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Moving Block Specification

Part 5 – Engineering Rules

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1 Background

This document is Part 5 of Deliverable D4.1 “Moving Block Specifications” from the Project titled “Completion of activities for Adaptable Communication, Moving Block, Fail Safe Train Localisation (including satellite), Zero on site Testing, Formal Methods and Cyber Security” (Project Acronym: X2Rail-5; Grant Agreement No 101014250).

Deliverable D4.1 is made up of several different parts. This is Part 5 – Engineering Rules. See Part 1 – Introduction for a list of the different Parts of this Deliverable.

All terms and abbreviations, and all references for all parts of D4.1 are located in Part 1 – Introduction.

2 Engineering Rules

This section provides Engineering Rules for an ETCS Level 3 system, where they are in addition to those required for ETCS Level 2. Since there is no complete, documented set of Engineering Rules for an ETCS Level 2 application, the working group has documented rules which they believe to be an enhancement of, or in addition to, those normally applied on Level 2 projects. Engineering Rules are also included where the system requirements in Part 3 require configuration of the L3 Trackside in order to select, or support, optional behaviours.

There are no Engineering Rules included where Part 3 states that there is project-specific design. Further Engineering Rules may be required, depending on the project-specific design.

The section is structured into sub-sections, based on the Operational Scenarios which were used by the Working Group in X2Rail-1 as a development tool for the Rules and Requirements. These Operational Scenarios are listed in the Methodology section in Part 1.

Each rule has been structured in four different parts:

- ID: each item is given a Unique ID, structured as follows:

  <Type>-<Section>-<Number>

  where:

  <Type> is “ENG” for D4.1 Part 5 – Engineering Rules

  <Section> is an abbreviation within the document for a section of rules

  <Number> is a number unique to the rule within a <Section>

- Rule: This is the text of the Rule
- Rationale: This is the reasoning explaining why and in which situations this Rule is needed
- Guidance: This is a proposal for the Rule implementation or other aspects to be considered during its implementation.

Several new or revised Engineering Rules have been identified which apply to multiple scenarios concerning the operation of trains in Level 3. These are listed at the start of this section of this document.

2.1 Generic Engineering Rules

This section provides 'generic' rules for an ETCS Level 3 system. Generic rules are valid across multiple scenarios.

ENG-Generic-1 [X2R3 D4.2: ENG-Generic-1]

The L3 Trackside shall be configured to update a Movement Authority (MA) only in accordance with application-specific operational needs.

Rationale:

On a Level 3 Moving Block railway the End of Authority (EoA) can be at an arbitrary location on the track. Therefore, rules may be required to avoid unnecessary MA extensions over short distances.

Guidance:

A specific minimum distance for MA extension should be established, as well as a minimum time interval to send an update. Where this constraint is not required the distance and time could be set to zero. This can assist in avoiding the radio communication network becoming overloaded, and avoid repeated updates of the driver display with, potentially, accompanying audible alerts.

Requirements: REQ-MA-4

ENG-Generic-2 [X2R3 D4.2: ENG-Generic-2]

Infrastructure Managers shall define EoA Exclusion Areas where the system shall not bring any part of a train to a stand due to it reaching an EoA.

Rationale:

On a Level 3 Moving Block railway the End of Authority can be at an arbitrary location on the track. Therefore, depending on the application, rules may be required to avoid trains stopping in areas where it is not considered safe or suitable.

Guidance:

Examples include avoiding MAs that end inside a tunnel, over a level crossing, junctions or any other areas where stopping a train is considered undesirable from a safety or operational perspective. Where it is unacceptable for a train to stop with a pantograph in a powerless section, the engineering of the EoA Exclusion areas should take account of potential positions of the pantograph. Projects may also consider configuration of Non-Stopping Areas for EoA Exclusion Areas. Note: Non-stopping areas transmitted by ETCS only provide information to the driver.

Requirements: REQ-EoAExclusionArea-1; REQ-EoAExclusionArea-2

ENG-Generic-3 [X2R3 D4.2: ENG-Generic-4]

The Infrastructure Managers shall define the maximum length of an Unknown Track Status Area that can be safely cleared by the L3 Trackside without sweeping or visual inspection.

Rationale:

This is to avoid needing to sweep short lengths of an Unknown Track Status Area left due to differences in the reported train length after shunting, splitting or joining.

Guidance:

The length of the Unknown Track Status Area that can be cleared without sweeping needs to be established based on the vehicles using the railway and should be less than the length of the shortest vehicle operating on the railway.

Requirements: REQ-TrackStatus-19; REQ-TrackStatus-22

ENG-Generic-4 [X2R3 D4.2: ENG-Generic-5]

Where the accurate determination of the rear of the train is required to avoid operational impact, the L3 Trackside engineering shall consider project specific mitigations to manage the confidence interval within train position reports.

Rationale:

This is to avoid the impact on the operational performance of the line due to the assumed train position locking points or crossings.

Guidance:

This is project specific but could include, for example, the use of TTD around junctions, or having balise groups close enough to the End of Mission areas to minimise the confidence interval in train position reporting to the L3 Trackside. This may apply where trains regularly undertake End of Mission or stop at platforms or in passing loops with a requirement for other trains to pass or use other routes. In deciding whether to provide extra facilities, consideration should be given to the likelihood that a train is unable to report integrity confirmed.

Requirements: REQ-TTD-2; REQ-TTD-3

ENG-Generic-5 [X2R3 D4.2: ENG-Generic-6]

The Infrastructure Manager shall establish the length of a “L3 Margin” to be used by the L3 Trackside when generating Movement Authorities.

Rationale

Use of the L3 Margin defined in this Rule enables reduction of the probability of a collision or derailment arising from an unsupervised or unauthorised movement of a train.

Guidance:

The L3 Margin is intended to protect against one forwards or backwards movement of a stationary train. It is not intended to protect against multiple forwards or backwards movements, or against unlimited unsupervised movement.

