APS Core Functional Behaviour

1 Document Information

Work Items in this document

Location	draft	approved	awaiting approvals	deleted	Total
Contained	80	210	3	0	293
Recycle bin	1	0	0	50	51
External	0	4	0	0	4

2 Table of Contents

Guideline for a uniform notation

	APS	ETCS	FOT
Message	MessageFromInterface*	Message or Packet Name (Message or Packet #Number)	MessageFromInterface
Attribute	attributeFromInterface* (e.g. vMaxProfile)	ATTRIBUTE	attributeFromInterface

Value	ValueFromInterface* (e.g. VmaxMarker)	VALUE (Enum) / value (INT)	VALUE (except Boolean -> [value])
Formatting	• Upper case at the beginning of bullet points • Notation of self-defined terms according to the glossary (e.g. Movement Permission, Drive Protection Section)? • Lower case for existing terms, which are also defined in glossary (e.g. trackside asset)? • Names and types of interface elements like specified in Interface documentation (see above) • Interfaces: Bsp. RCA2 Interface		
Wording	• Use wording according to Logical Functions: e.g. grant, reject, distribute, translate, provide, propagate, ... Do not use synonyms if not necessary: e.g. accept, allow, deny, transmit, compute, send, ... • Use official abbreviations only • Speed vs. velocity? • Movable (AE) vs. Moveable (BE)? (auch in Interfaces und Capella)		
Articles	Use an MP and a MovementPermission		
Linking	Link Test Cases to REQs and also to Sub-REQs?		

* Either a link for the specific WI or in the formal form used inside the specific interface **[** draft **]**

3 Glossary

Term	Status	Abbrev.	Description
Advanced Protection System	Approved	APS	APS is the building block within smartrail 4.0 which has the objective to avoid safety endangering situations and damaging events affecting people
Aggregation Rule	Approved		An Aggregation Rule is part of the aggregation logic of SRP-3068 - APS Object Aggregation. An Aggregation Rule defines under which conditions and in which way information is aggregated. Every type of update sent to SRP-3068 - APS Object Aggregation over SRP-4705 - Controller Interface is aggregated by a particular set of Aggregation Rules.
Allocation Section	Approved		An Allocation Section is a set of not necessary connected WI-6991 - Track Sections that cannot be used simultaneously because of a conflict regarding the WI-1980 - Structure gauge.
APS App	Approved		Application from the WI-2077 - smartrail 4.0 system architecture, which supports emergency and safety critical interactions of authorized persons with the WI-2035 - Advanced Protection System. The functional scope of APS App is currently under consideration.
APS Movement Authority Transactor	Approved	APS-MT	Component from the WI-6893 - Reference CCS Architecture, that translates the information received from the WI-2035 - Advanced Protection System into ETCS messages and forwards them to the registered ETCS-enabled WI-7832 - Rolling Stock (Vehicle)s and vice versa, translates back the ETCS messages received from the registered ETCS-enabled WI-7832 - Rolling Stock (Vehicle)s and forwards them to the WI-2035 - Advanced Protection System.
APS Object Aggregation	Approved	APS-OA	Component from the WI-6893 - Reference CCS Architecture, which aggregates the information available about the physical operating state within the WI-7665 - CCS Area and maps this information on the WI-3265 - Topology in order to keep the WI-2033 - APS Operating State up to date. It is also responsible for the distribution of the demands received from WI-2993 - APS Safety Logic. The functional scope of APS-OA is currently under consideration.
APS Operating State	Approved		The APS Operating State is the logical representation of the real physical operating state within the WI-7665 - CCS Area. The APS Operating State is the single source of truth for all decisions made by WI-2993 - APS Safety Logic.
APS Safety Logic	Approved	APS-SL	Component from the WI-6893 - Reference CCS Architecture, which checks the safety of planned operations within the WI-7665 - CCS Area on request and demands their execution when operation is granted to be safe. It is also responsible for propagating updates of the WI-2033 - APS Operating State. The functional scope of APS-SL is currently under consideration.
APS Safety Manager	Approved	APS-SM	Component from the WI-6893 - Reference CCS Architecture, which is responsible to continuously supervise a set of conditions, which is required for safe track-bound movements within the WI-7665 - CCS Area. The APS Safety Manager shall detect when these conditions are no longer met and then initiate predefined risk-mitigating measures. Both the conditions as well as the risk-mitigating measures are being clarified. The functional scope of APS-SM is currently under consideration.
CCS Area	Approved		The CCS Area is the common, topologically delimited, effective range of the following components of the WI-6893 - Reference CCS Architecture: SRP-3086 - TMS Plan Execution, WI-2993 - APS Safety Logic, WI-2983 - APS Object Aggregation, WI-2010 - APS Safety Manager, WI-6909 - APS Movement Authority Transactor, WI-7500 - APS Mobile Object Transactor, WI-7495 - APS Fixed Object Transactor. The listed components are responsible for the WI-2546 - Control-Command and Signalling in this area.
Drive Protection Section	Approved	DPS	A Drive Protection Section is an abstraction for any location on the WI-3998 - Railway Network that may adopt different states due to controllable WI-2164 - Trackside Assets (e.g. points or level crossings). A Drive Protection Section represents a WI-6991 - Track Section that can be brought to different WI-2496 - Trafficability states or give flank protection in order to ensure the WI-2496 - Trafficability or safety of a WI-2013 - Track Route.
Drive Protection Section Group	Approved	DPS-Group	A Drive Protection Section Group contains all WI-6947 - Drive Protection Sections that have some interdependencies among themselves (i.e. a request of a different WI-2496 - Trafficability state may affect any other WI-6947 - Drive Protection Section of the group).
End of Authority	Approved	EOA	WI-3412 - European Train Control System specific term. The End of Authority is defined as the location to which an ETCS train is authorised to proceed and where the target speed is zero.
Movable Object	Approved	MOB	A Movable Object is the logical representation of a WI-8058 - Track-bound Vehicle in the WI-2033 - APS Operating State. A Movable Object is uniquely identifiable and is allocated to a WI-7517 - Track Position within the WI-7665 - CCS Area.
Movement Condition	Approved		A Movement Condition is a condition under which a particular aspect of a movement of a WI-2036 - Movable Object is considered to be safe. A Movement Condition must be equal or more restrictive for the same aspect of a movement, than the resulting condition of WI-8015 - Usage Conditions, WI-7870 - Usage Restrictions and properties of the WI-2036 - Movable Object. An example for a Movement Condition is the vmax speed profile of a WI-1974 - Movement Permission.
Movement Mode	Approved		A Movement Mode describes which WI-2037 - Safety Actor is assigned to which WI-3301 - Safety Responsibility during a WI-3255 - Movement (Train Run / Shunting Movement). In case of ETCS a Movement Mode is translated to a ETCS MA Mode.
Movement Permission	Approved	MP	A Movement Permission is an authorization for a WI-2036 - Movable Object to move in a defined direction and along a defined WI-2013 - Track Route. A Movement Permission always refers to exactly one WI-2036 - Movable Object. A Movement Permission includes all WI-8016 - Movement Conditions under which the movement of the refered WI-2036 - Movable Object is considered to be safe and to which the WI-2036 - Movable Object has to adhere.
Occupancy	Approved		An Occupany defines the referenced WI-6991 - Track Section as "occupied", meaning that the WI-6991 - Track Section is potentially occupied by an unidentified object. An Occupancy is an element managed by the WI-2983 - APS Object Aggregation. It is created and deleted, when the state of WI-7752 - Occupancy Sections, WI-2036 - Movable Objects and WI-1974 - Movement Permission are aggregated.
Occupancy Section	Approved	OCS	An Occupancy Section is a list of WI-6991 - Track Sections reporting the status "occupied" or "unoccupied" according to the information provided by the underlying WI-2202 - Clear Track Signalling Installation / WI-6900 - Train Detection System.
Occupational safeguard	In Review		An Occupational safeguard is a WI-7721 - Safeguard that is introduced to protect a workplace in the track area. It is planned and implemented in advance, but is only released for the track employees when the responsible track employee reports that the track area is ready for usage. The responsibility an Occupational safeguard is local.
Operational safeguard	draft		An operational safeguard is a WI-7721 - Safeguard that can be introduced by the system as well as by a employee in a control center. The responsibility for an operational safeguard always lies with the employee in a control center, only the employee in a control center can release an operational safeguard.
Risk Buffer	Approved	RB	The Risk Buffer is the WI-2013 - Track Route which connects gap-free to the front of a WI-1974 - Movement Permission and which describes the extent of the route that could potentially be occupied by the WI-2036 - Movable Object of the WI-1974 - Movement Permission, if the risk mitigation achieved by the WI-2411 - Automatic Train Protection is insufficient to keep the WI-2036 - Movable Object within its WI-1974 - Movement Permission.

Risk Path	Approved		The Risk Path is the WI-2013 - Track Route which describes a route that could potentially be occupied by another track-bound WI-7832 - Rolling Stock (Vehicle) (risk of flank collisions). Its extent corresponds at least to the endangered WI-7753 - Allocation Section of a WI-1974 - Movement Permission and can be extended to the route between the protecting element (e.g. WI-6947 - Drive Protection Section) and the endangered WI-7753 - Allocation Section of a WI-1974 - Movement Permission if track-enforced flank protection is required.
Safeguard	In Review		A Safeguard secures an element or section of a system against unintentional access. It is performed due to a WI-3462 - Funktionale Einschränkung and is realized in the interlocking. There are three types of safeguards: WI-8448 - Occupational safeguard, WI-8452 - Technical safeguard and WI-8451 - Operational safeguard. Geschäftsobjektmodell: SRP-12557 - Funktionale Einschränkung
Safety Actor	Approved	SA	A Safety Actor is the logical representation of a WI-7334 - System or a person in the WI-2033 - APS Operating State, who assumes the WI-3301 - Safety Responsibility for a certain aspect in the WI-7665 - CCS Area. An example for a system which is represented as a Safety Actor is a WI-7724 - Onboard Unit. An example for a person which is represented as a Safety Actor is a WI-2831 - Engine Driver
Safety Responsibility	Approved	SR	A Safety Responsibility is the obligation of a WI-2037 - Safety Actor to monitor and enforce a specific behaviour of a system.
Safety Rule	Approved		A Safety Rule is part of the safety logic of SRP-3066 - APS Safety Logic. A Safety Rule defines how a particular condition is checked. Every type of request sent to SRP-3066 - APS Safety Logic over SRP-4729 - Interlocking Control and Monitoring Interface is checked by a specific set of Safety Rules.
Sicherungsdossier	Approved		Das Sicherungsdossier umfasst sämtliche notwendigen Massnahmen, die für die sichere Durchführung einer Arbeitsstelle notwendig sind. Das Dossier beinhaltet die Sicherheitsdispositive (inkl. Arbeitsschutz), die erforderlichen SRP-12557 - Funktionale Einschränkung (inkl. SRP-12553 - Kapazitätseinschränkung) und Informationen zum Eingriffsmanagement. Das Dossier wird im Laufe der Baustellenplanung laufend ergänzt und weiter detailliert.
Technical safeguard	In Review		A Technical safeguard is a WI-7721 - Safeguard that can only be introduced and released by the system in the event of detected deviations from the functional target state of a system. The system is responsible for the Technical safeguard.
Track Route	Approved		The Track Route describes the extent of a navigable gap-free and overlap-free route on the WI-3265 - Topology in a defined direction. In practice WI-7868 - Navigability means that the WI-3265 - Topology offers the possibility for a track-bound WI-7832 - Rolling Stock (Vehicle) to run over the Track Route without direction change. This excludes e.g. setting-back track, but does not take into account the current WI-2496 - Trafficability of the underlying WI-6947 - Drive Protection Sections. The previous term "Track Path" has been replaced by the term "Track Route"
Track-bound Vehicle	Approved	TBV	A Track-bound vehicle is a WI-7832 - Rolling Stock (Vehicle) which is tied to the rail due to the wheelset in operation.
Usage Condition	Approved		A Usage Condition is the logical representation of a rail operational constraint for using the WI-3265 - Topology, which results from the physical and geographical properties of the WI-3265 - Topology. An example for a Usage Condition is the speed limitation of a WI-2042 - Point, set during the engineering and commissioning process.
Usage Restriction	Approved		A Usage Restriction is the logical representation of a rail operational constraint to use the WI-3265 - Topology, which is created in addition to the predefined WI-8015 - Usage Condition(s). A Usage Restriction restricts a certain aspect of the WI-3265 - Topology, for example the maximum allowed speed. An example for a Usage Restriction is a temporary speed restriction within the geometric extent of a construction site.
Usage Restriction Area	Approved	URA	A Usage Restriction Area is the logical representation of an area on the WI-3265 - Topology to which one or more WI-7870 - Usage Restrictions of different types apply. A Usage Restriction Area does, for example, guarantee the compliance with all rail operational constraints resulting from a construction site (e.g. barrier, direction of traffic agreement, speed restriction).

4 Functional Principles

4.1 Drive Protection Section

[Key Principle] DPS abstraction

A Drive Protection Section is defined as an abstraction of any location on the WI-3998 - Railway Network that may adopt different states due to controllable WI-2164 - Trackside Assets. A Drive Protection Section represents a WI-6991 - Track Section that can be brought to different WI-2496 - Trafficability states or give flank protection in order to ensure the WI-2496 - Trafficability or safety of a WI-2013 - Track Route.

Any WI-2164 - Trackside Asset that needs to be controlled in order to ensure the WI-2496 - Trafficability of a WI-2013 - Track Route is therefore represented in APS by one to many group(s) of one to many WI-6947 - Drive Protection Section(s).

The following list shows examples of such trackside assets, represented by WI-6947 - Drive Protection Sections:

- point
- single- or double-slip points
- set of points(e.g. for lane changes)
- derailers
- turntables
- level crossings
- gates

A counter example for a trackside asset which is not represented as a DPS is an axle counter or a clear track signal, because it is not controlled in order to ensure trafficability, but acts as a sensor on the track.

Based on the above definition a DPS has two main characteristics:

- It provides trafficability of a specific track section
- It ensures flank protection due to its trafficability state

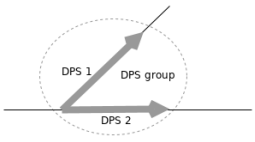
A DPS group is defined by one to many DPS(s) of the same trackside asset which have interdependent trafficability states:

- It is for example not possible that the two DPSs representing the end positions of a point are both fully trafficable at the same time. One of the DPSs will always be fully trafficable, while the other DPS is not trafficable
- It is however possible that the two DPSs representing the end positions of a point are both neither trafficable (e.g. while point is turning).

[approved]

4.1.1 Representation of a point

[Key Principle] DPS representation of a point



By Claus Rudolf - Eigenes Werk, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=34802314

A point is represented by a DPS group with two DPSs one for each end position the point can take. The extent of each DPS must be chosen in such manner that it certainly covers the movable parts of the point, primarily the tongues and the crossing, if the crossing is movable. A DPS may provide flank protection in the direction of the opening sideof the point, but not in the direction of the tip side of the point, as the point can be infringed.

[approved]

[Key Principle] DPS representation of a point - states (non-exhaustive)

State of trackside asset	dpsGroupState	trafficability		flankProtection	
		DPS 1	DPS 2	DPS 1	DPS 2
Point locked in straight end position 	READY	NONE	FULL	TRUE	FALSE

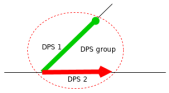
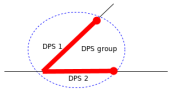
Point locked in diverging end position, but not ready to accept a request for a state change 	UNAVAILABLE	FULL	NONE	FALSE	TRUE
End position of point unknown while processing 	PROCESSING	NONE	NONE	FALSE	FALSE
End position of point unknown due to a failure 	UNAVAILABLE	NONE	NONE	FALSE	FALSE

Table 1 : Example DPS states for a point in some operational situations

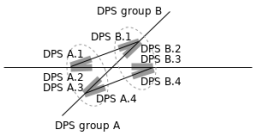
[approved]

Weichenaufschneidung

Der Prozess und Verhalten beim Aufschneiden von Weichen fehlt noch

4.1.2 Representation of a single- or double-slip point

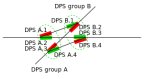
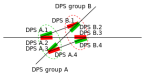
[Key Principle] DPS representation of a single- or double-slip point



By PeMoMuc - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=38561941

A double-slip point consists of two pairs of points, with each pair controlled by one point machine. This leads to a total of 4 different end positions. This can be represented with 8 DPSs grouped into 2 DPS groups, one for each pair of points. Single-slip points may be represented analogously by 4 DPSs grouped into 2 DPS groups. Similarly to the point, the extent of all DPSs shall cover at least the movable parts of the branches (normally only the length of the tongues in the case of single- and double-slip points). [approved]

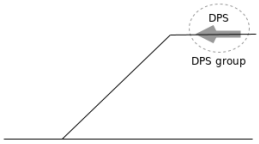
[Key Principle] DPS Representation of a double slip - states (non-exhaustive)

State of trackside asset	dpsGroupState		trafficability of DPS group A				trafficability of DPS group B			
	A	B	A.1	A.2	A.3	A.4	B.1	B.2	B.3	B.4
Double slip in the end position so that it is trafficable in straight direction 	READY	READY	NONE	FULL	NONE	FULL	FULL	NONE	FULL	NONE
Double slip in the end position so that it is trafficable in crossing direction, but group B is not ready to accept a request for a state change 	READY	UNAVAILABLE	FULL	NONE	FULL	NONE	NONE	FULL	NONE	FULL

[approved]

4.1.3 Representation of a derailer

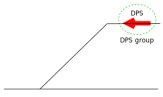
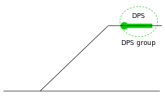
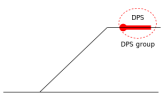
[Key Principle] DPS representation of a derailer



By Sean Lamb (User:Slambo) - Own work, CC BY-SA 2.5, https://commons.wikimedia.org/w/index.php?curid=1184709

A derailer changes the trafficability of a track cause it can enforce derailment. A derailer is represented with a DPS group containing a single DPS. The DPS shall be at least as long as the mechanical part of the derailer inserted on the rail. [approved]

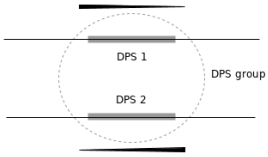
[Key Principle] DPS representation of a derailer - states (non-exhaustive)

State of trackside asset	dpsGroupState	trafficability	flankProtection
Inserted derailer which stops forbidden movements by derailment. 	READY	NONE	TRUE
Non-inserted derailer allowing movement over it. 	READY	FULL	FALSE
A derailer whose state is unknown neither provides flank protection nor can be used to ensure safe movement over it. 	UNAVAILABLE	NONE	FALSE

[approved]

4.1.4 Representation of a level crossing

[Key Principle] DPS representation of a level crossing

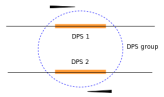


By David Monniaux - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=2199963

A level crossing can be represented by a DPS group with one DPS for each Track Section inside the barriers protecting them. The DPS of such a group can adopt different states concerning trafficability, but obviously a DPS representing a level crossing cannot provide flank protection. Furthermore all DPSs belonging to the same level crossing always have the same state.

[approved]

[Key Principle] DPS representation of a level crossing - states (non-exhaustive)

State of trackside asset	dpsGroupState	trafficability		flankProtection	
		DPS 1	DPS 2	DPS 1	DPS 2
Barriers are open (or at least closure has not been confirmed by the trackside asset). It may be crossed with limitations or under certain conditions (e.g.only with reduced speed and if the engine driver has assumed the responsibility of ensuring that there is no road traffic). 	READY	LIMITED	LIMITED	FALSE	FALSE
Barriers are closed and tracks are therefore fully trafficable without any restrictions. 	READY	FULL	FULL	FALSE	FALSE
Barriers are closing and therefore level crossing can still be crossed only under certain conditions or with limitations only. 	PROCESSING	LIMITED	LIMITED	FALSE	FALSE

[approved]

4.2 Movable Object

[Key Principle] Introduction of MOB

Each WI-8058 - Track-bound Vehicle, whose unique identification is communicated to WI-2035 - Advanced Protection System will be represented as a WI-2036 - Movable Object. Consequently a MOB represents an uniquely identified TBV.

A MOB may represent further characteristics of a TBV. The following list gives examples of these characteristics (**non-exhaustive**):

- Position
- Extent
- Operational Id
- Max speed
- Train category
- Axle load
- Cant deficiency

[approved]

[Key Principle] Identification of a MOB

A TBV is identified by APS via the unique identification of its on-board unit, as long as the on-board unit has an existing communication session with APS. The unique identification of the on-board unit is mapped to the MOB.

A TBV which cannot be uniquely identified by APS will not be represented as a MOB and will therefore not be allowed to move within the WI-7665 - CCS Area.

[approved]

[Key Principle] Localisation of a MOB

APS uses the received localisation information of a WI-8058 - Track-bound Vehicle (TBV) to position the corresponding MOB and allocate its extent to the topology. The MOBs extent results from the combination of the MOBs front and rear position as well as the path between. The MOBs extent is always greater than the actual extent of the corresponding TBV, since APS must take into account the inaccuracy of the localisation technology used in order to safely represent the TBV.

The following list shows the localisation technologies which are used to determine the front or rear position of the MOB:

- Front position of MOB:

- **ETCS Position Report:** The front position of the MOB is determined on base of the Maximum Safe Front End of the TBV stated in the ETCS position report (ETCS packet #0), received by APS in a ETCS Message e.g. Train Position Report TPR or Start of Mission SoM.

- Rear position of MOB:

- **Clear Track Signalling (CTS):** The rear position of the MOB is determined on base of the information sent by the underlying CTS technology, which states, if the CTS supervised track segment is clear or occupied. Therefore the rear position of the MOB will be only adjusted if the underlying CTS technology reports an unoccupied state. The shortening of the rear position is done up to the next occupied reporting track segment. This means that the rear position of the MOB will always be at the end of the currently occupied track segment.
- **Train Integrity Monitoring System (TIMS):** The rear position of the MOB is determined on base of the safe length (Estimated Front End to Minimum Safe Rear End) and the train-integrity. Both information, the safe length as well as the train-integrity are stated in the ETCS TPRs, received by APS.
- **GLAT-Train End Tag:** The rear position of the MOB is expected to be determined on base of the information sent by an independent GLAT-Train End Tag, which will be attached to the end of every TBV. The GLAT-Train End Tag is supposed to send a distinct position on the railway network.
  ***Note**: This technology (GLAT) is in the conception stage and is therefore not available yet.*

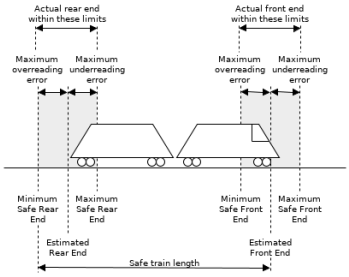


Figure 1 Reported positions of a track-bound vehicle

[approved]

4.2.1 Life cycle of a MOB

[Key Principle] MOB Creation

A MOB will be created by APS, if it receives a previously unknown unique identification of a TBV.

Subsequently if the created MOB can be located within the WI-7665 - CCS Area:

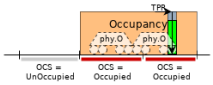
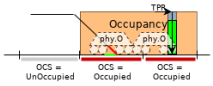
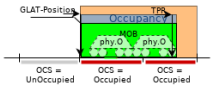
- APS will position the MOB and allocate its extent to the topology
- APS will create an initial WI-1974 - Movement Permission which is associated to the MOB
  - The MP is permanently associated to the MOB and is therefore linked to the life cycle of the MOB
  - The initial extent of this MP will have the same length than the extent of the MOB

[approved]

[Key Principle] Initial aggregation of the MOBs extent

The initial aggregation of the MOBs extent is working different than during its life cycle.

Based on the different combinations of localisation technologies, there are different approaches to initially aggregate the MOBs extent.

Combination of localisation technologies	Illustration	Aggregation Logic
Front position of MOB: ETCS SoM Rear position of MOB: CTS technology		• The MOB is created with front position at the Maximum Safe Front End stated in the SoM Position Report, received by APS • The rear position of the MOB is set to the same position as the front position of the MOB, which means that the MOB extent is zero. This is because the actual rear position of the TBV is unkown, because the occupancy reported by the CTS technology could be caused in conjunction with other non identified TBVs • The MOB extent will grow when the MOB starts to move until the rear position can be determined by a distinct point, which will be the end of an occupied CTS section
Front position of MOB: ETCS SoM Rear position of MOB: TIMS		• The MOB is created with front position at the Maximum Safe Front End stated in the SoM Position Report, received by APS • The rear position of the MOB is set to the same position as the front position of the MOB, which means that the MOB extent is zero. This is because the actual rear position of the TBV is unkown, because it is not stated by a distinct point. Even if APS receives the safe length of the TBV, it cannot predict in which direction the MOB shall extend, if not considering the state of the underlying DPS for aggregation • If the MOB starts moving the MOBs extent will grow until the full safe length is reached. Due to updates the MOB front and rear position will be adjusted according to the safe length
Front position of MOB: ETCS SoM Rear position of MOB: GLAT-Train End Tag ***Note**: currently not available*		• Not yet defined, as the conditions for use have not yet been defined

[approved]

[Key Principle] MOB Update

Updates to the MOB are triggered by the updates that APS receives about the corresponding TBV. If the information can be allocated to the MOB, it will be aggregated to the MOB.

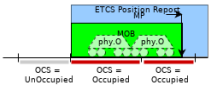
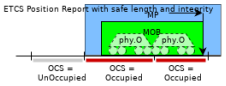
The following list shows examples of information leading to an update of the MOB (**non-exhaustiv**):

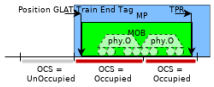
- Front and rear position
- Current velocity
- Characteristics like the length, axle load, cant deficiency or max velocity
- Operational state

[approved]

[Key Principle] Aggregation of the MOBs extent during its life cycle

Based on the different combinations of localisation technologies, there are different approaches to aggregate the MOBs extent during its life cycle.

Combination of localisation technologies	Illustration	Aggregation Logic
Front position of MOB: ETCS Position Report Rear position of MOB: CTS technology		• The front position of the MOB is updated with every received ETCS Position Report (packet #0) to the Maximum Safe Front End • The rear position of the MOB is always at the end of the currently occupied track segment • This technology combination features the highest difference between the MOBs extent and the physical extent of the TBV
Front position of MOB: ETCS Position Report Rear position of MOB: TIMS		• The front position of the MOB is updated with every received ETCS Position Report to the Maximum Safe Front End • The rear position of the MOB is updated with every received ETCS Position Report to the stated safe length if train-integrity is given • Contrary to what might be expected, this technology combination does not guarantee a fixed extent of the MOB. The reason is, that according to the ETCS specification, the Minimum Safe Rear End is the position that the TIMS delivers to the on-board unit at a certain point in time. If this is not updated between more than one ETCS Position Report, the Estimated Rear End is fixed and the safe length is accordingly modified in the ETCS Position Report. This means that the rear position of the MOB will be fixed, while the front position might get updated
Front position of MOB: ETCS Position Report Rear position of MOB:		

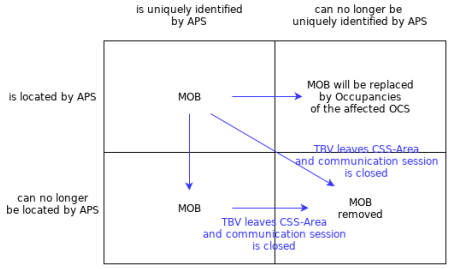
Front position of MOB: ETCS Position Report Rear position of MOB: GLAT-Train End Tag ***Note**: currently not available*		• Not yet defined, as the conditions for use have not yet been defined

[approved]

[Key Principle] MOB removal

A MOB will be removed in the following two cases:

- It will be removed if the represented TBV actually leaves the WI-7665 - CCS Area and the communication session between APS and the TBV is closed. At this time it can neither be uniquely identified anymore by APS nor can it be located anymore by APS.
- It will be removed and replaced by WI-7748 - Occupancy of the affected WI-7752 - Occupancy Sections, if the represented TBV can not be uniquely identified anymore by APS.



