FP1 MOTIONAL
European Rail Network and Mobility Management

Deliverable 2.3
Use Cases for planned technical developments of the project

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Responsible/Author:	Marco Ferreira (HACON)
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Reviewers: Francisco Lozano (ENYSE)
Isabel Meseguer Hijós (CAF)

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Report contributors		
Name	*Beneficiary Short Name*	*Details of contribution*
Marco Ferreira	HACON	Initial draft, review and consolidation
WP3 partners	WP3 partners	WP3 use cases contribution, actors and data available
WP10 partners	WP10 partners	WP10 use cases contribution, actors and data available
WP19 partners	WP19 partners	WP19 use cases contribution, actors and data available

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1. Executive Summary

This document forms Deliverable 2.3 “Use Cases for planned technical developments of the project” of FP1 MOTIONAL Project. It is designed to present the new technical Use Cases proposed by the MOTIONAL project. The report also includes an analysis of data availability in prototype environments.

The deliverable contains 160 Use Cases (UCs) covering all technical activities within MOTIONAL Work Packages (WPs). These Use Cases reflect the project tasks in form of a story between the actors and the MOTIONAL platforms. The use cases will be used to design the proposed solutions and later on development reports they can be used to validate that the technical developments were able to fulfil the initially defined goals.

2. Abbreviations and acronyms

Abbreviation / Acronym	Description
ABT	Account Based Ticketing
AI	Artificial Intelligence
API	Application programming interface
ASP	Apportionment and Settlement Platform
ATO	Automatic Train Operation
B2B	Business-to-Business
B2C	Business-to-Customer
BLE	Bluetooth Low Energy
C-DAS	Connected Driver Advisory System
CEN	European Committee for Standardization
CI	Common Interface
CMS	Capacity Management System
DRT	Demand Responsive Transportation
ECMT	European Capacity Management Tool
ERA	European Union Agency for Railways
ERA	European Union Agency for Railways
ERJU	Europe's Rail Joint Undertaking
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
FA	Flagship Area
FCM	Face Capture Module
FP	Flagship Project
FRMCS	Future Rail Mobile Communications System
FRS	Face Recognition Server
FTE	Forum Train Europe
GA	Grant Agreement
GJT	Generalized Journey Time
GoA	Grade of Automation
GPS	Global Positioning System
GTFS	General Transit Feed Specification
HFCS	Hands Free Control System
HL3	Hybrid Level 3
HMI	Human Machine Interface
HST	High Speed Train
HTO	Human, Technology, Organization
IAMS	Intelligent Asset Management System
ID	Identification
IM	Infrastructure Manager
KPI	Key Performance Index
LTP	Long-term Planning
LZB	Linienzugbeeinflussung (Linear Train Control)
MaaS	Mobility as a Service
MAWP	Multi Annual Working Plan

MAWP	Multi Annual Work Program
MMS	Maintenance Management System (railway asset management)
MILP	Mixed-Integer Linear Programming
NeTEx	Network Timetable Exchange
OCC	Operation Control Centre
OJP	Open Journey Planning API
OSDM	Open Sales and Distribution Model
PCS	Path Coordination System
PESP	Periodic Event Scheduling Problem
POT	Passenger-Oriented Timetabling
PRM	Person with Reduced Mobility
RDMP	Research Data Management Plan
RFC	Rail Freight Corridor
RNE	RailNet Europe
RTLS	Real Time Location Service
RU	Railway Undertaker
S2R	Shift2Rail
SERA	Single European Railway Area
SFERA	Smart communications For Efficient Railways Activities
SG	Sub-Group
SIRI	Service Interface for Real Time Information
SP	System Pilar
SP	System Pillar
SPOT	Strategic Passenger-Oriented Timetabling
STP	Short-Term Planning
TAF	Telematics Applications for Freight services
TAP	Telematics Applications for Passenger services
TCR	Temporary Capacity Restriction
TE	Technical Enabler
TE	Technical Enabler
TMS	Traffic Management Systems
TOC	Train Operation Company
TPE	Train Path Envelope
TPS	Train Planning System
TRL	Technology Readiness Level
TSI	Technical Specifications for Interoperability
TSP	Transport Service Provider
TTR	Timetable Redesign
UC	Use Case
UWB	Ultra-Wide Band
WP	Work Package
WS	Work Stream
YCS	Yard Coordination System

3. Background

The main objective of the MOTIONAL project is to improve the flexibility, efficiency, resilience, and capacity adaptation of the European rail network to support the development of a Single European Rail Area. This involves the development of functional requirements, specifications, and solutions for future European Traffic Management, including common network management, train planning, operations, automation and mobility management.

The target solution of the project is a dynamic network and traffic management at the European scale built upon a harmonized functional system architecture for agile, borderless, mixed-traffic operations and integration of Rail with other transport modes. The benefits of the project can be numerous and include the extension of capacity planning at the European level, enabling automatic management of cross-border rail traffic, improving service offers, operations, capacity utilization, and the information and distribution of multimodal offers, enhancing the competitiveness of rail-based mobility chains.

To achieve the project objectives, the project is divided into four sub-groups that will work on different areas, namely:

- SG1 Planning systems and processes including cross-border;
- SG2 Integration of TMSs and processes including cross-border traffic management;
- SG3 Integrate Rail with other transport modes;
- SG4 Digital enablers.

This deliverable will describe the Use cases of each sub-group in detail, from where it can be extracted requirements and the expected results of each Use case.

4. Objective/Aim

The objective of this deliverable is to outline the planned technical developments of the MOTIONAL project presenting the use cases that the project aims to explore. These technical advancements have been designed to address specific challenges and opportunities identified within the scope of the project. By outlining these use cases, we aim to demonstrate the potential impact and practical applications of the proposed developments.

This deliverable aims to provide a comprehensive overview of the use cases for each planned technical development, reflecting the project tasks in form of a story between the actors outlining the activities involved on their development. The use cases will be described including details like pre-conditions, triggers, expected results and other important characteristics that define a use case. This deliverable also intends to report on the analysis of data availability in prototype environments to not block the project during the development phase.

To be able to correctly define a use case it's important to correctly define what it means in the system engineering context. A use case refers to a description of a specific interaction between a user or external system and the system being developed. It describes the sequence of events that occur when an actor (i.e. a user or an external system) performs a specific task or action using the system, including the input and output involved, as well as any relevant conditions or constraints. The Use cases are often used to help identify and document system requirements and can also be used as a guide for the test cases of the functionality and usability of the system during the development phase, validating if the expected results are achieved.

The use cases identified in this deliverable will serve as the foundation for the development work to be carried out in 2024 within the respective development work packages (4, 6, 8, 11, 13, 15, 17, 20, 22, 24). These use cases, as the basis for development, will aim to achieve TRL4-5 in alignment with project milestone 12 (Maturity check point – Prototype validation 1 (Development) – TRL 4-5). New use cases will be defined for the demonstration phase of the project (2025, 2026) in "D2.5 Use Cases for project demonstrations", where higher TRLs will be defined for each of the demonstration Use Cases.

5. Methodology

The MOTIONAL project follows a structured approach to developing the necessary use cases, with four sub-groups working on specific areas of the project. The goal of this methodology is to provide a framework for the development of use cases that considers the project structure and ensures that those use cases are comprehensive, accurate, and meet the needs of the stakeholders.

The following methodology will only apply to the sub-groups 1, 2 and 3, as the identification and management of sub-group 4 will be done in WP26.

The following methodology will be applied:

1. Identify the stakeholders: The first step of each sub-group is to identify the stakeholders who will be impacted by MOTIONAL project. The stakeholders could include railway undertakings, infrastructure managers, regulators, passengers, freight owners, etc. Those will be the main actors on the developed use cases.
2. Define the scope: Once the actors have been identified, the scope of each sub-group needs to be defined. This includes identifying the objectives, goals, and expected outcomes of the project, aligned with the MOTIONAL grant agreement.
3. Develop sub-group specific use cases: Based on the actors' needs analysis, each sub-group should develop use cases that are specific to their area of the project. These use cases should be comprehensive and cover all the relevant aspects.
4. Consolidate the sub-group specific use cases: The sub-group specific use cases need to be consolidated into a single document for each work package. This document will serve as the basis for the system specification.
5. Validate the consolidated use cases: Once the consolidated use cases have been developed, they need to be validated by the WP partners. This ensures that the use cases accurately reflect their requirements and expectations. Validating that they can be transferred to WP2.
6. Finalize the consolidated use cases at WP2: Once the consolidated use cases have been validated, they should be consolidated by WP2 on the present document. The final use cases should be comprehensive, clear, and unambiguous.

Following this methodology, we guarantee that the project activities work on a standardized way and that they have the relevant information to develop the system specification for the project activities. The use cases will serve as the basis for developing the system specification. The system specification should describe the technical requirements of the rail system, including the hardware, software, and interfaces.

5.1. Use case description template

This section will present the Use Case template created at WP2 to have a standardized approach to creating Use Cases on the MOTIONAL project.

The MOTIONAL project Use Cases are identified following the following scheme:
"UC-FP1-WPx*x*-*yy*" where *xx* represents work package number responsible by the development of this use case, and *yy* represent the identification of this Use Case inside the WP, *yy* shall be consecutively numbered for each WP.
The template provides guidelines on what should be included at each row.

Name	*Descriptive Name of the Use Case*
ID	*ID of the Use Case "UC-FP1-WPxx-yy"*
Description	*Short description of the Use Case*
Related to task/subtask(s)	*Precise task/subtask that this Use Case relates to (specification/implementation/demonstration)*
Impact on other task(s)	*Indicate tasks that may depend on the results of this Use Case (dependencies identification)*
Technical Enabler(s)	*Indicate TE involved "Number-Name"*
Interactions SP/FP	*Indicate (when applicable) the interactions with the System Pillar or other Flagship Projects*
Actor(s)	*Involved actors (active and passive ones)*
Trigger	*Action or event that trigger the Use Case*
Pre-Condition(s)	*Preconditions of the Use Case / what is the state of the system, which allows to perform the Use Case*
Input	*Required input(s) to execute the use case*
Result/Requirement	*What will be the expected result of the Use Case*
Final State	*If applicable describe the expected final state of the system after the Use Case was performed*
Sequence	*List steps of the Use Case (to be filled during specification phase)* 1. *Step x* 2. *Step y* 3. *Step z*
Expected Implementation Date	*Date when the UC is expected to be ready for tests (Month Year)*
Involved components (System)	*List the software/hardware components that will be involved to run the Use Case (to be filled during specification phase)*
Responsible partner/person	*Company and Main contact who is responsible to describe this Use Case and guarantee the system design and implementation*
Notes	*Additional notes for the Use Case*

Table 1: Use Case Template

Due to the different levels of maturity of each sub-group in relation to their specification, the use cases defined on the use cases sections may miss some of the fields established on this template. All sub-group will still use the same tabular format as basis to define the use cases, which will be improved on later stages to include all the necessary information.

5.2. Data availability for prototype environments

The prototype environments and demonstration of the project are crucial for the development and testing of the project results. To ensure that the use cases can be executed successfully in these environments, it is important to have access to relevant and accurate data.

The project Research Data Management Plan (RDMP) [1]outlines the policies and procedures for managing the research data throughout the project lifecycle. The RDMP includes information on data collection, storage, sharing, and preservation. It also includes guidelines for ensuring data quality, security, and confidentiality.

To ensure that the data availability for prototype environments is in line with the project RDMP, the following steps should be taken:

1. Identify the data requirements for the prototype environments: The first step is to identify the data requirements for the defined use cases. This includes identifying the types of data required, the format of the data, and the sources of the data.
2. Ensure that the data is collected and stored according to the RDMP: The data should be collected and stored according to the policies and procedures outlined in the project RDMP. This includes ensuring that the data is of high quality, and that it is stored securely.
3. Make the data available for the prototype environments: Once the data has been collected and stored, it should be made available for the prototype environments. This includes ensuring that the data is accessible to the relevant development team, and that it is in the appropriate format for the prototype environments.
4. Ensure that the data is properly managed in the prototype environments: The data should be properly managed in the prototype environments to ensure that it is used in a way that is consistent with the project RDMP. This includes ensuring that the data is not used for purposes outside of the project scope, and that it is properly secured and backed up.

On this deliverable the data identified should be related to the necessary data to run the use cases at the end of the development stage of the project (end of 2024) and be updated later during the demonstration planning phase. The identified data should be then included on upcoming versions of the “D2.1 Research Data Management Plan”.

By following these steps, the rail research project can ensure that the data availability for prototype environments is consistent with the project RDMP, and that the use cases can be executed successfully.

[1] FP1-WP02-D-HAC-001-01 D2.1 Research Data Management Plan

5.3. Consolidation and analysis of use cases

In this section, it is presented the consolidation and analysis processes applied to integrate diverse use cases across various work packages, ensuring a coherent and comprehensive representation of the project's objectives.

The use cases identified will be used on a later stage to define the use cases for demonstrations on the deliverable D2.5 Use Cases for project demonstrations.

5.3.1. Checking Consistency and Uniformization of Content

To ensure a seamless integration of use cases, an initial step involved a review of each use case's content by each sub-group. This review was aimed at identifying inconsistencies, ambiguities, or redundancies in the information provided. Additionally, efforts were made to ensure uniformity in the terminology and format used to describe the use cases.

5.3.2. Actors Definition Alignment

An essential aspect of consolidating use cases involved aligning the definitions of actors across the different work packages. The actors identified in each use case were analysed for their roles, responsibilities, and interactions within the respective scenarios. Through cross-package collaboration and alignment, a unified and standardized definition of actors was achieved, promoting a cohesive understanding of the use cases and their associated stakeholders.

5.3.3. Template Fulfilment

Efforts were made to adhere to a standardized template for presenting use cases. However, due to the evolving nature of the project and specific work package requirements, complete template fulfilment was challenging at this stage. Work Package 3 and 10 have committed to provide the necessary information to fulfil the template requirements at a later stage as this was not on the scope of those work packages to complete their specification of those use cases at month 13.

This ongoing process ensures that all use cases will align with the prescribed format and provide a holistic representation of the project's objectives.

The consolidation and analysis processes described above were crucial in integrating diverse use cases into a cohesive and coherent representation. These efforts set the stage for a unified understanding of the project's goals, facilitating effective collaboration and strategic decision-making moving forward.

6. Actors

This section provides an overview of the actors involved in the MOTIONAL technical Use cases. Understanding their roles and responsibilities is essential for the successful implementation of the proposed technical developments.
Consistent actor definition across project activities is vital to prevent misunderstandings. It fosters collaboration, clarity, and effective communication, ensuring smooth information exchange and aligned efforts towards common goals.

Actors can be individuals, organizations, or external automated systems that interact with the technology being developed in MOTIONAL. By describing the actors, we enable comprehensive analysis of their involvement, facilitating effective communication and collaboration among project partners and external stakeholders.

Table 2 – Actors definition

Actor name	Actor definition
Advanced Protection System (APS)	Abbreviation used within RCA context [RCA]. In the RCA, the APS is mainly the trackside train protection (today RBC) and the route protection (today Interlocking).
ATO-Onboard Unit (ATO-OB)	A set of functions that translates the information contained in the journey profile received from the ATO TS into train trajectories and controls the traction and braking systems for automated train runs. This system is deployed on-board train units and has bi-directional communication with the Trackside equipment. It is able to optimise the performance of one train and command the train unit running without driver intervention. (From D15.1[2])
ATO-Trackside facility (ATO-TS)	A set of functions that interfaces with the TMS, which contains the operational data and infrastructure data that is required by the ATO On-Board. The ATO trackside communicates with the Train Operation On-Board equipment of the trains. It defines the train journey profiles according to the traffic management data. (From D15.1)
City Transit Operators	Business participant (private) managing public transit services with a municipality scope (e.g. Shuttle services, local minibuses etc.)
Capacity Management System (CMS)	Capacity Management System for planning and maintaining the Capacity Plan at IMs including train paths and Temporary Capacity Restrictions (TCR)
CMS Operator/User	User of the CMS
Connected DAS Onboard-Unit (C-DAS OB)	On-Board unit that receives the data from the trackside (C-DAS TS), performs the calculation for the driving advice (if not done previously on the trackside by RU or IM), and sends the driving advice to the user interface to be displayed. (From D15.1)
Connected DAS Trackside facility (C-DAS TS)	System that establishes the communication to the C-DAS OB, that is, from ground to on-board systems. It can be integrated into the TMS or a separate system on the IM side or/and on the RU side depending on the architecture. This system creates data packages, e.g., SFERA messages, from data received from the TMS (normally on the IM side), and transmits it to the C-DAS OB. It also receives data from C-DAS OB which can be sent to the TMS. (From D15.1)

[2] FP1-WP15-D-RISE-003-03 - D15.1 Requirements for the deployment of TMS linked with ATO/C-DAS

Consumer of data	User, application or system that uses data collected by other systems or stored in repositories.
Centralised Traffic Control System (CTC System)	Synonym for Operations Control Center (OCC)
CTC System Operator	User of the CTC System. This term is expected to cover OCC operator, CTC operator and signaller. Among other tasks it is responsible for safe routes both in normal and degraded operations, authorizes train movements by commands to interlockings over remote control areas (routes), conducts safety communication, for instance in case of European Instructions or alarm calls and controls shunting over main tracks.
Data Analyst	Representative of the TSP who accesses the Demand Analytics Dashboard to inspect past and forecasted demand of Travellers within the MaaS platform of the TSP.
Data Lake service	The "Data lake" is the cornerstone of comprehensive data management in our municipal ecosystem, consolidating a wealth of information concerning multimodal transport, demand analysis, and disruption management. Serving as the single point of truth, it unifies data from diverse sources, ensuring a central repository of reliable, up-to-date information. This invaluable resource facilitates data-driven decision-making, enhancing efficiency and responsiveness across the municipality's transport infrastructure, ultimately promoting seamless and effective multimodal transportation services.
Decision Support System (DSS)	Decision Support System or component thereof. System for computing necessary statistics for decision making.
Emergency Coordinator	A person who coordinates activities in emergency situations (Incident Management)
Emergency/rescue services	Within this block, it is included the emergency personnel who handles or acts in emergency situations (incident managements) or the police responsible.
Intelligent Asset Management System (IAMS)	Maintenance management system for railroad infrastructure systems, supporting the entire process chain, from data acquisition to decision making.
IM-Trackside staff	Trackside staff of an Infrastructure Manager
Infrastructure Operators	Municipal organization responsible for maintenance of infrastructure such as roads, electricity, etc.
Inspection Vehicle	As part of railway asset management for inspection of tracks or other components of the railway infrastructure (see also FP3-IAM4RAIL)
Integration Layer (IL)	Messaging Platform based on publish&subscribe mechanism as introduced in Shift2Rail alongside the CDM with link to the System Pillar
Interlocking	A general term applied to the controlling of the setting and releasing of “signals” and “points” to prevent unsafe conditions arising, and equipment which performs this function (from Subset 23 of CCS TSI)
Metro Service Provider	Specific Transport Service Provider that provides metro services and means of transports.
MMS Manager	Responsible person for maintenance management using the Maintenance Management System (MMS)
MMS Operator	A user of the Maintenance Management System (MMS)
Mobility Account Provider	Derivation from retailer. Business participant owning the Mobility Account.
Municipal Independent	Business participant (private) managing public transit services with a

Operators	municipality scope (e.g. Shuttle services, local minibuses etc.)
Municipality management personnel	Representatives of e.g., road management reporting on roadworks, city council reporting on festivals, etc. Generally trusted sources from municipal governing or affecting bodies.
Node planner	Responsible for creating rolling stock plans within a node. Can be both IMs and RUs.
OCC Operator	Person who is responsible for monitoring and controlling the systems and processes within the Operation Control Centre (OCC). The operator's role may include tasks such as: - Monitoring the status of equipment, systems, and processes in real-time. - Responding to alerts and alarms generated by the monitoring systems. - Coordinating and managing traffic. - Troubleshooting issues and resolving problems that arise. - Communicating with other operators, technicians, and stakeholders to coordinate activities and resolve issues. - Following established procedures and protocols to ensure the safe and efficient operation of the control centre.
Other multimodality operators	Business participant offering non-public services for multimodal travel (e.g. Taxi operator, bike rentals, scooter rental, car sharing)
Operators of integrated systems	This covers the operators of the systems integrated for yard/station management, digital maintenance planning, ETS simulator, crew/rolling stock assignment (interface emulation only).
Person with Disabilities / Person with Reduced Mobility	Any person who has a permanent or temporary physical, mental, intellectual or sensory impairment which, in interaction with various barriers, may hinder his or her full and effective use of transport on an equal basis with other passengers or whose mobility when using transport is reduced due to age
Purchaser	A purchaser represents the entity which has booked an offer. It is the person to contact in case of changes to the booking primary. A purchaser does not need to travel.
Rail Administrator / Infrastructure Manager (IM)	Body or firm responsible in particular for establishing, managing and maintaining railway infrastructure, including traffic management and control-command and signalling». In addition, the management of royalties.
Railway Service Provider	Specific Transport Service Provider that provides railway services and means of transports.
RBC	Radio Block Centre (ETCS). A centralised safety unit that receives train position information via radio and sends movement authorities via radio to trains. (from Subset 23 of CCS TSI)
Retailer	A retailer is an organization selling the products of Transport service provider(s) using the services of distributors. A TSP can play the role of a retailer in connection with both its own products and those of a partner TSP by whom it is licensed.
Railway Undertaking (RU)	Public or private undertaking whose principal business is to provide services for the transport of goods and/or passengers by rail with a requirement that the undertaking ensure traction; this also includes undertakings which provide traction only. (Directive 2012/34/EU). This also covers the train operators.
RU-crew dispatcher	A person at a RU dispatching the crew members to be assigned to train services
RU-rolling stock dispatcher	A person at a RU dispatching the rolling stock to be assigned to train services
Service Provider (SP)	Role of an organization offering service(s), especially but not exclusively to transportation.

Station Operator	Entity responsible for administration and operation of railway station building and related infrastructure (focus especially on station building not platforms). Decision maker with respect to marketability of station.
System publishing infrastructure restrictions	This could be e.g., the Digital Maintenance Planning System as introduced in FP3-IAM4RAIL WP8 (task 4) or, for EU-wide TCRs a future RNE based centralised application. The TCRs are specified in a draft version of TAF TSI.
Terminal manager	Responsible person for terminal handling (loading/unloading wagons) at freight terminals within a freight yard.
Timetable planner/designer	Responsible for creating strategic, long-term or short-term timetables and also for making adjustments. Can be both IMs and RUs.
Traffic Management System (TMS)	Traffic management ensures the safe, efficient and punctual operation of the railway, including effective recovery from service disruption. This is the system for monitoring and managing the traffic and the signalling system from the control centres. It covers a broad range of functionalities and, therefore, it is expressed in some cases as multi-actor system, which includes several actors.
TMS Conflict Detection module	A technical module of the TMS for detecting conflicts of capacity objects (e.g., trains, TCRs) addressing needs for re-planning
TMS Conflict Resolution module	A technical module of the TMS for providing solutions for detected conflicts of capacity objects (e.g., trains, TCRs)
TMS Deviation Detection module	A technical module of the TMS for identifying the deviations (e.g., train timing, used route/track) of real operation from the operational plan.
TMS Event Logger	A technical module of the TMS for logging any relevant events as identified from integrated sensors, systems or processes including user activities.
TMS Forecast Calculation module	A technical module of the TMS for calculating the train running which is used for conflict detection and provision of estimated arrival or handover times
TMS HMI	TMS Human-Machine Interface
TMS Manager	Ultimately responsible for deciding which trains have priority in the event of conflicts and therefore which trains are penalized in their resolution.
TMS Operational Plan	A technical module of the TMS for maintaining and providing the Operational Plan for other TMS components or interfaces
TMS Operator	A user of a TMS, can sometimes also be called Line Manager. Within this actor it is the dispatcher. Among other tasks it is responsible for a feasible route plan according to the (working) timetable, monitors train path deviations and updates train timings, orders, and routes and contacts train drivers in case of disturbances and disruptions. It would be the actor in charge of supervising and managing the trains, being responsible for ensuring that they comply with their planned schedule and for minimizing the impact that delays may cause on the transportation plan, making the necessary decisions to resolve possible problems. conflicts (crossings and scopes) that could occur.
Train operating company (TOC)	Train operating company is the responsible for running trains
Train driver	The driver of a train. Train drivers are responsible for driving trains in a safe, punctual, and economic manner over various routes in accordance with rail rules, regulations, and procedures. With ATO GoA3/4, there is no driver onboard the train. (From D15.1).
Transport Service Provider (TSP)	Organization providing both physical services and means of transport: aircrafts, trains, metros, coaches, buses, bike-sharing, car-sharing, etc.
Traveller	The traveller is the person making a travel in accordance with the terms and conditions of the entitlement(s)
Urban Transport Service	Company that provides public transportation services, such as buses, trains,

Provider	trams, and subways.
Weather station	Facility equipped with instruments for measuring atmospheric conditions such as temperature, pressure, humidity, wind speed, wind direction, and precipitation.
Yard Manager	Responsible person for and controlling the yard and operational planning of its shunting movements.
YCS	Yard Coordination System controlling the movements on the tracks in a yard area
YCS Operator	The user of a YCS

7. SG1 – WP3 Use Cases

The use cases, identified in MOTIONAL WS1.1, are shown in the table below. Each use case is linked with the reference WPs pair (WP4-5 Integration of planning systems and processes including cross-border planning, WP6-7 Decision support for planning and timetable optimisation, WP8-9 and operational feedback for improved planning).

The specific outcomes for WS1.1 stated in the GA are listed below:

- Enhance future railway processes by integrating capacity planning systems of European Infrastructure Managers with external processes. This includes cross-border planning with representative use cases for long-term and short-term timetable planning, enabling European-wide capacity allocation and new concepts like TTR by FTE/RNE, and factoring in station and yard capacity at the network level.
- Develop advanced algorithms for railway timetable and rolling stock planning. These algorithms aim to enhance long-term and short-term timetabling, optimizing network utilization and synchronizing with rolling stock planning. Real-world demonstrations will lay the groundwork for future decision support tools, improving railway efficiency and capacity.
- Enhance railway timetable planning through improved simulation methods and feedback loops between operations and planning. Objectives include developing punctual and robust timetables, using decision support methods and modules like TMS – C-DAS/ATO. The focus is on improving traffic simulation methods, models, and system modules to evaluate capacity more effectively, considering innovative technologies and automation such as "ERTMS," ETCS Hybrid Level 3, C-DAS, and ATO.

Use Case Id	Use Case Name	WP	Responsible partners
UC-FP1-WP3-1	International late path request placed between X-8 and X-2	4-5	HACON
UC-FP1-WP3-2	International path request placed after X-2 and before X+12	4-5	HACON
UC-FP1-WP3-3	Showing and handling of impact of imported TCR	4-5	HACON
UC-FP1-WP3-4	Planning and allocation of capacity for different planning horizons	4-5	HACON
UC-FP1-WP3-5	Data exchange between traffic management system (TMS) and local or national capacity management/planning system (CMS)	4-5	HACON
UC-FP1-WP3-6	Data exchange between national capacity management/planning system (national CMS) and local, yard-based capacity management/planning system (local CMS)	4-5	HACON
UC-FP1-WP3-7	Cross-border ad hoc planning 1	4-5	TRV/KTH
UC-FP1-WP3-8	Cross-border ad hoc planning 2	4-5	TRV/KTH
UC-FP1-WP3-9	Cross-border ad hoc planning and simulation	4-5	TRV/KTH
UC-FP1-WP3-10	YCS: Update the initial A/D-yard plan	4-5	TRV/RISE
UC-FP1-WP3-11	YCS: Updated planned arrival times	4-5	TRV/RISE

UC-FP1-WP3-12	YCS: Wagons for outbound train not ready for departure on time	4-5	TRV/RISE
UC-FP1-WP3-13	YCS: New shunting need from YM	4-5	TRV/RISE
UC-FP1-WP3-14	YCS: Cleanup of short-term track allocation plan	4-5	TRV/RISE
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UC-FP1-WP3-34	Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – normal ERTMS implementation strategy	8-9	TRV/VTI
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Table 3: MOTIONAL WS1.1 Use Cases list

7.1. UC-FP1-WP3-1 – International late path request placed between X-8 and X-2

Name	International late path request placed between X-8 and X-2
ID	UC-FP1-WP3-1
Partner	HACON
Demonstration associated	Demo 3
Description	International capacity allocation process is (in general) not agile enough for the market needs (too long time to construct an international path). This happens in all time horizons, but especially for late and short-term requests. There are several problems, for example, IMs have different processes and deadlines and there is no immediate access to one IMs information for another IM. In this use case the focus is on solving the problem for international late path requests placed between X-8 and X-2.
Related to task/subtask(s)	Tasks 4.3, 5.2.2
Impact on other task(s)	
Technical Enabler(s)	TE1
Interactions SP/FP	TBD
Actor(s)	IMs, RUs (as a capacity applicants)
Notes	General considerations: • The nature of the networks, types of borders, etc. need to be considered. • Track availability in border stations (interchange points) needs to be considered. • Consider variations of the paths depending on the period of the year or the weekday (Applicants may want different timetable or even route, O/Ds in different periods or weekday for the same “service”, TCR periods).

7.2. UC-FP1-WP3-2 – International path request placed after X-2 and before X+12)

Name	International path request placed after X-2 and before X+12)
ID	UC-FP1-WP3-2
Partner	HACON
Demonstration associated	Demo 3
Description	International capacity allocation process is (in general) not agile enough for the market needs (too long time to construct an international path). This happens in all time horizons, but especially for late and short-term requests. There are several problems, for example, IMs have different processes and deadlines and there is no immediate access to one IMs information for another IM. In this use case the focus is on solving the problem for international path requests placed after X-2 and before X+12.
Related to task/subtask(s)	Tasks 4.3, 5.2.2
Impact on other task(s)	
Technical Enabler(s)	TE1
Interactions SP/FP	TDB
Actor(s)	IMs, RUs (as a capacity applicants)
Notes	General considerations: • The nature of the networks, types of borders, etc. need to be considered. • Track availability in border stations (interchange points) needs to be considered. • Consider variations of the paths depending on the period of the year or the weekday (Applicants may want different timetable or even route, O/Ds in different periods or weekday for the same “service”, TCR periods).

7.3. UC-FP1-WP3-3 – Showing and handling of impact of imported TCR

Name	Showing and handling of impact of imported Temporary Capacity Restrictions (TCR) on the currently planned international train paths.
ID	UC-FP1-WP3-3
Partner	HACON
Demo associated	Demo 3
Description	The CMS planning application shows new or changed TCRs received from a central service. The impact of the changed TCRs on international freight trains can be identified and handled by the Capacity Planner. 1. Local TCR causes changes to path(s) at/behind the border (handover) location 2. Behind-the-border TCR causes changes to path(s) in local network 3. Freight Corridor (RFC) view on impact and changes resulting from a) and b)
Related to task/subtask(s)	Tasks 4.2, 5.2.1
Impact on other task(s)	TBD
Technical Enabler(s)	TE1
Interactions SP/FP	SP/RNE: cross-border topic, FP5
Actor(s)	CMS operator
Notes	Expected identification of harmonization needs of national Planning rules – shared view (IMs / RNE) Expected input to SP/RNE in relation to TCR specification

7.4. UC-FP1-WP3-4 – Planning and allocation of capacity for different planning horizons

Name	Planning and allocation of capacity for different planning horizons
ID	UC-FP1-WP3-4
Partner	HACON
Demo associated	Demo 5
Description	The national CMS planning application demonstrates the support of new planning processes by using it for planning and allocation of capacity for different planning horizons involving 1. RNE train path envelopes and TCR; 2. Long-term capacity agreements and capacity partitioning; 3. Rolling planning process and conjunction to annual allocation; 4. Interface prototype supporting ECMT/capacity hub (RNE) integration; 5. Modelling and (capacity-)handling of planned changes of the infrastructure; 6. Generation of standard reports.
Related to task/subtask(s)	Tasks 4.3, 5.2.2
Impact on other task(s)	TBD
Technical Enabler(s)	TE1, TE2
Interactions SP/FP	SP/RNE: Timetable Re-Design (TTR)
Actor(s)	CMS operator
Notes	Expected identification of harmonization needs of national planning rules or paradigms in national planning

7.5. UC-FP1-WP3-5 – Data exchange between TMS and national CMS

Name	Data exchange between traffic management system (TMS) and local or national capacity management/planning system (CMS)
ID	UC-FP1-WP3-5
Partner	HACON
Demo associated	Demo 6
Description	The national and local (yard) based CMS planning application demonstrate the exchange of data with TMS showing new planning process involving the use of operational feedback information. The following sub-Use Cases are covered: 1. New or changed plan in national CMS sent to TMS a) train path b) TCR; 2. New or changed local plan of yard based local CMS sent to TMS, a) train consist b) later arrival in departure track c) earlier arrival in departure track d) track assignment change e) changed or new track reservation f) changed or new shunting activities with impact on lines; 3. New or changed operational TCR in TMS sent to national and local yard-based CMS; 4. Up-to-date train position feed-back from TMS to national CMS for deviation detection (track/time);
Related to task/subtask(s)	Tasks 4.4, 5.2.3
Impact on other task(s)	TBD
Technical Enabler(s)	TE2, TE6
Interactions SP/FP	SP/RNE: Timetable Re-Design (TTR): TCR, ad-hoc paths
Actor(s)	CMS operator TMS operator
Notes	Expected identification of harmonization needs of national planning rules or paradigms in national planning

7.6. UC-FP1-WP3-6 – Data exchange between CMS and local CMS

Name	Data exchange between national capacity management/planning system (national CMS) and local, yard-based capacity management/planning system (local CMS)
ID	UC-FP1-WP3-6
Partner	HACON
Demo associated	Demo 7.1
Description	The national CMS planning application demonstrates the exchange of data with local (yard) based CMS showing new planning process capabilities. The following sub-Use Cases are covered: 1. New or changed plan in national CMS sent to yard based local CMS a) train path b) TCR; 2. New or changed local plan of yard based local CMS sent to national CMS, a) train consist b) later arrival in departure track c) earlier arrival in departure track d) track assignment change e) changed or new track reservation f) changed or new shunting activities with impact on lines;
Related to task/subtask(s)	Tasks 4.5, 5.2.4
Impact on other task(s)	TBD
Technical Enabler(s)	TE6
Interactions SP/FP	SP/RNE: Timetable Re-Design (TTR): TCR, ad-hoc paths, R-CDM, FP5
Actor(s)	CMS operator
Notes	Expected identification of harmonization needs of national planning rules or paradigms in national planning

7.7. UC-FP1-WP3-7 – Cross-border ad hoc planning 1

Name	Cross-border ad hoc planning 1
ID	UC-FP1-WP3-7
Partner	TRV A.E. KTH
Demonstration associated	Demo 2
Description	Timetable planners need support to take decisions when processing requests for ad hoc train path insertions or change requests, minor or major, for existing train paths. In this use case, we consider a static scenario in which none of the existing trains can be adjusted or modified while searching for residual capacity for inserting a single train path. The use case will be demonstrated between Malmö and Alnabru freight yards or on a subsection of this line.
Related to task/subtask(s)	Tasks 4.2, 4.5, 5.2
Impact on other task(s)	
Technical Enabler(s)	TE1
Interactions SP/FP	
Actor(s)	Timetable planners (at IMs and RUs -as a capacity applicants)
Notes	

7.8. UC-FP1-WP3-8 – Cross-border ad hoc planning 2

Name	Cross-border ad hoc planning 2
ID	UC-FP1-WP3-8
Partner	TRV A.E. KTH
Demonstration associated	Demo 2
Description	Timetable planners need support to take decisions when processing requests for ad hoc train path insertions or change requests, minor or major, for existing train paths. In this use case, we consider a dynamic scenario in which existing trains can be adjusted or modified when searching for residual capacity for inserting a single train path. Other freight trains may be adjusted to some degree, also passenger trains may get smaller adjustment but subject to any delivery commitments. The use case will be demonstrated between Malmö and Alnabru freight yards or on a subsection of this line.
Related to task/subtask(s)	Tasks 4.2, 4.5, 5.2
Impact on other task(s)	
Technical Enabler(s)	TE1
Interactions SP/FP	
Actor(s)	Timetable planners (at IMs and RUs -as a capacity applicants)
Notes	

7.9. UC-FP1-WP3-9 – Cross-border ad hoc planning and simulation

Name	Cross-border ad hoc planning and simulation
ID	UC-FP1-WP3-9
Partner	TRV A.E. KTH
Demonstration associated	Demo 2
Description	Timetable planners need support to make judgements when processing requests for ad hoc train path insertions or change requests, minor or major, for existing train paths. This use case builds on the previous ones, but simulation is added as a tool for assessing the robustness of different train path insertion alternatives. Either a macroscopic or microscopic simulation tool will be used here.
Related to task/subtask(s)	Tasks 4.2, 4.5, 5.2
Impact on other task(s)	
Technical Enabler(s)	TE1
Interactions SP/FP	
Actor(s)	Timetable planners (at IMs and RUs -as a capacity applicants)
Notes	

7.10. UC-FP1-WP3-10 – YCS: Update the initial A/D-yard plan

Name	YCS: Update the initial A/D-yard plan and make it conflict free for the next few hours.
ID	UC-FP1-WP3-10
Partner	TRV A.E. RISE
Demonstration associated	Demo 4
Description	The LM, YM and TM update the initial plan for the next few hours.
Related to task/subtask(s)	Tasks 4.5, 5.1, 5.2.4, 5.3
Impact on other task(s)	WP11/12: Tasks 11.3.8, 12.2.8.
Technical Enabler(s)	TE6
Interactions SP/FP	FP5 (data integration via FP5 WP32)
Actor(s)	TMS Operator for the hand-over yard, also called Line Manager – LM, active Yard Manager – YM, active Terminal Manager -TM, active Train driver, passive TMS Operators for adjacent lines, passive RU, passive
Notes	This use case represents the planning work done during e.g. the beginning of a shift, or after a large disruption has occurred. The actors may need to, e.g., call each other and discuss in order to find a solution they all find satisfactory. The updated ready-to-depart times may be later than the current planned departure time. However, the departure times are not changed in YCS but rather in the TMS system. Small updates are handled in use case UC-FP1-WP3-11, UC-FP1-WP3-12 and UC-FP1-WP3-13.

7.11. UC-FP1-WP3-11 – YCS: Update planned arrival times

Name	YCS: Updated planned arrival times
ID	UC-FP1-WP3-11
Partner	TRV A.E. RISE
Demonstration associated	Demo 4
Description	Information regarding updated planned arrival times is received from TMS, replanning is triggered. Information propagated to TM/YM, who make secondary responses to this.
Related to task/subtask(s)	Tasks 4.5, 5.1, 5.2.4, 5.3
Impact on other task(s)	WP 11/12: Tasks 11.3.8, 12.2.8.
Technical Enabler(s)	TE6
Interactions SP/FP	FP5 (data integration via FP5 WP32),
Actor(s)	TMS Operator for the hand-over yard, also called Line Manager – LM, active Yard Manager – YM, active Terminal Manager -TM, active Train driver, passive TMS Operators for adjacent lines, passive RU, passive
Notes	The actors may need to, e.g., call each other and discuss in order to find a solution they all find satisfactory. The updated ready-to-depart times may be later than the current planned departure time. However, the departure times are not changed in YCS but rather in the TMS system.

