



ERJU SYSTEM PILLAR

20 System Definition Traffic CS



System Definition Traffic CS

DRAFT

Approval by Reviewers

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1 Preamble

1.1 Purpose

This document describes the System Definition as required per [SPP-18060 - TCS_System Architecture Description CCS System V0.3] phase 2 for the Traffic CS 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-18060 - TCS_System Architecture Description CCS System V0.3]). 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).

Note:

This documentation is not intended for a general audience. For a comprehensive understanding of Traffic CS, please refer to the Traffic CS System Concept [SPP-19049 - Traffic CS System Concept V1.0].

1.3 Context of this document

As shown in SPT2TRAFFIC-12784 the System Definition of the Traffic CS system is based on the following inputs:

- [SPP-18060 - TCS_System Architecture Description CCS System V0.3]:
This document allocates the functions and requirements identified for the CCS-Systems (System Level 3 system) to the different System Level 4 systems. Traffic CS is one of these System Level 4 systems.
Therefore, [SPP-18060 - TCS_System Architecture Description CCS System V0.3] identifies all functions and requirements to be fulfilled by the Traffic CS system.

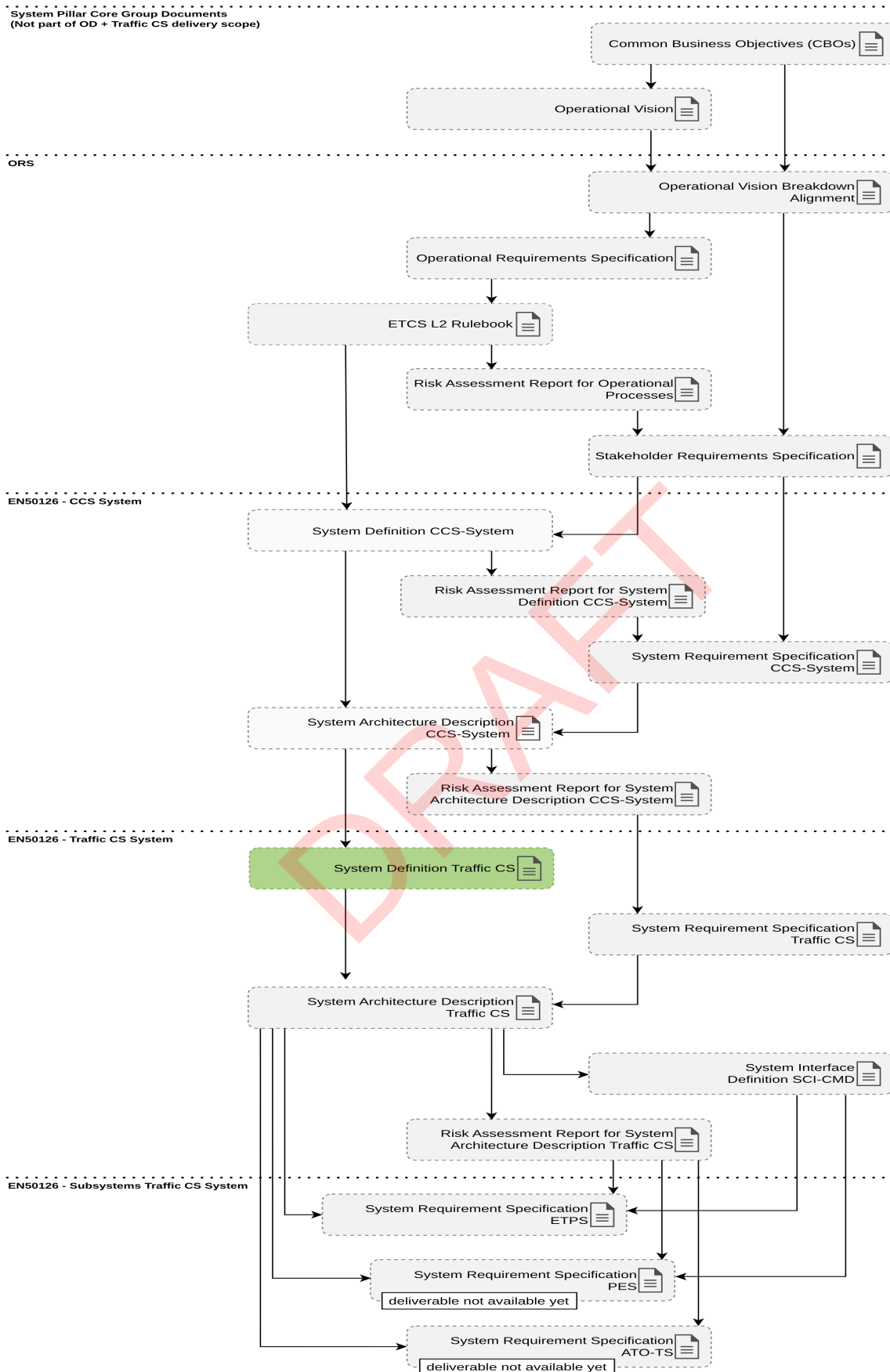
Note:

In the System Definition of the Traffic CS system no new functions or requirements are defined compared to the [SPP-18060 - TCS_System Architecture Description CCS System V0.3]. The goal of System Definition of the Traffic CS system is to reduce the scope from the overarching CCS-System to the Traffic CS system.

The System Definition of the Traffic CS system itself is an input document for the subsequent System Architecture Description of the Traffic CS system.

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

SPT2TRAFFIC-12784 below shows the System Definition of the Traffic CS system in the context of the overall document list (see also [SPP-19283 - Release Note ESPR1.0]).



ID	SPT2TRAFFIC-12784
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1.4 Glossary

1.4.1 Terms and definitions

Term	Definition
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1.4.2 Abbreviations

Abbreviation	Definition
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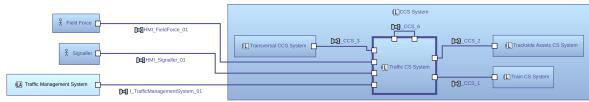









2 System Definition

2.1 System, mission profiles and assumptions

2.1.1 System description

Traffic CS System




Is responsible to execute the operational plan while controlling and reporting infrastructure usages. The execution of a plan means controls infrastructure users and infrastructure states in a compatible and safe way to fulfil the plan at the right point in time. For unsafe events (wrong-side failures or events e.g input or process failures) it reacts directly with safe reactions.

ID	SPMS-2823
Context Diagram	 <p>Figure 1 Context Diagram of Traffic CS System</p>
Allocated	<ul style="list-style-type: none"> •  SPMS-2840 - Maintain Traffic CS System configuration data •  SPMS-2874 - Control track path allocation for movement permissions •  SPMS-2886 - Observe point status •  SPMS-2895 - Monitor+Store Traffic CS System asset state •  SPMS-2929 - Control usage restrictions •  SPMS-2944 - Aggregate movable objects information •  SPMS-5265 - Control target state of one point •  SPMS-5332 - Generate train-specific timetable information •  SPMS-7115 - Acknowledge train data

2.1.1.1 Human actors

Signaller


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

ID	SPMS-2827
Allocated	<ul style="list-style-type: none"> •  SPMS-2853 - Supervise state of the railway •  SPMS-6532 - Monitor system asset state information •  SPMS-6953 - Use system voice communication

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-2808
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Allocated	<ul style="list-style-type: none"> •  SPMS-7319 - Carry out maintenance tasks
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2.1.1.2 External systems

Traffic Management System

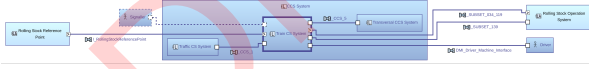













Traffic Management System covers the management and the planning level.

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-2813
Allocated	<ul style="list-style-type: none"> •  SPMS-2843 - Calculate operational traffic plan •  SPMS-5399 - Provide planned activation time

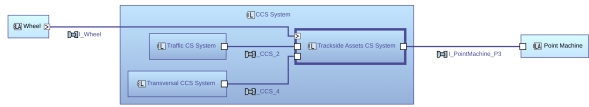





Train CS System

Is responsible, but not exclusively for all relevant functions related to train protection and automatic driving from the point of view of one train.

ID	SPMS-2807
Context Diagram	 <p>Figure 2 Context Diagram of Train CS System</p>
Allocated	<ul style="list-style-type: none"> •  SPMS-2862 - Calculate information to support driving •  SPMS-2870 - Control automatic driving speed of one train •  SPMS-2872 - Calculate safe speed profiles of one train •  SPMS-2878 - Determine position and state of one train •  SPMS-2880 - Measure+Estimate 1D acceleration of one train •  SPMS-2892 - Measure+Estimate 1D speed of one train front end •  SPMS-2897 - Supervise standstill of one train •  SPMS-2921 - Supervise compliance of speed profiles of one train •  SPMS-2928 - Control state of train doors •  SPMS-6884 - Monitor+Store Train CS System asset state •  SPMS-6933 - Control voice communication for one train •  SPMS-6971 - Determine proximity of station platform •  SPMS-7248 - Maintain Train CS System configuration data

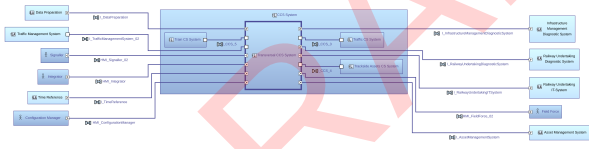



Trackside Assets CS System

Is responsible for controlling and observing the trackside objects like points, track vacancy detection, level crossings and others.


ID	SPMS-2818
Context Diagram	 <p>The diagram shows the Trackside Assets CS System as a central component. It receives data from 'Wheel' and 'Trackside Assets CS System' (via DB_Trackside_P0) and sends data to 'Point Machine' (via DB_Trackside_P0). The system is composed of several sub-systems: Traffic CS System, Transversal CCS System, and Trackside Assets CS System. The Trackside Assets CS System is further divided into DB_Trackside_P0, DB_Trackside_P1, and DB_Trackside_P2.</p> <p><i>Figure 3 Context Diagram of Trackside Assets CS System</i></p>
Allocated	<ul style="list-style-type: none"> •  SPMS-2851 - Determine required position of one point machine •  SPMS-2914 - Sense+Observe position of one point •  SPMS-2919 - Sense+Observe track vacancy proving section state •  SPMS-6533 - Monitor+Store Trackside Assets CS System asset state •  SPMS-6534 - Maintain Trackside Assets CS System configuration data


Transversal CCS System

Is responsible for configuration data and diagnosis.

ID	SPMS-2819
Context Diagram	 <p>The diagram shows the Transversal CCS System as a central component. It receives data from 'Traffic CS System' (via DB_Trackside_P0), 'Transversal CCS System' (via DB_Trackside_P1), and 'Trackside Assets CS System' (via DB_Trackside_P2). The system is composed of several sub-systems: Traffic CS System, Transversal CCS System, and Trackside Assets CS System. The Transversal CCS System is further divided into DB_Trackside_P0, DB_Trackside_P1, and DB_Trackside_P2.</p> <p><i>Figure 4 Context Diagram of Transversal CCS System</i></p>
Allocated	<ul style="list-style-type: none"> •  SPMS-2834 - Maintain configuration data •  SPMS-2922 - Synchronise current time •  SPMS-4502 - Monitor+Evaluate system asset state

2.1.2 System objectives








In this chapter, all objectives from the  SPMS-2823 - Traffic CS System perspective are described by the following aspect:

- Exchange scenarios. 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 and control loops are not yet created and will be added in a future release of this document. See  SPP-18060 - TCS_System Architecture Description CCS System V0.3] for the functional chains and control loops of the overall CCS System

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 execute an Operational plan movement. An Operational plan movement consist of at least one movement event and operates at least one train. Furthermore, an operational plan movement can contain movement restrictions.

ID	SPMS-3314
Involved entities	<ul style="list-style-type: none"> •  SPMS-2807 - Train CS System •  SPMS-2813 - Traffic Management System •  SPMS-2818 - Trackside Assets CS System •  SPMS-2819 - Transversal CCS System •  SPMS-2822 - Driver •  SPMS-2823 - Traffic CS System •  SPMS-2827 - Signaller

2.1.2.1-2 - Perform operational plan movement

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

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

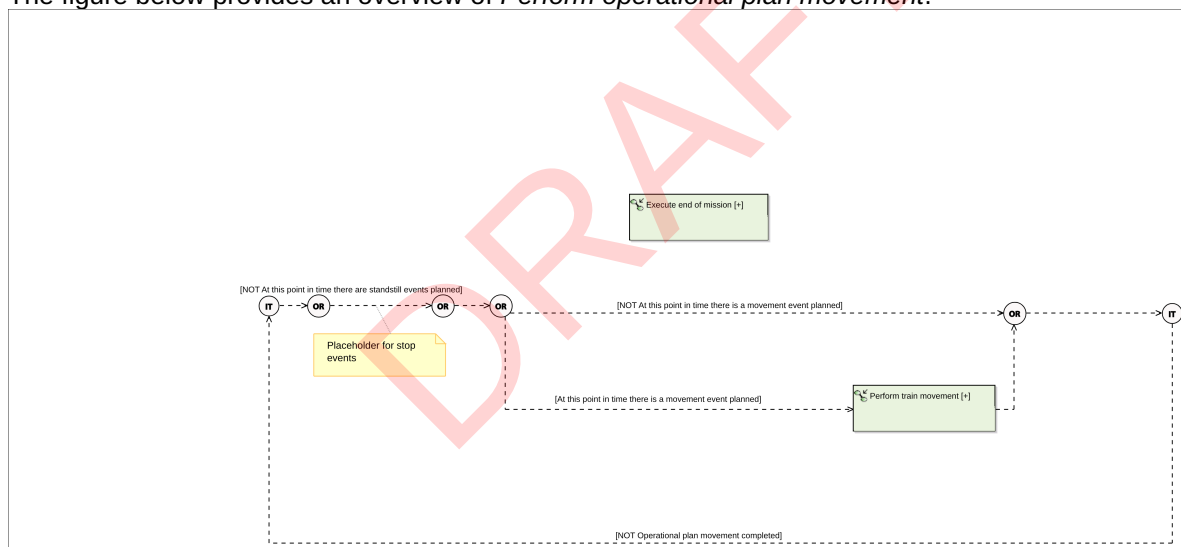


Figure 5 Diagram [LFCD] Perform operational plan movement [Functional chain description]

ID	SPMS-4553
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 (Traffic control and supervision view)

This exchange scenario describes the sequence of scenarios of one operational plan which could happen during the movement or standstill of the train from Traffic Control And Supervision view.

The figure below provides an overview of *Perform operational plan movement (Traffic control and*

supervision view).

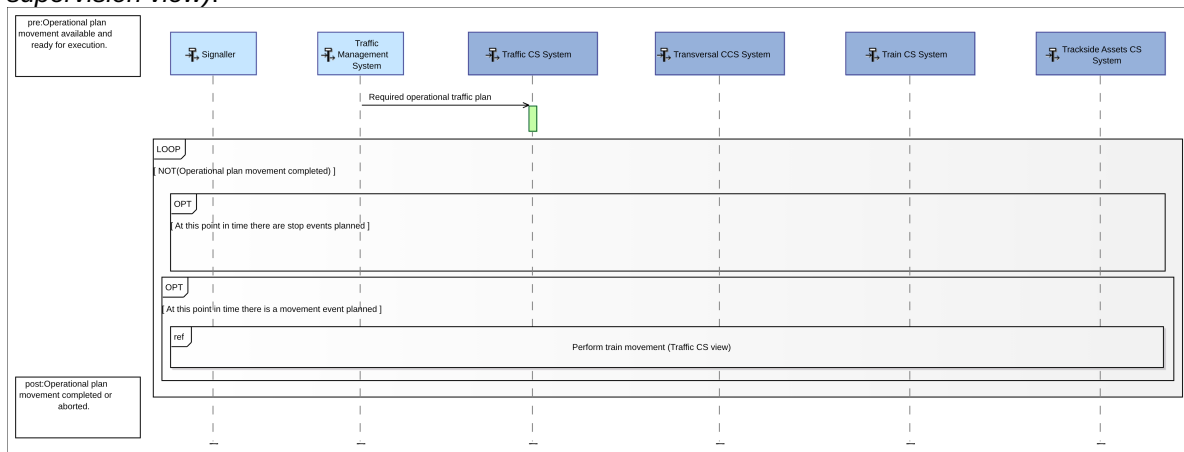










Figure 6 Diagram [LES] Perform operational plan movement (Traffic control and supervision view) [Exchange scenario]

ID	SPMS-5995
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 need the system to perform a movement of the train from one location to another with the involvement of the Signaller and Driver to enable the operation on the train.

ID	SPMS-3316
Involved entities	<ul style="list-style-type: none"> •  SPMS-2807 - Train CS System •  SPMS-2813 - Traffic Management System •  SPMS-2818 - Trackside Assets CS System •  SPMS-2819 - Transversal CCS System •  SPMS-2820 - Rolling Stock Operation System •  SPMS-2822 - Driver •  SPMS-2823 - Traffic CS System •  SPMS-2827 - Signaller

2.1.2.2-2 - 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*.

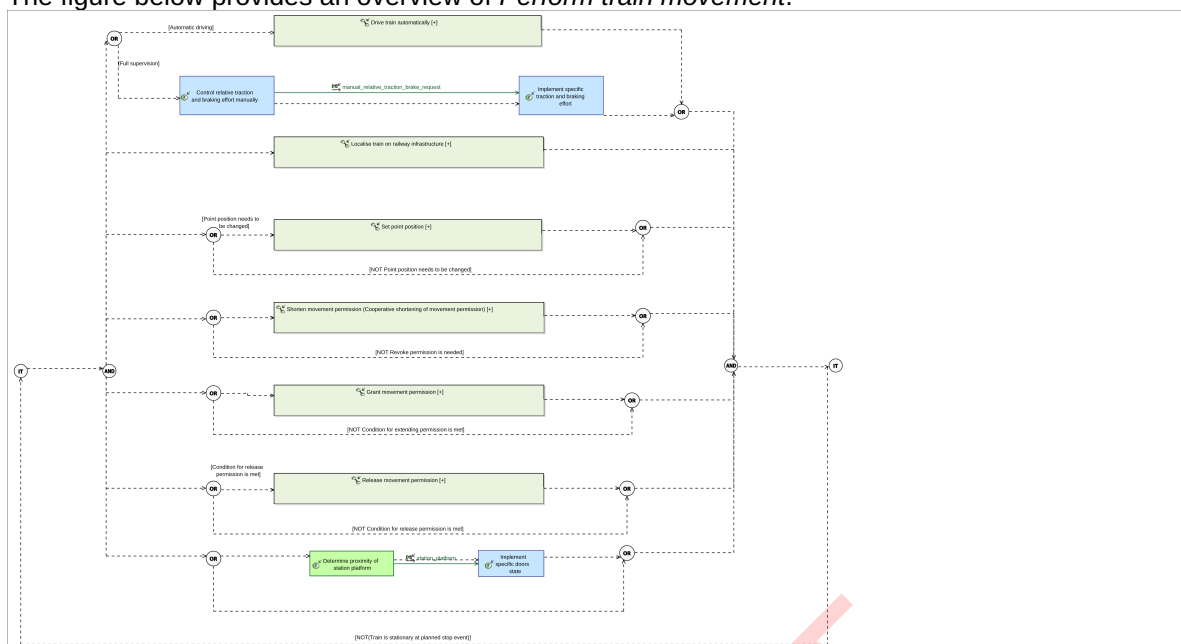


Figure 7 Diagram [LFCD] Perform train movement [Functional chain description]

ID	SPMS-4473
Pre Condition	Distance and speed permission is indicated to the Driver AND Movement permission is indicated to the Signaller AND Distance and speed restriction is provided to the Traffic Management System AND Planned movement event is ready for execution AND Train is stationary and localised.
Post Condition	Movement is completed AND Train is stationary at planned stop event AND train doors are unlocked

2.1.2.2-3 - Perform train movement (Traffic CS view)

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 from SPMS-2823 - Traffic CS System view.

The figure below provides an overview of *Perform train movement (Traffic CS view)*.

