

ERTMS on SATELLITE Galileo Game Changer

D2.2 Functional and Not Functional Test Specification

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EXECUTIVE SUMMARY

This document has the objective to describe the Functional and Not Functional Test Specification that can be applied to the Enhanced ERTMS Functional Architecture, suitable for the introduction of the GNSS technology and the Virtual Balise concept, as defined in the ERSAT-EAV, NGTC, START, RHINOS Projects, and consolidated in the WP 2 of the ERSAT GGC Project.

While the deliverable D2.1 of the ERSAT GGC Project, “Enhanced Functional ERTMS Architecture Capable of using GNSS and Public Radio TLC Technologies”, defined the consolidated Functional Architecture and the related ERTMS Operational Scenarios, the current document describes the Functional and Not Functional Test Specification applicable to such enhanced architecture. It aims at the specification of the functional and not functional tests required for carrying out the end-to-end validation of systems compliant with D2.1.

This document is the result of the Task 2.2 of ERSAT GGC, and constitute the deliverable D2.2 – “Functional and Not Functional Test Specification”.

This document is the result of several technical notes shared between the partners of the WP 2, and contains both the Test Cases and Test Sequences necessary for carrying out the validation of the system defined in the Enhanced ERTMS Functional Architecture, and the definition of the Laboratory Environment necessary to perform such tests.

The level of detail of the document has been maintained as much as possible the same as the one used for the definition of the Enhanced Functional Architecture described in the deliverable D2.1. When, during the definition of the Test Cases and of the Lab Environment, it emerged the need to define further detailed assumptions not contained in the definition of the Enhanced Architecture, some hypotheses were discussed and realistic assumptions were made. Such assumptions are listed in a specific chapter of the document.



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ACRONYM AND ABBREVIATION

| Acronym | Definition |
|-----------|--|
| ASTS | Ansaldo STS |
| ADC | Analog to Digital Converter |
| ARAIM | Advanced RAIM |
| ATPL | Along Track Protection Level |
| BG | Balise Group |
| BTM | Balise Transmission Module |
| CMD | Cold Movement Detector |
| CRAIM | Carrier phase RAIM |
| CRC | Cyclic Redundancy Check |
| CENELEC | Comité Européen de Normalisation Électrotechnique |
| D | Deliverable |
| DB | Data Base |
| DMI | Driver Machine Interface |
| EDOR | ERTMS Data only Radio |
| EoM | End of Mission |
| ERA | European Railway Agency |
| ERTMS | European Rail Traffic Management System |
| ERSAT GGC | ERTMS on SATELLITE Galileo Game Changer |
| ETCS | European Train Control System |
| EU | European Union |
| EVC | European Vital Computer |
| GAD/TV | GNSS Augmentation Dissemination / Trackside Verification |
| GBAS | Ground-Based Augmentation System |
| GNSS | Global Navigation Satellite System |
| GSM | Global System for Mobile Communications |
| GSM-R | GSM-Railway |
| FS | Full Supervision |
| HA | Hazard Analysis |
| HMI | Human Machine Interface |
| HPL | Horizontal Protection Level |
| IMU | Inertial Measurement Unit |
| IP | Internet Protocol |
| LRBG | Last Relevant Balise Group |
| LS | Limited Supervision |
| MA | Movement Authority |
| MinSFE | Minimum Safe Front End |
| MLCP | Multi-Link Communication Platform |
| MOPS | Minimum Operational Performance Standards |
| MP-TCP | MultiPath TCP |
| NGTC | Next Generation Train Control |
| NP | No Power |
| OS | On Sight |
| OTC | Operational Test Case |
| PBG | Physical Balise Group |



| Acronym | Definition |
|---------|--|
| PVT | Position, Velocity, Time |
| QoS | Quality of Service |
| PR | Position Report |
| RAIM | Receiver Autonomous Integrity Monitoring |
| RBC | Radio Block Centre |
| RBS | Radio Block Section |
| RF | Radio Frequency |
| RHINOS | Railway High Integrity Navigation Overlay System |
| RM | Radio Message |
| SB | Stand-By |
| SBS | Space Based Services for Railway Signalling |
| SFE | Safe Front End |
| SIS | Signal in Space |
| SoM | Start of Mission |
| SR | Staff Responsible |
| STARS | Satellite Technology for Advanced Railway Signalling |
| SV | Satellite Vehicle |
| TCP | Transport Control Protocol |
| THR | Tolerable Hazard Rate |
| TMS | Traffic Management System |
| TMT | Technical Management Team |
| TN | Technical Note |
| UNISIG | Union Industry OF Signalling |
| VB | Virtual Balise |
| VBD | Virtual Balise Detection |
| VBG | Virtual Balise Group |
| VBR | Virtual Balise Reader |
| VBTS | Virtual Balise Transmission System |
| WP | Work Package |

Table 1: Acronym and abbreviation



1. BACKGROUND

In the framework of the Project ERSAT GGC (Grant Agreement No 776039), WP2 is related to the review and the consolidation of the Enhanced ERTMS Functional Architecture, suitable for the introduction of the GNSS technology and the Virtual Balise concept, already used in the frame of 3InSat, ERSAT-EAV, NGTC, STARS, RHINOS projects and RFI ERSAT programme. WP2 has also the objective to define and develop the Functional and Not Functional Test Specification to validate new ERTMS systems, obtained by the instantiation of the above consolidated Enhanced ERTMS Functional Architecture.

In the context of ERSATGGC WP 2, the Task 2.1, concluded in June 2018, defined in the deliverable D2.1 such Enhanced ERTMS Functional Architecture, while the Task 2.2 aimed at the definition of the aforementioned Functional and Not Functional Test Specification. It provided as deliverable D2.2 the current document ("Functional and Not Functional Test Specification"), which describes the specification of the functional and not functional tests required for carrying out the end to end validation of systems compliant with D 2.1.

In order to produce the Functional and Not Functional Test Specification, the following approach has been followed:

- The reference normative for ERTMS/ETC test suites has been analysed, and the applicable documents have been selected ([2]);
- In order to define the test cases required for the validation of systems implementing the Enhanced Functional ERTMS Architecture defined in D2.1, it was necessary to define some additional assumptions, not described in the level of detail of D2.1, but necessary to define in an accurate way the tests to be performed and the related lab environment ([3], [4]);
- The modifications to the ERTMS/ETCS laboratory environment necessary to test a system implementing the new architecture have been identified ([5]);
- Two classes of test cases have been identified as significant for the validation of the new architecture, the first associated to the Operational Scenarios defined in the deliverable D2.1, and the other related to the cross-talk. Subsequently, an analysis of the cross-talk applied to the Virtual Balise concept has been performed ([6]);
- Finally, the test cases and related test sequences have been generated ([7], [8]).

The aim of this document is to complement the existing ERTMS/ETCS test suites with a set of test cases specifically applicable to the validation of the new Enhanced ERTMS Functional Architecture, while the current reference ERTMS/ETC test suites shall be considered still valid. Being the Enhanced Architecture presented in D2.1 designed to allow the ERTMS to operate seamlessly with Virtual Balises, the existing tests applicable to the ERTMS system and to the other components can still be executed without modifications. Similarly, the Public Radio TLC Technologies have been introduced in the Enhanced Architecture defined in D2.1 by maintaining unaltered all the existing interfaces, and by applying the IP-based solution as a layer that is transparent to the current communication protocols, while the integrity of the messages is guaranteed by the existing ERTMS/ETCS safety layers and algorithms. Therefore, the current



ERTMS/ETC test suites aimed at the verification of the communication between the trackside and the on-board constituents are seamlessly applicable to the systems implementing the new architecture, and thus it has not been necessary to include in the current document additional test cases related to the introduction of the Public Radio TLC Technologies.



2. INTRODUCTION

The aim of this document is to identify the Functional and Not Functional Test Specification applicable to the Enhanced Functional ERTMS Architecture Capable of using GNSS and Public Radio TLC Technologies, as defined in the deliverable D2.1 of ERSAT GGC. The current document is the outcome of the ERSAT GGC Task 2.2, and constitute the deliverable D2.2 – “Functional and Not Functional Test Specification”.

Chapter 3 contains the assumptions necessary to complement the deliverable D2.1 in order to define in an accurate way the tests to be performed and the related lab environment.

Chapter 4 concentrates on the high level description of the laboratory environment suitable to perform the tests on the ERTSM/ETCS systems implementing the Enhanced Functional Architecture.

Chapter 5 contains the list of the tests with description which will be executed to validate the systems implementing the Architecture defined in D2.1. It contains the Test Cases and related Test Sequences using the ERA structure already defined for ERTMS.



3. ASSUMPTIONS

From a functional point of view, the implementation of a satellite-based railway system (Trackside Virtual Balises and On-board Virtual Balise Reader) is expected to match the following assumptions:

- **Virtual Balise:**

- The virtual balises are not 'real', each one is one spot on a map, but they will be treated in the same way as physical balises.
- The signalling designer will place virtual balises in the green areas in the same way as it is done for physical balises. This means that the rules to assign the value of the Q_LOCACC parameter is assumed to be the same. It could be seen as the uncertainty in the installation of the balise in combination with the distance between balises, the only thing is that with virtual balises there will not be a real balise on the sleeper, but just a 'mark' on the track. The uncertainty in the case of virtual balises is related to the expected GNSS accuracy in that area.
- The Q_LOCACC concept has to be considered for virtual balises by the VBR, so it has to be exported to the VBR database as well.
- Backwards compatibility will be guaranteed in specifications, so the physical meaning of the variable Q_LOCACC is the same as that related to physical balises.
- The on-board track DB containing the virtual balises is built once the position of the virtual balises has been fixed ('marked') on the track. In the track areas suitable for placing virtual balises (green areas), a survey will be done to obtain the VB coordinates.
- In order to give the directional information, the balise groups with more than one balise are recommended for ERTMS application, independently if the balises are physical or virtual.

- **VBR (Virtual balise Reader):**

- The VBR will calculate the estimated position and compare it with its VB database, to send the corresponding VB telegram to the kernel, together with the virtual balise location accuracy (taking into account the offset position from the GNSS antenna to the Eurobalise antenna, the odometry data and its uncertainty). The position in the track is related to the LRBG.
- The VBR will consider the balise location accuracy (Q_LOCACC_GNSS) as the maximum of the actual virtual balise location accuracy and the variable Q_LOCACC.

$$Q_LOCACC_GNSS = \text{Max} (Q_LOCACC, \text{Virtual Balise Detection Accuracy (in the moment of balise reception)})$$

- The Virtual Balise Reader (VBR) will provide at each balise passage, the balise telegram with location (balise centre and time and odometer stamp) and the final accuracy (Q_LOCACC_GNSS).
- For the calculation of the Confidence Interval it will be necessary to replace the Q_LOCACC already given in packet number 5 with the real value given by the VBR (Q_LOCACC_GNSS). (Note: Q_LOCACC maximum value is limited to 63m).
- In compliance to the backwards compatibility achievements, the VBR will deliver to the EVC Kernel the balise telegram and the Q_LOCACC_GNSS (i.e., the corrected value considering the Q_LOCACC, because the kernel would add the Q_LOCACC).



$Q_LOCACC_GNSS = \text{Max} [(Q_LOCACC, \text{Virtual Balise Detection Accuracy}) - Q_LOCACC]$. Anyway, the implementation will be different for each company.

▪ **Calculation assumptions:**

○ **Confidence Interval**

When the train has run a distance s (measured distance) from the balise group (1), the confidence interval on board is:

Confidence interval = $L_DOUBTUNDER + L_DOUBTOVER =$
 $Q_LOCACC_GNSS + Q_LOCACC + \text{under-reading_amount}$
 $+ Q_LOCACC_GNSS + Q_LOCACC + \text{over-reading_amount}$

Being the under-reading_amount = $\text{tolerance} + \text{error_odo}(\%) * s / 100$

Similar for over-reading_amount = $\text{tolerance} + \text{error_odo}(\%) * s / 100$

$Q_LOCACC(1)$ is substituted by the Q_LOCACC_GNSS uncertainty given by the VBR in that instant. This new mechanism should be good to be implemented inside the VBR.

The error of the VBR (equivalent to the BTM error of $\pm 1\text{m}$) is not included in the onboard tolerance, this concept does not exist for VBR.

○ **Expectation window**

The expectation window to find the next balise group (2) is the interval where the next linked balise group must be found, (taking into account the distance of the antenna to the estimated front end), then the expected window for linking is:

FROM

$(s + L_DOUBTUNDER \geq D_LINK(2) - Q_LOCACC(2))$

TO

$(s - L_DOUBTOVER \leq D_LINK(2) + Q_LOCACC(2))$

Being "s" the estimated distance run from the LRBG to the antenna position.



4. LABORATORY ENVIROMENT

The ERTMS/ETCS on-board equipment based on Virtual Balise Concept will include a Virtual Balise Reader, which will be interfaced with the trackside satellite equipment. This interface is expected to be proved before performing the tests included in Subset-076-6-3, such as stated for the existing interfaces (e.g. Basic Parameters CCS safety characteristics relevant for interoperability, ERTMS/ETCS and GSM-R airgap interfaces On-board interfaces internal to CCS, ERTMS/ETCS DMI and Interface to data recording for regulatory purposes).

To test the new functionalities of Virtual Balises, the Subset-094 'Functional Requirements for an on-board reference Test Facility' has to be updated to include suitable testing architecture that allows the possibility of testing Virtual Balises. It has to be remarked that Subset-094 reference test architecture is focused on performing the tests defined in Subset-076-6-3, this is, it is intended for functional tests of the on-board equipment EVC, to check its compliance with Subset-026.

The following figure from Subset-094 has slightly been modified to show the proposed overview of the ETCS On-board test architecture taking into account the Virtual Balise Reader, considering the available information at the moment. The proposed changes are circled in blue.

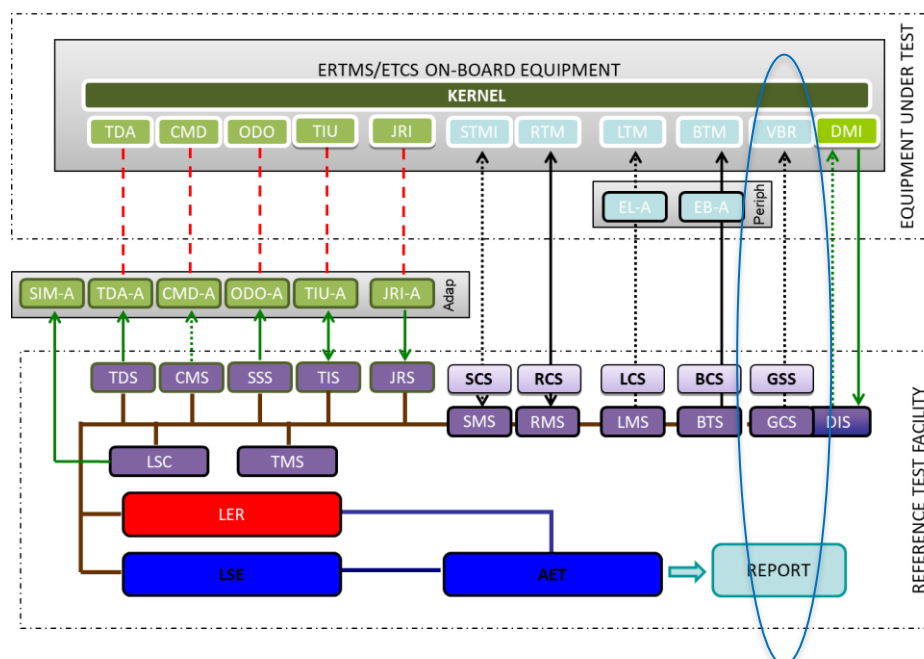


Figure 1: ETCS On-board test architecture taking into account the Virtual Balise Reader

Regarding the testing architecture, the proposal considers a VB Simulator module and its interfaces (to be noticed that they are proposed as optional, similarly to Euroloop). The VB Simulator module proposed consists of:

- GSS: GNSS Signal Simulator, providing the needed raw data for the VBR. The signal from GSS would input directly to the VBR antenna connector;
- GCS: Geographical Coordinates Simulator: generating the geographical coordinates according to both the current position in the track and to the track ground truth. The GCS is connected to GSS, which is in charge of generating the simulation of the satellite signals.



Note1: It is to be clarified that the BTS is expected to generate only the physical balises, not the virtual balises.

Note 2: The VB positions and the time stamp and distance when the train passes the positions of VB locations in the track, shall be recorded in the laboratory for analysis.

