



ERJU SYSTEM PILLAR

20 System Definition CCS System



System Definition CCS System

DRAFT

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1 Preamble

1.1 Purpose

This document describes the System Definition as required per [SPP-349 - [EN 50126-1:2017]] phase 2 for the SPMS-2098 - CCS System (system under consideration).

The purpose of the System Definition is to provide a basis of information about the system under consideration to enable RAMS analysis and security analysis (phase 3 of [SPP-349 - [EN 50126-1:2017]]). Furthermore, it provides a basis for the derivation of requirements.

1.2 Intended audience

Domain experts involved in the tendering, development, verification, validation or assessment of the system under consideration (e.g. System Engineers, RAMS Engineers, Developer, Tester, Assessors, etc).

1.3 Document context

As shown in SPP-18384, the System Definition of the SPMS-2098 - CCS System is based on the following inputs:

- [SPP-19161 - OD_ETCS L2 Rulebook_V0.3]:
This document contains the harmonized operational processes which are envisaged for the future SERA.

Note:

The traceability between the artefacts of the [SPP-19161 - OD_ETCS L2 Rulebook_V0.3] and the System Definition of the SPMS-2098 - CCS System is shown in [SPP-18366 - TCS_System Definition CCS-System: Traceability Report Operational Processes_V0.3].

- [SPP-19163 - OD_Stakeholder Requirements Specification CCS System_V0.2]:
This document contains overarching requirements derived from [SPP-8684 - System Pillar Common Business Objectives (May 2022)].

Note:

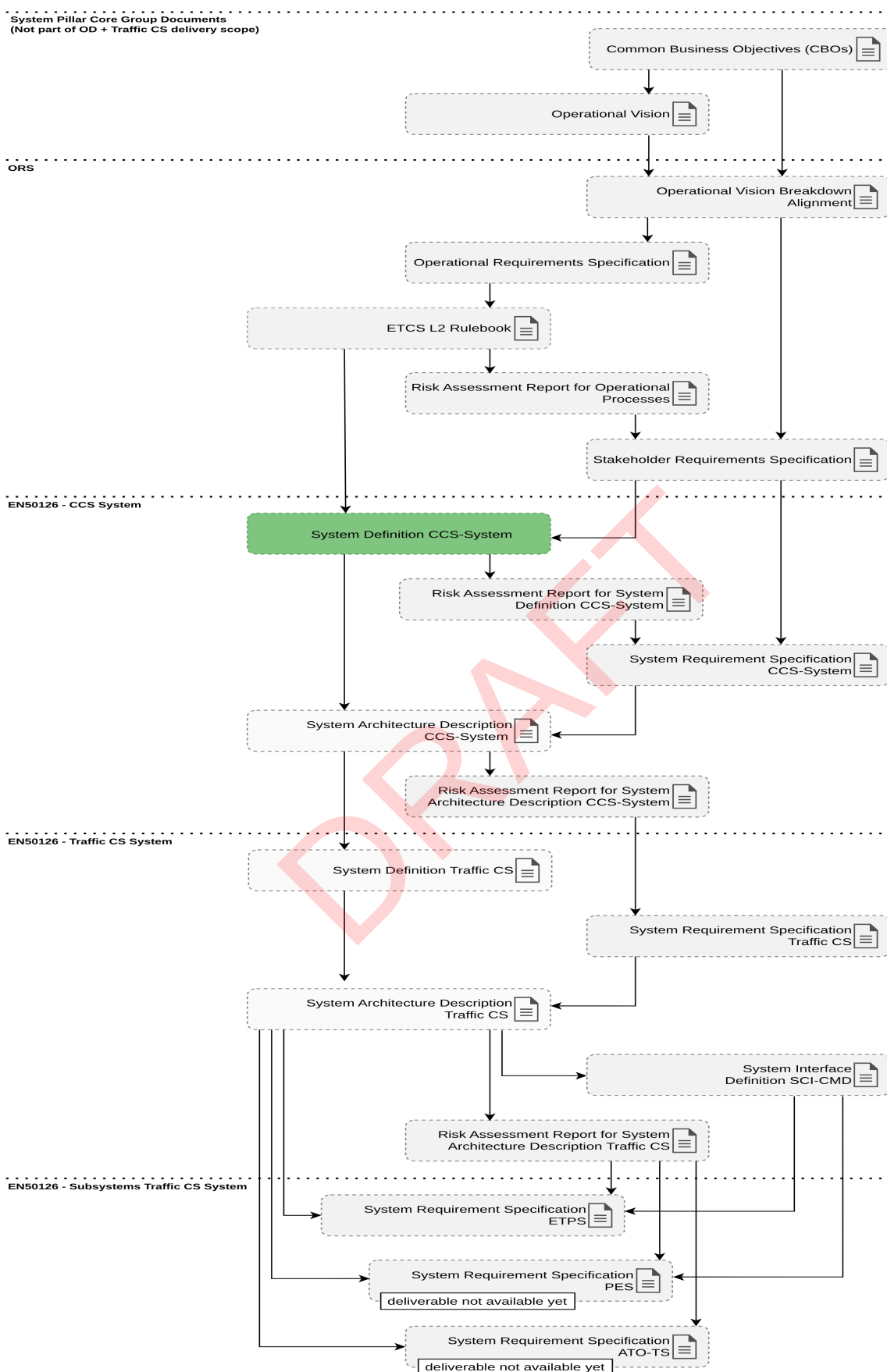
The traceability between the artefacts of the [SPP-19163 - OD_Stakeholder Requirements Specification CCS System_V0.2] and the System Definition of the SPMS-2098 - CCS System is shown in [SPP-18366 - TCS_System Definition CCS-System: Traceability Report Operational Processes_V0.3].

Using these inputs ensures that the SPMS-2098 - CCS System fulfils the goals of the System Pillar and is aligned to the harmonised operational processes envisioned for the SERA.

The System Definition of the SPMS-2098 - CCS System itself is an input document for the subsequent Risk and Hazard Analysis and System Architecture Description of the SPMS-2098 - CCS System.


The [SPP-18362 - EET_Requirements Management Plan Version_1.0] explains in more detail the dependencies between the different documents.

SPP-18384 below shows the System Definition of the CCS System in the context of the overall document list (see also [SPP-19283 - Release Note ESPR1.0]).



1.4 Glossary

1.4.1 Terms and definitions

Term	Definition
CCS System	The control command and signalling (CCS) system covers signalling, train control, positioning equipment and telecommunications. 
Single European Railway Area	Defining the fundamental design principles and process for adopting a functional architecture for rail as a system, with a focus on CCS, CMS and TMS supporting the implementation of the SERA (Single European Railway Area)

1.4.2 Abbreviations

Abbreviation	Definition
SERA	Single European Railway Area



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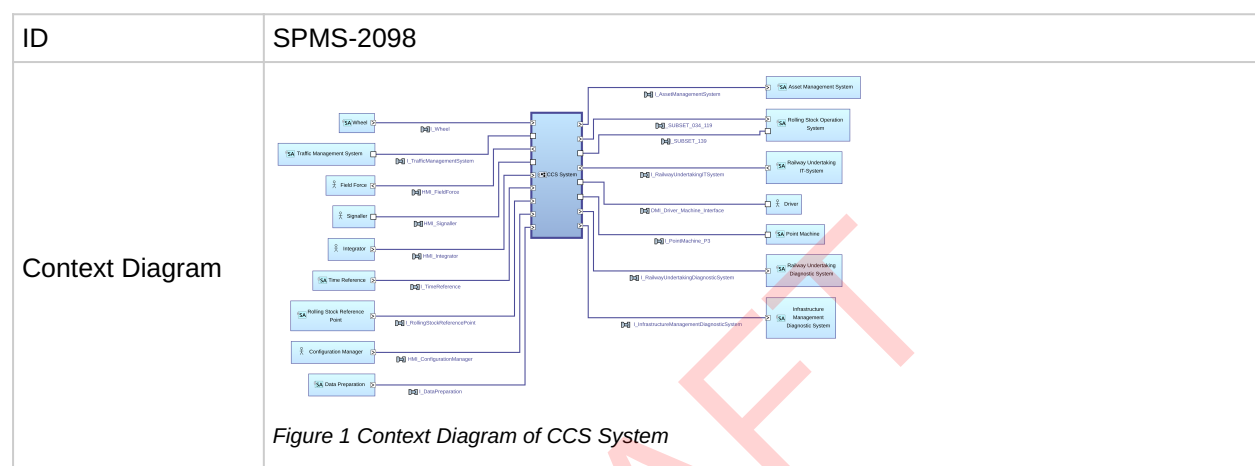
2 System Definition

2.1 System, mission profiles and assumptions

2.1.1 System description

CCS System






The  SPMS-2098 - CCS System is a vital framework in railway operations, ensuring the safe and efficient movement of trains. By utilising precise signalling and train protection mechanisms, it helps to prevent collisions and mitigate other operational risks. The  SPMS-2098 - CCS System enables seamless and secure train operations across diverse railway networks, prioritising safety and reliability.



2.1.1.1 Human actors












2.1.1.1-1 - Signaller

Staff in charge of authorising trains/shunting movements and of issuing instructions to train drivers to ensure safe train operation.

ID	SPMS-2090		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none">  SPMS-2198 - HMI_Signaller 	bidirectional	<ul style="list-style-type: none">  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none">  SPMS-2167 - Supervise state of railway operation  SPMS-2172 - Use system voice communication  SPMS-6482 - Monitor system asset state information 		




2.1.1.1-2 - Driver

A person capable and authorised to drive trains, including locomotives, shunting locomotives, work trains, maintenance railway vehicles or trains for the carriage of passengers or goods by rail in autonomous, responsible and safe manner. (Reference: Article 3 of Directive 2007/59/EC)

ID	SPMS-2096		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-2204 - DMI_Driver_Machine_Interface 	bidirectional	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-2106 - Control relative traction and braking effort manually •  SPMS-2109 - Toggle train cab •  SPMS-2126 - Control start of mission activities manually •  SPMS-2134 - Authorise automatic driving state •  SPMS-2158 - Supervise guideway of one train •  SPMS-2174 - Use system voice communication •  SPMS-2177 - Supervise passenger exchange •  SPMS-6819 - Switch train power •  SPMS-6821 - Control registration of functional number 		




2.1.1.1-3 - Field Force

The field force is the single point of contact when maintenance activity or construction work is carried out in the field, e.g. this actor is responsible for the safety of the staff in the field.

ID	SPMS-6160		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-2199 - HMI_FieldForce 	incoming from	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-7317 - Carry our maintenance task 		





2.1.1.1-4 - Configuration Manager

is responsible to manage and supervise distribution of configuration data published by Integrators for CCS system. This role is also responsible for producing the distribution-job defining the target and when to preload and activate Configuration data. In this context it is usually an Infrastructure Manager or Train Operator/Owner.

ID	SPMS-2103		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-2206 - HMI_ConfigurationManager 	outgoing to	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-2129 - Prepare+Supervise distribution of the configuration data 		

2.1.1.1-5 - Integrator

is responsible for the overall CCS Configuration of a specific instance Deployment of the CCS System including: Integration Testing, Verification, Validation, Approval (including assessment according to TSI CCS (if relevant) and CENELEC standards (if relevant)), Homologation (authorisation for vehicle or trackside instances).



ID	SPMS-6240		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-6516 - HMI_Integrator 	outgoing to	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-6241 - Check+Sign configuration data •  SPMS-6518 - Provide configuration data 		



2.1.1.2 External systems

2.1.1.2-1 - Traffic Management System

Traffic Management System covers the management and the planning level.





Traffic Management is responsible for all planning activities including producing an operational plan, based upon the operational state and operational events. A conflict free operational plan would be sent to Traffic Control and Supervision usually at the beginning of a service day. Change of planning can be done for the next minutes up to the next year. A plan includes regular or incidence-related commands for infrastructure users (e.g. trains, construction sites), including measures to correct deviations or to stabilize the traffic flow in short term.

ID	SPMS-2097		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-2200 - I_TrafficManagementSystem 	bidirectional	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System



Allocated	<ul style="list-style-type: none"> •  SPMS-2131 - Provide planned activation time for infrastructure •  SPMS-2148 - Calculate operational traffic plan
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







2.1.1.2-2 - Point Machine

The point machine is an apparatus for moving and detecting point blades from a source of power, usually electric. It may also include a system to mechanically lock the point in a physical end position. The point machine safety relevant signalling component, ensuring safe passage of railway vehicles over moveable elements at points, crossings and derailleurs.

ID	SPMS-2100		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-2202 - I_PointMachine_P3 	bidirectional	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-2125 - Exert force on point rails •  SPMS-2132 - Has physical behaviour moves+lies+is locked 		







2.1.1.2-3 - Rolling Stock Operation System

Represents a collection of functionalities of on-board systems which are external to the  SPMS-2098 - CCS System. This actor includes the Train Control Management System and other control systems e.g. door control, traction control or braking control and can be specific to the class from the supplier of the rolling stock; but it interacts with the  SPMS-2098 - CCS System over a standardised interface.

ID	SPMS-2094		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-2195 - I_SUBSET_139 	bidirectional	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
	<ul style="list-style-type: none"> •  SPMS-2197 - I_SUBSET_034_119 	bidirectional	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-2114 - Implement specific doors state •  SPMS-2146 - Implement specific traction and braking effort •  SPMS-2163 - Control cab mode of one train •  SPMS-6817 - Control power of one train 		




2.1.1.2-4 - Rolling Stock Reference Point

Represents any point on the structure of one rolling stock including undercarriage, wheels etc. that can be used to determine this reference point's relative motion to the track. The reference point has a 3 axis coordinate system, that is aligned with the coordinate system of the body it is notionally attached to.

ID	SPMS-2091		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-2196 - I_RollingStockReferencePoint 	outgoing to	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-2127 - Has acceleration vector in relation to rolling stock coordinates •  SPMS-2135 - Has position in relation to geographical coordinates •  SPMS-2138 - Has position and direction in relation to track coordinates •  SPMS-2140 - Has velocity in relation to track coordinates 		

2.1.1.2-5 - Wheel

Represents the physical wheel of one rolling stock. Is used as a special kind of rolling stock reference point.

ID	SPMS-2101		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-2201 - I_Wheel 	outgoing to	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-2141 - Has wheel position and direction in relation to track coordinates 		

2.1.1.2-6 - Data Preparation

Is responsible to prepare and validate configuration data required by the CCS system.




This system encompasses the contributions of three types of stakeholders:

Infrastructure Manager: Provides infrastructure related configuration data, such as track topology.

Railway Undertaking: Provides Vehicle related configuration data, such as static train/vehicle characteristics used for the parametrisation of the CCS on-board.




Supplier: Delivers application specific configuration data, such as hardware configurations or software parameters for onboard or wayside components.

ID	SPMS-2088
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Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-2205 - I_DataPreparation 	outgoing to	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-2128 - Provide+sign configuration data 		




2.1.1.2-7 - Railway Undertaking IT-System

Is responsible to provide information about railway undertaking planning times of configuration updates activation.

ID	SPMS-5084		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-5133 - I_RailwayUndertakingITSystem 	outgoing to	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-6570 - Provide planned activation time for vehicle 		

2.1.1.2-8 - Asset Management System




Is responsible to track the condition, lifecycle, and maintenance activities of railway assets, supporting informed decisions and optimised maintenance planning based on diagnostic and monitoring data.

ID	SPMS-6204		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-6229 - I_AssetManagementSystem 	incoming from	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-2111 - Plan maintenance tasks+Manage asset 		

2.1.1.2-9 - Infrastructure Management Diagnostic System




Is responsible for analysing and interpreting the collected diagnostic and monitoring data from the infrastructure management assets. It focuses on advanced processing of the data.

ID	SPMS-6202
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Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-6230 - I_InfrastructureManagementDiagnosticSystem 	incoming from	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-6206 - Analyse Infrastructure Manager system asset state 		




2.1.1.2-10 - Railway Undertaking Diagnostic System

Is responsible for analysing and interpreting the collected diagnostic and monitoring data from the railway undertaking assets. It focuses on advanced processing of the data.

ID	SPMS-6203		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-6231 - I_RailwayUndertakingDiagnosticSystem 	incoming from	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-6207 - Analyse Railway Undertaking system asset state 		

2.1.1.2-11 - Time Reference

Represents an integral entity designed to supply precise time information. Serve as a reliable source for current time data across multiple regions and time zones. Maintain synchronisation with official global time standards, ensuring accurate and consistent time delivery.

ID	SPMS-6265		
Interfaces	Interface	Direction	Partner
	<ul style="list-style-type: none"> •  SPMS-6266 - I_TimeReference 	outgoing to	<ul style="list-style-type: none"> •  SPMS-2098 - CCS System
Allocated	<ul style="list-style-type: none"> •  SPMS-2171 - Provide current time 		

2.1.2 System objectives

In this chapter, all objectives are described by the following aspects:

- A context diagram, showing the relationship between objectives and involved entities.
- Exchange scenarios, describe the interactions between actors and the system by focusing on the exchange of information in a given context and with a time axis.

- Functional chains, showing an ordered set of involved functions.
- Control loops, showing an ordered set of involved functions and their allocation

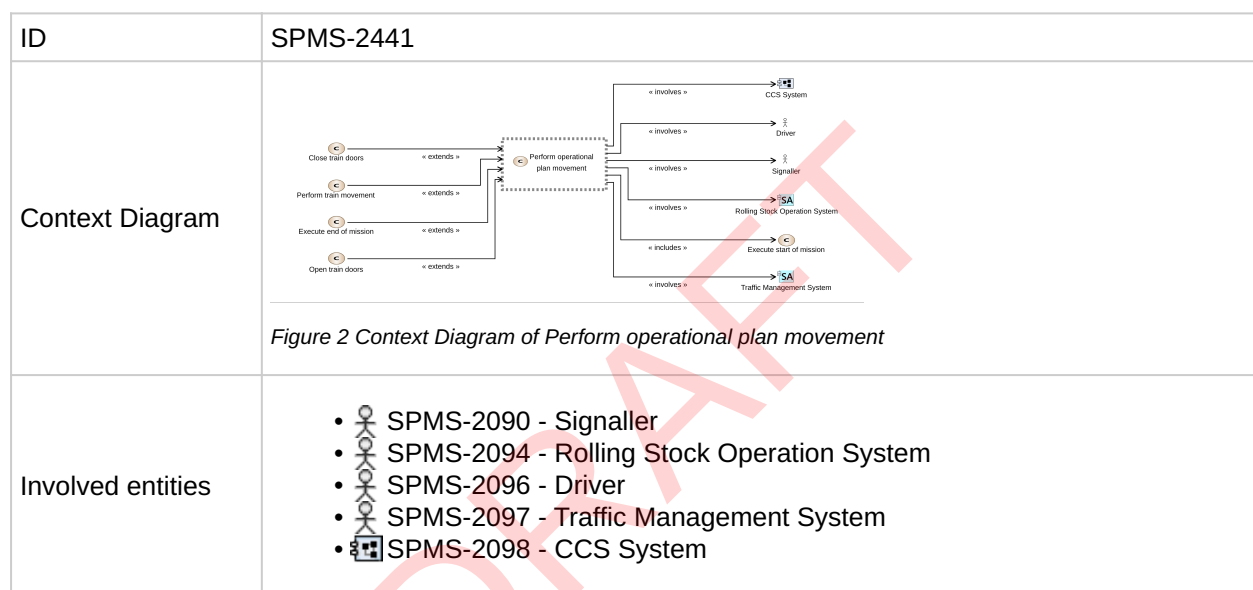
Please note that System objectives are being realised as system capabilities in the context of this chapter.

2.1.2.1 Perform operational plan movement

2.1.2.1-1 - Perform operational plan movement

The Traffic Management System needs the system to executes an Operational plan movement. An Operational plan movement consist of at least one movement event and operates at least one rolling stock.

Furthermore, an operational plan movement can contain movement restrictions.



2.1.2.1-2 - Perform operational plan movement

This exchange scenario describes the sequence of scenarios of one operational plan which could happen during the movement or stillstand of the train.

The figure below provides an overview of *Perform operational plan movement*.

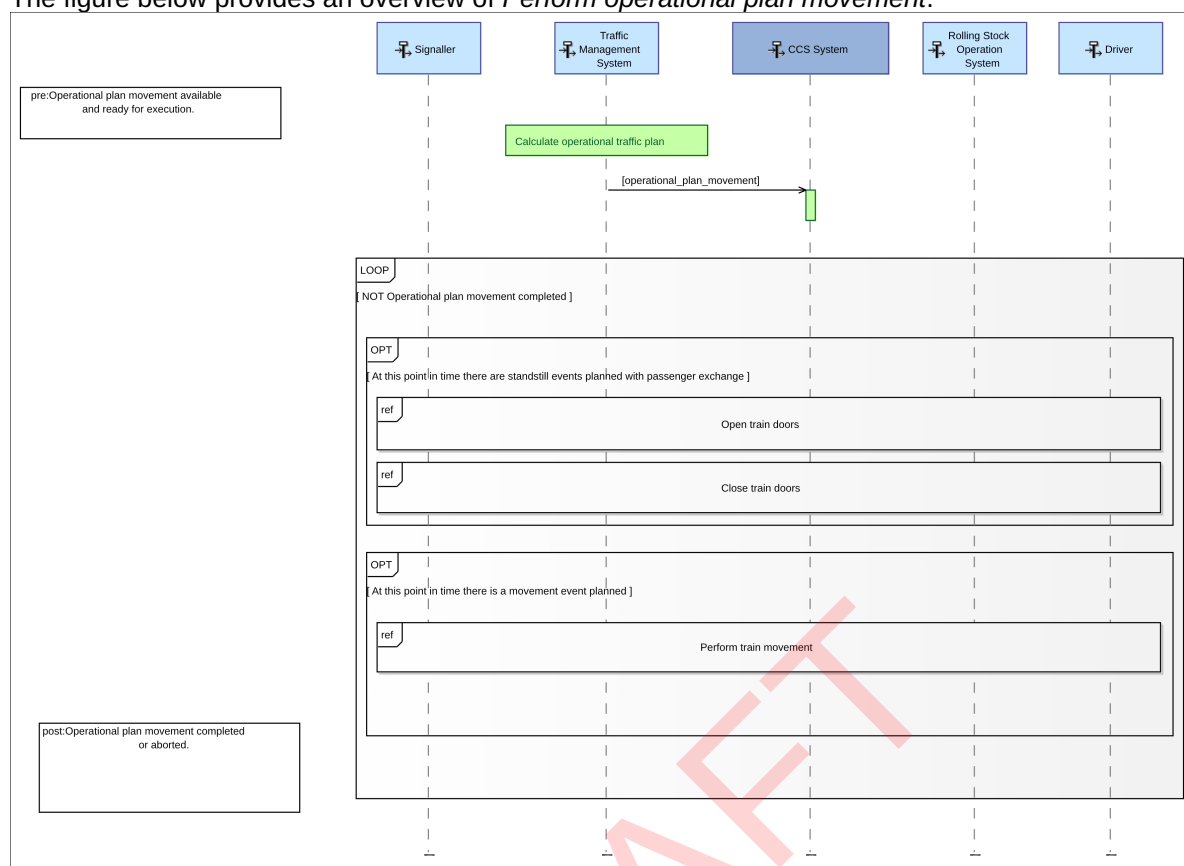


Figure 3 Diagram [SES] Perform operational plan movement [Exchange scenario]

ID	SPMS-5702
Pre Condition	Operational plan movement available and ready for execution.
Post Condition	Operational plan movement completed or aborted.

2.1.2.1-3 - Perform operational plan movement

This functional chain describes the sequence of processes of one operational plan which could happen during the movement or stillstand of the train.

The figure below provides an overview of *Perform operational plan movement*.

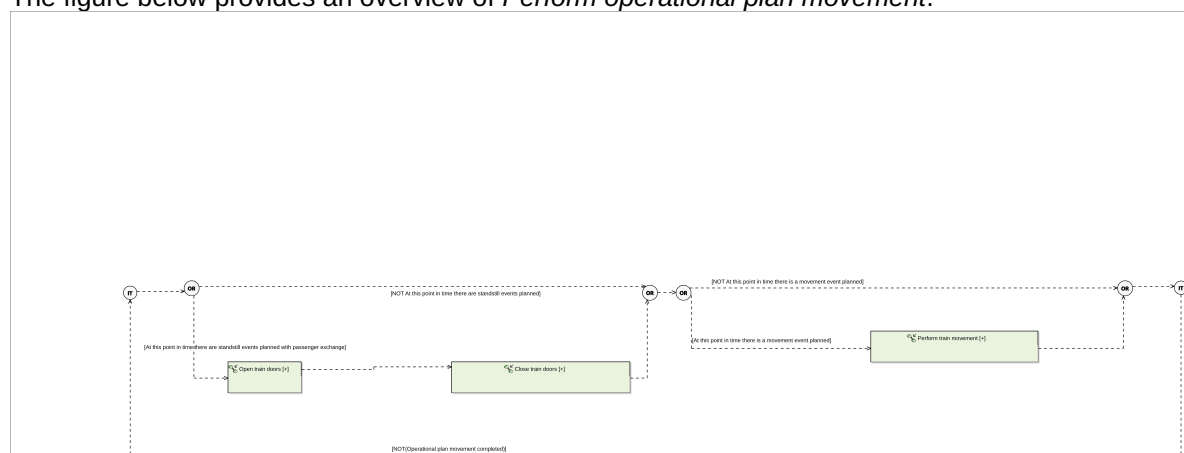


Figure 4 Diagram [SFCD] Perform operational plan movement [Functional chain description]

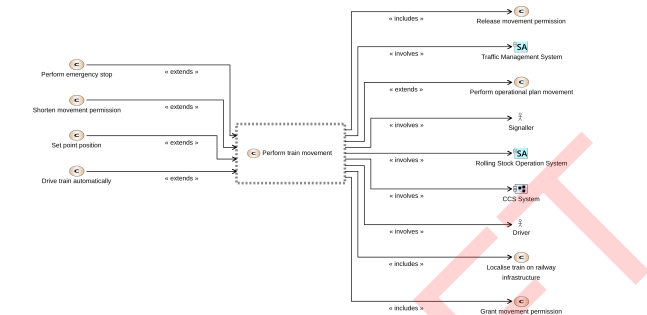
ID	SPMS-4437
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Pre Condition	Operational plan movement available and ready for execution.
Post Condition	Operational plan movement completed or aborted.

2.1.2.2 Perform train movement

2.1.2.2-1 - Perform train movement

The Traffic Management System needs the system to perform a train movement according to the operational plan movement event.

ID	SPMS-2440
Context Diagram	 <p>The context diagram shows the 'Perform train movement' use case (C2) as the central element. It is surrounded by several other use cases and systems: <ul style="list-style-type: none"> 'Perform emergency stop' (C1) includes 'Perform train movement'. 'Shorten movement permission' (C3) includes 'Perform train movement'. 'Set point position' (C4) includes 'Perform train movement'. 'Drive train automatically' (C5) includes 'Perform train movement'. 'Perform train movement' (C2) includes 'Release movement permission' (C6). 'Perform train movement' (C2) involves 'Traffic Management System' (SA). 'Perform train movement' (C2) extends 'Perform operational plan movement' (C7). 'Perform train movement' (C2) involves 'Signaller' (F). 'Perform train movement' (C2) involves 'Rolling Stock Operation System' (SA). 'Perform train movement' (C2) involves 'CCS System' (F). 'Perform train movement' (C2) involves 'Driver' (F). 'Perform train movement' (C2) includes 'Localise train on railway infrastructure' (C8). 'Perform train movement' (C2) includes 'Grant movement permission' (C9). </p> <p><i>Figure 5 Context Diagram of Perform train movement</i></p>
Involved entities	<ul style="list-style-type: none"> SPMS-2090 - Signaller SPMS-2094 - Rolling Stock Operation System SPMS-2096 - Driver SPMS-2097 - Traffic Management System SPMS-2098 - CCS System

2.1.2.2-2 - Perform train movement

This exchange scenario describes the sequence of scenarios that support train movement. These scenarios may occur during the operation of a train in full supervision or automatic driving mode, with the movement requested by the Traffic Management System in accordance with the operational plan.

The figure below provides an overview of *Perform train movement*.

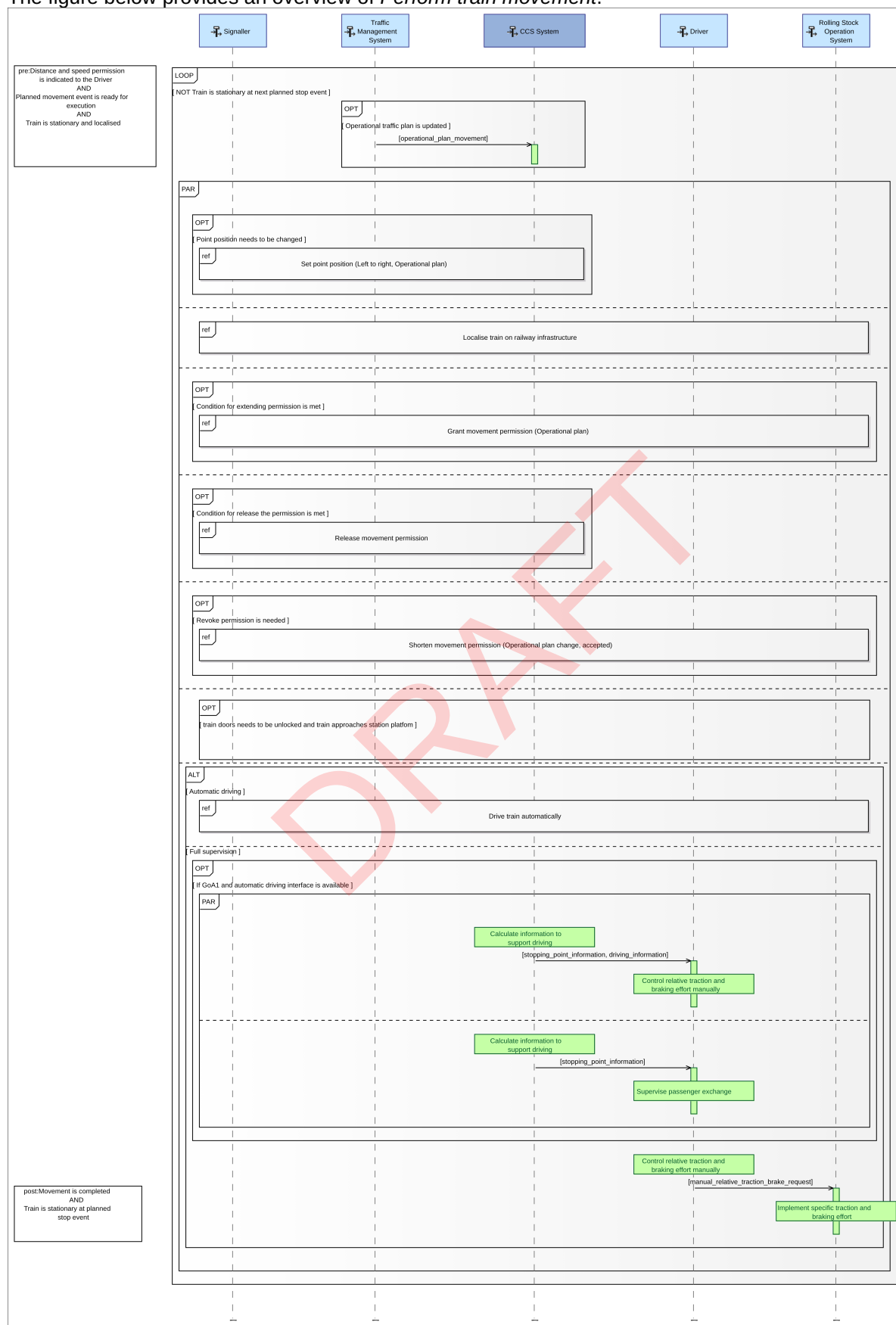


Figure 6 Diagram [SES] Perform train movement [Exchange scenario]

ID	SPMS-5541
Pre Condition	<p>Distance and speed permission is indicated to the Driver</p> <p>AND</p> <p>Planned movement event is ready for execution</p> <p>AND</p> <p>Train is stationary and localised</p>
Post Condition	<p>Movement is completed</p> <p>AND</p> <p>Train is stationary at planned stop event</p>

2.1.2.2-3 - Perform train movement

This functional chain outlines the sequence of processes that facilitate train movement. These processes may occur during the operation of a train in full supervision or automatic driving mode. The figure below provides an overview of *Perform train movement*.

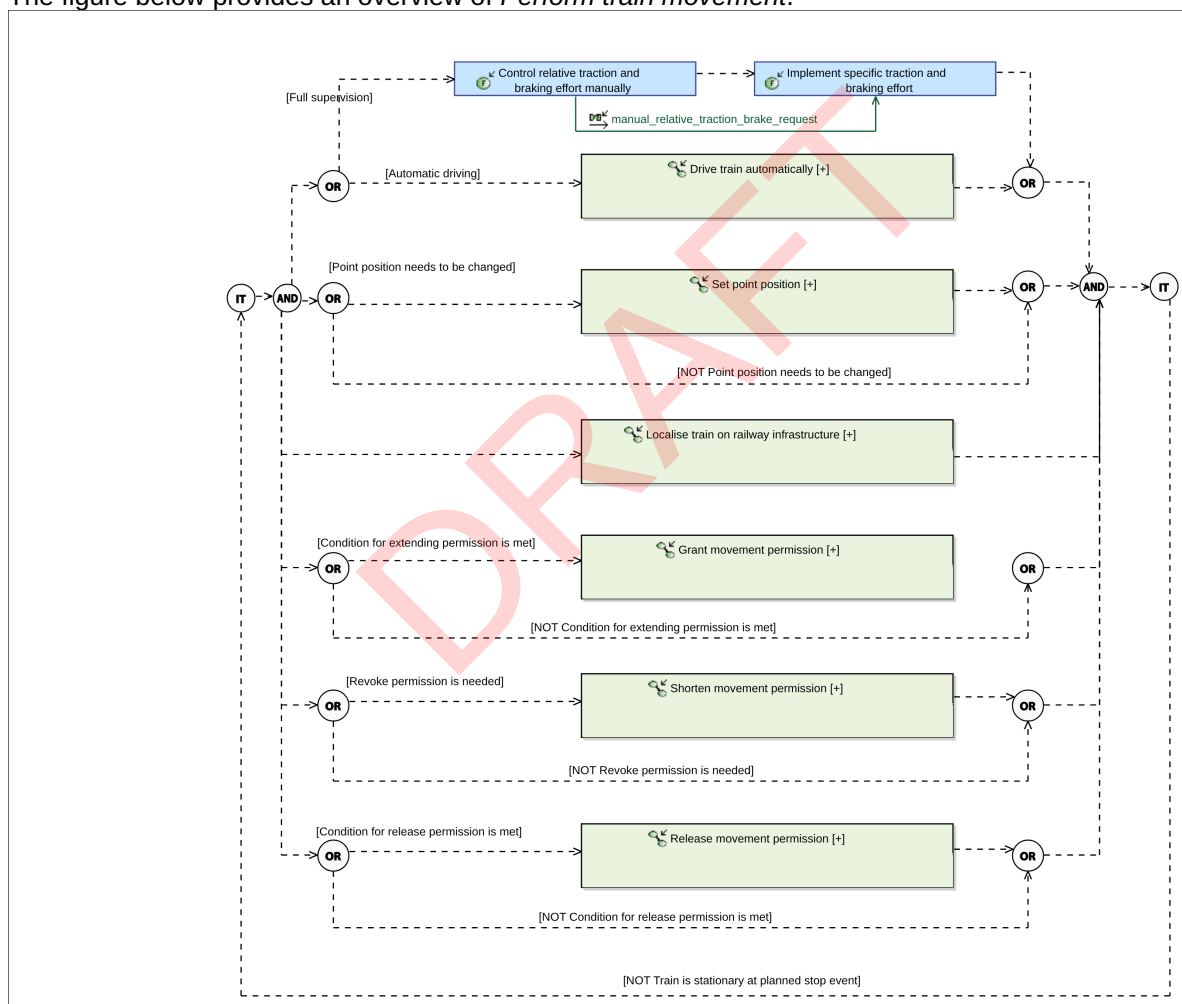




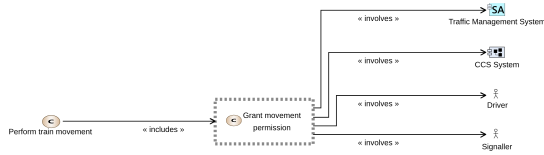
Figure 7 Diagram [SFCD] Perform train movement [Functional chain description]

ID	SPMS-4436
Involved Functions	<ul style="list-style-type: none"> •  SPMS-2106 - Control relative traction and braking effort manually •  SPMS-2146 - Implement specific traction and braking effort

2.1.2.3 Grant movement permission

2.1.2.3-1 - Grant movement permission

The CCS system needs to grant movement permissions that ensure safe train operations, taking into account all relevant safety constraints. These constraints include infrastructure characteristics, train parameters, track layout, current occupation of track sections by other movements, and any applicable usage restrictions.