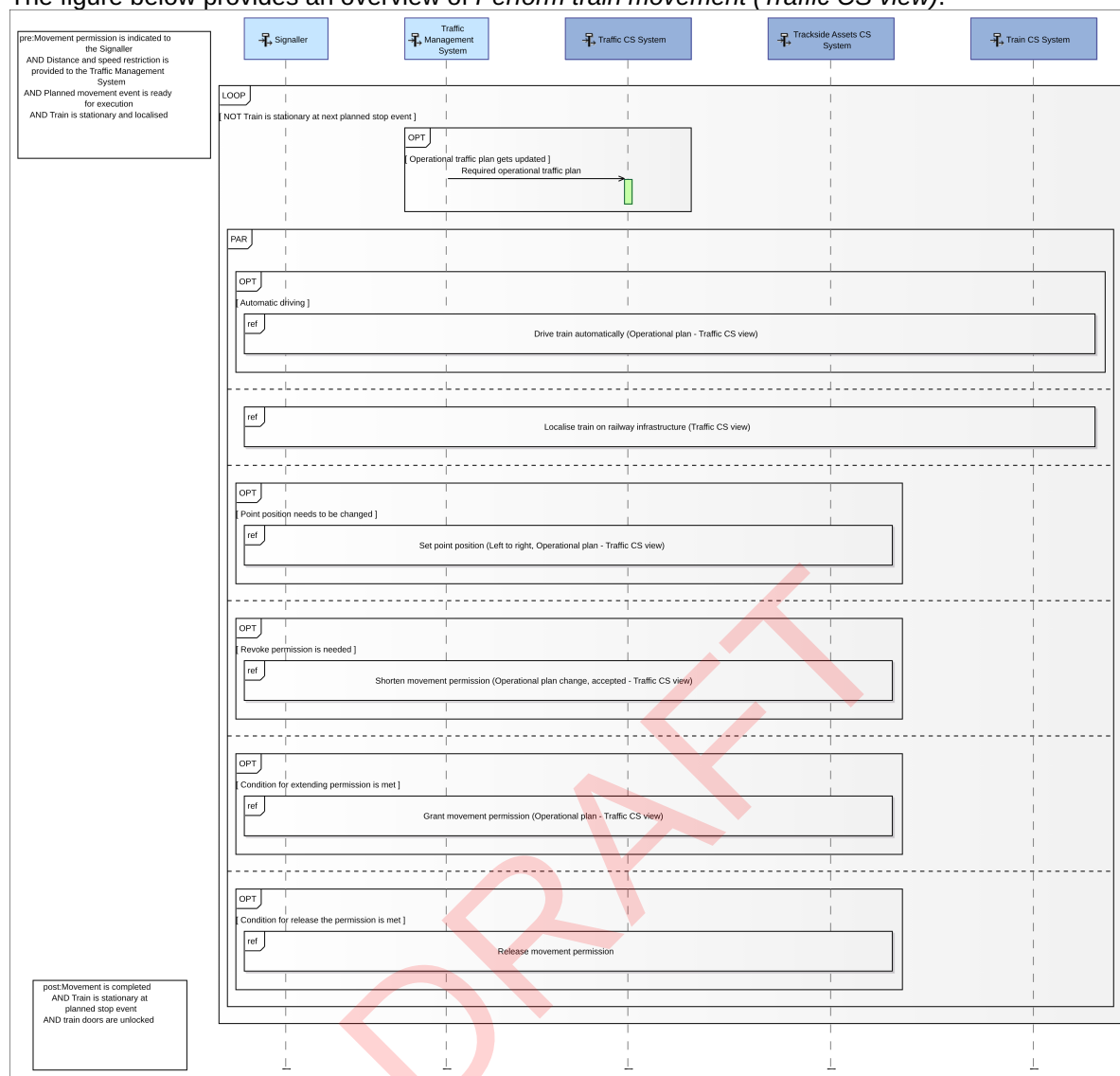


Figure 8 Diagram [LES] Perform train movement (Traffic CS view) [Exchange scenario]






ID	SPMS-5644
Pre Condition	Movement permission is indicated to the Signaller AND Distance and speed restriction is provided to the Traffic Management System AND Planned movement event is ready for execution AND Train is stationary and localised
Post Condition	Movement is completed AND Train is stationary at planned stop event AND train doors are unlocked

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-3305
Involved entities	<ul style="list-style-type: none"> •  SPMS-2807 - Train CS System •  SPMS-2813 - Traffic Management System •  SPMS-2822 - Driver •  SPMS-2823 - Traffic CS System •  SPMS-2827 - Signaller

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-2813 - Traffic Management System according to the operational plan or by the  SPMS-2827 - Signaller.

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

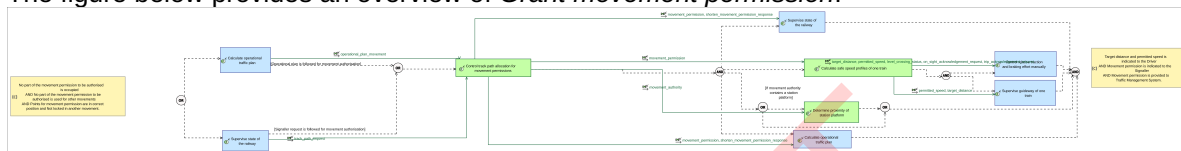




Figure 9 Diagram [LFCD] Grant movement permission [Functional chain description]

ID	SPMS-4462
Pre Condition	<p>No part of the movement permission to be authorised is occupied AND No part of the movement permission 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>

2.1.2.3-3 - Grant movement permission (Operational plan - Traffic CS view)

This scenario describes the sequence of functions related to each other to grant a movement permission requested by the  SPMS-2813 - Traffic Management System according to the operational plan from  SPMS-2823 - Traffic CS System view.

The figure below provides an overview of *Grant movement permission (Operational plan - Traffic CS*

view).

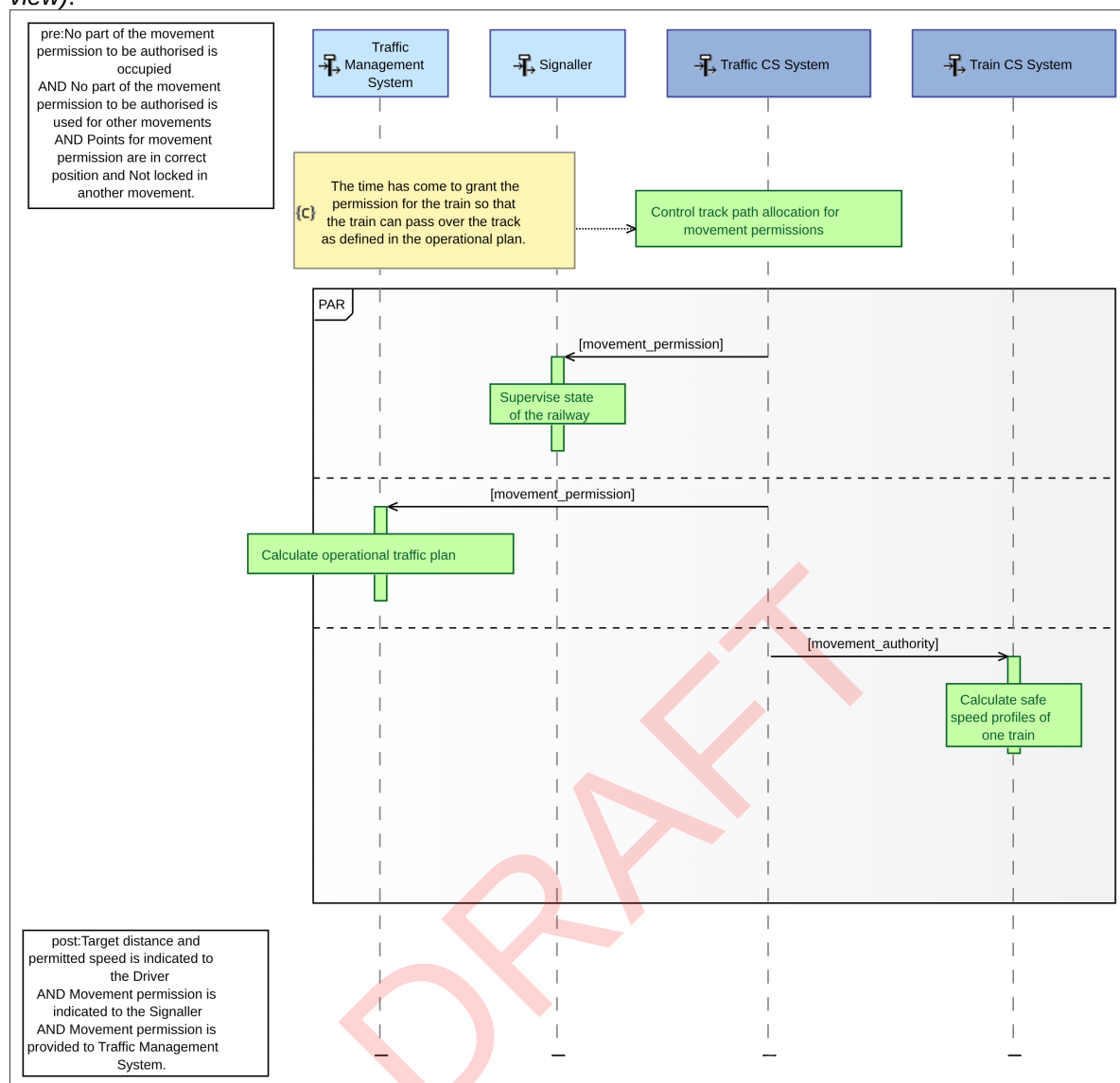




Figure 10 Diagram [LES] Grant movement permission (Operational plan - Traffic control and supervision view) [Exchange scenario]

ID	SPMS-5645
Pre Condition	No part of the movement permission to be authorised is occupied AND No part of the movement permission 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.

2.1.2.3-4 - Grant movement permission (Signaller request - Traffic CS view)

This scenario describes the sequence of functions related to each other to grant a movement permission requested by the  SPMS-2827 - Signaller from  SPMS-2823 - Traffic CS System view.

The figure below provides an overview of *Grant movement permission (Signaller request - Traffic CS*

view).

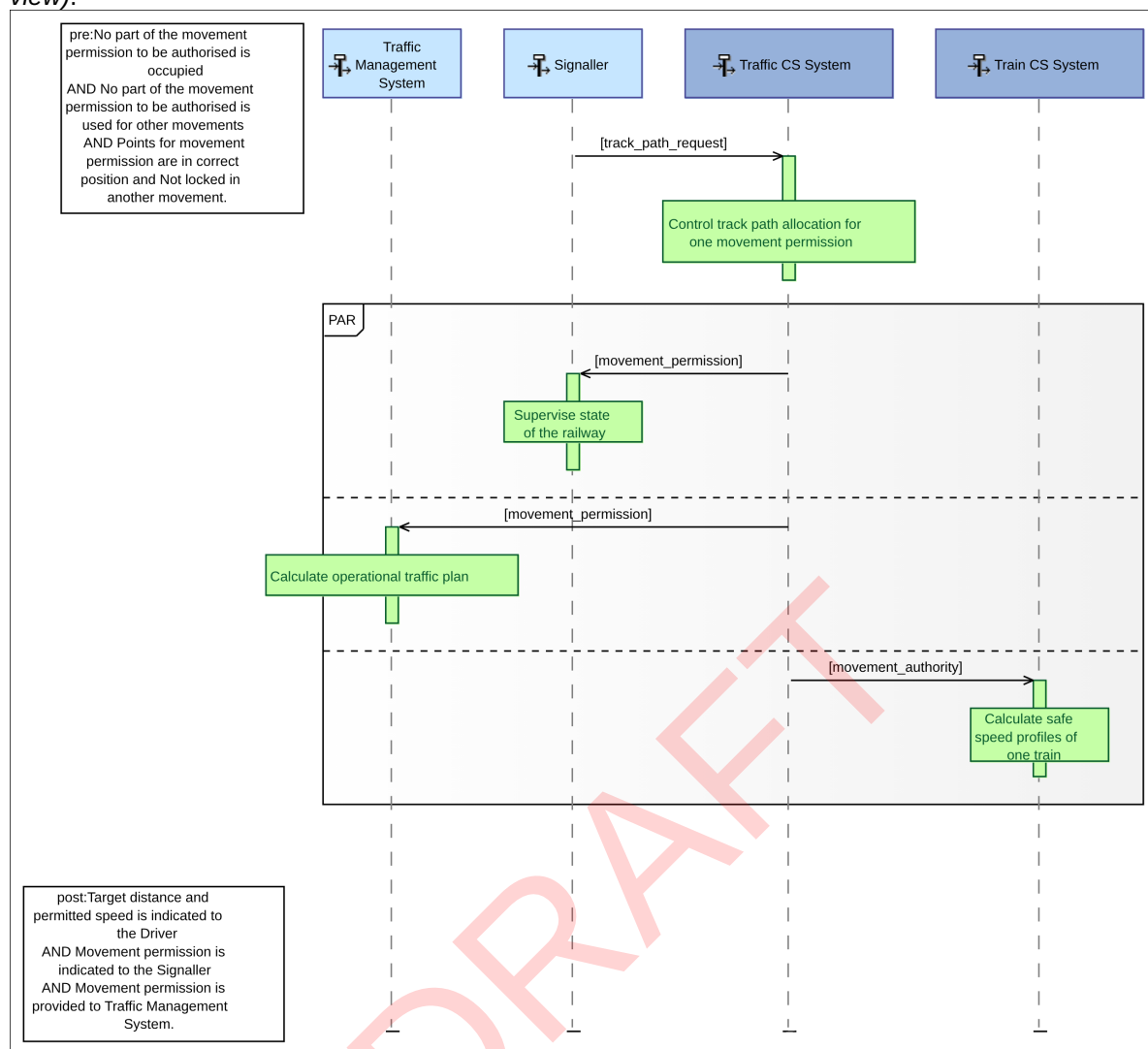


Figure 11 Diagram [LES] Grant movement permission (Signaller request - Traffic control and supervision view) [Exchange scenario]



ID	SPMS-5811
Pre Condition	No part of the movement permission to be authorised is occupied AND No part of the movement permission 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.

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, ensuring that all permissions are managed with full consideration of safety constraints. Safe movement authorizations and driving limitations are constrained by infrastructure characteristics, train characteristics, and the track layout. The

system must ensure that the release of movement permissions does not conflict with the operational plan.

ID	SPMS-5345
Involved entities	<ul style="list-style-type: none"> •  SPMS-2807 - Train CS System •  SPMS-2818 - Trackside Assets CS System

2.1.2.4-2 - 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*.

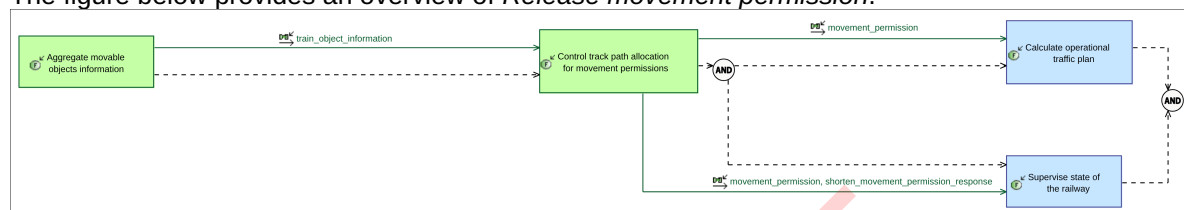


Figure 12 Diagram [LFCD] Release movement permission [Functional chain description]

ID	SPMS-5364
Pre Condition	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

2.1.2.4-3 - 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*.

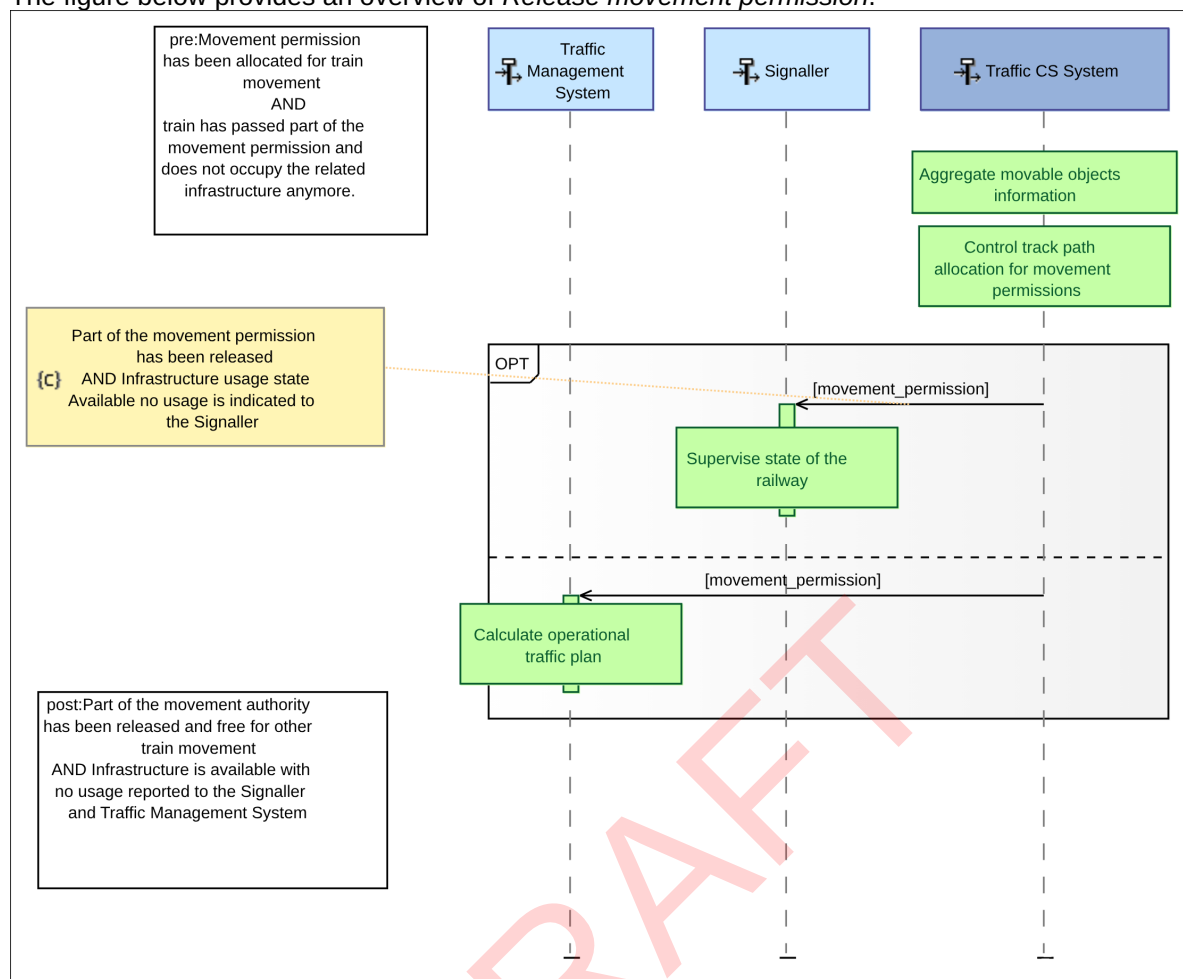


Figure 13 Diagram [LES] Release movement permission [Exchange scenario]

ID	SPMS-5369
Pre Condition	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






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

2.11.2.5.2 – 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 system if it does not lead to an immediate impact such that the train needs to brake.

ID	SPMS-5041
Involved entities	<ul style="list-style-type: none"> •  SPMS-2807 - Train CS System •  SPMS-2813 - Traffic Management System •  SPMS-2822 - Driver •  SPMS-2823 - Traffic CS System •  SPMS-2827 - Signaller

2.1.2.5-3 - Shorten movement permission (Cooperative shortening of 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 Traffic Management System or by the Signaller.

The figure below provides an overview of *Shorten movement permission (Cooperative shortening of movement permission)*.

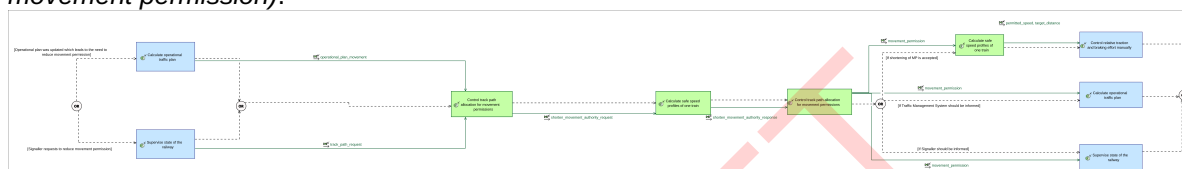


Figure 14 Diagram [LFCD] Shorten movement permission (Cooperative shortening of movement permission) [Functional chain description]

ID	SPMS-5426
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2.1.2.5.1 Shorten movement permission (Signaller request)

2.1.2.5.1-1 - Shorten movement permission (Signaller request, accepted - Traffic CS view)

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

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

Traffic CS view).

