INFORMATION TECHNOLOGIES FOR SHIFT TO RAIL

D2.2 – Travel Shopping Specifications – FREL

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EXECUTIVE SUMMARY

This document is about the Travel Shopping functions specification, their behaviour, data model and external interfaces.

The content of other IT²RAIL functional areas is not detailed in this document because they are not in the Shopping's scope.

This is a co-modal system[1], so each itinerary offer item provided by a travel expert is independent from the other ones provided by other travel experts.

All terms and acronyms are defined in the IT²RAIL glossary.

[1] from the booking/ticketing perspective

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LIST OF ABBREVIATIONS

AREL	**A**dditional **REL**ease
BT	**B**ooking and **T**icketing
CW	**C**loud **W**allet
CDB L	**C**lass **D**iagram **B**lank
CRB L	**C**apability **R**ealisation **B**lank
FREL	**F**inal **REL**ease
FS L	**F**unction **S**cenario
GUI	**G**raphical **U**ser **I**nterface
GDS	**G**lobal **D**istribution **S**ystem
ID	**ID**entification
IDB	**I**nterface **D**iagram **B**lank
LCBD	**L**ogical **C**omponent **B**reak**D**own
LFBD	**L**ogical **F**unction **B**reak**D**own
MCB	**M**issions **C**apabilities **B**lank
NA	**N**ot **A**pplicable
PA	**P**ersonal **A**ssistant
PRM	**P**erson with **R**educed **M**obility
SBP	**S**oftware **B**est **P**ractices
TC	**T**ravel **C**ompanion
TCO	**T**icket **C**ontrolling **O**rganisation
TOC	**T**ransport **O**perating **C**arrier
TS	**T**ravel **S**hopping
TSO	**T**ravel **S**ervice **O**perator
TSP	**T**ravel **S**ervice **P**rovider
URI	**U**niform **R**esource **I**dentifier
URL	**U**niform **R**esource **L**ocator
WP	**W**ork **P**ackage

1. INTRODUCTION

This document specifies the main functions of the Travel Shopping functional area. Each function is described by their functioning and external interfaces.

The shopping architecture aims at managing and aggregating distributed travel shopping data and distributed journey planning expertise.

It creates the basis for a one-stop shop for co-modally marketed transport products and services whose combinations can answer to door-to-door mobility queries.

The main roles of the Travel Shopping process are the to:

- Build the network reference resource;
- Identify the “smartest” routes corresponding to the customer’s mobility request criteria;
- Manage calls to travel expert(s) in order to collect itinerary offer items;
- Aggregate travel expert(s) itinerary offer items and provide a list of itinerary offers corresponding to the customer’s mobility request criteria;
- Store the shopping context for subsequent booking, payment and ticketing processes.

2. REFERENCED DOCUMENTS

This section lists the document reference number, title, revision, and date of all documents referenced in the specifications document.

Reference Number	Title	Revision	Date
	IT²RAIL -Proposal_second stage_SECTION 1-3_28082014_.pdf	1	Oct. 09th, 2014
	FM Submission IP4-V4.pdf	4	Nov. 08th, 2014
D2.2	Travel shopping specifications – AREL	2	May 27th, 2017
D2.4	Core Integration Report	1	Sep 14th, 2016
D2.5	Additional Integration Report	1	Aug 3rd, 2017
D2.3	“Software Components Pack” including “Implementation Choices”	1	May 2nd, 2017
D1.8	Proof-of-Concept Package Resolvers Full Features		

Table 1: Referenced documents

3. OPERATIONAL ASPECTS

3.1 PRINCIPLES

The Travel Shopping will establish the basis for the Travel Shopping Technical Demonstrator for SHIFT²RAIL IP4 contributing to its overall objectives in the following manner:

- It establishes the architecture for managing and aggregating distributed travel shopping data and distributing journey planning expertise;
- It creates the basis for a one-stop shop for co-modal pre-paid marketed transport products and services whose combinations can answer to door-to-door mobility queries (intermodal is not in the scope of IT²RAIL s and will be addressed in S2R projects);
- It allows for the presentation of transport service attributes and facilities taking into account Traveller preferences in connection with carbon footprint and 'reduced mobility' needs, among others;
- It interfaces with Interoperability framework to overcome interoperability obstacles, so protecting the Customer from the fragmentation of messaging and codification standards which make travel shopping so difficult and risky in today's fragmented travel marketplace.

IT²RAIL will address the full scope of IP4 but with a reduced complexity:

- Only Co-modal[2] travels are considered within IT²RAIL ;
- Only a limited numbers of modes are considered within IT²RAIL (Urban, Rail, Air, Coaches and Walking);
- Only simple use cases will be addressed – not the full complexity of European travel. Functionalities like ancillary products or after sales process are not considered within IT²RAIL.

[2] from the booking/ticketing perspective

3.2 SCOPE/PURPOSE

WP2 will develop in two main areas, for a simplified possible implementation in accordance with the IT²RAIL use case:

- A pre-search set of functions designed to establish the scope of the mobility query, the data and journey planning expertise to be interrogated, and the setting of various filters and parameters, to improve the efficiency of the search and to ensure compliance with Customer preferences;
- The access of distributed data and journey planning expertise, as identified by the pre-search functions, and their combination to produce a list of available travel solutions answering to the Customer's query.

In the *pre-search stage*, the application makes use of Interoperability Framework – Location Resolver for decoding of the mobility query to help build a meta-network of potential origins, destinations and mid-points, most likely to yield the smartest results. Then it makes use of Interoperability Framework – Travel Expert Resolver for identifying the necessary data and journey planning resources to be accessed in order to build the travel solutions.

The *data access and combination stage* uses service descriptors retrieved from the Interoperability Framework – Service Registry to format the queries according to the annotation attached to the services published by each Travel Expert / Travel Expert Manager.

In summary, an eco-system of journey planning expertise is configured in real-time for each Customer query, and interrogated to solve different portions of the Customer's trip which are then combined to produce a choice of valid travel solutions.

Some 'placeholder' work will be undertaken to establish a skeleton of the additional modules required for development in Shift2Rail IP4 in order to handle intermodal availability and pricing logic.

The whole is couched in a *Mobility Request Manager* component which assures the dialogue with the Customer and/or his/her Travel Companion from whence the Customer's shopping cart and preferences are constructed or accessed, and to whom the final choice of travel solutions are presented for comparison and selection, upon which WP3 takes control for subsequent booking, payment and ticketing processes.

The entire work is predicated upon the definition of a *Travel Shopping ontology* persisting across each deployable IT²RAIL transport mode, and is split between specifications deliverables (benefitting from multiple contributors' participation) and implementation deliverables (assigned more pointedly according to different contributor expertise and experience) in order to deliver the work package Pilot components as a whole.

3.3 DESIGN DRIVERS

3.3.1 Semantic Interoperability

In order to enable the interoperability principle and interact with the Interoperability Framework, any Travel Shopping compliant system will provide (by annotating the provided services) or use semantic interoperability technology (resolver, broker…) as defined in Interoperability Framework specifications (D1.8 - Proof-of-Concept Package Resolvers Full Features).

3.3.2 Service Architecture

IT²RAIL being by nature distributed, the use of an architecture based on service provides multiple advantages.

A distributed service architecture promotes the following concepts:

- Service isolation: a provided service should be independent from the rest of the eco-system;
- Loose coupling: a modification of a service should not impact or very little the other services;
- Contractual interface: a service commits on its interfaces;
- Implementation agnostic: a service definition is independent from its implementation.

This enables the possibility to interface legacy systems to the new eco-system with minimal adaptation and targets seamless integration with loose coupling providing isolation of existing systems and enabling new business models.

Using this service architecture, the IT²RAIL specifications does not describe a single operational system but the way multiple systems/services should cooperate to offer the best service possible to the end-user.

4. ACTORS AND USE CASES

4.1 ACTORS

This paragraph describes the main actors, who are involved in the IT²RAIL shopping flow:

- **The Traveller** is a generic name for IT²RAIL end-users. He/she He/she can take the roles of Customer or Passenger according to his/her his/her current activity;

- **The Customer**. Using his/her his/her smart device, he/she he/she does a mobility request, selects one or several segments to create his/her his/her trip and pays his/her his/her booking (s) (in IT²RAIL the payment is done at the end of the booking process for finalising the entitlement, and the trip is made of journeys bunched as co-modal components of the trip). The Customer may not be the Passenger;

- The **Passenger**, using his/her his/her smart device and, possibly one or several physical media, “tap” one of them to access to the transport network. In case of manual access check, he/she he/she presents the relevant medium to the operator of the TSP (presenting as well in some cases an official ID document).

In many cases, the **Customer** and the **Passenger** will be the same person, though it is possible for the tickets to be bought for the Passenger by another person (e.g. a corporate purchasing team buying tickets for a business Passenger).

In addition, many other actors play a role in the IT²RAIL environment. These roles are typically based in service providers (e.g. the providers of transport services).

- **Travel Companion Provider (TCP)**: This actor provides the Travel Companion Application and travel cloud services. This technical role may correspond to IT businesses;

- **Transport Service Provider (TSP)**: This actor offers the customer its fare products for purchase;

- **Offer Provider:** this actor computes and provides itinerary offers, which correspond to the mobility request of the customer;

- **Offer Item Provider:** this actor computes and provides itinerary offer items, which correspond to a part of the mobility request of the customer. An Offer Provider combines these offers to get an aggregated itinerary offer;

- **Interoperability Framework:** this actor provides the cost-effective technical means that allow participant devices, systems and applications to interoperate;

- **Trip Tracker:** This actor tracks disruptions and allows the traveller to build a new itinerary;

- **Business Analytics:** this actor analyses the behaviour of the IT²RAIL multimodal ecosystem. This actor computes KPIs based on shopping usage data.

4.2 CONTEXT

The Travel Shopping is the first step of the mobility request management.

The customer interacts with the Travel Shopping through the Travel Companion Application. The Travel Companion provides the Travel shopping with customer's mobility requests and with user preferences, then it receives from the Travel Shopping a list of itineraries offers corresponding to each mobility request.

The Travel Shopping relies on the interoperability framework for the location of stop places, the travel expert identification and for the interaction with travel experts through the IF travel expert broker.

The Travel Shopping provides data to the Booking and Ticketing process (itinerary offer details) and to the business analytics (itinerary offers).

The Travel Shopping provides the capability to calculate alternatives to the itineraries provided.

4.3 USE CASES

IT²RAIL Shopping work package is contributing to the IT²RAIL Mission and Capabilities.

