ERTMS/ETCS – Class 1
Performance Requirements for Interoperability
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Company	Technical Approval	Management approval
ALCATEL		
ALSTOM		
ANSALDO SIGNAL		
BOMBARDIER		
INVENSYS RAIL		
SIEMENS		

1. MODIFICATION HISTORY

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2. TABLE OF CONTENTS

3. INTRODUCTION

3.1.1.1   This document contains an analysis of the required technical performances of ERTMS/ETCS equipment that are relevant for interoperability.

3.1.1.2   This means that only characteristics meeting the two following criteria are taken into account:

    a) they must be linked to events that happen on interoperable equipment interfaces. This generally makes it possible to measure the corresponding technical performance at such interfaces. (Exception are clock accuracy and odometric performances, for which the supplier will indicate suitable procedures for demonstration, that are in any case outside the scope of this document).

    b) they must be relevant for the acceptability of a train on a given line

3.1.1.3   According to SRS Class 1 (SUBSET-026) chapter 2, the interoperable interfaces are:

    a) the MMI-Driver FIS;

    b) the TIU-train FIS;

    c) intentionally deleted;

    d) the Eurobalise airgap FFFIS ;

    e) the Euroloop airgap FFFIS;

    f) the GSM-R Mobile – Euroradio FFFIS;

    g) the GSM-R fixed network – RBC FIS;

    h) the RBC-RBC FIS.

3.1.1.4   Procedures for the demonstration of achievement of performances are not in the scope of this document.

3.1.1.5   RAMS requirements are not in the scope in this document.

3.1.1.6   Only levels 0, 1, 2 and 3 are considered in this document.

3.1.1.7   Intentionally deleted

3.1.1.8   Performance requirements in level STM will be according to the corresponding "national" system and are not considered here. (Please refer to SUBSET-059 "Performance requirements for STMs")

3.1.1.9   Chapter 4 contains an example, to clarify the criteria used to identify performance requirements relevant for interoperability.

3.1.1.10   Chapter 5 contains the list of performance requirements and their values.

4. CLARIFICATION OF CRITERIA

4.1.1.1   This chapter contains considerations, to make clear which criteria were followed to identify technical performance requirements of ERTMS equipment, that are relevant for interoperability.

4.1.1.2   The starting point is, obviously, the fact that ERTMS must allow the achievement of operational performances of the railway transportation system, where it is installed.

4.1.1.3   In any case, such operational performances do not depend only on ERTMS: their achievement is in general related to various factors, e.g.,

   a) Physical characteristics of the trackside, such as gradients

   b) Design of the trackside signalling, such as block length, spacing of balise groups, etc.

   c) Quality of installation, such as accuracy of positioning of balise groups

   d) Train characteristics, such as length, braking capability, etc.

   e) Technical performances of non-ERTMS equipment, such as response time of train detection equipment, delay of messages in GSM-R network, etc.

   f) Accuracy of information used by ERTMS equipment, such as resolution of variables

   g) Technical performances of the ERTMS equipment, such as response times, accuracy of location functions, etc.

4.1.1.4   Considering, for instance, the accuracy of supervision of the EOA, it is affected by:

   a) Knowledge of the train location (with respect to the LRBG), depending on the accuracy of train location ensured by the ERTMS on-board equipment and on the spacing of balise groups (design of trackside signalling)

   b) Knowledge of the distance to the EOA, depending on resolution and accuracy of distances given in the MA messages and on accuracy of balise installation

   c) Knowledge of line gradients, depending on resolution and accuracy of information in profile messages

   d) Accuracy of the train speed measured by the ERTMS on-board equipment

   e) Accuracy of braking model and parameters, (i.e., accuracy of the modelling of the train)

4.1.1.5   Only technical performance requirements related to characteristics of ERTMS equipment and relevant for interoperability are considered in this document: for them limit values, according to the state-of-the-art of technological solutions, are given.

4.1.1.6   Other factors, related to physical characteristics of the line or the train, design of trackside signalling, accuracy of installation or modelling of the train, are out of the scope.

5. VALUES FOR TECHNICAL PERFORMANCES

5.1 General considerations

5.1.1.1   The following tables summarise the possible values for technical performance requirements of ERTMS on-board equipment. For each of them feasibility limits are indicated.

5.1.1.2   Technical performance requirements implying response times are defined according to a start event and a stop event, which can be observed on interoperable interfaces.

5.1.1.3   If the start event defining the performance is the receiving of a message by the on-board ERTMS equipment, the value is valid if the actions due to previously received messages are completed (e.g., emergency brake order completely issued, communication session established, indication to driver updated).

5.1.1.4   If the end event defining the performance is the sending of a message by the on-board ERTMS equipment, the value is valid if the sending of previous messages is completed

5.1.1.5   Note: according to SUBSET-026, in case of balise transmission "telegram" is the information sent by one balise and "message" is the whole set of "telegrams" sent by the balises of a group.