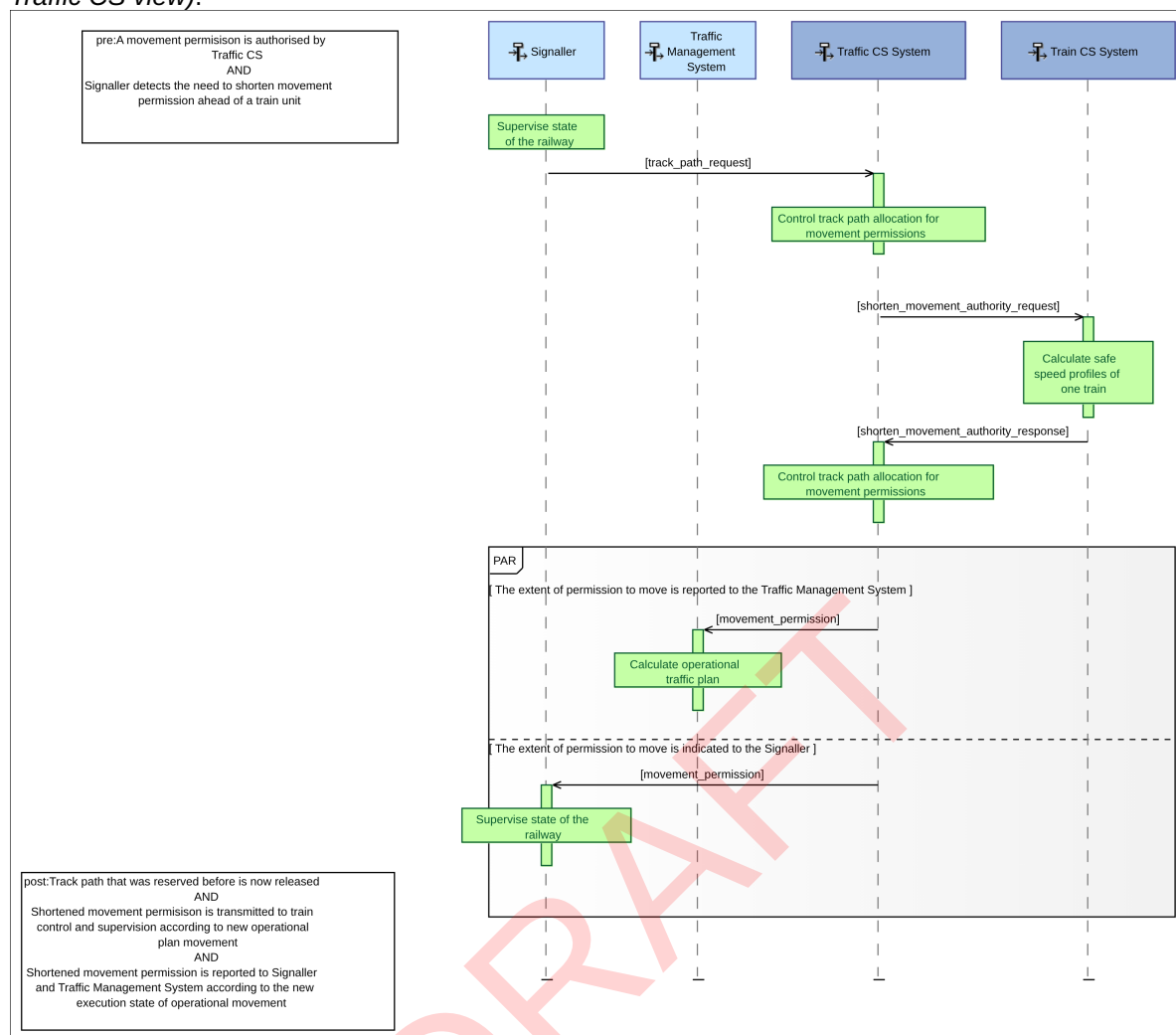


Figure 15 Diagram [LES] Shorten movement permission (Signaller request, accepted - Traffic CS view) [Exchange scenario]

ID	SPMS-5685
Pre Condition	A movement permission is authorised by Traffic CS AND Signaller detects the need to shorten movement permission ahead of a train unit
Post Condition	Track path that was reserved before is now released AND Shortened movement permission is transmitted to train control and supervision according to new operational plan movement AND Shortened movement permission is reported to Signaller and Traffic Management System according to the new execution state of operational movement

2.1.2.5.1-2 - Shorten movement permission (Signaller request, rejected)

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

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

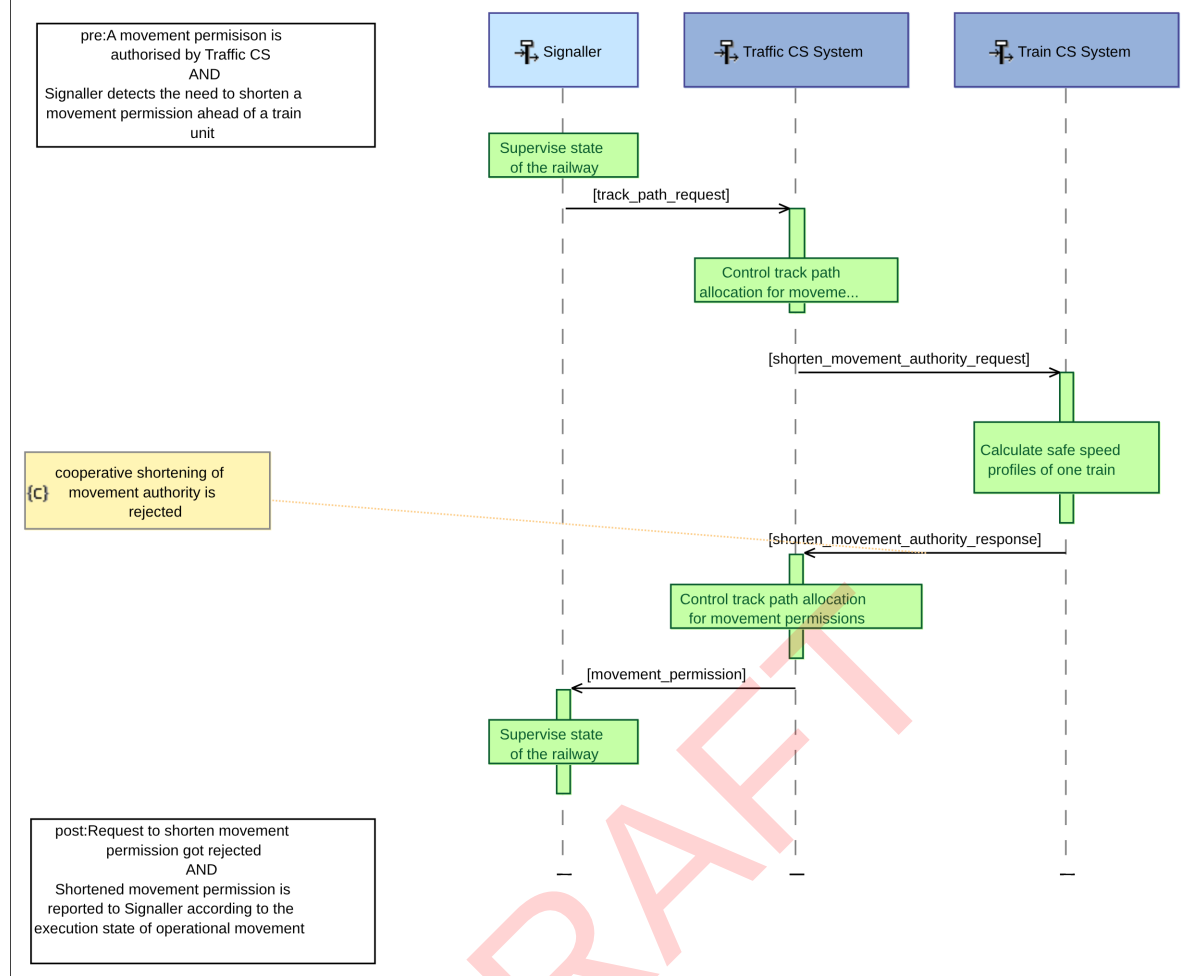


Figure 16 Diagram [LES] Shorten movement permission (Signaller request, rejected) [Logical exchange scenario]

ID	SPMS-5171
Pre Condition	A movement permission is authorised by Traffic CS AND Signaller detects the need to shorten a movement permission ahead of a train unit
Post Condition	Request to shorten movement permission got rejected AND Shortened movement permission is reported to Signaller according to the execution state of operational movement

2.1.2.5.2 Shorten movement permission (Operational plan change)

2.1.2.5.2-1 - Shorten movement permission (Operational plan change, accepted - Traffic CS view)

This exchange scenario describes the exchange of information on the interfaces of the Traffic CS System when a shortening request for an active movement permission is triggered by the Traffic Management System and will be accepted by the Traffic CS System, focusing on the Traffic CS view.

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

accepted - Traffic CS view).

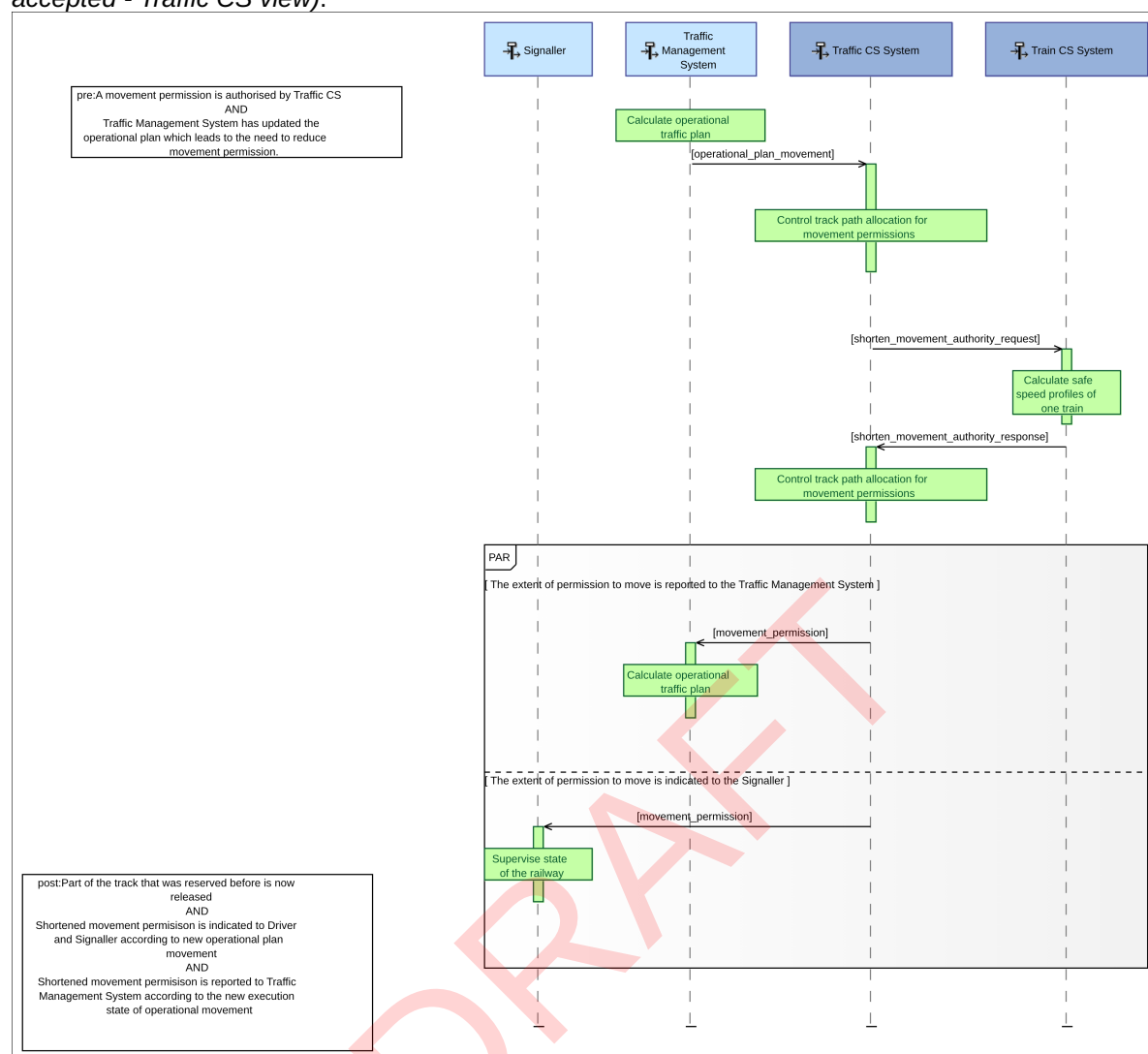


Figure 17 Diagram [LES] Shorten movement permission (Operational plan change, accepted - Traffic CS view) [Logical exchange scenario]

ID	SPMS-5684
Pre Condition	A movement permission is authorised by Traffic CS AND Traffic Management System has updated the operational plan which leads to the need to reduce movement permission.
Post Condition	Part of the track that was reserved before is now released AND Shortened movement permission is indicated to Driver and Signaller according to new operational plan movement AND Shortened movement permission is reported to Traffic Management System according to the new execution state of operational movement

2.1.2.5.2-2 - Shorten movement permission (Operational plan change, rejected)

This exchange scenario describes the exchange of information on the interfaces of the Traffic CS System when a shortening request for an active movement permission is triggered by the Traffic Management

System and will be rejected by the Traffic CS System.

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

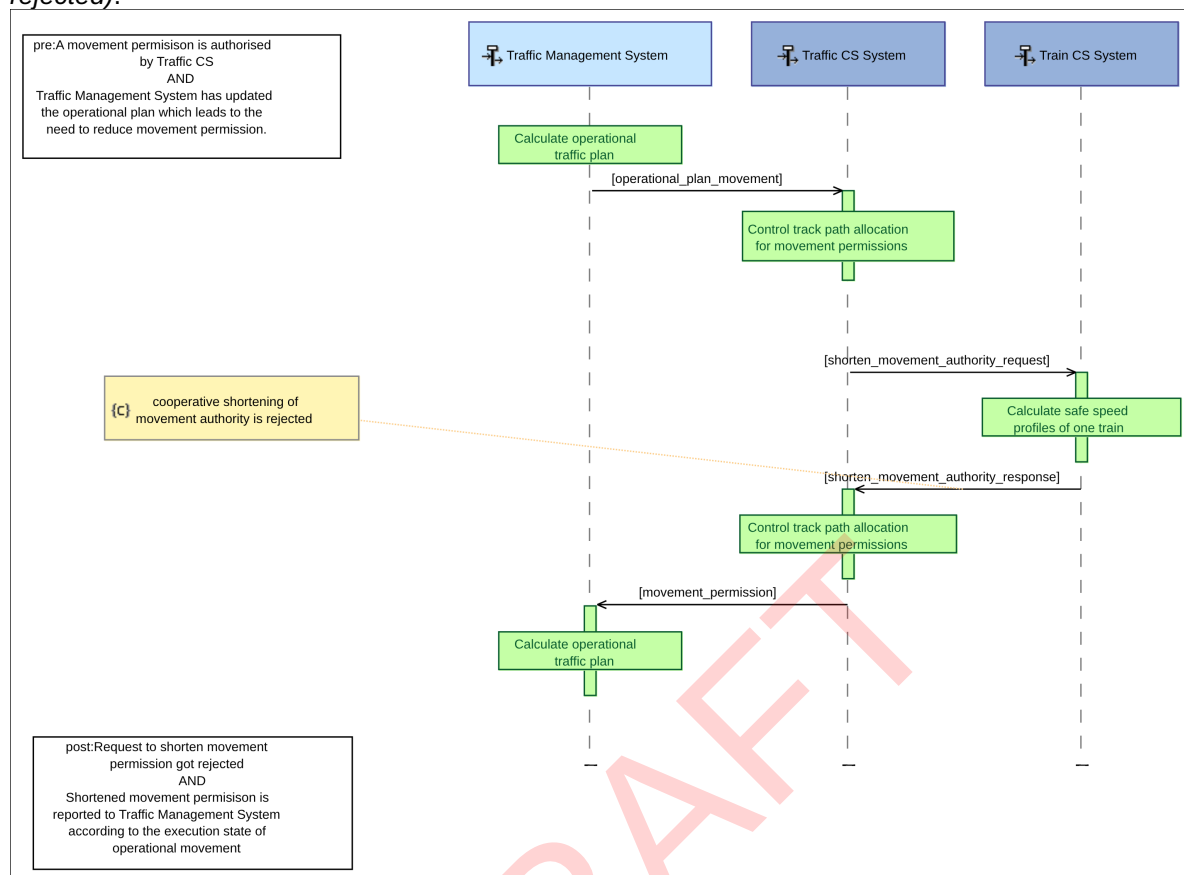


Figure 18 Diagram [LES] Shorten movement permission (Operational plan change, rejected) [Exchange scenario]






ID	SPMS-5131
Pre Condition	A movement permission is authorised by Traffic CS 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 AND Shortened movement permission is reported to Traffic Management System according to the execution state of operational movement

2.1.2.6 Set point position



2.1.2.6-1 - 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).

ID	SPMS-3312
----	-----------

Involved entities	<ul style="list-style-type: none"> •  SPMS-2812 - Point Machine •  SPMS-2813 - Traffic Management System •  SPMS-2818 - Trackside Assets CS System •  SPMS-2823 - Traffic CS System •  SPMS-2827 - Signaller
-------------------	--

2.1.2.6-2 - 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 19 Diagram [LFCD] Set point position [Functional chain description]

ID	SPMS-4476
Pre Condition	The estimated position of the point is not in the required end position
Post Condition	<p>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.</p>

2.1.2.6-3 - Set point position (Left to right, Operational plan - Traffic CS view)

This scenario describes the sequence of functions related to each other in case of an operational plan movement requiring "right end position" point position request by the  SPMS-2813 - Traffic Management System from  SPMS-2823 - Traffic CS System view.

The figure below provides an overview of *Set point position (Left to right, Operational plan - Traffic CS*

view).

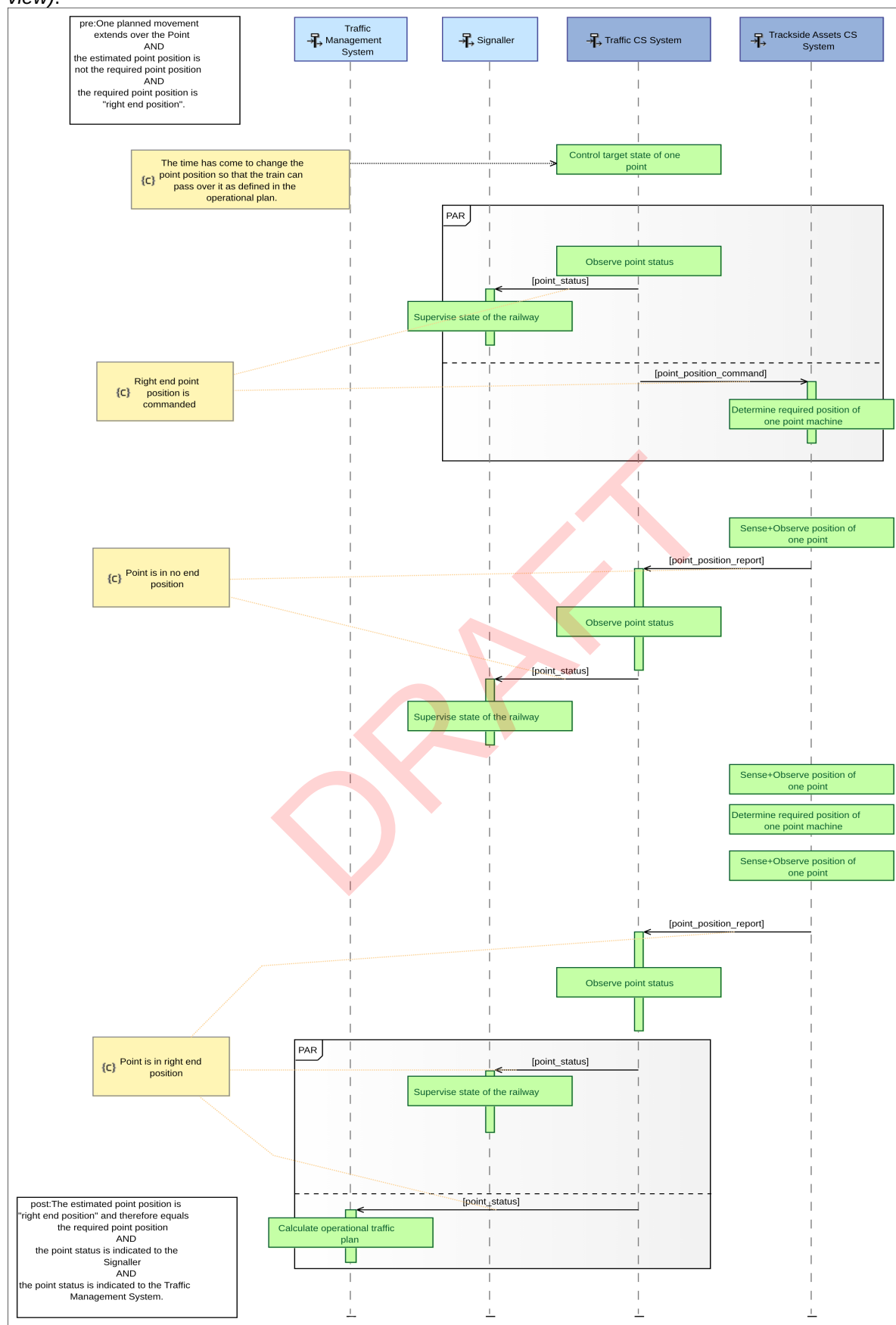




Figure 20 Diagram [LES] Set point position (Left to right, Operational plan - Traffic CS view) [Logical exchange scenario]

ID	SPMS-4715
Pre Condition	<p>One planned movement extends over the Point AND the estimated point position is not the required point position AND the required point position is "right end position".</p>
Post Condition	<p>The estimated point position is "right end position" and therefore equals the required point position AND the point status is indicated to the Signaller AND the point status is indicated to the Traffic Management System.</p>

2.1.2.6-4 - Set point position (Left to right, Signaller request - Traffic CS view)

This scenario describes the sequence of functions related to each other in case of a "right end position" point position request by the  SPMS-2827 - Signaller from  SPMS-2823 - Traffic CS System view. The figure below provides an overview of *Set point position (Left to right, Signaller request - Traffic CS*

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view).

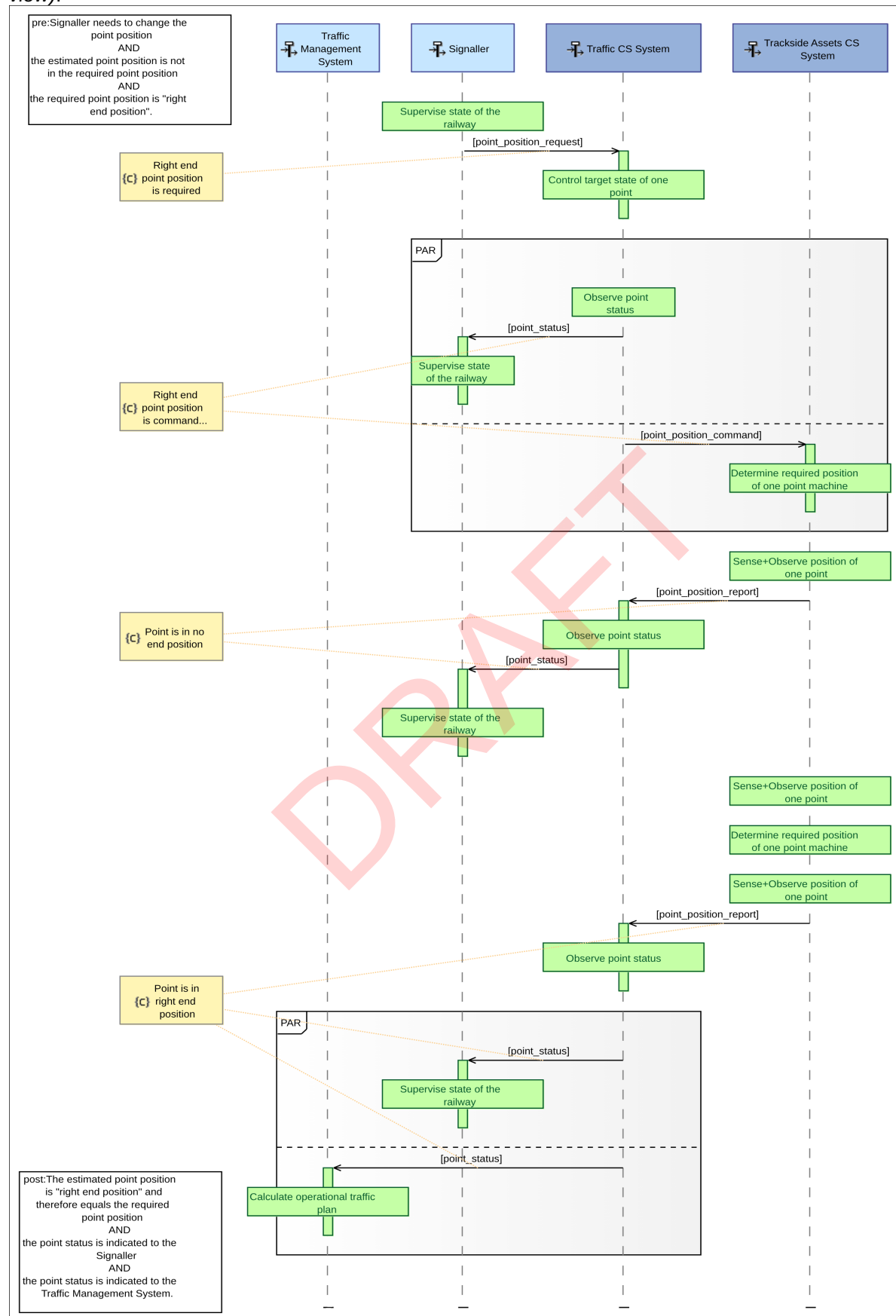


Figure 21 Diagram [LES] Set point position (Left to Right, Signaller request - Traffic CS view) [Logical exchange scenario]





ID	SPMS-4788
Pre Condition	Signaller needs to change the point position AND the estimated point position is not in the required point position AND the required point position is "right end position".
Post Condition	The estimated point position is "right end position" and therefore equals the required point position AND the point status is indicated to the Signaller AND the point status is indicated to the Traffic Management System.