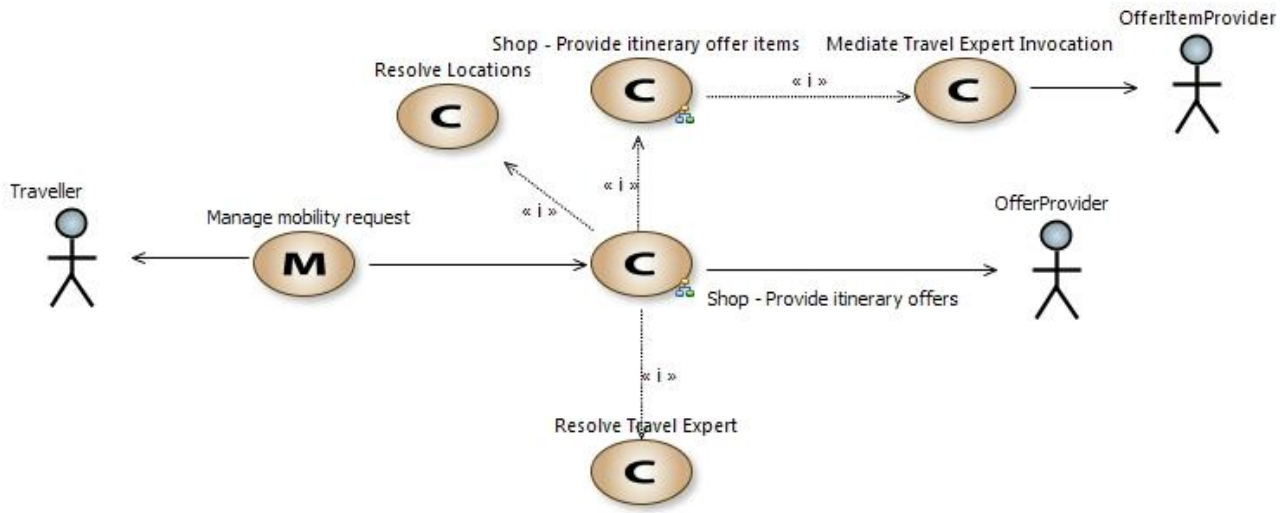

Figure 1 Travel Shopping capabilities

The travel shopping collects the mobility request formulated by the traveller to fulfil the mission **Manage mobility request**.

The main capabilities of the Shopping are the following:

- **Resolve locations**: the travel shopping calls the location resolver in order to identified stop places located near to addresses, which are specified in the mobility request;
- **Resolve travel expert(s)**: the travel shopping calls the travel expert resolver in order to identify travel expert(s), which have the capacity to provide itinerary offer item(s);
- **Shop – Provide itinerary offer items**: the travel shopping interacts with travel expert(s) (through the interoperability framework, which is in charge of the mediation of the travel expert invocation);
- **Shop – Provide itinerary offers**: the travel shopping provides a list of itinerary offers corresponding to the mobility request criteria;
- **Mediate travel Expert Invocation**: this capability corresponds to the interactions between the shopping process and travel experts. This capability is described with more details in the Interoperability Framework Specifications (D1.8).

5. DESIGN DECISIONS AND CONSTRAINTS

This chapter contains all the design decision that may arise from one work package and that may affect other work packages.

Only the Travel Companion application is able to provide mobility requests to the Travel Shopping. The customer must use the Travel Companion application to specify his mobility request.
The Network Graph Manager provides statistical data (to build the network reference resource) to the Meta Route Explorer. The Network Graph Manager is described in the Interoperability Framework specification (Proof-of-Concept Package Resolvers Full Features - D1.8). There is no direct interaction between statistical data provider and the Meta Route Explorer.
The Offer Builder temporary stores the shopping context. This storage cannot exceed a couple of hours (the exact duration is configurable).
The user may customise the outcome of the shopping flow by using user preferences. User preferences (distinction between filtering and sorting preferences…) are fully described in the Travel Companion specification (D5.2 - Travel Companion Specifications). Within the shopping flow, the user preferences logic is the following one: • In the scope of IT²RAIL, the Meta Route Explorer and the Offer Builder consider user preferences: these preferences are “exclude a transportation mode” and “exclude a carrier”; • Other preferences, which are available in the mobility request, are transmitted to travel experts within the functional exchange “Get Offer Item List”. Travel expert shopping services may consider or not these user preferences.
Itinerary offer items may differ from one travel expert to another one: some travel experts do not consider user information when computing itinerary offer item. In order to build consistent itinerary offers, the offer builder may filter itinerary offer items provided by a travel expert. The description of the flow designed for IT²RAIL is here: • The Offer Builder liaises with the travel expert descriptor and then collects asynchronously the descriptions of all services/products this travel expert may offer; • Based on the services/products description of the travel expert, the Offer Builder module may adapt its request to the travel expert broker (and indirectly to the travel expert); • Based on the services/products description of the travel expert, the Build Offer module may interpret the itinerary offer items list received from the travel expert: Each itinerary offer item is analysed in order to identify, at least: the Itinerary, the number of passengers and the passenger categories covered by the itinerary offer item; o If it succeeds for all itinerary offer items, only solutions that match the mobility request are kept for the itinerary offer aggregation; o If it does not succeed for at least one itinerary offer item, then the Offer Builder module ignores the itinerary offer items list received from the travel expert.

In the scope of the IT²RAIL project, the Mobility Request Manager is in charge of an additional functionality: to filter the mobility request response content. As the mobility request response messages may take a long time to process, and in order to facilitate the display of the itinerary offers by the Travel Companion, the Mobility Request Manager returns a simplified mobility request response. The content of this simplified mobility request response is determined by the Travel Companion.

Table 2: Design decisions and constraints table

6. COMPONENTS

6.1 TRAVEL SHOPPING COMPONENTS

The TS Travel Shopping component is decomposed into four components:

- The **Mobility Request Manager**: this component interacts with the Travel Companion, collects mobility requests and user preferences and provides the list of itinerary offers to the travel companion and the business analytics;
- The **Shopping Orchestrator**: this component coordinates the functional components of the shopping process;
- The **Meta-Route Explorer**: this component builds the meta network and manages the selection of the smartest routes;
- The **Offer Builder**: this component collects itinerary offer items form the travel experts (through the broker) and builds the list of itinerary offers.

The TS Travel Expert shopping component is decomposed into two roles:

- The **Travel Expert Journey Planner**: this role provides data required to build the meta network;
- The **Travel Expert Offer Builder**: this role provides itinerary offer items.

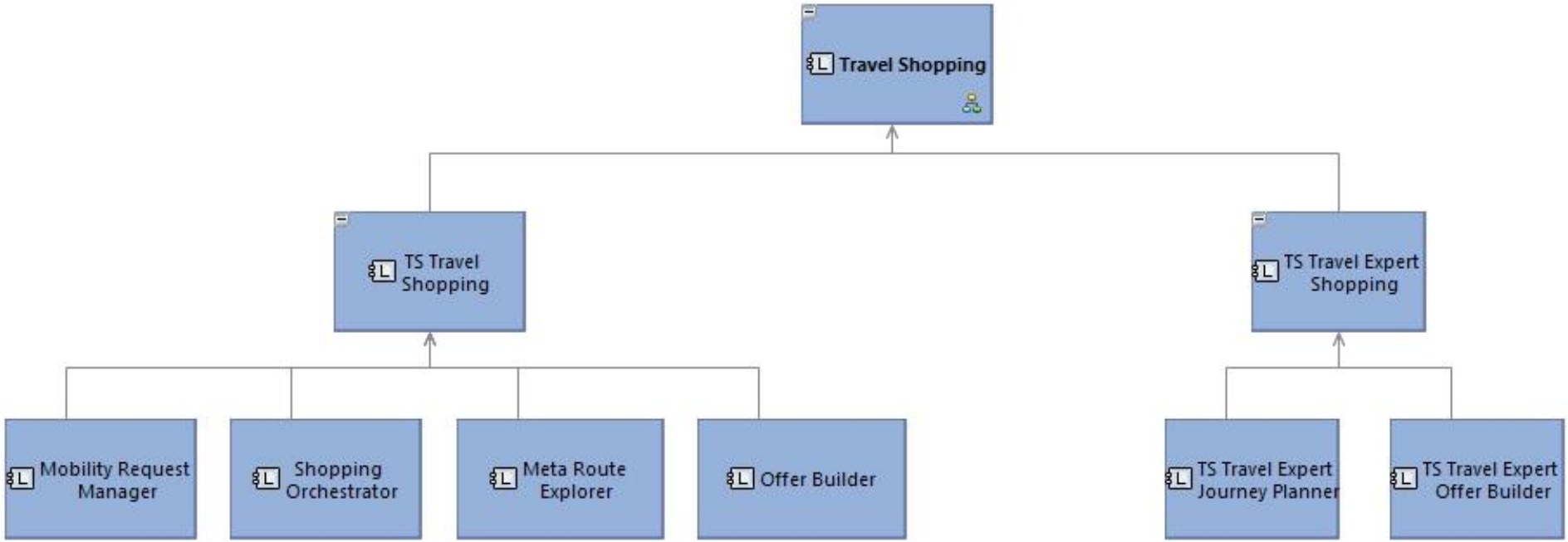

Figure 2: Travel Shopping components breakdown

7. FUNCTIONAL ASPECTS

In order to provide a seamless purchasing experience for all aspects of travel shopping, a set of functions are required that manage and aggregate distributed travel shopping data and distributed Journey Planning expertise.

7.1 ACTIVITY DIAGRAMS

7.1.1 Travel Shopping Functions

The Travel Shopping main components are:

- **Travel Shopping:** this function aggregates the elements of a travel solution to compose a full itinerary offer;
- **Travel Expert Shopping:** this function provides the Travel Shopping with all needed information for a single or set of TSPs regarding the TSPs capabilities.

The Travel Shopping is responsible for the offer constitution computation. This computation is based on the following functions:

- **ManageMobilityRequest (Mobility Request Manager):** this function is interacting with the Travel Companion to get the mobility request and the customer preferences. It aims at preparing the mobility request before the itinerary offer computation;

- **DecodeMobilityRequest (Shopping Orchestrator):** this function aims at decoding the mobility request to identify the stop places, which are located near to the origin and the destination specified by the customer through the IF location resolver;

- **OrchestrateShopping (Shopping Orchestrator):** this function aims at managing the shopping flow and at coordinating all shopping modules;

- **PrepareTravelExpertList (Shopping Orchestrator):** this function aims at identifying travel experts for each meta travel expert episode through the IF travel expert resolver;

- **SelectSmartestRoutes (Meta Route Explorer):** this function aims at defining the most relevant (in the sense that will be specified below) routes, which are joining the origin and the destination specified in the mobility request;

- **BuildNetworkReferenceResource (Meta Route Explorer):** the network reference resource is based on statistical data provided by each travel expert. This function aims at aggregating this data to generate some networks (inter-agglomeration and intra-agglomeration);

- **GetItineraryOfferItemsFromTravelExperts (Offer Builder):** this function is interacting with the Interoperability Framework to get itinerary offer items from travel experts;

- **FilterItineraryOfferItems (Offer Builder):** this function aims at filtering itinerary offer items provided by a travel expert to select only the ones matching the mobility request criteria;

- **AggregateItineraryOffers (Offer Builder):** this function aims at building itinerary offer by using itinerary offer items provided by travel experts;

- **StoreShoppingContext (Offer Builder):** this function stores temporary the details of each itinerary offer in the offer builder shopping context storage;

- **ProvideItineraryOfferDetails (Offer Builder):** the booking and ticketing process needs itinerary offer details to convert itinerary offer into booking. This function aims at providing these details.

Travel Expert Shopping itself is decomposed into two functions:

- **PublishStatisticalData (Travel Expert Journey Planner):** this function provides statistical data for the construction of the network reference resource;

- **ComputeItineraryOfferItem (Travel Expert Offer Builder):** this function provides itinerary offer items corresponding to the request coming from the Travel Shopping Offer Builder through the interoperability framework.

