FP6-FutuRe
Cost effective regional lines

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TECHNICAL SPECIFICATIONS FOR USING REGIONAL LINES FOR FREIGHT SERVICES

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Date	Name	Affiliation	Position/Project Role	Action/ Short Description
15.07.2024	Matthias Walter	Hacon	WP co-leader	Creation of document
19.08.2024	Thomas Walker	Hacon	Task leader	Author
26.08.2024	Ira Kataria	Hacon	WP leader	Author, reviewer
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10.09.2024	Martin Václavík	AZD	Reviewer	Review within FP6
12.09.2024	Michael Meyer zu Hörste	DLR	Task participant, Reviewer	Internal review within WP6
20.09.2024	Tiago Fonseca	GTSP	Task participant	Internal review within WP6
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17.06.2025	Fabrizio Burro	FT	WP1 Leader	Quality check

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Executive Summary

Regional railways play a crucial role in Europe, not only by serving rural areas but also by acting as feeders for passenger and freight traffic to the main network. These lines provide an essential, environmentally friendly mode of transport—regional railways enable passengers to reach remote stations and rural destinations effectively.

Given this context, the courier, express, and parcel (CEP) services industry is booming due to shifts in consumer shopping habits and increased retail activity. This growth is putting pressure on road infrastructure and local communities, highlighting the need for more sustainable freight logistics. One innovative solution is to leverage underutilized public transport, such as trams and regional trains, for freight delivery, particularly in smaller towns and rural areas. Task 6.6 within WP6 of FP6 FutuRe aims to enhance freight services to regional and rural areas by leveraging rail transport instead of road. The primary focus is to define and specify innovative solutions for integrating first and last mile transport with passenger trains. Key activities include specifying information, routing, and booking functions for cargo distribution, as well as providing transport offers based on available capacity. Furthermore, the task analyses and defines the necessary framework conditions to effectively implement these freight services.

Deliverable 6.7 outlines how to integrate cargo distribution with passenger trains, reviewing similar initiatives, operational details, and system requirements. The specifications have been described through use cases, requirements, sequence diagrams, components, functions, and interfaces and standards. These specifications are supported by a review of related projects and studies.

Despite a promising start to Task 6.6, we have been unable to secure a demonstration partner. Given this situation, continuing the project to implement and demonstrate the described functionalities to a suitable Technology Readiness Level seems unfeasible in the subsequent demonstration in WP11.

List of Acronyms

Abbreviation / Acronym	Definition
API	Application Programming Interface
CEP	Courier, express and parcel services
DRT	Demand responsive transport
FP	Flagship Project
GTFS	General Transit Feed Specification
MERITS	Multiple East-West Railways Integrated Timetable Storage
NeTEx	Network Timetable Exchange
PIS	Passenger Information System
TSP	Transport Service Provider
UC	Use Case
WP	Work Package

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1. Introduction

The courier, express and parcel services (CEP) industry is growing rapidly causing increasing transport of freight. Changed consumers' shopping behaviour resulted in a steady increase in retail trade over the last couple of years. However, the demand for CEP services is also growing due to stationary retail trade.

Both road infrastructure and the residents themselves are affected in the first place, raising the question of how the ever-increasing flow of goods can be delivered to large cities, small towns, villages or rural areas. A change in freight logistics is needed. It is therefore necessary to use existing modes of transportation in a more environmentally friendly and efficient way – providing for more sustainability along the transport chain.

Another aspect is that even in large cities, local public transport is underutilised at times. Trams are not fully utilised or even empty in the late morning, or in the evening after the rush-hour traffic has subsided. This also applies to suburban and regional trains.

The idea of Task 6.6. is to combine both perspectives, to provide public transport with additional utilisation of its vehicles/trains and thus additional revenue, and to provide the CEP industry with an environmentally friendly solution to its transport problems without increasing air pollution and even saving CO2 emissions. Medium-sized and small towns in rural areas seem particularly suitable for this. On the one hand, longer distances are covered by regional rail transport. On the other hand, the delivery of freight is more difficult than in urban centres due to the comparatively small number of items and the decentralised settlement structure.

Deliverable 6.7 reports on the specification of information, routing and booking functions for cargo distribution by passenger trains. This includes providing transport offers based on available capacity.

The deliverable comprises the following sections: Chapter 2 provides an overview of selected projects with a similar background. A study answers questions about operational details and provides insights into framework conditions to provide freight services to be considered, with the conclusions related to the specification elaborated in sub-chapter 2.3. Chapter 3 provides specifications for using regional lines for freight services by defining the system actors, describing three use cases and deriving the associated requirements. This also includes sequence diagrams and information on components and functions as well as interfaces and standards. Chapter 4 talks about the transferability of the results across Europe. Chapter 5 contains the conclusion of the deliverable and a preliminary outlook.

2. Related work

The topic of distributing freight in regional and rural areas using rail has for a long time been part of railway research. Many promising approaches were tried out in projects with different concepts from trolley wagons to freight trams, most were abandoned due to financial constraints. Some current projects as well as a related study are briefly presented. A brief conclusion links the related work to the specification in Chapter 3.

2.1. Related projects

2.1.1 Freight transport by tram in Karlsruhe (Germany)

Since 2018 a joint venture demonstrates how containerisation and trams contribute to emission-free city logistics. The joint project LogIKTram aims to develop a logistics concept and an ICT platform for freight transportation in trams and light rail vehicles. The region Karlsruhe in Germany acts as pilot region. It uses a standardised “City-Container” with a capacity of 2.1 cubic meters. At the same time multiple transport modes are integrated: trams for the "middle" and E-Cargobikes for the "last mile“.

The final event of the research project took place on 28th of June 2024 and included a live demonstration of a prototype implementation for which a light rail vehicle was adapted. Automated loading and unloading were made possible with an electrically assisted bicycle trailer, that drove itself into the designated area of the tram. In addition to securing the transport containers, the positioning of the streetcars at the stations was important to move the transport containers with highest precision and to comply with the normal passenger changeover times in passenger transport.

Further information can be found on the project website[1]. A final report has not yet been published.

2.1.2 Feasibility Study and "Öffi-Packerl"-Project in Vienna (Austria)

Based on the positive results of a feasibility study indicating public interest in eco-friendly package delivery in trams the project “Öffi-Packerl” explores tram-based goods transport. It is based on a crowdsourcing delivery approach (people using public transport voluntarily carry packages), an app facilitates matching users' commuting routes with suitable packages. The project focuses on reducing environmental impact and enhancing urban living quality.

[1] https://logiktram.de/

The objective of the project is to develop a prototype transport platform that coordinates and links the available transport capacities (passengers) with freight (parcels) to be transported. In addition, prototype parcel stations, which are operated autonomously, serve as temporary interim storage facilities at the stops.

The research project has been running since 2022, first test deliveries were made in 2024, and it will end in 2025. Further information can be found on the website of Fraunhofer Austria Research.[2].

2.1.3 Parcel transport by tram in Schwerin (Germany)

The German logistics company DHL was trialling the use of trams to fill packing stations located at stops. A special tram line in Schwerin, capital city of the federal state Mecklenburg-Vorpommern in Northeast Germany, transported up to 450 packages daily in mobile containers once a day to designated stations along its route.

After a little over a year, however, these special tram have stopped running in March 2024 due to a lack of demand. Passengers were not on-board while these packages were transported in the trams.