[approved]

4.3 Movement Permission

[Key Principle] Movement Permissions compared to Traditional Routes

In APS movements are granted with WI-1974 - Movement Permissions that differs in several points from routes in traditional interlocking systems:

- A WI-1974 - Movement Permission does not reference a fix predefined route, but can basically reference any arbitrarily chosen WI-2013 - Track Route.
- When a WI-1974 - Movement Permission is requested, APS will only check if all conditions are met to grant it safely, but it will not make the route setting itself. Everything required to grant the WI-1974 - Movement Permission (e.g. correct position of points or level crossings) has to be requested separately in advance to the WI-1974 - Movement Permission. Furthermore APS does not automatically release part of the topology claimed by a granted WI-1974 - Movement Permission, if the WI-2036 - Movable Object has passed that topology. This shall be achieved by a new request which shortens the extent of the WI-1974 - Movement Permission at its rear.
- A WI-1974 - Movement Permission comes along with a speed information that shall not be exceeded. But unlike to the signal aspects of traditional routes, a speed profile with possibly multiple speed changes may be defined along of the WI-2013 - Track Route of the WI-1974 - Movement Permission. Obviously the speed profile cannot contain a speed higher than the maximum allowed by the topology.

[approved]

4.3.1 Life Cycle of a Movement Permission

[Key Principle] Operations on Movement Permissions

The following table gives an overview of the different operations that allow the WI-2035 - Advanced Protection System to create, update and remove a WI-1974 - Movement Permission.

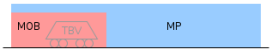
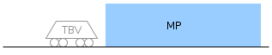
Operation	Application
Creation	The creation of a new WI-1974 - Movement Permission must be requested for each planned movement.
Extension	The extension of an existing WI-1974 - Movement Permission can be requested before, during or after the execution of a movement.
Increase of Speed	The increase of speed within an existing WI-1974 - Movement Permission can be requested before, during or after the execution of a movement.
Removal	The removal of an existing WI-1974 - Movement Permission can be requested before, during or after the execution of a movement. If the movement is ongoing, then the removal results in stopping the WI-8058 - Track-bound Vehicle. In this case, WI-2035 - Advanced Protection System will remove the WI-1974 - Movement Permission only after stopping. In addition, an existing WI-1974 - Movement Permission must be removed by WI-2035 - Advanced Protection System in certain situations.
Shortening at rear end	During an ongoing movement, WI-2035 - Advanced Protection System must permanently check whether some WI-2013 - Track Route can safely be released. Whenever this is the case, WI-2035 - Advanced Protection System must shorten the corresponding WI-1974 - Movement Permission at its rear end.
Shortening at front end	Before, during or after the execution of a movement, some hazardous situation can occur where WI-2035 - Advanced Protection System must shorten an existing WI-1974 - Movement Permission at its front end in order to avoid or reduce as much damage as possible.

[draft]

[Key Principle] Creation of a Movement Permission

WI-2035 - Advanced Protection System will create a requested WI-1974 - Movement Permission if all conditions are met to safely grant this WI-1974 - Movement Permission, see [Kapitel mit Creation Rules referenzieren].

There are two possible characteristics a WI-1974 - Movement Permission can have: it can be bound to a particular WI-2036 - Movable Object or it can be without any reference to a WI-2036 - Movable Object ('to whom it may concern'). These characteristics result in completely different meanings of the WI-1974 - Movement Permission.

Characteristic	Meaning
The WI-1974 - Movement Permission is bound to a WI-2036 - Movable Object. 	The WI-1974 - Movement Permission is supposed to be translated by SRP-3080 - APS Movement Authority Transactor and to be sent to the SRP-3081 - Vehicle Supervisor at the TBV represented by the WI-2036 - Movable Object. Therefore, the extent of the WI-1974 - Movement Permission must contain the full extent of the WI-2036 - Movable Object.
The WI-1974 - Movement Permission is of the kind 'to whom it may concern'. 	The WI-1974 - Movement Permission is supposed to be translated by SRP-3071 - APS Fixed Object Transactor and to be sent to the SRP-3072 - Object Controller of each affected light signal. Therefore, there is no relation between the WI-1974 - Movement Permission and any WI-8058 - Track-bound Vehicle.

[draft]

[Key Principle] Front end and rear end of a Movement Permission

Depending on the characteristic of the WI-1974 - Movement Permission, there are different requirements for its rear end and its front end.

Characteristic	Rear end	Front end
The WI-1974 - Movement Permission is bound to a WI-2036 - Movable Object.	Due to the given rules of the SRP-3081 - Vehicle Supervisor, the extent of the WI-1974 - Movement Permission must fully contain the extent of the associated WI-2036 - Movable Object. For capacity reasons we demand that the rear end of the WI-1974 - Movement Permission is located at the rear end of the associated WI-2036 - Movable Object.	Since the WI-1974 - Movement Permission will be displayed to the WI-2831 - Engine Driver as a WI-7220 - Movement Authority, the front end of the WI-1974 - Movement Permission can be located at any position. Only if release speed is required, then there are some conditions for the front end to be satisfied, see 4.3.4 - Using a Movement Permission until the End.
The WI-1974 - Movement Permission is of the kind 'to whom it may concern'.	The front end of the WI-1974 - Movement Permission must be located at some light signal in order to notify the WI-2831 - Engine Driver about the permission to drive. Due to the different signalling in every country, the light signals must be marked as 'potential rear end of an MP' on the topology.	The rear end of the WI-1974 - Movement Permission must be located at some 'target marker' like e.g. a light signal, a signal board or a buffer stop. Due to the great variety of signals among different countries, these target markers must be available on the topology.

[draft]

[Key Principle] Extension of a Movement Permission

WI-2035 - Advanced Protection System will extend a WI-1974 - Movement Permission due to an extension request, if all conditions are met to safely grant the WI-1974 - Movement Permission that results from concatenating the existing one with the requested extension, see [Kapitel mit Extension Rules referenzieren].

The requesting component only hast to send the extension, hence no conflict can arise when WI-2035 - Advanced Protection System is shortening the WI-1974 - Movement Permission at the same time. [draft]

[Key Principle] Increase of speed within a Movement Permission

to do [draft]

[Key Principle] Removal of a Movement Permission

The WI-2035 - Advanced Protection System will remove a WI-1974 - Movement Permission due to a removal request, if all conditions are met to safely remove this WI-1974 - Movement Permission, see [Kapitel mit Removal Rules referenzieren].

In addition, there are the following triggers for WI-2035 - Advanced Protection System to remove a WI-1974 - Movement Permission (non-exhaustive list):

- The WI-1974 - Movement Permission is bound to a WI-2036 - Movable Object being removed
- The WI-2035 - Advanced Protection System is shortening a WI-1974 - Movement Permission at its rear end and the new rear end coincides with its front end, see 4.3.1-7 - [Key Principle] Shortening of a Movement Permission at its rear end.
- SRP-3081 - Vehicle Supervisor removes the WI-7220 - Movement Authority after an emergency stop.

[draft]

[Key Principle] Shortening of a Movement Permission at its rear end

WI-2035 - Advanced Protection System is responsible for the shortening of a WI-1974 - Movement Permission at its rear end. Depending on the characteristic of the WI-1974 - Movement Permission, there are different triggers and rules for the execution of this shortening.

Characteristic	Trigger	New rear end of the WI-1974 - Movement Permission
The WI-1974 - Movement Permission is bound to a WI-2036 - Movable Object.	The rear end of the associated WI-2036 - Movable Object is being updated.	The new rear end of the associated WI-2036 - Movable Object.
The WI-1974 - Movement Permission is of the kind 'to whom it may concern'.	One of the rules for the light signal at the rear end of the WI-1974 - Movement Permission to switch to the aspect 'stop' is satisfied, see [separate rule set].	The border of the WI-2202 - Clear Track Signaling Installation belonging to the next light signal following the current rear end of the WI-1974 - Movement Permission in moving direction, if there is such a light signal which is not located at the front end of the WI-1974 - Movement Permission. Otherwise, the shortening results in the removal of the WI-1974 - Movement Permission.

[draft]

[Key Principle] Shortening of a Movement Permission at its front end

to do [draft]

4.3.2 Structure of a Movement Permission

[Key Principle] Morphology of a Movement Permission

A WI-1974 - Movement Permission regroups all elements required to evaluate the safeness of a movement:

- The extent of the WI-1974 - Movement Permission is the extent, inside which the movement is permitted. It is defined by a WI-2013 - Track Route in the direction of movement.
- The WI-2020 - Risk Buffer is a WI-2013 - Track Route directly in front of the extent of the WI-1974 - Movement Permission. Its purpose is to mitigate the risk, when a WI-2036 - Movable Object traverses the end of the extent of the WI-1974 - Movement Permission.
- The WI-2017 - Risk Path defines the WI-2013 - Track Route, from which another WI-2036 - Movable Object may enter the extent of the WI-1974 - Movement Permission. The WI-2017 - Risk Path therefore covers at least those parts of the topology, that may not to be used simultaneously with the extent of the WI-1974 - Movement Permission.
- Speed change markers define the speed profile, that shall be complied to during movement. It represents either an increase of decrease of speed starting form this point. In case of an increase of speed, a track-bound vehicle may accelerate only after the rear of the corresponding WI-2036 - Movable Object has passed the location of the speed change marker. In case of a decrease, the WI-2036 - Movable Object has to reduce its speed before its front reach the location of speed change marker.
- An already granted WI-1974 - Movement Permission should not become more restrictive (except due to emergencies) but may be weakened at any time.

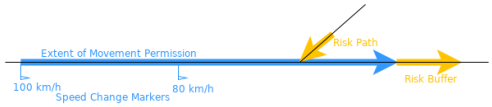


Figure 2: Morphology of a movement permission

[approved]

4.3.2.1 Risk Buffer

[Key Principle] Risk Buffer for overlap in front of a Movement Permission

A WI-2020 - Risk Buffer extends the topology claimed by the extent of the WI-1974 - Movement Permission, with an additional WI-2013 - Track Route directly in front of the extent of the WI-1974 - Movement Permission. The WI-2020 - Risk Buffer mitigates the risk, if a WI-2036 - Movable Object overruns its WI-8201 - End of Authority and therefore leaves the WI-7220 - Movement Authority transmitted to the WI-7724 - Onboard Unit.
The WI-2020 - Risk Buffer is required every time, when the risk that a WI-2036 - Movable Object overruns the granted extent of the WI-1974 - Movement Permission is not acceptable. This is especially the case in:

- situations where the supervision of covered distance is not safe enough (e.g. WI-1974 - Movement Permission granted with a release speed)
- situations where the extent of damage is extremely high, due to special environmental conditions related to higher speeds (e.g. longer tunnels, areas with handling of hazardous goods)

Primarily the second point is based on a large number of factors not controllable by APS. Therefore it is not possible to compute the minimal required length of a WI-2020 - Risk Buffer only based on WI-7756 - Safety Rules. For the environmental part some engineering data (called Risk Buffer Profiles) is required. A Risk Buffer Profile defines the required minimum length of a WI-2020 - Risk Buffer for a specific WI-6991 - Track Section and speed.
In situations where the risk that the WI-2036 - Movable Object will overrun the WI-8201 - End of Authority is already acceptably low (e.g. a vehicle at standstill or fully supervised by a technical equipment), the WI-2020 - Risk Buffer may be reduced to 0 meter in length. [approved]

4.3.2.2 Risk Path

[Key Principle] Required Risk Paths for a Movement Permission to be granted

A geometrical conflict between two movements may happen per definition where the extent of a WI-1974 - Movement Permission traverses an WI-7753 - Allocation Section. Each WI-6991 - Track Section that is not contained in the extent of a WI-1974 - Movement Permission shall be covered by a WI-2017 - Risk Path in order to be not usable for an other WI-1974 - Movement Permission.
To ensure safety in situations where not all movement are controlled by APS (e.g. siding tracks) sole reservation of conflicting WI-6991 - Track Section is not enough to mitigate the risk of flank collisions. In such cases trafficability shall be set up in a way, that ensure that no endangering movement is possible towards the WI-1974 - Movement Permission. This is done by extending the WI-2017 - Risk Paths until a protecting element. A protecting element is mainly a WI-6947 - Drive Protection Section in a state that provides flank protection or a buffer stop.

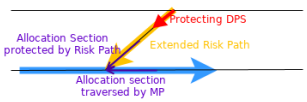


Figure 3: Risk path assuring track enforced flank protection with a DPS

A further protecting element can also be a WI-1974 - Movement Permission of an other WI-2036 - Movable Object, since it cannot move in an uncontrolled way, which leads to a flank protection. It also protects the WI-7753 - Allocation Section from any other rear movement.

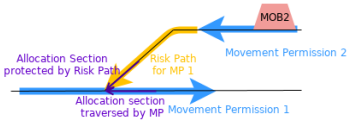


Figure 4: Risk path assuring track enforced flank protection with an other movement permission

[approved]

4.3.3 Safety Responsibility Profile

[Key Principle] Definition of a Safety Responsibility Profile along with movement permission

To allow a handover of some WI-8014 - Safety Responsibility from one WI-8014 - Safety Responsibility to another WI-8013 - Safety Actor while moving, the concept of WI-1974 - Movement Permission is extended with some safety responsibility markers. The set of all safety responsibility markers is called safety responsibility profile. Safety responsibility markers indicate that beyond this location a different WI-8096 - Movement Mode is required to go ahead with the movement. A WI-1974 - Movement Permission always has a safety responsibility marker located at its rear location containing the WI-8096 - Movement Mode in which the WI-2036 - Movable Object is currently running. **[** approved **]**

[Key Principle] Movement Modes and corresponding safety responsibility assignments

Movement Mode	Safety responsibility assignment		
	Guarantee free track	Supervise maximal speed	Supervise target location
Full Supervision without precise approach of target	APS-SL / APS-SM	Vehicle supervisor	Vehicle supervisor
On Sight without precise approach of target	Engine driver	Vehicle supervisor	Vehicle supervisor

Table 2: Movement Modes and corresponding safety responsibility assignments

[approved **]**

[Key Principle] Mapping of Movement Modes with ECTS Modes

Movement Mode	ETCS Mode
Full Supervision without precise approach of target	FS without release speed
On Sight without precise approach of target	OS without release speed

Table 3: Mapping of Movement Modes with ECTS Modes

[approved **]**

[Key Principle] Movement Mode transition from FS to OS without precise approach of target in case of ETCS

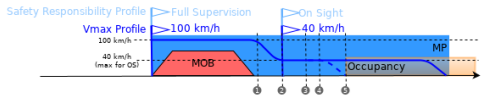


Figure 5: Transition form full supervision to on sight movement mode

1. Location of service break indication (SBI) for speed reduction to maximum speed allowed for on sight mode at the beginning of acknowledge area
2. Begin of acknowledgement area and explicit speed change marker to maximum speed allowed for on sight mode
3. Engine driver acknowledges on sight mode
4. Location of service break indication (SBI) for a stop at begin of on sight area
5. Begin of area where movement has to be be executed necessarily with "on sight" (e.g. due to an occupancy)

The location of the begin of the acknowledgement area (2) is determined by TMS-PE and provided along with the safety responsibility profile. An explicit reduction of speed is also provided by TMS-PE so that the maximum speed is reduced to the one allowed for on sight mode latest at the beginning of the acknowledgement area.

When WI-2036 - Movable Object moves along its WI-1974 - Movement Permission with an on sight area ahead, its WI-8201 - End of Authority is temporary set to begin of on sight area (5) until engine driver confirms the mode change. The request to acknowledge "acknowledge on sight mode" is then displayed to engine driver immediately when the WI-2036 - Movable Object enters the acknowledgement area (2) as speed criteria is already fulfilled. If the engine driver confirms the request before SBI for a stop at begin of on sight area (4), he can proceed over begin of on sight area (5) without any further breaking.

For an optimal operation TMS-PE should choose location of begin of acknowledgment area in such way, that engine driver has just enough time to confirm on sight mode before the service break indication for a stop at begin of on sight area (4).

APS can guarantee that driver is informed about on sight area at least at a certain distance before of its begin, by checking the distance between the begin of acknowledgement area with speed reduction to maximal allowed speed for on sight mode and the begin of on sight area. **[** approved **]**

4.3.4 Using a Movement Permission until the End

[Key Principle] General conditions required to allow a movement until the end of a movement permission

Due to inaccuracy of localisation and restrictive braking curves guarantying safety event in unfavorable conditions, it is not possible for a WI-2036 - Movable Object to use a granted WI-1974 - Movement Permission until far end.

Thus for operational situations when a WI-2036 - Movable Object is required to move until the end of granted WI-1974 - Movement Permission (e.g. during bypassing of trains or approaching a buffer stop) some additional principles are required:

1. The engine driver must be aware that the current movement requires a precise stopping. In traditional railway operation this is the normal case as a movement normally ends at a well defined main signal. As with APS a WI-1974 - Movement Permission may be issued to almost every location, precise stopping procedures have to be communicated more explicitly.
2. There must be a well defined location in the field that allows the engine driver to recognize in the field where exactly he has to stop (e.g. a signal board or another unambiguous object such as a buffer stop or the end of a platform).
3. For the case that vehicle is stopped too late, APS has to check that enough additional topology behind the intended stopping point has been requested (and therefore will be reserved), such that no collision hazards that may arise.
4. Before the release of the additional topology, APS has to ensure that the vehicle has effectively stopped at intended location and will not move anymore. This can obviously not be detected though normal localisation mechanisms as the accuracy is per definition to imprecise for such situations.

[approved **]**

[Key Principle] Release speed with movement permission target marker and window

When the engine driver is required to drive until a location beyond the resolution of displayed on board information, he has to be informed on an alternative way about the exact stopping location. This location has to be obviously visible in the field, so that the engine driver is capable to recognize it while driving.

For this purpose APS defines the concept of *movement permission target marker*. This is an oriented object located on reference topology

- where a recognizable object (e.g. signal board or buffer stop) is located in the field
- **and** where APS is able to detect if vehicle runs too far (e.g. the begin of a new WI-7752 - Occupancy Section)

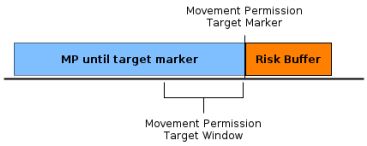


Figure 6: Movement Permission until Target Marker

Whenever a WI-1974 - Movement Permission is required to be used until its far end, the front end of its extent has to be located exactly at the location of a a movement permission target marker.

To allow an unambiguous recognition of the stopping point by the engine driver, a *movement permission target window* in front of the target marker must be defined along with the WI-1974 - Movement Permission. The movement permission target window is the part of the extent of the WI-1974 - Movement Permission inside which the engine driver is required to look for the location to stop.

The unambiguousness can be ensured either if the movement permission target window contains exactly one movement permission target marker or if engine driver is explicitly informed about the one where he is intended to stop. As uniqueness of movement permission target marker within movement permission target window may be difficult to guarantee, an explicit information is the preferable solution.

It is also worth to notice that the correct recognition of correct stopping point is not directly safety critical as vehicle is still supervised, but a confusion may lead to unnecessary safety reactions of engine driver. So for ergonomic reasons and to avoid unwanted operational consequences a clear communication about stopping location is desirable. **[** approved **]**

[Key Principle] Information for engine driver about the movement permission target marker with ECTS

When a release speed is defined along with a ETCS movement authority, ETCS on board unit will switch to release speed monitoring (RSM) when all required conditions are fulfilled and inform engine driver by displaying the release speed on driver-machine interface (DMI). As the exact moment of the switch is difficult to determine for the track side, relying only on the moment, when release speed is display to the engine driver, is insufficient.

So when the WI-2036 - Movable Object enters movement permission target window, APS Movement Transactor sends a message to the on bord unit with a textual instruction displayed to the engine driver on DMI, containing an unambiguous designation of stopping point. The designation is taken from movement target marker defined in topo data supplied by engineering data preparation (e.g. operational name of signal board or univoke description like "at end of platform 7 in station of Bern"). **[** approved **]**

[Key Principle] Localisation of a track bound vehicle moving with release speed

As movements with release speed are per definition operated beyond normal localisation accuracy, another method has to be used to detect if track bound vehicle runs over the end of granted WI-1974 - Movement Permission or not. Therefore APS requires some feedback from a device installed in the track located just behind movement permission target marker (e.g. an CTS section or even a single axle counter) able to report if vehicle has crossed this point or not.

This allows APS Object Aggregation to keep the front end of WI-2036 - Movable Object at movement permission target marker as long as the device does not report a crossing movement, even if max safe front end is reported already beyond the movement permission target marker by the on board localisation.

If the vehicle really moves beyond the front end of the WI-1974 - Movement Permission the device will detect the overrun. In this case APS Object Aggregation has to consider again the max safe front end reported by on board localisation. In consequence the WI-2036 - Movable Object will cover a part of the extent of the WI-2020 - Risk Buffer preventing from releasing this part of topology. Furthermore this anormal situation where a WI-2036 - Movable Object is located outside of its WI-1974 - Movement Permission can be easily recognized by other systems and allow them to take the required counter measures to get back to normal.

APS Object Aggregation has also to switch back to normal max safe front end based aggregation of the WI-2036 - Movable Object in case that the min safe front end is reported beyond the movement permission target marker, even if the device used for the detection of the overrun does not report the occupancy (e.g. because it is faulty).

[approved]

[Key Principle] Localisation with release speed based on an occupancy section

A concrete solution to detect an overrun is an WI-7752 - Occupancy Section that begins just behind the movement permission target marker. APS Object Aggregation can assume safely that vehicle has not moved beyond the end of the WI-1974 - Movement Permission as long as the WI-7752 - Occupancy Section still reports CLEAR.

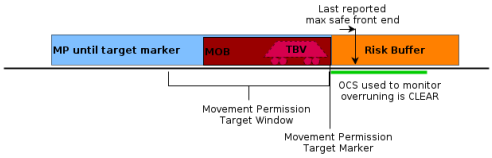


Figure 7: Localisation with an occupancy section of a track bound vehicle moving with release speed and stopped as intended

Starting from the moment where the WI-7752 - Occupancy Section is reported as OCCUPIED, the front end of the WI-2036 - Movable Object has to be placed at location of max safe front end.

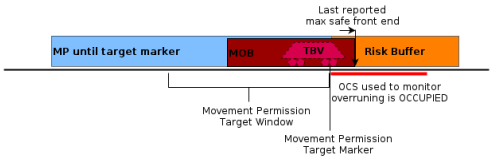


Figure 8: Localisation with an occupancy section of a track bound vehicle moving with release speed in overrun situation

To avoid an ambiguous situation where the WI-7752 - Occupancy Section is reported as occupied due to another track bound vehicle coming form the other side, the WI-1974 - Movement Permission should be requested with a WI-2020 - Risk Buffer covering at least the whole WI-7752 - Occupancy Section to monitor the correct stopping of track bound vehicle. But this requirement is not absolutely required to mitigate the hazard of a collision and thus may be checked by APS Safety Logic in an optional manner. [approved]

[Key Principle] Localisation with release speed in case of a movement toward a buffer stop

In situations where an overrun of the end of WI-1974 - Movement Permission cannot endanger other track bound movements (i.e. a movement towards a buffer stop), APS Object Aggregation can keep the front end of WI-2036 - Movable Object at location of corresponding movement target marker without any further measures. A movement permission target marker therefore has to include the information if some overrun monitoring by APS is required or not.

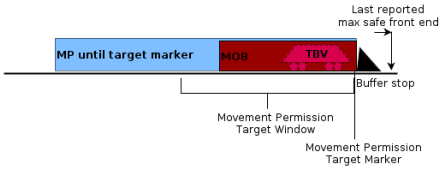


Figure 9: Localisation of a track bound vehicle moving with release speed towards a buffer stop

[approved]

[Key Principle] Hazard mitigation when vehicle runs over the end of a movement permission with release speed

The release speed is a threshold bellow which the engine driver is authorized to continue until the defined stopping point without supervision of the max safe front end of the WI-2036 - Movable Object.
To ensure nevertheless the safety, APS Safety Logic has to guarantee that the track bound vehicle still gets stopped within the WI-2020 - Risk Buffer with a confidence level that is high enough to reach the safety target. Concretely it has to check the ratio between the length of the WI-2020 - Risk Buffer and the height of the release speed: a higher release speed requires also a longer WI-2020 - Risk Buffer.
The following two factors determine a safe ratio between the length of the WI-2020 - Risk Buffer and release speed:

- delay until a potential overrun can be detected by APS and/or on board equipment
- delay until the track bound vehicle can be stopped in case of an overrun

A safe situation can be described to with the following inequations:

$$L_{RiskBuffer} \geqslant D_{SafeOverrunDetection} + D_{EmegencyBrakeActication}$$

$$V_{ReleaseSpeed} \leqslant V_{EmergecyBrakeLimit} - V_{MaxUnderReading}$$

with

$V_{ReleaseSpeed}$	the release speed requested along with WI-1974 - Movement Permission
$V_{MaxUnderReading}$	the presumed maximal under reading amount of measured speed
$V_{EmergecyBrakeLimit}$	the speed below which the vehicle can be stopped with an emergency brake command before the WI-2020 - Risk Buffer front end, that can be calculated based on the function $V_{EmergencyBrakeDeceleration}(d)$
$V_{EmergencyBrakeDeceleration}(d)$	the speed limit in function of remaining distance until location of WI-2020 - Risk Buffer front end below which the vehicle can be stopped with an emergency brake command before the WI-2020 - Risk Buffer front end
$L_{RiskBuffer}$	the length of the WI-2020 - Risk Buffer extent
$D_{SafeOverrunDetection}$	the distance distance behind movement permission target marker required to safely detect the overrun in APS
$D_{EmergencyBrakeActivation}$	the running distance until emergency brake is fully activated after APS has detected the overrun, including system delays, reaction times and physical factors such as time to build up braking power

The first inequation ensures that the length of the WI-2020 - Risk Buffer extent is long enough to allow APS to react in case of an overrun. The second one ensures that the release speed is low enough to ensure a safe stopping of the vehicle within the WI-2020 - Risk Buffer extent.

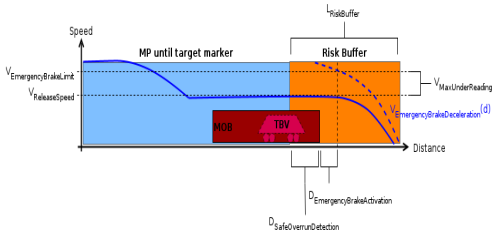


Figure 10: Dependency between length of risk buffer extent and release speed

The value $D_{SafeOverRunDetection}$ is determined by the method used to detect that the track bound vehicle run over the front end of the granted WI-1974 - Movement Permission.

The possibilities available to stop the track bound vehicle within the WI-2020 - Risk Buffer will determine the value of $D_{EmergencyBrakeActivation}$.