ID	SPMS-5295
Context Diagram	 <p>The context diagram shows the 'Grant movement permission' use case (c) being included by 'Perform train movement' (c). It involves four external entities: Traffic Management System (SA), CCS System (SA), Driver (A), and Signaller (A). Arrows indicate that the use case involves each of these entities.</p> <p><i>Figure 8 Context Diagram of Grant movement permission</i></p>
Involved entities	<ul style="list-style-type: none"> SPMS-2090 - Signaller SPMS-2096 - Driver SPMS-2097 - Traffic Management System SPMS-2098 - CCS System

2.1.2.3-2 - Grant movement permission

This functional chain describes the sequence of functions related to each other to grant a movement permission requested by the SPMS-2097 - Traffic Management System according to the operational plan or by the SPMS-2090 - Signaller.

The figure below provides an overview of *Grant movement permission*.

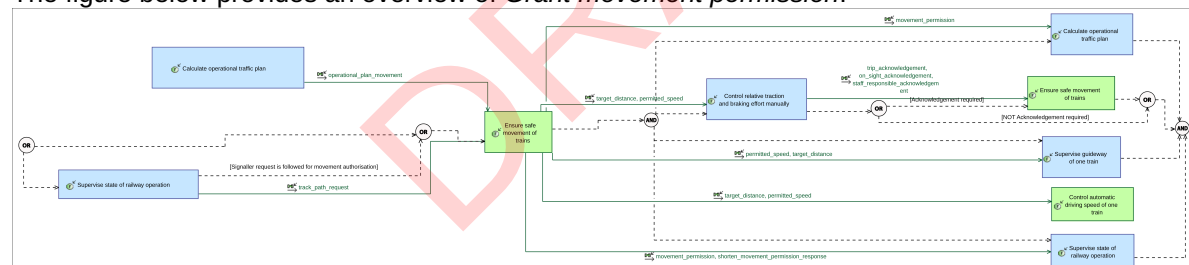








Figure 9 Diagram [SFCD] Grant movement permission [Functional chain description]

ID	SPMS-5298
Pre Condition	<p>No part of the movement authority to be authorised is occupied AND No part of the movement authority to be authorised is used for other movements AND Points for movement permission are in correct position and Not locked in another movement.</p>
Post Condition	<p>Target distance and permitted speed is indicated to the Driver AND Movement permission is indicated to the Signaller AND Movement permission is provided to Traffic Management System.</p>

Involved Functions	<ul style="list-style-type: none"> •  SPMS-2106 - Control relative traction and braking effort manually •  SPMS-2137 - Ensure safe movement of trains •  SPMS-2148 - Calculate operational traffic plan •  SPMS-2158 - Supervise guideway of one train •  SPMS-2167 - Supervise state of railway operation •  SPMS-2180 - Control automatic driving speed of one train
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2.1.2.3.1 Grant movement permission (Operational plan)

2.1.2.3.1-1 - Grant movement permission (Operational plan)

This exchange scenario describes exchange of information between system and actors for grant movement permission. The CCS System considers all safety relevant information to grant a movement to a train based on the planned operational plan movement.

The figure below provides an overview of *Grant movement permission (Operational plan)*.

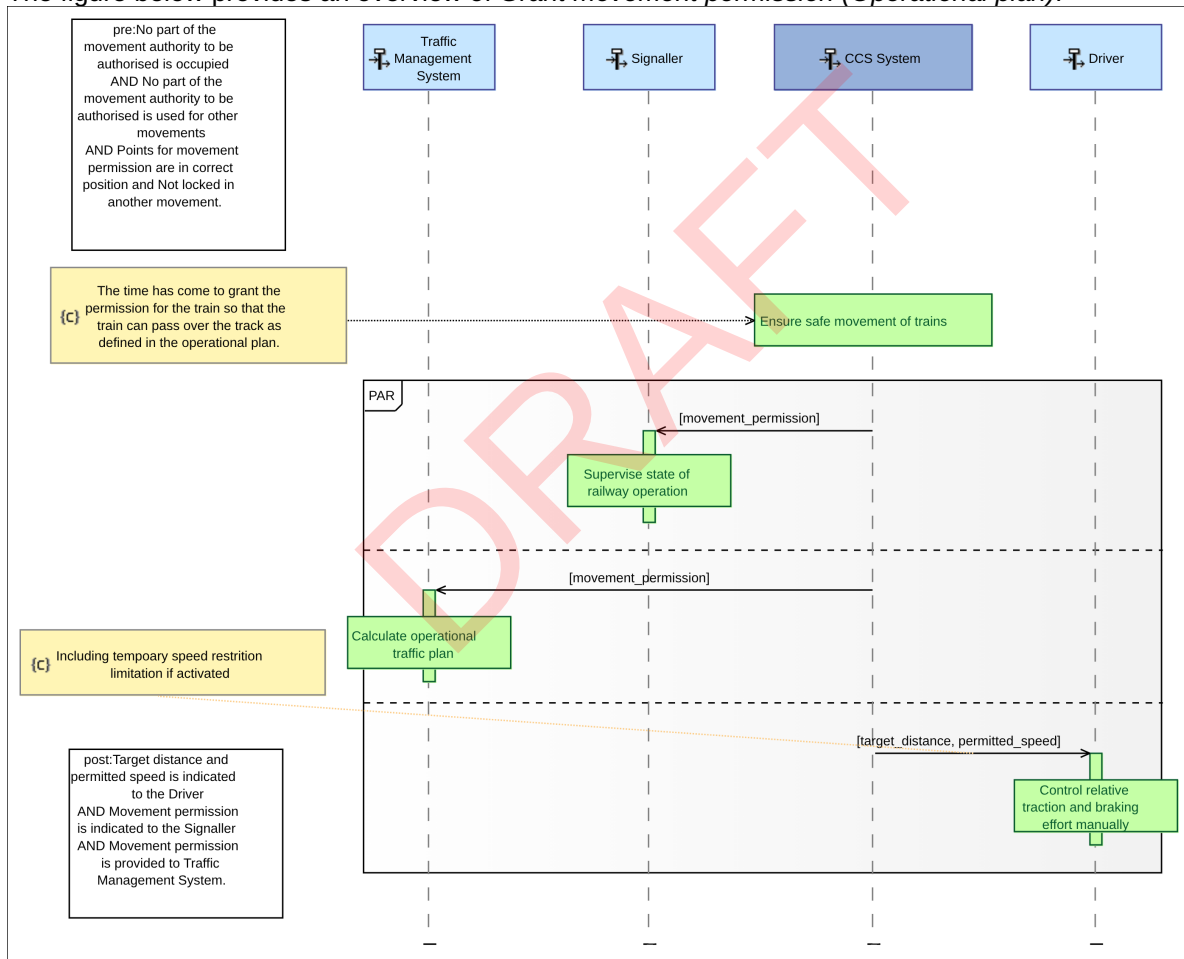


Figure 10 Diagram [SES] Grant movement permission (Operational plan) [Exchange scenario]

ID	SPMS-5361
Pre Condition	<p>No part of the movement authority to be authorised is occupied AND No part of the movement authority to be authorised is used for other movements AND Points for movement permission are in correct position and Not locked in another movement.</p>

Post Condition	Target distance and permitted speed is indicated to the Driver AND Movement permission is indicated to the Signaller AND Movement permission is provided to Traffic Management System.
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[SAB] Grant and release movement permission (Operational plan) [Control loop]

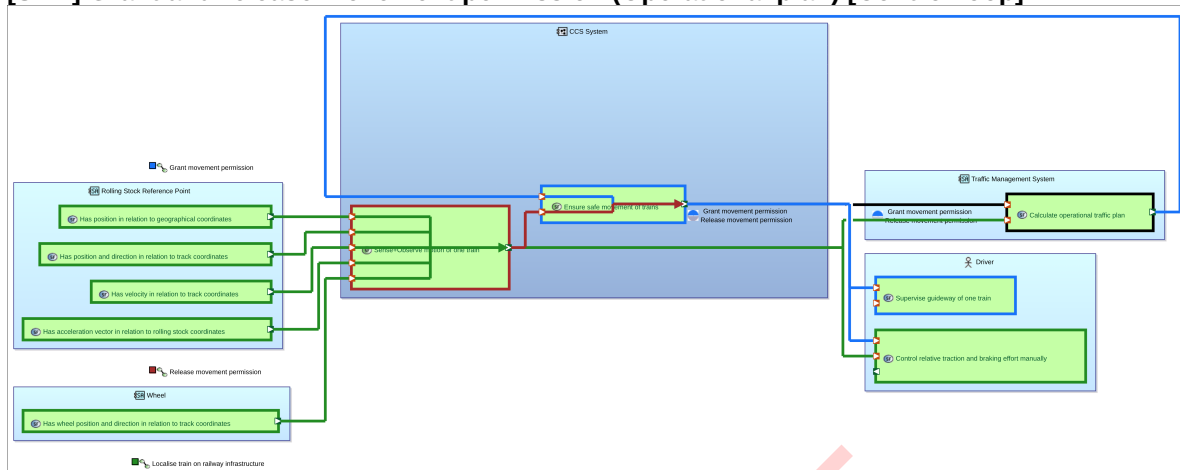


Figure 11 Diagram [SAB] Grant and release movement permission (Operational plan) [Control loop]

ID	SPMS-5508
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2.1.2.3.2 Grant movement permission (Signaller request)

2.1.2.3.2-1 - Grant movement permission (Signaller request)

This exchange scenario describes exchange of information between system and actors for grant movement permission. The CCS System considers all safety relevant information to grant a movement to a train based on the signaller request.

The figure below provides an overview of *Grant movement permission (Signaller request)*.

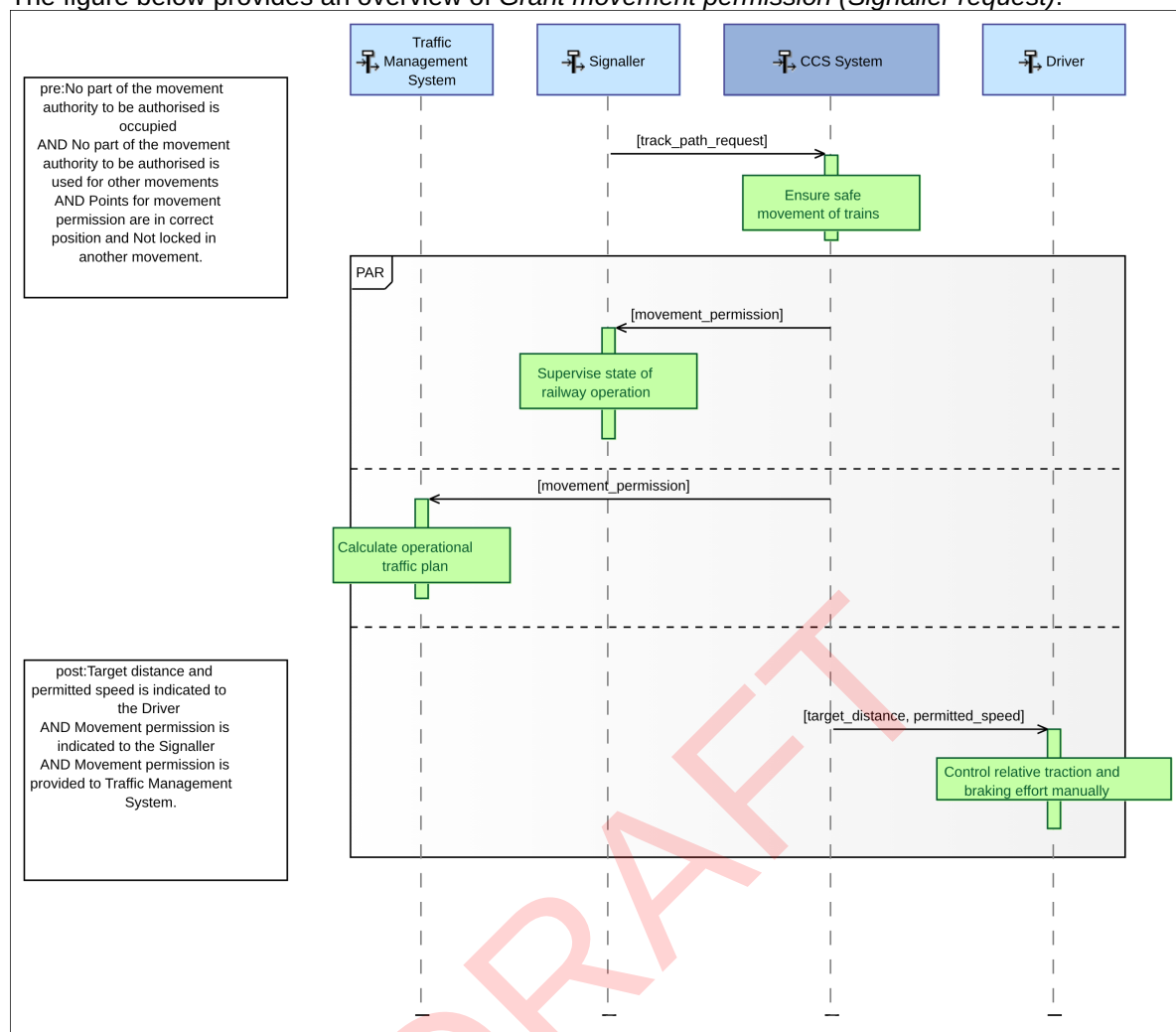


Figure 12 Diagram [SES] Grant movement permission (Signaller request) [Exchange scenario]

ID	SPMS-5514
Pre Condition	No part of the movement authority to be authorised is occupied AND No part of the movement authority to be authorised is used for other movements AND Points for movement permission are in correct position and Not locked in another movement.
Post Condition	Target distance and permitted speed is indicated to the Driver AND Movement permission is indicated to the Signaller AND Movement permission is provided to Traffic Management System.

[SAB] Grant and release movement permission (Signaller) [Control loop]

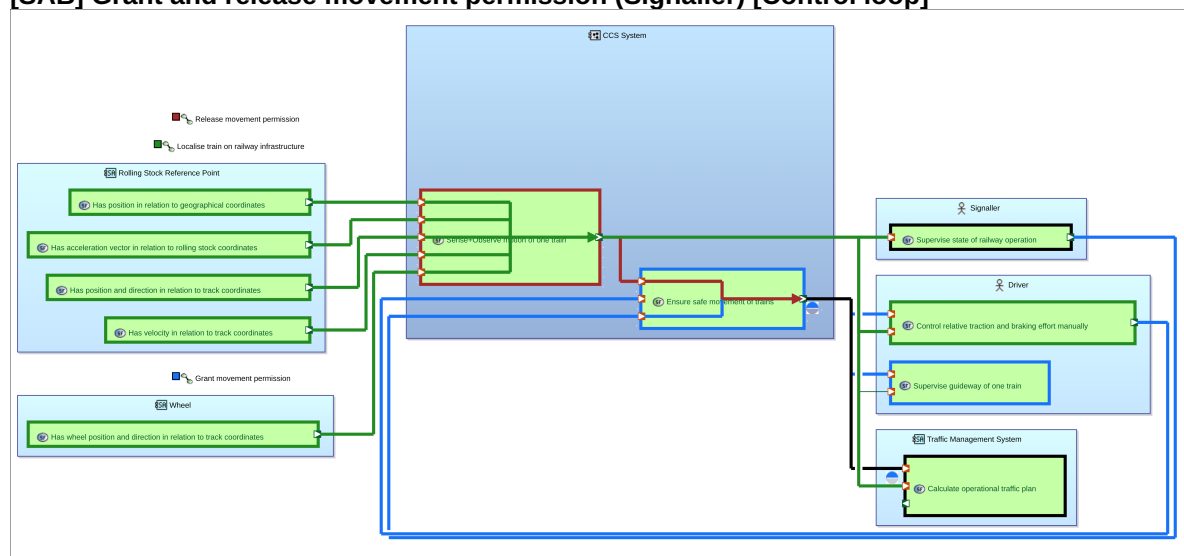


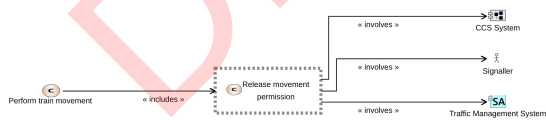
Figure 13 Diagram [SAB] Grant and release movement permission (Signaller) [Control loop]

ID	SPMS-5866
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2.1.2.4 Release movement permission

2.1.2.4-1 - Release movement permission

The Traffic Management System or the Signaller need the system to release a part of the movement permission, that is no longer occupied in order to use it for other movements.

ID	SPMS-5296
Context Diagram	 <p>Figure 14 Context Diagram of Release movement permission</p>
Involved entities	<ul style="list-style-type: none"> SPMS-2090 - Signaller SPMS-2097 - Traffic Management System SPMS-2098 - CCS System

2.1.2.4-2 - Release movement permission

This scenario describes the sequence of functions related to each other to release a movement permission according to the operational plan and the train position (train has passed part of the movement permission).

The figure below provides an overview of *Release movement permission*.

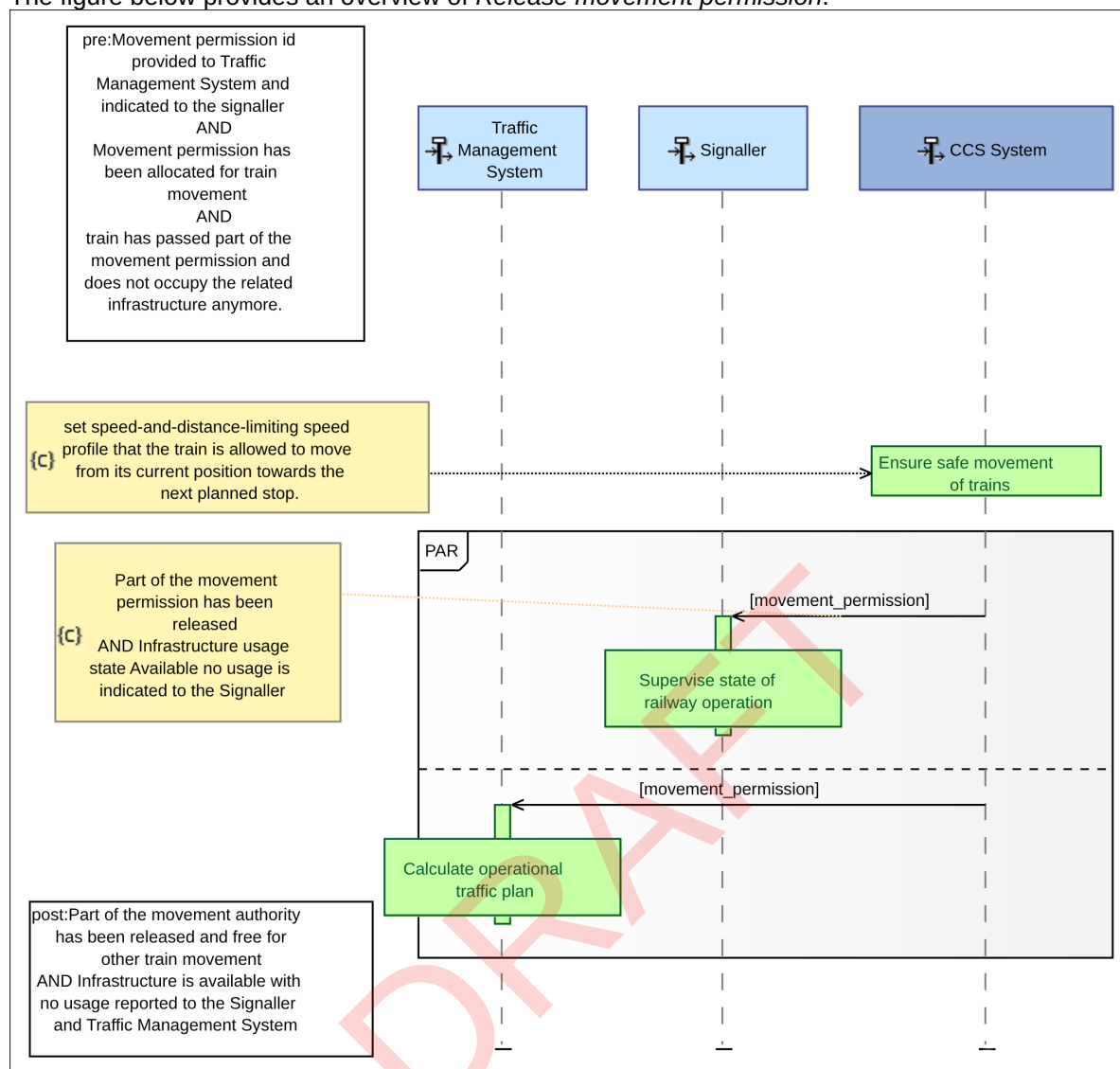


Figure 15 Diagram [SES] Release movement permission [Exchange scenario]

ID	SPMS-5362
Pre Condition	<p>Movement permission id provided to Traffic Management System and indicated to the signaller</p> <p>AND</p> <p>Movement permission has been allocated for train movement</p> <p>AND</p> <p>train has passed part of the movement permission and does not occupy the related infrastructure anymore.</p>
Post Condition	<p>Part of the movement authority has been released and free for other train movement</p> <p>AND Infrastructure is available with no usage reported to the Signaller and Traffic Management System</p>

2.1.2.4-3 - Release movement permission

2.11.2.4.3 - Release movement permission
This functional chain describes the sequence of functions related to each other to release a movement permission according to the operational plan and the train position (train has passed part of the movement permission).

The figure below provides an overview of *Release movement permission*.

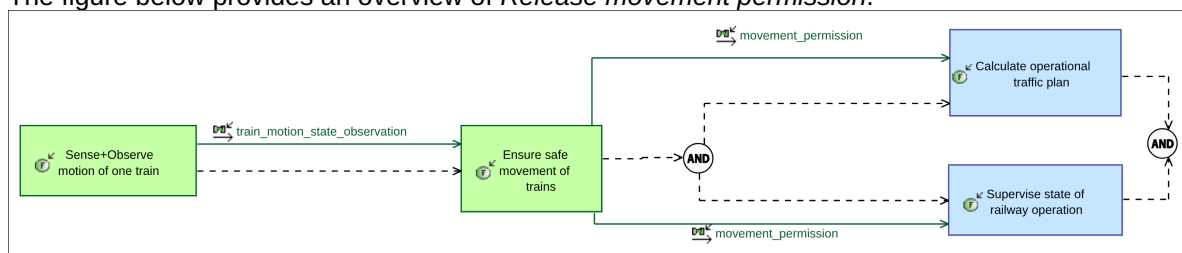


Figure 16 Diagram [SFCD] Release movement permission [Functional chain description]

ID	SPMS-5316
Pre Condition	Movement permission id provided to Traffic Management System and indicated to the signaller AND Movement permission has been allocated for train movement AND train has passed part of the movement permission and does not occupy the related infrastructure anymore.
Post Condition	Part of the movement authority has been released and free for other train movement AND Infrastructure is available with no usage reported to the Signaller and Traffic Management System
Involved Functions	<ul style="list-style-type: none"> SPMS-2137 - Ensure safe movement of trains SPMS-2148 - Calculate operational traffic plan SPMS-2167 - Supervise state of railway operation SPMS-2192 - Sense+Observe motion of one train

Note:

Control loops for "Release movement permission" are shown in:

- SPMS-5508 - [SAB] Grant and release movement permission (Operational plan) [Control loop]
- SPMS-5866 - [SAB] Grant and release movement permission (Signaller) [Control loop]

2.1.2.5 Shorten movement permission

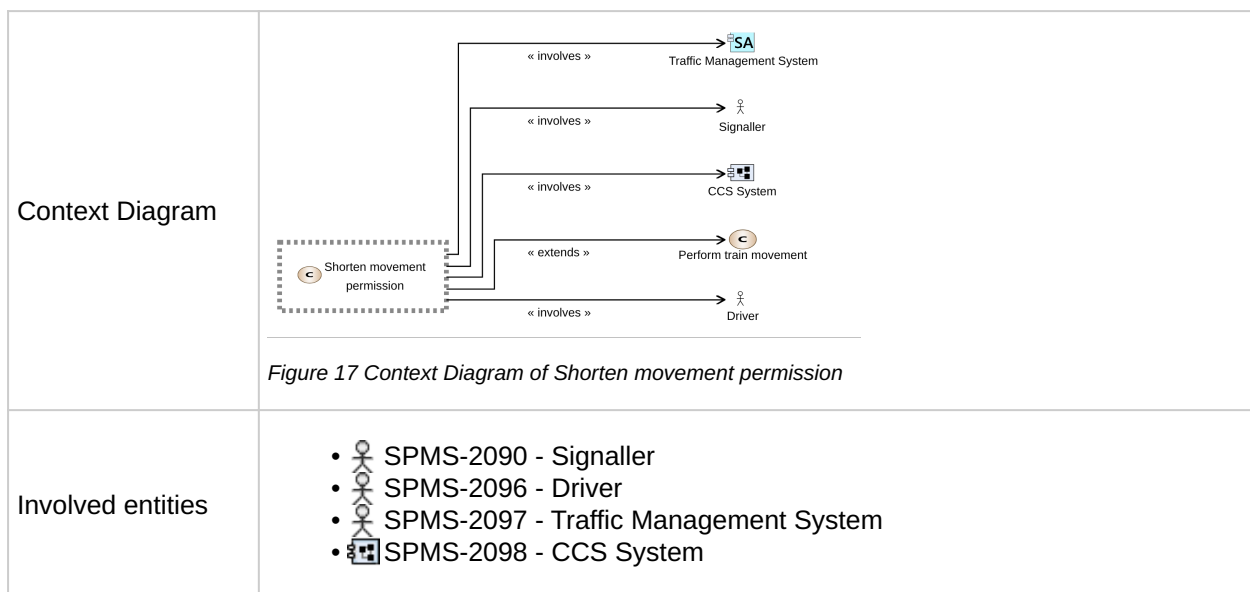
Disclaimer: In the actual scope, the concept of actualisation of operational plan by the Traffic Management System (TMS) is still under development. Therefore, in the actual document the focus is on the Shortening of the movement permission requested by the Signaller.

2.1.2.5-2 - Shorten movement permission

The Traffic Management System or the Signaller need the system to shorten a movement permission which has already been authorised.

Note: in the scope it is foreseen that a movement permission is only shortened by the CCS System if it does not lead to an immediate impact such that the train needs to brake.

ID	SPMS-2442
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2.1.2.5-3 - Shorten movement permission

This functional chain describes the sequence of functions related to each other in case an active movement permission needs to be shortened. Such request can be triggered by the SPMS-2097 - Traffic Management System or by the SPMS-2090 - Signaller. The figure below provides an overview of *Shorten movement permission*.

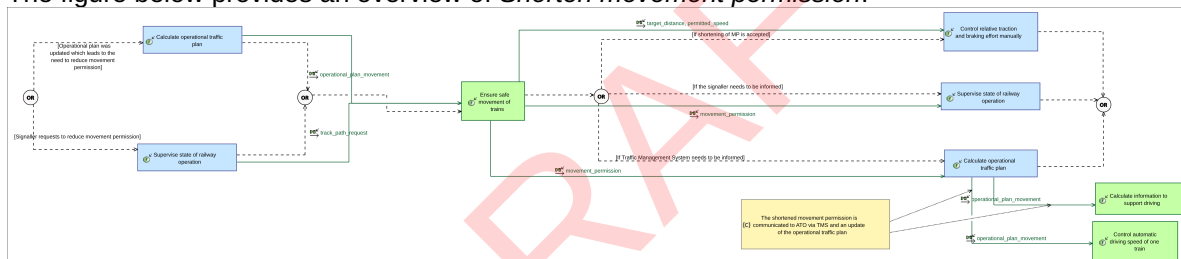


Figure 18 Diagram [SFCD] Shorten movement permission [Functional chain description]

ID	SPMS-4441
Pre Condition	CCS System has a valid movement permission AND [Traffic Management System OR Signaller detects the need to shorten a movement permission ahead of one train]
Post Condition	[Shortened movement permission is indicated to the Driver according to new operational plan movement AND shortened movement permission is indicated to the Signaller according to new operational plan movement AND Part of the track that was reserved before is now released] OR [Request to shorten movement permission got rejected]
Involved Functions	<ul style="list-style-type: none"> SPMS-2106 - Control relative traction and braking effort manually SPMS-2137 - Ensure safe movement of trains SPMS-2148 - Calculate operational traffic plan SPMS-2160 - Calculate information to support driving SPMS-2167 - Supervise state of railway operation SPMS-2180 - Control automatic driving speed of one train

2.1.2.5.1 Shorten movement permission (Operational plan change)

2.1.2.5.1-1 - Shorten movement permission (Operational plan change, accepted)

This exchange scenario describes the exchange of information on the interfaces of the CCS System when a shortening request for an active movement permission is triggered by the Traffic Management System (e.g. due to an update of the operational plan) and will be accepted by the CCS System.

The figure below provides an overview of *Shorten movement permission (Operational plan change, accepted)*.

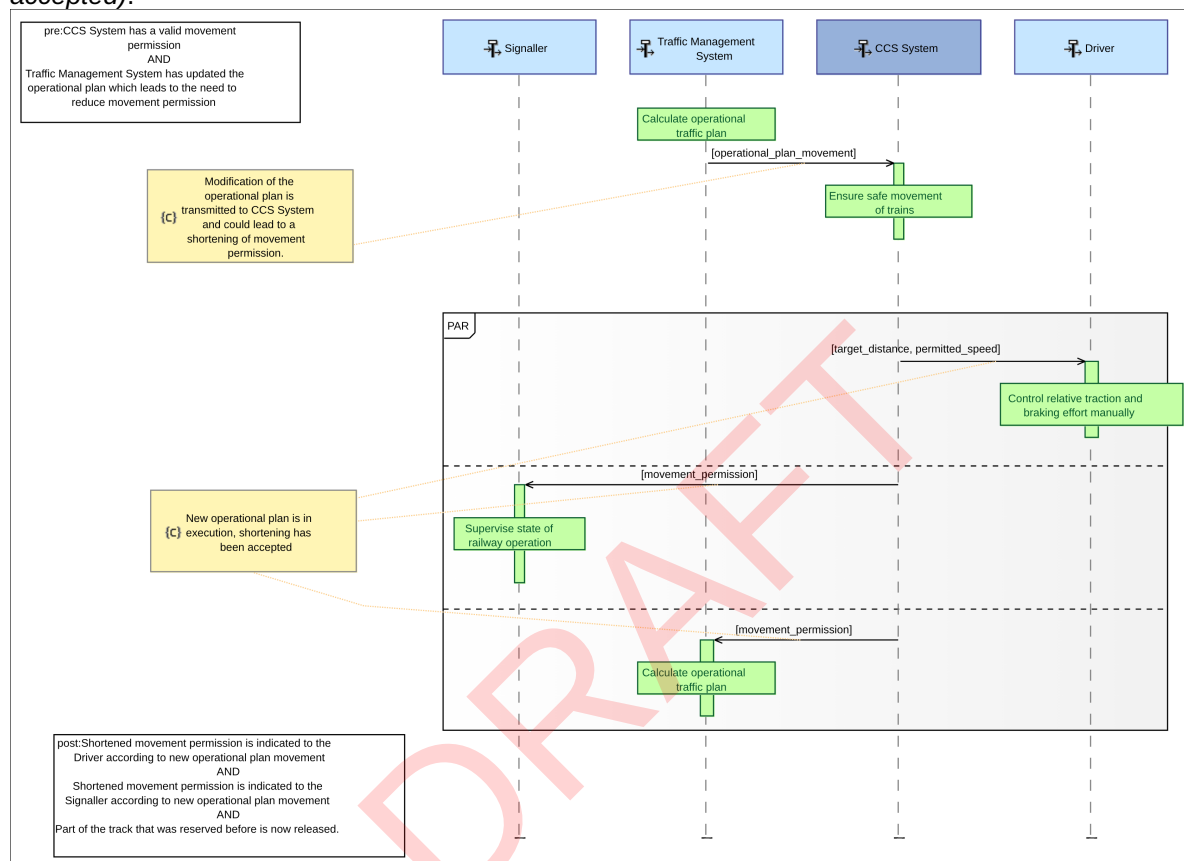


Figure 19 Diagram [SES] Shorten movement permission (Operational plan change, accepted) [Exchange scenario]

ID	SPMS-4326
Pre Condition	CCS System has a valid movement permission AND Traffic Management System has updated the operational plan which leads to the need to reduce movement permission
Post Condition	Shortened movement permission is indicated to the Driver according to new operational plan movement AND Shortened movement permission is indicated to the Signaller according to new operational plan movement AND Part of the track that was reserved before is now released.

2.1.2.5.1-2 - Shorten movement permission (Operational plan change, rejected)

2.11.2.1.2 Shorten movement permission (Operational plan change, rejected)
This exchange scenario describes the exchange of information on the interfaces of the CCS System when a shortening request for an active movement permission is triggered by the Traffic Management System (e.g. due to an update of the operational plan) and will be rejected by the CCS System.

The figure below provides an overview of *Shorten movement permission (Operational plan change, rejected)*.

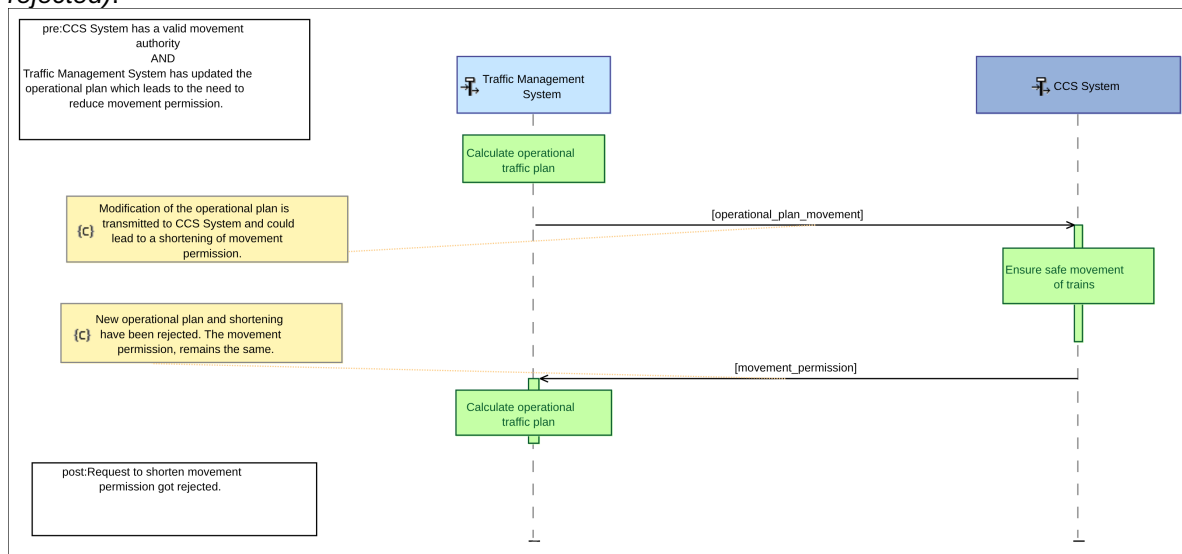


Figure 20 Diagram [SES] Shorten movement permission (Operational plan change, rejected) [Exchange scenario]

ID	SPMS-4336
Pre Condition	CCS System has a valid movement authority AND Traffic Management System has updated the operational plan which leads to the need to reduce movement permission.
Post Condition	Request to shorten movement permission got rejected.

[SAB] Shorten movement permission (Operational plan) [Control loop]

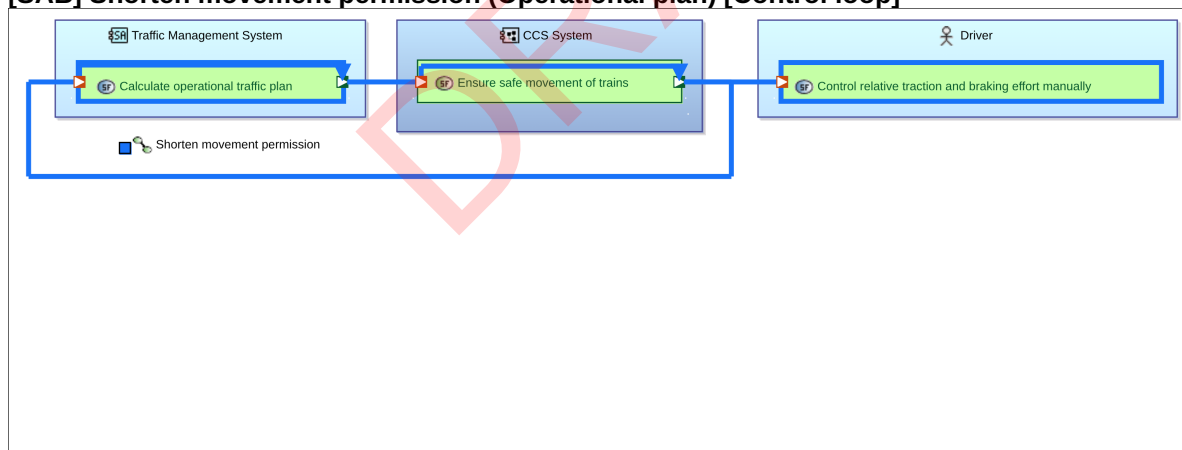


Figure 21 Diagram [SAB] Shorten movement permission (Operational plan) [Control loop]

ID	SPMS-5691
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2.1.2.5.2 Shorten movement permission (Signaller request)

2.1.2.5.2-1 - Shorten movement permission (Signaller request, accepted)

This exchange scenario describes the exchange of information on the interfaces of the CCS System when

a shortening request for an active movement permission is triggered by the Signaller and will be accepted by the CCS System.