2.1.2.7 Activate usage restriction



2.1.2.7-1 - 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 planned or unplanned restriction area.

ID	SPMS-3318
Involved entities	<ul style="list-style-type: none"> •  SPMS-2813 - Traffic Management System •  SPMS-2818 - Trackside Assets CS System •  SPMS-2823 - Traffic CS System •  SPMS-2827 - Signaller

2.1.2.7-2 - Activate usage restriction

This functional chain describes the sequence of functions related to each other in case of an activation request by the  SPMS-2813 - Traffic Management System for a planned usage restriction or by the  SPMS-2827 - Signaller for an unplanned usage restriction.

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

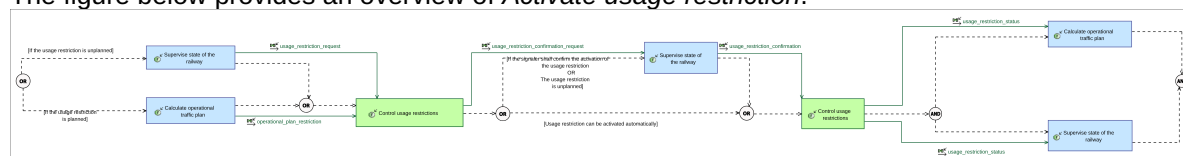



Figure 22 Diagram [LFCD] Activate usage restriction [Functional chain description]

ID	SPMS-4469
Pre Condition	Planned usage restriction is available in CCS system, provided ba operational plan.

Post Condition	<p>The usage restriction is activated AND Signaller and Traffic Management System are informed about the activation status.</p>
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2.1.2.7-3 - 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-2813 - Traffic Management System for a planned usage restriction.

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

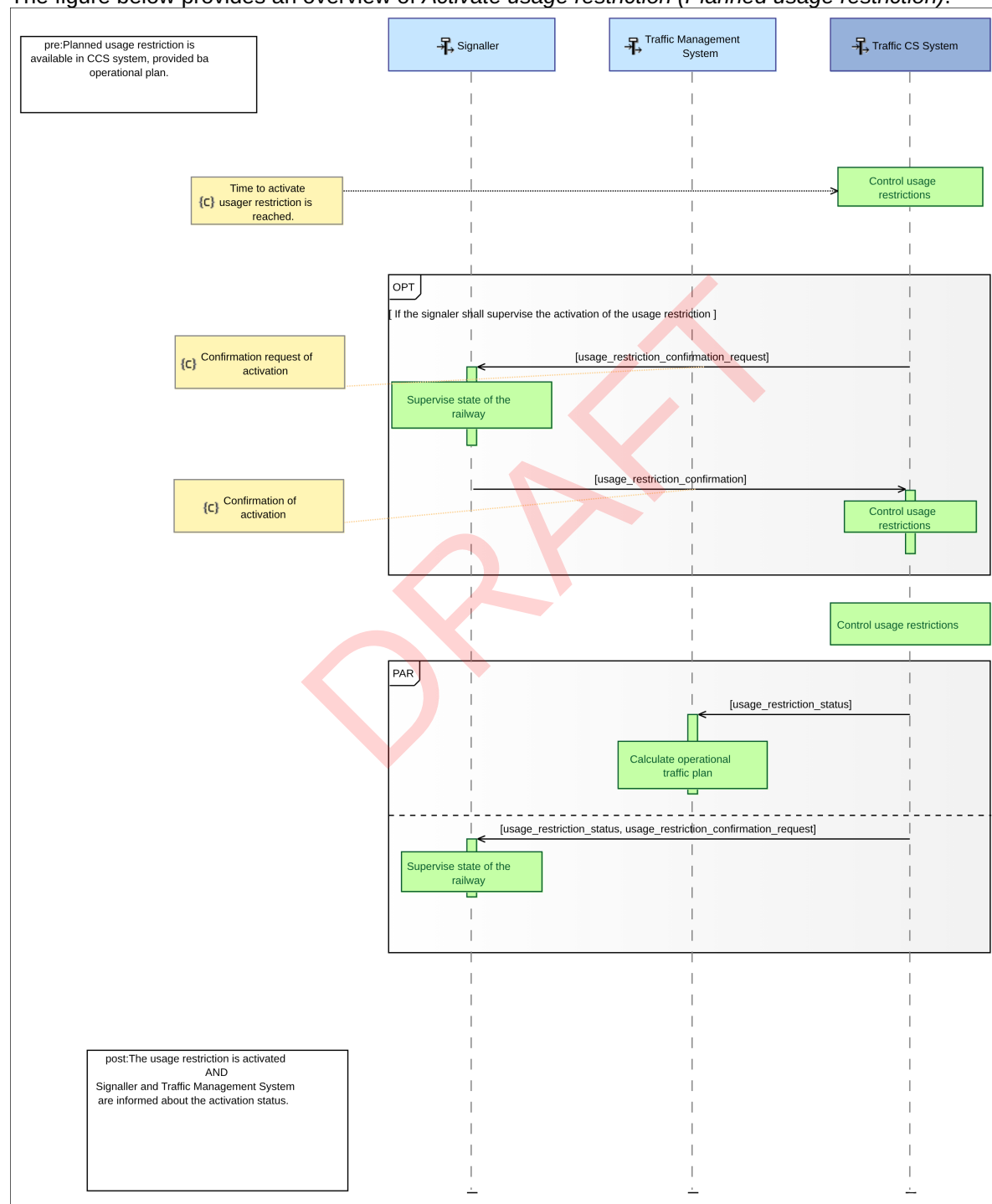



Figure 23 Diagram [LES] Activate planned usage restriction (Planned usage restriction) [Logical exchange scenario]

ID	SPMS-4355
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.

2.1.2.7-4 - Activate usage restriction (Unplanned TSR)

This scenario describes the sequence of functions related to each other in case of an activation request by the  SPMS-2090 - Signaller for an unplanned temporary speed restriction.

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

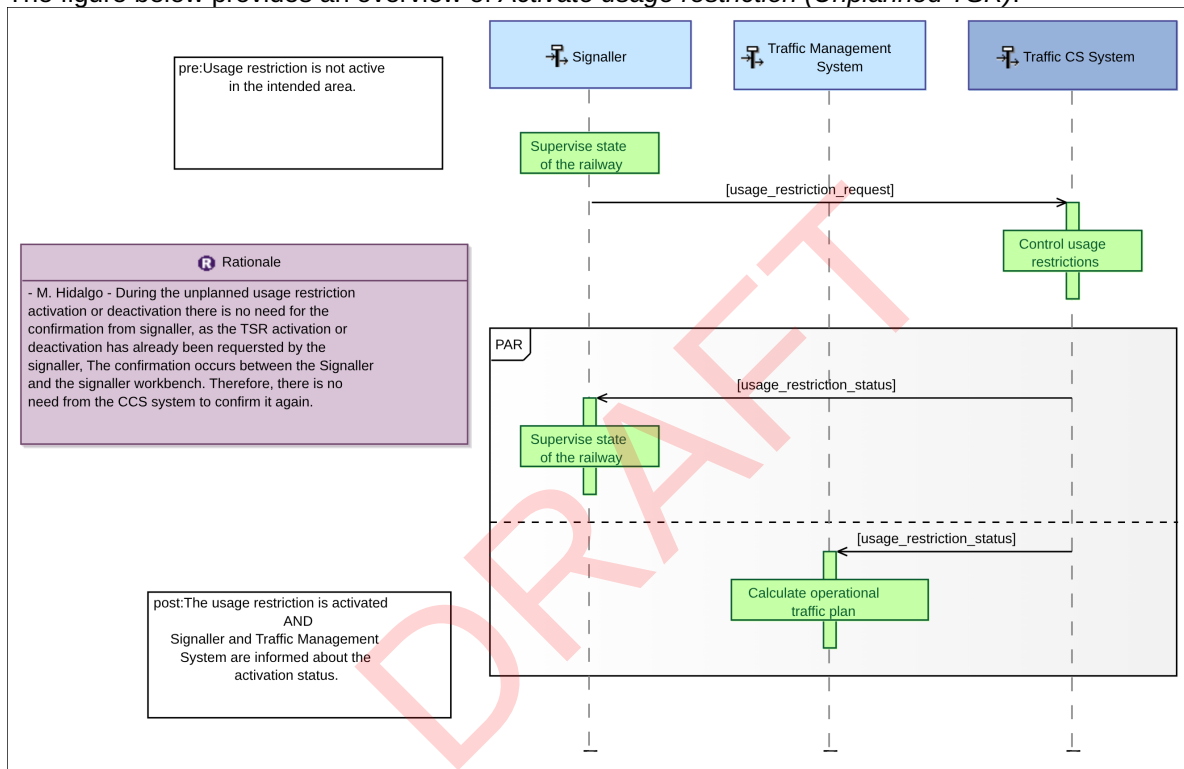


Figure 24 Diagram [LES] Activate usage restriction (Unplanned TSR)

ID	SPMS-7246
Pre Condition	Usage restriction is not active in the intended area.
Post Condition	The usage restriction is activated AND Signaller and Traffic Management System are informed about the activation status.

2.1.2.8 Deactivate usage restriction





2.1.2.8-1 - 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.

The Signaller needs the system to consider and deactivate 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.

Note: Activation and deactivation need both to be implemented safely by the system. At this stage, the potential different criticalities of activation or deactivation 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-4518
Involved entities	<ul style="list-style-type: none"> •  SPMS-2813 - Traffic Management System •  SPMS-2818 - Trackside Assets CS System •  SPMS-2823 - Traffic CS System •  SPMS-2827 - Signaller

2.1.2.8-2 - Deactivate usage restriction

This functional chain describes the sequence of functions related to each other in case of a deactivation request by the ♂ SPMS-2813 - Traffic Management System for a planned usage restriction or by the ♀ SPMS-2827 - Signaller for an unplanned usage restriction.

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

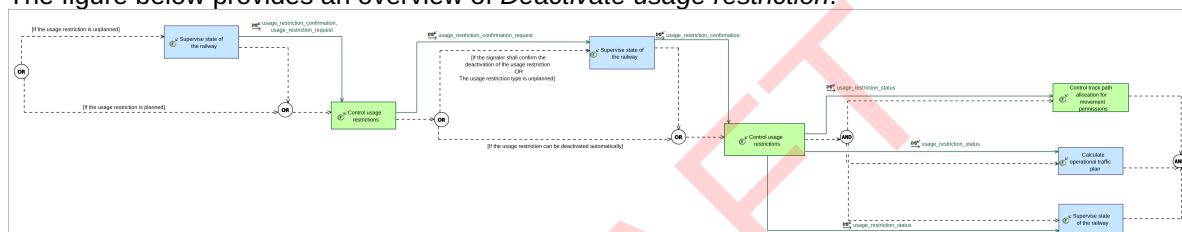


Figure 25 Diagram [LFCD] Deactivate usage restriction [Functional chain description]

ID	SPMS-4470
Post Condition	The usage restriction is activated AND Signaller and Traffic Management System are informed about the activation status.

2.1.2.8-3 - 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-2813 - Traffic Management System for a planned usage restriction.

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

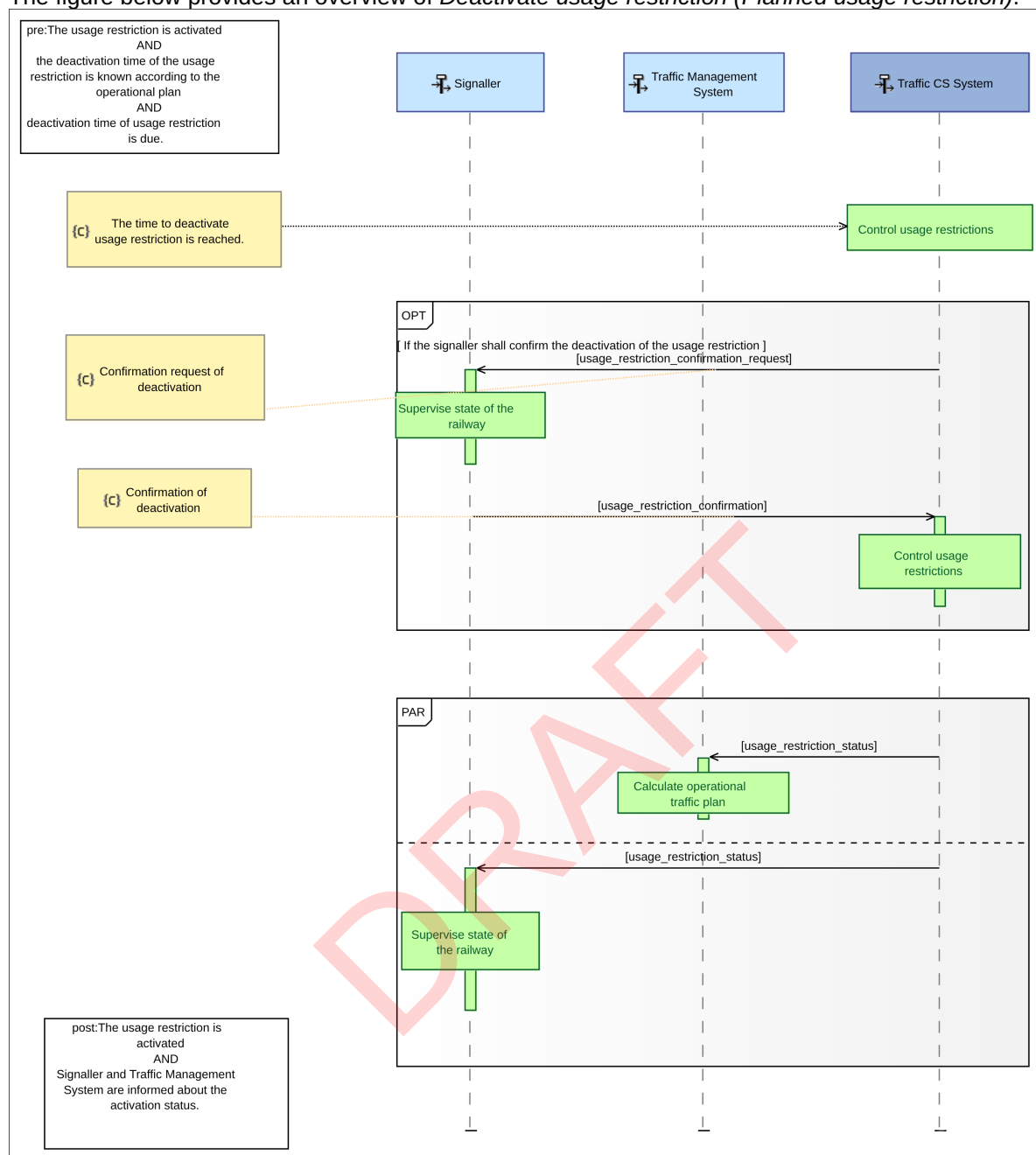


Figure 26 Diagram [LES] Deactivate usage restriction (Planned usage restriction) [Logical exchange scenario]

ID	SPMS-4363
Pre Condition	The usage restriction is activated AND the deactivation time of the usage restriction is known according to the operational plan AND deactivation time of usage restriction is due.
Post Condition	The usage restriction is activated AND Signaller and Traffic Management System are informed about the activation status.

2.1.2.8-4 - Deactivate usage restriction (Unplanned TSR)

This scenario describes the sequence of functions related to each other in case of a deactivation request by the ♀ SPMS-2090 - Signaller for an unplanned temporary speed restriction.

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

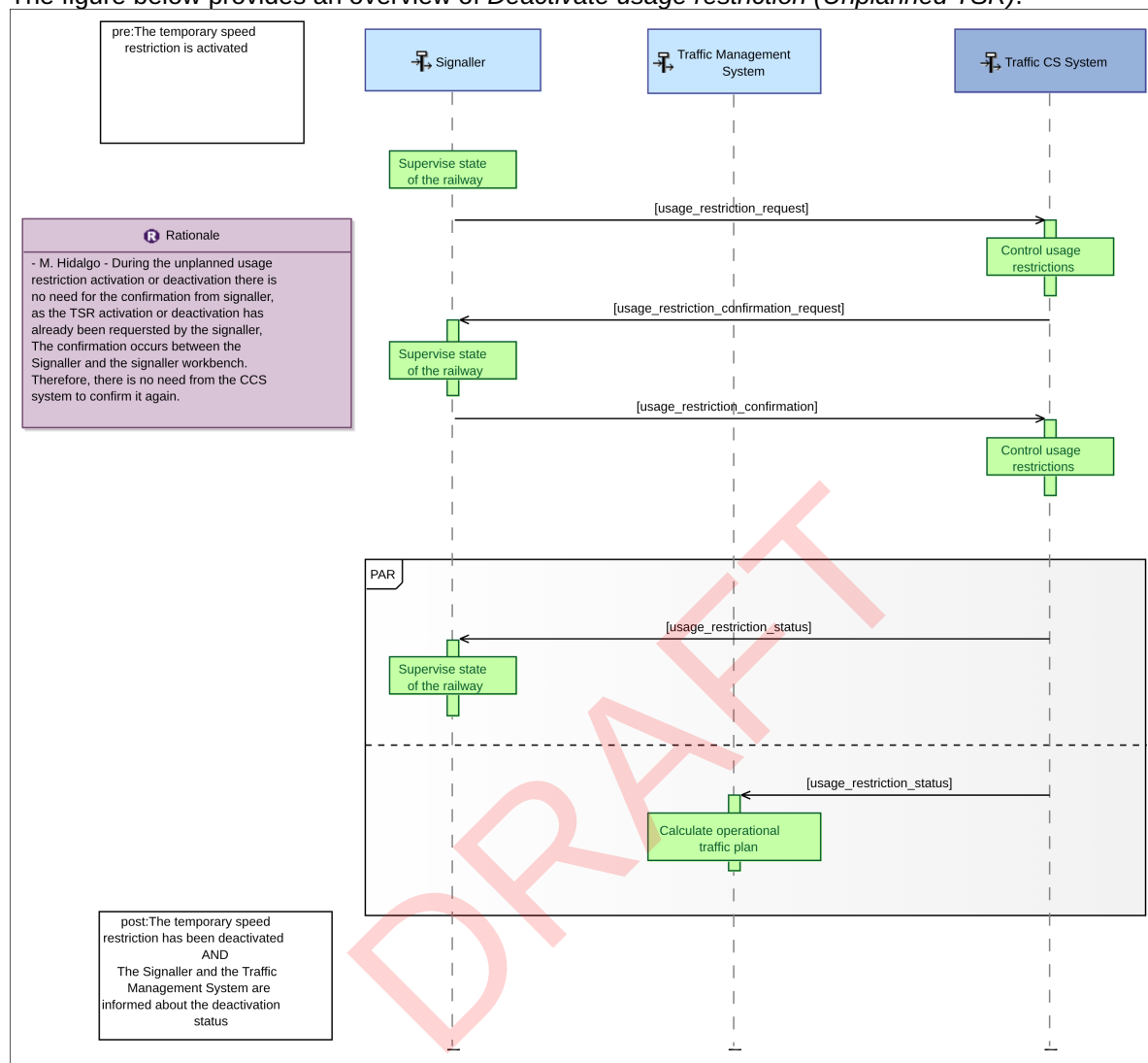


Figure 27 Diagram [LES] Deactivate usage restriction (Unplanned TSR)








ID	SPMS-7249
Pre Condition	The temporary speed restriction is activated
Post Condition	<p>The temporary speed restriction has been deactivated AND The Signaller and the Traffic Management System are informed about the deactivation status</p>

2.1.2.9 Drive train automatically

2.1.2.9-1 - 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-5346
Involved entities	<ul style="list-style-type: none"> •  SPMS-2807 - Train CS System •  SPMS-2809 - Rolling Stock Reference Point •  SPMS-2813 - Traffic Management System •  SPMS-2820 - Rolling Stock Operation System •  SPMS-2822 - Driver •  SPMS-2823 - Traffic CS System •  SPMS-2829 - Wheel

2.1.2.9-2 - 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 28 Diagram [LFCD] Drive train automatically [Functional chain description]

ID	SPMS-5365
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]

2.1.2.9-3 - Drive train automatically (Operational plan - Traffic CS view)

This scenario describes the sequence of functions related to each other to drive a train automatically according to the operational plan from  SPMS-2823 - Traffic CS System view.

The figure below provides an overview of *Drive train automatically (Operational plan - Traffic CS view)*.

