



EEIG ERTMS Users Group

123-133 Rue Froissart, 1040 Brussels, Belgium

Tel: +32 (0)2 673.99.33 - TVA BE0455.935.830

Website: www.ertms.be E-mail: info@ertms.be

ERTMS USERS GROUP – ENGINEERING GUIDELINE

68. Start of Mission in L2 & L3 (B3)

Reference: 18E120

Version: 3-

Date: 2024-06-28

Modification history

Version	Date	Modification / Description	Editor
0.1	31/07/15	Transfer ERA guideline [ERA_SoM] to EUG template for update to B3	K.K. HAGELAND
0.2	16/09/16	Updated after review (v5.1 on Viadesk)	K.K. HAGELAND
0.3	24/04/17	Updated after discussions and review (v6 on Viadesk)	K.K. HAGELAND
0.4	30/06/17	Updated after review	K.K. HAGELAND
0.5	04/07/17	Updated after discussions in ESG 60	K.K. HAGELAND
0.6	31/01/18	Updated after comments	K.K. HAGELAND
0.7	19/02/18	Updated after comments	K.K. HAGELAND
0.8	23/02/18	For workshop	K.K. HAGELAND
0.9	29/06/18	Reinstated SR hazards. Added Q_SCALE issue	K.K. HAGELAND
0.10	02/07/18	Actions from ESG 68	G. RIDOLFI
0.11	19/10/18	Updated references to hazards. Updated after comments	K.K. HAGELAND
0.12	25/10/18	Updated after comments from Network Rail to 0.9	K.K. HAGELAND
0.13	10/12/18	Updated after final remarks from ESG 69 and discussion in ESG 70	K.K. HAGELAND
1.0	05/02/19	Release of version 1	D. CUESTA
1.1	12/05/2020	Update after UNISIG comments and ESG83	J. ALEXANDE R
1.2	30/10/2020	Update after UNSIG comments and discussion at ESG86	A. JOOS and G. RIDOLFI

1.3	11/01/2021	Updated after ESG87	A. JOOS and G. RIDOLFI
1.4	29/03/2021	Update after ESG88&89 Update against TO 2020 (CR1313)	A. JOOS
1e	24/05/2021	Added pictures on 'Unambiguous train position' and 'trusted area' Update against TO 2020 (CR1313, CR1318 and CR1326) Added clause 7.3.2.7 Modification in the simplified SoM flowchart (1.1.1.7) EUG version referencing format adopted (0a, 0b, 1-, 1a, 1b, etc.)	A. JOOS
1f	29/06/2021	Modifications in simplified SoM flowchart (1.1.1.7) converted into footnotes after ESG92	A. JOOS
1g	19/10/2021	Integration of CR1410 based on comments ESG93	A. JOOS
2-	03/12/2021	Cleaned up for publication	A. JOOS
2a	26/01/2022	Modification to the figure about unambiguous train position	A. JOOS
	14/06/2022	4.1.1.16 and 4.1.1.17 added: train rejection at SoM	A. JOOS
	09/09/2022	4.1.1.16 modified	LBO
2b	2023-05-02	Reference number 19E045 replaced by 18E120 due to duplication	A. Bäämhielm
	2023-05-10	Closed open comments in ESG107	EUG ESG
	2023-10-24	Update on basis of Actions 1177 and 1194	T. Laguérie
2c	2024-01-29	Changing written order by European Instruction, added the 0km/h TSR solution and possibility to send EI7 through ETCS text message	T. Laguérie
	2024-01-29	Updated references (both external and internal) to proper cross-references	A. Baarnhielm
2d	2024-05-27	Corrections to document style and layout and editorial corrections.	A. Bäämhielm
3-	2024-06-28	Official version	C. Zieleman

Table of Contents

1.	Introduction	6
1.1	Foreword	6
1.2	Scope and Field of Application	7
1.3	Document structure	8
2.	References and Abbreviations	9
2.1	Definitions.....	9
2.2	Abbreviations.....	9
2.3	References	10
3.	Start of mission principles	11
4.	Start of mission using MA in Full Supervision.....	13
4.1	Introduction.....	13
4.2	Interaction diagram.....	15
5.	Start of mission using MA with OS mode profile.....	16
5.1	Introduction.....	16
5.2	Interaction diagram.....	16
6.	Start of Mission using Staff Responsible mode	18
6.1	Introduction.....	18
6.2	Interaction diagram	20
7.	SR hazard mitigation.....	22
7.1	Introduction.....	22
7.2	List of hazards	22
7.3	Mitigation by protection of specific location	22
7.3.1	Stop if in SR information.	22
7.3.2	List of expected balises in SR mode (only in level 2/3).....	23
7.3.3	Permitted distance (D_SR) included in SR authorisation from the RBC.	24
7.3.4	Permitted distance to travel in SR mode (D_NVSTFF) in National Values.	24
7.3.5	RBC controlling that an SR movement is protected.....	24
7.4	Protection of speed.....	24
7.4.1	Permitted SR speed.....	24
7.4.2	Temporary speed restriction	25
7.4.3	Avoid entry of too high SR speed.....	25