2.1.4 Freight transport by bus in northern Scandinavia

Another innovative example is the combined transportation of passengers and freight by bus in the north of Scandinavia. The companies Bussgods in Sweden[3] and Matkahuolto in Finland[4] transport both in the same vehicles. These are combined overland buses, with the temporary addition of pure freight buses on high-volume routes.

Bussgods and Matkahuolto normally handle the main leg of transportation. Private customers must drop off and collect their shipments at a pick-up point. However, both companies also work together with freight service providers who can be involved for the first- and last-mile or organise the international onward transport. Individual agreements on collection and delivery are possible for companies.

There is a wide range of goods which are accepted for transport. Everything that fits in a bus is transported, for example complete sets of car tires, bicycles and motorcycles, guitars or skiing equipment. Live animals are not accepted, apart from fishing bait.

[2] https://www.fraunhofer.at/de/forschung/green-logistics.html#783417386

[3] https://bussgods.se/

[4] https://www.matkahuolto.fi/en

2.2. Related study

In 2022 the German Parcel and Express Logistics Association (Bundesverband Paket und Expresslogistik e.V., BPEX) commissioned a study on the use of local public transport systems for parcel transport over the last mile. The central question of the study was the following: "Can the integration of local public transport systems or public transport infrastructures into CEP logistics contribute to greater sustainability on the last mile?"[5]

The involved stakeholders agree that a contribution to sustainability is possible even though the road to realisation seems long and many stakeholders would have to be involved. This conclusion and the findings from the study were obtained through stakeholder involvement in form of surveys and expert interviews. However, there is a great need for research and regulation for the concept concerning the following topics (most important statements marked by underlining):

- <u>Existing public transport capacities should be utilised in a mixed passenger and freight operation, not in an exclusive freight operation.</u>
  The public transport networks are mostly utilised to capacity. It is therefore often not possible to increase the frequency of services by adding exclusive freight lines because the all-day demand for public transport capacities by CEP for freight transport cannot be predicted.
- <u>Priority must always be granted to passenger transport.</u>
- The use of public transport for freight transport in mixed operation during off-peak times, when public transport capacities are not fully utilised, ensures that passenger transport is prioritised.
- <u>To implement freight transport via public transport in mixed operation, political support would first be required at all governmental levels. This includes support measures for the necessary investments in public transport systems.</u>
  Politicians would have to create the necessary framework so that freight transport could become a permissible field of activity for public transport operators.
- <u>The logistical integration of public transport into the last mile could be realised in principle.</u>
- But it would depend heavily on the location of the CEP depots, the delivery areas in the public transport networks and the logistical suitability of the public transport systems themselves. The concept will only achieve the greatest possible eco-efficiency with short CEP public transport pre-runs and the longest possible main public transport runs in direct connections, because for short distances, the additional handling processes required would be too time-consuming in relation to the distance.

[5] https://www.bpex-ev.de/publikationen/studien.html?year=2022

- A standardised swap body should be used.
  Different container shapes would lead to extreme costs for the approval of logistics-compatible conversions of public transport vehicles for load securing.
- Questions remain regarding the transfer of risk, liability and possible recourse claims in the event of non-fulfilment of the transport order by public transport operators.
- Any personnel capacities for additional container handling in combined transport need to be clarified.
- The necessary change in the mindset of the stakeholders from pure passenger transport to combined transport will take a long period of time.
  Operation requires the greatest possible reliability, transparent processes and IT-supported communication between transport companies and CEP logistics.

2.3. Conclusions from related work for the specifications

The findings of the research on the related work, the related study and other desktop research were presented during a WP6 workshop on February, 22nd and 23rd, 2024, in Hanover. The aim of the workshop was to sensitise the participants to the topic of freight transport in regional and rural areas and to present the status of similar and comparable projects, as well as initial considerations on the transferability of the results. The discussion provided additional input for the development of the use cases.

The main outcomes taken from the projects are:

- Delivery of cargo/packages via public transport (all projects);
- Transport of cargo on designated lines and vehicles ("Schwerin" and "Scandinavia") vs. the feasibility of combining goods and passenger transport (all other projects);
- Passengers transporting packages ("Vienna") vs. containerised transports all other projects);
- Apps facilitating matching users' commuting routes with suitable packages ("Vienna") and development of ICT platform ("Karlsruhe");

Focusing on a regional context and on cost reduction in the FP6 project, combining goods and passenger transport is considered the preferred choice for the specification in this deliverable when compared to designated vehicles/trains that are exclusively used for freight transport in times during the day and night with a low number of passenger trains.

The discussion at the workshop revealed that both shipment of single parcels ("Vienna" case) and containerised transports ("Frankfurt" and "Karlsruhe") seem to be promising approaches. Hence, each approach is reflected by a use case specified in Section 3 (see first two use cases in Subsection 3.2). As the crowdsourcing solution ("Vienna") requires a good match of the demand for transport to passengers willing to transport a parcel, a more flexible way was deemed better for offering a transport service without containers. Hence, the corresponding use case does not rely on a transport by passengers; instead, a train conductor accepts parcels at the respective departure station and hands them over at the respective destination station.

As in the Vienna and Karlsruhe case, an application will facilitate users to find routes for their shipments; here, it is the Passenger Information System (PIS), especially the PIS frontend.

In addition, the related study provided important insights for the refinement of the use cases and the further detailing of the specifications. The key findings are:

- Mixed passenger and freight operation preferred over exclusive freight operation;
- Limiting freight operation to off-peak times;
- Political will and the necessity of subsidies;
- Integration of public transportation into last-mile delivery concepts for freight;
- Short pre-runs and long-distance main runs preferred;
- Utilisation of standardised swap bodies;
- Legal aspects.

The key findings of the study that have been considered relevant for the specification in Chapter 3 and that have not already been mentioned as outcome of the studies are briefly discussed in the following paragraph.

A freight transport in passenger trains during off-peak times can be easily reflected in the PIS, namely by adjusting the timetable data accordingly, cf. the specification of use cases in Subsection 3.2. The integration of public transportation into last-mile delivery of parcels is not considered in this deliverable; this could be an interesting topic for a follow-up project. The utilisation of standardized containers or swap bodies is considered in the second and especially in the third use case (see Subsection 3.2).

3. Specifications for using regional lines for freight services

This chapter contains a specification for a system that provides information about transport options for freight in passenger trains. Such information is provided to two types of users, namely to private persons who want to send a shipment by train but also to CEP companies who check for available capacity for freight transport in regional trains. These two groups are active users of the system, i.e. they are so called system actors, which are described in Section 3.1 in more detail.

The system that is specified is the Passenger Information System (PIS) which is defined within WP6 of FP6 and that provides also other services such as journey planning, trip options including DRT and trip options for passengers with reduced mobility, see [Deliverable D6.2 of FP6 FutuRe]. Hence, the specifications made in this chapter for freight transport are only defining a part of the overall PIS. The part of the system addressed in this chapter is defined by three use cases that are documented in Section 3.2

In Section 3.3, all requirements that have been derived from the use cases are listed. The list comprises functional and non-functional requirements.

In Section 3.4, the solution, i.e. the way how the system can accomplish the requirements, is illustrated by a sequence diagram that shows the relevant components and functions of the PIS. These components and functions are explained in more detail in Section 3.5.