Note 3: The new VBR module will be defined in future specifications, analogous to physical Eurobalise modules and interfaces (Subset-036 and Subset-085)



5. TEST CASES

This section contains the test cases that have been created to test a future VB application based on the architecture described in the deliverable D2.1 or ERSAT GGC [1].

There are separated in two parts:

- In order to test the features described in [1], a list of test cases based on the Operational Scenarios have been defined and are included in the section 5.1 ([8]);
- Due to the nature of the Virtual Balise compared to the Physical Balise, the cross-talk has been identified as a main topic to be analysed. Such examination is contained in [2], and based on that analysis specific test cases have been developed and are contained in the section 5.2 ([7]).

5.1 Operational Scenarios

The main engineering rules that are specified for the VB application in document D2.1 are:

1. A limited number of Physical Balises are to be laid within the stations for:
 - a. The initialization of the satellite tracking system (i.e. during the SoM phases) to allow it to safely discriminate the correct track on which the train is located.
 - b. Ensuring the capture and processing of telegrams that contain information related to safety.

The proposed list of operational test scenarios as described in D2.1 are listed below. An additional test case regarding linking has been added. These test cases will have to be adapted for each specific application.

As the interface between the VBR and the EVC is not a standard interface at this moment, no variables are specified for the internal checks that will have to be done and the step is described with text at this stage.

Some more OTC will have to be defined for the onboard database when it is agreed how to load it in the onboard equipment, how to update it and if necessary checks are to be done before starting a mission.



The test cases proposed and its traceability to deliverable D2.1 are listed in the table below:

| OTC No | OTC Title | OTC Objective | Traceability to DEL 2.1 | X |
|--------|---|---|-------------------------|---|
| SoM1 | SoM in L2 with known position. Train is in a terminal station. | The aim of this test case is to verify that the SoM procedure is performed correctly. RBC sends the MA with Shifted location reference (OS or LS and FS) | 5.4.1 5.4.4 (b1) | |
| SoM2 | SoM in L2 with known position. Train is in a terminal or intermediate station. The first Radio Block Section is not available | The aim of this test case is to verify that the SoM procedure is performed properly when the conditions of freedom of the RBC in advance of the train are not satisfied. When the RBC receives a MA request it sends a SR authorisation (set to a minimum distance) only after Override procedure. | 5.4.2 (a) 5.4.4 (a) | |
| SoM3 | SoM in L2 with known position. Train is in a terminal station. The VBR has not completed the track DB uploading | The aim of this test case is to verify that the SoM procedure is performed properly when the VBR has not completed the track DB uploading. When the RBC receives a MA request it sends a SR authorisation (set to a distance, which allows the train movement) only after Override procedure. RBC shall inform the driver and the dispatcher about the reason of the missed MA. | 5.4.2 (b) | |
| SoM4 | SoM in L2 with known position. Train is in an intermediate station | The aim of this test case is to verify that the SoM procedure is performed correctly. RBC sends the MA (OS or LS and FS) | 5.4.3 | |



| OTC No | OTC Title | OTC Objective | Traceability to DEL 2.1 | X |
|--------|---|--|---------------------------------------|------------------|
| SoM5 | SoM in L2 with known position. Train is in the line block equipped only with virtual balises. | The aim of this test case is to verify that the RBC sends a MA to the EVC (OS or LS and FS). When the driver has previously performed an EoM along the line and the previous communication session is considered as closed due to a Safe Connection Failure. | 5.5 | |
| SoM6 | SoM in L2 with unknown position. Train is in a terminal station, intermediate station or with the train in the line block equipped only with virtual balises. | The aim of this test case is to clarify how SoM procedure is performed when the train is in a terminal station and the EVC sends start of mission position report including Q_Status unknown or invalid | 5.6.1 5.6.6 5.6.7 5.4.4 (b2) | |
| SoM7 | SoM in L2 with unknown position. Train is in a terminal station. TMS-RBC connection is available | The aim of this test case is to clarify how SoM procedure is performed when the train is in a terminal station and sends start of mission position report including Q_Status unknown or invalid and the TMS-RBC connection is available. | 5.6.2 | |
| SoM8 | SoM in L2 with unknown position. Train is in a terminal station. TMS-RBC connection is available. Confirmation of the driver of the Signal Id. | The aim of this test case is to clarify how SoM procedure is performed when the EVC sends start of mission position report including Q_Status unknown or invalid and the driver has to acknowledge the Signal Id sent from RBC to the VBR | 5.6.3 | Alternative path |



| OTC No | OTC Title | OTC Objective | Traceability to DEL 2.1 | X |
|--------|--|--|-------------------------|------------------|
| SoM9 | SoM in L2 with unknown position. Train is in a terminal station. TMS-RBC CONNECTION IS NOT AVAILABLE. | The aim of this test case is to clarify how SoM procedure is performed when the train is in a terminal station and sends start of mission position report including Q_Status unknown or invalid and the TMS-RBC connection is not available. | 5.6.4 | |
| SoM10 | SoM in L2 with unknown position. Train is in a terminal station. TMS-RBC CONNECTION IS NOT AVAILABLE. Train position approximation with command from Dispatcher. | The aim of this test case is to verify that the SoM procedure is performed properly when the train position is unknown but there is a command to the Dispatcher to set track. | 5.6.5 | Alternative path |
| LINK1 | Verification of the value of Q_LOCACC for every BG (Physical BG and Virtual BG) and that all balises are read correctly | The aim of this test case is to verify the value of Q_LOCACC is correct for every balise group (Physical BG and Virtual BG) and the balises are read correctly | - | |

Table 2: List of OTCs

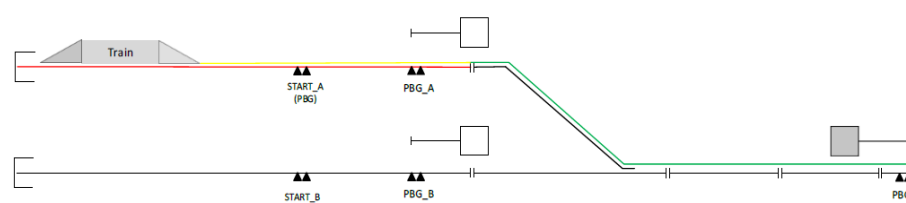


5.1.1 SOM with known position

5.1.1.1 SoM1: SoM in L2 with known position. Train is in a terminal station

This datasheet covers the following cases:

- SoM in L2 with known position. Train is in a terminal station;
- Start of mission in L2 with Q_STATUS "KNOWN". The train proceeds in the opposite direction with respect to the previous Mission (i.e. when arriving on the station platform).

| TEST CASE DESCRIPTION | | | | |
|-----------------------|---|--|---|--|
| | | Code | Version | Title |
| Test Case | | SoM1 | 01 | SoM in L2 with known position. Train is in a terminal station. |
| Baseline applicable | | Baseline 3 | | |
| Test case author | | ... | | |
| Test Objective(s) | | The aim of this test case is to verify that the SoM procedure is performed correctly and that the RBC sends the MA with Shifted location reference to the EVC: <ul style="list-style-type: none">▪ An On-Sight (OS) or a Limited Supervision (LS) profile up to the first signal in advance of the train▪ Full Supervision MA from the first signal in advance of the train up to the last virtual signal where the FS conditions are all fulfilled | | |
| Diagram | |  | | |
| Starting conditions | | Level | 2 | |
| | | Mode | SB | |
| | | Train Speed (km/h) | 0 Km/h | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ Each platform belonging to a Terminal Station is equipped with two physical BGs, one BG aligned with the starting signal and one BG placed near and in rear of the starting signal.▪ The conditions of freedom of the Route in advance of the train position are satisfied.▪ The VBR has successfully completed the update of the Track DB. | |
| Sequence of OTC | | Checkpoints | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | OK? |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | |
| | | DMI(I) | DRIVER ID | |
| | | JRU | | |



| | | | | |
|---|---|--------|---|--|
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection "Connection Up" | |
| | | DMI(I) | | |
| | | JRU | Message 155 Message 32 Message 159 | |
| 3 | EVC sends the SoM Position Report message with valid position. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 157 Q_STATUS = 1 (valid) Packet 0 NID_LRBG ≠ 16777215 Q_DIRLRBG ≠ 2 Q_DLRBG ≠ 2 DMI_SYMB_STATUS ST03 | |
| 4 | RBC checks the SoM PR message and regards as valid. | | RBC receives the SoM PR message and checks that: – No PR variables have Unknown value. – The LRBG of the PR is included in the RBC configuration. The reference BG of the PR received is located in advance of the Min Safe Front End of the train | |
| 5 | The GAD/TV sends the info to select the track. | | The GAD/TV sends to the VBR the information to select the track in not ambiguous way (or an equivalent information which defines the platform) to the VBR, where the train is localized. | |
| 6 | VBR initialized. | | | |
| 7 | Visualization of the train on RBC HMI monitor. | | RBC commands the visualization of the train icon on the RBC HMI Monitor. | |
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | Driver selects Data Entry Driver enters the train running number | |
| | | JRU | Message 129 Packet 11 Packet 0 | |
| 9 | RBC checks the data and sends the acknowledge of Train Data. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 8 M_ACK = 1 | |



| | | | | |
|----|---|--------|---|-----|
| 10 | The EVC sends the acknowledgment. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL | |
| 11 | Driver selects START after receiving from the Dispatcher the authorization to press it. | DMI(O) | | |
| | | DMI(I) | Driver selects Start | |
| | | JRU | M_DRIVERACTION = 19 Message 132 Q_MARQSTREASON =xxxx1 (Start selected by driver) Packet 0 | |
| 12 | The RBC sends a MA with Shifted Location Reference message. | DMI(O) | | ... |
| | | DMI(I) | | |
| | | JRU | Message 33 Packet 15 L_ENDSECTION=L1 (up to last virtual signal where the FS conditions are all fulfilled) Packet 21 Packet 27 Packet 80 D_MAMODE=D1 M_MAMODE=0 (OS) or 2 (LS) L_MAMODE=L2 (up to the first signal in advance of the train) | |
| 13 | The EVC shows the acknowledgment request to OS/LS. | DMI(O) | OS/LS mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO08/MO22 | |
| 14 | Acknowledgement of OS/LS. | DMI(O) | | |
| | | DMI(I) | Acknowledgement of OS/LS mode | |
| | | JRU | M_DRIVERACTIONS = 0/13 | |
| 15 | The EVC switches to OS/LS mode and reports to the RBC the train position. | DMI(O) | OS/LS symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=1/12 DMI_SYMB_STATUS MO07/MO21 Message 136 Packet 0 M_MODE=1/12 | |



| | | | |
|-----------------------|--------------------|---|-----------|
| Final state | Level | | 2 |
| | Mode | | OS/ LS |
| | Train Speed (km/h) | | ... |
| | Other parameters | If the train is equipped with CMD, when it switches in SB mode and no cold movement occurred it is able to re-validated the stored information, that back “Valid” | |
| Final Test Result | (OK or not OK) | | |
| Field of Application | | | |
| Briefing instructions | | | |

Table 3: Test case SoM1



5.1.1.2 SoM2: SoM in L2 with known position. The first Radio Block Section is not available

This datasheet covers the following cases:

- Start of mission in L2 with Q_STATUS “KNOWN” with the first Radio Block Section is not available. Train is in a terminal station;
- Start of mission in L2 with Q_STATUS “KNOWN” with the first Radio Block Section is not available. Train is in an intermediate station.

| TEST CASE DESCRIPTION | | | | |
|-----------------------|---|--|---|---|
| | | Code | Version | Title |
| Test Case | | SoM2 | 01 | SoM in L2 with known position. Train is in a terminal or intermediate station. The first Radio Block section is not available |
| Baseline applicable | | Baseline 3 | | |
| Test case author | | ... | | |
| Test Objective(s) | | The aim of this test case is to verify that the SoM procedure is performed correctly and that the RBC does not send any MA, but sends a SR Authorisation with D_SR set to a minimum distance, sufficient to allow the train movement in SR mode only after Override procedure. | | |
| Diagram | | - | | |
| Starting conditions | | Level | 2 | |
| | | Mode | SB | |
| | | Train Speed (km/h) | 0 Km/h | |
| | | Additional starting conditions | ▪ The first Radio Block section is not available | |
| Sequence of OTC | | Checkpoints | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | OK? |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | |
| | | DMI(I) | DRIVER ID | |
| | | JRU | | |
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection “Connection Up” | |
| | | DMI(I) | | |
| | | JRU | Message 155 Message 32 Message 159 | |



| | | | | |
|----|---|--------|---|--|
| 3 | EVC sends the SoM Position Report message with valid position. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | <p>Message 157 Q_STATUS = 1 (valid) Packet 0 NID_LRBG ≠ 16777215 Q_DIRLRBG ≠ 2 Q_DLRBG ≠ 2</p> <p>DMI_SYMB_STATUS ST03</p> | |
| 4 | RBC checks the SoM PR message and regards as valid. | | <p>RBC receives the SoM PR message and checks that:</p> <ul style="list-style-type: none"> – No PR variables have Unknown value. – The LRBG of the PR is included in the RBC configuration. <p>The reference BG of the PR received is located in advance of the Min Safe Front End of the train</p> | |
| 5 | The GAD/TV sends the info to select the track. | | The GAD/TV sends to the VBR the information to select the track in not ambiguous way (or an equivalent information which defines the platform) to the VBR, where the train is localized. | |
| 6 | VBR initialized. | | | |
| 7 | Visualization of the train on RBC HMI monitor. | | RBC commands the visualization of the train icon on the RBC HMI Monitor. | |
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | <p>Driver selects Data Entry Driver enters the train running number</p> | |
| | | JRU | <p>Message 129 Packet 11 Packet 0</p> | |
| 9 | RBC checks the data and sends the acknowledge of Train Data. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | <p>Message 8 M_ACK = 1</p> | |
| 10 | The EVC sends the acknowledgment. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | <p>Message 146</p> <p>Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL</p> | |



| | | | | |
|-----------------------|--|--------------------|---|-----|
| 11 | Radio Block section is not available. | | The conditions of freedom of the Radio Block Section in advance of the train position are not satisfied (i.e. it is not possible to set and/or lock the departure route within the station) | |
| 12 | The Driver does not selects START. | | The Driver should not receive the authorization from the Dispatcher to press the START button on DMI (operational rule) | |
| 13 | If the Driver selects START. | DMI(O) | | |
| | | DMI(I) | Driver selects Start | |
| | | JRU | M_DRIVERACTION = 19 Message 132 Q_MARQSTREASON =xxxx1 (Start selected by driver) Packet 0 | |
| 14 | The RBC does not send any MA and sends a SR Authorisation | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 2 D_SR = D_NVOVTRP | |
| 15 | The EVC shows the acknowledgment request to SR. | DMI(O) | SR mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO10 | |
| 16 | Acknowledgement of SR. | DMI(O) | | |
| | | DMI(I) | Acknowledgement of SR mode | |
| | | JRU | M_DRIVERACTIONS = 3 | |
| 17 | The EVC switches to SR mode and reports to the RBC the train position. | DMI(O) | SR symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=2 DMI_SYMB_STATUS MO09 Message 136 Packet 0 M_MODE=2 | |
| Final state | | Level | | 2 |
| | | Mode | | SR |
| | | Train Speed (km/h) | | ... |
| | | Other parameters | | |
| Final Test Result | | (OK or not OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