The distance a train may move in SB before the brakes are applied is set by the value of D_NVROLL and the distance for trains to come to a stand depends on the braking characteristics of the train.

A distance of 2 x D_NVROLL for the value of the L3 Margin is a reasonable estimate for most applications.

Requirements: REQ-MA-2; REQ-MA-3

ENG-Generic-6 [X2R3 D4.2: ENG-Generic-7]

The Infrastructure Manager shall establish the application specific rules for establishing where Movement Authorities may end and the boundaries of track status areas when Fixed Virtual Block is deployed.

Rationale:

The configuration of the system when using FVB depends on the operational needs of the railway.

Guidance:

The design should take account of the required train movements including where End of Mission and Start of Mission will occur, where splitting and joining may occur and the required capacity of the railway.

Requirements: REQ-Reserved-1

ENG-Generic-7 [X2R3 D4.2: ENG-Generic-8]

The Infrastructure Manager shall decide whether an Unknown Track Status Area created due to a faulty TTD may be treated as Clear following sweeping or other checks.

Rationale:

If an Occupied TTD can be shown faulty, by passage of a train, then the Unknown Track Status Area can be cleared, and normal operation can resume.

Guidance:

In the event of failure of a TTD, the area will be considered as Unknown Track Status. The L3 Trackside may be able to monitor the passage of trains using Train Position Reports. In this case the Unknown Track Status Area can be removed.

The operational advantages of relying solely on Position Reports in the event of a TTD failure could be significant. However, in establishing that the TTD status can be "ignored" the Infrastructure Manager should consider robust processes, such as sweeping, to confirm it is a TTD failure and not an obstruction on the railway.

Requirements: REQ-TTD-11

ENG-Generic-8 [X2R3 D4.2: ENG-Generic-9]

The L3 Trackside shall be configured to use Balise Linking Information.

Rationale:

Use of Balise Linking information improves the accuracy of train positioning, fundamental to the L3 Trackside locating every train in the L3 Area of Control.

Guidance:

It is expected that Balise Linking Information will be used in Level 3 areas.

It is recommended for the first expected Balise Group in the linking chain when authorising trains to move to set a linking reaction which will brake the train if it is not found as expected.

Requirements: REQ-MA-6

ENG-Generic-9 [X2R3 D4.2: ENG-Generic-10]

The Infrastructure Manager shall configure the L3 Trackside options for authorising a train without integrity confirmed to move within or enter a L3 area.

Rationale:

This is for operational reasons and to avoid leaving the area behind the train in an Unknown track status.

Guidance:

Engineering is needed to define the conditions required for the L3 Trackside to authorise the movement of a train which is not reporting train integrity confirmed at Start of Mission.

The Infrastructure Manager may decide that trains without train integrity confirmed may not be authorised to move until extra controls are in place. The configuration options should include:

- Issue an MA irrespective of integrity status,
- Do not issue an MA unless integrity is confirmed,
- Only issue an MA when no integrity is confirmed after an authorisation is received via the TMS.

Requirements: REQ-MA-9

ENG-Generic-10 [X2R3 D4.2: ENG-LossTI-2]

The Infrastructure Manager shall determine whether or not additional mitigation measures are required to protect against hazards arising from unintentional movements of railway vehicles.

Rationale:

Unintentional movements of railway vehicles could result in hazards.

Guidance:

A Hazard Analysis will be required to determine the hazards associated with unintentional movements of railway vehicles.

The Hazard Analysis will depend on the specific topology of the railway, and whether there is protection (e.g. trap points) or detection (e.g. TTD) provided in locations where vehicles are regularly parked or stationary.

The Hazard Analysis will depend on the nature of the rolling stock permitted to run on a railway. If the rolling stock can be assured to become stationary in the event of loss of integrity, then additional mitigation may not be required. If the rolling stock includes vehicles which are not assured to become stationary, then the analysis may determine that it is necessary to protect the area in rear of the train which has lost train integrity.

A potential additional mitigation measure is to implement a propagation algorithm for Unknown Track Status areas.

If propagation of Unknown Track Status is required, it is project specific to define the propagation algorithm, including location, timing and extent. Such an algorithm may require configurable parameters.

If propagation of Unknown Track Status is required, it may also be necessary to consider propagation across handover boundaries between adjacent L3 Trackside systems.

Requirements: None

ENG-Generic-11 [New]

The L3 Trackside shall be engineered so that, if an area of track within a Reserved Status Area becomes Occupied before the L3 Trackside has authorised a train for this Reserved Status Area, it will:

a) restrict the Authorisation to the start of the Occupied area

or

b) not send the authorisation to the train

or

c) request a decision from the Traffic Management System

Rationale:

This functionality enables the L3 Trackside to react as required if an area of track within a Reserved Status Areas becomes occupied.

Guidance:

Each Infrastructure Manager must decide, in conjunction with the Railway Undertakings, which option should be chosen.

Requirements: REQ-MA-8

ENG-Generic-12 [New]

If there is splitting of trains during normal operation, then the Infrastructure Manager shall consider including TTD sections to cover the areas where splitting takes place.

Rationale:

In the absence of TTD, an error in entry of train length can result in the L3 Trackside becoming unaware of rail vehicles remaining in an area of track.

Guidance:

TTD used to protect splitting trains should cover the area where splitting is performed, but not extend beyond that area, so that it cannot be occupied by another train not involved in the splitting operation.

Requirements: None

ENG-Generic-13 [X2R3 D4.2: ENG-OS-1]

The L3 Trackside shall be engineered so that, if an area of track within a Reserved Status Area becomes Unknown before the L3 Trackside has authorised a train for this Reserved Status Area, it will:

a) include an OS mode profile for the Unknown Track Status Area

or

b) restrict the Authorisation to the start of the Unknown area

or

c) not send the authorisation to the train

or

d) request a decision from the Traffic Management System

Rationale:

The L3 Trackside must be configured with the rule for how to react if Unknown Track Status Area appears within a Reserved Status Area.