The figure below provides an overview of *Shorten movement permission (Signaller request, accepted)*.

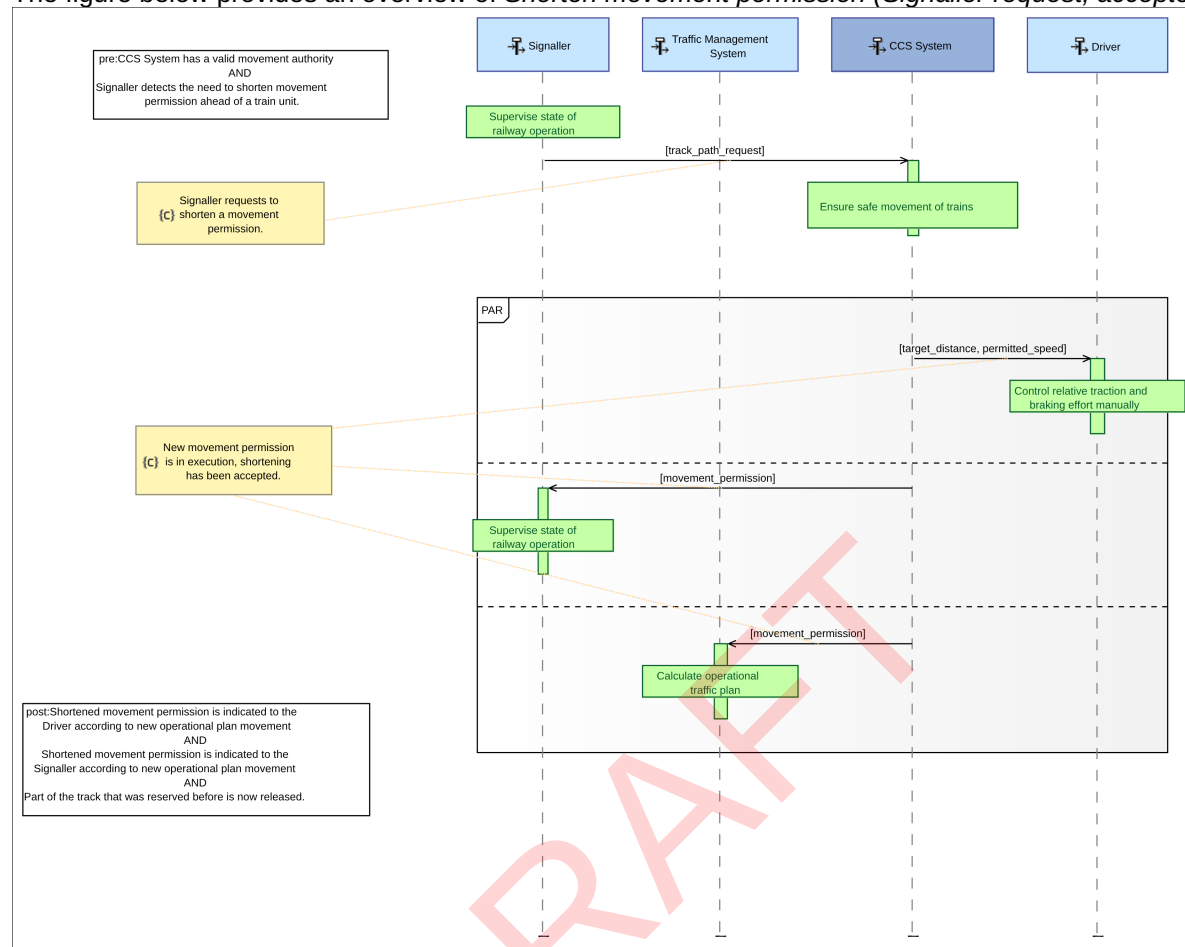


Figure 22 Diagram [SES] Shorten movement permission (Signaller request, accepted) [Exchange scenario]

ID	SPMS-4334
Pre Condition	CCS System has a valid movement authority AND Signaller detects the need to shorten movement permission ahead of a train unit.
Post Condition	Shortened movement permission is indicated to the Driver according to new operational plan movement AND Shortened movement permission is indicated to the Signaller according to new operational plan movement AND Part of the track that was reserved before is now released.

2.1.2.5.2-2 - Shorten movement permission (Signaller request, rejected)

This exchange scenario describes the exchange of information on the interfaces of the CCS System when a shortening request for an active movement permission is triggered by the Signaller and will be accepted by the CCS System.

The figure below provides an overview of *Shorten movement permission (Signaller request, rejected)*.

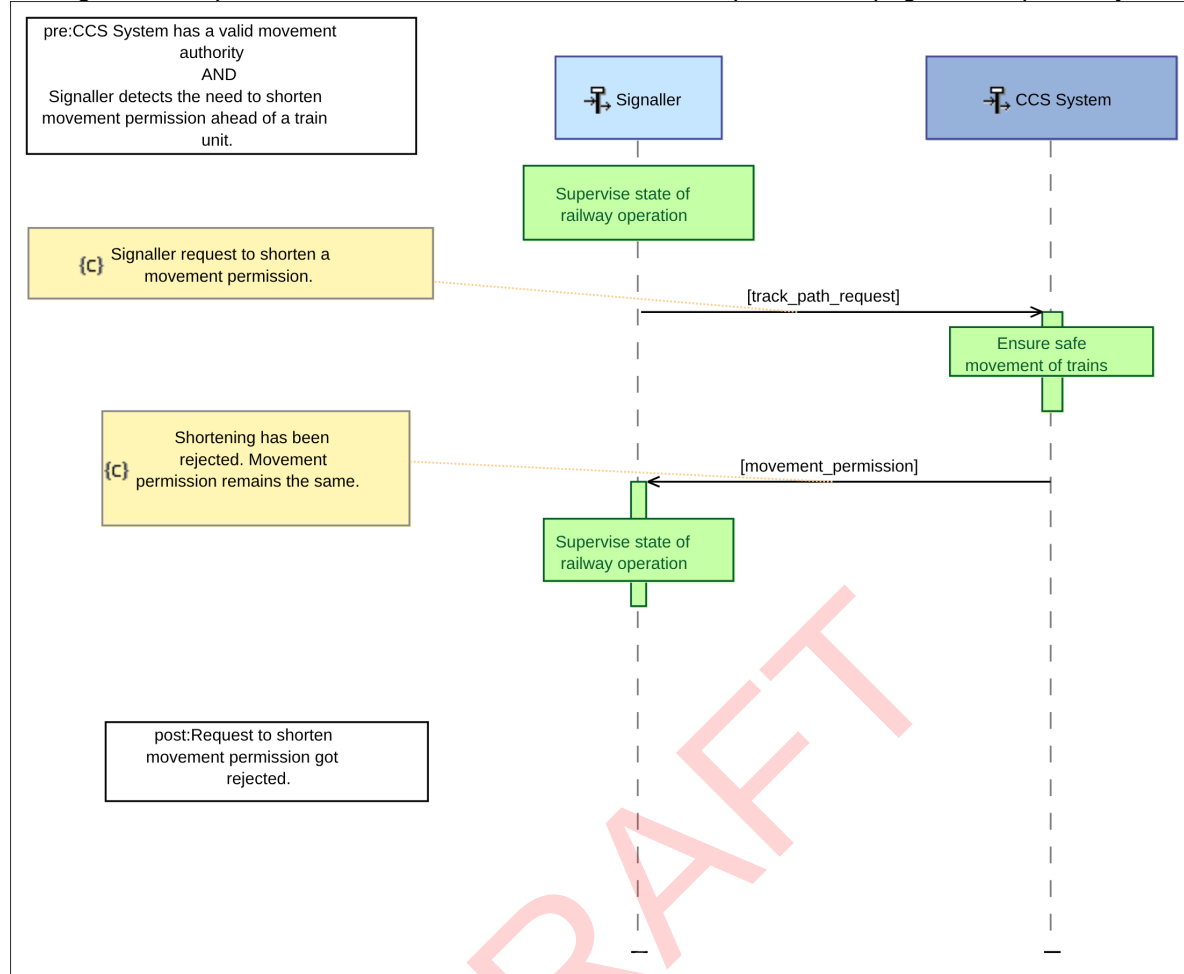


Figure 23 Diagram [SES] Shorten movement permission (Signaller request, rejected) [Exchange scenario]

ID	SPMS-4337
Pre Condition	CCS System has a valid movement authority AND Signaller detects the need to shorten movement permission ahead of a train unit.
Post Condition	Request to shorten movement permission got rejected.

[SAB] Shorten movement permission (Signaller) [Control loop]

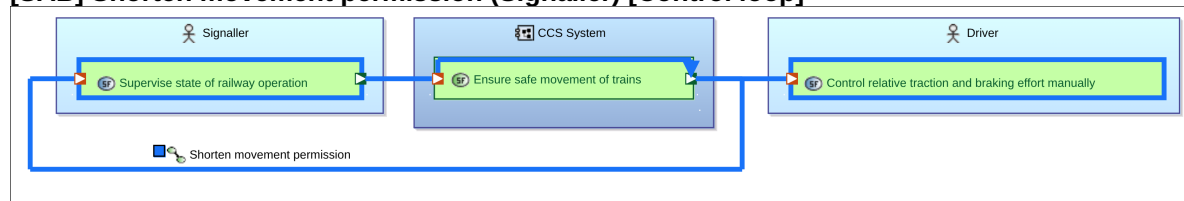


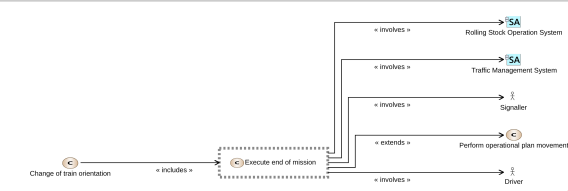
Figure 24 Diagram [SAB] Shorten movement permission (Signaller) [Control loop]

ID	SPMS-5867
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2.1.2.6 Execute End of Mission

2.1.2.6-1 - Execute end of mission

The Driver, Signaller and Traffic Management System needs the CCS reference system to execute the end of mission. This capability does not power off the rolling stock.

ID	SPMS-2439
Context Diagram	 <p>The diagram shows a central use case 'Execute end of mission' (labeled with a circled 'C'). It is connected to several external use cases: 'Change of train orientation' (includes), 'Perform operational plan movement' (extends), and 'Driver' (involves). Additionally, it has four 'involves' relationships with external systems: 'Rolling Stock Operation System', 'Traffic Management System', 'Signaller', and 'SA' (Signaller Authority).</p> <p>Figure 25 Context Diagram of Execute end of mission</p>
Involved entities	<ul style="list-style-type: none"> • SPMS-2090 - Signaller • SPMS-2094 - Rolling Stock Operation System • SPMS-2096 - Driver • SPMS-2097 - Traffic Management System

2.1.2.6-2 - Execute end of mission

This exchange scenario describes the exchange of information on the interfaces of the CCS System when a cab is closed by the driver during an End of mission with the possibility that the train is powered off..

The figure below provides an overview of *Execute end of mission*.

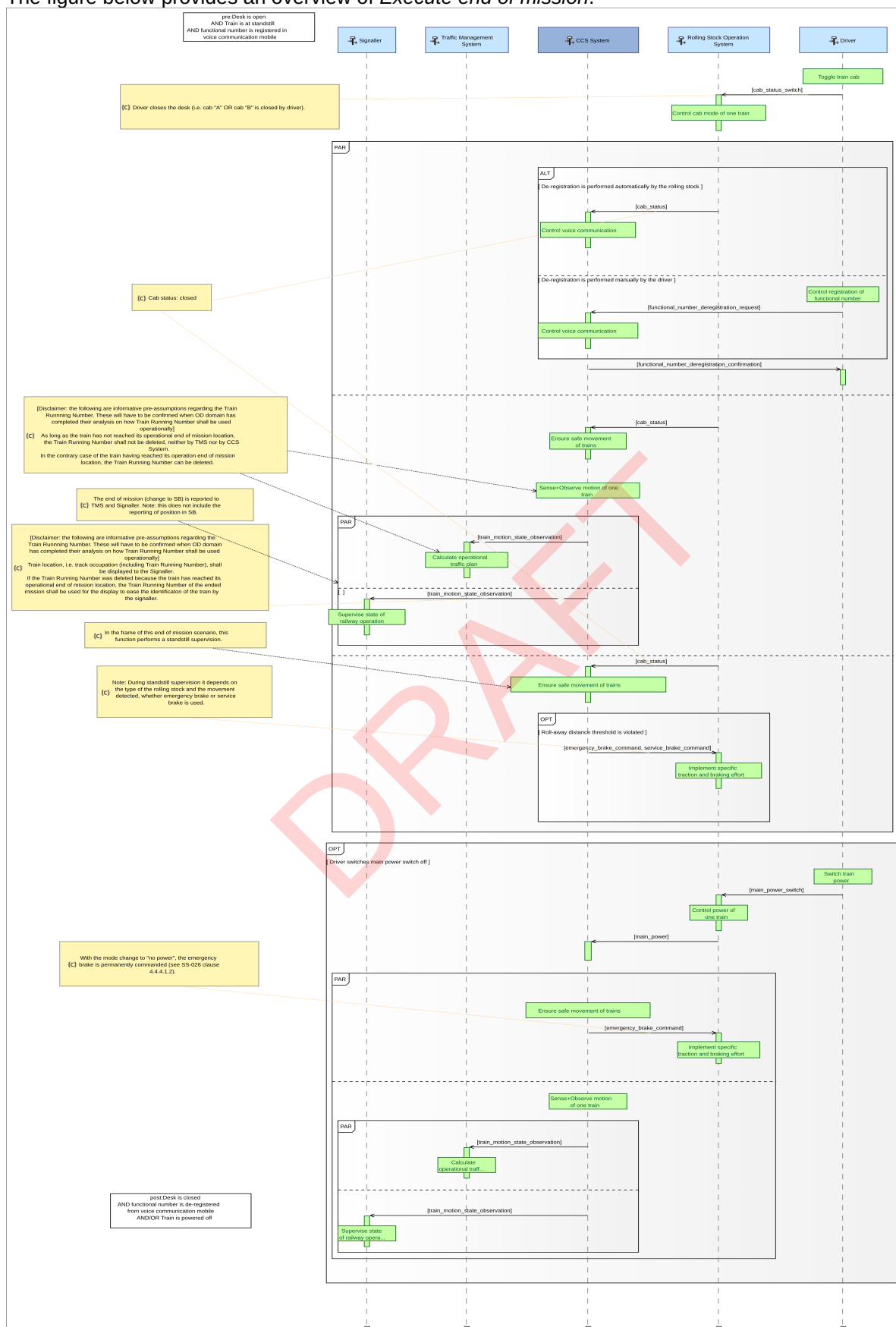


Figure 26 Diagram [SES] Execute end of mission

ID	SPMS-4344
Pre Condition	Desk is open AND Train is at standstill AND functional number is registered in voice communication mobile
Post Condition	Desk is closed AND functional number is de-registered from voice communication mobile AND/OR Train is powered off

2.1.2.6-3 - Execute end of mission

This functional chain describes the sequence of functions related to each other when a cab is closed by the driver during an End of mission with the possibility that the train is powered off.

The figure below provides an overview of *Execute end of mission*.

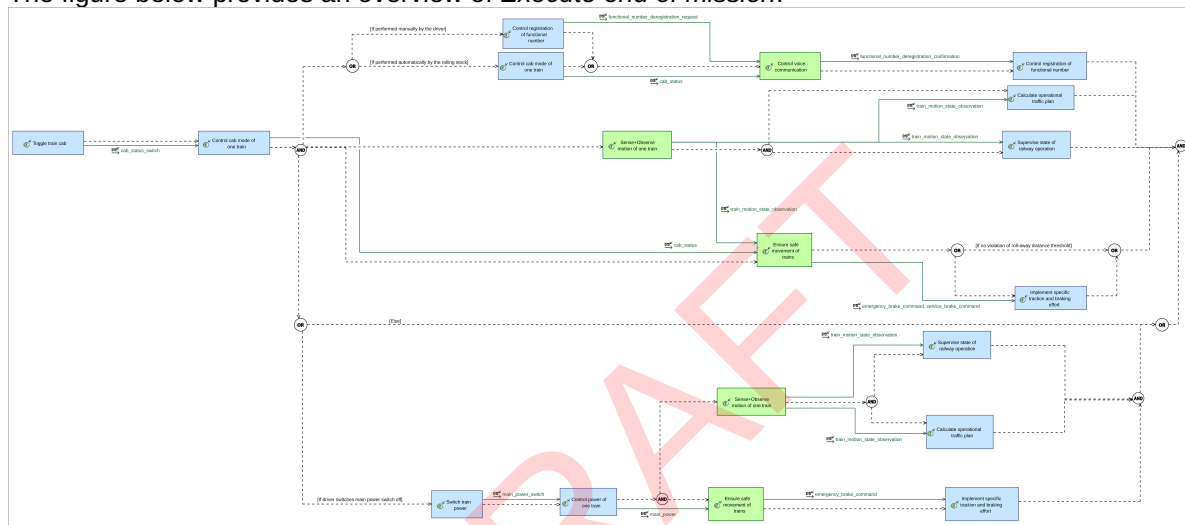


Figure 27 Diagram [SFCD] Execute end of mission [Functional chain description]

ID	SPMS-4442
Pre Condition	Desk is open AND Train is at standstill AND functional number is registered in voice communication mobile
Post Condition	Desk is closed AND functional number is de-registered from voice communication mobile AND/OR Train is powered off
Involved Functions	<ul style="list-style-type: none"> • SF SPMS-2109 - Toggle train cab • SF SPMS-2110 - Control voice communication • SF SPMS-2137 - Ensure safe movement of trains • SF SPMS-2146 - Implement specific traction and braking effort • SF SPMS-2148 - Calculate operational traffic plan • SF SPMS-2163 - Control cab mode of one train • SF SPMS-2167 - Supervise state of railway operation • SF SPMS-2192 - Sense+Observe motion of one train • SF SPMS-6817 - Control power of one train • SF SPMS-6819 - Switch train power • SF SPMS-6821 - Control registration of functional number

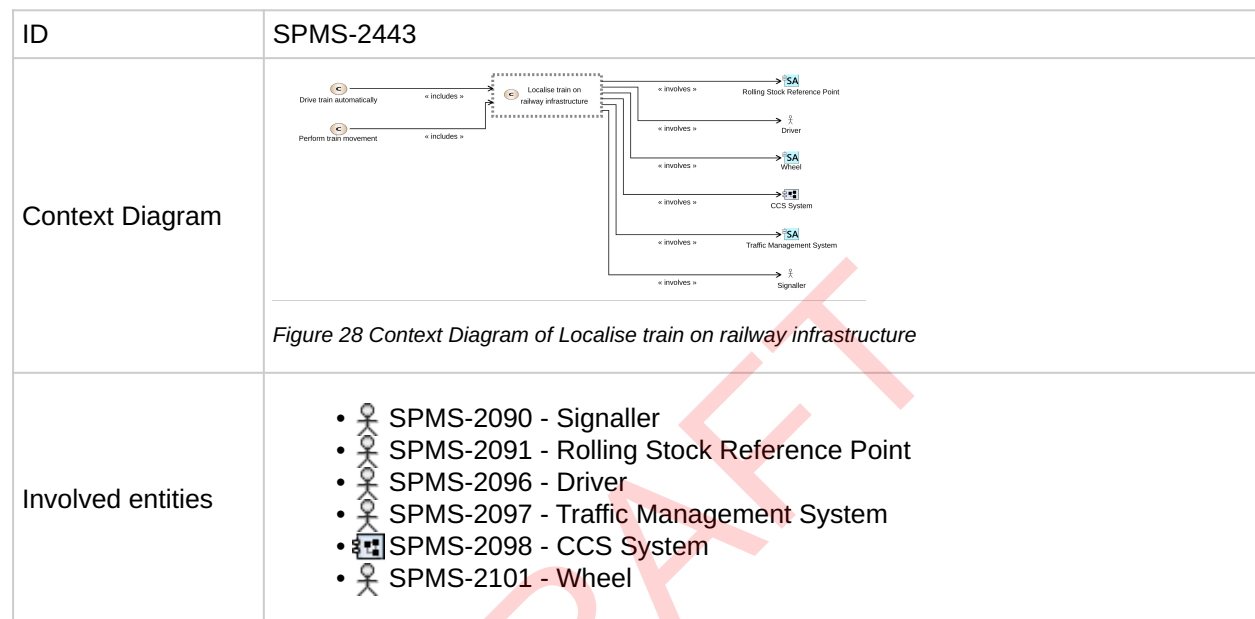
2.1.2.7 Localise train on railway infrastructure

2.1.2.7-1 - Localise train on railway infrastructure

The Signaller needs the system to observe all track occupancies in the corresponding occupancy extent in a proper representation in order to perform safe train operation.

The Driver needs the system to observe the current speed in order to avoid overspeed and to maintain (or be in line with) the time table.

The Traffic Management System needs the system to observe the motion of one train in order to provide accurate plans.



2.1.2.7-2 - Localise train on railway infrastructure

This scenario includes the functions to detect the occupation of a track vacancy proving section as well as to determine localisation information of one rolling stock in order to combine all functionality to localise a train on the railway infrastructure.

The figure below provides an overview of *Localise train on railway infrastructure*.

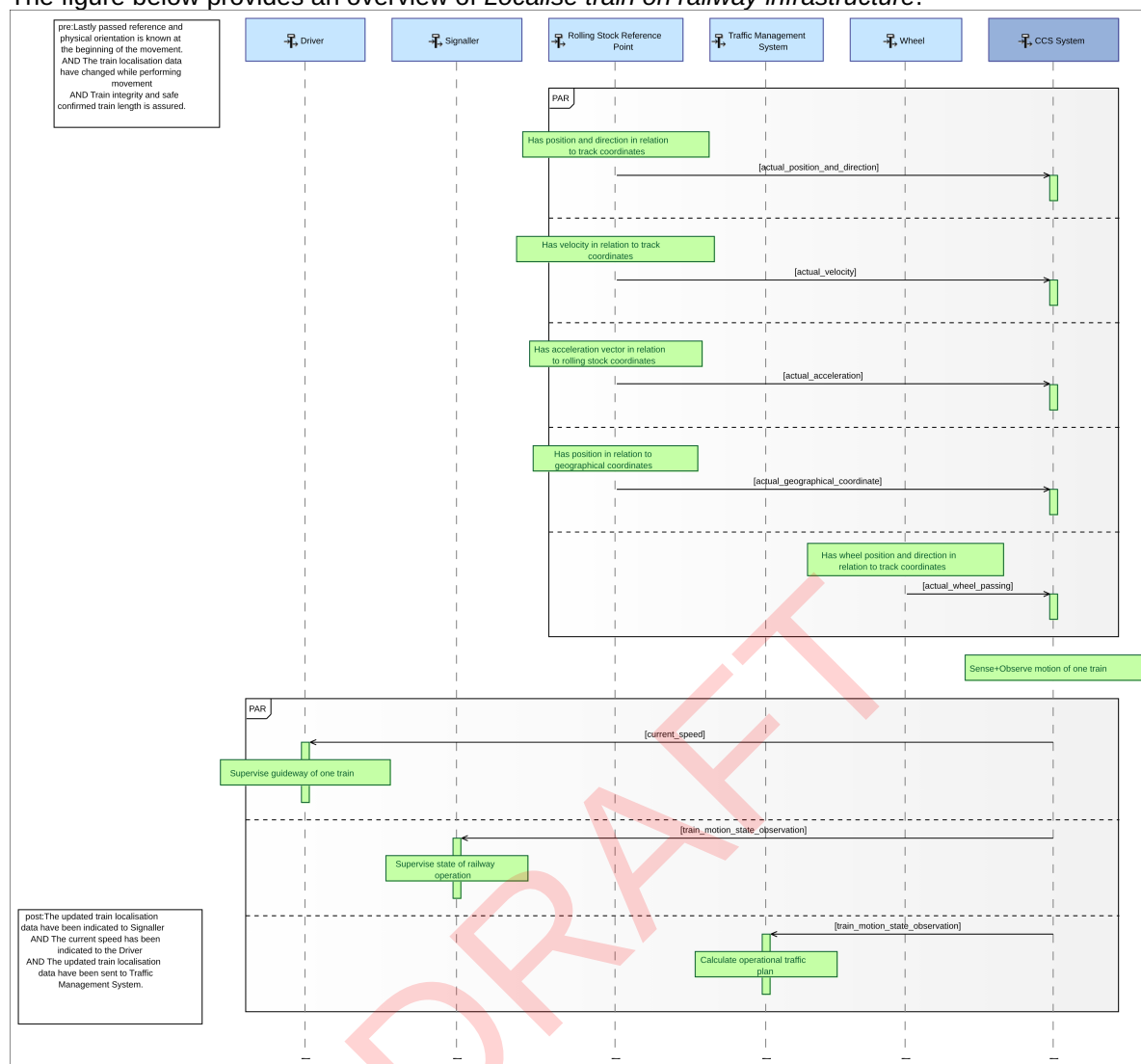


Figure 29 Diagram [SES] Localise train on railway infrastructure [Exchange scenario]

ID	SPMS-4329
Pre Condition	<p>Lastly passed reference and physical orientation is known at the beginning of the movement.</p> <p>AND The train localisation data have changed while performing movement</p> <p>AND Train integrity and safe confirmed train length is assured.</p>
Post Condition	<p>The updated train localisation data have been indicated to Signaller</p> <p>AND The current speed has been indicated to the Driver</p> <p>AND The updated train localisation data have been sent to Traffic Management System.</p>

2.1.2.7-3 - Localise train on railway infrastructure

This functional chain includes the functions to detect the occupation of a track vacancy proving section as well as to determine localisation information of one rolling stock in order to combine all functionality to localise a train on the railway infrastructure.

The figure below provides an overview of *Localise train on railway infrastructure*.

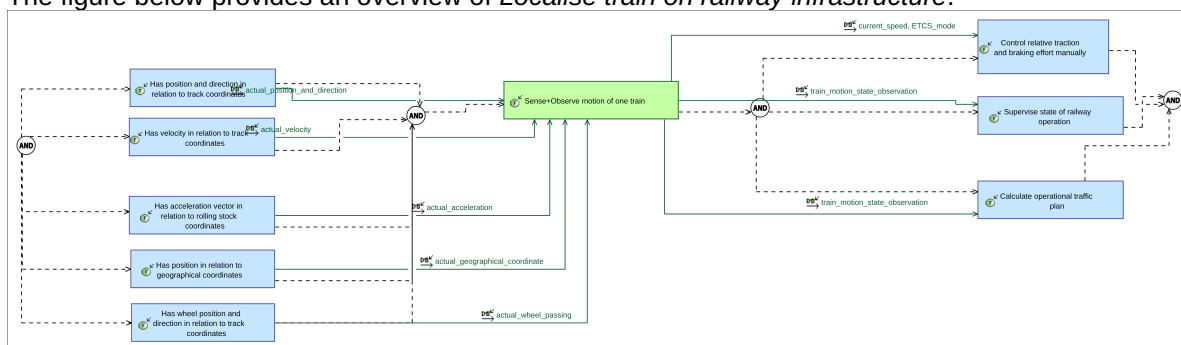


Figure 30 Diagram [SFCD] Localise train on railway infrastructure [Functional chain description]

ID	SPMS-4438
Pre Condition	<p>Lastly passed reference and physical orientation is known at the beginning of the movement.</p> <p>AND The train localisation data have changed while performing movement</p> <p>AND Train integrity and safe confirmed train length is assured.</p>
Post Condition	<p>The updated train localisation data have been indicated to Signaller</p> <p>AND The current speed has been indicated to the Driver</p> <p>AND The updated train localisation data have been sent to Traffic Management System.</p>
Involved Functions	<ul style="list-style-type: none"> SPMS-2106 - Control relative traction and braking effort manually SPMS-2127 - Has acceleration vector in relation to rolling stock coordinates SPMS-2135 - Has position in relation to geographical coordinates SPMS-2138 - Has position and direction in relation to track coordinates SPMS-2140 - Has velocity in relation to track coordinates SPMS-2141 - Has wheel position and direction in relation to track coordinates SPMS-2148 - Calculate operational traffic plan SPMS-2167 - Supervise state of railway operation SPMS-2192 - Sense+Observe motion of one train

[SAB] Localise train on railway infrastructure [Control loop]

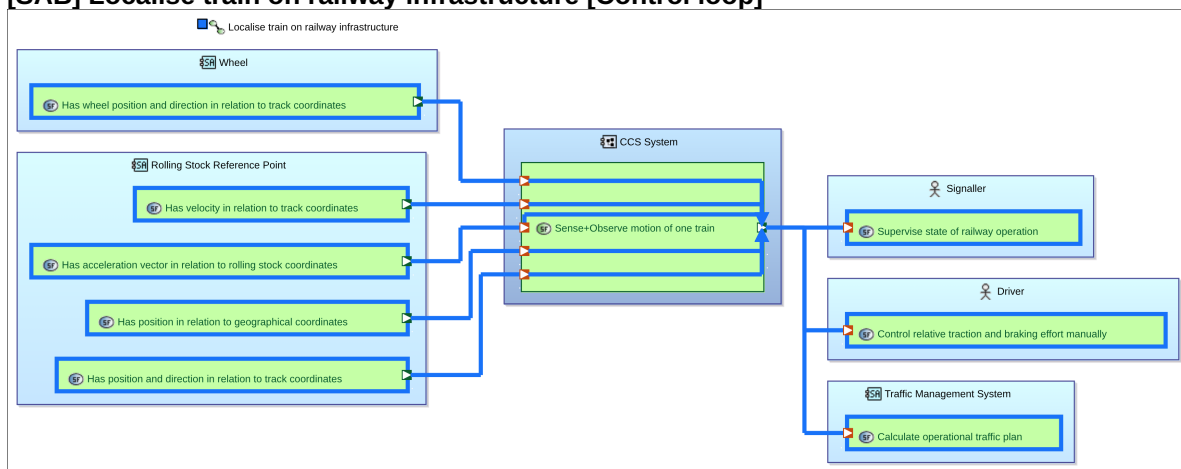


Figure 31 Diagram [SAB] Localise train on railway infrastructure [Control loop]

ID	SPMS-5825
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Note:

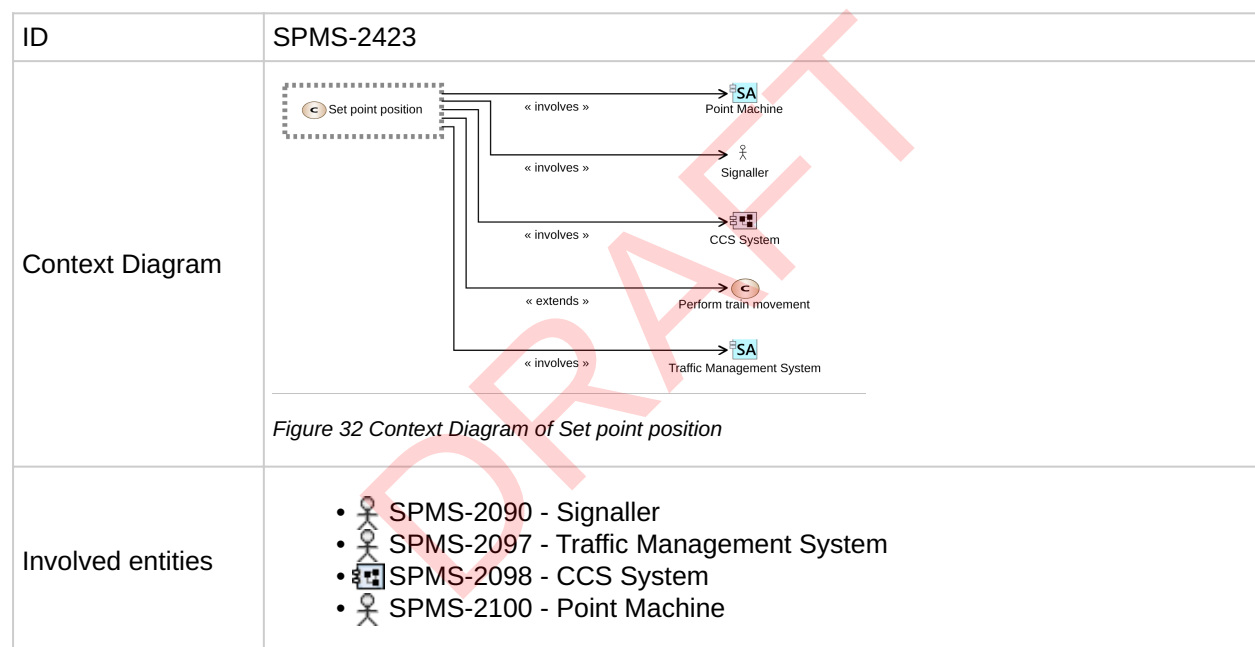
"Localise train on railway infrastructure" is also shown in the following Control loops:

- SPMS-5508 - [SAB] Grant and release movement permission (Operational plan) [Control loop]
- SPMS-5866 - [SAB] Grant and release movement permission (Signaller) [Control loop]

2.1.2.8 Set point position

2.1.2.8-1 - Set point position

The Traffic Management System or the Signaller need the system to set a point to the required position (e.g. to perform a train movement).



2.1.2.8-2 - Set point position







This functional chain describes the sequence of functions related to each other in case of a point position request by the SPMS-2813 - Traffic Management System or the SPMS-2827 - Signaller.

The figure below provides an overview of *Set point position*.




Figure 33 Diagram [SFCD] Set point position [Functional chain description]

ID	SPMS-4444
Pre Condition	The estimated point position is not in the required end position.
Post Condition	The estimated position of the point is in the required end position AND the point status is indicated to the Signaller AND the point status is indicated to the Traffic Management System.

Involved Functions	<ul style="list-style-type: none"> •  SPMS-2108 - Sense+Observe point status •  SPMS-2125 - Exert force on point rails •  SPMS-2132 - Has physical behaviour moves+lies+is locked •  SPMS-2148 - Calculate operational traffic plan •  SPMS-2167 - Supervise state of railway operation •  SPMS-2190 - Control position of one point
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2.1.2.8.1 Set point position (Left to right, Operational plan)

2.1.2.8.1-1 - Set point position (Left to right, Operational plan)

This scenario describes the sequence of functions related to each other in case of a operational plan movement requiring "left end position" point position request by the  SPMS-2813 - Traffic Management System.

DRAFT

The figure below provides an overview of *Set point position (Left to right, Operational plan)*.