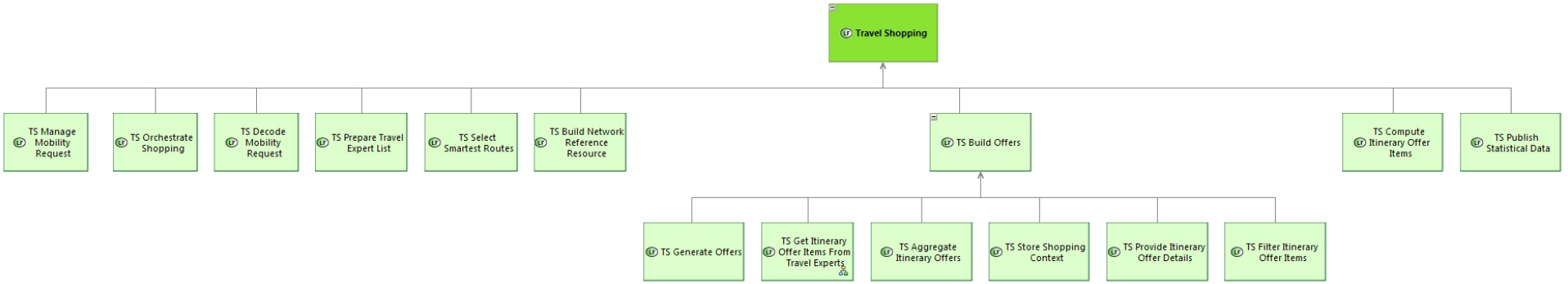

Figure 3: Travel Shopping functions breakdown

7.1.2 Travel Shopping functional architecture

The Travel Shopping functional architecture is described in this diagram:

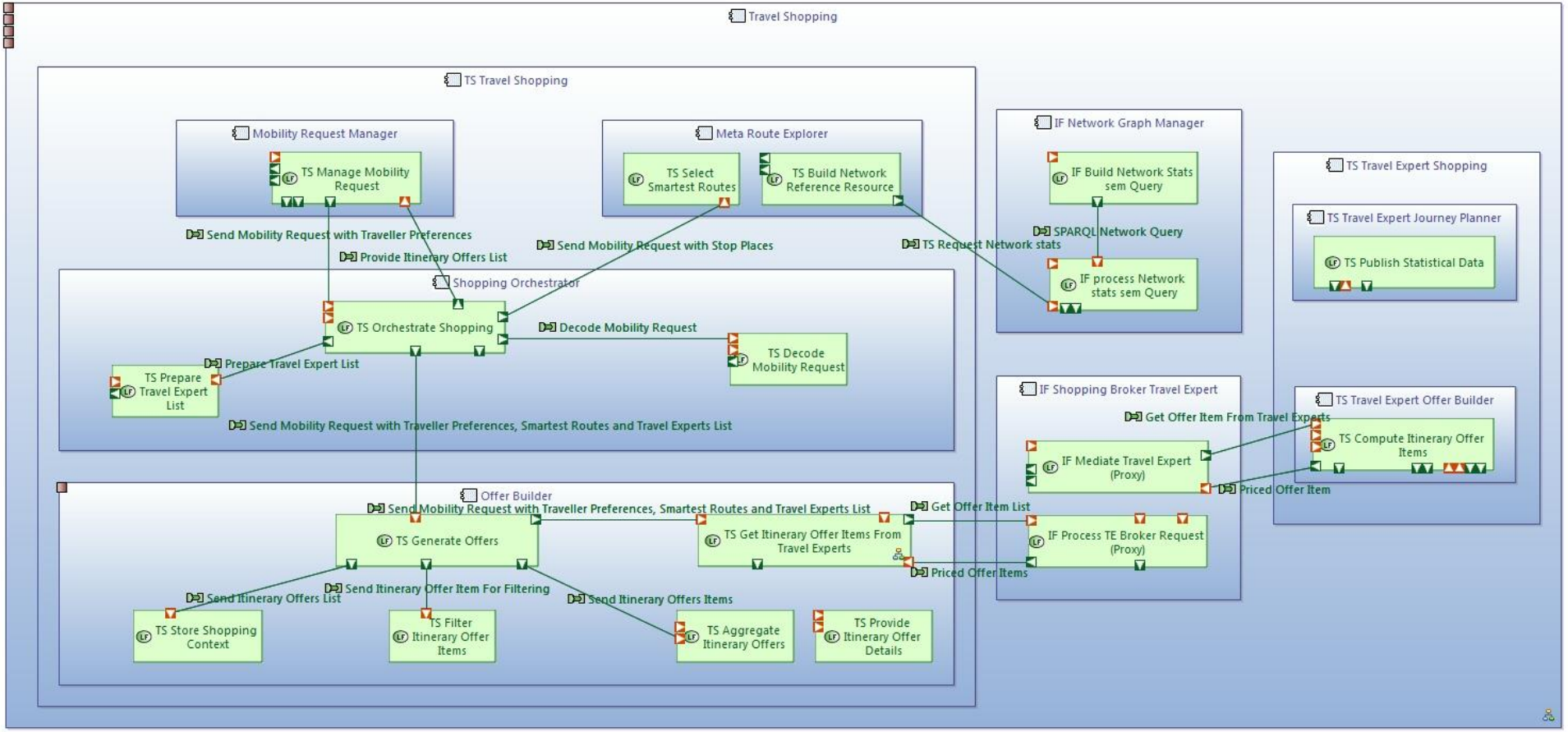

Figure 4: Travel Shopping functional architecture

The Travel Shopping functional component details are detailed in the following table:

Travel Shopping functions	
Component	**Description**
Mobility Request manager	This component manages the function “ManageMobilityRequest” This service is involved in the following use cases: • Get the mobility query; • Get customer preferences from the Travel Companion; • Communicate the itinerary offers list to the Travel Companion; • Communicate the itinerary offers list to the Business Analytics.
Travel Shopping Orchestrator	This component coordinates the functional components of the shopping process, these components are: • The resolvers (location resolver and travel expert resolver); • The Meta Route Explorer; • The Offer Builder. This component manages the following functions: • OrchestrateShopping; • DecodeMobilityRequest; • PrepareTravelExpertList.
Meta Route Explorer	This service is involved in the following functions: • BuildNetworkReferenceResource; • SelectSmartestRoutes.
Offer Builder	This component aggregates the elements of a travel solution to compose one or several itinerary offers. This component manages the following functions: • GetItineraryOfferItemsFromTravelExperts; • FilterItineraryOfferItems; • AggregateItineraryOffers; • StoreShoppingContext; • ProvideItineraryOfferDetails. Two functions are not visible in the Travel Shopping functional architecture. These two functions are not in IT²RAIL scope and will be developed in the scope of the Shift2Rail project:

	• ApplyMultimodalPricingLogic; • ApplyMultimodalAvailabilityLogic.
Travel Expert Shopping services	
Component	**Description**
Travel Expert Journey Planner	This component manages the function “PublishStatisticalData”
Travel Expert Offer Builder	This component manages the function “ComputeItineraryOfferItem”

Table 3: Travel Shopping Functions

The travel shopping process involves some functional components, which are provided by other functional areas:

Component	**Description**
Interoperability Framework	This service is involved in the following use cases: • Resolve Location; • Resolve Travel expert; • Provide information on Travel Expert coverage.
Travel Companion	This service is involved in the following use cases: • Provide the user preferences

Table 4: Used functions by Travel Shopping

8. CAPABILITIES: SEQUENCE DIAGRAMS

8.1 PRESENTATION

This section synthesises all the capabilities of the Shopping process. These specifications are written following the use cases methodology. Each use case is described with text and sequences diagram(s). The data exchanged across the actors and systems are then described in detail in the Interface specification document.

Only the “nominal / normal” scenarios are described in this release of this specification document.

Travel Shopping will focus on the following system capabilities:

- Provide statistical data for the Meta Route Explorer
- Provide offers
- Build itinerary offers list
- Provide itinerary offer items
- Provide itinerary offer items – Booking and Ticketing

8.2 CAPABILITIES SPECIFICATIONS

8.2.1 Provide statistical data for the Meta Route Explorer

This scenario describes the statistical data synchronisation between travel experts and the meta route explorer.

The meta route explorer defines smartest routes corresponding to a mobility request by using some networks.

These networks are generated asynchronously with statistical data provided by each travel expert.

The Shopping functions involved in this scenario are:

- **TS Publish Statistical Data**: this function provides statistical data;
- **TS Build Network Reference Resource**: this function computes the network reference resource based on the statistical data.

The following scenario shows where these shopping function are used:

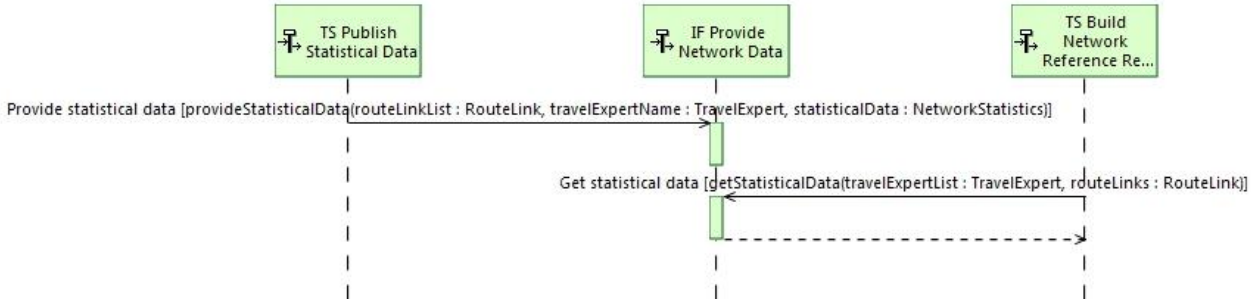

Figure 5: Shopping - Provide Statistical Data for the Meta Route Explorer scenario

This scenario realises two functional exchanges of the Shopping functions:

- The TS Publish Statistical Data function realises the following functional exchange:
  - **Provide statistical data for the meta route explorer:** This functional exchange provides statistical data to the Assets Manager for storage. Statistical data is described in the network data model paragraph.
- The TS Build Network Reference Resource function realises the following functional exchange:
  - **Get statistical data for the meta route explorer:** The meta route explorer calls the Assets Manager to collect statistical data to build some meta networks.

8.2.2 Provide offers

This scenario describes the shopping process: the customer specifies a mobility request through the Travel Companion application and gets as reply a list of itinerary offers corresponding to the initial mobility request.

The Shopping functions involved in this scenario are:

- **MobilityRequestManager associated functions**: these functions get the mobility request from the Travel Companion application and retrieve the customer preferences from the Travel Companion. The Mobility Request Manager associated functions then provide the mobility request and the associated customer preferences to the shopping orchestrator. At the end of the shopping flow, the Mobility Request Manager associated functions provide the list of itinerary offers to the Travel Companion application and the IT²RAIL Business Analytics;
- **ShoppingOrchestrator associated functions**: these functions coordinate exchanges with all shopping components. These functions interact with the interoperability framework **LocationResolver** and **TravelExpertResolver** associated functions;
- **MetaRouteExplorer associated functions**: these functions compute smartest routes corresponding to the mobility request. This computation relies on some networks built with statistical data provided by travel experts;
- **OfferBuilder associated functions:** these functions are involved in the Build Offer sub-process (please see the chapter Build itinerary offers list).