Guidance:

Option a) enables the L3 Trackside to automatically authorise trains to sweep Unknown Track Status Areas, thus improving availability of the railway and minimising the workload of the Dispatcher. However, for some railways this functionality may not be desirable as authorisation by a Dispatcher may be preferred.

Each Infrastructure Manager must decide, in conjunction with the Railway Undertakings, which option should be chosen. This may be affected by whether TTD is provided. In some countries, drivers are expected to accept an On-sight movement authority and drive cautiously checking for vehicles or other significant obstructions without having been previously advised. Other countries may require the Driver to be aware of the reason for the On- sight movement authority.

Requirements: REQ-MA-7

ENG-Generic-14 [X2R3 D4.2: ENG-HO-1]

The L3 Trackside shall be engineered such that the furthest balise group(s) beyond each border of the Area of Control which is required to be known to L3 Trackside shall be placed at a distance from the border not less than the maximum train length allowed to run on the line, plus a margin.

Rationale:

This is to ensure that the L3 Trackside can interpret a position report from a train when it has completely left the Area of Control, which will allow the Track Status to be cleared up to the border.

Guidance:

The margin could be computed so that the L3 Trackside is able to detect a train reporting integrity confirmed having passed the border with its CRE, which allows it to regard the track up to the border as Clear.

The margin could be calculated taking in account at least the following:

a) the maximum speed of the line;

b) the number of position report repetitions defined in Appendix A3.1 of SS26 [SS026]. This influences when the On-board will terminate the session;

c) the frequency of position reports;

d) the frequency of TIMS confirmations.

Where there are divergences beyond the border of the Area of Control, all potential paths should be considered.

Should the CRE still be within the Area of Control when the communications between the train and the L3 Trackside are terminated, another method will be required to clear the track at the border, for example via TTD input if present, or by sweeping in On-Sight mode.

Requirements: REQ-HO-2

2.2 Trackside Initialisation

2.2.1 Introduction

On a Level 3 railway the Train Location of trains is determined by position reports received from the trains which are recorded and evaluated by the L3 Trackside. When the system is initialised, the L3 Trackside will consider the whole railway as not Clear until it can establish the Train Location of all trains/vehicles, particularly those that are not communicating. This section considers the issues to be addressed by Engineering Rules to support the safe and efficient initialisation of the system and resumption of normal train operations. The Infrastructure Manager needs to understand the risks and put in place appropriate procedures and technical controls.

2.2.2 Rules

ENG-TrackInit-1 [X2R3 D4.2: ENG-TrackInit-1]

Infrastructure Managers shall select which information is to be stored by the L3 Trackside and establish for how long it can be used safely when the L3 Trackside is re-initialised.

Rationale:

Stored information may no longer be valid and may require confirmation. The rules for which information must be stored and for how long it will be used need to be the subject of site-specific assessment.

Guidance:

In circumstances in which the system cannot be sure that all the stored information is still relevant, then either it should be confirmed by the Dispatcher, or all the information discarded, and the status of the railway treated as track status Unknown.

Information which may be relevant to store can be found in the linked requirements.

In assessing how long information may be considered valid, it should be considered whether the information can be used to prevent a potentially obstructed section being declared Clear (due to human error) or whether it will be used to enable the system to establish a section is not obstructed. In the former the information may be considered valid for longer whereas in the latter a short time period is recommended based on the amount and extent of train movements which may have occurred.

Requirements: REQ-TrackInit-2; REQ-TrainLoc-2, REQ-TrackStatus-27, REQ-Reserved-12

ENG-TrackInit-2 [X2R3 D4.2: ENG-TrackInit-2]

The Infrastructure Manager shall configure whether or not the L3 Trackside shall require confirmation by the Responsible Person that the trackside initialisation procedure is complete when using Stored Information.

Rationale:

If Stored Information is used at Trackside Initialisation, confirmation by the Responsible Person is optional.

Guidance

None.

Requirements: REQ-TrackInit-3

2.3 Start of Mission

2.3.1 Introduction

When trains undertake Start of Mission, it is not always possible to identify their Train Location unambiguously or determine that there are no other trains in front of them. One key operational difference from Level 2 is that the movement of trains which are unable to report train integrity confirmed (due to failure or absence of TIMS) needs to be managed differently, considering the operational impact of a train moving without integrity confirmed.

2.3.2 Rules

ENG-SoM-1 [New]

The Infrastructure Manager shall configure whether or not the L3 Trackside shall alert the TMS of a train which has terminated its communication session without Validated Train Data being received by the L3 Trackside.

Rationale:

This is used in case the Dispatcher has to take an additional action to protect the train, i.e. extend the Unknown area to protect the train.

Guidance:

The Driver could begin the Start of Mission procedure, but then close the desk before completing the procedure, thus terminating the communications. The L3 Trackside can be configured to alert the TMS in this situation.

The Dispatcher, following non-harmonised rules, may need to contact the Driver to protect the train e.g. where this train is, whether it was a Driver's mistake, etc.

Requirements: REQ-SoM-7

ENG-SoM-2 [New]

The Infrastructure Manager shall configure whether or not the L3 Trackside shall alert the TMS if a train has not report Validated Train Data within a configurable time.

Rationale:

In the event of a failure in the communication which prevents the reception of the Validated Train Data, the Dispatcher can take the needed action so that the operation is not affected.

Guidance:

The Driver could begin the Start of Mission procedure, but fail to complete the procedure. The L3 Trackside can be configured to alert the TMS in this situation.

The Dispatcher, following non-harmonised rules, may need to contact the Driver to ensure e.g. where this train is, whether it was a Driver's mistake, etc.

Requirements: REQ-SoM-8

2.4 Level Transitions

2.4.1 Introduction

Transitions in and out of Level 3 areas are not significantly different from those out of Level 2 areas, except that the system must be engineered so that the L3 Trackside can detect non-communicating trains entering the L3 Area of Control.

2.4.2 Rules

ENG-LevelTrans-1	[X2R3 D4.2: ENG-LevelTrans-1]

The Infrastructure Manager shall engineer a means for the L3 Trackside to monitor trains entering the L3 Area of Control.

