagged as co-modal (Text displayed: Connection unsecured - he would have to handle himself the risk of misconnection), whereas some others are flagged as inter-modal (Text displayed: Connection is secured - there is an interline agreement amongst the carriers), and some other are mixed (e.g. inter-modal outbound and co-modal inbound)

The scenario below illustrates the co-modal shopping scenario in POC1.

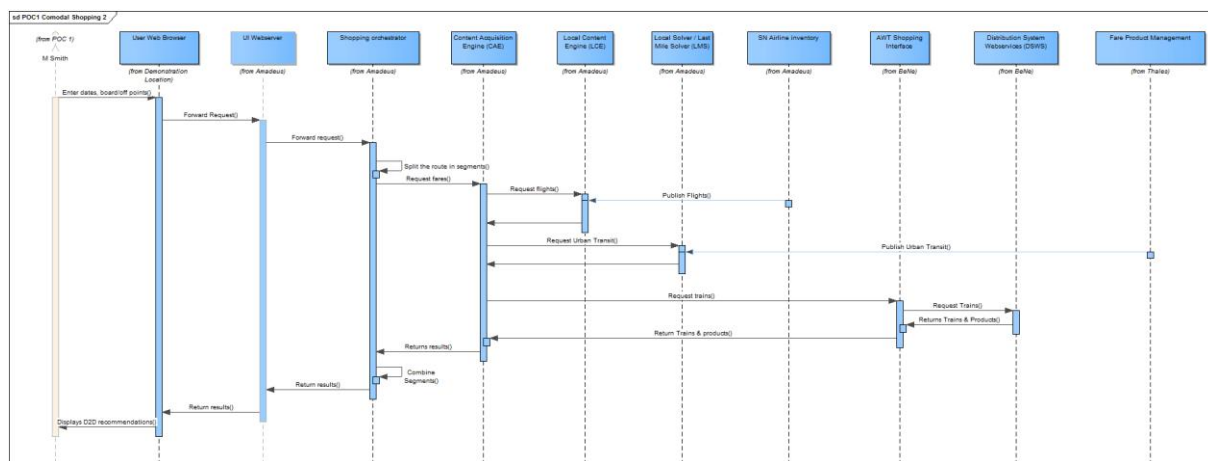


Figure 2 – POC1 Co-modal Shopping

The scenario below illustrates the co-modal shopping scenario in POC1.

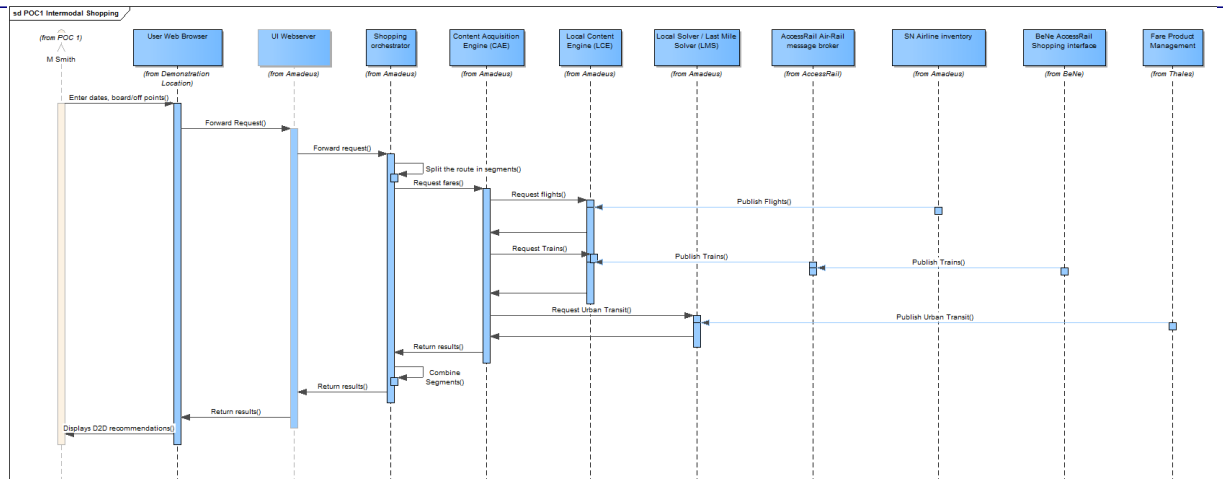


Figure 3 – POC1 Intermodal Shopping

### Booking

Among all the recommendations offered, Mr Smith selects a co-modal recommendation for a door-to-door multimodal journey. The complete journey is a juxtaposition of Brussels Airlines flights, SNCB/NS trains, and Urban transits in Amsterdam and Rome, purchased in a co-modal way. At the end of the scenario, Mr Smith receives his booking confirmation, with a different e-ticket per segment.



- **Co-modal booking**

The use case below illustrates the co-modal booking scenario in POC1.

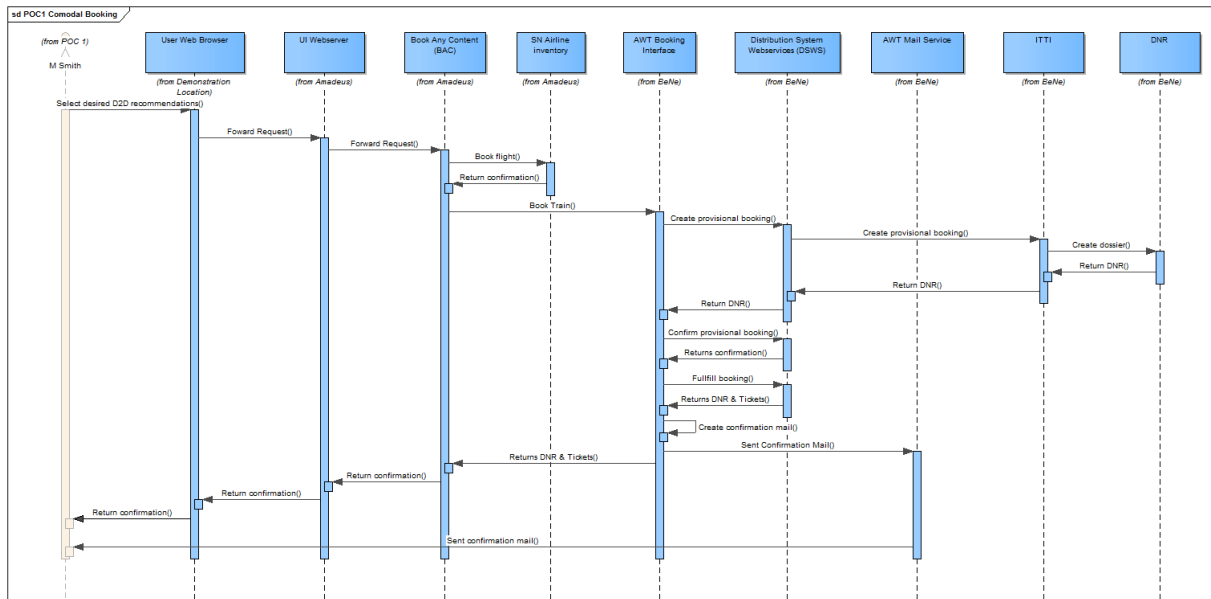


Figure 4 – POC1 Co-modal Booking

- **Intermodal booking**

The use case below illustrates the intermodal booking scenario in POC1.

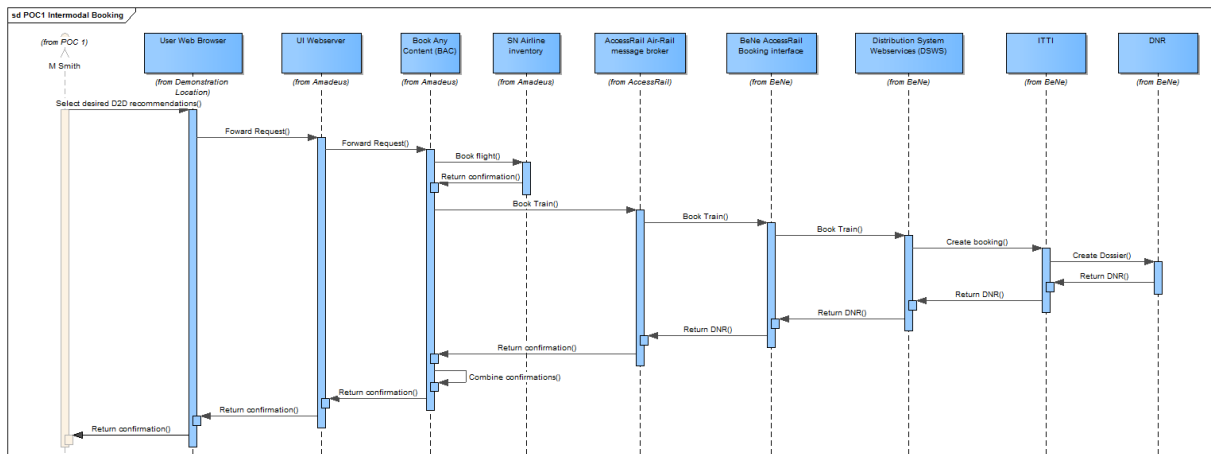


Figure 5 – POC1 Intermodal Booking

This scenario is similar to the co-modal booking scenario, but this time the complete journey is an integrated solution with Brussels Airlines as the validating carrier, Access Rail (acting as operating carrier on behalf of SNCB/NS railway operators), and Urban transits in Amsterdam and Rome. At the end of the scenario, Mr. Smith receives one global booking confirmation / with a complete trip summary and an E-ticket containing all the segments is also sent to the user via email.



### 4.1.2 POC2 Design

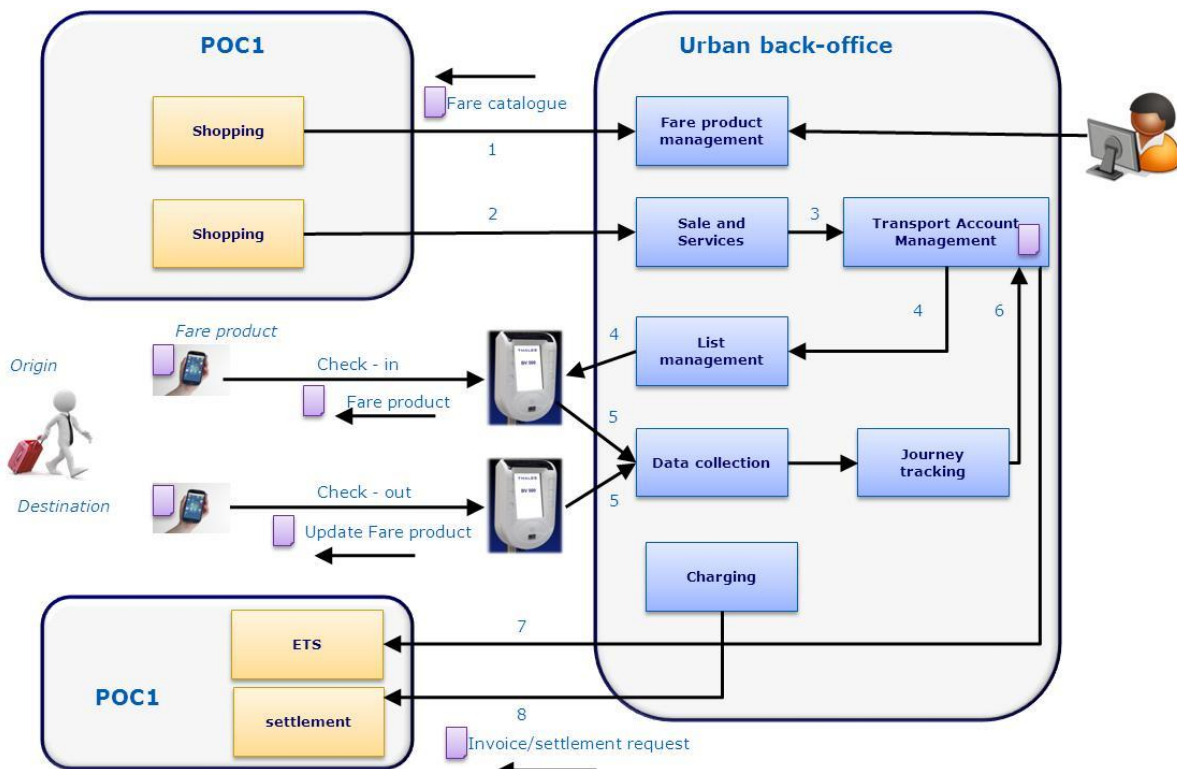
POC2 is sharing 4 external interfaces with POC1:

- Contract establishment: this interface allows POC1 subsystem to register PTA products sold to the travellers (In AWT it is the PTA that sells the product)

In an international pan European multimodal travel context, the traveller shall travel through several urban network segments operated by distinct PTOs. The risk for such a customer to misuse a fare product in a given urban segment does exist, impacting the way the PTOs get finally paid. In addition and knowing PTO networks are often interconnected without complex access control mechanisms in place to prevent the use of a particular PTO network with the “wrong” fare product, the usage of one PTO product may lead to generate fraud/misuse on another PTO network. In AWT, it has been decided to restrict fare products to PTAs products, integrating in its pricing the cost associated to the risk described above. The clearinghouse settlement process is defined and mature enough for this range of products.