Table 4: Test case SoM2



5.1.1.3 SoM3: SoM in L2 with known position. Train is in a terminal station. The VBR has not completed the track DB uploading

| TEST CASE DESCRIPTION | | | | |
|-----------------------|---|--|---|---|
| | | Code | Version | Title |
| Test Case | | SoM3 | 01 | SoM in L2 with known position. Train is in a terminal station. The VBR has not completed the track DB uploading |
| Baseline applicable | | Baseline 3 | | |
| Test case author | | ... | | |
| Test Objective(s) | | The aim of this test case is to verify that the SoM procedure is performed correctly and that the RBC does not send any MA, but sends a SR Authorisation with D_SR set to a minimum distance, sufficient to allow the train movement in SR mode only after Override procedure. | | |
| Diagram | | - | | |
| Starting conditions | | Level | 2 | |
| | | Mode | SB | |
| | | Train Speed (km/h) | 0 Km/h | |
| | | Additional starting conditions | ▪ The VBR has not completed the track DB uploading | |
| Sequence of OTC | | Checkpoints | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | OK? |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | |
| | | DMI(I) | DRIVER ID | |
| | | JRU | | |
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection “Connection Up” | |
| | | DMI(I) | | |
| | | JRU | Message 155 Message 32 Message 159 | |
| 3 | EVC sends the SoM Position Report message with valid position | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 157 Q_STATUS = 1 (valid) Packet 0 NID_LRBG ≠ 16777215 Q_DIRLRBG ≠ 2 Q_DLRBG ≠ 2 DMI_SYMB_STATUS ST03 | |



| | | | | |
|----|---|--------|---|--|
| 4 | RBC checks the SoM PR message and regards as valid. | | RBC receives the SoM PR message and checks that: <ul style="list-style-type: none"> – No PR variables have Unknown value. – The LRBG of the PR is included in the RBC configuration. The reference BG of the PR received is located in advance of the Min Safe Front End of the train | |
| 5 | The GAD/TV sends the info to select the track. | | The GAD/TV sends to the VBR the information to select the track in not ambiguous way (or an equivalent information which defines the platform) to the VBR, where the train is localized. | |
| 6 | VBR initialized | | | |
| 7 | Visualization of the train on RBC HMI monitor. | | RBC commands the visualization of the train icon on the RBC HMI Monitor. | |
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | Driver selects Data Entry Driver enters the train running number | |
| | | JRU | Message 129 Packet 11 Packet 0 | |
| 9 | RBC checks the data and sends the acknowledge of Train Data. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 8 M_ACK = 1 | |
| 10 | The EVC sends the acknowledgment | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL | |
| 11 | If the Driver selects START | DMI(O) | | |
| | | DMI(I) | Driver selects Start | |
| | | JRU | M_DRIVERACTION = 19 Message 132 Q_MARQSTREASON =xxxx1 (Start selected by driver) Packet 0 | |

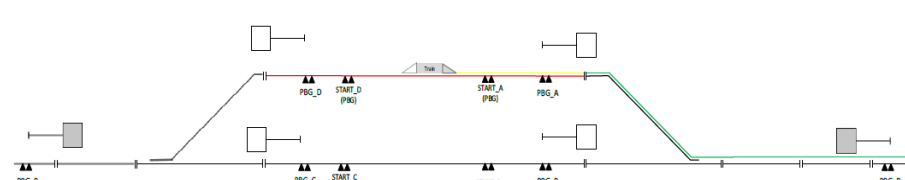


| | | | | |
|-----------------------|---|--------------------|---|-----|
| 12 | The VBR has not completed the track DB uploading | | The Track DB uploading should take few seconds and it is transparent to the driver and Dispatcher | |
| 13 | The RBC does not send any MA and sends a SR Authorisation and a text message to inform the Driver about the reason of the missed MA | DMI(O) | Text message | |
| | | DMI(I) | | |
| | | JRU | Message 2 D_SR = D_NVOVTRP Packet 72 | |
| 14 | RBC inform the Dispatcher (with an alarm on the HMI Monitor) about the reason of the missed MA | | | |
| 15 | The EVC shows the acknowledgment request to SR | DMI(O) | SR mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO10 | |
| 16 | Acknowledgement of SR | DMI(O) | | |
| | | DMI(I) | Acknowledgement of SR mode | |
| | | JRU | M_DRIVERACTIONS = 3 | |
| 17 | The EVC switches to SR mode and reports to the RBC the train position | DMI(O) | SR symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=2 DMI_SYMB_STATUS MO09 Message 136 Packet 0 M_MODE=2 | |
| Final state | | Level | | 2 |
| | | Mode | | SR |
| | | Train Speed (km/h) | | ... |
| | | Other parameters | | |
| Final Test Result | | (OK or not OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

Table 5: Test case SoM3



5.1.1.4 SoM4: SoM in L2 with known position. Train is in an intermediate station

| TEST CASE DESCRIPTION | | | | |
|-----------------------|---|--|---|---|
| | | Code | Version | Title |
| Test Case | | SoM4 | 01 | SoM in L2 with known position. Train is in an intermediate station. |
| Baseline applicable | | Baseline 3 | | |
| Test case author | | ... | | |
| Test Objective(s) | | The aim of this test case is to verify that the SoM procedure is performed correctly and that the RBC sends the MA to the EVC: <ul style="list-style-type: none">▪ An On-Sight (OS) or a Limited Supervision (LS) profile up to the first signal in advance of the train;▪ Full Supervision MA from the first signal in advance of the train up to the last virtual signal where the FS conditions are all fulfilled. | | |
| Diagram | |  | | |
| Starting conditions | | Level | 2 | |
| | | Mode | SB | |
| | | Train Speed (km/h) | 0 Km/h | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ Each platform belonging to an Intermediate Railway Station is equipped with one physical BG aligned to each starting signal.▪ The conditions of freedom of the Route in advance of the train position are satisfied.▪ The VBR has successfully completed the update of the Track DB.▪ There is no switch point that may lead to an alternative route, located between the LRBG and the MaxSFE (with respect to the train orientation). | |
| Sequence of OTC | | Checkpoints | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | OK? |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | |
| | | DMI(I) | DRIVER ID | |
| | | JRU | | |



| | | | | |
|---|---|--------|--|--|
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection "Connection Up" | |
| | | DMI(I) | | |
| | | JRU | Message 155 Message 32 Message 159 | |
| 3 | EVC sends the SoM Position Report message with valid position. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 157 Q_STATUS = 1 (valid) Packet 0 NID_LRBG ≠ 16777215 Q_DIRLRBG ≠ 2 Q_DLRBG ≠ 2 DMI_SYMB_STATUS ST03 | |
| 4 | RBC checks the SoM PR message and regards as valid. | | RBC receives the SoM PR message and checks that: – No PR variables have Unknown value. – The LRBG of the PR is included in the RBC configuration. The reference BG of the PR received is located in rear of the Min Safe Front End of the train | |
| 5 | The GAD/TV sends the info to select the track. | | The GAD/TV sends to the VBR the information to select the track in not ambiguous way to the VRB, where the train is localized. | |
| 6 | VBR initialized. | | | |
| 7 | Visualization of the train on RBC HMI monitor. | | RBC commands the visualization of the train icon on the RBC HMI Monitor. | |
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | Driver selects Data Entry Driver enters the train running number | |
| | | JRU | Message 129 Packet 11 Packet 0 | |
| 9 | RBC checks the data and sends the acknowledge of Train Data. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 8 M_ACK = 1 | |



| | | | | |
|----|--|--------|--|-----|
| 10 | The EVC sends the acknowledgment | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL | |
| 11 | Driver selects START after receiving from the Dispatcher the authorization to press it | DMI(O) | | |
| | | DMI(I) | Driver selects Start | |
| | | JRU | M_DRIVERACTION = 19 Message 132 Q_MARQSTREASON =xxxx1 (Start selected by driver) Packet 0 | |
| 12 | The RBC sends a MA | DMI(O) | | ... |
| | | DMI(I) | | |
| | | JRU | Message 3 Packet 15 L_ENDSECTION=L1 (up to last virtual signal where the FS conditions are all fulfilled) Packet 21 Packet 27 Packet 80 D_MAMODE=D1 M_MAMODE=0 (OS) or 2 (LS) L_MAMODE=L2 (up to the first signal in advance of the train) | |
| 13 | The EVC shows the acknowledgment request to OS/LS | DMI(O) | OS/LS mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO08/MO22 | |
| 14 | Acknowledgement of OS/LS | DMI(O) | | |
| | | DMI(I) | Acknowledgement of OS/LS mode | |
| | | JRU | M_DRIVERACTIONS = 0/13 | |
| 15 | The EVC switches to OS/LS mode and reports to the RBC the train position | DMI(O) | OS/LS symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=1/12 DMI_SYMB_STATUS MO07/MO21 Message 136 Packet 0 M_MODE=1/12 | |



| | | | |
|-----------------------|--------------------|--|-----------|
| Final state | Level | | 2 |
| | Mode | | OS/ LS |
| | Train Speed (km/h) | | ... |
| | Other parameters | | |
| Final Test Result | (OK or not OK) | | |
| Field of Application | | | |
| Briefing instructions | | | |

Table 6: Test case SoM4



5.1.1.5 SoM5: SoM in L2 with known position. Train is in the line block equipped only with virtual balises.

| TEST CASE DESCRIPTION | | | | |
|-----------------------|--|--|---|-----|
| | Code | Version | Title | |
| Test Case | SoM5 | 01 | SoM in L2 with known position. Train is in the line block equipped only with virtual balises. | |
| Baseline applicable | Baseline 3 | | | |
| Test case author | ... | | | |
| Test Objective(s) | The aim of this test case is to verify that the SoM procedure is performed correctly and that the RBC sends the MA to the EVC: <ul style="list-style-type: none">▪ An On-Sight (OS) or a Limited Supervision (LS) profile up to the first signal in advance of the train;▪ Full Supervision MA from the first signal in advance of the train up to the last virtual signal where the FS conditions are all fulfilled. | | | |
| Diagram | | | | |
| Starting conditions | Level | 2 | | |
| | Mode | SB | | |
| | Train Speed (km/h) | 0 Km/h | | |
| | Additional starting conditions | <ul style="list-style-type: none">▪ The Driver has performed an EoM along the line.▪ The previous communication session is considered as closed.▪ RBC considers the line track section as occupied by a not connected train.▪ RBC has stored, during the previous mission, both NID_OPERATIONAL and NID_ENGINE of the train, and then RBC knows that the direction of train is the same of the previous mission.▪ The VBR has successfully completed the update of the Track DB. | | |
| Sequence of OTC | | Checkpoints | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | OK? |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | |
| | | DMI(I) | DRIVER ID | |
| | | JRU | | |



| | | | | |
|---|---|--------|--|--|
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection "Connection Up" | |
| | | DMI(I) | | |
| | | JRU | Message 155 Message 32 Message 159 | |
| 3 | EVC sends the SoM Position Report message with valid position. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 157 Q_STATUS = 1 (valid) Packet 0 NID_LRBG ≠ 16777215 Q_DIRLRBG ≠ 2 Q_DLRBG ≠ 2 DMI_SYMB_STATUS ST03 | |
| 4 | RBC checks the SoM PR message and regards as valid. | | RBC receives the SoM PR message and checks that: – No PR variables have Unknown value. – The LRBG of the PR is included in the RBC configuration. The reference BG of the PR received is located in rear of the Min Safe Front End of the train | |
| 5 | The GAD/TV sends the info to select the track. | | The GAD/TV sends to the VBR the information to select the track in not ambiguous way to the VBR, where the train is localized. | |
| 6 | VBR initialized. | | | |
| 7 | Visualization of the train on RBC HMI monitor. | | RBC commands the visualization of the train icon on the RBC HMI Monitor. | |
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | Driver selects Data Entry Driver enters the train running number | |
| | | JRU | Message 129 Packet 11 Packet 0 | |
| 9 | RBC checks the data and sends the acknowledge of Train Data | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 8 M_ACK = 1 | |



| | | | | |
|----|--|--------|--|--|
| 10 | The EVC sends the acknowledgment. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL | |
| 11 | Driver selects START after receiving from the Dispatcher the authorization to press it | DMI(O) | | |
| | | DMI(I) | Driver selects Start | |
| | | JRU | M_DRIVERACTION = 19 Message 132 Q_MARQSTREASON =xxxx1 (Start selected by driver) Packet 0 | |
| 12 | The RBC sends a MA | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 3 Packet 15 L_ENDSECTION=L1 (up to last virtual signal where the FS conditions are all fulfilled) Packet 21 Packet 27 Packet 80 D_MAMODE=D1 M_MAMODE=0 (OS) or 2 (LS) L_MAMODE=L2 (up to the first signal in f of the train) | |
| 13 | The EVC shows the acknowledgment request to OS/LS | DMI(O) | OS/LS mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO08/MO22 | |
| 14 | Acknowledgement of OS/LS | DMI(O) | | |
| | | DMI(I) | Acknowledgement of OS/LS mode | |
| | | JRU | M_DRIVERACTIONS = 0/13 | |
| 15 | The EVC switches to OS/LS mode and reports to the RBC the train position | DMI(O) | OS/LS symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=1/12 DMI_SYMB_STATUS MO07/MO21 Message 136 Packet 0 M_MODE=1/12 | |



| | | | |
|-----------------------|--------------------|--|-----------|
| Final state | Level | | 2 |
| | Mode | | OS/ LS |
| | Train Speed (km/h) | | ... |
| | Other parameters | | |
| Final Test Result | (OK or not OK) | | |
| Field of Application | | | |
| Briefing instructions | | | |

Table 7: Test case SoM5

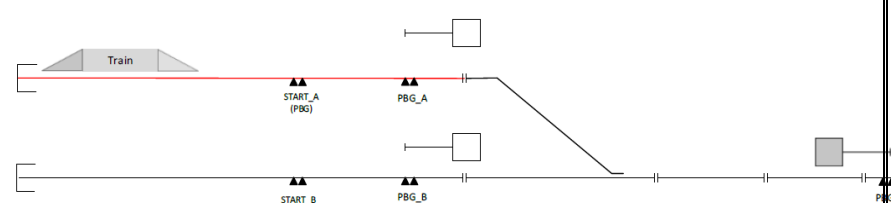
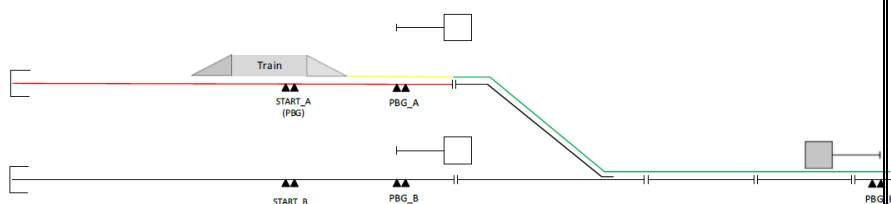


5.1.2 SOM with Q_STATUS “UNKNOWN”

5.1.2.1 SoM6: Nominal case. SoM in L2 with Q_STATUS “UNKNOWN”

This datasheet covers the following cases:

- Nominal case. Start of mission in L2 with Q_STATUS “UNKNOWN” with the train in a terminal station;
- Nominal case. Start of mission in L2 with Q_STATUS “UNKNOWN” with the train in an intermediate station;
- Nominal case. Start of mission in L2 with Q_STATUS “UNKNOWN” with the train in the line block equipped only with virtual balise;
- Start of mission in L2 with Q_STATUS “UNKNOWN”. The train proceeds in the opposite direction with respect to the previous Mission (i.e. when arriving on the station platform).