Rationale:

This is to prevent a train from entering the L3 Area of Control unnoticed by the L3 Trackside and support establishing track status.

Guidance:

This can be done by engineering, such as a short TTD section at the border or other means that are application specific. The provision of TTD either side of the border allows the L3 Trackside to monitor the progress of trains and confirm that a "ghost" train has not followed an authorised movement. The provision of balises, which are known to the L3 Trackside, can be used to help establish the correct position of all trains transitioning.

Requirements: REQ-LevelTrans-1

2.5 End of Mission

2.5.1 Introduction

When a train completes a journey and the Driver closes the desk, an End of Mission position report is sent by the ETCS On-board and the train disconnects.

2.5.2 Rules

ENG-EoM-1	[X2R3 D4.2: ENG-EoM-1]

The Infrastructure Manager shall consider the provision of TTD in areas where trains are regularly left without a communication session.

Rationale:

The location of trains not in communication will be regarded as Unknown Areas. Even if trains are provided with Cold Movement Detection, this is only useful once the train reconnects and it may have safety benefits to detect the movement of trains which should not be moved.

Guidance:

TTD should be considered for both where trains are regularly left not in communication and for the running lines in the vicinity, in order to detect runaways particularly if the gradient is unfavourable.

Requirements: None

2.6 Reversing

2.6.1 Introduction

For a train to move in Reversing avoiding impact on other train movements, the furthest location that the rear of a train can reach has to be defined by the Infrastructure Managers.

2.6.2 Rules

ENG-Rev-1	[New]

Infrastructure Managers shall define the Boundary for Reversing for each area in which a train may reverse to escape a dangerous situation.

Rationale:

This is to know where the rear end of a train may stop after reversing and thereby avoid collision with other train movements. Projects could decide to have multiple fixed boundary locations depending on the types of trains operating on the line.

Guidance:

This rule is optional as the location for a Boundary for Reversing could also be calculated dynamically per train, e.g. depending on the actual train length.

Figure 1 illustrates the location of the Boundary for Reversing, being the end of the area to be protected from other train movements. The Reversing Area is where a train may start to reverse, and the Reversing Distance is how far it may reverse from

the reference location. The Reversing Margin should consider the lengths of trains permitted to reverse and an estimated distance for the trains to brake to stop if overpassing the permitted reversing distance.

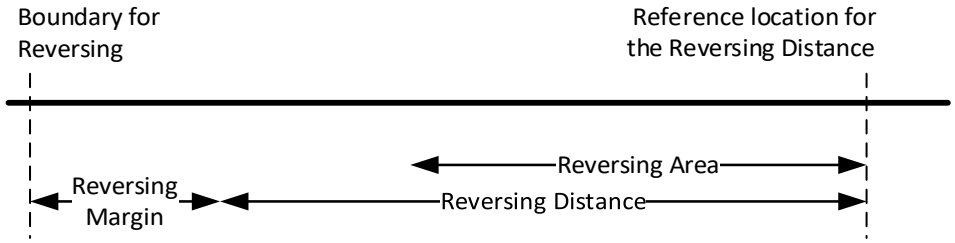

Figure 1: Area to protect for a reversing train

Requirements: REQ-Rev-1

2.7 Shunting

2.7.1 Introduction

For the L3 Trackside to monitor the Train Location of all trains and vehicles, it is necessary for them to be communicating. Entry into Shunting mode causes the train to disconnect and, hence, this should only be permitted where the L3 Trackside has been configured to manage the extent of the movement in Shunting mode and protect other train movements.

2.7.2 Rules

ENG-SH-1	[X2R3 D4.2: ENG-SH-1]

The Infrastructure Manager shall define Permanent and Temporary Shunting Areas in the L3 Trackside where operationally required.

Rationale:

Shunting Areas are used to protect shunting activities from other authorised train movements and to protect authorised train movements from shunting activities.

Guidance:

Shunting Areas are predefined areas in which shunting is allowed. Permanent Shunting Areas are always active, whilst Temporary Shunting Areas can be activated and deactivated as required.

One possibility could be to pre-configure in the L3 Trackside a set of areas where movements in SH mode could take place and allow the TMS to activate and possibly link them where needed, thus resulting in larger shunting areas. Infrastructure Managers could restrict the extent of shunting areas to areas where corresponding protection means such as, for example, derailing points, balises with "Danger for

Shunting Information" or TTD are available. A similar method may be used to manage shunting in Level 2, however the reliance on train position reports means that shunting has to be more tightly controlled.

Requirements: REQ-SH-1

2.8 Communication Failure

2.8.1 Introduction

For a system which relies on train position reports, situations where communication is not available need to be managed. The L3 Trackside will normally apply controls or timers to generate safe reactions if communication is lost for too long.

2.8.2 Rules

ENG-LossComms-1 [X2R3 D4.2: ENG-LossComms-1]

The Infrastructure Manager shall establish the value of a mute timer within the L3 Trackside to detect a loss of regular train position reports.

Rationale:

The L3 Trackside needs to establish when a train is not providing sufficient train position reports (possibly due to communications failure) in order to take safe reactions. Since communications can be lost and re-established during normal operation, a suitable delay is required before the L3 Trackside reacts.

Guidance:

The timer is restarted whenever a message is received from a train. The timer expires when the configured value is reached without receipt of a further message. If the timer expires, the L3 Trackside will treat this train as having lost communications. The value of the mute timer will be longer than the variable T_NVCONTACT and less than the communication session expiry, as defined in [SS026]. Use of the mute timer in this range permits a faster reaction to a loss of communications between a train and the L3 Trackside, when compared with waiting for communication session expiry. It should be possible to disable the mute timer if detection of communication session expiry is sufficient. For the mute timer to be applicable, T_NVCONTACT should not be set to infinity and should be significantly less than the communication expiry session time in [SS026], and M_NVCONTACT must not be set to 'no reaction'. If the mute timer is not used, then it is recommended to have a reaction defined for specific M_NVCONTACT, since then the L3 Trackside will be certain that the train has come to a stop by session expiry.