7.5 Loss of the communication session 25

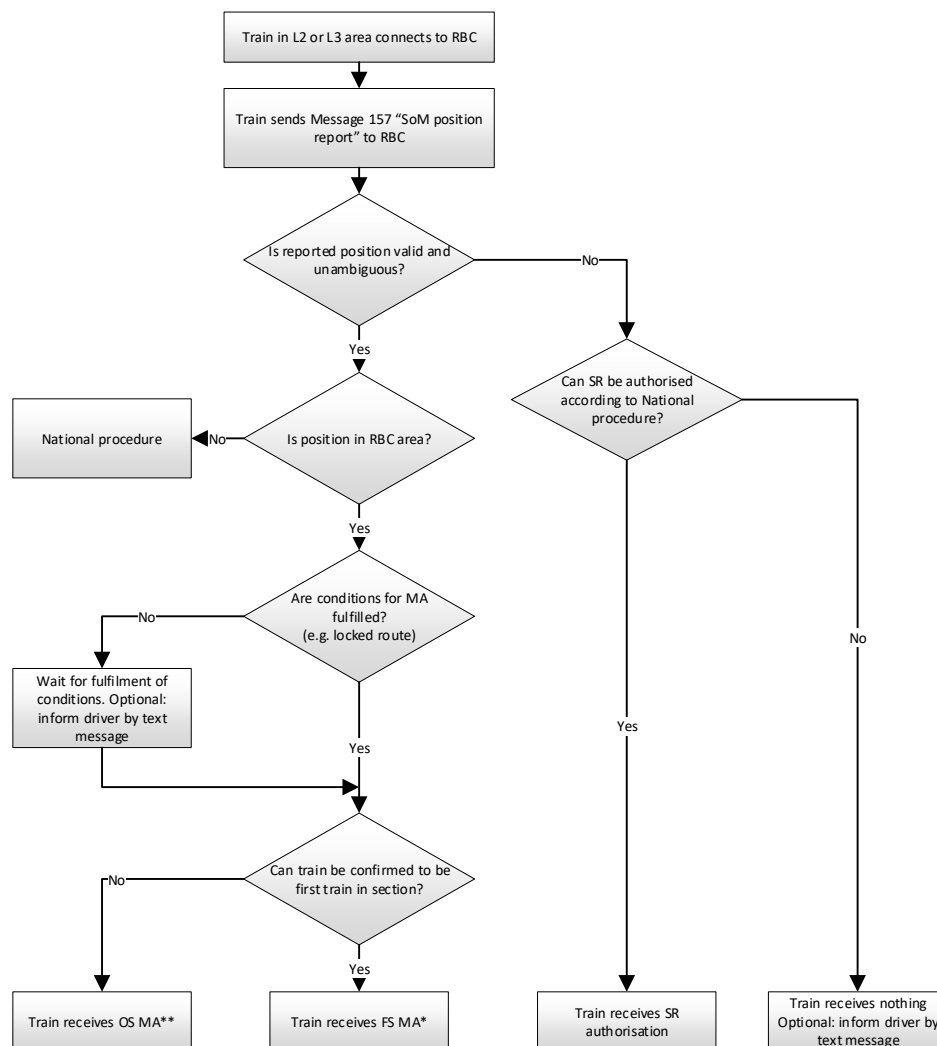
 7.5.1 National rules..... 25

8. Track Ahead Free request 27

1. Introduction

1.1 Foreword

- 1.1.1.1 The procedure of Start of Mission (SoM) in normal operation is defined technically in chapter 5 of the SRS (see SUBSET-026 [1]). This only covers the defined behaviour of the on-board and leaves options for Trackside implementation. Degraded situations are described in particular in section 5.4.5, of the SUBSET-026 [1].
- 1.1.1.2 Operationally, the SoM procedure is defined in ETCS rules sections 6.2, 6.4 and 6.40 (see TSI OPE [2]). Degraded situations may impose a need for non-harmonised rules. The reader is also recommended to read the DMI specification [3] where there are complimentary flow charts for the menus used during SoM.
- 1.1.1.3 Each railway has different historical processes, different types of railways and locations can have differing operational requirements. This affects how the Trackside is required to behave during the SoM process to provide consistent behaviour and information to the Driver. This guideline identifies the issues and scenarios which the Trackside may be required to manage and proposes solutions which may be applied where required by the railway.
- 1.1.1.4 This guideline gives recommendations for the SoM procedure for levels 2 and 3 to provide consistency for the dispatcher and driver both in normal and degraded situations.
- 1.1.1.5 It is assumed that for L3 the same procedure used for L2 is also applicable, however, additional conditions could be necessary according to the different L3 variations (e.g., train integrity information available could be a condition the Radio Block Centre (RBC) considers before providing an authorisation to move the train).
- 1.1.1.6 Figure 1 shows a simplified flowchart of the SoM procedure seen from the RBC. Please see SUBSET-026 [1], 5.4.4 for more details. This flowchart does not consider driver actions but assumes that actions in a nominal SoM procedure are performed.
 - 1.1.1.6.1 Note: The term “simplified flowchart” means that only high-level steps of the process are mentioned (without indicating detailed conditions behind them) and it does not contain the description of the dialogue between the RBC and the on-board.



* the implementation project can always decide to use MA with On Sight mode profile or to use Staff Responsible mode at Start of Mission
 ** Implementation projects can choose to always use SR mode at start of mission for operational reasons

Figure 1: Simplified SoM flowchart

1.1.1.7 This guideline is part of a bundle of guidelines with the Overall ETCS guideline [6] being the main guideline which will redirect the reader to the relevant guidelines. Be aware that the Overall ETCS guideline may also include recommendations which are related to the topics addressed in this guideline.

1.2 Scope and Field of Application

1.2.1.1 It is strongly recommended that any entity using ETCS follow the principles defined in this guideline.

1.2.1.2 This guideline is applicable for ETCS levels 2 and 3 based on ERTMS/ETCS Baseline 3 Release 2, System Version 2.Y.

- 1.2.1.3 This guideline considers the ERA/OPI/2020-2 [4]. In addition, CR1313, CR1318 and CR1326 are identified to have an impact on this guideline and the latter is adapted accordingly.
- 1.2.1.4 The scope of this document is to give recommendations on configuration of the trackside ETCS system to fulfil SoM procedure according to flowchart in chapter 5.4.4 of SUBSET-026 [1].
- 1.2.1.5 Re-authorisation to move after trip and service brake with Movement Authority (MA) shortening at front end of the train is not in the scope of this guideline, but principles will be similar.
- 1.2.1.6 This guideline is applicable for where both trackside and on-board systems use System Version 2.Y.

1.3 Document structure

- 1.3.1.1 Chapter 1 is an introduction to the content of the document
- 1.3.1.2 Chapter 2 provides the abbreviations, definitions and references used in this document.
- 1.3.1.3 Chapter 3 provides generic start of mission principles.
- 1.3.1.4 Chapter 4 provides the guideline for start of mission in level 2/3 using Movement Authority in FS mode.
- 1.3.1.5 Chapter 5 provides the guideline for start of mission in level 2/3 using Movement Authority in OS mode.
- 1.3.1.6 Chapter 6 provides the guideline for start of mission in level 2/3 using SR mode.
- 1.3.1.7 Chapter 7 describes identified hazards for operation in SR mode with mitigations.
- 1.3.1.8 Chapter 8 describes the use of Track Ahead Free request.