7.12. UC-FP1-WP3-12 – YCS: Wagons for outbound train not ready for departure on time

Name	YCS: Wagons for outbound train not ready for departure on time
ID	UC-FP1-WP3-12
Partner	TRV A.E. RISE
Demonstration associated	Demo 4
Description	Replanning triggered by information from terminal about cars not being ready for departure on time.
Related to task/subtask(s)	Tasks 4.5, 5.1, 5.2.4, 5.3
Impact on other task(s)	WP 11/12: Tasks 11.3.8, 12.2.8.
Technical Enabler(s)	TE6
Interactions SP/FP	FP5 (data integration via FP5 WP32),
Actor(s)	TMS Operator for the hand-over yard, also called Line Manager – LM, active Yard Manager – YM, active Terminal Manager -TM, active Train driver, passive TMS Operators for adjacent lines, passive (active) RU, passive
Notes	The actors may need to, e.g., call each other and discuss in order to find a solution they all find satisfactory. The updated ready-to-depart times may be later than the current planned departure time. However, the departure times are not changed in YCS but rather in the TMS system.

7.13. UC-FP1-WP3-13 – YCS: New shunting need from YM

Name	YCS: New shunting need from YM
ID	UC-FP1-WP3-13
Partner	TRV A.E. RISE
Demonstration associated	Demo 4
Description	Replanning triggered by new information from Yard Manager regarding shunting operations that requires track capacity on A/D-yard.
Related to task/subtask(s)	Tasks 4.5, 5.1, 5.2.4, 5.3
Impact on other task(s)	WP 11/12: Tasks 11.3.8, 12.2.8.
Technical Enabler(s)	TE6
Interactions SP/FP	FP5 (data integration via FP5 WP32),
Actor(s)	TMS Operator for the hand-over yard, also called Line Manager – LM, active Yard Manager – YM, active Terminal Manager -TM, active Train driver, passive TMS Operators for adjacent lines, passive (active) RU, passive
Notes	The actors may need to, e.g., call each other and discuss in order to find a solution they all find satisfactory. The updated ready-to-depart times may be later than the current planned departure time. However, the departure times are not changed in YCS but rather in the TMS system.

7.14. UC-FP1-WP3-14 – YCS: Cleanup of short-term track allocation plan

Name	YCS: Cleanup of short-term track allocation plan
ID	UC-FP1-WP3-14
Partner	TRV A.E. RISE
Demonstration associated	Demo 7.2
Description	The track allocation for an arrival/departure yard is updated for short-term planning in YCS. A (long-term) track allocation plan exists. The cleanup the special requirements for the considered time period into consideration. Train arrival and departure times are considered as given and fixed.
Related to task/subtask(s)	Tasks 4.5, 5.1, 5.2.4, 5.3
Impact on other task(s)	WP 11/12: Tasks 11.3.8, 12.2.8.
Technical Enabler(s)	TE6
Interactions SP/FP	FP5 (data integration via FP5 WP32)
Actor(s)	Timetable planner for the hand-over yard, active Timetable planner for adjacent lines, passive Yard Manager – YM, passive Terminal Manager -TM, passive Train driver, passive RU, passive
Notes	Time perspective for this use case is about 1 month before day of operation. An initial track allocation plan is assumed to exist from the long-term planning.

7.15. UC-FP1-WP3-15 – YCS: Adjust track allocation plan according to changes from CMS

Name	YCS: Adjust track allocation plan according to changes from CMS
ID	UC-FP1-WP3-15
Partner	TRV A.E. RISE
Demonstration associated	Demo 7.2
Description	The timetable in the CMS is updated and the track allocation plan in YCS should be adjusted to match the updated timetable.
Related to task/subtask(s)	Tasks 4.5, 5.1, 5.2.4, 5.3
Impact on other task(s)	WP 11/12: Tasks 11.3.8, 12.2.8.
Technical Enabler(s)	TE6
Interactions SP/FP	FP5 (data integration via FP5 WP32)
Actor(s)	Timetable planner for the hand-over yard, active Timetable planner for adjacent lines, active Yard Manager – YM, passive Terminal Manager -TM, passive Train driver, passive RU, passive
Notes	Time perspective for this use case is about 1 month before day of operation. An initial track allocation plan is assumed to exist from the long-term planning.

7.16. UC-FP1-WP3-16 – YCS: Adjusted handling capacity of yard operations

Name	YCS: Adjusted handling capacity of yard operations
ID	UC-FP1-WP3-16
Partner	TRV A.E. RISE
Demonstration associated	Demo 7.2
Description	The short-term track allocation plan for the arrival/departure yard needs to be updated to match adjusted handling capacity of terminal operations or marshalling.
Related to task/subtask(s)	Tasks 4.5, 5.1, 5.2.4, 5.3
Impact on other task(s)	WP 11/12: Tasks 11.3.8, 12.2.8.
Technical Enabler(s)	TE6
Interactions SP/FP	FP5 (data integration via FP5 WP32)
Actor(s)	Timetable planner for the hand-over yard, active Timetable planner for adjacent lines, passive Yard Manager – YM, active Terminal Manager -TM, active Train driver, passive RU, passive
Notes	Time perspective for this use case is about 1 month before day of operation. An initial track allocation plan is assumed to exist from the long-term planning.

7.17. UC-FP1-WP3-17 – CMS decision supporter to plan a cross-border path

Name	CMS decision supporter to plan a cross-border path
ID	UC-FP1-WP3-17
Partner	MERMEC
Demonstration associated	Demo 1
Description	The planning operator performs a cross-border path request. All the involved CMSs harmonize the final timetable evaluating their local availability and TCRs.
Related to task/subtask(s)	Tasks 4.2, 5.2, 5.2.1
Impact on other task(s)	
Technical Enabler(s)	TE1
Interactions SP/FP	SP/RNE: cross-border topic
Actor(s)	RU CMS operators.
Notes	Forecast and Conflict detection/resolution module as output of WP17-WP18

7.18. UC-FP1-WP3-18 – Decision support for timetable planning with a temporary single-track section

Name	Decision support for timetable planning with a temporary single-track section
ID	UC-FP1-WP3-18
Partner	TRV A.E. LIU, NRD A.E. SINTEF
Demonstration associated	Demo 10.2
Description	A timetable planner needs support to make good decisions in case of a TCR. The TCR is of such magnitude that it has a significant impact on the traffic and will lead to large delays if we don't make a new plan. It is time-consuming to make temporary timetables which in practice often results in the trains running according to the original timetable, with delays. With an algorithm that returns a new timetable given the new prerequisites, the timetable planner could get input to which decisions to make according to some KPIs. Two TCRs of different characters will be analysed: 1) A TCR that is located on a double-track line where one of the tracks is closed, and 2) A TCR that is located on a single-track line where some part of the line has a speed reduction for all trains.
Related to task/subtask(s)	Tasks 6.3, 7.4
Impact on other task(s)	Task 8.3
Technical Enabler(s)	TE3
Interactions SP/FP	
Actor(s)	Timetable planners (at IMs)
Notes	

7.19. UC-FP1-WP3-19 – Decision support for constructing adjusted hourly timetables

Name	Decision support for constructing adjusted hourly timetables
ID	UC-FP1-WP3-19
Partner	NSR
Demonstration associated	Demo 10.1
Description	Preventive maintenance of the railway infrastructure necessitates the closure of some parts of the networks for a few days, forcing adjustments on the generic timetable. The problem of finding an adjusted timetable arises quite often: almost every weekend has maintenance works at multiple locations. The use case focuses on the cyclic case with a cycle time of 1 hour, i.e., the timetable is repeated every hour. In particular, it deals with producing a conflict-free adjusted hourly timetable (AHT) in which the services of the generic timetable may be adjusted be being fully cancelled, partially cancelled or shifted in time. The AHT is valid for duration of a given set of infrastructure maintenance works. Moreover, the maintenance works are scattered throughout the country and tend to affect the flow on multiple corridors of a highly inter-connected railway network. Therefore, it is desirable to consider the entire country's AHT, rather than splitting up the problem geographically.
Related to task/subtask(s)	Tasks 6.3, 7.4
Impact on other task(s)	
Technical Enabler(s)	TE3
Interactions SP/FP	
Actor(s)	Timetable planners (at RU and IM)
Notes	

7.20. UC-FP1-WP3-20 – Decision support for rolling stock stabling

Name	Decision support for rolling stock stabling
ID	UC-FP1-WP3-20
Partner	NSR
Demonstration associated	Demo 11.2
Description	We will demonstrate a decision support algorithm based on a construction and local search heuristic for constructing a rolling stock stabling plan for a railway node. The algorithm will be demonstrated on node Utrecht. Utrecht Central is the most central and busiest train station (both in terms of number of passengers and number of trains) of the Netherlands and has been found to be a hard nut to crack. The node of Utrecht has three stabling yards. The goal of the research is to improve the quality of the initial plan using more complicated logic which is tailored more towards the characteristics of the infrastructure of the node. It is also expected that the plans can be made more recognizable to planners. In the demonstrator, we will show that the test cases can be solved sufficiently quickly. Moreover, experienced node planners will assess the benefits of the proposed algorithm.
Related to task/subtask(s)	Tasks 6.4, 7.5
Impact on other task(s)	
Technical Enabler(s)	TE6
Interactions SP/FP	
Actor(s)	Node planners (at RU)
Notes	

7.21. UC-FP1-WP3-21 – Usability of an optimization-based decision support system for long term timetabling

Name	Usability of an optimization-based decision support system for long term timetabling
ID	UC-FP1-WP3-21
Partner	TRV A.E. RISE
Demonstration associated	Demo 8.2
Description	When constructing the annual timetable planners have to modify train paths to resolve conflicts. There are many ways that the train paths can be modified to obtain a conflict-free timetable, but planners rarely have time to explore different solutions as there are strict deadlines. There are optimization algorithms that could be used to support the planners, and this use-case focuses on how to make an interactive usable optimization-based decision support system. Specifically, the use-case considers a timetable planner who wants to solve the conflicts for a train, or a set of trains, in the long-term planning process.
Related to task/subtask(s)	Tasks 6.2, 7.3
Impact on other task(s)	
Technical Enabler(s)	TE4
Interactions SP/FP	
Actor(s)	Timetable planners (at IMs)
Notes	

7.22. UC-FP1-WP3-22 – Decision support for strategic timetabling

Name	Decision support for strategic timetabling
ID	UC-FP1-WP3-22
Partner	NSR
Demonstration associated	Demo 8.1
Description	For strategic timetabling, decision support algorithms that can optimize the trade-off between service quality and operational cost of a timetable need to be developed. In this use case, we focus on cyclic timetables with a cycle time of 1 hour. In addition, we want to minimize the total generalized travel time for all passengers together. This includes waiting time, in-train time and transfer time.
Related to task/subtask(s)	Tasks 6.2, 7.3
Impact on other task(s)	
Technical Enabler(s)	TE4
Interactions SP/FP	
Actor(s)	Timetable designers (at RUs/IMs)
Notes	

7.23. UC-FP1-WP3-23 – Decision support for strategic station routing

Name	Decision support for strategic station routing
ID	UC-FP1-WP3-23
Partner	DLR
Demonstration associated	Demo 8.1
Description	Network-level planning algorithms cannot guarantee that their generated timetables are viable when taking the microscopic station infrastructure into account. A timetable planner may, therefore, want to validate the feasibility on important station nodes before proceeding to the next stages of the timetabling process. For a given macroscopic timetable, we will demonstrate an algorithm that finds a robust station routing or reports its inability to do so. We also want to investigate whether this algorithm may return additional feedback to aid the network-level planning. Furthermore, when provided with predefined infrastructure variants containing small modifications (e.g., an additional switch), the algorithm will be able to assess their benefit for implementing the specific given timetable.
Related to task/subtask(s)	Tasks 6.2, 7.3
Impact on other task(s)	
Technical Enabler(s)	TE4
Interactions SP/FP	
Actor(s)	Timetable designers (at RUs/IMs)
Notes	

7.24. UC-FP1-WP3-24 – Decision support for tactical timetabling

Name	Decision support for tactical timetabling
ID	UC-FP1-WP3-24
Partner	NRD A.E. SINTEF
Demonstration associated	Demo 8.1
Description	In this Use Case, we will focus on one or more lines in Norway, where we will generate new timetables from scratch using an interactive approach. Route planners will be able to add one or more train services at a time and decide their periodicity. The algorithm will employ the concept of quasi-periodic timetabling, where we allow small deviations from the very restrictive periodic departures, while guaranteeing a perfectly periodic published timetable for the passengers.
Related to task/subtask(s)	Tasks 6.2, 7.3
Impact on other task(s)	
Technical Enabler(s)	TE4
Interactions SP/FP	
Actor(s)	Timetable designers (at RUs/IMs)
Notes	

7.25. UC-FP1-WP3-25 – Using timetable optimizer and decision support for STP

Name	Using timetable optimizer and decision support for STP
ID	UC-FP1-WP3-25
Partner	HACON
Demo associated	Demo 9
Description	The national CMS planning application demonstrates the Use of a timetable optimiser as a part of a decision support module for timetable adjustments (STP). The following sub-Use Cases are covered: 1. Introduction of new or changed paths triggering the need for re-optimization of the capacity plan; 2. Introduction of new or changed TCRs triggering the need for re-optimization of the capacity plan; 3. Studying an optimized plan before implementing the change in the plan (decision support module); 4. Synchronization of the resulting optimized plan update with TMS;
Related to task/subtask(s)	Tasks 6.3.1, 7.4.2
Impact on other task(s)	TBD
Technical Enabler(s)	TE3
Interactions SP/FP	
Actor(s)	CMS operator TMS operator
Notes	

7.26. UC-FP1-WP3-26 – Decision support for timetabling by conflict detection and resolution (CDR) algorithms

Name	Decision support for timetabling by conflict detection and resolution (CDR) algorithms.
ID	UC-FP1-WP3-26
Partner	INDRA
Demo associated	Demo 10.4
Description	The objective is to develop a decision tool that identify the conflicts that arise after perturbations and generate a new free-conflict timetable without modifying the commercial timetable. The conflict detection and resolution (CDR) software offers a list of possible resolution methods for specific conflict types (such as crossing conflict) and the planner can choose among them in order to resolve these conflicts, modifying the timetable. The following sub use cases are covered: 4. Create a TSR in a track that affects the capacity of the network 5. Create a possession in a track 6. Changes in train-paths in the timetable schedule motivated by exceptional situations 7. Create new train-paths in the timetable schedule
Related to task/subtask(s)	Tasks 6.3.1, 7.4.1, 7.4.3
Impact on other task(s)	
Technical Enabler(s)	TE3
Interactions SP/FP	
Actor(s)	Timetable planners (at RU and IM)
Notes	

7.27. UC-FP1-WP3-27 – Use of timetable optimizer and decision support for STP

Name	Use of timetable optimizer and decision support for STP
ID	UC-FP1-WP3-27
Partner	Hitachi/NRD A.E. SINTEF
Demo associated	Demo 10.5
Description	The software component developed by Hitachi/SINTEF will demonstrate functionalities for optimizing timetables in the Short-term Period (from one day to one year ahead) taking into account TCRs, new trains requests and network characteristics. It will be configured in the Genoa SCCM area, a plant currently in operation with a variety of cases including single and double track lines, the presence of route alternatives, and stations of significant complexity. The following possible sub-Use Cases are considered: 1. A scheduled work that completely interrupts a stretch of line or puts a station out of service for a period 2. An accidental event such as flooding of a station or derailment of a train. The trains must be redirected to an alternative route for a period of time that cannot be determined in advance 3. Interruption due to works on only one track of a double-track line 4. Changes to station layout, e.g., platform not available for a period 5. Add a new train to the timetable schedule, given specific constraints
Related to task/subtask(s)	Tasks 6.3.1, 7.4.3
Impact on other task(s)	
Technical Enabler(s)	TE3
Interactions SP/FP	
Actor(s)	Timetable planners (at RU and IM)
Notes	

7.28. UC-FP1-WP3-28 – Automatic rolling stock planning

Name	Automatic rolling stock planning
ID	UC-FP1-WP3-28
Partner	NRD A.E. SINTEF
Demonstration associated	Demo 11.1
Description	This Use Case is complementary to the Use Case UC-FP1-WP3-24 about long-term timetabling. For every new timetable generated in UC-FP1-WP3-7, we will compute an optimal (or almost optimal) rolling stock plan, with the objective of minimizing the number of locomotives necessary to fulfil the timetable.
Related to task/subtask(s)	Tasks 6.4, 7.5
Impact on other task(s)	
Technical Enabler(s)	TE6
Interactions SP/FP	
Actor(s)	Timetable planners (at RU)
Notes	

7.29. UC-FP1-WP3-29 – Optimized insertion of short-term train-paths into a predefined timetable

Name	Optimized insertion of short-term train-paths into a predefined timetable
ID	UC-FP1-WP3-29
Partner	SNCF and EMSE
Demonstration associated	Demo 10.3
Description	In this use-case, we will demonstrate algorithms which optimize the insertion of short-term train-paths (STTP) into a predefined timetable. We propose a global and integrated approach to address the problem by slightly reoptimizing train speed profiles, routes or platform assignments, without modifying the commercial timetable. The purpose is to showcase a global and integrated approach considering both regional and local views, taking as inputs the nominal timetable, the planned maintenance and works, and the requested STTPs. The output will be the modified timetable with as many as possible STTPs inserted within it. The validation will be done with the microscopic OSRD simulator provided by SNCF Réseau.
Related to task/subtask(s)	6.3
Impact on other task(s)	
Technical Enabler(s)	TE3
Interactions SP/FP	
Actor(s)	Regional and local timetable planners (at IM)
Notes	

7.30. UC-FP1-WP3-30 – Improved railway traffic simulation models for capacity evaluation of ETCS

Name	Improved railway traffic simulation models for capacity evaluation of ETCS
ID	UC-FP1-WP3-30
Partner	SNCF
Demonstration associated	Demo 13.2
Description	Simulation methods for capacity evaluation of different development aspects of ETCS, such as ETCS level 2 optimal braking and ETCS Hybrid level 3 Specific line to be determined according to the upcoming project at SNCF Reseau and the WP8/9 planning.
Related to task/subtask(s)	Tasks 8.4.1, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	TBD
Actor(s)	IMs, RUs (as a capacity applicants)
Notes	General considerations: • Future developments of ETCS need to be considered. • ETCS Hybrid L3 is not already defined, then a most appropriate set simulation parameters need to be defined.

7.31. UC-FP1-WP3-31 – Feedback loop from simulation to planning for large scale networks

Name	Feedback loop from simulation to planning for large scale networks
ID	UC-FP1-WP3-31
Partner	TRV A.E. KTH
Demonstration associated	Demo 12.1
Description	Railway traffic creates dependencies between trains running for long times and at different lines. To get a complete evaluation of the traffic, IMs need to be able to capture all these dependencies and perform stochastic traffic simulations in large networks. Microscopic models are at a high level-of-detail, which makes it complicated and time consuming to simulate traffic in large networks. There is a need for model with lower level-of-detail, that can handle large datasets but still give reliable results.
Related to task/subtask(s)	Tasks 8.3.1, 9.1
Impact on other task(s)	
Technical Enabler(s)	TE5
Interactions SP/FP	
Actor(s)	IMs and RUs (that want to evaluate current or future traffic)
Notes	The idea is to demonstrate the existing simulation tool PROTON in a Swedish use case and simulate a large network.

7.32. UC-FP1-WP3-32 – Historical data analysis to improve traffic simulations and traffic planning

Name	Historical data analysis to improve traffic simulations and traffic planning
ID	UC-FP1-WP3-32
Partner	TRV A.E. LU and SNCF
Demonstration associated	Demo 12.1 + Demo 12.3
Description	In stochastic simulations, primary delays are inserted to capture timetable performance indexes such as punctuality and arrival delay. To get accurate output from the simulations, it is important that the input is correct and corresponds to real world historical data. Therefore, we 1) need to perform analyses of historical data and 2) calibrate primary delay distributions, to turn the data into realistic disturbance distributions which can be used in operational railway simulations. In the use case, there are of two datasets, one Swedish and one French, that can be assessed in respective demonstrations.
Related to task/subtask(s)	Tasks 8.3.2, 9.1
Impact on other task(s)	
Technical Enabler(s)	TE5
Interactions SP/FP	
Actor(s)	IMs and RUs (performing stochastic simulations)
Notes	

7.33. UC-FP1-WP3-33 – Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – co-existence

Name	Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – co-existence
ID	UC-FP1-WP3-33
Partner	TRV A.E. VTI
Demonstration associated	Demo 13.7
Description	Develop a demonstrator in a train-driver simulator where the effects of a new ERTMS roll-out strategy can be studied. A method called co-existence (ERTMS marker boards and lineside signalling co-exist) will be implemented in the simulator, which includes parts of the Scandinavian Mediterranean corridor.
Related to task/subtask(s)	Tasks 8.4.1, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE 7
Interactions SP/FP	
Actor(s)	Train driver
Notes	

7.34. UC-FP1-WP3-34 – Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – normal ERTMS implementation strategy

Name	Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – normal ERTMS implementation strategy
ID	UC-FP1-WP3-34
Partner	TRV A.E. VTI
Demonstration associated	Demo 13.7
Description	Develop a demonstrator in a train-driver simulator where the effects of a standard ERTMS roll-out-strategy can be studied. In this strategy, lines are equipped with either lineside signalling or ERTMS marker boards (and in-cab signalling).
Related to task/subtask(s)	Tasks 8.4.1, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE 7
Interactions SP/FP	
Actor(s)	Train driver
Notes	

7.35. UC-FP1-WP3-35 – Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – special cases

Name	Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – special cases.
ID	UC-FP1-WP3-35
Partner	TRV A.E. VTI
Demonstration associated	Demo 13.7
Description	Develop a demonstrator in a train-driver simulator where the effects of a new ERTMS roll-out strategy can be studied. A method called co-existence (ERTMS marker boards and lineside signalling co-exists) will be implemented in the simulator, which includes parts of the Scandinavian Mediterranean corridor. Scenarios that include special cases are developed in order to be studied.
Related to task/subtask(s)	Tasks 8.4.1, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE 7
Interactions SP/FP	
Actor(s)	Train driver
Notes	

7.36. UC-FP1-WP3-36 – Generating plans through different inputs

Name	Generating plans through different inputs
ID	UC-FP1-WP3-36
Partner	CAF
Demonstration associated	Demo 13.4
Description	Through this use case, we want to be able to generate a plan, taking into account different parameters. One of the most important things to consider is the time of day or the area where the track is located in order to define through one or the other if the planning is done as a headway or as a timetable. This would be done as follows: • If we take into account the time of day, if it is an off-peak time, the planning will be by timetable and if it is a rush hour it will be done by headway. • If we take into account the space through which the track runs, the planning will be done in the following way: if it is an urban area, the planning will be by headway; if on the contrary it runs through an area of branch lines, the planning will be by timetable.
Related to task/subtask(s)	Tasks 8.3, 8.4, 9.1, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	FA6: FUTURE
Actor(s)	TMS Operator
Notes	

7.37. UC-FP1-WP3-37 – Validation of planning

Name	Validation of planning
ID	UC-FP1-WP3-37
Partner	CAF
Demonstration associated	Demo 13.4
Description	The objective of this use case is to validate the planning generated with the simulation environment to see if it meets the needs presented
Related to task/subtask(s)	Tasks 8.3, 8.4, 9.1, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	FA6: FUTURE
Actor(s)	• TMS Operator
Notes	

7.38. UC-FP1-WP3-38 – Planning simulation and acceptance

Name	Planification simulation and acceptance
ID	UC-FP1-WP3-38
Partner	CAF
Demonstration associated	Demo 13.4
Description	The objective of this use case is to compare different plans that have been generated and validated in steps before. Then the TMS operator will choose the one that best fits the needs and implement it.
Related to task/subtask(s)	Tasks 8.3, 9.1, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	FA6: FUTURE
Actor(s)	• TMS Operator
Notes	

7.39. UC-FP1-WP3-39 – Planning changes based on data analytics

Name	Planning changes based on data analytics
ID	UC-FP1-WP3-39
Partner	CAF
Demonstration associated	Demo 13.4
Description	The objective of this use case is to be able to make changes in the planning, generating a new one, based on the results obtained from the analysis of historical data that we have carried out through big data.
Related to task/subtask(s)	Tasks 8.3, 8.4
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	FA6: FUTURE
Actor(s)	TMS Operator
Notes	

7.40. UC-FP1-WP3-40 – System effects of different grades of automation

Name	System effects of different grades of automation
ID	UC-FP1-WP3-40
Partner	TRV A.E. KTH
Demonstration associated	Demo 13.6
Description	Analyse system effects of ATO with different grades of automation on selected lines on the Swedish and Norwegian national railway network with macro and micro simulation tools. Preliminary RailSys and PROTON will be used as tools. The lines will be of different types: single track/double track, mixed traffic/only passenger/mainly freight and urban/rural environments.
Related to task/subtask(s)	Tasks 8.4.2, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	FP2 WP32
Actor(s)	IMs and RUs
Notes	

7.41. UC-FP1-WP3-41 – System effects of DATO concepts

Name	System effects of DATO concepts
ID	UC-FP1-WP3-41
Partner	ProRail
Demonstration associated	Demo 13.1
Description	Demonstrate by use cases the system effects of different DATO concepts, such as HL3 and ATO GoA2 or higher, on a corridor of the national railway network with a micro simulation tool.
Related to task/subtask(s)	Tasks 8.4, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE5, TE7
Interactions SP/FP	FP2 WP17: Next Generation Brake Systems with adhesion management functions – Phase 1: Demonstrator preparation and pre-validation FP2 WP32: DATO Assessment and Potential identification FP2 WP37: ETCS HL3 Deployment Strategies
Actor(s)	IMs and TOCs
Notes	

7.42. UC-FP1-WP3-42 – Feedback loops between crew plan and operation

Name	Feedback loops between crew plan and operation
ID	UC-FP1-WP3-42
Partner	NSR
Demonstration associated	Demo 12.2
Description	Determine the robustness of a crew plan using simulation modelling based on representative delay distributions
Related to task/subtask(s)	Task 8.3
Impact on other task(s)	Task 9.1
Technical Enabler(s)	TE5
Interactions SP/FP	
Actor(s)	Timetable designer/planner at RU
Notes	A new simulation software will be developed for this purpose. Existing crew planning tool will be modified and linking interfaces are built.

7.43. UC-FP1-WP3-43 – Assess the feasibility of a change in the network topology

Name	Assess the feasibility of a change in the network topology
ID	UC-FP1-WP3-43
Partner	INDRA
Demonstration associated	Demo 12.4
Description	In this use case we will demonstrate the performance of a capacity analysis tool with several topologies and timetables. In case of poor performance by simulating with a specific topology, the capacity tool is used to accurate identify bottlenecks that can be solve by topology changes. Iterative simulations with different topologies facilitate timetabling.
Related to task/subtask(s)	Tasks 8.3.1, 9.1
Impact on other task(s)	
Technical Enabler(s)	TE5
Interactions SP/FP	
Actor(s)	IMs and RUs
Notes	

7.44. UC-FP1-WP3-44 – Effects of C-DAS in capacity

Name	Effects of C-DAS in capacity
ID	UC-FP1-WP3-44
Partner	INDRA
Demonstration associated	Demo 13.3
Description	INDRA will evaluate the capacity of the infrastructure with new elements such as C-DAS and/or ETCS level 2. The objective is to analyse the changes in capacity with C-DAS.
Related to task/subtask(s)	Task 8.4.2, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	
Actor(s)	IMs and RUs
Notes	

7.45. UC-FP1-WP3-45 – Effects of introducing ETCS Hybrid Level 3 on lines with dense traffic

Name	Effects of introducing ETCS Hybrid Level 3 on lines with dense traffic
ID	UC-FP1-WP3-45
Partner	TRV A.E. KTH
Demonstration associated	Demo 13.6
Description	Analyse and compare the effect on capacity and operations on selected lines on the Swedish network by moving from ETCS L2 to a ETCS HL3 setup. The selected lines will be a subset of those used in UC-FP1-WP3-40. Deterministic simulation is first used to compute the effect on technical headways with varying combinations of virtual (HL3) block lengths. Further, stochastic simulation is used for assessing the effects on, e.g., capacity/robustness and punctuality.
Related to task/subtask(s)	Tasks 8.4.2, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	FP2 WP17/WP18
Actor(s)	IMs and RUs
Notes	

7.46. UC-FP1-WP3-46 – Simulation tool including the effect of communications and positioning to assess energy consumption and capacity

Name	Effects of C-DAS on energy consumption and capacity
ID	UC-FP1-WP3-46
Partner	CEIT
Demonstration associated	Demo 13.5
Description	Analyse the effects of C-DAS on operations (e.g., energy consumption, capacity, punctuality), taking into account the effects of on-board communication and positioning. Input on communications and positioning parameters comes from FP2.
Related to task/subtask(s)	Tasks 8.4.2, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	FP2 WP22/WP28
Actor(s)	IMs and RUs
Notes	

7.47. UC-FP1-WP3-47 – Effects from varying adhesion conditions and introducing new generation braking system

Name	Effects from varying adhesion conditions and introducing new generation braking system
ID	UC-FP1-WP3-47
Partner	TRV A.E. KTH
Demonstration associated	Demo 13.6
Description	Analyse the effects on capacity and operations (e.g., capacity, punctuality, robustness) under varying adhesion conditions and from introducing new generation braking system with improved adhesion management. The idea is to use a representative and suitable line for this use case, preferably one from the set of lines that will be used in UC-FP1-WP3-40. Deterministic simulation is used first to compute the effect on technical headways under conditions both with and without new generation braking system. Further, stochastic simulation, is used for assessing the effects on, e.g., capacity/robustness and punctuality. Input on brake parameter modelling comes from FP2.
Related to task/subtask(s)	Tasks 8.4.2, 9.2
Impact on other task(s)	
Technical Enabler(s)	TE7
Interactions SP/FP	FP2 WP17/WP18
Actor(s)	IMs and RUs
Notes	

8. SG1 – WP3 data availability for prototype environments

The following table summarizes the key information related to data availability for WP3 prototype environments. It identifies the required data for the execution of WP3 use cases, the data providers expected to feed this use cases. There will be a link to the project Research Data Management Plan, as this data need to be included on the document in the next phase of the project, where will be found more details about how this data will be managed within the project.
The table provides a clear and concise overview of the information, making it easy to reference and use as needed.

Table 4 – WP3 data availability for prototype environments

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP3-1	International late path request placed between X-8 and X-2	1. Network topology data, including speeds, signals etc 2. Timetable data	Trafikverket, NRD/Bane NOR
UC-FP1-WP3-2	International path request placed after X-2 and before X+12	1. Network topology data, including speeds, signals etc 2. Timetable data	Trafikverket, NRD/Bane NOR
UC-FP1-WP3-3	Showing and handling of impact of imported TCR	1. Network topology data, including speeds, signals etc 2. Timetable data	Trafikverket (under discussion), NRD/Bane NOR can be used as alternative
UC-FP1-WP3-4	Planning and allocation of capacity for different planning horizons	1. Network topology data, including speeds, signals etc 2. Timetable data	Trafikverket
UC-FP1-WP3-5	Data exchange between traffic management system (TMS) and local or national capacity management/planning	1. Network topology data, including speeds, signals etc 2. Timetable data	Trafikverket

Use case ID	Use case name	Data required for UC execution	Data provider
	system (CMS)		
UC-FP1-WP3-6	Data exchange between national capacity management/planning system (national CMS) and local, yard-based capacity management/planning system (local CMS)	1. Network topology data including Malmö yard, including speeds, signals etc 2. Timetable data	Trafikverket
UC-FP1-WP3-7	Cross-border ad hoc planning 1	1. Network topology data, including speeds, signals etc 2. Timetable data	1. Trafikverket 2. NRD/ BaneNor
UC-FP1-WP3-8	Cross-border ad hoc planning 2	1. Network topology data, including speeds, signals etc 2. Timetable data	1. Trafikverket 2. NRD/ BaneNor
UC-FP1-WP3-9	Cross-border ad hoc planning and simulation	1. Network topology data, including speeds, signals etc 2. Timetable data	1. Trafikverket 2. NRD/ BaneNor
UC-FP1-WP3-10	YCS: Update the initial A/D-yard plan	1. Real time TMS data 2. Yard topology data	Trafikverket
UC-FP1-WP3-11	YCS: Updated planned arrival times	1. Real time TMS data 2. Yard topology data	Trafikverket
UC-FP1-WP3-12	YCS: Wagons for outbound train not ready for departure on time	1. Real time TMS data 2. Yard topology data	Trafikverket
UC-FP1-WP3-13	YCS: New shunting need from YM	1. Real time TMS data 2. Yard topology data	Trafikverket

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP3-14	YCS: Cleanup of short-term track allocation plan	1. Yard topology data 2. Timetable data	Trafikverket
UC-FP1-WP3-15	YCS: Adjust track allocation plan according to changes from CMS	1. Yard topology data 2. Timetable data	Trafikverket
UC-FP1-WP3-16	YCS: Adjusted handling capacity of yard operations	1. Yard topology data 2. Timetable data	Trafikverket
UC-FP1-WP3-17	CMS decision supporter to plan a cross-border path	1. Topology data 2. Timetable data 3. Train characteristics 4. TCR	RFI
UC-FP1-WP3-18	Decision support for timetable planning with a temporary single-track section	1. Network topology data, including speeds, signals etc 2. Timetable data	1. Trafikverket 2. NRD/ BaneNor
UC-FP1-WP3-19	Decision support for constructing adjusted hourly timetables	1. Network topology data 2. Timetable data 3. TCR	NSR
UC-FP1-WP3-20	Decision support for rolling stock stabling	1. Network topology data 2. Timetable data 3. Rolling stock data	NSR
UC-FP1-WP3-21	Usability of an optimization-based decision support system for long term timetabling	1. Network topology data, including speeds, signals etc 2. Timetable data	1. Trafikverket 2. NRD/ BaneNor

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP3-22	Decision support for strategic timetabling	1. Network topology data, including travel times 2. Line plan 3. Expected passenger demand	NSR
UC-FP1-WP3-23	Decision support for strategic station routing	1. Network topology data of stations, including signals, speeds etc. 2. Line plan 3. Timetable data, including train types	NSR
UC-FP1-WP3-24	Decision support for tactical timetabling	1. Network topology data 2. Train characteristics (speed, stopping patterns, priorities, etc.)	Jernbanedirektorat(NRD)
UC-FP1-WP3-25	Using timetable optimizer and decision support for STP	1. Network topology data, including speeds, signals etc 2. Timetable data	Trafikverket
UC-FP1-WP3-26	Decision support for timetabling by conflict detection and resolution (CDR) algorithms.	1. Topology data 2. Timetable data 3. Train characteristics	Indra
UC-FP1-WP3-27	Use of timetable optimizer and decision support for STP	1. Network topology data 2. Train characteristics (speed, stopping patterns, priorities, etc.) 3. Timetable data 4. TCRs	Hitachi Rail (STS), Rete Ferroviaria Italiana (RFI)
UC-FP1-WP3-28	Automatic rolling stock planning	1. Network topology data 2. Train characteristics (speed, stopping patterns, priorities, etc.) 3. Timetable data	Jernbanedirektorat(NRD), some timetable data maybe generated by SINTEF.

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP3-29	Optimized insertion of short-term train-paths into a predefined timetable	1. Network topology data (microscopic) including speeds, signals, ... 2. Timetable data 3. Timetable trains and train demand characteristics (departure and arrival times, speed, margins, rolling stock, stopping patterns, ...)	SNCF
UC-FP1-WP3-30	Improved railway traffic simulation models for capacity evaluation of ETCS	1. Scheme Plan 2. Trains ETCS braking characteristics	SNCF
UC-FP1-WP3-31	Feedback loop from simulation to planning for large scale networks	1. Network topology data, including speeds, signals etc 2. Timetable data	Trafikverket
UC-FP1-WP3-32	Historical data analysis to improve traffic simulations and traffic planning	1. Timetable data 2. Historical data (delay)	Trafikverket SNCF
UC-FP1-WP3-33	Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – co-existence	1. Network topology data, including speeds, signals, signs, etc	Trafikverket
UC-FP1-WP3-34	Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – normal ERTMS implementation strategy	1. Network topology data, including speeds, signals etc	Trafikverket
UC-FP1-WP3-35	Demonstrate effect of ETCS level 2 roll-out strategy in terms of drivability, capacity and safety – special cases.	1. Network topology data, including speeds, signals etc	Trafikverket
UC-FP1-WP3-36	Generating plans through	1. Network topology data, including speeds, signals etc	CAF

Use case ID	Use case name	Data required for UC execution	Data provider
	different input	2. Rolling Stock	
UC-FP1-WP3-37	Validation of planning	1. Planning generated in UC-FP1-WP3-7	CAF
UC-FP1-WP3-38	Planification simulation and acceptance	1. Planning validated in UC-FP1-WP3-8	CAF
UC-FP1-WP3-39	Planning changes based on data analytics	1. Historical data 2. Actual planning	CAF
UC-FP1-WP3-40	System effects of different grades of automation	1. Network topology data, including speeds, signals etc 2. Timetable data	1. Trafikverket 2. NRD/ BaneNor
UC-FP1-WP3-41	System effects of DATO concepts	1. Microscopic model of to be defined line. Accompanying timetable. Parameters for modelling the DATO tech.	ProRail
UC-FP1-WP3-42	Feedback loops between crew plan and operation	1. Timetable data 2. Rolling stock schedule 3. Macroscopic infrastructure data 4. Crew duties All data has to be from the same period	NSR
UC-FP1-WP3-43	Assess the feasibility of a change in the network topology	1. Topology data 2. Timetable data 3. Train characteristics	Indra
UC-FP1-WP3-44	Effects of C-DAS in capacity	1. Topology data 2. Timetable data 3. Train characteristics	Indra
UC-FP1-WP3-45	Effects of introducing ETCS	1. Network topology data, including speeds, signals etc	Trafikverket

Use case ID	Use case name	Data required for UC execution	Data provider
	Hybrid Level 3 on lines with dense traffic	2. Timetable data 3. Delay distributions for stochastic simulation	
UC-FP1-WP3-46	Effects of C-DAS on energy consumption and capacity	1. Network topology 2. Timetable data 3. Rolling stock data	ADIF
UC-FP1-WP3-47	Effects from varying adhesion conditions and introducing new generation braking system	1. Network topology data, including speeds, signals etc 2. Timetable data 3. Delay distributions for stochastic simulation	Trafikverket

9. SG2 – WP10 Use Cases

The use cases, identified in MOTIONAL WS1.2, are shown in the table below. Each use case is linked with the reference WPs pair (WP11-12 Integration of TMSs and processes including cross-border traffic management, WP13-14 Improved resilience and efficiency of disruption management, WP15-16 Linking TMS to ATO/C-DAS for optimised operations, WP17-18 Automated decisions and decision support for traffic management optimisation).

The specific outcomes for WS1.2 stated in the GA are listed below:

- Create a harmonized cross-border traffic management system supported by the future European TMS. The objective is to integrate and develop interoperable processes and interfaces between TMS and other resource management systems, ensuring efficient cross-border traffic within and between Infrastructure Managers, while also handling short-term planning, incidents, disruptions, yard and station management, electric traction systems, and rolling stock and crew scheduling.
- Focus on creating a cooperative multi-actor planning and decision support system for managing major railway incidents and disruptions. It aims to enhance system resilience and efficiency through innovative network management processes, decision support systems, and an advanced web-based HMI. This system enables interaction with various actors, including railway asset maintenance and utilizes AI and Machine Learning for context-aware decision-making.
- Develop decision support for C-DAS and ATO operations by seamlessly integrating TMS with ATO/C-DAS while considering human factors. The process involves assuring the functionality of TMS and ATO/C-DAS individually, gradually adding new features. This will be tested in simulations and live environments using tools and methodologies that realistically depict future ATO/C-DAS performance with human involvement.