Requirements: REQ-LossComms-1; REQ-LossComms-2

ENG-LossComms-2 [New]

The Infrastructure Manager shall ensure that the reaction to expiry of the session timer (T_NVCONTACT), defined in parameter M_NVCONTACT, is not set to “No Reaction”

Rationale:

In a railway operating using L3, it is important the trains come to a stop if communications are lost.

Guidance:

None

Requirements: None

2.9 Loss of train integrity

2.9.1 Introduction

The L3 Trackside will need to be configured with some information for the processing of Train Integrity.

2.9.2 Rules

ENG-LossTI-1 [X2R3 D4.2: ENG-LossTI-1]

The Infrastructure Manager shall establish the value of the 'Integrity wait' timer used by the L3 Trackside, according to project specific requirements.

Rationale:

The timer enables the L3 Trackside to react when a position report other than ‘No integrity information available’ has not been received within a set time.

Guidance:

The timer will have a special value that means the function is disabled. Configuring this timer to a high value would be similar to disabling the function, whilst a too short value might create unnecessary Unknown areas.

Requirements: REQ-LossTI-4; REQ-LossTI-5

ENG-LossTI-2 [X2R3 D4.2: ENG-LossTI-3]

The Infrastructure Manager shall configure the L3 Trackside to accept confirmation of integrity by the Driver if this is required by the project.

Rationale:

The L3 Trackside must be configured whether or not to accept confirmation of Train Integrity by the Driver.

Guidance:

The L3 Trackside is specified to either accept or ignore train integrity confirmation by the Driver. This must be configured on a project by project basis.

The benefit of accepting confirmation of train integrity by the Driver is that it provides a mechanism for clearing Unknown Track Status Areas behind a train which has not been able to confirm train integrity using an external device, thus avoiding the need for sweeping of the Unknown Track Status Area.

Accepting confirmation of train integrity by the Driver introduces risk into the L3 System, in terms of both the risk of the Driver performing the procedure and the risk of train integrity being confirmed incorrectly.

Requirements: REQ-TrainLoc-9; REQ-MA-9

ENG-LossTI-3 [X2R3 D4.2: ENG-LossTI-4]

The Infrastructure Manager shall configure whether the L3 Trackside authorises a Movement Authority either for a train reporting 'loss of integrity' or a train reporting 'No integrity information available' for longer than the Integrity wait Timer.

Rationale:

Movement of a train without integrity within the L3 area could have significant impact on the operational availability. In some situations, however it may be required, for example to move a train without integrity into a siding.

Guidance

If the L3 Trackside is configured not to authorise an MA for a train unable to confirm integrity, this could cause operational difficulties since this may prohibit a failed train from being moved to a siding – obstructing traffic and disrupting operations. Therefore, projects may decide to apply this rule only for certain areas to limit the operational impact.

Requirements: REQ-MA-9; REQ-LossTI-3

ENG-LossTI-4 [X2R3 D4.2: ENG-LossTI-5]

The reaction the L3 Trackside takes when a train reports loss of integrity, or when there is an assumed loss of integrity due to the integrity wait timer expiring, shall be engineered according to project specific requirements.

Rationale:

Depending on project specific requirements, the L3 Trackside can be configured to take a safe reaction including update the MA, allow the train to reach the end of the MA without extending it, stop the train, protecting other movements, etc.

Guidance:

In considering whether to send an emergency stop message the movement of the train should be considered and whether passengers or staff may be exposed to risk due to an emergency stop or collision of the divided parts of the train. In particular, sending an emergency stop message should be avoided if the train is in RV to escape a, potentially, greater hazard.

The Infrastructure manager may configure the L3 Trackside to utilise additional information (e.g. reported train speed) to determine if the Loss of Integrity is intentional or not. Intentional Loss of Integrity will occur for example when a train is split as part of an operational procedure. An unintentional loss of integrity could be for example the train coupling breaking, or a failure of the TIMS equipment.

The reaction of the L3 Trackside may be configured differently depending on the outcome of this – e.g. only take a reaction if the Loss of Integrity is considered unintentional.

It is important to note though that a reported loss of Integrity may be part of an intentional splitting operation, and so any reaction taken by the L3 Trackside needs to balance safety with operational performance.

Requirements: REQ-LossTI-3

2.10 SR Movement

2.10.1 Introduction

There are scenarios where it may be necessary to move a train in SR mode. For example, if a train does not have a valid position, it will be necessary to let that train move so that it can determine a valid position. Another possible scenario is when a train has a valid position but cannot obtain a Movement Authority and it is necessary to move the train.

The Dispatcher will be requested to validate or enter the value of SR distance. A maximum permitted SR distance should be configured to ensure that the SR distance provided to the train is safe.

2.10.2 Rules

ENG-MovSR-1	[X2R3 D4.2: ENG-MoveSR-1]

The Infrastructure Manager shall determine the maximum distance for SR Authorisation the L3 Trackside is able to authorise.

Rationale:

SR Authorisation is required in order to move trains without a Known Location. All train movements in SR must be protected. Some Infrastructure Managers may determine that limiting the distance for SR Authorisation reduces risk of operational errors.

Guidance:

The operational advantage of moving trains in SR is that it is possible to move trains in degraded situations. Long distances for SR Authorisation may increase the risk of operational errors. This is similar in L2; however, the risk is greater in L3 systems where there may not be TTD to detect a train that has overpassed its intended stopping location.

Requirements: REQ-MovSR-1; REQ-MovSR-3

2.11 Fixed Virtual Block Systems

2.11.1 Introduction

In Fixed Virtual Block designs engineering rules are required to correspond the FVB sections with the control of points. For example, where points are located near boundaries or radio holes.

2.11.2 Rules

ENG-FVB-1	[X2R3 D4.2: ENG-FVB-1]

For systems with FVB, the L3 Trackside shall be engineered such that for FVBs which contain points or crossings, the FVB boundaries are at Release Points associated with the points or crossings.