2. References and Abbreviations

2.1 Definitions

2.1.1.1 The following table includes terms and definitions which are used in the current document:

Terminology	Definition
Unambiguous position	A valid position reported by the train can still be ambiguous from the RBC point of view, e.g. if there is a set of points between the Last Relevant Balise Group (LRBG) and the train front end. Unambiguous position is defined in this document as a valid position that is unambiguous from the RBC point of view (see also H0003 in SUBSET-113 [5]). Figure 2 shows a non-exhaustive list of examples where a train position seen from trackside is unambiguous.

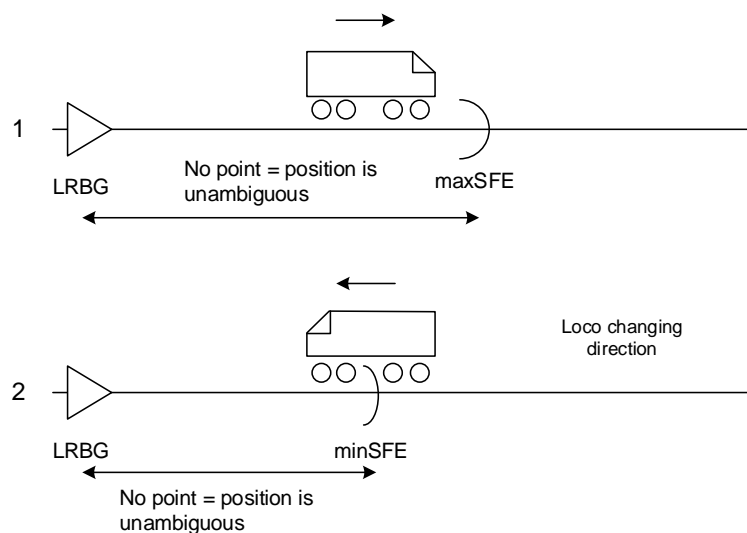


Figure 2: Scenario examples of unambiguous train position

2.2 Abbreviations

2.2.1.1 The following table includes acronyms and abbreviations which are used in the current document:

Abbreviation	Description
IXL	Interlocking
MA	Movement of Authority
RBC	Radio Block Centre

SoM	Start of Mission; procedure for start-up of an ETCS train
TSR	Temporary Speed Restrictions

2.3 References

2.3.1.1 The following documents and versions apply:

Ref. N°	Document Reference	Title	Version
[1]	SUBSET-026	ERTMS/ETCS Class 1 System Requirements Specification	3.6.0
[2]	TSI OPE	ERTMS Operational Principles and Rules, Appendix A to TSI OPE, adopted by Commission Regulation (EU) 2015/995 of 8 June 2015 Amending Decision 2012/757/EU.	4
[3]	ERA_ERTMS_015560	ETCS Driver Machine Interface	3.6.0
[4]	ERA/OPI/2020-2	Opinion of the European Union Agency for Railways to the European Commission regarding error corrections of current ERTMS baselines	2020-05-05
[5]	SUBSET-113	ETCS hazard log	1.4.0
[6]	22E087	Overall ETCS	1-

3. Start of mission principles

- 3.1.1.1 The preferred ETCS mode for all supervised movements is Full Supervision (FS). It is however not possible to always grant FS mode when starting a mission due to lack of information. SoM procedure will then end in On Sight mode (OS) or Staff Responsible mode (SR). OS mode is in general preferred as it ensures train supervision according to route conditions. It is also possible to always use SR mode after SoM for even higher degree of standardisation of procedures, also in degraded situations. This gives a trade-off between simplicity of procedures and degree of train supervision.
- 3.1.1.2 The MA sent at SoM should include track description covering at least the whole train length. If required, the shifted MA reference should be used. This is to avoid message “Entering OS/FS”.
- 3.1.1.2.1 Note: On-boards without CR1318 may introduce the hazardous situation described by ETCS-H0097 in SUBSET-113 [5] after receiving message 33 (MA with shifted location reference) at SoM after changing train orientation.
- 3.1.1.2.2 Note: If an accurate track description is not possible to be provided, e.g. due to a moveable element not known to the RBC, a worst-case track description could be used to ensure that the train is respecting any restrictions that may be present on the infrastructure in the area that it is leaving. Safety of movements over tracks that are not known to the RBC is in the responsibility of National rules.
- 3.1.1.3 Use of different Q_SCALE values on-board and trackside can lead to a misinterpretation of the extent of the track description sent with an MA. This may result in message “Entry in FS/OS” being shown to the driver on the DMI. Possible solutions could be to always send a track description for some distance (meters) in addition to the calculated required distance, or for the RBC to apply the largest Q_SCALE when calculating where to start the track description, always rounding up.
- 3.1.1.3.1 Note: As an example, in Figure 3, the RBC may send an MA with a track description starting at the min safe rear end calculated by $D_LRBG - L_DOUBTOVER - L_TRAIN = 95,1\text{ m}$ with a Q_SCALE of 10 cm. The on-board could calculate the train length calculated with Q_SCALE of 1 m, expecting track description from 95 m to prevent the message “Entry in FS/OS”. The on-board is missing 0,1 m and displays the message.

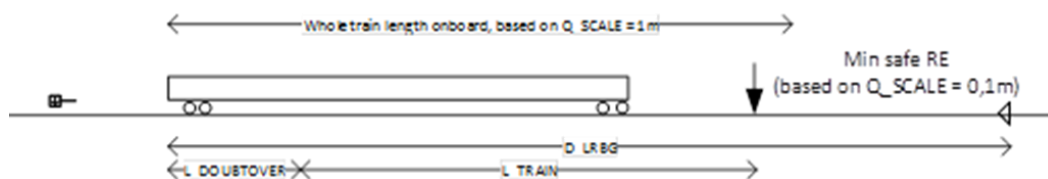


Figure 3: Difference in Q_SCALE value between on-board and trackside

- 3.1.1.4 Engineering and procedures for SoM should aim to transmit an FS MA as soon as possible to the train, while at the same time ensuring transparent and predictable behaviour.
- 3.1.1.4.1 Note: Conditions for FS are not harmonised and can vary according to national engineering rules.
- 3.1.1.5 If the implementation project decides to grant an MA in FS, when possible, refer to chapter 4. If the implementation project decides to always start with MA in OS, refer to chapter 5. If the implementation project decides to always start with movement in SR, please see chapter 6.
- 3.1.1.5.1 Note: Scenarios for degraded situations will lead to transitions from chapter 4 to chapter 5, and subsequently from chapter 5 to chapter 6.
- 3.1.1.6 As the driver is not informed by the on-board if an MA or SR authorisation cannot be sent, a text message can be used to advise the driver and/or the dispatcher on the situation and on further actions to proceed.
- 3.1.1.6.1 Note: Once the driver has selected Start the on-board will wait until the trackside responds with no means to escape the situation as the override button is not selectable. Each implementation should consider if an option for the system to escape the wait loop should be implemented, e.g., to command an MA of zero length from the estimated front end of the train or authorise SR with an SR distance of 0 meters. An MA with a speed restriction (TSR or SSP) of 0 km/h could also be sent.