The following scenario shows where the Shopping functions are used:

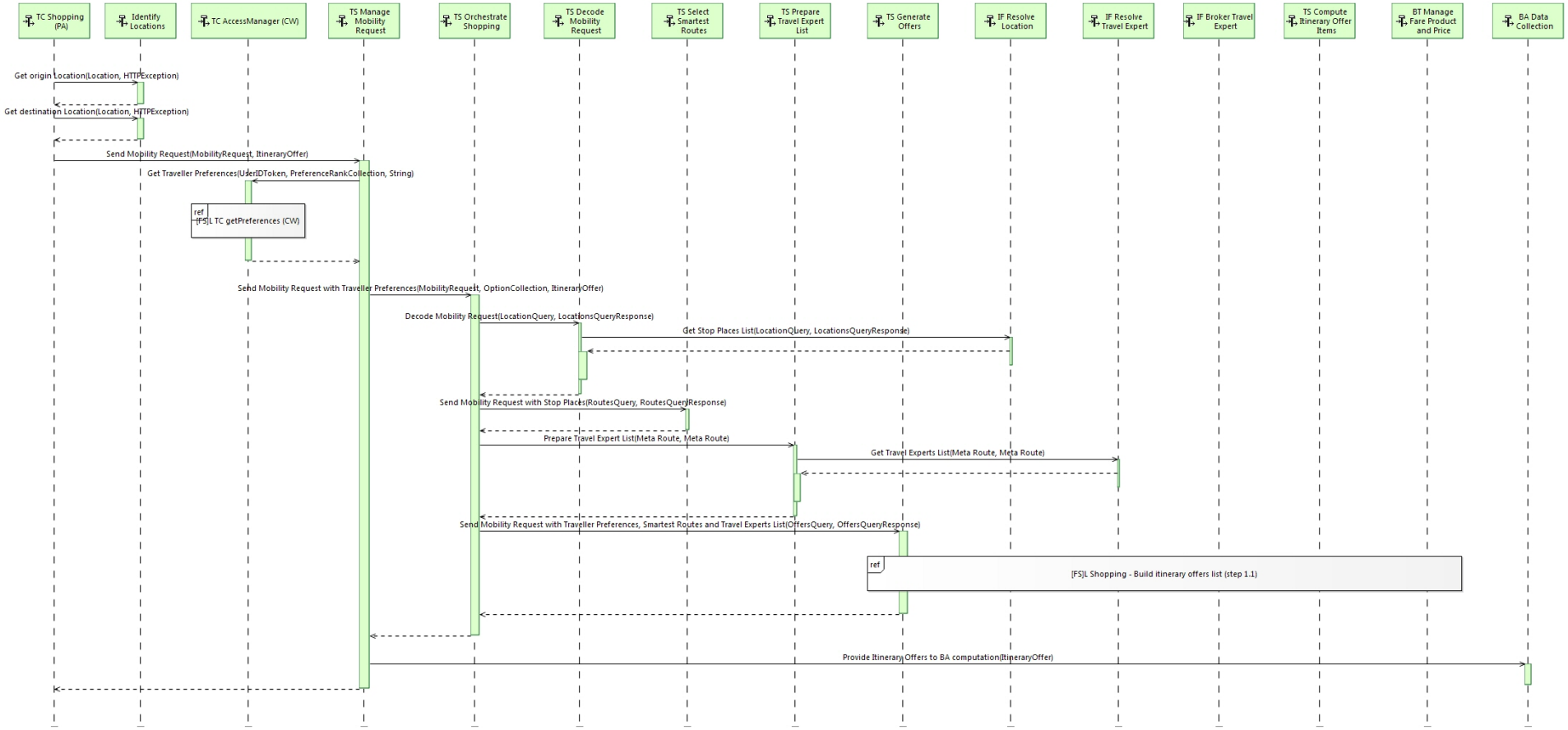

Figure 6: Shopping - Provide Offers (step 1) scenario

This scenario realises the following functional exchanges of the Shopping functions:

- The **MobilityRequestManager** functions realise the following functional exchanges:
  - **Get Traveller Preferences**: this functional exchange requests customer preferences from the Travel Companion;
  - **Send Mobility Request with Traveller Preferences**: this functional exchange provides the mobility request with the customer's preferences to the Shopping Orchestrator;
  - **Provide Consolidated Itinerary Offers**: This functional exchange is in charge of providing a list of travel solutions to the Travel Companion;
  - **Provide itinerary offers for BA computations**: This functional exchange provides itinerary offers to Business Analytics.
- The **ShoppingOrchestrator** functions realise the following functional exchanges:
  - **Decode Mobility Request**: this functional exchange requests the list of stop places located near to the mobility request's origin and the destination from the Location Resolver;
  - **Send Mobility Request with Stop Places**: this functional exchange provides the mobility request with the list of stop places to the Meta Route Explorer and gets as reply a list of smartest routes;
  - **Prepare Travel Expert List**: this functional exchange requests the list of travel experts for each meta travel expert episode from the Travel Expert Resolver;
  - **Send Mobility Request with Traveller Preferences, Smartest Routes and Travel Experts List**: this functional exchange provides the mobility request enriched with customer preferences, smartest routes and the list of associated travel experts, and gets as reply a list of itinerary offers;
  - **Provide Itinerary Offers List**: This functional exchange provides the list of itinerary offers to the Mobility Request Manager.
- The functions realised by the OfferBuilder follow in the next chapter 8.2.3.

8.2.3 Build itinerary offers list

This scenario describes the itinerary offer building process: the offer builder gets a mobility request enriched with customer preferences, smartest routes and the list of associated travel experts from the Shopping Orchestrator. The Offer Builder calls travel experts to get a list of itinerary offer items for each meta travel expert episode. The itinerary offer items are aggregated to build itinerary offers.

The following scenario shows where the Shopping functions are used:

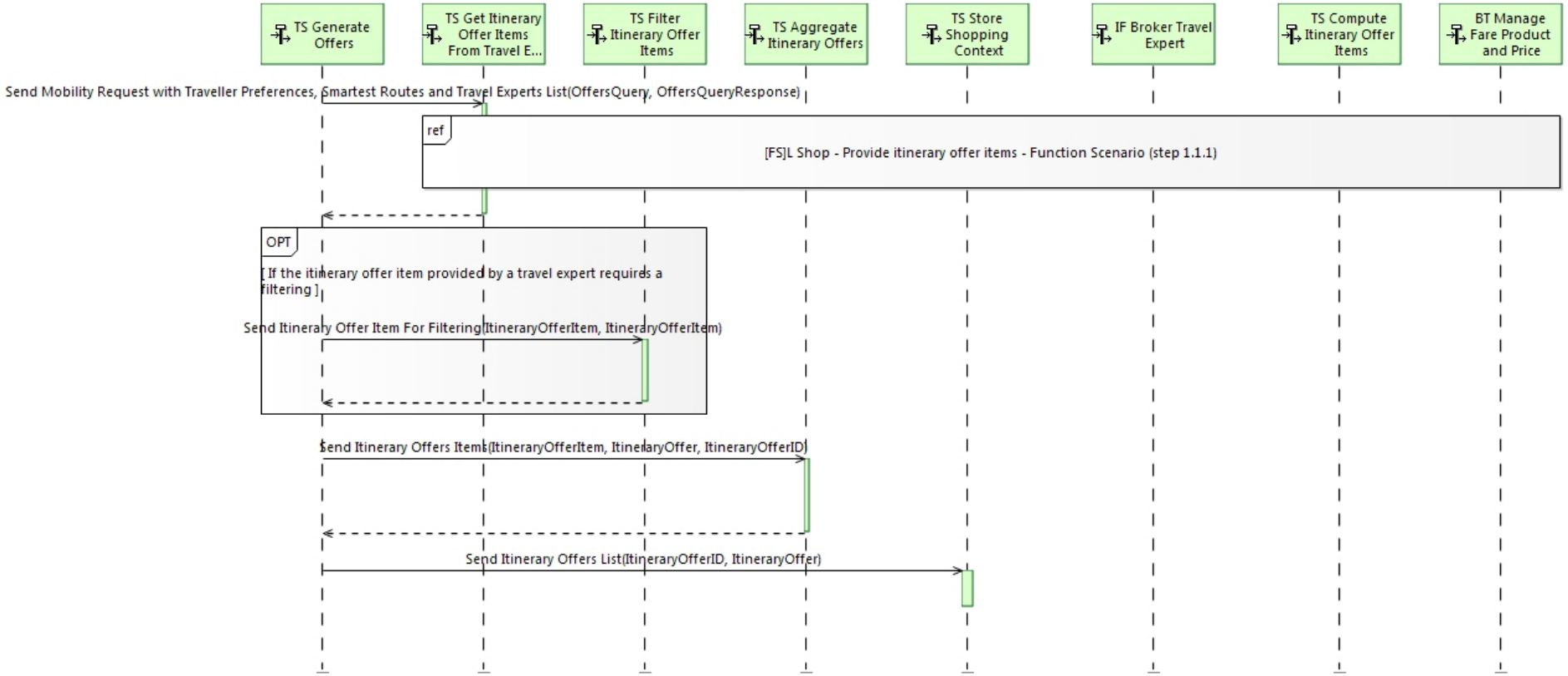

Figure 7: Shopping – Build Itinerary Offers List (step 1.1) scenario

This scenario realises the following functional exchanges of the Shopping functions:

- The OfferBuilder function realises the following functional exchange:
  - **Get Offer Item List:** this functional exchange is detailed in the chapter Provide itinerary offer items;
  - **Send Itinerary Offer For Filtering:** this functional exchange filters itinerary offer items provided by a travel expert to select only the ones matching the mobility request criteria;
  - **Aggregate Itinerary Offers Items:** this functional exchange initiates the itinerary offers computation;
  - **Store Shopping Context:** this functional exchange stores all details of the aggregated itinerary offers.

8.2.4 Provide itinerary offer items

This scenario realises the interactions between the Travel Shopping Offer Builder and each Travel Expert Offer Builder. This interaction is managed by the Interoperability Framework Broker.