In the final Section 3.6, a brief look is taken at interfaces between the specified system and external systems. For these interfaces, it is checked whether standard interfaces or standard data formats exist. The section provides only a brief overview as [Deliverable D6.8 of FP6 FutuRe] elaborates on this topic.

3.1. System actors

A PIS that shall support planning of freight shipments in passenger trains is specified in this deliverable. Persons and/or other systems interacting with this PIS are called system actors. For the use cases outlined in Section 3.2, the system actors are mentioned in the field “Actor” in the use case tables presented in Section 3.2.

Table 1 lists all system actors that are part of the use cases described in Section 3.2.

Table 1: System Actors

Actor	Description
User	The user is either a person planning to ship a parcel or a CEP company planning to transport freight by train from A to B. A CEP company is a postal and logistics company that primarily transports shipments of comparatively low weight and volume - such as letters, small parcels, documents or small parts.
Transport Service Provider (TSP)	Organization providing both physical services and means of transport: trains, metros, coaches, buses,

	bike-sharing, car-sharing, DRT etc.
Booking System	External component for booking capacity for freight in a passenger train or for buying a parcel stamp/a code for the shipment of a single parcel. This component is provided by a TSP or a CEP company, respectively.

In the specification in the following subsections, an external booking system is mentioned. It can be used by either a person or a CEP company (depending on the use case) to book a parcel shipment. Such a booking system might be connected directly via interfaces with the PIS, i.e. with the routing system. As the PIS is in the focus of WP6 and as the PIS will only provide a button for accessing the external booking system, the booking system itself is not listed in

Table 1. Though, in a broader sense, it is also a system actor.

3.2. Use Cases

This section presents three use cases in which transport of freight by passenger trains is planned. The first two use cases concern private persons who want to send a parcel via train. The third use case is a business case where a CEP company uses the system to plan the transport of freight placed in containers. Each of the three use cases describes the interactions between actors and the system that shall be developed. For all three use cases, the complete scenario is described whereas the technical specifications focus on the PIS.

The first use case (UC-FP6-WP6-6.1) considers a private person that wants to send a single parcel from station A to station B. The person must bring the parcel to the desired start station A where the parcel is handed over to a train conductor who stores the parcel in a dedicated area of the train. When the train arrives at station B, the train conductor delivers the parcel to a parcel recipient who must be on time at the station. The actual use case is about checking which trains offer such a transport of a parcel from A to B. A frontend of the system must allow the user to enter the desired start and destination location and the desired date and time when the shipment shall take place. The timetable data must include the information if a train offers the service or not and the price of the service. This service is only considered for a transport without any transfer of a parcel from one train to another. Transfers would require sorting and consolidation of parcels of different users which is not feasible for a train conductor who must also inspect tickets of travellers amongst other things.

The second use case (UC-FP6-WP6-6.2) extends the first use case by allowing for transfers and by decoupling drop-off, transport and pick-up of a parcel in time. Allowing for transfers means that a person can send a parcel from the station A where the parcel is dropped off not only to stations that are served by a direct connection but also to other stations via a route that comprises transfers, i.e. more than one leg. Decoupling in time means that drop-off and pick-up need not happen just in time, i.e. synchronized with the departure at station A and the arrival at station B.

For this decoupling, parcel lockers that are placed at stations are needed so that a sender of a parcel can bring the parcel to a station and put it in the parcel locker. A worker of a logistics company would at some point in time retrieve all parcels out of the parcel locker, put them into a container and move the container into a train. The container is then fetched out of the train at a station where the parcels can be sorted and consolidated, i.e. assigned to new containers. These stations are called hub stations. Each new container is determined for a specific destination station. The new containers are then routed through the rail network to their respective destination. When a container reaches its destination, the container is unloaded from the train and the parcels are retrieved from the container and put in a parcel locker by a worker. From the parcel locker, the receiver of the shipment can pick it up.

For the second use case, significantly more equipment and resources are needed. Especially the stations serving as a hub would require spatial resources for logistics operations. All stations in the hub and spoke network would require a parcel locker and space for container handling at platforms.

The actual use case regarding this extended scenario covers the planning of a parcel shipment using the PIS. A user can query the PIS for a trip option for their parcel by entering a start address, e.g. their home address, and the destination address. The system will respond with trip option including:

- a walk or car drive covering the first mile, i.e. from the home address to the parcel locker at a nearby station A,
- the main part of the trip between station A and a station B close by the destination address, and
- a walk or car drive for the last mile, i.e. from the parcel locker at station B to the destination address.

The use case is similar to a trip search for a traveller. The major challenge - when supporting a trip search for parcels in the described way - is to model the routing options of a parcel that is transported in a container in the timetable data. Section 3.3, which describes requirements for the use case, will shed more light on this challenge.

The third and final use case focuses on a different type of user, namely on a CEP company, i.e. on a logistics company. It is assumed that the CEP company has a distribution centre close to a regional railway station and/or in a city centre. In these distribution centres, parcels are consolidated for shipment by train. For easy and efficient handling, mobile parcel lockers or swap bodies are used to transport the parcels. Mobile parcel lockers are parcel lockers that can be loaded into and unloaded from trains so that operations of the CEP company such as retrieval of packages put into the parcel locker by users or filling of parcels into the locker can be done in a distribution centre. The CEP company uses the system to query which trains can transport their parcel lockers considering capacity restrictions. Such a query must specify not only the start station and the destination station but also the number and type of swap bodies or mobile parcel lockers that shall be transported.

In all use cases, a booking step is foreseen at the end of the respective sequence. In the first two use cases, the booking step may consist of buying a parcel stamp without actually reserving capacity. In the second use case, the capacity for parcels of users is rather limited by the capacity of the parcel locker at the drop-off station than by the capacity of the trains for transporting parcel lockers. In the third use case, booking includes reserving capacity of the respective train.

In the following, a template is used to document the use cases. Each use case is identified by an ID. This ID is also part of the identifiers of the requirements that have been derived for the use case so that a requirement can easily be linked to the corresponding use case. The requirements are listed in the subsequent Section 3.3.

3.2.1 UC-FP6-WP6-6.1 Direct shipment of a single parcel from station A to station B

Name	A user (end customer) plans to ship a single parcel from station A to station B without transfer possibility (must stay on the train) and with mandatory personal drop off and pick-up
ID	UC-FP6-WP6-6.1
Description	Existing journey planning applications shall be enhanced to provide potential users (individuals or shops) with information which trains (existing train services) can transport easy-to-handle freight like parcels. A user cannot or will not travel with the same train but will bring their parcel to the train. In the train, the conductor will place the parcel in a minor modified (locked) compartment (ideally sorted by pick-up stations or destinations are clearly marked on the parcel). At the destination (a regional stopping point/station), an identified person picks up the parcel from the conductor of the train when it stops. The journey planner will return suitable trains from the starting station to the end station. Since there will not be additional staff, the usage of transfer connections is not possible. *This use case is to be seen in addition to industrial parcel delivery concepts, which require dedicated significant modifications of existing waggons or building new flexible waggons to automate the pick-up, transport and delivery of complete parcel boxes to regional stations.*
Related to task/subtask(s)	T6.6

Impact on other task(s)	-
Interactions SP/FP	Interaction with FP5 (intermodal trip search) -> both need a trip search for freight transportation considering capacities
Actor(s)	User (end customer sending the parcel), Transport Service Provider (TSP) for Rail, booking system
Trigger	User wants to send a parcel from station A to station B by train
Pre-Condition(s)	● Available railway timetable data ● Available information on which trains can be used for freight transportation (for this use case it is assumed that the capacity for parcels in a train is not a limiting factor). ● Available information on pick-up/drop-off locations (track/waggon) and times ● Availability of trip planning application ● External identification system for the person who is authorized for pick-up
Input	Origin, destination, Depart/Arrival Time
Result/Requirement	Trip options that are available for freight transport and there is a “Booking” button leading to an external booking system with capacity and price information
Sequence	1. User enters origin, destination, and desired departure/arrival time for the shipment on a journey planning application. 2. User triggers trip search. 3. The journey planning algorithm seeks trips for the parcels considering the requirements set by the user. 4. User receives trip options and prices. 5. User can access the external booking system.
Involved components (System)	Journey planning application, TSP system, booking system
Responsible partner/person	Thomas Walker, Hacon Lars Deiterding, Hacon

Notes	The field “Description” covers the complete scenario to understand the context of the specification. The specification focuses on the PIS.