4. Start of mission using MA in Full Supervision

4.1 Introduction

- 4.1.1.1 This chapter 4 is only applicable if the implementation project decides to grant an MA with FS when possible.
- 4.1.1.2 Whenever possible, a train should receive an MA with FS after SoM.
- 4.1.1.3 Situations will occur where FS is not possible e.g. due to an unknown or ambiguous train position, or because the trackside cannot guarantee that the track between the train and the next Marker Board in the path of the train is not occupied. This is addressed in chapters 5 and 6.
- 4.1.1.4 Trains must have a valid and unambiguous position to achieve FS. It is recommended to have a Cold Movement Detector connected to the on-board unit when this is available on the market to reduce the occurrences of an invalid and/or unknown position.
- 4.1.1.5 To guarantee an unambiguous train position when the SoM is performed close to points, additional engineering methods might be necessary.
- 4.1.1.6 One method to guarantee an unambiguous train position is to implement the concept of a trusted area, visualised in Figure 4. The RBC should be engineered to only send an FS MA to the train if it is located within the trusted area and if the reported position refers to an LRBG within the trusted area.

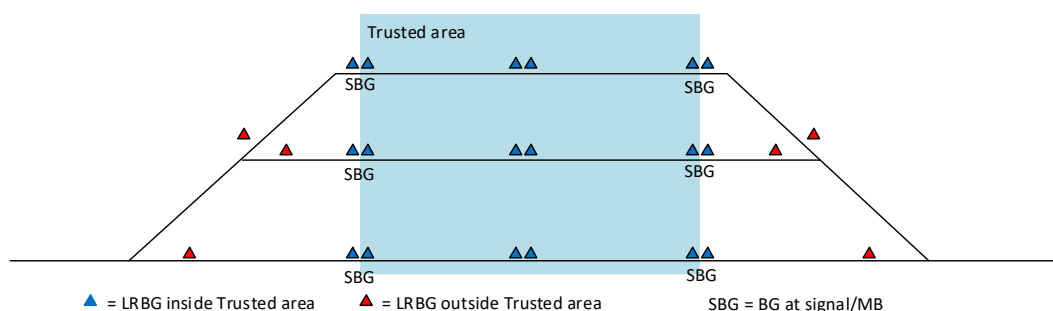


Figure 4: Layout of balise group positioning which determines the trusted area

- 4.1.1.7 If the balise message includes directional information and a balise in the group is not read correctly, the balise message may be rejected, see SUBSET-026 [1] sections 3.16.2.4 and 3.16.2.5. In this situation, the balise group will not become LRBG, according to SUBSET-026 [1] A.3.3.4. It is therefore recommended to use at least one duplicated balise group that includes no directional data or two single balises in order to guarantee an unambiguous train position and to mitigate against balise reading errors or a missed balise.
- 4.1.1.8 Information from the train detection system might help to obtain an unambiguous train position, when a (large) train confidence interval occupies multiple track sections. The RBC can use this information to subtract the portion of the confidence interval which overlaps the track section observed as unoccupied.

- 4.1.1.9 The RBC can also check whether the train confidence interval reported by the train matches the Train Running Number to avoid issuing an MA to a wrong train.
- 4.1.1.9.1 Note: If available, information from the IXL, track vacancy proving system and TMS can enable the RBC to revalidate a position reported as invalid by the on-board.
- 4.1.1.10 Where the system can determine that there is no train between the reported location and the entry to the next route section, then an FS MA can be sent. This requires the correct engineering of routes and track sections to enable the determination that the presence of another train is sufficiently improbable. Information from e.g. a train detection system (detection of conflicting movement) or an RBC (train data of last reported train compared to present train) can be used in addition.
- 4.1.1.10.1 Note: Engineering rules will determine when the reported position can be sufficiently close to the start of the next route section.
- 4.1.1.10.2 Note: Sending track section information on the IXL – RBC interface may not be supported by all suppliers.
- 4.1.1.11 In situations where the system cannot determine if the track ahead up to the first Marker Board is clear, the system should send an MA in OS according to chapter 5.
- 4.1.1.12 As an alternative solution, the Track Ahead Free (TAF) request function can be used. Please see chapter 8.
- 4.1.1.12.1 Note: To advise the driver how to proceed in any deviations from a normal procedure, the RBC can, in addition to any rejection/acceptance, be configured to send a text message during the SoM process. Examples of information to be sent in the text message could include information regarding the location that may be invalid or unknown, or the location is valid but not within the RBC control area. Such information can also be sent to the signaller through the RBC interface or Traffic Management System (TMS). Although text messages may provide useful information on how to proceed in an unexpected situation, use of text messages must be carefully considered due to interoperability reasons.
- 4.1.1.13 Specific situations during SoM may occur where a train reports a valid position with an LRBG outside the RBC area to which the on-board is connected. Since the RBC is not allowed to reject a train with a valid position (Q_STATUS=VALID) according to SUBSET-026 [1] 5.4.4, trackside should either send an order to connect with the RBC that knows the LRBG or send a disconnection order to the on-board. By doing so, according to clause 3.5.3.5.2 of SUBSET-026 [1], the existing communication session with the current RBC will be terminated. Optionally, a text message can be sent to the driver to provide more information.
- 4.1.1.14 The RBC and TMS can be configured as such that an RBC is able to send an order to connect with the right RBC to the train if the LRBG in the position report of the train, is not known by the RBC. The TMS identifies that the LRBG is outside the RBC area.