The following scenario shows where these Shopping functions are used:

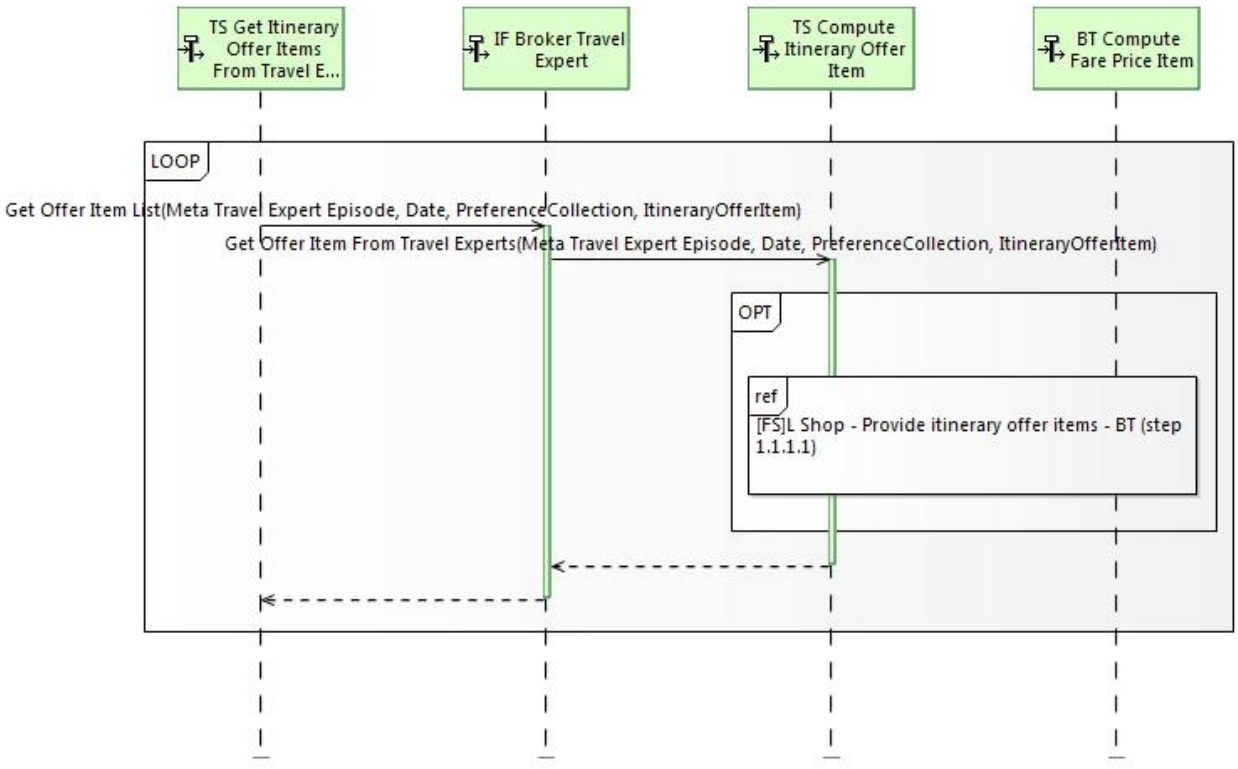

Figure 8: Shopping - Provide Itinerary Offer Items (step 1.1.1) scenario

This scenario realises the following functional exchanges of the Shopping functions:

- The OfferBuilder function realises the following functional exchange:
  - **Get Offer Item List**: this functional exchange interacts with the Interoperability Framework Broker to call each travel expert. The Offer Builder calls the Broker with a list of offer requests and the associated travel experts. The Broker will then call each travel expert to request a list of itinerary offer items.
- The **TravelExpertOfferBuilder** function is potentially involved in the "Provide itinerary offer items – B&T" scenario, which is described in the chapter Provide itinerary offer items – Booking and Ticketing.

8.2.5 Provide itinerary offer items – Booking and Ticketing

This scenario describes the interactions between Travel Expert Offer Builder and Booking and Ticketing functional components. This scenario is an **optional scenario** and does not apply for all Travel Experts.

The following scenario shows where the Shopping and Booking and Ticketing functions are used:

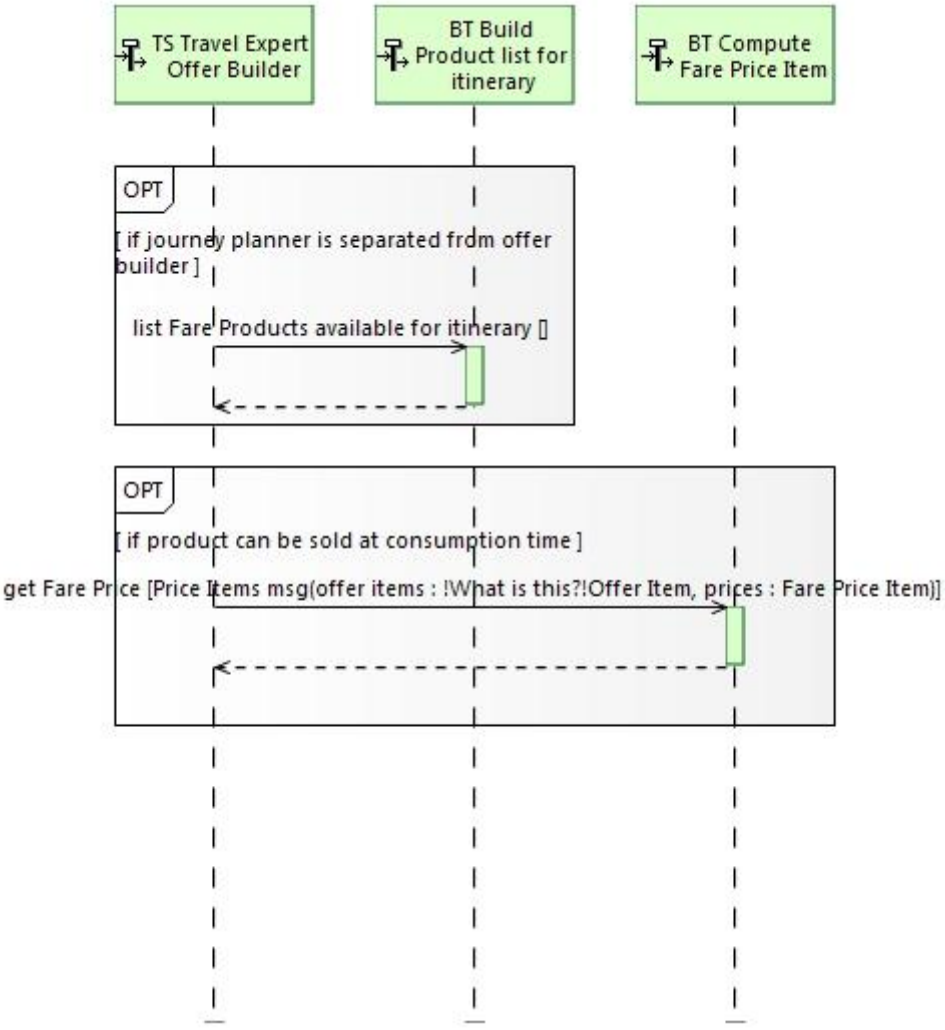

Figure 9: Shopping - Provide Itinerary Offer Items – Booking and Ticketing (step 1.1.1.1) scenario

This scenario realises the following functional exchanges of the Shopping functions:

- The **BookingAndTicketing** function realises the following functional exchange:
  - **List Fare Products Available For Itinerary**: this functional exchange is detailed in the Booking and Ticketing specification.
  - **List Fare Price**: this functional exchange is detailed in the Booking and Ticketing specification.

9. FUNCTIONAL EXCHANGES

9.1 FUNCTIONAL EXCHANGE DETAILS

This chapter contains the detail of each functional exchange.

9.1.1 Functional Exchanges provided by Travel Shopping

This is the list of functional exchanges provided by the shopping:

Name	Purpose
Mobility Request Manager	
Functional Exchange 1 – Send Mobility Request	This functional exchange provides the mobility request.
Functional Exchange 2 – Provide itinerary offers for BA computations	This functional exchange provides itinerary offers to Business Analytics.
Shopping Orchestrator	
Functional Exchange 3 – Send Mobility Request with Traveller Preferences	This functional exchange provides the mobility request with the customer preferences.
Functional Exchange 4 – Decode Mobility Request	This functional exchange retrieves the list of stop places.
Functional Exchange 5 – Prepare Travel Expert List	This functional exchange retrieves the list of travel experts.
Meta Route Explorer	
Functional Exchange 6 – Send Mobility Request with Stop Places	This functional exchange provides the mobility request with the list of associated stop places.
Offer Builder	
Functional Exchange 7 – Send Mobility Request with Traveller Preferences, Smartest Routes and Travel Experts List	This functional exchange provides the mobility request with the customer preferences, the list of associated stop places and the list of associated travel experts.
Functional Exchange 8 – Get Offer Item List	This functional exchange is used to Get Offers from a specific Travel Expert, for the Meta Travel Expert Episodes relevant to this Travel Expert.
Functional Exchange 9 – Provide Offer Detail For Offer Display	This functional exchange provides itinerary offer details.

9.1.2 Mobility Request Manager

This Component provides two functional exchanges to IT²RAIL compliant systems.

Functional Exchange 1 - Send Mobility Request

Functional ExchangeID:	1
Functional Exchange Name:	Send Mobility Request
Purpose of the Functional Exchange	This functional exchange receives a mobility request from the Travel Companion
Requestor:	TC Shopping (PA)
Provider	TS Manage Mobility Request
Description:	This functional exchange receives a mobility request from a Traveller who is using the Travel Companion mobile app.
Impact to CREL	Partial
Impact to AREL	Complete
Impact to FREL	Complete
Preconditions:	A traveller wants to know more information regarding specific itineraries. A mobility request is issued by the Travel Companion mobile app.
Postconditions:	The Mobility Request Manager retrieves user preferences from Travel Companion Cloud then a mobility request enriched with Traveller Preferences is sent to the Travel Shopping Orchestrator.
Request / Input	Mobility Request (see Capella Model)
Response / Output	ItinerayOffer (see Capella Model)
Exceptions:	
Notes and Issues:	

Functional Exchange 2 - Provide itinerary offers for BA computations

Functional Exchange ID:	2
Functional Exchange Name:	Provide Itinerary Offers for BA computations
Purpose of the Interface	The purpose of this interface is to provide itinerary offers to Business Analytics
Requestor:	TS Manage Mobility Request
Provider	Business Analytics: BA Data Collection
Description:	This interface is in charge of providing a list of itinerary offers to Business Analytics for its own computations.
Impact to CREL	Partial
Impact to AREL	Complete
Impact to FREL	Complete
Preconditions:	The Travel Shopping Orchestrator completed all activities related to a shopping request. Itinerary offers were sent to Travel Companion.
Postconditions:	Itinerary offers are returned to Business Analytics.
Request / Input	ItineraryOffer (see Capella Model)
Response / Output	
Exceptions:	
Notes and Issues:	

9.1.3 Shopping Orchestrator

This function provides three functional exchanges to IT²RAIL compliant systems.

Functional Exchange 3 - Send Mobility Request with Traveller Preferences

Functional Exchange ID:	3
Functional Exchange Name:	Send Mobility Request with Traveller Preferences
Purpose of the Functional Exchange	This functional exchange sends a mobility request enriched with user preferences.
Requestor:	TS Manage Mobility Request
Provider	TS Orchestrate Shopping
Description:	This functional exchange sends a mobility request along with user preferences to the Shopping Orchestrator.
Impact to CREL	Partial
Impact to AREL	Complete
Impact to FREL	Complete
Preconditions:	The Mobility Request Manager collected user preferences from Travel Companion.
Postconditions:	A mobility request with traveller preferences is forwarded to the Travel Shopping Orchestrator in order to decode the mobility query.
Request / Input	Date, MetaJourney, PreferenceCollection (see Capella Model)
Response / Output	ItineryOffer (see Capella Model)
Exceptions:	
Notes and Issues:	

Functional Exchange 4 - Decode Mobility Request

Functional Exchange ID:	4
Functional Exchange Name:	Decode Mobility Request
Purpose of the Functional Exchange	Decode locations
Requestor:	TS Orchestrate Shopping
Provider	TS Decode Mobility Request
Description:	Provide list of Stop Place within a given radius of an identified Location
Impact to CREL	Complete
Impact to AREL	Complete
Impact to FREL	Complete
Preconditions:	Valid LocationQuery with Identified Location
Postconditions:	Zero, one or more StopPlace returned
Request / Input	**Location Query** (see Capella Model)
Response / Output	**LocationsQueryResponse** (see Capella Model)
Exceptions:	Invalid request
Notes and Issues:	Additional notes, issues and comments

Functional Exchange 5 - Prepare Travel Expert List

Functional Exchange ID:	5
Functional Exchange Name:	Prepare Travel Expert List
Purpose of the Functional Exchange	Associate Meta Travel Expert Episode with corresponding Travel Expert service descriptors

Requestor:	TS Orchestrate Shopping
Provider	TS Prepare Travel Expert List
Description:	Associate Meta Travel Expert Episode with corresponding Travel Expert service descriptors
Impact to CREL	Complete
Impact to AREL	Complete
Impact to FREL	Complete
Preconditions:	Valid Meta Travel Expert Episode request
Postconditions:	Zero, one or more Travel Expert service descriptors are associated with input Meta Travel Expert Episode
Request / Input	**MetaRoutes (incl. Meta Travel Expert Episode)** (see Capella Model)
Response / Output	**MetaRoutes (incl. Meta Travel Expert Episode), Travel Expert Identification** (see Capella Model)
Exceptions:	
Notes and Issues:	

9.1.4 Meta Route Explorer

This function provides one functional exchange to IT²RAIL compliant systems.