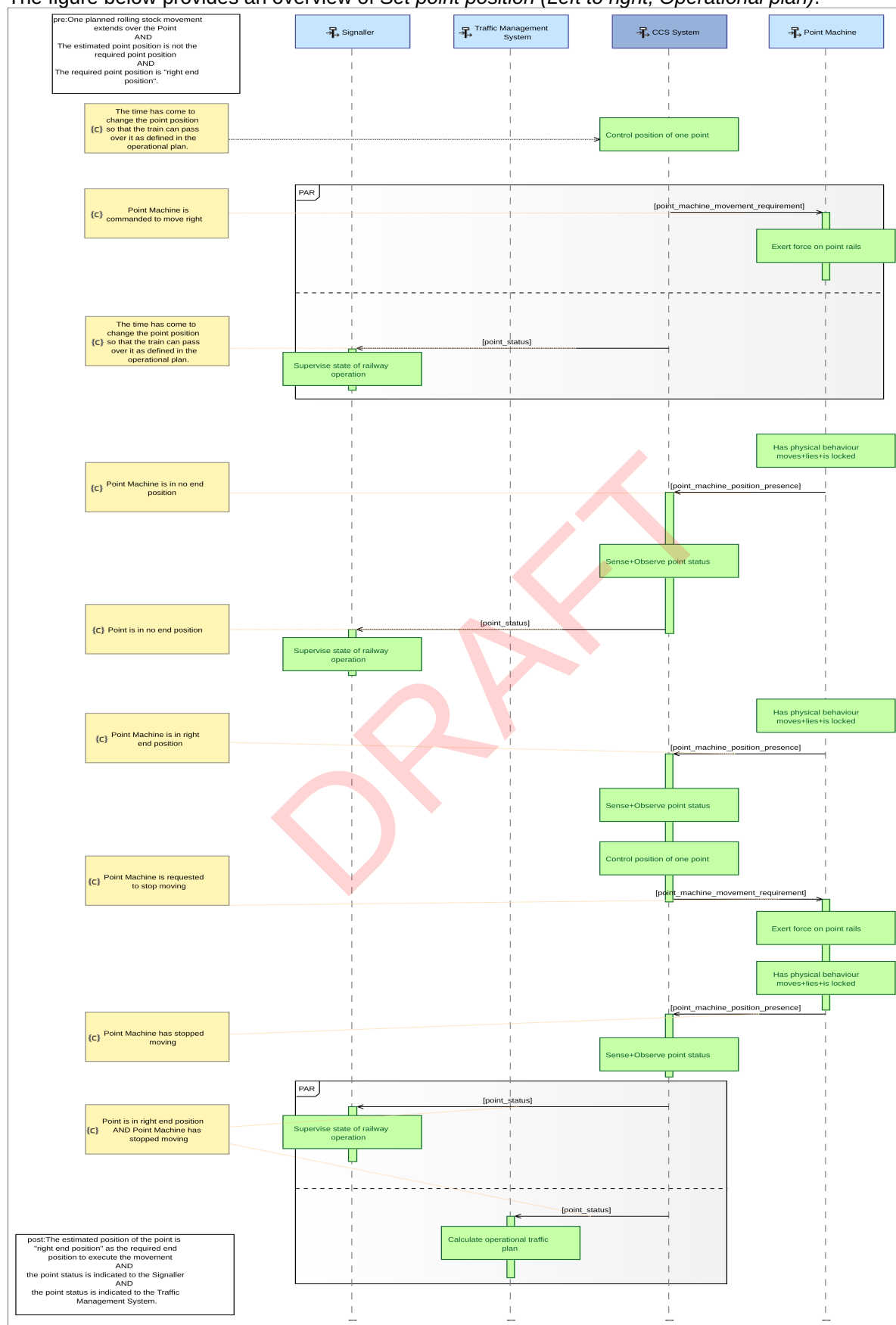


Figure 34 Diagram [SES] Set point position (Left to right, Operational plan) [Exchange scenario]

ID	SPMS-4342
Pre Condition	<p>One planned rolling stock movement extends over the Point</p> <p>AND</p> <p>The estimated point position is not the required point position</p> <p>AND</p> <p>The required point position is "right end position".</p>
Post Condition	<p>The estimated position of the point is "right end position" as the required end position to execute the movement</p> <p>AND</p> <p>the point status is indicated to the Signaller</p> <p>AND</p> <p>the point status is indicated to the Traffic Management System.</p>

[SAB] Set point position (Operational plan) [Control loop]

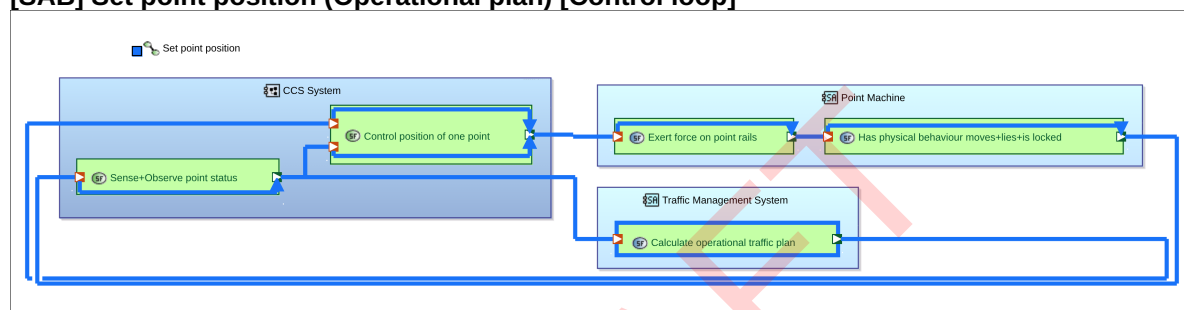



Figure 35 Diagram [SAB] Set point position (Operational plan) [Control loop]

ID	SPMS-5286
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2.1.2.8.2 Set point position (Left to right, Signaller request)

2.1.2.8.2-1 - Set point position (Left to right, Signaller request)

This scenario describes the sequence of functions related to each other in case of a "left end position" point position request by the  SPMS-2827 - Signaller.

The figure below provides an overview of *Set point position (Left to right, Signaller request)*.

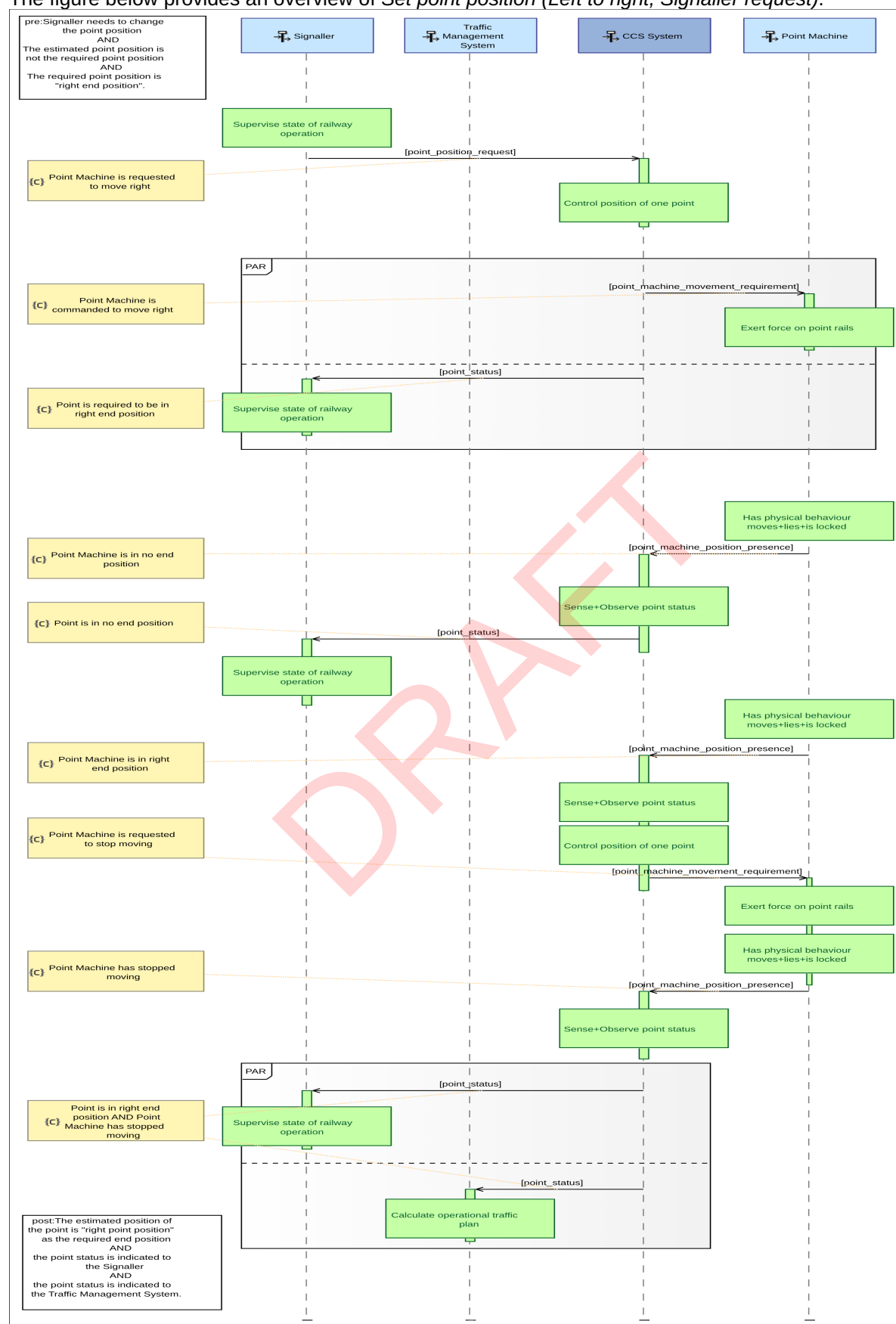


Figure 36 Diagram [SES] Set point position (Left to right, Signaller request) [Exchange scenario]

ID	SPMS-4769
Pre Condition	Signaller needs to change the point position AND The estimated point position is not the required point position AND The required point position is "right end position".
Post Condition	The estimated position of the point is "right point position" as the required end position AND the point status is indicated to the Signaller AND the point status is indicated to the Traffic Management System.

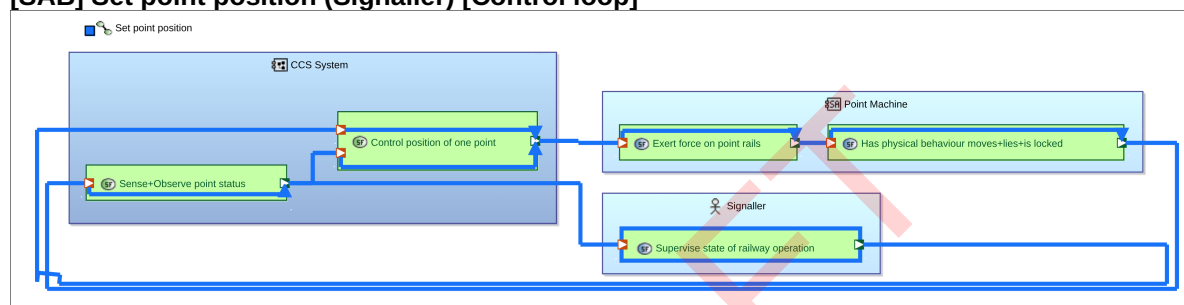
[SAB] Set point position (Signaller) [Control loop]

Figure 37 Diagram [SAB] Set point position (Signaller) [Control loop]

ID	SPMS-5868
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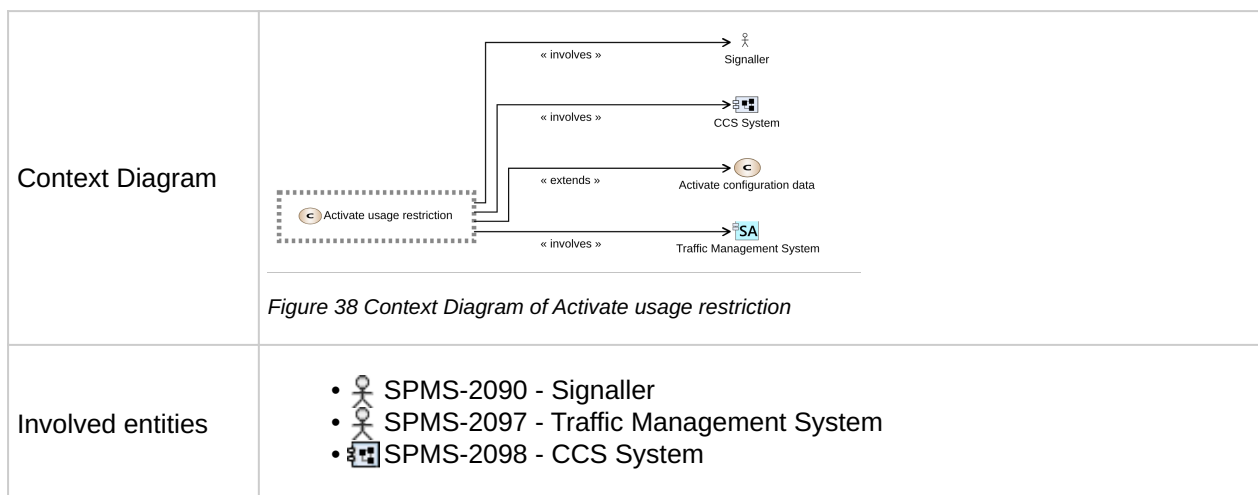
2.1.2.9 Activate usage restriction**2.1.2.9-1 - Activate usage restriction**

The Traffic Management System needs the system to consider and activate planned usage restrictions (e.g. temporary unavailability of some areas, Temporary Speed Restrictions, points locked in only one position) included in the Operational Plan in order to reserve track path and perform supervised train movement.


The Signaller needs the system to consider and activate unplanned usage restrictions (e.g. temporary unavailability of some areas, Temporary Speed Restrictions, points locked in only one position) not included in the Operational Plan in order to reserve track path and perform supervised train movement.

Note: The usage restriction does not apply to trains that have already been granted a Movement Authority overlapping the restricted area.

ID	SPMS-2438
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2.1.2.9-2 - Activate usage restriction (Planned usage restriction)

This scenario describes the sequence of functions related to each other in case of an activation request by the  SPMS-2097 - Traffic Management System for a planned usage restriction.

The figure below provides an overview of *Activate usage restriction (Planned usage restriction)*.

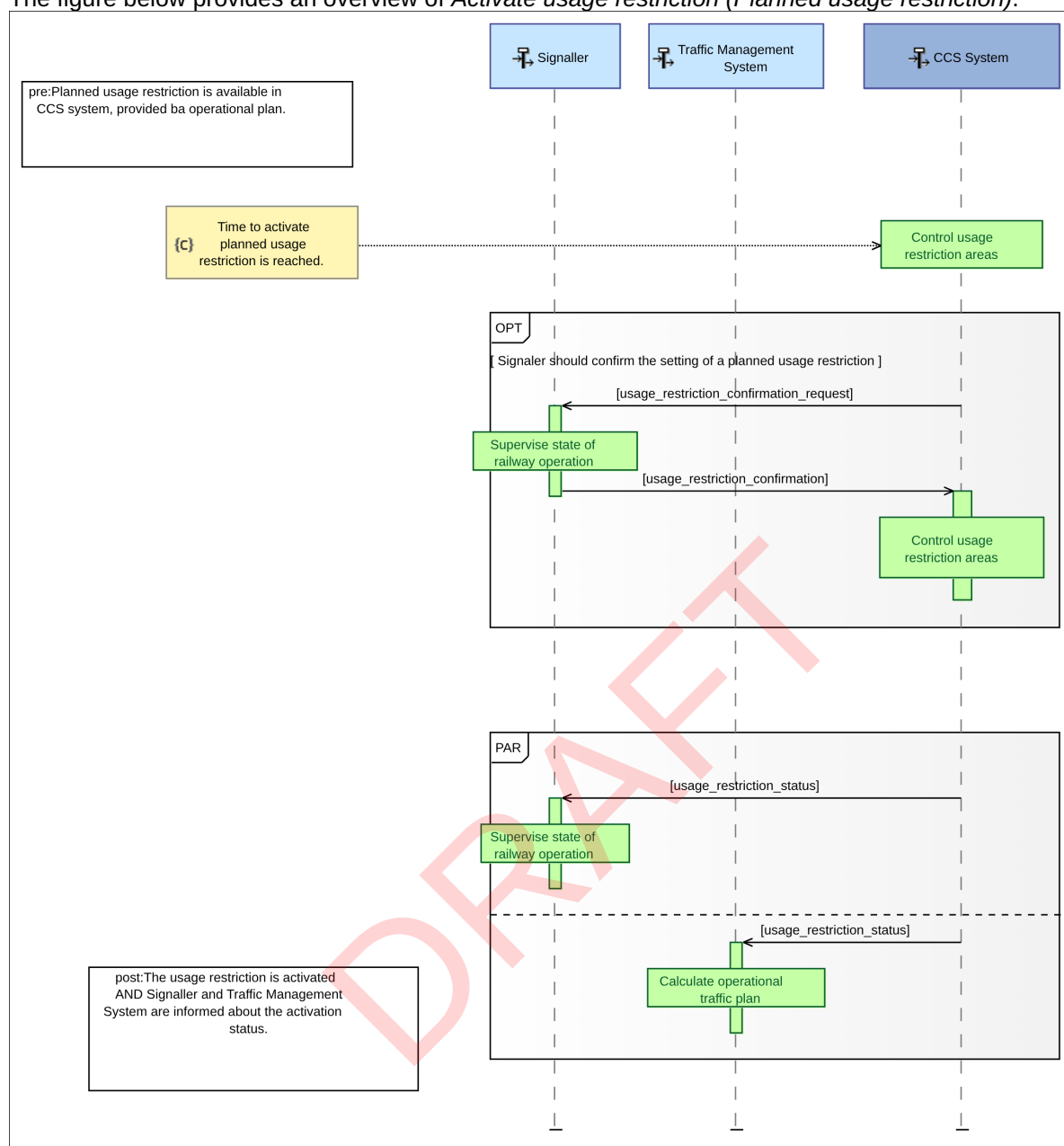




Figure 39 Diagram [SES] Activate usage restriction (Planned usage restriction) [Exchange scenario]

ID	SPMS-5753
Pre Condition	Planned usage restriction is available in CCS system, provided ba operational plan.
Post Condition	The usage restriction is activated AND Signaller and Traffic Management System are informed about the activation status.

2.1.2.9-3 - Activate usage restriction

This functional chain describes the sequence of functions related to each other in case of an activation request by the  SPMS-2097 - Traffic Management System for a planned usage restriction or by the  SPMS-2090 - Signaller for an unplanned usage restriction.

The figure below provides an overview of *Activate usage restriction*.

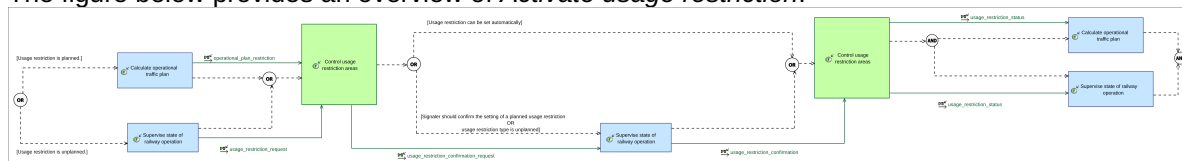


Figure 40 Diagram [SFCD] Activate usage restriction [Functional chain description]

ID	SPMS-4435
Involved Functions	<ul style="list-style-type: none"> • SPMS-2148 - Calculate operational traffic plan • SPMS-2159 - Control usage restriction areas • SPMS-2167 - Supervise state of railway operation

[SAB] Activate Usage restriction [Control loop]

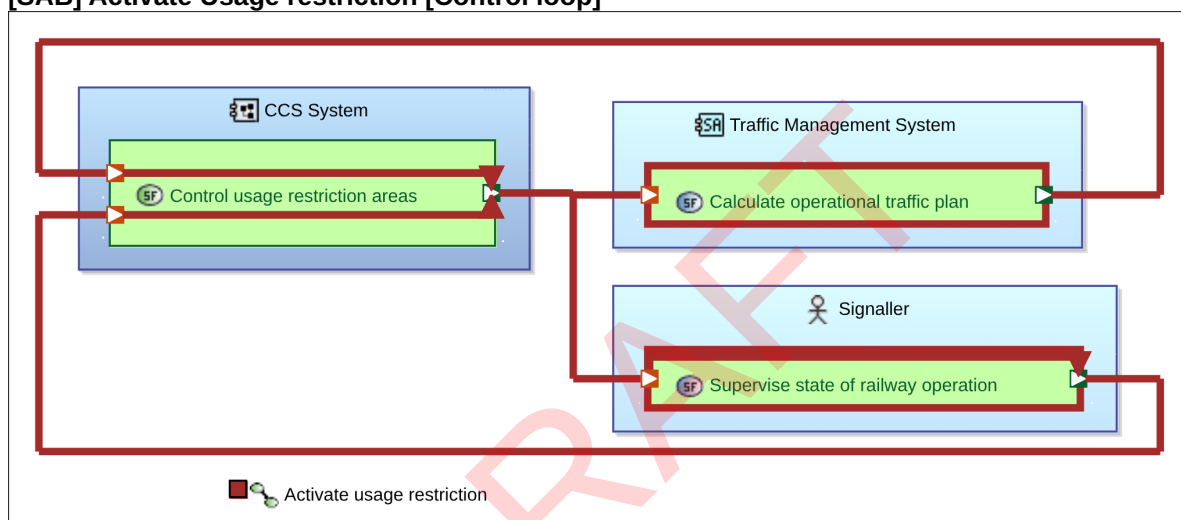


Figure 41 Diagram [SAB] Activate Usage restriction [Control loop]

ID	SPMS-5689
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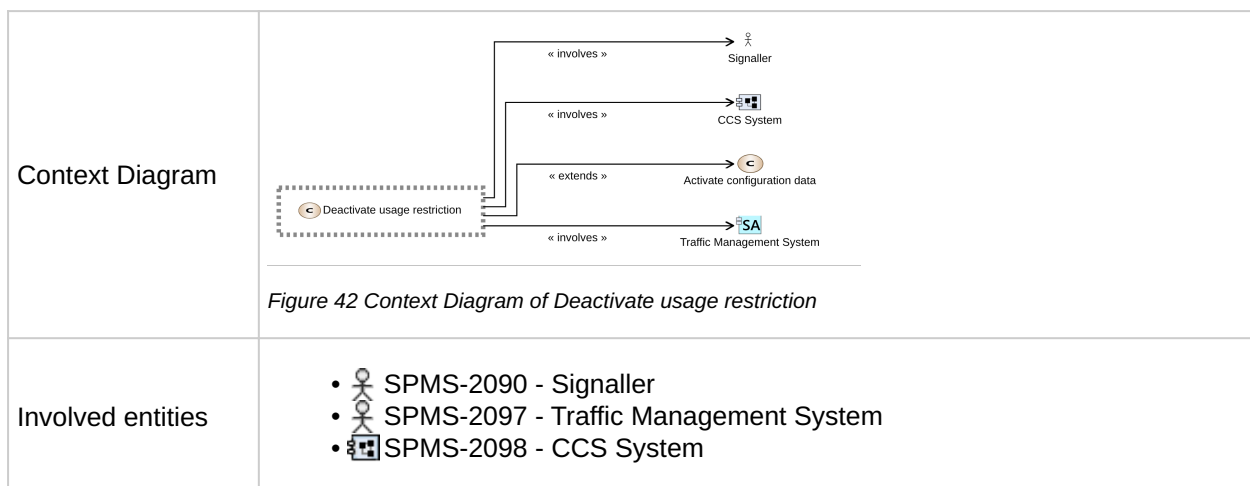
2.1.2.10 Deactivate usage restriction

2.1.2.10-1 - Deactivate usage restriction

The Traffic Management System needs the system to deactivate planned usage restrictions (e.g. temporary unavailability of some areas, Temporary Speed Restrictions, points locked in only one position) included in the Operational Plan.

Note: Activation and deactivation need both to be implemented safely by the system. At this stage, the potential different criticalities of activation or deactivation (for example in today's system the feature to deactivate a usage restriction is implemented at a higher SIL than activating it) appears not to be relevant, as the activation as well as the deactivation of usage restrictions will be checked by the respective functions of the model implementing safety logic.

ID	SPMS-2436
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2.1.2.10-2 - Deactivate usage restriction (Planned usage restriction)

This scenario describes the sequence of functions related to each other in case of a deactivation request by the SPMS-2097 - Traffic Management System for a planned usage restriction.

The figure below provides an overview of *Deactivate usage restriction (Planned usage restriction)*.

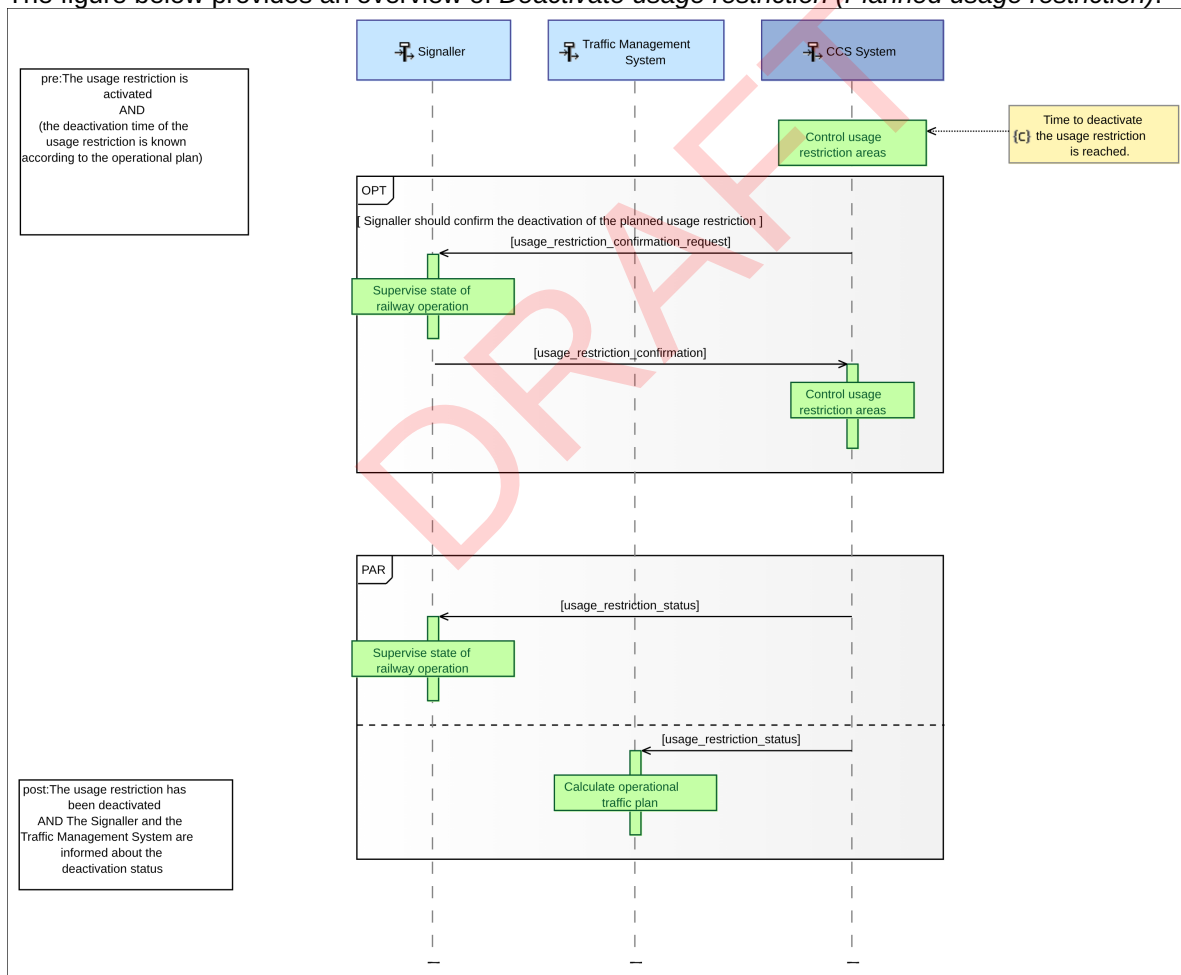




Figure 43 Diagram [SES] Deactivate usage restriction (Planned usage restriction) [Exchange scenario]

ID	SPMS-4345
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Pre Condition	<p>The usage restriction is activated</p> <p>AND</p> <p>the deactivation time of the usage restriction is known according to the operational plan</p> <p>AND</p> <p>deactivation time of usage restriction is due</p>
Post Condition	<p>The usage restriction has been deactivated</p> <p>AND The Signaller and the Traffic Management System are informed about the deactivation status</p>

2.1.2.10-3 - Deactivate usage restriction

This functional chain describes the sequence of functions related to each other in case of a deactivation request by the  SPMS-2097 - Traffic Management System for a planned usage restriction or by the  SPMS-2090 - Signaller for an unplanned usage restriction.

The figure below provides an overview of *Deactivate usage restriction*.

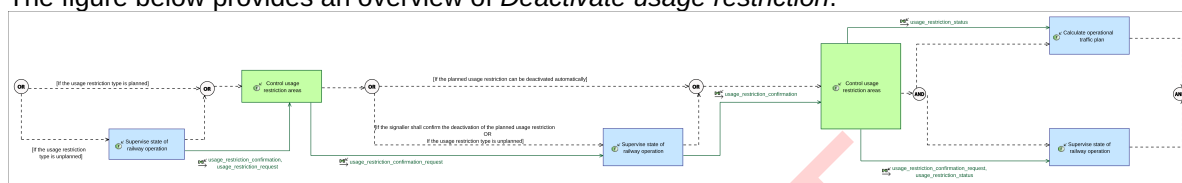





Figure 44 Diagram [SFCD] Deactivate usage restriction (planned) [Functional chain description]

ID	SPMS-4828
Involved Functions	<ul style="list-style-type: none"> •  SPMS-2148 - Calculate operational traffic plan •  SPMS-2159 - Control usage restriction areas •  SPMS-2167 - Supervise state of railway operation

[SAB] Deactivate usage restriction [Control loop]

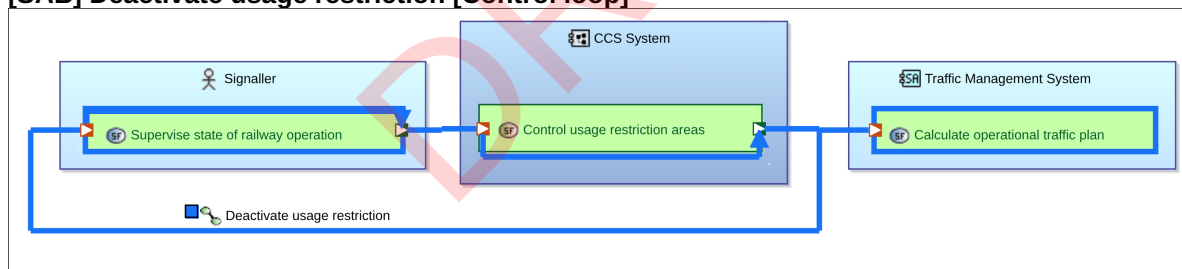


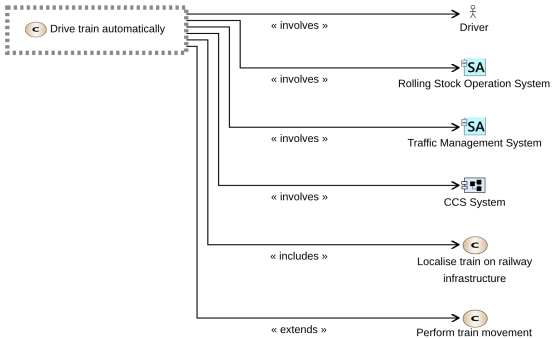




Figure 45 Diagram [SAB] Deactivate usage restriction [Control loop]

ID	SPMS-6480
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2.1.2.11 Drive train automatically

2.1.2.11-1 - Drive train automatically

The Railway Undertaking represented as Driver needs the system to drive the train automatically between two operational timing points according to the operational plan movement. This is done by controlling the relative traction and brake effort and providing it directly to the Rolling Stock Operation System, leading to the actuation of the required traction and brake effort by the train. The involvement of the Traffic Management System ensures coordination and alignment with the operational plan.

ID	SPMS-5297
Context Diagram	 <p>The diagram shows a central use case 'Drive train automatically' (represented by a circle with a 'C' icon) connected to several external entities. The connections are as follows:</p> <ul style="list-style-type: none"> « involves » Driver (Actor icon) « involves » Rolling Stock Operation System (SA icon) « involves » Traffic Management System (SA icon) « involves » CCS System (Icon with a square and a circle) « includes » Localise train on railway infrastructure (Circle with a 'C' icon) « extends » Perform train movement (Circle with a 'C' icon) <p>Figure 46 Context Diagram of Drive train automatically</p>
Involved entities	<ul style="list-style-type: none"> •  SPMS-2094 - Rolling Stock Operation System •  SPMS-2096 - Driver •  SPMS-2097 - Traffic Management System •  SPMS-2098 - CCS System

2.1.2.11-2 - Drive train automatically

This scenario describes the sequence of functions related to each other to drive a train automatically according to the operational plan.

The figure below provides an overview of *Drive train automatically*.

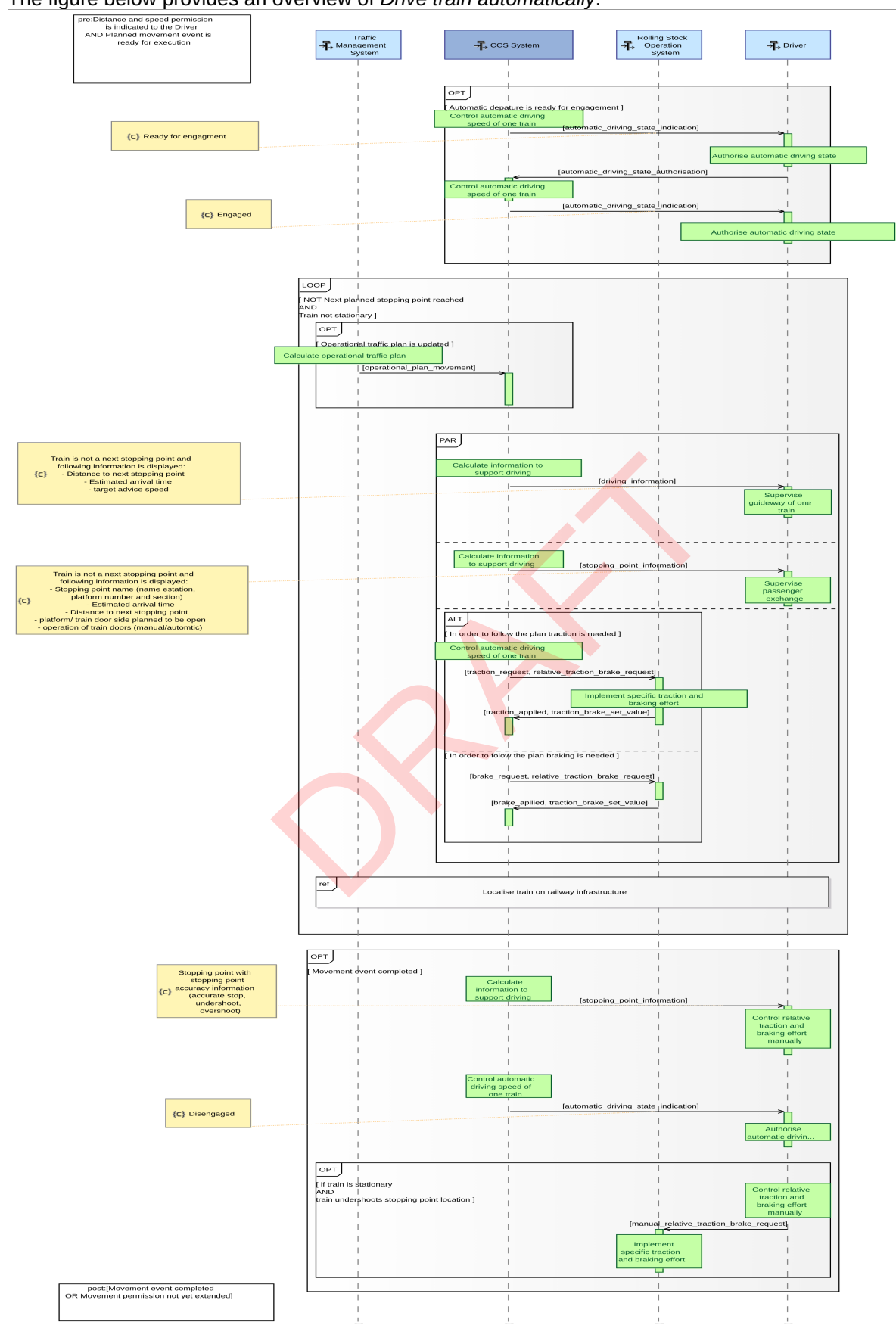


Figure 47 Diagram [SES] Drive train automatically [Exchange scenario]

ID	SPMS-5444
Pre Condition	Distance and speed permission is indicated to the Driver AND Planned movement event is ready for execution
Post Condition	[Movement event completed OR Movement permission not yet extended]

2.1.2.11-3 - Drive train automatically

This functional chain describes the sequence of functions related to each other to drive a train automatically according to the operational plan.

The figure below provides an overview of *Drive train automatically*.