4.1.1.15 This is particularly of interest near the borders of RBCs with overlapping areas.

4.2 Interaction diagram

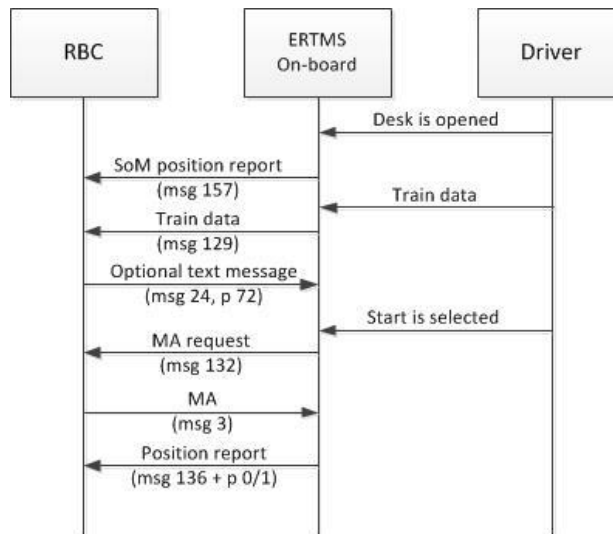


Figure 5: Interaction diagram of SoM procedure in FS

Sequence:

- 1) Driver opens desk and the on-board contacts the RBC including the SoM position report
- 2) Driver enters/validates the train data
- 3) Validated train data is sent to the RBC
- 4) If information is required to be sent to the driver, e.g. about position status, a text message can be sent to a train.
- 5) Driver selects start
- 6) The on-board sends an MA request to the RBC
- 7) The RBC sends an MA (in addition the following information can be sent: National Values, a Level Transition Order containing the list of supported levels and TSR's)
- 8) Train sends a position report to inform about the change to FS mode

5. Start of mission using MA with OS mode profile

5.1 Introduction

- 5.1.1.1 This chapter 5 applies if either the implementation project has decided to always use MA in OS at SoM, or if FS cannot be granted as described in 4.1.1.3.
- 5.1.1.2 In situations where it is not possible to send an MA with FS, OS is the mode that provides the best supervision of the train. After SoM, a train with an unambiguous valid position will receive an MA including an OS mode profile starting from the train front end if the IXL conditions to authorise a movement are fulfilled, e.g. route is locked.
- 5.1.1.3 This solution allows, assuming a route is set for the train, that after SoM the train will move in OS mode to the first Marker Board, and normally from there switch to FS mode.
- 5.1.1.4 To minimise the distance in OS mode when the position is valid, a Marker Board can be positioned a short distance in advance of locations where SoM is likely to occur. Ideally, the starting train has not yet reached the OS speed (National Vvalue) at the Marker Board where the train can change mode to FS.
- 5.1.1.5 For situations where it is not possible to send an MA, e.g., when the position of the train is unknown or ambiguous, it is necessary to use SR mode after SoM. Refer to chapter 6.
- 5.1.1.6 As an alternative solution, the TAF request function can be used. Refer to chapter 8.
 - 5.1.1.6.1 Note: If the train has a large confidence interval, it is possible that the on-board will switch from SB mode to FS mode immediately due to the maximum front end already being in advance of the Marker Board and hence in the FS area. Please consider mitigations described in SUBSET-113 [5], hazard ETCS-H0074.
- 5.1.1.7 In case the large confidence interval is as such that the maximum safe front end remains in the OS mode profile and is not yet in the FS area, the SoM happens in OS, but the transition from OS mode to FS is delayed.

5.2 Interaction diagram

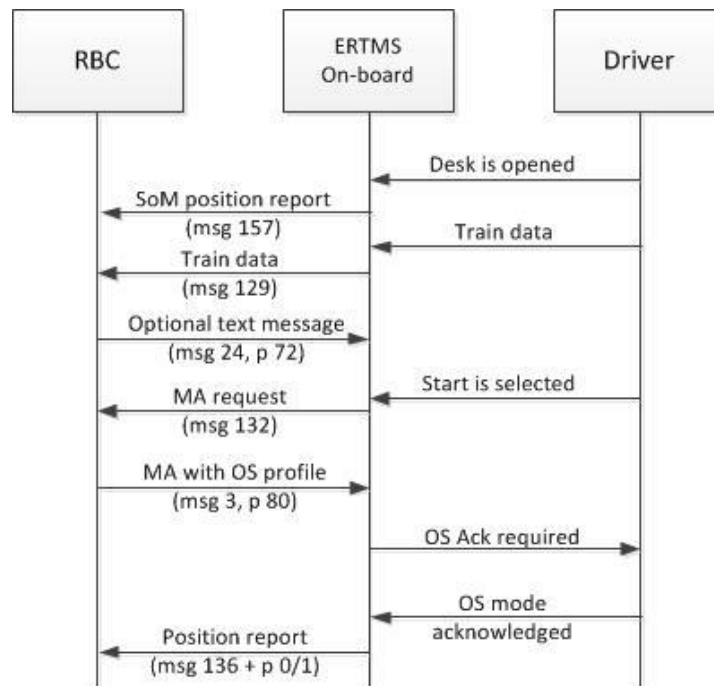


Figure 6: Interaction diagram of SoM procedure in OS

Sequence:

- 1) Driver opens desk and the on-board contacts the RBC including the SoM position report
- 2) Driver enters/validates train data
- 3) Validated train data is sent to the RBC
- 4) If information is required to be sent to the driver, e.g. about position status, a text message can be sent to a train.
- 5) Driver selects start
- 6) The on-board sends an MA request to the RBC
- 7) If either the implementation project has decided to always use MA in OS at SoM, or if FS cannot be granted, the RBC sends an MA in OS if the conditions to send the MA in OS are fulfilled (additional information can be sent in the same message, e.g. National Values, Level Transition Order containing the list of supported levels and TSR's)
- 8) The on-board requires the driver to acknowledge OS mode
- 9) Driver acknowledges OS mode
- 10) Train sends a position report to inform about the change to OS mode

6. Start of Mission using Staff Responsible mode

6.1 Introduction

6.1.1.1 The preferred solution in ETCS due to safety and operational reasons is to start in a mode supporting train supervision according to route status; nevertheless, this is not always possible, e.g. in case of ambiguous position or if a route cannot be set. This chapter provides guidelines for these situations, using SR mode.

6.1.1.1.1 Note: Implementation projects can choose to always use SR mode at SoM for operational reasons.

6.1.1.2 The override procedure should not be used in normal operational situations, and a solution for starting in SR mode should not require the driver to override.