- Product catalogue : this interface allows the POC1 subsystem to get the PTA fare catalogues,
- Settlement request : this interface allows the POC2 subsystem to get the invoice files generated by PTAs in order to proceed with global invoicing, Applicable to intermodal mode only, not applicable to co-modal)
- Flown interface: this interface allows POC2 to inform POC1 subsystem that the urban travel sold has been actually consumed.

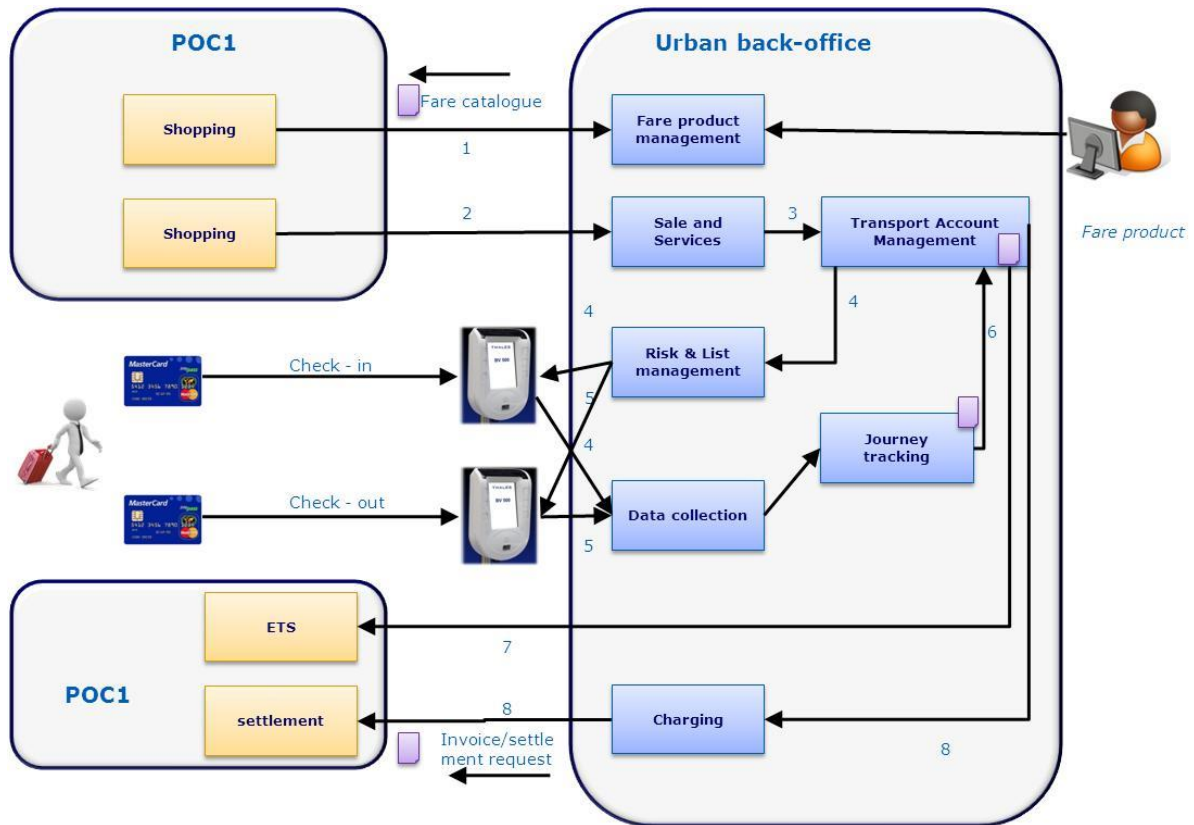
The following sequence diagrams provide in detail the way and the sequence of these interface invocations. Specificities are introduced according to the “back-office centric” or the “card centric” mode which is applied.





**Figure 1 : Card centric use case detail**

1. Requesting Urban catalogue
2. Notify sale
3. Updating traveller's data
4. Product distribution
5. Transaction collection
6. Update traveller's account
7. Flown message
8. Invoice/settlement request



**Figure 2 : Back office centric use case detail**

1. Requesting Urban catalogue
2. Notify sale
3. Updating traveller's data & product distribution
4. Risk assessment & distribution
5. Transaction collection + PCI DSS EMV data
6. Update traveller's account
7. Flown message
8. Invoice/Settlement request



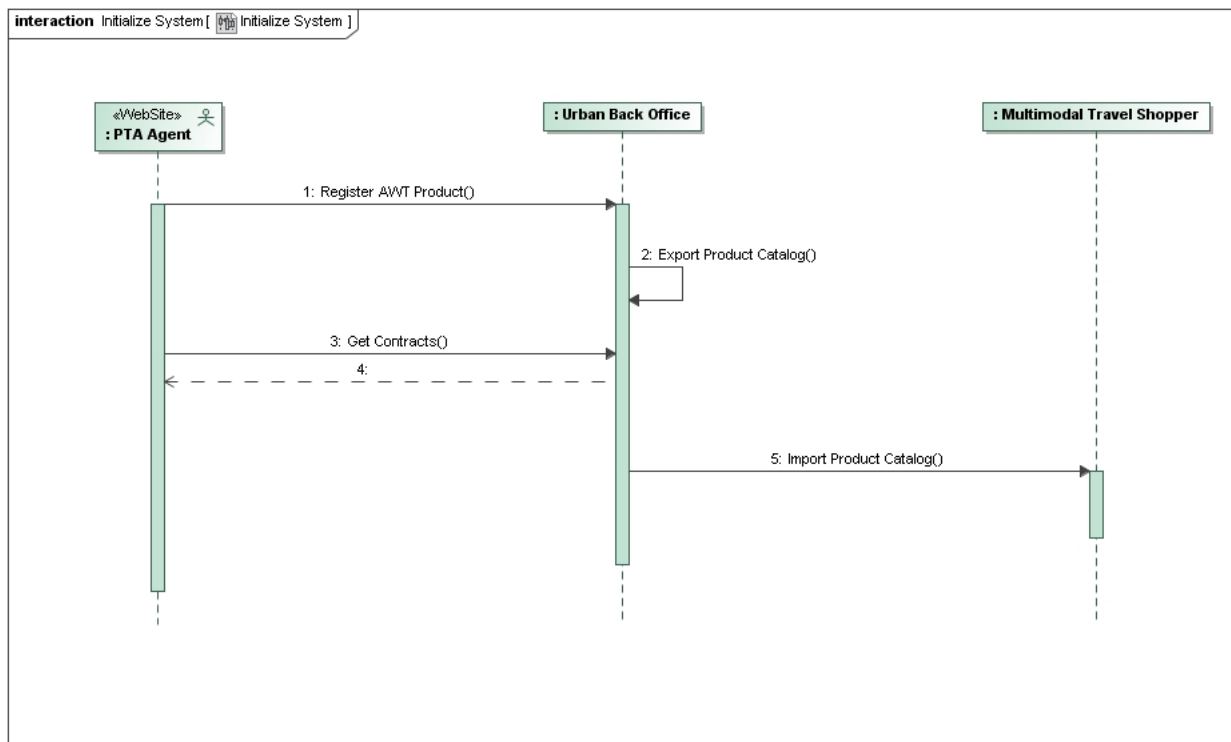
One of the main difference between the card-centric and the account-based approaches is around the way the financial risks are managed from the operator prospective. A card-centric approach introduces minimum risks for the operator since by definition the card used to enter and exit the urban network is securing the Fare Product consumption by providing a secure mean to reconstruct the traveller's urban segment. In an account-based approach, payment and settlement processes are triggered at BO level once the traveller has completed his urban segment and possible after it misused its fare product introducing post-travel complex revenue collection processes. It provides more flexibility to the traveller but it is introducing more risks risk to the operator.

In the AWT POC2, both approaches are addressed.

## POC2 detailed design

### Initialize System / Products

The use case below illustrates the system initialization before product sales: the PTA Agent can register new products through the Urban Back Office Web site. The PTA Agent can visualize all the contracts associated to each products of the catalog. The Multimodal Travel Shopper is receiving the new product catalogs (each time a PTA has modified them). They can then be sold by the Multimodal Travel Shopper