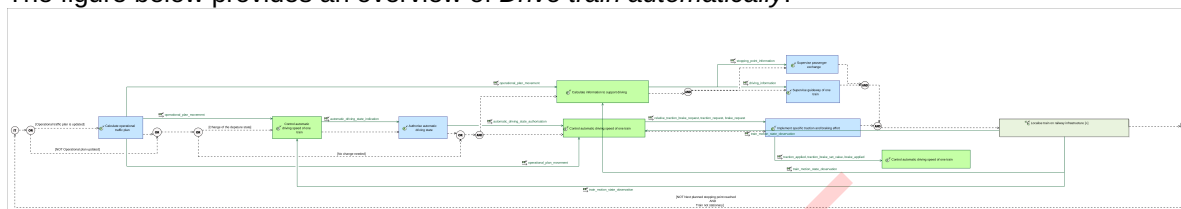


Figure 48 Diagram [SFCD] Drive train automatically [Functional chain description]

ID	SPMS-5359
Pre Condition	Distance and speed permission is indicated to the Driver AND Planned movement event is ready for execution
Post Condition	[Movement event completed OR Movement permission not yet extended]
Involved Functions	<ul style="list-style-type: none"> • SF SPMS-2134 - Authorise automatic driving state • SF SPMS-2146 - Implement specific traction and braking effort • SF SPMS-2148 - Calculate operational traffic plan • SF SPMS-2158 - Supervise guideway of one train • SF SPMS-2160 - Calculate information to support driving • SF SPMS-2177 - Supervise passenger exchange • SF SPMS-2180 - Control automatic driving speed of one train

[SAB] Drive train automatically [Control loop]

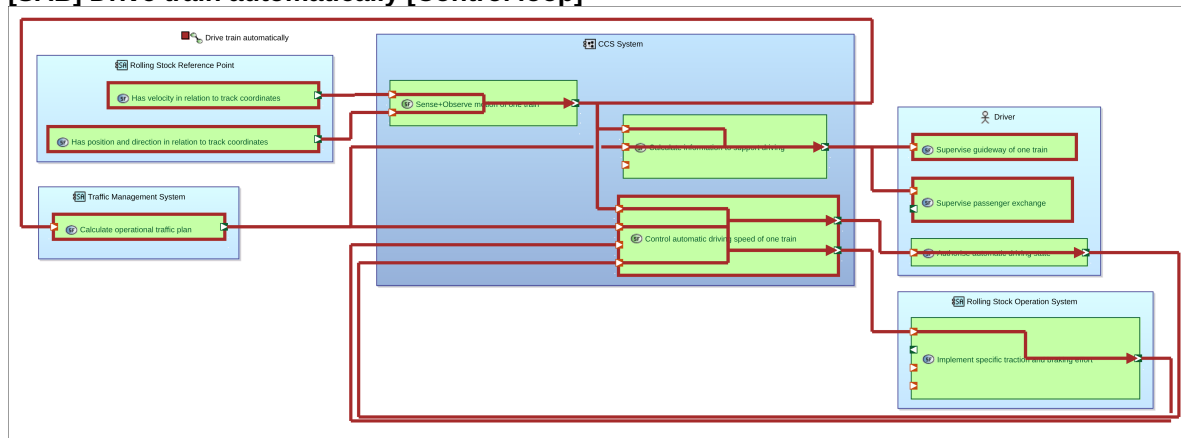


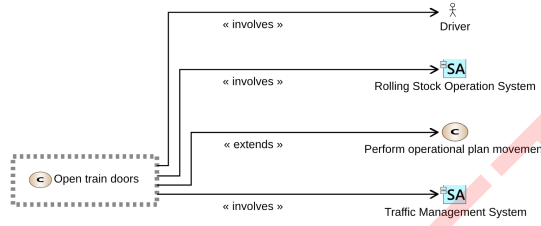



Figure 49 Diagram [SAB] Drive train automatically [Control loop]

ID	SPMS-5690
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2.1.2.12 Open train doors

2.1.2.12-1 - Open train doors

The Traffic Management System needs the CCS system to perform a passenger exchange according to the operational plan by controlling the train doors so that the passengers can board and align to the respective platform.

ID	SPMS-6624
Context Diagram	 <p>The context diagram shows the 'Open train doors' use case (represented by a dashed rectangle with a circle icon) interacting with four external entities: Driver, Rolling Stock Operation System, Perform operational plan movement, and Traffic Management System. The relationships are as follows: <ul style="list-style-type: none"> « involves » to Driver « involves » to Rolling Stock Operation System « extends » to Perform operational plan movement « involves » to Traffic Management System </p> <p>Figure 50 Context Diagram of Open train doors</p>
Involved entities	<ul style="list-style-type: none"> •  SPMS-2094 - Rolling Stock Operation System •  SPMS-2096 - Driver •  SPMS-2097 - Traffic Management System

2.1.2.12-2 - Open train doors

This scenario describes the sequence of functions to open the train doors. The train door side and train door opening operation is obtained while a train approaches the station and is part of the scenario Perform train movement - specifically in the reference scenario Drive train automatically and the sequence of full supervision movement.

The figure below provides an overview of *Open train doors*.

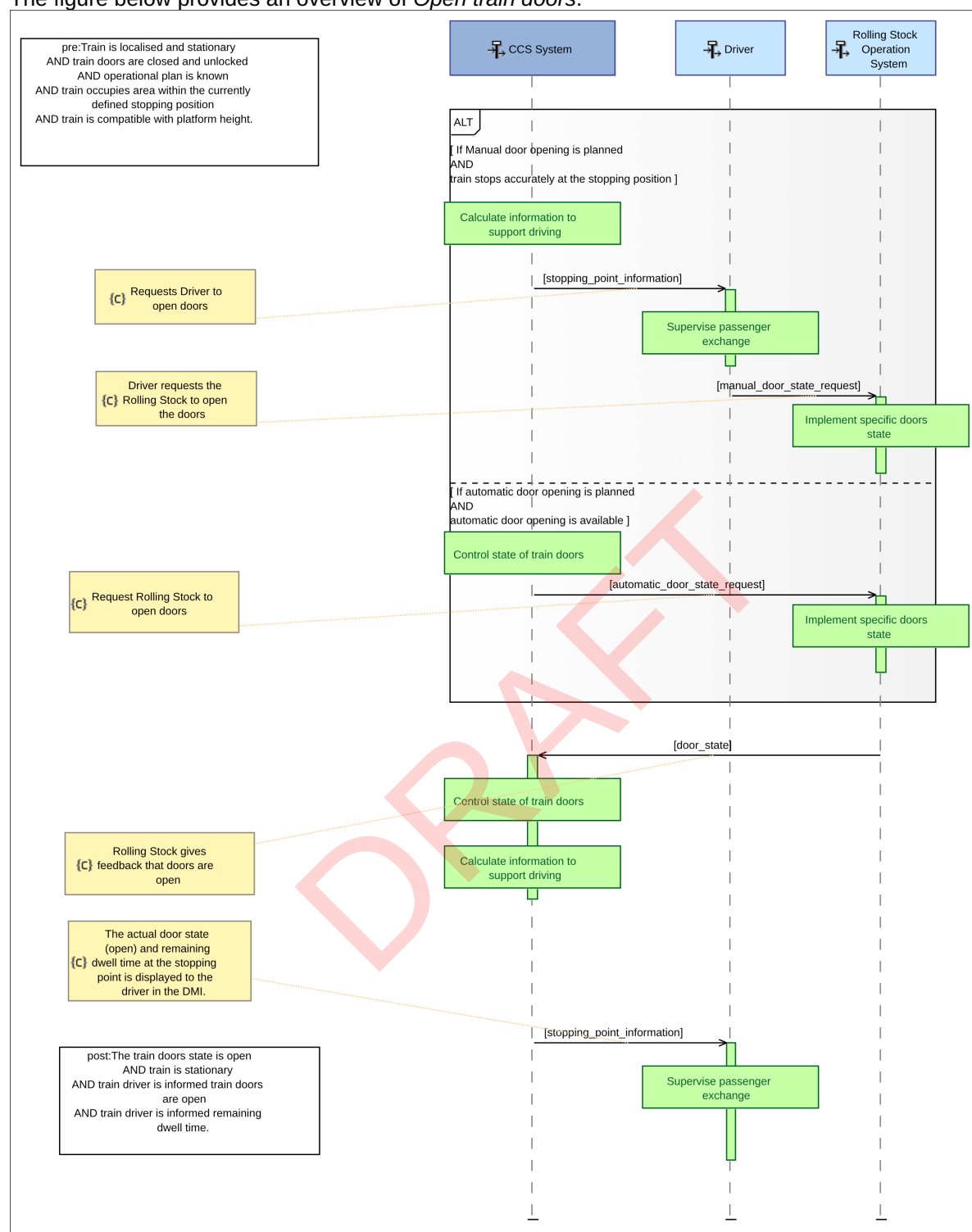


Figure 51 Diagram [SES] Open train doors

ID	SPMS-6658
Pre Condition	Train is localised and in standstill AND train doors are closed and unlocked AND operational plan is known AND train occupies area within the currently defined stopping position AND train is compatible with platform height.

Post Condition	<p>The train doors state is open AND train is in standstill AND train driver is informed train doors are open AND train driver is informed about the remaining dwell time.</p>
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2.1.2.12-3 - Open train doors

This functional chain describes the sequence of functions related to open the train doors. The train door side and train door opening operation is obtained while train approaches the station and is part of the scenario Perform train movement specifically in the reference scenario Drive train automatically and the sequence of full supervision movement.

The figure below provides an overview of *Open train doors*.

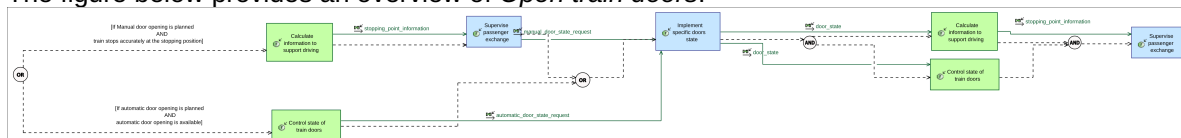


Figure 52 Diagram [SFCD] Open train doors [Functional chain description]

ID	SPMS-6729
Pre Condition	<p>Train is localised and in standstill AND train doors are closed and unlocked AND operational plan is known AND train occupies area within the currently defined stopping position AND train is compatible with platform height.</p>
Post Condition	<p>The train doors state is open AND train is in standstill AND train driver is informed train doors are open AND train driver is informed about the remaining dwell time.</p>
Involved Functions	<ul style="list-style-type: none"> • SF SPMS-2107 - Control state of train doors • SF SPMS-2114 - Implement specific doors state • SF SPMS-2160 - Calculate information to support driving • SF SPMS-2177 - Supervise passenger exchange

[SAB] Open train doors [Control loop]

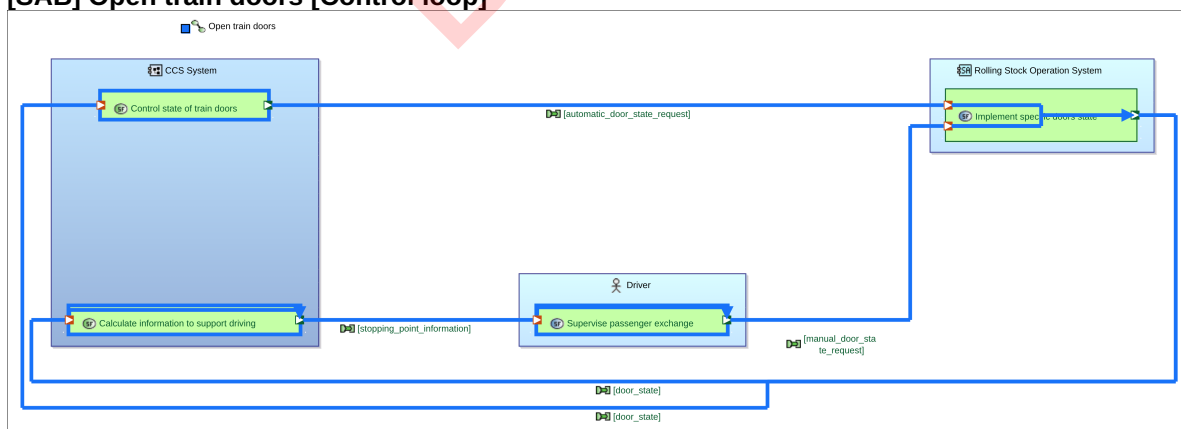


Figure 53 Diagram [SAB] Open train doors [Control loop]

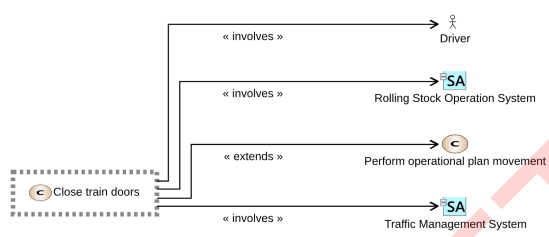
ID	SPMS-6732
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2.1.2.13 Close train doors

2.1.2.13-1 - Close train doors

The Traffic Management System needs the CCS System to perform a passenger exchange according to the operational plan by closing the train doors so that the passenger exchange ends.

Note: Platform staff and Train Manager are out of the scope of this System Capability, since they don't have a direct interaction with the CCS System.

ID	SPMS-6625
Context Diagram	 <p>The context diagram shows the 'Close train doors' use case (represented by a dashed circle) interacting with four external entities: Driver (actor), Rolling Stock Operation System (system), Perform operational plan movement (use case), and Traffic Management System (system). The relationships are as follows: <ul style="list-style-type: none"> Driver « involves » Rolling Stock Operation System Rolling Stock Operation System « involves » Perform operational plan movement Perform operational plan movement « extends » Close train doors Close train doors « involves » Traffic Management System </p> <p>Figure 54 Context Diagram of Close train doors</p>
Involved entities	<ul style="list-style-type: none"> • SPMS-2094 - Rolling Stock Operation System • SPMS-2096 - Driver • SPMS-2097 - Traffic Management System

2.1.2.13-2 - Close train doors

This sequence scenario describes the sequence of functions to close the train doors. There are two alternatives; the driver closing them manually or the CCS system closing the train doors automatically.

Note: The type of door closing operation is defined in the Operational Plan and it sent to CCS during the SysC Perform Train Movement

The figure below provides an overview of *Close train doors*.

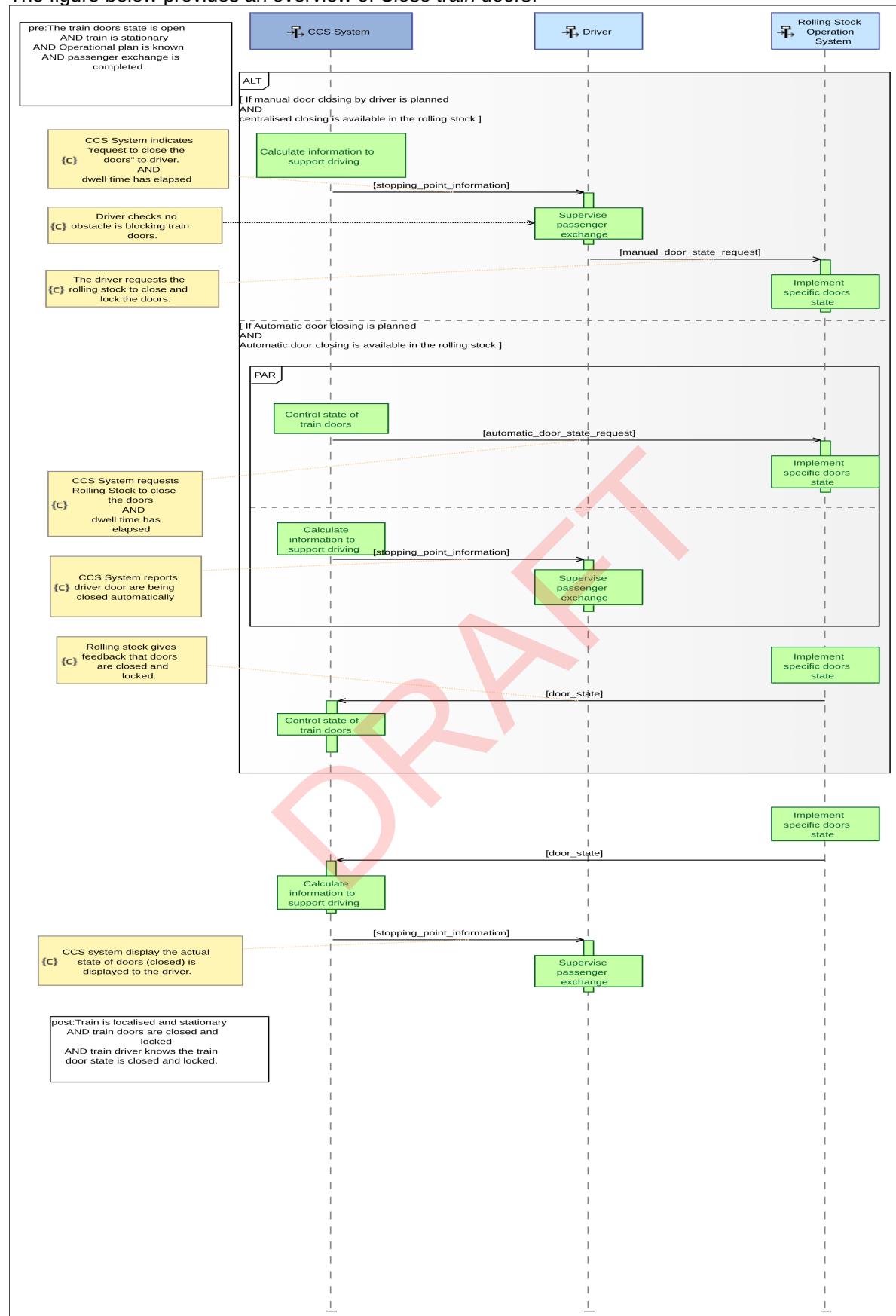


Figure 55 Diagram [SES] Close train doors

ID	SPMS-6659
Pre Condition	The train doors state is open AND train is in standstill AND Operational plan is known AND passenger exchange is completed.
Post Condition	Train is localised and in standstill AND train doors are closed and locked AND train driver knows the train door state is closed and locked.

2.1.2.13-3 - Close train doors

This functional chain describes the sequence of functions to close the train doors.

The figure below provides an overview of *Close train doors*.

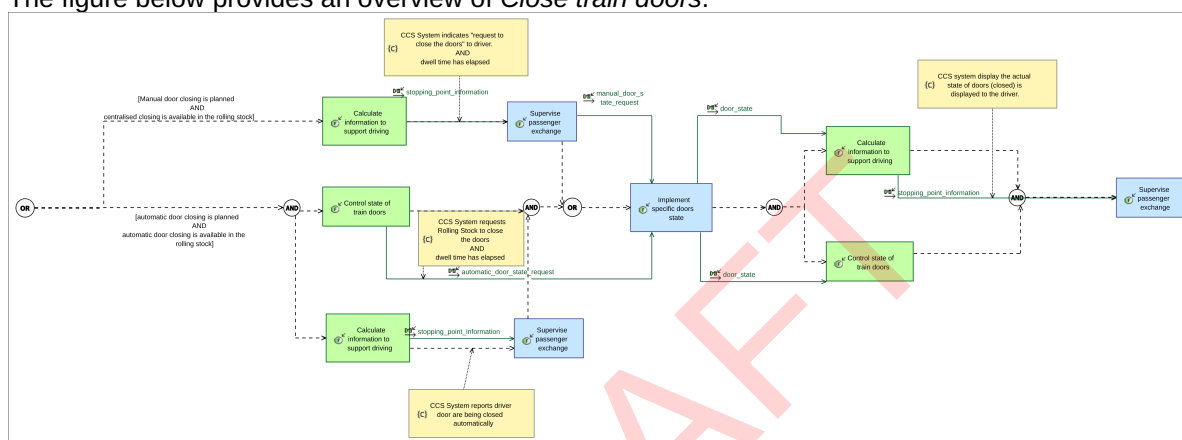


Figure 56 Diagram [SFCD] Close train doors [Functional chain description]

ID	SPMS-6881
Pre Condition	The train doors state is open AND train is in standstill AND Operational plan is known AND passenger exchange is completed.
Post Condition	Train is localised and in standstill AND train doors are closed and locked AND train driver knows the train door state is closed and locked.
Involved Functions	<ul style="list-style-type: none"> • 5F SPMS-2107 - Control state of train doors • 5F SPMS-2114 - Implement specific doors state • 5F SPMS-2160 - Calculate information to support driving • 5F SPMS-2177 - Supervise passenger exchange

[SAB] Close train doors [Control loop]

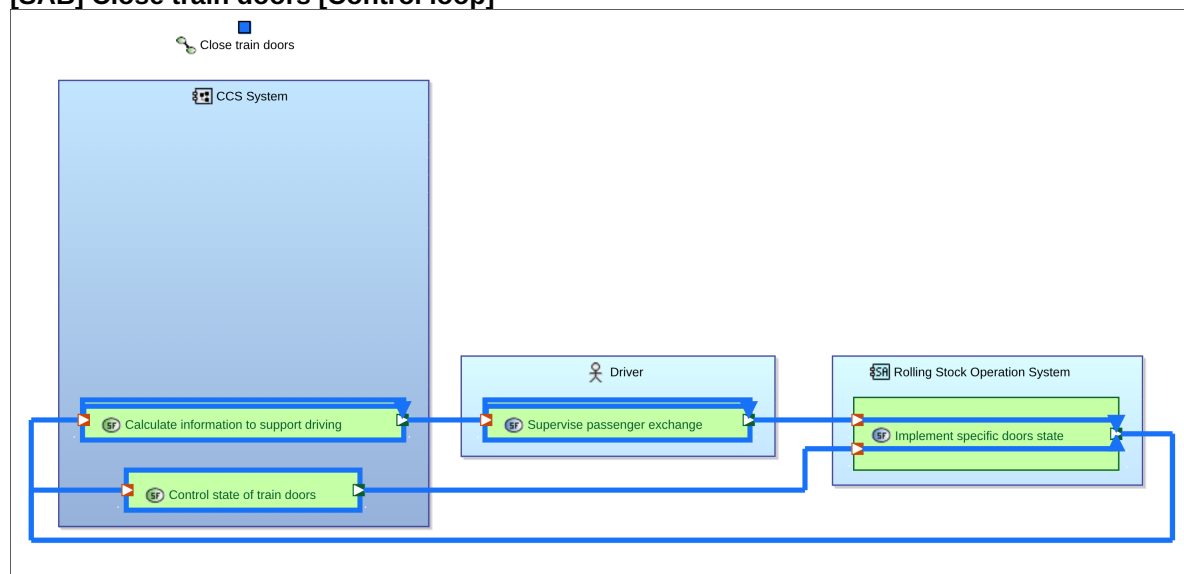


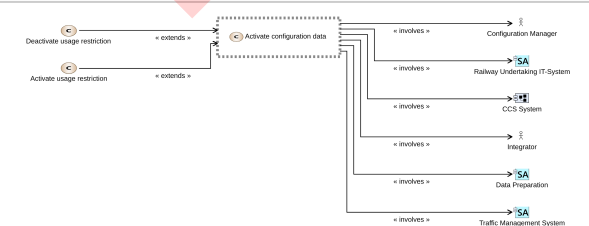
Figure 57 Diagram [SAB] Close train doors [Control loop]

ID	SPMS-6921
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2.1.2.14 Activate configuration data

2.1.2.14-1 - Activate configuration data

This capability enables the import and update SPT2TS-127779 - Configuration Data, including steps such as preloading, deactivation, and activation within the CCS system. In addition, it provides a mechanism to distribute new configuration data across different system levels in a consistent and controlled manner. This capability is extended by Activate usage restriction and Deactivate usage restriction capabilities when handling configuration updates related to infrastructure side.

ID	SPMS-2428
Context Diagram	 <p>Figure 58 Context Diagram of Activate configuration data</p>
Involved entities	<ul style="list-style-type: none"> SPMS-2088 - Data Preparation SPMS-2097 - Traffic Management System SPMS-2098 - CCS System SPMS-2103 - Configuration Manager SPMS-5084 - Railway Undertaking IT-System SPMS-6240 - Integrator

2.1.2.14-2 - Activate configuration data (Infrastructure Data)

This scenario describes the sequence of functions related to each other to activate a new set of configuration data (infrastructure data) within the  SPMS-2098 - CCS System.

DRAFT

The figure below provides an overview of *Activate configuration data (Infrastructure Data)*.

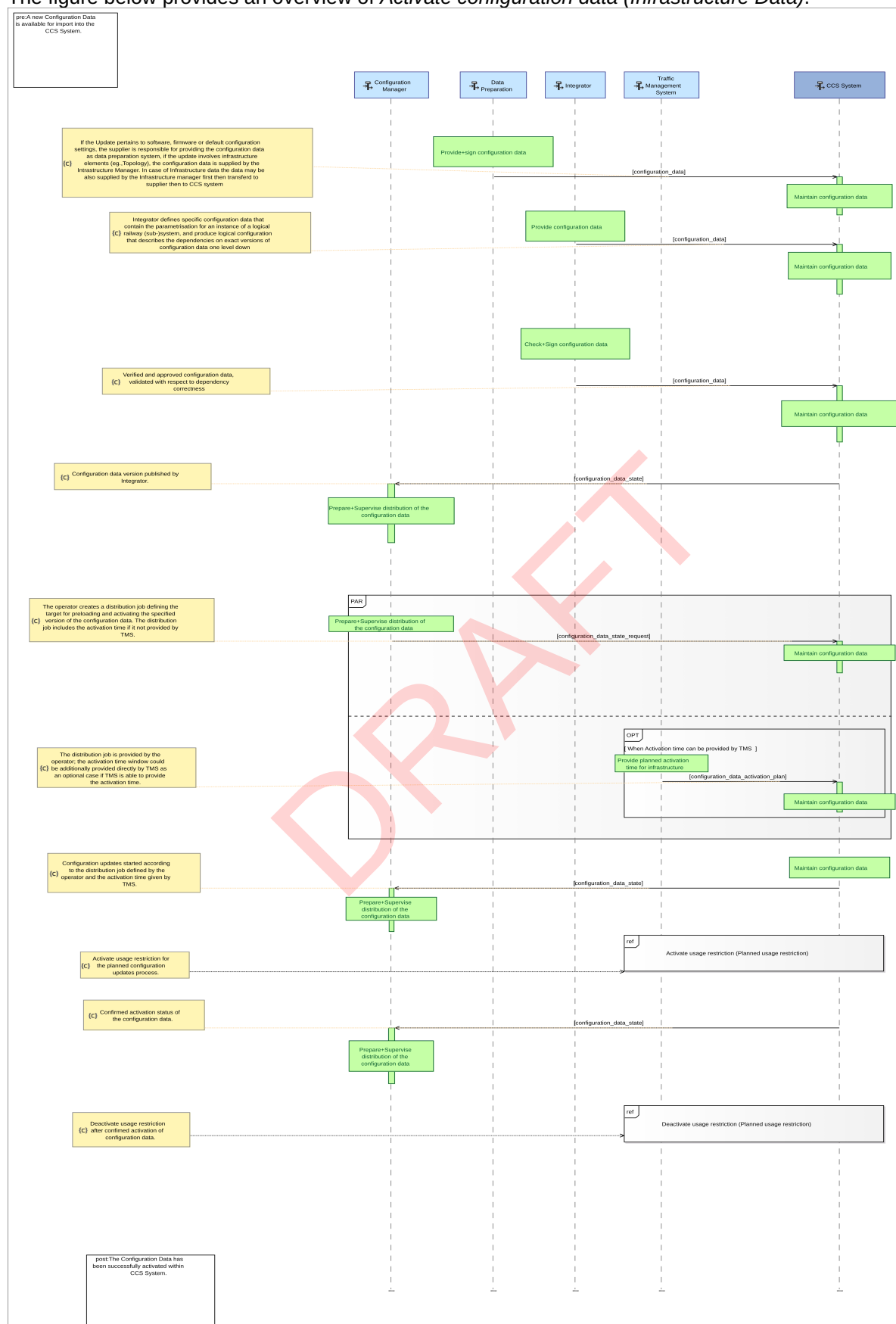


Figure 59 Diagram [SES] Activate configuration data (Infrastructure Data) [Exchange scenario]

ID	SPMS-4331
Pre Condition	A new Configuration Data is available for import into the CCS System.
Post Condition	The Configuration Data has been successfully activated within CCS System.

2.1.2.14-3 - Activate configuration data (Vehicle Data)

This scenario describes the sequence of functions related to each other to activate a new set of configuration data (vehicle data) within the CCS System.

DRAFT

The figure below provides an overview of *Activate configuration data (Vehicle Data)*.

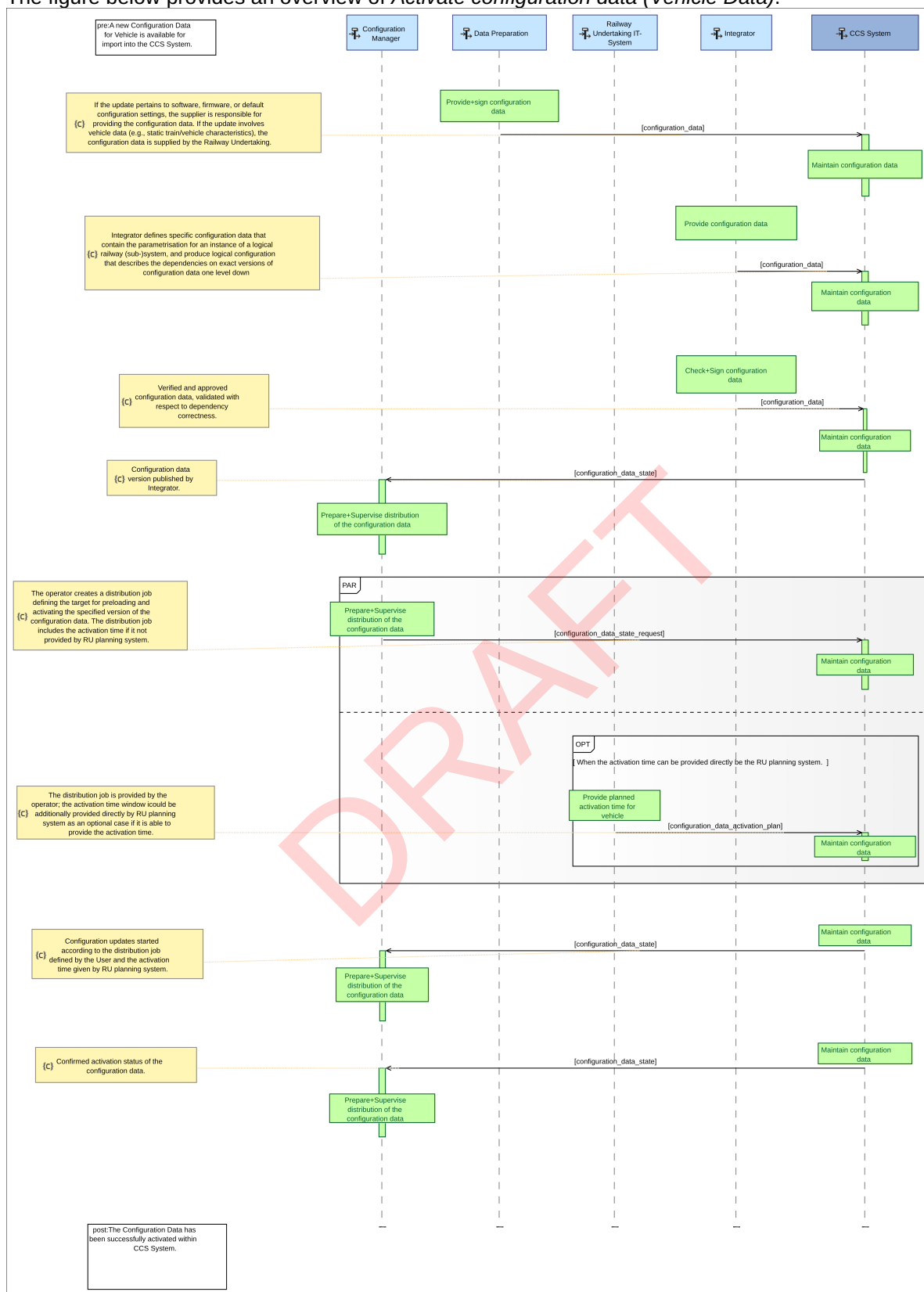


Figure 60 Diagram [SES] Activate configuration data (Vehicle data) [Exchange scenario]

ID

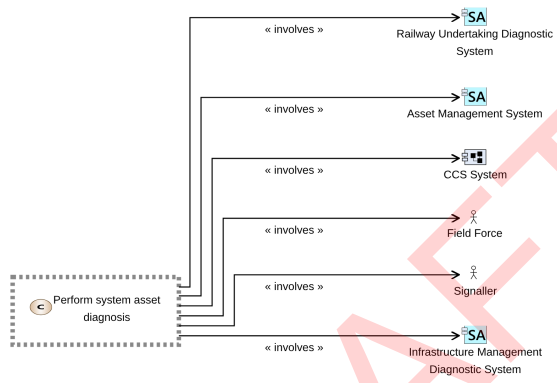






SPMS-5968

Pre Condition	A new Configuration Data for Vehicle is available for import into the CCS System.
Post Condition	The Configuration Data has been successfully activated within CCS System.


2.1.2.15 Perform system asset diagnosis

2.1.2.15-1 - Perform system asset diagnosis

This capability enables the continuous monitoring and health assessment of assets within the CCS system. It involves supervision of asset conditions and performance to detect degradation, faults, or anomalies. The system evaluates diagnostic and monitoring data to determine asset health status and provides insights to relevant stakeholders.

ID	SPMS-2435
Context Diagram	 <p>The context diagram shows the 'Perform system asset diagnosis' use case (represented by a circle with a 'C') interacting with six external systems. Each interaction is labeled with '« involves »'. The systems are: Railway Undertaking Diagnostic System, Asset Management System, CCS System, Field Force, Signaller, and Infrastructure Management Diagnostic System. Each system is represented by a specific icon: a train for the Railway Undertaking Diagnostic System, a gear for the Asset Management System, a computer monitor for the CCS System, a person for the Field Force, a person with a signal for the Signaller, and a train for the Infrastructure Management Diagnostic System.</p> <p><i>Figure 61 Context Diagram of Perform system asset diagnosis</i></p>
Involved entities	<ul style="list-style-type: none"> •  SPMS-2090 - Signaller •  SPMS-2098 - CCS System •  SPMS-6160 - Field Force •  SPMS-6202 - Infrastructure Management Diagnostic System •  SPMS-6203 - Railway Undertaking Diagnostic System •  SPMS-6204 - Asset Management System

2.1.2.15-2 - Perform system asset diagnosis

This scenario describes the sequence of functions related to each other to monitor and evaluate state of a  SPMS-2098 - CCS System asset.

The figure below provides an overview of *Perform system asset diagnosis*.

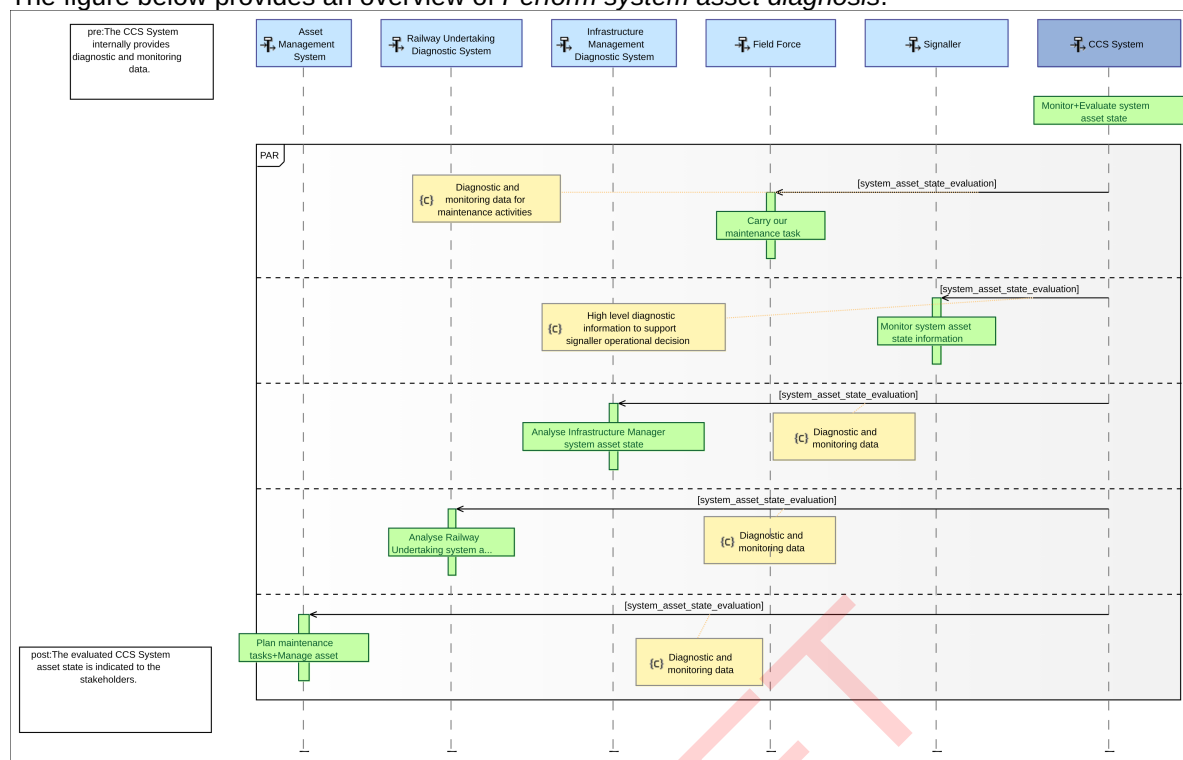


Figure 62 Diagram [SES] Perform system asset diagnosis [Exchange scenario]

ID	SPMS-4343
Pre Condition	The CCS System internally provides diagnostic and monitoring data.
Post Condition	The evaluated CCS System asset state is indicated to the stakeholders.

2.1.2.15-3 - Perform system asset diagnosis

This functional chain describes the sequence of functions related to each other to monitor and evaluate malfunctions of a SPMS-2098 - CCS System asset.

The figure below provides an overview of *Perform system asset diagnosis*.