| TEST CASE DESCRIPTION | | | |
|-----------------------|--|---------|---|
| Test Case | Code | Version | Title |
| SoM6 | 01 | | SoM in L2 with unknown position. Train is in a terminal station, intermediate station or with the train in the line block equipped only with virtual balises. |
| Baseline applicable | Baseline 3 | | |
| Test case author | ... | | |
| Test Objective(s) | <p>The aim of this test case is to verify that the SoM procedure is performed correctly and that the RBC sends the SR Authorization message.</p> <p>The train starts to move and detects the first Physical BG and the RBC sends the MA to the EVC:</p> <ul style="list-style-type: none"> ▪ An On-Sight (OS) or a Limited Supervision (LS) profile up to the first signal in advance of the train ▪ Full Supervision MA from the first signal in advance of the train up to the last virtual signal where the FS conditions are all fulfilled | | |
| Diagram | <p>1°:</p>  <p>2°:</p>  | | |



| | | | | | |
|---------------------|---|--------------------------------|--|--|-----|
| Starting conditions | | Level | 2 | | |
| | | Mode | SB | | |
| | | Train Speed (km/h) | 0 Km/h | | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ Each platform belonging to a Terminal Station is equipped with two physical BGs, one BG aligned with the starting signal and one BG placed near and in rear of the starting signal.▪ RBC considers the platform occupied by a not connected train.▪ The conditions of freedom of the Route in advance of the train position are satisfied.▪ RBC has stored the association between Nid_engine and Track section of the train, and▪ then RBC knows the direction of the train.▪ The VBR has successfully completed the update of the Track DB. | | |
| Sequence of OTC | | Checkpoints | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | | |
| | | DMI(I) | DRIVER ID | | |
| | | JRU | | | |
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection “Connection Up” | | |
| | | DMI(I) | | | |
| | | JRU | Message 155 Message 32 Message 159 | | |
| 3 | EVC sends the SoM Position Report message with Invalid or Unknown position. | DMI(O) | | | |
| | | DMI(I) | | | |
| | | JRU | Message 157 Q_STATUS = 0/2 (Invalid/Unknown) Packet 0 DMI_SYMB_STATUS ST03 | | |
| 4 | RBC checks the SoM PR message | | RBC considers the SoM PR Invalid/unknown, and then RBC considers the train Not Localized. | | |
| 5 | No visualization of the train on RBC HMI monitor | | RBC cannot visualize any train icon on the RBC HMI Monitor. | | |
| 6 | The RBC accepts the train. | DMI(O) | | | |
| | | DMI(I) | | | |
| | | JRU | Message 41 NID_LRBG = 16777215 M_ACK = 1 | | |



| | | | | |
|----|---|--------|---|--|
| 7 | The EVC sends the acknowledgment | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 | |
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | Driver selects Data Entry Driver enters the train running number | |
| | | JRU | Message 129 Packet 11 Packet 0 | |
| 9 | RBC checks the data and sends the acknowledge of Train Data. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 8 M_ACK = 1 | |
| 10 | The EVC sends the acknowledgment. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL | |
| 11 | RBC checking. | | RBC checks that a not connected train is present on the track section and RBC checks that the association between Nid_engine stored and Nid_engine received from the EVC is the same. RBC regards the position of the train as "APPROXIMATE". | |
| 12 | The GAD/TV sends the info to select the track. | | The GAD/TV sends to the VBR the information to select the track in not ambiguous way to the VBR, where the train position is "APPROXIMATE". | |
| 13 | VBR initialized | | | |
| 14 | Driver selects START after receiving from the Dispatcher the authorization to press it. | DMI(O) | | |
| | | DMI(I) | Driver selects Start | |
| | | JRU | M_DRIVERACTION = 19 Message 132 Q_MARQSTREASON =xxxx1 (Start selected by driver) Packet 0 | |



| | | | | |
|----|---|--------|--|--|
| 15 | The RBC does not send any MA and sends a SR Authorisation. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 2 D_SR = infinite Packet 63 NID_BG (1) = Balise of the current RBS. NID_BG (2) = Balise of the RBS in advance. | |
| 16 | The EVC shows the acknowledgment request to SR. | DMI(O) | SR mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO10 | |
| 17 | Acknowledgement of SR | DMI(O) | | |
| | | DMI(I) | Acknowledgement of SR mode | |
| | | JRU | M_DRIVER_ACTIONS = 3 | |
| 18 | The EVC switches to SR mode and reports to the RBC the mode transition | DMI(O) | SR symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=2 DMI_SYMB_STATUS MO09 Message 136 Packet 0 M_MODE=2 | |
| 19 | EVC starts to move and detects the first Physical BG (or the first VBG in case that the train is in the line block equipped only with virtual balises) and reports to the RBC the train position. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 136 Packet 0 NID_LRBG#16777215 Q_DIRLRBG#2 Q_DLRBG#2 | |
| 20 | Visualization of the train on RBC HMI monitor | | RBC regards the EVC as localized and commands the visualization of the train icon on the RBC HMI Monitor. | |

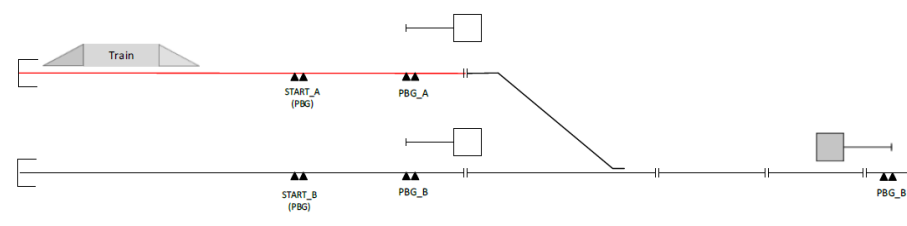
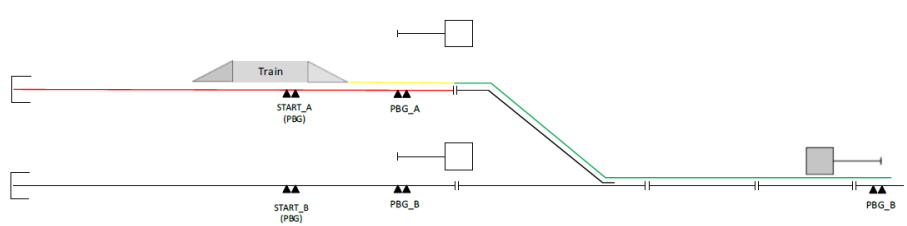


| | | | | |
|-----------------------|--|--------------------|--|-------|
| 21 | The RBC sends a MA | DMI(O) | | ... |
| | | DMI(I) | | |
| | | JRU | Message 3 Packet 15 L_ENDSECTION=L1 (up to last virtual signal where the FS conditions are all fulfilled) Packet 21 Packet 27 Packet 80 D_MAMODE=D1 M_MAMODE=0 (OS) or 2 (LS) L_MAMODE=L2 (up to the first signal in front of the train) | |
| 22 | The EVC shows the acknowledgment request to OS/LS | DMI(O) | OS/LS mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO08/MO22 | |
| 23 | Acknowledgement of OS/LS | DMI(O) | | |
| | | DMI(I) | Acknowledgement of OS/LS mode | |
| | | JRU | M_DRIVERACTIONS = 0/13 | |
| 24 | The EVC switches to OS/LS mode and reports to the RBC the train position | DMI(O) | OS/LS symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=1/12 DMI_SYMB_STATUS MO07/MO21 Message 136 Packet 0 M_MODE=1/12 | |
| Final state | | Level | | 2 |
| | | Mode | | OS/LS |
| | | Train Speed (km/h) | | ... |
| | | Other parameters | | |
| Final Test Result | | (OK or not OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

Table 8: Test case SoM6



5.1.2.2 SoM7: SoM in L2 with Q_STATUS “UNKNOWN” with the train in a terminal station. TMS-RBC connection available.

| TEST CASE DESCRIPTION | | | |
|-----------------------|--|---------|---|
| | Code | Version | Title |
| Test Case | SoM7 | 01 | SoM in L2 with unknown position. Train is in a terminal station. TMS-RBC CONNECTION IS AVAILABLE. |
| Baseline applicable | Baseline 3 | | |
| Test case author | ... | | |
| Test Objective(s) | <p>The aim of this test case is to verify that the SoM procedure is performed correctly and that the RBC sends the SR Authorization message.</p> <p>The train starts to move and detects the first Physical BG and the RBC sends the MA to the EVC:</p> <ul style="list-style-type: none"> An On-Sight (OS) or a Limited Supervision (LS) profile up to the first signal in advance of the train - Full Supervision MA from the first signal in advance of the train up to the last virtual signal where the FS conditions are all fulfilled | | |
| Diagram | <p>1^o:</p>  <p>2^o:</p>  | | |



| | | | | | | |
|---------------------|---|--------------------------------|---|--|-----|--|
| Starting conditions | | Level | 2 | | | |
| | | Mode | SB | | | |
| | | Train Speed (km/h) | 0 Km/h | | | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ Each platform belonging to a Terminal Station is equipped with two physical BGs, one BG aligned with the starting signal and one BG placed near and in rear of the starting signal.▪ The conditions of freedom of the Route in advance of the train position are satisfied.▪ RBC is not able to associate the track with train NID_ENGINE▪ The VBR has successfully completed the update of the Track DB.▪ TMS-RBC connection is available. | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | | | |
| | | DMI(I) | DRIVER ID | | | |
| | | JRU | | | | |
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection “Connection Up” | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 155 Message 32 Message 159 | | | |
| 3 | EVC sends the SoM Position Report message with Invalid or Unknown position. | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 157 Q_STATUS = 0/2 (Invalid/Unknown) Packet 0 DMI_SYMB_STATUS ST03 | | | |
| 4 | RBC checks the SoM PR message | | RBC considers the SoM PR Invalid/unknown, and then RBC considers the train Not Localized. | | | |
| 5 | No visualization of the train on RBC HMI monitor | | RBC cannot visualize any train icon on the RBC HMI Monitor. | | | |
| 6 | The RBC accepts the train. | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 41 NID_LRBG = 16777215 M_ACK = 1 | | | |
| 7 | The EVC sends the acknowledgment | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 146 | | | |



| | | | | |
|----|---|--------|--|--|
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | Driver selects Data Entry Driver enters the train running number | |
| | | JRU | Message 129 Packet 11 Packet 0 | |
| 9 | RBC checks the data and sends the acknowledge of Train Data. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 8 M_ACK = 1 | |
| 10 | The EVC sends the acknowledgment. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL | |
| 11 | RBC checking. | | RBC checks that a NID_OPERATIONAL received by the TMS is the same reported by the EVC and RBC checks that the track section associated to the NID_OPERATIONAL received by the TMS is considered, by the RBC, occupied by a not connected train. RBC notifies to GAD/TV the information related to the not ambiguous train position | |
| 12 | The GAD/TV sends the info to select the track. | | The GAD/TV sends to the VBR the information to select the track in not ambiguous way to the VBR, according to the information received by the TMS. | |
| 13 | RBC checking. | | RBC regards the position of the train as "APPROXIMATE". | |
| 14 | VBR initialized | | | |
| 15 | Driver selects START after receiving from the Dispatcher the authorization to press it. | DMI(O) | | |
| | | DMI(I) | Driver selects Start | |
| | | JRU | M_DRIVERACTION = 19 Message 132 Q_MARQSTREASON =xxxx1 (Start selected by driver) Packet 0 | |



| | | | | |
|----|--|--------|--|-----|
| 16 | The RBC does not send any MA and sends a SR Authorisation. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 2 D_SR = infinite Packet 63 NID_BG (1) = Balise of the current RBS. NID_BG (2) = Balise of the RBS in advance. | |
| 17 | The EVC shows the acknowledgment request to SR. | DMI(O) | SR mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO10 | |
| 18 | Acknowledgement of SR | DMI(O) | | |
| | | DMI(I) | Acknowledgement of SR mode | |
| | | JRU | M_DRIVER_ACTIONS = 3 | |
| 19 | The EVC switches to SR mode and reports to the RBC the mode transition | DMI(O) | SR symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=2 DMI_SYMB_STATUS MO09 Message 136 Packet 0 M_MODE=2 | |
| 20 | EVC starts to move and detects the first Physical BG and reports to the RBC the train position | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 136 Packet 0 NID_LRBG#16777215 Q_DIRLRBG#2 Q_DLRBG#2 | |
| 21 | Visualization of the train on RBC HMI monitor | | RBC regards the EVC as localized and commands the visualization of the train icon on the RBC HMI Monitor. | |
| 22 | The RBC sends a MA | DMI(O) | | ... |
| | | DMI(I) | | |
| | | JRU | Message 3 Packet 15 L_ENDSECTION=L1 (up to last virtual signal where the FS conditions are all fulfilled) Packet 21 Packet 27 Packet 80 D_MAMODE=D1 M_MAMODE=0 (OS) or 2 (LS) L_MAMODE=L2 (up to the first signal in front of the train) | |
| 23 | The EVC shows the acknowledgment request to OS/LS | DMI(O) | OS/LS mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO08/MO22 | |

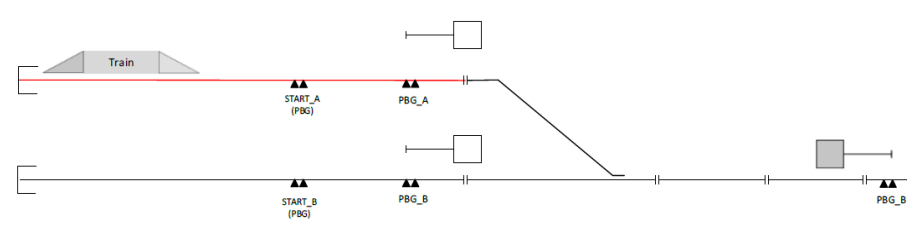
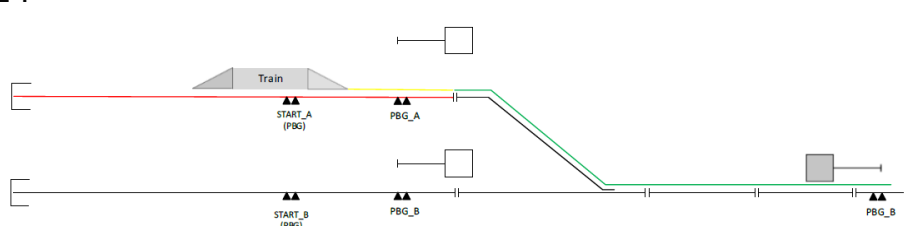


| | | | | |
|-----------------------|--|--------------------|---|-------|
| 24 | Acknowledgement of OS/LS | DMI(O) | | |
| | | DMI(I) | Acknowledgement of OS/LS mode | |
| | | JRU | M_DRIVERACTIONS = 0/13 | |
| 25 | The EVC switches to OS/LS mode and reports to the RBC the train position | DMI(O) | OS/LS symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=1/12 DMI_SYMB_STATUS MO07/MO21 Message 136 Packet 0 M_MODE=1/12 | |
| Final state | | Level | | 2 |
| | | Mode | | OS/LS |
| | | Train Speed (km/h) | | ... |
| | | Other parameters | | |
| Final Test Result | | (OK or not OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

Table 9: Test case SoM7



5.1.2.3 SoM8: SoM in L2 with Q_STATUS “UNKNOWN” with the train in a terminal station. TMS-RBC connection available and with confirmation from the driver of the Signal Id.

| TEST CASE DESCRIPTION | | | |
|-----------------------|--|---|-------|
| Test Case | Code | Version | Title |
| SoM8 | 01 | SoM in L2 with unknown position. Train is in a terminal station. TMS-RBC CONNECTION IS AVAILABLE. Confirmation of the driver of the Signal Id | |
| Baseline applicable | Baseline 3 | | |
| Test case author | ... | | |
| Test Objective(s) | <p>The aim of this test case is to verify that the SoM procedure is performed correctly and that the RBC sends the SR Authorization message.</p> <p>The train starts to move and detects the first Physical BG and the RBC sends the MA to the EVC:</p> <ul style="list-style-type: none"> An On-Sight (OS) or a Limited Supervision (LS) profile up to the first signal in advance of the train - Full Supervision MA from the first signal in advance of the train up to the last virtual signal where the FS conditions are all fulfilled | | |
| Diagram | <p>1°:</p>  <p>2°:</p>  | | |



| | | | | | | |
|---------------------|---|--------------------------------|---|--|-----|--|
| Starting conditions | | Level | 2 | | | |
| | | Mode | SB | | | |
| | | Train Speed (km/h) | 0 Km/h | | | |
| | | Additional starting conditions | <ul style="list-style-type: none">Each platform belonging to a Terminal Station is equipped with two physical BGs, one BG aligned with the starting signal and one BG placed near and in rear of the starting signal.The conditions of freedom of the Route in advance of the train position are satisfied.RBC is not able to associate the track with train NID_ENGINEThe VBR has successfully completed the update of the Track DB.TMS-RBC connection is available. | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | | | |
| | | DMI(I) | DRIVER ID | | | |
| | | JRU | | | | |
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection “Connection Up” | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 155 Message 32 Message 159 | | | |
| 3 | EVC sends the SoM Position Report message with Invalid or Unknown position. | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 157 Q_STATUS = 0/2 (Invalid/Unknown) Packet 0 DMI_SYMB_STATUS ST03 | | | |
| 4 | RBC checks the SoM PR message | | RBC considers the SoM PR Invalid/unknown, and then RBC considers the train Not Localized. | | | |
| 5 | No visualization of the train on RBC HMI monitor | | RBC cannot visualize any train icon on the RBC HMI Monitor. | | | |
| 6 | The RBC accepts the train. | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 41 NID_LRBG = 16777215 M_ACK = 1 | | | |
| 7 | The EVC sends the acknowledgment | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 146 | | | |