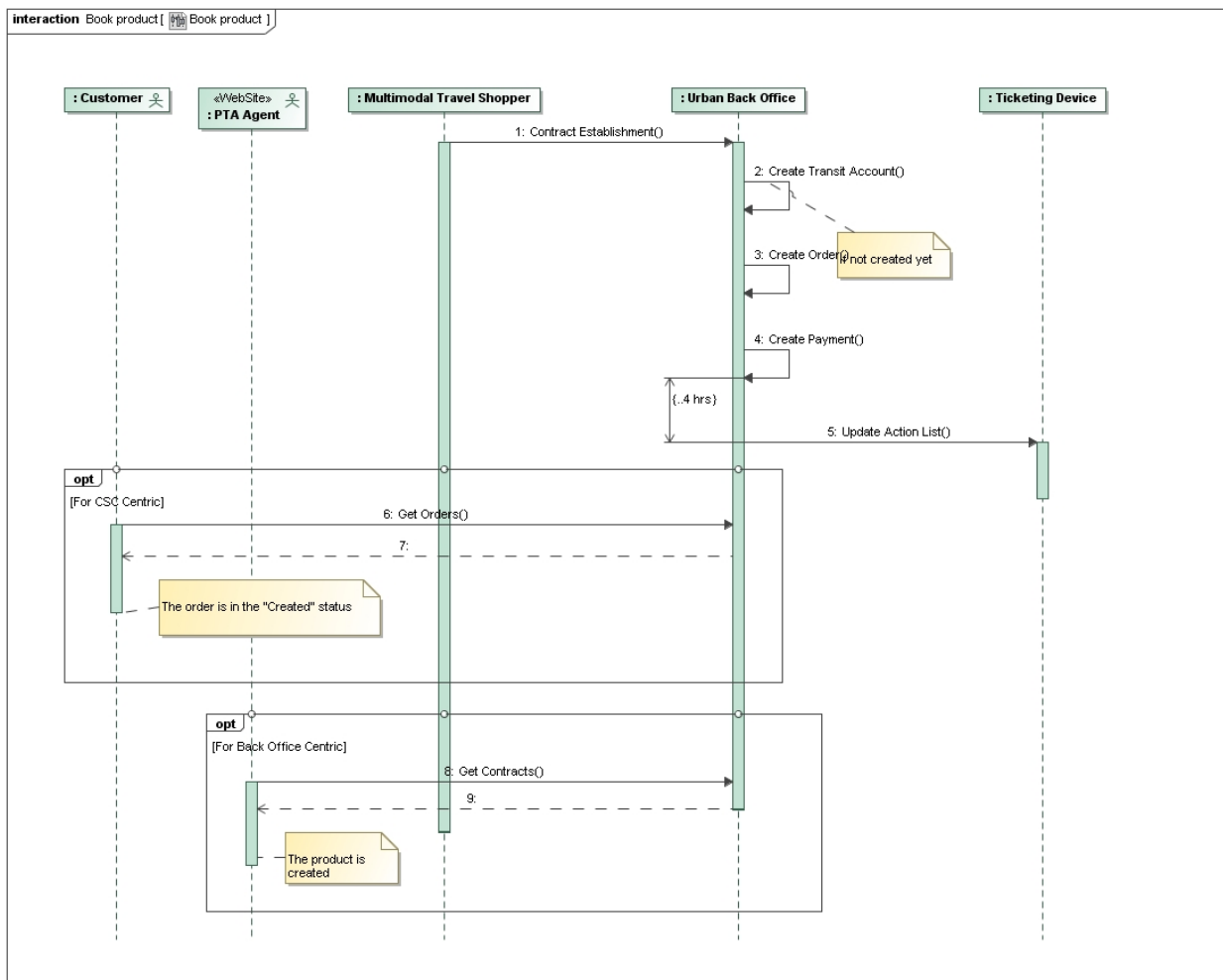






### Book PTA product:

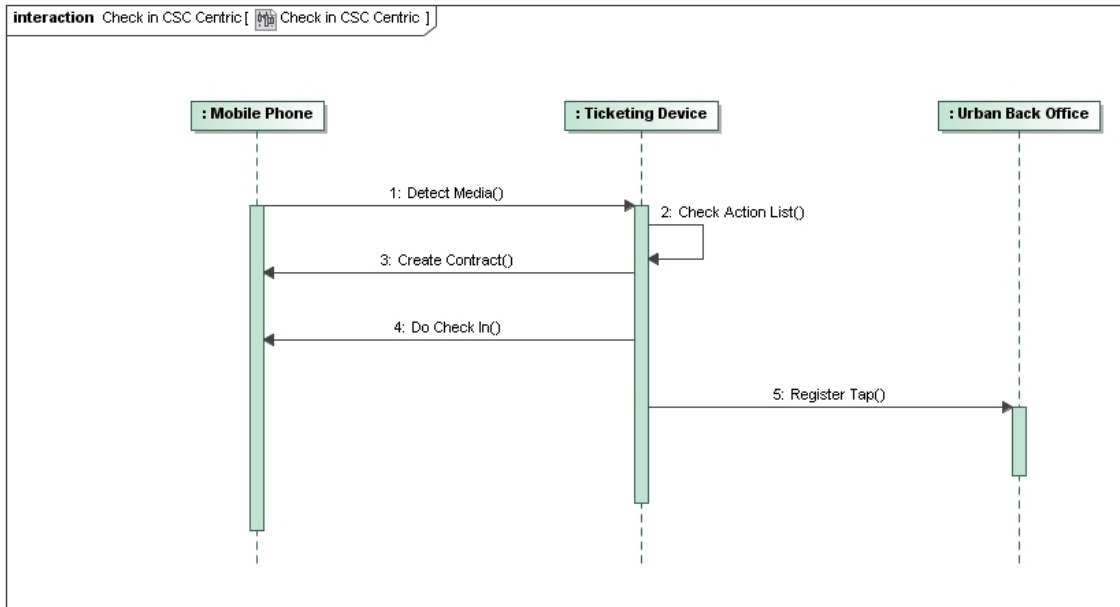
The use case below illustrates the way the PTA products are booked by the Multimodal Travel Shopper from POC1. The Multimodal Travel Shopper (POC 1) calls a Web Service of “Contract Establishment” on the Urban Back Office (to order a product). Then the sold product is sent to the “Ticketing Devices” through “Action Lists”. This allows the Customer to consume his product when he presents his media on the ticketing Device such as a Validator in Metro Station.





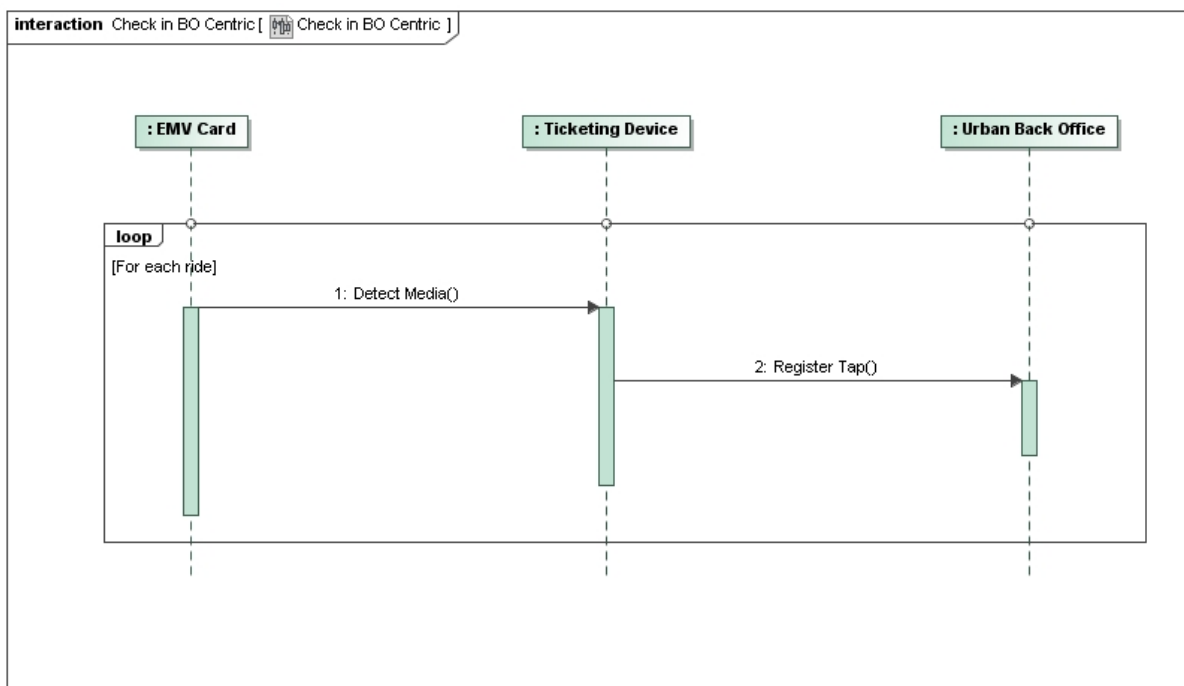
### Check in CSC Centric

The use case below illustrates in detail how the customer check-in is managed at POC2 level when in card-centric mode. His media for validation is his Mobile Phone with HCE (Hardware Card Emulation) through SIM based secured element.



### Check in BO Centric

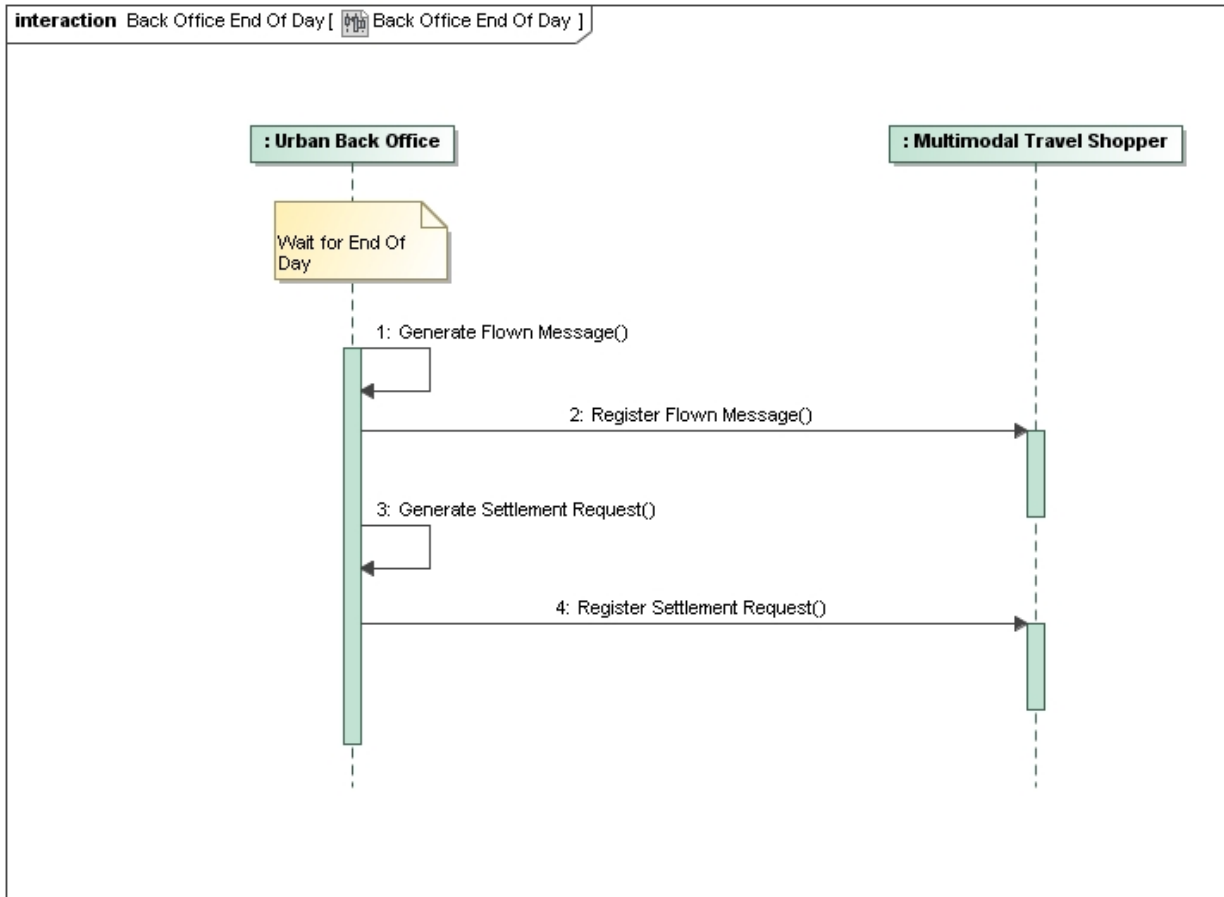
The use case below illustrates in detail how the customer check-in is managed at POC2 level when in back-office centric mode. His media for validation is his own EMV Card. It's the same EMV card that was used when booking his travel with the Multimodal Travel Shopper (in POC1)





## Back office batches

The use case below illustrates the batch activities performed by POC2 to generate and transmit Flown (product consumption) and settlement documents. These batches can be triggered periodically (once a day could be enough for daily financial consolidation)





### 4.1.3 POC 3 Design

POC3 delivers trip tracking service. It shares an interface with the POC1, so that it can receive the trips purchased in POC1.