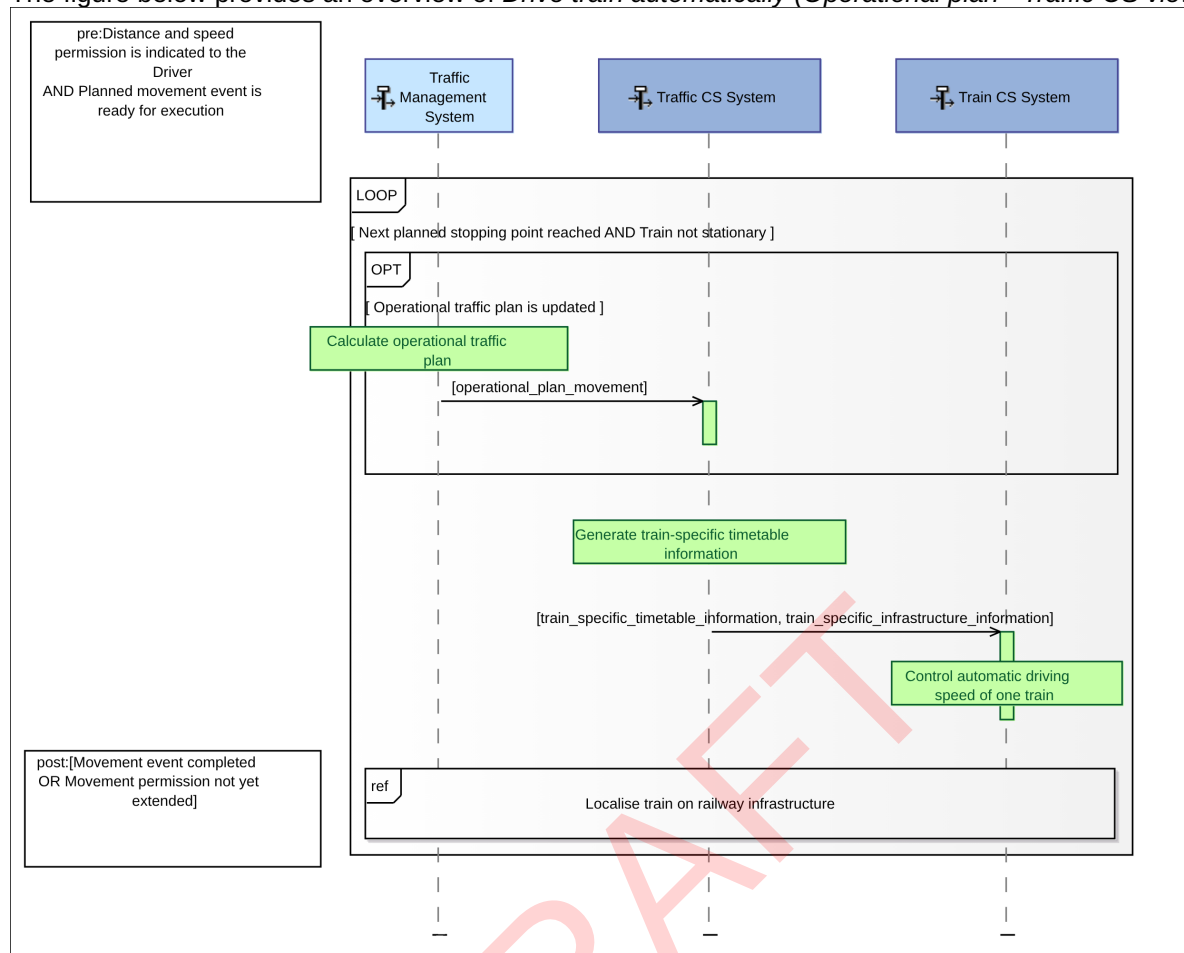







Figure 29 Diagram [LES] Drive train automatically (Operational plan - Traffic CS view) [Logical exchange scenario]

ID	SPMS-5740
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]

2.1.2.10 Open train doors

2.1.2.10-1 - Open train doors

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

ID	SPMS-6888
Involved entities	<ul style="list-style-type: none"> •  SPMS-2807 - Train CS System •  SPMS-2813 - Traffic Management System •  SPMS-2820 - Rolling Stock Operation System •  SPMS-2822 - Driver •  SPMS-2823 - Traffic CS System

2.1.2.10-2 - Open train doors

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

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

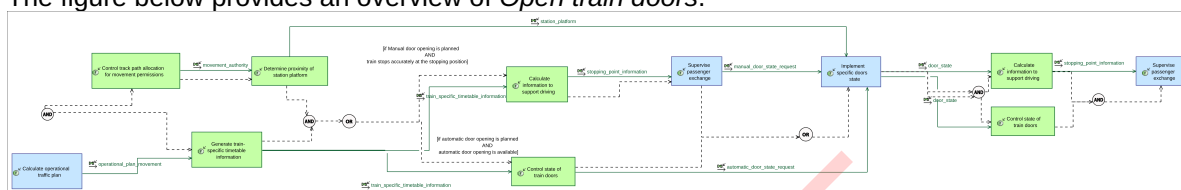


Figure 30 Diagram [LFCD] Open train doors [Functional chain description]

ID	SPMS-6911
Pre Condition	<p>Train is localised and in standstill AND train doors are closed and unlocked AND train doors side (right/left/both) to be open are known AND train doors opening operation (manual/automatic) 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 remaining dwell time.</p>

2.1.2.10-3 - Open train doors

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

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

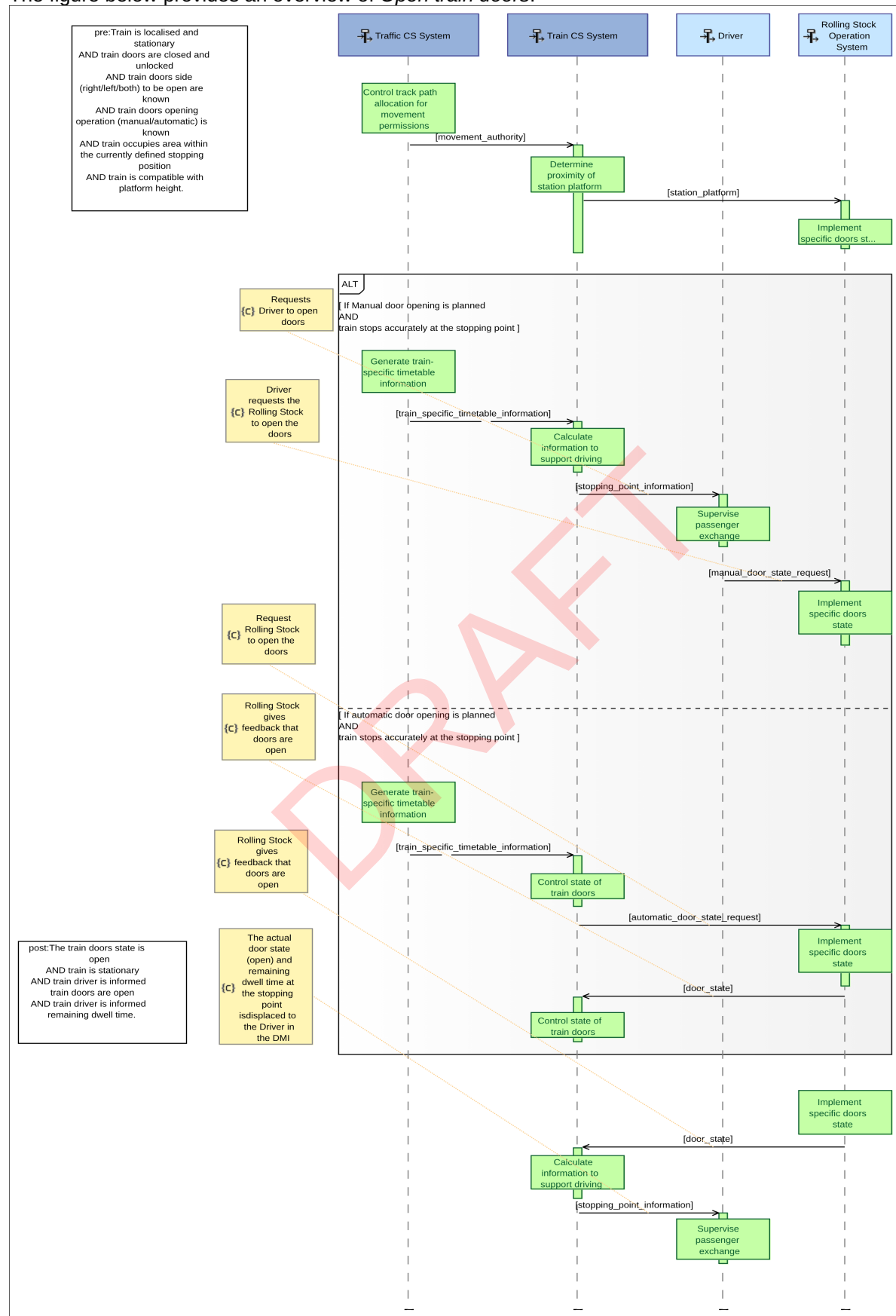


Figure 31 Diagram [LES] Open train doors [Exchange scenario]

ID	SPMS-6899
Pre Condition	<p>Train is localised and in standstill AND train doors are closed and unlocked AND train doors side (right/left/both) to be open are known AND train doors opening operation (manual/automatic) 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 remaining dwell time.</p>

2.1.2.11 Close train doors

2.1.2.11-1 - 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 CCS System

ID	SPMS-3304
Involved entities	<ul style="list-style-type: none"> SPMS-2807 - Train CS System SPMS-2820 - Rolling Stock Operation System SPMS-2822 - Driver SPMS-2823 - Traffic CS System

2.1.2.11-2 - 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.

The figure below provides an overview of Close train doors.

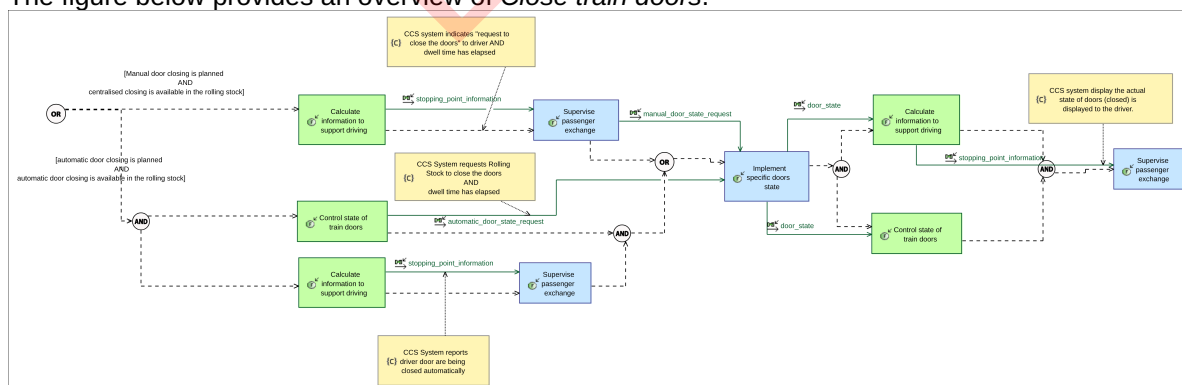


Figure 32 Diagram [LFCD] Close train doors

ID	SPMS-4471
Pre Condition	<p>The train doors state is open AND train is in standstill AND Operational plan is known AND passenger exchange is completed.</p>

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.
----------------	--

2.1.2.11-3 - 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 Traffic and Train CS during the SysC Perform Train Movement

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

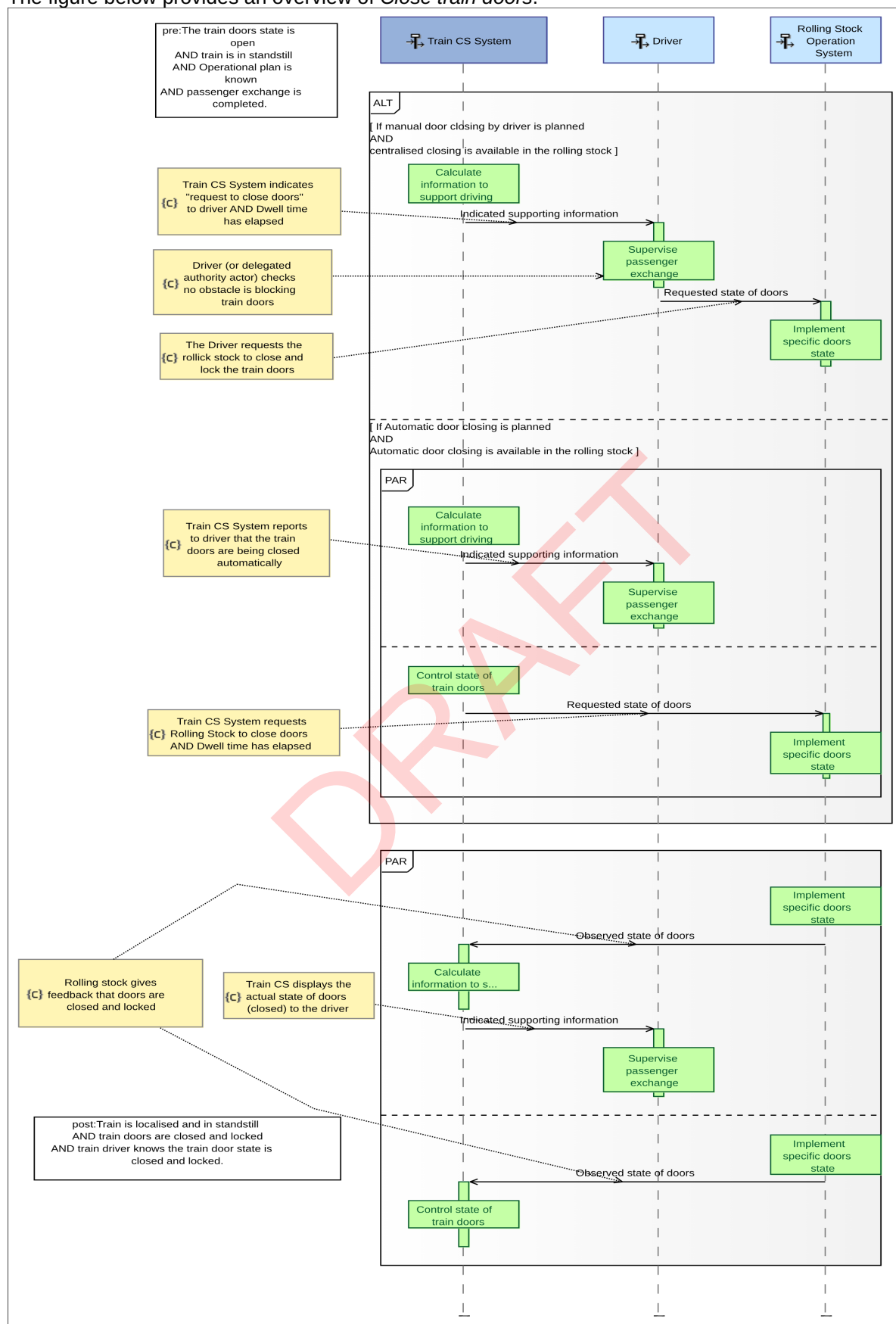





Figure 33 Diagram [LES] Close train doors

ID	SPMS-4381
Pre Condition	<p>The train doors state is open AND train is in standstill AND Operational plan is known AND passenger exchange is completed.</p>
Post Condition	<p>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.</p>

2.1.2.12 Execute End of Mission

2.1.2.12-1 - Execute end of mission

The Driver, Signaller and Traffic Management System needs the CCS reference system to execute the end of mission. This capability includes the deregistration of functional number, the cab closure as well as powering off the rolling stock.

ID	SPMS-3313
Involved entities	<ul style="list-style-type: none"> •  SPMS-2820 - Rolling Stock Operation System •  SPMS-2822 - Driver •  SPMS-2827 - Signaller

2.1.2.12-2 - Execute end of mission

This functional chain describes the sequence of functions related to each other in case an End of Mission (i.e. cab closure and possibly power off) is executed by the driver.

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

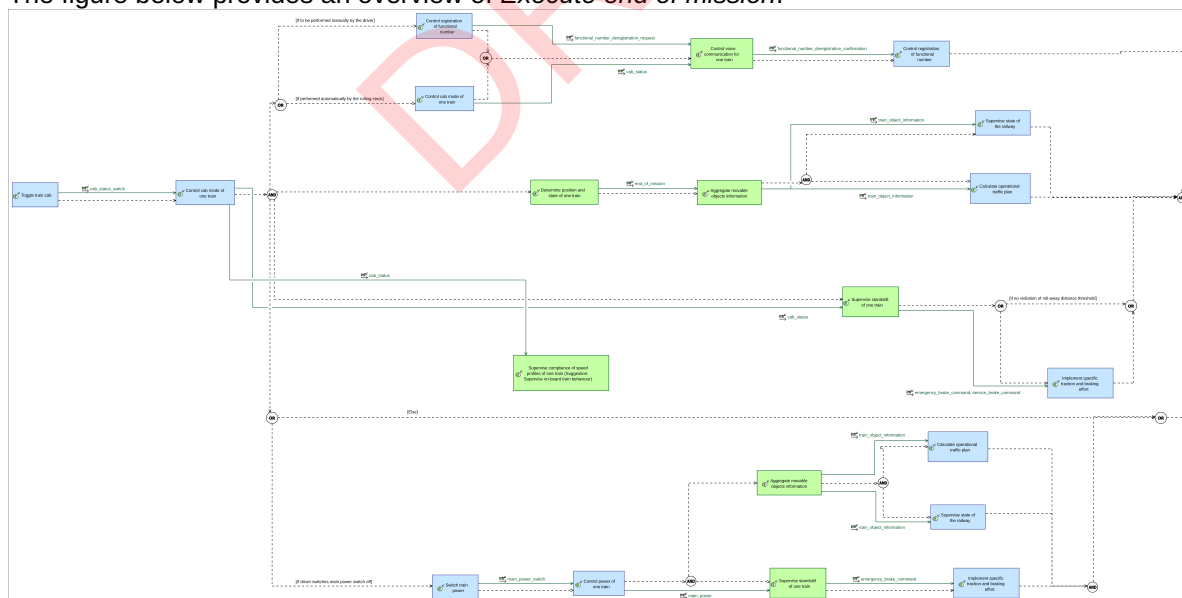


Figure 34 Diagram [LFCD] Execute end of mission [Functional chain description]

ID	SPMS-5703
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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

2.1.2.12-3 - Execute end of mission (Traffic CS view)

This exchange scenario (focusing on the Traffic CS view) describes the exchange of information on the interfaces of the Traffic CS System when an End of Mission (i.e. cab closure and possibly power off) is executed by Train CS.

The figure below provides an overview of *Execute end of mission (Traffic CS view)*.

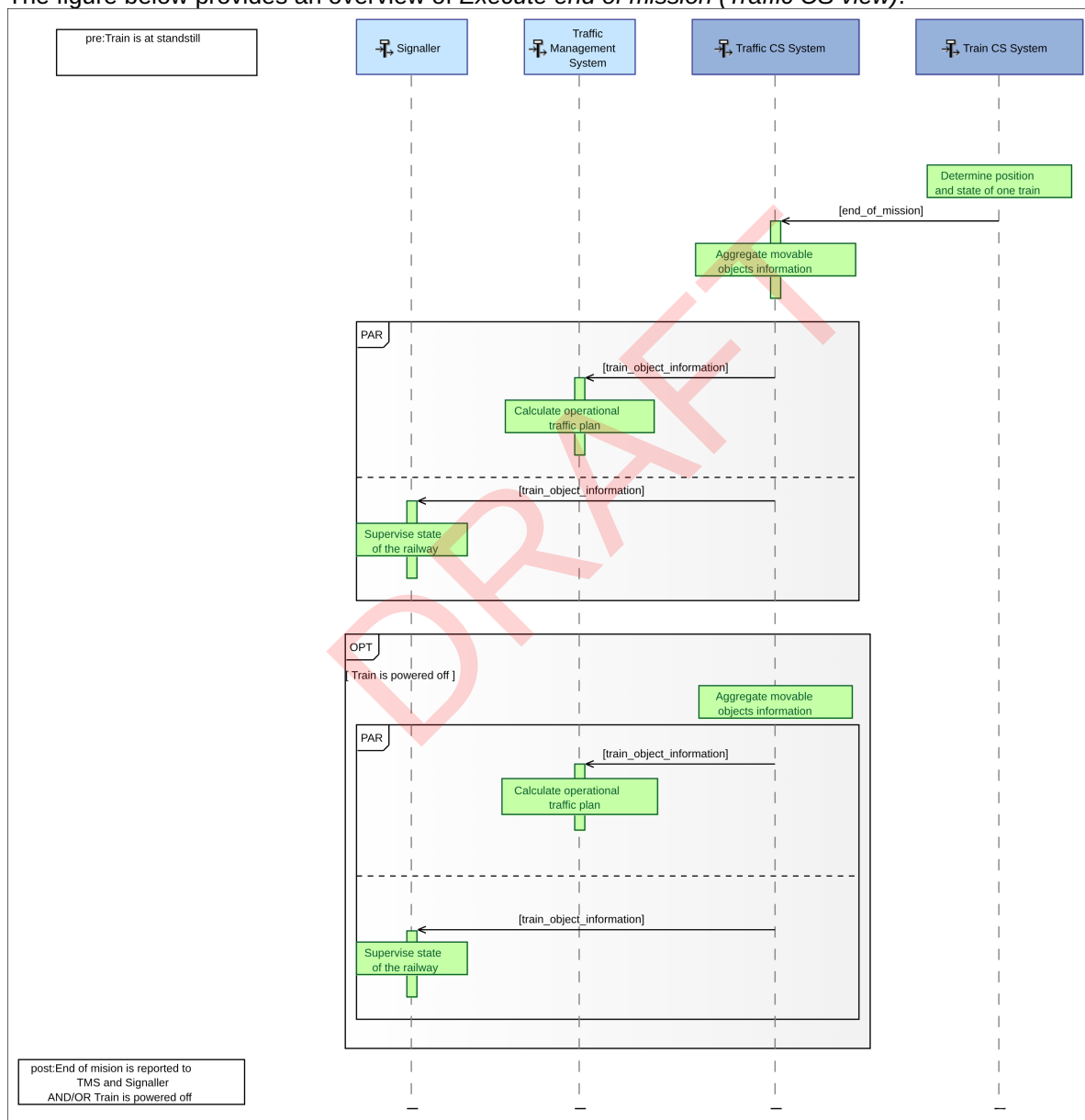


Figure 35 Diagram [LES] Execute end of mission (Traffic CS view)

ID	SPMS-7162
Pre Condition	Train is at standstill

Post Condition	End of mision is reported to TMS and Signaller AND/OR Train is powered off
----------------	---

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.