The function $V_{EmergencyBrakeDeceleration}(d)$ depends on vehicle capabilities and is often also designed as braking curve.

The choice of a safe combination of the release speed and the length of WI-2020 - Risk Buffer extent can be done in two manners: choose a release speed and deduce minimally required extent of WI-2020 - Risk Buffer or vice versa.
Initially the one or the other strategy may be used by a component (e.g. TMS Plan Execution) when requesting a WI-1974 - Movement Permission. The choice will depend on most important aspect for the given situation: either a quick approach of target or a minimization of supplementary topology that needs to be reserved.
If a hazardous situation is detected after APS Safety Logic has granted a WI-1974 - Movement Permission (e.g. due to inaccurate assumptions while checking the safety rules), the reduction of release speed (with in consequence an emergency stop) remains the only option as if no additional topology can be reserved.

Several possibilities exists to concretely implement the hazard mitigation related to the release speed. First of all ETCS provides an integrated feature that fully supports the release speed concept. For vehicles running without ETCS supervision, alternative functionalities can be implemented in APS to detect an overrun and trigger an emergency stop from track side. **[** approved **]**

[Key Principle] Overrun detection and emergency brake activation by ETCS on board supervision

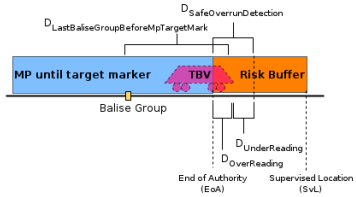


Figure 11: Overrun detection by ETCS on board supervision

When a release speed is transmitted along with an ECTS movement authority to the track bound vehicle, the SRP-3081 - Vehicle Supervisor (considered in here als part of the safety relevant system) supervises the min safe front end instead of the max safe front end when running with release speed. In other words the vehicle will get tripped when its min safe front end passes the end of authority (instead of max safe front end usually). Therefore the value $D_{SafeOverrunDetection}$ can be described based on odometer accuracy interval with following equation:

$$D_{SafeOverrunDetection} = D_{OverReading} + D_{UnderReading}$$

with

$D_{OverReading}$	the odometer over reading amount a location where overrun is detected
$D_{UnderReading}$	the odometer under reading amount a location where overrun is detected

The values $D_{OverReading}$ and $D_{UnderReading}$ can be estimated with the flowing function based on the requirements for interoperability specified in ERTMS/ETCS subset 41:

$$D_{OverReading} = 5m + 5\% \cdot D_{LastBaliseGroupBeforeMpTargetMarker}$$
$$D_{UnderReading} = 5m + 5\% \cdot D_{LastBaliseGroupBeforeMpTargetMarker}$$

with

$D_{LastBaliseGroupBeforeMpTargetMarker}$	the traveled distance after passing the last balise group in front of the movement permission target marker

In case that the actual over or under reading amount is higher than the estimated values, the situation case to be reconsidered (i.e. the vehicle supervisor will reduce the release speed accordingly).

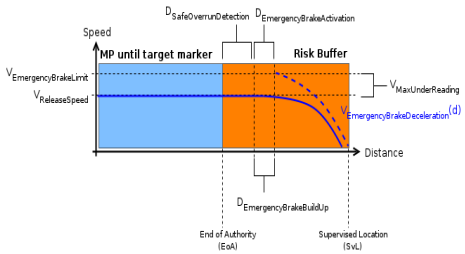


Figure 12: Emergency brake activation by ETCS on board supervision

The value of $D_{EmergencyBeakeActivation}$ can be calculated like this:

$$D_{EmergencyBrakeActivation} = D_{EmergencyBrakeBuildUp}$$
$$= T_{EmergencyBrakeBuildUp}\ (V_{ReleaseSpeed} + V_{MazUnderReading})$$

with

$T_{EmergencyBrakeBuildUp}$	The time required to fully build up breaking power after the emergency brake command has been triggered by the ETCS on board unit

The speed limit $V_{EmergencyBrakeLimit}$ allowing a safe stop within WI-2020 - Risk Buffer can be calculated by using the emergency brake deceleration curve for the location where overrun is detected:

$$V_{EmergencyBrakeLimit} = V_{EBD}(L_{RiskBuffer} - D_{OverReading} - D_{UnderReading} - D_{EmergencyBrakeActivation})$$

with

$V_{EBD}(d)$	The emergency braking deceleration curve of vehicle either defined with de gamma or lambda braking moder defined in ERTMS/ETCS subset 26.

The disadvantage of this method is that it is based on the assumption that over and under reading amount will not exceed the presumed calculated value. So the actual value of over and under reading amount has to be monitored by APS and additional measures taken if they exceed to grant a WI-1974 - Movement Permission with a fixed WI-2020 - Risk Buffer and guaranteed minimal release speed.

Fortunately ETCS provides a feature to let the on board unit calculate the maximal allowable release speed based on a given overlap distance to keep the situation safe. But as actual release speed is not reported back by ETCS on board unit. Thus it also has to be recalculated at track side if required for some further decisions.

With this principle a control loop is created between traffic management system optimizing the requests for the given operational situation and on board equipment executing the requests as good as possible to remain guarantee the safety..

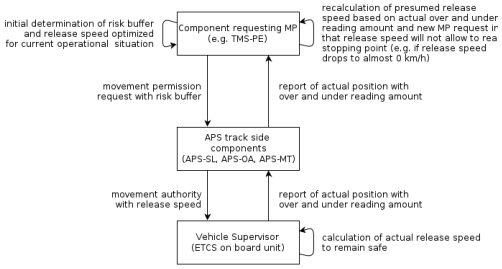


Figure 13: Control loop with release speed calculated by ETCS on board unit

[approved]

[Key Principle] Overrun detection with an occupancy section behind movement permission target marker

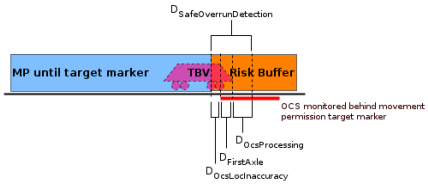


Figure 14: Overrun detection with an occupancy section behind movement permission target marker

An overrun is detected by an occupation of the WI-7752 - Occupancy Section behind of the movement permission target marker, the value $D_{SafeOverrunDetection}$ can be described with following equation:

$$D_{SafeOverrunDetection} = D_{OcsLocInaccuracy} + D_{FirstAxle} + D_{OcsProcessing}$$
$$= D_{OcsLocInaccuracy} + D_{FirstAxle} + T_{OcsProcessing}\,(V_{ReleaseSpeed} + V_{MaxUnderReading})$$

with

$D_{OcsLocInaccuracy}$	the inaccuracy of localization of the WI-7752 - Occupancy Section on reference topology compared to real position in the field
$D_{FirstAxle}$	the distance between the front end of the vehicle and the first axle
$T_{OcsProcessing}$	the time required by APS Object Aggregation to receive the information about an occupation of the WI-7752 - Occupancy Section aggregate it into WI-2036 - Movable Object and finally required by APS Safety Manager to recognize the situation as overrun

The value $D_{OcsLocInaccuracy}$ depends on the accuracy guaranteed by the engineering data preparation. It might either be specified for each WI-7752 - Occupancy Section in topo data or parameterized as default value for a specific application of APS.
The value $D_{FirstAxle}$ is specific for a given track bound vehicle. So it can be calculated based on vehicle properties (if known) or as fall back set to a default value representing the worst case situation among all expected vehicles.
The value $T_{OcsProcessing}$ can be parameterized for a specific application of APS system based on non functional requirements that the system guarantees. [approved]

[Key Principle] Emergency brake activation with APS Safety Manager in case of an overrun

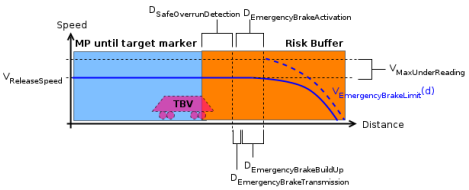


Figure 15: Emergency stop initiated by APS safety manager

In case of activation of emergency brake with APS Safety Manager, the value $D_{EmergencyBrakeActivation}$ can be described with following equation:

$$D_{EmergencyBrakeActivation} = D_{EmergencyBrakeTransmission} + D_{EmergencyBrakeBuildUp}$$
$$= (T_{EmergencyBrakeTransmission} + T_{EmergencyBrakeBuildUp})\,(V_{ReleaseSpeed} + V_{MaxUnderReading})$$

with

$T_{EmergencyBrakeTransmission}$	the time required for APS Safety Manager to transmit the emergency brake command to the vehicle or alternatively to the engine driver
$T_{EmergencyBrakeBuildUp}$	the time required fully build up breaking power on vehicle after it has received the emergency brake command, including the reaction time of engine driver if emergency brake command is initiated manually

The value $T_{EmergencyBrakeTransmission}$ can be parameterized for a specific application of APS system based on non functional requirements that the system guarantees.
The value $T_{EmergencyBrakeBuildUp}$ as well as $V_{EmergencyBrakeLimit}(d)$ are specific for a given track bound vehicle. So it can be calculated based on vehicle properties (if known, e.g. brake weight percentage) or as fall back set to a default value representing the worst case situation among all expected vehicles.

The advantage of this method is that it is somewhat independent of technology used to supervise the track bound vehicle. The disadvantage is that it relies on availability of connection between APS and the vehicle. Hazards resulting by a loss of this connection have therefore to be mitigated additionally.

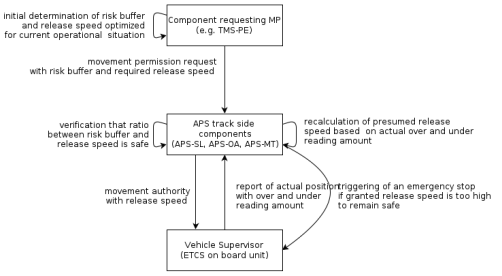


Figure 16: Control loop when APS has to grant a fixed release speed and trigger an emergency stop in case of an overrun

[approved]

4.3.5 Translation of a Movement Permission into an ETCS Movement Authority

[Key Principle] Location reference of a movement authority

As all locations which are relevant to describe some profile elements along an ETCS movement authority have to be expressed in a positive distance the location reference shall be chosen in a way that it is located behind the corresponding movable object. This may be achieved either by

1. using one of the eight last balise groups reported and still stored by the OBU and which have been entirely passed by the vehicle
2. using the concept of shifted location reference to align location reference with rear position of movement permission.

APS is basically the second solution as it provides some advantages:

1. With shifted location reference every case is covered, even when vehicle moves toward last relevant balise group (LRBG) after turning.
2. It allows always to use the last reported balise group as reference and therefore does not require to keep a list of all reported balise groups.
3. This approach is closer to the APS concept of movement permission and therefore leads to less complexity in translation.

[approved]

[Key Principle] Translation of speed changes as ETCS SSP

Relevant data alongside the movement permission such as allowed maximal speeds are expressed in ETCS with a chain of values and incremental distances from a value to the next one starting from a defined location reference.
In case of the static speed profile, the first such incremental distance D_STATIC is always 0, as the location reference of a movement authority is per design always aligned with rear location of movement permission in APS. Every upcoming speed change marker k leads to a corresponding entry in SSP with incremental distance D_STATIC(k) calculated as a position difference of two subsequent speed change markers.
To indicate that the speed profile provided alongside with a movement permission has no validity beyond the WI-8201 - End of Authority, a last entry with a special value indicating "no valid speed" is always added to SSP.

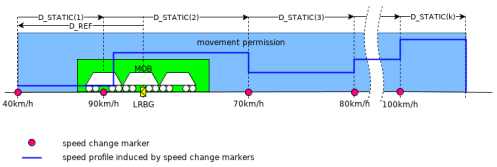


Figure 17: Translation of speed change markers of movement permission to ETCS SSP of a movement authority

[draft]

[Key Principle] Translation of a movement permission with a safety responsibility profile to an ETCS MA mode profile

In case of ETCS sections with WI-8096 - Movement Mode "on sight" inside a safety responsibility profile are translated with to an MA mode profile (ETCS packet #27). WI-8096 - Movement Mode "full supervision" do not require any specific translation within an MA, as operation mode FS is defined as the default in case of ETCS level 2/3.

In sections of WI-1974 - Movement Permission with a WI-8096 - Movement Mode requiring some speed limitations (e.g. on sight), APS-SL is responsible to ensure that the Vmax profile defined with Vmax markers takes care of those limitations. APS-MT derives then the maximal allowed speed for a specific MA mode (V_MAMODE in ETCS packet #80) from the Vmax profile taking the speed at the beginning of the acknowledgement area. The possibility to define maximal allowed speed over a national value (V_NVONSIGHT of ETCS packet #3) is not directly used with APS. [approved]

4.4 Occupancy Section and Occupancy

[Key Principle] Introduction Occupancy-Section and Occupancy

Each area of the railway network that is equipped with a track side asset capable of detecting if an area is occupied by a vehicle or not is represented by an WI-7752 - Occupancy Section (abbr. OCS) in APS. Such a technology is named WI-2202 - Clear Track Signaling Installation or WI-6900 - Train Detection System and comprises for example the following systems:

- track circuits
- axle counters

Each OCS can report the two states:

- "*occupied*" if a track bound vehicle has been detected within the related section.
- "*clear*" if no track bound vehicle entered the defined track section

If an OCS reports an occupation, which cannot be related to a located and identified vehicle, APS creates an WI-7748 - Occupancy in its Operating State for the corresponding OCS. This protective measure implies that the respective OCS can only be claimed by other vehicles under certain limitations, as for example that the ETCS-mode has to be set to on sight (OS).

If the cause of a track occupation can be related to a granted movement, APS may omit the creation of an additional WI-7748 - Occupancy as the concerned topology is already claimed by some other objects such as an MP or a MOB. In return, APS has to cross check if it has to create an WI-7748 - Occupancy retrospectively when an MP or MOB is removed. [approved]

4.4.1 Basic Life Cycle of an Occupancy

[Key Principle] Creating and Removing an Occupancy due to OCS state information

An WI-7748 - Occupancy is only **created or removed** and **never altered**.

- **Created:** If an WI-7752 - Occupancy Section states "*occupied*" and cannot be assigned to a located and identified MOB
- **Removed:** If the WI-7752 - Occupancy Section underlying an existing occupancy states "*clear*"

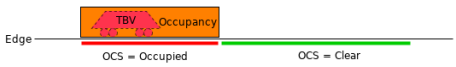


Figure 18: Relation between an occupancy and an occupancy section

Adjacent WI-7752 - Occupancy Section which are reported as "*occupied*" result in the creation of independent WI-7748 - Occupancy objects, even if it may have been caused by the same vehicle. This leads to a simpler logic for creation and removal of Occupancies.

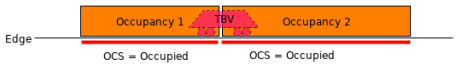


Figure 19: Adjacent occupancy sections leads to independent occupancies

[approved]

4.4.2 Assignment of an occupied OCS to a moving MOB

[Key Principle] Assignment of an occupied OCS to a moving MOB

A track bound vehicle, which moves on a track leads to a sequence of OCSs being reported as occupied. If each reported occupation of an OCS implied the creation of an WI-7748 - Occupancy, it would lead to a complex logic in order to identify whether or not the cause of the WI-7748 - Occupancy is the current movement itself. Furthermore, it would also cause unnecessary limitations (e.g. On Sight movements). Thus, APS will create an WI-7748 - Occupancy only in cases when there is a risk that the track is occupied by an object that cannot be explained by a regular situation otherwise controlled by APS.

Consequently, when a MOB is running inside its MP, a reported occupation of an OCS is assigned to the movement of a MOB if the following conditions are met:

1. The OCS, which changes its state from "*clear*" to "*occupied*" has to be (at least partially) between the rear end of a MOB and the front end of its MP.
2. The corresponding MP shall feature a maximum speed of more than 0 km/h.

Thus, no WI-7748 - Occupancy will be created in such situations.

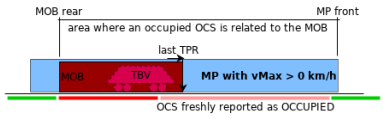


Figure 20: OCS reported as occupied due to the movement of a MOB after receiving a TPR withing the extend of OCS

The previous figure depicts the normal scenario when a track bound vehicle enters a new OCS while moving inside its MP. However, as information coming from track side localisation equipment and information issued directly by on

board devices of track bound vehicles are transmitted via independent channels, it is difficult for APS to make assumptions about the order of different localisation information. The rules used to assign an WI-7748 - Occupancy to a MOB are solving this issue without requiring an explicit synchronization. This helps to reduce the complexity of APS`s aggregation logic.

Figure 21: OCS reported as occupied due to the movement of a MOB before receiving a TPR withing the extend of OCS

In an extrem situation (e.g. with short OCS, high speeds and/or low TPR frequency) it may happen that the OCS after the next is reported as occupied before the directly adjacent one.

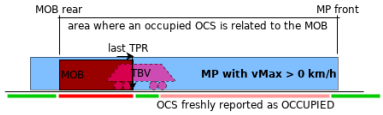


Figure 22: Extrem situation where over next OCS is reported as occupied before of previous one

The definition used to assign an occupied OCS to the movement of a MOB also implies that any OCS entirely located behind a MOB leads to an WI-7748 - Occupancy, even if its occupation was caused by the MOB but got delayed in the system. However, this should not be an issue as it is quite improbable in practice and in any case would get resolved quickly when the OCS reports clear again.

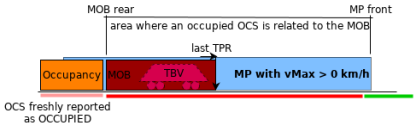


Figure 23: OCS occupied behind the MOB

Another border case arises, when different causes lead to an occupation report of an OCS. Such a situation can occur for example, if two MPs have been granted such that they both end inside the same OCS. In this case it is no longer possible for APS to determine which MOB is the origin of the OCS's occupancy report. Nevertheless, no WI-7748 - Occupancy is created by APS as the situation is still entirely plausible.

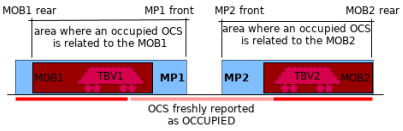


Figure 24: Ambiguous situation when two MOBs are allowed to enter the same OCS simultaneously

A similar situation arises when a MOB enters an OCS whose adjacent OCS is already occupied (i.e. an WI-7748 - Occupancy has been an created). In this case the cause of the reported occupation of the OCS, which is located between the MOB and the WI-7748 - Occupancy can be either due to the movement of the MOB itself or an unplanned movement of a vehicle inside the WI-7748 - Occupancy. APS still considers that the most probable cause in this situation is the movement of the MOB and therefore omits to create another WI-7748 - Occupancy. (NOTE: An alternative solution would be to reject the MP that allows the MOB to approach the reported Occupancy, if an unexpected movement of a vehicle inside the WI-7748 - Occupancy represented an unacceptable hazard.)

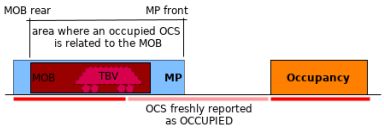


Figure 25: An Ambiguous situation when a MOB is allowed to enter OCS just in front of an other occupancy

The principle of assigning an OCS to a MOB can be considered as safe even if it seems to lead to a loss of information at a first glance. The extent of an occupied OCS is covered in all situations (at least for the part where the real occupation occurs) by another object claiming the topology, either a MP and/or a MOB. The safety is guaranteed by the following rationales:

- **All MPs are granted only after safety checks:** The MP of the MOBs were granted by the APS after checking all rules defined by the APS safety logic. Concepts such as risk buffers add further safety margins.
- **Movement of vehicles is supervised:** The execution of movement is supervised by an on board unit guarantying that the MOB will stay inside its granted MP.

[approved]

[Key Principle] Deferred Creation of Occupancies

As a counter part to the principle of omitting the creation of an WI-7748 - Occupancy if the cause can be related to the movement of a MOB (see IA-23023 - [Key Principle] Assignment of an occupied OCS to a moving MOB), APS has to ensure that the WI-7748 - Occupancy is created in a postponed manner, when a MOB and/or its MP is updated or removed and leads to an OCS that can no longer be assigned to the movement of a MOB according to conditions defined in IA-23023 - [Key Principle] Assignment of an occupied OCS to a moving MOB.

The first of such situations arises, when a MOB gets removed for example due to customary rundown with subsequent termination of the connection with APS.

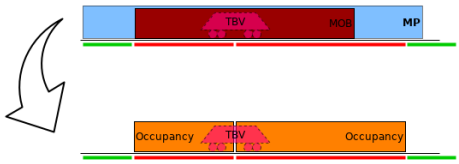


Figure 26: Postponed creation of an occupancy at rundown of a MOB

The second situation is related to the adjustment of a MOB`s rear end, when an OCS in between the MOB`s rear and front end is reported as clear and the next OCS on which the MOB`s rear end is positioned has to be still considered as occupied (i.e. because it has been reported as occupied but not as clear).

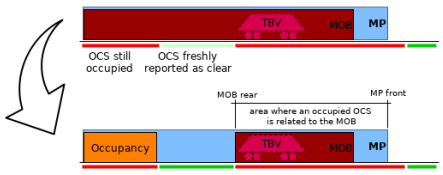


Figure 27: Postponed creation of an occupancy when an OCS remains occupied behind another one that is reported as clear

A MOB shortened because a new safe length has been reported may also require the creation of a postponed WI-7748 - Occupancy if an OCS that has to be still considered as occupied remains behind of the MOB.

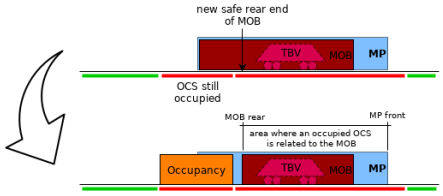


Figure 28: Postponed creation of an occupancy when an OCS remains occupied behind a MOB reporting a shorter safe length

However no WI-7748 - Occupancy is created when a MOB is shortened and thus no longer covering an occupied OCS that still fulfills the conditions to be assigned to an other MOB.

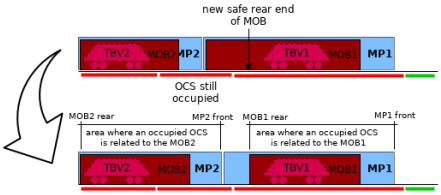


Figure 29: OCS remains occupied behind a MOB reporting a shorter safe length but can be assigned to another following MOB

[approved]

OCS that are shorter than maximal distance between axles

The handling of OCSs that are shorter than maximal allowed distance between axles of a vehicle has not been defined yet. The problem with such a short OCS is that it may state "clear" while the TBV is still located on the OCS.

4.4.3 Adjustment of the MOB extent based on OCS information

[Key Principle] Adjusting the MOB extent based on OCS information

OCSs have a defined extent on the topology and thus can be used by the APS to determine the safe rear end for MOBs. APS uses this information as fallback, if there is no information about a safe rear end coming from the on board localisation system of a TBV. Concretely APS shortens the rear end of a MOB if an OCS located (even partially) within the extent of the MOB states "*clear*".

As it is required that the on board localisation system allows to clearly identify and localise at least the front end to be able to create a MOB, the OCS information is never used by APS for prolonging the MOB at front end.

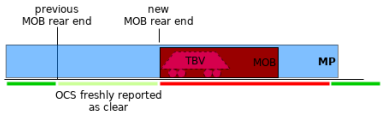


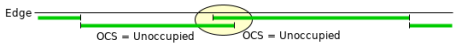
Figure 30: Adjustment of the MOB rear end after an OCS reported as clear

[approved]

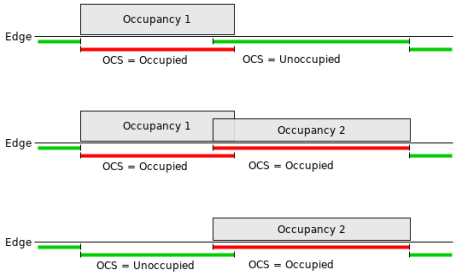
4.4.4 Handling of information from overlapping Occupancy Sections

[Key Principle] Overlapping Occupancy-Sections

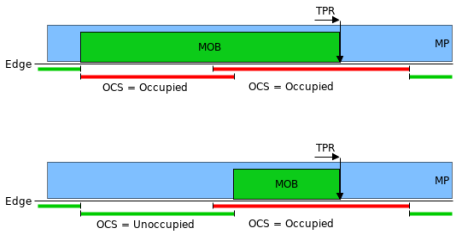
On real topology a OCS could overlap with an other OCS. For example if one OCS uses axle counters and the next OCS uses track circuit.



If no MOB is identified on an occupied OCS an Occupancy shall be created on the whole CTS, which means also on the overlapping range. So if two overlapping OCS are occupied two overlapping occupancies shall be created. And if a CTS reports the status "*clear*" the whole Occupancy shall be removed.



If a MOB is identified on one or more occupancies a CTS status of "*clear*" shall be used if no safe length is reported from the localisation technology. In such a case the MOB shall be shortened so that the rear end is positioned at the end of the unoccupied section.



[approved]

Ungenauigkeit von Occupancies

Die Position von GFM kann unter Umständen nicht ganz korrekt sein. Zum Beispiel nach Instandstellungsarbeiten mit Aufschotterung kommt es vor, dass z.B. Achszähler leicht verschoben sind.

Wie soll damit umgegangen werden?

4.5 Usage Restriction Area

[Key Principle] Introduction of the Usage Restriction Area

In railway operations, situations occur on a railway network in which certain track sections cannot be used in the same way as usual due to failures of track side assets, damage to edges or construction work. In APS those situations are treated with WI-1996 - Usage Restriction Areas where the planning instance or track side staff have the possibility to intervene into the railway operations and restrict the existing usage conditions of the relevant track sections concerned in order to prevent unsafe operations.

The WI-1996 - Usage Restriction Area has the following characteristics:

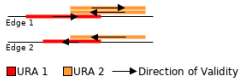
- A URA contains a list of track sections that are directed and have a certain extent.
- Within a URA the existing WI-8015 - Usage Conditions of the included track sections may be restricted by so called WI-7870 - Usage Restrictions.
- The existing WI-8015 - Usage Conditions are still valid and will be validated independently of the defined WI-7870 - Usage Restrictions.
- Each WI-7870 - Usage Restriction is validated independently, even when multiple URAs overlap each other

As a consequence a request will be rejected by APS, if it does not fulfill each defined WI-7870 - Usage Restriction as well as each WI-8015 - Usage Conditions valid for the claimed topology. [approved]

[Key Principle] Definition of the Area

The geometrical extent of a URA is defined by a list of directed track sections. The included track sections do not necessarily have to be connected. This is because there are situations, where a URA has to cover parallel positioned track sections, for example, due to a construction site.

URAs may overlap each other. To illustrate the possibilities in creating URAs, the following diagram shows two URAs, each covering two parallel, differently directed track sections and overlapping each other.



[approved]

[Key Principle] Life cycle of a URA

A URA may be created upon request or upon demand of a authorized system or person which takes the responsibility for the creation of the URA.

The removal of a URA is safety critical because subsequent operations may utilize the track sections of a URA in an unsafe way, if the URA is removed to early. If a URA shall be removed it has to be assured, that the relevant track section can be used safely without the WI-7870 - Usage Restrictions defined by the URA. This is why a URA may only be removed by an authorized person or system, which takes the full responsibility for the removal of the URA.