Use Case Id	Use Case Name	WP	Responsible partners
UC-FP1-WP10-01	Information exchange for Automatic Route Setting (ARS)	11-12	ATSA
UC-FP1-WP10-02	Information exchange for Monitor & Control Train	11-12	ATSA
UC-FP1-WP10-03	Monitor & Control the field elements	11-12	ATSA
UC-FP1-WP10-04	Support for trans-border travel related decisions for station operator	11-12	PKP
UC-FP1-WP10-05	Detail train timetable for energy saving, ATO-TS	11-12	STS
UC-FP1-WP10-06	Information exchange between TMS and C-DAS TS	11-12	INDRA
UC-FP1-WP10-07	Cooperative conflict resolution (Two TMSs)	11-12	MERMEC
UC-FP1-WP10-08	Exchanging real-time train data regarding the border stations.	11-12	MERMEC
UC-FP1-WP10-09	Short-term maintenance needs or accidental situation which requires a pre-alignment of the train journey parts	11-12	ADIF
UC-FP1-WP10-10	Sending and Receiving train running forecast	11-12	HACON

	information		
UC-FP1-WP10-11	Pre-aligned decisions cross-border	11-12	HACON
UC-FP1-WP10-12	Consider constraints or needs of integrated processes and related systems integrated	11-12	HACON
UC-FP1-WP10-13	Train running forecast of the TMS improved by integration of TMS with systems and processes related to yard, station and so on	11-12	ADIF
UC-FP1-WP10-14	Planning and/or management of systems and processes using information received from the TMS	11-12	ADIF
UC-FP1-WP10-15	Sending and Receiving track allocation information between TMS and YCS	11-12	TRV
UC-FP1-WP10-16	Notifying TMS and YCS operators about disruptions and request	11-12	TRV
UC-FP1-WP10-17	IAMS interface	11-12	CEIT
UC-FP1-WP10-18	Involving multi-actors in decision making	13-14	HACON
UC-FP1-WP10-19	Critical alarm management	13-14	STS
UC-FP1-WP10-20	Short-term management of a possible asset failure	13-14	STS
UC-FP1-WP10-21	Preventive functional assessment (PFA)	13-14	STS
UC-FP1-WP10-22	Disruption management and activation of emergency services.	13-14	ADIF
UC-FP1-WP10-23	Disruption management and activation of a maintenance intervention	13-14	ADIF
UC-FP1-WP10-24	Solving of Rolling stock dispatching conflicts using reserves and swaps	13-14	NSR
UC-FP1-WP10-25	Proactive solving of macro tasks for crew dispatching	13-14	NSR
UC-FP1-WP10-26	Trespassing	13-14	TRV/VTI
UC-FP1-WP10-28	Infrastructure problems detected by railway staff	13-14	TRV/VTI
UC-FP1-WP10-30	Train Path Envelope calculation	15-16	PR
UC-FP1-WP10-31	TMS-ATO feedback loop	15-16	PR
UC-FP1-WP10-32	TMS-ATO operation interactions between human actors in different conditions	15-16	PR
UC-FP1-WP10-33	TMS enhancements to support C-DAS operations	15-16	INDRA
UC-FP1-WP10-34	C-DAS simulator	15-16	CEIT
UC-FP1-WP10-35	RTTP-updates to increase C-DAS efficiency	15-16	TRV
UC-FP1-WP10-36	Traffic regulation based on the time of the day	15-16	CAF
UC-FP1-WP10-37	Traffic regulation based in track areas	15-16	CAF
UC-FP1-WP10-38	Traffic regulation considering adhesion factors	15-16	CAF
UC-FP1-WP10-39	ATO-TMS integration	15-16	AZD
UC-FP1-WP10-40	Performances comparison between C-DAS and C-DAS-O architectures	15-16	STS
UC-FP1-WP10-41	Notification of conflict	17-18	ÖBB-INFRA
UC-FP1-WP10-42	Presentation of notification	17-18	ÖBB-INFRA
UC-FP1-WP10-43	Presentation of additional information on conflict	17-18	ÖBB-INFRA

UC-FP1-WP10-44	Resolution of conflict	17-18	ÖBB-INFRA
UC-FP1-WP10-45	Automatic Conflict Detection and Resolution using AI applied to Depots and Terminal Stations environment	17-18	ENYSE
UC-FP1-WP10-46	Optimized conflict resolution based on realistic forecast calculation	17-18	HACON
UC-FP1-WP10-47	Automated very short-term decision making for real time operation for departing train	17-18	GTSD
UC-FP1-WP10-48	Automated very short-term decision making for real time operation to keep sequence	17-18	GTSD
UC-FP1-WP10-49	Operator notification in case of automated very short-term decision making	17-18	GTSD
UC-FP1-WP10-50	For real time operation system must request movement authorities	17-18	GTSD
UC-FP1-WP10-51	Optimized conflict detection and resolution	17-18	STS
UC-FP1-WP10-52	Train that cannot continue on its route	17-18	FS
UC-FP1-WP10-53	Dispatcher constraints entry	17-18	FS
UC-FP1-WP10-54	Ability to provide multiple solutions	17-18	AZD
UC-FP1-WP10-55	Real-time operation of algorithm	17-18	AZD
UC-FP1-WP10-56	Automatic Conflict detection and resolution	17-18	INDRA
UC-FP1-WP10-57	Decision support system for different conflicts	17-18	INDRA
UC-FP1-WP10-58	Conflict detection and resolution	17-18	MERMEC
UC-FP1-WP10-59	Very short-term decision	17-18	MERMEC
UC-FP1-WP10-60	Evaluation platform	17-18	SNCF
UC-FP1-WP10-61	Test bed for local TMS evaluation	17-18	SNCF

Table 5: MOTIONAL WS1.2 Use Cases list

9.1. UC-FP1-WP10-01 – Information exchange for Automatic Route Setting (ARS)

Name	Information exchange for Automatic Route Setting (ARS)
ID	UC-FP1-WP10-01
Partner	ATSA
Demo associated	Demo 1 (task 12.2.1)
Description	Communication between TMS providing the trip info via Integration Layer (IL) and the CTC System to set the route in the automatic way (ARS). The TMS constantly updates the operational Timetable (TT) on the Integration Layer adopting it to the changing traffic situation. CTC System uses it to set routes for individual trains in the automatic way based on the trip info out of operational TT taking it from IL.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.1, 12.2.1
Impact on other task(s)	None
Technical Enabler(s)	TE 8 - “Real-time connection of rail networks as managed by TMSs and involved actors”.
Interactions SP/FP	SP Interaction
Actor(s)	Initiator: TMS / TMS Operator. Other systems involved: CTC System, Integration Layer.
Sequence	1. The operational timetable including trips of many trains is being published by the TMS on Integration Layer. 2. All registered subscribers (including CTC System) of timetable information are notified about timetable change. 3. The CTC System takes decision if the change is important from its perspective and specify filter criteria to indicate which part of the whole timetable needs to be taken from IL. 4. CTC System continues operation according to new / modified timetable.
Notes	None

9.2. UC-FP1-WP10-02 – Information exchange for Monitor & Control Train

Name	Information exchange for Monitor & Control Train
ID	UC-FP1-WP10-02
Partner	ATSA
Demo associated	Demo 1 (task 12.2.1)
Description	Communication between CTC System providing interlocking and RBC info about train to the TMS system via the Integration Layer. CTC System publishes constantly train status information / blocks occupancies received from RBC / interlocking on Integration Layer. TMS accesses Integration Layer and uses this information to optimize operational timetable.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.1, 12.2.1
Impact on other task(s)	None
Technical Enabler(s)	TE 8 - “Real-time connection of rail networks as managed by TMSs and involved actors”.
Interactions SP/FP	SP interaction
Actor(s)	Initiator: CTC System that receives information from Interlocking/RBC. Other systems involved: TMS, Integration Layer.
Sequence	1. CTC System periodically while the train moves publishes train status information on Integration Layer. 2. Information is stored on IL. 3. Registered subscribers are notified about updated train status by IL. 4. The information is processed, and operational timetable is updated if applicable by the TMS.
Notes	None

9.3. UC-FP1-WP10-03 – Monitor & Control the field elements

Name	Monitor & Control the field elements
ID	UC-FP1-WP10-03
Partner	ATSA
Demo associated	Demo 1 (task 12.2.1)
Description	Information about restrictions, limitations, maintenance activities available on Integration Layer are provided to CTC and TMS systems. External systems publish information to Integration Layer about restrictions / limitations like speed restriction, adhesion restriction, power restriction or maintenance activities. CTC System and TMS can use it to include it in the route setting or updating operational timetable.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.1, 12.2.1
Impact on other task(s)	None
Technical Enabler(s)	TE8 - "Real-time connection of rail networks as managed by TMSs and involved actors". TE10 - "Integration of TMS with a) yard management system and processes; b) station management system and processes; c) energy management (Electric Traction System); d) real-time crew / rolling stock dispatching".
Interactions SP/FP	SP interaction
Actor(s)	Initiator: Systems publishing infrastructure restrictions, to IL; Other systems involved: CTC System, TMS, Integration Layer
Sequence	1. External system publishes on Integration Layer information about restriction / limitation like: speed restriction, adhesion restriction, power restriction, maintenance activity. 2. All registered subscribers are notified about new restriction defined and take proper action: a. CTC System can use the information in its Automatic Route Setting mechanisms. b. TMS can modify operational timetable.
Notes	None

9.4. UC-FP1-WP10-04– Support for trans-border travel related decisions for station operator

Name	Support for trans-border travel related decisions for station operator
ID	UC-FP1-WP10-04
Partner	PKP
Demo	Demo 2 (task 12.2.2)
Description	Trans-border transport availability is an important aspect when making decision regarding economic effectiveness of station operation. For ensuring effective decision-making process one needs to receive relevant data in accessible and well visualized form. Proposed use case is based on dashboards and relevant data processing and logic for helping to make an informed decision. For example, we can visualize areas (selected main cities) using geographical maps available from the stations within one or more legs of a trans-border journey.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.2, 12.2.2
Impact on other task(s)	None
Technical Enabler(s)	TE9 - **“**Modelling and decision support for cross-border traffic management”
Interactions SP/FP	FP3-IAM4RAIL/(WP14, WP15) where the asset management decision support systems for stations are being developed
Actor(s)	Station Operator, Data Lake service, DSS
Sequence	1. Accessing DSS. 2. Selection of appropriate station to analyse. 3. Setting how many target stations being analysed. 4. Setting parameters (geographical distance, maximum number of connections). 5. DSS generates dashboard with indicated accessibility network.
Notes	– System must analyse the trans-border travel availability for selected destination stations. – System shall visualise the information in readable way. – System must communicate with Data Lake to access necessary info on trans-border travel.

9.5. UC-FP1-WP10-05 - Detail train timetable for energy saving ATO-TS

Name	Detail train timetable for energy saving ATO-TS
ID	UC-FP1-WP10-05
Partner	STS
Demo associated	Demo 3 (task 12.2.3)
Description	Provide ATO-TS with a revision of the train timetable (as defined by CDM) that includes a time reference for intermediate timing points to optimize the train energy consumption.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.3, 12.2.3
Impact on other task(s)	FP1/WP5 (Task 15.4.4)
Technical Enabler(s)	TE8 - “Real-time connection of rail networks as managed by TMSs and involved actors”
Interactions SP/FP	None
Actor(s)	ATO-TS, TMS
Sequence	1. Acquisition of the operational plan. 2. Evaluation of the detailed train timetables. 3. Publishing of the detailed train timetables.
Notes	None

9.6. UC-FP1-WP10-06 – Information exchange between TMS and C-DAS TS

Name	Information exchange between TMS and C-DAS TS
ID	UC-FP1-WP10-06
Partner	INDRA
Demo associated	Demo 4 (task 12.2.4)
Description	Communication between TMS providing the trip information and C-DAS TS system.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.4, 12.2.4
Impact on other task(s)	FP1/WP16 (Task 16.3)
Technical Enabler(s)	TE8 - "Real-time connection of rail networks as managed by TMSs and involved actors"
Interactions SP/FP	None
Actor(s)	TMS, C-DAS TS
Sequence	1. Requirements review to define the exchange of information between TMS and C-DAS TS. 2. Definition of the exchange communication protocol (communication system, interfaces and flow). 3. Functional testing to verify accurate and timely information exchange. 4. Definition of the messages involved in the interfaces (Messages, information included in each message, timing of the messages, messages flow). 5. Continuous monitoring
Notes	None

9.7. UC-FP1-WP10-07 – Cooperative conflict resolution (Two TMs)

Name	Cooperative conflict resolution (Two TMSs)
ID	UC-FP1-WP10-07
Partner	MERMEC
Demo associated	Demo 5 (task 12.2.5)
Description	A train conflict solution shall consider also the possible choices taken by the TMS behind the border.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.5, 12.2.5
Impact on other task(s)	None
Technical Enabler(s)	TE8 - "Real-time connection of rail networks as managed by TMSs and involved actors" TE9 - "Modelling and decision support for cross-border traffic management"
Interactions SP/FP	SP/RNE: cross-border topic
Actor(s)	TMS/ TMS Operator
Sequence	1. TMS1 Operator chooses a conflict solution. 2. Conflict solution is sent to TMS 2. 3. TMS2 Operator accepts or rejects the proposal solution (and eventually adds a note). 4. When accepted the conflicts is solved in both the TMSs.
Involved components (System)	TMS Event Logger, TMS Deviation Detection module, TMS Forecast Calculation module, TMS Conflict Detection module, TMS Conflict Resolution module, TMS Operational Plan, Cooperative Interface.
Notes	Prerequisites: Two TMSs, current plans loaded and a conflict in the border common track present.

9.8. UC-FP1-WP10-08 - Exchanging real-time train data regarding the border stations

Name	Exchanging real-time train data regarding the border stations.
ID	UC-FP1-WP10-08
Partner	MERMEC
Demo associated	Demo 5 (task 12.2.5)
Description	The TMS shall be able to exchange train characteristic, issues, and forecast information with neighbour TMSs.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.5, 12.2.5
Impact on other task(s)	FP1/WP17-18 (Tasks 17.2.8, 18.2.8)
Technical Enabler(s)	TE8 - "Real-time connection of rail networks as managed by TMSs and involved actors" TE9 - "Modelling and decision support for cross-border traffic management"
Interactions SP/FP	SP/RNE: cross-border topic
Actor(s)	TMS
Sequence	1. A deviation for a cross border/area train is detected by the related module. 2. Forecast is updated for the above train. 3. Train information is sent to the neighbouring TMS by Cooperative module. 4. The neighbouring TMS updates its operational plan accordingly.
Involved components (System)	TMS Event Logger, TMS Deviation Detection module, TMS Forecast Calculation module, TMS Operational Plan, Cooperative Interface.
Notes	Prerequisites: Two TMSs, current plans loaded and at least a cross border/area train with delay.

9.9. UC-FP1-WP10-09 – Short-term maintenance needs or accidental situation which requires a pre-alignment of the train journey parts

Name	Short-term maintenance needs or accidental situation which requires a pre-alignment of the train journey parts
ID	UC-FP1-WP10-09
Partner	ADIF FM
Demo associated	Demo 6 (task 12.2.6) (Assumed by Hacon)
Description	Short-term maintenance needs or accidental situation detected. Exchange of information between TMSs. Pre-alignment between the parts of a journey including a border. Decision/alignment done before crossing the border.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.6, 12.2.6
Impact on other task(s)	None
Technical Enabler(s)	TE8 - "Real-time connection of rail networks as managed by TMSs and involved actors" TE9 - "Modelling and decision support for cross-border traffic management"
Interactions SP/FP	SP/RNE: cross-border topic
Actor(s)	TMS/TMS operator
Sequence	1. Starting point: train operating from TMS A to TMS B without incidences. 2. Short-term maintenance needs or accidental situation detected arising in the TMS A. 3. The TMS A informs about the change in the operation to the TMS B. 4. Pre-alignment between the parts of a journey including a border. 5. Alignment done before crossing the border.
Notes	This scenario can be also given with an incident in the area B controlled by the TMS B.

9.10. UC-FP1-WP10-10 – Sending and receiving train running forecast information

Name	Sending and Receiving train running forecast information
ID	UC-FP1-WP10-10
Partner	HACON
Demo associated	Demo 6 (task 12.2.6)
Description	The TMS shall be able to receive forecast information from other sources, e.g., a neighbouring TMS.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.6, 12.2.6
Impact on other task(s)	None
Technical Enabler(s)	TE8 - "Real-time connection of rail networks as managed by TMSs and involved actors"
Interactions SP/FP	SP/RNE: cross-border topic
Actor(s)	TMS/TMS Operator
Sequence	1. Train related to path started in foreign network. 2. Forecasted arrival time at handover point with local network received via TAF/TSI (e.g., by RNE/TIS or foreign TMS). 3. Forecast calculation in local TMS is triggered for the local fraction of the journey in accordance with the planned path (where possible). 4. Forecast result validated.
Notes	Preconditions: – a planned inbound cross-border freight path available in local TMS.

9.11. UC-FP1-WP10-11 – Pre-aligned decisions cross-border

Name	Pre-aligned decisions cross-border
ID	UC-FP1-WP10-11
Partner	HACON
Demo associated	Demo 6 (task 12.2.6)
Description	Aligning decisions by knowing capacity restrictions behind the border (until next node behind the border)
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.6, 12.2.6
Impact on other task(s)	None
Technical Enabler(s)	TE8 - "Real-time connection of rail networks as managed by TMSs and involved actors" TE9 - "Modelling and decision support for cross-border traffic management"
Interactions SP/FP	SP/RNE: cross-border topic
Actor(s)	TMS/TMS operator
Sequence	1. Train related to path started in local network. 2. Forecast calculation from current position to next node behind the border triggered (according to planned path). 3. Conflict with TCR behind the border is detected and shown. 4. Local dispatcher holds back the train on local network to maintain capacity in area towards the border until TCR is gone. 5. Forecast result validated.
Notes	Preconditions: – a planned outbound cross-border freight path available in local TMS. – a TCR with defined end time behind the border (neighbouring network) affecting the planned path.

9.12. UC-FP1-WP10-12 – Consider constraints or needs of integrated processes and related systems integrated

Name	Consider constraints or needs of integrated processes and related systems integrated
ID	UC-FP1-WP10-12
Partner	HACON
Demo associated	Demo 7 (task 12.2.7)
Description	Provide forecast / updated operational plan considering yard/station planning, digital maintenance planning, ETS simulation, crew/rolling stock assignment
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.7, 12.2.7
Impact on other task(s)	None
Technical Enabler(s)	TE10 - "Integration of TMS with a) yard management system and processes; b) station management system and processes; c) energy management (Electric Traction System); d) real-time crew / rolling stock dispatching"
Interactions SP/FP	FP3-IAM4RAIL: IAMS/DMPS integration for track maintenance information. FP5-TRANS4M-R: integration of yard capacity production
Actor(s)	TMS/TMS Operator, Operators of integrated systems
Sequence	1. Train related to path started in local network. 2. A TCR is imported/updated from track maintenance planning system DMPS (IAMS, FP3). 3. Forecast calculation from current position shows up with conflict(s) with the imported TCR. 4. TMS Operator adapts Operational Plan to solve the conflict(s). **a. Yard management system and processes** 5. Updated Operational Plan is sent to Yard Management System causing a conflict in a yard track for handling the train. 6. Conflict is solved by Yard Operator by adapting conflicting track reservations. **b. Station management system and processes** 7. Updated Operational Plan is sent to Station Management System causing a conflict in a depot /station track for handling or holding the train.

	8. Conflict is solved by Station Operator by adapting conflicting track reservations. **c. Energy management (Electric Traction System)** 9. Updated Operational Plan is sent to Electric Traction System (ETS) Simulator causing a power restriction conflict when train will depart from one of the next stops at a station. 10. Conflict is solved by ETS Simulator handing back the solution to TMS. 11. TMS is adapting operational plan followed by recalculation of the forecast. **d. Real-time crew dispatching** 12. Updated Operational Plan because of the delay, a conflict with a crew link for driver exchange, reflected by a Control Rule in the Operational Plan is detected and automatically solved by TMS by delaying the linked outbound train accordingly. 13. TMS automatically updates the Operational Plan followed by re-calculation of the forecast and sending updated Operational Plan to Crew Dispatching System. **e. Real-time rolling stock dispatching** 14. Updated Operational Plan because of the delay, a conflict with a rolling stock link for material exchange, reflected by a Control Rule in the Operational Plan is detected and automatically solved by TMS by delaying the linked outbound train accordingly. 15. TMS automatically updates the Operational Plan followed by re-calculation of the forecast and sending updated Operational Plan to Rolling Stock Dispatching System.
Notes	None

9.13. UC-FP1-WP10-13 – Trains running forecast of the TMS improved by integration of TMS with systems and processes related to yards, stations and so on

Name	Train running forecast of the TMS improved by integration of TMS with systems and processes related to yard or station management, asset/maintenance planning and management, real-time crew / rolling stock dispatching and electric traction systems.
ID	UC-FP1-WP10-13
Partner	ADIF FM (assumed by HACON)
Demo associated	Demo 7 (task 12.2.7)
Description	Input received from yard/station planning, digital maintenance planning, ETS simulation, crew/rolling stock assignment systems by the TMS. Calculation of the train running forecast by the TMS considering this information. Result, train running forecast improved.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.7, 12.2.7
Impact on other task(s)	None
Technical Enabler(s)	TE10 - "Integration of TMS with a) yard management system and processes; b) station management system and processes; c) energy management (Electric Traction System); d) real-time crew / rolling stock dispatching"
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator, Operators of integrated systems
Sequence	1. The local system (Yard Management system or Station Management System) sets an operation with impact on the track assignment for the train of the TMS. 2. Local system informs to the TMS of the change of track assignment. 3. The TMS adjusts the track assigned considering the information received from the local system.
Notes	None

9.14. UC-FP1-WP10-14 – Planning and/or management of systems and processes using information received from the TMS

Name	Planning and/or management of systems and processes related to yard or station management, asset/maintenance planning and management, real-time crew / rolling stock dispatching and electric traction systems taking into account the information received from the TMS
ID	UC-FP1-WP10-14
Partner	ADIF FM (assumed by HACON)
Demo associated	Demo 7 (task 12.2.7)
Description	The TMS sends to the other planning/management local systems (yard, stations, etc) info of updated train running forecast and/or updated operational plan. The local systems use this information.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.7, 12.2.7
Impact on other task(s)	None
Technical Enabler(s)	TE10 - "Integration of TMS with a) yard management system and processes; b) station management system and processes; c) energy management (Electric Traction System); d) real-time crew / rolling stock dispatching"
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator, Operators of integrated systems
Sequence	1. There is an update in the train´s operational plan due to updated train running forecast. 2. The TMS informs the local system on the update. 3. The local system takes into account the updated information received from the TMS to implement its actions.
Notes	None

9.15. UC-FP1-WP10-15 – Sending and receiving track allocation information between TMS and YCS

Name	Sending and Receiving track allocation information between TMS and YCS
ID	UC-FP1-WP10-15
Partner	TRV
Demo associated	Demo 8 (task 12.2.8)
Description	Trigger: Change(s) in track allocation for YCS. Results: The TMS operator has an updated view on track allocation that has impact on interaction with neighbouring area supervised and controlled by an YCS. The YCS Operator has an updated view on track allocation that has impact on interaction with neighbouring TMS area.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.8, 12.2.8
Impact on other task(s)	None
Technical Enabler(s)	TE10 - “Integration of TMS with a) yard management system and processes; b) station management system and processes; c) energy management (Electric Traction System); d) real-time crew / rolling stock dispatching”
Interactions SP/FP	FP5-TRANS4M-R
Actor(s)	TMS/TMS Operator, YCS/YCS Operator
Sequence	None
Notes	None

9.16. UC-FP1-WP10-16 – Notifying TMS and YCS operators about disruptions and requests

Name	Notifying TMS and YCS Operators about disruptions and requests
ID	UC-FP1-WP10-16
Partner	TRV
Demo associated	Demo 8 (task 12.2.8)
Description	Trigger: Spontaneous or operator-initiated deviation from plan. Results: Interactions between TMS and YCS Operators through their systems about disruptions and requests on changes in plan for track allocation.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.8, 12.2.8
Impact on other task(s)	None
Technical Enabler(s)	TE10 - “Integration of TMS with a) yard management system and processes; b) station management system and processes; c) energy management (Electric Traction System); d) real-time crew / rolling stock dispatching”
Interactions SP/FP	FP5-TRANS4M-R
Actor(s)	TMS/TMS Operator, YCS/YCS Operator
Sequence	None
Notes	None

9.17. UC-FP1-WP10-17 – IAMS interface

Name	IAMS interface
ID	UC-FP1-WP10-17
Partner	CEIT
Demo associated	Demo 9 (task 12.2.9)
Description	Definition and development of the Interface of the future autonomous Inspection Vehicle for the infrastructure (FP3) and its integration with the Intelligent Asset Management System (IAMS). To receive information about asset status and planned interventions and deliver allocated paths to execute inspections and interventions.
Related to WP(s)	WP11/12
Related to task/subtask(s)	Tasks 11.3.9, 12.2.9
Impact on other task(s)	Tasks 11.1 and 11.2 about development requirements and alignment
Technical Enabler(s)	TE10 - "Integration of TMS with a) yard management system and processes; b) station management system and processes; c) energy management (Electric Traction System); d) real-time crew / rolling stock dispatching"
Interactions SP/FP	FP3-IAM4RAIL
Actor(s)	TMS, IAMS, Inspection Vehicle
Sequence	1. IAMS requests the interventions of the Inspection Vehicle on specific track paths (to TMS or to inspection vehicle directly). • IAMS provides critical status alerts of the assets of the infrastructure to TMS. • Inspection Vehicle routes are set by TMS using the information received from IAMS and Inspection Vehicle location. • Inspection Vehicle receives the route for the intervention on the specific track. 2. Use of TMS is optional, a direct link between IAMS and Inspection Vehicle can be considered in case of lack of TMS.
Notes	None

9.18. UC-FP1-WP10-18 – Involving multi-actors in decision making

Name	Involving multi-actors in decision making
ID	UC-FP1-WP10-18
Partner	HACON
Demo associated	Demo 10 (task 14.1.2)
Description	Options for changes of the Operational Plan for addressing incidents and related conflict scenarios are shared and commented on by multiple actors including responsible RU and maintenance staff (MMS Operator)
Related to WP(s)	WP13/14
Related to task/subtask(s)	Tasks 13.2.3, 14.1.2
Impact on other task(s)	None
Technical Enabler(s)	TE 13 - "Cooperative planning multi-actors within rail". TE 14 - "Integration of incident management and customer information, with IM and RU interaction and Decision Support for Disruption management"
Interactions SP/FP	FP3-IAM4RAIL: IAMS/DMPS integration for track maintenance information
Actor(s)	TMS/TMS operator, involved RU, MMS Operator, CMS/ CMS User, IAMS
Sequence	1. A major incident causes an immediate blockage of a track section in TMS. 2. TMS Operator enters track blockage restriction in TMS leading to conflicts with running and planned trains. 3. TMS generates solution options for regulating today's trains conflicting with the track blockage. 4. TMS Operator accepts a solution and TMS implements Operational Plan change for today's trains accordingly. 5. CMS receives blockage restriction from TMS. 6. CMS users are starting to analyse the impact on planned trains for the next days. 7. CMS user registers accidental possession request for track repair and sent to IAMS (DMPS). 8. Accidental possession (including different track blockages and temporary speed restrictions for 4 days) is set-up for track repair in IAMS (DMPS) and sent to CMS/TMS.

	9. CMS users and involved RUs are replanning the impacted trains in CMS leading to introduction of a new resource link between two trains. 10. Replanning results in CMS (capacity plan updates) are sent back to TMS. 11. TMS is updating its Operational Plan accordingly. 12. The RU sends the new resource link to TMS/CMS for considering the knock-on effects of further plan changes or delays.
Notes	None

9.19. UC-FP1-WP10-19 – Critical alarm management

Name	Critical alarm management
ID	UC-FP1-WP10-19
Partner	STS
Demo associated	Demo 10 (task 14.1.2) and Demo 11 (Task 14.2)
Description	The CTC System Operator is supported to reduce the effort and stress required to manage critical events, by providing through the HMI different type of help (suggestion, useful info...) and supporting the critical event resolution
Related to WP(s)	WP13/14
Related to task/subtask(s)	Tasks 13.2 (13.2.1, 13.2.5), 13.5 (13.5.1, 13.5.2, 13.5.4)
Impact on other task(s)	Task *13.6 (13.6.1, 13.6.3), 14.1*
Technical Enabler(s)	TE 11 - **"**HMI for TMS based on User Experience (UX) Design and user input". TE 13 - "Cooperative planning multi-actors within rail". TE 14 - "Integration of incident management and customer information, with IM and RU interaction and Decision Support for Disruption management"
Interactions SP/FP	None
Actor(s)	CTC System Operator, IAMS, TMS, Integration Layer, the MMS Operator, the IM and all other subsystems/actors potentially involved into the provision of alarm and/or the implementation of the remediation, depending on the type of possible failure.
Sequence	1. The Integration Layer conveys an alarm to the system, which classifies it as critical or not by using the DSS. 2. If the event is critical, the DSS selects a series of countermeasures to be visualised to the operator. 3. The operator makes a decision and contacts the other actors for its implementation; 4. The effectiveness of the decision is assessed and sent back to the system in order to learn the quality of the DSS. 5. If the event is new or no remediation is included in the system, the Operator is required to make a decision and the system learns from such a decision.
Notes	All the interactions of the involved actors with the system are computer-based.

9.20. UC-FP1-WP10-20 – Short-term management of a possible asset failure

Name	Short-term management of a possible asset failure
ID	UC-FP1-WP10-20
Partner	STS
Demo associated	Demo 10 (task 14.1.2) and Demo 11 (Task 14.2)
Description	The system receives monitoring information, determines if it is a symptom of an upcoming failure of an asset and evaluates which is the preferable time window in which to plan intervention and the kind of intervention
Related to WP(s)	WP13/14
Related to task/subtask(s)	*Tasks 13.2 (13.2.2), 13.5 (13.5.1, 13.5.2)*
Impact on other task(s)	*Task 13.6 (13.6.1, 13.6.3), 14.1*
Technical Enabler(s)	TE 11 - **"**HMI for TMS based on User Experience (UX) Design and user input". TE 14 - "Integration of incident management and customer information, with IM and RU interaction and Decision Support for Disruption management"
Interactions SP/FP	FP3-IAM4RAIL/(WP 3-4)
Actor(s)	CTC System Operator, IAMS, TMS, Integration Layer, the MMS Operator, the IM and all other subsystems/actors potentially involved into the provision of alarm and/or the implementation of the remediation, depending on the type of possible failure.
Sequence	1. The Integration Layer conveys sensing data on assets to the system and TMS-related data and determines the probability of having a failure from IAMS. 2. If the failure probability is high, the DSS selects a series of countermeasures to be visualised to the operator and how to reschedule traffic. 3. The operator makes a decision and contacts the other actors for its implementation and TMS for traffic rescheduling. 4. The effectiveness of the decision is assessed and send back to the system in order to learn the quality of the DSS. 5. If the failing asset is new or no remediation is included in the system, the operator is required to make a decision and the system learns from such a decision.
Notes	All the interactions of the involved actors with the system are

	computer-based.

9.21. UC-FP1-WP10-21 – Preventive functional assessment (PFA)

Name	Preventive functional assessment (PFA)
ID	UC-FP1-WP10-21
Partner	STS
Demo associated	Demo 10 (task 14.1.2) and Demo 11 (Task 14.2)
Description	To cope with a lack of monitoring data for assets that are not used for a long period, preventive functional assessment needs to be conducted. The system continuously monitors the assets and support the CTC System Operator in identifying such assets and suggesting when the PFA needs to be done rearranging the railway traffic accordingly.
Related to WP(s)	WP13/14
Related to task/subtask(s)	*Tasks 13.2 (13.2.2), 13.5 (13.5.2)*
Impact on other task(s)	*Task 13.6 (13.6.1, 13.6.3), 14.1*
Technical Enabler(s)	TE 11 - **"**HMI for TMS based on User Experience (UX) Design and user input". TE 14 - "Integration of incident management and customer information, with IM and RU interaction and Decision Support for Disruption management"
Interactions SP/FP	FP3-IAM4RAIL/(WP 3-4)
Actor(s)	CTC System Operator, IAMS, TMS, DSS, Integration Layer, the MMS Operator, the IM and all other subsystems/actors potentially involved into the provision of alarm and/or the implementation of the PFA, depending on the type of asset to be assessed.
Sequence	1. The Integration Layer conveys sensing data on assets to the system and TMS-related data and determines which asset has been not monitored for a long period and a PFA is needed. 2. If an asset needs to be subject to PFA, the DSS selects a series of actions to be visualised to the operator and how to reschedule traffic. 3. The operator makes a decision and contacts the other actors for its implementation and TMS for traffic rescheduling. 4. The effectiveness of the decision is assessed and send back to the system in order to learn the quality of the DSS.

	5. If the asset for PFA is new or no actions has been found in the system, the operator is required to make a decision and the system learns from such a decision.
Notes	All the interactions of the involved actors with the system are computer-based.

9.22. UC-FP1-WP10-22 – Disruption management and activation of emergency services

Name	Disruption management and activation of emergency services.
ID	UC-FP1-WP10-22
Partner	ADIF FM
Demo associated	Demo 10 (task 14.1.2) (assumed by STS)
Description	When a failure in the train or the trackside is detected, the system shows on the IM Operator's HMI information about the failure occurred which is leading to the traffic disruption. Such information is acquired from TMS and/or sensors deployed at the assets. It is also indicated that an intervention is required, in particular, the need to activate emergency services/organisation.
Related to WP(s)	WP13/14
Related to task/subtask(s)	*Tasks 13.5 (13.5.1), 13.2 (13.2.1, 13.2.2, 13.2.3)*
Impact on other task(s)	*Tasks 13.6 (13.6.1, 13.6.3), 14.1*
Technical Enabler(s)	TE 13 - "Cooperative planning multi-actors within rail "; and TE 14 - "Integration of incident management and customer information, with IM and RU interaction and Decision Support for Disruption management ".
Interactions SP/FP	None
Actor(s)	IM Operator, TMS, TMS Manager,TMS Operator, Emergency Coordinator,
Sequence	1. TMS monitors and controls the traffic and the signalling systems. 2. From the monitoring of the state of trackside assets, the system receives information about a disruption due to an asset failure (train or infra failure). As a consequence of this, the traffic is interrupted in the line. The information is received/collected from different subsystems. 3. Alarm indication received by the operator. 4. System shows through the IM Operator's HMI info about failure type. 5. System shows through the HMI to the IM Operator info about the disruption if known (duration, train affected, section of the network affected). 6. To help in the making decision of the operator, System displays through the HMI suggestions/proposal of steps

	to follow to mitigate/resolve the situation as soon as possible. 7. The decision of activation of emergency services is made by the responsible managing the incident (alternative transport to transport passengers, shuttle service, trailer train to help the train).
Notes	Pre-Conditions: - TMS monitoring and controlling the traffic and the signalling systems. - Asset failure detected leading to a traffic disruption. - TMS capable of detecting (receiving the info from the monitoring of the sub-systems, even throughout an Alarm Dispatcher Module integrated in the TMS) and informing real-time incidents in the sub-systems to the IM Operators. Management of alarm indications. - Multi-actor workflow including decision negotiation and management. - HMI available to receive the reporting of information/suggestions.

9.23. UC-FP1-WP10-23 – Disruption management and activation of a maintenance intervention

Name	Disruption management and activation of a maintenance intervention
ID	UC-FP1-WP10-23
Partner	ADIF FM
Demo associated	Demo 10 (task 14.1.2) (assumed by STS)
Description	When a failure in the train or the trackside is detected, the IM system shows on the HMI information about the failure occurred which is leading to the traffic disruption. It is also indicated that an intervention is required, specifically a maintenance intervention (needed resources (people), expected duration, impact on traffic…).
Related to WP(s)	WP13/14
Related to task/subtask(s)	*Tasks 13.5 (13.5.1, 13.5.3), 13.2 (13.2.1, 13.2.2, 13.2.3*
Impact on other task(s)	*Tasks 13.6 (13.6.1, 13.6.3), 14.1*
Technical Enabler(s)	TE 13 - "Cooperative planning multi-actors within rail "; and TE 14 - "Integration of incident management and customer information, with IM and RU interaction and Decision Support for Disruption management ".
Interactions SP/FP	Not identified
Actor(s)	IM Operator, TMS/TMS Operator, MMS Manager and MMS Operator
Sequence	1. The IM system receives information about a disruption because of asset failure (train or infra failure). The traffic is interrupted in the affected section. This is detected by the monitoring of the different subsystems. 2. HMI shows to the CTC system operator info about failure and the proposal of steps which are needed to mitigate the problem. 3. DSS provides info of necessary maintenance tasks to mitigate the failure, including required resources (people, assets, ...), expected duration, impact on traffic. 4.
Notes	See UC-FP1-WP10-22: Disruption management and activation of emergency services.

9.24. UC-FP1-WP10-24 - Solving of Rolling stock dispatching conflicts using reserves and swaps

Name	Solving of Rolling stock dispatching conflicts using reserves and swaps
ID	UC-FP1-WP10-24
Partner	NSR
Demo associated	Demo 10 (Task 14.1)
Description	Conflicts in the rolling stock circulation of a railway operator are usually solved manually. We aim to develop an algorithm that can automatically solve such rolling stock circulation conflicts that result from disruptions. The input is the actual rolling stock schedule, a disruption and the corresponding modified timetable. The output is the adjusted rolling stock schedule.
Related to WP(s)	WP13/14
Related to task/subtask(s)	Task 13.2 (13.2.4), 14.1
Impact on other task(s)	None
Technical Enabler(s)	TE13 - “Cooperative planning multi-actors within rail”; and TE 14 - “Integration of incident management and customer information, with IM and RU interaction and Decision Support for Disruption Management ”.
Interactions SP/FP	None
Actor(s)	RU-rolling stock dispatcher
Sequence	1. Monitor conflicts in the rolling stock schedule. 2. Prioritize the conflicts based on impact. 3. Select conflict with highest impact and find solutions for this conflict by running the algorithm. 4. Evaluate the proposed solution.
Notes	None

9.25. UC-FP1-WP10-25 - Proactive solving of macro tasks for crew dispatching

Name	Proactive solving of macro tasks for crew dispatching
ID	UC-FP1-WP10-25
Partner	NSR
Demo associated	Demo 10 (Task 14.1)
Description	When conflicts in a driver/guard duty occurs, algorithms exist to help dispatchers solve these conflicts. Currently, these algorithms need manual triggering. We aim to move towards autonomous conflict solving by the system, under certain predefined conditions.
Related to WP(s)	WP13/14
Related to task/subtask(s)	Task 13.2 (13.2.4), 14.1
Impact on other task(s)	None
Technical Enabler(s)	TE 14 - “Integration of incident management and customer information, with IM and RU interaction and Decision Support for Disruption Management ”.
Interactions SP/FP	None
Actor(s)	RU-crew dispatcher
Sequence	1. Monitor conflicts. 2. Let the algorithm solve the conflicts. 3. Evaluate pro-active solution proposals from the algorithm. 4. Accept/decline solution proposals.
Notes	None

9.26. UC-FP1-WP10-26 - Trespassing

Name	Trespassing
ID	UC-FP1-WP10-26
Partner	TRV/VTI
Demo associated	Demo 11 (Task 14.2)
Description	Detection of one or more unauthorized persons entering the track area leading to a stop in traffic until the TMS Operator is able to confirm that the track is clear (of obstacles).
Related to WP(s)	WP13/14
Related to task/subtask(s)	Tasks 13.2, 13.3, 14.1, 14.2
Impact on other task(s)	None
Technical Enabler(s)	TE 11 - "HMI for TMS based on User Experience (UX) Design and user input".
Interactions SP/FP	None
Actor(s)	TMS/TMS operator, Emergency/rescue services, Train driver.
Sequence	1.Trespassing is detected (by a detection system or by a person). 2. The TMS Operator is informed that a trespassing occurs. 3. The affected area is protected from train traffic (automatically or by the TMS Operator). 4. The emergency/rescue services are contacted (if not already informed) and send to the area of interest. 5. The emergency/rescue services search the area and contact the TMS Operator when the track area is clear. 6. The track area is confirmed clear, and the traffic re-planned continues accordingly.
Notes	Trespassing causes a lot of delays and are today the main cause to injuries and deaths in the railway system. In this situation, the TMS Operator needs support to determine if the track area is clear. The use case includes human-machine interaction based on users' experience.