For each trip, it identifies the legs and requests the different providers' reports on changes or altercations on their legs. The following picture provides an overview of the design:

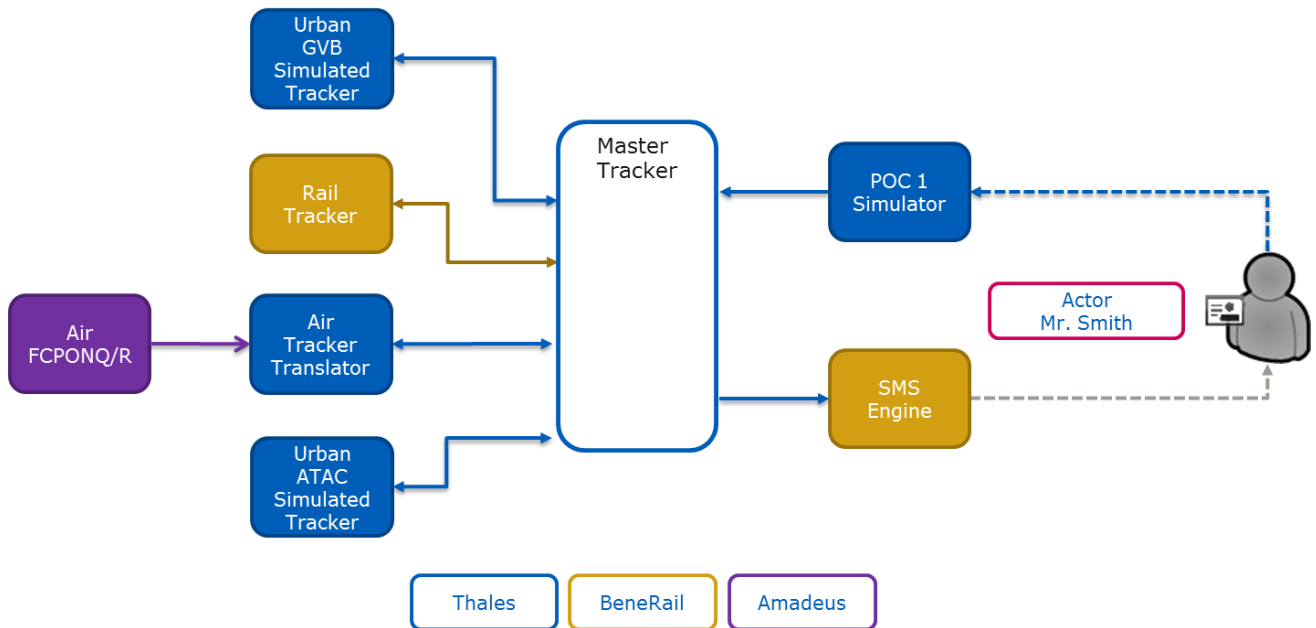


Figure 1 - POC3 Overall design

The following picture is a component diagram with the communication flow, including inputs and outputs. They represent the same mechanisms with different level of detail.

The Master Tracker has been created to orchestrate the Trip Tracking activity. It receives the details from the trip of the passenger (Mr Smith) sent by POC1.

With the trip details, the Master Tracker subscribes from all the different sub-trackers notifications on any change on relevant disruptions. In order to use existing Air Notification service, a specific Air Tracker translator has been implemented.

The passenger (Mr Smith) is notified by a GSM SMS Engine when there is any change on his itinerary.



POC3 scenario

The use case below illustrates the POC3 interruption scenario.

Mr. Smith wants his trip to be tracked for him and whether it is a Co-modal or an Intermodal trip, the Trip Tracker behaves the same way. With tracking active, Mr. Smith will be notified by SMS of all disruptions that may affect his travel in real-time.

The Master Tracker (MT) receives a request to track a trip (journey) from POC1. The pre-agreed itinerary, similar to the one described before is sent to the MT by POC1.

The MT then tracks the outbound journey and sends the track requests to the sub-trackers.

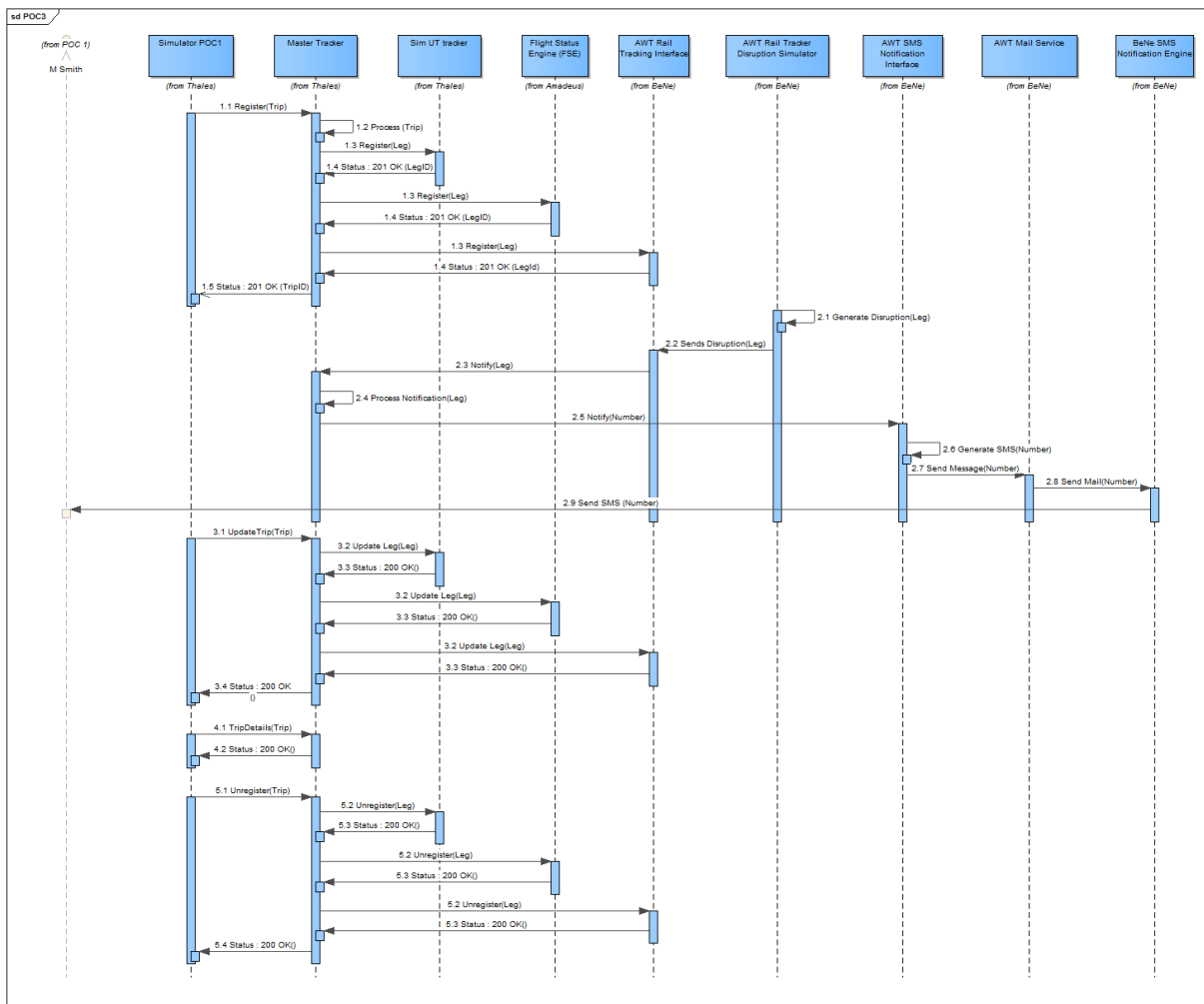


Figure 2 - POC3 Sequence Example

1. Register Trip
  - 1.1. POC1 Simulator registers trip with Master Tracker
  - 1.2. Break down trip in different legs
  - 1.3. Register different legs with corresponding sub trackers
  - 1.4. Returns successful leg registration to Master Tracker
  - 1.5. Master Track returns successful trip registration to POC1 Simulator



- 
2. Generate Disruption
    - 2.1. Disruption simulator generates a disruption
    - 2.2. Disruption simulator sends to Rail Tracking Interface
    - 2.3. Rail tracking interface notifies Master Tracker
    - 2.4. Master Tracker determines impact of disruption on entire trip
    - 2.5. In case of impact on trip, Master Tracker invokes the Notification Service
    - 2.6. Notification Service generates an SMS
    - 2.7. Notification Service contacts the Mail Service
    - 2.8. The Mail Service forwards the Mail to the SMS Notification Service
    - 2.9. The SMS Notification Interface notifies the customer by SMS
  3. Update Trip (Not implemented in POC3). This could be done the following way:
    - 3.1. POC1 Simulator sends update on trip details
    - 3.2. Notifies corresponding sub tracker of updated leg
    - 3.3. Returns successful leg update to Master Tracker
    - 3.4. Returns successful tip update to POC1 Simulator
  4. Retrieve Trip Details
    - 4.1. POC1 Simulator requests Master Tracker for overall trip status
    - 4.2. Returns trip details to POC1 Simulator
  5. Unregister Trip
    - 5.1. POC1 Simulator sends annulation/cancellation request for trip to Master Track
    - 5.2. Master Tracker notifies the different sub trackers of the annulated/cancelled legs
    - 5.3. Return successful leg registration to Master Tracker
    - 5.4. Master Track returns successful trip annulation/cancellation to POC1 Simulator



## 6 Looking Forward

### Overall distribution perspective

#### *Multimodal content aggregation and distribution*

The AWT POC demo proves that technology can radically enhance customer adoption of comodal travel solutions:

- Because it reduces customer time-spent, effort, and risk:
- Instead of visiting several sites, the customer is able to search for D2D solutions in a single site (time-spent)
- This also allows for automated comparison shopping whether on price, total travel time, or number of connections (time and effort)
- The aggregation of travel content and journey planning saves the customer from the task of calculating the feasibility of comodal travel connections (effort)
- The aggregation and contextual treatment of booking, payment and ticketing processes reduces the risk that the customer fails to secure one or more segments of their planned journey (risk)

The POC demo exercise suggests, nevertheless, that for comodality further research is required in at least the following areas.

#### **The scalability of interoperability**

Interoperability between our supply chain links for Rail and Urban was achieved only by creating new, bilateral interfaces for shopping, booking and ticketing

Comparison of the small scale of the AWT eco-system with a Pan-European equivalent suggests that the business case aspects of such scalability needs further examination from the cost angle

Further research and analysis of the interoperability problematic in terms of standardisation versus a semantics-based approach would be a worthwhile investment

#### **Passenger Rights**

Whilst technology can help in many areas, it cannot tackle the big weakness with comodal travel solutions: that the passenger has no real protection from the effects of missed connections caused by service disruptions.

Passenger rights regulations only address this problematic when it occurs between segments within the same transport mode. An approach to establishing passenger rights across modes is essential, but one which is sensitive to the inequities between the modes in terms of value of services offered (ticket prices) when seeking to establish liability.

[The AWT POC demo has shown that technology can deliver an Integrated Ticket across Air, Rail and Urban transport modes in a way not yet seen in the market-place.](#)

Although the Air-Rail portion of this three-mode Integrated Ticket relies on a Rail aggregator (AccesRail) appearing as an Airline by developing the full set of IATA standard messaging, from shopping through to ticketing, AWT has managed to show how Urban Transport can be incorporated:



---

Using only dummy IATA airline designator codes and city location codes; and, compliance with IATA standard messages for only the Travel Entitlement issuance and consumption management step (and not other upstream airline messaging standards).

Since the investment required by the full-scale 'conversion' to an airline is so heavy, this comparatively cheaper innovation to achieve the same result is a promising one.