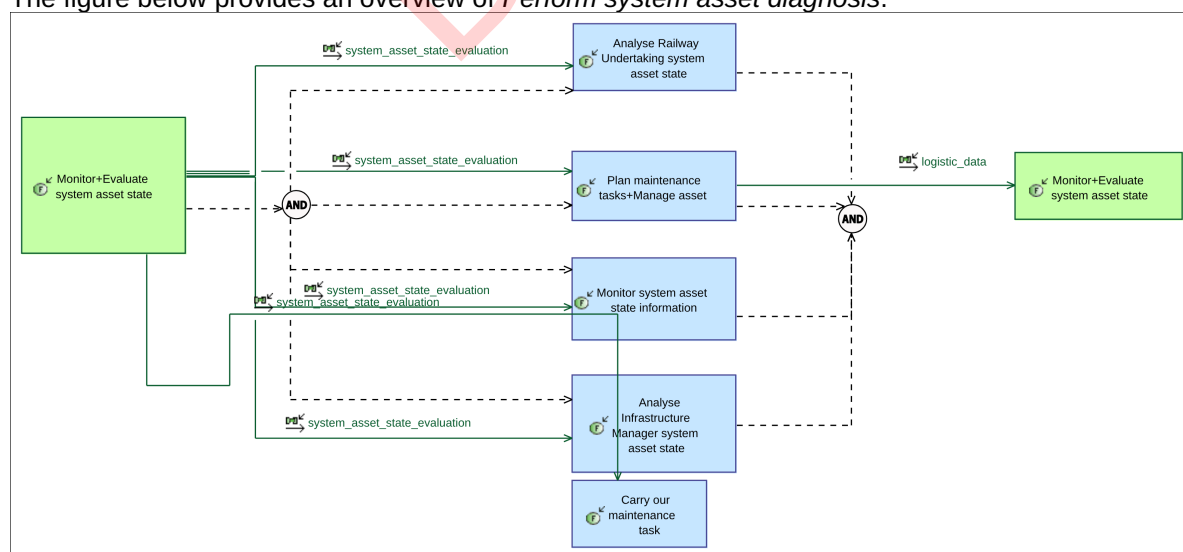








Figure 63 Diagram [SFCD] Perform system asset diagnosis [Functional chain description]

ID	SPMS-4439
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Pre Condition	The CCS System internally provides diagnostic and monitoring data.
Post Condition	The evaluated CCS System asset state is indicated to the stakeholders.
Involved Functions	<ul style="list-style-type: none"> •  SPMS-2111 - Plan maintenance tasks+Manage asset •  SPMS-2121 - Monitor+Evaluate system asset state •  SPMS-6206 - Analyse Infrastructure Manager system asset state •  SPMS-6207 - Analyse Railway Undertaking system asset state •  SPMS-6482 - Monitor system asset state information •  SPMS-7317 - Carry out maintenance task

2.1.3 Mission profiles

2.1.3.1 Operating assumptions

Will be provided in further release.

2.1.3.2 Operating factors

Will be provided in further release.

2.1.3.3 Reference mission profile(s)

Will be provided in further release.

2.1.3.4 Long term maintenance strategy and conditions

Will be provided in further release.

2.1.4 System states

Will be provided in further release.

2.2 System Interfaces

2.1.1 - System description shows the CCS System and its interfaces with external actors.




2.2.1 Interfaces and interactions with physical environment














Will be provided in a future release.

2.2.2 Interfaces and interactions with human actors




This section describes the human actors of the CCS System and the interfaces of the CCS System to these actors.

2.2.2-2 - HMI_Signaller

The interface  SPMS-2198 - HMI_Signaller connects  SPMS-2090 - Signaller with  SPMS-2098 - CCS System.




































ID	SPMS-2198
Exchange items	<ul style="list-style-type: none"> •  SPMS-2372 - movement_permission •  SPMS-2386 - point_position_request •  SPMS-2392 - train_motion_state_observation •  SPMS-2398 - usage_restriction_status •  SPMS-2407 - usage_restriction_request •  SPMS-2418 - track_path_request •  SPMS-4826 - usage_restriction_confirmation •  SPMS-4827 - usage_restriction_confirmation_request •  SPMS-5288 - point_status •  SPMS-6233 - system_asset_state_evaluation •  SPMS-6466 - configuration_data_state •  SPMS-6514 - voice_information_exchange •  SPMS-7137 - unconditional_emergency_stop_request

2.2.2-3 - DMI_Driver_Machine_Interface




The interface  SPMS-2204 - DMI_Driver_Machine_Interface connects  SPMS-2098 - CCS System with  SPMS-2096 - Driver.


This interface needs to be according to ERA_ERTMS_015560 (https://www.era.europa.eu/system/files/2023-12/index006_-_ERA_ERTMS_015560_v400.zip).

ID	SPMS-2204
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Exchange items	<ul style="list-style-type: none"> •  SPMS-2371 - train_data •  SPMS-2373 - permitted_speed •  SPMS-2375 - target_distance •  SPMS-2400 - current_speed •  SPMS-2406 - driver_ID •  SPMS-2408 - driving_information •  SPMS-2409 - stopping_point_information •  SPMS-2414 - train_running_number •  SPMS-3868 - automatic_driving_state_authorisation •  SPMS-3869 - automatic_driving_state_indication •  SPMS-6514 - voice_information_exchange •  SPMS-6602 - on_sight_acknowledgement •  SPMS-6691 - permission_request •  SPMS-6693 - on_sight_acknowledgement_request •  SPMS-6873 - functional_number_deregistration_request •  SPMS-6928 - text_message •  SPMS-6966 - functional_number_deregistration_confirmation •  SPMS-7109 - trip_acknowledgement •  SPMS-7110 - trip_acknowledgement_request •  SPMS-7111 - train_data_validation •  SPMS-7159 - list_of_balise_staff_responsible •  SPMS-7160 - staff_responsible_acknowledgement •  SPMS-7161 - staff_responsible_acknowledgement_request •  SPMS-7168 - ETCS_level_request •  SPMS-7169 - ETCS_level •  SPMS-7170 - radio_network_request •  SPMS-7171 - contact_RBC •  SPMS-7174 - radio_network_id •  SPMS-7175 - RBC_data_request •  SPMS-7176 - communication_session_not_established •  SPMS-7177 - ETCS_mode •  SPMS-7216 - virtual_balise_cover •  SPMS-7227 - functional_number_registration_request •  SPMS-7228 - functional_number_registration_confirmation •  SPMS-7237 - permission_request_available
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2.2.2-4 - HMI_FieldForce

The interface  SPMS-2199 - HMI_FieldForce connects  SPMS-6160 - Field Force with  SPMS-2098 - CCS System.




ID	SPMS-2199
Exchange items	<ul style="list-style-type: none"> •  SPMS-6233 - system_asset_state_evaluation

2.2.2-5 - HMI_ConfigurationManager

The interface  SPMS-2206 - HMI_ConfigurationManager connects  SPMS-2103 - Configuration Manager with  SPMS-2098 - CCS System.

ID	SPMS-2206
Exchange items	<ul style="list-style-type: none"> ▶ SPMS-6466 - configuration_data_state ▶ SPMS-6467 - configuration_data_state_request

2.2.2-6 - HMI_Integrator




The interface  SPMS-6516 - HMI_Integrator connects  SPMS-6240 - Integrator with  SPMS-2098 - CCS System.

ID	SPMS-6516
Exchange items	<ul style="list-style-type: none"> ▶ SPMS-6465 - configuration_data

2.2.3 Interfaces and interactions with external systems




This section describes the external system interacting with the CCS System and the interfaces of the CCS System to these external systems.

2.2.3-1 - I_TrafficManagementSystem

The interface  SPMS-2200 - I_TrafficManagementSystem connects  SPMS-2097 - Traffic Management System with  SPMS-2098 - CCS System.




ID	SPMS-2200
Exchange items	<ul style="list-style-type: none"> ▶ SPMS-2370 - operational_plan_movement ▶ SPMS-2372 - movement_permission ▶ SPMS-2392 - train_motion_state_observation ▶ SPMS-2398 - usage_restriction_status ▶ SPMS-5288 - point_status ▶ SPMS-5548 - operational_plan_restriction ▶ SPMS-6466 - configuration_data_state ▶ SPMS-6468 - configuration_data_activation_plan

2.2.3-2 - I_PointMachine_P3







The interface  SPMS-2202 - I_PointMachine_P3 connects  SPMS-2098 - CCS System with  SPMS-2100 - Point Machine.

ID	SPMS-2202
Exchange items	<ul style="list-style-type: none"> ▶ SPMS-2377 - point_machine_movement_requirement ▶ SPMS-2381 - point_machine_position_presence




2.2.3-3 - I_SUBSET_034_119

The interface  SPMS-2197 - I_SUBSET_034_119 connects  SPMS-2098 - CCS System with  SPMS-2094 - Rolling Stock Operation System.









This interface needs to be according to https://www.era.europa.eu/system/files/2023-09/index081_-_SUBSET-119_v400.pdf.

ID	SPMS-2197
Exchange items	<ul style="list-style-type: none"> •  SPMS-2378 - emergency_brake_command •  SPMS-2380 - service_brake_command •  SPMS-2382 - traction_cut_off_command •  SPMS-2385 - cab_status •  SPMS-6872 - main_power •  SPMS-6990 - station_platform




2.2.3-4 - I_SUBSET_139





The interface  SPMS-2195 - I_SUBSET_139 connects  SPMS-2098 - CCS System with  SPMS-2094 - Rolling Stock Operation System.

This interface needs to be according to https://www.era.europa.eu/system/files/2023-09/index088_-_SUBSET-139_v100.pdf.



ID	SPMS-2195
Exchange items	<ul style="list-style-type: none"> •  SPMS-2393 - relative_traction_brake_request •  SPMS-2394 - traction_applied •  SPMS-2395 - traction_brake_set_value •  SPMS-2396 - traction_request •  SPMS-2397 - automatic_door_state_request •  SPMS-2405 - door_state •  SPMS-5481 - brake_request •  SPMS-5482 - brake_applied


2.2.3-5 - I_RollingStockReferencePoint

The interface  SPMS-2196 - I_RollingStockReferencePoint connects  SPMS-2091 - Rolling Stock Reference Point with  SPMS-2098 - CCS System.




ID	SPMS-2196
Exchange items	<ul style="list-style-type: none"> •  SPMS-6519 - actual_acceleration •  SPMS-6520 - actual_geographical_coordinate •  SPMS-6521 - actual_position_and_direction •  SPMS-6522 - actual_velocity


2.2.3-6 - I_Wheel

The interface  SPMS-2201 - I_Wheel connects  SPMS-2101 - Wheel with  SPMS-2098 - CCS System.




ID	SPMS-2201
Exchange items	<ul style="list-style-type: none">  SPMS-6523 - actual_wheel_passing


2.2.3-7 - I_DataPreparation

The interface  SPMS-2205 - I_DataPreparation connects  SPMS-2088 - Data Preparation with  SPMS-2098 - CCS System.




ID	SPMS-2205
Exchange items	<ul style="list-style-type: none">  SPMS-6465 - configuration_data



2.2.3-8 - I_RailwayUndertakingITSystem

The interface  SPMS-5133 - I_RailwayUndertakingITSystem connects  SPMS-2098 - CCS System with  SPMS-5084 - Railway Undertaking IT-System.




ID	SPMS-5133
Exchange items	<ul style="list-style-type: none">  SPMS-6468 - configuration_data_activation_plan

2.2.3-9 - I_AssetManagementSystem

The interface  SPMS-6229 - I_AssetManagementSystem connects  SPMS-2098 - CCS System with  SPMS-6204 - Asset Management System.




ID	SPMS-6229
Exchange items	<ul style="list-style-type: none">  SPMS-6233 - system_asset_state_evaluation  SPMS-6464 - logistic_data

2.2.3-10 - I_InfrastructureManagementDiagnosticSystem

The interface  SPMS-6230 - I_InfrastructureManagementDiagnosticSystem connects  SPMS-2098 - CCS System with  SPMS-6202 - Infrastructure Management Diagnostic System.




ID	SPMS-6230
Exchange items	<ul style="list-style-type: none"> ▶ SPMS-6233 - system_asset_state_evaluation

2.2.3-11 - I_RailwayUndertakingDiagnosticSystem

The interface  SPMS-6231 - I_RailwayUndertakingDiagnosticSystem connects  SPMS-2098 - CCS System with  SPMS-6203 - Railway Undertaking Diagnostic System.

ID	SPMS-6231
Exchange items	<ul style="list-style-type: none"> ▶ SPMS-6233 - system_asset_state_evaluation


2.2.3-12 - I_TimeReference

The interface  SPMS-6266 - I_TimeReference connects  SPMS-6265 - Time Reference with  SPMS-2098 - CCS System.

ID	SPMS-6266
Exchange items	<ul style="list-style-type: none"> ▶ SPMS-2412 - time_reference

2.3 System functions

2.3.1 Functional overview

 SPMS-4430 shows the allocation of functions to the CCS System and to the external systems and human actors.

[SAB] CCS System [Function allocation]

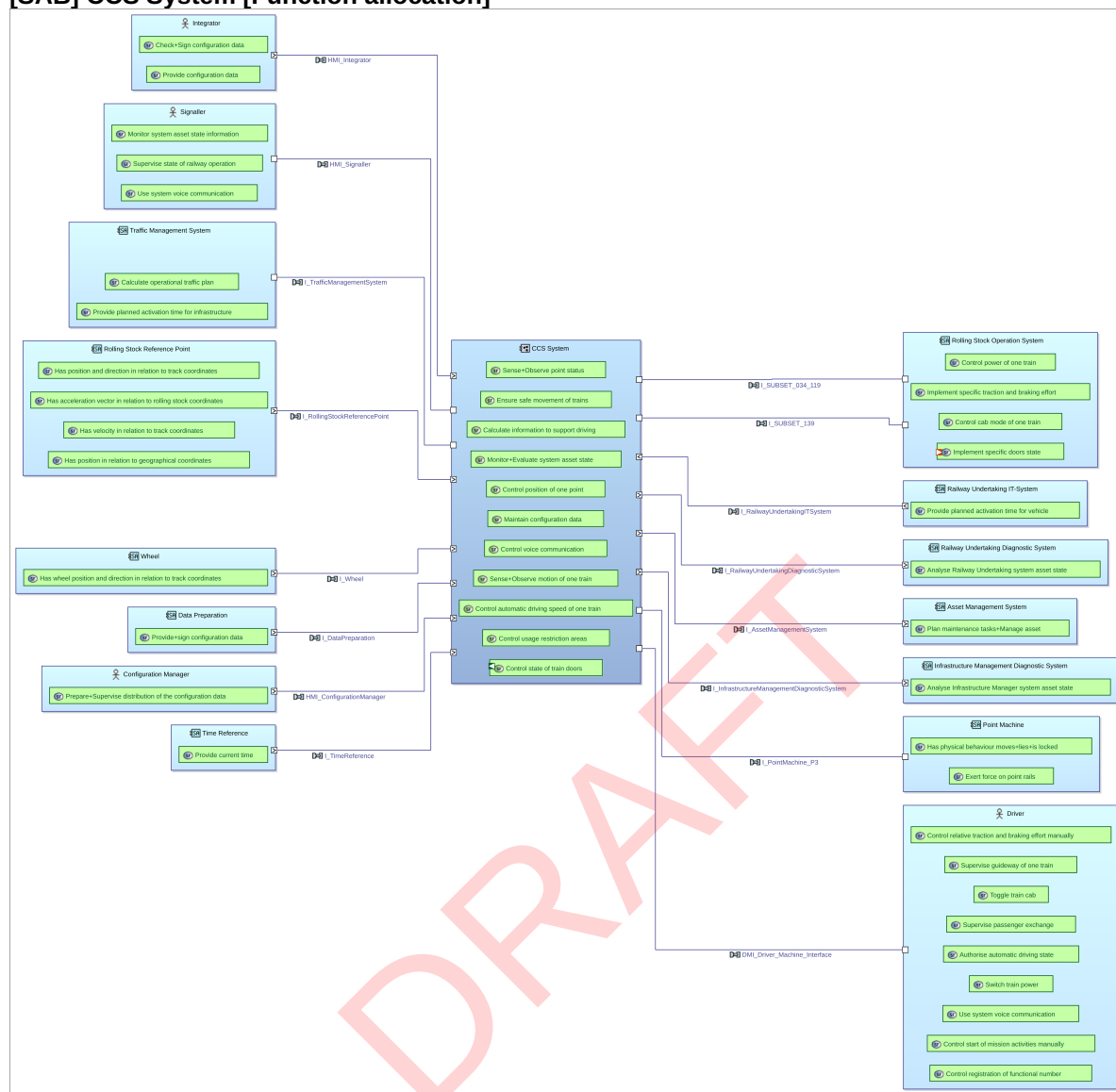


Figure 64 Diagram [SAB] CCS System [Function allocation]

ID	SPMS-4430
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2.3.2 Functions in the scope of the system under consideration













This section describes the functions allocated to the CCS System (system under consideration).






































2.3.2-1 - Sense+Observe motion of one train

This function is allocated to SPMS-2098 - CCS System.

This function senses the following states of one train: power on/off, cab activated/not activated.

This function senses the passing of one wheel by infrastructure reference location, the passing of one infrastructure reference location by one train reference point and the motions parameters speed and acceleration. In order to derive an observation of the estimated motion of the train. This includes the occupation of track and all of its relevant navigation parameters, such as speed and acceleration.

ID	SPMS-2192																						
Context Diagram	<div></div> <p>Figure 65 Context Diagram of Sense+Observe motion of one train</p>																						
Input exchanges	<table><tr><th>Input exchanges</th><th>Source function</th><th>Function allocated to</th></tr><tr><td><div> SPMS-2244 - Actual wheel passing<ul style="list-style-type: none"> SPMS-6523 - actual_wheel_passing</div></td><td><div> SPMS-2141 - Has wheel position and direction in relation to track coordinates</div></td><td><div> SPMS-2101 - Wheel</div></td></tr><tr><td><div> SPMS-2238 - Actual present geographical coordinate<ul style="list-style-type: none"> SPMS-6520 - actual_geographical_coordinate</div></td><td><div> SPMS-2135 - Has position in relation to geographical coordinates</div></td><td><div> SPMS-2091 - Rolling Stock Reference Point</div></td></tr><tr><td><div> SPMS-2239 - Actual present position and direction<ul style="list-style-type: none"> SPMS-6521 - actual_position_and_direction</div></td><td><div> SPMS-2138 - Has position and direction in relation to track coordinates</div></td><td><div> SPMS-2091 - Rolling Stock Reference Point</div></td></tr><tr><td><div> SPMS-2234 - Actual acceleration<ul style="list-style-type: none"> SPMS-6519 - actual_acceleration</div></td><td><div> SPMS-2127 - Has acceleration vector in relation to rolling stock coordinates</div></td><td><div> SPMS-2091 - Rolling Stock Reference Point</div></td></tr><tr><td><div> SPMS-2243 - Actual velocity<ul style="list-style-type: none"> SPMS-6522 - actual_velocity</div></td><td><div> SPMS-2140 - Has velocity in relation to track coordinates</div></td><td><div> SPMS-2091 - Rolling Stock Reference Point</div></td></tr><tr><td><div> SPMS-7178 - Provided driver information<ul style="list-style-type: none"> SPMS-2371 - train_data SPMS-2414 - train_running_number SPMS-7169 - ETCS_level SPMS-7111 - train_data_validation</div></td><td><div> SPMS-2126 - Control start of mission activities manually</div></td><td><div> SPMS-2096 - Driver</div></td></tr></table>	Input exchanges	Source function	Function allocated to	<div> SPMS-2244 - Actual wheel passing<ul style="list-style-type: none"> SPMS-6523 - actual_wheel_passing</div>	<div> SPMS-2141 - Has wheel position and direction in relation to track coordinates</div>	<div> SPMS-2101 - Wheel</div>	<div> SPMS-2238 - Actual present geographical coordinate<ul style="list-style-type: none"> SPMS-6520 - actual_geographical_coordinate</div>	<div> SPMS-2135 - Has position in relation to geographical coordinates</div>	<div> SPMS-2091 - Rolling Stock Reference Point</div>	<div> SPMS-2239 - Actual present position and direction<ul style="list-style-type: none"> SPMS-6521 - actual_position_and_direction</div>	<div> SPMS-2138 - Has position and direction in relation to track coordinates</div>	<div> SPMS-2091 - Rolling Stock Reference Point</div>	<div> SPMS-2234 - Actual acceleration<ul style="list-style-type: none"> SPMS-6519 - actual_acceleration</div>	<div> SPMS-2127 - Has acceleration vector in relation to rolling stock coordinates</div>	<div> SPMS-2091 - Rolling Stock Reference Point</div>	<div> SPMS-2243 - Actual velocity<ul style="list-style-type: none"> SPMS-6522 - actual_velocity</div>	<div> SPMS-2140 - Has velocity in relation to track coordinates</div>	<div> SPMS-2091 - Rolling Stock Reference Point</div>	<div> SPMS-7178 - Provided driver information<ul style="list-style-type: none"> SPMS-2371 - train_data SPMS-2414 - train_running_number SPMS-7169 - ETCS_level SPMS-7111 - train_data_validation</div>	<div> SPMS-2126 - Control start of mission activities manually</div>	<div> SPMS-2096 - Driver</div>	
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<div> SPMS-2244 - Actual wheel passing<ul style="list-style-type: none"> SPMS-6523 - actual_wheel_passing</div>	<div> SPMS-2141 - Has wheel position and direction in relation to track coordinates</div>	<div> SPMS-2101 - Wheel</div>																					
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<div> SPMS-2243 - Actual velocity<ul style="list-style-type: none"> SPMS-6522 - actual_velocity</div>	<div> SPMS-2140 - Has velocity in relation to track coordinates</div>	<div> SPMS-2091 - Rolling Stock Reference Point</div>																					
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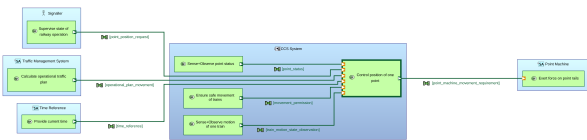




















































































Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-6660 - Estimated motion state <ul style="list-style-type: none">  SPMS-2400 - current_speed 	 SPMS-2158 - Supervise guideway of one train	 SPMS-2096 - Driver
	 SPMS-6479 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2159 - Control usage restriction areas	 SPMS-2098 - CCS System
	 SPMS-2302 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2180 - Control automatic driving speed of one train	 SPMS-2098 - CCS System
	 SPMS-2308 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2160 - Calculate information to support driving	 SPMS-2098 - CCS System
	 SPMS-2300 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2148 - Calculate operational traffic plan	 SPMS-2097 - Traffic Management System
	 SPMS-2301 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2190 - Control position of one point	 SPMS-2098 - CCS System
	 SPMS-2303 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System
	 SPMS-2336 - Estimated motion state <ul style="list-style-type: none">  SPMS-2400 - current_speed  SPMS-7177 - ETCS_mode 	 SPMS-2106 - Control relative traction and braking effort manually	 SPMS-2096 - Driver
	 SPMS-2330 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2167 - Supervise state of railway operation	 SPMS-2090 - Signaller

2.3.2-2 - Control position of one point

This function is allocated to  SPMS-2098 - CCS System.

This function determines the target position of one point for the planned movement of the train on the intended path. Furthermore, this function receives the requested point position from the Signaller and controls the point position according to this when the respective point is not allocated to an intended path.

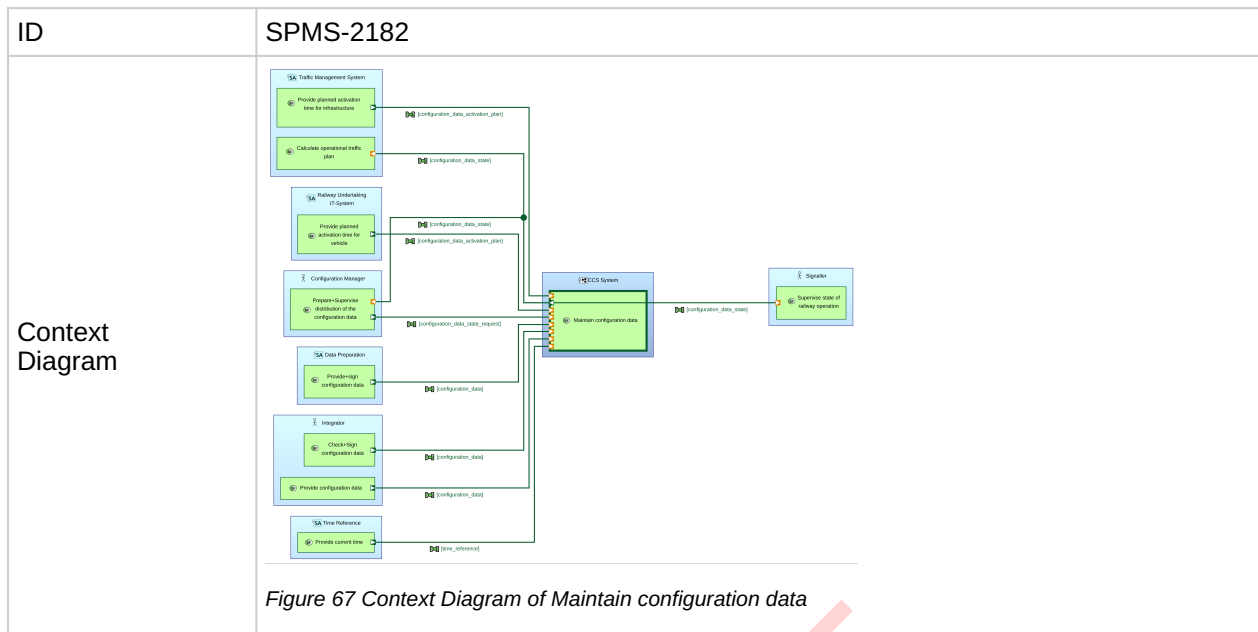
ID	SPMS-2190
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Context Diagram	<div></div> <p>Figure 66 Context Diagram of Control position of one point</p>																							
Input exchanges	<table><thead><tr><th>Input exchanges</th><th>Source function</th><th>Function allocated to</th></tr></thead><tbody><tr><td><div> SPMS-2311 - Observed point status</div><div><ul style="list-style-type: none"> SPMS-5288 - point_status</div></td><td><div> SPMS-2108 - Sense+Observe point status</div></td><td><div> SPMS-2098 - CCS System</div></td></tr><tr><td><div> SPMS-2301 - Estimated motion state</div><div><ul style="list-style-type: none"> SPMS-2392 - train_motion_state_observation</div></td><td><div> SPMS-2192 - Sense+Observe motion of one train</div></td><td><div> SPMS-2098 - CCS System</div></td></tr><tr><td><div> SPMS-2250 - Authorised distance and speed restriction</div><div><ul style="list-style-type: none"> SPMS-2372 - movement_permission</div></td><td><div> SPMS-2137 - Ensure safe movement of trains</div></td><td><div> SPMS-2098 - CCS System</div></td></tr><tr><td><div> SPMS-2258 - Provided current time</div><div><ul style="list-style-type: none"> SPMS-2412 - time_reference</div></td><td><div> SPMS-2171 - Provide current time</div></td><td><div> SPMS-6265 - Time Reference</div></td></tr><tr><td><div> SPMS-2350 - Required operational traffic plan</div><div><ul style="list-style-type: none"> SPMS-2370 - operational_plan_movement</div></td><td><div> SPMS-2148 - Calculate operational traffic plan</div></td><td><div> SPMS-2097 - Traffic Management System</div></td></tr><tr><td><div> SPMS-4628 - Requested point position</div><div><ul style="list-style-type: none"> SPMS-2386 - point_position_request</div></td><td><div> SPMS-2167 - Supervise state of railway operation</div></td><td><div> SPMS-2090 - Signaller</div></td></tr></tbody></table>	Input exchanges	Source function	Function allocated to	<div> SPMS-2311 - Observed point status</div> <div><ul style="list-style-type: none"> SPMS-5288 - point_status</div>	<div> SPMS-2108 - Sense+Observe point status</div>	<div> SPMS-2098 - CCS System</div>	<div> SPMS-2301 - Estimated motion state</div> <div><ul style="list-style-type: none"> SPMS-2392 - train_motion_state_observation</div>	<div> SPMS-2192 - Sense+Observe motion of one train</div>	<div> SPMS-2098 - CCS System</div>	<div> SPMS-2250 - Authorised distance and speed restriction</div> <div><ul style="list-style-type: none"> SPMS-2372 - movement_permission</div>	<div> SPMS-2137 - Ensure safe movement of trains</div>	<div> SPMS-2098 - CCS System</div>	<div> SPMS-2258 - Provided current time</div> <div><ul style="list-style-type: none"> SPMS-2412 - time_reference</div>	<div> SPMS-2171 - Provide current time</div>	<div> SPMS-6265 - Time Reference</div>	<div> SPMS-2350 - Required operational traffic plan</div> <div><ul style="list-style-type: none"> SPMS-2370 - operational_plan_movement</div>	<div> SPMS-2148 - Calculate operational traffic plan</div>	<div> SPMS-2097 - Traffic Management System</div>	<div> SPMS-4628 - Requested point position</div> <div><ul style="list-style-type: none"> SPMS-2386 - point_position_request</div>	<div> SPMS-2167 - Supervise state of railway operation</div>	<div> SPMS-2090 - Signaller</div>		
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Output exchanges	<table><thead><tr><th>Output exchanges</th><th>Target function</th><th>Function allocated to</th></tr></thead><tbody><tr><td><div> SPMS-2361 - Required point machine movement</div><div><ul style="list-style-type: none"> SPMS-2377 - point_machine_movement_requirement</div></td><td><div> SPMS-2125 - Ensure point machine movement</div></td><td><div> SPMS-2100 - Point Machine</div></td></tr></tbody></table>	Output exchanges	Target function	Function allocated to	<div> SPMS-2361 - Required point machine movement</div> <div><ul style="list-style-type: none"> SPMS-2377 - point_machine_movement_requirement</div>	<div> SPMS-2125 - Ensure point machine movement</div>	<div> SPMS-2100 - Point Machine</div>																	
Output exchanges	Target function	Function allocated to																						
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2.3.2-3 - Maintain configuration data

This function is allocated to  SPMS-2098 - CCS System.

This function refers to the continuous process of managing, updating, and maintaining (including functionalities like preloading and activation) the configuration data of CCS system.



Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2339 - Planned activation time <ul style="list-style-type: none">  SPMS-6468 - configuration_data_activation_plan 	 SPMS-2131 - Provide planned activation time for infrastructure	 SPMS-2097 - Traffic Management
	 SPMS-2209 - Required state of configuration data <ul style="list-style-type: none">  SPMS-6467 - configuration_data_state_request 	 SPMS-2129 - Prepare+Supervise distribution of the configuration data	 SPMS-2103 - Configuration
	 SPMS-4587 - Provided current time <ul style="list-style-type: none">  SPMS-2412 - time_reference 	 SPMS-2171 - Provide current time	 SPMS-6265 - Time Reference
	 SPMS-6244 - Configuration data <ul style="list-style-type: none">  SPMS-6465 - configuration_data 	 SPMS-6241 - Check+Sign configuration data	 SPMS-6240 - Integrator
	 SPMS-6445 - Configuration data <ul style="list-style-type: none">  SPMS-6465 - configuration_data 	 SPMS-2128 - Provide+sign configuration data	 SPMS-2088 - Data Preparation
	 SPMS-6524 - Configuration data <ul style="list-style-type: none">  SPMS-6465 - configuration_data 	 SPMS-6518 - Provide configuration data	 SPMS-6240 - Integrator
	 SPMS-6579 - Planned activation time <ul style="list-style-type: none">  SPMS-6468 - configuration_data_activation_plan 	 SPMS-6570 - Provide planned activation time for vehicle	 SPMS-5084 - Railway Under

	Output exchanges	Target function	Function allocated to
Output exchanges	SPMS-2242 - Actual state of configuration data <ul style="list-style-type: none"> SPMS-6466 - configuration_data_state 	SPMS-2129 - Prepare+Supervise distribution of the configuration data	SPMS-2103 - Configuration Manager
	SPMS-6037 - Actual state of configuration data <ul style="list-style-type: none"> SPMS-6466 - configuration_data_state 	SPMS-2167 - Supervise state of railway operation	SPMS-2090 - Signaller
	SPMS-6038 - Actual state of configuration data <ul style="list-style-type: none"> SPMS-6466 - configuration_data_state 	SPMS-2148 - Calculate operational traffic plan	SPMS-2097 - Traffic Management System

2.3.2-4 - Control automatic driving speed of one train

This function is allocated to SPMS-2098 - CCS System.

This function manages the automatic driving mode of one train by determining the driving speed and controlling the required traction and brake effort. It is designed to operate at Grades of Automation (GoA) higher than GoA 1, ensuring efficient train operations.

The function transitions through the following states See Subset-125 chapter 9):

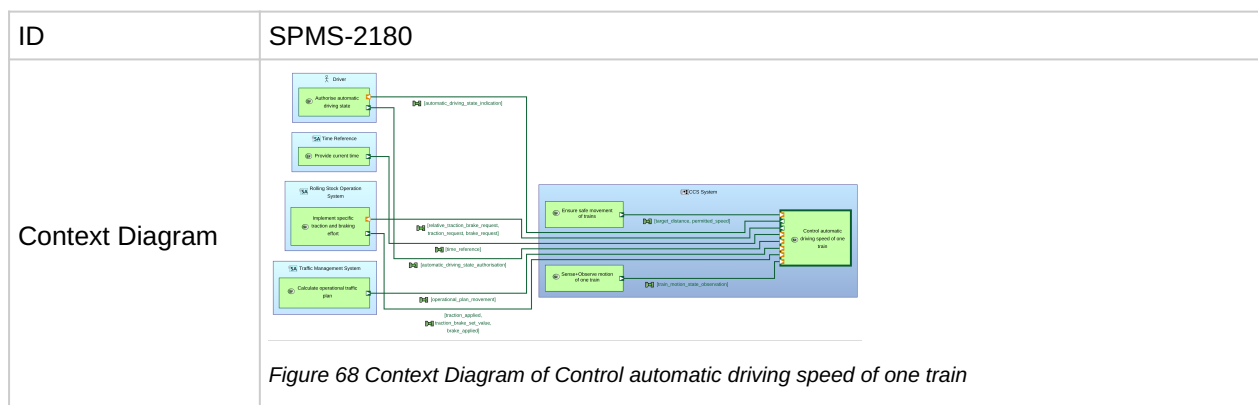
Available: Available to be used but is not actively controlling the train.






































Ready for engagement: All conditions are fulfilled

Engaged: The driver engaged the automatic driving and the function actively controlling the train's speed and the required traction and braking forces.

Disengaging: The system is in the process of transferring control back to the driver.

When the driver engages this function to initiate automatic driving, the system autonomously manages the train's speed and traction/brake efforts, optimizing for efficiency under the specified automation grade. To be checked if input is missing regarding current state of emergency brakes as required by Subset 125 Ch. 9.1.1.1.

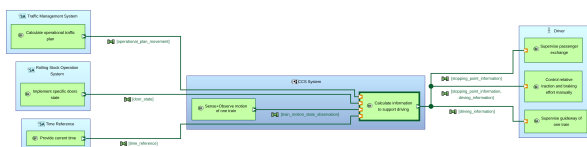































Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2225 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-2375 - target_distance  SPMS-2373 - permitted_speed 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System
	 SPMS-2302 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System
	 SPMS-2245 - Applied level of traction and brake effort <ul style="list-style-type: none">  SPMS-2394 - traction_applied  SPMS-2395 - traction_brake_set_value  SPMS-5482 - brake_applied 	 SPMS-2146 - Implement specific traction and braking effort	 SPMS-2094 - Rolling Stock
	 SPMS-2360 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2148 - Calculate operational traffic plan	 SPMS-2097 - Traffic Manag
	 SPMS-2247 - Authorised automatic driving state <ul style="list-style-type: none">  SPMS-3868 - automatic_driving_state_authorisation 	 SPMS-2134 - Authorise automatic driving state	 SPMS-2096 - Driver
	 SPMS-2260 - Provided current time <ul style="list-style-type: none">  SPMS-2412 - time_reference 	 SPMS-2171 - Provide current time	 SPMS-6265 - Time Referen
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2365 - Required relative traction and brake effort <ul style="list-style-type: none">  SPMS-2393 - relative_traction_brake_request  SPMS-2396 - traction_request  SPMS-5481 - brake_request 	 SPMS-2146 - Implement specific traction and braking effort	 SPMS-2094 - Rolling Stock O
	 SPMS-2321 - Indicated automatic driving state <ul style="list-style-type: none">  SPMS-3869 - automatic_driving_state_indication 	 SPMS-2134 - Authorise automatic driving state	 SPMS-2096 - Driver

2.3.2-5 - Calculate information to support driving

This function is allocated to  SPMS-2098 - CCS System.

This function calculates and provides supporting information to the driver to help him driving the train and opening the doors (e.g. remaining departure time, approaching a stopping point, stopping accuracy).