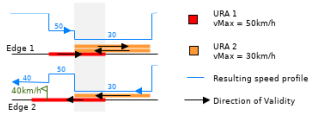
The modification of an existing URA is safety critical, for the same reason as the removal of a URA. APS does not support the modification of an existing URA. In order to modify an existing URA, the existing URA has to be replaced by a new URA. [approved]

[Key Principle] Speed Restriction

In order to restrict the maximal allowed velocity within an area, a URA with the WI-7870 - Usage Restriction of type speed restriction may be used.

The speed restriction of the URA applies to the entire geometrical extent of the URA. It is defined by fix constant. As mentioned above, for granting a request, each relevant WI-7870 - Usage Restriction and WI-8015 - Usage Conditions are validated separately by APS.

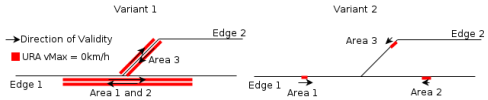
The following diagram illustrates the result of overlapping URAs with different speed restrictions:



[approved]

[Key Principle] Entry Prohibition

The entry prohibition into a specific area can be achieved by requesting an URA which restricts the allowed velocity with a vMax of 0 km/h. The following diagram illustrates two possible variants to prohibit the entrance into a specific area:



Variant 1 restricts the movement of track-bound vehicles inside the complete area whereas Variant 2 only restricts the entry to the area, but allows to exit and to move inside the area. [approved]

[Key Principle] Usage Restriction Area for Occupational safeguard

For the realization of a WI-8448 - Occupational safeguard an URA can be requested at APS, stating a person who is responsible for the URA.

In order to support the corresponding business process, APS guarantees that:

- An URA can be safely viewed on the APS App, according to the required safety integrity level of the APS App
- An URA stating a responsible person, can only be removed, if the relevant request has been granted by this person or if the removal was requested by this person itself

Also it is currently assumed that:

- That the APS app consists of a mobile client and a server-side application, and that the mobile client can subscribe to parts of the Operating State in the server application and thus always receive the current status of the Operating State.
- The responsible person must not confirm the URA via the APS App in order to be responsible.
- The responsible person does not have to release the URA via the APS App in order to release the Occupational Safequard for the track-side personnel in duty, but will release the Operational Safequard using a manual process.
- It shall be technically ensured that the person responsible for the URA is present on site at the WI-8448 - Occupational safeguard to be able to guarantee that all actions carried out within the WI-8448 - Occupational safeguard are finished before removing the WI-8448 - Occupational safeguard. Compliance with this condition is currently not dealt with by APS.

[draft]

4.6 Operating State

[Key Principle] Objects and states composing the APS operating state

The WI-2033 - APS Operating State holds the information required to guarantee the safety by the APS. The stored information is used for the following purposes:

- Aggregation of WI-2036 - Movable Objects and unresolved WI-7748 occupancies in SRP-3068 - APS Object Aggregation based up on reception of new raw information form and may be other transactors in future.
- Checking the WI-7756 - Safety Rules when SRP-3066 - APS Safety Logic is requested to grant a state change.

The information handled in WI-2033 - APS Operating State can be subdivided into three categories:

- The state information received directly from the SRP-3080 - APS Movement Authority Transactor and the SRP-3071 - APS Fixed Object Transactor.
- The information about demands addressed by SRP-3066 - APS Safety Logic.
- The aggregated information obtained by combining all available raw information into a generic abstraction.

Note: it is not necessary to store the aggregated information in WI-2033 - APS Operating State in a permanent manner, as it may be recreated at any time base on raw information.

The aggregated information as well as a part of the raw information is propagated by SRP-3068 - APS Object Aggregation to other components to allow them to take their decisions up on the current operating state. [draft]

[Key Principle] Information stored in APS operating state received from APS-FOT

The following information received form SRP-3071 - APS Fixed Object Transactor is stored in WI-2033 - APS Operating State:

- Current trafficability and flank protection state of WI-6947 - Drive Protection Sections
- Current group state of WI-6948 - Drive Protection Section Groups
- Current occupation state of WI-7752 - Occupancy Sections

[draft]

[Key Principle] Information stored in APS operating state received from APS-MT

The following information received form SRP-3080 - APS Movement Authority Transactor is stored in WI-2033 - APS Operating State:

- Most recently received localisation report for each connected device, i.e. ETCS on board unit.

[draft]

[Key Principle] Information stored in APS operating state received from APS-SL

The following information received form SRP-3066 - APS Safety Logic is stored in WI-2033 - APS Operating State:

- Most recently demanded WI-1974 - Movement Permission for each WI-2036 - Movable Object

[draft]

[Key Principle] Information aggregated by APS-OA

The following information aggregated within SRP-3068 - APS Object Aggregation is also stored:

- Properties of resolved WI-2036 - Movable Objects (e.g. cant deficiency and axle load categories, maximal speed)
- Information about movements of WI-2036 - Movable Objects (e.g. last known extent and speed as well last currently granted WI-1974 - Movement Permission)
- Unresolved WI-7748 occupancies

[draft]

[Key Principle] Generic event processing in APS-OA

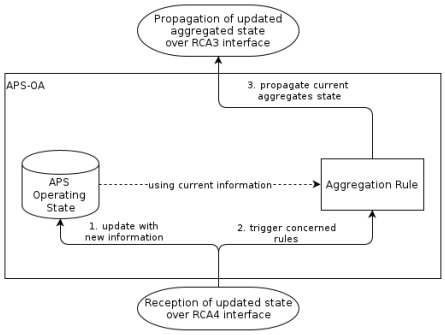


Figure 31: Generic event processing in APS Object Aggregation

SRP-3068 - APS Object Aggregation processes new states up on reception of an event over RCA4 interface using the following three steps:

1. First of all the WI-2033 - APS Operating State is updated with the raw information freshly received with an incoming event. Generally it is sufficient that to only keep the last state of a given object (e.g. current state of a WI-6947 - Drive Protection Section or most recent localisation report transmitted by an on board device) so no historical information will be kept in WI-2033 - APS Operating State.
2. In a second step SRP-3068 - APS Object Aggregation has to identify all the objects that have to be aggregated again, due to current state change. The logic used for this identification is defined by a set of trigger rules.
3. In a third and last step, the identified aggregation rules are applied on updated WI-2033 - APS Operating State and any state changes on aggregated objects are propagated over RCA3 interface to all consumers, especially SRP-3066 - APS Safety Logic.

[draft **]**

5 Components

APS Safety Logic

The **APS Safety Logic** decides if a request is granted or rejected depending on the resulting risk. The request can ask for a state change of an SRP-5014 - Trackside Asset / Warning Area or the creation / modification / removal of a WI-1974 - Movement Permission or a WI-1996 - Usage Restriction Area. For the decision, the **APS Safety Logic** stores the state of the SRP-5014 - Trackside Assets, the WI-1974 - Movement Permissions, the position of the WI-2036 - Movable Objects (e.g. trains), the current WI-1996 - Usage Restriction Areas. and the topological data. A request shall only be granted if it does not cause a danger pattern of SRP-3069 - APS Safety Manager.

APS Object Aggregation

The **APS Object Aggregation** combines the information received over different channels from the trackside world to one consolidated representation that is provided to the SRP-3066 - APS Safety Logic. That consolidated representation contains the state of the WI-2036 - Movable Object (e.g. trains) like position and extend as well as the state of the SRP-5014 - Trackside Assets. In the other communication direction, it dispatches information from the SRP-3066 - APS Safety Logic using the corresponding communication channels to the outside world. This information includes the WI-1974 - Movement Permissions, the state request for the SRP-5014 - Trackside Asset and warning messages for WI-2327 - Personnel at Trackside and WI-2831 - Engine Driver.

APS Safety Logic & Object Aggregation

The **APS Safety Logic & Object Aggregation** is the logical component that regroups SRP-3068 - APS Object Aggregation and SRP-3066 - APS Safety Logic.

APS Movement Authority Transactor

The **APS Movement Authority Transactor** communicates with the registered ETCS capable vehicles. Among others it translates the WI-1974 - Movement Permissions to ETCS Movement Authorities and sends them to the vehicle. In the other direction it will receive the train position reports from the vehicle and forward them to the SRP-3068 - APS Object Aggregation.

APS Fixed Object Transactor

The **APS Fixed Object Transactor** enables the connection of an SRP-3072 - Object Controller to the SRP-3068 - APS Object Aggregation. Therefore it translates between the generic SRP-4705 - Controller Interface to the more specific SRP-5008 - EULYNX Interface.

6 Functional Requirements

Structure of Functional Requirements

The Functional Requirements (SRQ) are structured by Capability Realizations [CR] and Interface Scenarios [IS] in accordance to the used Capella types. Each Functional Requirement refers to a Logical Function [LF], which is referenced in title of the Functional Requirement by using square brackets. The naming of the listed Capability Realizations, Interface Scenarios and Logical Functions matches the naming of the corresponding elements in Capella. **[** approved **]**

6.1 [CR] Monitor and Control Trafficability of Railway Network

6.1.1 [IS] Request Trafficability or Flank Protection for DPS

6.1.1.1 Sequence Diagrams

[IS] Request Trafficability for DPS

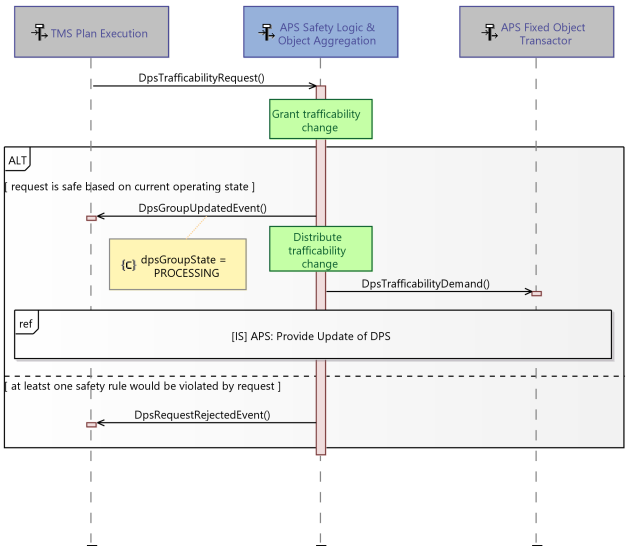


Diagram 1: Request Trafficability for DPS

[approved **]**

[IS] Request Flank Protection for DPS

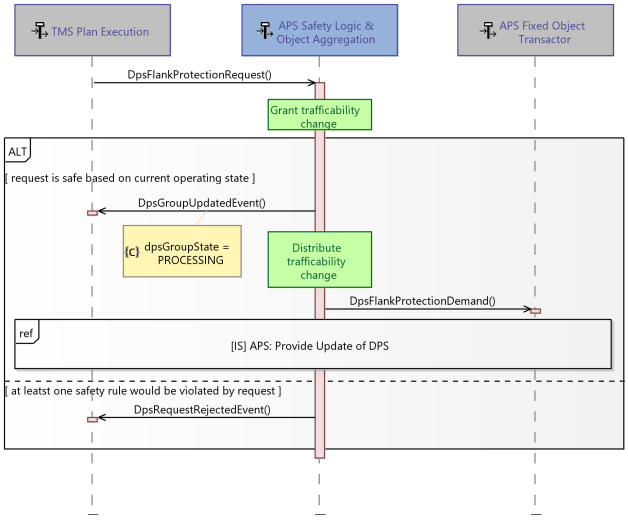


Diagram 2: Request Flank Protection for DPS

[approved **]**

6.1.1.2 Functional Requirements

6.1.1.2.1 [LF] Grant Trafficability Change

IA-23009 - [Grant Trafficability Change] Check DPS request according to Safety Rules

Each SRP-18725 - DpsTrafficabilityRequest or SRP-19458 - DpsFlankProtectionRequest received by IA-23665 - APS Safety Logic & Object Aggregation over SRP-4729 - Interlocking Control and Monitoring Interface shall be checked for it's safety according to the WI-7756 - Safety Rules.

If at least one of the WI-7756 - Safety Rules is not fulfilled the SRP-18725 - DpsTrafficabilityRequest or SRP-19458 - DpsFlankProtectionRequest shall be rejected. Only if all of the WI-7756 - Safety Rules are fulfilled the SRP-18725 - DpsTrafficabilityRequest or SRP-19458 - DpsFlankProtectionRequest shall be granted. **[** approved **]**

IA-23286 - [Grant Trafficability Change] [Safety Rule] Requested DPS shall exist

The SRP-18725 - DpsTrafficabilityRequest and SRP-19458 - DpsFlankProtectionRequest shall be rejected if the WI-6947 - Drive Protection Section identified by its ID is not defined in WI-3265 - Topology currently loaded by IA-23665 - APS Safety Logic & Object Aggregation. **[** approved **]**

IA-23290 - [Grant Trafficability Change] [Safety Rule] Requested DPS must not be claimed by MP

The SRP-18725 - DpsTrafficabilityRequest and SRP-19458 - DpsFlankProtectionRequest shall be rejected if a WI-6947 - Drive Protection Section in the WI-6948 - Drive Protection Section Group to which the requested WI-6947 - Drive Protection Section belongs is claimed by a WI-1974 - Movement Permission.
[approved **]**

IA-23291 - [Grant Trafficability Change] [Safety Rule] Requested DPS must not be claimed by Risk-Buffer

The SRP-18725 - DpsTrafficabilityRequest and SRP-19458 - DpsFlankProtectionRequest shall be rejected if a WI-6947 - Drive Protection Section in the WI-6948 - Drive Protection Section Group to which the requested WI-6947 - Drive Protection Section belongs is claimed by a WI-2020 - Risk Buffer.
[approved **]**

IA-23292 - [Grant Trafficability Change] [Safety Rule] Requested DPS must not be claimed by Risk-Path

The SRP-18725 - DpsTrafficabilityRequest and SRP-19458 - DpsFlankProtectionRequest shall be rejected if a WI-6947 - Drive Protection Section in the WI-6948 - Drive Protection Section Group to which the requested WI-6947 - Drive Protection Section belongs is claimed by a WI-2017 - Risk Path. **[** approved **]**

IA-23293 - [Grant Trafficability Change] [Safety Rule] Requested DPS must not be claimed by Occupancy

The SRP-18725 - DpsTrafficabilityRequest and SRP-19458 - DpsFlankProtectionRequest shall be rejected if a WI-6947 - Drive Protection Section in the WI-6948 - Drive Protection Section Group to which the requested WI-6947 - Drive Protection Section belongs is claimed by an WI-7748 - Occupancy. **[** approved **]**

IA-23294 - [Grant Trafficability Change] [Safety Rule] State of the requested DPS-Group shall be Ready

The SRP-18725 - DpsTrafficabilityRequest and SRP-19458 - DpsFlankProtectionRequest shall be rejected if the WI-6948 - Drive Protection Section Group to which the requested WI-6947 - Drive Protection Section belongs has not the state READY. **[** approved **]**

IA-22892 - [Grant Trafficability Change] Rejected DPS request shall be propagated

Each rejected SRP-18725 - DpsTrafficabilityRequest or SRP-19458 - DpsFlankProtectionRequest shall be propagated by immediately sending a SRP-18742 - DpsRequestRejectedEvent with the corresponding rejectCode back over SRP-4729 - Interlocking Control and Monitoring Interface. **[** approved **]**

IA-22889 - [Grant Trafficability Change] DPS group update shall be propagated

Each granted SRP-18725 - DpsTrafficabilityRequest or SRP-19458 - DpsFlankProtectionRequest (i.e. all WI-7756 - Safety Rules stated in IA-23009 - [Grant Trafficability Change] Check DPS request according to Safety Rules are fulfilled) shall be propagated as SRP-18728 - DpsGroupUpdatedEvent over SRP-4729 - Interlocking Control and Monitoring Interface with the following attribute values:

Attribute Name	Value
dpsGroupState	dpsGroupState set to PROCESSING
dpsStates	A dpsState for each WI-6947 - Drive Protection Section belonging to the same WI-6948 - Drive Protection Section Group as the requested WI-6947 - Drive Protection Section with • flankProtection set to FALSE • trafficability set according default value while processing as defined in WI-6949 - Engineering Data

[approved **]**

6.1.1.2.2 [LF] Distribute Trafficability Change

IA-22897 - [Distribute Trafficability Change] DPS demand shall be distributed

Each SRP-18725 - DpsTrafficabilityRequest or SRP-19458 - DpsFlankProtectionRequest received by IA-23665 - APS Safety Logic & Object Aggregation via the SRP-4729 - Interlocking Control and Monitoring Interface shall be distributed, immediately after request was granted, as a SRP-14466 - DpsTrafficabilityDemand or SRP-21522 - DpsFlankProtectionDemand via the SRP-4705 - Controller Interface The demand shall be distributed exclusively to the SRP-3071 - APS Fixed Object Transactor under control of the relevant DPS. **[** approved **]**

6.1.1.3 Test Cases

6.1.1.3.1 APS-SL-OA

IA-24076 - [Test Case] Request Trafficability or Flank Protection for DPS

dps-request-flank-protection-true-for-derailer-CHAM-Ev23.json
dps-request-trafficability-full-for-Ix-on-CHAM.G72.json
dps-request-trafficability-full-for-Ix-on-CHAM.G73.json
dps-request-trafficability-full-for-point-CHAM-1-diverging.json
dps-request-trafficability-full-for-point-CHAM-1-straight.json
dps-request-trafficability-full-for-point-CHAM-2-diverging.json
dps-request-trafficability-full-for-point-CHAM-27-diverging.json
dps-request-trafficability-full-for-point-CHAM-28-diverging-demand-fail.json
dps-request-trafficability-full-for-point-CHAM-28-diverging.json
dps-request-trafficability-full-for-point-CHAM-3-diverging.json
dps-request-trafficability-full-for-point-CHAM-4-diverging.json

dps-request-trafficability-limited-for-lx-on-CHAM.G73-already-limited.json

dps-request-trafficability-limited-for-lx-on-CHAM.G73.json [approved]

IA-24079 - [Test Case] dps-request-trafficability-reject-because-dps-is-securing-risk-path

dps-request-trafficability-reject-because-dps-is-securing-risk-path.json [approved]

IA-24080 - [Test Case] dps-request-trafficability-reject-because-other-in-group-is-securing-risk-path

dps-request-trafficability-reject-because-other-in-group-is-securing-risk-path.json [approved]

IA-24081 - [Test Case] dps-request-trafficability-reject-because-other-in-group-used-by-mp

dps-request-trafficability-reject-because-other-in-group-used-by-mp.json [approved]

IA-24082 - [Test Case] dps-request-trafficability-reject-because-other-in-group-used-by-occupancy

dps-request-trafficability-reject-because-other-in-group-used-by-occupancy.json [approved]

IA-24083 - [Test Case] dps-request-trafficability-reject-because-other-used-by-risk-buffer

dps-request-trafficability-reject-because-other-used-by-risk-buffer.json [approved]

IA-24084 - [Test Case] dps-request-trafficability-reject-because-used-by-mp

dps-request-trafficability-reject-because-used-by-mp.json [approved]

IA-24085 - [Test Case] dps-request-trafficability-reject-because-used-by-occupancy

dps-request-trafficability-reject-because-used-by-occupancy.json [approved]

IA-24086 - [Test Case] dps-request-trafficability-reject-because-used-by-risk-buffer

dps-request-trafficability-reject-because-used-by-risk-buffer.json [approved]

IA-24087 - [Test Case] dps-request-trafficability-reject-unknown-dpsid

dps-request-trafficability-reject-unknown-dpsid.json [approved]

6.1.2 [IS] Provide Update of DPS

6.1.2.1 Sequence Diagrams

[IS] Provide Update of DPS

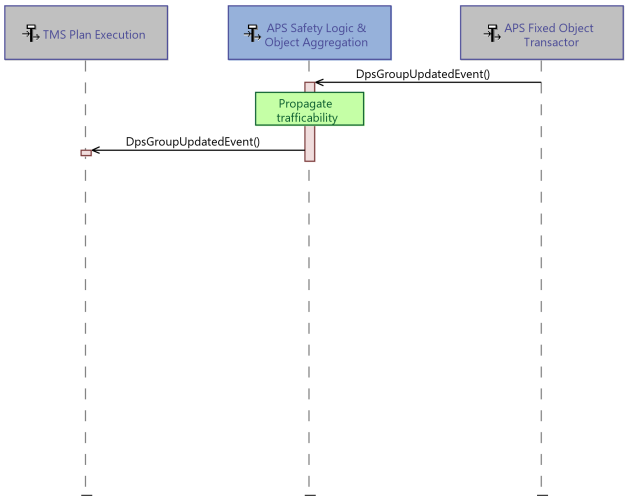


Diagram 3: Provide Update of DPS

[approved]

6.1.2.2 Functional Requirements

6.1.2.2.1 [LF] Propagate Trafficability

IA-23012 - [Propagate Trafficability] DPS group update shall be propagated

Each SRP-14167 - DpsGroupUpdatedEvent received by IA-23665 - APS Safety Logic & Object Aggregation via the SRP-4705 - Controller Interface shall update the operational state and then immediately be propagated as a SRP-18728 - DpsGroupUpdatedEvent over the SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

6.1.2.3 Test Cases

6.1.2.3.1 APS-SL-OA

[Test Cases] Provide Update of DPS

No explicit test cases are defined for this scenario (see https://code.sbb.ch/projects/PN_ES/repos/aps-e2e-test/browse/src/main/resources/testcases/Trafficability/Provide-Update-of-DPS).
The functionality is implicitly tested with test cases listed in 6.1.1.3 - Test Cases [approved]

6.2 [CR] Monitor and Control track-bound Movement

6.2.1 [IS] Provide Update of track-bound vehicle

6.2.1.1 Sequence Diagrams

[IS] Startup of track-bound vehicle

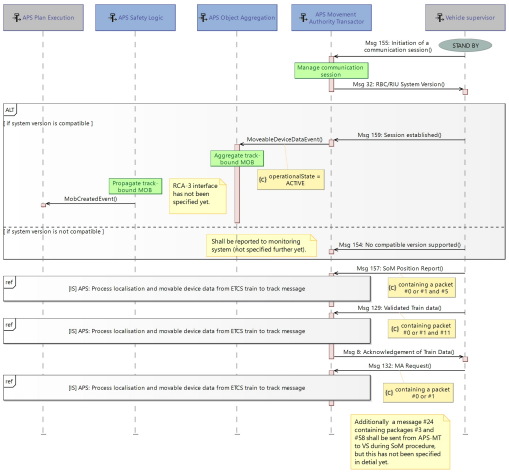


Diagram 4: Startup of track-bound Vehicle

[draft]

[IS] Update of track-bound vehicle

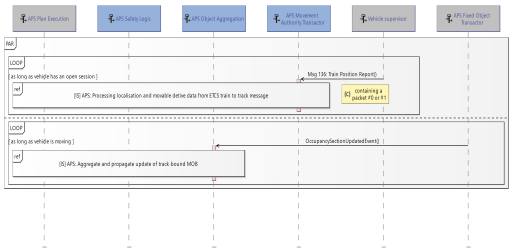


Diagram 5: Update of track-bound Vehicle

[draft]

[IS] Rundown of track-bound vehicle

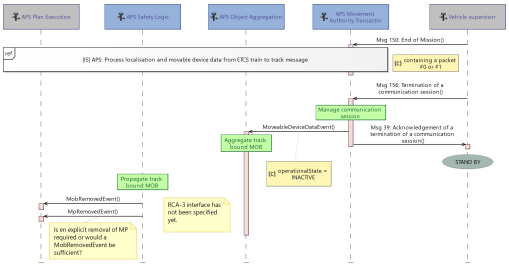


Diagram 6: Rundown of track-bound Vehicle

[draft]

[IS] Process localisation and movable device data from ETCS train to track message

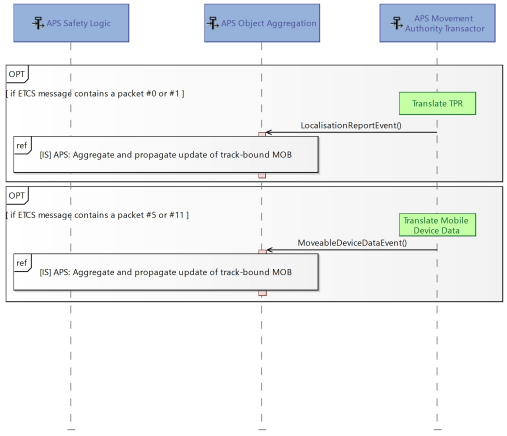


Diagram 7: Process localisation and movable device data from ETCS train to track message

[draft]

[IS] Aggregate and propagate track-bound MOB

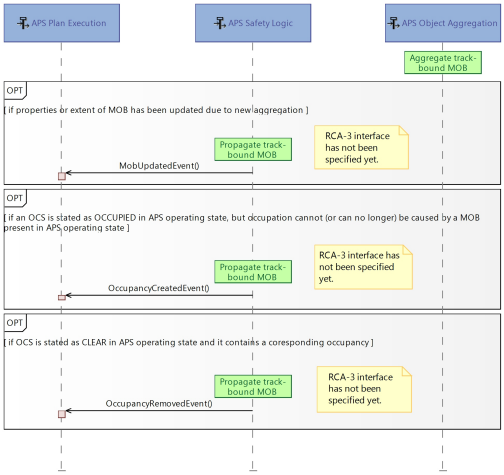


Diagram 8: Aggregate and propagate track-bound MOB

[draft **]**

6.2.1.2 Functional Requirements

6.2.1.2.1 [LF] Manage communication session

IA-25999 - [Manage communication session] RBC System version shall be sent to OBU

For each "Initiation of a communication session" (ETCS Message #155) received by the SRP-3080 - APS Movement Authority Transactor and over the SRP-4732 - ETCS TS - OB interface the session identified by NID_ENGINE shall be added in its internal state and a RBC/RIU System Version (ETCS Message #32) with the System Version 2.1 shall be sent to the SRP-3081 - Vehicle Supervisor over the SRP-4732 - ETCS TS - OB interface.

[draft **]**

IA-26314 - [Manage communication session] Session established shall initialize a new session in internal state

If a "Session established" (ETCS Message #159) received by SRP-3080 - APS Movement Authority Transactor over SRP-4732 - ETCS TS - OB interface, a new blank session identified by NID_ENGINE of ETCS message shall be added to the internal state of SRP-3080 - APS Movement Authority Transactor. **[** draft **]**

IA-26000 - [Manage communication session] Session established shall lead to a MovableDeviceDataEvent

If a "Session established" (ETCS Message #159) received by SRP-3080 - APS Movement Authority Transactor over SRP-4732 - ETCS TS - OB interface, a SRP-14486 - MovableDeviceDataEvent shall be sent over the SRP-4705 - Controller Interface using IA-26303 - [Manage communication session] [Translation Rule] Build up of initial MovableDeviceDataEvent. **[** draft **]**

IA-26303 - [Manage communication session] [Translation Rule] Build up of initial MovableDeviceDataEvent

Attribute	Value
deviceControlId	Shall be set to the value of attribute NID_ENGINE of corresponding session.
operationalState	Shall be set to ACTIVE.
All other attributes	Shall remain undefined.