9.27. UC-FP1-WP10-28 - Infrastructure problems detected by railway staff

Name	Infrastructure problems detected by railway staff
ID	UC-FP1-WP10-28
Partner	TRV/VTI

Demo associated	Demo 11 (Task 14.2)
Description	The train driver (or other railway staff) notices something unusual and contacts the TMS Operator by voice communication system. Depending on the information given by the Train Driver the TMS Operator has to decide if the traffic can go on and under which conditions. In this situation, the TMS Operator needs support to determine how serious the problem is and which subsequent actions that are appropriate.
Related to WP(s)	WP13/14
Related to task/subtask(s)	Tasks 13.2, 13.3, 14.1, 14.2
Impact on other task(s)	None
Technical Enabler(s)	TE 11 - “HMI for TMS based on User Experience (UX) Design and user input”.
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator, Train driver, IM- Trackside staff
Sequence	1. A potential infrastructure failure is detected by a Train driver who contacts the TMS Operator. 2. The TMS Operator understands that actions are needed. 3. Traffic is protected within affected area. 4. The TMS Operator contacts maintenance personnel and initiates a new temporary Operational plan. 5. The TMS Operator is informed that the problem is solved and the TMS Operator re-plans accordingly.
Notes	In contrast to detected by any technical system. In this situation, the TMS Operator needs support from personnel at the suspected point of failure to determine how serious the problem is and which subsequent actions that are appropriate. *The use case includes human-machine interaction based on users’ experience.*

9.28. UC-FP1-WP10-30 - Train Path Envelope calculation

Name	Train Path Envelope calculation
ID	UC-FP1-WP10-30
Partner	PR
	Demo 12 (task 16.2), Demo 14 (task 16.4)
Description	Based on an RTTP received from the TMS, the ATO-TS computes TPEs for all connected trains with possibly additional Timing Points to guarantee conflict-free traffic, which are sent to the ATO-OBs of the connected trains.
Related to WP(s)	WP15/16
Related to task/subtask(s)	Tasks 15.3, 15.4, 16.2, 16.4.1
Impact on other task(s)	None
Technical Enabler(s)	TE 15 - “TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables”
Interactions SP/FP	FP2-R2DATO/(WP39)
Actor(s)	TMS/TMS Operator, ATO-TS
Sequence	1) TMS sends RTTP to ATO-TS 2) ATO-TS generates TPEs for all trains 2a) If there are conflicting TPEs then ATO-TS tries to resolve them 2b) If conflicts cannot be resolved for current RTTP, the TMS is warned 3) ATO-TS sends conflict-free TPEs within SPs and JP to all connected ATO-OB
Notes	None

9.29. UC-FP1-WP10-31 - TMS-ATO feedback loop

Name	TMS-ATO feedback loop
ID	UC-FP1-WP10-31
Partner	PR
Demo associated	Demo 12 (task 16.2), Demo 14 (task 16.4)
Description	The ATO-TS updates the TPEs based on Status Reports from the ATO-OBs or asks the TMS to provide a new RTTP based on infeasible TPEs instances.
Related to WP(s)	WP15/16
Related to task/subtask(s)	Tasks 15.3, 15.4, 16.2, 16.4.1
Impact on other task(s)	None
Technical Enabler(s)	TE 12 - “Real-time convergence between planning & feedback loop from operations [TRL 4/5].” TE 15 - “TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables”
Interactions SP/FP	FP2-R2DATO/(WP39)
Actor(s)	TMS/TMS Operator, ATO-TS, ATO-OB, Train driver
Sequence	1. ATO-TS receives status reports from TMS or from ATO-OB 2a. For ATO-OB updates: ATO-TS updates TPEs. 2b. If no feasible TPE can be generated, TMS is warned to update RTTP. 2c. For infeasible TPEs: TMS generates and sends updated RTTP to ATO-TS. 3. For RTTP update: ATO-TS updates TPEs (see UC-FP1-WP10-28) 4. ATO-TS sends updated conflict-free TPEs within SPs and SP to all ATO-OBs.
Notes	None

9.30. UC-FP1-WP10-32 - TMS-ATO operation interactions between human actors in different conditions

Name	TMS-ATO operation interactions between human actors in different conditions
ID	UC-FP1-WP10-32
Partner	PR
Demo associated	Demo 12 (task 16.2), Demo 14 (task 16.4)
Description	Actions by and HF impact of human operators (i.e. Train drivers, CTC System Operators, TMS Operator) when using ATO-TMS
Related to WP(s)	WP15/16
Related to task/subtask(s)	Tasks 15.3, 15.4, 16.2, 16.4
Impact on other task(s)	None
Technical Enabler(s)	TE 12 - "Real-time convergence between planning & feedback loop from operations [TRL 4/5]." TE 15 - "TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables"
Interactions SP/FP	FP2-R2DATO/(WP32), FP2-R2DATO/(WP39)
Actor(s)	TMS/TMS Operator, ATO-TS, ATO-OB, CTC System Operator, Train Driver
Sequence	1. Interactions in normal conditions. 2. Interactions in disturbed conditions (small delays). 3. Interactions in disrupted conditions (changed services).
Notes	None

9.31. UC-FP1-WP10-33 - TMS enhancements to support C-DAS operations

Name	TMS enhancements to support C-DAS operations
ID	UC-FP1-WP10-33
Partner	INDRA
Demo associated	Demo 13 (Task 16.3)
Description	Analysis of improvements in the TMS operation based on the data provided by C-DAS.
Related to WP(s)	WP15/16
Related to task/subtask(s)	Task 16.3
Impact on other task(s)	None
Technical Enabler(s)	TE 12 - “Real-time convergence between planning & feedback loop from operations [TRL 4/5].” TE 15 - “TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables”
Interactions SP/FP	FP2-R2DATO
Actor(s)	TMS/TMS Operator
Sequence	1. TMS receives Status Report (SR) from C-DAS TS. 2. TMS optimises their operation through forecast calculation using Status Report (SR) 3. TMS operator manually replans in short term (a new RTTP is generated and sent to C-DAS TS).
Notes	None

9.32. UC-FP1-WP10-34 - C-DAS simulator

Name	C-DAS simulator
ID	UC-FP1-WP10-34
Partner	CEIT
Demo associated	Demo 13 (Task 16.3)
Description	Improved simulation environment to improve efficiency of C-DAS operations considering the interaction with the TMS (received RTTP) and the effect of the OBT2S communications, on-board location estimation and energy optimisation on the JP/TPE calculation.
Related to WP(s)	WP15/16
Related to task/subtask(s)	Task 15.3 and 16.3
Impact on other task(s)	None
Technical Enabler(s)	TE 15 - “TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables”
Interactions SP/FP	FP2-R2DATO
Actor(s)	TMS, C-DAS TS, C-DAS OB
Sequence	In a simulation environment: 1. C-DAS TS receives RTTP 2. From the RTTP, C-DAS TS generates JP/TPEs for the trains 3. C-DAS OB calculates improved train trajectories with the JP received from C-DAS TS taking into account positioning accuracy and communications performance. 4. Status reports are sent back to C-DAS TS and JP/TPEs are updated
Notes	The actors C-DAS TS and C-DAS OB are both simulated

9.33. UC-FP1-WP10-35 - RTTP-updates to increase C-DAS efficiency

Name	RTTP-updates to increase C-DAS efficiency
ID	UC-FP1-WP10-35
Partner	TRV
Demo associated	Demo 13 (Task 16.3)
Description	Provides support for updating the RTTP, manually and/or to some extent automatically, based on feedback from C-DAS TS/C-DAS OB to improve the quality of the RTTP and optimize the overall efficiency of traffic management.
Related to WP(s)	WP15/16
Related to task/subtask(s)	Tasks 15.3, 16.3
Impact on other task(s)	None
Technical Enabler(s)	TE 12 - "Real-time convergence between planning & feedback loop from operations [TRL 4/5]." TE 15 - "TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables"
Interactions SP/FP	SP interaction
Actor(s)	TMS/TMS Operator, C-DAS TS, C-DAS OB, Train Driver
Sequence	1. The TMS Operator turns on functionality for "improve C-DAS planning". 2. C-DAS TS calculates if there are inefficiencies in the current RTTP for the C-DAS trains. When inefficiencies are detected, continue with next step. 3. C-DAS TS calculates an updated proposed RTTP (p-RTTP). 4. TMS illustrates relevant parts of p-RTTP, together with other relevant information 5. TMS Operator inspects p-RTTP and determine if and how RTTP should be adjusted. 6. The TMS Operator updates the RTTP. Minor modifications of RTTP might be made automatically without any explicit acceptance from TMS operator. 7. From the updated RTTP, C-DAS TS generates updated JP/TPE for each train. The TMS might present some result from the JP for the TMS Operator. 8. C-DAS TS sends JP to C-DAS OB which calculate the train trajectory. 9. Information on how the train will fulfil the JP is sent back to C-DAS TS and the TMS together with information if the JP was fulfilled or not.

	10. The TMS presents the information for the TMS Operator and gives tools to update the RTTP if needed.
Notes	The actors C-DAS OB and Train Driver can both be simulated and real system and driver.

9.34. UC-FP1-WP10-36 – Traffic regulation based on the time of the day

Name	Traffic regulation based on the time of the day
ID	UC-FP1-WP10-36
Partner	CAF
Demo associated	Demo 15 (task 16.5)
Description	In this use case, the regulation of transport in the face of possible disturbances will be defined by the time, whether it is a rush or an off-peak hour. If it is a rush hour, it will be regulated by headway. If it is an off-peak hour, it will be regulated by timetable
Related to WP(s)	WP15/16
Related to task/subtask(s)	Tasks 15.5, 16.5
Impact on other task(s)	None
Technical Enabler(s)	TE 15 - "TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables"
Interactions SP/FP	FP6-FUTURE
Actor(s)	TMS/TMS Operator, ATO-OB
Sequence	It is needed at least two trains to test the interval regulation. 1. Train A suffers a delay at the station exit of 5% of the planned time. 2. It is evaluated if the established schedule is being met. 3. Two situations: a. If it is fulfilled, end of the use case b. If it is not fulfilled, it is assessed whether it is in a peak or off-peak hour, to generate the regulation strategy. i. Time-base Regulation. Rush hour. In the checks it must be verified that it is regulating by interval. ii. Time-Base Regulation. Off-peak hour. In the checks, it must be verified that it is being regulated by time. 4. The necessary Journey profile is generated with the new regulation conditions in order to recover the planning that was being worked on. 5. The JPs are transmitted to the trains. 6. Trains execute the received JPs. 7. The regulation algorithm checks at the target point set by the regulation strategy whether schedule compliance has been recovered.

	8. Two situations: a. If compliance is achieved, end of the use case. b. If not fulfilled, return to section 3b.
Notes	Minimum two trains

9.35. UC-FP1-WP10-37 – Traffic regulation based in track areas

Name	Traffic regulation based in track areas
ID	UC-FP1-WP10-37
Partner	CAF
Demo associated	Demo 15 (task 16.5)
Description	The regulation in this case will be defined by space, i.e. it will be influenced by whether the train is in an urban area or on the contrary in a branch line area.
Related to WP(s)	WP15/16
Related to task/subtask(s)	Tasks 15.5, 16.5
Impact on other task(s)	None
Technical Enabler(s)	TE 15 - "TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables"
Interactions SP/FP	FP6-FUTURE
Actor(s)	TMS /TMS Operator, ATO-OB
Sequence	It is needed at least two trains to test the interval regulation. 1. Train A suffers a delay at the station exit of 5% of the planned time. 2. It is evaluated if the established schedule is being met. 3. Two situations: a. If it is fulfilled, end of the use case. b. If it is not fulfilled, it is assessed whether it is in a rush or off-peak hour, to generate the regulation strategy. i. Space-based Regulation. Urban core. Checks should verify that it is being regulated by interval. ii. Space-based Regulation. Branches. In the checks it must be verified that it is being regulated by time schedule. 4. The necessary Journey profile is generated with the new regulation conditions in order to recover the planning that was being worked on. 5. The JPs are transmitted to the trains. 6. Trains execute the received JPs. 7. The regulation algorithm checks at the target point set by the regulation strategy whether schedule compliance has been recovered. 8. Two situations: a. If compliance is achieved, end of the use case. b. If not fulfilled, return to section 3b.

Notes	Minimum two trains

9.36. UC-FP1-WP10-38 - Traffic regulation considering adhesion factors

Name	Traffic regulation considering adhesion factors
ID	UC-FP1-WP10-38
Partner	CAF
Demo associated	Demo 15 (task 16.5)
Description	*The regulation in this case will be defined by space or by time, i.e., focusing on space, it will be influenced by whether the train is in an urban area or on the contrary in a branch line area, otherwise, if we focus on time there will be these two options:* • *If it is a rush hour, it will be regulated by headway.* • *If it is an off-peak hour, it will be regulated by timetable.*
Related to WP(s)	WP15/16
Related to task/subtask(s)	Tasks 15.5, 16.5
Impact on other task(s)	None
Technical Enabler(s)	TE 15 - "TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables"
Interactions SP/FP	FP6-FUTURE
Actor(s)	TMS/TMS Operator, ATO-OB
Sequence	It is needed at least two trains to test the interval regulation. 1. Train A receives a JP coming from the regulation system warning that there is a change of adhesion. 2. The ETCS curve is reduced and therefore the ATO curve is reduced. This implies that the speed of the train is reduced. 3. There is a delay of 5 to 10% over the planning in which the train is operating. 4. An assessment is made as to whether the established schedule is being adhered to. 5. Two situations: a. If it is fulfilled, end of the use case b. If it is not fulfilled, it is evaluated whether it is regulated by time of day or by the space through which the train is running. 6. Two situations:

	a. If the train is running taking into account the time of day. i. It is assessed whether it is in a peak or off-peak hour, in order to generate the regulation strategy. ii. The necessary Journey profile is generated with the new regulation conditions in order to recover the planning that was being worked on. iii. The JPs are transmitted to the trains in real time, without the need for the trains to arrive at the stations. Iv. Trains execute the received JPs. v. The regulation algorithm checks at the target point set by the regulation strategy whether schedule compliance has been recovered. Vi. Two situations: 1. If complied with, end of the use case. 2. If not complied with, return to section 6.a.i. b. If the train runs taking into account the space through which it is running. i. It is assessed whether it is located in the urban core or in a branch area, in order to generate the regulation strategy. ii. The necessary Journey profile is generated with the new regulation conditions in order to recover the planning that was being worked on. iii. The JPs are transmitted to the trains in real time, without the need for the trains to arrive at the stations. iv. Trains execute the received JPs. v. The regulation algorithm checks at the target point set by the regulation strategy whether schedule compliance has been recovered. vi. Two situations: 1. If compliance is met, end of the use case 2. 2. If not complied with, return to section 6.b.i.
Notes	Minimum two trains,

9.37. UC-FP1-WP10-39 - ATO-TMS integration

Name	ATO-TMS integration
ID	UC-FP1-WP10-39
Partner	AZD
Demo associated	Demo 15 (task 16.5)
Description	Demonstration of ATO-TS-TMS integration platform (Integration Layer) developed in subtask 15.4.4 to prove a function of given framework between TMS subsystem and ATO-TS supporting autonomous train operations to manage data transfer between the technologies/subsystems involved in WP15
Related to WP(s)	WP15/16
Related to task/subtask(s)	Tasks 15.4.4, 16.5
Impact on other task(s)	None
Technical Enabler(s)	TE 15 - "TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables"
Interactions SP/FP	FP2-R2DATO, FP6-FUTURE
Actor(s)	• Integration Layer • TMS / TMS Operator • ATO-TS (or GoA3-4 equivalent system) • Train Driver/ATO-OB able to operate the train
Sequence	1. The TMS – ATO-TS integration platform (Integration Layer) continuously reacts to the events that occur on both TMS and ATO-TS sides. 2. The TMS operator or autonomous TMS subsystem sets train paths for involved train(s). 3. The TMS provides the planned timetable and is able to adjust this timetable regarding the current traffic situation. 4. The ATO-TS communicates with ATO-OB/C_DAS OB of involved train(s): a. Presents the adjusted timetable and train path following the input from TMS to the trains. b. Gets positions and estimated arrival times from the trains and passes this information to the TMS and its subsystems in order to be able to optimise the traffic.
Notes	STS will provide the integration platform developed in subtask 15.4.4

9.38. UC-FP1-WP10-40 - Performances comparison between C-DAS and C-DAS-O architectures

Name	Performances comparison between C-DAS-C and C-DAS-O architectures
ID	UC-FP1-WP10-40
Partner	STS
Demo associated	Demo 13 (task 16.3)
Description	Demonstration of two C-DAS architectures, C-DAS-C (according to D15.1) and C-DAS-O (according to D15.1), and the comparison between their performances in terms of energy saving using algorithms from WP12. The innovation of the approach lies in comparing two architectures: • the C-DAS-C that calculates trackside train positions and therefore the energy saving profiles thus avoiding the integration with onboard odometry to collect train positions, thus limiting onboard installations to drastically reduce recurrent engineering costs; • the C-DAS-O that makes onboard all energy saving calculations thus requiring the onboard installation of a GPS sensor.
Related to WP(s)	WP15/16
Related to task/subtask(s)	Task16.3
Impact on other task(s)	FP1/WP12 (Task 12.2.3)
Technical Enabler(s)	TE 12 - “Real-time convergence between planning & feedback loop from operations [TRL 4/5].” TE 15 - “TMS speed regulation of trains, precise routes and target times for ATO and dynamic timetables”
Interactions SP/FP	None
Actor(s)	Integration Layer, TMS, ATO-TS, C-DAS TS, C-DAS OB
Sequence	1. Demonstration of a C-DAS-C architecture (with the C-DAS module at trackside level) and collection of the results. 2. Demonstration of a C-DAS-O architecture (with the C-DAS module on board) and collection of the results. 3. Comparison between performances of the two architectures in terms of energy saving .
Notes	None

9.39. UC-FP1-WP10-41 - Notification of conflict

Name	Notification of conflict
ID	UC-FP1-WP10-41
Partner	ÖBB-INFRA
Demo associated	Demo 16 (task 18.2.1)
Description	TMS Conflict Detection Module detects conflict and triggers notification to TMS Operator.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Task 17.2.1
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	SP interaction
Actor(s)	TMS/TMS Operator
Sequence	1. The system reacts either to already happened unforeseeable conflicts e.g. due to technical or human errors, etc, or it forecasts the upcoming conflicts and calculates countermeasures to prevent them from happening. 2. The system simulates the trains and predicts a possible conflict in a given time frame. 3. The notification to the TMS Operator is triggered.
Involved components (System)	TMS Conflict Detection module
Notes	None

9.40. UC-FP1-WP10-42 - Presentation of notification

Name	Presentation of notification
ID	UC-FP1-WP10-42
Partner	ÖBB-INFRA
Demo associated	Demo 16 (task 18.2.1)
Description	Notifications about the conflict are presented to the TMS Operator.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Task 17.2.1
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	System Pillar
Actor(s)	TMS/TMS Operator
Sequence	1. Based on the types of conflicts, the notification about the conflict is presented to the TMS Operator.
Involved components (System)	TMS Conflict Detection module
Notes	None

9.41. UC-FP1-WP10-43 - Presentation of additional information on conflict

Name	Presentation of additional information on conflict
ID	UC-FP1-WP10-43
Partner	ÖBB-INFRA
Demo associated	Demo 16 (task 18.2.1)
Description	Upon the TMS Operator's interaction (e.g. mouse click), additional information about the conflict is presented (e.g. train type, train number, reason for conflict). If calculation of solutions is already finished, solutions are presented as well. All "additional information" is presented in a clear and concise manner.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Task 17.2.1
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	SP interaction
Actor(s)	TMS⁄TMS Operator
Sequence	1. The TMS Operator interacts with the system to receive additional information on the conflict. 2. All relevant information to take reactive or predictive measures are presented. 3. The TMS Operator performs the measures.
Involved components (System)	TMS Conflict Detection module, TMS Conflict Resolution module
Notes	None

9.42. UC-FP1-WP10-44 - Resolution of conflict

Name	Resolution of conflict
ID	UC-FP1-WP10-44
Partner	ÖBB-INFRA
Demo associated	Demo 16 (task 18.2.1)
Description	TMS Conflict Resolution Module assesses the conflict's impact on the rail network and calculates - within a predefined timeframe - three different options *(different number or options could be provided)* to resolve the conflict (e.g. redirecting other trains etc.). If no resolution is calculated (e.g. after calculation abort), the module triggers a notification to the TMS Operator and operational management. The TMS Operator provides feedback to the system regarding the quality of proposed solutions.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Task 17.2.1
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	System Pillar
Actor(s)	TMS/TMS Operator
Sequence	1. The TMS Conflict Resolution module gets notified about the conflict. 2. The TMS Conflict Resolution module calculates possible solutions and triggers the presentation to the TMS Operator. 3. The TMS Operator provides feedback about the quality of the proposed solutions.
Involved components (System)	TMS Conflict Resolution module
Notes	None

9.43. UC-FP1-WP10-45 – Automatic Conflict Detection and Resolution using AI applied to Depots and Terminal Stations environment

Name	Automatic Conflict Detection and Resolution using AI applied to Depots and Terminal Stations environment
ID	UC-FP1-WP10-45
Partner	ENYSE
Demo associated	Demo 17 (task 18.2.2)
Description	Provide updated operational plan by applying optimized conflict resolution to the conflicts indicated by the forecast based on the user choosing from the list of all possible solutions identified by AI.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Tasks 17.2.2, 18.2.2
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - "Real-time conflict detection & resolution for main line and optimization"
Interactions SP/FP	FP6-FUTURE (application to Regional Lines)
Actor(s)	TMS/TMS Operator
Sequence	1. A conflict is detected when a train is about to enter/leave a depot or a terminal station, then a. TMS Conflict Identification Module detects conflict when a train is about to be introduced at the depot and triggers notification to TMS Operator ➔ impact on the depot b. TMS Conflict Identification Module detects conflict when a train is about to leave the depot and triggers notification to TMS Operator ➔ impact on main line c. TMS Conflict Identification Module detects conflict when a train is about arriving a terminal station and triggers notification to TMS Operator ➔ impact on the terminal station d. TMS Conflict Identification Module detects conflict when a train is about leaving a terminal station and triggers notification to TMS Operator ➔ impact on main line 2. The TMS Conflict Resolution module presents info about the conflict to the TMS Operator and propose different

	calculation alternatives based on user needs (including ranking criteria), then 3. The TMS Conflict Resolution module calculates possible solutions and presents them ranked (according to the defined criteria) to the TMS Operator, and then 4. The TMS Operator provides feedback about the quality of the proposed solutions (if any)
Notes	None

9.44. UC-FP1-WP10-46 – Optimized conflict resolution based on realistic forecast calculation

Name	Optimized conflict resolution based on realistic forecast calculation
ID	UC-FP1-WP10-46
Partner	HACON
Demo associated	Demo 18 (task 18.2.3)
Description	Provide updated operational plan by applying optimized conflict resolution to the conflicts indicated by the forecast
Related to WP(s)	WP17/18
Related to task/subtask(s)	Tasks 17.2.3, 17.2.6, 18.2.3
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	None
Actor(s)	TMS / TMS operator
Sequence	1. An incoming train position report or a TCR change causes train delays and related conflicts of impacted trains are detected following the updated train running forecast. 2. TMS Operator initiates optimized Conflict Resolution. 3. TMS displays solutions to trains’ conflicts in a sandbox for studying. 4. TMS Operator confirms implementation of the solution. 5. Operational Plan is updated accordingly.
Notes	None

9.45. UC-FP1-WP10-47 - Automated very short-term decision making for real-time operation for departing train

Name	Automated very short-term decision making for real-time operation for departing train
ID	UC-FP1-WP10-47
Partner	GTSD
Demo associated	Demo 19 (Subtask 18.2.4)
Description	Within a time slot between 0 and few minutes system detects a blocking for a train, ready to depart from platform. System will stop the train at platform to avoid higher impact.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Subtask 17.2.5, 18.2.4
Impact on other task(s)	None
Technical Enabler(s)	TE 16 - ”Automation of very short-term train control decisions”
Interactions SP/FP	FP2-R2DATO/(WP44/45)
Actor(s)	TMS/TMS Operator
Sequence	None
Notes	Assumption: Development can be started in 2023 using existing X2R4 CDM environment to exchange Data with TMS.

9.46. UC-FP1-WP10-48 - Automated very short-term decision making for real time operation to keep sequence

Name	Automated very short-term decision making for real-time operation to keep sequence
ID	UC-FP1-WP10-48
Partner	GTSD
Demo associated	Demo 19 (Subtask 18.2.4)
Description	Within a time slot between 0 and few minutes system detects a sequence conflict with other train. System will delay lower priority train if impact on operational plan can be minimized.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Subtask 17.2.5, 18.2.4
Impact on other task(s)	None
Technical Enabler(s)	TE 16 - ”Automation of very short-term train control decisions”
Interactions SP/FP	FP2-R2DATO/(WP44/45)
Actor(s)	TMS/TMS Operator
Sequence	None
Notes	Assumption: Development can be started in 2023 using existing X2R4 CDM environment to exchange Data with TMS.

9.47. UC-FP1-WP10-49 - Operator notification in case of automated very short-term decision making

Name	Operator notification in case of automated very short term decision making
ID	UC-FP1-WP10-49
Partner	GTSD
Demo associated	Demo 19 (Subtask 18.2.4)
Description	Operator must be informed about automated decision making by system. He must know impact and remaining time to reject automated action.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Subtask 17.2.5, 18.2.4
Impact on other task(s)	None
Technical Enabler(s)	TE 16 - ”Automation of very short-term train control decisions”
Interactions SP/FP	FP2-R2DATO/(WP44/45)
Actor(s)	TMS/TMS Operator
Sequence	None
Notes	None

9.48. UC-FP1-WP10-50 - For real time operation system must request movement authorities

Name	For real time operation system must request movement authorities
ID	UC-FP1-WP10-50
Partner	GTSD
Demo associated	Demo 19 (Subtask 18.2.4)
Description	System must simulate timing and extend of Movement Authorities to execute TMS plan best possible.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Subtask 17.2.5, 18.2.4
Impact on other task(s)	None
Technical Enabler(s)	TE 16 - ”Automation of very short-term train control decisions”
Interactions SP/FP	FP2-R2DATO/(WP44/45)
Actor(s)	TMS/APS
Sequence	None
Notes	Assumption 1: FP2-APS is executing ETCS L3 Moving Block or ETCS L3 Hybrid, Moving Block which track occupations. Assumption 2: SCI-CMD interface specification is available in a mature state, ready for standardization. If these assumptions cannot be applied, this part has to be postponed to next wave projects.

9.49. UC-FP1-WP10-51 – Optimized conflict detection and resolution

Name	Optimized conflict detection and resolution
ID	UC-FP1-WP10-51
Partner	STS
Demo associated	Demo 20 (Subtask 18.2.5)
Description	Provide forecasted operational plan by applying optimized conflict detection and resolution; multiple plans shall come from the optimal solution according to different specified criteria.
Related to WP(s)	WP17/18
Related to task/subtask(s)	17.2.6, 18.2.5
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator
Sequence	1. Acquisition of the Operational Plan 2. Analysis of the Operational Plan 3. Generation of multiple Preliminary Production Plans, each guided by a given set of criteria 4. Publishing of the Preliminary Production Plans
Notes	None

9.50. UC-FP1-WP10-52 - Train that cannot continue on its route

Name	Train that cannot continue on its route
ID	UC-FP1-WP10-52
Partner	FS
Demo associated	Demo 20 (Subtask 18.2.5)
Description	The TMS Operator may suspend the automatic route setting for a train in the event the train cannot continue.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Subtask 17.2.6, 18.2.5
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator
Sequence	1. The TMS Operator recognizes a train that could cause a traffic disruption; 2. The TMS Operator suspends the automatic route setting for this train; 3. The optimizer consider the train unavailable to move for a configurable time interval; 4. When the service is reallocated, the forecast calculation and automatic conflict resolution are updated.
Involved components (System)	TMS Conflict Detection module, TMS Conflict Resolution module, TMS HMI
Notes	None

9.51. UC-FP1-WP10-53 - Dispatcher constraints entry

Name	Dispatcher constraints entry
ID	UC-FP1-WP10-53
Partner	FS
Demo associated	Demo 20, 23 (Subtasks 18.2.5 and 18.2.8)
Description	The TMS Operator sets one or more constraints which are binding for the optimizer.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Subtasks 17.2.6, 17.2.8, 18.2.5, 18.2.8
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	None
Actor(s)	TMS /TMS Operator
Sequence	1. The TMS Operator sets a constraint into the system; 2. The optimizer cannot remove the constraint defined by the TMS Operator; 3. The optimizer must take into account the constraint in the elaborations.
Involved components (System)	TMS Conflict Detection module, TMS Conflict Resolution module, TMS HMI
Notes	None

9.52. UC-FP1-WP10-54 – Ability to choose the optimal solution

Name	Ability to provide multiple solutions
ID	UC-FP1-WP10-54
Partner	AZD
Demo associated	Demo 21 (task 18.2.6)
Description	The system shall provide multiple conflict-free resolutions if possible.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Tasks 17.2.6, 18.2.6
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization” TE 16 - (partially)
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator
Sequence	1. Detection of the conflict 2. Request to resolve the conflict 3. Multiple conflict-free solutions should be provided
Notes	None

9.53. UC-FP1-WP10-55 – Real-time operation of algorithm

Name	Real-time operation of algorithm
ID	UC-FP1-WP10-55
Partner	AZD
Demo associated	Demo 21 (task 18.2.6)
Description	Automatic conflict detection as soon as they appear in time, conflict resolution on request.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Tasks 17.2.6, 18.2.6
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization” TE 16 - (partially)
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator
Sequence	1. Conflict occurrence in the traffic forecast 2. Immediate detection of the conflict by TMS 3. Identification of the type of conflict by TMS 4. The visual representation of the conflict depending on its type
Notes	None

9.54. UC-FP1-WP10-56 – Automatic Conflict detection and resolution

Name	Automatic Conflict detection and resolution
ID	UC-FP1-WP10-56
Partner	INDRA
Demo associated	Demo 22 (Subtask 18.2.7)
Description	For a conflict or number of conflicts, develop a system to automatically solve them, taken into account pre-defined parameters for the solution
Related to WP(s)	WP17/18
Related to task/subtask(s)	Tasks 17.2.7
Impact on other task(s)	FP1/(WP6, WP7)
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator
Sequence	1. Define the types of conflicts involved in automatic conflict detection and resolution. 2. Define detection conditions for each type of conflict. 3. Define available resolution methods for each type of conflict. 4. Define the assessment of each resolution method. 5. Order resolution methods by priority (assessment) for each type of conflict. 6. Apply the resolution method according to the assessment.
Notes	None

9.55. UC-FP1-WP10-57 – Decision support system for different conflicts

Name	Decision support system for different conflicts
ID	UC-FP1-WP10-57
Partner	INDRA
Demo associated	Demo 22 (Subtask 18.2.7)
Description	Develop a system that allows to simulate different situations e.g. the conflict solution obtained in WP17, and other solution applied by TMS Operator.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Tasks 18.2.7
Impact on other task(s)	FP1/(WP6, WP7)
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator
Sequence	1. The system operates in real-time, detecting all existing conflicts based on forecast calculations. 2. It presents them in an open sandbox for visualization. 3. Utilizing the sandbox environment, a resolution method is applied to address the identified conflicts. 4. The behaviour of elements involved in the scenario is monitored within the sandbox. 5. Conflict resolution is applied, enabling changes to be made in the timetable, providing a new conflict-free one.
Notes	None

9.56. UC-FP1-WP10-58 – Conflict detection and resolution

Name	Conflict detection and resolution
ID	UC-FP1-WP10-58
Partner	MERMEC
Demo associated	Demo 23 (task 18.2.8)
Description	Providing conflict detection after a train deviation and applying or suggesting conflict solution.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Tasks 17.2.8,18.2.8
Impact on other task(s)	FP1/WP11/12 (Tasks 11.3.5, 12.2.5)
Technical Enabler(s)	TE 16 - ”Automation of very short-term train control decisions” TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	SP requirements.
Actor(s)	TMS/ TMS Operator
Sequence	1. A deviation for a train is detected by the related module. 2. Forecast is updated for the above train. 3. Conflicts are detected and shown to the TMS Operator (semi-automatic mode). 4. Conflicts are solved and solution is applied in automatic mode or proposed to the TMS Operator in semi-automatic mode. 5. TMS Operator can choose a solution in semi-automatic mode.
Involved components (System)	TMS Event Logger, TMS Deviation Detection module, TMS Forecast Calculation module, TMS Conflict Detection module, TMS Conflicts Resolution module, TMS Operational Plan, TMS HMI
Notes	Prerequisites: current plan loaded.

9.57. UC-FP1-WP10-59 – Very short-term decision

Name	Very short-term decision
ID	UC-FP1-WP10-59
Partner	MERMEC
Demo associated	Demo 23 (task 18.2.8)
Description	In automatic and semi-automatic mode in the case in which the operational plan has to be performed within a couple of minutes the system shall actuate it.
Related to WP(s)	WP17/18
Related to task/subtask(s)	Tasks 17.2.8,18.2.8
Impact on other task(s)	None
Technical Enabler(s)	TE 16 - ”Automation of very short-term train control decisions” TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	SP requirements.
Actor(s)	TMS
Sequence	1. A conflict with a conflict solution proposal is present on TMS HMI. 2. The conflict should be solved in at last couple of minutes or it remains unsolved, so the TMS Conflict Resolution module forces the solution that is based on the chosen algorithm. 3. The conflict disappears on TMS HMI.
Involved components (System)	TMS Event Logger, TMS Deviation Detection module, TMS Forecast Calculation module, TMS Conflicts Detection module, TMS Conflicts Resolution module, TMS Operational Plan, TMS HMI.
Notes	Prerequisites: current plan loaded, semi-automatic mode and a conflict to be solved is present (e.g., the TMS Operator has not made any choice).

9.58. UC-FP1-WP10-60 – Evaluation platform

Name	Evaluation platform
ID	UC-FP1-WP10-60
Partner	SNCF
Demo associated	Demo 25 (task 18.3.2)
Description	Development of a platform, based on a microscopic simulator, to evaluate the performances of the TMS
Related to task/subtask(s)	Tasks 17.2.3,18.3.2
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator, IM
Sequence	1. Acquisition of all the input data: simulation model and parameters, optimization algorithms. 2. Definition of the features of the prediction and of the parameters of the interfaces between the prediction, the simulator and the optimization algorithms. 3. Definition and implementation of the evaluation KPIs.
Notes	None

9.59. UC-FP1-WP10-61 - Test bed for local TMS evaluation

Name	Test bed for local TMS evaluation
ID	UC-FP1-WP10-61
Partner	SNCF
Demo associated	Demo 25 (task 18.3.2)
Description	Performance evaluation of optimisation algorithms for local level traffic management in a single region
Related to task/subtask(s)	Subtask 17.2.4, 18.3.2
Impact on other task(s)	None
Technical Enabler(s)	TE 17 - “Real-time conflict detection & resolution for main line and optimization”
Interactions SP/FP	None
Actor(s)	TMS/TMS Operator, IM
Sequence	1. Definition of specific deployment parameters (which KPIs for the optimization algorithm and for the evaluation, frequency of the optimization, types of operational decisions). 2. Run of the evaluation platform to evaluate the algorithm performances. 3. If needed, improvement of the optimization algorithms and return to steps 1 and 2 for further evaluation.
Notes	Required inputs: historical data on perturbation scenarios, topology of the network, theoretical timetable, an evaluation platform, optimization algorithms

10. SG2 – WP10 data availability for prototype environments

The following table summarizes the key information related to data availability for WP10 prototype environments. It identifies the required data for the execution of WP10 use cases, the data providers expected to feed this use cases. There will be a link to the project Research Data Management Plan, as this data need to be included on the document in the next phase of the project, where will be found more details about how this data will be managed within the project.
The table provides a clear and concise overview of the information, making it easy to reference and use as needed.