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2.2 System interfaces




2.2.1 Interfaces and interactions with physical environment











This will be provided in a future release.

2.2.2 Interfaces and interactions with human actors




This section describes the human actors of the Traffic CS system and the interfaces of the Traffic CS system to these actors.

2.2.2-1 - HMI_Signaller_01

The interface  SPMS-2963 - HMI_Signaller_01 connects  SPMS-2827 - Signaller with  SPMS-2823 - Traffic CS System.

ID	SPMS-2963
Exchange items	<ul style="list-style-type: none">  SPMS-2372 - movement_permission  SPMS-2386 - point_position_request  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-5562 - train_object_information  SPMS-7137 - unconditional_emergency_stop_request

2.2.2-2 - HMI_FieldForce_01

The interface  SPMS-4484 - HMI_FieldForce_01 connects  SPMS-2808 - Field Force with  SPMS-2823 - Traffic CS System.

ID	SPMS-4484
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
2.2.3 Interfaces and interactions with external systems

This section describes the external system interacting with the Traffic CS system and the interfaces of the Traffic CS system to these external systems.

2.2.3-1 - I_CCS_1




The interface  SPMS-2952 - I_CCS_1 connects  SPMS-2823 - Traffic CS System with  SPMS-2807 - Train CS System.

ID	SPMS-2952
----	-----------

Exchange items	<ul style="list-style-type: none"> •  SPMS-5446 - shorten_movement_authority_request •  SPMS-5666 - train_specific_timetable_information •  SPMS-5835 - movement_authority •  SPMS-6664 - train_position_report •  SPMS-7042 - end_of_mission •  SPMS-7234 - unconditional_emergency_stop •  SPMS-7235 - acknowledgement_emergency_stop •  SPMS-7242 - shorten_movement_authority_response •  SPMS-7718 - train_specific_infrastructure_information
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

2.2.3-2 - I_CCS_2

The interface  SPMS-2953 - I_CCS_2 connects  SPMS-2823 - Traffic CS System with  SPMS-2818 - Trackside Assets CS System.

ID	SPMS-2953
Exchange items	<ul style="list-style-type: none"> •  SPMS-3283 - point_position_report •  SPMS-3286 - point_position_command •  SPMS-6569 - track_vacancy_proving_section_report

2.2.3-3 - I_CCS_3

The interface  SPMS-2973 - I_CCS_3 connects  SPMS-2819 - Transversal CCS System with  SPMS-2823 - Traffic CS System.

ID	SPMS-2973
Exchange items	<ul style="list-style-type: none"> •  SPMS-2412 - time_reference •  SPMS-3251 - system_state_observation •  SPMS-6465 - configuration_data •  SPMS-6988 - monitoring_data •  SPMS-6989 - diagnostic_data

2.2.3-4 - I_TrafficManagementSystem_01

The interface  SPMS-2958 - I_TrafficManagementSystem_01 connects  SPMS-2813 - Traffic Management System with  SPMS-2823 - Traffic CS System.

ID	SPMS-2958
----	-----------

Exchange items	<ul style="list-style-type: none"> SPMS-2370 - operational_plan_movement SPMS-2372 - movement_permission SPMS-2398 - usage_restriction_status SPMS-5288 - point_status SPMS-5548 - operational_plan_restriction SPMS-5562 - train_object_information
----------------	--

2.2.3-5 - I_CCS_6

The interface SPMS-4619 - I_CCS_6 connects SPMS-2823 - Traffic CS System with SPMS-2823 - Traffic CS System.

The internal interface SPMS-4619 - I_CCS_6 connects an SPMS-2823 - Traffic CS System instance with another SPMS-2823 - Traffic CS System instance.

ID	SPMS-4619
----	-----------

2.3 System functions

2.3.1 Functional overview

2.1.1 - System description shows the allocation of functions to the Traffic CS system and to the external systems and human actors.

[LAB] Traffic CS System [Function allocation]

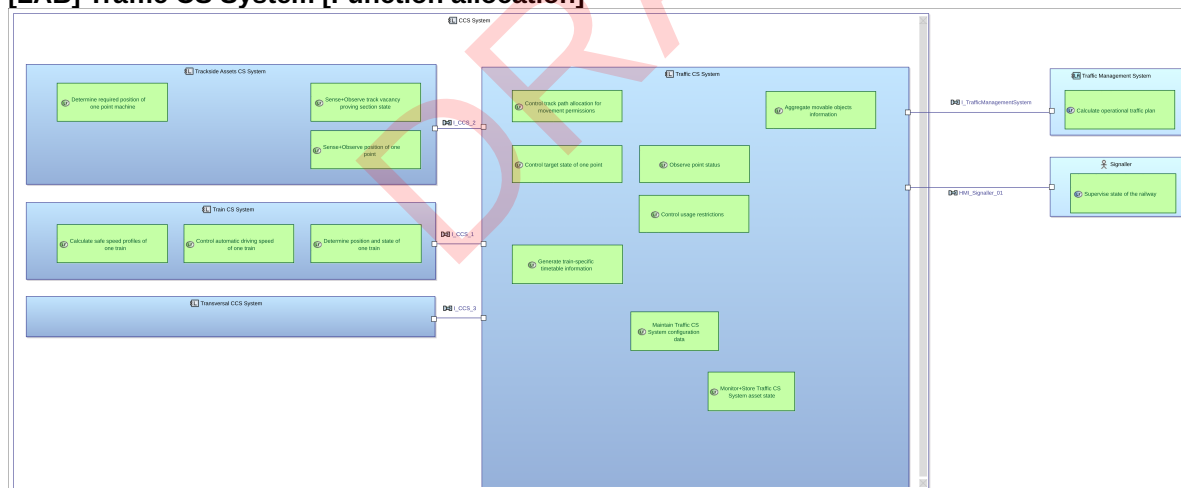


Figure 36 Diagram [LAB] Traffic CS System [Function allocation]

ID	SPMS-4617
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2.3.2 Functions in the scope of the system under consideration

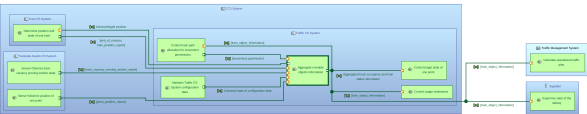




























































This section describes the functions allocated to the Traffic CS system (system under consideration).























2.3.2-1 - Aggregate movable objects information

This function is allocated to  SPMS-2823 - Traffic CS System.


This function aggregates and stores information (e.g. position) submitted by different actors (e.g., Trackside Asset CS, Train CS) and outputs of other functions into an operational state representation of movable objects.

Movable objects are defined as trains and wagons that either submit localisation and/or additional data (such as speed and status) or are localised by alternative technologies such as TTD systems. The scope is extended to include track workers (actor Field Force) that have an own localisation device. Further extension of the scope can be done in the following analysis steps.

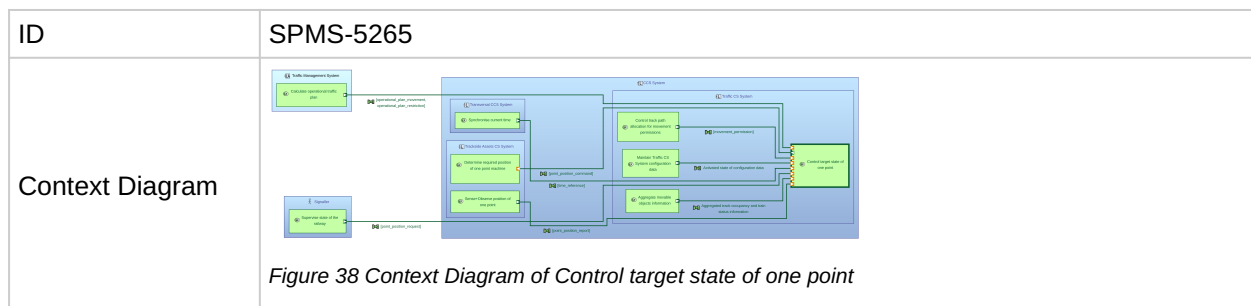
ID	SPMS-2944																				
Context Diagram	<div></div> <p>Figure 37 Context Diagram of Aggregate movable objects information</p>																				
Input exchanges	<table><tr><th>Input exchanges</th><th>Source function</th><th>Function allocated to</th></tr><tr><td><div> SPMS-3039 - Allocated track path</div><ul style="list-style-type: none"><div> SPMS-2372 - movement_permission</div></td><td><div> SPMS-2874 - Control track path allocation for movement permissions</div></td><td><div> SPMS-2823 - Traffic CS Sys</div></td></tr><tr><td><div> SPMS-3212 - Determined train position and state</div><ul style="list-style-type: none"><div> SPMS-7042 - end_of_mission</div><div> SPMS-6664 - train_position_report</div></td><td><div> SPMS-2878 - Determine position and state of one train</div></td><td><div> SPMS-2807 - Train CS Sys</div></td></tr><tr><td><div>No exchange items allocated on  SPMS-3130 - Activated state of configuration data.</div></td><td><div> SPMS-2840 - Maintain Traffic CS System configuration data</div></td><td><div> SPMS-2823 - Traffic CS Sys</div></td></tr><tr><td><div> SPMS-5268 - Observed point position</div><ul style="list-style-type: none"><div> SPMS-3283 - point_position_report</div></td><td><div> SPMS-2914 - Sense+Observe position of one point</div></td><td><div> SPMS-2818 - Trackside As</div></td></tr><tr><td><div> SPMS-4648 - Observed track vacancy proving section state</div><ul style="list-style-type: none"><div> SPMS-6569 - track_vacancy_proving_section_report</div></td><td><div> SPMS-2919 - Sense+Observe track vacancy proving section state</div></td><td><div> SPMS-2818 - Trackside As</div></td></tr></table>	Input exchanges	Source function	Function allocated to	<div> SPMS-3039 - Allocated track path</div> <ul style="list-style-type: none"><div> SPMS-2372 - movement_permission</div>	<div> SPMS-2874 - Control track path allocation for movement permissions</div>	<div> SPMS-2823 - Traffic CS Sys</div>	<div> SPMS-3212 - Determined train position and state</div> <ul style="list-style-type: none"><div> SPMS-7042 - end_of_mission</div><div> SPMS-6664 - train_position_report</div>	<div> SPMS-2878 - Determine position and state of one train</div>	<div> SPMS-2807 - Train CS Sys</div>	<div>No exchange items allocated on  SPMS-3130 - Activated state of configuration data.</div>	<div> SPMS-2840 - Maintain Traffic CS System configuration data</div>	<div> SPMS-2823 - Traffic CS Sys</div>	<div> SPMS-5268 - Observed point position</div> <ul style="list-style-type: none"><div> SPMS-3283 - point_position_report</div>	<div> SPMS-2914 - Sense+Observe position of one point</div>	<div> SPMS-2818 - Trackside As</div>	<div> SPMS-4648 - Observed track vacancy proving section state</div> <ul style="list-style-type: none"><div> SPMS-6569 - track_vacancy_proving_section_report</div>	<div> SPMS-2919 - Sense+Observe track vacancy proving section state</div>	<div> SPMS-2818 - Trackside As</div>		
Input exchanges	Source function	Function allocated to																			
<div> SPMS-3039 - Allocated track path</div> <ul style="list-style-type: none"><div> SPMS-2372 - movement_permission</div>	<div> SPMS-2874 - Control track path allocation for movement permissions</div>	<div> SPMS-2823 - Traffic CS Sys</div>																			
<div> SPMS-3212 - Determined train position and state</div> <ul style="list-style-type: none"><div> SPMS-7042 - end_of_mission</div><div> SPMS-6664 - train_position_report</div>	<div> SPMS-2878 - Determine position and state of one train</div>	<div> SPMS-2807 - Train CS Sys</div>																			
<div>No exchange items allocated on  SPMS-3130 - Activated state of configuration data.</div>	<div> SPMS-2840 - Maintain Traffic CS System configuration data</div>	<div> SPMS-2823 - Traffic CS Sys</div>																			
<div> SPMS-5268 - Observed point position</div> <ul style="list-style-type: none"><div> SPMS-3283 - point_position_report</div>	<div> SPMS-2914 - Sense+Observe position of one point</div>	<div> SPMS-2818 - Trackside As</div>																			
<div> SPMS-4648 - Observed track vacancy proving section state</div> <ul style="list-style-type: none"><div> SPMS-6569 - track_vacancy_proving_section_report</div>	<div> SPMS-2919 - Sense+Observe track vacancy proving section state</div>	<div> SPMS-2818 - Trackside As</div>																			































Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-3021 - Aggregated track occupancy and train status information <ul style="list-style-type: none">  SPMS-5562 - train_object_information 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS System
	 SPMS-3028 - Aggregated track occupancy and train status information <ul style="list-style-type: none">  SPMS-5562 - train_object_information 	 SPMS-2929 - Control usage restrictions	 SPMS-2823 - Traffic CS System
	 SPMS-3050 - Aggregated track occupancy and train status information <ul style="list-style-type: none">  SPMS-5562 - train_object_information 	 SPMS-2843 - Calculate operational traffic plan	 SPMS-2813 - Traffic Management System
	 SPMS-4666 - Aggregated track occupancy and train status information <ul style="list-style-type: none">  SPMS-5562 - train_object_information 	 SPMS-2853 - Supervise state of the railway	 SPMS-2827 - Signaller
	<p>No exchange items allocated on  SPMS-5274 - Aggregated track occupancy and train status information.</p> <p>No exchange items allocated on  SPMS-7765 - Acknowledged position.</p>	 SPMS-5265 - Control target state of one point  SPMS-2878 - Determine position and state of one train	 SPMS-2823 - Traffic CS System  SPMS-2807 - Train CS System

2.3.2-2 - Control target state of one point

This function is allocated to  SPMS-2823 - Traffic CS 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. The time it takes to set the point, and other constraints like electrical load shall be taken into account.



Input exchanges	Input exchanges	Source function	Function allocated to	
	 SPMS-4546 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement  SPMS-5548 - operational_plan_restriction 	 SPMS-2843 - Calculate operational traffic plan	 SPMS-2813 - Traffic Manager	
	 SPMS-3228 - Observed point position <ul style="list-style-type: none">  SPMS-3283 - point_position_report 	 SPMS-2914 - Sense+Observe position of one point	 SPMS-2818 - Trackside Assets	
	No exchange items allocated on  SPMS-5274 - Aggregated track occupancy and train status information.	 SPMS-2944 - Aggregate movable objects information	 SPMS-2823 - Traffic CS System	
	 SPMS-5275 - Requested point position <ul style="list-style-type: none">  SPMS-2386 - point_position_request 	 SPMS-2853 - Supervise state of the railway	 SPMS-2827 - Signaller	
	 SPMS-5276 - Provided current time <ul style="list-style-type: none">  SPMS-2412 - time_reference 	 SPMS-2922 - Synchronise current time	 SPMS-2819 - Transversal CC	
	No exchange items allocated on  SPMS-5277 - Activated state of configuration data.	 SPMS-2840 - Maintain Traffic CS System configuration data	 SPMS-2823 - Traffic CS System	
	 SPMS-5278 - Allocated track path <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS System	
Output exchanges	Output exchanges	Target function	Function allocated to	
	 SPMS-3227 - Required point position <ul style="list-style-type: none">  SPMS-3286 - point_position_command 	 SPMS-2851 - Determine required position of one point machine	 SPMS-2818 - Trackside Assets CS System	

2.3.2-3 - Control track path allocation for movement permissions

This function is allocated to  SPMS-2823 - Traffic CS System.

This function performs a safe allocation of a track path for a planned train movement, i.e.

- determines track paths that need to be allocated for train movement
- checks that the track path for a planned train movement is clear

- checks whether there are no conflicting track paths already allocated to other train movements nor restrictions already defined
- supervises and verifies that the switchable trackside assets for train movement are in the required position
- locks required switchable trackside assets
- generates the authorisation and if relevant the track conditions for movement for one train inside the allocated track path and reports it to the train.
- checks if the first position reported by a train fits to the expected position from the operational plan. It means for example that before executing the operational plan this cross check is performed and that in case of deviations the operational plan is not executed. Based on this Traffic CS information, Traffic Management System would then have to update the operational plan accordingly so that it fits again and can be executed.

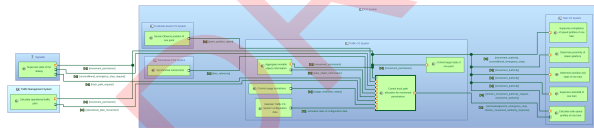
Note: The function also involves flank protection supervision that can be either ensured by trackside assets being part of the requested track path or by logic (if railway vehicle movements close to the train can be excluded).





































This function also performs the safe allocation of a track path as a reaction to a failure (the requested track path is transmitted by the function "Determine reaction to failure").







The function also releases track parts that are no longer used for train movement after checking the corresponding rules, e.g.,

- releases allocated portion of track path which is overpassed and therefore no more occupied by the train
- ensures that allocated portion of track in front of the train will not be released if it is still to be used by the train
- releases allocated portion of track in front of the train if it is ensured to not be used anymore (e.g. overlap release at the end of the journey)

Note: We currently do not have a data model defined and therefore there might be room for interpretation if flank protection is contained in the requested track path. The current assumption is that the function checks that all rules are fulfilled to either reserve or release a track path.

ID	SPMS-2874
Context Diagram	 <p><i>Figure 39 Context Diagram of Control track path allocation for movement permissions</i></p>

Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-3220 - Observed point position <ul style="list-style-type: none">  SPMS-3283 - point_position_report 	 SPMS-2914 - Sense+Observe position of one point	 SPMS-2818 - Trackside Ass
	 SPMS-3021 - Aggregated track occupancy and train status information <ul style="list-style-type: none">  SPMS-5562 - train_object_information 	 SPMS-2944 - Aggregate movable objects information	 SPMS-2823 - Traffic CS Sys
	<p>No exchange items allocated on</p>  SPMS-3131 - Activated state of configuration data.	 SPMS-2840 - Maintain Traffic CS System configuration data	 SPMS-2823 - Traffic CS Sys
	 SPMS-3000 - Usage restriction state <ul style="list-style-type: none">  SPMS-2398 - usage_restriction_status 	 SPMS-2929 - Control usage restrictions	 SPMS-2823 - Traffic CS Sys
	 SPMS-5424 - Respond and request for movement authority data <ul style="list-style-type: none">  SPMS-7235 - acknowledgement_emergency_stop  SPMS-7242 - shorten_movement_authority_response 	 SPMS-2872 - Calculate safe speed profiles of one train	 SPMS-2807 - Train CS Syst
	 SPMS-3079 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2843 - Calculate operational traffic plan	 SPMS-2813 - Traffic Manag
	 SPMS-3123 - Requested track path <ul style="list-style-type: none">  SPMS-2418 - track_path_request 	 SPMS-2853 - Supervise state of the railway	 SPMS-2827 - Signaller
	 SPMS-3042 - Provided current time <ul style="list-style-type: none">  SPMS-2412 - time_reference 	 SPMS-2922 - Synchronise current time	 SPMS-2819 - Transversal C
	 SPMS-7719 - Request emergency stop <ul style="list-style-type: none">  SPMS-7137 - unconditional_emergency_stop_request 	 SPMS-2853 - Supervise state of the railway	 SPMS-2827 - Signaller

Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-3039 - Allocated track path <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2944 - Aggregate movable objects information	 SPMS-2823 - Traffic CS System
	 SPMS-3044 - Allocated track path <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2853 - Supervise state of the railway	 SPMS-2827 - Signaller
	 SPMS-3052 - Allocated track path <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2843 - Calculate operational traffic plan	 SPMS-2813 - Traffic Manager
	 SPMS-5278 - Allocated track path <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-5265 - Control target state of one point	 SPMS-2823 - Traffic CS System
	 SPMS-3065 - Allocated track path <ul style="list-style-type: none">  SPMS-5446 - shorten_movement_authority_request  SPMS-5835 - movement_authority 	 SPMS-2872 - Calculate safe speed profiles of one train	 SPMS-2807 - Train CS System
	 SPMS-3232 - Allocated track path <ul style="list-style-type: none">  SPMS-5835 - movement_authority 	 SPMS-2878 - Determine position and state of one train	 SPMS-2807 - Train CS System
	 SPMS-6982 - Allocated track path <ul style="list-style-type: none">  SPMS-5835 - movement_authority 	 SPMS-6971 - Determine proximity of station platform	 SPMS-2807 - Train CS System
	 SPMS-7661 - Allocated track path <ul style="list-style-type: none">  SPMS-5835 - movement_authority  SPMS-7234 - unconditional_emergency_stop 	 SPMS-2921 - Supervise compliance of speed profiles of one train	 SPMS-2807 - Train CS System
	 SPMS-2991 - Allocated track path <ul style="list-style-type: none">  SPMS-5835 - movement_authority 	 SPMS-2897 - Supervise standstill of one train	 SPMS-2807 - Train CS System

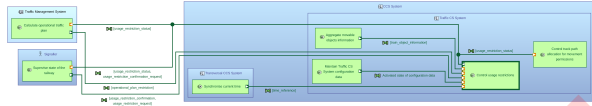
2.3.2-4 - Control usage restrictions

This function is allocated to  SPMS-2823 - Traffic CS System.

This function:

- Creates a planned usage restriction area according to the operational plan restriction and stores it until the time for the activation has been reached.