[draft **]**

IA-26001 - [Manage communication session] No compatible version supported shall be transmitted to monitoring

If a "No compatible version supported" (ETCS Message #154) is received by the SRP-3080 - APS Movement Authority Transactor over the SRP-4732 - ETCS TS - OB interface, no session shall be established but monitoring shall informed about mismatch of versions. **[** draft **]**

IA-26308 - [Manage communication session] Termination of a communication session shall lead to a MovableDeviceDataEvent

If a "Termination of a communication session" (ETCS Message #156) is received by the SRP-3080 - APS Movement Authority Transactor over the SRP-4732 - ETCS TS - OB interface, a SRP-14486 - MovableDeviceDataEvent shall be sent over the SRP-4705 - Controller Interface using IA-26309 - [Manage communication session] [Translation Rule] Build up of final MovableDeviceDataEvent. **[** draft **]**

IA-26309 - [Manage communication session] [Translation Rule] Build up of final MovableDeviceDataEvent

Attribute	Value
deviceControlId	Shall be set to the value of attribute NID_ENGINE of corresponding session.
operationalState	Shall be set to INACTIVE.
All other attributes	Shall remain undefined.

[draft **]**

IA-26002 - [Manage communication session] Termination of a communication session shall be acknowledged

If a "Termination of a communication session" (ETCS Message #156) is received by the SRP-3080 - APS Movement Authority Transactor over the SRP-4732 - ETCS TS - OB interface, an "Acknowledgement of termination of a communication session" (ETCS Message #39) shall be sent back to the SRP-3081 - Vehicle Supervisor over the SRP-4732 - ETCS TS - OB interface. **[** draft **]**

IA-26315 - [Manage communication session] Termination of a communication session shall remove session from internal state

If a "Termination of a communication session" (ETCS Message #156) is received by the SRP-3080 - APS Movement Authority Transactor over the SRP-4732 - ETCS TS - OB interface, the session identified by NID_ENGINE shall be removed from internal state. **[** draft **]**

6.2.1.2.2 [LF] Translate TPR

IA-26313 - [Translate TPR] First reception of an ETCS message containing a packet #0 shall initialize movement path

Up on reception by SRP-3080 - APS Movement Authority Transactor over SRP-4732 - ETCS TS - OB interface of first ETCS message containing a packet #0, the WI-8500 - Movement Path shall be initialized and kept along with the session of the device identified with NID_ENGINE of ETCS message. The initial WI-8500 - Movement Path corresponds to the WI-2013 - Track Route composed by only the WI-3999 - Track Edge on which the balise group referenced by NID_LRBG of ETCS packet #0 in direction of the train movement induced by Q_DIRTRAIN.

The initial location reference is set to the location at a distance corresponding to the sum of the attributes D_LRBG and L_DOUBTUNDER in direction induced by Q_DIRTRAIN.

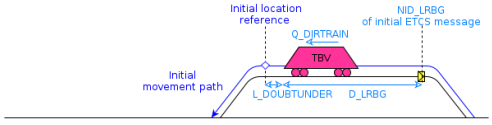


Figure 32: Initial computation of movement path

[draft **]**

IA-26317 - [Translate TPR] Subsequent reception of an ETCS message containing a packet #0 shall update movement path

Each ETCS message received by SRP-3080 - APS Movement Authority Transactor over SRP-4732 - ETCS TS - OB interface and containing a packet #0, the WI-8500 - Movement Path kept along with the session of the device identified with NID_ENGINE of ETCS message shall be updated. All WI-3999 - Track Edges shall be removed from they, if they are located

- behind the WI-3999 - Track Edge on which the balise group referenced by NID_LRBG of ETCS packet #0 is located if location reference isahead of the balise group
- or behind the WI-3999 - Track Edge of location reference otherwise.

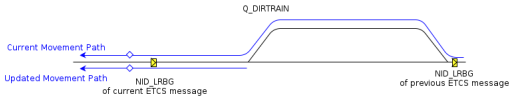


Figure 33: Update of movement path up on reception of a new train position report when location reference is ahead of last relevant balise group

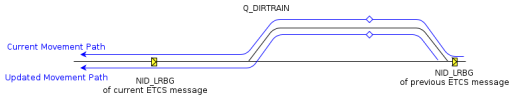


Figure 34: Update of movement path up on reception of a new train position report when location reference is behind last relevant balise group

[draft]

IA-26304 - [Translate TPR] An ETCS message containing a packet #0 shall lead to a LocalisationReportEvent

Each ETCS message received by SRP-3080 - APS Movement Authority Transactor over SRP-4732 - ETCS TS - OB interface and containing a packet #0, shall lead to a SRP-14242 - LocalisationReportEvent sent over SRP-4705 - Controller Interface using IA-26312 - [Translate TPR] [Translation Rule] Build up of LocalisationReportEvent up on reception of an ETCS packet #0.

[draft]

IA-26312 - [Translate TPR] [Translation Rule] Build up of LocalisationReportEvent up on reception of an ETCS packet #0

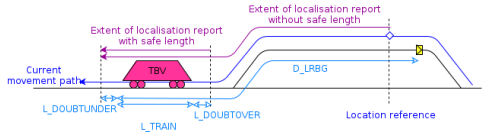


Figure 35: Computation of localisation report extent

Attribute	Value
deviceControlId	Shall be set to the value of attribute NID_ENGINE of corresponding session.
extent	Shall be computed based on the current WI-8500 - Movement Path associated to the session of the device identified with NID_ENGINE of ETCS message (see IA-26313 - [Translate TPR] First reception of an ETCS message containing a packet #0 shall initialize movement path, IA-26317 - [Translate TPR] Subsequent reception of an ETCS message containing a packet #0 shall update movement path and IA-26316 - [Translate MP] MpDemand shall update the movement path of associated session) and the attributes D_LRBG, L_DOUBTOVER, L_DOUBTUNDER and (if defined) L_TRAIN. Concretely the WI-2013 - Track Route defining the extent is computed as follow: 1. Cut out the WI-2013 - Track Route of current WI-8500 - Movement Path in front of balise group referenced by NID_LRBG in ETCS Message with a length corresponding to the sum of attributes D_LRBG and L_DOUBTUNDER (i.e. the location of the max safe front end position). 2. In case of a reported safe train length (i.e. if Q_LENGTH is set to “Train integrity confirmed by integrity monitoring device” or “Train integrity confirmed by driver”), the WI-2013 - Track Route obtain in first step is shortened at rear to obtain a WI-2013 - Track Route with a length corresponding to the sum of attributes L_TRAIN, L_DOUBTUNDER and L_DOUBTOVER (i.e. the location of the min safe rear end position). 3. Otherwise the WI-2013 - Track Route obtained in first step is is cut off at the current location reference.
velocity	Shall be set to the value of attribute V_TRAIN of ETCS Packet #0 converted into a integer value representing kilometers per hour.

safeLength	The attribute safeLength shall be set depending on the value of "Q_LENGTH" from ETCS Packet #0:
	• The attribute safeLength is set to "true" if the value of "Q_LENGTH" is:
	  ◦ 1 (Train integrity confirmed by integrity monitoring device)
	  ◦ 2 (Train integrity confirmed by driver)
	• The attribute safeLength is set to "false" if the value of "Q_LENGTH" is:
	  ◦ 0 (No train integrity information available)
	  ◦ 3 (Train integrity lost)

createdAt	Shall be set t to the time of the event creation.

[draft]

6.2.1.2.3 [LF] Translate Movable Device Data

IA-26305 - [Translate Movable Device Data] An ETCS message containing a packet #5 shall lead to a MovableDeviceDataEvent

Each ETCS message received by SRP-3080 - APS Movement Authority Transactor over SRP-4732 - ETCS TS - OB interface and containing a packet #5, shall lead to a SRP-14486 - MovableDeviceDataEvent sent over SRP-4705 - Controller Interface using IA-26310 - [Translate Movable Device Data] [Translation Rule] Build up of MovableDeviceDataEvent when train running number changed. [draft]

IA-26310 - [Translate Movable Device Data] [Translation Rule] Build up of MovableDeviceDataEvent when train running number changed

Attribute	Value
deviceControlId	Shall be set to the value of attribute NID_ENGINE of corresponding session.
operationId	Shall be set to the value of attribute NID_OPERATIONAL of ETCS packet #5 received from train.
All other attributes	Shall remain undefined.

[draft]

IA-26307 - [Translate Movable Device Data] An ETCS message containing a packet #11 shall lead to a MovableDeviceDataEvent

Each ETCS message received by SRP-3080 - APS Movement Authority Transactor over SRP-4732 - ETCS TS - OB interface and containing a packet #11, shall lead to a SRP-14486 - MovableDeviceDataEvent sent over SRP-4705 - Controller Interface using IA-26311 - [Translate Movable Device Data] [Translation Rule] Build up of MovableDeviceDataEvent when validated train data is submitted. [draft]

IA-26311 - [Translate Movable Device Data] [Translation Rule] Build up of MovableDeviceDataEvent when validated train data is submitted

Attribute	Value
deviceControlId	Shall be set to the value of attribute NID_ENGINE of corresponding session.
length	Shall be set to the value of attribute L_TRAIN of ETCS packet #11
trainCategory	Shall be set to the value of attribute NC_TRAIN of ETCS packet #11
cantDeficiencyCategory	Shall be set to the value of attribute NC_CDTRAIN of ETCS packet #11
axleLoadCategory	Shall be set to the value of attribute M_AXLELOADCAT of ETCS packet #11
loadingGaugeCategory	Shall be set to the value of attribute M_LOADINGGAUGE of ETCS packet #11
maxSpeed	Shall be set to the value of attribute V_MAXTRAIN of ETCS packet #11
All other attributes	Shall remain undefined.

[draft]

IA-26383 - [Translate Movable Device Data] An ETCS message #132 shall lead to a MovableDeviceDataEvent

If a "MA Request" (ETCS Message #132) is received by the SRP-3080 - APS Movement Authority Transactor over the SRP-4732 - ETCS TS - OB interface a SRP-14486 - MovableDeviceDataEvent shall be sent over the SRP-4705 - Controller Interface using IA-26382 - [Translate Movable Device Data][Translation Rule] Build up of MovableDeviceDataEvent up on reception of an ETCS message #132. [draft]

IA-26382 - [Translate Movable Device Data][Translation Rule] Build up of MovableDeviceDataEvent up on reception of an ETCS message #132

Attribute	Value
deviceControlId	Shall be set to the value of attribute NID_ENGINE of corresponding session.
operationalState	Shall be set to READY_FOR_MA.

All other attributes	Shall remain undefined.

[draft]

6.2.1.2.4 [LF] Aggregate track-bound MOB

IA-26360 - [Aggregate track-bound MOB] The state of each occupancy section shall be initialized in APS operating state when TOPO data is loaded

When receives SRP-3068 - APS Object Aggregation the WI-6950 - Topo Data over SRP-12324 - Engineering & Data Preparation - Topo Interface , each WI-7752 - Occupancy Section shall be initialized in WI-2033 - APS Operating State as follow:

Attribute	Type	Multiplicity	Description	Initial value
ocsId	ID	1	Unique and stable identification of the WI-7752 - Occupancy Section	Shall be derived fromt the ocsId of the WI-7752 - Occupancy Section.
occupancyState	SRP-14223 - OccupancyState	1	State information about occupation of the given section	Shall be initialized with value UNKNOWN.

[draft]

IA-26361 - [Aggregate track-bound MOB] An occupancy shall be created in APS operating state for each occupancy section when TOPO data is loaded

When receives SRP-3068 - APS Object Aggregation the WI-6950 - Topo Data over SRP-12324 - Engineering & Data Preparation - Topo Interface , each WI-7752 - Occupancy Section shall lead to an WI-7748 - Occupancy in WI-2033 - APS Operating State built up a follow:

Attribute	Type	Multiplicity	Description	Initial value
occupancyId	ID	1	Unique and stable identification of the SRP-18810 - MovableObject during its whole life cycle	Shall be derived from the ocsId of the WI-7752 - Occupancy Section.
extent	SRP-18796 - TrackSection	1..*	Extent on reference topology potentially occupied.	Shall be initialized with the extent of the WI-7752 - Occupancy Section

[draft]

IA-26333 - [Aggregate track-bound MOB] Each reception of a MovableDeviceDataEvent with operationalState euqal to ACTIVE shall add a new movable object to the APS operating state

Each SRP-14486 - MovableDeviceDataEvent received by SRP-3068 - APS Object Aggregation over SRP-4705 - Controller Interface with attribute operatingState set to ACTIVE, shall lead to a new WI-2036 - Movable Object to be added to WI-2033 - APS Operating State. The following information shall be kept in WI-2033 - APS Operating State for each WI-2036 - Movable Object:

Attribute	Type	Multiplicity	Description	Initial value
mobId	ID	1	Unique ans stable identification of the WI-2036 - Movable Object during its whole life cycle	Shall be derived from the deviceControlId of SRP-14486 - MovableDeviceDataEvent.
operationalState	SRP-18853 - OperationalStateType	1	Operational state of the SRP-18810 - MovableObject	Shall be initialized with value ACTIVE.
operationId	String	0..1	Current train running number	Shall be initially undefined.
maxSpeed	SRP-18880 - VehicleVelocity (km/h)	0..1	Maximum speed of the MOB	Shall be initially undefined.
trainCategory	SRP-18894 - TrainCategory	0..1	ETCS train category	Shall be initially undefined.
cantDeficiencyCategory	SRP-18895 - CantDeficiencyCategory	0..1	ETCS Cant deficiency category	Shall be initially undefined.
axleLoadCategory	SRP-18893 - AxleLoadCategory	0..1	ETCS Axle load category	Shall be initially undefined.
rawExtent	SRP-18812 - TrackRoute	0..1	Raw extent as it was most recently reported with a SRP-14242 - LocalisationReportEventover SRP-4705 - Controller Interface	Shall be initially undefined.
aggregatedExtent	SRP-18812 - TrackRoute	0..1	Resulting extent after aggregation of all information available about WI-2036 - Movable Object	Shall be initially undefined.
safeLength	Boolean	0..1	Flag that specifies if the rawExtent can be considered as safe (i.e. it is safe to assume that the train bound vehicle is located within rawExtent).	Shall be initially undefined.
velocity	SRP-18880 - VehicleVelocity (km/h)	0..1	Most recent velocity reported with a SRP-14242 - LocalisationReportEventover SRP-4705 - Controller Interface	Shall be initially undefined.

[draft]

IA-26334 - [Aggregate track-bound MOB] Each reception of a MovableDeviceDataEvent with operationalState equal to INACTIVE shall remove corresponding movable object from the APS operating state

Each SRP-14486 - MovableDeviceDataEvent received by SRP-3068 - APS Object Aggregation over SRP-4705 - Controller Interface with attribute operatingState set to INACTIVE, shall lead to the removal of the corresponding WI-2036 - Movable Object together with its WI-1974 - Movement Permission from WI-2033 - APS Operating State. [draft]

IA-26319 - [Aggregate track-bound MOB] Each reception of a MovableDeviceDataEvent shall update APS operating state

Each SRP-14486 - MovableDeviceDataEvent received by SRP-3068 - APS Object Aggregation over SRP-4705 - Controller Interface, shall update the following attributes of the WI-2036 - Movable Object in WI-2033 - APS Operating State where mobId is equal to the deviceControlId:

Attribute	Value
mobId	Shall be equal to deviceControlId and be used to identify the SRP-18810 - MovableObject.
operationalId	Shall be updated to the value of attribute operationalId of SRP-14486 - MovableDeviceDataEvent unless it is undefined.
operationalState	Shall be updated to the value of attribute operationalState of SRP-14486 - MovableDeviceDataEvent unless it is undefined.
trainCategory	Shall be updated to the value of attribute trainCategory of SRP-14486 - MovableDeviceDataEvent unless it is undefined.
axleLoadCategory	Shall be updated to the value of attribute axleLoadCategory of SRP-14486 - MovableDeviceDataEvent unless it is undefined.
cantDeficencyCategory	Shall be updated to the value of attribute cantDeficencyCategory of SRP-14486 - MovableDeviceDataEvent unless it is undefined.
length	Shall be updated to the value of attribute length of SRP-14486 - MovableDeviceDataEvent unless it is undefined.
maxSpeed	Shall be updated to the value of of attribute maxSpeed of SRP-14486 - MovableDeviceDataEvent unless it is undefined.

[draft]

IA-26320 - [Aggregate track-bound MOB] Each reception of a LocalisationReportEvent shall update APS operating state

Each SRP-14242 - LocalisationReportEvent received by SRP-3068 - APS Object Aggregation over SRP-4705 - Controller Interface, shall update the following attributes of the WI-2036 - Movable Object in WI-2033 - APS Operating State where mobId is equal to the deviceControlId:

Attribute	Value
mobId	Shall be equal to deviceControlId and be used to identify the SRP-18810 - MovableObject.
rawExtent	Shall be updated to the value of attribute extent of SRP-14242 - LocalisationReportEvent.
safeLength	Shall be updated to the value of attribute safeLength of SRP-14242 - LocalisationReportEvent.
velocity	Shall be updated to the value of attribute velocity of SRP-14242 - LocalisationReportEvent.

[draft]

IA-26363 - [Aggregate track-bound MOB] Each reception of a OccupancySectionUpdatedEvent shall update APS operating state

Each SRP-14221 - OccupancySectionUpdatedEvent received by SRP-3068 - APS Object Aggregation over SRP-4705 - Controller Interface, shall update the attribute occupancyState of the corresponding WI-7752 - Occupancy Section in WI-2033 - APS Operating State. [draft]

IA-26321 - [Aggregate track-bound MOB] Each addition or update of a movable object to APS operating state shall trigger an new aggregation

Each time some values of a WI-2036 - Movable Object is updated in WI-2033 - APS Operating State, the following aggregation rules shall be applied:

- IA-26326 - [Aggregate track-bound MOB] [Aggregation Rule] Computation of aggregated extent of a movable object
- IA-26325 - [Aggregate track-bound MOB] [Aggregation Rule] Creation of occupancies for unresolved occupied OCS

[draft]

IA-26365 - [Aggregate track-bound MOB] Each removal of a movable object from APS operating state shall trigger an new aggregation

Each time a WI-2036 - Movable Object is removed from WI-2033 - APS Operating State, the following aggregation rules shall be applied:

- IA-26325 - [Aggregate track-bound MOB] [Aggregation Rule] Creation of occupancies for unresolved occupied OCS

[draft]

IA-26362 - [Aggregate track-bound MOB] Each update of the state of a occupancy section in APS operating state shall trigger an new aggregation
Each time ~~some values of~~ an WI-7752 - Occupancy Section is updated in WI-2033 - APS Operating State, the following aggregation rules shall be applied:

- IA-26326 - [Aggregate track-bound MOB] [Aggregation Rule] Computation of aggregated extent of a movable object
- IA-26325 - [Aggregate track-bound MOB] [Aggregation Rule] Creation of occupancies for unresolved occupied OCS
- IA-26364 - [Aggregate track-bound MOB] [Aggregation Rule] Removal of occupancies when corresponding OCS is reported as clear

[draft]

IA-26326 - [Aggregate track-bound MOB] [Aggregation Rule] Computation of aggregated extent of a movable object
The value of aggregatedExtent of a WI-2036 - Movable Object is a WI-2013 - Track Route derived from its rawExtent as well as the occupancyState of WI-7752 - Occupancy Sections having a geometric intersection (whose length is greater than zero meter) with it.
The front end of the aggregatedExtent corresponds to the location inside of the rawExtent nearest its front end that fulfills the following condition:

- The occupancyState of at least one WI-7752 - Occupancy Section equals to a state other than CLEAR in WI-2033 - APS Operating State at this location.

The rear end of the aggregatedExtent corresponds to the location inside of the rawExtent nearest its front end that fulfills the following conditions:

- The location is in rear of the front end of the aggregatedExtent.
- The occupancyState of at least one WI-7752 - Occupancy Section is stated as CLEAR in WI-2033 - APS Operating State at this location.
- The occupancyState of no other WI-7752 - Occupancy Section is stated as something different than CLEAR in WI-2033 - APS Operating State at this location.

[draft]

IA-26325 - [Aggregate track-bound MOB] [Aggregation Rule] Creation of occupancies for unresolved occupied OCS
For each WI-7752 - Occupancy Section in WI-2033 - APS Operating State fulfilling the following conditions, a new WI-7748 - Occupancy initialized in same way as specified in IA-26360 - [Aggregate track-bound MOB] The state of each occupancy section shall be initialized in APS operating state when TOPO data is loaded shall be added to WI-2033 - APS Operating State:

- No WI-7748 - Occupancy with an occupancyId equal to the ocsId of the WI-7752 - Occupancy Section exists in WI-2033 - APS Operating State.
- The WI-7752 - Occupancy Section is is stated as something else than CLEAR in WI-2033 - APS Operating State.
- The WI-7752 - Occupancy Section has no geometric intersection whose length is greater than zero meter with the aggregatedExtent of a WI-2036 - Movable Object or the extent of the part of the WI-1974 - Movement Permission in front of the aggregatedExtent of the WI-2036 - Movable Object.

[draft]

IA-26364 - [Aggregate track-bound MOB] [Aggregation Rule] Removal of occupancies when corresponding OCS is reported as clear
Each WI-7748 - Occupancy in WI-2033 - APS Operating State shall be removed, if the corresponding WI-7752 - Occupancy Section is is stated as CLEAR. [draft]

6.2.1.2.5 [LF] Propagate track-bound MOB

IA-23016 - [Propagate track-bound MOB] Occupancy creation shall be propagated
Each creation of an WI-7748 - Occupancy shall immediately be propagated with a SRP-18789 - OccupancyCreatedEvent over SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

IA-23590 - [Propagate track-bound MOB] Occupancy removal shall be propagated
Each removal of an WI-7748 - Occupancy shall immediately be propagated with a SRP-18788 - OccupancyRemovedEvent over SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

IA-24020 - [Propagate track-bound MOB] MOB creation shall be propagated
Each creation of a SRP-18810 - MovableObject shall be immediately propagated with a SRP-18808 - MobCreatedEvent over SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

IA-24019 - [Propagate track-bound MOB] MP creation shall be propagated
Each creation of a SRP-18825 - MovementPermission shall be immediately propagated with a SRP-18820 - MpCreatedEvent over SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

IA-23655 - [Propagate track-bound MOB] MOB update shall be propagated
Each update of a WI-2036 - Movable Object shall immediately be propagated with a SRP-18807 - MobUpdatedEvent over SRP-4729 - Interlocking Control and Monitoring Interface. [draft]

IA-24022 - [Propagate track-bound MOB] MOB removal shall be propagated
Each removal of a SRP-18810 - MovableObject shall be immediately propagated with a SRP-18809 - MobRemovedEvent over SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

IA-24021 - [Propagate track-bound MOB] MP removal shall be propagated
Each removal of a SRP-18825 - MovementPermission shall immediately be propagated with a SRP-18821 - MpRemovedEvent over SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

6.2.1.2.6 [LF] Translate state of occupancy section

IA-26414 - [Translate state of occupancy section] An EULYNX Message "TVPS Occupancy Status" shall lead to an OccupancySectionUpdateEvent
Each EULYNX SRP-27628 - Message "TVPS Occupancy Status" received by SRP-3071 - APS Fixed Object Transactor over the SRP-5008 - EULYNX Interface from the subsystem SRP-13293 - EULYNX SCI-TDS - Train Detection System shall lead to an SRP-14221 - OccupancySectionUpdatedEvent sent over the SRP-4705 - Controller Interface using IA-26413 - [Translate state of occupancy section] [Translation Rule] Build up of an OccupancySectionUpdateEvent from an EULYNX Message "TVPS Occupancy Status".
[awaiting approvals]

IA-26413 - [Translate state of occupancy section] [Translation Rule] Build up of an OccupancySectionUpdateEvent from an EULYNX Message "TVPS Occupancy Status"
The attribute ocsId of the SRP-14221 - OccupancySectionUpdatedEvent shall be set to the value of the TrackVacancyProvingSections occupancySectionId whose operationalId matches the received SenderIdentifier.