Table 6 – WP10 data availability for prototype environments

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP10-01	Information exchange for Automatic Route Setting (ARS)	1. Network topology data, including infrastructure data, signals etc 2. Timetable data	1. ATSA
UC-FP1-WP10-02	Information exchange for Monitor & Control Train	1. Network topology data, including infrastructure data, signals etc 2. Dynamic States (operational) like train position	ATSA
UC-FP1-WP10-03	Monitor & Control the field elements	1. Network topology data, including infrastructure data, signals etc 2. Temporary constraints like temporary speed restriction, power restriction or low adhesion limitation	ATSA
UC-FP1-WP10-04	Support for trans-border travel related decisions for station operator	1. Timetable data	1. PKP IT 2. MERITS 3. HAFAS
UC-FP1-WP10-05	Detail train timetable for	1. Network topology data, including speeds, signals etc.	STS

Use case ID	Use case name	Data required for UC execution	Data provider
	energy saving ATO-TS	2. Planned timetable data 3. Operational plan 4. Composition data of railway undertakings	
UC-FP1-WP10-06	Information exchange between TMS and C-DAS TS	1. Network topology elements of the infrastructure 2. Real time traffic plan 3. Train characteristics (weight, max speed, length...)	INDRA
UC-FP1-WP10-07	Cooperative conflict resolution (Two TMSs)	1. Network topology (infrastructure data) 2. Timetable	RFI
UC-FP1-WP10-08	Exchanging real time train data regarding the border stations.	1. Network topology (infrastructure data) 2. Timetable 3. TCR	RFI
UC-FP1-WP10-09	Short-term maintenance needs or accidental situation which requires a pre-alignment of the train journey parts	1. Network topology data, including speeds, signals etc. 2. Timetable data	Trafikverket
UC-FP1-WP10-10	Sending and Receiving train running forecast information	3. Network topology data, including speeds, signals etc. 4. Timetable data	Trafikverket
UC-FP1-WP10-11	Pre-aligned decisions cross-border	1. Network topology data, including speeds, signals etc. 2. Timetable data	Trafikverket, NRD/Bane NOR

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP10-12	Consider constraints or needs of integrated processes and related systems integrated	1. Network topology data, including speeds, signals etc. 2. Timetable data	Trafikverket
UC-FP1-WP10-13	Train running forecast of the TMS improved by integration of TMS with systems and processes related to yard, station and so on	1. Network topology data, including speeds, signals etc. 2. Timetable data	Trafikverket
UC-FP1-WP10-14	Planning and/or management of systems and processes using information received from the TMS	1. Network topology data, including speeds, signals etc. 2. Timetable data	Trafikverket
UC-FP1-WP10-15	Sending and Receiving track allocation information between TMS and YCS	1. Timetable information from TMS 2. Track allocation information from YCS 3. Track allocation information, departure and arrival information for freight trains	Trafikverket
UC-FP1-WP10-16	Notifying TMS and YCS operators about disruptions and request	1. Timetable information from TMS 2. Track allocation information from YCS 3. Track allocation information, departure and arrival information for freight trains	Trafikverket
UC-FP1-WP10-17	IAMS interface	1. Track allocation from TMS 2. A lert messages from IAMS	CEIT
UC-FP1-WP10-18	Involving multi-actors in decision making	1. Network topology data, including speeds, signals etc.	Trafikverket

Use case ID	Use case name	Data required for UC execution	Data provider
		2. Timetable data	
UC-FP1-WP10-19	Critical alarm management	1. Alarms with observation information from systems under active monitoring 2. Remediation commands to actors for alarm management 3. Feedback of remediation effectiveness.	STS
UC-FP1-WP10-20	Short-term management of a possible asset failure	1. Observation information from systems under active monitoring 2. TMS-related data 3. Probability of failure occurrence 4. Remediation commands to actors for preventive failure management 5. Feedback of remediation effectiveness.	STS
UC-FP1-WP10-21	Preventive functional assessment (PFA)	1. Observation information from systems under active monitoring 2. TMS-related data 3. Remediation commands to actors for early maintenance management 4. Traffic rescheduling for TMS 5. Feedback of remediation effectiveness.	STS
UC-FP1-WP10-22	Disruption management and activation of emergency services.	1. Alarms with observation information from systems under active monitoring	STS

Use case ID	Use case name	Data required for UC execution	Data provider
		2. Remediation commands to actors for alarm management 3. Feedback of remediation effectiveness.	
UC-FP1-WP10-23	Disruption management and activation of a maintenance intervention	1. Alarms with observation information from systems under active monitoring 2. Remediation commands to actors for alarm management 3. Feedback of remediation effectiveness.	STS
UC-FP1-WP10-24	Solving of Rolling stock dispatching conflicts using reserves and swaps	1. Timetable data 2. Rolling stock data 3. Conflict	NSR
UC-FP1-WP10-25	Proactive solving of macro tasks for crew dispatching	1. Timetable data 2. Rolling stock data 3. Crew data 4. Conflict	NSR
UC-FP1-WP10-26	Trespassing	1. RTTP 2. Topology/Infrastructure data 3. Communication data 4. Event data/state	Trafikverket
UC-FP1-WP10-28	Infrastructure problems detected by railway staff	1. RTTP 2. Topology/Infrastructure data 3. Communication data 4. Event data/state	Trafikverket
UC-FP1-WP10-30	Train Path Envelope	1. Network topology data (including signalling)	PR (Manual insertion in

Use case ID	Use case name	Data required for UC execution	Data provider
	calculation	2. Timetable data 3. Train data	tool)
UC-FP1-WP10-31	TMS-ATO feedback loop	1. Network topology data (including signalling) 2. Timetable data 3. Train data	PR (Manual insertion in tool)
UC-FP1-WP10-32	TMS-ATO operation interactions between human actors in different conditions	1. Network topology data (including signalling) 2. Timetable data 3. Train data	PR, NSR
UC-FP1-WP10-33	TMS enhancements to support C-DAS operations	1. Network topology elements of the infrastructure 2. Real time traffic plan 3. Train characteristics (weight, max. speed, length...)	INDRA
UC-FP1-WP10-34	C-DAS simulator	1. Network topology data 2. Timetable data 3. Train data	CEIT
UC-FP1-WP10-35	RTTP-updates to increase C-DAS efficiency	1. Network topology data (including signalling) 2. Timetable data 3. Train data	TrafikVerket
UC-FP1-WP10-36	Traffic regulation based on the time of the day	1. Network topology data, including speeds, signals etc 2. Rolling Stock 3. Planning generated in WP8	CAF
UC-FP1-WP10-37	Traffic regulation based on	1. Network topology data, including speeds, signals etc	CAF

Use case ID	Use case name	Data required for UC execution	Data provider
	track areas	2. Rolling Stock 3. Planning generated in WP8	
UC-FP1-WP10-38	Traffic regulation considering adhesion factors	1. Network topology data, including speeds, signals etc 2. Rolling Stock 3. Planning generated in WP8	CAF
UC-FP1-WP10-39	ATO-TMS integration	1. Network topology data 2. Operational train data 3. Pre-planned (default) timetable	AZD
UC-FP1-WP10-40	Integration of a Trackside Positioning manager into ATO-TS/TMS architecture for C-DAS TS operation	1. Network topology data 2. Timetable data 3. Train data	STS
UC-FP1-WP10-41	Notification of conflict	1. Network topology data 2. Timetable data 3. Train data	ÖBB-INFRA
UC-FP1-WP10-42	Presentation of notification	1. Network topology data 2. Timetable data 3. Train data	ÖBB-INFRA
UC-FP1-WP10-43	Presentation of additional information on conflict	1. Network topology data 2. Timetable data 3. Train data	ÖBB-INFRA
UC-FP1-WP10-44	Resolution of conflict	1. Network topology data 2. Timetable data 3. Train data	ÖBB-INFRA

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP10-45	Automatic Conflict Detection and Resolution using AI applied to Depots and Terminal Stations environment	1. Network topology 2. Timetable data 3. Rolling stock data 4. Event data/state	ÖBB-INFRA
UC-FP1-WP10-46	Optimized conflict resolution based on realistic forecast calculation	1. Network topology data, including speeds, signals etc. 2. Timetable data	Trafikverket
UC-FP1-WP10-47	Automated very short-term decision making for real time operation for departing train	1. Network topology 2. Timetable data 3. Rolling stock data 4. Train movement 5. Restrictions 6. Operational feedback	GTSD (in alternative SCI-OP interface GTSD simulation environment)
UC-FP1-WP10-48	Automated very short term decision making for real time operation to keep sequence		
UC-FP1-WP10-49	Operator notification in case of automated very short term decision making		
UC-FP1-WP10-50	For real time operation system must request movement authorities		
UC-FP1-WP10-51	Optimized conflict detection and resolution	1. Network topology data, including speeds, signals etc. 2. Planned timetable data 3. Operational plan 4. Composition data of railway undertakings 5. Planned state of the infrastructure (cf. disruption)	1. FS 2. FS 3. TMS (STS) 4. FS 5. FS
UC-FP1-WP10-52	Train that cannot continue on its route	1. Network topology data, including speeds, signals etc. 2. Planned timetable data	1. FS 2. FS

Use case ID	Use case name	Data required for UC execution	Data provider
		3. Operational plan (before optimization) 4. Composition data of railway undertakings 5. Planned status of the infrastructure (cf. disruption)	3. TMS (STS) 4. FS 5. FS
UC-FP1-WP10-53	Dispatcher constraints entry	1. Network topology data, including speeds, signals etc. 2. Planned timetable data 3. Operational plan (before optimization) 4. Composition data of railway undertakings 5. Planned status of the infrastructure (cf. disruption)	1. FS 2. FS 3. TMS (STS/MERMEC) 4. FS 5. FS
UC-FP1-WP10-54	Ability to provide multiple solutions	1. Timetable data 2. Train data 3. Network topology data	AZD
UC-FP1-WP10-55	Real-time operation of algorithm	1. Timetable data 2. Train data 3. Network topology data	AZD
UC-FP1-WP10-56	Automatic Conflict detection and resolution	1. Network topology elements of the infrastructure 2. Real time traffic plan 3. Train characteristics (weight, max. speed, length...) 4. Scenario with conflicts	INDRA
UC-FP1-WP10-57	Decision support system for different conflicts	1. Network topology elements of the infrastructure 2. Real time traffic plan 3. Train characteristics (weight, max. speed, length...) 4. Scenario with conflicts	INDRA

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP10-58	Conflict detection and resolution	1. Network topology (infrastructure data) 2. Timetable 3. TCR	RFI
UC-FP1-WP10-59	Very short term decision	1. Network topology (infrastructure data) 2. Timetable 3. Semi-automatic mode	RFI
UC-FP1-WP10-60	Evaluation platform	1. Infrastructure information at microscopic level 2. Rolling-stock reutilization constraints 3. Timetable information 4. Perturbation scenarios	1. SNCF Réseau 2. RUs 3. SNCF Réseau 4. SNCF Réseau
UC-FP1-WP10-61	Test bed for local TMS evaluation	1. Infrastructure information at microscopic level 2. Rolling-stock reutilization constraints 3. Timetable information 4. Perturbation scenarios	1. SNCF Réseau 2. RUs 3. SNCF Réseau 4. SNCF Réseau

11. SG3 – WP19 Use Cases

The use cases, identified in MOTIONAL WS1.3, are shown in the table below. Each use case is linked with the reference WPs pair (WP20-21 Integration of Rail with other transport modes, WP22-23 Services for Inclusive rail-based Mobility, WP24-25 Anticipate demand and improved resource utilization).

The specific outcomes for WS1.3 stated in the GA are listed below:

- Integration of Rail with other transport modes: the focus is on the improvement and development of B2B platforms and services to foster the expansion of the cooperation between mobility providers in various technical topics, such as data sharing, providing of common services in sales and distribution. This is supported by a dedicated activity on standardised interfaces (expansion of existing standards and development of new ones for recommendation when necessary).
- Services for inclusive rail-based mobility: the services in scope focus on the environment in railway hubs to facilitate customer journeys and allow an efficient cooperation between rail and other transport mobility providers through connected services. Those services include travel assistance across modes (esp. PRM), hands-free solutions, smart information, and platform-based guidance.
- Anticipate demand and improved resource utilisation: passenger demand analysis and coordinated response of the mobility solutions as a whole. Areas of study include short-term and long-term demand forecast calculation, simulation of demand and associated reaction of the mobility networks using Digital Twins, rail capacity improvement and information on disruption across modes.

Use Case Id	Use Case Name	WP	Responsible partners
UC-FP1-WP19-01	Journey Planning as a B2B intermodal service	20-21	HACON, INDRA
UC-FP1-WP19-02	Retailer as ticket vendor selling a product provided by a TSP as distributor via OSDM API	20-21	HACON, DB, INDRA
UC-FP1-WP19-03	Enable TSPs to visualise mobility demand (UI)	20-21	HACON
UC-FP1-WP19-04	Financial Services. Mobility Offer apportionment	20-21	GTSD
UC-FP1-WP19-05	Financial Services. Pay as-you-go apportionment	20-21	GTSD
UC-FP1-WP19-06	Financial Services. Distributed Ledger	20-21	GTSD
UC-FP1-WP19-07	Financial Services. Processing of CEN NeTEx Fare data	20-21	GTSD
UC-FP1-WP19-08	Exchange of disruptions and mitigation strategies information	20-21	STS
UC-FP1-WP19-09	Unified multimodal information storage and update	20-21	PKP
UC-FP1-WP19-10	Accessing multimodal information data for creating multimodal travel plans between on municipal level	20-21	PKP
UC-FP1-WP19-11	Support for multimodality related decisions for	20-21	PKP

	station operator		
UC-FP1-WP19-12	Totem T-Ais. 1 specific spot for people with visual disability	22-23	ADIF, MALAGA
UC-FP1-WP19-13	Totem T-Ais. 1 specific spot for people with hearing impairment, PRM, motor disability, cognitive impairment, language misunderstanding and some visual impairments.	22-23	ADIF, MALAGA
UC-FP1-WP19-14	Gap filler	22-23	ADIF
UC-FP1-WP19-15	Gobo	22-23	ADIF
UC-FP1-WP19-16	Accessible Robot	22-23	ADIF
UC-FP1-WP19-17	Guiding Accessible Software	22-23	ADIF, MALAGA
UC-FP1-WP19-18	Guiding Accessible Intelligent Tool with physical complementary signalling in different languages	22-23	ADIF
UC-FP1-WP19-19	Frictionless validation	22-23	INDRA
UC-FP1-WP19-20	Indoor guidance	22-23	INDRA
UC-FP1-WP19-21	Account based ticketing	22-23	INDRA
UC-FP1-WP19-22	Hands Free. UWB Walk-in	22-23	GTSD
UC-FP1-WP19-23	Hands Free. UWB Walk-out	22-23	GTSD
UC-FP1-WP19-24	Hands Free. UWB Intermodal transfer	22-23	GTSD
UC-FP1-WP19-25	Hands Free. UWB In station assistance	22-23	GTSD
UC-FP1-WP19-26	Hands Free. Face Recognition Walk-in	22-23	GTSD
UC-FP1-WP19-27	Hands Free. Face Recognition Walk-out	22-23	GTSD
UC-FP1-WP19-28	Illuminated Platform Edge “Attention”	22-23	DB
UC-FP1-WP19-29	Illuminated Platform Edge “Orientation”	22-23	DB
UC-FP1-WP19-30	Illuminated Platform Edge “Capacity”	22-23	DB
UC-FP1-WP19-31	Notices for other modes of transport with connections at the railway station	24-25	ADIF, INDRA, MALAGA
UC-FP1-WP19-32	Notifications for activation of passenger flow management protocols	24-25	ADIF, INDRA
UC-FP1-WP19-33	Disruption management through Transport Data Hub	24-25	INDRA
UC-FP1-WP19-34	Reporting of external events influencing the multimodal transport on the municipal level	24-25	PKP
UC-FP1-WP19-35	Information exchange between disparate mode operators allowing swift and through propagation of disruption specification	24-25	PKP
UC-FP1-WP19-36	Ex-ante timetable punctuality	24-25	FS
UC-FP1-WP19-37	Timetable optimization based on MCT (Minimum Connection Time)	24-25	FS, STS
UC-FP1-WP19-38	Railway disruption management through optimization processes	24-25	FS, STS
UC-FP1-WP19-39	Generation of the library of situations	24-25	ETRA I+D
UC-FP1-WP19-40	Detection of situations	24-25	ETRA I+D
UC-FP1-WP19-41	Supporting timetabling decisions with	24-25	PKP

	visualisation and severity estimation of present disturbances in the municipality		
UC-FP1-WP19-42	Decision support for incidents management	24-25	GTSD
UC-FP1-WP19-43	Sandboxing for test of incident mitigation scenarios	24-25	GTSD
UC-FP1-WP19-44	Alert for Possible Overcrowding Situations based on Occupancy Forecast Data	24-25	HACON
UC-FP1-WP19-45	Request Journey alternatives to avoid crowded routes	24-25	HACON
UC-FP1-WP19-46	Training of the Short-term Prognosis Model	24-25	ETRA I+D
UC-FP1-WP19-47	Short-term prognosis	24-25	ETRA I+D
UC-FP1-WP19-48	Decision support system for short term forecasting on municipal level.	24-25	PKP
UC-FP1-WP19-49	Forecast Occupancy of Vehicles using Journey Planning Requests Data	24-25	HACON
UC-FP1-WP19-50	Display Forecasted Occupancy Information to Travellers when Planning Trips	24-25	HACON
UC-FP1-WP19-51	Estimation of station staff required to provide quality customer service	24-25	ADIF, INDRA
UC-FP1-WP19-52	Decision support system for long term forecasting on municipal level.	24-25	PKP
UC-FP1-WP19-53	Transport offer optimisation	24-25	GTSD
UC-FP1-WP19-54	Analysis of Travel Demand Data based on Forecasted Data	24-25	HACON

Table 7: MOTIONAL WS1.3 Use Cases list

All use cases identified in MOTIONAL WS1.3 are now detailed in the following sub-section.

High-level uses cases in WP20/WP21

11.1. UC-FP1-WP19-01 Journey Planning as a B2B intermodal service

Name	Journey Planning as a B2B intermodal service
ID	UC-FP1-WP19-01
Description	TSP provides parts of an itinerary in their transportation domain in order to calculate itineraries which fulfil B2B mobility requests, to provide a journey to a traveller.
Related to task/subtask(s)	Specification: Task 19.1, Task 19.2 Implementation: Task 20.1, Task 20.2 Demonstration: Task21.2, Task21.4
Impact on other task(s)	A TSP can use the data flow from the requests of this use case to improve the demand forecast data expected on Task 19.6 and Task 19.7.
Technical Enabler(s)	TE18, TE19
Interactions SP/FP	Interaction with FP6 (Using DRT Journey planning e.g., via OJP) Interaction with SP (Provide standardisation guidelines for B2B interaction regarding Journey planning requests - OJP)
Actor(s)	TSP, Traveller, Retailer (can be a TSP)
Trigger	The traveller requests an intermodal journey in the retailer app
Pre-Condition(s)	Agreement between Retailer and TSP (Business) Retailer and TSP have OJP interfaces (Technical) Traveller using retailer app
Input	Origin, destination and departure time of the journey (Traveller) OJP mobility request (Retailer)
Result/Requirement	The TSP provide Journey Planning offers in the OJP format to the Retailer, which can then present to their customers (Traveller)
Final State	The traveller receives the offers for their requested journey
Sequence	List steps of the Use Case 1. Traveller request journey on the Retailer app 2. Retailer process the request and forward different OJP mobility requests to the relevant TSPs 3. The TSP process the request and reply with mobility offers in OJP format 4. Retailer combines the mobility offers and present them to the traveller
Expected Release Date	Implementation expected in June 2024

Involved components (System)	Retailer: Mobile application, MaaS platform (Journey Planning Orchestrator) TSP: OJP service
Responsible partner/person	Hacon: Marco Ferreira Indra: Juan Castro
Notes	This use case will be applied to the MaaS platforms provided by: • HACON/CFL • INDRA/MDM Hacon also expect to interface with regional services provided by FP6 (including DRT)

11.2. UC-FP1-WP19-02 Retailer as ticket vendor selling a product provided by a TSP as distributor via OSDM API

Name	Retailer as ticket vendor selling a product provided by a TSP as distributor via OSDM API
ID	UC-FP1-WP19-02
Description	It shows the benefits of the use of OSDM for the interoperable distribution of rail and intermodal products. Allowing a retailer to sell 3rd party products via OSDM API.
Related to task/subtask(s)	Specification: Task 19.1, Task 19.2 Implementation: Task 20.1, Task 20.2 Demonstration: Task 21.4
Impact on other task(s)	None
Technical Enabler(s)	TE18, TE19
Interactions SP/FP	Interaction with SP (Provide standardisation guidelines for B2B interaction regarding Journey planning requests - OSDM)
Actor(s)	TSP (Distributor), Purchaser, Retailer (may additionally act as TSP)
Trigger	The traveller request offers for an intermodal journey and wants to book one
Pre-Condition(s)	Agreement between Retailer and PTO (Business) Retailer and TSP(s) have OSDM interfaces (Technical) Purchaser using retailer app and used journey planning to calculate routes for his journey.
Input	Journey planning information Passenger information
Result/Requirement	The Retailer provides a booked journey to the traveller(s), including product(s), I.e.: • Journey including the product of one TSP • Journey including the product of two TSPs (one might be the Retailers own TSP in case he acts as distributor) • Journey including non-rail parts (bus, ship, city traffic) • Journey including additional carriers integrated by the TSP/Distributor via OSDM offline • Optionally, Journey including dogs, bicycles, optional seat allocation
Final State	The purchaser receives a booked offer for his requested journey

Sequence	List steps of the Use Case: 1. The purchaser provides the passenger information and journey details to the retailer 2. The retailer requests the offer from the distributor(s) system(s). 3. The retailer aggregates the retrieved offers 4. The retailer provides the offer to the purchaser 5. The purchaser selects the offer that better suits his needs 6. The retailer (pre-)books the selected offers at the distributor(s) 7. The retailer requests to confirm the (pre-)booked offers at the distributor(s) 8. The distributor(s) confirms the (pre-) booked offers 9. The distributor(s) creates the fulfilment 10. The retailer optionally finalizes the fulfilment 11. The distributor(s) confirm the fulfilment 12. The retailer provides the fulfilments (entitlements) of the distributor(s) to the purchaser
Expected Release Date	Implementation expected End of 2024
Involved components (System)	Retailer application (Mobile application or Web application) OSDM distributer service
Responsible partner/person	Hacon/SQILLS: Marco Ferreira DB: Jan Möllmann INDRA: Juan Castro
Notes	This use case will be applied to the TSP platforms provided by: • HACON/SQILLS/SJ • DB • INDRA/MDM The use case will fulfil at least one of the mentioned result options. The payment step is outside the scope of OSDM

11.3. UC-FP1-WP19-03 Enable TSPs to visualise mobility demand (UI)

Name	Enable TSPs to visualise mobility demand (UI)
ID	UC-FP1-WP19-03
Description	This use case intends to enhance the data shared among transportation stakeholders, sharing services demand information through an UI allowing TSPs to be able to adjust their offer at specific demand peaks.
Related to task/subtask(s)	Specification: T19.1, T19.5, T19.6 Implementation: T20.1 Demonstration: T21.4
Impact on other task(s)	None
Technical Enabler(s)	TE18, TE23, TE24
Interactions SP/FP	None
Actor(s)	TSP1, TSP2, MaaS platform
Trigger	TSP1 accesses the UI interface
Pre-Condition(s)	Agreement between two TSPs to share their demand information. The TSPs need to provide to their travellers Journey Planning services provided by the same platform.
Input	Journey planning data from the TSP1
Result/Requirement	TSP2 visualises the demand information from TSP1
Final State	Demand information is available on the UI to any TSP
Sequence	List steps of the Use Case (to be filled during specification phase) 1. TSP1 logs in to the Data analytics portal. 2. TSP1 visualises demand data of TSP2 available on the UI.
Expected Release Date	November 2024
Involved components (System)	Data analytics platform, Data analytics portal
Responsible partner/person	HACON
Notes	

11.4. UC-FP1-WP19-04 Financial services. Mobility offer apportionment

Name	Financial Services. Mobility Offer apportionment
ID	UC-FP1-WP19-04
Description	This use case is associated with Enabler 18, Improving Rail Integration through B2B Intermodal Services. It deals with financial services made available to operators in order to support sales and distribution across different transportation networks The focus is on 'Pre-paid' apportionment model. Rail and other service operators share mobility packages (typical mobility package is like intercity train ticket, regional train ticket, bus ticket, and national museum ticket). The package is sold by a retailer, potentially the train operator. The collected revenue is apportioned between service providers based on agreed ratios.
Related to task/subtask(s)	Specification. Task 19.1. Implementation. Task 20.1. Demonstration. Task 21.5.
Impact on other task(s)	This use case may have some synergy with Task 19.2 (Enabler 19, standardized interfaces)
Technical Enabler(s)	TE18. Improving Rail Integration through B2B Intermodal Services.
Interactions SP/FP	Interaction with SP is associated with standards and refers to synergy with task 19.2.
Actor(s)	Traveller. Transport Service Provider (TSP). (e.g. Rail operator, regional train operator, bus operator). Service Provider (SP). Generalization of TSP. Here this will be the company managing non transport services part of the package (e.g. company managing the operation of the museum)
Trigger	Traveller purchase of a mobility offer Trigger of Revenue Settlement.
Pre-Condition(s)	Traveller purchasing a mobility offer Mobility Package recorded at the ASP (including apportionment rules)
Input	Sale transaction is uploaded to the ASP platform. Base demo will use native ASP interface and simulated sale transaction
Result/Requirement	Detailed revenue settlement between Service Providers participating in the offer.

Final State	Settlement is made available to the TSPs and published to the Distributed Ledger (refer to associated use case)
Sequence	1. Sale transaction uploaded to the ASP 2. Transaction checked for consistency 3. Revenue apportionment update triggered in near real time (apportionment per TSP based on configured rules can be checked at the ASP) Steps 1 to 3 are performed per sale operation. Use Case may include several purchases initiated by multiple travellers. 4. At the time of the settlement, the revenue settlement report is generated for all sales. The report contains the revenue attributed per TSP. This report is used (outside of the ASP), for a bank transfer (or equivalent) between the Retailer and TSPs. 5. Publish settlement in the Distributed Ledger
Expected implementation Date	Q4 2024
Involved components (System)	ASP MaaS Platform, Distributed Ledger Interface
Responsible partner/person	GTSD RCS
Notes	Demo will include multiple purchase operations and several types of Mobility Packages. Base implementation uses simulated sales. Connection to real TSP networks is an option to be studied with a potential synergy with Enabler 19 (standardized interfaces)

11.5. UC-FP1-WP19-05 Financial services. Pay-as-you-go apportionment

Name	Financial Services. Pay as-you-go apportionment
ID	UC-FP1-WP19-05
Description	This use case is associated with Enabler 18, Improving Rail Integration through B2B Intermodal Services. It deals with financial services made available to operators in order to support sales and distribution across different transportation networks The focus is on 'Pay-as-you-go' model: travellers do intermodal journeys (on train, bus, ...) using a Mobility Account. There is no pre-paid ticket. Fares are charged on the mobility account and then settled to the Transport Service Providers.
Related to task/subtask(s)	Specification. Task 19.1. Specification of Enabler 18 Implementation. Task 20.1. Improve Rail integration using B2B Intermodal Services Demonstration. Task 21.5. Demonstration GTSD
Impact on other task(s)	This use case may have some synergy with Task 19.2 (Enabler 19, standardized interfaces)
Technical Enabler(s)	TE18. Improving Rail Integration through B2B Intermodal Services.
Interactions SP/FP	No interaction foreseen
Actor(s)	Traveller. (Traveller having subscribed to a Mobility Account and owning a physical or digital token linked to this account.) Mobility Account Provider (derivation from retailer - . Business participant owning the Mobility Account.) Transport Service Provider (TSP). Rail operator, bus operator, bike sharing service, …
Trigger	Trigger of Revenue Settlement. Typically, daily trigger.
Pre-Condition(s)	TSPs recorded at the ASP platform. Apportionment rules configured at the ASP Mobility accounts created for each traveller. Within the context of the demo, the ASP Owner is assumed to be the Mobility Account Provider. Accounts are created at the ASP. Effective payment (i.e. Mobility Account credit) is outside of the use case. However, post-payment is an assumption.
Input	Travellers are doing intermodal journeys over the network of the configured TSPs. This is typically train, bus, bike rental, …. Demo

	will include multiple TSPs and multiple travel cases. Travel transactions are uploaded at the ASP platform. Base demo will use native ASP interface and simulated travels (traveller journey simulation).
Result/Requirement	Detailed revenue settlement.
Final State	The settlement is made available to the TSPs and published to the Distributed Ledger (refer to associated use case)
Sequence	1. Travel transaction uploaded to the ASP 2. Travel transaction checked for consistency 3. Travel transaction processed against Mobility Account 4. Mobility account updated (can be checked at the ASP) 5. Revenue apportionment update triggered in near real time (apportionment per TSP based on configured rules can be checked at the TSP) Steps 1 to 5 are performed per transaction. They can also be performed per transaction batch depending on the demo scenario 6. At the time of the settlement, the revenue settlement report is generated for all received travels. The report contains the revenue attributed per TSP. This report is used (outside of the ASP), for a bank transfer (or equivalent) between the Mobility Account Provider and the TSP. 7. Publish settlement in the Distributed Ledger
Expected implementation Date	Q4 2024
Involved components (System)	ASP MaaS Platform, Distributed Ledger Interface
Responsible partner/person	GTSD RCS
Notes	Demo will include multiple travel cases and various apportionment rules when applicable. Base implementation uses simulated travels on real transportation networks (network to be selected and simulator to be set-up). Connection to real TSP networks is an option to be studied with a potential synergy with Enabler 19 (standardized interfaces)

11.6. UC-FP1-WP19-06 Financial services. Distributed Ledger

Name	Financial Services. Distributed Ledger
ID	UC-FP1-WP19-06
Description	This use case is associated with Enabler 18, Improving Rail Integration through B2B Intermodal Services. It deals with financial services made available to operators in order to support sales and distribution across different transportation networks The focus is on the publishing of revenue settlement records (in case of combined pre or post-paid offers). A distributed ledger (DL) is used with Block Chain as a Systems' network. Each participant can have its own node. The targeted business benefits include transparency, trust and auditability of mobility revenue settlements. This use case is connected to other Financial Services use cases that generate settlements records.
Related to task/subtask(s)	Specification. Task 19.1. Implementation. Task 20.1 Demonstration. Task 21.5.
Impact on other task(s)	The synergy is within Task 20.1, between use cases part of Sub Task 20.1.2
Technical Enabler(s)	TE18. Improving Rail Integration through B2B Intermodal Services.
Interactions SP/FP	No interaction foreseen
Actor(s)	Transport Service Provider (TSP). (e.g. Rail operator, regional train operator, bus operator). Service Provider (SP). Generalization of TSP. Company managing non transport services and associated with the offers when applicable
Trigger	The ASP (Apportionment and Settlement Platform) publishes settlement records
Pre-Condition(s)	TSP registered in the Distributed Ledger
Input	Settlement record including movements, amounts and balances.
Result/Requirement	Ledger block distributed to TSP and SP
Final State	TSP and SP can view and validate ledger blocks
Sequence	1. Settlement record generated by the ASP following the processing of combined sale transactions. 2. Settlement record processed by the Distributed Ledger interface and distributed into the Distributed Ledger 3. TSP connects to its node 4. TSP validates (signs) the new blocks.

	5. TSP checks block history.
Expected implementation Date	Q4 2024
Involved components (System)	Cloud ASP Platform, Distributed Ledger, Distributed Ledger Interface
Responsible partner/person	GTSD RCS
Notes	This use case is connected with other financial services use cases.

11.7. UC-FP1-WP19-07 Financial services. Processing of CEN NeTEx Fare data.

Name	Financial Services. Processing of CEN NeTEx Fare data
ID	UC-FP1-WP19-07
Description	This use case is associated with Enabler 19, Develop Standardized Interfaces. It deals with financial services made available to operators in order to support sales and distribution across different transportation networks The focus is on the processing of standardized fare transactions provided by TSPs.
Related to task/subtask(s)	Specification. Task 19.2 Implementation. 20.2
Impact on other task(s)	This use case is connected to B2B Intermodal Services part of Task 20.1 and especially Fare Collection Tools
Technical Enabler(s)	TE18, TE19.
Interactions SP/FP	Interaction with SP is associated with standards. Here CEN NeTEx part 3, Public transport fares exchange format is used.
Actor(s)	Traveller. Transport Service Provider (TSP), one or several TSPs, one of them being retailer
Trigger	Traveller purchase Trigger of Revenue Settlement.
Pre-Condition(s)	Products recorded at the ASP (including apportionment rules) ASP platform and Retailer have CEN NeTEx part 3 interface
Input	Traveller purchases a set of Fare Product at the Retailer. Sale transaction generated by the Retailer in CEN NeTEx part 3 format and transmitted to the ASP Base demo will use Retailer simulator generating NeTEx transactions
Result/Requirement	Detailed revenue settlement between Service Providers participating in the offer, processed based on input data in NeTEx format
Final State	Settlement is made available to the TSPs
Sequence	1. CEN NeTEx Part 3 Sales transaction generated at the Retailer 2. Transaction transferred to the ASP platform 3. Transaction checked for consistency

	4. Revenue apportionment update triggered in near real time (apportionment per TSP based on configured rules can be checked at the ASP) Steps 1 to 3 are performed per sale operation. Use Case may include several purchases initiated by multiple travellers.
Expected implementation Date	Q4 2024
Involved components (System)	ASP MaaS Platform
Responsible partner/person	GTSD RCS
Notes	NA

11.8. UC-FP1-WP19-08 Exchange of disruptions and mitigation strategies information

Name	Exchange of disruptions and mitigation strategies information
ID	UC-FP1-WP19-08
Description	In order to minimize the impacts of an occurred disruption, the railway TSP chooses the mitigation strategy to be implemented and an incident message is produced to inform passengers accordingly
Related to task/subtask(s)	Specification: Task 19.1, Task 19.2 Development: Task 20.1, Task 20.2 Demonstration: Task 21.6
Impact on other task(s)	Output data of disruption management system (Task 19.9) is needed for this use case
Technical Enabler(s)	TE18, TE19, TE27
Interactions SP/FP	
Actor(s)	Railway Service Provider, Consumer of data
Trigger	The Railway Service Provider chooses the mitigation strategy to be implemented
Pre-Condition(s)	Occurrence of a disruption
Input	Disruption information Set of mitigation strategies proposed
Result/Requirement	An incident message is generated and can be acquired by consumers of data
Final State	Passengers are informed of a possible incident and how to proceed with their journey
Sequence	List steps of the Use Case 1. Railway SP views disruption information and the proposed mitigation strategies (if any) on Disruption Management HMI 2. Railway SP chooses the mitigation strategy to be implemented 3. An incident message (in a standardized data format) related to the occurred event and the chosen mitigation strategy is generated 4. Provision of the incident message in SIRI SX and mitigation strategy via API
Expected Release Date	November 2024
Involved components (System)	Disruption Management HMI, disruption management system
Responsible partner/person	STS
Notes	This use case will be applied to platform provided by STS

11.9. UC-FP1-WP19-09 Unified multimodal information storage and update

Name	Unified multimodal information storage and update
ID	UC-FP1-WP19-09
Description	Multimodal transport requires municipal level analysis and treatment. Information from railway operators, public city transport operators and smaller service providers has its own local specificity. Exchange and integration of municipal information in this aspect can be realized with one system designed for storing disparate data i.e. data lake. Business users will be able to provide relevant information for other municipal level operators for the purpose of travel integration.
Related to task/subtask(s)	Specification: 19.1, 19.2 Development: 20.1, 20.1.1 Demonstration: 21
Impact on other task(s)	Information provided by B2B actor to the system can be used in realization of UCs relevant to tasks 22 and 24-25.
Technical Enabler(s)	TE18, TE19
Interactions SP/FP	FP3 - Multimodality information can be used for better railway station asset management in WP14-15
Actor(s)	Railway Service Provider; City Transit Operators; Municipal Independent Operators; Station Operators; Other multimodality operators;
Trigger	Operator intends to update their information in the system in order to keep it current on the single point of truth system
Pre-Condition(s)	Agreement between actors (Business) Actors have access to the data lake interfaces (Technical)
Input	Data request
Result/Requirement	System is provided with updated data in the arranged format
Final State	Updated or included new information from business users
Sequence	1. Actor creates data to be included 2. Data is being sent 3. System validates data and returns validation results 4. System creates internal metadata and includes it into data lake
Expected Release Date	Autumn 2024 (TRL5)
Involved components (System)	Municipal Data lake, Municipal Data Exchange Interface External: Operator's system
Responsible partner/person	PKP, Jerzy Baranowski
Notes	Initial version to be discussed with other 19.1 partners

11.10. UC-FP1-WP19-10 Accessing multimodal information data for creating multimodal travel plans between on municipal level

Name	Accessing multimodal information data for creating multimodal travel plans between on municipal level
ID	UC-FP1-WP19-10
Description	Multimodal transport requires municipal level analysis and treatment. Information from railway operators, public city transport operators and smaller service providers has its own local specificity. Exchange and integration of municipal information in this aspect can be realized with a one system designed for storing disparate data i.e., data lake. This can be used to exchange complete travel plans from one municipality to another. A Travel planning application (B2B partner) can access unified data lake to obtain verified data for their application.
Related to task/subtask(s)	Specification: 19.1, 19.2 Development: 20.1, 20.1.1 Demonstration: 21
Impact on other task(s)	Synergy with disturbance management: 24.5, 25.1, Multimodality information relevant for accessibility mobile solutions: 22.1
Technical Enabler(s)	TE18, TE19
Interactions SP/FP	-
Actor(s)	Railway Service Provider; City Transit Operators; Municipal Independent Operators; Other multimodality operators; ¡
Trigger	Operator intends to access data to update multimodality information in their planning system
Pre-Condition(s)	Agreement between actors (Business) Actors have access to the data lake interfaces (Technical)
Input	Data request
Result/Requirement	Actor receives requested data in the arranged format
Final State	• Data delivery
Sequence	Data access request: 1. Actor specifies required data and metadata through API 2. Request is being sent 3. Data is being verified for changes 3. Data is being sent 4. Actor processes the data
Expected Release Date	Autumn 2024 (TRL5)
Involved components (System)	Municipal Data lake, Municipal Data Exchange Interface External: Travel Planning Application

Responsible partner/person	PKP, Jerzy Baranowski
Notes	Initial version to be discussed with other 19.1 partners

11.11. UC-FP1-WP19-11 Support for multimodality decisions

Name	Support for multimodality related decisions for station operator
ID	UC-FP1-WP19-11
Description	Multimodal transport availability is an important aspect when making decision regarding economic effectiveness of station operation. For ensuring effective decision making process one needs to receive relevant data in accessible and well visualized form. Proposed use case is based on dashboards and relevant data processing and logic for helping to make an informed decision. For example, we can visualize areas using geographical maps available from the stations within one or more legs of a multimodal journey.
Related to task/subtask(s)	Specification: 19.1, 19.2 Development: 20.1, 20.1.1
Impact on other task(s)	-
Technical Enabler(s)	TE18
Interactions SP/FP	FP3 (WP14, WP15) where the asset management decision support systems for stations are being developed
Actor(s)	Station operator
Trigger	Need for economical decision making on a station level
Pre-Condition(s)	Functioning data lake with disparate data on municipal level (Technical) Actor has access to the data lake interfaces (Technical)
Input	Call to Decision Support System (DSS)
Result/Requirement	The system provides as result a possible decision for the required support
Final State	n/a
Sequence	1. Accessing DSS 2. Selection of appropriate station to analyse 3. Setting how many modes of transport are being analysed 4. Setting parameters (geographical distance, maximum number of connections) 5. DSS generates dashboard with indicated connective areas
Expected Release Date	Autumn 2024 (TRL5)
Involved components (System)	Municipal Data lake, DSS dashboard, Municipal Data Exchange Interface
Responsible partner/person	PKP, Jerzy Baranowski
Notes	Initial version to be discussed with other 19.1 partners

11.12. UC-FP1-WP19-12 Totem – T-Ais no 1 (ADIF)

Name	Totem T-Ais. 1 specific spot for people with visual disability
ID	UC-FP1-WP19-12
Description	Totem receives information from transportation information sources, offering specific information to people according to their requests.
Related to task/subtask(s)	T19.3, T22.1 (Subtask 22.1.2), T23.2
Impact on other task(s)	T19.5
Technical Enabler(s)	TE20
Interactions SP/FP	N/A
Actor(s)	Person with disabilities (visual)
Trigger	A person with disabilities needs to reach independently different points in the railway multimodal station, but there is not enough of easily accessible information.
Pre-Condition(s)	• Registered INECO Totem T-Ais research project. • To have the access of data that provides this information: PTO and Rail Administrator's data sources.
Input	• Data from Metro of Malaga (PTO) • Data from Administrator
Result/Requirement	Accessible and personalized information.
Final State	Traveler receives personalized accessible information.
Sequence	1. Locate Totem in an easy to reach and accessible place inside the station. 2. Accessible information about journeys and accessible routes to different places at the station will be shown for people with visual disability.
Expected Release Date	November 2024
Involved components (System)	TSP and Rail Administrator Information Platform, Totem T-Ais System
Responsible partner/person	ADIF FM and Metro de Málaga
Notes	

11.13. UC-FP1-WP19-13 Totem T_Ais no 2 (ADIF)

Name	Totem T-Ais. 1 specific spot for people with hearing impairment, PRM, motor disability, cognitive impairment, language misunderstanding and some visual impairments; also can be used by persons with no disabilities.
ID	UC-FP1-WP19-13
Description	Totem receives information from transportation information sources, offers specific information in text by screen, loudspeaker and magnetic induction loop, to people according to their requests.
Related to task/subtask(s)	T19.3, T22.1 (Subtask 22.1.2), T23.2
Impact on other task(s)	T19.5
Technical Enabler(s)	TE20
Interactions SP/FP	N/A
Actor(s)	Person with disabilities
Trigger	A person with disabilities needs to reach independently different points in the railway multimodal station, but there is not enough of easily accessible information.
Pre-Condition(s)	• Registered INECO Totem T-Ais research project. • To have the access of data that provides this information: PTO and Rail Administrator's data sources.
Input	• Data from Metro of Malaga (PTO) • Data from Administrator
Result/Requirement	Accessible and personalized information.
Final State	Traveler receives personalized accessible information.
Sequence	1. Locate Totem in an easy to reach and accessible place inside the station. 2. Accessible information about journeys and accessible routes to different places at the station will be shown.
Expected Release Date	November 2024
Involved components (System)	TSP and Rail Administrator Information Platform, Totem T-Ais System
Responsible partner/person	ADIF FM and Metro de Málaga
Notes	