- Creates an unplanned usage restriction area on a Signaller request.
- checks if all conditions for the activation/deactivation of usage restrictions are fulfilled taking into account feedback from Signaller as well as already active usage restriction areas and the current operational state i.e. states of trackside assets and trains currently using the infrastructure (e.g. track occupancies, train-specific authorisations, allocated track paths)).
- If necessary request trackside asset states or derive additional usage restrictions associated to specific usage restrictions.
- informs the respective functions about the activation or deactivation of a relevant usage restrictions (e.g. "request target state of one trackside asset" about a blocked trackside asset).
- provides information about the execution state of usage restrictions
- stores the activated usage restrictions




























ID	SPMS-2929		
Context Diagram	 <p>Figure 40 Context Diagram of Control usage restrictions</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	No exchange items allocated on SPMS-3135 - Activated state of configuration data.	SPMS-2840 - Maintain Traffic CS System configuration data	SPMS-2823 - Traffic CS System
	SPMS-2988 - Required operational traffic plan <ul style="list-style-type: none"> SPMS-5548 - operational_plan_restriction 	SPMS-2843 - Calculate operational traffic plan	SPMS-2813 - Traffic Management System
	SPMS-3028 - Aggregated track occupancy and train status information <ul style="list-style-type: none"> SPMS-5562 - train_object_information 	SPMS-2944 - Aggregate movable objects information	SPMS-2823 - Traffic CS System
	SPMS-3078 - Provided usage restriction state <ul style="list-style-type: none"> SPMS-4826 - usage_restriction_confirmation SPMS-2407 - usage_restriction_request 	SPMS-2853 - Supervise state of the railway	SPMS-2827 - Signaller
	SPMS-3045 - Provided current time <ul style="list-style-type: none"> SPMS-2412 - time_reference 	SPMS-2922 - Synchronise current time	SPMS-2819 - Transversal CCS System

Output exchanges	Output exchanges	Target function	Function allocated to
	SPMS-3000 - Usage restriction state <ul style="list-style-type: none"> SPMS-2398 - usage_restriction_status	SPMS-2874	SPMS-2823 - Traffic CS System
	SPMS-3173 - Usage restriction state <ul style="list-style-type: none"> SPMS-2398 - usage_restriction_status	SPMS-2843	SPMS-2813 - Traffic CS System
	SPMS-3174 - Usage restriction state <ul style="list-style-type: none"> SPMS-2398 - usage_restriction_status SPMS-4827 - usage_restriction_confirmation_request	SPMS-2853	SPMS-2827 - Traffic CS System

2.3.2-5 - Generate train-specific timetable information

This function is allocated to SPMS-2823 - Traffic CS System.
This function generates a non-safety time-table from the operational plan movement. This time-table is only operational plan and time dependant.

ID	SPMS-5332
Context Diagram	<p>Figure 41 Context Diagram of Generate train-specific timetable information</p>

Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-5333 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2843 - Calculate operational traffic plan	 SPMS-2813 - Traffic Management System
	 SPMS-5334 - Provided current time <ul style="list-style-type: none">  SPMS-2412 - time_reference 	 SPMS-2922 - Synchronise current time	 SPMS-2819 - Transversal CCS System
	No exchange items allocated on  SPMS-5335 - Activated state of configuration data.	 SPMS-2840 - Maintain Traffic CS System configuration data	 SPMS-2823 - Traffic CS System
Output exchanges	No exchange items allocated on  SPMS-5515 - Determined train position and state.	 SPMS-2878 - Determine position and state of one train	 SPMS-2807 - Train CS System
	Output exchanges	Target function	Function allocated to
	 SPMS-3182 - Generated train-specific timetable and infrastructure information <ul style="list-style-type: none">  SPMS-5666 - train_specific_timetable_information 	 SPMS-2862 - Form Traffic CS System	 SPMS-2807 - Train CS System
	 SPMS-4549 - Generated train-specific timetable information <ul style="list-style-type: none">  SPMS-5666 - train_specific_timetable_information 	 SPMS-2928 - Form Traffic CS System	 SPMS-2807 - Train CS System
	 SPMS-3067 - Generated train-specific timetable information <ul style="list-style-type: none">  SPMS-5666 - train_specific_timetable_information  SPMS-7718 - train_specific_infrastructure_information 	 SPMS-2870 - Form Traffic CS System	 SPMS-2807 - Train CS System

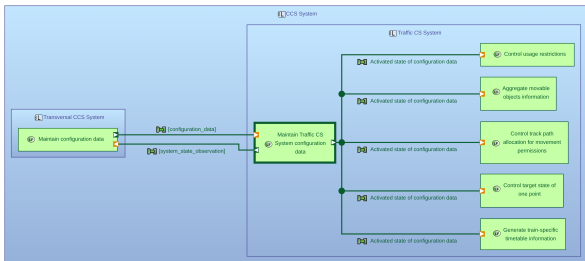























2.3.2-6 - Maintain Traffic CS System configuration data

This function is allocated to  SPMS-2823 - Traffic CS System.

This functions preloads, and activates preloaded system configuration version. For configuration changes that have an implication on the operation or safety, this function also stops the operation of the system for system configuration purposes before the activation, and restarts the operation of the system for system configuration purposes after the activation of the new system configuration. Finally, this function distributes the new active system configuration data.

This function stores, updates and delivers static trackside attribute data. The data is synchronised downstream from the Transversal CCS data storage and no changes are provided upstream from this

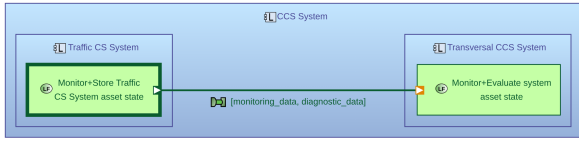





function. As the function does not manipulate the data in any way, the input is the same as the output.

ID	SPMS-2840		
Context Diagram	 <p>Figure 42 Context Diagram of Maintain Traffic CS System configuration data</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-2993 - Actual state of configuration data <ul style="list-style-type: none">  SPMS-6465 - configuration_data 	 SPMS-2834 - Maintain configuration data	 SPMS-2819 - Transversal CCS System
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-3211 - Activated state of configuration data <ul style="list-style-type: none">  SPMS-3251 - system_state_observation 	 SPMS-2834 - Maintain configuration data	 SPMS-2819 - Transversal CCS System
	No exchange items allocated on  SPMS-3130 - Activated state of configuration data.	 SPMS-2944 - Aggregate movable objects information	 SPMS-2823 - Traffic CS System
	No exchange items allocated on  SPMS-3131 - Activated state of configuration data.	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS System
	No exchange items allocated on  SPMS-3135 - Activated state of configuration data.	 SPMS-2929 - Control usage restrictions	 SPMS-2823 - Traffic CS System
	No exchange items allocated on  SPMS-5277 - Activated state of configuration data.	 SPMS-5265 - Control target state of one point	 SPMS-2823 - Traffic CS System
	No exchange items allocated on  SPMS-5335 - Activated state of configuration data.	 SPMS-5332 - Generate train-specific timetable information	 SPMS-2823 - Traffic CS System

2.3.2-7 - Monitor+Store Traffic CS System asset state

This function is allocated to  SPMS-2823 - Traffic CS System.

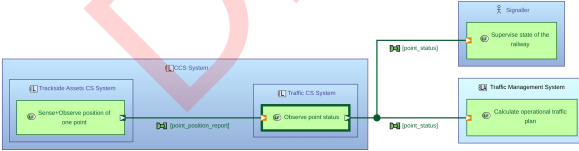




This function monitors and stores the state of  SPMS-2823 - Traffic CS System, in order to provide asset conditions continuously.









ID	SPMS-2895		
Context Diagram	 <p>The diagram shows the 'Traffic CS System' context. Inside, there are two sub-systems: 'Traffic CS System' and 'Transversal CCS System'. The 'Traffic CS System' contains a function 'Monitor+Store Traffic CS System asset state'. The 'Transversal CCS System' contains a function 'Monitor+Evaluate system asset state'. A data flow labeled '[monitoring_data, diagnostic_data]' connects the two functions.</p> <p><i>Figure 43 Context Diagram of Monitor+Store Traffic CS System asset state</i></p>		
Input exchanges	No inputs defined for this function.		
Output exchanges	Output exchanges  SPMS-3062 - Monitoring and diagnostic data <ul style="list-style-type: none">  SPMS-6988 - monitoring_data  SPMS-6989 - diagnostic_data 	Target function  SPMS-4502 - Monitor+Evaluate system asset state	Function allocated to  SPMS-2819 - Transversal CCS System

2.3.2-8 - Observe point status

This function is allocated to  SPMS-2823 - Traffic CS System.

This function observes the overall state of one point including its availability and its position compared to the required point position.


ID	SPMS-2886		
Context Diagram	 <p>The diagram shows the 'Traffic CS System' context. Inside, there are two sub-systems: 'Trackside Assets CS System' and 'Traffic CS System'. The 'Trackside Assets CS System' contains a function 'Sense+Observe position of one point'. The 'Traffic CS System' contains a function 'Observe point status'. A data flow labeled '[point_position_report]' connects the two functions. The 'Observe point status' function is also connected to a 'Signal' function (Supervise state of the railway) and a 'Traffic Management System' function (Calculate operational traffic plan).</p> <p><i>Figure 44 Context Diagram of Observe point status</i></p>		
Input exchanges	Input exchanges  SPMS-3209 - Observed point position <ul style="list-style-type: none">  SPMS-3283 - point_position_report 	Source function  SPMS-2914 - Sense+Observe position of one point	Function allocated to  SPMS-2818 - Trackside Assets CS System

Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-3189 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2853 - Supervise state of the railway	 SPMS-2827 - Signaller
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-5339 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2843 - Calculate operational traffic plan	 SPMS-2813 - Traffic Management System

2.3.3 Functions from the surrounding system(s)

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

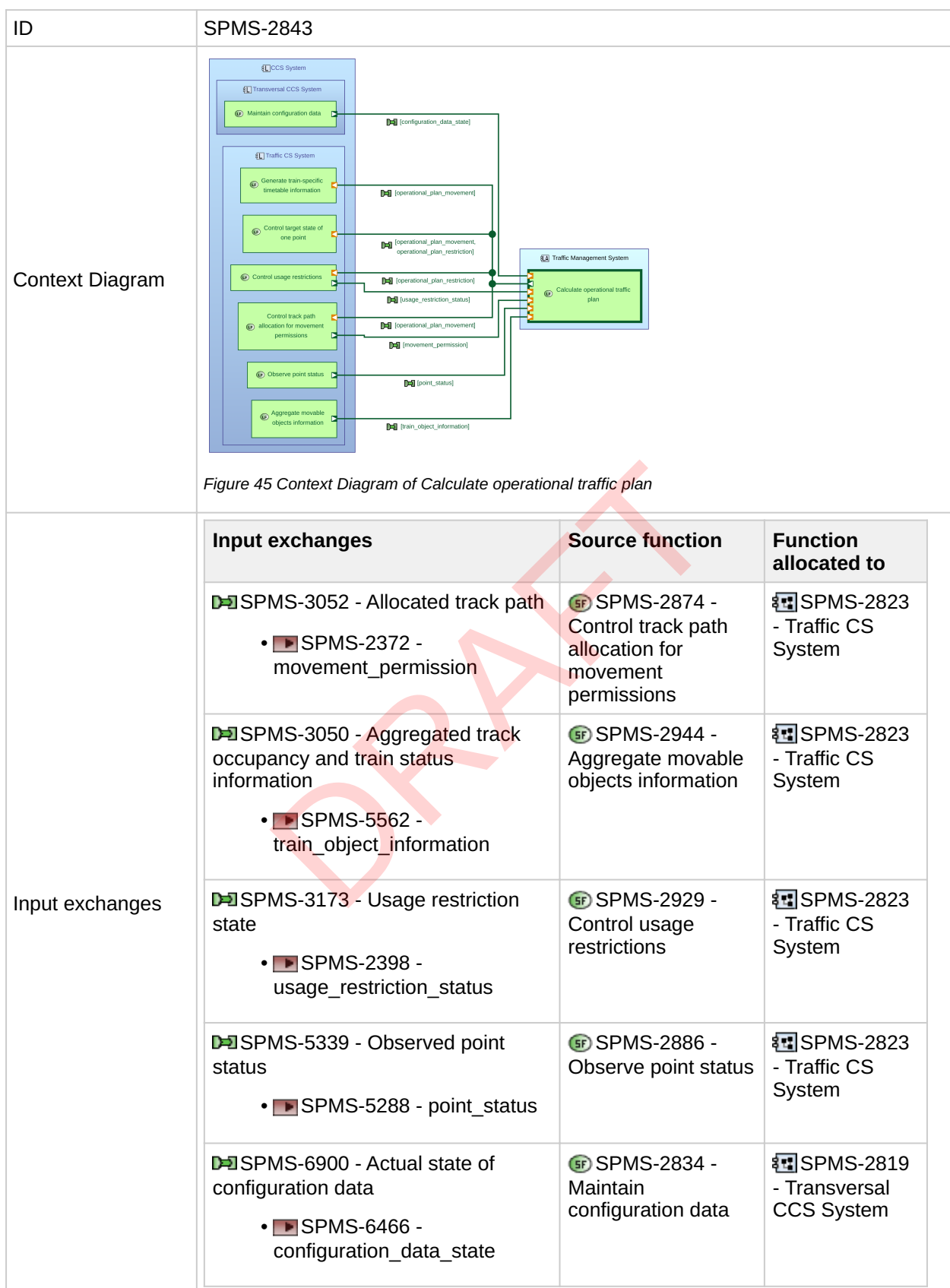
2.3.3-1 - Calculate operational traffic plan


















This function is allocated to  SPMS-2813 - 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.

Additionally, this function also transmits the planned usage restrictions to Traffic CS.

This function receives back from Traffic CS the state of execution of the operational plan, e.g. the execution state of movements and restrictions etc..

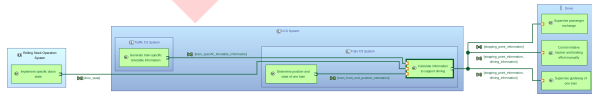




























Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-2988 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-5548 - operational_plan_restriction 	 SPMS-2929 - Control usage restrictions	 SPMS-2823 - Traffic CS System
	 SPMS-4546 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement  SPMS-5548 - operational_plan_restriction 	 SPMS-5265 - Control target state of one point	 SPMS-2823 - Traffic CS System
	 SPMS-3079 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS System
	 SPMS-5333 - Required operational traffic plan <ul style="list-style-type: none">  SPMS-2370 - operational_plan_movement 	 SPMS-5332 - Generate train-specific timetable information	 SPMS-2823 - Traffic CS System

2.3.3-2 - Calculate information to support driving

This function is allocated to  SPMS-2807 - Train CS System.

This function provides supporting information for the driver in helping driving the train and opening the doors : remaining departure time, approaching a stopping point, stopping accuracy.

ID	SPMS-2862
Context Diagram	 <p>Figure 46 Context Diagram of Calculate information to support driving</p>

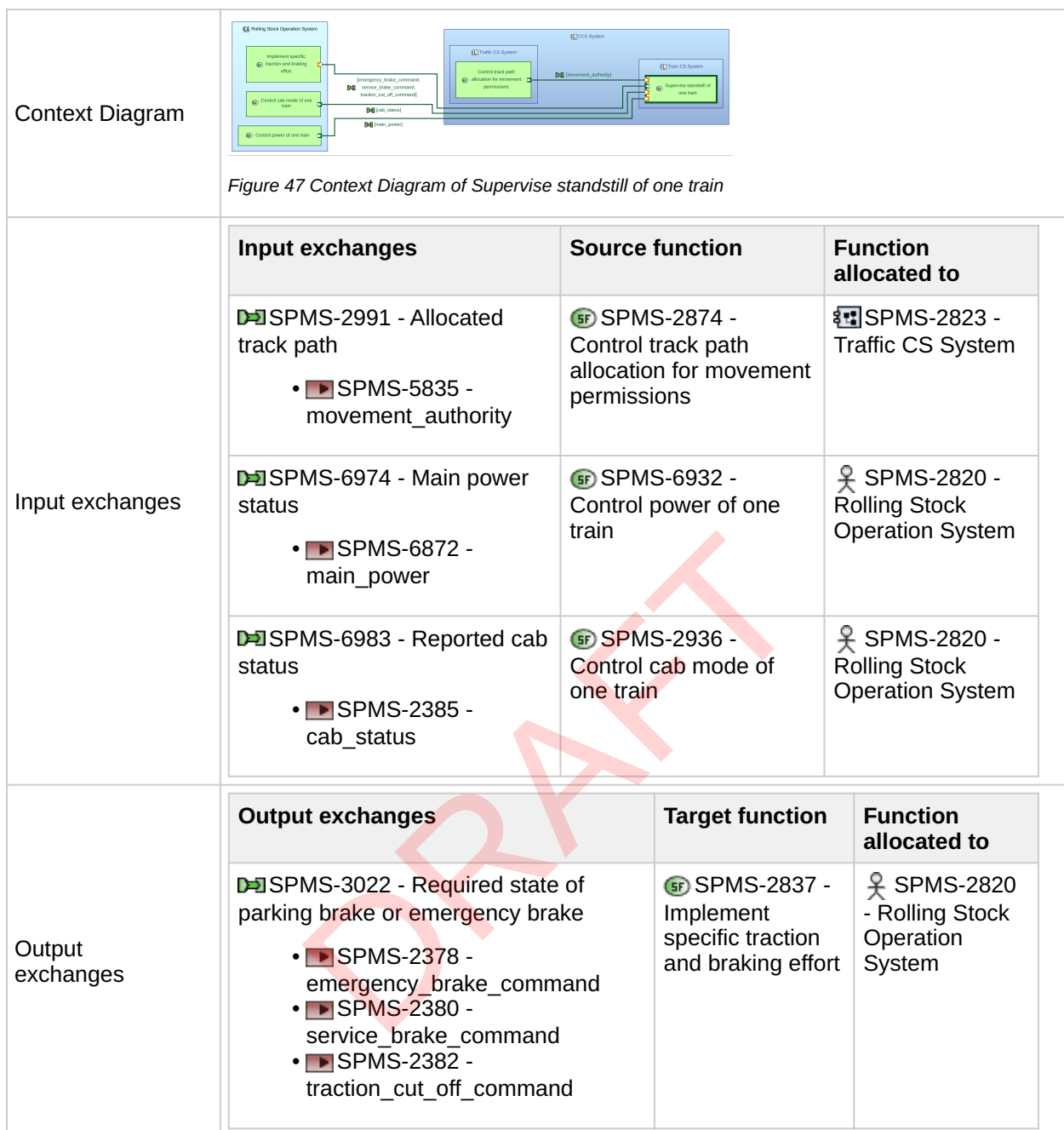
Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-3182 - Generated train-specific timetable and infrastructure information <ul style="list-style-type: none">  SPMS-5666 - train_specific_timetable_information 	 SPMS-5332 - SPMS-2823 - Traffic Control System	 SPMS-2823 - Traffic Control System
	 SPMS-6525 - Observed state of doors <ul style="list-style-type: none">  SPMS-2405 - door_state 	 SPMS-4559 - SPMS-2820 - Rolling Stock Control System	 SPMS-2820 - Rolling Stock Control System
	 SPMS-6993 - Determined train position and state <ul style="list-style-type: none">  SPMS-5667 - train_front_end_position_estimation 	 SPMS-2878 - SPMS-2807 - Train CS System	 SPMS-2807 - Train CS System
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-3186 - Indicated supporting information <ul style="list-style-type: none">  SPMS-2409 - stopping_point_information  SPMS-2408 - driving_information 	 SPMS-2836 - Control relative traction and braking effort manually	 SPMS-2822 - Driver
	 SPMS-3187 - Indicated supporting information <ul style="list-style-type: none">  SPMS-2409 - stopping_point_information  SPMS-2408 - driving_information 	 SPMS-2933 - Supervise guideway of one train	 SPMS-2822 - Driver
	 SPMS-4561 - Indicated supporting information <ul style="list-style-type: none">  SPMS-2409 - stopping_point_information 	 SPMS-4560 - Supervise passenger exchange	 SPMS-2822 - Driver

2.3.3-3 - Supervise standstill of one train

This function is allocated to  SPMS-2807 - Train CS System.

This function 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.

ID	SPMS-2897
----	-----------



2.3.3-4 - Control state of train doors

This function is allocated to **SPMS-2807 - Train CS System**.

This function sends requests to the rolling stock to control the state of doors based on the required 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).

ID	SPMS-2928		
Context Diagram	<p>Figure 48 Context Diagram of Control state of train doors</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	SPMS-4549 - Generated train-specific timetable information <ul style="list-style-type: none"> SPMS-5666 - train_specific_timetable_information 	SPMS-5332 - Generate train-specific timetable information	SPMS-2823 - Traffic CS System
Output exchanges	SPMS-4562 - Observed state of doors <ul style="list-style-type: none"> SPMS-2405 - door_state 	SPMS-4559 - Implement specific doors state	SPMS-2820 - Rolling Stock Operation System
	Output exchanges	Target function	Function allocated to
	SPMS-4564 - Requested state of doors <ul style="list-style-type: none"> SPMS-2397 - automatic_door_state_request 	SPMS-4559 - Implement specific doors state	SPMS-2820 - Rolling Stock Operation System
















2.3.3-5 - Supervise compliance of speed profiles of one train

This function is allocated to SPMS-2807 - Train CS System.


This function ensure safe speed of one train by supervising the compliance of the train speed with the speed profiles of that train. If the speed-profile is about to be violated or is actually violated, an emergency brake reaction is required or full service brake or traction cut off. This function triggers emergency reaction as response to an emergency command.

This function needs the cab status in order to determinie the supervision mode in Train CS.

ID	SPMS-2921		
Context Diagram	<p>Figure 49 Context Diagram of Supervise compliance of speed profiles of one train</p>		

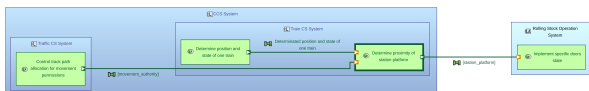







Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-7661 - Allocated track path <ul style="list-style-type: none">  SPMS-5835 - movement_authority  SPMS-7234 - unconditional_emergency_stop 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS System
	 SPMS-2995 - Reported cab status <ul style="list-style-type: none">  SPMS-2385 - cab_status 	 SPMS-2936 - Control cab mode of one train	 SPMS-2820 - Rolling Stock Operation System
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-3020 - Required state of full service brake or traction cut off or emergency brake <ul style="list-style-type: none">  SPMS-2380 - service_brake_command  SPMS-2382 - traction_cut_off_command  SPMS-2378 - emergency_brake_command 	 SPMS-2837 - Implement specific traction and braking effort	 SPMS-2820 - Rolling Stock Operation System





2.3.3-6 - Determine proximity of station platform

This function is allocated to  SPMS-2807 - Train CS System.

