ERTMS/ETCS

FUNCTIONAL REQUIREMENTS FOR AN ON-BOARD

REFERENCE TEST FACILITY

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1. AMENDMENT RECORD

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4.0.0	18/12/24		ETCS Baseline 4 Release 1 release version	Jean-François Verdin

2. TABLE OF CONTENTS

3. REFERENCES, TERMS AND ABBREVIATIONS

3.1 Reference documents

Table 1: Reference documents

Ref. N°	Document Reference	Title
[1]	Subset-023	Glossary of Terms and Abbreviations
[2]	Subset-026	System Requirements Specification
[3]	Subset-027	FIS Juridical Recording
[4]	Subset-034	TIU FIS
[5]	Subset-035	STM FFFIS
[6]	Subset-036	Eurobalise FFFIS
[7]	Subset-037-1	EuroRadio FIS GSM-R CS/PS Communication Functional Module and Coordinating Function FRMCS/GSM-R
[8]	Subset-044	FFFIS for Euroloop
[9]	A11 T6001	Radio transmission FFFIS for EuroRadio
[10]	Subset-056	Safe Time Layer STM FFFIS
[11]	Subset-057	Safe Link Layer STM FFFIS
[12]	Subset-058	Application Layer STM FFFIS
[13]	Subset-085	Test specification for Eurobalise FFFIS
[14]	Subset-076-6-3	Test Sequences
[15]	Subset-076-7	Scope of the test specifications
[16]	ERA_ERTMS_040063	Test Sequence validation and evaluation for Ss-076
[17]	Subset-040	Dimensioning and engineering rules
[18]	Subset-041	Performance requirements for interoperability
[19]	ERA_ERTMS_015560	ETCS Driver Machine Interface
[20]	Subset-059	Performance requirements for STM
[21]	Subset-048	Trainborne FFFIS for Radio Infill
[22]	Subset-047	Trackside-Trainborne FIS for Radio Infill
[23]	Subset-038	Offline key management FIS
[24]	Subset-092-1	ERTMS EuroRadio Conformance Requirements
[25]	Subset-092-2	ERTMS EuroRadio Test Cases Safety Layer
[26]	Subset-037-2	EuroRadio FIS Safety Layer
[27]	Subset-143	ATO over ETCS – Interface Specification – Communication Layers for On-board Communication
[28]	Subset-130	ATO-OB / ETCS-OB FFFIS – Application Layer
[29]	Subset-125	ATO over ETCS – System Requirements Specification
[30]	Subset-147	FFFIS part: CCS Consist Network Communication Layers

Table 1: Reference documents

Ref. N°	Document Reference	Title
[31]	Subset-119	Train Interface FFFIS

3.2 Terms and abbreviations

3.2.1.1 For general terms, definitions and abbreviations refer to document [1]. New terms and abbreviations used in this document are specified here.

Table 2: Abbreviations

Abbreviation	**Definition**
AET	Automatic Evaluation Tool
ATOCS	ATO on-board Communication Simulator
ATOPS	ATO on-board Packets Simulator
BCS	Eurobalise Communication Simulator
BTS	Eurobalise Telegram Simulator
CCS	Control, Command and Signalling
CMD	Cold Movement Detection
CMD-A	Cold Movement Detection Adaptor
CMS	Cold Movement Simulator
DIS	DMI Interface Simulator
EB-A	Eurobalise Antenna
EL-A	Euroloop Antenna
ISDN	Integrated Services Digital Network
JRI	Juridical Recording Interface
JRI-A	Juridical Recording Interface Adaptor
JRS	Juridical Recording Simulator
LCS	Euroloop Communication Simulator
LER	Laboratory Event Recorder
LMS	Euroloop Messages Simulator
LSC	Laboratory Scenario Controller
LSE	Laboratory Scenario Editor
ODO	Odometry function
ODO-A	Odometry Adaptor
RCS	EuroRadio Communication Simulator
RMS	EuroRadio Messages Simulator
SCS	STM Communication Simulator
SIM-A	Simulation Management Adaptor

Table 2: Abbreviations

Abbreviation	Definition
SMS	STM Messages Simulator
SSS	Speed Sensor Simulator
TDA	Train Data Acquisition through external sources
TDA-A	Train Data Acquisition Adaptor
TDS	Train Data Simulator
TIU-A	Train Interface Unit Adaptor
TIS	Train Interface Simulator
TMS	Train Motion Simulator
TSI	Technical Specification for Interoperability

4. OBJECTIVES

4.1.1.1 This document defines the functional requirements for an ETCS reference test facility to perform tests on the on-board Interoperability Constituent.