Rationale:

Release Points are used to release infrastructure such that it can be used for another route. It is therefore logical for these locations to align with the boundaries of Fixed Virtual Blocks, so that clearance of an FVB and releasing of infrastructure are aligned.

Guidance:

Release Points are defined for points and crossings in section 2.13.

It is project specific whether the points area which is also an EoA Exclusion area is covered by a single FVB.

Requirements: None

ENG-FVB-2 [X2R3 D4.2: ENG-FVB-2]

For systems with FVB, the L3 Trackside shall be engineered such that an FVB boundary is at a boundary of the L3 Area.

Rationale:

The L3 Trackside only supervises the Track Status within its boundaries.

Guidance:

None.

Requirements: None

ENG-FVB-3 [X2R3 D4.2: ENG-FVB-3]

For systems with FVB and without TTD, the L3 Trackside shall be engineered such that a Radio Hole is covered and aligned with a single FVB.

Rationale:

The L3 Trackside only needs to supervise a Radio Hole as one FVB section, as the L3 Trackside will not be able to determine FVB status from Train Position Reports within a Radio Hole.

Guidance:

With this engineering rule, the boundaries of the FVB will be aligned with the Radio Hole boundaries.

Additional consideration may be required for preconfigured Temporary Radio Holes.

Requirements: None

ENG-FVB-4 [X2R3 D4.2: ENG-FVB-4]

For a system using Fixed Virtual Blocks, these shall be engineered to align the Trackside Train Detection system boundaries with the Fixed Virtual Block boundaries.

Rationale:

To enable a mixture of trains operating in Level 3 and legacy trains to operate on a line, the L3 Trackside needs to be able to combine the reports received from trains reporting integrity confirmed with information received from the Trackside Train Detection and to enable consistent movement authorisations to be issued.

Guidance:

It is still possible to further subdivide a TTD section into several Virtual Blocks for use with trains operating in Level 3.

This minimises the risk of trains that are unknown to the Level 3 Trackside being able to 'hide' between two communicating ETCS trains and be a danger for the ETCS train authorised into a route already occupied by another ETCS train.

Requirements: None

2.12 Trackside Train Detection (TTD)

2.12.1 Introduction

Engineering rules are required for those moving block system types designed with Trackside Train Detection included.

2.12.2 Rules

ENG-TTD-1	[X2R3 D4.2: ENG-TTD-1]

For systems with TTD, the L3 Trackside shall be engineered such that for TTDs which contain points or crossings, the TTD boundaries are at Release Points associated with the points or crossings.

Rationale:

Release Points are used to release infrastructure such that it can be used for another route. It is therefore logical for these locations to align with the boundaries of TTDs, so that clearance of a TTD and releasing of infrastructure are aligned. TTDs can help release infrastructure more quickly than just relying on Train Position Reports.

Guidance:

As with engineering for a L2 scheme, consideration needs to be taken with the location of TTD boundaries relative to the fouling point to account for vehicle overhang.

Note that projects may have additional constraints in the trackside engineering that may prevent aligning the TTD boundaries with the Release Point location. For example, there may be existing TTD located on the track which cannot be re-engineered so that the Release points are exactly aligned.

Requirements: None

2.13 Points

2.13.1 Introduction

Engineering rules are required for the design of points or other moveable infrastructure, and crossings or other areas where train movements may conflict without moveable infrastructure being positioned close to junctions.

2.13.2 Rules

ENG-PTS-1 [New]

The Infrastructure Manager shall engineer Release Points for points in the L3 Area, to define when points will be released after the passage of a train.

Rationale:

Points will remain locked until a train has cleared the points.

Guidance:

The Release Points must be at or beyond the Fouling Points for the divergences, and at or beyond the Point Toe for convergences, as shown in Figure 2 below.

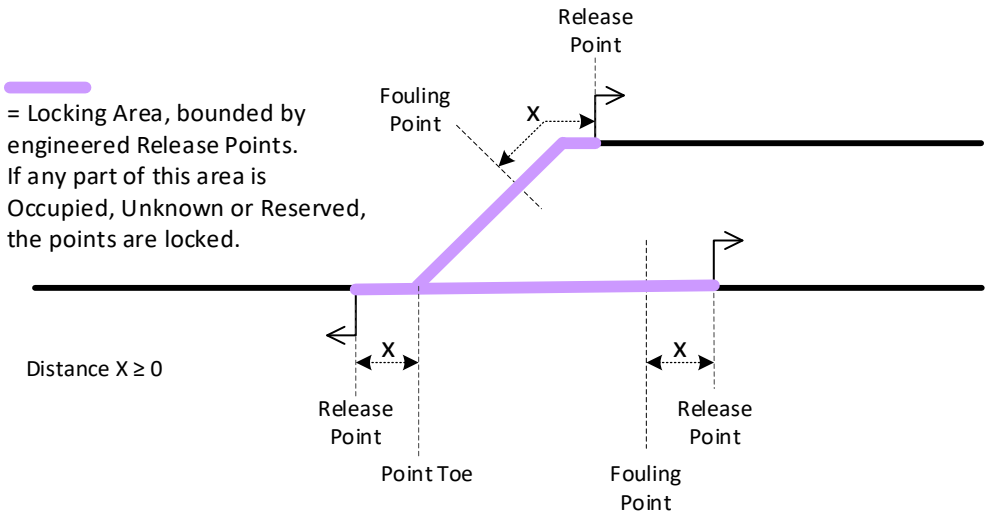

Figure 2: Release Point for Points

The Fouling Points are determined by the topology of the points and the loading gauge, and represent where rail vehicles on the divergent paths would come into contact, as shown in Figure 3.