Functional Exchange 6 - Send Mobility Request with Stop Places

Functional Exchange ID:	6
Functional Exchange Name:	Send Mobility Request with Stop Places
Purpose of the Functional Exchange	To provide a list of meta routes
Requestor:	TS Orchestrate Shopping
Provider	TS Select Smartest Routes
Description:	The service provides a list of meta routes to reach an end point from a start point for each meta journey requested.
Impact to CREL	Partial
Impact to AREL	Partial
Impact to FREL	complete
Preconditions:	The travel shopping orchestrator provides a mobility query containing: • A list of Meta journeys. For each Meta journey, the user needs to precise the origin and destination points with the nearest Stop Places; • Possibly travellers' information and search options.
Postconditions:	The process provides the list of smartest routes covering the meta journey requested.
Request / Input	**Date, StopPlaceCode, MetaJourney, PreferenceCollection** (see Capella Model)
Response / Output	**Date, StopPlaceCode, MetaJourney, MetaRoutes** (see Capella Model)
Exceptions:	
Notes and Issues:	

9.1.5 Offer Builder

This function provides three functional exchanges to IT²RAIL compliant systems.

Functional Exchange 7 - Send Mobility Request with Traveller Preferences, Smartest Routes and Travel Experts List

Functional Exchange ID:	7
Functional Exchange Name:	Send Mobility Request with Traveller Preferences, Smartest Routes and Travel Experts List
Purpose of the Functional Exchange	To return a list of aggregated itinerary offers
Requestor:	TS Orchestrate Shopping
Provider	TS Build Offer
Description:	To return a list of aggregated itinerary offers with transport number, schedule and price
Impact to CREL	Partial
Impact to AREL	Partial
Impact to FREL	Complete
Preconditions:	The travel shopping orchestrator provides a request containing a list of smartest routes and the travel experts to call for each route.
Postconditions:	The process returns a list of aggregated itinerary offers.
Request / Input	**Meta Route, TravelExpert, Date, PreferenceCollection** (see Capella Model)
Response / Output	**ItineraryOffer** (see Capella Model)
Exceptions:	
Notes and Issues:	

Functional Exchange 8 - Get Offer Item List

Functional Exchange ID:	8
Functional Exchange Name:	Get Offer Item List
Purpose of the Functional Exchange	Functional exchange is used to Get Offers from a specific Travel Expert, for the Meta Travel Expert Episodes relevant to this Travel Expert.
Requestor:	TS Get Itinerary Offer Items From Travel Experts
Provider	IF Broker Travel Expert
Description:	Request includes request information needed for the Travel Expert to retrieve offers for each Meta Travel Expert Episode. Search Options and Traveller preferences are also specified. Response includes the list of offers retrieved and consolidated by the Travel Expert
Impact to CREL	Not Applicable
Impact to AREL	Partial
Impact to FREL	Complete
Preconditions:	A list of Meta Travel Expert Episodes, search options and traveller preferences relevant for the Travel Expert are identified.
Postconditions:	Travel Expert provided with a list of offers for the list of Meta Travel Expert Episodes.
Request / Input	**MetaTravelExpertEpisode, Date, PreferenceCollection** (see Capella Model)
Response / Output	**ItineraryOfferItem** (see Capella Model)
Exceptions:	
Notes and Issues:	

Functional Exchange 9 - Provide Offer Detail For Offer Display

Functional Exchange ID:	9
Functional Exchange Name:	Provide Itinerary Offer Details
Purpose of the Functional Exchange	This functional exchange provides itinerary offer details
Requestor:	Ticketing & Booking: BT Orchestrate Booking
Provider	TS Build Offer
Description:	The Offer Builder temporary stores itinerary offer details. These details are used by other WP.
Impact to CREL	Not applicable
Impact to AREL	Partial
Impact to FREL	Complete
Preconditions:	An application requests details related to a given itinerary offer.
Postconditions:	Itinerary offer details are provided to the requestor
Request / Input	**ItineraryOfferRefID** (see Capella Model)
Response / Output	**ItineraryOffer** (see Capella Model)
Exceptions:	
Notes and Issues:	

9.2 FUNCTIONAL EXCHANGES PROVIDED BY OTHER FUNCTIONAL AREAS

9.2.1 Functional Exchanges provided by Interoperability Framework

The list of functional exchanges is here provided by the Interoperability Framework and Resolvers (see WP1 specifications - Interoperability Framework Specification - D1.8):

Name	Purpose
Functional exchange 10 - Resolve Location	This functional exchange is to decode unspecified locations.
Functional exchange 11 - Resolve Travel Expert	This functional exchange is to associate travel experts with the smartest routes identified by the Meta Route Explorer.
Functional exchange 12 - Provide Travel Expert Functionality	This functional exchange is to get access to the functionalities of the Travel Experts.
Functional Exchange 13 - Get statistical data for the meta route explorer	This functional exchange gets statistical data for the Meta Route Explorer.

9.2.2 Functional Exchanges provided by Travel Companion

The list of functional exchanges provided by the Travel Companion (see WP5 Specification - D5.2 - Travel Companion Specifications) is here:

Name	Purpose
Functional exchange 14 – Get Traveller Preferences	This functional exchange provides the traveller preferences

9.3 DATA MODEL

This chapter contains the functional / conceptual data model of Shopping.

9.3.1 Overview of the Mobility Request data model

This high-level class diagram shows the main classes and their relationships concerning the Mobility Request class model.

Some class attributes aim at clarifying the contents and use of the class.

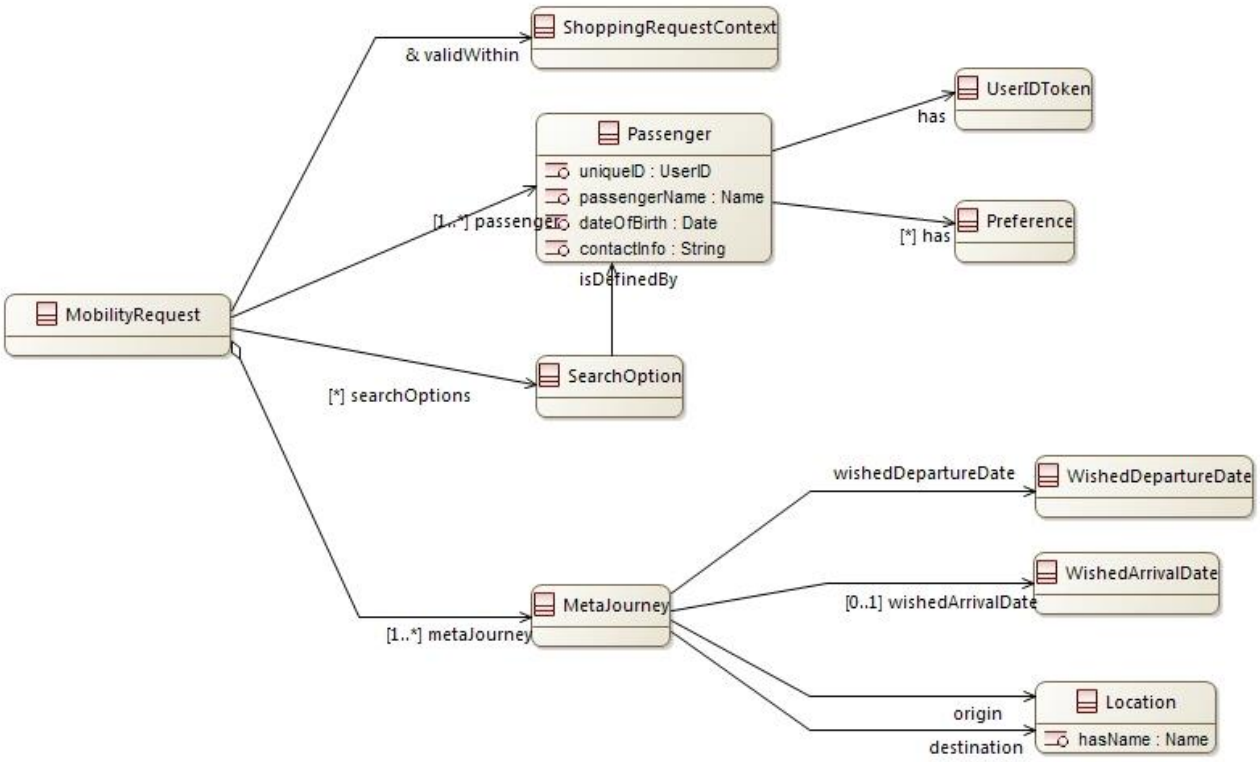

Figure 10: Mobility Request data model

This data model shows the organisation of the Mobility Request in IT²RAIL.

The Mobility Request contains the following items:

- Some location items: these elements correspond to the origin and the destinations of the Meta Journey, which are specified by the user in the Mobility Request;
- Some dates: the dates correspond to the moment when the user wants to start and/or finish his trips;
- Some preferences: the Mobility Request contains the set of one-time preferences, which are specified by the user. It contains also the user ID token to retrieve the user preferences, which are stored in the Travel Companion Cloud.

9.3.2 Overview of the Itinerary Offer data model

This high-level class diagram shows the main classes and their relationships concerning the Itinerary Offer class model.

Some class attributes aim at clarifying the contents and use of the class.