The attribute occupancyState of the SRP-14221 - OccupancySectionUpdatedEvent from type SRP-14223 - OccupancyState shall be set according the following mapping table:

EULYNX Value	Description	SRP-14223 - OccupancyState
0x00	Undefined	UNKNOWN
0x01	TVPS is in state vacant	VACANT
0x02	TVPS is in state occupied	OCCUPIED
0x03	TVPS is in disturbed state	UNKNOWN
All other cases		UNKNOWN

[awaiting approvals]

6.2.1.3 Test Cases

6.2.1.3.1 APS-SL-OA

6.2.1.3.1.1 Startup of TBV

IA-25722 - [Test Case] MOB and MP with zero extent created due to LR without safe length, MOB update due to MDD with readyForMA
SL-startup-tbv-1234-CHAM.G12.json
SL-startup-tbv-7866-CHAM.G83-G73.json
SL-startup-tbv-7866-CHAM.G93.json
SL-startup-tbv-7866-CHAM.W4.json
SL-localisationreport-due-to-start-of-mission.json

Testing Scope:

- MOB and MP with zero extent shall be created for each received LocalisationReportEvent which cannot be mapped to a existing MOB and safeLength FALSE
- MOB and MP shall be created with the same direction and dependent on the direction specified in the LocalisationReportEvent
- MP shall be created without a safetyResponsibilityProfile and with readMovementMode STANDSTILL
- Creation of MOB and MP shall be propagated via the RCA2 Interface
- MOB shall be updated due to a received MovableDeviceDataEvent with operationalState READY_FOR_MA
- Update of MOB shall be propagated via the RCA2 Interface

[draft]

6.2.1.3.1.2 Provide update of TBV

IA-25707 - [Test Case] Moving MOB at exact position due to LR with safe length

movement-mob-4711-with-safe-length-start-CHAM.G83-to-G3.3.json

Testing Scope:

- Correct aggregation of MOB due to LocalisationReportEvent with safeLength TRUE
- Update of MOB shall be propagated via the RCA2 Interface

[draft **]**

IA-25708 - [Test Case] Moving MOB extended at front due to LR without safe length

movement-mob-4711-start-CHAM.G83-to-G73.json

Testing Scope:

- Correct aggregation of MOB due to LocalisationReportEvent with safeLength FALSE
- Update of MOB shall be propagated via the RCA2 Interface

[draft **]**

IA-25718 - [Test Case] Moving MOB extended at front due to LR without safe length, occupied OCS is aggregated to MOB

movement-mob-4711-start-CHAM.G83-stop-in-G3.3.json

Testing Scope:

- Correct aggregation of MOB due to LocalisationReportEvent with safeLength FALSE and OccupancySectionUpdatedEvent
- Update of MOB shall be propagated via the RCA2 Interface

[draft **]**

IA-24161 - [Test Case] Aggregation of OCS state change to OCCUPIED leads to the creation of an Occupancy

occupancy-created-when-there-is-no-mp-on-ocs.json

Testing Scope:

- Correct aggregation of an OCS state change to OCCUPIED, while no MOB is known by APS at the concerned location
- Creation of an Occupancy shall be progagated via the RCA2 Interface

[draft **]**

IA-26045 - [Test Case] Aggregation of OCS state change to CLEAR leads to the removal of an Occupancy

clear-CHAM.G3.2.json

Testing Scope:

- Correct aggregation of an OCS state change to CLEAR, while no MOB is known by APS at the concerned location
- Removal of an Occupancy shall be progagated via the RCA2 Interface

[draft **]**

IA-26086 - [Test Case] Aggregation of OCS state change to OCCUPIED and is between the MOB`s rear and MP`s front end

occupancy-right-ahead-mob-is-assigned-to-mp.json
occupancy-over-one-ocs-ahead-mob-is-assigned-to-mp.json
occupancies-ahead-mob-one-after-another-are-assigned-to-mp.json
occupancy-in-mp-is-assigned-to-mp-when-right-ahead-is-another-occupancy-outside-mp.json
occupancy-on-ocs-at-the-end-of-two-mp-is-assigned-to-mp-two-mobs-going-to-each-other.json
occupancy-on-ocs-at-the-end-of-mp-is-assigned-to-mp.json

Testing Scope

- Correct aggregation of an OCS state change to OCCUPIED, while a MOB is on the adjacent OCS and the OCS is covered by the MOB`s MP
- No Update message shall be propagated via the RCA2 Interface

[draft **]**

IA-26087 - [Test Case] Aggregation of OCS state change to OCCUPIED which is not between the MOB`s rear and MP`s front end

occupancy-created-behind-mob-when-this-ocs-status-changed-to-clear-right-before-it.json

Testing Scope

- Correct aggregation of an OCS state change to OCCUPIED, while no MP coveres the OCS
- No Update message shall be propagated via the RCA2 Interface

[draft **]**

IA-26088 - [Test Case] Subsequent creation of an Occupancy which can no longer be assigned to a MOB

SL-movabledevicedata-due-to-end-of-mission-after-movement.json
movement-mob-4711-with-safe-length-start-CHAM.G83-to-G3.3-occupancy-created-behind-mob-after-moving-away-from-G73.json

Testing Scope

- Correct system behaviour while an assigned OCS State Change to OCCUPIED can no longer be assigned to a sourcing MOB
- OccupancyCreatedEvent shall be propagated via the RCA2 Interface

[draft **]**

IA-26095 - [Test Case] Subsequent creation of an Occupancy and adjustment of the MOB`s extent, because MOB does no longer cover gap free connected sequence of OCS with state OCCUPIED

clear-CHAM.G3.3-during-movement-mob.json

Testing Scope

- Correct system behaviour while a MOB does no longer cover a gap free connected sequence of OCCUPIED stating OCS.
- OccupancyCreatedEvent shall be propagated via the RCA2 Interface
- MobUpdatedEvent shall be propagated via the RCA2 Interface

[draft **]**

IA-26281 - [Test Case] Correct aggregation of the extent of a MOB with release speed when max safe front end is beyond front of MP, but OCS is still reported as CLEAR

localisation-report-within-risk-buffer-when-this-ocs-clear-and-mp-with-release-speed.json

Testing Scope:

- Correct aggregation of MOB front within the MP with release speed when the occupation section is CLEAR

[draft **]**

IA-26282 - [Test Case] Correct aggregation of the extent of a MOB with release speed when max safe front end is beyond front of MP after OCS is reported as OCCUPIED (i.e. train driver overpasses EoA)

localisation-report-within-risk-buffer-when-this-ocs-occupied-and-mp-with-release-speed.json

Testing Scope:

- Correct aggregation of MOB front within the Risk Buffer when MP is with release speed when the occupation section is reported as OCCUPIED

[draft **]**

6.2.1.3.1.3 Rundown of TBV

IA-24164 - [Test Case] MOB and MP removed due to an End of Mission and Occupancy created for each previously covered OCS

SL-movabledevicedata-due-to-end-of-mission-after-movement.json

SL-movabledevicedata-due-to-end-of-mission.json

Testing Scope:

- The correct processing of a MovableDeviceDataEvent with operationalState INACTIVE
- Removal of MOB shall be propagated via the RCA2 Interface
- Removal of MP shall be propagated via the RCA2 Interface
- Creation of Occupancy shall be propagated via the RCA2 Interface

[draft **]**

6.2.1.3.2 APS-MT

6.2.1.3.2.1 Startup of TBV

IA-25733 - [Test Case] Start of Mission (ETCS Message #157) shall be translated and propagated as LocalisationReportEvent

MT-start-of-mission-with-safe-length.json

MT-start-of-mission-without-safe-length.json

Testing Scope:

- Correct translation of Start of Mission (ETCS Message #157) into LocalisationReportEvent

[draft **]**

IA-26318 - [Test Case] Start of Mission (ETCS Message #157) shall be translated and propagated as MovableDeviceDataEvent if it contains a packet #5

MT-start-of-mission-without-safe-length-with-packet-5.json

Testing Scope:

- Correct translation of Start of Mission (ETCS Message #157) containing a packet #5 into MovableDeviceDataEvent

[draft **]**

IA-26054 - [Test Case] Validated Train Data (ETCS Message #129) shall be translated and propagated as LocalisationReportEvent and MovableDeviceDataEvent

MT-validated-train-data-message129.json

Testing Scope:

- Correct translation of Validated Train Data (ETCS Message #129) into LocalisationReportEvent and MovableDeviceDataEvent

[draft **]**

IA-26053 - [Test Case] MA Request (ETCS Message #132) shall be translated and propagated as LocalisationReportEvent and MovableDeviceDataEvent

MT-ma-request-message132.json

Testing Scope:

- Correct translation of MA Request (ETCS Message #132) into LocalisationReportEvent and MovableDeviceDataEvent

[draft **]**

6.2.1.3.2.2 Provide update of TBV

IA-25639 - [Test Case] Train Position Report (ETCS Message #136) shall be translated and propagated as LocalisationReportEvent

MT-tpr-nominal-side-orientation-and-direction-nominal.json

MT-tpr-nominal-side-orientation-and-direction-reverse.json

MT-tpr-reverse-side-orientation-and-direction-nominal.json

MT-tpr-reverse-side-orientation-and-direction-reverse.json

Testing Scope:

- Correct translation of Train Position Report (ETCS Message #136) into LocalisationReportEvent
- Correct translation of LocalisationReportEvent while the APS-MT has an acknowledged MA for the corresponding TBV
- LocalisationReportEvent shall be provided via the RCA4 Interface

[draft **]**

6.2.1.3.2.3 Rundown of TBV

IA-24163 - [Test Case] End of Mission (Message #150) shall be translated and propagated as MovableDeviceDataEvent

MT-end-of-mission.json

Testing Scope:

- Correct translation of End of Mission (ETCS Message #150) into MovableDeviceDataEvent with operationalState INACTIV
- MovableDeviceDataEvent shall be provided via the RCA4 Interface

[draft **]**

6.2.1.3.3 APS-FOT

6.2.1.3.3.1 Translate state of occupancy section

IA-26412 - [Test Case] EULYNX Message "TVPS Occupancy Status" shall be translated and propagated to OccupancySectionUpdatedEvent

FOT-occupancy-CHAM.G1.1.json

FOT-vacant-CHAM.G1.1-after-occupying.json

Testing Scope:

- Reading of the APS-FOT configuration data für TDS subsystem and TVPS mapping to OCS
- Correct translation of EULYNX Message "TVPS Occupancy Status" into OccupancySectionUpdatedEvent with CLEAR and VACANT state
- OccupancySectionUpdatedEvent shall be provided via the RCA4 Interface

[awaiting approvals **]**

6.2.2 [IS] Request Permission for track-bound Movement

6.2.2.1 Sequence Diagrams

[IS] Request Permission for track-bound Movement

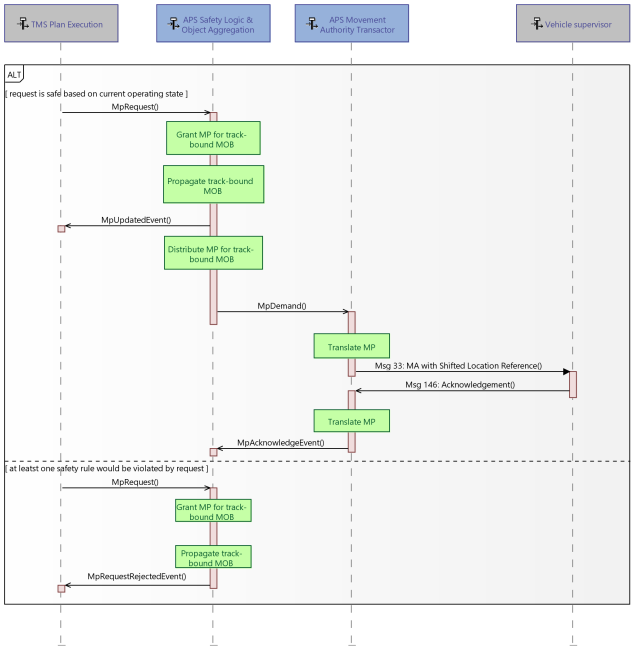


Diagram 9: Request Permission for track-bound Movement

[approved]

6.2.2.2 Functional Requirements

6.2.2.2.1 [LF] Grant MP for track-bound MOB

IA-22930 - [Grant MP for track-bound MOB] MP request shall be checked according to Safety Rules

Each SRP-18824 - MpRequest received by SRP-3066 - APS Safety Logic over SRP-4729 - Interlocking Control and Monitoring Interface shall be checked for it's safety according to the Safety Rules.

If at least one of the WI-7756 - Safety Rules is not fulfilled the SRP-18824 - MpRequest shall be rejected. Only if all of the Safety Rules are fulfilled the SRP-18824 - MpRequest shall be granted and the SRP-18825 - MovementPermission shall be updated. [approved]

IA-23453 - [Grant MP for track-bound MOB] [Safety Rule] State of MOB shall be READY_FOR_MA

The SRP-18824 - MpRequest shall be rejected if the SRP-18810 - MovableObject for which the requested SRP-18825 - MovementPermission is to apply is not in state READY_FOR_MA. [approved]

IA-23459 - [Grant MP for track-bound MOB] [Safety Rule] MP shall claim a Track Route

The SRP-18824 - MpRequest shall be rejected if the requested SRP-18825 - MovementPermission does not claim a valid WI-2013 - Track Route. [approved]

IA-23466 - [Grant MP for track-bound MOB] [Safety Rule] MP shall cover and have same orientation as MOB

The SRP-18824 - MpRequest shall be rejected if the requested SRP-18825 - MovementPermission does not completely cover the SRP-18810 - MovableObject, for which the requested SRP-18825 - MovementPermission is to apply or if it does not have the same orientation as the SRP-18810 - MovableObject. [approved]

IA-25821 - [Grant MP for track-bound MOB] [Safety Rule] MP shall not be shortened unless it is in Movement Mode STANDSTILL

The SRP-18824 - MpRequest shall be rejected if the SRP-18813 - FrontTrackEdgeMarker is moved against the SRP-18810 - MovableObject`s direction of travel according to the previous SRP-18825 - MovementPermission except if the SRP-24402 - SafetyResponsibilityMarker at the rear end has WI-8096 - Movement Mode STANDSTILL. [approved]

IA-23498 - [Grant MP for track-bound MOB] [Safety Rule] MP shall not overlap another MOB, an occupancy or an already granted MP, risk buffer or risk path if not explicitly allowed to

The SRP-18824 - MpRequest shall be rejected if its extent overlaps a WI-6991 - Track Section which is already claimed by another SRP-18810 - MovableObject, an WI-7748 - Occupancy or an already granted SRP-18825 - MovementPermission, WI-2020 - Risk Buffer or WI-2017 - Risk Path unless it is explicitly allowed by one of the following safety rules:

- IA-25616 - [Grant MP for track-bound MOB] [Safety Rule] MP may overlap another MOB or a granted MP if the movement mode is ON_SIGHT OR STANDSTILL and the other MOB is at standstill or moving away from the requested MP
- IA-23513 - [Grant MP for track-bound MOB] [Safety Rule] MP may overlap an occupancy if movement mode is ON_SIGHT OR STANDSTILL

[approved]

IA-25616 - [Grant MP for track-bound MOB] [Safety Rule] MP may overlap another MOB or a granted MP if the movement mode is ON_SIGHT OR STANDSTILL and the other MOB is at standstill or moving away from the requested MP

The SRP-18824 - MpRequest shall **not** be rejected, if there exists a WI-6991 - Track Section representing an overlapping between the extend of the requested SRP-18825 - MovementPermission and another SRP-18810 - MovableObject or a granted SRP-18825 - MovementPermission but

- the overlapping is fully covered by an **acknowledged safety responsibility profile section** with WI-8096 - Movement Mode ON_SIGHT or STANDSTILL
- and either
  - the initial Vmax of the overlapped SRP-18825 - MovementPermission (or the one of overlapped SRP-18810 - MovableObject) is equal to 0.
  - or the overlapped SRP-18825 - MovementPermission (or the one of overlapped SRP-18810 - MovableObject) and the requested SRP-18825 - MovementPermission have the same orientation
  - or the overlapped SRP-18825 - MovementPermission (or the one of overlapped SRP-18810 - MovableObject) and the requested SRP-18825 - MovementPermission opposite orientations away from each other.

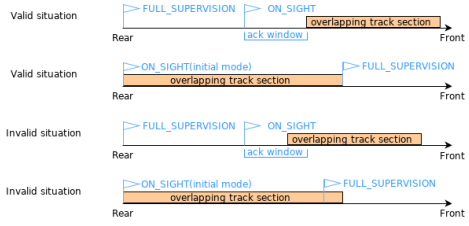


Figure 36: Safety responsibility profile in case of an overlapping between an MP and an already claimed track section

[approved]

IA-23513 - [Grant MP for track-bound MOB] [Safety Rule] MP may overlap an occupancy if movement mode is ON_SIGHT OR STANDSTILL

The SRP-18824 - MpRequest shall **not** be rejected, if there exists a WI-6991 - Track Section representing an overlapping between the extent of the requested SRP-18825 - MovementPermission and an WI-7748 - Occupancy but the overlapping is fully covered by an **acknowledged safety responsibility profile section** with WI-8096 - Movement Mode ON_SIGHT or STANDSTILL.

[approved]

[Grant MP for track-bound MOB] [Definition] Safety Responsibility Profile Section

A **safety responsibility profile section** is a WI-2013 - Track Route whose extent is either

- equal to the extent of the SRP-18825 - MovementPermission if the SRP-18825 - MovementPermission has no SRP-24402 - SafetyResponsibilityMarker
- or the part between the rear end of the SRP-18825 - MovementPermission and the first SRP-24402 - SafetyResponsibilityMarker srm_1 whitout any other SRP-24402 - SafetyResponsibilityMarker srm_x such that distanceFromRear of srm_x is shorter or equal than distancefromRear of srm_1
- or the part between two consecutive SRP-24402 - SafetyResponsibilityMarker srm_i and srm_{i+1} without any other SRP-24402 - SafetyResponsibilityMarker srm_x such that distanceFromRear of srm_x is longer or equal than distancefromRear of srm_i and shorter or equal than distanceFromRear of srm_{i+1}.

- or the part after last SRP-24402 - SafetyResponsibilityMarker srm_n without any other SRP-24402 - SafetyResponsibilityMarker srm_x such that distanceFromRear of srm_x is longer or equal than distancefromRear of srm_n.

[approved]

[Grant MP for track-bound MOB] [Definition] Acknowledged Safety Responsibility Profile Section

An **acknowledged safety responsibility profile section** is a safety responsibility profile section whose extent is either

- equal the whole safety responsibility profile section if its rear end is located at rear end of SRP-18825 - MovementPermission
- or the part of safety responsibility profile section beginning after the ackWindowLength otherwise.

[approved]

IA-23468 - [Grant MP for track-bound MOB] [Safety Rule] All DPS within MP shall be trafficable

If the requested SRP-18825 - MovementPermission overlaps a WI-6947 - Drive Protection Section:

- The SRP-18824 - MpRequest shall not be rejected if the WI-6947 - Drive Protection Section has trafficability state FULL.
- The SRP-18824 - MpRequest shall not be rejected if the WI-6947 - Drive Protection Section has trafficability state LIMITED and SRP-18900 - VmaxMarker located just before or at begin of WI-6947 - Drive Protection Section has a vMax less or equal to maximal allowed speed for limited trafficability.
- The SRP-18824 - MpRequest shall be rejected in any other case.

[approved]

IA-24210 - [Grant MP for track-bound MOB] [Safety Rule] MP shall contain maximum {k} Vmax profiles

The SRP-18824 - MpRequest shall be rejected if requested SRP-18825 - MovementPermission contains more than {k} SRP-18900 - VmaxMarkers, wherein the value of {k} is configurable. [approved]

IA-23467 - [Grant MP for track-bound MOB] [Safety Rule] Vmax profile of MP shall contain Vmax marker at rear

The SRP-18824 - MpRequest shall be rejected if the maximal allowed speed profile of the requested SRP-18825 - MovementPermission does not contain at least one SRP-18900 - VmaxMarker located exactly at the rear of the SRP-18825 - MovementPermission. [approved]

IA-23462 - [Grant MP for track-bound MOB] [Safety Rule] The VmaxProfile of MP shall be conform to Topology

The SRP-18824 - MpRequest shall be rejected if the requested SRP-18825 - MovementPermission contains a SRP-18900 - VmaxMarker with a higher vMax than the last speed profile marker in WI-3265 - Topology located just before or at same position than the SRP-18900 - VmaxMarker.

Relevant vMax of speed profile markers in WI-3265 - Topology are those of cant deficiency profile and axle load profile corresponding to the category specified in the SRP-18810 - MovableObject. If a speed profile marker contains no axle load profiles, than there shall be no speed limitation regarding the axle load and therefore the speed of the requested SRP-18825 - MovementPermission shall only be conform to the cant deficiency profile. [approved]

IA-25820 - [Grant MP for track-bound MOB] [Safety Rule] The Vmax profile of the MP shall not contain a lower speed than the previous MP in the overlapping range

The SRP-18824 - MpRequest shall be rejected if the SRP-18900 - VmaxMarker at the rear end contains a velocity lower than the velocity from the last one in the previously granted SRP-18825 - MovementPermission or if at least one SRP-18900 - VmaxMarker contains a lower velocity inside the overlapping range from the previously granted SRP-18825 - MovementPermission.

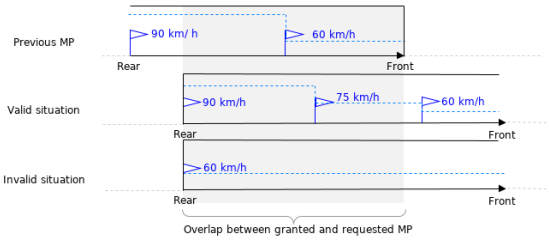


Figure 37: Update of speed profile intersecting with a previously granted section

[approved]

IA-25611 - [Grant MP for track-bound MOB] [Safety Rule] The safety responsibility markers shall be located within extent of MP

The SRP-18824 - MpRequest shall be rejected if one of the SRP-24402 - SafetyResponsibilityMarkers has a longer distance from rear than the length of extent of the requested SRP-18825 - MovementPermission. [approved]

IA-25612 - [Grant MP for track-bound MOB] [Safety Rule] The safety responsibility markers shall be spaced by a minimal distance

The SRP-18824 - MpRequest shall be rejected, if SRP-18825 - MovementPermission contains at least one SRP-24402 - SafetyResponsibilityMarker (other than rearMovementMode) and either

- first SRP-24402 - SafetyResponsibilityMarker has a distance from rear less than minimally allowed distance for the initial WI-8096 - Movement Mode
- or the incremental distance between the location of a SRP-24402 - SafetyResponsibilityMarker SRM and the next following one is less than minimally allowed distance for the WI-8096 - Movement Mode of SRM.

The minimally allowed distance shall be configurable separately for each WI-8096 - Movement Mode configurable, wherein Infinity shall also be a possible value (i.e. would enforce that no other SRP-24402 - SafetyResponsibilityMarker is allowed afterwards).

Note: *The minimal allowed distance shall be chosen according to resolution supported by all participating components (e.g. in case of ETCS it shall be greater or equal to value defined for Q_SCALE in packet #80).* [approved]

IA-25614 - [Grant MP for track-bound MOB] [Safety Rule] The length of the acknowledgement window of each safety responsibility marker shall be conform to minimal and maximal length required for movement mode

The SRP-18824 - MpRequest shall be rejected if one of the SRP-24402 - SafetyResponsibilityMarkers has a length for the acknowledgement window that is shorter than the minimal or longer than the maximal required length, wherein the lower and upper boundaries are configurable. [approved]

IA-25613 - [Grant MP for track-bound MOB] [Safety Rule] The length of the acknowledgement window of each safety responsibility marker shall not be longer than distance to next safety responsibility marker

The SRP-18824 - MpRequest shall be rejected if the SRP-18825 - MovementPermission contains two safety responsibility marker SM1 and SM2 such that sum of the distance form rear and the length of acknowledgement window of SM1 is longer or equal to the distance from rear of SM2. [approved]

IA-25615 - [Grant MP for track-bound MOB] [Safety Rule] The length of the acknowledgement window of last safety responsibility marker shall not be longer than the distance until end of extend of movement permission

The SRP-18824 - MpRequest shall be rejected if the length of acknowledgement window of the last SRP-24402 - SafetyResponsibilityMarkerof the requested SRP-18825 - MovementPermission is longer or equal than the length of the extent of the requested SRP-18825 - MovementPermission . [approved]

IA-23895 - [Grant MP for track-bound MOB] [Safety Rule] Vmax at rear shall be conform to movement mode at rear

The SRP-18824 - MpRequest shall be rejected if Vmax at rear is higher than the maximum speed allowed for the WI-8096 - Movement Mode at rear.

Figure 38: Conformance between Vmax and movement mode at rear

[approved]

IA-25815 - [Grant MP for track-bound MOB] [Safety Rule] Movement mode standstill and Vmax with 0km/h shall be only in combination at rear

The SRP-18824 - MpRequest shall be rejected if a SRP-18900 - VmaxMarker with 0 km/h and a SRP-24402 - SafetyResponsibilityMarker with WI-8096 - Movement Mode STANDSTILL is not in combination at rear position.

Figure 39 Conformance Vmax = 0km/h and movement mode Standstill

[approved]

IA-25817 - [Grant MP for track-bound MOB] [Safety Rule] Vmax = 0 km/h shall be only at rear

The SRP-18824 - MpRequest shall be rejected if there exists a SRP-18900 - VmaxMarker with 0 km/h at a position other than rear of the SRP-18825 - MovementPermission. [approved]

IA-25816 - [Grant MP for track-bound MOB] [Safety Rule] Movement mode Standstill shall be only at rear

The SRP-18824 - MpRequest shall be rejected if there exists a SRP-24402 - SafetyResponsibilityMarker with WI-8096 - Movement Mode STANDSTILL at a position other than rear of the SRP-18825 - MovementPermission.

[approved]

IA-25818 - [Grant MP for track-bound MOB] [Safety Rule] MP extent on Standstill and Vmax = 0 km/h shall be same like MOB extent

The SRP-18824 - MpRequest shall be rejected if it contains a SRP-24402 - SafetyResponsibilityMarker with WI-8096 - Movement Mode STANDSTILL and a SRP-18900 - VmaxMarker with Vmax of 0 km/h in case the extend of the SRP-18825 - MovementPermission is different to the extent of the SRP-18810 - MovableObject. [approved]

IA-25608 - [Grant MP for track-bound MOB] [Safety Rule] Vmax at rear shall be conform to movement mode of first safety responsibility marker

The SRP-18824 - MpRequest shall be rejected if Vmax at rear is higher than the maximum speed allowed for the WI-8096 - Movement Mode of a SRP-24402 - SafetyResponsibilityMarker *srm* without any SRP-18900 - VmaxMarker *vm* such that distance from rear of *vm* is shorter or equal to distance from rear of *srm*.

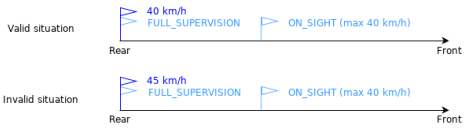


Figure 40: Conformance between Vmax at rear and first safety responsibility marker

[approved]

IA-25610 - [Grant MP for track-bound MOB] [Safety Rule] Vmax of first Vmax marker shall be conform to movement mode at rear

The SRP-18824 - MpRequest shall be rejected if Vmax of a SRP-18900 - VmaxMarker vm is higher than the maximum speed allowed for WI-8096 - Movement Mode at rear without any SRP-24402 - SafetyResponsibilityMarker sm such that distance from rear of sm is shorter or equal to distance from rear of vm.

Figure 41: Conformance between movement mode at rear and first Vmax marker

[approved]

IA-25607 - [Grant MP for track-bound MOB] [Safety Rule] Vmax of every Vmax marker shall be conform to movement mode of following safety responsibility markers or located at the same position

The SRP-18824 - MpRequest shall be rejected if Vmax of a SRP-18900 - VmaxMarker vm1 is higher than the maximum speed allowed for the WI-8096 - Movement Mode of a SRP-24402 - SafetyResponsibilityMarker sm

- with distance from rear of vm1 shorter or equal than distance from rear of sm
- and without any other SRP-18900 - VmaxMarker vm2 between vm1 and sm, i.e.such that
  distance from rear of vm1 is shorter than distance from rear of vm2 and distance from rear of vm2 is shorter or equal than distance from rear of sm.

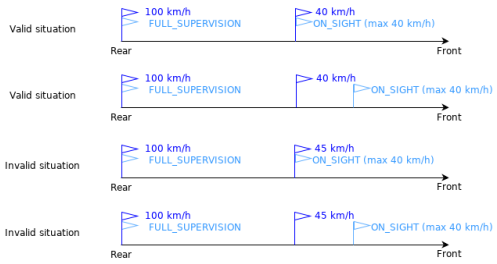


Figure 42: Conformance between safety responsibility marker and previous Vmax marker

[approved]

IA-25609 - [Grant MP for track-bound MOB] [Safety Rule] Vmax of every Vmax marker shall be conform to movement mode of preceding safety responsibility marker

The SRP-18824 - MpRequest shall be rejected if Vmax of a SRP-18900 - VmaxMarker vm is higher than the maximum speed allowed for the WI-8096 - Movement Mode of a SRP-24402 - SafetyResponsibilityMarker sm1

- with distance from rear of sm shorter than distance from rear of vm
- and without any other SRP-24402 - SafetyResponsibilityMarker sm2 between sm1 and vm, i.e.such that
  distance from rear of sm1 is shorter than distance from rear of sm2 and distance from rear of sm2 is shorter or equal than distance from rear of vm.

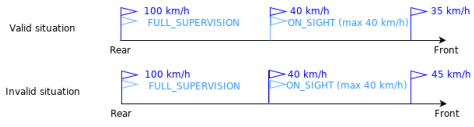


Figure 43: Conformance between safety responsibility marker and following Vmax markers until next safety responsibility marker

[approved]

IA-25819 - [Grant MP for track-bound MOB] [Safety Rule] Safety responsibility marker of an updated MP shall be the same like the previous in the overlapping range

The SRP-18824 - MpRequest shall be rejected if the SRP-24402 - SafetyResponsibilityMarker at the rear end differs from the last one in the previously granted SRP-18825 - MovementPermission, or
if at least one of the previously granted SRP-24402 - SafetyResponsibilityMarkers inside the overlapping range from the previously granted SRP-18825 - MovementPermission have a different WI-8096 - Movement Mode/position,
or if a new SRP-24402 - SafetyResponsibilityMarker inside the overlapping range from the previously granted SRP-18825 - MovementPermission has a more restrictive WI-8096 - Movement Mode as the SRP-24402 - SafetyResponsibilityMarker before it.