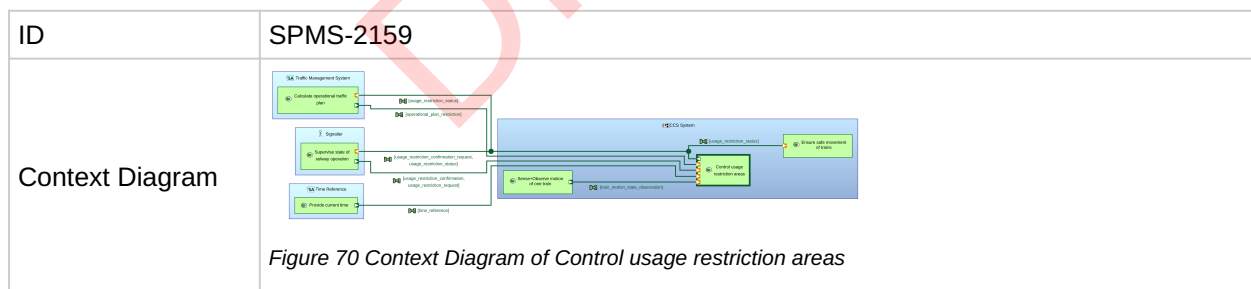
ID	SPMS-2160		
Context Diagram	 <p>The context diagram shows the function 'Calculate information to support driving' (SF) as a central component. It receives inputs from 'Traffic Management System' (SF), 'Rolling Stock Operation System' (SF), and 'Time Reference' (SF). It provides outputs to 'Driver' (Actor), 'Train' (Actor), and 'Rolling Stock Operation System' (SF). The diagram includes various data flows and control flows between these components.</p>		
	Figure 69 Context Diagram of Calculate information to support driving		
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2354 - Required operational traffic plan <ul style="list-style-type: none"> SPMS-2370 - operational_plan_movement	 SPMS-2148 - Calculate operational traffic plan	 SPMS-2097 - Traffic Management System
	 SPMS-2261 - Provided current time <ul style="list-style-type: none"> SPMS-2412 - time_reference	 SPMS-2171 - Provide current time	 SPMS-6265 - Time Reference
	 SPMS-2308 - Estimated motion state <ul style="list-style-type: none"> SPMS-2392 - train_motion_state_observation	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System
	 SPMS-6515 - Observed state of doors <ul style="list-style-type: none"> SPMS-2405 - door_state	 SPMS-2114 - Implement specific doors state	 SPMS-2094 - Rolling Stock Operation System































Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2327 - Indicated supporting information <ul style="list-style-type: none"> •  SPMS-2409 - stopping_point_information •  SPMS-2408 - driving_information 	 SPMS-2106 - Control relative traction and braking effort manually	 SPMS-2096 - Driver
	 SPMS-2328 - Indicated supporting information <ul style="list-style-type: none"> •  SPMS-2408 - driving_information 	 SPMS-2158 - Supervise guideway of one train	 SPMS-2096 - Driver
	 SPMS-2329 - Indicated supporting information <ul style="list-style-type: none"> •  SPMS-2409 - stopping_point_information 	 SPMS-2177 - Supervise passenger exchange	 SPMS-2096 - Driver

2.3.2-6 - Control usage restriction areas

This function is allocated to  SPMS-2098 - CCS System.

This function stores and controls the creation and deletion of usage restriction areas. It is responsible for the activation and deactivation of planned usage restriction areas at the planned time. If necessary, it requests the Signaller confirmation before the usage restriction is activated. This function rejects any unplanned temporary speed restriction (TSR) activation request when the train has already been authorized to enter the TSR area. It changes the output state regarding a restriction based on the input request/demand to either activate or deactivate a certain usage restriction. It keeps and shows a record of the activated usage restriction areas.



Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2357 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-5548 - operational_plan_restriction 	 SPMS-2148 - Calculate operational traffic plan	 SPMS-2097 - Traffic Management System
	 SPMS-4728 - Provided current time <ul style="list-style-type: none">  SPMS-2412 - time_reference 	 SPMS-2171 - Provide current time	 SPMS-6265 - Time Reference
	 SPMS-4824 - Provided usage restriction state <ul style="list-style-type: none">  SPMS-4826 - usage_restriction_confirmation  SPMS-2407 - usage_restriction_request 	 SPMS-2167 - Supervise state of railway operation	 SPMS-2090 - Signaller
Output exchanges	 SPMS-6479 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System
	 SPMS-2216 - Usage restriction state <ul style="list-style-type: none">  SPMS-2398 - usage_restriction_status 	 SPMS-2137 - Sense+Observe motion of one train	 SPMS-2098 - CCS System
	 SPMS-2215 - Usage restriction state <ul style="list-style-type: none">  SPMS-2398 - usage_restriction_status 	 SPMS-2148 - Calculate operational traffic plan	 SPMS-2097 - Traffic Management System
	 SPMS-2219 - Usage restriction state <ul style="list-style-type: none">  SPMS-4827 - usage_restriction_confirmation_request  SPMS-2398 - usage_restriction_status 	 SPMS-2167 - Supervise state of railway operation	 SPMS-2090 - Signaller

2.3.2-7 - Ensure safe movement of trains

This function is allocated to  SPMS-2098 - CCS System.

This function:

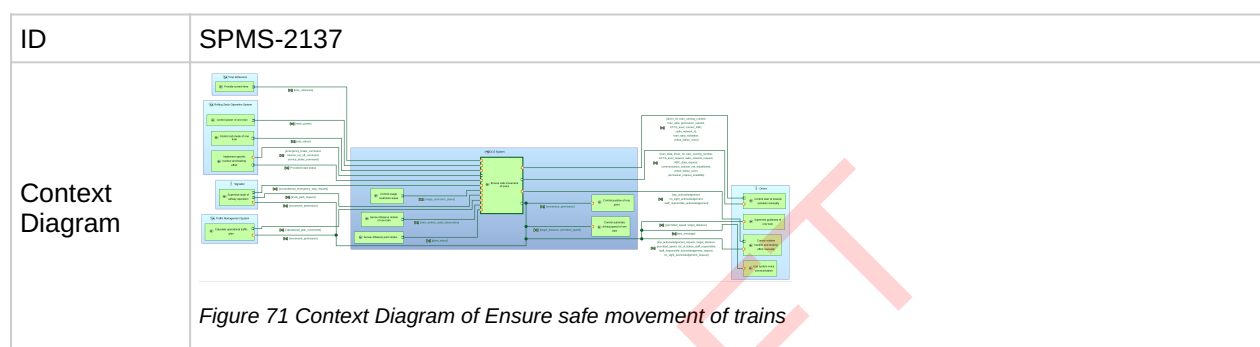
- controls the speed-and-distance-limiting speed profile over distance for trains for every moment in time, taking all safety constraints into account.















































Basic behaviour is to set speed-and-distance-limiting speed profile in a way that the train is allowed to move from its current position towards the next planned stop or a preceding train.












It determines the next section of track path that the train should be allowed to travel on and the maximum safe speed-profile along this path. One key thing to understand is that although the function produces only one speed-and-distance-limiting speed profile per train, it needs to take into account information about the whole area of control, such as the state of infrastructure elements, the speed-and-distance-limiting speed profiles of other trains (since these portions of infrastructure are already in use), temporary speed restriction (TSR) and the positions of other trains, vehicles, track workers and equipment trains. It also coordinates the use of a recently activated temporary speed restriction (TSR) to avoid a brake intervention.

There is therefore a portion of the behaviour that looks at the entire railway within the area of control.




































- ensures safe speed of one train by supervising the compliance of the train speed with the speed profiles granted to this train. If the speed-profile is about to be violated or is actually violated, an emergency brake, or a full service brake or traction cut-off reaction is required.
- supervises the train movement in case of standstill. For example it can react with emergency brake command in case of violation of the roll-away distance threshold.



Input exchanges	Input exchanges	Source function	Function allocated to	
	 SPMS-2259 - Provided current time <ul style="list-style-type: none">  SPMS-2412 - time_reference 	 SPMS-2171 - Provide current time	 SPMS-6265 - Time Reference	
	 SPMS-2310 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2108 - Sense+Observe point status	 SPMS-2098 - CCS System	
	 SPMS-2303 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System	
	 SPMS-2351 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2148 - Calculate operational traffic plan	 SPMS-2097 - Traffic Management	
	 SPMS-2347 - Requested track path <ul style="list-style-type: none">  SPMS-2418 - track_path_request 	 SPMS-2167 - Supervise state of railway operation	 SPMS-2090 - Signaller	
	 SPMS-2216 - Usage restriction state <ul style="list-style-type: none">  SPMS-2398 - usage_restriction_status 	 SPMS-2159 - Control usage restriction areas	 SPMS-2098 - CCS System	
	 SPMS-2341 - Provided driver information <ul style="list-style-type: none">  SPMS-2406 - driver_ID  SPMS-2414 - train_running_number  SPMS-2371 - train_data  SPMS-6691 - permission_request  SPMS-7169 - ETCS_level  SPMS-7171 - contact_RBC  SPMS-7174 - radio_network_id  SPMS-7111 - train_data_validation  SPMS-7216 - virtual_balise_cover 	 SPMS-2126 - Control start of mission activities manually	 SPMS-2096 - Driver	
	 SPMS-6694 - Acknowledged permission <ul style="list-style-type: none">  SPMS-7109 - trip_acknowledgement  SPMS-6602 - on_sight_acknowledgement  SPMS-7160 - staff_responsible_acknowledgement 	 SPMS-2106 - Control relative traction and braking effort manually	 SPMS-2096 - Driver	
	 SPMS-6969 - Main power status <ul style="list-style-type: none">  SPMS-6872 - main_power 	 SPMS-6817 - Control power of one train	 SPMS-2094 - Rolling Stock Control	

Input exchanges	Source function	Function allocated to
 SPMS-6978 - Reported cab status <ul style="list-style-type: none">  SPMS-2385 - cab_status 	 SPMS-2163 - Control cab mode of one train	 SPMS-2094 - Rolling Stock C
 SPMS-7094 - Requested emergency stop <ul style="list-style-type: none">  SPMS-7137 - unconditional_emergency_stop_request 	 SPMS-2167 - Supervise state of railway operation	 SPMS-2090 - Signaller
No exchange items allocated on  SPMS-7167 - Provided brake status.	 SPMS-2146 - Implement specific traction and braking effort	 SPMS-2094 - Rolling Stock C

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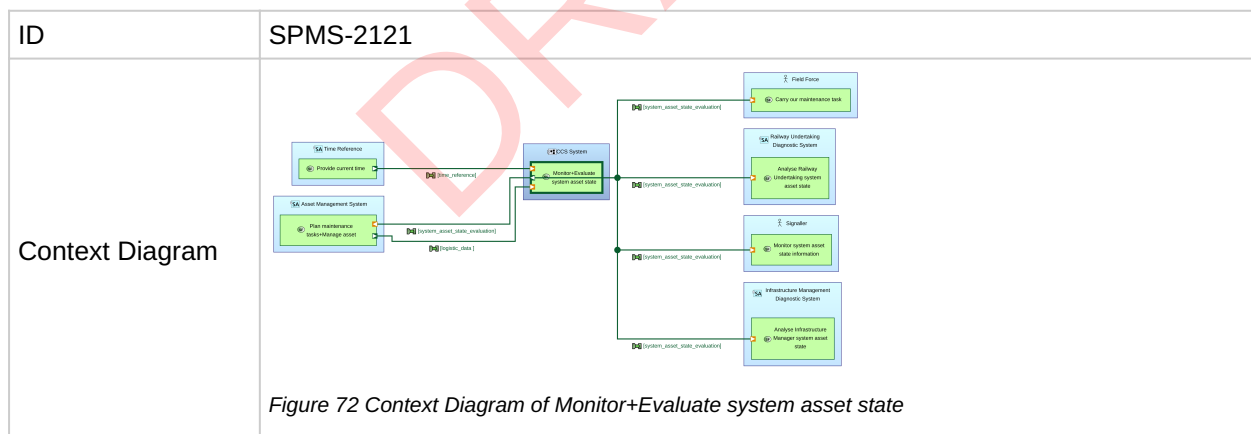
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2225 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-2375 - target_distance  SPMS-2373 - permitted_speed 	 SPMS-2180 - Control automatic driving speed of one train	 SPMS-2098 - CCS System
	 SPMS-6930 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-6928 - text_message 	 SPMS-2174 - Use system voice communication	 SPMS-2096 - Driver
	 SPMS-2249 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2148 - Calculate operational traffic plan	 SPMS-2097 - Traffic Manager
	 SPMS-2250 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2190 - Control position of one point	 SPMS-2098 - CCS System
	 SPMS-2326 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-7110 - trip_acknowledgement_request  SPMS-2375 - target_distance  SPMS-2373 - permitted_speed  SPMS-7159 - list_of_balise_staff_responsible  SPMS-7161 - staff_responsible_acknowledgement_request  SPMS-6693 - on_sight_acknowledgement_request 	 SPMS-2106 - Control relative traction and braking effort manually	 SPMS-2096 - Driver
	 SPMS-2325 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-2373 - permitted_speed  SPMS-2375 - target_distance 	 SPMS-2158 - Supervise guideway of one train	 SPMS-2096 - Driver
	 SPMS-7230 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2167 - Supervise state of railway operation	 SPMS-2090 - Signaller





























Output exchanges	Target function	Function allocated to
SPMS-2323 - Indicated start of mission data <ul style="list-style-type: none"> SPMS-2371 - train_data SPMS-2406 - driver_ID SPMS-2414 - train_running_number SPMS-7168 - ETCS_level_request SPMS-7170 - radio_network_request SPMS-7175 - RBC_data_request SPMS-7176 - communication_session_not_established SPMS-7216 - virtual_balise_cover SPMS-7237 - permission_request_available 	SPMS-2126 - Control start of mission activities manually	SPMS-2096 - Driver
SPMS-6951 - Required state of full service brake or traction cut off or emergency brake <ul style="list-style-type: none"> SPMS-2378 - emergency_brake_command SPMS-2382 - traction_cut_off_command SPMS-2380 - service_brake_command 	SPMS-2146 - Implement specific traction and braking effort	SPMS-2094 - Rolling Stock

2.3.2-8 - Monitor+Evaluate system asset state

This function is allocated to **SPMS-2098 - CCS System**.

This function monitors the CCS System assets, evaluates and displays the actual state of these assets based on the collected and aggregated diagnostic and monitoring data.



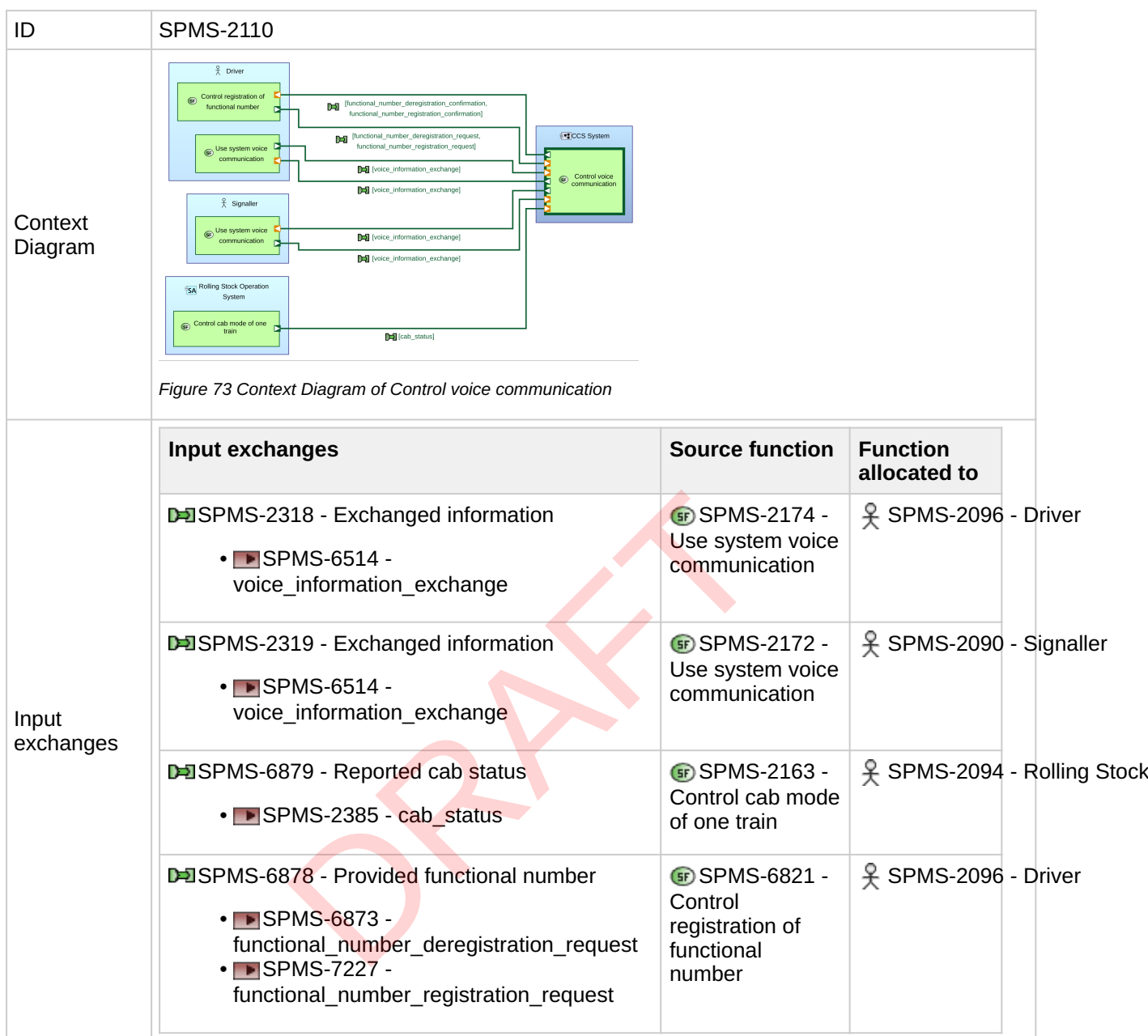
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2264 - Provided current time <ul style="list-style-type: none">  SPMS-2412 - time_reference 	 SPMS-2171 - Provide current time	 SPMS-6265 - Time Reference
	 SPMS-6242 - Logistic data <ul style="list-style-type: none">  SPMS-6464 - logistic_data 	 SPMS-2111 - Plan maintenance tasks+Manage asset	 SPMS-6204 - Asset Management System
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2296 - Evaluated system asset state <ul style="list-style-type: none">  SPMS-6233 - system_asset_state_evaluation 	 SPMS-2111 - Plan maintenance tasks+Manage asset	 SPMS-6204 - Asset Management System
	 SPMS-4496 - Evaluated system asset state <ul style="list-style-type: none">  SPMS-6233 - system_asset_state_evaluation 	 SPMS-6482 - Monitor system asset state information	 SPMS-2090 - Signaller
	 SPMS-6209 - Evaluated system asset state <ul style="list-style-type: none">  SPMS-6233 - system_asset_state_evaluation 	 SPMS-6206 - Analyse Infrastructure Manager system asset state	 SPMS-6202 - Infrastructure Management Diagnostic System
	 SPMS-6210 - Evaluated system asset state <ul style="list-style-type: none">  SPMS-6233 - system_asset_state_evaluation 	 SPMS-6207 - Analyse Railway Undertaking system asset state	 SPMS-6203 - Railway Undertaking Diagnostic System
	 SPMS-6232 - Evaluated system asset state <ul style="list-style-type: none">  SPMS-6233 - system_asset_state_evaluation 	 SPMS-7317 - Carry out maintenance task	 SPMS-6160 - Field Force














2.3.2-9 - Control voice communication

This function is allocated to  SPMS-2098 - CCS System.

This function covers all the voice communication applications needs in according to specifications referred in TSI CCS 4.2.4.2.

One part of the functionality is the registration and de-registration of the functional number. By this, it enables the activation and deactivation of the voice communication channel between driver and signaller.

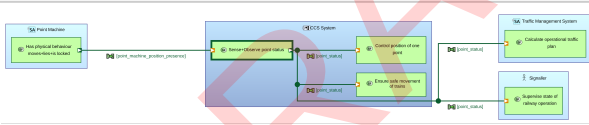






















Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-5664 - Exchanged information <ul style="list-style-type: none">  SPMS-6514 - voice_information_exchange 	 SPMS-2174 - Use system voice communication	 SPMS-2096 - Driver
	 SPMS-5665 - Exchanged information <ul style="list-style-type: none">  SPMS-6514 - voice_information_exchange 	 SPMS-2172 - Use system voice communication	 SPMS-2090 - Signaller
	 SPMS-6967 - Indicated functional number <ul style="list-style-type: none">  SPMS-6966 - functional_number_deregistration_confirmation  SPMS-7228 - functional_number_registration_confirmation 	 SPMS-6821 - Control registration of functional number	 SPMS-2096 - Driver

2.3.2-10 - Sense+Observe point status

This function is allocated to  SPMS-2098 - CCS System.

This function senses and observes the state of one point (on one or more point machines) based on the blades position of the Point.

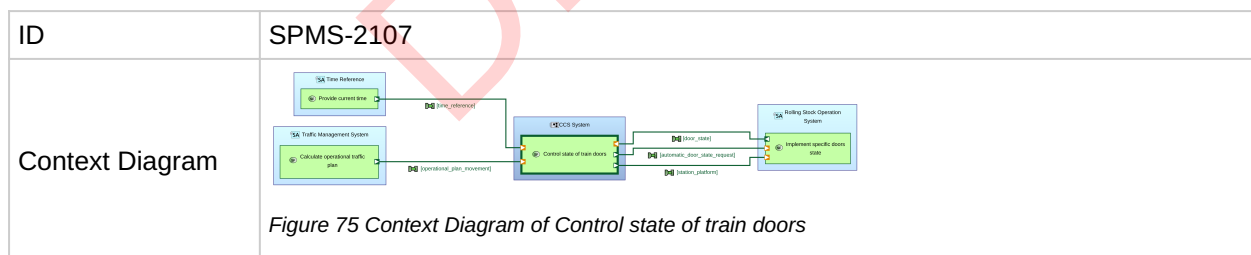
ID	SPMS-2108		
Context Diagram	 <p>Figure 74 Context Diagram of Sense+Observe point status</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2237 - Actual physical point machine position <ul style="list-style-type: none">  SPMS-2381 - point_machine_position_presence 	 SPMS-2132 - Has physical behaviour moves+lies+is locked	 SPMS-2100 - Point Machine





















Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2310 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System
	 SPMS-5329 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2148 - Calculate operational traffic plan	 SPMS-2097 - Traffic Management System
	 SPMS-2311 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2190 - Control position of one point	 SPMS-2098 - CCS System
	 SPMS-2312 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2167 - Supervise state of railway operation	 SPMS-2090 - Signaller

2.3.2-11 - Control state of train doors

This function is allocated to  SPMS-2098 - CCS System.

This function sends requests to the rolling stock to control the state of doors based on the required operational plan, which provides the required side to open (left, right, both) as well as the door opening mode (automatic - manual is covered by the function Calculate Information to support Driving) and which doors to open (depending on the platform length and train position).




Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2266 - Provided current time <ul style="list-style-type: none">  SPMS-2412 - time_reference 	 SPMS-2171 - Provide current time	 SPMS-6265 - Time Reference
	 SPMS-2316 - Observed state of doors <ul style="list-style-type: none">  SPMS-2405 - door_state 	 SPMS-2114 - Implement specific doors state	 SPMS-2094 - Rolling Stock Operation System
	 SPMS-2359 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2148 - Calculate operational traffic plan	 SPMS-2097 - Traffic Management System
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2213 - Requested state of doors <ul style="list-style-type: none">  SPMS-2397 - automatic_door_state_request 	 SPMS-2114 - Implement specific doors state	 SPMS-2094 - Rolling Stock Operation System
	 SPMS-7976 - Provided station and platform information <ul style="list-style-type: none">  SPMS-6990 - station_platform 	 SPMS-2114 - Implement specific doors state	 SPMS-2094 - Rolling Stock Operation System

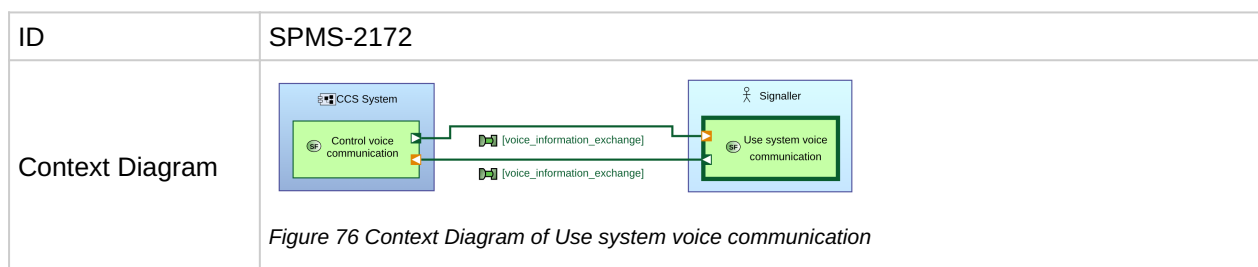
2.3.3 Functions from the surrounding systems and human actors









This section describes the functions allocated to the surrounding systems and human actors.

2.3.3-1 - Use system voice communication

This function is allocated to  SPMS-2090 - Signaller.

This function represents the need from to use the voice communication to the Driver.

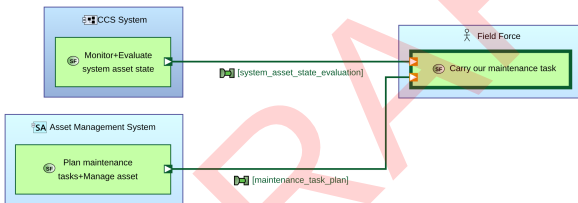










Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-5665 - Exchanged information <ul style="list-style-type: none"> •  SPMS-6514 - voice_information_exchange 	 SPMS-2110 - Control voice communication	 SPMS-2098 - CCS System
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2319 - Exchanged information <ul style="list-style-type: none"> •  SPMS-6514 - voice_information_exchange 	 SPMS-2110 - Control voice communication	 SPMS-2098 - CCS System


2.3.3-2 - Carry our maintenance task

This function is allocated to  SPMS-6160 - Field Force.

This function executes the maintenance schedule and tasks.

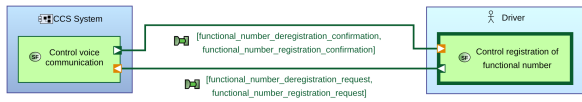










ID	SPMS-7317		
Context Diagram	 <p><i>Figure 77 Context Diagram of Carry our maintenance task</i></p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-6232 - Evaluated system asset state <ul style="list-style-type: none"> •  SPMS-6233 - system_asset_state_evaluation 	 SPMS-2121 - Monitor+Evaluate system asset state	 SPMS-2098 - CCS System
	 SPMS-2340 - Planned maintenance task <ul style="list-style-type: none"> •  SPMS-6774 - maintenance_task_plan 	 SPMS-2111 - Plan maintenance tasks+Manage asset	 SPMS-6204 - Asset Management System
Output exchanges	No outputs defined for this function.		

2.3.3-3 - Control registration of functional number


This function is allocated to  SPMS-2096 - Driver.

This function represents the registration and de-registration by the driver of the functional number in the

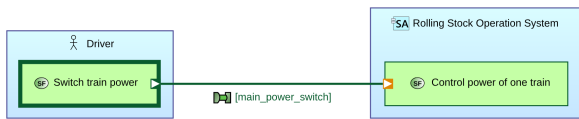
radio module.





ID	SPMS-6821		
Context Diagram	 <p>Figure 78 Context Diagram of Control registration of functional number</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-6967 - Indicated functional number <ul style="list-style-type: none">  SPMS-6966 - functional_number_deregistration_confirmation  SPMS-7228 - functional_number_registration_confirmation 	 SPMS-2110 - Control voice communication	 SPMS-2098 - CCS System
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-6878 - Provided functional number <ul style="list-style-type: none">  SPMS-6873 - functional_number_deregistration_request  SPMS-7227 - functional_number_registration_request 	 SPMS-2110 - Control voice communication	 SPMS-2098 - CCS System

2.3.3-4 - Switch train power


This function is allocated to  SPMS-2096 - Driver.

This function represents the switching on and off of the train power by the driver (via the main power switch).

ID	SPMS-6819		
Context Diagram	 <p>Figure 79 Context Diagram of Switch train power</p>		

Input exchanges	No inputs defined for this function.		
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-6876 - Required power status <ul style="list-style-type: none">  SPMS-6871 - main_power_switch 	 SPMS-6817 - Control power of one train	 SPMS-2094 - Rolling Stock Operation System










2.3.3-5 - Control power of one train

This function is allocated to  SPMS-2094 - Rolling Stock Operation System.


This function controls the main power in the operating train.

The power mode can be:

- Power-on
- Power-off.






ID	SPMS-6817		
Context Diagram	 <p>Figure 80 Context Diagram of Control power of one train</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-6876 - Required power status <ul style="list-style-type: none">  SPMS-6871 - main_power_switch 	 SPMS-6819 - Switch train power	 SPMS-2096 - Driver
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-6969 - Main power status <ul style="list-style-type: none">  SPMS-6872 - main_power 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System

2.3.3-6 - Provide planned activation time for vehicle


This function is allocated to  SPMS-5084 - Railway Undertaking IT-System.

This function manages the update of configuration data for vehicle which includes also the provision of the best point in time for the update.

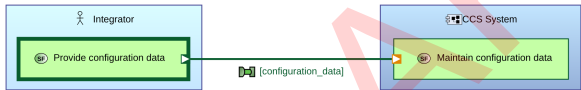




ID	SPMS-6570
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Context Diagram	 <p>Figure 81 Context Diagram of Provide planned activation time for vehicle</p>		
Input exchanges	No inputs defined for this function.		
Output exchanges	Output exchanges  SPMS-6579 - Planned activation time <ul style="list-style-type: none">  SPMS-6468 - configuration_data_activation_plan 	Target function  SPMS-2182 - Maintain configuration data	Function allocated to  SPMS-2098 - CCS System


2.3.3-7 - Provide configuration data

This function is allocated to  SPMS-6240 - Integrator.

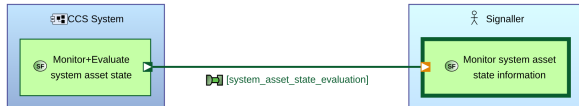












This function enables the Integrator to prepare and structure configuration data based on system dependencies.

ID	SPMS-6518		
Context Diagram	 <p>Figure 82 Context Diagram of Provide configuration data</p>		
Input exchanges	No inputs defined for this function.		
Output exchanges	Output exchanges  SPMS-6524 - Configuration data <ul style="list-style-type: none">  SPMS-6465 - configuration_data 	Target function  SPMS-2182 - Maintain configuration data	Function allocated to  SPMS-2098 - CCS System


2.3.3-8 - Monitor system asset state information

This function is allocated to  SPMS-2090 - Signaller.














This function enables the signaller to monitor the state of system assets through high-level diagnostic and monitoring data supporting awareness and decision-making without requiring technical analysis.

ID	SPMS-6482								
Context Diagram	<div></div> <p>Figure 83 Context Diagram of Monitor system asset state information</p>								
Input exchanges	<table><tr><th>Input exchanges</th><th>Source function</th><th>Function allocated to</th></tr><tr><td><div> SPMS-4496 - Evaluated system asset state<ul style="list-style-type: none"> SPMS-6233 - system_asset_state_evaluation</div></td><td><div> SPMS-2121 - Monitor+Evaluate system asset state</div></td><td><div> SPMS-2098 - CCS System</div></td></tr></table>			Input exchanges	Source function	Function allocated to	<div> SPMS-4496 - Evaluated system asset state<ul style="list-style-type: none"> SPMS-6233 - system_asset_state_evaluation</div>	<div> SPMS-2121 - Monitor+Evaluate system asset state</div>	<div> SPMS-2098 - CCS System</div>
Input exchanges	Source function	Function allocated to							
<div> SPMS-4496 - Evaluated system asset state<ul style="list-style-type: none"> SPMS-6233 - system_asset_state_evaluation</div>	<div> SPMS-2121 - Monitor+Evaluate system asset state</div>	<div> SPMS-2098 - CCS System</div>							
Output exchanges	No outputs defined for this function.								


2.3.3-9 - Check+Sign configuration data

This function is allocated to  SPMS-6240 - Integrator.

This function enables the Integrator to verify the completeness and consistency of configuration data before it is released. It ensures that all dependencies are correctly resolved. Upon successful checking, the configuration data is formally approved and signed as valid for distribution and use in the CCS system.






ID	SPMS-6241								
Context Diagram	<div></div> <p>Figure 84 Context Diagram of Check+Sign configuration data</p>								
Input exchanges	No inputs defined for this function.								
Output exchanges	<table><tr><th>Output exchanges</th><th>Target function</th><th>Function allocated to</th></tr><tr><td><div> SPMS-6244 - Configuration data</div><ul style="list-style-type: none"><div> SPMS-6465 - configuration_data</div></td><td><div> SPMS-2182 - Maintain configuration data</div></td><td><div> SPMS-2098 - CCS System</div></td></tr></table>	Output exchanges	Target function	Function allocated to	<div> SPMS-6244 - Configuration data</div> <ul style="list-style-type: none"><div> SPMS-6465 - configuration_data</div>	<div> SPMS-2182 - Maintain configuration data</div>	<div> SPMS-2098 - CCS System</div>		
Output exchanges	Target function	Function allocated to							
<div> SPMS-6244 - Configuration data</div> <ul style="list-style-type: none"><div> SPMS-6465 - configuration_data</div>	<div> SPMS-2182 - Maintain configuration data</div>	<div> SPMS-2098 - CCS System</div>							

2.3.3-10 - Analyse Railway Undertaking system asset state


This function is allocated to  SPMS-6203 - Railway Undertaking Diagnostic System.






This function analyses the diagnostics and monitoring data for advanced processing/interpretation in cases of condition based maintenance for example.

ID	SPMS-6207
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Context Diagram	 <p>Figure 85 Context Diagram of Analyse Railway Undertaking system asset state</p>		
Input exchanges	Input exchanges  SPMS-6210 - Evaluated system asset state <ul style="list-style-type: none">  SPMS-6233 - system_asset_state_evaluation 	Source function  SPMS-2121 - Monitor+Evaluate system asset state	Function allocated to  SPMS-2098 - CCS System
Output exchanges	No outputs defined for this function.		

2.3.3-11 - Analyse Infrastructure Manager system asset state

This function is allocated to  SPMS-6202 - Infrastructure Management Diagnostic System. This function analyses the diagnostics and monitoring data for advanced processing/interpretation in cases of condition based maintenance for example.










ID	SPMS-6206		
Context Diagram	 <p>Figure 86 Context Diagram of Analyse Infrastructure Manager system asset state</p>		
Input exchanges	Input exchanges  SPMS-6209 - Evaluated system asset state <ul style="list-style-type: none">  SPMS-6233 - system_asset_state_evaluation 	Source function  SPMS-2121 - Monitor+Evaluate system asset state	Function allocated to  SPMS-2098 - CCS System
Output exchanges	No outputs defined for this function.		

2.3.3-12 - Supervise passenger exchange


This function is allocated to  SPMS-2096 - Driver.

This function manages the states of train doors during manual operation, ensuring safe opening and closing. It prioritises passenger safety by preventing injuries that might occur in the gap between the platform and the train. It checks that there are no obstacles or passengers in the middle of the doors before closing and troubleshoots doors in cases train doors can not be closed properly.

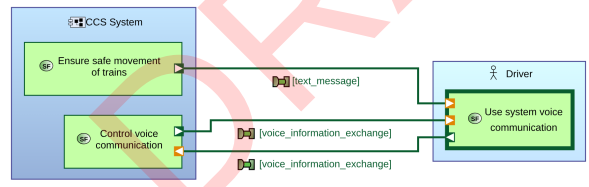








ID	SPMS-2177
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Context Diagram	 <p>Figure 87 Context Diagram of Supervise passenger exchange</p>		
Input exchanges	Input exchanges  SPMS-2329 - Indicated supporting information <ul style="list-style-type: none">  SPMS-2409 - stopping_point_information 	Source function  SPMS-2160 - Calculate information to support driving	Function allocated to  SPMS-2098 - CCS System
Output exchanges	Output exchanges  SPMS-2346 - Requested state of doors manually <ul style="list-style-type: none">  SPMS-6743 - manual_door_state_request 	Target function  SPMS-2114 - Implement specific doors state	Function allocated to  SPMS-2094 - Rolling Stock Operation System

2.3.3-13 - Use system voice communication


This function is allocated to  SPMS-2096 - Driver.

This function represents the need from to use the voice communication to the Signaller.

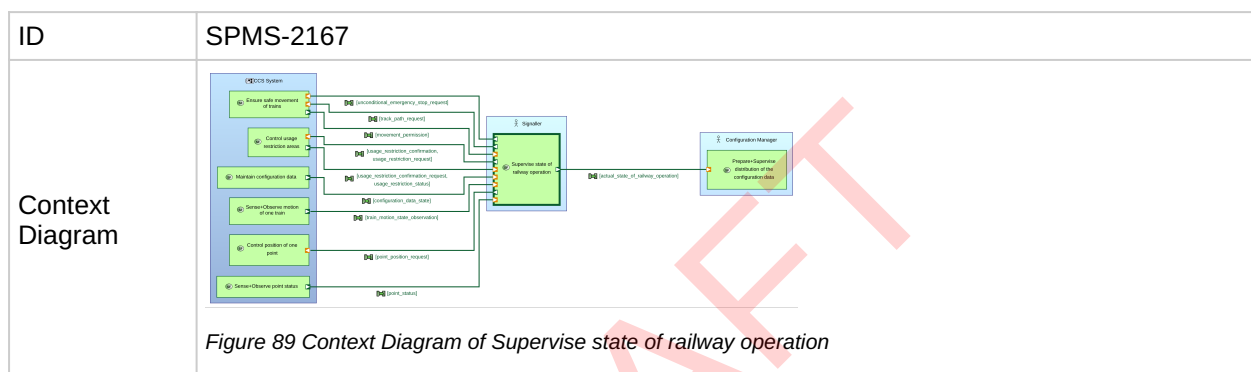
ID	SPMS-2174		
Context Diagram	 <p>Figure 88 Context Diagram of Use system voice communication</p>		
Input exchanges	Input exchanges  SPMS-5664 - Exchanged information <ul style="list-style-type: none">  SPMS-6514 - voice_information_exchange  SPMS-6930 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-6928 - text_message 	Source function  SPMS-2110 - Control voice communication  SPMS-2137 - Ensure safe movement of trains	Function allocated to  SPMS-2098 - CCS System  SPMS-2098 - CCS System






















Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2318 - Exchanged information <ul style="list-style-type: none">  SPMS-6514 - voice_information_exchange 	 SPMS-2110 - Control voice communication	 SPMS-2098 - CCS System






















2.3.3-14 - Supervise state of railway operation

This function is allocated to  SPMS-2090 - Signaller.