6.1.1.3 The following issues should be considered when authorising SR movement unless a lineside signal is used to authorise the SR movement according to TSI OPE [2]:

- The driver wrongfully believes they have received authorisation (either verbally or by the RBC) and departs without authorisation.
- The dispatcher does not know the real location of the train. Location information could be based on verbal information from the driver which has to be cross checked with information in the traffic management system. The communication between dispatcher and driver and/or the check of traffic management data can fail.
- The dispatcher shall authorise the driver to depart with a European Instruction 7 (see TSI OPE [2]), which is normally a verbal communication which can fail, and the driver shall acknowledge.
- If a Stop Marker must be passed, the dispatcher shall authorise the driver with European Instruction 1 or 7 (see TSI OPE [2]) to pass the Stop Marker. The Dispatcher is responsible to check if the path of the train is clear or secured by a route, introducing risk of human errors. Override may be necessary if a balise with Stop if in SR message is located by the Marker Board.

Failures occurring in any of these issues can cause a wrongful departure of a train. Depending on remaining mitigations and the situation, this could result in a derailment or a collision.

6.1.1.4 Scenarios where the override procedure is necessary because FS/OS/SR authorisation cannot be granted is not covered by this document but will result in using SR to start the mission.

6.1.1.5 Where available, information from the TMS, the RBC and the IXL can be used as additional condition to trigger an SR authorisation from the RBC, mitigating issues identified in 6.1.1.3. Such information can be among others:

- assumed position according to route plan
- train running number according to route plan
- dispatcher entry

- set route
- track occupation
- position information in the RBC (possibly position defined as invalid)

Availability of such information is implementation dependent but mitigates misunderstandings in oral communication between driver and dispatcher.

- 6.1.1.6 If the implementation project has decided to always use SR at the SoM, the RBC should, when the train reports a valid position at specified locations, send SR mode authorisation to the train on receipt of an MA request.
- 6.1.1.6.1 Note: To always use SR is one of the possible solutions that can be implemented when SoM occurs at the border of the RBC area, however this specific scenario is not dealt with this guideline.
- 6.1.1.6.2 Note: It is recommended to send an MA if the train position is valid and unambiguous, and route conditions for the MA are fulfilled.
- 6.1.1.6.3 In case the RBC cannot send an MA (e.g. no route is set, not all the route elements are locked or the train has no valid position), the RBC should send an SR authorisation in response to an MA request, if national conditions for SR authorisation are fulfilled. Note: Example conditions to provide SR authorisation from the RBC: the system assumes that there is a train at the start point of the scheduled route by cross checking the train running number received from the on-board and from the TMS.
- 6.1.1.7 The driver will always need additional authorisation to depart in SR mode either by a European Instruction 7 or a signal aspect, according to TSI OPE [2].
- 6.1.1.8 In normal SoM situations, the use of European Instructions should be avoided mainly due to time consumption and potential misinterpretations during operation.
- 6.1.1.8.1 Note: Information from the TMS regarding the train position and SR authorisation may not be available for all applications.
- 6.1.1.9 Using a “list of balises in SR” (P63) mitigates partly the risk of moving through a different path than the expected one when TMS/dispatcher wrongly gives the system permission to send SR authorisation due to a wrongly assumed position (see also 6.1.1.5). The list of balises in SR also prevents the need to use the override procedure if balises with “Stop if in SR” message are used. Use of balise list together with SR authorisation is recommended.
- 6.1.1.10 Although the SoM procedure is completed before the train starts to move, the main goal is to achieve an MA for the train. When SoM is likely to occur without a valid position, a balise group should be placed in rear of and sufficiently far away from the Marker Board to provide positioning. This will enable the train to obtain a valid position and receive an MA from the RBC before passing the Marker Board. Calculation of this distance is dependent on balise antenna position, processing and reaction times, allowed speed and required braking distance if MA cannot be provided.

- 6.1.1.11 To achieve the protection of specific locations, identified by risk analysis, balises with the information “Stop if in SR” can be used; in addition the RBC can send packet 63 with the list of BG can be passed in SR excluding the last one on the route (which ensures that if train passes over that one still in SR, it will be stopped).
- 6.1.1.11.1 Note: Unless the balise is included in a balise list, balise with “Stop if in SR” will require the driver to override to pass.
- 6.1.1.12 Unauthorised movements in SR can also be stopped by sending unconditional emergency stop message in case such movements are detected. For example using a condition that all movements, including SR movements, shall be protected by at least against conflicting train movements which can occur, or by checking passing direction of balise group in SR mode to detect if movement is in the correct direction.
- 6.1.1.12.1 Note: Using unconditional emergency stop message to stop unauthorised SR moves will only work if the on-board is connected to an RBC.
- 6.1.1.13 For trains changing direction there is a possibility that the train is positioned over a balise group, the position may be interpreted as ambiguous by the RBC. Making use of a different LRBG will mitigate this problem.
- 6.1.1.14 If a train position is not valid and/or is ambiguous, a text message could be sent to inform the driver about the assumed position/set route to verify that it is correct.
- 6.1.1.14.1 Note: This clause only applies if driver is asked to check against the SR authorisation provided by the system; the text message should not contain safety critical details, for instance just the number of the signal.
- 6.1.1.15 If the position of a train in SR is detected to be outside of the area controlled by the RBC there is a possible deadlock situation. This could e.g. be solved by informing the driver, or by the RBC instructing the on-board to connect to the correct RBC.

6.2 Interaction diagram

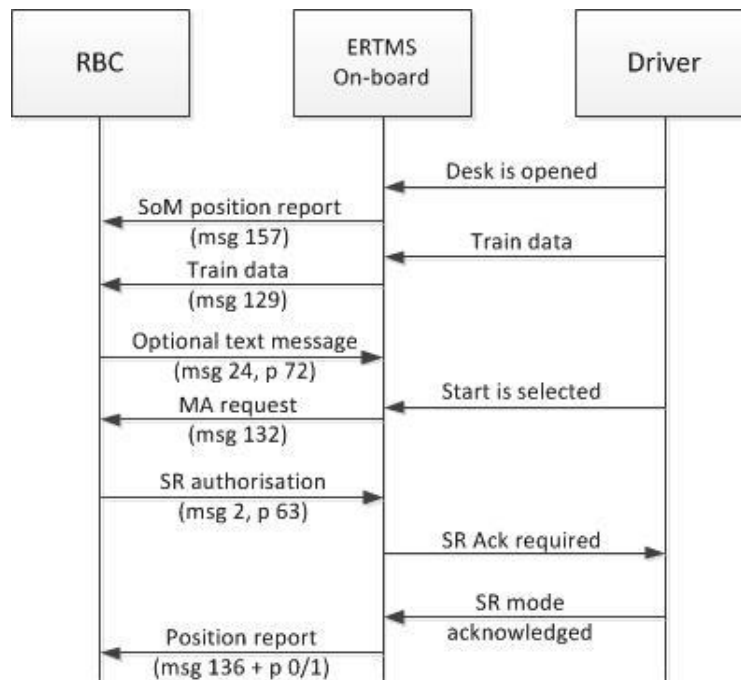


Figure 7: Interaction diagram of SoM procedure in SR

Sequence:

- 1) Driver opens the desk and the on-board contacts the RBC including the SoM position report
- 2) Driver enters/validates train data
- 3) Validated train data is sent to the RBC
- 4) If information is required to be sent to the driver, e.g. about position status, a text message can be sent to a train.
- 5) The Driver selects start
- 6) The on-board sends an MA request to the RBC
- 7) If either the implementation project has decided to always use MA in SR at SoM, or if FS cannot be granted, the RBC cannot reply with an MA, because the conditions for MA in FS or OS are not fulfilled. The RBC sends an SR authorisation in response to an MA request. SR authorisation may be subject to additional approval by e.g. dispatcher. It is recommended to include list of balises to ensure correct positioning and to mask any balises with information "Stop if in SR".
- 8) The on-board requires the driver to acknowledge SR mode
- 9) Lineside signal, the driver will obey the aspect of the signal and applies national operational rule.
- 10) No lineside signal, driver contacts dispatcher to receive European Instruction 7 and applies operational rules according to TSI OPE [2].
- 11) The Driver acknowledges SR mode
- 12) The Train sends a position report to inform about the change to SR mode

7. SR hazard mitigation

7.1 Introduction

- 7.1.1.1 Movements in SR mode introduce several hazards due to the limited supervision of movements whilst in SR.
- 7.1.1.2 Some hazards can be mitigated by engineering, some by operational procedures or by a combination of engineering and procedures.
- 7.1.1.3 This chapter identifies relevant hazards when driving in SR mode, and address mitigations that can be used.

7.2 List of hazards

- 7.2.1.1 The following hazards related to movements in SR are identified.
 - 1) Too long movement due to:
 - a) Driver brakes too late and overshoots the end point.
 - b) Misunderstanding about what is the end point.
 - c) Driver fails to notice stop marker.
 - 2) Movement is authorised for different location than actual location of the train due to misunderstanding on where the train is located.
 - 3) Intentionally wrongful movement.
 - 4) Movement in wrong direction due to confusion on what direction the movement is authorised for.
 - 5) An object in an uncontrolled state (being the reason for moving in SR) fails leading to derailment or collision, e.g., a switch or a moveable bridge.
 - 6) Too high speed due to manual adjustment of allowed speed in SR.
 - 7) Another train movement in the path of the SR movement, e.g. if SR authorisation is wrongfully given for a path in conflict with an MA for another train.

7.3 Mitigation by protection of specific location

7.3.1 Stop if in SR information.

- 7.3.1.1 Balises with the packet of Stop if in SR can be installed in all the specific locations that have to be protected. The train which passes the balises sending this information will be tripped and stopped before the critical location. The speed at which the train can pass these balises shall be considered.
- 7.3.1.2 For operational reasons, these balises are recommended to be located at the signal or the Marker Board such that it is intuitive for the driver and that a trip when running in SR with authorisation is prevented. When a Marker Board passed in SR according to TSI OPE [2] a written order is required and via the override procedure the transition to trip mode is prevented.
- 7.3.1.3 If the balise containing “Stop if in SR” is included in a list of balises sent with the SR authorisation, the “Stop if in SR” is suppressed and no override is necessary. If the train has not received a list of balises, all movements in SR over these balises

will require override. If the train has received a list of balises that cannot be updated e.g. due to radio failure, there is a possibility for a wrongful suppression of the “Stop if in SR” message.

- 7.3.1.4 The location of the “Stop if in SR” balise will result from a safety and operational analysis including needed safety zones to stop the train.
- 7.3.1.5 For on-boards without a communication session established, this is the only protection possible for specific locations.
- 7.3.1.6 For implementations with lineside signals, to minimise the installation of balises, they should be installed only in signals that are able to show a non-proceed aspect. If operationally preferred to avoid the need of override procedure when showing proceed aspect from the lineside signal, switchable balises must be used.
- 7.3.1.7 Balise with Stop if in SR information will mitigate hazards 1), 2) and 4) by stopping the movement when passing the balise.
- 7.3.1.8 Balise with Stop if in SR information will partly mitigate hazard 3) by stopping the movement when passing the balise. However, there is a significant probability that a driver performing an intentionally wrongful movement also will override this message.

7.3.2 List of expected balises in SR mode (only in level 2/3).

- 7.3.2.1 Certain locations can be protected by means of a list of balises in SR mode if there are balise groups in appropriate locations and the train position is known. Once this information has been received, the on-board will be tripped if a balise group is not included in the list is read.
- 7.3.2.2 The solution involves the installation of balises in the specific locations that must be protected. The installation of these balises can be minimised by a safety analysis of the locations where SR movements are likely to occur (e.g., SoM locations).
- 7.3.2.3 List of balises may, if train position is unknown, be based on information coming from a system outside of the ETCS system, e.g. assumed position reported from the TMS.
- 7.3.2.4 This solution is not recommended as a standalone protection because it does not cover the degraded situation in level 2/3 when there is no connection to the RBC. But it could be used as add-on to other mitigations.
- 7.3.2.5 List of expected balises in SR mode will mitigate hazards 1), 2), 3) and 4) by stopping movements over balises that are not in the balise list.
- 7.3.2.6 List of expected balises in SR mode will mitigate hazard 7).
- 7.3.2.6.1 Note: List of expected balises in SR cannot be exchanged between the Handing Over (HOV) RBC and Accepting (ACC) RBC during an RBC-RBC handover (HO) procedure. If this function is to be used, the RBC-RBC HO in locations where SoM regularly take place, should be avoided.

7.3.2.6.2 Note: CR1410 was raised to propose a solution to this issue, but this has not been incorporated into the relevant specifications yet, and as of the date of issue of this guideline document there is no agreed solution.