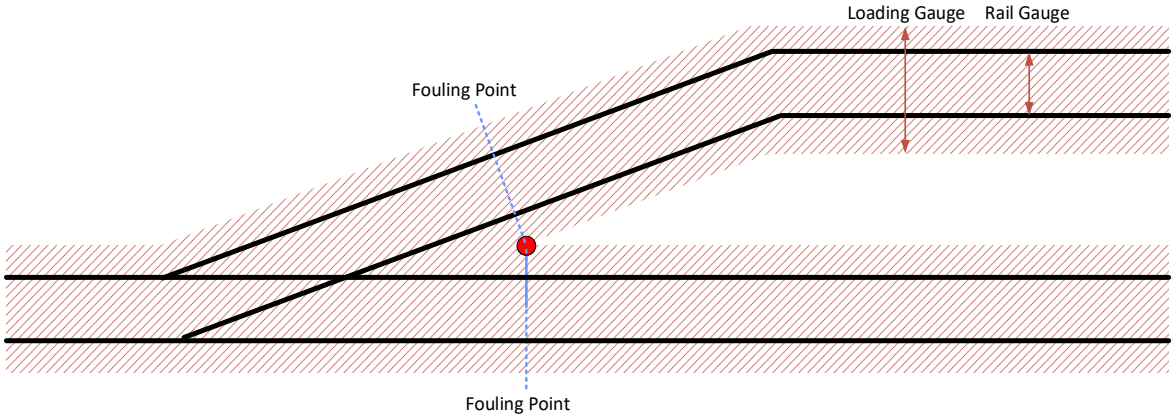

Figure 3: Fouling Points for Points

In order to determine the value of "X" as shown in Figure 2, consideration should be given to the risk of rollback of a train which is stationary, with its rear at a Release Point.

The area bounded by the Release Point will be similar to that which would be bounded by TTD in a traditional signalling system.

For a system with Fixed Virtual Blocks, the Release Points will define Fixed Virtual Block boundaries.

For a system with TTD, if there is a TTD over the Points, this will provide the locking and release.

Requirements: REQ-PTS-1, REQ-PTS-2

ENG-PTS-2 [New]

The Infrastructure Manager shall engineer Release Points for Crossings in the L3 Area, to define when Crossings will be released after the passage of a train.

Rationale:

Crossings will remain locked for using in one direction only, until a train has cleared the Crossing.

Guidance:

The Release Points must be at or beyond the Fouling Points as shown in Figure 4 below.

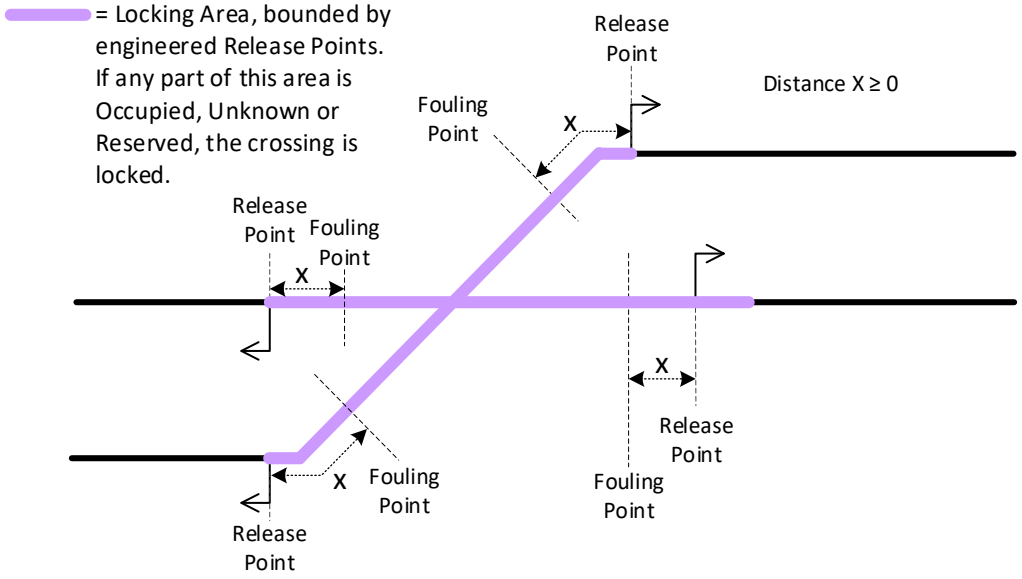

Figure 4: Release Points for Crossing

The Fouling Points are determined by the topology of the crossing and the loading gauge, and represent where rail vehicles on the different paths would come into contact, in a similar manner to points, as shown in Figure 3.

In order to determine the value of "X" as shown in Figure 4, consideration should be given to the risk of rollback of a train which is stationary, with its rear at a Release Point.

The area bounded by the Release Point will be similar to that which would be bounded by TTD in a traditional signalling system.

For a system with Fixed Virtual Blocks, the Release Points will define Fixed Virtual Block boundaries.

For a system with TTD, if there is a TTD over the Crossing, this will provide the locking and release.

Requirements: REQ-PTS-1, REQ-PTS-2

ENG-PTS-3 [New]

The Infrastructure Manager shall engineer Sweeping Points for points in the L3 Area, to define the extent of the point which will be swept by a sweeping train.

Rationale:

A sweeping train which passes successfully confirms that part of the alternate leg of the points is clear.

Guidance:

The Sweeping Points must be at or beyond the Fouling Points for the divergences, and at or beyond the Point Toe for convergences. The Sweeping Points must also be at or within the area defined by Release Points. This is shown in Figure 5 below.