| | | | | |
|----|---|--------|---|--|
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | Driver selects Data Entry Driver enters the train running number | |
| | | JRU | Message 129 Packet 11 Packet 0 | |
| 9 | RBC checks the data and sends the acknowledge of Train Data. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 8 M_ACK = 1 | |
| 10 | The EVC sends the acknowledgment. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL | |
| 11 | RBC checking. | | RBC checks that a NID_OPERATIONAL received by the TMS is the same reported by the EVC and RBC checks that the track section associated to the NID_OPERATIONAL received by the TMS is considered occupied by RBC. | |
| 12 | RBC sends a message to the VBR (as part of text message below) | | A message with the "Signal Id" associated to the Track is sent to the VBR | |
| 13 | RBC sends a plain text message with the "Signal Id" associated to the Track to the EVC. | DMI(O) | Text Message | |
| | | DMI(I) | | |
| | | JRU | Message 24 Packet 72 Q_TEXTCONFIRM = 1 Q_TEXTREPORT = 1 NID_TEXTMESSAGE | |
| 14 | Driver confirms the Text Message and the EVC sends the Text Message Acknowledged by Driver message | DMI(O) | | |
| | | DMI(I) | Driver confirms the Text Message | |
| | | JRU | M_DRIVERACTIONS = 23 Message 158 NID_TEXTMESSAGE | |
| 15 | RBC checking. | | RBC notifies to GAD/TV the information related to the not ambiguous train position | |



| | | | | |
|----|--|--------|--|--|
| 16 | The GAD/TV sends the info to select the track. | | The GAD/TV sends to the VBR the information to select the track in not ambiguous way to the VBR, according to the information received by the TMS. | |
| 17 | RBC checking. | | RBC regards the position of the train as "APPROXIMATE". | |
| 18 | VBR initialized | | | |
| 19 | Driver selects START after receiving from the Dispatcher the authorization to press it. | DMI(O) | | |
| | | DMI(I) | Driver selects Start | |
| | | JRU | M_DRIVERACTION = 19 Message 132 Q_MARQSTREASON =xxxx1 (Start selected by driver) Packet 0 | |
| 20 | The RBC does not send any MA and sends a SR Authorisation. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 2 D_SR = infinite Packet 63 NID_BG (1) = Balise of the current RBS. NID_BG (2) = Balise of the RBS in advance. | |
| 21 | The EVC shows the acknowledgment request to SR. | DMI(O) | SR mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO10 | |
| 22 | Acknowledgement of SR | DMI(O) | | |
| | | DMI(I) | Acknowledgement of SR mode | |
| | | JRU | M_DRIVERACTIONS = 3 | |
| 23 | The EVC switches to SR mode and reports to the RBC the mode transition | DMI(O) | SR symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=2 DMI_SYMB_STATUS MO09 Message 136 Packet 0 M_MODE=2 | |
| 24 | EVC starts to move and detects the first Physical BG and reports to the RBC the train position | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 136 Packet 0 NID_LRBG#16777215 Q_DIRLRBG#2 Q_DLRBG#2 | |
| 25 | Visualization of the train on RBC HMI monitor | | RBC regards the EVC as localized and commands the visualization of the train icon on the RBC HMI Monitor. | |

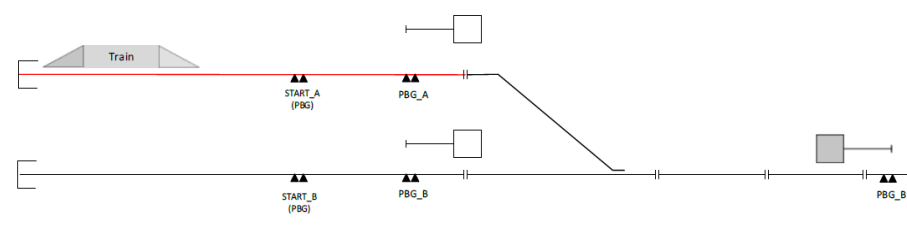
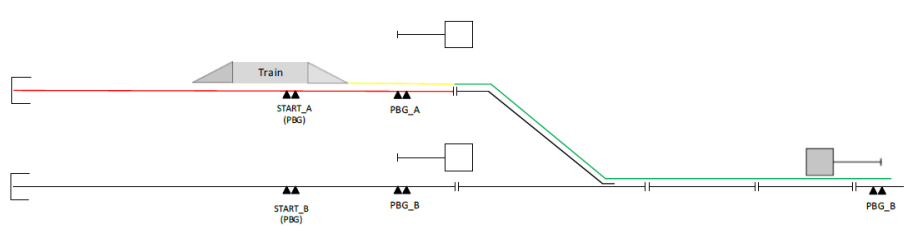


| | | | | |
|-----------------------|--|--------------------|--|-------|
| 26 | The RBC sends a MA | DMI(O) | | ... |
| | | DMI(I) | | |
| | | JRU | Message 3 Packet 15 L_ENDSECTION=L1 (up to last virtual signal where the FS conditions are all fulfilled) Packet 21 Packet 27 Packet 80 D_MAMODE=D1 M_MAMODE=0 (OS) or 2 (LS) L_MAMODE=L2 (up to the first signal in front of the train) | |
| 27 | The EVC shows the acknowledgment request to OS/LS | DMI(O) | OS/LS mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO08/MO22 | |
| 28 | Acknowledgement of OS/LS | DMI(O) | | |
| | | DMI(I) | Acknowledgement of OS/LS mode | |
| | | JRU | M_DRIVERACTIONS = 0/13 | |
| 29 | The EVC switches to OS/LS mode and reports to the RBC the train position | DMI(O) | OS/LS symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=1/12 DMI_SYMB_STATUS MO07/MO21 Message 136 Packet 0 M_MODE=1/12 | |
| Final state | | Level | | 2 |
| | | Mode | | OS/LS |
| | | Train Speed (km/h) | | ... |
| | | Other parameters | | |
| Final Test Result | | (OK or not OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

Table 10: Test case SoM8



5.1.2.4 SoM9: SoM in L2 with Q_STATUS “UNKNOWN” with the train in a terminal station. TMS-RBC connection NOT available.

| TEST CASE DESCRIPTION | | | |
|-----------------------|---|---------|---|
| | Code | Version | Title |
| Test Case | SoM9 | 01 | SoM in L2 with unknown position. Train is in a terminal station. TMS-RBC CONNECTION IS NOT AVAILABLE. |
| Baseline applicable | Baseline 3 | | |
| Test case author | ... | | |
| Test Objective(s) | <p>The aim of this test case is to verify that the SoM procedure is performed and the driver selects Override with the authorization of the Dispatcher.</p> <p>The train starts to move and detects the first Physical BG and the RBC sends the MA to the EVC:</p> <ul style="list-style-type: none"> ▪ An On-Sight (OS) or a Limited Supervision (LS) profile up to the first signal in advance of the train ▪ - Full Supervision MA from the first signal in advance of the train up to the last virtual signal where the FS conditions are all fulfilled | | |
| Diagram | <p>1^o:</p>  <p>2^o:</p>  | | |



| | | | | | | |
|---------------------|---|--------------------------------|---|--|-----|--|
| Starting conditions | | Level | 2 | | | |
| | | Mode | SB | | | |
| | | Train Speed (km/h) | 0 Km/h | | | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ Each platform belonging to a Terminal Station is equipped with two physical BGs, one BG aligned with the starting signal and one BG placed near and in rear of the starting signal.▪ The conditions of freedom of the Route in advance of the train position are satisfied.▪ RBC is not able to associate the track with train NID_ENGINE▪ The VBR has successfully completed the update of the Track DB.▪ TMS-RBC connection is NOT available. | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | | | |
| | | DMI(I) | DRIVER ID | | | |
| | | JRU | | | | |
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection “Connection Up” | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 155 Message 32 Message 159 | | | |
| 3 | EVC sends the SoM Position Report message with Invalid or Unknown position. | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 157 Q_STATUS = 0/2 (Invalid/Unknown) Packet 0 DMI_SYMB_STATUS ST03 | | | |
| 4 | RBC checks the SoM PR message | | RBC considers the SoM PR Invalid/unknown, and then RBC considers the train Not Localized. | | | |
| 5 | No visualization of the train on RBC HMI monitor | | RBC cannot visualize any train icon on the RBC HMI Monitor. | | | |
| 6 | The RBC accepts the train. | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 41 NID_LRBG = 16777215 M_ACK = 1 | | | |
| 7 | The EVC sends the acknowledgment | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 146 | | | |



| | | | | |
|----|---|--------|---|--|
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | Driver selects Data Entry Driver enters the train running number | |
| | | JRU | Message 129 Packet 11 Packet 0 | |
| 9 | RBC checks the data and sends the acknowledge of Train Data. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 8 M_ACK = 1 | |
| 10 | The EVC sends the acknowledgment. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL | |
| 11 | Driver selects OVERRIDE after receiving from the Dispatcher the authorization to press it. | DMI(O) | | |
| | | DMI(I) | Override EoA selected | |
| | | JRU | M_DRIVER_ACTIONS = 14 | |
| 12 | The EVC switches to SR (OV) mode and reports to the RBC the mode transition | DMI(O) | Override EoA symbol Vperm = V_NVSUPOVTRP | |
| | | DMI(I) | | |
| | | JRU | M_MODE = 2 V_PERM = V_NVSUPOVTRP DMI_SYMB_STATUS MO03 Message 136 Packet 0 M_MODE = 2 | |
| 13 | EVC starts to move and detects the first Physical BG and reports to the RBC the train position | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 136 Packet 0 NID_LRBG#16777215 Q_DIRLRBG#2 Q_DLRBG#2 | |
| 14 | VBR initialized | | | |
| 15 | Visualization of the train on RBC HMI monitor | | RBC regards the EVC as localized and commands the visualization of the train icon on the RBC HMI Monitor. | |

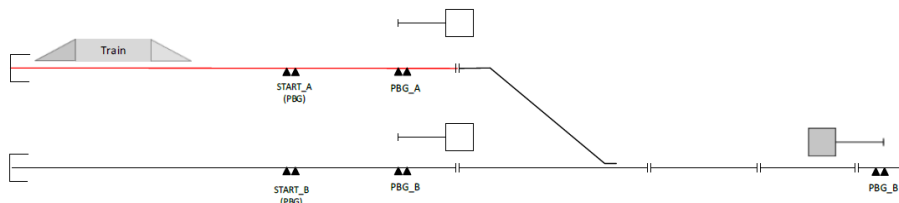
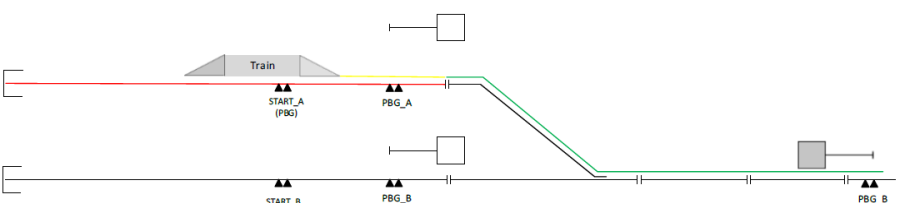


| | | | | |
|-----------------------|--|--------------------|--|-------|
| 16 | The RBC sends a MA | DMI(O) | | ... |
| | | DMI(I) | | |
| | | JRU | Message 3 Packet 15 L_ENDSECTION=L1 (up to last virtual signal where the FS conditions are all fulfilled) Packet 21 Packet 27 Packet 80 D_MAMODE=D1 M_MAMODE=0 (OS) or 2 (LS) L_MAMODE=L2 (up to the first signal in front of the train) | |
| 17 | The EVC shows the acknowledgment request to OS/LS | DMI(O) | OS/LS mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO08/MO22 | |
| 18 | Acknowledgement of OS/LS | DMI(O) | | |
| | | DMI(I) | Acknowledgement of OS/LS mode | |
| | | JRU | M_DRIVERACTIONS = 0/13 | |
| 19 | The EVC switches to OS/LS mode and reports to the RBC the train position | DMI(O) | OS/LS symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=1/12 DMI_SYMB_STATUS MO07/MO21 Message 136 Packet 0 M_MODE=1/12 | |
| Final state | | Level | | 2 |
| | | Mode | | OS/LS |
| | | Train Speed (km/h) | | ... |
| | | Other parameters | | |
| Final Test Result | | (OK or not OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

Table 11: Test case SoM9



5.1.2.5 SoM10: SoM in L2 with Q_STATUS “UNKNOWN” with the train in a terminal station. TMS-RBC connection NOT available and train position approximation with command from dispatcher.

| TEST CASE DESCRIPTION | | | |
|-----------------------|--|---------------|---|
| Test Case | Code SoM10 | Version 01 | Title SoM in L2 with unknown position. Train is in a terminal station. TMS-RBC CONNECTION IS NOT AVAILABLE. Train position approximation with command from Dispatcher. |
| Baseline applicable | Baseline 3 | | |
| Test case author | ... | | |
| Test Objective(s) | <p>The aim of this test case is to verify that the SoM procedure is performed correctly and that the RBC sends the SR Authorization message.</p> <p>The train starts to move and detects the first Physical BG and the RBC sends the MA to the EVC:</p> <ul style="list-style-type: none"> An On-Sight (OS) or a Limited Supervision (LS) profile up to the first signal in advance of the train Full Supervision MA from the first signal in advance of the train up to the last virtual signal where the FS conditions are all fulfilled | | |
| Diagram | <p>1°:</p>  <p>2°:</p>  | | |
| Starting conditions | Level | 2 | |
| | Mode | SB | |
| | Train Speed (km/h) | 0 Km/h | |



| | | | | | | |
|-----------------|---|--------------------------------|---|--|-----|--|
| | | Additional starting conditions | <ul style="list-style-type: none">▪ Each platform belonging to a Terminal Station is equipped with two physical BGs, one BG aligned with the starting signal and one BG placed near and in rear of the starting signal.▪ The conditions of freedom of the Route in advance of the train position are satisfied.▪ RBC is not able to associate the track with train NID_ENGINE▪ The VBR has successfully completed the update of the Track DB.▪ A command to the Dispatcher to set track in not ambiguous way is available.▪ TMS-RBC connection is NOT available. | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The driver validates or introduces the Driver ID. | DMI(O) | | | | |
| | | DMI(I) | DRIVER ID | | | |
| | | JRU | | | | |
| 2 | The establishment of a communication session is initiated by the EVC. | DMI(O) | Safe radio connection “Connection Up” | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 155 Message 32 Message 159 | | | |
| 3 | EVC sends the SoM Position Report message with Invalid or Unknown position. | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 157 Q_STATUS = 0/2 (Invalid/Unknown) Packet 0 DMI_SYMB_STATUS ST03 | | | |
| 4 | RBC checks the SoM PR message | | RBC considers the SoM PR Invalid/unknown, and then RBC considers the train Not Localized. | | | |
| 5 | No visualization of the train on RBC HMI monitor | | RBC cannot visualize any train icon on the RBC HMI Monitor. | | | |
| 6 | The RBC accepts the train. | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 41 NID_LRBG = 16777215 M_ACK = 1 | | | |
| 7 | The EVC sends the acknowledgment | DMI(O) | | | | |
| | | DMI(I) | | | | |
| | | JRU | Message 146 | | | |



| | | | | |
|----|--|--------|--|--|
| 8 | The driver selects train data entry. Train data and train running number is entered or revalidated. | DMI(O) | | |
| | | DMI(I) | Driver selects Data Entry Driver enters the train running number | |
| | | JRU | Message 129 Packet 11 Packet 0 | |
| 9 | RBC checks the data and sends the acknowledge of Train Data. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 8 M_ACK = 1 | |
| 10 | The EVC sends the acknowledgment. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 146 Message 136 Packet 5 NID_OPERATIONAL ADDITIONAL DATA NID_OPERATIONAL | |
| 11 | The GAD/TV sends the info to select the track. | | GAD/TV sends to the VBR the information to select the track in not ambiguous way where the train is localised, according to the command from the Dispatcher. | |
| 12 | RBC sends a plain text message with the "Signal Id" associated to the Track selected by the Dispatcher | DMI(O) | Text Message | |
| | | DMI(I) | | |
| | | JRU | Message 24 Packet 72 Q_TEXTCONFIRM = 1 Q_TEXTREPORT = 1 NID_TEXTMESSAGE | |
| 13 | Driver confirms the Text Message and the EVC sends the Text Message Acknowledged by Driver message | DMI(O) | | |
| | | DMI(I) | Driver confirms the Text Message | |
| | | JRU | M_DRIVERACTIONS = 23 Message 158 NID_TEXTMESSAGE | |
| 14 | RBC checking. | | RBC regards the position of the train as "APPROXIMATE". | |
| 15 | VBR initialized | | | |