11.14. UC-FP1-WP19-14 – Gap filler (ADIF)

Name	Gap Filler for the gap between platform and rail stock
ID	UC-FP1-WP19-14
Description	Piece to solve gap between platform and train.
Related to task/subtask(s)	T19.5 , T22.1 (Subtask 22.1.2), T23.
Impact on other task(s)	
Technical Enabler(s)	TE22
Interactions SP/FP	N/A
Actor(s)	Traveller
Trigger	Gap between platform and train that can cause people to fall between the train and the platform.
Pre-Condition(s)	Horizontal gap between platform and train.
Input	Distance between platform and rolling stock and definition of the element that could serve to fill it in according to the current standards.
Result/Requirement	Reducing the gap between platform and rolling stock and facilitating the transition of passengers between train and platform. Resolution of interfaces between infrastructure and rolling stock.
Final State	Improve travellers safe and comfortable transition between platform and rolling stock.
Sequence	1. Prepare a technical analysis to find out the specific places that need intervention at the selected station. 2. Select critical points in platform to apply Gap Filler. 3. Installation of Gap Filler. 4. Test period
Expected Release Date	November 2024
Involved components (System)	Gap filler, Railway Station, Technical Integration
Responsible partner/person	ADIF FM
Notes	

11.15. UC-FP1-WP19-15 – Gobo (ADIF)

Name	Gobo useful information lights for the traveller with or without disabilities
ID	"UC-FP1-WP19-15"
Description	Gobo to indicate on wall or floor useful indicative information.
Related to task/subtask(s)	T19.5, T22.1 (Subtask 22.1.2), T23.2
Impact on other task(s)	
Technical Enabler(s)	TE22
Interactions SP/FP	N/A
Actor(s)	Traveller
Trigger	Lack of public transport information to people with disabilities.
Pre-Condition(s)	Lack of public transport information to people with disabilities.
Input	Important information to be shown at certain places.
Result/Requirement	Important accessible information showed at certain places.
Final State	Important accessible information showed at certain places.
Sequence	1. Establish where to show the message or image. 1. Install one gobo in that area. 1. Proof whether the visibility is properly or not and decide between wall or floor to redirect the light. 5. Test period
Expected Release Date	November 2024
Involved components (System)	Gobo , Railway Station, Technical Integration
Responsible partner/person	ADIF FM
Notes	

11.16. UC-FP1-WP19-16 – Accessible Robot

Name	Accessible Robot
ID	UC-FP1-WP19-16
Description	Guiding of people with disabilities inside of the multimodal railway station
Related to task/subtask(s)	T19.3, T22.1 (Subtask 22.1.2), T23.2
Impact on other task(s)	
Technical Enabler(s)	TE20
Interactions SP/FP	N/A
Actor(s)	Person with disabilities
Trigger	People with disabilities that have difficulties to reach different spots in the multimodal station.
Pre-Condition(s)	Passengers who need help moving their luggage or moving themselves to the correct spot in the station do not have support that can be independent of human assistance.
Input	• Data from Metro of Malaga (PTO) • Data from Administrator • Other data
Result/Requirement	Support with displacement and orientation at the station of the traveller with disabilities or other special needs towards the correct spot in the station
Final State	The traveller reaches the needed spot at the multimodal station
Sequence	1. Establish where the traveller needs to go. 2. Book the robot at specific date and hour. 3. Once in the station, robot will be expecting to the traveller. 4. The traveller let the robot to guide him by gripping robot's handlebar 5. The robot moves through the station towards the destination while guiding the traveller 6. Traveler gets to the destination
Expected Release Date	November 2024
Involved components (System)	Rail Administrator Information Platform, Guiding Accessible SW, Robot
Responsible partner/person	ADIF FM
Notes	

11.17. UC-FP1-WP19-17 – Guiding Accessible Software

Name	Guiding Accessible Software
ID	UC-FP1-WP19-17
Description	Guiding of people with disabilities inside of the multimodal railway station
Related to task/subtask(s)	T19.3, T19.5, T22.1 (Subtask 22.1.2), T23.2
Impact on other task(s)	
Technical Enabler(s)	TE 20, TE 22
Interactions SP/FP	N/A
Actor(s)	Traveller
Trigger	People with disabilities that have difficulties to reach different points in the multimodal station and improve traveling experience.
Pre-Condition(s)	Lack of digital support that could improve traveller experience for people with disabilities and make it more accessible.
Input	• Data from Metro of Malaga (PTO) • Data from Administrator • Other data
Result/Requirement	Improvement of the travel experience for people with disabilities.
Final State	The travellers with disabilities can easily find accessible routes in the multimodal station that can help them to make their journey from the point A to the point B.
Sequence	• The traveller accesses the SW • The best route / service according to the needs of the traveller is located • Traveler uses the support of the SW to get to the destination
Expected Release Date	November 2024
Involved components (System)	TSP and Rail Administrator Information Platform, Guiding Accessible Software, Robot, Guiding Accessible Intelligent Tool, Totem T-Ais, Assistance Integrative Mobile App
Responsible partner/person	ADIF FM and Metro de Málaga
Notes	

11.18. UC-FP1-WP19-18 – Guiding Accessible Intelligent Tool

Name	Guiding Accessible Intelligent Tool with physical complementary signalling in different languages
ID	UC-FP1-WP19-18
Description	Guiding of people with disabilities inside of the multimodal railway station
Related to task/subtask(s)	T19.3, T19.5, T22.1 (Subtask 22.1.2), T23.2
Impact on other task(s)	
Technical Enabler(s)	TE 20, TE 22
Interactions SP/FP	N/A
Actor(s)	Traveller
Trigger	People with disabilities that have difficulties to reach different points in the multimodal station and improve traveling experience.
Pre-Condition(s)	Lack of digital support that could improve traveller experience for people with disabilities and make it more accessible.
Input	• Data from Metro of Malaga (PTO) • Data from Administrator • Other data
Result/Requirement	Improvement of the travel experience for people with disabilities.
Final State	The travellers with disabilities can find accessible intelligent routes in the multimodal station that can help them to make their journey from the point A to the point B with information in real time.
Sequence	• The traveller accesses the SW or identifies visual/physical signalling on the floor • The best route / service according to the needs of the traveller is located • Traveler uses the support of the SW to get to the destination
Expected Release Date	November 2024
Involved components (System)	TSP and Rail Administrator Information Platform, Guiding Accessible Software, Guiding Accessible Intelligent Tool
Responsible partner/person	ADIF FM
Notes	

11.19. UC-FP1-WP19-19 - UC Frictionless Validation

Name	Frictionless validation
ID	UC-FP1-WP19-19
Description	A user is able to validate a ticket without showing any visual ticket to the validation equipment facilitating the access to public transport.
Related to task/subtask(s)	Specification – Task 19.4 – Specification Enabler 21 Development – Task 22.2 – Hands-free Solutions & Smart Information Demonstration - Task 23.1 - Demonstration in Madrid
Impact on other task(s)	Task 19.3 – Specification Enabler 20 Task 22.1 – Travel assistance across modes
Technical Enabler(s)	TE 20 (Validation solution) TE 21 (Application)
Interactions SP/FP	N/A
Actor(s)	Traveller
Trigger	The user wants to get into the platform.
Pre-Condition(s)	The user is registered in the platform and has an active account The user has balance at the account or is subscribed to post-billing The user has installed the app on the mobile device and has UWB/BLE enabled
Input	The active account and balance/subscription
Result/Requirement	The user reaches the platform
Final State	The user is granted access through validating against the account balance/subscription
Sequence	1. The user approaches to the platform 2. The validation solution detects the mobile app of the user 3. The validation solution checks the user profile at the back-office level 4. The validation solution opens the gate 5. The user reaches the platform
Expected Release Date	November 2024
Involved components (System)	Validation equipment, Ticketing System, MaaS App
Responsible partner/person	Indra Sistemas S.A Enrique Jimenez
Notes	This UC is available for any passenger, but it should be adapted to PRM

11.20. UC-FP1-WP19-20 - UC Indoor guidance

Name	Indoor guidance
ID	UC-FP1-WP19-20
Description	The user receives information of the map of the station and is guided to the platform facilitating the access of PRM to public transport.
Related to task/subtask(s)	Specification – Task 19.3 – Specification Enabler 20 Development – Task 22.1 – Travel assistance across modes Demonstration - Task 23.1 - Demonstration in Madrid
Impact on other task(s)	Task 19.4 – Specification Enabler 21 Task 22.2 – Hands-free Solutions & Smart Information
Technical Enabler(s)	TE 20 (Location solution) TE 21 (Application)
Interactions SP/FP	N/A
Actor(s)	Traveller
Trigger	The user gets into the station and wants to get to the platform.
Pre-Condition(s)	The user has installed the application on the smartphone
Input	N/A
Result/Requirement	The user reaches the platform
Final State	The user is in the platform
Sequence	1. The user arrives to the station 2. The application detects that is on the platform and activates the guiding mode 3. The app shows a notification 4. The user opens the guiding mode 5. The map of the station appears 6. The app shows the accessible itinerary to the user 7. The user sees itself on the map and follow the indications
Expected Release Date	November 2024
Involved components (System)	MaaS App MaaS platform Indoor guidance tool Wireless devices in stations
Responsible partner/person	Indra Sistemas S.A Enrique Jimenez
Notes	This user is available for any passenger but is mainly addressed to PRM in order to facilitate their access to the Public Transport

11.21. UC-FP1-WP19-21 - UC Account based ticketing

Name	Account based ticketing
ID	UC-FP1-WP19-21
Description	Account-Based Ticketing is a ticketless way of allowing people to travel meaning they tap or scan using a secure token, linked to an account in the back office, to make a journey. The location and amount of taps calculates the fare, which is charged to the passenger during or post journey. This means riders no longer need to buy a ticket and can benefit from best fare policies.
Related to task/subtask(s)	Specification – Task 19.4 – Specification Enabler 21 Development – Task 22.2 – Hands-free Solutions & Smart Information Demonstration - Task 23.1 - Demonstration in Madrid
Impact on other task(s)	Task 19.3 – Specification Enabler 20 Task 22.1 – Travel assistance across modes
Technical Enabler(s)	TE 20 (Validation solution) TE 21 (Application)
Interactions SP/FP	N/A
Actor(s)	Traveller
Trigger	The user wants to travel.
Pre-Condition(s)	The user is registered on the ecosystem and has an associated account
Input	N/A
Result/Requirement	The user receives the fare at the end of the day
Final State	N/A
Sequence	1. The user gets into the station 2. The user taps on the validation equipment 3. The back office registers the entrance of the user 4. The user taps at leaving the station 5. The back office registers the end of the trip 6. The back office calculates the fare 7. The user receives a notification at the end of the day with the price of the trip/trips done at the end of the day with the cheapest solution
Expected Release Date	November 2024
Involved components (System)	ABT
Responsible partner/person	Indra Sistemas S.A Enrique Jimenez
Notes	N/A

11.22. UC-FP1-WP19-22- Hands Free. UWB Walk-in

Name	Hands Free. UWB Walk-in
ID	UC-FP1-WP19-22
Description	This use case is associated with Enabler 21, Hands Free solutions for travellers using rail services and transferring between operators and mobility modes. It addresses the case of passengers entering a mobility hub and especially the situation where the entry to the hub (or to some parts of the hub) is controlled using automated gates. The focus is on hands-free interaction with the gate line and associated processing.
Related to task/subtask(s)	Specification. Task 19.4. Specification Enabler 21 Implementation. Task 22.2. Hands-free Solutions & Smart Information Demonstration. Task 23.5. Demonstration in Amsterdam
Impact on other task(s)	This use case may have some synergy with Task 19.3 (Enabler 20, Travel Assistance Across Modes)
Technical Enabler(s)	21. Hands Free solutions for travellers using rail services and transferring between operators and mobility modes.
Interactions SP/FP	
Actor(s)	Traveller. Traveller having a UWB Wearable Tag used as a token interacting with the gate line of the mobility hub. Transport Service Provider (TSP) managing the gate line at the hub.
Trigger	Traveller entering the positioning area (detection area) ahead of the gate line.
Pre-Condition(s)	UWB tag registered and valid.
Input	Solution setup. Especially detection area configured and Hands-free Ticketing sensors (i.e. UWB Anchors) placed adequately.
Result/Requirement	Traveller guided to the gate line, access granted
Final State	Traveller in the closed area of the hub.
Sequence	1. The passenger, having a UWB Wearable Tag, enters the positioning area. 2. UWB Anchors receive the signals from the UWB Tag and exchange data with the RTLS (Real Time Location System) Gateway. 3. The RTLS Gateway calculates and updates continuously the positioning of the traveller and informs the HFCS (Hands Free Control System). 4. The HFCS determines the validity of the Tag.

	5. When the Tag is valid, the HFCS monitors movement of the traveller towards the gate line end when they enter a given gate aisle, this one displays a welcome message and guidance information 6. The gate mechanism opens the door and lets the passenger enter. 7. The HFCS updates its internal status.
Expected implementation Date	Q4 2024
Involved components (System)	Gate line, UWB Anchors, RTLS (Real Time Location System), HFCS (Hands Free Control System).
Responsible partner/person	GTSD RCS
Notes	Demo will happen in an operational environment (real mobility hub) where some gate lines will be adapted for the purpose of the use case.

11.23. UC-FP1-WP19-23- Hands Free. UWB Walk-out

Name	Hands Free. UWB Walk-out
ID	UC-FP1-WP19-23
Description	This use case is associated with Enabler 21, Hands Free solutions for travellers using rail services and transferring between operators and mobility modes. It addresses the case of passengers leaving a mobility hub and especially the situation where the entry to the hub (or to some parts of the hub) is controlled using automated gates. The focus is on hands-free interaction with the gate line and associated processing.
Related to task/subtask(s)	Specification. Task 19.4. Specification Enabler 21 Implementation. Task 22.2. Hands-free Solutions & Smart Information Demonstration. Task 23.5. Demonstration in Amsterdam
Impact on other task(s)	This use case may have some synergy with Task 19.3 (Enabler 20, Travel Assistance Across Modes)
Technical Enabler(s)	21. Hands Free solutions for travellers using rail services and transferring between operators and mobility modes.
Interactions SP/FP	Potential interaction with SP in relation with Task 19.3
Actor(s)	Traveller. Traveller having a UWB Wearable Tag used as a token interacting with the gate line of the mobility hub. Transport Service Provider (TSP) managing the gate line at the hub.
Trigger	Traveller in the “inner zone” of the station approaches the gate line and enters the positioning area (detection area)
Pre-Condition(s)	UWB tag registered and valid (typically, entry registered)
Input	Solution setup. Especially detection area configured and Hands-free Ticketing sensors (i.e. UWB Anchors) placed adequately.
Result/Requirement	Traveller guided to the gate line, exit granted
Final State	Traveller outside of the inner zone of the hub.
Sequence	1. The passenger, having a UWB Wearable Tag, enters the positioning area. 2. UWB Anchors receive the signals from the UWB Tag and exchange data with the RTLS (Real Time Location System) Gateway. 3. The RTLS Gateway calculates and updates continuously the positioning of the traveller and informs the HFCS (Hands Free Control System).

	4. The HFCS determines the validity of the Tag. 5. When the Tag is valid, the HFCS monitors movement of the traveller towards the gate line end when they enter a given gate aisle, this one displays an acknowledgment 6. The gate mechanism opens the door and lets the passenger exit. 7. The HFCS updates its internal status.
Expected implementation Date	Q4 2024
Involved components (System)	Gate line, UWB Anchors, RTLS (Real Time Location System), HFCS (Hands Free Control System).
Responsible partner/person	GTSD RCS
Notes	Demo will happen in an operational environment (real mobility hub) where some gate lines will be adapted for the purpose of the use case.

11.24. UC-FP1-WP19-24- Hands Free. UWB Intermodal transfer

Name	Hands Free. UWB Intermodal transfer
ID	UC-FP1-WP19-24
Description	This use case is associated with Enabler 21, Hands Free solutions for travellers using rail services and transferring between operators and mobility modes and Enabler 22 Platform based guidance It addresses the case of passengers transferring from train to another mobility mode (e.g. LRT, bus, taxi) The focus is on interactive guidance (floor signs lit up to show direction).
Related to task/subtask(s)	Specification. Task 19.4., Task 19.5 Specification Enabler 21, 22 Implementation. Task 22.2. Hands-free Solutions & Smart Information, Task 22.3. General approach to platform-based guidance Demonstration. Task 23.5. Demonstration in Amsterdam (to be confirmed)
Impact on other task(s)	No impact
Technical Enabler(s)	21. Hands Free solutions for travellers using rail services and transferring between operators and mobility modes. 22. Platform based guidance
Interactions SP/FP	No interaction foreseen
Actor(s)	Traveller. Traveller having a UWB Wearable Tag used as a token and associated with travel rights Transport Service Provider (TSP) managing the mobility hub
Trigger	Traveller in the mobility hub, leaving the train, crossing the gate and about to transfer
Pre-Condition(s)	UWB tag registered. Traveller has a valid travel right (here with intermodal journey registered)
Input	Solution setup. Especially detection area configured and Hands-free Ticketing sensors (i.e. UWB Anchors) placed adequately.
Result/Requirement	Traveller guided to the next mobility mode
Final State	Traveller heading for the next mobility mode (LRT platform
Sequence	1. The passenger, having a UWB Wearable Tag is leaving the train area and crosses the gate 2. UWB walk-out use case is carried out 3. The HFCS detects that the next travel episode for the traveller is via another mobility mode 4. The HFCS lights up the Floor sign with the adequate message to guide the traveller

Expected implementation Date	Q4 2024
Involved components (System)	Floor signs, UWB Anchors, RTLS (Real Time Location System), HFCS (Hands Free Control System).
Responsible partner/person	GTSD RCS
Notes	Demo should happen in an operational environment (real mobility hub)

11.25. UC-FP1-WP19-25- Hands Free. UWB In Station Assistance

Name	Hands Free. UWB In station assistance
ID	UC-FP1-WP19-25
Description	This use case is associated with Enabler 20, PRM information sharing, and associated assistive tools The focus is on in station staff assistance to people with disabilities (not limited to physical impairments)
Related to task/subtask(s)	Specification. Task 19.3. Specification Enabler 20 Implementation. Task 22.1. Travel assistance across modes Demonstration. Task 23.3. Demonstration in Amsterdam
Impact on other task(s)	Connection with Task 22.2, Hands-free Solutions & Smart Information
Technical Enabler(s)	20, PRM information sharing, and associated assistive tools
Interactions SP/FP	reference to TAP TSI PRM
Actor(s)	Traveller. Traveller having a UWB Wearable Tag used as a token and associated with disabled profile Transport Service Provider (TSP) managing the mobility hub
Trigger	Traveller enters the mobility hub
Pre-Condition(s)	UWB tag registered with disabled profile.
Input	Solution setup. Especially detection area configured and Hands-free Ticketing sensors (i.e. UWB Anchors) placed adequately.
Result/Requirement	In station staff informed of the presence of a traveller with disabilities (and ready to provide assistance)
Final State	Station staff informed
Sequence	1. The passenger, having a UWB Wearable Tag associated with a disabled profile enters the mobility hub. 2. UWB Anchors receive the signals from the UWB Tag and exchange data with the RTLS (Real Time Location System) Gateway. 3. The HFCS determines the validity of the Tag, the profile associated with the tag. 4. The HFCS sends a text message to a station staff mobile phone with a detailed context (location, nature of the disability)
Expected implementation Date	Q4 2024
Involved components (System)	UWB Anchors, RTLS (Real Time Location System), HFCS (Hands Free Control System).
Responsible partner/person	GTSD RCS
Notes	Demo should happen in an operational environment (real mobility hub)

11.26. UC-FP1-WP19-26- Hands Free. Face recognition Walk-in

Name	Hands Free. Face Recognition Walk-in
ID	UC-FP1-WP19-26
Description	This use case is associated with Enabler 21, Hands Free solutions for travellers using rail services and transferring between operators and mobility modes. It addresses the case of passengers entering a closed area in the mobility hub (boarding area or equivalent) where access is granted through face recognition (for registered passengers) The focus is on hands-free interaction with gate lines and associated processing.
Related to task/subtask(s)	Specification. Task 19.4. Specification Enabler 21 Implementation. Task 22.2. Hands-free Solutions & Smart Information Demonstration. Task 23.3. Demonstration in Amsterdam (to be confirmed)
Impact on other task(s)	No impact foreseen.
Technical Enabler(s)	21. Hands Free solutions for travellers using rail services and transferring between operators and mobility modes.
Interactions SP/FP	No interaction at this stage
Actor(s)	Traveller. Traveller having registered for face recognition service. Transport Service Provider (TSP) managing the gate line at the hub and providing the face recognition service
Trigger	Traveller approaching the gate line (boarding area)
Pre-Condition(s)	Traveller having registered for the transit face recognition service at the FRS (registration done with smart phone)
Input	Solution setup. Especially gate setup with FCM (Face Capture Module), FRS (Face Recognition Server) deployment
Result/Requirement	Access granted to the boarding area
Final State	Traveller in the closed area (boarding area)
Sequence	1. A traveller registered at the face recognition service approaches the dedicated gate 2. The gate FCM captures the facial signature in real time and sends it to the cloud FCS platform. 3. The FCS processes the signature and confirms the travel rights. 4. The FCS sends back the agreement to the gate 5. The gate mechanism opens the door and lets the passenger enter.
Expected implementation Date	Q4 2024

Involved components (System)	Gate line with FCM (Face Capture Module), Cloud FRS (Face Recognition Server).
Responsible partner/person	GTSD RCS
Notes	Demo will happen in an operational environment (real mobility hub) where some gate lines will be adapted for the purpose of the use case.

11.27. UC-FP1-WP19-27- Hands Free. Face recognition Walk-out

Name	Hands Free. Face Recognition Walk-out
ID	UC-FP1-WP19-27
Description	This use case is associated with Enabler 21, Hands Free solutions for travellers using rail services and transferring between operators and mobility modes. It addresses the case of travellers leaving a gated area in a mobility hub (e.g. case where access to platforms is controlled ahead of boarding). Exit is granted through face recognition for those of the travellers having subscribed to the service. The focus is on hands-free interaction with gate lines and associated processing.
Related to task/subtask(s)	Specification. Task 19.4. Specification Enabler 21 Implementation. Task 22.2. Hands-free Solutions & Smart Information Demonstration. Task 23.3. Demonstration in Amsterdam (to be confirmed)
Impact on other task(s)	No impact foreseen.
Technical Enabler(s)	21. Hands Free solutions for travellers using rail services and transferring between operators and mobility modes.
Interactions SP/FP	No interaction at this stage
Actor(s)	Traveller. Traveller having registered for face recognition service. Transport Service Provider (TSP) managing the gate line at the hub and providing the face recognition service
Trigger	Traveller leaving the gated area. Note that the face recognition is assumed to be provided by dedicated gates and the traveller (assumed to be a frequent traveller) uses these lanes.
Pre-Condition(s)	Traveller having registered for the transit face recognition service at the FRS (registration done with smart phone)
Input	Solution setup. Especially gate setup with FCM (Face Capture Module), FRS (Face Recognition Server) deployment
Result/Requirement	Traveller leaves the closed area.
Final State	Traveller outside of the closed area
Sequence	1. A traveller registered at the face recognition service approaches the dedicated gate line. 2. The gate FCM captures the facial signature in real time and sends it to the cloud FCS platform. 3. The FCS processes the signature and confirms the travel rights.

	4. The FCS sends back the agreement to the gate 5. The gate mechanism opens the door and lets the passenger leave the gates area
Expected implementation Date	Q4 2024
Involved components (System)	Gate line with FCM (Face Capture Module), Cloud FRS (Face Recognition Server).
Responsible partner/person	GTSD RCS
Notes	Demo will happen in an operational environment (real mobility hub) where some gate lines will be adapted for the purpose of the use case.

11.28. UC-FP1-WP19-28 Illuminated Platform Edge

Name	Illuminated Platform Edge: Use case “Attention”
ID	UC-FP1-WP19-28
Description	The Illuminated Platform Edge (IPE) is designed to facilitate a more efficient and attentive travel experience for passengers while also enhancing their safety. By constantly illuminating the platform edge in a red colour when no train is present, it should effectively raise awareness of the potential danger zone. If the train is arriving, the IPE flashing red lights to promptly notify passengers about the arrival or departure of trains and should effectively warning them about potentially hazardous situations.
Related to task/subtask(s)	Specification. Task 19.5. Specification Enabler 22 Implementation. Task 22.3. platform based guidance Demonstration. Task 23.3. Demonstration in Berlin or Hannover
Impact on other task(s)	-
Technical Enabler(s)	TE22
Interactions SP/FP	-
Actor(s)	The main actor is the **traveller**. The other part is the Metro Service Provider (S-Bahn Berlin). The implementation and management of this system are under the supervision of Deutsche Bahn Station&Service AG (station owner), which is operated by the stationmanagement (in this case Berlin).
Trigger	The system remains illuminated in a constant red colour until a sensor on the track detects an approaching train. At that point, the system activates flashing lights to promptly warn and alert passengers about the train's imminent arrival. The second Trigger is a “train stopping sensor” at the station.
Pre-Condition(s)	The Illuminated Platform Edge requires integration with sensor technology and supervision software, as well as access to the internet. It is already possible to establish a connection with passengers' information systems, enhancing the functionality and effectiveness of the system.
Input	The Illuminated Platform Edge incorporates sensors located on both the tracks and the platform, enabling the detection of various train parameters. These sensors gather real-time data to provide accurate and up-to-date information to passengers, facilitating better planning and decision-making regarding their travel arrangements.
Result/Requirement	By stepping back from the danger zone as indicated by the Illuminated Platform Edge, passengers ensure their safety. In addition, the system provides real-time information, enabling passengers to stay informed about train schedules and capacities. This improved travel experience not only enhances safety but also contributes to more efficient and expedient journeys.

Final State	The passengers successfully boarded the train and departed from the station.
Sequence	1. The system remains illuminated in a constant red colour, indicating the potential danger zone. 2. As a train approach and passes the sensor, the platform edge starts flashing, alerting passengers to the imminent arrival of the train. 3. The flashing stops as the train arrived in the station and passengers proceed to board the train. 4. Once the train departs from the platform, the system continues to blink and issue warnings, cautioning passengers to be aware of the departing train.
Expected Release Date	Q1 2024
Involved components (System)	Illuminated Platform edge, sensor technology and supervision software
Responsible partner/person	Christopher Schubert, DB Station&Service AG, Vincent Genz SIUT GmbH
Notes	The demonstrator at station Berlin Südkreuz has already been integrated structurally, requiring coordination of technology, software, sensors, etc. Subsequently, validation will take place.

11.29. UC-FP1-WP19-29 Illuminated Platform Edge

Name	Illuminated Platform Edge: Use Case “Orientation”
ID	UC-FP1-WP19-29
Description	The Illuminated Platform Edge can be utilized to display the various train compartments on the platform and the train stopping position (e.g. short trains), providing information to passengers and reducing boarding time.
Related to task/subtask(s)	Specification. Task 19.5. Specification Enabler 22 Implementation. Task 22.3. platform based guidance Demonstration. Task 23.3. Demonstration in Berlin or Hannover
Impact on other task(s)	-
Technical Enabler(s)	TE22
Interactions SP/FP	-
Actor(s)	The main actor is the traveller. The implementation and management of this system are under the supervision of Deutsche Bahn Station&Service AG, which is operated by the station management Berlin.
Trigger	The system remains illuminated in a constant red colour until the sensor detects an approaching train, capturing information about the train's length and model. Once detected, the system becomes active and displays the positioning of the train on the platform, providing relevant information alongside it. This comprehensive display of information helps passengers prepare for the train's arrival and make informed decisions regarding their boarding and travel plans.
Pre-Condition(s)	The implementation of the Illuminated Platform Edge necessitates the integration of sensor technology and supervision software, along with internet connectivity. It is already possible to establish a connection with passengers' information, enhancing the functionality and effectiveness of the system.
Input	The Illuminated Platform Edge incorporates sensors positioned on both the tracks and the platform, enabling the detection of various train parameters such as train type, arrival time, and specific compartments like multi-purpose compartments. These sensors gather real-time data, providing passengers with precise and up-to-date information.
Result/Requirement	Passengers are informed about the positioning of the train and its compartments even before its arrival, leading to decreased boarding time and ensuring a fair distribution of passengers across the entire platform. This advance information enables passengers to make more efficient boarding decisions and contributes to a smoother and more organized boarding process.

Final State	The passengers successfully boarded the train and departed from the station.
Sequence	1. The system maintains a steady red colour, indicating the potential danger zone. 2. As a train approach and passes the sensor, the platform edge displays the train stopping position by a running light and provides advance information of the train compartments. 3. The passengers position themselves. 4. The flashing stops as the train arrived in the station and passengers proceed to board the train. 5. After the train departs from the platform, the system continues to blink and issue warnings, reminding passengers to be cautious of the departing train.
Expected Release Date	Q1 2024
Involved components (System)	Illuminated Platform edge, sensor technology and supervision software
Responsible partner/person	Christopher Schubert, DB Station&Service AG, Vincent Genz SIUT GmbH
Notes	The demonstrator at Südkreuz Berlin Station has already been integrated structurally, requiring coordination of technology, software, sensors, etc. Subsequently, validation will take place.

11.30. UC-FP1-WP19-30 Illuminated Platform Edge

Name	Illuminated Platform Edge: Use case “Capacity”
ID	UC-FP1-WP19-30
Description	The Illuminated Platform Edge can be utilized to display the capacity of the specific train compartments on the platform using the traffic light colours, offering information to passengers and streamlining the boarding process.
Related to task/subtask(s)	Specification. Task 19.5. Specification Enabler 22 Implementation. Task 22.3. platform based guidance Demonstration. Task 23.3. Demonstration in Berlin or Hannover
Impact on other task(s)	-
Technical Enabler(s)	TE22
Interactions SP/FP	-
Actor(s)	The main actor is the traveller. The implementation and management of this system are under the supervision of Deutsche Bahn Station&Service AG, which is operated by the stationmanagement Berlin.
Trigger	The system remains illuminated in a constant red colour until the sensor detects an approaching train and reads the capacity of each compartment on the track a defined time before arriving. At that moment, the system becomes active and displays the positioning of the train on the platform and the capacity of the compartments by using traffic light colours on the platform.
Pre-Condition(s)	The implementation of the Illuminated Platform Edge necessitates the integration of sensor technology and supervision software, along with internet connectivity. It is already possible to establish a connection with passengers information systems, enhancing the functionality and effectiveness of the system. Also, a suitable capacity sensor (train dependent or independent) must be used.
Input	The Illuminated Platform Edge incorporates sensors positioned on both the tracks and the platform, enabling the detection of various train parameters such as train type, arrival time, and capacity. These sensors gather real-time data, providing passengers with precise and up-to-date information. This enhances their ability to plan and make informed decisions regarding their travel arrangements.
Result/Requirement	Passengers receive advance information regarding the positioning and capacity of the train prior to its arrival, resulting in reduced boarding time and promoting an equitable distribution of passengers throughout the entire train. This advanced knowledge empowers passengers to make more efficient boarding decisions, ultimately leading to a smoother and more organized boarding process. By optimizing the allocation of passengers across the train, the system enhances overall efficiency and improves the travel experience for everyone involved.

Final State	The passengers successfully boarded the train and departed from the station.
Sequence	1. The system maintains a steady red colour, indicating the potential danger zone. 2. As a train approach and passes the capacity on the track, the platform edge begins to display the advance information about the capacity of train compartments by using green, yellow and red colour on the platform. 3. The passengers position themselves in advance. 4. A defined time before train arrival a red light starting to flash. 5. By train stopping the flashing stops as the train arrived in the station and passengers proceed to board the train. 5. After the train departs from the platform, the system continues to blink and issue warnings, reminding passengers to be cautious of the departing train.
Expected Release Date	Q2 2024
Involved components (System)	Illuminated Platform edge, sensor technology especially capacity sensor and supervision software
Responsible partner/person	Christopher Schubert, DB Station&Service AG, Vincent Genz SIUT GmbH

11.31. UC-FP1-WP19-31 Notices for other modes of transport with connections at the railway station

Name	Notices for other modes of transport with connections at the railway station
ID	UC-FP1-WP19-31
Description	Create a warning to inform the other operators providing services at the station in order to improve the provision of their services. This warning is obtained from the results of the rail passenger demand forecasting model, comparing the long-term demand forecast data with the average expected demand data for that period at the station. Then an information warning will be published to the rest of the operators of transport services related to the station. These operators will be mainly the Malaga metro and taxi drivers. In this way the capacity of the different modes of transport that make up the modal chains at the station can be guaranteed.
Related to task/subtask(s)	Specification: Task 19.6, 19.7 Development: Task 24.1, 24.2 Demonstration: Task 25.2
Impact on other task(s)	N/A
Technical Enabler(s)	TE24
Interactions SP/FP	N/A
Actor(s)	• Rail Administrator (Owner of the railway infrastructure) • Metro Service Provider (Other transport mode provider) • Railway Service Provider
Trigger	Unexpected increase of passenger's demand which requires bigger frequencies in the other transport modes that complete the modal chains in the station with rail, mainly metro and taxi.
Pre-Condition(s)	To have the access of data that provides this information: PTO and Rail Administrator’s data sources
Input	Real time passenger demand data from Metro of Malaga (PTO) Real time data from Administrator (taxis, incidents in rail system – delays for trains-, etc.)
Result/Requirement	Informative warning to adjust the frequencies of the services of the other modes of transport to ensure a good service. And better management of resources
Final State	Interchange of incidents notifications between Metro PTO and ADIF

Sequence	1. Data from the long-term forecasting model available 2. Compare the data from the prediction model with the average data obtained for the same period of the day, in order to determine whether or not there is a significant increase in demand that requires additional services from the other transport operators at the station. 3. Adjustment of warnings in the model to the demand 4. Notification of the incident to the PTO (Metro) 5. Frequency adjustment of other services
Expected Release Date	November 2024
Involved components (System)	- Railway Subsystems (incidents information, taxis information, travellers information, etc. Provided by ADIF using different information platforms available). - Forecast platform which provides forecast demand developed by INDRA. - HMI dashboard (Display information platform developed by INDRA). - Metro Subsystem (rail passenger transport operator).
Responsible partner/person	ADIF FM, INDRA, Metro de Málaga
Notes	

11.32. UC-FP1-WP19-32 Notifications for activation of passenger flow management protocols

Name	Notifications for activation of passenger flow management protocols
ID	UC-FP1-WP19-32
Description	In the event that the results of short-term passenger demand forecasts imply a substantial increase in demand compared to the usual station demand for that timetable, a series of protocols for passenger flow management at the station may be applied. These protocols shall be developed by the station manager and shall define the different safety levels to be applied depending on the increase in demand. For this Use Case, it is necessary to define the limit increases in demand above which it will be necessary to implement these protocols at the station. The main objective is to guarantee the safety and fluidity of pedestrian flows in the station.
Related to task/subtask(s)	Specification: Task 19.6, Development: Task 24.1 Demonstration: Task 25.2
Impact on other task(s)	Task 19.3, Task 19.5, Task 22.1, Subtask 22.1.1, Subtask 22.1.2, Task 23.2
Technical Enabler(s)	TE 23
Interactions SP/FP	N/A
Actor(s)	• Rail Administrator (Owner of the railway infrastructure) • Metro Service Provider (Other transport mode provider) • Railway Service Provider
Trigger	An unexpected increase in passenger demand requiring measures to ensure security at the station.
Pre-Condition(s)	To have the access of data that provides this information (PTO and Rail Administrator's data sources). And the development, by the station manager, of the different security protocols to be implemented.
Input	Real time passenger demand data from Metro of Malaga (PTO) Real time data from Administrator (taxis, incidents in rail system – delays for trains-, etc.)
Result/Requirement	Anticipation for the implementation of passenger flow management protocols.
Final State	Interchange of information with the station staff in order to activate appropriate passenger flow management protocols.