3.2.2 UC-FP6-WP6-6.2 Shipment of a single parcel from address A to address B via parcel lockers at stations

Name	A user plans to ship a single parcel (within a region) via public transport from address A to address B via parcel lockers at stations
ID	UC-FP6-WP6-6.2
Description	The user (end customer) wants to send a single parcel from (address) point A to (address) point B and uses drop-off/pick-up points (e.g. a parcel locker) close to points A and B (directly at the station) for this. The transport between the drop-off and the pick-up location will be done by regional passenger trains to be environmentally friendly. All parcels from the drop-off location are collected, transferred to a container and transported with the train to the next transshipment point where the parcels are transhipped to other trains. Trains starting at transshipment points can deliver a container with parcels to a station where the container is unloaded, and parcels are filled in a parcel locker from where recipients can pick up their parcel. Workers of a parcel delivery company (CEP company) process the parcels at the drop-off/pick-up and transshipment points. The trip planning application provides information on which routes such services can be offered as the respective (connected) trains are equipped and included in this specific service offer. The trip planer returns the train trip the parcel will take as well as the route for walking/car from address A to the drop-off point and from the pick-up point to address B. The scheduled departure and arrival time and basic tariff information are shown, and the end customer can click on a button to open the external booking system of the CEP company. Potentially such services could be offered also multimodally with buses or other means of transportation. Alternatively, the trip planning application is just running as backend service for the CEP company system and the CEP frontend is used in which a specific optional service “local green public transport” is selected when searching for shipment options.
Related to task/subtask(s)	T6.6
Impact on other task(s)	-

Interactions SP/FP	Interaction with FP5 (intermodal trip search) -> both need a trip search for freight transportation considering capacities
Actor(s)	User (end customer), Transport Service Provider (TSP) for Rail, CEP-company, booking system
Trigger	User wants to send a parcel from address A to address B by train
Pre-Condition(s)	• Available timetable includes railway timetable data and information for each train whether it can transport a container/box with parcels. • In addition, for each train data whether a container/box can be unloaded/loaded at a station or not. • If containers/boxes can be loaded, data on the latest drop-off time, and if containers can be unloaded, data on the earliest pick-up time. • Interfaces to and respective functions in CEP backend systems/frontends
Input	Origin, destination, Depart/Arrival Time
Result/Requirement	Trip options that represent the trip of the parcel or a message that a trip could not be found, first and last mile routes for walking or car, link to external booking system with price and capacity information
Sequence	1. User (end customer) enters input data on a journey planning application for a trip search for parcels. 2. User triggers trip search for parcels. 3. Journey planning algorithm seeks trips for a parcel shipment considering the requirements set by the user, calculates first and last mile routes for different modes of transport (walk, car), and determines/displays the prices (set by the CEP company for the leg served by passenger trains/public transport). 4. User receives trip options for a parcel shipment. 5. User can access the external booking system.
Involved components (System)	Journey planning system, TSP system, booking system
Responsible partner/person	Thomas Walker, Hacon Matthias Walter, Hacon

Notes	The field "Description" covers the complete scenario to understand the context of the specification. The specification focuses on the PIS.

3.2.3 UC-FP6-WP6-6.3 CEP company plans a shipment of freight

Name	CEP company plans to install a regional collection- and distribution network for parcels. This use case includes the shipment of single parcels within the region (see UC-FP6-WP6-6.2)
ID	UC-FP6-WP6-6.3
Description	CEP companies can use regional train lines to serve inner cities. Therefore, they use a regional distribution centre outside the inner-city located close to a station at the regional line. Standardised swap bodies or entire parcel lockers are to be transported with the regional train into the city with parcels that have their destination inside the city, and vice versa, parcels that have their origin in the city are to be transported out of the city. In both cases, a worker of the CEP company must take the swap body/parcel locker from the train and ensure the further processing. Swap bodies can be transported to a delivery base in the city which serves as a basis for the delivery to the addressee, mobile parcel lockers can be placed directly at the intermediate stations (on the train route from/towards the city centre) where they are taken out of the train and end customers can pick-up and drop-off their parcels there. The journey planning application will help the CEP company to find suitable regional trains that can be used for parcel delivery.
Related to task/subtask(s)	T6.6
Impact on other task(s)	-
Interactions SP/FP	Interaction with FP5 (intermodal trip search) -> both need a trip search for freight transportation considering capacities
Actor(s)	Transport Service Provider (TSP) for rail, CEP company (with existing inner-city collection and distribution network), booking system
Trigger	A CEP company wants to transport parcels in a sustainable way using existing passenger train services from a regional

	distribution/consolidation centre to distribution hubs in metropolitan areas or in the opposite direction.
Pre-Condition(s)	• Availability of suitable railway vehicles/trains for freight transport (suitable multi-purpose compartments for mixed use); • Availability of suitable railway vehicles/trains used in regional trains for handling standardised swap-bodies/mobile packaging stations (transhipment on/off railway vehicles/trains, door width and height and load securing); • Availability of suitable railway stations/platforms for transhipment and handling of swap-bodies/mobile packaging stations (level or hight-free transhipment, security aspects); • Available railway timetable data that include data from CEP company about freight transport feasibility (including minimum handling times at parcel hubs); • Availability of trip planning application
Input	Origin, destination, Depart/Arrival Time, number and type of swap bodies
Result/Requirement	Trip options that are available for freight transport are shown to the CEP company.
Sequence	1. CEP company enters origin, destination, desired departure/arrival time, and number and type of swap bodies for the shipment on a journey planning application. 2. CEP company triggers trip search. 3. The journey planning algorithm seeks trips for the swap bodies considering the requirements set by the CEP company. 4. CEP company receives trip options. 5. CEP company can access the external booking system.
Involved components (System)	Journey planning application, TSP system, booking system
Responsible partner/person	Thomas Walker, Hacon Lars Deiterding, Hacon
Notes	The field “Description” covers the complete scenario to understand the context of the specification. The specification focuses on the PIS.

3.3. List of Requirements

This section lists the requirements for each use case. A requirement is a need that must be or should be satisfied by the solution to be developed in order to be an acceptable solution. Hence, a requirement is a necessary or desired capability or characteristic of the system specified in this document.