5.2 Response Times

5.2.1.1   Delay between receiving of a balise message and applying the emergency brake

Description	delay between receiving of a balise message and applying the emergency brake
Start Event	The reference mark of the on-board antenna leaving the "side lobe zone" of the last balise in the group (1.3 m from the reference mark of the balise)
Stop Event	Beginning of issuing of the braking order on the TIU-train interface
Value	< 1 sec
Notes	It is assumed that the activation of the emergency brake is required by the message contained in the balise group

5.2.1.2   Delay between receiving of a balise message and initiating a communication session establishment

Description	delay between receiving of a balise message and initiating a communication session establishment
Start Event	The reference mark of the on-board antenna leaving the "side lobe zone" of the last balise in the group (1.3 m from the reference mark of the balise)
Stop Event	Beginning of sending of the connection request to the GSM-R mobile Euroradio interface
Value	< 1.5 sec
Notes	It is assumed that the establishment of the communication session is required by the message contained in the balise group

5.2.1.3   Delay between receiving of a balise message and reporting the resulting change of status on-board (e.g., update of EOA, level transition, mode change)

Description	delay between receiving of a balise message and reporting the resulting change of status on-board
Start Event	The reference mark of the on-board antenna leaving the "side lobe zone" of the last balise in the group (1.3 m from the reference mark of the balise)
Stop Event	Indication to the driver
Value	< 1.5 sec
Notes	It is assumed that the change of status is required by the message contained in the balise group The value indicated in this case includes additional delay for the display of the information

5.2.1.4   Delay between receiving of a MA via radio (both from RBC and from radio in-fill) and the update of EOA on-board

Description	delay between receiving of a MA via radio (both from RBC and from radio in-fill) and the update of EOA on-board
Start Event	Reception of the complete MA message at the GSM-R mobile Euroradio interface
Stop Event	Indication to the driver
Value	< 1.5 sec
Notes	It is assumed that the update of the EOA is required by the message received The value indicated in this case includes additional delay for the display of the information

5.2.1.5   Delay between receiving of a MA from Euroloop and the update of EOA on-board

Description	delay between receiving of a MA from Euroloop and the update of EOA on-board

Description	delay between receiving of a MA from Euroloop and the update of EOA on-board
Start Event	A) On-board Euroloop receiver is synchronised, and B) A complete MA message has been received atthe Euroloop air gap interface
Stop Event	Indication to the driver
Value	< 1.5 sec
Notes	It is assumed that the update of the EOA is required by the message received The value indicated in this case includes additional delay for the display of the information

Description	delay between receiving of a MA from Euroloop and the update of EOA on-board
Start Event	A) On-board EUROLOOP receiver knows loop spectrum code, and B) Loop signal becomes available the on-board, and C) On-board Euroloop receiver is not yet synchronised
Stop Event	Indication to the driver
Value	< 3.0 sec
Notes	It is assumed that the update of the EOA is required by the message received The value indicated in this case includes additional delay for the display of the information

5.2.1.6   Delay between receiving of an emergency message and applying the reaction on-board

Description	delay between receiving of an emergency message and applying the reaction on-board
Start Event	Reception of the complete MA message at the GSM-R mobile Euroradio interface
Stop Event	Indication to the driver and/or beginning of issuing of braking order, if required
Value	< 1 sec, for brake order < 1.5 sec, for indication to the driver
Notes	The value given in the case of indication to the driver includes additional delay for the display of the information

5.2.1.7   Delay between receiving of a radio message and initiating a communication session establishment

Description	delay between receiving of a radio message and initiating a communication session establishment
Start Event	Reception of the complete message at the GSM-R mobile Euroradio interface
Stop Event	Beginning of sending of the connection request at the GSM-R mobile Euroradio interface
Value	< 1 sec
Notes	It is assumed that the establishment of the communication session is required by the message received. This performance applies in the case of RBC/RBC handover.

5.2.1.8   Delay between passing an EOLM and decoding of the first loop message

Description	delay between passing an EOLM and decoding of the first loop message
Start Event	The reference mark of the on-board antenna leaving the "side lobe zone" of the last balise of the group giving the EOLM packet (1.3 m from the reference mark of the balise)
Stop Event	Indication to the driver (update of EOA, according to the new MA received)
Value	$\leq$ 4 sec
Notes	It is assumed that the loop signal is received latest 1.0 s after the defined start event. In case the signal is present earlier than the delay, the train will not exploit the full length of the Euroloop cable. The value indicated in this case includes additional delay for the display of the information

5.2.1.9   Cycle of position reports

Description	cycle of position reports
Start Event	not applicable
Stop Event	not applicable
Value	> 5 sec
Notes	This performance defines the maximum rate for sending of position reports, that can be requested to an on-board ERTMS equipment.

5.3 Accuracy

5.3.1.1 Position accuracy measured on-board

Description	position accuracy measured on-board
Start Event	not applicable
Stop Event	not applicable
Value	for every travelled distance s the accuracy shall be better or equal to ± (5m + 5% s) Reference point (normally a balise group) Distance travelled (s) 5m+5% s 5m+5% s Confidence interval Over-reading amount Under-reading amount
Notes	This performance requirement includes the error for detection of balise location, as defined in the Eurobalise specifications. Also in case of malfunctioning the on-board equipment shall evaluate a safe confidence interval. •

5.3.1.2 Accuracy of speed known on-board

Description	accuracy of speed known on-board
Start Event	not applicable
Stop Event	not applicable
Value	± 2 km/h for speed lower than 30 km/h, then increasing linearly up to ± 12 km/h at 500 km/h
Notes	

5.3.1.3 Age of location measurement for position report to trackside

Description	age of location measurement for position report to trackside
Start Event	not applicable

Description	age of location measurement for position report to trackside
Stop Event	not applicable
Value	The location of the train head indicated in a position report shall be estimated less than 1 sec before the beginning of sending of the corresponding position report.
Notes	

5.3.2 Clock

5.3.2.1   Safe clock drift

Description	safe clock drift
Start Event	not applicable
Stop Event	not applicable
Value	0.1 %
Notes	This value is not only a performance but also a safety related requirement as it refers to clock information used for time-stamping of messages and for supervision of time-outs, the magnitude of which is a few minutes. Time Stamp resolution is defined in SUBSET-026