The AWT Integrated Ticket achievement suggests that further research could be fruitful in the following areas:

- **Research into multimodal passenger flows** – as the AWT Phase 1 study pointed out, current travel statistics tend to align with the silo structure of the separate transport markets. We can know how many people took a train, or a plane, but we do not know whether the passenger who took the plane also took a train on the same journey, or also rode on public transport.

Research into a scientific method of collecting multimodal passenger flow data could result in valuable insights into the business opportunities for providers of combining their services with intermodal partners to exploit those flows to their mutual benefit.

- **Research into an Integrated Ticketing Standard** which did not depend upon the conversion of one mode into another, but which remained compatible with the Airline Interline e-Ticketing standard might produce a new and less costly technology which would complement heightened awareness of intermodal business opportunities as described above, and help promote Integrated Ticketing to a greater extent than is currently the case.

### Collaboration!

The need for collaboration between stakeholders from the different transport sectors was a strong theme of the AWT Phase 1 study.

It is clear that the level of collaboration required to pursue the afore-mentioned research areas for both comodality and Intermodality, as suggested by our AWT POC demo today, will not occur naturally in the market-place.

This suggests some possible directions for the application of seed-bed funding strategy/policy at Commission level in order to stimulate the necessary collaboration in its pursuit of the 2011 white paper on transport vision.





## Rail perspective

### Technical challenges

Aggregating content from Rail Service Providers on a European scale is a major challenge today. Accessing full carrier content requires direct inventory access through proprietary interfaces. A multiplication of proprietary interface connection requires heavy investment and will be seen by most retailers as a prohibitive cost.

Industry initiatives, like the Full Service Model initiative (FSM), aiming to standardise interfacing between Rail Service Providers and all actors in the distribution chain can lead to:

- lower integration cost
- all sales channels (railway's own sales channels and third party retailers) accessing more content
- attracting more IT and Retail service providers into the Rail market

### Standardization and data access

The exchange of planned Timetable data between Rail Service Providers is currently managed within the UIC-MERITS frame, resulting in an integrated data-set delivered to and used by 32 members.

Planned timetable data exchange with third parties is currently possible, based on an agreement between MERITS members (the MERITS MOU) allowing access for third parties to 'calculated timetable data', typically obtained via a request to a journey planner under the control of a MERITS member.

Next to that, individual Rail Service Providers have setup bilateral agreements with online retailers and content aggregators to provide raw (none calculated) timetable data for their own rail services.

For retailers operating on a European scale, this leaves the option to make an agreement with a MERITS member under the terms of the MERITS MOU or to integrate timetable data from separate rail service providers.

Expected improvements for European wide timetable acquisition would rely on TAP/TSI implementation and completion or an updated multilateral agreement for timetable data provision, e.g an updated MERITS MOU, more tailored to multi modal journey planning needs.

Regarding **real-time data**, standards for data exchange between Rail Service Providers are available. A central integration point where data from multiple RSP's is matched with planned timetables/schedules on international rail journeys is not readily available on a European scale.

It exists on a smaller scale within the Railway alliance, based on multilateral agreement both on data provision and usage and on the joint management of a centralised integration tool, provided by Hacon.

Collaboration on a larger European scale would be required as well as the use or development of centralised or decentralised integration tool(s).



### *Inter-modal: advantages and challenges of the business model*

Inter-modal collaboration between air and rail operators can bring clear benefits on certain routes where airports are linked to long distance railway lines :

- it facilitates air & rail operators in developing a seamless, high quality and (high speed) inter-modal offer, directly connecting city centres, via airport-hubs
- allowing airlines to reach more catchment areas with (high speed) rail services, a cost effective and environmentally friendly alternative to short haul feeder flights
- allowing railways to attract extra passengers on long distance routes

During the demo, only one route was focussed on. Questions arise if the POC setup could be easily expanded without changing the whole framework.

One question is if the number of rail segment that are done before the flight is actually manageable taking into account e.g pricing, settlement and other product rules.

If the rail partner in the air-rail business partnership is able to propose products on a 'rail-network', covering more than one train segment, it is manageable to include this in the inter-modal product setup.

Actually, for the Benelux market, solutions exist where there is are not only air-rail product that are covering the main Intercity segment from airport to city centre along that route but also products that cover geographical zones, allowing passengers to change trains from the Intercity segment to other (local or regional) trains .

Regarding the potential network of airlines that could be connected, the question arises if extension is technically and commercially feasible.

The business agreement as demonstrated here in AWT is an airline standard 'interline agreement' between Brussels Airlines as an airline and marketing carrier and SNCB/NS as railway operating carriers, represented by AccesRail. In the 'interline agreement', it can be stated if the agreement only applies to SN operated flights or if this could also include all other interline partners of Brussels Airlines, potentially with differentiated price levels.

There is a technical pre-condition, i.e. that every interline partner needs to have the necessary interline system-links in place with AccesRail. This is the case today for +100 airlines.

But inter-modal collaboration comes with important challenges still.

A major business requirement of air & rail operators is to facilitate 'free flow bookings' and seamless travel for Air-Rail passengers. This requires important IT investments for the railway partner to adopt/imitate the airline shopping, booking, ticketing and back-office processes to match those of the airline business partners

Next to the alignment of IT capabilities, the gap needs to bridge between business processes and procedures of airline and rail environments, e.g.

- managing different booking horizons
- settlement based on moment of travel (flown coupons in air environment) instead of moment of confirmed booking (ticket creation in railway environment)
- different regulations on passenger rights etc.

For railways to engage and invest in such a business partnership there needs to be a clear view on the longer term business potential and a clear understanding of business risks.



---

In order to better estimate the business potential, more data on multi-modal travel patterns are needed. European data gathering initiatives would be recommended.

For a better understanding of business risks in multi-modal partnerships, cross-sector collaboration should be fostered in order to share best practices and templates for multilateral business agreements. This could replace the current practice of establishing and negotiating bilateral agreements.

The IATA Travel Partners Standards Council is a platform that aims to improve such cross-sector collaboration.

Also FSM (and IATA NDC) initiatives have an ambition to improve multi-modal integration.

The question remains when FSM, for example, will reach a level maturity that will lead to a change for customers.

FSM and NDC are to be seen as enablers – they lower barriers. If lowering barriers as such will be sufficient for different actors to adopt new standards and further invest into collaboration, remains a key question. It is likely that further investment on a larger scale, by multiple actors, will depend on actual customer demand and/or competitive advantage achieved by ‘first movers’. A ‘first mover’ incentive scheme could be considered.

### ***Further business considerations***

For multi-modal travel to be a success it needs to appeal to both passengers and transport service providers. This is also true for the topic of Passenger rights.

It is key that passengers are well informed about their rights in all transport modes.

Passenger rights across transport modes should be available and comparable but they should also take into account the operational and commercial context of each mode of transport, as the development of a multimodal market requires products that are economically viable for the Transport Service Providers. Rights and obligations and economic viability of collaboration need to be well balanced.



---

## The Urban perspective

### *Dedicated products and sales channels for pan European foreign travellers*

Pan European/foreign travellers may not be necessarily the main target of the urban operators, even if they can represent up to 50% of the travellers in certain European attractive cities. Instead, the daily commuters are more often targeted with flexible and smart products.

Instead and to remain pragmatic, urban operators may address this population with dedicated products sold through dedicated sales channels. As an example, some specific products coupling urban transportation and museum visits can be purchased in some places such as hotels or central station, or through the internet whenever this is possible.

Foreign traveller's behaviours shall also be considered as they will differ from the way the daily commuters do behave. One concrete example is related to the fact that the foreign travellers are by definition not familiar with the urban network they will go through, which may lead to travel mistakes. Such travellers may exit few stations beyond the itinerary booked. Another example would be a traveller using his fare product outside of its validity period (peak hours excluded or week-end only pass). This could be solved by accommodating either products specifically designed to address this point and/or by using post-paid or pay-as-you-go specific products actually invoiced based on the actual travel performed.

But this approach may provide some business limitations for the urban operators: card-based prepaid specific products represent some financial value, are anonymous, can be stolen and are also candidates by construction to human error once they are sold. It therefore introduces some risk of financial loss for the urban operator.

### *Urban fare media complexity and fragmentation*

Sales processes in the air and rail industry do not match the ones in urban transportation. Fare structures in the urban sector are far more complex and sales processes may not be centred on origin-destination fare products as in air and rail transportation mode. Furthermore, urban sales products are often assuming that the customer perfectly know the structure of the fare products. For example in urban transportation a customer will look for a 5 zones pass for a week. The urban sales processes are made more complex by the fact that fare product must not overlap for a given customer account and/or fare media.

Fare media fragmentation is about the fact that one fare media is required per urban network (e.g. operated by a given operator). For a nice intermodal pan European travelling experience, this shall be ideally hidden to the customer using card-less media, as technically demonstrated in AWT. This approach does impact the ticketing processes (booking, reconstruction, settlement) managed by the urban back-office as demonstrated and its generalization require urban computation adaptation which at the end represent extra cost for the urban operators.

### *Urban fare media types and product deliveries*

As a reminder, the set of fare media available today can be card-based (ticket, pre-loaded card ...) and/or contactless (NFC, QR-code based). The customer may travel anonymously in some card-based scheme or can be known in account-based schemes, in which case the travel can be computed and associated to a traveller.



Urban operators are always looking for the right balance between the traveller experience provided and the risks encountered: card-based products are easier to generate and manage (example: the price is fixed and cannot vary between the time it has been purchased and the time it has been used). On the other hand this material can be manipulated the wrong way which may lead to loss for the operator (example: if a batch of tickets is stolen or lost).

Contactless media may be a nice solution to enable and enrich the pan European traveller experience but it requires investments from the operator to adapt their front-office equipment surrounding their urban networks. QR-code for example can be a nice solution for the traveller but it requires investments in the infrastructure (since it requires a real-time message exchange between front and back-office) and may be subject to fraud since it can be easily copied. EMV-based solution is more secure for the operator and is less subject to fraud, but requires as well investments to align the solution and its infrastructure.

### ***Maturity and complexity of EMV and NFC-based media***

EMV and NFC-based media seem to be the ideal solution from the pan European traveller perspective. For the urban operator it is introducing further risks and complexity to handle:

- Technology maturity: several NFC protocols co-exist today which lead smartphones to behave differently according to their brand and model. Therefore, it is more or less impossible today to commit on a solution which support all the possible smartphones. Which lead to extra cost and effort for the urban operators to enable the use of this technology on a large market scale.
- Regulation: depending on countries, the regulation differs which lead to different restriction on how and where to use EMV cards. In some European countries for example, the EMV capability can be used only in the country of origin and is disabled abroad. This can be hardly solved with technology.
- Business model: the use of NFC and EMV requires agreement with new actors for the urban operators: banks, smartphone provider, and telecom provider. The business model of the urban operator shall be adjusted accordingly and this lead to extra cost and effort to the operator.
- Degraded modes: in AWT only a nominal basic case has been demonstrated to prove the scalability of the legacy urban applications. Some degraded mode need to be further investigated to secure the pan European traveller experience. For example, how shall be managed the situation when the smartphone is out of service or is running out of battery when the traveller enters the urban network for which a NFC product has been purchased ? Same question for EMV in case the traveller's EMV card is in failure?

### ***Necessity for a fast and reliable IT infrastructure***

The reuse of the legacy urban solutions has been demonstrated end to end successfully in AWT. To generalize the approach, huge processing power and storage capabilities are needed to manage the huge volume of data manipulated internally in the urban back-offices and exposed to the outside : product catalogs, customer unique ID, stop place unique ID and correlation with IATA settlement, ...). As seen previously, the generalization of the use of state-of-the art customer-based media and products tailored for the pan European traveller (EMV, QR-code, NFC account-based) requires permanent fast reliable connectivity between front and back-offices urban components.