The requirements are documented following a template. Each requirement has an ID as a unique identifier. This ID indicates which use case the requirement was derived from and whether it is a functional or non-functional requirement. In case of a functional requirement, the ID contains the suffix "_FRQ". In case of a non-functional requirement, the suffix is "_NFRQ". Two priorities levels are used to differentiate between requirements: the level "MUST" marks requirements that must be met by the system, the level "Nice-to-have with high priority" tags requirements that shall be met by the system.

3.3.1 T6.6_UC6.1_FRQ01 Flag in timetable data indicating the option of transporting parcels

Requirement ID	T6.6_UC6.1_FRQ01
Requirement Name	A flag in timetable data must indicate if a train service can transport parcels or not
Use Case ID	UC-FP6-WP6-6.1
Category	Functional
Priority	MUST
Main goal	The system must know which passenger train services can transport parcels so that trip options can be calculated that allow the shipment of parcels.
Assumptions	Static timetable data are available. It is known which trains/train services can transport parcels (or parcel lockers or swap bodies).
Specification	The static timetable data are extended by a flag for those services that can transport parcel(s).
Additional Notes	-

3.3.2 T6.6_UC6.1_FRQ02 Option in frontend to search for trips for parcels

Requirement ID	T6.6_UC6.1_FRQ02
Requirement Name	Option in frontend to search for trips for parcel(s)
Use Case ID	UC-FP6-WP6-6.1
Category	Functional
Priority	MUST
Main goal	The frontend of the journey planning application must enable the user to select the option that a trip search is done for a parcel or a container of parcels.
Assumptions	-

Specification	The journey planning application offers a dedicated cluster for suggested parcel trips in the overview of trip options. The cluster button can be clicked by the user to trigger a trip search for a parcel.
Additional Notes	-

3.3.3 T6.6_UC6.1_FRQ03 Computation of trips for parcels

Requirement ID	T6.1_UC6.1_FRQ03
Requirement Name	Computation of trips that permit the transport of parcels
Use Case ID	UC-FP6-WP6-6.1
Category	Functional
Priority	MUST
Main goal	The journey planning application can offer trip options for the transport of a parcel.
Assumptions	Static timetable data have been extended by a flag indicating whether a train can transport parcels or not.
Specification	The journey planning application must be able to compute trip options between stations which are connected by a service without transfer that facilitates the transport of parcels. In addition, a first and last mile walk shall be calculated if addresses were chosen as start location and destination location, respectively, for the trip request.
Additional Notes	-

3.3.4 T6.6_UC6.1_FRQ04 Display of prices for the transport of a parcel

Requirement ID	T6.6_UC6.1_FRQ04
Requirement Name	Display of prices for the transport of a parcel
Use Case ID	UC-FP6-WP6-6.1
Category	Functional
Priority	Nice-to-have with high priority
Main goal	The user shall be informed about prices for a parcel shipment by a passenger train.
Assumptions	The parcel is transported within a region, i.e. within a country and not across a border. Depending on the “region” and the transport distance, the prices depend most likely only on the size and the weight of the parcel but not on the distance between origin and destination as the cost intensive part is the handling of the parcels and not the transport itself. The prices are covering transport costs (provided by railway undertaking/TSP) and handling costs (provided by CEP).
Specification	The journey planning application provides for a trip option for a parcel shipment a list of prices. The list comprises prices for parcels of different size and weight and will be available in the trip details view.
Additional Notes	-

3.3.5 T6.6_UC6.1_FRQ05 Booking of a parcel shipment

Requirement ID	T6.6_UC6.1_FRQ05
Requirement Name	Booking of a parcel shipment
Use Case ID	UC-FP6-WP6-6.1
Category	Functional
Priority	Nice-to-have with high priority
Main goal	The user shall be capable to book a parcel shipment via a link to an external booking system that is provided by a CEP company.
Assumptions	External booking system of a CEP company is available and can be integrated into the PIS via an API.
Specification	The journey planning application provides for each entry in the list of prices for a parcel shipment a link to the external booking system where a parcel stamp can be bought. The list comprises prices for parcels of different size and weight and will be available in the trip details view.
Additional Notes	-

3.3.6 T6.6_UC6.1_NFRQ01 Performance requirement

Requirement ID	T6.6_UC6.1_NFRQ01
Requirement Name	Performance requirement
Use Case ID	UC-FP6-WP6-6.1
Category	Performance
Priority	Nice-to-have with high priority
Main goal	Trip options for parcels between stations shall be computed in an acceptable amount of time which is not significantly larger than the time needed for a similar trip search for a traveller.
Assumptions	-
Specification	The journey planning application takes at most 150% of the time that is needed for calculating a comparable trip for a traveller.
Additional Notes	A comparable trip for a traveller would be a trip from a station to another station. The time required for data transfer between the server (backend) and a frontend must be ignored as it depends on the performance of the network that is not under control of FP6 WP6.

3.3.7 T6.6_UC6.2_FRQ01 Modelling the capacity of trains in the timetable data

Requirement ID	T6.6_UC6.2_FRQ01
Requirement Name	Capacity of trains for transporting containers with parcels must be modelled in the timetable data

Use Case ID	UC-FP6-WP6-6.2
Category	Functional
Priority	MUST
Main goal	The service for planning parcel transport must consider the capacity of a train for transporting containers of parcels.
Assumptions	If a regional train travels from a rural area to a city centre (or in the opposite direction) and has x intermediate stops with containers with parcels to be loaded but only storage place for y containers with parcels with y < x, the timetable must foresee which train can load/unload a container at which station.
Specification	The timetable data must specify for each train service that can transport parcels at which stop(s) a container can be loaded and at which stop(s) a container can be unloaded if the capacity of the train is not sufficient to load/unload a container at each stop.
Additional Notes	The modelling in the timetable data could be done by prohibiting boarding/alighting for containers at specific stops.

3.3.8 T6.6_UC6.2_FRQ02 Time for sorting and consolidating must be reflected in the timetable data

Requirement ID	T6.1_UC1.1.2_FRQ02
Requirement Name	The time needed for sorting of parcels and consolidating of shipments at hubs, i.e. at bigger stations where containers “transfer” from one train to another, must be reflected in the timetable data.
Use Case ID	UC-FP6-WP6-6.2
Category	Functional
Priority	MUST
Main goal	The system must provide a realistic duration for trips.
Assumptions	Parcels in a container that is loaded at a rural station are sent to different destinations (different cities, different regions). At bigger stations where unloading of containers and a transfer to other trains is possible, time is needed for sorting and consolidating parcels so that the parcels in a container loaded into a train head in the right direction.
Specification	The journey planning application must foresee sufficient time for transfers of containers with parcels (at hub stations).
Additional Notes	The modelling in the timetable data could be done by sufficiently large transfer times.

3.3.9 T6.6_UC6.2_FRQ03 Unloading at hubs

Requirement ID	T6.6_UC6.2_FRQ03
Requirement Name	Containers that were loaded not at hubs but at normal stations must always be unloaded at a hub.

Use Case ID	UC-FP6-WP6-6.2
Category	Functional
Priority	MUST
Main goal	Parcels shall reach their destination, and containers that were loaded at a normal station and hence contain parcels with different destination must not be unloaded at another normal station but only at a hub.
Assumptions	
Specification	The timetable data must ensure that containers which were loaded at a normal station must be unloaded at a hub. This is especially relevant for train services between hubs that also serve normal stations as intermediate stops.
Additional Notes	It is easy to model this requirement for services that run between a regional/rural station (normal station) and a city centre (hub station) in both directions: A train service to the city centre is only allowed to load containers and another service in opposite direction is only allowed to unload containers. But for train services between hubs that serve also normal stations in between, this is more difficult to model. The modelling in the timetable data could be done by sections in which loading and unloading is possible in general but not both for the same container.