Note: *More restrictive is defined inside APS as the following, starting with the least restrictive MovemendMode: FULL_SUPERVISION -> ON_SIGHT -> STANDSTILL*

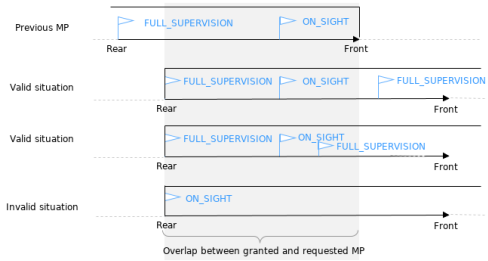


Figure 44 Update of safety responsibility profile intersecting with a previously granted section

[approved]

IA-23461 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer of MP shall claim a Track Route

The SRP-18824 - MpRequest shall be rejected if the WI-2020 - Risk Buffer of the requested SRP-18825 - MovementPermission does not claim a valid SRP-18812 - TrackRoute. [approved]

IA-23464 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer and MP shall have same orientation

The SRP-18824 - MpRequest shall be rejected if the WI-2020 - Risk Buffer of the requested SRP-18825 - MovementPermission does not have the same orientation as the requested SRP-18825 - MovementPermission.
[approved]

IA-24049 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer shall be in front of MP

The SRP-18824 - MpRequest shall be rejected if the WI-2020 - Risk Buffer of the requested SRP-18825 - MovementPermission is not located in front of the requested SRP-18825 - MovementPermission. [approved]

IA-24038 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer shall be adjacent to MP

The SRP-18824 - MpRequest shall be rejected if the WI-2020 - Risk Buffer of the requested SRP-18825 - MovementPermission overlaps with the requested SRP-18825 - MovementPermission or if there is a gap between the WI-2020 - Risk Buffer and the requested SRP-18825 - MovementPermission [approved]

IA-23518 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer shall not overlap another MOB, an occupancy or an already granted MP, risk buffer or risk path if not explicitly allowed to

The SRP-18824 - MpRequest shall be rejected if the the WI-2020 - Risk Buffer of the requested SRP-18825 - MovementPermission overlaps a WI-6991 - Track Section which is already claimed by another SRP-18810 - MovableObject, an WI-7748 - Occupancy or an already granted SRP-18825 - MovementPermission, WI-2020 - Risk Buffer or WI-2017 - Risk Path unless it is explicitly allowed by one of the following safety rules:

- IA-25617 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer may overlap another MOB or a granted MP if movement mode is ON_SIGHT OR STANDSTILL and other MOB is at standstill or moving away from requested MP
- IA-23515 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer of MP may overlap an Occupancy if movement mode is ON_SIGHT OR STANDSTILL

[approved]

IA-25617 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer may overlap another MOB or a granted MP if movement mode is ON_SIGHT OR STANDSTILL and other MOB is at standstill or moving away from requested MP

The SRP-18824 - MpRequest shall not be rejected, if the WI-2020 - Risk Buffer of the requested SRP-18825 - MovementPermission overlaps a WI-6991 - Track Section which is already claimed by another SRP-18810 - MovableObject or a granted SRP-18825 - MovementPermission but

- safety responsibility profile features an acknowledged WI-8096 - Movement Mode of ON_SIGHT or STANDSTILL at least at the end of the extent of the requested SRP-18825 - MovementPermission
- and either
  - the initial Vmax of overlapped SRP-18825 - MovementPermission (or the one of overlapped SRP-18810 - MovableObject) is equal to 0.
  - or the overlapped SRP-18825 - MovementPermission (or the one of overlapped SRP-18810 - MovableObject) and the requested SRP-18825 - MovementPermission have the same orientation
  - or the overlapped SRP-18825 - MovementPermission (or the one of overlapped SRP-18810 - MovableObject) and the requested SRP-18825 - MovementPermission opposite orientations away from each other.

[approved]

IA-23515 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer of MP may overlap an Occupancy if movement mode is ON_SIGHT OR STANDSTILL

The SRP-18824 - MpRequest shall not be rejected, if its extent overlaps a WI-6991 - Track Section which is already claimed by an WI-7748 - Occupancy but safety responsibility profile features an acknowledged WI-8096 - Movement Mode of ON_SIGHT or STANDSTILL at the end of the requested SRP-18825 - MovementPermission extent. [approved]

IA-23990 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer of MP shall be trafficable

The SRP-18824 - MpRequest shall be rejected if the WI-2020 - Risk Buffer of the requested SRP-18825 - MovementPermission claims a WI-6947 - Drive Protection Section which is not trafficable. The SRP-18824 - MpRequest shall always be rejected in this case, regardless of whether the WI-6947 - Drive Protection Section is trailable or not. [approved]

IA-23460 - [Grant MP for track-bound MOB] [Safety Rule] Risk Buffer of MP shall be conform to Risk Buffer profile

The SRP-18824 - MpRequest shall be rejected if the WI-2020 - Risk Buffer of the requested SRP-18825 - MovementPermission does not have a length, which is at least as long as specified in the general WI-2020 - Risk Buffer profile or if existing, in the specific WI-2020 - Risk Buffer profile of the WI-3265 - Topology.

The specific WI-2020 - Risk Buffer profile shall be determined based on the front position and the highest vMax among all SRP-18900 - VmaxMarkers of the requested SRP-18825 - MovementPermission. [approved]

IA-23469 - [Grant MP for track-bound MOB] [Safety Rule] Risk Path of MP shall claim a Track Route

The SRP-18824 - MpRequest shall be rejected if the WI-2017 - Risk Path of the requested SRP-18825 - MovementPermission does not claim a valid SRP-18812 - TrackRoute [approved]

IA-23470 - [Grant MP for track-bound MOB] [Safety Rule] Risk Path shall be directed towards the Allocation Section intersecting with the MP

The SRP-18824 - MpRequest shall be rejected if the WI-2017 - Risk Path of the requested SRP-18825 - MovementPermission does not end at its front with a WI-6991 - Track Section belonging to an WI-7753 - Allocation Section intersecting with extend of the requested SRP-18825 - MovementPermission. [approved]

IA-24091 - [Grant MP for track-bound MOB] [Safety Rule] Risk Path of MP must not overlap a granted MP

The SRP-18824 - MpRequest shall be rejected if the WI-2017 - Risk Path of the requested SRP-18825 - MovementPermission claims a WI-6991 - Track Section which is already claimed by a granted SRP-18825 - MovementPermission. [approved]

IA-24169 - [Grant MP for track-bound MOB] [Safety Rule] Risk Path of MP must not overlap another MOB

The SRP-18824 - MpRequest shall be rejected if the WI-2017 - Risk Path of the requested SRP-18825 - MovementPermission claims a WI-6991 - Track Section which is already claimed by another SRP-18810 - MovableObject. [approved]

IA-24168 - [Grant MP for track-bound MOB] [Safety Rule] Risk Path of MP must not overlap a Occupancy

The SRP-18824 - MpRequest shall be rejected if the WI-2017 - Risk Path of the requested SRP-18825 - MovementPermission claims a WI-6991 - Track Section which is already claimed by a WI-7748 - Occupancy. [approved]

IA-23473 - [Grant MP for track-bound MOB] [Safety Rule] Risk Path of MP shall guarantee the protection of structure gauge

The SRP-18824 - MpRequest shall be rejected if its extent intersects with a WI-6991 - Track Section of an WI-7753 - Allocation Section and the same WI-7753 - Allocation Section contains a WI-6991 - Track Section which is neither part of the extend of the SRP-18825 - MovementPermission nor fully covered by the extend of a WI-2017 - Risk Path. [approved]

IA-24245 - [Grant MP for track-bound MOB] [Safety Rule] Risk Path of MP shall not be trafficable

The SRP-18824 - MpRequest shall be rejected if, it is possible that a track-bound vehicle enters the WI-2017 - Risk Path of the requested SRP-18825 - MovementPermission between its rear and front. This is the case, if there exists a WI-3999 - Track Edge in WI-3265 - Topology which is navigable in direction of the WI-2017 - Risk Path and not secured itself by another WI-2017 - Risk Path.
[approved]

IA-23474 - [Grant MP for track-bound MOB] [Safety Rule] Risk Path of MP shall guarantee track enforced flank protection if required

If the extend of a SRP-18824 - MpRequest intersects with a WI-6991 - Track Section of an WI-7753 - Allocation Section whose threshold for vMax requiring track enforced flank protection is lower than the vMax of the SRP-18900 - VmaxMarker location within of just before WI-7753 - Allocation Section, then track enforced flank protection is required.
In such cases the SRP-18824 - MpRequest shall be rejected, if the rear of the WI-2017 - Risk Path of the requested SRP-18825 - MovementPermission protecting the WI-7753 - Allocation Section, does not fully contain a WI-6947 - Drive Protection Section which guarantees flank protection and has the same orientation than the WI-2017 - Risk Path.
[approved]

IA-26277 - [Grant MP for track-bound MOB] [Safety Rule] The front end of MP shall be located exactly at the position of a target marker if it uses Release Speed

The SRP-18824 - MpRequest shall be rejected, if the attribute useReleaseSpeed of the requested SRP-18825 - MovementPermission is set to true and the front end of the extent is not located at the position of a target marker. [approved]

IA-24778 - [Grant MP for track-bound MOB] [Safety Rule] The vMaxProfile of MP shall be confirm to overlapping URAs

The SRP-18824 - MpRequest shall be rejected if the extend of the requested SRP-18825 - MovementPermission has at least one SRP-18900 - VmaxMarker with a higher speed within a intersecting SRP-23476 - UsageRestrictionArea in the operational state with a SRP-23657 - TrackSectionDirected in the same direction or before that without further SRP-18900 - VmaxMarker up to its beginning in the same direction. [approved]

IA-22931 - [Grant MP for track-bound MOB] Rejected MP request shall be propagated

Each rejected SRP-18824 - MpRequest shall be propagated by immediately sending a SRP-18823 - MpRequestRejectedEvent with the corresponding rejectCode, back over SRP-4729 - Interlocking Control and Monitoring

Interface. [approved]

6.2.2.2.2 [LF] Propagate track-bound MOB

IA-22932 - [Propagate track-bound MOB] MP update shall be propagated

Each update of a SRP-18825 - MovementPermission shall immediately be propagated with a SRP-18822 - MpUpdatedEvent over SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

6.2.2.2.3 [LF] Distribute MP for track-bound MOB

IA-22934 - [Distribute MP for track-bound MOB] MP demand shall be distributed

Each granted SRP-18824 - MpRequest shall be distributed as a SRP-14485 - MpDemand over SRP-4705 - Controller Interface after, but never before SRP-18822 - MpUpdatedEvent has been sent (IA-22932 - [Propagate track-bound MOB] MP update shall be propagated), according to the following distribution rule:

[approved]

IA-23521 - [Distribute MP for track-bound MOB] [Distribution Rule] MP demand shall be sent to APS-MT

A SRP-14485 - MpDemand shall always be sent exclusively to SRP-3080 - APS Movement Authority Transactor

[approved]

6.2.2.2.4 [LF] Translate MP

IA-26316 - [Translate MP] MpDemand shall update the movement path of associated session

If the SRP-3080 - APS Movement Authority Transactor receives a SRP-14485 - MpDemand via the SRP-4705 - Controller Interface, the WI-8500 - Movement Path of association session shall be replaced by the WI-2013 - Track Route resulting by merging the current WI-8500 - Movement Path together with the extent and the riskBufferExtend of demanded SRP-18825 - MovementPermission. The location reference is set to the rear end location of the demanded SRP-18825 - MovementPermission.

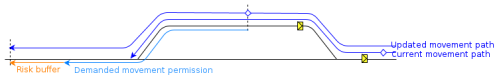


Figure 45: Update of movement path up on reception of a MpDemand

[draft]

IA-24012 - [Translate MP] MpDemand shall be translated and communicated as ETCS Message #33

If the SRP-3080 - APS Movement Authority Transactor receives a SRP-14485 - MpDemand via the SRP-4705 - Controller Interface, it shall be translated to an ETCS Message #33 (Movement Authority) containing a packet #15 (Level 2/3 Movement Authority) and packet #27 (International Static Speed Profile).

A package #5 (Linking) shall be added if at least one balise group is located inside of the extent of the demanded SRP-18825 - MovementPermission.

A package #80 (Mode Profile) shall be added if initial WI-8096 - Movement Mode is ON_SIGHT or at least one of the SRP-24402 - SafetyResponsibilityMarkers has WI-8096 - Movement Mode ON_SIGHT.

Finally the complete ETCS Message shall be be propagated over the SRP-4732 - ETCS TS - OB interface. [approved]

IA-24294 - [Translate MP] [Translation Rule] Values that shall be used to build ETCS message #33

Attribute	Value
NID_MESSAGE	33
L_MESSAGE	Shall indicate the length of the message in bytes, including all packets and all variables defined in the message header (NID_MESSAGE and L_MESSAGE also).
T_TRAIN	Shall be set to time, according to trainborne clock, at which message is sent.
M_ACK	Shall be set fix to 1 (Acknowledgement required).
NID_LRBG	Shall be set to the value of last received packet #0 (Position report) or packet #1 (Position Report based on two balise groups).
Q_SCALE	Shall be set fix to 1 (1 m scale).
D_REF	Shall be set to the distance between that rear position of requested SRP-18825 - MovementPermission and position of balise group referenced in NID_LRBG. The value shall be expressed in meters as value rounded down to the next lower positive integer. The value shall be a negative value if the rear position of requested SRP-18825 - MovementPermission is located on reverse side of balise group and positive otherwise.

[approved]

IA-26196 - [Translate MP] [Translation Rule] Values that shall be used to build ETCS packet #5 inside of a message #33 if at least one balise group is located inside of the demanded movement permission or risk buffer extent

Attribute	Value
NID_PACKET	5
Q_DIR	Shall be set to • 1 (nominal) if movement is to be operated in nominal direction in relation to balise group referenced by NID_LRBG in message #33 • 0 (reverse) if movement is to be operated in reverse direction in relation to balise group referenced by NID_LRBG in message #33
L_PACKET	Shall indicate the length of the packet in bits, including all bits of the packet header.
Q_SCALE	Shall be set fix to 1 (1 m scale).
D_LINK	Shall be set to the distance between the rear location of demanded SRP-18825 - MovementPermission extent and the location of the first balise group.
Q_NEWCOUNTRY	Shall be set to • 1 if the country code (NID_C) of the first balise group is different than the one of referenced by NID_LRBG in message #33 • 0 otherwise
NID_C	Shall be set to the country code (NID_C) of the first balise group if it is different than the one of referenced by NID_LRBG in message #33.
NID_BG	Shall be set to the ID (NIG_BG) of the first overpassed balise group.
Q_LINKORIENTATION	Shall be set to • 1 (nominal) if the first balise group is aligned with the extend of the demanded SRP-18825 - MovementPermission • 0 (reverse)if the first balise group is not aligned with the extend of the demanded SRP-18825 - MovementPermission
Q_LINKREACTION	Shall be set fix to 10 (no reaction).
Q_LOCACC	Shall be set to the value of the attribute localisationAccuracy defined in topo data for the first balise group. The value shall be expressed in meters as positive value rounded up to the next lower positive integer.
N_ITER	Shall be set to the number of balise groups located inside the extent or riskBufferExtent of demanded SRP-18825 - MovementPermission minus 1.
The following set of attributes shall be repeated once for each balise group (there after designed as BG_k) contained in the extent of the demanded SRP-18825 - MovementPermission starting with the second one and ordered by increasing distance from rear.	
D_LINK(k)	Shall be set to the distance between the location balise group BG_{k-1} and BG_k.
Q_NEWCOUNTRY(k)	Shall be set to • 1 if the country code (NID_C) of BG_k is different than the one of BG_{k-1} • 0 otherwise
NID_C(k)	Shall be set to the country code (NID_C) of the balise group BG_k if it is different than the one of BG_{k-1}.
NIG_BG(k)	Shall be set to the ID (NID_BG) of the balise group BG_k.
Q_LINKORIENTATION(k)	Shall be set to

	• 1 (nominal) if the balise group BG_k is aligned with the extend of the demanded SRP-18825 - MovementPermission • 0 (reverse)if the balise group BG_k is not aligned with the extend of the demanded SRP-18825 - MovementPermission
Q_LINKREACTION(k)	Shall be set fix to 10 (no reaction).
Q_LOCACC(k)	Shall be set to the value of the attribute localisationAccuracy defined in topo data for the balise group BG_k. The value shall be expressed in meters as positive value rounded up to the next greater positive integer.

[approved]

IA-24053 - [Translate MP] [Translation Rule] Values that shall be used to build ETCS packet #15 inside of a message #33

Attribute	Value
NID_PACKET	15
Q_DIR	Shall be set to • 1 (nominal) if movement is to be operated in nominal direction in relation to balise group referenced by NID_LRBG in message #33 • 0 (reverse) if movement is to be operated in reverse direction in relation to balise group referenced by NID_LRBG in message #33
L_PACKET	Shall indicate the length of the packet in bits, including all bits of the packet header.
Q_SCALE	Shall be set fix to 1 (1 m scale).
V_EMA	Shall be set fix to 0.
T_EMA	Shall be set fix to 1023 (no timeout).
N_ITER	Shall be set fix to 0.
L_SECTION(k)	Undefined as N_ITER always set to 0.
Q_SECTIONTIMER(k)	Undefined as N_ITER always set to 0.
T_SECTIONTIMER(k)	Undefined as N_ITER always set to 0.
D_SECTIONTIMERSTOPLOC(k)	Undefined as N_ITER always set to 0.
L_ENDSECTION	Shall be set to the distance between the rear and front position of extent of requested SRP-18825 - MovementPermission. The value shall be expressed in meters as value rounded down to the next lower positive integer.
Q_SECTIONTIMER	Shall be set fix to 0.
T_SECTIONTIMER	Undefined as Q_SECTIONTIMER always set to 0.
D_SECTIONTIMERSTOPLOC	Undefined as Q_SECTIONTIMER always set to 0.
Q_ENDTIMER	Shall be set fix to 0.
T_ENDTIMER	Undefined as Q_ENDTIMER always set to 0.
D_ENDTIMERSTARTLOC	Undefined as Q_ENDTIMER always set to 0.
Q_DANGERPOINT	• 1 if attribute useReleaseSpeed of the demanded SRP-18825 - MovementPermission is true • 0 otherwise
D_DP	Shall be set to the length of the riskBufferExtend.
V_RELEASEDP	Shall be set fix to 126 (use on board calculated release speed).
Q_OVERLAP	Shall be set fix to 0.
D_STARTOL	Undefined as Q_OVERLAP always set to 0.
T_OL	Undefined as Q_OVERLAP always set to 0.
D_OL	Undefined as Q_OVERLAP always set to 0.
V_RELEASEOL	Undefined as Q_OVERLAP always set to 0.

[approved]

IA-24052 - [Translate MP][Translation Rule] Values that shall be used to build ETCS packet #27 inside of a message #33

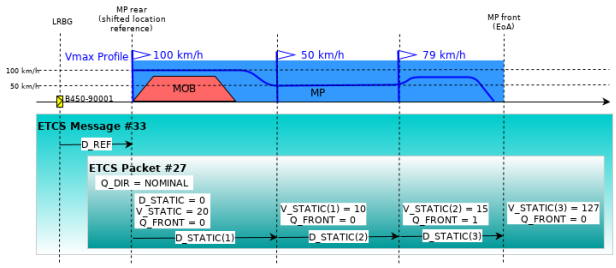


Figure 46: Translation of a vMax profile into a SSP profile

Attribute	Value
NID_PACKET	27
Q_DIR	Shall be set to • 1 (nominal) if movement is to be operated in nominal direction in relation to balise group referenced by NID_LRBG in message #33 • 0 (reverse) if movement is to be operated in reverse direction in relation to balise group referenced by NID_LRBG in message #33
L_PACKET	Shall indicate the length of the packet in bits, including all bits of the packet header.
Q_SCALE	Shall be set fix to 1 (1 m scale).
D_STATIC	Shall be set fix to 0.
V_STATIC	Shall be set to vMax of SRP-18900 - VmaxMarker located at rear position of requested SRP-18825 - MovementPermission.
Q_FRONT	Shall be set fix to 1 (no train delay).
N_ITER	Shall be set to count of SRP-18900 - VmaxMarkers.
The following set of attributes shall be repeated once for each SRP-18900 - VmaxMarker (there after designed as VM_k)starting with the second one and ordered by increasing distance from rear..	
D_STATIC(k)	Shall be set to • the distance between the rear and front position of extent of requested SRP-18825 - MovementPermission for last iteration • or, in all other cases, the incremental distance between location of VM_k and VM_{k-1}. The value shall be expressed in meters as value rounded down to the next lower positive integer.
V_STATIC(k)	Shall be set to • 127 (telling that the static speed profile description ends at this location) for last iteration • or, in all other cases, vMax of VM_k in kilometers per hour divided by 5 and rounded down to the next integer.

	Q_FRONT(k)	Shall be set to • 1 (no train delay) for last iteration or in case vMax of VM_k **lower** than vMax of VM_{k-1} • 0 (with train delay) otherwise.
	N_ITER(k)	Shall be set fix to 0 (no diverging speeds for specific categories).

[approved]

IA-24051 - [Translate MP] [Translation Rule] Values that shall be used to build ETCS packet #80 inside of a message #33 if initial movement mode is ON_SIGHT or at least one of the safety responsibility makers has movement mode ON_SIGHT

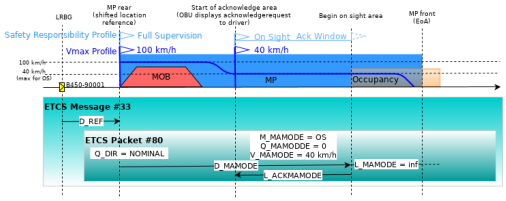


Figure 47: Translation of a safety responsibility profile into a MA mode profile when entering an on sight area from full supervision

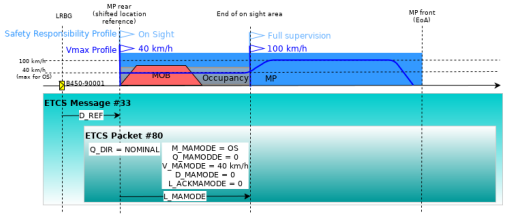


Figure 48: Translation of a safety responsibility profile into a MA mode profile when leaving an on sight area to full supervision

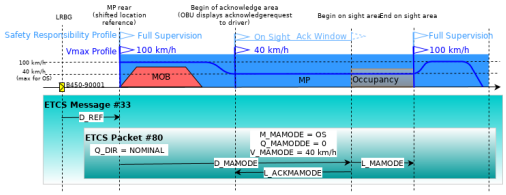


Figure 49: Translation of a safety responsibility profile into a MA mode profile when traversing an on sight area

Attribute	Value
NID_PACKET	80
Q_DIR	Shall be set to • 1 (nominal) if movement is to be operated in nominal direction in relation to balise group referenced by NID_LRBG in message #33 • 0 (reverse) if movement is to be operated in reverse direction in relation to balise group referenced by NID_LRBG in message #33
L_PACKET	Shall indicate the length of the packet in bits, including all bits of the packet header.
Q_SCALE	Shall be set fix to 1 (1 m scale).
D_MAMODE	Shall be set • fix to 0 if rearMovementMode of SRP-18825 - MovementPermissionis ON_SIGHT • or to sum of distanceFromMpRear and ackWindowLength of first SRP-24402 - SafetyResponsibilityMarker with WI-8096 - Movement Mode ON_SIGHT The value shall be expressed in meters as value rounded down to the next lower positive integer.
M_MAMODE	Shall be set fix to 00 (OS).
V_MAMODE	Shall be set • to vMax of SRP-18900 - VmaxMarker located at rear in case that initial WI-8096 - Movement Mode is ON_SIGHT • or to vMax of SRP-18900 - VmaxMarker located at or just before of the first SRP-24402 - SafetyResponsibilityMarker with WI-8096 - Movement Mode ON_SIGHT.
L_MAMODE	Shall be set • to distanceFromMpRear of first SRP-24402 - SafetyResponsibilityMarker regardless of its WI-8096 - Movement Mode if rearMovementMode of SRP-18825 - MovementPermissionis ON_SIGHT and SRP-18825 - MovementPermission contains at least one SRP-24402 - SafetyResponsibilityMarker • or to the incremental distance between the location of first SRP-24402 - SafetyResponsibilityMarker with WI-8096 - Movement Mode ON_SIGHT and next following SRP-24402 - SafetyResponsibilityMarker regardless of its WI-8096 - Movement Mode if initial WI-8096 - Movement Mode is not ON_SIGHT and SRP-18825 - MovementPermission contains at least two SRP-24402 - SafetyResponsibilityMarkers • to value 32767 (infinity) otherwise. The value shall be expressed in meters as value rounded down to the next lower positive integer.
L_ACKMAMODE	Shall be set • fix to 0 if rearMovementMode of SRP-18825 - MovementPermission is ON_SIGHT • or to ackWindowLength of first SRP-24402 - SafetyResponsibilityMarker with WI-8096 - Movement Mode ON_SIGHT otherwise. The value shall be expressed in meters as value rounded down to the next lower positive integer.
Q_MAMODE	Shall be set fix to 0 (SvL shall be derived from EoA).
N_ITER	Shall be set to count of SRP-24402 - SafetyResponsibilityMarkers with WI-8096 - Movement Mode ON_SIGHT minus one if first one if initial WI-8096 - Movement Mode is not ON_SIGHT
The following set of attributes shall be repeated once for each SRP-24402 - SafetyResponsibilityMarker with WI-8096 - Movement Mode ON_SIGHT (designated there after with SRM_k) • starting with the first one if initial WI-8096 - Movement Mode is ON_SIGHT and the second one otherwise • and ordered by increasing distanceFromRear.	
D_MAMODE(k)	Shall be set to • sum ackWindowLength and distanceFromMpRear of SRM_k if rearMovementMode of SRP-18825 - MovementPermission is ON_SIGHT • or, in all other cases, $\begin{aligned} & distanceFromRear(SRM_k) \\ & + ackWindowLength(SRM_k) \\ & - distanceFromRear(previousOnSightSrm(SRM_k)) \\ & - ackWindowLength(previousOnSightSrm(SRM_k)) \end{aligned}$ *Note: previousOnSightSrm(SRM_k) represents the SRP-24402 - SafetyResponsibilityMarker with WI-8096 - Movement Mode ON_SIGHT and next shorter distanceFromRear than SRM_k.*

	The value shall be expressed in meters as value rounded down to the next lower positive integer.
M_MAMODE(k)	Shall be set fix to 00 (OS).
V_MAMODE(k)	Shall be set to vMax of marker located at or just before of SRM_k.
L_MAMODE(k)	Shall be set to • to value 32767 (infinity) if SRM_k is the one with the greatest distanceFromMpRear of all SRP-24402 - SafetyResponsibilityMarkers • or, in all other cases, $distanceFromRear(nextSrm(SRM_k))$ $- distanceFromRear(SRM_k)$ $- ackWindowLength(SRM_k)$ *Note: nextSrm(SRM_k) represents the SRP-24402 - SafetyResponsibilityMarker with next longer distanceFromRear than SRM_k regardless of its WI-8096 - Movement Mode.* The value shall be expressed in meters as value rounded down to the next lower positive integer.
L_ACKMAMODE(k)	Shall be set to ackWindowLength of SRM_k.
Q_MAMODE(k)	Shall be set fix to 0 (SvL shall be derived from EoA).