Sequence	1. Data from the short-term forecasting model available 2. Compare the data from the prediction model with the average data obtained for the same period of the day, in order to determine whether or not there is a significant increase in demand that requires additional services from the other transport operators at the station. 3. Adjustment of warnings in the model to the demand 4. Notification of the incident to the station manager in order to choose the protocol to be implemented. 5. Protocol implementation.
Expected Release Date	November 2024
Involved components (System)	- Railway Subsystems (Provided by ADIF using different information platforms available). - Forecast platform which provides forecast demand developed by INDRA. - HMI dashboard (Display information platform developed by INDRA).
Responsible partner/person	ADIF FM, INDRA
Notes	

11.33. UC-FP1-WP19-33 Disruption management through Transport Data Hub

Name	Disruption management through Transport Data Hub
ID	UC-FP1-WP19-33
Description	During the course of an incident, it is necessary to keep users of the transport service informed in real time. The future of intelligent transport systems is therefore guided by these coincident requirements towards a seamless and transparent of integrated applications hub that fuses all relevant information and provides the best solution to inform passengers. Information on the incident in real time must be communicated to passengers and.
Related to task/subtask(s)	Specification: Task 19.9 Development: Task 24.5 Demonstration: Task 25.2
Impact on other task(s)	N/A
Technical Enabler(s)	TE 27
Interactions SP/FP	N/A
Actor(s)	OCC Operator, Traveller
Trigger	Incidence of the service affecting passengers
Pre-Condition(s)	Transport data information for different transport operators and different transport modes in real time. Need for integrated intermodal information in real time.
Input	Transport data service information. Transport real time information. Transport data disruption.
Result/Requirement	Improve commercial offer with intermodal transport real-time information for the whole network to passenger.
Final State	Incident registered and notified to the client.
Sequence	1. A service incident occurs, for example, a road cut 2. The hub receives the incident data, or it is entered by the OCC operator. 3. The incident information is published from the hub. 4. The incident information is displayed in the information systems in stations in real time. 5. The incident is resolved. 6. The incident information is eliminated in the information systems in stations in real time.
Expected Release Date	November 2024
Involved components (System)	Railway subsystems Real time information system Transport Data Hub

Responsible partner/person	Indra Sistemas S.A Enrique Jimenez
Notes	Real information system is the device that shows real time information in stations

11.34. UC-FP1-WP19-34 Reporting of external events influencing the multimodal transport

Name	Reporting of external events influencing the multimodal transport on the municipal level.
ID	UC-FP1-WP19-34
Description	Individual localized disruption events on a municipal level have to be reported to data sharing infrastructure. Because such events have disparate character (positive and negative) they have to have an appropriate data structure and input mechanisms to report their different kinds to the data lake.
Related to task/subtask(s)	Specification: Task 19.9 Development: Task 24.5 Demonstration: Task 25.1
Impact on other task(s)	-
Technical Enabler(s)	TE 27
Interactions SP/FP	-
Actor(s)	Transport Service Providers, infrastructure operators, municipality management personnel, travellers(moderated)
Trigger	Event influencing multimodal travel occurs and is observed by the actor
Pre-Condition(s)	-
Input	Report of the event/disruption
Result/Requirement	Disruption data included into data structure
Final State	n/a
Sequence	1. Actor wants to report an event 2. Actor fills required form 3. Form is submitted and processed via API 4. Data lake is updated.
Expected Release Date	November, 2024
Involved components (System)	Municipal Data lake, Municipal Data Exchange Interface, communication form
Responsible partner/person	PKP, Jerzy Baranowski
Notes	

11.35. UC-FP1-WP19-35 Information exchange between disparate mode operators

Name	Information exchange between disparate mode operators allowing swift and thorough propagation of disruption specification
ID	UC-FP1-WP19-35
Description	Certain disruptions on municipal level have organizational effect. For example because of random causes operator has to cancel certain connections or reduce their capabilities. Such effects have distributed character and require different treatment than individual events.
Related to task/subtask(s)	Specification: Task 19.9 Development: Task 24.5 Demonstration: Task 25.1
Impact on other task(s)	-
Technical Enabler(s)	TE 27
Interactions SP/FP	-
Actor(s)	Transport Service Providers
Trigger	Operator wants to report (broadcast) information about disruption in their transport network.
Pre-Condition(s)	Operator is involved in the data sharing solution (data lake) as a data provider and or consumer.
Input	Request to report disruption.
Result/Requirement	Information will be included in the data lake
Final State	-
Sequence	1. Operator wants to report distributed event/disruption 2. Operator prepares disruption information 3. Information is submitted and processed via API 4. Data lake is updated
Expected Release Date	November, 2024
Involved components (System)	Municipal Data lake, Municipal Data Exchange Interface, operator's system
Responsible partner/person	PKP, Jerzy Baranowski
Notes	

11.36. UC-FP1-WP19-36 Ex-ante timetable punctuality

Name	Ex-ante timetable punctuality
ID	UC-FP1-WP19-36
Description	Evaluation of ex-ante punctuality based on infrastructure settings and timetable scenario
Related to task/subtask(s)	Specification: Task 19.9 Development: Task 24.4 Demonstration: Task 25.1
Impact on other task(s)	N/A
Technical Enabler(s)	TE26
Interactions SP/FP	N/A
Actor(s)	Railway Service Provider
Trigger	-
Pre-Condition(s)	Access to timetable data (Trenitalia timetable systems) and infrastructure features
Input	Historical timetable and punctuality data
Result/Requirement	Ex-ante timetable punctuality evaluation
Final State	Rescheduling of planned timetable to maximise railway capacity
Sequence	1. Historical timetable data collection 2. Ex-ante punctuality evaluation 3. Timetable weaknesses detection 4. Timetable alteration/rescheduling
Expected Release Date	November 2024
Involved components (System)	- Railway Timetable Database - Punctuality Estimator
Responsible partner/person	FS: Giovanni Luca Giacco
Notes	

11.37. UC-FP1-WP19-37 Timetable optimization based on MCT (Minimum Connection Time)

Name	Timetable optimization based on MCT
ID	UC-FP1-WP19-37
Description	Timetable optimization based on a mixed integer linear programming formulation able to generate optimal connections by modification of an initial timetable
Related to task/subtask(s)	Specification: Task 19.9 Development: Task 24.4 Demonstration: Task 25.1
Impact on other task(s)	N/A
Technical Enabler(s)	TE26
Interactions SP/FP	N/A
Actor(s)	Railway Service Provider
Trigger	-
Pre-Condition(s)	Access to timetable data (Trenitalia timetable systems)
Input	Timetable data
Result/Requirement	The algorithms provide the optimal connection times within stations of the network at a given time frame
Final State	Timetable adjustments based on the results of the optimization algorithm
Sequence	1. Acquisition of timetable data from GTFS format to the database 2. Computation of the current connections in stations of the network 3. Run of the optimization algorithm 4. Generation of the optimized timetable 5. KPIs for results' validation
Expected Release Date	November 2024
Involved components (System)	- Optimization software (OPL Cplex) - Railway Timetable Database - Capacity optimization HMI
Responsible partner/person	FS: Giovanni Luca Giacco STS: Pietro Calcagno
Notes	

11.38. UC-FP1-WP19-38 Railway disruption management through optimization processes

Name	Railway disruption management through optimization processes
ID	UC-FP1-WP19-38
Description	Disruption management system supports service providers in managing disruptions. Different mitigation strategies are proposed to mitigate impacts of disruption.
Related to task/subtask(s)	Specification: Task 19.9 Development: Task 24.5 Demonstration: Task 25.1
Impact on other task(s)	Task 19.1
Technical Enabler(s)	TE 27
Interactions SP/FP	Interaction with FP3 (disruptions prescribed by asset management)
Actor(s)	Railway Service Provider
Trigger	A disruption occurs in the railway service
Pre-Condition(s)	Agreement between Railway Service Provider and Service Providers of other transportation modes (Business) Link between railway subsystems and disruption management system
Input	Disruption information (delayed or cancelled trains, etc.) Passenger flow data
Result/Requirement	The algorithms provide mitigation strategies that enables managing the disrupted situation
Final State	The railway service provider receives a set of possible mitigation strategies
Sequence	1. The system acquires railway disruption information and passenger flow data from railway subsystems. 2. Data feed optimization algorithms. 3. The multimodal disruption management system provides different multimodal mitigation strategies as output, if needed. 4. Disruption Management HMI shows the identified strategies.
Expected Release Date	November 2024
Involved components (System)	Disruption management HMI, disruption management system, (railway subsystems)
Responsible partner/person	STS: Pietro Calcagno FS: Giovanni Luca Giacco
Notes	

11.39. UC-FP1-WP19-39 Generation of the library of situations

Name	Generation of the library of situations
ID	UC-FP1-WP19-39
Description	Situations for Strategic Management can be generated by identifying them by experts and by unsupervised learning methods. Both methods will be used to generate the Library of Situations with the historical data provided by FGC in the demonstrator of task 25.4.
Related to task/subtask(s)	Specification: Task 19.9 Development: Task 24.4, Task 24.5 Demonstration: Task 25.4
Impact on other task(s)	N/A
Technical Enabler(s)	TE 26 TE 27
Interactions SP/FP	N/A
Actor(s)	Transport Service Provider
Trigger	Availability of new historical data.
Pre-Condition(s)	Availability of historical data with which to carry out the training. At the discretion of a system operator.
Input	Historical data (disruption information, timetables)
Result/Requirement	Library in which the situations produced in the transport network are defined.
Final State	Library of situations ready to be used.
Sequence	1. Availability of new historical data. 2. The system operator activates the identification of situations. 3. Identification of situations in the data. 4. Updated Situation Library.
Expected Release Date	November 2024
Involved components (System)	Data Manager, Situation Identifier, Situations Library
Responsible partner/person	ETRA I+D:
Notes	

11.40. UC-FP1-WP19-40 Detection of situations

Name	Detection of situations
ID	UC-FP1-WP19-40
Description	Based on the situations stored in the situations library and the information generated in real time by FGC in the demonstrator of task 25.4, the current state of the transport network will be identified with the situations available in the library.
Related to task/subtask(s)	Specification: Task 19.9 Development: Task 24.4, Task 24.5 Demonstration: Task 25.4
Impact on other task(s)	N/A
Technical Enabler(s)	TE 26 TE 27
Interactions SP/FP	N/A
Actor(s)	Transport Service Provider
Trigger	Availability of new data
Pre-Condition(s)	Availability of new data
Input	New real-time data (disruption information, timetables, etc.)
Result/Requirement	Identified situation or identification of a situation not previously produced
Final State	If the location was in the library, it is associated with the actual status. If the situation is new it is added to the library.
Sequence	1. New data available. 2. Comparison of the new data with that of the library 3. The situation in the library is identified 4. The situation in the library is not identified and a new situation is generated
Expected Release Date	November 2024
Involved components (System)	Data Manager, Situation Library, Situations Detector, Strategic Manager
Responsible partner/person	ETRA I+D:
Notes	

11.41. UC-FP1-WP19-41 Supporting timetabling decisions

Name	Supporting timetabling decisions with visualisation and severity estimation of present disturbances in the municipality
ID	UC-FP1-WP19-41
Description	During planning of operation (resource allocation) and timetabling information is needed are there any disruptions/events that require special activity. Proposed system provides decision support using a relevant dashboard with necessary information.
Related to task/subtask(s)	Specification: Task 19.9 Development: Task 24.4, Task 24.5 Demonstration: Task 25.1
Impact on other task(s)	-
Technical Enabler(s)	TE 26, TE 27
Interactions SP/FP	-
Actor(s)	Transport Service Provider
Trigger	Start of planning of timetable or resources.
Pre-Condition(s)	None
Input	Request from the transport operator
Result/Requirement	Visualisation of present disruptions in geographical and temporal context with severity assessment.
Final State	*n/a*
Sequence	1. Operator requests decision support for planning operations 2. System accesses data infrastructure to collect disruption data 3. Disruptions are visualized with temporal constraints and severity estimation 4. Operator takes planning decision
Expected Release Date	November 2024
Involved components (System)	Municipal Data lake, dashboarding system, analysis support module
Responsible partner/person	PKP, Martyna Dudzicz
Notes	

11.42. UC-FP1-WP19-42 Decision support for incidents management

Name	Decision support for incidents management
ID	UC-FP1-WP19-42
Description	Decision support for the operator to carry out corrective actions (reinforcement of service for example) and to manage incidents on the urban transport network, thanks to the short-term passenger flow prediction.
Related to task/subtask(s)	Specification: Task 19.8 Development: Task 24.3 Demonstration: Task 25.5
Impact on other task(s)	Task 24.5
Technical Enabler(s)	TE25
Interactions SP/FP	N/A
Actor(s)	OCC Operator Urban Transport Service Provider Weather station
Trigger	Incident on the urban transport network, or operator request for situational awareness.
Pre-Condition(s)	The system is in nominal state: Nominal operational state where all the functions of the System are available. The system is in online mode: Mode in which the system offers functions dependent on real-time acquisition of field data, such as a supervision function for example.
Input	The required input data are: •Passenger short term demand •Current offer forecast (vehicle movements) •Network topology •Station topologies •Walking times •Vehicle characteristics (max capacity, number of available seats …) For modelling passenger behaviour in case of incident, additional data are required: •Incident •Weather •Passenger profile characteristics in demand (behaviour, with or without luggage, person with reduced mobility …) And also for modelling passenger exchange times, the following data are required: •Vehicle dwell time •Station occupancy •Vehicle occupancy •Number of onboarding and alighting passengers •Passenger profile characteristics in demand (behaviour, with or

	without luggage, person with reduced mobility …)
Result/Requirement	Passenger KPI, modelling exchange time and crowd flow.
Final State	The system is in nominal state. The system is in online mode.
Sequence	List steps of the Use Case: 1. Incident on the urban transport network, or operator request for situational awareness. 2. Input Data Collection (including passenger short term demand from TE23) 3. Passenger KPI computation
Expected Implementation Date	November 2024
Involved components (System)	**Micro simulator** using passenger short term demand and current offer forecast to simulate flows of passengers across the different transport systems. The micro simulator includes **passenger exchange time models**, **crowd flow models**, and **passenger behaviour models in case of incident**. **Digital Twin Components** based on Digital Twin general framework and concepts defined by FA1 SG4.
Responsible partner/person	GTSD: Philippe Bernard (GTSF)
Notes	This use case is a first draft that needs to be reviewed/discussed.

11.43. UC-FP1-WP19-43 Sandboxing for test of incident mitigation scenarios

Name	Sandboxing for test of incident mitigation scenarios
ID	UC-FP1-WP19-43
Description	This use case extends the behaviour of the "Decision support for incidents management" use case by providing the operator with a digital twin acting as a sandbox where he can simulate different scenarios and assess the impact of potential changes or improvements. By experimenting in the sandbox, the operator can test new strategies and make data-driven decisions before implementing them in the physical world.
Related to task/subtask(s)	Specification: Task 19.8 Development: Task 24.3 Demonstration: Task 25.5
Impact on other task(s)	Task 24.5
Technical Enabler(s)	TE25
Interactions SP/FP	N/A
Actor(s)	Operator Urban Transport Service Provider Weather station
Trigger	Operator request for testing scenarios in a sandbox.
Pre-Condition(s)	The system is in nominal state: Nominal operational state where all the functions of the system are available. The system is in online mode: Mode in which the system offers functions dependent on real-time acquisition of field data, such as a supervision function for example.
Input	The required input data are: •Passenger short term demand •Current offer forecast (vehicle movements) •Network topology •Station topologies •Walking times •Vehicle characteristics (max capacity, number of available seats …) •Incident •Weather •Scenario to be assessed (i.e. only updated train movements) •Models from the "Decision support for incidents management" use case: • Passenger exchange time models • Crowd flow models • Passenger behaviour models in case of incident
Result/Requirement	Passenger KPI, modelling exchange time and crowd flow, and

	taking into account assessed scenarios.
Final State	The system is in nominal state. The system is in sandbox mode: Mode in which the system offers functions that do not impact operations, they run in a controlled environment, isolated from the rest of the system. But as for the online mode, functions dependent on real-time acquisition of field data can be offered there.
Sequence	List steps of the Use Case: 1. Operator request for testing scenarios in a sandbox 2. Sandbox mode activation 3. Input Data Collection (including passenger short term demand from TE23) 4. Acquisition of the scenario to be assessed (i.e. only updated train movements) 5. Passenger KPI computation taking into account the assessed scenario
Expected Implementation Date	November 2024
Involved components (System)	**Micro simulator** using passenger short term demand and current offer forecast to simulate flows of passengers across the different transport systems. The micro simulator includes **passenger exchange time models**, **crowd flow models**, and **passenger behaviour models in case of incident**. **Digital Twin Components** based on Digital Twin general framework and concepts defined by FA1 SG4.
Responsible partner/person	GTSD: Philippe Bernard (GTSF)
Notes	This use case is a first draft that needs to be reviewed/discussed.

11.44. UC-FP1-WP19-44 Alert for Possible Overcrowding Situations based on Occupancy Forecast Data

Name	Alert for Possible Overcrowding Situations based on Occupancy Forecast Data
ID	UC-FP1-WP19-44
Description	This use case involves providing advance alerts to both travellers and transport service providers about potential overcrowding situations in public transport vehicles based on occupancy forecast data. By analysing the forecasted vehicle occupancy data, the system can proactively notify passengers and operation managers in advance, enabling them to take necessary actions to mitigate overcrowding risks.
Related to task/subtask(s)	Specification: T19.6, T19.7, T19.9 Implementation: T24.1, T24.2, T24.5 Demonstration: T21.4
Impact on other task(s)	-
Technical Enabler(s)	TE27, TE23, TE24
Interactions SP/FP	Possible interaction with FP6 to align specification between main line and regional lines
Actor(s)	Transport Service Provider, Traveller
Trigger	Availability of occupancy forecast data
Pre-Condition(s)	Occupancy forecast data is available, communication channels to the travellers and TSPs are available
Input	Occupancy forecast data for specific travel periods, vehicle capacity threshold for overcrowding
Result/Requirement	Advance alerts sent to affected travellers and TSPs about possible overcrowding situations during specific travel periods.
Final State	Both travellers and TSPs are informed in advance about a potential overcrowding, enabling them to plan accordingly and take necessary actions.
Sequence	1. The system collect occupancy forecast data for specific travel periods from the data analytics platform. 2. The system analyses the forecasted occupancy data to identify potential overcrowding situations during specific travel periods. 3. Whenever the forecasted occupancy data crosses the defined threshold, trigger the alert generation service. 4. Generate advance alerts for travellers, indicating possible overcrowding if this impact their trips.

	5. Simultaneously, alert operation managers about the predicted overcrowding situations. 6. The communication interface sends advance alerts via appropriate channels (e.g., mobile apps, email, or text messages). 7. Travelers receive advance alerts
Expected Release Date	November 2024
Involved components (System)	Data Analytics Platform, Alert Generation Service, Retailer App
Responsible partner/person	Marco Ferreira (HACON)
Notes	The effectiveness of the alerts relies on the accuracy of the occupancy forecast data and the timely delivery of advance alerts to travellers and operation managers.

11.45. UC-FP1-WP19-45 Request Journey alternatives to avoid crowded routes

Name	Request Journey alternatives to avoid crowded routes
ID	UC-FP1-WP19-45
Description	The use case expects to provide the traveller with the possibility to seamlessly request alternative routes when crowded routes are detected on his journey. The system should then provide alternative offers avoid the congested routes.
Related to task/subtask(s)	Specification: T19.6, T19.7, T19.9 Implementation: T24.1, T24.2, T24.5 Demonstration: T21.4
Impact on other task(s)	-
Technical Enabler(s)	TE27, TE23, TE24
Interactions SP/FP	-
Actor(s)	Traveller, Retailer
Trigger	Traveller receives alert of overcrowded route
Pre-Condition(s)	Occupancy data is available, communication channels to the travellers, journey planning service is available
Input	Select trip alternative
Result/Requirement	The system provides alternative routes that avoid crowded routes.
Final State	The traveller has access to alternative routes that avoid crowded routes.
Sequence	1. After receiving an alert about a crowed route regarding one of the traveller journeys, the traveller gets the option to request alternative routes for his journey on the user interface (Retailer app). 2. The traveller clicks on the request alternatives (optional) 3. Retailer process the request (MaaS platform), collect the journey details and forward the necessary mobility requests to the relevant TSPs 4. Retailer combines the alternative mobility offers and present them to the traveller
Expected Release Date	November 2024
Involved components (System)	Retailer App, **MaaS platform (Journey Planning Orchestrator)**
Responsible partner/person	Marco Ferreira (HACON)

Notes	

11.46. UC-FP1-WP19-46 Training of the Short-term Prognosis Model

Name	Training of the Short-term Prognosis Model
ID	UC-FP1-WP19-46
Description	To carry out the short-term prognosis, a demand prediction model based on a deep neural network will be used. This use case covers the training of the prediction model using the historical data generated by FGC within the demonstrator corresponding to Task 25.4 and additional information such as weather.
Related to task/subtask(s)	Specification: Task 19.6 Development: Task 24.1, Task 24.2 Demonstration: Task 25.4
Impact on other task(s)	
Technical Enabler(s)	TE23
Interactions SP/FP	
Actor(s)	Transport Service Provider
Trigger	Availability of historic data
Pre-Condition(s)	Availability of historic data
Input	New demand data
Result/Requirement	Short-term prediction model
Final State	Short-term prediction model available
Sequence	1. Availability of new historical data. 2. The system operator activates the training of the short-term prediction model. 3. Short-term prediction model trained.
Expected Release Date	November 2024
Involved components (System)	Data Manager, Trainer, Prediction Model
Responsible partner/person	ETRA I+D
Notes	

11.47. UC-FP1-WP19-47 Short-term prognosis

Name	Short-term prognosis
ID	UC-FP1-WP19-47
Description	From the previously trained model and using real-time data provided by FGC in the demonstrator corresponding to Task 25.4, the short-term prediction will be made. The forecasted data will be compared with the real ones, the quality of the prognosis will be determined and the corresponding KPIs will be generated.
Related to task/subtask(s)	Specification: Task 19.6 Development: Task 24.1, Task 24.2 Demonstration: Task 25.4
Impact on other task(s)	
Technical Enabler(s)	TE23
Interactions SP/FP	
Actor(s)	Transport Service Provider
Trigger	Availability of new data
Pre-Condition(s)	Availability of new data Availability of the trained short-term prediction model
Input	New demand data
Result/Requirement	Short-term demand prediction
Final State	Short-term demand prediction
Sequence	1. New data available. 2. Prediction of the short-term demand 3. Short-term demand data available
Expected Release Date	November 2024
Involved components (System)	Data Manager, Trained Model, Predictor, Prediction Model
Responsible partner/person	ETRA I+D
Notes	

11.48. UC-FP1-WP19-48 Decision support system for short term forecasting

Name	Decision support system for short term forecasting on municipal level
ID	UC-FP1-WP19-48
Description	On municipal level short term is understood as a weekly period where TO has to provide capacity requirements to central planner, as rail timetable is already locked. For this purpose efficient demand prognosis is needed that will fuse historical data with relevant outside covariates, such like weather, events etc.
Related to task/subtask(s)	Specification: 19.6,19.7, 19.9 Development: Task 24.1 Demonstration: Task 25
Impact on other task(s)	-
Technical Enabler(s)	TE23
Interactions SP/FP	n/a
Actor(s)	Transport service provider
Trigger	Request for decision support in capacity planning.
Pre-Condition(s)	-
Input	Planner create request for short term demand prediction on selected line/lines
Result/Requirement	System, in a form of dashboard, will provide necessary information relevant to create the capacity requests.
Final State	n/a
Sequence	1. Planner requests prognosis during capacity planning 2. System creates prognosis using data obtained from Data Lake 3. Prognosis is visualized and presented in form of a dashboard 4. Planner creates capacity plan.
Expected Release Date	November 2024
Involved components (System)	Municipal Data lake, short term prediction software, dashboarding system, Demand dataset builder
Responsible partner/person	PKP, Włodzimierz Woźniak
Notes	

11.49. UC-FP1-WP19-49 Forecast Occupancy of Vehicles using Journey Planning Requests Data

Name	Forecast Occupancy of Vehicles using Journey Planning Requests Data
ID	UC-FP1-WP19-49
Description	This use case involves predicting the occupancy of transportation vehicles based on journey planning requests data (or other sources), which includes information about the origin, destination, and expected time of travel for customers.
Related to task/subtask(s)	Specification: T19.6 Implementation: T24.1 Demonstration: T21.4
Impact on other task(s)	T19.9, providing demand information can enhance disruptions management
Technical Enabler(s)	TE23
Interactions SP/FP	Possible interaction with FP6 to align specification between main line and regional lines
Actor(s)	-
Trigger	New journey planning request data received
Pre-Condition(s)	Journey planning requests data is available, historical vehicle occupancy data is collected
Input	Journey planning request data (origin, destination, expected travel time)
Result/Requirement	Predicted occupancy for specific routes and time slots
Final State	The system provides forecasted occupancy information for various routes and time slots.
Sequence	List steps of the Use Case (to be filled during specification phase) 1. The MaaS platform process and provide new journey planning requests data, including origin, destination, and time of departure or arrival, during time interval (e.g. daily). 2. The data analytics platform gathers the new data 3. The data analytics platform considering historical vehicle occupancy data and journey planning request data, analysis the new data, training the model. 4. The system updates the trained occupancy model of the transport network. 5. Store the forecasted occupancy model for future reference.
Expected Release Date	November 2024

Involved components (System)	Data Analytics Platform, Machine Learning Occupancy Model, MaaS platform
Responsible partner/person	Marco Ferreira (HACON)
Notes	The accuracy of the occupancy forecast may vary based on the quality and completeness of the vehicle occupancy and journey planning request data. This Use Case can cover short and long term forecast calculations.

11.50. UC-FP1-WP19-50 Display Forecasted Occupancy Information to Travelers when Planning Trips

Name	Display Forecasted Occupancy Information to Travelers when Planning Trips
ID	UC-FP1-WP19-49
Description	This use case involves displaying forecasted vehicle occupancy information to travellers when they plan their trips through a trip planning interface.
Related to task/subtask(s)	Specification: T19.6 Implementation: T24.1 Demonstration: T21.4
Impact on other task(s)	-
Technical Enabler(s)	TE23
Interactions SP/FP	Possible interaction with FP6 to align specification between main line and regional lines
Actor(s)	Travellers
Trigger	Traveller initiates the trip planning process
Pre-Condition(s)	Traveller uses journey planning tool Forecasted vehicle occupancy data is available
Input	Journey planning request data (origin, destination, expected travel time)
Result/Requirement	Display of forecasted vehicle occupancy information for the proposed journeys
Final State	The traveller receives relevant forecasted occupancy information for trip planning.
Sequence	List steps of the Use Case (to be filled during specification phase) 1. Traveller enters their origin, destination, and preferred time of travel. 2. The trip planning interface displays several trip option and fetches forecasted vehicle occupancy information for the journeys. 3. Display the forecasted vehicle occupancy to the traveller on the trip planning interface.
Expected Release Date	November 2024
Involved components (System)	Journey Planning app, Data Analytics Platform
Responsible partner/person	Marco Ferreira (HACON)
Notes	The displayed forecasted occupancy information is for planning

	purposes and may not reflect real-time changes in vehicle availability.

11.51. UC-FP1-WP19-51 Estimation of station staff required to provide quality customer service

Name	Estimation of station staff required to provide quality customer service
ID	UC-FP1-WP19-51
Description	In the event that the results of long-term passenger demand forecasts imply a substantial increase in demand compared to the usual station demand for that timetable in order to adequately sizing the staff required to meet this demand while complying with minimum quality standards. This dimensioning can be applied for long-term passenger demand.
Related to task/subtask(s)	Specification: Task 19.6, Task 19.7 Development: Task 24.1, 24.2 Demonstration: Task 25.2
Impact on other task(s)	-
Technical Enabler(s)	TE24
Interactions SP/FP	-
Actor(s)	• Rail Administrator (Owner of the railway infrastructure) • Metro PTO (Other transport mode provider) • Rail transport Service Provider
Trigger	Optimisation of the customer services provided, mainly cleaning and security services at the station.
Pre-Condition(s)	To have the access of data that provides this information (PTO and Rail Administrator's data sources). Definition of the relationship between the increase in demand and the staffing needs for its sizing.
Input	Real time passenger demand data from Metro of Malaga (PTO) Real time data from Administrator (taxis, incidents in rail system – delays for trains-, etc.)
Result/Requirement	Anticipation for exceptional station staffing.
Final State	-

Sequence	1. Data from long-term forecasting model available. 2. Compare the data from the prediction model with the average data obtained for the same period, in order to determine whether or not there is a significant increase in demand that requires additional services from the other transport operators at the station. 3. Definition of relationships between the increase in demand and the increase in necessary personnel. 4. Notification of the incident to the station manager in order to sizing the personnel required for the station. 5. Protocol implementation.
Expected Release Date	November 2024
Involved components (System)	- Railway Subsystems (Information provided by ADIF using different information platforms available). - Forecast platform which provides forecast demand developed by INDRA. - HMI dashboard (Display information platform developed by INDRA).
Responsible partner/person	ADIF FM, INDRA
Notes	

11.52. UC-FP1-WP19-52 Decision support system for long term forecasting

Name	Decision support system for long term forecasting on municipal level
ID	UC-FP1-WP19-52
Description	On municipal level long term is understood as a 5 times per year period for changes and/or updates in the TO timetable. For this period most important are seasonal effects, coordination with different operators etc.
Related to task/subtask(s)	Specification: PKP Use Cases from 19.6,19.7, 19.9 Development: Task 24.2, WP20 T20.1.1 (information transfer from multimodal TOs) Demonstration: Task 25
Impact on other task(s)	-
Technical Enabler(s)	TE 24
Interactions SP/FP	-
Actor(s)	Transport service provider
Trigger	Request for decision support in timetable planning.
Pre-Condition(s)	-
Input	Planner create request for long term demand prediction on selected line/lines
Result/Requirement	System, in a form of dashboard, will provide necessary information relevant to create the capacity requests.
Final State	n/a
Sequence	1.Planner requests prognosis during timetable planning 2.System creates prognosis using data obtained from Data Lake 3.Prognosis is visualized and presented in form of a dashboard 4.Planner creates capacity plan.
Expected Release Date	November 2024
Involved components (System)	Municipal Data lake, short term prediction software, dashboarding system, Demand dataset builder
Responsible partner/person	PKP, Włodzimierz Woźniak
Notes	

11.53. UC-FP1-WP19-53 Transport offer optimisation

Name	Transport offer optimisation
ID	UC-FP1-WP19-53
Description	Optimisation of the transport offer at a macro level based on long term prediction of how passengers flow across the urban transport network.
Related to task/subtask(s)	Specification: Task 19.8 Development: Task 24.3 Demonstration: Task 25.5
Impact on other task(s)	Task 24.4
Technical Enabler(s)	TE25
Interactions SP/FP	N/A
Actor(s)	OCC Operator Urban Transport Service Provider
Trigger	Operator request for situational awareness on a selected day of operation.
Pre-Condition(s)	The system is in nominal state: Nominal operational state where all the functions of the System are available. The system is in offline mode: Mode in which the system offers functions independent of real-time acquisition of field data, such as a train operation planning function.
Input	Passenger long term demand Planned offer (timetable) Network topology Station topologies Walking times Vehicle characteristics (max capacity, number of available seats …)
Result/Requirement	Passenger KPI useful to analyse the impacts and to contribute to the optimisation of the offer.
Final State	The system is in nominal state. The system is in offline mode.
Sequence	List steps of the Use Case: 1. Operator request for situational awareness on a selected day of operation. 2. Input Data Collection (including passenger long term demand from TE24) 3. Passenger KPI computation
Expected Implementation Date	November 2024
Involved components (System)	**Macro simulator** using passenger long term demand and planned offer to analyse impacts and to contribute to the optimisation of the offer at a macro level. **Digital Twin Components** based on Digital Twin general

	framework and concepts defined by FA1 SG4.
Responsible partner/person	GTSD: Philippe Bernard (GTSF)
Notes	This use case is a first draft that needs to be reviewed/discussed.

11.54. UC-FP1-WP19-54 Analysis of Travel Demand Data based on Forecasted Data

Name	Analysis of Travel Demand Data based on Forecasted Data
ID	UC-FP1-WP19-54
Description	This use case enables transport service providers to analyse travel demand data using forecasted vehicle occupancy. By analysing the forecasted data, service providers can make informed decisions regarding vehicle deployment, scheduling, and resource allocation.
Related to task/subtask(s)	Specification: T19.6 Implementation: T24.1 Demonstration: T21.4
Impact on other task(s)	-
Technical Enabler(s)	TE24
Interactions SP/FP	Possible interaction with FP6 to align specification between main line and regional lines
Actor(s)	Data analyst (TSP)
Trigger	Availability of forecasted vehicle occupancy data
Pre-Condition(s)	Forecasted vehicle occupancy data is available (journey planning information is integrated), historical travel demand data is collected
Input	Forecasted vehicle occupancy data, historical travel demand data
Result/Requirement	Insights and analysis of travel demand patterns based on forecasted data
Final State	Transport service providers gain valuable insights into travel demand patterns and are better equipped to optimize their operations.
Sequence	1. Collect forecasted vehicle occupancy data 2. Integrate the forecasted data with historical travel demand data. 3. Apply data analysis techniques to identify travel demand patterns and trends. 4. Display relevant data in a dashboard for TSP's to analyse 5. TSP's can perform resource allocation analysis based on the forecasted data to optimize vehicle deployment and scheduling.
Expected Release Date	November 2024
Involved components (System)	Data Analytics Platform, Demand analytics dashboard

Responsible partner/person	Marco Ferreira (HACON)
Notes	The accuracy and effectiveness of the analysis depend on the quality and relevance of the forecasted data and historical travel demand data.

12. SG3 – WP19 data availability for prototype environments

The following table summarizes the key information related to data availability for WP19 prototype environments. It identifies the required data for the execution of WP19 use cases, the data providers expected to feed this use cases. There will be a link to the project Research Data Management Plan, as this data need to be included on the document in the next phase of the project, where will be found more details about how this data will be managed within the project.
The table provides a clear and concise overview of the information, making it easy to reference and use as needed.

Table 8 – WP19 data availability for prototype environments

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP19-01	Journey Planning as a B2B intermodal service	1. Railway timetable with planned schedules 2. Railway real time timetable information 3. Timetable from other modes 4. Realtime data from other modes 5. Interface with other platforms	1. CFL, MDM 2. CFL 3. N/A 4. CFL (Flex) 5. HACON, INDRA
UC-FP1-WP19-02	Retailer as ticket vendor selling a product provided by a TSP as distributor via OSDM API.	The distributor needs: • Location Data • Timetable Data • Fare Data The retailer has two options: • Without any data (using OSDM location search and OSDM offer search only). (INDRA-DB)	DB, SJ and MDM

Use case ID	Use case name	Data required for UC execution	Data provider
		• With Retailer location data and timetable data using OSDM offer search on a provided Journey) SJ-DB.	
UC-FP1-WP19-03	Enable TSPs to visualise mobility demand (UI)	1. Mobility services demand forecast data	1. This data is generated on UC-FP1-WP19-49, using data from CFL
UC-FP1-WP19-04	Financial Services. Mobility Offer apportionment	1. Sales Transactions associated with Mobility Packages. Native ASP format	Dedicated Simulator
UC-FP1-WP19-05	Financial Services. Pay as-you-go apportionment	1. Travel Transactions reflecting Mobility Account consumption on multiple mobility modes including rail. Native ASP format	Dedicated Simulator
UC-FP1-WP19-06	Financial Services. Distributed Ledger	1. Input data comes from UC 19-04 and 19-05 as settlement records	ASP Platform
UC-FP1-WP19-07	Financial services. Processing of CEN NeTEx Fare data.	1. NeTEx Sales transactions	Dedicated Simulator. Operator's transactions as an option
UC-FP1-WP19-08	Exchange of disruptions and mitigation strategies information	1. Disruption information 2. Set of mitigation strategies proposed	1. STS 2. STS
UC-FP1-WP19-09	Unified multimodal information storage and update	1. Railway timetable with planned schedules From Railway Service Provider 2. Railway timetable with planned schedules from City Transit Operators;	ŁKA POLREGIO PKP-Intercity PLK Municipality Transport

Use case ID	Use case name	Data required for UC execution	Data provider
		3. Railway timetable with planned schedules From Municipal Independent Operators; 4. Passenger streams from Station Operators;	System (bus, taxi, tram etc) Car sharing Bike sharing etc.
UC-FP1-WP19-10	Accessing multimodal information data for creating multimodal travel plans between on municipal level	Municipal Data lake service, ETL	API municipal data lake PKP
UC-FP1-WP19-11	Support for multimodality decisions	Municipal Data lake service	API municipal data lake PKP
UC-FP1-WP19-12	Totem T-Ais. 1 specific spot for people with visual disability	1. Data from Metro of Malaga (PTO) 2. Data from Administrator	ADIF and Metro de Málaga
UC-FP1-WP19-13	Totem T-Ais. 1 specific spot for people with hearing impairment, PRM, motor disability, cognitive impairment, language misunderstanding and some visual impairments.	1. Data from Metro of Malaga (PTO) 2. Data from Administrator	ADIF and Metro de Málaga
UC-FP1-WP19-14	Gap filler	1. Distance between platform and rolling stock and definition of the element that could serve to fill it in according to the current standards.	ADIF and Renfe

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP19-15	Gobo	1. Important information to be shown at certain places.	ADIF and Renfe
UC-FP1-WP19-16	Accessible Robot	1. Data from Metro of Malaga (PTO) 2. Data from Administrator 3. Other data	ADIF and Metro de Málaga
UC-FP1-WP19-17	Guiding Accessible Software	1. Data from Metro of Malaga (PTO) 2. Data from Administrator 3. Other data	ADIF and Metro de Málaga
UC-FP1-WP19-18	Guiding Accessible Intelligent Tool	1. Data from Metro of Malaga (PTO) 2. Data from Administrator 3. Other data	ADIF and Metro de Málaga
UC-FP1-WP19-19	Frictionless validation	1. Ticket sample	INDRA
UC-FP1-WP19-20	Indoor guidance	1. Map of the station	Metro de Madrid (MDM)
UC-FP1-WP19-21	Account based ticketing	1. Fare information	INDRA
UC-FP1-WP19-22	Hands Free. UWB Walk-in	1. Station Configuration with anchors positioning, detection area	Prototype station provided by GTSD
UC-FP1-WP19-23	Hands Free. UWB Walk-out	1. Station Configuration with anchors positioning, detection area	Prototype station provided by GTSD

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP19-24	Hands Free. UWB Intermodal transfer	1. Station Configuration with anchor positioning, detection area, intermodal transfer conditions	Prototype station provided by GTSD
UC-FP1-WP19-25	Hands Free. UWB In station assistance	1. Station Configuration with anchor positioning, detection area, intermodal transfer conditions	Prototype station provided by GTSD
UC-FP1-WP19-26	Hands Free. Face Recognition Walk-in	1. Registration of testers face signature	Testing team faces, no registration of real travellers
UC-FP1-WP19-27	Hands Free. Face Recognition Walk-out	1. Registration of testers face signature	Testing team faces, no registration of real travellers
UC-FP1-WP19-28	Illuminated platform edge - Attention	1. Incoming train data with real-time arriving time, Sensor detection train stopping, Sensor detection train departure	DB (Station sensors)
UC-FP1-WP19-29	Illuminated platform edge – Orientation	1. Incoming train data with real-time arriving time, 2. Incoming train data with train architecture/lengths	DB (Station Sensors), Metro Berlin
UC-FP1-WP19-30	Illuminated platform edge - Capacity	1. Incoming train data with real-time arriving time, 2. Incoming train data with train architecture/lengths, Incoming train data with capacity load of train compartments	DB (Station Sensors), Metro Berlin
UC-FP1-WP19-31	Notices for other modes of transport with connections at the railway station	1. Real time passenger demand data from Metro of Malaga (PTO) 2. Real time data from Administrator (taxis, incidents in rail system – delays for trains-, etc.)	ADIF and Metro de Málaga

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP19-32	Notifications for activation of passenger flow management protocols	1. Real time passenger demand data from Metro of Malaga (PTO) 2. Real time data from Administrator (taxis, incidents in rail system – delays for trains-, etc.)	ADIF and Metro de Málaga
UC-FP1-WP19-33	Disruption management through Transport Data Hub	1. Disruption sample 2. Transport information	INDRA
UC-FP1-WP19-34	Reporting of external events influencing the multimodal transport on the municipal level	1. Report of the event/disruption 2. Catalogue of possible events and disruptions	PKP S.A. ŁKA Municipality Transport System (bus, taxi, tram etc)
UC-FP1-WP19-35	Information exchange standard for disparate mode operators allowing swift and thorough propagation of disruption specification	Request to report disruption. 1. Railway timetable with planned schedules From Railway Service Provider 2. Railway timetable with planned schedules from City Transit Operators; 3. Railway timetable with planned schedules From Municipal Independent Operators;	ŁKA POLREGIO PKP-Intercity PLK Municipality Transport System (bus, taxi, tram etc)
UC-FP1-WP19-36	Ex-ante timetable punctuality	1. Historical timetable and punctuality data	FS
UC-FP1-WP19-37	Timetable optimization based on MCT (Minimum Connection Time)	1. Timetable data	FS
UC-FP1-WP19-38	Railway disruption management through optimization processes	1. Disruption information 2. Passenger flow data linked with train position	1. STS 2. FS
UC-FP1-WP19-39	Generation of the library of situations	1. Historical data (disruption information, timetables)	1. FGC

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP19-40	Detection of situations	1. New real-time data (disruption information, timetables, etc.)	1. FGC
UC-FP1-WP19-41	Supporting timetabling decisions with visualisation and severity estimation of present disturbances in the municipality	1. Request from the transport operator 2. Historical data (disruption information, timetables, weather,) 3. New real-time data (disruption information, timetables, weather,) 4. Traction failure log 5. Calendar Mass Events	ŁKA POLREGIO PKP-Intercity PLK PGE-Energetyka Kolejowa OperatorsSport/Cultural Facilities
UC-FP1-WP19-42	Decision support for incidents management	The required input data are: 1. Passenger short term demand 2. Current offer forecast (vehicle movements) 3. Network topology 4. Station topologies 5. Walking times 6. Vehicle characteristics (max capacity, number of available seats …) For modelling passenger behaviour in case of incident, additional data are required: 7. Incident 8. Weather Passenger profile characteristics in demand (behaviour, with or without luggage, person with reduced mobility …)	The passenger short term demand should come from TE23 (more specifically from UC-FP1-WP19-47), but during the development phase, we can be satisfied with contextualized input data from TE23, and at worst, we can use open data from a city or data that we will have generated for a virtual city based on real data.