3.3.10 T6.6_UC6.2_FRQ04 Computation of trips for parcels from address to address

Requirement ID	T6.6_UC6.2_FRQ04
Requirement Name	Computation of trips for parcels from address to address via parcel lockers including walk/car legs for first/last mile.
Use Case ID	UC-FP6-WP6-6.2
Category	Functional
Priority	MUST
Main goal	The journey planning application must calculate trips for parcels including (1) a first mile leg from the start address to a parcel locker at a station, (2) transfers and (3) a last mile leg from a parcel locker to the destination address so that a user can check how fast a parcel can be send in passenger trains from address to address.
Assumptions	-
Specification	When requested for address-to-address trip options for a parcel, the journey planning application must calculate trip options considering • the flag that indicates whether a train service transports containers with parcels or not, • the capacity of trains for containers (modelled by entry/exit bans) • the transfer times for container/parcels at hubs, • the sections between hubs where loading and unloading is not allowed for the same container.
Additional Notes	-

3.3.11 T6.6_UC6.2_NFRQ01 Performance requirement

Requirement ID	T6.6_UC6.2_NFRQ01
Requirement Name	Performance requirement
Use Case ID	UC-FP6-WP6-6.2
Category	Performance
Priority	Nice-to-have with high priority
Main goal	Trip options for parcels between addresses sent via parcel lockers shall be computed in an acceptable amount of time which is not significantly larger than the time needed for a similar trip search for a traveller.
Assumptions	
Specification	The journey planning application takes at most 150% of the time that is needed for calculating a comparable trip for a traveller.
Additional Notes	A comparable trip for a traveller would be a trip from an address to another address. The time required for data transfer between the server (backend) and a frontend must be ignored as it depends on the performance of the network that is not under control of FP6 WP6.

3.3.12 T6.6_UC6.3_FRQ01 Extended options in frontend to search for trips for parcels

Requirement ID	T6.6_UC6.3_FRQ01
Requirement Name	Extended options in frontend to search for trips for parcel(s)
Use Case ID	UC-FP6-WP6-6.3
Category	Functional
Priority	MUST
Main goal	The frontend of the journey planning application must enable the user to additionally input the type and the number of swap bodies or mobile parcel lockers that shall be transported.
Assumptions	-
Specification	When defining a trip search request for parcels in the frontend, the user from a CEP company can select from different types of swap bodies/mobile parcel lockers and input the number of swap bodies/mobile parcel lockers that shall be transported.
Additional Notes	-

3.3.13 T6.6_UC6.3_FRQ02 Information about capacity offer in trains

Requirement ID	T6.6_UC6.3_FRQ02
Requirement Name	Detailed and up-to-date information about capacity offer in trains
Use Case ID	UC-FP6-WP6-6.3
Category	Functional
Priority	MUST

Main goal	The trip options that are calculated for requests from CEP companies shall consider the available capacity for swap bodies/mobile parcel lockers, i.e. previous bookings that reduce the remaining capacity must be considered.
Assumptions	It is assumed that data about the available capacity for swap bodies/mobile parcel lockers is available
Specification	The PIS backend must be equipped with real-time data about the remaining capacity in all trains and for all sections of a service, i.e. the capacity information must be available for each partial trip between subsequent stops. From the data about remaining capacity the PIS backend must be able to derive the remaining capacity for the different types of swap bodies and mobile parcel lockers.
Additional Notes	-

3.3.14 T6.6_UC6.3_FRQ03 Computation of trips for swap bodies/mobile parcel lockers

Requirement ID	T6.6_UC6.3_FRQ03
Requirement Name	Computation of trips for swap bodies/mobile parcel lockers considering capacity constraints
Use Case ID	UC-FP6-WP6-6.3
Category	Functional
Priority	MUST
Main goal	The journey planning application must calculate trips for swap bodies/mobile parcel lockers that are feasible regarding capacity constraints for each leg of the trip.
Assumptions	It is assumed that data about the available capacity for swap bodies/mobile parcel lockers is available.
Specification	Given the type and number of swap bodies/mobile parcel lockers defined for a trip request by a CEP company, the journey planning application must consider the remaining capacity in all trains associated with a computed trip option and ensure that only trip options are returned that have sufficient capacity left on all legs.
Additional Notes	-

3.3.15 T6.6_UC6.3_FRQ04 Booking of a freight transport in a passenger train

Requirement ID	T6.6_UC6.3_FRQ04
Requirement Name	Booking of a freight transport in a passenger train
Use Case ID	UC-FP6-WP6-6.3
Category	Functional
Priority	MUST
Main goal	A CEP company shall be able to book the transport of swap bodies/mobile parcel lockers based on a trip search via a link to an external booking system that is provided by a TSP.

Assumptions	External booking system of a TSP is available and can be integrated into the PIS via an API.
Specification	The journey planning application provides for a trip option for a shipment of a container a link to the external booking system of a TSP where capacity can be reserved.
Additional Notes	-

3.3.16 T6.6_UC6.3_NFRQ01 Performance requirement

Requirement ID	T6.6_UC6.3_NFRQ01
Requirement Name	Performance requirement
Use Case ID	UC-FP6-WP6-6.3
Category	Performance
Priority	Nice-to-have with high priority
Main goal	Trip options for parcels sent by CEP companies via swap bodies/mobile parcel lockers shall be computed in an acceptable amount of time which is not significantly larger than the time needed for a similar trip search for a traveller.
Assumptions	
Specification	The journey planning application takes at most 150% of the time that is needed for calculating a comparable trip for a traveller.
Additional Notes	A comparable trip for a traveller would be a trip from a station to another station. The time required for data transfer between the server (backend) and a frontend must be ignored as it depends on the performance of the network that is not under control of FP6 WP6.

3.4. Sequence diagram

In this section, we present a sequence diagram that depicts how the specified system supports the three use cases. A sequence diagram, also called exchange scenario, features as basic elements the actors and the components of the system that are involved in the use case and depicts the flow of messages between these elements in time sequence from top to bottom of the diagram. The messages originate from events and functions of the actors and components and are also represented in the diagram. Messages, also named actions, are represented by solid arrows. Response messages (return actions) are depicted by dashed arrows. The sequence diagrams are based on the Unified Modelling Language (UML) which is a general-purpose visual modelling language that covers several types of diagrams, amongst others interaction diagrams of which sequence diagrams are a subset.

Figure 1 represents the sequence diagram for use cases UC-FP6-WP6-6.1, UC-FP6-WP6-6.2 and UC-FP6-WP6-6.3. As main actor, it involves a user who wants to send a parcel or, in case of a CEP company, a container of parcels. Other actors such as the TSP are not shown as they are involved only indirectly by providing timetable data to the backend of the PIS. Furthermore, the sequence diagram comprises two components: the frontend and the backend of the PIS. These components are depicted as blue boxes. The functions of both components are shown in green boxes below the respective component. The components and their functions will be explained in more detail in Section 3.5. In this section, the actions and the flow of data depicted in the sequence diagram are described.