This is also a prerequisite to manage simple and secure refund and rollback mechanisms at urban level, as it does exist with AIR and RAIL products. This aspect has not been addressed in AWT and assuming the business model is validated and refund mechanisms are confirmed to be introduced in an intermodal trip then it does require probably also permanent reliable links between front and back-office elements to prevent misuse and fraud.

### ***About CO2 and PRM***

In the Urban transport world, CO2 consumption is often not considered as a key point for travel decision and is not considered as a business driver. As a consequence, CO2 data for urban transportation is often neither computed nor exposed to the customer. Incentives and regulations shall rather be put in place to move further on this aspect in urban transportation.

PRM management in the urban jungle is also far more complex than in the other transport modes with restricted well-known managed access facilities. As a consequence, PRM is more often addressed today in the urban sector with dedicated products, even using alternative transport medium (example : provide a product for a PRM to transfer from A to B using a minivan rather than providing a way for him to go through the urban network and facilities). These products exist but are often not advertised massively: pursuing the AWT approach demonstrated, this may require these products to be tagged with PRM in order to allow the traveller to perform his selection at shopping stage. Beside and more globally, the non-availability of urban data for PRM may be also addressed at business and regulation levels to allow the urban operators to invest more on this matter.

### ***Risk management***

For AWT, the retailer directly transfers the money to the product owner when co-modal whereas in intermodal the money is kept at the airline level and a settlement is performed by IATA. This imposes the use of an electronic ticket ID associated with the fare product sale to allow apportionment in a further step.

This approach impacts deeply the urban operator business model since it is introducing both new actors, settlement and payment mechanisms. For the urban operator, it implies some extra agreements and business model to be designed in order to enable multimodality.

For most urban operators covering small city-scaled networks, it means further investments and new business area to be deeply studied and tackled, which at the end requires extra cost. The use of EMV is a way for the urban operator to mitigate and transfer the risk to the bank but it requires a new business model. The alternative use of NFC-based technology minimize the change of the business model but does keep the risk on the urban operator side.

### ***Final considerations***

POC2 in AWT project demonstrated that a mix of solution is always preferred if not required as there is no “one size fits all” type of solution for such complex integration with air and rail sectors. In AWT has demonstrated a viable solution to address the pan European traveller who travels through different urban networks. The approach demonstrated allows the urban product owner to use simple products that will not overlap with existing products and a specific pricing strategy to cover financial risks.



AWT project envisioned both card centric and back office centric approaches as tools to answer the international travellers' mobility. The use of back office centric approach will limit the risk of misuse as access control is performed at the device level and as the traveller presents better solvability (either by being known or by putting a guarantee deposit for the fare media). Such approach should be used whenever possible and is an interesting answer to the fare media fragmentation. On the other hand card-centric approaches may better suit for "anonymous" pan European travellers. Mixing both approaches as demonstrated with AWT can be a way to address the media fragmentation with legacy urban systems.

Regarding the issue with fare media fragmentation, integrating a new fare media in a ticketing system has some business impacts. Integrating and providing "universal" multi-network fare media is a key point and AWT demonstrated its technical feasibility.

Questions relatives to apportionment and settlement are addressed in AWT POC2 with a best effort strategy. Triggering flown messages or settlement on a synchronous communication pattern is feasible but requires processing power and permanent connectivity between front and back-office elements.

Beside the technical aspects addressed and demonstrated with AWT, business and regulation matters shall be addressed to allow the urban operators to balance between costs, additional revenues, risks and pan European traveller satisfaction.

## The "Trip Tracking" perspective

The concept of trip tracking is still somehow strange to imagine and to fully understand how it will be in the future, the possibilities are overwhelming. With the AWT it was proved that it is possible to provide a near "Real Time" disruption notification service for a multimodal trip, that is possible to have during a Pan European trip a single point of contact through a low cost service and that is possible to provide this service on door to door trip offloading the traveller of monitoring all the travel segments.

### *Challenges*

Increase the number of services, an urban city includes multiple services that are not run a given route or track, these need to be modelled and included on a trip tracking service. Even the typical services like metro or bus on a large city with several transportations hubs need to be fully mapped and modelled to be able to perceive the implications of disruptions throughout the a complete journey.

The interfaces need to be designed to allow plug and play and to allow the auto-discovery of new services and provides.

### *Enhance the Operator service*

A trip tracking service despite all the services that can provide to the traveler, it can provide big benefits to the operators by allowing the management of the flow of passenger through the stations and hubs and in the rail/metro by improving the turnaround times in the stations and the occupancy distribution through the compositions.



### ***Proactive rather than reactive***

The future of trip tracking is connected to the generation of preemptive models and processing of complex events allowing the correlation of apparently non related events and to anticipate impacts through transportation networks. The evolution of these models will allow to proactively predicting cascading events through large transportation networks and cross communicating networks.

## **Settlement and geo-coding perspective**

### **Industry distribution architecture**

IATA standards and processes allow distribution across 260 member airlines (and many other participating airlines) and over 100,000 travel agents. The system relies on pillars such as industry standards, coding and multilateral agreements; together with industry settlement systems. Historically, this system has been airline-centric, but increasingly the system is being leveraged to facilitate the distribution of intermodal and multimodal itineraries; and even standalone distribution of surface transportation. This report demonstrates that many of aspects of IATA's industry distribution architecture are already fit for this purpose, and future enhancements will further enhance this capability.

### **The future of interline standards**

The electronic ticket is still the “backbone” of distribution processes and interline standards today. Standardised processes and data exchange allows any travel agent to sell an electronic ticket on the ticket stock of any validating carrier using a single process. An electronic ticket can include services operated by different carriers, who simply obtain control of their electronic coupon to carry the passenger, and to bill the validating carrier for their share of revenue when the service has been delivered.

Existing standards, such as the electronic ticketing standards, support intermodality, but generally use legacy messaging technology and emulate paper processes which tended to be air-to-air centric.

Emerging distribution standards (such as those being developed within the New Distribution Capability) use internet communication protocols and better support new transport operators and new distribution channels. These messages allow a much more flexible exchange of data allowing new content to be distributed, and allowing the exchange of rich media content to describe what is offered. This has obvious synergies for intermodal distribution, as intermodal services that do not immediately fit the air-centric model (for example, a day pass on a public transport system with now designated board or off point) could easily be described in an XML message and presented to a consumer. The NDC message schemas are now an industry standard, and are publically available for any party to implement.

The NDC Standard will enhance the capability of communications between airlines and travel agents, and between partners in interline itineraries. The NDC Standard will be open to any third party, intermediary, IT provider or non-IATA member, to implement and use.





The NDC Standard will enable the travel industry to transform the way air products are retailed to corporations, leisure and business travelers, by addressing the industry's current distribution limitations:

- Product differentiation and time-to-market
- Access to full and rich air content
- Transparent shopping experience

The Shopping schemas enable airlines to distribute their full product offers and to merchandize their baggage, seat choices and ancillary services, using rich content, in an anonymous or personalized manner.

The Order Management schemas enable airlines to manage NDC-driven orders throughout the entire lifecycle, from booking to fulfilment. It is composed of:

- The schemas for Booking & Servicing, to enable airlines and travel agents to manage the order from the traveler, once he/she has selected an offer, and service it at any point throughout the order lifecycle;
- The schemas for Payment & Ticketing, to enable airlines and travel agents to collect and pass form of payment details for the supported payment methods, offered by the airlines and selected by the traveler; these schemas will also allow travel agents to request accountable documents issuance to fulfil NDC-driven orders.

The Airline Profile schemas enable airlines to communicate the markets for which they are willing to respond to NDC-driven requests for offers and associated services.

There are no specific schemas for interline, however the Shopping and Order Management schemas will enable airlines to send requests for offers and associated services to their interline partners, and manage the resulting booking and servicing, including for ancillary products.

Another industry change program which The ONE Order program. This program is investigating replacing the electronic ticket (and traditional reservation records) with a simple, internet based method of recording fulfilment and consumption. ONE Order is the concept of a single Customer Order record, holding all data elements obtained and required for order fulfilment across the air travel cycle - such as customer data, order items, payment and billing information, fulfilment data and status.

One Order will result in the gradual disappearance of multiple reservation records as well as e-ticket/EMD concepts to be replaced by a single reference travel document. A new standardized and expandable reference will become the single access point for customer orders by third parties (interline partners, distribution channels, ground handling agents and airport staff, among others).

One Order will facilitate product delivery and settlement between airlines and their partners with one simplified and standardized order management process. All parties will follow a single process to service customers throughout their entire product purchase and delivery experience.

One Order will enable 'network airlines' and 'low-cost carriers' together with other operators (such as rail) to interact and provide combined services to customers.

Through a new streamlined process, all operators will be able to manage customers in a seamless and homogeneous manner despite having different business models and operational environments.



Further to the endorsement of the IATA Board of Governors at its meeting in December 2015, the initiative is moving into the Industry Standard development phase. The target for 2016 is to obtain the adoption of the One Order standard by the Passenger Services Conference (PSC). Industry participants are now contributing to build the standard within various working groups.

This would further support intermodality as surface operators who previously faced barriers to entry in implementing complex electronic ticket servers could interact with airlines and other operators using modern, flexible messages and processed more in line with “off the shelf” retail and accounting platforms.

Industry standards will continue to be enhanced to support intermodality. The Travel Partners Standards Council (TPSC) is a standing committee of the IATA Passenger Services Conference dedicated to this area.

The TPSC a joint forum for airlines and strategic partners who wish to develop standards that will facilitate the movement of passengers between different modes of transport. The TPSC works with other standard setting groups to better support intermodality in existing IATA standards, and also develops joint standards for intermodal operators.

### **The future of the agency system**

The agency system today comprises over 100,000 accredited agents, who (together with their system providers) use one set of processes to retail content across 260 IATA member airlines (and many others), and can settle with a single payable in each settlement period.

Changes to the agency accreditation model are occurring to attract a wider array of agencies and business models, and to better manage risk. A global default insurance is also being introduced.

IATA is also pioneering new alternative methods of payment for agencies, to introduce a pay-as-you-go model for agents who do not wish to utilize credit facilities. These changes will result in an agency environment that is faster, safer, cheaper, easier, and more relevant and customer centric.

### **IATA Industry Settlement Systems – well placed for a single multimodal transport area**

Today IATA offers a number of settlement platforms for passenger operations, the core of which are for settlement between travel agents and other transport providers (BSP, TIESS); and for settlement between airlines, and between airlines and their suppliers (ICH).

IATA is well placed to provide settlement that meets the needs of a single multimodal European transport area. The IATA platforms support netting of settlement (one payable and one receivable for each participant in each settlement period) to greatly improve cash flow and reduce transaction costs.

IATA platforms also operate in many countries (not just an operator’s home country, as is common with rail or other surface provider settlement), and support operation across multiple currencies.

Most importantly, the IATA platforms Centralised Risk management and agency accreditation, and centralized reporting.



With global reach, the IATA platforms support distribution outside of home markets and even outside of Europe, supporting inbound tourism. In today's environment, individual surface operators tend to only distribute and settle within their home markets, limiting reach.

### Industry coding

Today, IATA plays a role in providing coding for the entire industry, beyond just IATA members. This includes

- 2 character airline designators, e.g. "BA", and 3 character airline accounting codes, e.g. "125"
- Baggage Tag Issuer Codes (BTIC).
- Location coding, 3 character.
- Equipment type, passenger terminals (SSIM)

The challenge is that coding rules are determined by IATA Resolutions requiring unanimous agreement of IATA members. Due to structural limitations, there are also finite limits on the number of codes that can be issued. For example location codes are 3 alphabetical characters, and as such 17,576 are available. This is adequate for airport locations, but will never be adequate for railway stations – and certainly not for public transport stops.