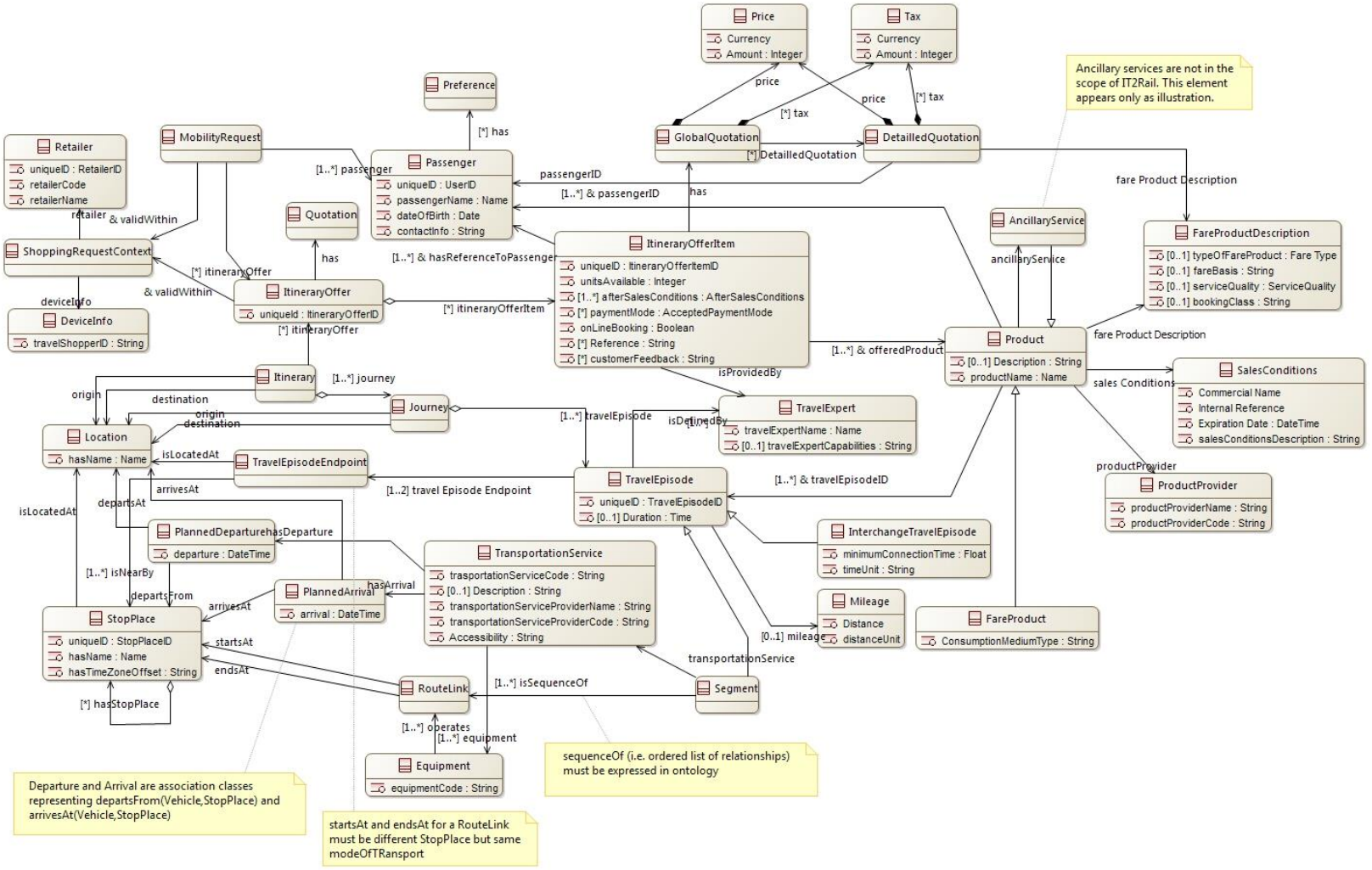

Figure 11: Itinerary Offer data model

This model shows the organisation of the Itinerary Offers in IT²RAIL.

The Itinerary Offer is a combination of Itinerary Offer items.

An Itinerary Offer item is computed by a travel expert and corresponds to a unique combination of the following elements:

- Passenger(s). A passenger is defined by a set of preferences and his passenger ID;
- Travel episode(s). The travel episode is a part of the itinerary;
- Product(s). A product can be associated to the following elements: a reservation, a fare product description and ancillary services.

Note: Ancillary services are not in IT²RAIL scope.

The Itinerary Offer contains also the description of the itineraries, which join origins and destinations specified in the Mobility Request.

9.3.3 Overview of the Network Data model

This high-level class diagram shows the main classes and their relationships concerning the Network Data class model.

Some class attributes aim at clarifying the contents and use of the class.

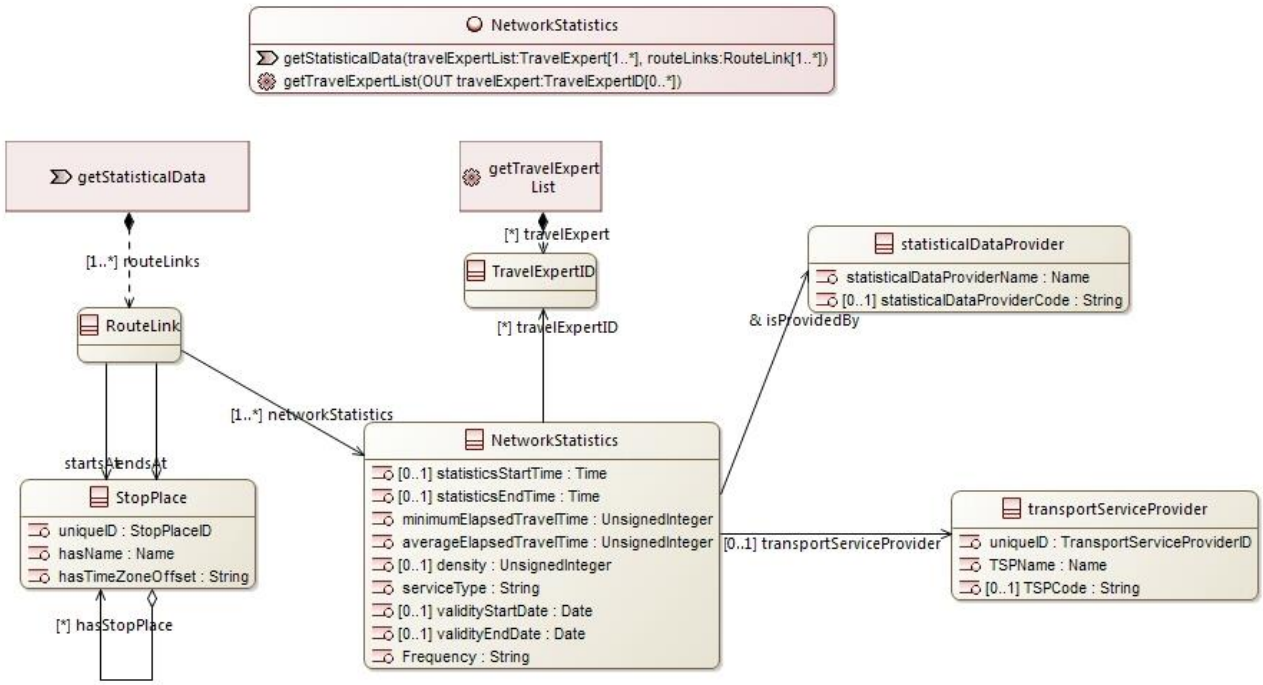

Figure 12: Statistical Data for the Meta Route Explorer model

This model shows the organisation of the Network Data in IT²RAIL.

The Network Data is a combination of Network daily statistics for a given list of RouteLinks.

These statistics are defined by a given Travel Expert.

9.3.4 Overview of the Itinerary model

This high-level class diagram shows the main classes and their relationships concerning the Itinerary class model.

Some class attributes aim at clarifying the contents and use of the class.

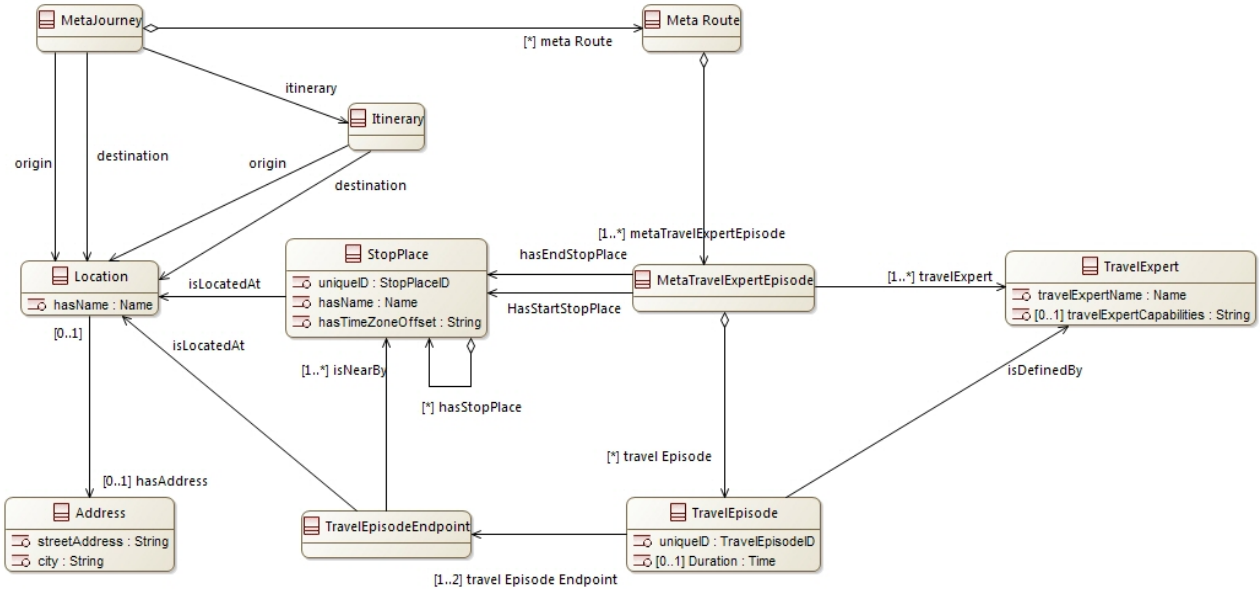

Figure 13: Itinerary model

This model shows the relationships between the itinerary and other routing items (journey, meta route, travel episode…).

9.4 INTERFACES

This chapter specifies the interfaces of the functions of the Shopping, with their inputs and outputs.

This is the list of functional exchanges provided by the shopping:

Name	Purpose
Interface 1 – Find Smartest Routes	This interface provides smartest routes
Interface 2 – Build Offers	This interface provides the list of itinerary offers
Interface 3 – Manage Travel Request	This interface manages travel requests

9.4.1 Find Smartest Routes interface

This interface is exposed by the TS Select Smartest Routes function.