The user – be it a private person or an employee of a CEP company – enters details of a trip request for the transport of freight such as start and destination location and desired departure time in the frontend of the PIS. In case of a user of a CEP company, the input also comprises the number and type of containers (swap bodies or mobile parcel lockers) so that the system can consider the capacity needs. The frontend processes the input and creates a trip request that is sent to the backend of the PIS. In the PIS backend, trip options are computed. For the trip search, the backend of the PIS uses the ad-hoc timetable that contains real-time information, e.g. delays or cancellations of stops or of a complete service (see [Deliverable D6.2 of FP6 FutuRe] for more details about the ad hoc timetable). The trip options computed by the PIS backend are sent to the PIS frontend where the options are displayed to the user.

When queried by a user who wants to send a single parcel, the PIS backend provides also pricings for the resulting trip options for the parcel. The pricing information would be presented like fares. Usually, the shipment of a parcel depends on size and weight of the parcel but not on the distance. A flat fee is charged for a delivery within a region independent from the distance between drop-off and pick-up location. A higher flat fee arises for shipments outside of the region if such extension of the service is possible as there are similar services in a neighbouring region and there are connecting parcel trains between the regions. Hence, a list of prices can be displayed that is independent from the start and destination location of a request. Items of the list, i.e. different postage prices can be linked to an online shop of a CEP company so that the user can buy a parcel stamp.

For a user of a CEP company who asks for a transport of a set of containers, capacity restrictions must be considered when doing the trip search. To this purpose, the backend of the PIS must be aware of the remaining capacity in trains considering bookings for containers already done. Information about remaining capacity could be provided similar to real-time delay data to the PIS backend or it could be fetched by the PIS backend via an API of the TSP.

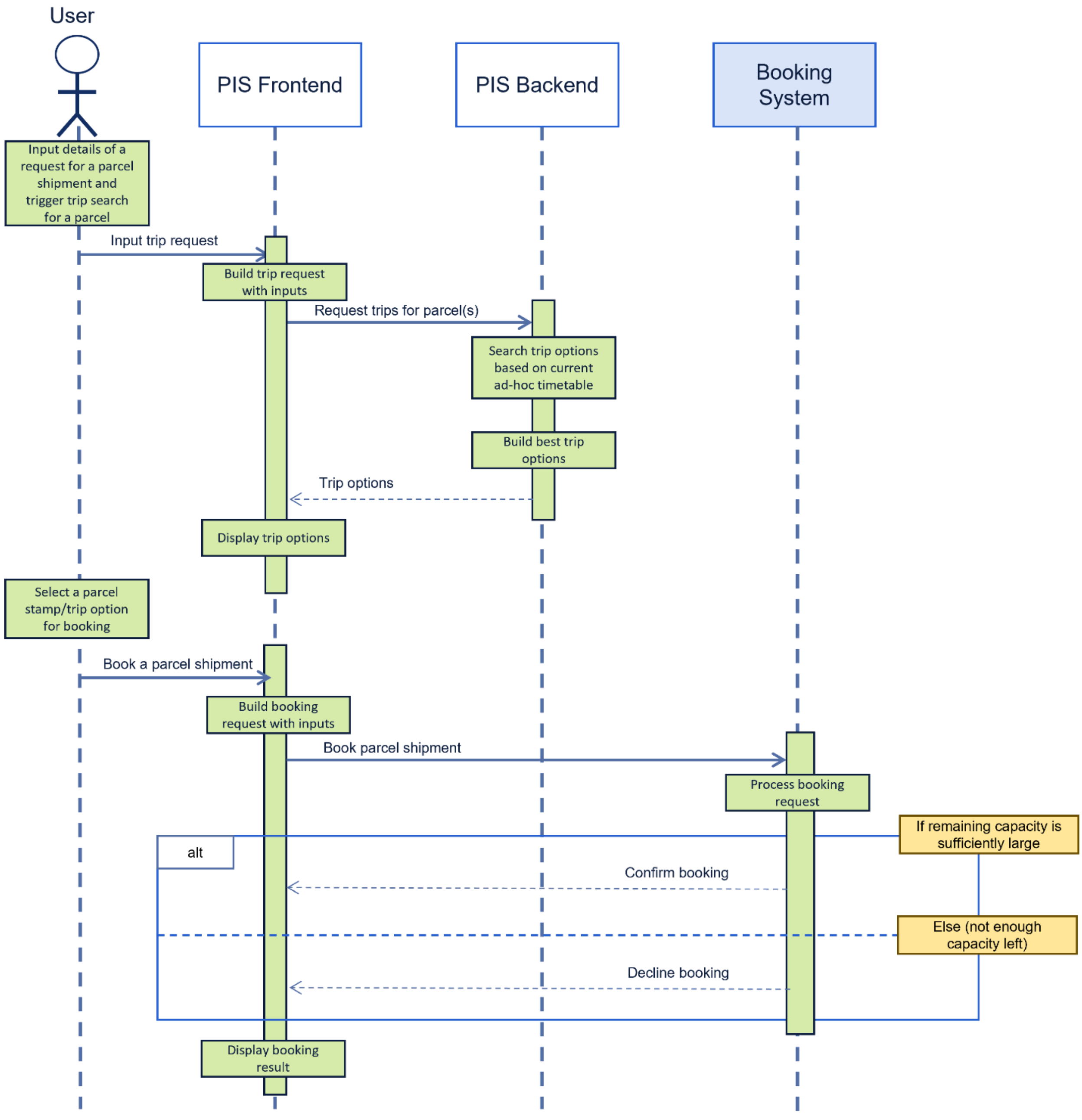

Figure 1: Sequence diagram for all three use cases

All components and functions that are shown in the sequence diagram under PIS Frontend and PIS backend must be developed for a PIS that supports the planning and booking of transport of freight in passenger trains. The diagram in Figure 1 represents the logical architecture of the corresponding part of the PIS on a high level. The components and functions will be explained in more detail in the following Section 3.5.

3.5. Components and functions

In this section, the components of the PIS and their functions that have been depicted in the sequence diagram in the previous section will be explained in more detail. Each component of the PIS and its functions are described in the following tables. For each component and each function, the associated requirements are listed in the tables as well so that it can be checked by which component and function a requirement is met and that all requirements are met and no requirement is uncovered.

3.5.1 PIS Frontend

Table 2 describes the PIS frontend and lists the related functional and non-functional requirements. The functional requirements are met by functions of the component. These functions are explained in Table 3, which also lists for each function the requirements covered by the function.