This function generates the station platform information when the train is approaching the platform station and train is about to stop. This function acts as trigger to start the unlocking process of the train doors.

Note: This function is also used to communicate track conditions to the on-board CCS (such as SS026 track conditions optional packets)

ID	SPMS-6971		
Context Diagram	 <p>The diagram shows the 'Determine proximity of station platform' function (SF) as a central component. It receives inputs from 'Control track path' (SF) and 'Movement authority' (SF). It sends outputs to 'Determine position and state of one train' (SF) and 'Determine proximity of station platform' (SF). The latter is connected to 'Rolling Stock Operation System' (SF).</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	<p>No exchange items allocated on  SPMS-6977 - Determinated position and state of one train.</p>  SPMS-6982 - Allocated track path <ul style="list-style-type: none">  SPMS-5835 - movement_authority 	 SPMS-2878 - Determine position and state of one train  SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2807 - Train CS System  SPMS-2823 - Traffic CS System

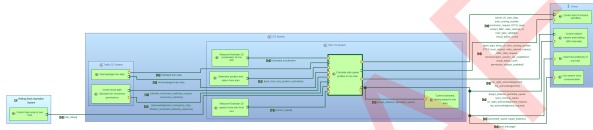
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-6973 - Determinated distance to the next station platform and properties <ul style="list-style-type: none">  SPMS-6990 - station_platform 	 SPMS-4559 - Implement specific doors state	 SPMS-2820 - Rolling Stock Operation System









































2.3.3-7 - Calculate safe speed profiles of one train











































This function is allocated to  SPMS-2807 - Train CS System.

This function calculates the safe driving limits for the train based on the input of train data and trackside conditions. It outputs the safety relevant speed profiles, and the speed/distance information to the Driver in order to allow him to drive the train and safely supervise the speed limits and distance targets. In more detail, this means that this function uses a braking model to calculate train-specific deceleration curves which are provided in the train-specific authorisation, so that a train can stop before reaching a danger point.

Additionally this function can accept or reject the request for a cooperative shortening of a movement authority.

ID	SPMS-2872
Context Diagram	 <p><i>Figure 51 Context Diagram of Calculate safe speed profiles of one train</i></p>

Input exchanges	Input exchanges	Source function	Function allocated to	
	 SPMS-3065 - Allocated track path <ul style="list-style-type: none">  SPMS-5446 - shorten_movement_authority_request  SPMS-5835 - movement_authority 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS Sys	
	 SPMS-3153 - Determined train position and state <ul style="list-style-type: none">  SPMS-5667 - train_front_end_position_estimation 	 SPMS-2878 - Determine position and state of one train	 SPMS-2807 - Train CS Sys	
	No exchange items allocated on  SPMS-3148 - Estimated acceleration.	 SPMS-2880 - Measure+Estimate 1D acceleration of one train	 SPMS-2807 - Train CS Sys	
	 SPMS-3165 - Estimated speed <ul style="list-style-type: none">  SPMS-2400 - current_speed 	 SPMS-2892 - Measure+Estimate 1D speed of one train front end	 SPMS-2807 - Train CS Sys	
	 SPMS-6236 - Activated cab status <ul style="list-style-type: none">  SPMS-2385 - cab_status 	 SPMS-2936 - Control cab mode of one train	 SPMS-2820 - Rolling Stock	
	 SPMS-3239 - Provided driver information <ul style="list-style-type: none">  SPMS-2406 - driver_ID  SPMS-2371 - train_data  SPMS-2414 - train_running_number  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-2852 - Control start of mission activities	 SPMS-2822 - Driver	
	 SPMS-6981 - Acknowledged permission <ul style="list-style-type: none">  SPMS-6602 - on_sight_acknowledgement  SPMS-7109 - trip_acknowledgement 	 SPMS-2836 - Control relative traction and braking effort manually	 SPMS-2822 - Driver	
	No exchange items allocated on  SPMS-7121 - Acknowledged train data.	 SPMS-7115 - Acknowledge train data	 SPMS-2823 - Traffic CS Sys	

Output exchanges	Output exchanges	Target function	Function allocated to	
	 SPMS-3190 - Calculated supervision limits <ul style="list-style-type: none">  SPMS-2373 - permitted_speed  SPMS-2375 - target_distance 	 SPMS-2933 - Supervise guideway of one train	 SPMS-2822 - Driver	
	 SPMS-3072 - Calculated supervision limits <ul style="list-style-type: none">  SPMS-2375 - target_distance  SPMS-2373 - permitted_speed 	 SPMS-2870 - Control automatic driving speed of one train	 SPMS-2807 - Train CS Sys	
	 SPMS-3191 - Calculated supervision limits <ul style="list-style-type: none">  SPMS-2375 - target_distance  SPMS-2373 - permitted_speed  SPMS-5939 - level_crossing_status  SPMS-6693 - on_sight_acknowledgement_request  SPMS-7110 - trip_acknowledgement_request 	 SPMS-2836 - Control relative traction and braking effort manually	 SPMS-2822 - Driver	
	 SPMS-6992 - Calculated supervision limits <ul style="list-style-type: none">  SPMS-6928 - text_message 	 SPMS-6952 - Use system voice communication	 SPMS-2822 - Driver	
	 SPMS-5424 - Respond and request for movement authority data <ul style="list-style-type: none">  SPMS-7235 - acknowledgement_emergency_stop  SPMS-7242 - shorten_movement_authority_response 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS Sy	
	 SPMS-3188 - 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-2852 - Control start of mission activites	 SPMS-2822 - Driver	
	No exchange items allocated on  SPMS-7120 - Validated train data.	 SPMS-7115 - Acknowledge train data	 SPMS-2823 - Traffic CS Sy	

2.3.3-8 - Control automatic driving speed of one train

This function is allocated to SPMS-2807 - Train CS 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

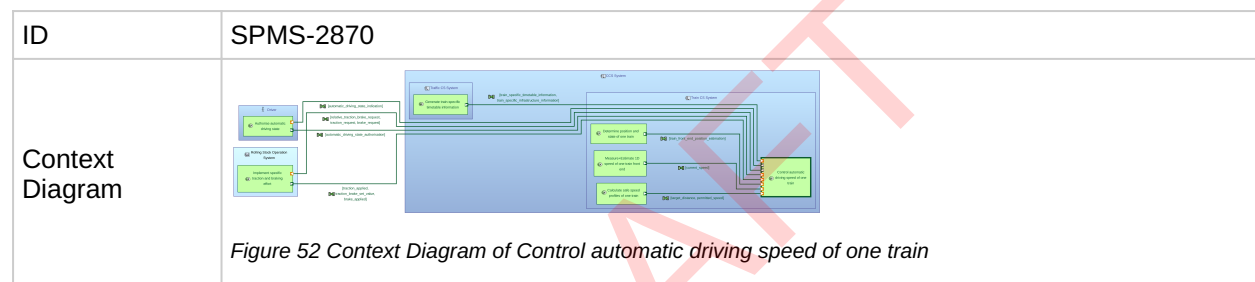
Engaged: The driver engaged the automatic driving and the function actively controlling the train's speed and the required traction and braking forces.





























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.

This function need to follow a train-specific timetable constrained by:

- secure path/danger point
- overspeed limits (static and dynamics)
- driving style settings
- train-specific overspeed limits
- train-specific braking models
- jerk limits constraints for passenger comfort or specific freight constraints



Input exchanges	Input exchanges	Source function	Function allocated to	
	 SPMS-3067 - Generated train-specific timetable information <ul style="list-style-type: none">  SPMS-5666 - train_specific_timetable_information  SPMS-7718 - train_specific_infrastructure_information 	 SPMS-5332 - Generate train-specific timetable information	 SPMS-2823 - Traffic CS Sys	
	 SPMS-3072 - Calculated supervision limits <ul style="list-style-type: none">  SPMS-2375 - target_distance  SPMS-2373 - permitted_speed 	 SPMS-2872 - Calculate safe speed profiles of one train	 SPMS-2807 - Train CS Sys	
	 SPMS-3169 - Estimated speed <ul style="list-style-type: none">  SPMS-2400 - current_speed 	 SPMS-2892 - Measure+Estimate 1D speed of one train front end	 SPMS-2807 - Train CS Sys	
	 SPMS-3154 - Determined train position and state <ul style="list-style-type: none">  SPMS-5667 - train_front_end_position_estimation 	 SPMS-2878 - Determine position and state of one train	 SPMS-2807 - Train CS Sys	
	 SPMS-3051 - 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-2837 - Implement specific traction and braking effort	 SPMS-2820 - Rolling Stock	
	 SPMS-3055 - Authorised automatic driving state <ul style="list-style-type: none">  SPMS-3868 - automatic_driving_state_authorisation 	 SPMS-2907 - Authorise automatic driving state	 SPMS-2822 - Driver	

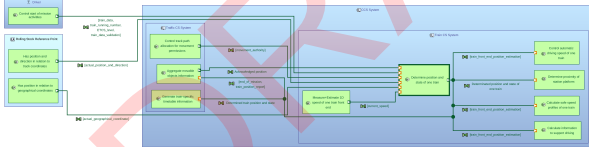
Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-3014 - Required relative traction and brake effort <ul style="list-style-type: none">  SPMS-2393 - relative_traction_brake_request  SPMS-2396 - traction_request  SPMS-5481 - brake_request 	 SPMS-2837 - Implement specific traction and braking effort	 SPMS-2820 - Rolling Stock Operation System
	 SPMS-3185 - Indicated automatic driving state <ul style="list-style-type: none">  SPMS-3869 - automatic_driving_state_indication 	 SPMS-2907 - Authorise automatic driving state	 SPMS-2822 - Driver

2.3.3-9 - Determine position and state of one train

This function is allocated to  SPMS-2807 - Train CS System.

This function reports, observes and monitors the following parameters of one train:

- front and rear end
- speed
- direction
- train mode (= power off, = standby ,...)
- Confirmation of successful joining operation
- Confirmation of successful splitting operation

ID	SPMS-2878
Context Diagram	 <p>The diagram shows a central function box labeled 'Determine position and state of one train' (SPMS-2878) connected to various external functions. Inputs include 'Train position and state' and 'Train mode'. Outputs include 'Train position and state' and 'Train mode'. The diagram is labeled 'Figure 53 Context Diagram of Determine position and state of one train'.</p>

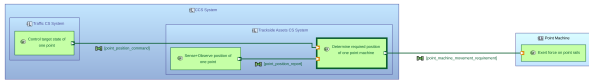
Input exchanges	Input exchanges	Source function	Function allocated to
	No exchange items allocated on SPMS-7765 - Acknowledged position.	SPMS-2944 - Aggregate movable objects information	SPMS-2823 - Traffic CS Sys
	SPMS-3171 - Estimated speed • SPMS-2400 - current_speed	SPMS-2892 - Measure+Estimate 1D speed of one train front end	SPMS-2807 - Train CS Syst
	SPMS-3004 - Actual present geographical coordinate • SPMS-6520 - actual_geographical_coordinate	SPMS-2945 - Has position in relation to geographical coordinates	SPMS-2809 - Rolling Stock
	SPMS-3007 - Actual present position and direction in track coordinates • SPMS-6521 - actual_position_and_direction	SPMS-2949 - Has position and direction in relation to track coordinates	SPMS-2809 - Rolling Stock
	SPMS-3232 - Allocated track path • SPMS-5835 - movement_authority	SPMS-2874 - Control track path allocation for movement permissions	SPMS-2823 - Traffic CS Sys
	SPMS-7766 - Provided driver information • SPMS-2371 - train_data • SPMS-2414 - train_running_number • SPMS-7169 - ETCS_level • SPMS-7111 - train_data_validation	SPMS-2852 - Control start of mission activities	SPMS-2822 - Driver

Output exchanges	Output exchanges	Target function	Function allocated to
	No exchange items allocated on SPMS-6977 - Determinated position and state of one train.	SPMS-6971 - SPMS-2807 - Traffic CS System	SPMS-2807 - Traffic CS System
	SPMS-3153 - Determined train position and state <ul style="list-style-type: none"> SPMS-5667 - train_front_end_position_estimation 	SPMS-2872 - SPMS-2807 - Traffic CS System	SPMS-2807 - Traffic CS System
	SPMS-3154 - Determined train position and state <ul style="list-style-type: none"> SPMS-5667 - train_front_end_position_estimation 	SPMS-2870 - SPMS-2807 - Traffic CS System	SPMS-2807 - Traffic CS System
	No exchange items allocated on SPMS-5515 - Determined train position and state.	SPMS-5332 - SPMS-2823 - Traffic CS System	SPMS-2823 - Traffic CS System
	SPMS-3212 - Determined train position and state <ul style="list-style-type: none"> SPMS-7042 - end_of_mission SPMS-6664 - train_position_report 	SPMS-2944 - SPMS-2807 - Traffic CS System	SPMS-2807 - Traffic CS System
	SPMS-6993 - Determined train position and state <ul style="list-style-type: none"> SPMS-5667 - train_front_end_position_estimation 	SPMS-2862 - SPMS-2807 - Traffic CS System	SPMS-2807 - Traffic CS System

2.3.3-10 - Determine required position of one point machine

This function is allocated to SPMS-2818 - Trackside Assets CS System.

This function determines the required Point Machine position based on the required Point position compared to the estimated Point Machine position.

ID	SPMS-2851
Context Diagram	 <p>Figure 54 Context Diagram of Determine required position of one point machine</p>





















Input exchanges	Input exchanges	Source function	Function allocated to
	SPMS-3227 - Required point position <ul style="list-style-type: none"> SPMS-3286 - point_position_command 	SPMS-5265 - Control target state of one point	SPMS-2823 - Traffic CS System
	SPMS-5816 - Observed point position <ul style="list-style-type: none"> SPMS-3283 - point_position_report 	SPMS-2914 - Sense+Observe position of one point	SPMS-2818 - Trackside Assets CS System
Output exchanges	Output exchanges	Target function	Function allocated to
	SPMS-3008 - Required point machine position <ul style="list-style-type: none"> SPMS-2377 - point_machine_movement_requirement 	SPMS-2932 - Sense+Observe position of one point machine	SPMS-2812 - Point Machine

2.3.3-11 - Sense+Observe position of one point


This function is allocated to SPMS-2818 - Trackside Assets CS System.

This function estimates the position state of one Point based on the sensed and estimated position of each Point Machine.

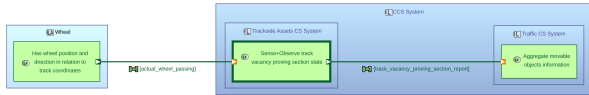




ID	SPMS-2914		
Context Diagram	<p>Figure 55 Context Diagram of Sense+Observe position of one point</p>		
Input exchanges	Input exchanges	Source function	Function allocated to
	SPMS-5815 - Actual physical point machine position <ul style="list-style-type: none"> SPMS-2381 - point_machine_position_presence 	SPMS-2942 - Has physical behaviour moves+lies+is locked	SPMS-2812 - Point Machine

Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-3209 - Observed point position <ul style="list-style-type: none">  SPMS-3283 - point_position_report 	 SPMS-2886 - Observe point status	 SPMS-2823 - Traffic CS System
	 SPMS-5816 - Observed point position <ul style="list-style-type: none">  SPMS-3283 - point_position_report 	 SPMS-2851 - Determine required position of one point machine	 SPMS-2818 - Trackside Assets CS System
	 SPMS-3228 - Observed point position <ul style="list-style-type: none">  SPMS-3283 - point_position_report 	 SPMS-5265 - Control target state of one point	 SPMS-2823 - Traffic CS System
	 SPMS-3220 - Observed point position <ul style="list-style-type: none">  SPMS-3283 - point_position_report 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS System
	 SPMS-5268 - Observed point position <ul style="list-style-type: none">  SPMS-3283 - point_position_report 	 SPMS-2944 - Aggregate movable objects information	 SPMS-2823 - Traffic CS System

2.3.3-12 - Sense+Observe track vacancy proving section state

This function is allocated to  SPMS-2818 - Trackside Assets CS System.

This function senses the passing of one wheel by infrastructure reference location in order to observe the occupation of one track vacancy proving section.

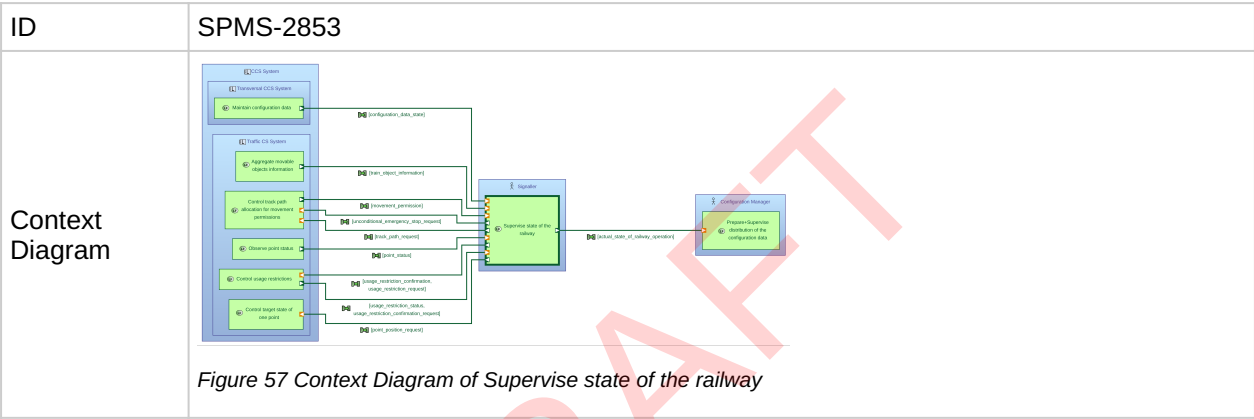
ID	SPMS-2919		
Context Diagram	 <p>Figure 56 Context Diagram of Sense+Observe track vacancy proving section state</p>		
Input exchanges	Input exchanges  SPMS-3015 - Actual wheel passing <ul style="list-style-type: none">  SPMS-6523 - actual_wheel_passing 	Source function  SPMS-2833 - Has wheel position and direction in relation to track coordinates	Function allocated to  SPMS-2829 - Wheel






















Output exchanges	Output exchanges	Target function	Function allocated to
	<div><div><div>SPMS-4648 - Observed track vacancy proving section state</div><div><div>• SPMS-6569 - track_vacancy_proving_section_report</div></div></div></div>	<div><div>SPMS-2944 -</div></div>	<div><div>SPMS-2823 -</div></div>






















2.3.3-13 - Supervise state of the railway

This function is allocated to SPMS-2827 - Signaller.

This function 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.



Input exchanges	Input exchanges	Source function	Function allocated to
	 SPMS-3044 - Allocated track path <ul style="list-style-type: none">  SPMS-2372 - movement_permission 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS System
	 SPMS-3174 - Usage restriction state <ul style="list-style-type: none">  SPMS-2398 - usage_restriction_status  SPMS-4827 - usage_restriction_confirmation_request 	 SPMS-2929 - Control usage restrictions	 SPMS-2823 - Traffic CS System
	 SPMS-3189 - Observed point status <ul style="list-style-type: none">  SPMS-5288 - point_status 	 SPMS-2886 - Observe point status	 SPMS-2823 - Traffic CS System
	 SPMS-4666 - Aggregated track occupancy and train status information <ul style="list-style-type: none">  SPMS-5562 - train_object_information 	 SPMS-2944 - Aggregate movable objects information	 SPMS-2823 - Traffic CS System
	 SPMS-6902 - Actual state of configuration data <ul style="list-style-type: none">  SPMS-6466 - configuration_data_state 	 SPMS-2834 - Maintain configuration data	 SPMS-2819 - Transversal CO

Output exchanges	Output exchanges	Target function	Function allocated to
	 SPMS-3078 - Provided usage restriction state <ul style="list-style-type: none">  SPMS-4826 - usage_restriction_confirmation  SPMS-2407 - usage_restriction_request 	 SPMS-2929 - Control usage restrictions	 SPMS-2823 - Traffic CS Sys
	 SPMS-3123 - Requested track path <ul style="list-style-type: none">  SPMS-2418 - track_path_request 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS Sys
	 SPMS-5275 - Requested point position <ul style="list-style-type: none">  SPMS-2386 - point_position_request 	 SPMS-5265 - Control target state of one point	 SPMS-2823 - Traffic CS Sys
	 SPMS-6903 - Actual state of railway operation <ul style="list-style-type: none">  SPMS-6772 - actual_state_of_railway_operation 	 SPMS-5400 - Prepare+Supervise distribution of the configuration data	 SPMS-5389 - Configuration
	 SPMS-7719 - Request emergency stop <ul style="list-style-type: none">  SPMS-7137 - unconditional_emergency_stop_request 	 SPMS-2874 - Control track path allocation for movement permissions	 SPMS-2823 - Traffic CS Sys
<p>The following ports are not connected to any exchange:</p> <ul style="list-style-type: none"> FOP 10 			

2.4 Scope of operational requirements and constraints

The requirements for the Traffic CS system are derived from to higher level CCS-Systems. [SPP-18362 - EET_Requirements Management Plan Version_1.0] describes the 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 higher level CCS-System are defined in [SPP-19161 - OD_ETCS L2 Rulebook_V0.3]. From the higher level CCS-Systems, the requirements and functions derived from these operating procedures are broken down to the Traffic CS system. [SPP-18362 - EET_Requirements Management Plan Version_1.0] describes the process in detail.







2.5 Existing safety measures

Will be provided in further 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-19283 - Release Note ESPR1.0]	This Release Note describes the scope of the ESPR1.0.	Link
[ SPP-18060 - TCS_System Architecture Description CCS System V0.3]	System Architecture of the CCS System according to .	Link
[ SPP-19049 - Traffic CS System Concept V1.0]	Traffic CS prepared this document to summarise the most important system requirements for Traffic CS and the solution concept how it is foreseen to fulfil these requirements. Furthermore, assumptions and expectations to external systems outside of Traffic CS are stated and roadmap is presented.	Link
[EN 50126-1:2017">  SPPRAMSS-349 - EN 50126-1:2017]	Railway Applications – The Specification and Demonstration of Reliability,	-

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

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