This function performed by the Signaller supervises the state of railway operation and intervenes when necessary (e.g. point is indicated in different state than expected). Furthermore, it confirms (and adapt if necessary) the activation or deactivation of usage restrictions for supervised trains.



Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2330 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System
	 SPMS-2219 - Usage restriction state <ul style="list-style-type: none">  SPMS-4827 - usage_restriction_confirmation_request  SPMS-2398 - usage_restriction_status 	 SPMS-2159 - Control usage restriction areas	 SPMS-2098 - CCS System
	 SPMS-2312 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2108 - Sense+Observe point status	 SPMS-2098 - CCS System
	 SPMS-6037 - Actual state of configuration data <ul style="list-style-type: none">  SPMS-6466 - configuration_data_state 	 SPMS-2182 - Maintain configuration data	 SPMS-2098 - CCS System
	 SPMS-7230 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System

Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2347 - Requested track path <ul style="list-style-type: none">  SPMS-2418 - track_path_request 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System
	 SPMS-4628 - Requested point position <ul style="list-style-type: none">  SPMS-2386 - point_position_request 	 SPMS-2190 - Control position of one point	 SPMS-2098 - CCS System
	 SPMS-4824 - Provided usage restriction state <ul style="list-style-type: none">  SPMS-4826 - usage_restriction_confirmation  SPMS-2407 - usage_restriction_request 	 SPMS-2159 - Control usage restriction areas	 SPMS-2098 - CCS System
	 SPMS-6039 - Actual state of railway operation <ul style="list-style-type: none">  SPMS-6772 - actual_state_of_railway_operation 	 SPMS-2129 - Prepare+Supervise distribution of the configuration data	 SPMS-2103 - Configuration
	 SPMS-7094 - Requested emergency stop <ul style="list-style-type: none">  SPMS-7137 - unconditional_emergency_stop_request 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System

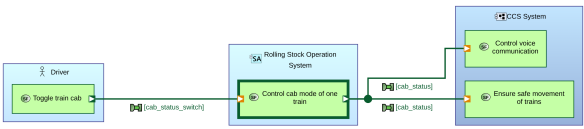




2.3.3-15 - Control cab mode of one train









This function is allocated to  SPMS-2094 - Rolling Stock Operation System.

This function controls the mode of a cab in the operating train.


The cab mode output of this function can be:

- Cab A activated
- Cab B activated
- No cab activated.

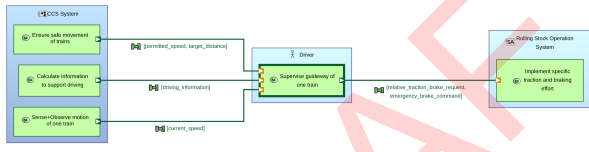













ID	SPMS-2163		
Context Diagram	 <p>Figure 90 Context Diagram of Control cab mode of one train</p>		
Input exchanges	Input exchanges  SPMS-2235 - Required cab status <ul style="list-style-type: none">  SPMS-6771 - cab_status_switch 	Source function  SPMS-2109 - Toggle train cab	Function allocated to  SPMS-2096 - Driver






Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-6879 - Reported cab status <ul style="list-style-type: none">  SPMS-2385 - cab_status 	 SPMS-2110 - Control voice communication	 SPMS-2098 - CCS System
	 SPMS-6978 - Reported cab status <ul style="list-style-type: none">  SPMS-2385 - cab_status 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System

2.3.3-16 - Supervise guideway of one train


This function is allocated to  SPMS-2096 - Driver.

This function supervises the track guideway, environment and behavior during automatic driving. In order to prevent collision with obstacles or persons on or near the line.

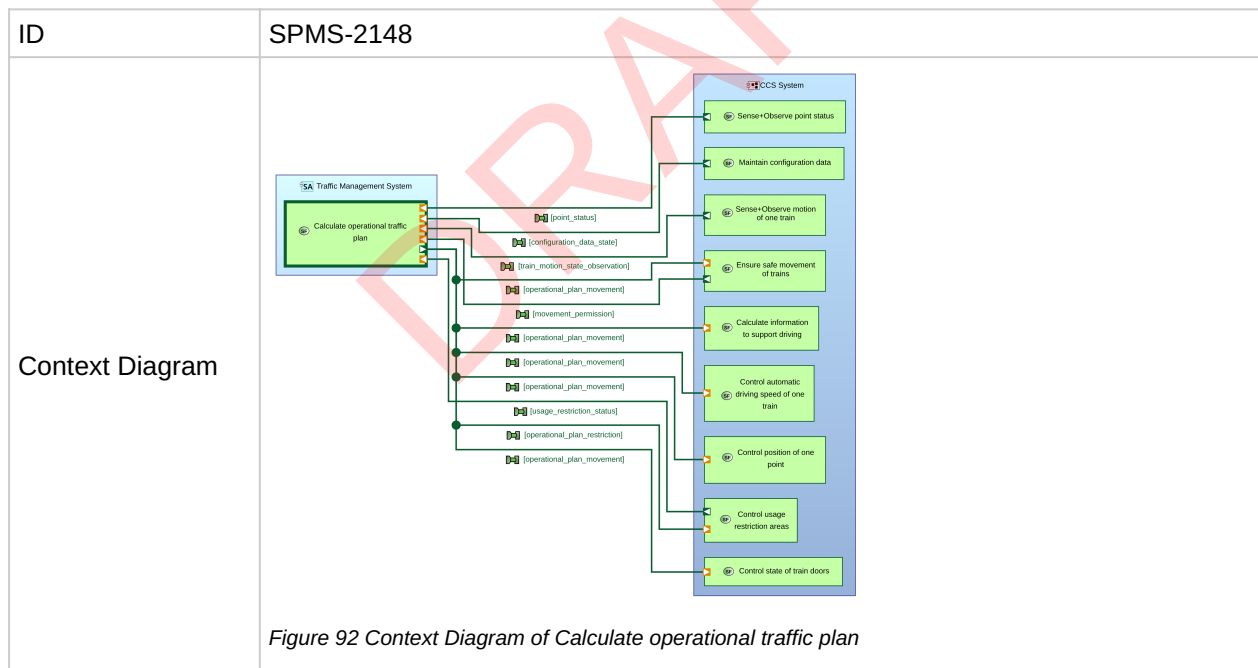
ID	SPMS-2158		
Context Diagram	 <p>Figure 91 Context Diagram of Supervise guideway of one train</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2325 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-2373 - permitted_speed  SPMS-2375 - target_distance 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System
	 SPMS-2328 - Indicated supporting information <ul style="list-style-type: none">  SPMS-2408 - driving_information 	 SPMS-2160 - Calculate information to support driving	 SPMS-2098 - CCS System
	 SPMS-6660 - Estimated motion state <ul style="list-style-type: none">  SPMS-2400 - current_speed 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System





















	Output exchanges	Target function	Function allocated to
Output exchanges	<p> SPMS-6744 - Required relative traction and brake effort manually</p> <ul style="list-style-type: none">  SPMS-2393 - relative_traction_brake_request  SPMS-2378 - emergency_brake_command 	<p> SPMS-2146 - Implement specific traction and braking effort</p>	<p> SPMS-2094 - Rolling Stock Operation System</p>

























2.3.3-17 - Calculate operational traffic plan

This function is allocated to  SPMS-2097 - Traffic Management System.


This function calculates the operational plans for all trains in the area of control before the train run starts and adapts it if needed during the train run. Thus, the calculation of the operational plans is based on the requirements from the capacity management, the actual operational situation (e.g. operational restrictions, delays of train runs). An Operational Movement is part of the Operational Plan, and consist of a timetable or train service specifying when and where particular events are to take place. Some of these events could be a commercial stop, a run through a certain location or even a change of train composition or a handover to another Traffic Management System. The most simple way of representation of such timetable is in a tabular form indicating station or run through location with arrival and departure time. More events could be associated at certain stations or locations depending on the Railway Undertaking needs. The Operational Movement is defined in such a way that the final user (passenger or freight company) knows if a particular timetable suits his needs.



Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2300 - Estimated motion state <ul style="list-style-type: none">  SPMS-2392 - train_motion_state_observation 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System
	 SPMS-2249 - Authorised distance and speed restriction <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System
	 SPMS-2215 - Usage restriction state <ul style="list-style-type: none">  SPMS-2398 - usage_restriction_status 	 SPMS-2159 - Control usage restriction areas	 SPMS-2098 - CCS System
	 SPMS-5329 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2108 - Sense+Observe point status	 SPMS-2098 - CCS System
	 SPMS-6038 - Actual state of configuration data <ul style="list-style-type: none">  SPMS-6466 - configuration_data_state 	 SPMS-2182 - Maintain configuration data	 SPMS-2098 - CCS System

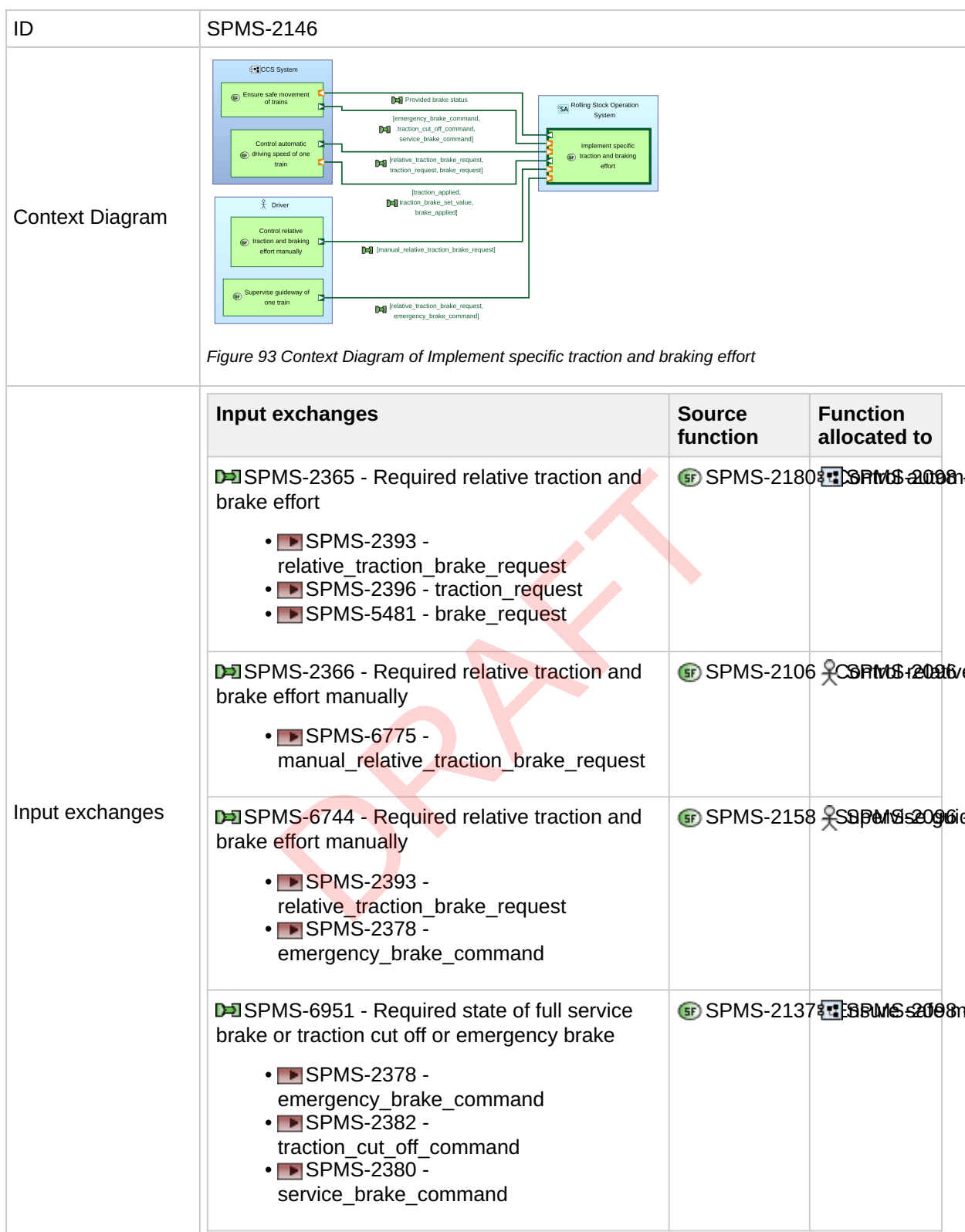
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2359 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2107 - Control state of train doors	 SPMS-2098 - CCS System
	 SPMS-2360 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2180 - Control automatic driving speed of one train	 SPMS-2098 - CCS System
	 SPMS-2350 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2190 - Control position of one point	 SPMS-2098 - CCS System
	 SPMS-2351 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System
	 SPMS-2354 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2160 - Calculate information to support driving	 SPMS-2098 - CCS System
	 SPMS-2357 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-5548 - operational_plan_restriction 	 SPMS-2159 - Control usage restriction areas	 SPMS-2098 - CCS System










2.3.3-18 - Implement specific traction and braking effort

This function is allocated to  SPMS-2094 - Rolling Stock Operation System.


This function is responsible for managing traction and braking efforts tailored to specific rolling stock:

- Traction Force Control: Adjusts the traction force based on current demands.
- Traction Force Interruption: Disengages traction force when required.
- Braking Control:
 - Service Brake: Regulates the service brake for effective deceleration during normal operations.
 - Parking Brake: Operates the parking brake to securely immobilise the vehicle when stationary.
 - Note: During standstill supervision it depends on the type of the rolling stock and the movement detected, whether emergency brake or service brake is used.
 - Emergency Brake: Deploys the emergency brake promptly for rapid deceleration as needed.

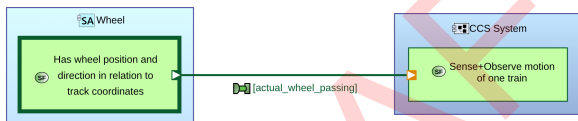






Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2245 - Applied level of traction and brake effort <ul style="list-style-type: none"> •  SPMS-2394 - traction_applied •  SPMS-2395 - traction_brake_set_value •  SPMS-5482 - brake_applied 	 SPMS-2180 - Control automatic driving speed of one train	 SPMS-2098 - CCS System
	<p>No exchange items allocated on  SPMS-7167 - Provided brake status.</p>	 SPMS-2137 - Ensure safe movement of trains	 SPMS-2098 - CCS System


2.3.3-19 - Has wheel position and direction in relation to track coordinates

This function is allocated to  SPMS-2101 - Wheel.

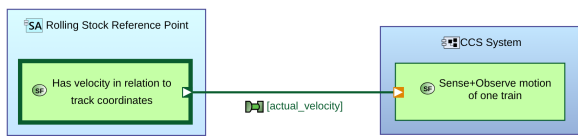
This passive function represents the position and passing direction in relation to track coordinates of one wheel.





ID	SPMS-2141		
Context Diagram	 <p>Figure 94 Context Diagram of Has wheel position and direction in relation to track coordinates</p>		
Input exchanges	No inputs defined for this function.		
Output exchanges	Output exchanges  SPMS-2244 - Actual wheel passing <ul style="list-style-type: none"> •  SPMS-6523 - actual_wheel_passing 	Target function  SPMS-2192 - Sense+Observe motion of one train	Function allocated to  SPMS-2098 - CCS System

2.3.3-20 - Has velocity in relation to track coordinates


This function is allocated to  SPMS-2091 - Rolling Stock Reference Point.

This passive function represents the actual velocity of one rolling stock reference point.






ID	SPMS-2140		
Context Diagram	 <p>Figure 95 Context Diagram of Has velocity in relation to track coordinates</p>		

Input exchanges	No inputs defined for this function.		
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2243 - Actual velocity <ul style="list-style-type: none">  SPMS-6522 - actual_velocity 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System


2.3.3-21 - Has position and direction in relation to track coordinates

This function is allocated to  SPMS-2091 - Rolling Stock Reference Point.

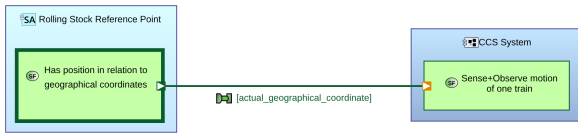
This passive function represents the position and direction in relation to track coordinates of one rolling stock reference point.





ID	SPMS-2138		
Context Diagram	 <p>Figure 96 Context Diagram of Has position and direction in relation to track coordinates</p>		
Input exchanges	No inputs defined for this function.		
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2239 - Actual present position and direction <ul style="list-style-type: none">  SPMS-6521 - actual_position_and_direction 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System

2.3.3-22 - Has position in relation to geographical coordinates


This function is allocated to  SPMS-2091 - Rolling Stock Reference Point.

This passive function represents the position in relation to geographical coordinates of one rolling stock reference point.










ID	SPMS-2135		
Context Diagram	 <p>Figure 97 Context Diagram of Has position in relation to geographical coordinates</p>		
Input exchanges	No inputs defined for this function.		

Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2238 - Actual present geographical coordinate <ul style="list-style-type: none">  SPMS-6520 - actual_geographical_coordinate 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System

2.3.3-23 - Authorise automatic driving state

This function is allocated to  SPMS-2096 - Driver.

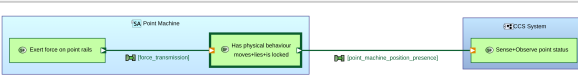
This function authorises the grade of automation in order to engage or disengage the automatic driving.









ID	SPMS-2134		
Context Diagram	 <p>Figure 98 Context Diagram of Authorise automatic driving state</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2321 - Indicated automatic driving state <ul style="list-style-type: none">  SPMS-3869 - automatic_driving_state_indication 	 SPMS-2180 - Control automatic driving speed of one train	 SPMS-2098 - CCS System
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2247 - Authorised automatic driving state <ul style="list-style-type: none">  SPMS-3868 - automatic_driving_state_authorisation 	 SPMS-2180 - Control automatic driving speed of one train	 SPMS-2098 - CCS System

2.3.3-24 - Has physical behaviour moves+lies+is locked


This function is allocated to  SPMS-2100 - Point Machine.

This passive function represents the mechanical blades position of the Point which can be sensed and estimated to an abstract Point Machine position.






ID	SPMS-2132		
Context Diagram	 <p>Figure 99 Context Diagram of Has physical behaviour moves+lies+is locked</p>		

Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-4799 - Exerted force <ul style="list-style-type: none">  SPMS-6773 - force_transmission 	 SPMS-2125 - Exert force on point rails	 SPMS-2100 - Point Machine
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2237 - Actual physical point machine position <ul style="list-style-type: none">  SPMS-2381 - point_machine_position_presence 	 SPMS-2108 - Sense+Observe point status	 SPMS-2098 - CCS System

2.3.3-25 - Provide planned activation time for infrastructure

This function is allocated to  SPMS-2097 - Traffic Management System.

This function manages the update of configuration data which includes also the provision of the best point in time for the update.

ID	SPMS-2131		
Context Diagram	 <p>Figure 100 Context Diagram of Provide planned activation time for infrastructure</p>		
Input exchanges	No inputs defined for this function.		
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2339 - Planned activation time <ul style="list-style-type: none">  SPMS-6468 - configuration_data_activation_plan 	 SPMS-2182 - Maintain configuration data	 SPMS-2098 - CCS System

2.3.3-26 - Prepare+Supervise distribution of the configuration data


This function is allocated to  SPMS-2103 - Configuration Manager.

This function assists the configuration data preparation and activation.

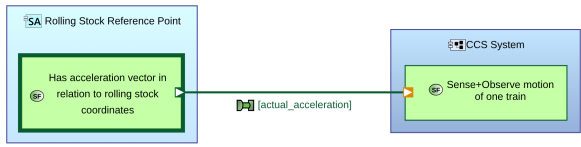
ID	SPMS-2129
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Context Diagram			
Figure 101 Context Diagram of Prepare+Supervise distribution of the configuration data			
Input exchanges	Input exchanges	Source function	Function allocated to
	SPMS-2242 - Actual state of configuration data <ul style="list-style-type: none"> SPMS-6466 - configuration_data_state	SPMS-2182 - Maintain configuration data	SPMS-2098 - CCS System
Output exchanges	SPMS-6039 - Actual state of railway operation <ul style="list-style-type: none"> SPMS-6772 - actual_state_of_railway_operation	SPMS-2167 - Supervise state of railway operation	SPMS-2090 - Signaller
	Output exchanges	Target function	Function allocated to
Output exchanges	SPMS-2209 - Required state of configuration data <ul style="list-style-type: none"> SPMS-6467 - configuration_data_state_request	SPMS-2182 - Maintain configuration data	SPMS-2098 - CCS System

2.3.3-27 - Has acceleration vector in relation to rolling stock coordinates


This function is allocated to  SPMS-2091 - Rolling Stock Reference Point.

This passive function represents the **actual** acceleration in relation to rolling stock coordinates of one rolling stock reference point.

ID	SPMS-2127
Context Diagram	 <p>Figure 102 Context Diagram of Has acceleration vector in relation to rolling stock coordinates</p>
Input exchanges	No inputs defined for this function.

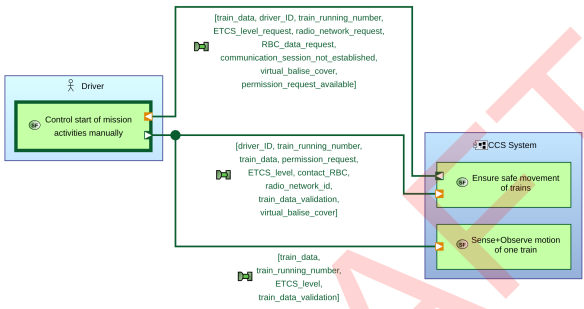












	Output exchanges	Target function	Function allocated to
Output exchanges	 SPMS-2234 - Actual acceleration <ul style="list-style-type: none">  SPMS-6519 - actual_acceleration 	 SPMS-2192 - Sense+Observe motion of one train	 SPMS-2098 - CCS System

2.3.3-28 - Control start of mission activities manually

This function is allocated to  SPMS-2096 - Driver.

This function represents the action of providing e.g. driver ID, train data, driver acknowledgements or other relevant information.

The driver validates the indicated information and requests permission for movement.

ID	SPMS-2126		
Context Diagram	 <p>Figure 103 Context Diagram of Control start of mission activities manually</p>		
Input exchanges	Input exchanges  SPMS-2323 - Indicated start of mission data <ul style="list-style-type: none">  SPMS-2371 - train_data  SPMS-2406 - driver_ID  SPMS-2414 - train_running_number  SPMS-7168 - ETCS_level_request  SPMS-7170 - radio_network_request  SPMS-7175 - RBC_data_request  SPMS-7176 - communication_session_not_established  SPMS-7216 - virtual_balise_cover  SPMS-7237 - permission_request_available 	Source function  SPMS-2137	Function allocated to  SPMS-2098 - CCS System









Output exchanges	Output exchanges	Target function	Function allocated to
	<p>➡ SPMS-2341 - Provided driver information</p> <ul style="list-style-type: none"> ➡ SPMS-2406 - driver_ID ➡ SPMS-2414 - train_running_number ➡ SPMS-2371 - train_data ➡ SPMS-6691 - permission_request ➡ SPMS-7169 - ETCS_level ➡ SPMS-7171 - contact_RBC ➡ SPMS-7174 - radio_network_id ➡ SPMS-7111 - train_data_validation ➡ SPMS-7216 - virtual_balise_cover 	<p>5F SPMS-2137 - Ensure safe movement of trains</p>	<p>🔌 SPMS-2098 - CCS System</p>
Output exchanges	<p>➡ SPMS-7178 - Provided driver information</p> <ul style="list-style-type: none"> ➡ SPMS-2371 - train_data ➡ SPMS-2414 - train_running_number ➡ SPMS-7169 - ETCS_level ➡ SPMS-7111 - train_data_validation 	<p>5F SPMS-2192 - Sense+Observe motion of one train</p>	<p>🔌 SPMS-2098 - CCS System</p>

2.3.3-29 - Exert force on point rails


This function is allocated to 🧑 SPMS-2100 - Point Machine.

This function converts electrical into mechanical energy to the needed force to move the blades of the Point.

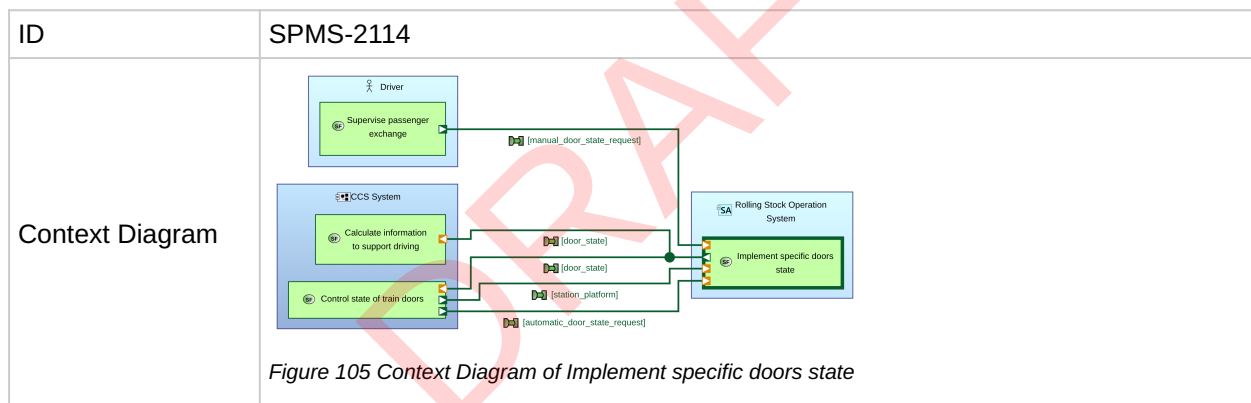
ID	SPMS-2125
Context Diagram	<p>Figure 104 Context Diagram of Exert force on point rails</p>





















Input exchanges	Input exchanges		Source function	Function allocated to
	 SPMS-2361 - Required point machine movement <ul style="list-style-type: none">  SPMS-2377 - point_machine_movement_requirement 		 SPMS-2190 - SPMS position on CCS system	 SPMS-2098 - Rolling Stock Operation System
Output exchanges	Output exchanges	Target function	Function allocated to	
	 SPMS-4799 - Exerted force <ul style="list-style-type: none">  SPMS-6773 - force_transmission 	 SPMS-2132 - Has physical behaviour moves+lies+is locked	 SPMS-2100 - Point Machine	

2.3.3-30 - Implement specific doors state


This function is allocated to  SPMS-2094 - Rolling Stock Operation System.

This function controls the vehicle specific door operation. This includes the sending of control signals and the actuation of the doors on vehicle side. Additionally senses the actual state of the door system and provides the estimated state as feedback.
















Input exchanges	Input exchanges		Source function	Function allocated to
	 SPMS-2346 - Requested state of doors manually <ul style="list-style-type: none">  SPMS-6743 - manual_door_state_request 		 SPMS-2177 - Supervise passenger exchange	 SPMS-2096 - Driver
	 SPMS-2213 - Requested state of doors <ul style="list-style-type: none">  SPMS-2397 - automatic_door_state_request 		 SPMS-2107 - Control state of train doors	 SPMS-2098 - CCS System
	 SPMS-7976 - Provided station and platform information <ul style="list-style-type: none">  SPMS-6990 - station_platform 		 SPMS-2107 - Control state of train doors	 SPMS-2098 - CCS System
Output exchanges	Output exchanges		Target function	Function allocated to
	 SPMS-2316 - Observed state of doors <ul style="list-style-type: none">  SPMS-2405 - door_state 		 SPMS-2107 - Control state of train doors	 SPMS-2098 - CCS System
	 SPMS-6515 - Observed state of doors <ul style="list-style-type: none">  SPMS-2405 - door_state 		 SPMS-2160 - Calculate information to support driving	 SPMS-2098 - CCS System

2.3.3-31 - Plan maintenance tasks+Manage asset


This function is allocated to  SPMS-6204 - Asset Management System.

This function organises schedules and assigns tasks to maintenance team based on the evaluated diagnostic and monitoring data.

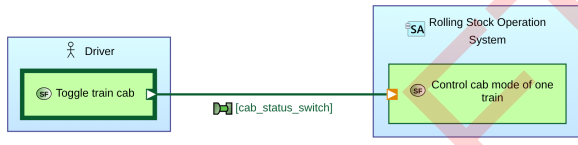




ID	SPMS-2111		
Context Diagram	 <p>Figure 106 Context Diagram of Plan maintenance tasks+Manage asset</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2296 - Evaluated system asset state <ul style="list-style-type: none">  SPMS-6233 - system_asset_state_evaluation 	 SPMS-2121 - Monitor+Evaluate system asset state	 SPMS-2098 - CCS System

Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2340 - Planned maintenance task <ul style="list-style-type: none">  SPMS-6774 - maintenance_task_plan 	 SPMS-7317 - Carry out maintenance task	 SPMS-6160 - Field Force
	 SPMS-6242 - Logistic data <ul style="list-style-type: none">  SPMS-6464 - logistic_data 	 SPMS-2121 - Monitor+Evaluate system asset state	 SPMS-2098 - CCS System


2.3.3-32 - Toggle train cab

This function is allocated to  SPMS-2096 - Driver.

This function represents the opening and closing of the train cab by the driver

ID	SPMS-2109		
Context Diagram	 <p>Figure 107 Context Diagram of Toggle train cab</p>		
Input exchanges	No inputs defined for this function.		
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2235 - Required cab status <ul style="list-style-type: none">  SPMS-6771 - cab_status_switch 	 SPMS-2163 - Control cab mode of one train	 SPMS-2094 - Rolling Stock Operation System

2.3.3-33 - Control relative traction and braking effort manually

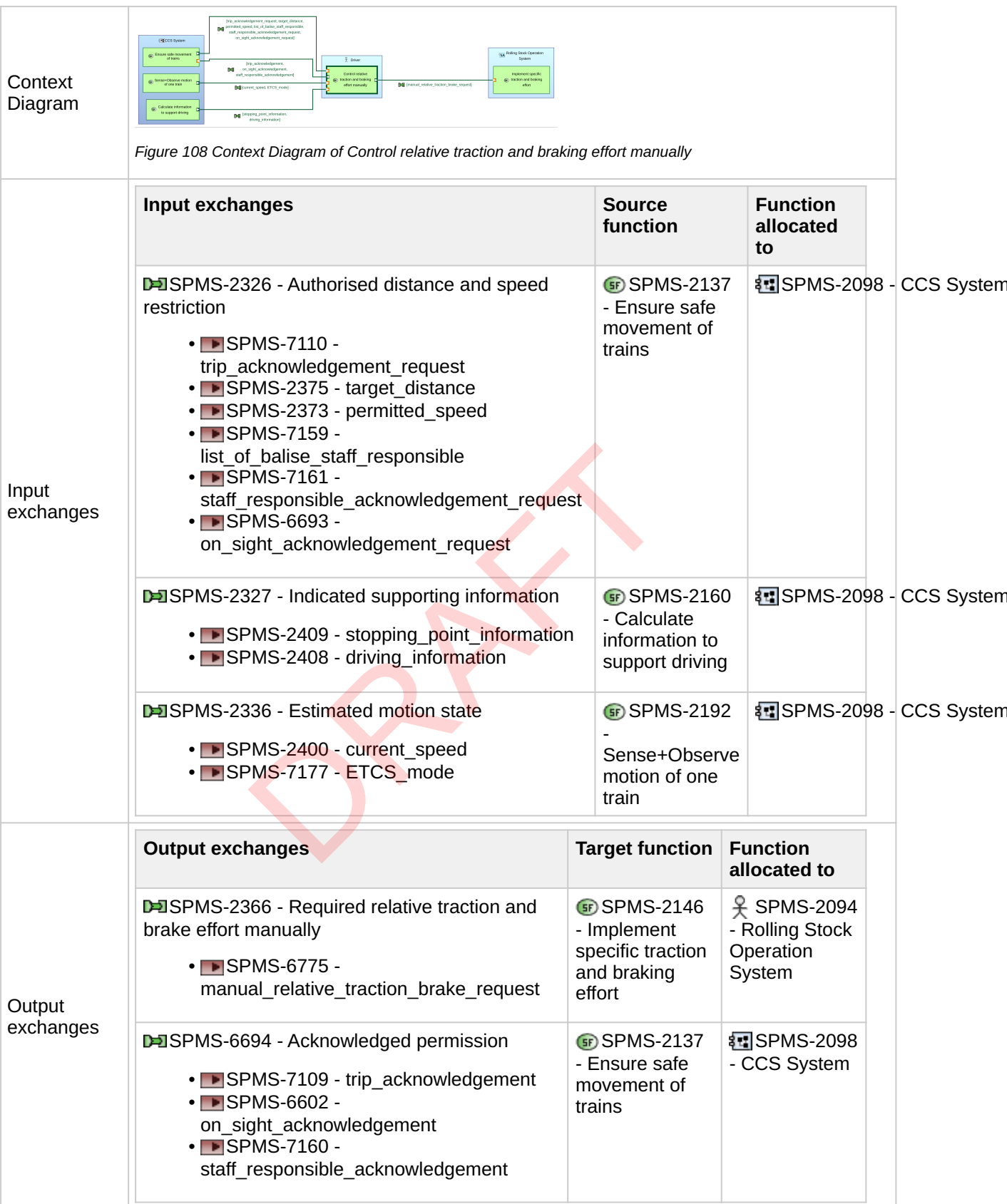
This function is allocated to  SPMS-2096 - Driver.

This function represents the driver's actions when driving the train.

It includes the control of traction and braking effort in order to:

- start the movement at the scheduled time
- make the speed as close as possible to the target speed
- stop correctly at each planned stopping point
- it evaluates whether the train has reached the stopping position accurately or overshooted or undershooted.

ID	SPMS-2106
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2.4 Scope of operational requirements and constraints

The overarching requirements are derived from [SPP-8684 - System Pillar Common Business Objectives (May 2022)] and are documented as [SPP-19163 - OD_Stakeholder Requirements Specification CCS System_V0.2]. The [SPP-18362 - EET_Requirements Management Plan Version_1.0] describes the derivation process in detail.

2.4.1 Review of past experience data for similar systems

Will be provided in further release.

2.4.2 Constraints imposed by existing infrastructure

Will be provided in further release.

2.4.3 System operating conditions and constraints

Will be provided in further release.

2.4.4 System maintenance conditions

Will be provided in further release.

2.4.5 Logistic support considerations

Not applicable in the scope of ERJU.

2.4.6 Operating procedures

The operating procedures relevant for the CCS System are defined in [SPP-19161 - OD_ETCS L2 Rulebook_V0.3].

As described in [SPP-18362 - EET_Requirements Management Plan Version_1.0], the artefacts of the [SPP-19161 - OD_ETCS L2 Rulebook_V0.3] are linked to the artefacts of the System Definition for the CCS System. [SPP-18366 - TCS_System Definition CCS-System: Traceability Report Operational Processes_V0.3] shows this linking.








2.5 Existing safety measures

Will be provided in a future release.

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3 Appendix

3.1 References

Id	Description	Reference
[ SPP-18362 - EET_Requirements Management Plan Version_1.0]	For System Pillar the plan describes a strategy for traceability between requirements levels, architecture elements and application conditions. Further the type of requirements and their related workflows are defined.	Link
[ SPP-19161 - OD_ETCS L2 Rulebook_V0.3]	ETCS L2 Rulebook	Link
[ SPP-19163 - OD_Stakeholder Requirements Specification CCS System_V0.2]	Stakeholder Requirements Specification	Link
[ SPP-18404 - OD_Stakeholder Requirements Specification: Traceability Report_V0.2]	Shows the linking between the Stakeholder Requirements and the CCS System.	Link
[ SPP-19283 - Release Note ESPR1.0]	This Release Note describes the scope of the ESPR1.0.	Link
[ SPP-18366 - TCS_System Definition CCS-System: Traceability Report Operational Processes_V0.3]	Shows the linking between the Operational Process defined for ETCS L2 Rulebook and the System Definition for the CCS-System.	Link
[EN 50126-1:2017">  SPPRAMSS-349 - EN 50126-1:2017]	Railway Applications – The Specification	-

Id	Description	Reference
	and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 1: Generic RAMS Process	

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