| | | | | |
|----|--|--------|--|--|
| 16 | Driver selects START after receiving from the Dispatcher the authorization to press it. | DMI(O) | | |
| | | DMI(I) | Driver selects Start | |
| | | JRU | M_DRIVERACTION = 19 Message 132 Q_MARQSTREASON =xxxx1 (Start selected by driver) Packet 0 | |
| 17 | The RBC does not send any MA and sends a SR Authorisation. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 2 D_SR = infinite Packet 63 NID_BG (1) = Balise of the current RBS. NID_BG (2) = Balise of the RBS in advance. | |
| 18 | The EVC shows the acknowledgment request to SR. | DMI(O) | SR mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO10 | |
| 19 | Acknowledgement of SR | DMI(O) | | |
| | | DMI(I) | Acknowledgement of SR mode | |
| | | JRU | M_DRIVERACTIONS = 3 | |
| 20 | The EVC switches to SR mode and reports to the RBC the mode transition | DMI(O) | SR symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=2 DMI_SYMB_STATUS MO09 Message 136 Packet 0 M_MODE=2 | |
| 21 | EVC starts to move and detects the first Physical BG and reports to the RBC the train position | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 136 Packet 0 NID_LRBG#16777215 Q_DIRLRBG#2 Q_DLRBG#2 | |
| 22 | Visualization of the train on RBC HMI monitor | | RBC regards the EVC as localized and commands the visualization of the train icon on the RBC HMI Monitor. | |



| | | | | |
|-----------------------|--|--------------------|--|-------|
| 23 | The RBC sends a MA | DMI(O) | | ... |
| | | DMI(I) | | |
| | | JRU | Message 3 Packet 15 L_ENDSECTION=L1 (up to last virtual signal where the FS conditions are all fulfilled) Packet 21 Packet 27 Packet 80 D_MAMODE=D1 M_MAMODE=0 (OS) or 2 (LS) L_MAMODE=L2 (up to the first signal in front of the train) | |
| 24 | The EVC shows the acknowledgment request to OS/LS | DMI(O) | OS/LS mode transition acknowledgement | |
| | | DMI(I) | | |
| | | JRU | DMI_SYMB_STATUS MO08/MO22 | |
| 25 | Acknowledgement of OS/LS | DMI(O) | | |
| | | DMI(I) | Acknowledgement of OS/LS mode | |
| | | JRU | M_DRIVERACTIONS = 0/13 | |
| 26 | The EVC switches to OS/LS mode and reports to the RBC the train position | DMI(O) | OS/LS symbol | |
| | | DMI(I) | | |
| | | JRU | M_MODE=1/12 DMI_SYMB_STATUS MO07/MO21 Message 136 Packet 0 M_MODE=1/12 | |
| Final state | | Level | | 2 |
| | | Mode | | OS/LS |
| | | Train Speed (km/h) | | ... |
| | | Other parameters | | |
| Final Test Result | | (OK or not OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

Table 12: Test case SoM10



5.1.3 LINKING INFORMATION

5.1.3.1 LINK1: Verify that the value of Q_LOCACC is correct for every BG (Physical BG and Virtual BG) and all balises are read correctly

| TEST CASE DESCRIPTION | | | | |
|-----------------------|---|--|---|---|
| | | Code | Version | Title |
| Test Case | | LINK1 | 01 | Verification of the value of Q_LOCACC for every BG (Physical BG and Virtual BG) and that all balises are read correctly |
| Baseline applicable | | Baseline 3 | | |
| Test case author | | ... | | |
| Test Objective(s) | | The aim of this test case is to verify the value of Q_LOCACC is correct for every balise group (Physical BG and Virtual BG) and the balises are read correctly | | |
| Diagram | | - | | |
| Starting conditions | | Level | 2 | |
| | | Mode | FS | |
| | | Train Speed (km/h) | Train running at the maximum speed of the line. | |
| | | Additional starting conditions | The train is running from the beginning to the end of the line. | |
| Sequence of OTC | | Checkpoints | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | OK? |
| 1 | The RBC sends linking information to the train. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | Message 3/33/24 LRBG0 NID_BG=BG Packet 5 D_LINK(i)=Di NID_BG(i)=BGi Q_LOCACC (i)= Q_LOCACCi N_ITER=n D_LINK (i+1)=Di+1 NID_BG (i+1)=BGi+1 Q_LOCACC(i+1) = Q_LOCACCi+1 (i=1,2,3....n) | |



| | | | | |
|-----------------------|---|---|---|-----|
| 2 | The Balise Group “i” is read correctly and inside its expectation window. | DMI(O) | | |
| | | DMI(I) | | |
| | | JRU | NID_BG (i) Q_LINK (i) = 1 D_LRBG + L_DOUBTUNDER - (offset between front end and antenna position) > Di – Q_LOCACC and D_LRBG - L_DOUBTOVER - (offset between front end and antenna position) < Di + Q_LOCACC (i=1,2,3...n) | |
| | | | | |
| Final state | | Level | | 2 |
| | | Mode | | FS |
| | | Train Speed (km/h) | | ... |
| | | Other parameters | | |
| Final Test Result | | (OK or not OK) | | |
| Field of Application | | ... | | |
| Briefing instructions | | Steps 1 and 2 are repeated for every linking information sent and every BG encountered. Note that L_DOUBTUNDER and L_DOUBTOVER take into account the Q_LOCACC_GNSS | | |

Table 13: Test case LINK1

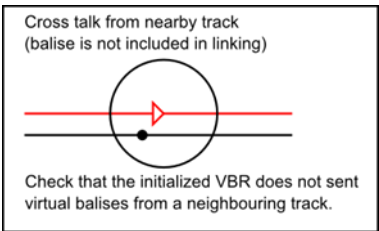


5.2 CRTK: CROSS TALK

5.2.1 CrTk1 : Cross-Talk from neighbouring track

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader;
- The train is moving and the estimated GNSS position gradually drifts towards the neighbouring track (Cross-Talk for virtual balise concept);
- A virtual balise from the neighbouring track gets within the range of the estimated GNSS position (Cross-Talk from neighbouring track).

| TEST CASE DESCRIPTION | | | |
|-----------------------|---|---------|------------------------------------|
| | Code | Version | Title |
| Test Case | CrTk1 | 01 | Cross-Talk from neighbouring track |
| Baseline applicable | Baseline 3 | | |
| Test case author | Bernd Gonska DLR | | |
| Test Objective(s) | The target of this test is to check that: The VBR does not emit virtual balises from a neighbouring track. | | |
| Diagram |  | | |



| | | | | | | |
|---------------------|--|--------------------------------|--|--|-----|--|
| Starting conditions | | Level | 2/3 (ERTMS/ETCS Level: 3/4) | | | |
| | | Mode | FS/SR (ERTMS/ETCS mode: 0/2) | | | |
| | | Radio Communication Session | Established | | | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ The VBR has a track data base that contains virtual balises for two parallel tracks. The tracks are straight, parallel and only a view meters apart.▪ The VBR is initialized with a route on one of the two tracks.▪ The estimated GNSS Error is at a constant level that is larger than the distance between the two parallel tracks. The trajectory of the estimated GNSS position will move along a straight line at constant speed. The line starts on one side of the correct track and then gradually crosses both tracks.▪ RTM: SAFE CONNECTION SET-UP▪ VBR: route initialized for one of the two tracks▪ GNSS: The GNSS must be working under conditions that generate an estimated GNSS error of a constant level that is higher than the distance between the two parallel tracks. The trajectory of the estimated GNSS position will move along a straight line at constant speed. The line starts on one side of the correct track and then gradually crosses both tracks.▪ ODO info: The Train is moving at constant speed fitting the GNSS speed.▪ TRACK DB (OBU side):The data base must contain virtual balises for both parallel tracks. | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The train is moving at constant speed. | ODO(I) | | | | |
| | | JRU | Messages 136 with no variation of V_TRAIN | | | |



| | | | | |
|---|---|---------|-------------------------------|--|
| 2 | The estimated GNSS Error is at a constant level that is larger than the distance between the two parallel tracks. The trajectory of the estimated GNSS position will move along a straight line at constant speed. The line starts on one side of the correct track and then gradually crosses both tracks. | GNSS(I) | | |
| | | | | |
| 3 | The estimated GNSS position crosses the initialized track. The position of a virtual balise from the initialized track is passed directly. | GNSS(I) | | |
| 4 | The virtual balise is emitted. | VBR(O) | | |
| | | JRU | Message 136 with new NID_LRBG | |



| | | | | |
|---|---|---------|--|--|
| 5 | The estimated GNSS position has drifted in the middle between the two tracks. The position of a virtual balise from the correct track and one virtual balise from the other track is passed indirectly. This means that the estimated GNSS position of the train projected onto the corresponding track hits the location of a virtual balise. Both virtual balises are within range of the estimated GNSS error. | GNSS(I) | | |
| 6 | The virtual balise of the initialized track is emitted. | VBR(O) | | |
| 7 | The virtual balise of the other track is not emitted. | VBR(O) | RBC commands the visualization of the train icon on the RBC HMI Monitor. | |



| | | | | |
|----|---|---------|--|-----|
| 8 | The estimated GNSS position has drifted completely to the other track. The position of a virtual balise from the initialized track is passed indirectly. The position of a virtual balise from the other track is passed directly. Both virtual balises are within range of the estimated GNSS error. | GNSS(I) | | |
| | | | | |
| 9 | The virtual balise of the initialized track is emitted. | VBR(O) | | |
| | | JRU | | |
| 10 | The virtual balise of the other track is not emitted. | VBR(O) | | |
| | | JRU | | |
| 11 | The estimated GNSS position has drifted even beyond the other track. The position of a virtual balise from the correct track and one virtual balise from the other track is passed indirectly. Both virtual balises are within range of the estimated GNSS error. | GNSS(I) | | |
| | | | | |
| 12 | The virtual balise of the initialized track is emitted. | VBR(O) | | ... |
| | | JRU | | |
| 13 | The virtual balise of the other track is not emitted. | VBR(O) | | |
| | | JRU | | |



| | | |
|-----------------------|--|---|
| Final state | Level 2/3 (ERTMS/ETCS Level: 3/4) | |
| | Mode FS/SR (ERTMS/ETCS Level: 0/2) | |
| | Radio Communication Session: ESTABLISHED | |
| | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: route initialized GNSS: The geographic trajectory has drifted to another track. ODO info: Train is moving at constant speed. Track DB (OBU side): loaded |
| Final Test Result | (OK or NOT OK) | |
| Field of Application | | |
| Briefing instructions | | |

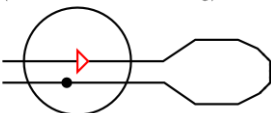
Table 14: Test case CRTK1



5.2.2 CrTk2 : Cross-Talk from SAME track

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader;
- The train is approaching a turning loop. The exit of the turning loop is geographically close to the current position (Cross-Talk for virtual balise concept);
- A virtual balise from the exit part of the turning loop gets within the range of the estimated GNSS position plus estimated GNSS error (Cross-Talk from same track).

| TEST CASE DESCRIPTION | | | |
|------------------------------|--|---------|----------------------------|
| | Code | Version | Title |
| Test Case | CrTk2 | 01 | Cross-Talk from same track |
| Baseline applicable | Baseline 3 | | |
| Test case author | Bernd Gonska DLR | | |
| Test Objective(s) | <p>The target of this test is to check that:</p> <ul style="list-style-type: none"> ▪ The VBR does not emit virtual balises from the same track that will be visited later (i.e. The VBR does not emit the balise from the exit part of the turning loop). | | |
| Diagram | <div style="border: 1px solid black; padding: 10px;"> <p>Cross talk from own route (balise is included in linking)</p>  <p>In a turning loop, the train can be close to a location that it will pass later. Balises from the wrong track part must not be sent. This is a delicate situation, because the cross talk balise is part of the expected route.</p> </div> | | |



| | | | | | | |
|---------------------|--|--------------------------------|---|--|-----|--|
| Starting conditions | | Level | 2/3 (ERTMS/ETCS Level: 3/4) | | | |
| | | Mode | FS/SR (ERTMS/ETCS mode: 0/2) | | | |
| | | Radio Communication Session | Established | | | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ The VBR has a track data base that contains two parallel tracks that are connected by a turning loop. The track data base contains virtual balises on both parallel track parts. The parallel parts are only a few meters apart.▪ The VBR is initialized with a route that covers the whole loop and both parallel track parts.▪ RTM: SAFE CONNECTION SET-UP▪ VBR: The initialized route covers the complete turning loop and the two parallel track parts.▪ GNSS: The GNSS must be working under conditions that generate an estimated GNSS error of a constant level. For example 8m. The geographic trajectory of the estimated position must be moving at constant speed in a straight line.▪ ODO info: Train is moving at constant speed fitting the GNSS speed.▪ Track BD (OBU side): The data base must contain exactly two virtual balise groups, one for each of the two parallel track parts. | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The train is moving at constant speed. | ODO(I) | | | | |
| | | JRU | Messages 136 with no variation of V_TRAIN | | | |



| | | | | |
|---|--|---------|-------------------------------|--|
| 2 | The estimated GNSS Error is at a constant level that is larger than the distance between the two parallel track parts. The trajectory of the estimated GNSS position will move along a straight line at constant speed. The line starts on one side of the correct track part and then gradually crosses both track parts (the test will stop before entering the turning loop). | GNSS(I) | | |
| | | | | |
| 3 | The estimated GNSS position crosses the initialized track. The position of a virtual balise from the initialized track is passed directly. | GNSS(I) | | |
| 4 | The virtual balise is emitted. | VBR(O) | | |
| | | JRU | Message 136 with new NID_LRBG | |



| | | | | |
|-----------------------|--|--|---|--|
| 5 | The estimated GNSS position has drifted even beyond the other track part. The estimated GNSS error still covers some part of the correct track part. The position of a virtual balise from the other track part is passed indirectly. According to the track database and the initialization of the route, this virtual balise group shall be the next expected virtual balise group. Note: If the test fails, it can be repeated with an additional virtual balise group placed in the middle of the turning loop | GNSS(I) | | |
| 6 | The virtual balise of the other track part is not emitted. | VBR(O) | | |
| Final state | | Level 2/3 (ERTMS/ETCS Level: 3/4) | | |
| | | Mode FS/SR (ERTMS/ETCS Level: 0/2) | | |
| | | Radio Communication Session: ESTABLISHED | | |
| | | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: route initialized. A turning loop with only one balise group after the turning loop lies ahead. GNSS: The geographic trajectory has drifted to a track part of the exit of the turning loop. ODO info: Train is moving at constant speed fitting the GNSS speed. Track DB (OBU side): loaded | |
| Final Test Result | | (OK or NOT OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

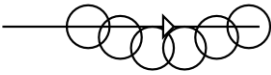
Table 15: Test case CRTK2



5.2.3 CrTk3 : evasion of virtual balise location

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader;
- The train is moving at a high speed and the estimated GNSS error is low. The estimated position has a maximum offset to the track within the range of the estimated GNSS error;
- Each GNSS calculation still covers a part of the correct track but not all parts of the track are covered (Cross-Talk for virtual balise concept);
- A virtual balise is placed on the track in a way such that no GNSS calculation directly covers the location (Evasion of virtual balise location).