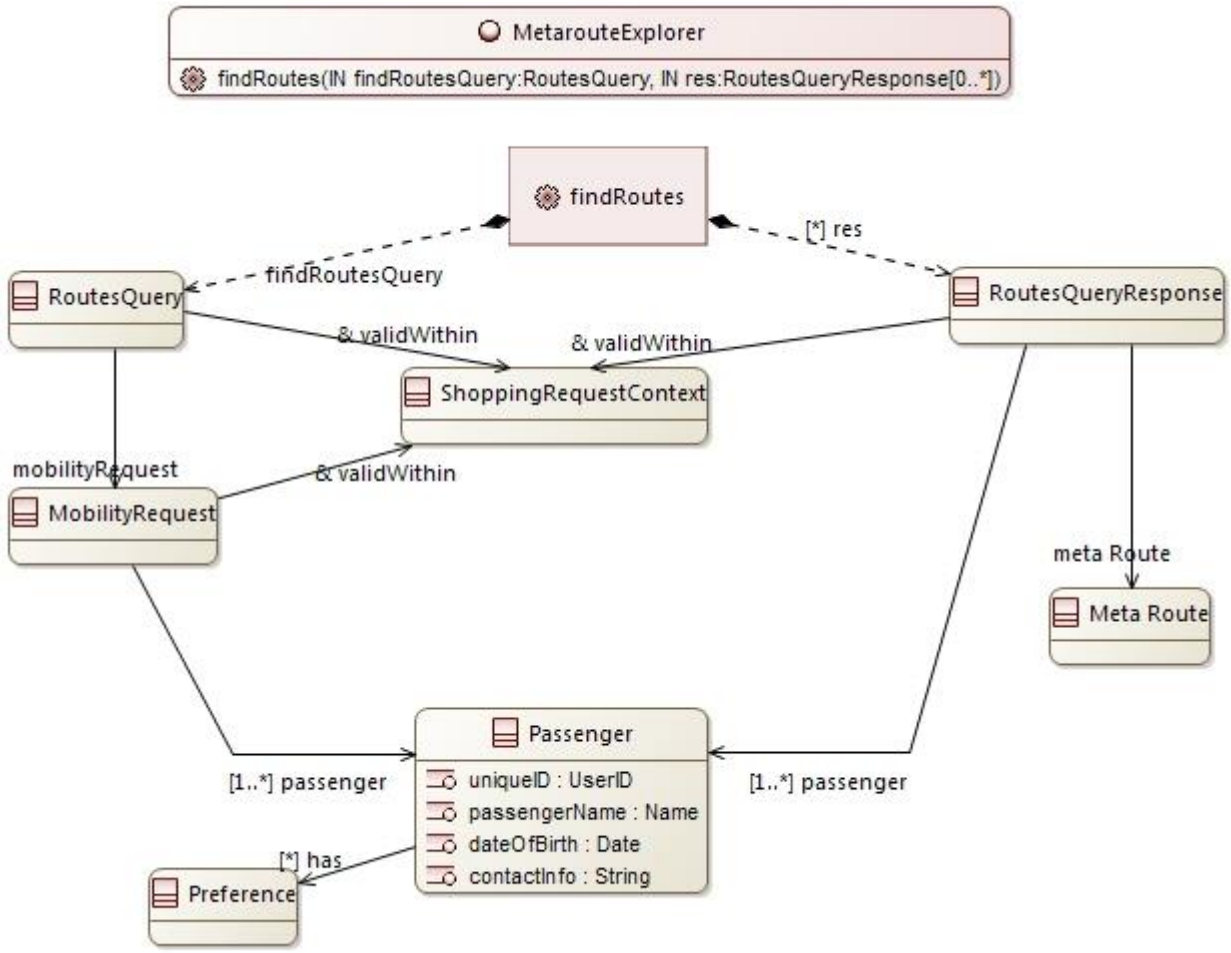

Figure 14: Find Smartest Routes interface

Interface ID:	1
Interface Name:	Find Smartest Routes interface
Purpose of the Interface	To provide a list of meta routes
Requestor:	Shopping Orchestrator
Provider	Meta Route Explorer
Description:	The service provides a list of meta routes to reach an end point from a start point for each meta journey requested.
Impact to CREL	Partial
Impact to AREL	Partial
Impact to FREL	complete
Preconditions:	The travel shopping orchestrator provides a mobility query containing: • A list of Meta journeys. For each Meta journey, the user needs to precise the origin and destination points with the nearest Stop Places; • Possibly travellers' information and search options.
Postconditions:	The process provides the list of smartest routes covering the meta journey requested.
Request / Input	**Date, StopPlaceCode, MetaJourney, PreferenceCollection** (see Capella Model)
Response / Output	**Date, StopPlaceCode, MetaJourney, MetaRoutes** (see Capella Model)
Exceptions:	
Notes and Issues:	

9.4.2 Build Offers interface

This interface is exposed by the TS Build Offer function.

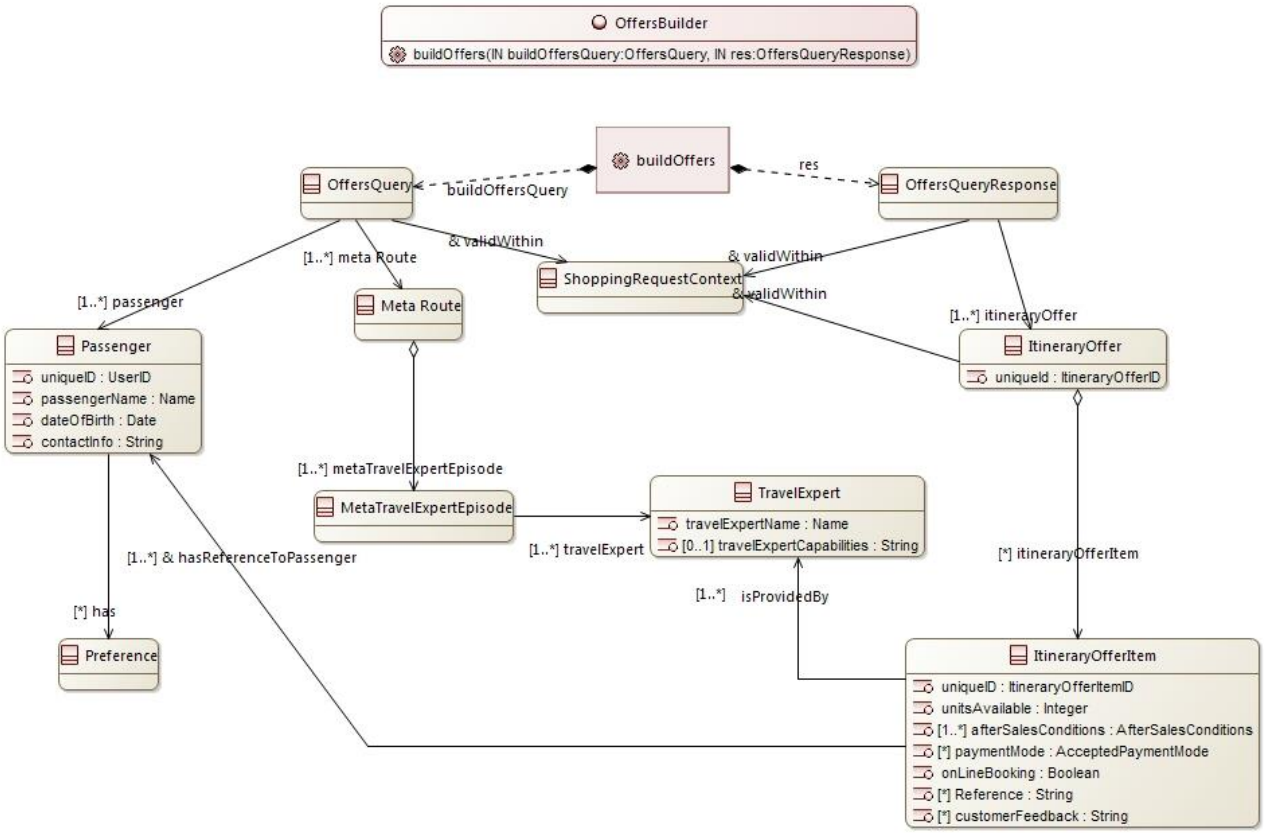

Figure 15: Build Offers interface

Interface ID:	2
Interface Name:	Build Offers interface
Purpose of the Interface	To return a list of aggregated itinerary offers

Requestor:	Shopping Orchestrator
Provider	Offer Builder
Description:	To return a list of aggregated itinerary offers with transport number, schedule and price
Impact to CREL	Partial
Impact to AREL	Partial
Impact to FREL	Complete
Preconditions:	The travel shopping orchestrator provides a request containing a list of smartest routes and the travel experts to call for each route.
Postconditions:	The process returns a list of aggregated itinerary offers.
Request / Input	**Meta Route, TravelExpert, Date, PreferenceCollection** (see Capella Model)
Response / Output	**ItineraryOffer** (see Capella Model)
Exceptions:	
Notes and Issues:	

9.4.3 Manage Travel Requests interface

This interface is exposed by the TS Manage Mobility Request function.

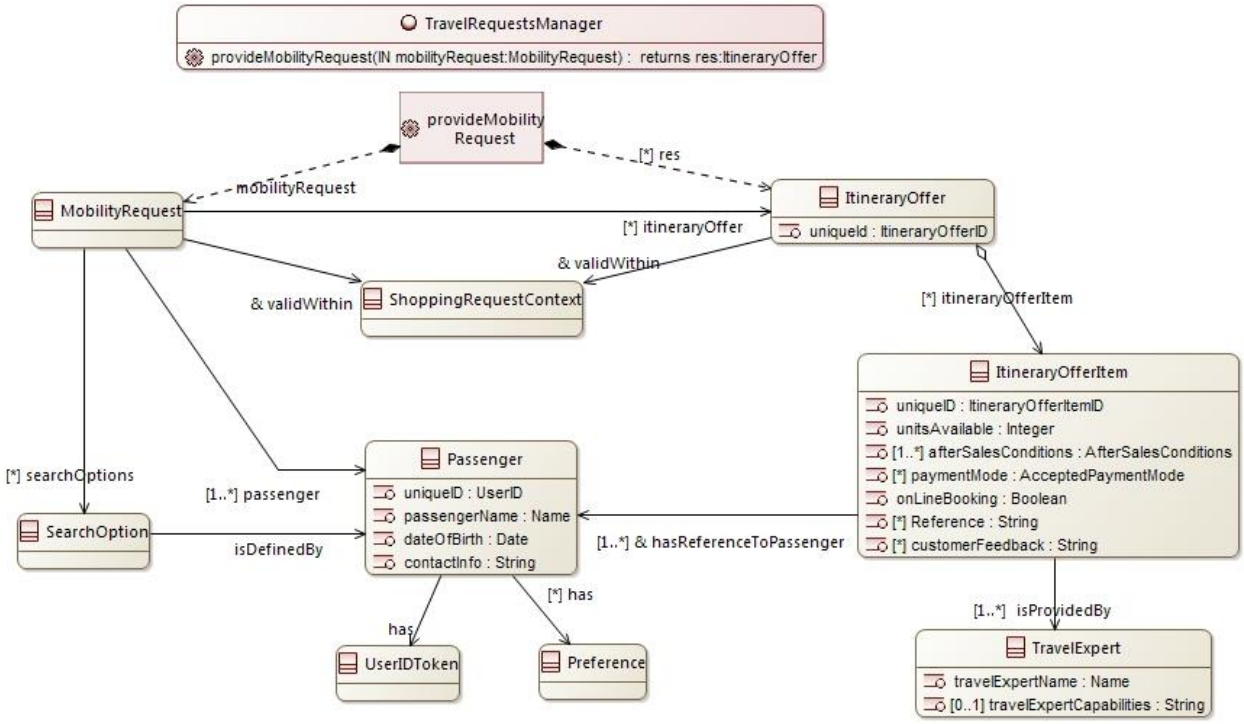

Figure 16 Mobility Request interface

Interface ID:	3
Interface Name:	Mobility Request interface
Purpose of the Interface	This functional exchange receives a mobility request from the Travel Companion

Requestor:	TC Shopping (PA)
Provider	Mobility Request Manager
Description:	This functional exchange receives a mobility request from a Traveller who is using the Travel Companion mobile app.
Impact to CREL	Partial
Impact to AREL	Complete
Impact to FREL	Complete
Preconditions:	A traveller wants to know more information regarding specific itineraries. A mobility request is issued by the Travel Companion mobile app.
Postconditions:	The Mobility Request Manager retrieves user preferences from Travel Companion Cloud then a mobility request enriched with Traveller Preferences is sent to the Travel Shopping Orchestrator.
Request / Input	Mobility Request (see Capella Model)
Response / Output	ItinerayOffer (see Capella Model)
Exceptions:	
Notes and Issues:	