Many rail way stations already have IATA 3 character location codes to facilitate air/rail distribution. Railway stations co-located at airports can also share location codes, and can be differentiated from the air terminals using standardized terminal indicators. To facilitate distribution across large numbers of individual stations, there are also railway location identifiers that are used to identify a number of smaller stations within a single area. Such codes can be used for automated pricing calculation, ticketing and interline billing.

The IATA Travel Partners Standards Council will continue to facilitate discussions about better using these limited codes to support intermodality (such as common-coding or zone based coding for rail areas). New distribution standards will also allow for better shopping and ordering processes across intermodal itineraries, and could potentially eliminate the constraints of applying airport/city coding to intermodal terminals. Transformation programs such as OneOrder will allow much richer reference data to be used across the distribution lifecycle, which could include geo-location coding concepts.

Co-operation between modal operators will continue to foster standardisation of coding to promote intermodality and efficiencies.



---

## 6.2 Conclusions

The conclusions listed here below are specific to the understanding developed by AWT for the design and planning of the POCs and as further supplemented by the development experience during the POC phase itself as well as interactive observations made by members of the Commission and others in the audience during the Demo day 26<sup>th</sup> February 2016 in Utrecht. They are in addition to the conclusions reached by the AWT Study delivered in Phase 1.

### **POC 1 Conclusions:**

#### **Single European Transport Area and Modal Shift**

The European Commission's 2011 white paper on transport envisages a future European Union with a single integrated travel and transport market enabling European residents and visitors to travel across Europe easily and seamlessly as a means to shift passengers from private car usage to more environmentally friendly forms of transport. Numerous benefits, social, environmental and economic are associated with this vision, which is key to the EU strategy on reducing carbon emissions generally.

The Commission's desired modal shift requires a merge of the current, silo structured, transport markets (each with their distinct and different type of retail outlets) such that a critical mass of travel retail outlets are capable of offering comprehensive European Transport content for search, planning, booking, purchase and ticketing.

In short, a generic one-stop-shop capability needs to be ubiquitously available. The traditionally very manual 'search, plan and purchase' activities need to be replaced by fully automated capabilities which can eliminate the risk and effort normally attached to their execution.

The requirement for generic one-stop-shop capabilities to be available in the market, places a significant role on 3<sup>rd</sup> party retailers (e.g. online travel agencies) as providers of the most comprehensive multimodal content. Dedicated (proprietary) Travel Service Provider (TSP) retail outlets (e.g. AirFrance.com, DeutscheBahn.com) will offer multimodal services, of course, but only those which are complementary to their own products and services; not those which are directly competitive with them.

#### **Advanced Purchase Travel**

The result of the current market configuration means that most long distance travel tends to be made with the traveler booking and purchasing the long distance ticket in advance, but purchasing supplementary travel services 'on the fly': especially the so-called 'first and last miles'. This type of 'enforced' shopping behaviour, tends to favour the use of carbon-footprint intensive solutions (private car, rented car, taxi) for use in getting from a destination airport or rail station, for example, to the traveler's final destination address.

A generic one-stop shop capability, which enables the advanced purchase of all travel segments, assists in committing the 'cost / environmentally-conscious' customer to the use of cheaper and environmentally friendlier forms of transport, because the selection of transport mode is not made during actual travel when fatigue, impatience, uncertainty, and stress may otherwise encourage the adoption of easier, but non-green, alternatives.



## Interoperability

The single most profound obstacle to realizing this one-stop-shop capability is the fragmentation of the market place, which exhibits a proliferation of different formats and protocols for accessing travel data and processing for the different modes/operators.

This is a 'show-stopper' obstacle, since harnessing the distribution mechanisms which can handle the variety and multitude of TSP protocols and formats in a sufficiently comprehensive way, is prohibitive from both cost and time perspectives. The AWT POCs relied on a number of existing implemented links, but still had to implement two relatively simple interfaces between the multimodal distribution orchestrator (supplied by Amadeus) and BeneRail and Thales sourcing Rail and Urban Transit data respectively. This took a major part of the POC budget, and illustrates the cost-scalability problematic if multiplied to a level which could achieve pan-European modal/ operator coverage.

Whilst adoption of sector-wide standards (formats/protocols) has proven very useful in the airline industry, and ongoing improvements can be expected in the railway and public transport sectors as well, full interoperability across modes through 'super standardization' is currently unrealistic. Solutions which render fragmentation less important, by offering translation and conversion capabilities, also need to be pursued since they obviate the requirement for players to adopt, or conform to, the same set of protocols / formats. *N.B. This approach is captured in the attempt to harness semantic web technology in the projects IT2Rail, Shift2Rail (IP4) and EU Travel.*

## Shopping response-time 'performance'

Another potential impact, when scaling up to the quantity of distributed travel data which could be accessed in response to customer queries, is on shopping response-times. Whilst the AWT POC was not configured to optimise this factor, since the quantity of distributed data accessed in the POC was so relatively small, it is clearly a concern, as highlighted by spectators from the audience during the demo. A number of observations can be made:

**The shopping request itself :** Even with very long distance trips in Europe including several stops, the main means of transportation would be Air, Rail, and Urban Transportation. You could add Ferries, maybe helicopter services, but these would be marginal modes. The most common shopping requests will always contain one origin and one destination, and 1 or 2 middle points in general. And it will contain a number of criteria linked to traveller's preferences.

**Traveller's preferences - parametrisation and filtering:** Travellers will probably define their 2 or 3 preferred transportation modes (in their profile for example). They will also be able to choose the cheapest, fastest, greenest, most adapted to the needs of disabled people, and a combination for those. For example: the fastest trip (parameter), in a range of 300 to 500 Euro (filter), Air and Rail only (with Urban Transport to solve the first/middle/last mile). These reduce dramatically the number of solutions and connections, therefore reducing the complexity of the search when added to the 'reduced' number of transport mode and middle points as stated previously.

**Algorithms and intelligence:** To solve this type of complex query, advanced algorithms have been implemented and continues to evolve. They equip the multimodal journey planners, and they can produce advanced intelligence that will ease the computation by, for example, discarding impossible/unrealistic routes and connections so optimising the trip solutions vs criteria provided.



Computing power will grow rapidly in the near future, cloud computing should boost it, therefore we can expect systems to be more and more efficient in answering complex requests. 'Big Data' could also support this acceleration, not only by giving best solutions (or part of solutions) already found for other travellers for the same requests/legs/modes, but also for sourcing statistical analyses on past shopping requests and associated purchases, introducing a potential 'learning' capability for appropriate search technology to optimise performance and efficiency in solving the query. It would also allow to better understand the flows of passengers between modes of transportation and their usage.

**Architecture / Calling the experts:** A key component that supports the scalability of performance, is architecture. In the AWT concept, the multimodal journey planner is connected to a number of 'experts' responsible to send back to the planner the best solution for a specific mode. These experts can be internal/central to the hosting multimodal journey planner (Air in the case of Amadeus in POC1), or external/distributed as supplied by other partners BeneRail and Thales (for Rail and Urban Transportation respectively) and from other service providers (Nokia HERE for cartography and pedestrian connections). Ultimately, this allows for a parallelisation of the query treatment with each 'expert' solving its part of the trip, and reducing overall processing duration.

**Optimisation of display:** The display of final valid travel solutions can also be optimised by showing the first results immediately while the system still computes to find other solutions. The end user experience is improved as he/she can start evaluating those results while some more will be populated. Therefore all this helps reducing the perceived time to solve the full multimodal trip.

### Current TSP retailing practices – comodality and intermodality

Travel solutions for door-2-door (D2D) itineraries comprise either the consecutive arrangement of stand-alone and separately priced travel products, or their integrated combination, with a single commercially agreed 'price' (or 'through fare') as conceived by two or more transport service providers.

The retail / purchase of stand-alone products to cover an entire journey, is characterized by multiple transport contracts, multiple payments and multiple tickets: we call it comodality.

The retail / purchase of combined-price products to cover an entire journey, is characterized by a single transport contract, single payment and single ticket; we call it Intermodality and it is the result of commercial agreements amongst transport providers who have identified market demand for a particular 'passenger flow' between any given origin and destination or origin and destination zones. The combined price and designed connectivity of their combined services becomes an effective way of increasing the passenger load beyond what was achievable when those same services were marketed independently only.

The problem with comodality today is that it requires the customer to do all the work to build the travel solution for their end-to-end trip and to take a number of risks. Calculating minimum connection times, searching for good connections, surfing the net to identify compatible services, at low prices and/or matching other personal criteria on total travel time, or carbon footprint takes a lot of effort and may even cause customers to abandon their trip plans. Risks are inherent in the book and purchase process itself, since, in the time it takes to secure one element of the itinerary, subsequently identified products and services may become unavailable, leading to partially paid travel solutions which may not be refundable; whilst, even if purchase is successful, risk of service



disruption during the trip itself translates into a risk of being left stranded, since no one transport provider has overall responsibility to ensure your passage from origin to destination. The customer can fall into the responsibility gaps between the separate transport contracts.

Intermodality on the other hand, means that all the effort of putting the trip together has already been performed by the participating transport providers, and the traveler is guaranteed to get to their final destination (due to the coverage of a single transport contract) whatever disruption of services befalls you on the way.

The problem with Intermodality, however, is that there is no global standard (proprietary or otherwise) for shopping, booking and purchasing any number of multimodal elements which have been conceived and marketed as a whole: an 'off the shelf' technology simply does not exist. Only bilateral niche examples exist between limited groupings, pairs of transport providers sharing a strong penetration in the same market, or at local / urban level, under a public services contract.

### **Technology solutions for Co-modality**

Making comodal retailing easy for customers, means eliminating as much as possible the effort and risk which today ensures that the upfront purchase of comodally offered travel products/services (to cover an entire journey) is such a rare phenomenon. The challenge is to simulate as much as possible the beneficial aspects of 'intermodality'. This implies:

- Surmounting interoperability barriers between TSPs and distributors, to ensure search access to a comprehensive set of the travel products and services which could be combined to solve the customer's trip requirements.
- Meta multimodal journey-planning is required to combine the journey planning expertise already available in the market, allowing for the automatic calculation and processing of minimum connection times between different modes/operators, in order to offer a list of 'valid, available, bookable, and purchaseable' travel solutions from which the customer can select.  
*N.B. useful attributes such as price, total travel time, carbon footprint, and availability of facilities for PRM (passengers with reduced mobility) are required as parameters to drive the search for, and/or automated sorting of, resulting travel solutions.*
- Contextual handling, or orchestration, of subsequent booking, purchasing, ticketing and after-sales processes with each of the TSP inventory/reservation/sales systems implied in any offered travel solution, in order to eliminate the risk of partially purchased itineraries.
- The availability of multimodal trip-tracking solutions which can identify service disruptions which threaten the integrity/validity of the subsequent parts of a comodal travel solution.
- Contextual handling of cancel and rebook services (after-sales) which allow for the easy re-accommodation of a Travel Solution interrupted by service disruption, in order to ensure that the traveler is able to complete their journey to final destination.

What technology cannot do, however, is to ensure that any service disruption which may be fatal to a pre-purchased itinerary, is properly compensated for in terms of expense. It is not obvious that a travel service which needs to be cancelled due to a delay in a preceding travel service, will be refunded or allowed without financial penalties. In this area, it is critical that some harmonization of passenger rights across transport modes is put in place to protect travelers with multimodal itineraries: else, we shall not see as significant a market take-up of one-stop-shopping for advanced purchased comodal travel solutions, as is required.