| TEST CASE DESCRIPTION | | | |
|-----------------------|---|---------|------------------------------------|
| | Code | Version | Title |
| Test Case | CrTk3 | 01 | Evasion of virtual balise location |
| Baseline applicable | Baseline 3 | | |
| Test case author | Bernd Gonska DLR | | |
| Test Objective(s) | <p>The target of this test is to check that:</p> <ul style="list-style-type: none"> ▪ The GNSS calculation is only repeated a certain number of times per second. So it is possible that parts of the track are not covered directly by the area defined by the estimated GNSS position plus the estimated GNSS error. ▪ The VBR shall emit virtual balises even if the location of the virtual balise is not covered directly. | | |
| Diagram | <div style="border: 1px solid black; padding: 10px;"> <p>Evasion (no direct visit)</p>  <p>The VBR never reaches the VB position within its current error radius. Check that the balise is sent anyway. This situation is very rare, but can be combined with the jump scenario.</p> </div> | | |



| | | | | | | |
|---------------------|---|--------------------------------|---|--|-----|--|
| Starting conditions | | Level | 2/3 (ERTMS/ETCS Level: 3/4) | | | |
| | | Mode | FS/SR (ERTMS/ETCS mode: 0/2) | | | |
| | | Radio Communication Session | Established | | | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ The VBR has a track data base that contains a virtual balises. The track is straight.▪ The VBR is initialized.▪ RTM: SAFE CONNECTION SET-UP▪ VBR: route initialized▪ GNSS: The GNSS must be working under conditions that generate an estimated GNSS error of a constant very low level. The trajectory of the estimated GNSS position must be moving at constant speed in a straight line parallel to the track with a maximum distance to the track that is just covered by the estimated GNSS error.▪ ODO info: Train is moving at constant high speed, fitting the GNSS speed.▪ Track DB (OBU side): Loaded | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The train is moving at constant high speed. | ODO(I) | | | | |
| | | JRU | Messages 136 with no variation of V_TRAIN | | | |



| | | | | |
|---|---|---------|--|--|
| 2 | <p>The estimated GNSS Error is at a small constant level. The trajectory of the estimated GNSS position must be moving at constant speed in a straight line parallel to the track with a maximum distance to the track that is just covered by the estimated GNSS error. This way, there are locations on the track that are not directly covered by any estimated error radius of any estimated GNSS position. Note: Imagine that each GNSS report determines a circle shaped area of the possible train position. Each circle intersects with the track. However, if the train is fast and the circles are small, then gaps can appear on the track:</p> <p>-()-()-()-</p> | GNSS(I) | | |
|---|---|---------|--|--|



| | | | | |
|-----------------------|--|--|---|--|
| 3 | The train indirectly passes a virtual balise location that is located exactly between two GNSS reports. Please check that none of the two GNSS reports cover the balise position with its estimated error range. | GNSS(I) | | |
| 4 | The virtual balise is emitted. | VBR(O) | | |
| | | JRU | Message 136 with new NID_LRBG | |
| Final state | | Level 2/3 (ERTMS/ETCS Level: 3/4) | | |
| | | Mode FS/SR (ERTMS/ETCS Level: 0/2) | | |
| | | Radio Communication Session: ESTABLISHED | | |
| | | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: route initialized. GNSS: The GNSS is working under conditions that generate an estimated GNSS error of a constant low level. The geographic trajectory has drifted outside the track. ODO info: Train is moving at constant high speed fitting the GNSS speed. Track DB (OBU side): Loaded | |
| Final Test Result | | (OK or NOT OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

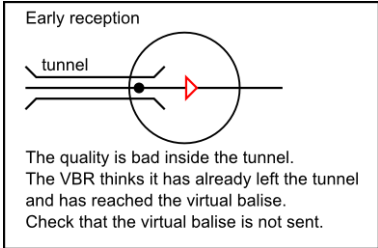
Table 16: Test case CRTK3



5.2.4 CrTk4 : early reception of a virtual balise

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader;
- The train is moving in an area of very high estimated GNSS error for some time (Cross-Talk for virtual balise concept);
- The estimated GNSS position reaches a virtual balise location (early reception of a virtual balise).

| TEST CASE DESCRIPTION | | | |
|-----------------------|---|---------|-------------------------------------|
| | Code | Version | Title |
| Test Case | CrTk4 | 01 | Early reception of a virtual balise |
| Baseline applicable | Baseline 3 | | |
| Test case author | Bernd Gonska DLR | | |
| Test Objective(s) | <p>The target of this test is to check that:</p> <ul style="list-style-type: none"> ▪ Virtual balises shall not be emitted when the estimated GNSS error is very high (The VBR does not emit the virtual balise until the GNSS quality gets better). <p>Explanation: Virtual balises shall be placed in areas where the GNSS quality is guaranteed to be good. If the estimated GNSS error is large, then there is a high probability that high quality area around the virtual balise has not been reached yet.</p> | | |
| Diagram |  | | |



| | | | | | | |
|---------------------|--|--------------------------------|--|--|-----|--|
| Starting conditions | | Level | 2/3 (ERTMS/ETCS Level: 3/4) | | | |
| | | Mode | FS/SR (ERTMS/ETCS mode: 0/2) | | | |
| | | Radio Communication Session | Established | | | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ The VBR has a track data base that contains a virtual balises. The track is straight.▪ The VBR is initialized with a route that contains the virtual balise.▪ RTM: SAFE CONNECTION SET-UP▪ VBR: route initialized▪ GNSS: The GNSS must be working under conditions that generate an estimated GNSS error of a constant very high level. For example 100m. The geographic trajectory of the estimated position must be moving at constant speed in a straight line.▪ ODO info: Train is moving at constant speed fitting the GNSS speed.▪ Track DB (OBU side): Loaded | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The train is moving at constant speed. The odometry has accumulated a confidence interval of at least 100m. | ODO(I) | | | | |
| | | JRU | Messages 136 with no variation of V_TRAIN | | | |
| 2 | The estimated GNSS Error is at a constant level of at least 100m. The estimated GNSS location is moving along a straight line at constant speed. The line is exactly on the track. | GNSS(I) | | | | |
| | | | | | | |
| 3 | The estimated GNSS position reaches the location of a virtual balise. | GNSS(I) | | | | |
| 4 | The virtual balise is not emitted | VBR(O) | | | | |
| | | JRU | No new Message 136 with new NID_LRBG | | | |



| | | | | |
|-----------------------|---|--|--|--|
| 5 | The train travels 80m and the GNSS quality suddenly improves. The estimated GNSS position jumps back 100m, the estimated GNSS error drops to 5m. The train is now 20m in rear of the virtual balise location. | GNSS(I) | | |
| 6 | After 20m the VBR emits the virtual balise. | VBR(O) | | |
| | | JRU | new Message 136 with new NID_LRBG | |
| Final state | | Level 2/3 (ERTMS/ETCS Level: 3/4) | | |
| | | Mode FS/SR (ERTMS/ETCS Level: 0/2) | | |
| | | Radio Communication Session: ESTABLISHED | | |
| | | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: route initialized. GNSS: High quality GNSS data ODO info: Train is moving at constant speed fitting the GNSS speed. Track DB (OBU side): Loaded | |
| Final Test Result | | (OK or NOT OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

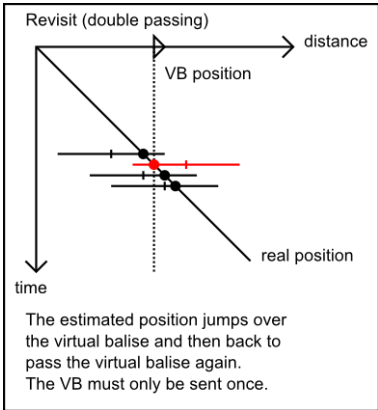
Table 17: Test case CRTK4



5.2.5 CrTk5 : revisiting a virtual balise location

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader;
- The train has just passed a virtual single balise group (cross-talk for virtual balise concept);
- Directly after that, the estimated GNSS position performs a backward jump (revisiting a virtual balise location).

| TEST CASE DESCRIPTION | | | |
|------------------------------|--|---------|--------------------------------------|
| | Code | Version | Title |
| Test Case | CrTk5 | 01 | Revisiting a virtual balise location |
| Baseline applicable | Baseline 3 | | |
| Test case author | Bernd Gonska DLR | | |
| Test Objective(s) | The target of this test is to check that: <ul style="list-style-type: none"> ▪ The VBR does not emit the same virtual balise twice if the estimated GNSS position jumps backward. | | |
| Diagram |  | | |



| | | | | | | |
|---------------------|--|--------------------------------|---|--|-----|--|
| Starting conditions | | Level | 2/3 (ERTMS/ETCS Level: 3/4) | | | |
| | | Mode | FS/SR (ERTMS/ETCS mode: 0/2) | | | |
| | | Radio Communication Session | Established | | | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ The VBR has a track data base that contains a virtual balises. The track is straight.▪ The VBR is initialized with a route that contains the virtual balise.▪ RTM: SAFE CONNECTION SET-UP▪ VBR: route initialized▪ GNSS: The GNSS must be working under conditions that generate an estimated GNSS error of a constant level. For example 20m. The geographic trajectory of the estimated position must be moving at constant speed in a straight line.▪ ODO info: Train is moving at constant speed fitting the GNSS speed.▪ Track DB (OBU side): Loaded | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The train is moving at constant speed. | ODO(I) | | | | |
| | | JRU | Messages 136 with no variation of V_TRAIN | | | |
| 2 | The estimated GNSS error is at a constant level. For example 20m. The estimated GNSS position is moving along a straight line at constant speed. The line matches the track. | GNSS(I) | | | | |
| | | | | | | |
| 3 | The position of a virtual balise is passed directly. | GNSS(I) | | | | |
| 4 | The virtual balise is emitted | VBR(O) | | | | |
| | | JRU | new Message 136 with new NID_LRBG | | | |
| 5 | The quality of the GNSS suddenly improves and the estimated GNSS position jumps back to a location before the virtual balise. | GNSS(I) | | | | |



| | | | | | |
|-----------------------|--|--|--|--|--|
| 6 | The virtual balise is not emitted again. | VBR(O) | | | |
| | | JRU | No new Message 136 (due to new BG picked up) with same NID_LRBG | | |
| Final state | | Level 2/3 (ERTMS/ETCS Level: 3/4) | | | |
| | | Mode FS/SR (ERTMS/ETCS Level: 0/2) | | | |
| | | Radio Communication Session: ESTABLISHED | | | |
| | | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: route initialized. GNSS: High quality GNSS data ODO info: Train is moving at constant speed fitting the GNSS speed. Track DB (OBU side): Loaded | | |
| Final Test Result | | (OK or NOT OK) | | | |
| Field of Application | | | | | |
| Briefing instructions | | | | | |

Table 18: Test case CRTK5



5.2.6 CrTk6 : delay inside a virtual balise group

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader;
- The train is moving slowly and passes the location of the first balise of a virtual balise group (cross talk for virtual balise concept);
- before passing the location of the second virtual balise in the group, the estimated GNSS position performs a backward jump by more than 12m (delay inside a virtual balise group).

| TEST CASE DESCRIPTION | | | | |
|-----------------------|-------------|---|---|-------------------------------------|
| | | Code | Version | Title |
| Test Case | | CrTk6 | 01 | Delay inside a virtual balise group |
| Baseline applicable | | Baseline 3 | | |
| Test case author | | Bernd Gonska DLR | | |
| Test Objective(s) | | The target of this test is to check that: <ul style="list-style-type: none">▪ The VBR does not stretch the distance between balises of the same virtual balise group (The second balise of the group has to be sent less than 12m apart from the first balise). | | |
| Diagram | | - | | |
| Starting conditions | | Level | 2/3 (ERTMS/ETCS Level: 3/4) | |
| | | Mode | FS/SR (ERTMS/ETCS mode: 0/2) | |
| | | Radio Communication Session | Established | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ The VBR has a track data base that contains a virtual balises. The track is straight.▪ The VBR is initialized with a route that contains the virtual balise.▪ RTM: SAFE CONNECTION SET-UP▪ VBR: route initialized▪ GNSS: The GNSS must be working under conditions that generate an estimated GNSS error of a constant level higher than 12m. The geographic trajectory of the estimated position must be moving at constant speed in a straight line.▪ ODO info: Train is moving at constant speed fitting the GNSS speed.▪ Track DB (OBU side): The data base must contain virtual balises group with at least two balises. The balises of the group shall be 10 m apart (if possible). | |
| Sequence of OTC | | Checkpoints | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | OK? |



| | | | | |
|---|---|---------|--|--|
| 1 | The train is moving at constant low speed. | ODO(I) | | |
| | | JRU | Messages 136 with no variation of V_TRAIN. V_TRAIN has a low value | |
| 2 | The estimated GNSS error is at a constant level higher than 12m. The estimated GNSS position is moving along a straight line at constant speed. The line matches the track. | GNSS(I) | | |
| | | | | |
| 3 | The position of the first balise in a virtual balise group is passed directly. | GNSS(I) | | |



| | | | | |
|---|--|---------|---|--|
| 4 | The first telegram of the virtual balise group is emitted. | VBR(O) | | |
| | | JRU | | |
| 5 | Before the second balise telegram is emitted, the quality of the GNSS suddenly increases and the estimated GNSS position jumps back by more than 12m. | GNSS(I) | | |
| 6 | The second telegram is emitted less than 12m after the first telegram. Note: This distance refers to the odometry of the train which is not reset by the GNSS update. | VBR(O) | | |
| | | JRU | new Message 136 from the LRBG picked up. | |
| 7 | The train accepts the balise group, there is no balise read error displayed. | DMI(O) | Note: If linking information is used, the linking reaction shall be set to "service brake" or "trip". | |



| | | | |
|-----------------------|--|--|--|
| Final state | Level 2/3 (ERTMS/ETCS Level: 3/4) | | |
| | Mode FS/SR (ERTMS/ETCS Level: 0/2) | | |
| | Radio Communication Session: ESTABLISHED | | |
| | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: route initialized. GNSS: The GNSS quality is good ODO info: Train is moving at constant speed fitting the GNSS speed. Track DB (OBU side): Loaded | |
| Final Test Result | (OK or NOT OK) | | |
| Field of Application | | | |
| Briefing instructions | | | |


Table 19: Test case CRTK6



5.2.7 CrTk7 : Jumping over a virtual balise

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader;
- The train is moving and the estimated GNSS position is highly underestimated (cross talk for virtual balise concept);
- The estimated GNSS position jumps forward and over a virtual balise location. The estimated GNSS position now lies further behind the virtual balise location than the current estimated GNSS error covers (Jumping over a virtual balise).

| TEST CASE DESCRIPTION | | | |
|------------------------------|--|--|-------------------------------|
| | Code | Version | Title |
| Test Case | CrTk7 | 01 | Jumping over a virtual balise |
| Baseline applicable | Baseline 3 | | |
| Test case author | Bernd Gonska DLR | | |
| Test Objective(s) | The target of this test is to check that: <ul style="list-style-type: none"> ▪ The VBR takes into account the difference between the estimated GNSS location and the intended position of the virtual balise (i.e. The balise message to the EVC has an estimated GNSS error and a reported virtual balise location that cover the correct balise location) | | |
| Diagram |  | | |
| Starting conditions | Level | 2/3 (ERTMS/ETCS Level: 3/4) | |
| | Mode | FS/SR (ERTMS/ETCS mode: 0/2) | |
| | Radio Communication Session | Established | |
| | Additional starting conditions | <ul style="list-style-type: none"> ▪ The VBR has a track data base that contains two virtual balise groups. The track is straight. ▪ The VBR is initialized with a route that contains the virtual balises ▪ RTM: SAFE CONNECTION SET-UP ▪ VBR: route initialized ▪ GNSS: The GNSS must be working under conditions that generate an estimated GNSS error of a constant level. For example 10m. The geographic trajectory of the estimated position must be moving at constant speed in a straight line. ▪ ODO info: Train is moving at constant speed fitting the GNSS speed. ▪ Track DB (OBU side): loaded. | |



| Sequence of OTC | | Checkpoints | | |
|-----------------|---|-------------|---|-----|
| Step | Description | Interfaces | Description of what to be tested at the interface | OK? |
| 1 | The train is moving at constant speed. | ODO(I) | | |
| | | JRU | Messages 136 with no variation of V_TRAIN. | |
| 2 | The estimated GNSS error is at a constant level of 10 m. The estimated GNSS position is moving along a straight line at constant speed. The line matches the track. | GNSS(I) | | |
| | | | | |
| 3 | The estimated GNSS error drops to 1m. The estimated GNSS position jumps forward by 10m. This is 8m beyond a virtual balise location. | GNSS(I) | | |
| 4 | The virtual balise is emitted immediately. | VBR(O) | Check that the balise location reported to the EVC and the estimated GNSS error actually cover the intended location of the virtual balise. Check also that all telegrams of the balise are received in the correct order and with a reasonable distance between each other. | |
| | | JRU | Note: The delay of 8m needs to be covered: If the estimated GNSS error is reported as 1m, then the location of the balise needs to be reported as lying 8m before the current location. If the current location is used for the balise, then the reported estimated GNSS error needs to be 9m. | |



| | | | | |
|---|---|---------|--|--|
| 5 | After some distance, the estimated GNSS error is again at a constant level of 10 m. The geographic trajectory of the estimated GNSS position is moving along a straight line at constant speed. The line matches the track. | GNSS(I) | | |
| 6 | The estimated GNSS error stays at 10m, but the estimated GNSS position jumps forward by 10m. This is 8m beyond a virtual balise location. | GNSS(I) | | |
| 7 | The virtual balise is emitted immediately. | VBR(O) | <p>Check that the balise location that is reported to the EVC and the estimated GNSS Error actually cover the intended location of the virtual balise.</p> <p>Check also that all telegrams of the balise are received in the correct order and with a reasonable distance between each other.</p> | |
| | | JRU | <p>Note: The delay of 8m needs to be covered: If the estimated GNSS Error is reported as 10m, then the location of the balise needs to be reported as lying 8m before the current location. If the current location is used for the balise, then the reported estimated GNSS Error needs to be more than 18m. However, there is room for optimization, if the train has not moved much, then it cannot jump significantly more than the last estimated Error allows. It is possible to use something in between these two options.</p> | |



| | | | |
|-----------------------|--|---|--|
| Final state | Level 2/3 (ERTMS/ETCS Level: 3/4) | | |
| | Mode FS/SR (ERTMS/ETCS Level: 0/2) | | |
| | Radio Communication Session: ESTABLISHED | | |
| | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: route initialized. GNSS: The estimated GNSS position is accurate. The estimated error is at 10m. ODO info: Train is moving at constant speed fitting the GNSS speed. Track DB (OBU side): Loaded | |
| Final Test Result | (OK or NOT OK) | | |
| Field of Application | | | |
| Briefing instructions | | | |