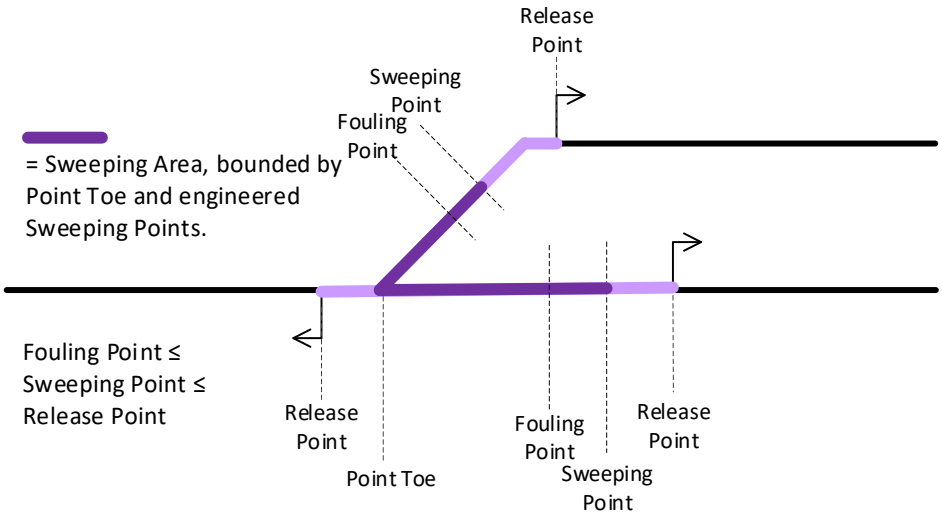

Figure 5: Sweeping Area for Points

The distances between the Fouling Points and the Sweeping Points, and between the Sweeping Points and the Release Points may depend on the Operational Rules for driving with an On Sight Mode Profile.

Requirements: REQ-PTS-4

ENG-PTS-4	[New]

The Infrastructure Manager shall engineer Sweeping Points for Crossings in the L3 Area, to define the extent of the Crossing which will be swept by a sweeping train.

Rationale:

A sweeping train which passes successfully confirms that part of the alternate leg of the Crossing is clear.

Guidance:

The Sweeping Points must be at or beyond the Fouling Points. The Sweeping Points must also be at or within the area defined by Release Points. This is shown in Figure 6 below.

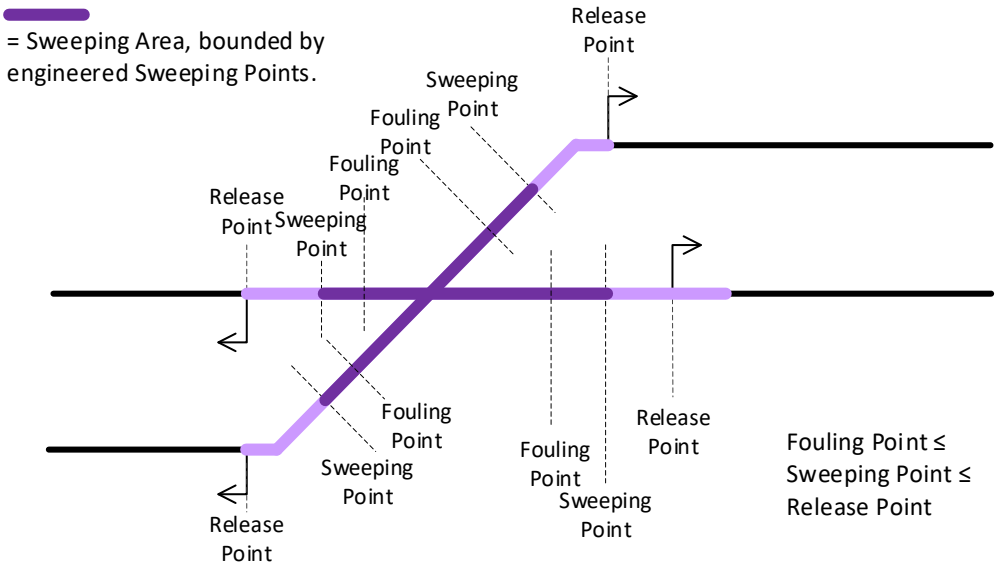

Figure 6: Sweeping Area for Crossing

The distances between the Fouling Points and the Sweeping Points, and between the Sweeping Points and the Release Points may depend on the Operational Rules for driving with an On Sight Mode Profile.

Requirements: REQ-PTS-4

ENG-PTS-5 [New]

For points within the L3 Area, in the case that the Sweeping Points are within the Locking Area, the Infrastructure Manager shall determine whether or not points are able to be moved after the passage of a sweeping train.

Rationale:

A sweeping train which passes successfully confirms that part of the alternate leg of the Crossing is clear. Infrastructure Managers may wish for the points to be moved without an override procedure in this case.

Guidance:

When the Sweeping Points are within the Release Points, a small area of Unknown Track Status Area may remain within the area defined by the Release Points. This would result in the points being locked, and therefore requiring an override to be moved.

Requirements; REQ-PTS-5

2.14 Radio Holes

2.14.1 Introduction

Engineering rules are required for the definition of radio holes.

2.14.2 Rules

ENG-RadioHole-1 [X2R3 D4.2: ENG-RadioHole-2]

The Infrastructure Manager shall engineer pre-defined Temporary Radio Holes which may be activated in the event of failure of communication system elements.

Rationale:

If part of the communications system fails, the Dispatcher needs to be able to instruct the L3 Trackside to not take a reaction if position reports are not received from a train.

Guidance:

The allocation of these Temporary Radio Holes depends on the communications architecture and likely interruptions to service due to failure. Enabled Radio Holes are treated as EoA exclusion areas.

Requirements: REQ-RadioHole-1

ENG-RadioHole-2 [X2R3 D4.2: ENG-RadioHole-3]

The Infrastructure Manager shall engineer for each Radio Hole the time allowed for a train to pass through the Radio Hole before the system reacts by alerting the Dispatcher.

Rationale:

If a train takes an excessive time to pass through a Radio Hole the Dispatcher may need to take other measures to confirm that there has not been an accident, or other reasons for the delay.

Guidance:

The time could be established automatically or by user or Dispatcher input. To avoid unnecessary alerts, it is recommended to use the lowest speed profile through the area reduced by 20% to allow for acceleration, braking and drivabilitydrivability.. When determining the length for a radio hole timer, it must be considered how the L3 trackside determines when a train has entered the radio hole and has left the radio hole. This will be project specific.

Requirements: REQ-RadioHole-4, REQ-RadioHole-6, REQ-RadioHole-7