7.3.3 Permitted distance (D_SR) included in SR authorisation from the RBC.

7.3.3.1 The on-board supervises braking curves with a target speed of zero to the end of the distance included in this packet and trips if it is over passed.

7.3.3.2 This solution would oblige the RBC to process the information of the route in advance to the sending of the SR authorisation. Any updated distance will consider the train position at the moment of sending the position report and will not be accurate if the train is moving.

7.3.3.3 This solution does not cover any scenario in which the location of the train is unknown, nor if the on-board is not connected to an RBC. In the case of a train position different from valid, a location can be assumed based on other systems, but such position will not be accurate. Consequently, this solution is not recommended as a standalone protection.

7.3.3.4 Permitted distance in SR mode will mitigate hazards 1) and 3) by supervising the movement to stop after the defined distance is travelled.

7.3.4 Permitted distance to travel in SR mode (D_NVSTFF) in National Values.

7.3.4.1 The on-board supervises braking curves with a target speed of zero to the end of the distance defined in this value and trips if it is over passed.

7.3.4.2 This distance is generic and hence not according to real danger points in a specific location.

7.3.4.3 Permitted distance in SR mode from National Values will partly mitigate hazard 3) by supervising the movement to stop after the defined distance is travelled.

7.3.5 RBC controlling that an SR movement is protected

7.3.5.1 For level 2/3 with a train communicating to an RBC, the RBC can check the reported position in SR against an allowed route. Properties of such a route must be defined in the IXL and the RBC.

7.3.5.2 A simplified method can be to check the direction of the SR movement. The movement direction can be derived from position reports from the on-board. This will mitigate hazards 1), 2), 3) and 4).

7.4 Protection of speed

7.4.1 Permitted SR speed

7.4.1.1 When the distance between the balise group with Stop if in SR and the danger point is insufficient to stop a train in rear of the danger location, depending on the risk of an unauthorised depart in SR, the permitted SR speed can be lowered in the approach area e.g., with National Value V_NVSTFF, even if the position of the train is unknown.

7.4.1.1.1 Note: This value is retained also if the train is restarted after No Power (NP) mode. A risk with this approach is that the driver will interpret the new ceiling speed as a target rather than a restriction.

7.4.1.2 A low permitted SR speed will limit stress on potentially failed objects, and limit consequences if a derailment occurs.

7.4.1.3 Permitted SR speed will mitigate hazards 1) and 3) by ensuring a low enough speed for the movement to be stopped before a danger point.

7.4.1.4 Permitted SR speed will partly mitigate hazard 5) by reducing speed over the uncontrolled object and by that reducing stress and consequence of failure.

7.4.2 Temporary speed restriction

7.4.2.1 In case there is a speed limitation with a value lower than the permitted SR speed, the RBC could send a TSR with the specific speed value. The on-board will accept this information both in SB and SR modes.

7.4.2.2 When the train starts to move, the most restrictive permitted speed applies. This solution does not cover any scenario in which the location of the train is unknown.

7.4.2.3 Alternatively, the TSR can be sent by balise.

7.4.2.3.1 Note: TSR sent from balise group can be ignored for trains in OS/FS mode either by marking the balise group as linked and not including the balise in the linking information in the MA, or by defining that revocable TSRs from balise shall be inhibited in level 2/3 (packet 64).

7.4.2.4 Use of TSR will mitigate hazards 1) and 3) by ensuring a low enough speed for the movement to be stopped before a danger point.

7.4.2.5 Use of TSR will partly mitigate hazard 5) by reducing speed over the uncontrolled object and by that reducing stress and consequence of failure.

7.4.2.6 For trains that does not implement CR1313, the TSR solution cannot be used if the TSR information is sent via a balise group marked as unlinked and if after the SoM procedure the train position is still unknown. Any information received via balise or RBC is rejected by the on-board equipment (clause 3.6.3.1.3.1 in SUBSET-026 [1]), thus also safety related information like a TSR.

7.4.2.7 Balise group marked as linked can be used to mitigate this problem.

7.4.3 Avoid entry of too high SR speed

7.4.3.1 Only operational procedure can mitigate the hazard induced by a wrong too high setting of allowed SR speed by the driver.

7.5 Loss of the communication session

7.5.1 National rules

7.5.1.1 Permission to run in level 2 with no communication session depends on the national rules. This recommendation only deals with scenarios in which the train is allowed to run in level 2 without a communication session.

- 7.5.1.2 After the on-board unsuccessfully attempts to connect to the RBC, the driver can enter train data, as specified in SUBSET-026 [1] 5.4.5.3 h), and SR will be proposed to the driver. Subsequently, the train will be in level 2 mode SR with no radio connection to the RBC and with the distance and speed allowed to run in SR as defined in the National Values or, if not available, in the default values.
- 7.5.1.3 Only operational procedures for driving distance and speed as described above can mitigate it.

8. Track Ahead Free request

- 8.1.1.1 A mode change from SR or OS to FS can be realised when the RBC can determine in a safe manner that the train is the first to enter a section. This can be determined by the ATAF process when the train is very close to the Marker Board.
- 8.1.1.2 To achieve FS mode earlier than what is achieved with the ATAF process, the RBC can send a TAF request to the on-board unit. It is the responsibility of the driver to confirm that the track is free up to the next Marker Board. When receiving this confirmation, the RBC can send an updated MA allowing FS.
- 8.1.1.3 In case the RBC is not able to determine whether the train is the first to enter a section, the TAF request might not display to the driver when the planning information is toggled on. Consequently, no transition from OS to FS can be performed when trackside relies solely on TAF requests.
- 8.1.1.3.1 Note: CR1326 (error CR included in B4) provides a solution to the issue described in 8.1.1.3.
- 8.1.1.4 Each implementation project must decide if a TAF request shall be used.
- 8.1.1.5 See SUBSET-026 [1], chapter 3.15.5 for more information on TAF functionality.
- 8.1.1.6 A TAF request message sent to a train in SB mode gives no opportunity to the driver to proceed if it cannot be confirmed that the track ahead is free.
- 8.1.1.7 Engineering rules will determine when TAF requests can be sent, e.g. at a location and distance where the driver normally should be able to see the next Marker Board.
- 8.1.1.8 Operational rules will determine what information the driver requires (such as visibility of a Marker Board) to make a safe decision to accept the request.