Table 2: Component PIS Frontend

Component Name	Component Description	Associated Requirement ID
PIS Frontend	The PIS Frontend is the user interface of the PIS and will be realized as a webapp, i.e. a web-browser-based application. It enables the user to specify a trip search request for a parcel (or a container of parcels) that is sent to the backend of the PIS from where the frontend receives transport options that are displayed by the frontend to the user.	T6.6_UC6.1_FRQ02 T6.6_UC6.1_FRQ04 T6.6_UC6.1_FRQ05 T6.6_UC6.3_FRQ01 T6.6_UC6.3_FRQ04

Table 3: Functions of the component PIS Frontend

Function Name	Function Description	Associated Functional Requirement ID
Build trip request with inputs	This function gathers the inputs that the user made in the trip request view of the frontend, e.g. start location, destination location, desired departure or arrival time, and – in case of a professional user from a CEP company – the number and the size/type of the containers to be transported. It also detects the cluster selected by the user so that a request for the transport of parcels can be distinguished from a trip request for a traveller. Based on these inputs, the function creates a trip request for parcels in the format expected by the backend.	T6.6_UC6.1_FRQ02 T6.6_UC6.3_FRQ01

Function Name	Function Description	Associated Functional Requirement ID
Display trip options	This function receives transport options for parcels from the backend in text format and translates this input into an interactive visual representation in the webapp where a user can, for example, select a transport option from the overview to see details of the transport option including postage prices. In addition, the function ensures that transport options are presented in a clear way and support screen readers.	T6.6_UC6.1_FRQ04
Build booking request with inputs	When a user selects a parcel stamp or when a CEP company wants to book the transport of swap bodies or mobile parcel lockers by a specified train, this function creates a booking request that is sent to the external booking system (provided by a CEP company or by a TSP, respectively).	T6.6_UC6.1_FRQ05
Display booking result	This function receives the response of the external booking system and displays it to the user. The response can either be a confirmation (in case of a parcel stamp, it can be a code that represents the stamp) or a declination.	T6.6_UC6.3_FRQ04

3.5.2 PIS Backend

Table 4 provides a description of the second component, the PIS backend. The table also lists the related functional and non-functional requirements that are met by this component. The functional requirements are fulfilled by functions of the component. These functions are explained in Table 5, which also lists for each function the requirements covered by the function.

Table 4: Component PIS Backend

Component Name	Component Description	Associated Requirement ID
PIS Backend	The PIS Backend provides amongst other services the trip search service to travellers either via the frontend or via other channels. To this purpose, the PIS Backend integrates static and real-time timetable data, orchestrates and runs routing algorithms and interfaces with external systems to enrich trip options by additional information	T6.6_UC6.1_FRQ01 T6.6_UC6.1_FRQ03 T6.6_UC6.1_FRQ04 T6.6_UC6.1_NFRQ01 T6.6_UC6.2_FRQ01 T6.6_UC6.2_FRQ02 T6.6_UC6.2_FRQ03 T6.6_UC6.2_FRQ04 T6.6_UC6.2_NFRQ01

Component Name	Component Description	Associated Requirement ID
		T6.6_UC6.3_FRQ02 T6.6_UC6.3_FRQ03 T6.6_UC6.3_NFRQ01

Table 5: Functions of the component PIS Backend

Function Name	Function Description	Associated Functional Requirement ID
Search trip options based on current ad-hoc timetable	This function takes origin, destination, requested departure or arrival time, the selected cluster (indicating whether a trip for a parcel or a passenger is searched) and other parameters such as number and size of containers as input and executes a trip search for parcels. The trip search is based on timetable data and data about first/last mile options. It considers static and also real-time data for arrival and departure times. The timetable data contain specific information regarding the transport of freight, e.g. • a flag indicating the capability of a train to transport a container of parcels, • long transfer times at hubs allowing for sorting and consolidating, • information about stops which are served by a train service, i.e. where a container is loaded or unloaded. The function returns several transport options for a parcel/container (or the information that no transport option was found).	T6.6_UC6.1_FRQ01 T6.6_UC6.1_FRQ03 T6.6_UC6.2_FRQ01 T6.6_UC6.2_FRQ02 T6.6_UC6.2_FRQ03 T6.6_UC6.2_FRQ04 T6.6_UC6.3_FRQ02 T6.6_UC6.3_FRQ03
Build best trip options	This function processes the transport options resulting from the function “Search trip options based on current ad-hoc timetable” It removes trip options that are too slow or feature too many transfers compared to other trip options. To the remaining transport options, it attaches postage prices.	T6.6_UC6.1_FRQ03 T6.6_UC6.1_FRQ04 T6.6_UC6.2_FRQ04 T6.6_UC6.3_FRQ03

Function Name	Function Description	Associated Functional Requirement ID
	Finally, this function returns the resulting transport options to the PIS frontend.	

3.6. Interfaces and Standards

Standardized interfaces and data formats help to improve quality of service, to keep implementation effort low and support connectivity between different systems. In this section, interfaces of the specified system and data needed by the system are identified. This is preparatory work for [Deliverable D6.8 of FP6 FutuRe] in which it is analysed whether standardized interfaces and standard data formats exist that can be used for implementing the specified solution or if there are gaps and if extensions of existing standards or even a new standard might be helpful.

The most important input from external parties is static timetable data provided by a TSP that must contain information about the options to transport freight in the scheduled services for passengers.

Another crucial piece of information is the remaining capacity for containers that shall be considered when a user from a CEP company queries the system for transport options. This kind of information must be provided by the TSP, i.e. by the rail operator who offers transport capacity for freight in its passenger trains.

Finally, postage prices that are shown to users must be provided by a CEP company that offers the transport service to end customers.

4. Transferability across Europe

The aim of the FP6 FutuRe project is to develop improvements tailored to regional rail but transferable across Europe. Hence, this chapter shall briefly discuss the transferability of the solutions specified in this deliverable.

The specifications in Chapter 3 focus on how a PIS can support users when planning the shipment of parcels in passenger trains. For this support, the PIS needs mainly timetable data that contain additional information and some algorithmic extensions. Many of the well-known timetable data formats are used across Europe, e.g. NeTEx, GTFS, HAFAS, MERITS etc. If these data formats are extended, all regions are covered implicitly and there is only the need that each region maintains its data. The situation for algorithmic extensions is similar: A few trip search algorithms are used across Europe and cover many regions. Here, economies of scale exist.

In regard to the actual transport of goods in passenger trains, the barriers for applying a uniform approach across Europe are higher because of differences between regions. The number of conductors per train varies across European regions and might even be zero so that no one can receive and hand out parcels. The space for parcels or containers with parcels differs depending on the rolling stock that is used; the existing infrastructure at stations may render the operation of parcel lockers possible or difficult. For example, elevators might be required to transport a container of parcels from a parcel locker to a platform where the container then will be loaded into a train. Finally, expectations from users can differ from region to region.

Depending on the situation in a region, a specific approach might be needed. For private persons who want to send a parcel, we have outlined two use cases. These use cases differ significantly from each other and can each be considered as a specific approach. The first use case does not rely on equipment such as parcel lockers whereas the second use case meets higher expectations regarding comfort for the user.

5. Conclusion and outlook

Deliverable 6.7 describes the specifications of information, routing and booking functions for cargo distribution by passenger trains. The specifications have been described through use cases, requirements, sequence diagrams, components, functions, and interfaces and standards.

The first two use cases (UC-FP6-WP6-6.1 and UC-FP6-WP6-6.2) concern private persons who want to send a parcel via train. The third use case (UC-FP6-WP6-6.3) is a business case where a CEP company uses the system to plan the transport of freight placed in containers. Each of the three use cases describes the interactions between actors and the system that shall be developed.

Although Task 6.6 got off to a good start, we have unfortunately not yet been able to find a demonstration partner. The minimum requirement would be the provision of (infrastructure and) timetable data (planned and real-time data) of existing train services. External third companies and the operating companies from the entire FA6-FutuRe project were approached but have unfortunately not shown interest.

Against this background, a continuation of the project by demonstrating the described functionalities up to a suitable Technology Readiness Level does not appear possible.

References

- Deliverable D6.2 of FP6 FutuRe, Specification of Multimodal Travel Solution (Final Release), Version 2, August 2024
- Deliverable D6.8 of FP6 FutuRe, Investigation of standards in Public Transport and gap analysis (Alpha Release)