Use case ID	Use case name	Data required for UC execution	Data provider
		And also for modelling passenger exchange times, the following data are required: 9. Vehicle dwell time 10. Station occupancy 11. Vehicle occupancy 12. Number of onboarding and alighting passengers 13. Passenger profile characteristics in demand (behaviour, with or without luggage, person with reduced mobility …)	
UC-FP1-WP19-43	Sandboxing for test of incident mitigation scenarios	The required input data are: 1. Passenger short term demand 2. Current offer forecast (vehicle movements) 3. Network topology 4. Station topologies 5. Walking times 6. Vehicle characteristics (max capacity, number of available seats …) 7. Incident 8. Weather 9. Scenario to be assessed (i.e. only updated train movements) 10. Models from the "Decision support for incidents management" use case: • Passenger exchange time models • Crowd flow models	The passenger short term demand should come from TE23 (more specifically from UC-FP1-WP19-47), but during the development phase, we can be satisfied with contextualized input data from TE23, and at worst, we can use open data from a city or data that we will have generated for a virtual city based on real data.

Use case ID	Use case name	Data required for UC execution	Data provider
		• Passenger behaviour models in case of incident	
UC-FP1-WP19-44	Alert for Possible Overcrowding Situations based on Occupancy Forecast Data	1. Mobility services demand forecast data	1. This data is generated on UC-FP1-WP19-49, using data from CFL
UC-FP1-WP19-45	Request Journey alternatives to avoid crowded routes	1. Alerts generated in UC-FP1-WP19-44 2. Journey planning services data provided by UC-FP1-WP19-01	1. Provided by other use cases, which rely on CFL data
UC-FP1-WP19-46	Training of the Short-term Prognosis Model	1. New demand data 2. Historical Data	FGC
UC-FP1-WP19-47	Short-term prognosis	1. New demand data 2. New real-time data	FGC
UC-FP1-WP19-48	Decision support system for short term forecasting on municipal level.	1. Planner create request for short term demand prediction on selected line/lines 2. Historical data: run time data (ticketing data, short term weather forecast, passenger density) 3. Calendar Mass Events	ŁKA POLREGIO PKP-Intercity PLK Operators Sport/Cultural Facilities
UC-FP1-WP19-49	Forecast Occupancy of Vehicles using Journey Planning Requests Data	1. Journey planning requests data 2. Vehicles occupancy (optional)	1. MaaS platform provided on UC-FP1-WP19-01 2. CFL

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP19-50	Display Forecasted Occupancy Information to Travelers when Planning Trips	1. Railway timetable with planned schedules 2. Railway real time timetable information 3. Occupancy forecast data	1. CFL 2. CFL 3. Calculate on UC-FP1-WP19-49
UC-FP1-WP19-51	Estimation of station staff required to provide quality customer service	1. Real time passenger demand data from Metro of Malaga (PTO) 2. Real time data from Administrator (taxis, incidents in rail system – delays for trains-, etc.)	ADIF and Metro de Málaga
UC-FP1-WP19-52	Decision support system for long term forecasting on municipal level.	1. Planner create request for long term demand prediction on selected line/lines 2. Historical data: run time data (ticketing data, long term weather forecast, passenger density) 3. Calendar Mass Events	ŁKA POLREGIO PKP-Intercity PLK Operators Sport/Cultural Facilities
UC-FP1-WP19-53	Transport offer optimisation	1. Passenger long term demand 2. Planned offer (timetable) 3. Network topology 4. Station topologies 5. Walking times 6. Vehicle characteristics (max capacity, number of available seats …)	The passenger long term demand should come from TE24 (more specifically from UC-FP1-WP19-52), but during the development phase , we can be satisfied with contextualized input data from TE24, and at worst, we can use open data from a city or data that we will have generated for a virtual city based on real data.

Use case ID	Use case name	Data required for UC execution	Data provider
UC-FP1-WP19-54	Analysis of Travel Demand Data based on Forecasted Data	1. Mobility services demand forecast data	This data is generated on UC-FP1-WP19-49, using data from CFL

13. Conclusions

This deliverable has provided a comprehensive overview of the use cases for planned technical developments of MOTIONAL project.

It is important to evaluate whether the number of use cases is sufficient and if the quality of their descriptions is adequate to define the functionalities to be develop in MOTIONAL.
The document includes a total of 164 use cases, covering all technical activities within Motional Work Packages. The use cases for SG3 are completed with all the necessary details to specify the functionalities to be developed in the project. The use cases for SG2 have a good level of description, identifying the sequence of steps in each use case. However, the use cases for SG1 still have a very high-level view.
For SG1 and SG2 the still need further refinement to ensure that the functionality is properly defined, and the project team will determine if any additional use cases need to be included or if the existing ones require further updates. Regarding the identification of data available for the execution of use cases, there is a small number of use cases that still do not have secured the necessary data for the project demonstrator's execution, which will be tracked as a risk for the demonstrators on task T2.4.2. The discussions to solve this gap should happen during Q1 2024.

Through extensive research and collaboration, we have identified key areas where technological advancements can address specific challenges and create opportunities improving rail capacity utilization, operations and service offers. The use cases presented in this deliverable highlight the practical applications and benefits that can be achieved through the successful implementation of these planned advancements.

The MOTIONAL project aims to drive positive societal impact and contribute to Europe's railway technological advancements, so that we can make rail the everyday mobility option.

Overall, this deliverable underscores our commitment to developing innovative solutions that contribute to Europe's position at the forefront of technological innovation in the rail industry. By focusing on the interoperability of systems, MOTIONAL aim to create seamless connectivity between different rail systems across Europe, fostering the development of a Single European Rail Area.

14. Bibliography

FP1 MOTIONAL project deliverables:

- FP1-WP02-D-HAC-001-01 D2.1 Research Data Management Plan
    - Authors: Marco Ferreira
- FP1-WP15-D-RISE-003-03 - D15.1 Requirements for the deployment of TMS linked with ATO/C-DAS
    - Authors: Joborn Martin, Olsson Peter
    - Co-Authors: Goverde Rob

15. Appendix A – FP1 MOTIONAL Glossary (Initial version)

The following table lists the different glossary terms referenced throughout the development of the MOTIONAL project:

Term	Definition	Abbr.	Source	WP	Co.	Person
(Rail) Infrastructure Manager	(Rail) Infrastructure Manager	IM	ERA: Glossary of railway terminology	10	HACON	Rolf Gooßmann
(Temporary) Capacity Restriction	Capacity restriction is a temporary full or partial unavailability of network infrastructure due to construction works, maintenance, inspection works or due to environmental influences and disruptions.		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann
'Pay-as-you-go' model	Contrary to 'pre-paid' model, you only pay for the travels you make		Used in a wide number of transit systems. Typically TFL in London.	20	GTSD	Laurent Bellet
Accident	Unwanted or unintended sudden event or a specific chain of such events which have harmful consequences; accidents are divided into the following categories: collisions; derailments; level crossing accidents; accidents to persons involving rolling stock in motion; fires and others		https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A32016L0798	24	ADIF	Victoria Guryn

Area of operation	Network or networks within one or more Member States where a railway undertaking intends to operate.		https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A32016L0798	24	ADIF	Victoria Guryn
Automatic Route Setting	Automatic Route Setting	ARS	ERA: Glossary of railway terminology	15	PRORAIL	Rob Goverde
Automatic Train Operation	Automatic Train Operation is technology for automating the operation of trains. The degree of the automatisation is shown by the Grade of Automatation (GoA)	ATO	Glossary - ERTMS	3	TRV	Kristian Persson
Automatic Train Operation	Automatic Train Operation	ATO	ERA: Glossary of railway terminology	15	HACON	Rolf Gooßmann
Automatic Train Operation - Onboard (unit)	Automatic Train Operation - Onboard (unit)	ATO-OB	TSI CCS 2022	15	HACON	Rolf Gooßmann
Automatic Train Operation - Trackside	Automatic Train Operation - Trackside	ATO-TS	TSI CCS 2022	15	HACON	Rolf Gooßmann
Automatic Train Protection	Automatic Train Protection	ATP	ERA: Glossary of railway terminology	15	PRORAIL	Rob Goverde
B2B Intermodal services	Arrangements between transit businesses (operators) with the objective to deliver intermodal services.		General B2B definition. https://www.investopedia.com/terms/b/btob.asp	20	GTSD	Laurent Bellet

Capacity	The total overall capability of the infrastructure that can be utilised by traffic or by maintenance. Capacity may apply to specific geographic sectors like stations or lines. Capacity usage must be requested, which results in capacity demand.		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann
Capacity Management System	System dealing with the long- to short-term planning and allocation of rail infrastructure capacity	CMS	https://rne.eu/capacity-management/general-information/	3	TRV	Kristian Persson
Capacity Management System	Capacity Management System	CMS	System Pillar: CMS_TMS System Concept R2 V1_3	11	HACON	Rolf Gooßmann
Capacity Plan	The capacity plan comprises any planned capacity usage (traffic and construction works) at any point in time during the planning period. The aim is a consistent and conflict free capacity plan.		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann
Capacity Planning	Capacity Planning is an instrument to determining the total theoretically available capacity supply (max. number of journeys per direction) and compare it to demand. Capacity can be requested from long term to short term (ad hoc slot ordering). Capacity planning supports the planning		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann

	along all-time horizons (strategic to short term).					
Capacity Production	Capacity production is the implementation of the operational plan. Capacity production begins when the train starts its scheduled mission and ends with when it ends.		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann
Causes	Actions, omissions, events or conditions, or a combination thereof, which led to an accident or incident;		https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A32016L0798	24	ADIF	Victoria Guryn
City Transit Operators	Business participant (private) managing public transit services with a municipality scope (eg. Shuttle services, local minibuses etc.)		N/A - created for the purpose of the project	20	PKP	Jerzy Baranowski
Communication-Based Train Control	Communication-Based Train Control	CBTC	ERA: Glossary of railway terminology	15	HACON	Rolf Gooßmann
Conceptual Data Model	Data model of the railway system focused on project- and platform-independent representation of the conceptual constituents of the rail system. The Conceptual Data Model adheres to a semantic approach. It leverages		LinX4Rail D3.3	30	UIC	Pierre Tane

	industry standards and federates from specialist modelling initiatives, where present, to model the various domains of the rail system.					
Conceptual Data Model (TMS)	Conceptual Data Model (TMS)	CDM	In2Rail_D7.5_Evaluation_of_the_Proof-of-concept_FINAL	10	HACON	Rolf Gooßmann
Conflict	A conflict is any difference between the operational plan and the forecast, regardless of any actual need for intervention to resolve it.		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann
Connected Driver Advisory System	Realizes a communications link to the Control Centre (or Traffic Management Centre) in each controlled area in which the train operates. This enables the provision of schedule, routing and speed restriction updates to trains in near real time, and also receipt of information from trains to the IM control centre to improve regulation decisions.	C-DAS	Driver Advisory System energy saving - railwaysignalling.eu	3	TRV	Kristian Persson

Connected Driver Advisory System	Connected Driver Advisory System	C-DAS	FR82-WP04-D-AC2-006-01_-_D4.4-Evaluation_of_C-DAS_demonstration	15	HACON	Rolf Gooßmann
Connector	A component of the federated dataspace trhough which a Participant in the ecosystem: 1- As a Producer, publishes machine-readable description of the data resources it makes available in the dataspace federated catalog 2- As a Producer, publishes machine-readable policies for use of the data resources it makes available to the dataspace 3- As a Consumer, peforms search and disvovery on the federated catalog of data resources available to it 4- As a Consumer, initiates a contract negotiation with the Producer for obtaining selected data resources 5- As a Producer, executes the contract negotiation initiated by a Consumer and grants access to the data resource if negotiation is successful based on the policy associated to the selected data resource 6- As a both Consumer and Producer performs		https://internationaldataspaces.org/wp-content/uploads/dlm_uploads/IDSA-Data-Connector-Report-92-No-8-September-2023-1.pdf	31	KB	M. vant Hoen

	the data exchange of a data resource ffrom the Producer to the Consumer upon successful negotiation of the contract on that data resource					
Consumer of data	User, application or system that uses data collected by other systems or stored in repositories.		https://satoricyber.com/glossary/data-consumer	20	STS	Pietro Calcagno
Control center	A centralised control system that controls the train movements in a large territory. from which to operate and supervise the system.		SP definitions	13	STS	Daniela Pietranera
Control Command and Signalling	All the equipment necessary to ensure safety and to command and control movements of trains authorised to travel on the network.	CCS	EU Directive 2008/57	17	HACON	Rolf Gooßmann

Control room	Core functional entity, and its associated physical structure, where Operators are stationed to carry out centralized control, monitoring and administrative responsibilities.		https://www.collinsdictionary.com/dictionary/english/control-room	13	STS	Daniela Pietranera
Data sharing	Means the publishing of data where access control may be applied		TSI telematics	3	NRD	Isabelle Tardy
Decision	A decision is a single action intended to make a modification the operational plan.		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann
Demand Responsive Transport	Demand Responsive Transport operates along more flexible routes in a more on-demand way. The routing is dynamic to pick-up and drop-off additional passengers en-route without significantly increasing the overall journey time. In most cases, these services are tendered and commissioned by the public sector, but in some casses they are owned and operated by private companies.		como.org.uk	20	HACON	Marco Ferreira
Development of the railway infrastructure	Network planning, financial and investment planning as well as the building and upgrading of the infrastructure.		Commission Delegated Decision (EU) 2017/2075	3	NRD	Isabelle Tardy

Deviation	A deviation is any difference between the operational plan and the actual state of traffic; unlike a conflict, deviations may only be mitigated but not solved.		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann
Digital Automated Train Operation	Digital Automated Train Operation	DATO	https://projects.shift2rail.org/download.aspx?id=2b268677-24b0-4d86-9463-f3b1680af7a0	15	PRORAIL	Rob Goverde
Digital Twin	a logical construct incorporating data, models, algorithms, software and so on that is associated with a physical system at various stages of his life cycle and exchanges data with it 1- A virtual representation, or digitally replicated version, of real-world entities and processes, synchronized at a specified frequency and fidelity (Digital twin Consortium definition). Alias: Digital Mirror 2- A system that provides such virtual representation and makes it available for the implementation of analysis, simulation and control applications of the represented system 3- An integrated simulation of a complex product/systems that, through physical models and sensor updates,		https://en.wikipedia.org/wiki/Digital_twin	28	DLR	A. Heckmann

	mirrors the life of its corresponding twin.					
Dispatching	Dispatching is the sum of actions intended to make modifications to the operational plan.		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann
Disruption management	Management of transport service disruption by considering solutions within the affected transport service and/or alternative transport modes as recovery strategies. The ultimate goal is to enable affected travellers to continue their own journeys.		N/A	20	STS	Pietro Calcagno
Distributed Ledger	A distributed ledger (also called a shared ledger or distributed ledger technology or DLT) is the consensus of replicated, shared, and synchronized digital data that is geographically		https://en.wikipedia.org/wiki/Distributed_ledger	20	GTSD	Laurent Bellet

	spread (distributed) across many sites, countries, or institutions.					
Driver Advisory System	Driver Advisory System	DAS	FR82-WP04-D-AC2-006-01_-_D4.4-Evaluation_of_C-DAS_demonstration	15	PRORAIL	Rob Goverde
Electric Traction System	Electric Traction System	ETS	http://www.railway-technical.com/infrastructure/electric-traction-power.html	11	HACON	Rolf Gooßmann
End-User representatives	Individual End-Users chosen to contribute to the system development process		https://www.lawinsider.com/dictionary/end-user-representative	13	STS	Daniela Pietranera
End-Users	Those who have the potential to be affected by the introduction of new assets or technologies or by proposed modifications to existing assets or technologies (includes operational staff or supplier maintenance staff and passengers).		https://www.collinsdictionary.com/dictionary/english/end-user	13	STS	Daniela Pietranera
Entities specialized in accessibility	Organizations that define, promote, and improve the accessibility of services, products, and environments for people with disabilities.		https://www.accessibilityassociation.org/s/	22	ADIF	Victoria Guryn

ERTMS Technical Specification for Freight / Passenger train operations	ERTMS Technical Specification for Freight / Passenger train operations	TAF/TAP TSI	ERA: Glossary of railway terminology	11	HACON	Rolf Gooßmann
European Rail Traffic Management System	European Rail Traffic Management System	ERTMS	ERA: Glossary of railway terminology	10	HACON	Rolf Gooßmann
European Traffic Management System (ERTMS)	The European Rail Traffic Management System (ERTMS) is a single European signalling and speed control system that ensures interoperability of the national railway systems, reducing the purchasing and maintenance costs of the signalling systems as well as increasing the speed of trains, the capacity of infrastructure and the level of safety in rail transport.	ERTMS	ERA Glossary	10	HACON	Rolf Gooßmann
European Union Agency for Railways	European Union Agency for Railways	ERA	European Union Agency for Railways Moving Europe towards a sustainable and safe railway system without frontiers. (europa.eu)	3	TRV	Kristian Persson

Extensive disruptions to traffic	Means that train services on a main railway line are suspended for six hours or more		https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A32016L0798	24	ADIF	Victoria Guryn
Federared Catalog	A Component of the federated dataspace that stores machine-readable descriptions of the data resources and policies by which data resources are made available by Producers. The catalog provides search and discovery capabilities used by Consumers to look for available data resources. Catalog entries retrieved by Consumers are used by Consumers to initiate contract negotation with the Producer in order to initiate the retrieval of the contracted data resource from the Producer's connector		https://docs.internationaldataspaces.org/ids-knowledgebase/v/dataspace-protocol/catalog/catalog.protocol	31	KB	M. vant Hoen

Federated Dataspace	A data space is a federated data and service ecosystem enabling the voluntary, sovereign and secure sharing of data between different entities, such as industry, SMEs and public administrations. The concept applies to various sectors, such as manufacturing, energy, tourism, health, mobility and freight. A dataspace is concerned with the cybersecure, reliable, scalable, sovereignty-preserving sharing and communication of data regardless of their econding in a specific format.		https://doi.org/10.5281/zenodo.510574 https://gaia-x.eu/what-is-gaia-x/deliverables/data-spaces/ https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en	31	KB	M. vant Hoen
FMI	functional mock-up interface		https://fmi-standard.org/	28	DLR	A. Heckmann
FMU	functional mock-up unit: a software library that implements a digital twin simulation model according to the FMI specification		https://fmi-standard.org/	28	DLR	A. Heckmann
Forecast	The forecast displays the future state of traffic. It based on the current operational state. The forecast projects the current operational plan into the future. A forecast for each train run under consideration of mutual train influence is processed (train run time, section run time, minimal section run time, detailed topology,		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann

	headways and train sequence, circulation, connection, etc.).					
Future Rail Mobile Communication System	Future Rail Mobile Communication System	FRMCS	UIC (https://uic.org/rail-system/telecoms-signalling/frmcs)	15	PRORAIL	Rob Goverde
Grade of Automation (ATO)	Grade of Automation (ATO)	GoA	Wikipedia	15	HACON	Rolf Gooßmann
HMI guidelines	Set of suggestions, recommendations, procedures and best practices to be followed in order to design and develop an HMI system with usability compliant with expectations, reduce chance of human errors and Operators' workload and improve situational awareness.		https://www.cmc-info.net/basic-specification.html	13	STS	Daniela Pietranera
Human Factor	Human Factor	HF	Wikipedia	15	PRORAIL	Rob Goverde
Human Machine Interface	Human Machine Interface is mainly the space and environment in which interactions between humans and machines occur, through complex relations between input and output exchanged among several sub-systems and/or peripheral devices and	HMI	https://csrc.nist.gov/glossary/term/human_machine_interface	13	STS	Daniela Pietranera

	presented by means of the display of graphical elements and data, from where Operators can issue commands and supervise the sub-systems behaviour.					
Human-Machine Interface	Human-Machine Interface	HMI	ERA: Glossary of railway terminology	13	HACON	Rolf Gooßmann
Incident	Means any occurrence, other than an accident or serious accident, affecting the safety of railway operations;		https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A32016L0798	24	ADIF	Victoria Guryn
Infrastructure capacity	The potential to schedule train paths requested for an element of infrastructure for a certain period		Directive 2012/34/EU of the Parliament and of the Council of 21 November 2012 establishing a single European railway area (recast) eimrail.org	3	NRD	Isabelle Tardy
Infrastructure Manager	Any body or undertaking for establishing, managing and maintaining railway infrastructure, including traffic management and control-command and signalling. The functions of the IMs on a network	IM	Glossary - EIM (eimrail.org) EU Directive 2007/59	3	TRV	Kristian Persson

	or part of a network may be allocated to different bodies or firms					
Infrastructure Operators	Municipal organization responsible for maintenance of infrastructure such as roads, electricity, etc.		N/A - created for the purpose of the project	24	PKP	Jerzy Baranowki
Integration Layer	Integration Layer	IL	In2Rail_D7.5_Evaluation_of_the_Proof-of-concept_FINAL	15	PRORAIL	Rob Goverde
Interlocking	A general term applied to the controlling of the setting and releasing of “signals” and “points” to prevent unsafe conditions arising, and equipment which performs this function.		ERA ERTMS/ETCS Glossary of Terms and Abbreviations	8	TRV	Kristian Persson
Journey Profile (ATO/C-DAS))	Journey Profile (ATO/C-DAS))	JP	TSI CCS 2022	15	PRORAIL	Rob Goverde

MaaS platform	A MaaS platform is a technical platform providing Mobility as a Service (MaaS). MaaS is the integration of, and access to, different transport services (such as public transport, ride-sharing, car-sharing, bike-sharing, scooter-sharing, taxi, car rental, ride-hailing and so on) in one single digital mobility offer, with active mobility and an efficient public transport system as its basis. This tailor-made service suggests the most suitable solutions based on the user's travel needs. MaaS is available anytime and offers integrated planning, booking and payment, as well as en route information to provide easy mobility and enable life without having to own a car.		UITP. Mobility as a Service; International Association of Public Transport: Brussels, Belgium, 2019. https://cms.uitp.org/wp/wp-content/uploads/2020/07/Report_MaaS_final.pdf	20	HACON	Marco Ferreira
Macroscopic infrastructure model	Node-link-models that contain aggregate information on nodes and links.		Hansen I. A., Pachl J. Railway timetabling and operations, 2014, Eurailpress, Hamburg, Germany, p. 315	8	TRV	Kristian Persson

Master Data	Master data represents "data about the business entities that provide context for business transactions".		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann
Mesoscopic infrastructure model	Node-link-models as syntheses of microscopic and macroscopic infrastructure models. Signal blocks and headways are modelled only in stations and interlocking areas, not on links.		Hansen I. A., Pachl J. Railway timetabling and operations, 2014, Eurailpress, Hamburg, Germany p. 315	8	TRV	Kristian Persson
Metro Service Provider	Specific Transport Service Provider that provides metro services and means of transports.			22	DB	Clemens Gantert
Microscopic infrastructure model	Node link models that contain, depending on their purpose, the highest possible level of detail on nodes and links		Hansen I. A., Pachl J. Railway timetabling and operations, 2014, Eurailpress, Hamburg, Germany, p. 316	8	TRV	Kristian Persson

Mobility Account	Online account supporting travel services pre and post paid, frequently used in multi-modality		Connected to ACCOUNT PROVIDER in TRANSMODEL. https://www.transmodel-cen.eu/wp-content/uploads/2015/01/TRM6_DataDefinitions-1.pdf. Connected to ISO/TR 21724 Connected to OSDM Travel Account	20	GTSD	Laurent Bellet
Mobility Account Provider	Derivation from retailer. Business participant owning the Mobility Account.		Connected to ACCOUNT PROVIDER in TRANSMODEL. https://www.transmodel-cen.eu/wp-content/uploads/2015/01/TRM6_DataDefinitions-1.pdf	20	GTSD	Laurent Bellet

Mobility demand	The mobility demand covers the users of the mobility service and their needs, choices and preferences. The following are described as being part of the demand side: — all travellers, including pedestrians, riders, drivers and cyclists, where the traveller could be of any age, with or without disabilities, etc.; — time of use of the transport service (e.g. ride, drive, delivery) which can affect the transport means to be used, e.g. availability and frequency of a delivery service; — origin, i.e. destination request defining the location of the mobility service which affects the route, mode and means choice; — mode and means demand based on occupancy, size or type of vehicle; — user needs and preferences concerning how the mobility service is recommended to take place, for example, travelling alone, travelling together with other (public transport, shared rides), comfort requirements, e.g. always a seat or a limited occupancy, inclusion or exclusion of specific transport modes and		ISO/TR 4447	20	HACON	Marco Ferreira

	means etc.					
Mobility package	Set of mobility services that can be purchased as a whole by travellers. Widely used in MaaS		Typical reference. https://maas-alliance.eu/wp-content/uploads/2018/03/ERT_MaaS_leaflet_FINAL.pdf	20	GTSD	Laurent Bellet
Mobility service	A mobility service is the integration of, and access to, different transport services that are integrated into a single mobility service representing the best value proposition for the		ISO/TR 7878	20	HACON	Marco Ferreira

	user and being accessible anytime on demand.					
Multimodal transport	Multimodal transport (also known as combined transport) is the transportation of goods under a single contract, but performed with at least two different modes of transport		https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XI-E-1&chapter=11&clang=_en	20	PKP	Jerzy Baranowski
Municipal Independent Operators	Business participant (private) managing public transit services with a municipality scope (eg. Shuttle services, local minibuses etc.)		N/A - created for the purpose of the project	20	PKP	Jerzy Baranowski
Municipality management personnel	Representatives of e.g. road management reporting on roadworks, city council reporting on festivals, etc. Generally trusted sources from municipal governing or affecting bodies.		N/A - created for the purpose of the project	24	PKP	Jerzy Baranowki
Network Timetable Exchange	NeTEx is a CEN Technical Standard for exchanging Public Transport schedules and related data. It is divided into three parts, each covering a functional subset of the CEN Transmodel for Public Transport Information:	NETEX	https://netex-cen.eu/	20	GTSD	Laurent Bellet

OCC Operator	Person who is responsible for monitoring and controlling the systems and processes within the Operation Control Centre (OCC). The operator's role may include tasks such as: - Monitoring the status of equipment, systems, and processes in real-time. - Responding to alerts and alarms generated by the monitoring systems. - Coordinating and managing traffic. - Troubleshooting issues and resolving problems that arise. - Communicating with other operators, technicians, and stakeholders to coordinate activities and resolve issues. - Following established procedures and protocols to ensure the safe and efficient operation of the control centre.		Definition made from Thales's documents, for instance https://www.thalesgroup.com/sites/default/files/database/d7/asset/document/integrated_communications_and_supervision_brochure.pdf	24	GTSD	Nicolas Germain
Open API for distributed journey planning	The Open API for distributed Journey Planninge (OJP) is a protocol standardised by CEN to enable cross-system journey planning and access to various other services commonly offered by Journey Planning systems.	OJP	Transmodel CEN/TS 17118:2017	20	HACON	Marco Ferreira

Open Sales and Distribution Model	OSDM (Open Sales and Distribution Model) defines an API to enable and simplify the sale of transport products. The API allows Retailers to access transport products provided by distributors. It also allows distributors to access transport product bricks provided by carriers or fare providers to build combined transport products. The aim of OSDM is to provide a simple API to access required information online, however OSDM also rovides an offline data exchange of fares. OSDM covers scheduled multimodal transport services (trains, busses, trams, ...). The API covers the full sales process including time table / offer serch, prebooking and booking, refund, exchange including special processes to handle delays, change of material and compensation.	OSDM	www.osdm.io	20	DB	Clemens Gantert
Operating state	The operating state describes the current state of production: • how trains move • where trains are • which route is set in control system • status of assets This information is based on inputs from		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann

	control systems.					
Operational Plan	Analogous to the capacity plan, the operational plan supplies the train and traffic control and all other components with the operational train data. The operational plan is fed from the active timetable buffer and contains all trains (from the timetable buffer) that are currently in their operational time window. The operational plan is the result of various influences (decisions from dispatching, map data, etc.). It is updated every single minute.		System Pillar: CMS_TMS System Concept R2 V1_3	10	HACON	Rolf Gooßmann

OSDM distributer	The distributor manages the lifecycle of a product sold (the travel contract). He therefore needs to establish information exchange with the retailer, carriers and TCOs involved. The distributor makes products available to the retailer. The distributor could provide direct services to the passenger to modify the ticket status (e.g. activate / check in on a ticket). The distributor combines fares defined by the carriers according to their rules.The distributor creates the ticket fulfillment data (e.g. pdf, pkpass, …). The distributor is introduced to separate the role of just selling tickets along a route (retailer) from the role of creating the ticket content and providing it to retailers for sale.		www.osdm.io	20	DB	Clemens Gantert
Other multimodality operators	Business participant offering non-public services for multimodal travel (eg. Taxi operator, bike rentals, scooter rental, car sharing)		N/A - created for the purpose of the project	20	PKP	Jerzy Baranowski
Person with Disabilities or Person with Reduced Mobility	Any person who has a permanent or temporary physical, mental, intellectual or sensory impairment which, in interaction with various barriers, may hinder his or her full and effective use of transport on an equal basis with other		TSI PRM	22	ADIF	Victoria Guryn

	passengers or whose mobility when using transport is reduced due to age					
Plan Execution (RCA)	Plan Execution (RCA)	PE	RCA_Alpha_ Architecture _Overview	17	HACON	Rolf Gooßman n
Rail Administrato r / Infrastructur e Manager	Body or firm responsible in particular for establishing, managing and maintaining railway infrastructure, including traffic management and control-command and signalling». In addition, the management of royalties.		EU Directive 2007/59	22	ADIF	Victoria Guryn
Rail Infrastructur e Manager	Rail Infrastructure Manager	RIM	ERA: Glossary of railway terminology (IM)	10	HACON	Rolf Gooßman n
Rail-Collaborative Decision Making	Rail-Collaborative Decision Making (RNE) to share operational information between actors. To send time stamps about process progress departure, train run and arrival. Concept is from airports and have now been adopted to ports and rail.	R-CDM	RNE Rhine Alpine Corridor	4	TRV	Magnus Wahlborg

Rail-Collaborative Decision Making (RNE)	Rail-Collaborative Decision Making (RNE)	R-CDM	RNE R-CDM Feasibility Study (https://cip.rne.eu/apex/download_my_file?in_document_id=9863)	11	HACON	Rolf Gooßmann
Railnet Europe	Railnet Europe	RNE	https://rne.eu/	11	HACON	Rolf Gooßmann
Railway Service Provider	Specific Transport Service Provider that provides railway services and means of transports.		Specific transport service provider (see Transport Service Provider term)	20	STS	Pietro Calcagno
Railway Undertaking	Any public or private undertaking, the principal business of which is to provide services for the transport of goods and/or passengers by rail with a requirement that the undertaking ensure traction; this also includes undertakings which provide traction only.	RU	Glossary - EIM (eimrail.org) EU Directive 2007/59	3	TRV	Kristian Persson
Railway Undertaking	Railway Undertaking	RU	ERA: Glossary of railway terminology	10	HACON	Rolf Gooßmann
Real time	The ability to exchange or process information on specified events (such as arrival at a station, passing a station or departure from a station) on the trains journey as they occur.		https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019R0773	24	ADIF	Victoria Guryn

Real-time Traffic Plan (as managed by a TMS)	Real-time Traffic Plan (as managed by a TMS)	RTTP	see Operational Plan	15	HACON	Rolf Gooßmann
Reference CCS Architecture	Reference CCS Architecture	RCA	ERA: Glossary of railway terminology	17	HACON	Rolf Gooßmann
Regulatory body	A body established by Member States responsible for monitoring competition in the railway market and to which an applicant has the right to appeal in cases where it believes it has been unfairly treated, discriminated against or is any other way aggrieved, in particular against decisions adopted by an infrastructure manager or where appropriate a railway undertaking		Glossary - EIM (eimrail.org)	3	NRD	Isabelle Tardy
Retailer	A retailer is an organization selling the products of Transport service provider(s) using the services of distributors. A TSP can play the role of a retailer in connection with both its own products and those of a partner TSP by whom it is licensed.		OSDM IRS-90918-10 Leaflet	20	HACON/ DB	Clemens Gantert Marco Ferreira
Revenue Settlement	Revenue distribution. In interoperable mobility platforms, the distribution of the revenue between operators		Typically addresses in ISO 24014	20	GTSD	Laurent Bellet

Route	The particular section or sections of line		https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019R0773	24	ADIF	Victoria Guryn
Scheduled stop	Planned stop for commercial or operational reasons.		https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019R0773	24	ADIF	Victoria Guryn
Segment Profile (ATO/C-DAS)	Segment Profile (ATO/C-DAS)	SP	TSI CCS 2022	15	PRORAIL	Rob Goverde
Service Provider	Role of an organization offering service(s), especially but not exclusively to transportation.	SP	CEN ISO-24014, ERA TAP	20	GTSD	Laurent Bellet
Smart Communications for Efficient Rail Activities	Smart Communications for Efficient Rail Activities	SFERA	UIC (https://uic.org/projects/sfera-smart-communications-for-efficient-rail-activities)	15	PRORAIL	Rob Goverde
Staff	Employees working for a railway undertaking or an infrastructure manager, or their contractors, undertaking tasks as specified in this Regulation.		https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019R0773	24	ADIF	Victoria Guryn
Standard Communication Interface Operational Plan (RCA)	Standard Communication Interface Operational Plan (RCA)	SCI-OP	RCA_Alpha_Architecture_Overview	17	HACON	Rolf Gooßmann

Standard Interface for Real-time Information	The SIRI Situation Exchange service covers the exchange of information describing an incident, typically an unplanned event such as a disruption, but also planned events that affect public transport or its use, such as engineering works, or major public events that will affect the use or availability of transport.	SIRI-SX	https://www.transmodel-cen.eu/siri-standard/	20	STS	Pietro Calcagno
Station Operator	Entity responsible for administration and operation of railway station building and related infrastructure (focus especially on station building not platforms)		N/A - created for the purpose of the project	20	PKP	Jerzy Baranowski
Technical Specification for Interoperability	A specification adopted in accordance with this Directive by which each subsystem or part of a subsystem is covered in order to meet the essential requirements and ensure the interoperability of the Union rail system	TSI	EU Directive 2016/797	3	TRV	Kristian Persson
Technical Specification for Interoperability	Technical Specification for Interoperability	TSI	ERA: Glossary of railway terminology	10	HACON	Rolf Gooßmann

Telematics Applications for Freight services	Applications for freight services, including information systems (real-time monitoring of freight and trains), marshalling and allocation systems, reservation, payment and invoicing systems, management of connections with other modes of transport and production of electronic accompanying documents.	TAF	Directive (EU) 2016/797, 11 May, the interoperability of the rail system within the European Union	3	ADIF	Mariano Martinez
Telematics Applications for Passenger services	Applications for passenger services, including systems which provide passengers with information before and during the journey, reservation and payment systems, luggage management and management of connections between trains and with other modes of transport.	TAP	Directive (EU) 2016/797, 11 May, the interoperability of the rail system within the European Union	3	ADIF	Mariano Martinez
Temporary Capacity Restriction	All planned event which lead to a reduction of infrastructure capacity during a specific time, necessary to keep the infrastructure and its equipment in good condition and to allow infrastructure development in accordance with market needs.	TCR	RNE Glossary	3	ADIF	Mariano Martinez
Temporary Capacity Restriction	Temporary Capacity Restriction	TCR	TAP TSI and TAF TSI	11	HACON	Rolf Gooßmann

Terminal operator	Freight terminal = A structure equipped for transhipment between at least two transport modes or between two different rail systems, and for temporary storage of freight, such as ports, inland ports, airports and rail-road terminals. Terminal Operator = An organisational entity, which is has been made responsible for the management of a marshalling yard, multimodal or intermodal terminal, port terminal.		Regulation (EU) No 1315/2013	3	NRD	Isabelle Tardy
Timetable	Document or system that gives details of a train(s) schedule over a particular route.		https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019R0773	24	ADIF	Victoria Guryn
Timetable planner, -IM and RU	Means somebody or firm responsible in particular for establishing, managing and maintaining railway infrastructure, including traffic management and control-command and signalling; the functions of the infrastructure manager on a network or part of a network may be allocated to different bodies or firms.		https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32012L0034	3	NRD	Isabelle Tardy

Timetable Redesign	"Timetable Redesign" (TTR) for optimal capacity management (TTR for Smart Capacity Management) is a project to review the current passenger and freight timetabling process defined in synergy between RailNet Europe (Infrastructure Managers) and Forum Train Europe (Railway Undertakings), in collaboration with the European Rail Freight Association (ERFA) and also shared with European institutional bodies (European Commission, Ministries, Regulatory Bodies), aimed at improving the degree of standardisation and efficiency of the railway system.	TTR	Timetable redesign project (TTR) project (rfi.it)	3	NRD	Isabelle Tardy
Timing Point (ATO/C-DAS)	Timing Point (ATO/C-DAS)	TP	ERA: Glossary of railway terminology	15	PRORAIL	Rob Goverde
Traffic Management	Traffic Management	TM	ERA: Glossary of railway terminology	10	HACON	Rolf Gooßmann
Traffic Management System	1. Ensemble of applications providing permanent control across the network, automatically sets routes for trains and logs train movements as well as detects and maybe solves potential conflicts.	TMS	https://www.thalesgroup.com/en/europe/germany/transportation/traffic-management-systems)	3	ADIF	Mariano Martinez

Traffic Management System	Traffic Management System	TMS	ERA: Glossary of railway terminology	10	HACON	Rolf Gooßmann
Train	A train is defined as (a) traction unit(s) with or without coupled railway vehicles with train data available operating between two or more defined points.		https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019R0773	24	ADIF	Victoria Guryn
Train Control and Monitoring System	Train Control and Monitoring System	TCMS	https://www.railwaysignalling.eu/train-control-and-monitoring-systems-tcms	15	PRORAIL	Rob Goverde
Train Control and Supervision (System)	Train Control and Supervision (System)	TCS	System Pillar: CMS_TMS System Concept R2 V1_3	15	PRORAIL	Rob Goverde
Train Path Envelope	Train Path Envelope	TPE	https://uic.org/events/IMG/pdf/documents-uic_irs90940_sfera_launch_webinar.pdf	15	HACON	Rolf Gooßmann
Transport Service Provider	Means any private or public company authorised to transport people in domestic or international passenger traffic. A 'transport service provider' accepts travel documents issued by the accredited sales points of its distributors. It plays the role of the contractual carrier with which the passenger has	TSP	TAF TSI	20	HACON	Marco Ferreira

	entered into a contract of carriage. Execution of the transport service may be entrusted, in part or in full, to a substitute carrier					
Travel transaction	Type of fare transaction associated with pay-as-you-go.		Typical references. https://www.gvb.nl/en/privacy-statement/why-does-gvb-use-your-personal-data/travelling-tram-bus-or-metro/travelling-your	20	GTSD	Laurent Bellet
Traveller (Mobility service user)	The traveller or mobility service user is very often the entity that requests the mobility service, selects the mobility service fulfilling the user needs and preferences, uses the service and pays for it.		ISO/TR 7878	20	HACON	Marco Ferreira

Urban Transport Service Provider	Company that provides public transportation services, such as buses, trains, trams, and subways.		https://projects.shift2rail.org/download.aspx?id=a43a848d-d80f-44e0-87e8-d070d99e485d Transport Service Provider limited to the urban areas	24	GTSD	Nicolas Germain
Weather station	Facility equipped with instruments for measuring atmospheric conditions such as temperature, pressure, humidity, wind speed, wind direction, and precipitation.		https://en.wikipedia.org/wiki/Weather_station	24	GTSD	Nicolas Germain
Working timetable	The data defining all planned train and rolling-stock movements which will take place on the relevant infrastructure during the period for which it is in force		EU Directive 2012/34	3	NRD	Isabelle Tardy
Workstation	The computer from which the User operates the system: normally this will comprise of one or more monitors, central processing unit and any other necessary peripherals.		https://csrc.nist.gov/glossary/term/workstation	13	STS	Daniela Pietranera

Yard	Marshalling yard - Site especially equipped with a number of tracks or other equipment for railway vehicle marshalling (switching) operations.		https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R0763-20200616	3	NRD	Isabelle Tardy

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