[approved **]**

IA-24155 - [Translate MP] A received Acknowledgement (Message #146) shall be translated into a MpAcknowledgeEvent

If a SRP-3080 - APS Movement Authority Transactor receives a message #146 (Acknowledgement) via the SRP-4732 - ETCS TS - OB interface, it shall create an SRP-23389 - MpAcknowledgeEvent and immediately propagate it over the SRP-4705 - Controller Interface **[** approved **]**

6.2.2.3 Test Cases

6.2.2.3.1 APS-SL-OA

6.2.2.3.1.1 Movement Permission

IA-23853 - [Test Case] MpUpdateRequest is granted, safe overlap with already granted MP

mp-accepted-overlapping-other-mp-onsight-vmax0-facing-eachother.json

mp-accepted-overlapping-other-mp-onsight-vmax40-not-facing-eachother.json

Testing Scope:

- Correct safety assessment of an MpUpdateRequest leading to a safe overlap with an already granted MP
- The granted MpUpdateRequest shall be distributed as an MpDemand via the RCA4 Interface
- The granted MpUpdateRequest shall be propagated as an MpUpdatedEvent via the RCA2 Interface

[approved **]**

IA-23887 - [Test Case] MpUpdateRequest is rejected, stated TrackRoute is invalid

reject-mp-because-path-is-not-navigable.json

Testing Scope:

- Correct safety assessment of an MpUpdateRequest whose MovementPermissionExtent has an invalid TrackRoute (not navigable)
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-23897 - [Test Case] MpUpdateRequest is rejected, unsafe overlap with an already granted MP

reject-mp-overlapping-other-mp.json

mp-reject-overlapping-other-mp-onsight-vmax5-facing-eachother.json

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest which would lead to an unsafe overlap with an already granted MP which does not have the necessary Movement Conditions in order to be overlapped
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

6.2.2.3.1.2 vMaxProfile

IA-25897 - [Test Case] MpUpdateRequest is granted, vMaxProfile adheres to the usage conditions

mp-accepted-focus-on-speed.json

mp-request-with-2-speed-profiles

mp-request-with-31-speed-profiles

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest with multiple VmaxMarkers
- Correct safety assessment of an MpUpdateRequest whose vMaxProfile has the VmaxMarker at the rear of the MP
- The granted MpUpdateRequest shall be distributed as an MpDemand via the RCA4 Interface
- The granted MpUpdateRequest shall be propagated as an MpUpdatedEvent via the RCA2 Interface

[approved **]**

IA-23854 - [Test Case] MpUpdateRequest is rejected, vMaxProfile is empty or VmaxMarker at rear of MP is not set

reject-mp-cause-first-vmarker-is-not-at-rear.json

reject-mp-cause-vmarker-list-is-empty.json

Testing Scope:

- Correct safety assessment of an MpUpdateRequest whose vMaxProfile does not have a VmaxMarker at the rear of the MP or whose vMaxProfile is empty
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-23889 - [Test Case] MpUpdateRequest is rejected, vMaxProfile violates the existing usage conditions

reject-mp-cause-of-speed.json

reject-mp-vmax-higher-than-ucs.json

Testing Scope:

- Correct safety assessment of an MpUpdateRequest whose vMaxProfile has a VmaxMarker with a higher speed than allowed by the topology
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-23891 - [Test Case] MpUpdateRequest is rejected, VmaxMarker is outside of MP

reject-mp-cause-vmarker-outside-mpPath.json

Testing Scope:

- Correct safety assessment of an MpUpdateRequest whose vMaxProfile has a VmaxMarker which is positioned outside of the movementPermissionExtent
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-23896 - [Test Case] MpUpdateRequest is rejected, vMaxProfile violates the requested safetyResponsibilityProfile and current rearMovementMode

reject-mp-on-sight-cause-of-safety-responsibilty-collision-speed.json

Testing Scope:

- Correct safety assessment of an MpUpdateRequest whose vMaxProfile violates the permitted vMax according to the requested safetyResponsibilityProfile and the current rearMovementMode
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-24215 - [Test Case] MpUpdateRequest is rejected, MpUpdateRequest has invalid number of vMaxMarkers

mp-reject-because-32-speed-profiles

Testing Scope:

- Correct safety assessment of an MpUpdateRequest whose vMaxProfile has more than the allowed 31 vMaxMarkers
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

6.2.2.3.1.3 Occupancy

IA-25908 - [Test Case] MpUpdateRequest is granted, safe overlap with an Occupancy

mp-accepted-movement-mode-over-occupancy-on-sight

Testing Scope:

- Correct safety assessment of an MpUpdateRequest leading to safe overlap with an Occupancy
- The granted MpUpdateRequest shall be distributed as an MpDemand via the RCA4 Interface
- The granted MpUpdateRequest shall be propagated as an MpUpdatedEvent via the RCA2 Interface

[approved]

IA-23898 - [Test Case] MpUpdateRequest is rejected, unsafe overlap with an Occupancy

reject-mp-request-over-occupancy.json

mp-rejected-movement-mode-over-occupancy-full-supervision

mp-rejected-ack-window-overlapps-occupancy

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest which would lead to an unsafe overlap with an Occupancy
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

6.2.2.3.1.4 Drive Protection Section

IA-23899 - [Test Case] MpUpdateRequest is rejected, unsafe overlap with a DPS

reject-mp-request-wrong-dpl.json

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest which would lead to an unsafe overlap with a DPS which has an insufficient DpsState (trafficability is NONE)
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

6.2.2.3.1.5 Movable Object

IA-23900 - [Test Case] MpUpdateRequest is rejected, MOB is not ready to accept a MA

reject-mp-request-wrong-operationalstate.json

Testing Scope:

- Correct safety assessment of the MpUpdatedRequest which is requested for a MOB which has not the operationalState READY_FOR_MA
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23892 - [Test Case] MpUpdateRequest is rejected, MOB is not completely covered

reject-mp-not-containing-mob.json

Testing Scope:

- Correct safety assessment of the MpUpdateRequest whose MovementPermissionExtent does not completely cover the MOB`s extent
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23888 - [Test Case] MpUpdateRequest is rejected, MOB and MP have opposite direction

reject-mp-cause-mob-and-mp-not-same-direction.json

Testing Scope:

- Correct assessment of the MpUpdateRequest whose MovementPermissionExtent has opposite direction to the MOB
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

6.2.2.3.1.6 Safety Responsibility Profile

IA-26038 - [Test Case] MpUpdateRequest is granted, vMaxProfile is conform to Vmax allowed by rearMovementMode and Vmax allowed by Movement Mode of safetyResponsibilityProfile

mp-accepted-vmax-conform-to-movement-mode-somewhere-within-mp-vmaxm-on-same-pos-as-srm.json

mp-accepted-vmax-conform-to-movement-mode-somewhere-within-mp.json

mp-accepted-vmax-conform-to-movement-mode-somewhere-within-mp-after-srm.json

mp-accepted-vmax-at-rear-equal-to-max-speed-allowed-on-sight-at-rear

mp-accepted-vmax-conform-to-movement-mode-at-rear

mp-accepted-vmax-at-rear-equal-to-max-speed-allowed-for-first-srm-on-sight

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest whose vMaxProfile is conform to Vmax allowed by Movement Mode of rearMovementMode and safetyResponsibilityProfile
- The granted MpUpdateRequest shall be distributed as an MpDemand via the RCA4 Interface
- The granted MpUpdateRequest shall be propagated as an MpUpdatedEvent via the RCA2 Interface

[approved]

IA-25699 - [Test Case] MpUpdateRequest is rejected, ackWindowLength is too short or too long

mp-rejected-ack-window-shorter-than-configured-minimal-length

mp-rejected-ack-window-longer-than-maximal-length

Testing Scope:

- Correct safety assessment of a MpUpdatedRequest which has an SafetyResponsibilityMarker with an ackWindowLength that is too short or too long
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-25701 - [Test Case] MpUpdateRequest is rejected, ackWindowLength reaches or exceeds the distance to the subsequent safetyResponsibilityMarker

mp-rejected-ack-window-length-equal-to-distance-to-next-srm

mp-rejected-ack-window-longer-than-distance-to-next-srm

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest which has a SafetyResponsibilityMarker with an ackWindowLength which reaches or exceeds the distance to the subsequent SafetyResponsibilityMarker
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-25703 - [Test Case] MpUpdateRequest is rejected, ackWindowLength ends at or behind the end of the MP

mp-rejected-ack-window-ends-right-at-the-end-of-mp

mp-rejected-ack-window-longer-than-mp

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest which has a SafetyResponsibilityMarker with an ackWindowLength which ends at or behind the end of the MP
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-25912 - [Test Case] MpUpdateRequest is rejected, SafetyResponsibilityMarker is positioned outside of the MP

mp-rejected-srm-is-out-of-mp-extent

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest which has a SafetyResponsibilityMarker whose distanceFromRear exceeds the extent of the MP
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-25705 - [Test Case] MpUpdateRequest is rejected, allowed vMax at the MP rear violates the vMax allowed by the rearMovementMode

mp-rejected-vmax-at-rear-higher-than-max-speed-allowed-on-sight-at-rear

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest which has a vMax at rear which is too high according to the RearMovementMode
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-26035 - [Test Case] MpUpdateRequest rejected, vMaxProfile exceeds Vmax allowed by rearMovementMode or Vmax allowed by Movement Mode of safetyResponsibilityProfile

mp-rejected-vmax-at-rear-higher-than-max-speed-allowed-for-first-srm-on-sight

mp-rejected-vmax-marker-at-srm-is-higher-than-max-speed-allowed-for-movem-mode.json

mp-rejected-vmax-marker-infront-of-srm-is-higher-than-Vmax-allowed-for-movement-mode.json

mp-rejected-vmax-marker-after-srm-is-higher-than-max-speed-allowed-for-movement-mode.json

mp-rejected-vmax-higher-than-max-allowed-speed-for-movement-mode-at-rear

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest whose exceeds to Vmax allowed by Movement Mode of rearMovementMode or safetyResponsibilityProfile
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

6.2.2.3.1.7 URA

IA-25598 - [Test Case] MpUpdateRequest is granted, safe overlap with URA

mp-accepted-over-ura-with-higher-speed-profile-opposite-direction

mp-accepted-over-ura-with-higher-speed-profile-same-direction

mp-accepted-over-ura-with-lower-speed-profile-because-direction-opposite

mp-accepted-over-ura-with-lower-speed-profile-same-direction-because-higher-speed-marker-after-ura

mp-accepted-over-ura-with-same-speed-profile-same-direction

mp-accepted-over-2-overlapping-uras

Testing Scope

- Correct safety assessment of an MpUpdateRequest leading to safe overlap with one or more URAs
- The granted MpUpdateRequest shall be distributed as an MpDemand via the RCA4 Interface
- The granted MpUpdateRequest shall be propagated as an MpUpdatedEvent via the RCA2 Interface

[approved **]**

IA-25603 - [Test Case] MpUpdateRequest is rejected, vMaxProfile violates the vMax of one or more URAs

mp-reject-over-ura-with-lower-speed-profile-same-direction

mp-reject-with-higher-speed-profile-before-ura-with-lower-speed-profile-same-direction

mp-reject-over-2-overlapping-uras

Testing Scope

- Correct safety assessment of an MpUpdateRequest which has a vMaxProfile exceeding the Usage Restrictions defined by one or more URAs
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

6.2.2.3.1.8 Risk Buffer

IA-23915 - [Test Case] MpUpdateRequest is granted, Risk Buffer is safe

mp-accept-with-risk-buffer-over-cleared-occupancy.json

mp-accept-with-risk-buffer-over-dps.json

mp-accept-with-risk-buffer-overlapping-irrelevant-occupancy.json

mp-accept-with-risk-buffer-overlapping-other-risk-buffer.json

mp-accept-with-risk-buffer-with-different-profile.json

mp-accepted-risk-buffer-over-occupancy-movement-mode-on-sight

mp-accepted-risk-buffer-over-occupancy-movement-mode-still-stand

mp-accepted-risk-buffer-over-occupancy-rear-movement-mode-on-sight-no-other-srm

Testing Scope

- Correct safety assessment of an MpUpdateRequest which has a safe Risk Buffer
- The granted MpUpdateRequest shall be distributed as an MpDemand via the RCA4 Interface
- The granted MpUpdateRequest shall be propagated as an MpUpdatedEvent via the RCA2 Interface

[approved **]**

IA-23962 - [Test Case] MpUpdateRequest is rejected, start position of the Risk Buffer is invalid

mp-reject-because-not-adjacent-risk-buffer.json

mp-reject-because-overlap-risk-buffer.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest which has an invalid Risk Buffer
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23963 - [Test Case] MpUpdateRequest is rejected, orientation of the Risk Buffer is invalid

mp-reject-because-of-wrong-direction-of-risk-buffer.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest which has a Risk Buffer with a different orientation than the MP
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23965 - [Test Case] MpUpdateRequest is rejected, Risk Buffer is at the rear of the MP

mp-reject-because-risk-buffer-behind-mp.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest which has a Risk Buffer which is at the rear of the MP
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23966 - [Test Case] MpUpdateRequest is rejected, Risk Buffer is not navigable or not trafficable

mp-reject-because-risk-buffer-over-trailable-dps.json
mp-reject-because-risk-buffer-over-untrafficable-dps.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest whose Risk Buffer is not navigable or not trafficable
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23968 - [Test Case] MpUpdateRequest is rejected, unsafe overlap of Risk Buffer with an Occupancy

mp-reject-because-risk-buffer-overlapping-occupancy.json
mp-rejected-risk-buffer-over-occupancy-movement-mode-full-supervision

Testing Scope

- Correct safety assessment of an MpUpdateRequest which would lead to an unsafe overlap of the Risk Buffer with an Occupancy, due to the insufficient Movement Conditions of the requested MP
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23969 - [Test Case] MpUpdateRequest is rejected, unsafe overlap of Risk Buffer with an already granted MP

mp-reject-because-risk-buffer-overlapping-other-mp.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest which would lead to an unsafe overlap of the Risk Buffer with an already granted MP, due to the insufficient Movement Conditions of the requested MP
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23970 - [Test Case] MpUpdateRequest is rejected, Risk Buffer is too short

mp-reject-because-risk-buffer-too-short-according-to-local-profile.json
mp-reject-because-too-short-risk-buffer.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest whose Risk Buffer is too short
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

6.2.2.3.1.9 Risk Path

IA-25896 - [Test Case] MpUpdateRequest is granted, MP and Risk Paths are safe

mp-accepted-with-flank-protection.json
mp-accept-with-risk-paths.json
mp-accept-with-risk-paths-only-allocation-sections.json

Testing Scope:

- Correct safety assessment of an MpUpdatedRequest which requires flank protection because it overlaps one or more Allocation Sections
- The granted MpUpdateRequest shall be distributed as an MpDemand via the RCA4 Interface
- The granted MpUpdateRequest shall be propagated as an MpUpdatedEvent via the RCA2 Interface

[approved]

IA-23975 - [Test Case] MpUpdateRequest is rejected, Risk Paths do not cover required Allocation Sections

mp-reject-because-not-all-allocations-sections-covered-by-risk-paths.json
mp-reject-cause-different-risk-path.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest whose Risk Paths do not cover all required Allocation Sections
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23978 - [Test Case] MpUpdateRequest is rejected, unsafe overlap of Risk Path with an already granted MP

mp-reject-cause-mp-in-risk-path.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest which would lead to an unsafe overlap of the Risk Path with an already granted MP
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23980 - [Test Case] MpUpdateRequest is rejected, Risk Path does not guarantee track enforced flank protection

mp-reject-cause-mp-risk-path-does-not-cover-securing-dps.json
mp-reject-only-allocation-section-in-risk-path-with-high-vmax.json
mp-reject-cause-mp-risk-path-covers-dps-but-is-not-secured.json
mp-reject-cause-dps-not-aligned-with-risk-path-.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest whose Risk Path does not end according to the requested vMax at a DPS that provides track enforced flank protection. Either because DPS is not covered or because DPS has an insufficient DpsState (trafficability is FULL, flank protection is FALSE), or because DPS does not provide flank protection in the required direction
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved]

IA-23981 - [Test Case] MpUpdateRequest is rejected, unsafe overlap of Risk Path with an Occupancy

mp-reject-cause-occupancy-in-risk-path.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest which would lead to an unsafe overlap of the Risk Path with an Occupancy
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-23982 - [Test Case] MpUpdateRequest is rejected, Risk Path is trafficable

mp-reject-cause-risk-path-has-entrance.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest whose Risk Path is trafficable (has an entrance between its rear and front position)
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[approved **]**

IA-23983 - [Test Case] MpUpdateRequest is rejected, Risk Path is not directed towards Allocation Section to be protected

mp-reject-cause-risk-path-wrong-direction.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest whose Risk Path is not directed towards the Allocation Section which is intersecting with the MP and therefore needs to be protected
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[draft **]**

IA-26274 - [Test Case] MpUpdateRequest is rejected, MOB created on the Risk Path

mp-rejected-mob-created-on-risk-path.json

Testing Scope

- Correct safety assessment of an MpUpdateRequest on whose Risk Path there is a MOB created
- The rejected MpUpdateRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface

[draft **]**

6.2.2.3.1.10 Release Speed

IA-26278 - [Test Case] MpRequest is granted, if the attribute useReleaseSpeed of the requested MP is set to true and the front end of the extent is located exactly at the position of a target marker

mp-accepted-with-release-speed.json

Testing Scope

- Correct safety assessment of an MpRequest with a Release Speed when the front end of MP is exactly located as a target marker.
- The granted MpRequest shall be distributed as an MpDemand via the RCA4 Interface.
- The granted MpRequest shall be propagated as an MpUpdatedEvent via the RCA2 Interface.

[approved **]**

IA-26279 - [Test Case] MpRequest is rejected, if the attribute useReleaseSpeed of the requested MP is set to true and the front end of the extent is located in front of the position of a target marker

mp-rejected-with-release-speed-mp-is-before-target-marker.json

Testing Scope

- Correct safety assessment of an MpRequest with a Release Speed when the front end of MP is located in front of a target marker.
- The rejected MpRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface.

[approved **]**

IA-26280 - [Test Case] MpRequest is rejected, if the attribute useReleaseSpeed of the requested MP is set to true and the front end of the extent is located after the position of a target marker

mp-rejected-with-release-speed-mp-is-after-target-marker.json

Testing Scope

- Correct safety assessment of an MpRequest with a Release Speed when the front end of MP is located after the position of a target marker.
- The rejected MpRequest shall be propagated as an MpRequestRejectedEvent with the correct RejectCode via the RCA2 Interface.

[approved **]**

6.2.2.3.2 APS-MT

6.2.2.3.2.1 Mp Demand

IA-25753 - [Test Case] Basic translation by APS-MT of a MP received with a MpDemand to an ETCS MA

mp-demand-fs-in-nominal-direction-on-nominal-side-of-balise.json
mp-demand-fs-in-nominal-direction-on-reverse-side-of-balise.json
mp-demand-fs-in-nominal-reverse-on-nominal-side-of-balise.json
mp-demand-fs-in-reverse-direction-on-reverse-side-of-balise.json

Testing Scope:

- Correct computation of D_REF in ECTS message #33 so that location reference is aligned with rear end of MP
- Correct computation of ETCS packet #15 in case that no release speed is demanded
- Correct computation of Q_DIR in all packets according to movement direction
- Consideration of all possible direction and orientations (nominal/reverse) combinations
- No inclusion of ECTS packet #80 as movement mode is completely full supervision
- Translation a ECTS message #146 back to a MpAcknowledgeEvent when received from OBU

Out of Scope:

- Correct computation of other ETCS packets than #15 (tested with other specific test cases)

[approved **]**

IA-25765 - [Test Case] Translation by APS-MT of a MP with multiple speed changes to lower and higher speeds

mp-demand-with-multiple-speed-changes.json

Testing Scope:

- Correct computation of other ETCS packet #27 with speed increases and decreases
- Correct rounding of D_STATIC and V_STATIC

[approved **]**

IA-25779 - [Test Case] Translation by APS-MT of a MP with movement mode on sight form begin until end

mp-demand-os-on-rear-further-no-other-srm.json

Testing Scope:

- Correct computation of other ETCS packet #80 a single MA mode
- Correct computation of L_MAMODE (set to infinity) as on sight area last until the end of MP

[approved **]**

IA-25778 - [Test Case] Translation by APS-MT of a MP with movement mode on sight and then full supervision
mp-demand-os-on-rear-further-fs.json

Testing Scope:

- Correct computation of other ETCS packet #80 a single MA mode
- Correct computation of L_MAMODE (set concrete length) as on sight area ends before the front end of MP

[approved]

IA-25780 - [Test Case] Translation by APS-MT of a MP with movement mode on sight not from begin of MP
mp-demand-os-on-rear-further-fs-os.json
mp-demand-os-on-rear-further-fs-os-fs.json

Testing Scope:

- Correct computation of other ETCS packet #80 a single MA mode
- Correct computation of D_MAMODE and L_ACKMAMODE as on sight area begins not at the rear end of MP

[approved]

IA-26283 - [Test Case] Translation by APS-MT of a MP with Release Speed MP front is right at the Target Marker
mp-demand-with-release-speed.json

Testing Scope:

- Correct computation of attributes related to danger point (Q_DANGERPOINT, D_DP and V_RELEASE_DP) in packet #15

[approved]

6.3 [CR] Manage Usage Restriction of Railway Network

6.3.1 [IS] Request Creation of Usage Restriction Area

6.3.1.1 Sequence Diagrams

[IS] Request Creation of Usage Restriction Area

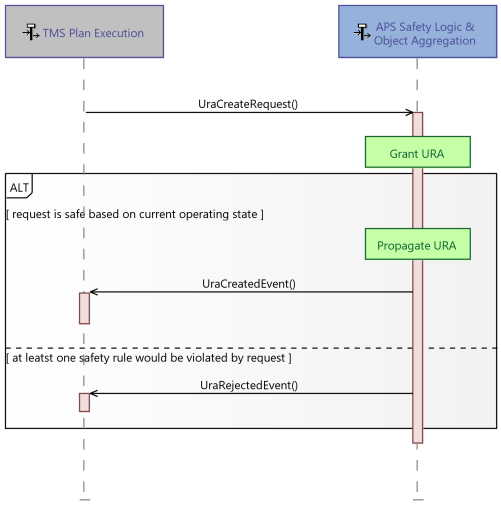


Diagram 10: Request Creation of Usage Restriction Area

[approved]

6.3.1.2 Functional Requirements

6.3.1.2.1 [LF] Grant URA

IA-24152 - [Grant URA] URA creation request shall be checked according to Safety Rules
Each SRP-23478 - UraCreateRequest received by IA-23665 - APS Safety Logic & Object Aggregation over SRP-4729 - Interlocking Control and Monitoring Interface shall be checked for it's safety according to the Safety Rules.

If at least one of the WI-7756 - Safety Rules is not fulfilled the SRP-23478 - UraCreateRequest shall be rejected. Only if all of the Safety Rules are fulfilled the SRP-23478 - UraCreateRequest shall be granted and the WI-1996 - Usage Restriction Area shall be created. [approved]

IA-24153 - [Grant URA] [Safety Rule] The requested URA Id shall be unique
The SRP-23478 - UraCreateRequest shall be rejected if an other WI-1996 - Usage Restriction Area already exists in operational state with the same id. [approved]

IA-24779 - [Grant URA] [Safety Rule] The URA shall cover an area
The SRP-23478 - UraCreateRequest shall be rejected if the requested WI-1996 - Usage Restriction Area does not cover a valid list with minimum one SRP-23657 - TrackSectionDirected with a clear direction. [approved]

IA-24154 - [Grant URA] [Safety Rule] The vMaxProfile of all MPs overlapping with the requested URA shall not exceed the vMax of the URA within the sections overlapping with the URA
The SRP-23478 - UraCreateRequest shall be rejected if the operational state contains a SRP-18825 - MovementPermission whose extent has at least one SRP-18900 - VmaxMarker with a higher speed within a SRP-23657 - TrackSectionDirected of the SRP-23476 - UsageRestrictionArea in the same direction or before that without further SRP-18900 - VmaxMarker up to its beginning in the same direction. [approved]

IA-24156 - [Grant URA] Rejected URA creation request shall be propagated
Each rejected SRP-23478 - UraCreateRequest shall be propagated by immediately sending a SRP-23475 - UraRejectedEvent with the corresponding rejectCode, back over SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

6.3.1.2.2 [LF] Propagate URA

IA-24157 - [Propagate URA] URA Creation shall be propagated
Each new created SRP-23476 - UsageRestrictionArea shall immediately be propagated with a SRP-23480 - UraCreatedEvent over SRP-4729 - Interlocking Control and Monitoring Interface. [approved]

6.3.1.3 Test Cases

IA-25580 - [Test Case] URA request shall be granted if existing MP does not violate speed condition
ura-accepted-on-G3.1-vMax15-direction-start-to-target
ura-accepted-on-G3.1-vMax15-direction-target-to-start
ura-accepted-on-G3.1-vMax15-with-directions-start-to-target-and-target-to-start
ura-accepted-on-3-edges-over-mp-with-higher-speed-profile-opposite-direction
ura-accepted-on-G23-to-G3.1-vMax5-direction-start-to-target

ura-accepted-on-risk-path-with-opposite-direction-of-mp-with-higher-speed-profile-and-opposite-direction
ura-accepted-on-risk-path-with-opposite-direction-of-mp-with-higher-speed-profile-and-same-direction
ura-accepted-on-risk-path-with-same-direction-of-mp-with-higher-speed-profile-and-opposite-direction
ura-accepted-on-risk-path-with-same-direction-of-mp-with-higher-speed-profile-and-same-direction

ura-accepted-over-mp-with-higher-speed-profiles-because-opposite-direction
ura-accepted-over-mp-with-lower-speed-profiles-opposite-direction

ura-accepted-over-mp-with-lower-speed-profiles-same-direction

ura-accepted-over-mp-with-same-speed-profiles-same-direction [approved]

IA-25593 - [Test Case] ura-reject-because-uraId-already-exists

ura-reject-because-uraId-already-exists [approved]

IA-25594 - [Test Case] ura-reject-because-edgeId-is-not-correct

ura-reject-because-edgeId-is-not-correct [approved]

IA-25595 - [Test Case] ura-reject-because-offset-on-edge-is-not-correct

ura-reject-because-offset-on-edge-is-not-correct [approved]

IA-25596 - [Test Case] ura-reject-over-mp-with-higher-speed-profiles-same-direction

ura-reject-over-mp-with-higher-speed-profiles-same-direction [approved]

6.3.2 [IS] View usage restriction

6.3.2.1 Sequence Diagrams

[IS] View usage restriction

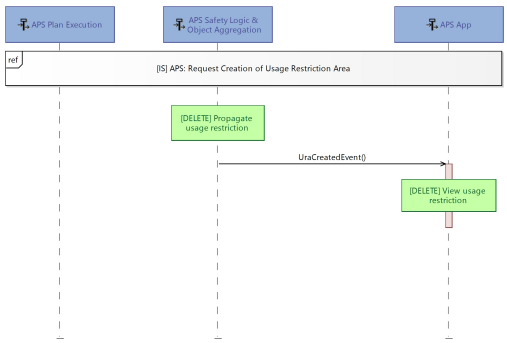


Figure 50 View usage restriction

[draft]

6.3.2.2 Functional Requirements

6.3.2.2.1 [LF] View usage restriction

IA-26266 - [View usage restriction] Display URA

For each SRP-23480 - UraCreatedEvent received by SRP-4643 - APS App over SRP-4729 - Interlocking Control and Monitoring Interface the corresponding WI-1996 - Usage Restriction Area shall be displayed on the SRP-4643 - APS App. [draft]

6.3.2.3 Test Cases

tbd

7 Open Issues

ETCS-Messages

Die ETCS-Messages die in diesem Dokument aufgeführt sind, sind nicht im Polarion dokumentiert und spezifiziert, so dass diese verlinkt werden könnten.

Update Naming Logical Functions

Das bisherige Naming der LF bedarf einer Überarbeitung. Vorschlag aktuell in Abklärung mit M. Kuhn durch M. Kaufmann