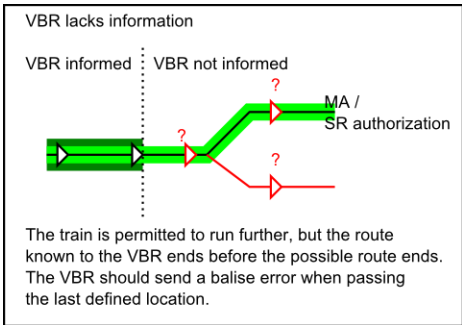
Table 20: Test case CRTK7



5.2.8 CrTk8 : Uninformed Virtual Balise Reader

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader;
- The train is moving and the estimated GNSS position leaves the last part of the initialized route (cross talk for virtual balise concept);
- The train reaches a location of another virtual balise group outside of the route (Uninformed Virtual Balise Reader).

| TEST CASE DESCRIPTION | | | |
|------------------------------|--|---------|----------------------------------|
| | Code | Version | Title |
| Test Case | CrTk8 | 01 | Uninformed Virtual Balise Reader |
| Baseline applicable | Baseline 3 | | |
| Test case author | Bernd Gonska DLR | | |
| Test Objective(s) | The target of this test is to check that: <ul style="list-style-type: none"> ▪ The VBR will not emit virtual balises if the train leaves the area of the initialized route. | | |
| Diagram |  | | |



| | | | | | | |
|---------------------|---|--------------------------------|---|--|-----|--|
| Starting conditions | | Level | 2/3 (ERTMS/ETCS Level: 3/4) | | | |
| | | Mode | FS/SR (ERTMS/ETCS mode: 0/2) | | | |
| | | Radio Communication Session | Established | | | |
| | | Additional starting conditions | <ul style="list-style-type: none">▪ The train approaches a switch in facing point movement.▪ The VBR has a track data base that contains a virtual balise group, for each of the three track parts around the switch.▪ The VBR is initialized only for the part before the switch, hence containing only one virtual balise.▪ The estimated GNSS Error is at a constant level. The trajectory of the estimated GNSS position will move along a straight line at constant speed. The line will be exactly on the track, following the straight track of the switch.▪ RTM: SAFE CONNECTION SET-UP▪ VBR: The route is initialized. The route ends at the switch.▪ GNSS: The trajectory of the estimated GNSS position will move along a straight line at constant speed. The line will be exactly on the track, following the straight track of the switch.▪ ODO info: Train is moving at constant speed fitting the GNSS speed.▪ Track DB (OBU side): The data base must contain all three virtual balises around the switch. | | | |
| Sequence of OTC | | Checkpoints | | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? | |
| 1 | The train is moving at constant speed. | ODO(I) | | | | |
| | | JRU | Messages 136 with no variation of V_TRAIN. | | | |
| 2 | The estimated GNSS error is at a constant low level. The trajectory of the estimated GNSS position is moving along a straight line at constant speed. The line matches the track. | GNSS(I) | | | | |
| | | | | | | |



| | | | | |
|---|--|---------|--|--|
| 3 | The estimated GNSS position matches the virtual balise location before entering the switch. | GNSS(I) | | |
| 4 | The virtual balise is emitted. | VBR(O) | The delay of 8m needs to be covered: If the estimated GNSS error is reported as 1m, then the location of the balise needs to be reported as lying 8m before the current location. If the current location is used for the balise, then the reported estimated GNSS error needs to be 9m. | |
| | | JRU | Message 136 with new NID_LRBG | |
| 5 | After some distance, train reaches the end of the route that is initialized in the VBR. Note: The movement authority of the train allows the train to continue, but the VBR data end here. It possible that the EVC, the VBR or the trackside have implemented something to prevent this situation from happening. | GNSS(I) | | |
| 6 | The VBR may trigger an error reaction here. | VBR(I) | | |



| | | | | |
|-----------------------|---|--|---|--|
| 7 | The train passes directly over the second virtual balise location. The virtual balise is listed in the track data base but lies after the area of the route that is initialized in the VBR. | GNSS(O) | | |
| 8 | The virtual balise group shall not be emitted. Note: The VBR may trigger an error reaction here. | VBR(O) | | |
| | | JRU | No Message 136 with new NID_LRBG | |
| Final state | | Level 2/3 (ERTMS/ETCS Level: 3/4) | | |
| | | Mode FS/SR (ERTMS/ETCS Level: 0/2) | | |
| | | Radio Communication Session: ESTABLISHED | | |
| | | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: The initialized route has been left. GNSS: The GNSS quality is good. ODO info: Train is moving at constant speed fitting the GNSS speed. Track DB (OBU side): Loaded | |
| Final Test Result | | (OK or NOT OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

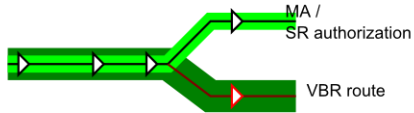
Table 21: Test case CRTK8



5.2.9 CrTk9 : Not updated Virtual Balise Reader

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader;
- The train is moving when the RBC provides a changed MA and new linking information, but no update of the VBR data (cross talk for virtual balise concept);
- The train reaches a location where the route stored in the VBR differs from the new MA (not updated Virtual Balise Reader).

| TEST CASE DESCRIPTION | | | |
|------------------------------|---|---------|-----------------------------------|
| | Code | Version | Title |
| Test Case | CrTk9 | 01 | Not updated Virtual Balise Reader |
| Baseline applicable | Baseline 3 | | |
| Test case author | Bernd Gonska DLR | | |
| Test Objective(s) | <p>The target of this test is to check that:</p> <ul style="list-style-type: none"> ▪ Determine the reaction of the VBR if MA and linking is updated, but the VBR is not (determine how the VBR reacts to the incomplete update and if virtual balises are emitted from the outdated track). | | |
| Diagram | <div style="border: 1px solid black; padding: 10px;"> <p>VBR not updated</p>  <p>The EVC receives an MA update, but the VBR update fails. It is unclear how data consistency can be checked.</p> </div> | | |



| | | | | | |
|---------------------|---|--------------------------------|---|---|-----|
| Starting conditions | | Level | | 2/3 (ERTMS/ETCS Level: 3/4) | |
| | | Mode | | FS/SR (ERTMS/ETCS mode: 0/2) | |
| | | Radio Communication Session | | Established | |
| | | Additional starting conditions | | <ul style="list-style-type: none">▪ The train approaches a switch in facing point movement.▪ The VBR has a track data base that contains a virtual balise group, for each of the three track parts around the switch.▪ The VBR is initialized for the diverging track, but the train will move along the straight track.▪ The estimated GNSS Error is at a constant level. The trajectory of the estimated GNSS position will move along a straight line at constant speed. The line will be exactly on the track, following the straight track of the switch.▪ RTM: SAFE CONNECTION SET-UP▪ VBR: The route is initialized.▪ GNSS: The GNSS must be working under conditions that generate an estimated GNSS error of a constant level. The trajectory of the estimated GNSS position must be moving at constant speed in a straight line.▪ ODO info: Train is moving at constant speed fitting the GNSS speed.▪ Track DB (OBU side): Loaded. | |
| Sequence of OTC | | Checkpoints | | | |
| Step | Description | Interfaces | Description of what to be tested at the interface | | OK? |
| 1 | The train is moving at constant speed. | ODO(I) | | | |
| | | JRU | Messages 136 with no variation of V_TRAIN. | | |
| 2 | The estimated GNSS error is at a constant level that covers the distance between the virtual balises from the diverging track and straight track. The geographic trajectory of the estimated GNSS position is moving along a straight line at constant speed. | GNSS(I) | | | |
| | | | | | |



| | | | | |
|---|---|---------|---|--|
| 3 | The estimated GNSS position matches the first virtual balise location. This is before the train enters the switch. | GNSS(I) | | |
| 4 | The virtual balise is emitted. | VBR(O) | | |
| | | JRU | Message 136 with new NID_LRBG | |
| 5 | The train passes directly over the second virtual balise location. The virtual balise is listed in the track data base but lies after the area of the route that is initialized in the VBR. | RBC(I) | Note: It possible that the EVC, the VBR or the trackside have implemented something to prevent this situation from happening. | |
| 6 | The VBR may trigger an error reaction here because the VBR is not updated about the new route. | VBR(I) | | |
| 7 | The estimated GNSS position moves along the straight track and passes indirectly through the virtual balise from the divergent track. Meaning, the estimated GNSS Error covers the location of the virtual balise from the diverging track. | GNSS(I) | | |
| 8 | The virtual balise group shall not be emitted | VBR(O) | | |
| | | JRU | No Message 136 with new NID_LRBG | |



| | | | | |
|-----------------------|--|--|--|--|
| 9 | After some distance, the estimated GNSS position passes directly through the virtual balise from the straight track. | GNSS(I) | | |
| 10 | The virtual balise group shall not be emitted. Note: The VBR is not initialized for this balise group. | VBR(O) | | |
| 11 | The EVC will trigger the brake due to a linking error. | TIU(O) | The linking information for this balise group shall be set to “service brake” or “trip”. | |
| Final state | | Level 2/3 (ERTMS/ETCS Level: 3/4) | | |
| | | Mode FS/SR (ERTMS/ETCS Level: 0/2) | | |
| | | Radio Communication Session: ESTABLISHED | | |
| | | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: Wrong route initialized. GNSS: The GNSS is working under conditions that generate an estimated GNSS error of a constant level. The estimated GNSS position is accurate. ODO info: Train is moving at constant speed fitting the GNSS speed. Track DB (OBU side): Loaded | |
| Final Test Result | | (OK or NOT OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

Table 22: Test case CRTK9



5.2.10 CrTk10 : Leaving the track

This datasheet covers the following cases:

- The train has on-board equipment including Virtual Balise Reader.
- The estimated GNSS position is drifting away from the initialized track and passes a virtual balise group by a distance larger than the estimated GNSS error would allow (Cross-Talk for virtual balise concept - leaving the track).

| TEST CASE DESCRIPTION | | | |
|------------------------------|--|--|-------------------|
| | Code | Version | Title |
| Test Case | CrTk10 | 01 | Leaving the track |
| Baseline applicable | Baseline 3 | | |
| Test case author | Bernd Gonska DLR | | |
| Test Objective(s) | The target of this test is to check that: <ul style="list-style-type: none"> ▪ The VBR shall not send a virtual balise and trigger an error reaction as well if the train has left the track. | | |
| Diagram | - | | |
| Starting conditions | Level | 2/3 (ERTMS/ETCS Level: 3/4) | |
| | Mode | FS/SR (ERTMS/ETCS mode: 0/2) | |
| | Radio Communication Session | Established | |
| | Additional starting conditions | <ul style="list-style-type: none"> ▪ The VBR has a track data base that contains a switch and three virtual balise groups, one on each track part. ▪ The train is approaching the switch in facing point movement. ▪ The VBR is initialized for the diverging track, but the train will move along the straight track. ▪ The estimated GNSS error shall be small enough to not cover the balise from the divergent track. ▪ RTM: SAFE CONNECTION SET-UP ▪ VBR: The route is initialized. ▪ GNSS: The GNSS must be working under conditions that generate an estimated GNSS error of a constant low level. The trajectory of the estimated GNSS position must be moving at constant speed in a straight line. ▪ ODO info: Train is moving at constant speed fitting the GNSS speed. ▪ Track DB (OBU side): Loaded. | |



| Sequence of OTC | | Checkpoints | | |
|-----------------|---|-------------|---|-----|
| Step | Description | Interfaces | Description of what to be tested at the interface | OK? |
| 1 | The train is moving at constant speed. | ODO(I) | | |
| | | JRU | Messages 136 with no variation of V_TRAIN. | |
| 2 | The estimated GNSS Error is at a constant low level that does not cover the distance between the virtual balises from the diverging track and straight track. The geographic trajectory of the estimated GNSS position is moving along a straight line at constant speed. | GNSS(I) | | |
| | | | | |
| 3 | The estimated GNSS position matches the first virtual balise location. This is before the train enters the switch. | GNSS(I) | | |
| 4 | The virtual balise is emitted. | VBR(O) | | |
| | | JRU | Message 136 with new NID_LRBG | |
| 5 | The estimated GNSS position moves along the straight track and passes indirectly through the virtual balise from the divergent track. However, the virtual balise does not lie in range of the estimated GNSS error. | GNSS(I) | | |



| | | | | |
|-----------------------|--|--|--|--|
| 6 | The virtual balise group shall not be emitted. The VBR may trigger an error reaction. | VBR(I) | Note: The VBR may trigger an error reaction earlier, because it could have detected that the train has left the track. | |
| 7 | The EVC will trigger the brake due to a linking error. | TIU(O) | The linking information for this balise group shall be set to “service brake” or “trip”. | |
| Final state | | Level 2/3 (ERTMS/ETCS Level: 3/4) | | |
| | | Mode FS/SR (ERTMS/ETCS Level: 0/2) | | |
| | | Radio Communication Session: ESTABLISHED | | |
| | | Other parameters | RTM: SAFE CONNECTION SET-UP VBR: Route initialized. GNSS: The GNSS has a good quality. The trajectory of the estimated GNSS position has left the track further than the estimated GNSS error would allow. ODO info: Train is moving at constant speed fitting the GNSS speed. Track DB (OBU side): Loaded | |
| Final Test Result | | (OK or NOT OK) | | |
| Field of Application | | | | |
| Briefing instructions | | | | |

Table 23: Test case CRTK10



6. CONCLUSIONS

In the frame of the WP 2 of the ERSAT GGC Project, the Enhanced ERTMS Functional Architecture, suitable for the introduction of the GNSS technology and the Virtual Balise concept, and for the integration of the IP based Public Mobile Radio Networks has been analysed, and described in the deliverable D2.1.

Subsequently, by following the same approach used for ERTMS, the use of this Enhanced Functional ERTMS Architecture requires the availability of the test suite to be applied for validating (end-to-end) systems based on this new solution. In the frame of the Task 2.2 of ERSAT GGC, the current specification of Functional and Non Functional Tests applicable to the Enhanced ERTMS Functional Architecture has been developed.

Starting from the reference normative for ERTMS/ETC test suites, the Enhanced Functional ERTMS Architecture has been analysed, in order to define the relevant test cases necessary to validate the systems based on the new architecture, and the current document has been produced as deliverable D2.2 of ERSAT GGC. A comprehensive approach has been followed, including also the identification of further assumptions, not contained in the level of detail of the deliverable D2.1 but necessary to define the test to be performed in an accurate way, and the analysis of the laboratory environment applicable to the new architecture.

Two categories of tests have been identified as relevant for the validation of systems implementing the Virtual Balise concept:

- The tests aimed at the verification of the compliance of the system with the Operational Scenarios described in the deliverable D2.1;
- The tests aimed at the verification of the behaviour of the system against the cross-talk.

As a result, the proposed specification includes:

- A list of assumptions about the Virtual Balise and the Virtual Balise Reader that are used for the definition of the test suite, including how the confidence interval and the expectation window shall be calculated;
- A description of the modifications that are foreseen in the ERTMS/ETCS laboratory environment in order to test the new Enhanced Functional Architecture;
- A list of test cases, including the tests with description which will be executed to validate the systems implementing the Architecture.

Both the Enhanced ERTMS Functional Architecture and the Specification of Functional and Non Functional Tests will be further evaluated and assessed by the Notify Bodies in the frame of the WP5 of ERSAT GGC. These steps lead the way to the certification process of the satellite assets to allow the ERTMS to operate seamlessly with Virtual Balises, and represent a fundamental contribution to the roadmap of the ERTMS for the adoption of the EGNSS satellite technology and the Public Radio TLC Technologies.



7. REFERENCES

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