### Technology solutions for Intermodality

The intermodal travel solution is a very attractive one, because, effectively, the implicated TSPs have already built into their joint offer most of the aspects which, for comodal retailing, need a technology injection into the distribution mechanisms behind the scenes. On top of that, an intermodal transport contract, is designed to take care of passengers' rights during the journey when the travel solution is disrupted due to a cancellation or delay.

For the most part, intermodal solutions, as bilaterally practiced, are designed to ensure that all of the different steps in their purchase conform to a single set of formats and protocols. There are basically two types of methods which are used to achieve this:

1. The principal TSP business partner encodes the services of its participating partner into its own inventory, so ensuring that all 'search thru purchase' transactions (including aftersales) only need to be performed using the principal TSP partner set of web services, and take advantage of the current retailer settlement system currently deployed by the principal TSP partner. Ticket validation, consumption of services monitoring, and partner settlement are handled according to bilateral arrangements.
2. Partner TSPs invest in their inventory/booking/sales systems to be able to handle transactions using the same set of formats/protocols, and take advantage of the corresponding retailer settlement system and possibly any interline partner settlement system.

Both these methods involve certain costs which, today, may be too prohibitive to allow for the sort of scalability required to realise the afore-mentioned single multimodal travel market vision.

The first method is on the one hand easier from the perspective of the distribution chain, but possibly relies on too many specific bilateral arrangements behind the scenes in order to scale up as a regular solution.

The second method manifests itself principally today, in the phenomenon of rail undertakings which have invested in compatibility with airline technology, in order, either, to partner with airlines in offering intermodal solutions, or to appear as an 'airline' on travel agency displays so as to compete for shorter haul origin and destinations, within the airline market-place. This second method certainly has scalability built in, because, the railway undertaking may exploit IATA-based settlement infrastructure both for international retailer and for business partner settlement purposes, as well as being in a position to increase the number of airline partners, without further technology investment.

The issue with this second method is that the cost of compatibility with the full set of airline messaging and procedures has significant cost: meaning that it is not at all evident that other railway or other modal undertakings will be tempted, despite the presence in the market of players offering hosting services and interfaces for this capability.

This second method may be made considerably more tempting, if the investment did not have to cover the full set of upstream shopping (schedules, fares, availability) and booking, seating, messages: and instead could focus only on interfacing with the Travel Entitlement issuance and consumption architecture, implicit in the implementation of IATA interline e-Ticketing standards. In this way, the solutions for overcoming interoperability issues, that were mentioned in relation to comodality, could also serve to radically cut the costs for this type of Intermodal solution.





This would seem to provide good argumentation for researching how an Intermodal Travel Entitlement issuance and consumption management system could be designed that, on the one hand would remain compatible with IATA interline e-Ticketing standards as well as offering certain specific features for non-Air modes, and, on the other, would be subject to an appropriate Governance model which included stakeholder associations representing all modes rather than only IATA airlines.

Finally, we must keep in mind the necessity for appropriate settlement and retailer accreditation infrastructure to underpin the multimodal vision. Our IATA partner has demonstrated current capabilities that could be, potentially relevant, albeit that there are obstacles to overcome in terms of current limitations in coding methodology for providers and locations, but which NDC (New Distribution Capability) may be able to assist with.

### **POC 2 conclusions:**

Urban Transport segments (1<sup>st</sup>, last and middle miles) can be integrated into longer distance travel itineraries, whether comodal or intermodal, regardless of the type of scheme (pre-paid, pay-as-you-go, post-paid, card-centric or Back-Office Centric).

Looking forwards, the following items need to be addressed:

1. The availability of easy to use and attractive Fare Media (e.g. NFC smart phone, EMV contactless bank card). Issues to be solved for NFC technology are the variety of communications standards which today mean smart phones have different capabilities with regards to compatibility with urban transport schemes; whilst for EMV contactless bank cards, national banking regulations may prohibit the use of foreign bank cards for use in urban transport networks.
2. The emergence of products which target international travelers (e.g. in Amsterdam, about 50% of travelers using urban transit are tourists – a good business case!) – e.g. specific to certain types of hubs (airports, train stations) but also potentially linking urban travel with destination services, facilities e.g. free pass to a museum, art gallery etc.
3. The expansion of sales channels for urban transit e.g. particularly for targeting travelers from other cities within same country, from other European states, or from outside Europe.
4. Carbon emissions – there is currently no methodology for calculating this and especially at passenger or traveler level, given that we are talking mass and anonymous transportation and that we cannot know, in advance, the precise utilization of the transport services that the urban travel entitlements enable: the customer has many choices for the consumption of such services: so even if calculable post-travel (once we have detected the travelers actual utilization) this could neither easily nor precisely be provided at shopping time, Perhaps this is not a big issue, given that public transportation is, in general, regarded as greener than private or personal alternative means of urban transport.
5. Facilities for passengers with reduced mobility (PRM) do exist on the urban transport networks, but currently there is no means for providing/distributing such data, into the supply chain, for it to appear at shopping time to web-based sales channels (either existing or future). This certainly needs to be addressed.



- 
6. IT infrastructure – processing capacity and reliable but flexible telecoms communications networks to ensure permanent connections between front office and back office equipment.

### **POC 3 conclusions:**

Multimodal Trip Tracking is possible by connecting an intelligent Master Tracker to the various operator/modal real time information feeds as well as to the itinerary structure of the purchased travel entitlements as ‘trips to be tracked’.

Moreover, intelligent multimodal trip tracking, when linked back into the shopping process in order to provide alternatives (in cases of fatal disruption of a tracked itinerary) and to invoke the orchestration of the relevant re-accommodation processes, is a pre-requisite for providing the confidence necessary for the customer to purchase comodally retailed travel services in advance.

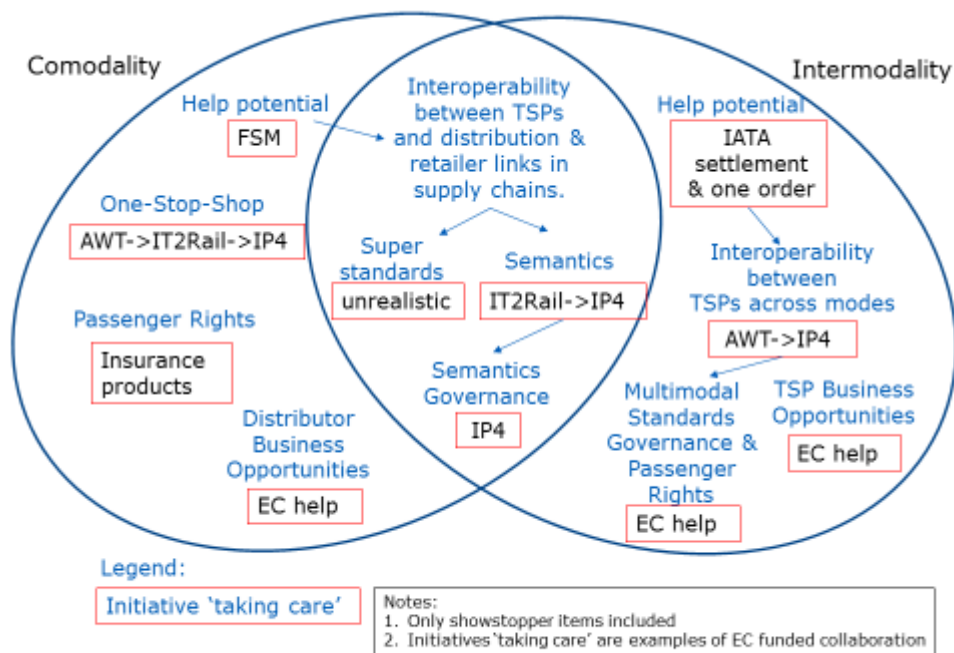
Such Trip Tracking cannot however fix, or compensate for, un-refundable tickets which may be never be used as a result of missed connections. Research into regulating the harmonisation of Passenger Rights across modes may assist closing this last remaining gap in the attraction of advance purchase of comodally travel services. However, this could prove to be difficult when dealing with Travel Services provided via multiple transport contracts, and may only achieve to reinforce the contractual rights of passengers for intermodally retailed products. Alternatively, such relevant research could reveal and disseminate the opportunities for travel insurance products to emerge to fill the ‘comodal gap’.

Multimodal Trip Tracking will require the emergence of new services particularly in the urban area for personal and shared transport modes, but promises to assist urban transport operators with passenger flow control (advice on which service the passenger should take to assist in vehicle load balance, whilst still respecting the traveler’s itinerary connections) and the proactive analysis of seemingly unrelated ‘events’ to provide predictive analysis of the accumulated impact of delays on the overall transport network.



**Conclusions graphic: The EC has a critical role to play:**

The following graphic illustrates the showstopper items emerging from the conclusions together with which EC funded initiatives ‘take care’ or should ‘take care’ of the item, and where further EC help is required. Note that the following recommendations section adds further detail.



**6.3 Recommendations**

These recommendations are largely derived from the technology considerations of the AWT phase 2 POCs. They are in addition to, as well as reinforcing (in some cases), the recommendations contained in the executive summary of the AWT study delivered in phase 1. Non-technical dimensions are referenced where they appear to be highly relevant in overcoming technology challenges, notably in those areas where a collaborative effort is required from industry stakeholders.

- Establish a process to define a Road Map with industry stakeholder assistance and an associated funding strategy.
- Road Map should identify key business case elements: reducing costs on technology items on the one hand and exposing business opportunities, on the other, to encourage market investment in them.
- Road Map should also ensure that suitable governance structures (industry stakeholder collaboration) are put in place to manage evolution of semantics, Intermodal Travel



---

Entitlement Management standards and anything else requiring support after individual initiatives finish.

- Road Map should consist of complementary Research / Innovation Initiatives and Implementation Projects:
  - Research into a scientific method of collecting statistics to establish multimodal passenger flows and corridors to aid distribution links in the supply chain (for comodality) and TSPs in general (for Intermodality) to appreciate the business opportunities.
  - Research into a passenger rights regulatory framework across transport modes for comodality if possible, and, if not, to reveal (in conjunction with established passenger corridors) disseminated business opportunities for travel insurance providers; and, for Intermodality to reinforce passengers contractual rights.
  - Research and innovation around the question of PRM for sectors where there are clearly difficulties in stock-taking of PRM facilities and/or with making available the relevant data into the relevant supply chains.
  - Research into the regulatory framework or appropriate Code of Conduct for multimodal distributors (current CRS CoC can provide a basis) in order to maintain level playing field in terms of transparency and neutrality.
  - A series of 'Connecting Europe Facility' (CEF) funded implementational projects at member state level to put in place relevant multimodal eco-systems that are compatible with the innovatory approach of current initiatives (IT2Rail, IP4) and which, therefore, should plug together. *N.B. this would require some umbrella coordination.*
- Establish coordination between the relevant DG units (from whichever DGs) to coordinate calls around the Road-Map and to set/monitor key Road Map deliverables for new initiatives (H2020, CEF...) and initiatives already in motion (e.g. future IP4 Calls for Members on Intermodality) – this should, incidentally, help streamline and optimise EC funding by avoiding duplication.
- Establish a process for maintaining and evolving the Road Map, together with industry stakeholders, to take account of new movements in the market-place, new technology, impending regulations at national or European level in non-travel, but related, sectors (e.g. banking), and newly encountered difficulties (e.g. from implementational projects) which may require complementary funded research / implementational initiatives to overcome.
- Develop a post-AWT project dissemination / communication plan to increase awareness of AWT conclusions amongst **key public and industry stakeholders**