4.1.1.2 It is also defined the prior requirements to be fulfilled by an on-board Interoperability Constituent before testing.

4.1.1.3 The reference test facility provides an environment for the execution of the tests specified in Subset-076-6-3 (See [14]).

4.1.1.4 This document and Subset-076-6-3 (See [14]), are the means envisaged by the TSI CCS to check the Basic Parameter *On-board ERTMS/ETCS functionality*, present in both Interoperability Constituents *ERTMS/ETCS on-board* and *Odometry*. This means that these documents define only part of the tests to be done on the above mentioned Interoperability Constituents, in order to achieve an EC Declaration of Conformity.

4.1.1.5 It is strongly recommended to perform the tests included in Subset-076-6-3 (See [14]), once the Basic Parameters *CCS safety characteristic relevant for interoperability*, *RMR, ETCS and ATO airgap interfaces* (only Eurobalise and Euroloop airgap interface), *On-board interfaces internal to CCS*, *ETCS DMI*, *On-board ATO functionality* and *Interface to data recording for regulatory purposes* have been proved.

4.1.1.6 The introduction of new specifications, as well as an increased level of modularity in the ERTMS/ETCS on-board unit architecture may have a major impact on the Subset-094 structure in the future.

4.1.1.7 In the current transition period, a scalable approach is being proposed, where most of the interface definitions from previous versions of this document are still maintained, some changes related to new TIU and ATO specifications are being introduced and one of the latest technologies in the TSI CCS, namely the FRMCS, is not being considered until its consolidation.

5. INTRODUCTION

5.1.1.1 The test architecture described in this document is focused on performing the tests defined in Subset-076-6-3 (See [14]), and hence, the compliance with Subset-026 (See [2]).

5.1.1.2 The test specifications in Subset-076-6-3 (See [14]) are designed to check the functional behaviour of the ERTMS/ETCS on-board equipment.

5.1.1.3 Note: within Subset-076-6-3 (See [14]) there are also some functional requirements with timing constraints. This kind of situations is also covered by the present document.

5.1.1.4 The object under test, i.e. the ERTMS/ETCS on-board equipment, is considered as a Black Box with a fixed number of defined interfaces and their determined range of values.

5.1.1.5 The interfaces are defined in Subset-026 (See [2]), section 2.5.3, “ERTMS/ETCS Reference Architecture” and are covered by European specifications.

5.1.1.6 The test facility shall therefore interact with the ERTMS/ETCS on-board equipment through these interfaces.

5.1.1.7 The test facility shall provide FFFIS compliant interfaces, where defined.

5.1.1.8 For the other cases, where only FIS specification is available, this document provides the needed complementary information to allow the data exchange between the ERTMS/ETCS on-board equipment and the test facility.

5.1.1.8.1 Note: For the Train Interface, where the TSI CCS has introduced a new FFFIS, to coexist with the FIS approach during the transition period, this document provides both alternatives.

5.1.1.9 For a proper testing, the test facility shall also provide the appropriate inputs to the on-board internal functions odometry, cold movement detection and train data acquisition from external sources. Since these internal interfaces are not standardized, this document provides the needed information to allow the data exchange between the ERTMS/ETCS on-board equipment and the test facility.

5.1.1.10 For the ERTMS/ETCS on-board equipment, the internal functions odometry and cold movement detection are considered as mandatory, while the interface related to the train data acquisition from external sources is considered as optional in Subset-026 (See [2]). Hence, although the test facility description provided in this document, contains all the possible interfaces, the optional ones shall only be used when implemented on the ERTMS/ETCS on-board equipment.

5.1.1.11 The analysis of the tests shall be done using the data extracted from the standard interfaces.

5.1.1.12 The components related to Euroloop and STM have been defined, although they are considered as optional interfaces for the ERTMS/ETCS on-board equipment. .

6. REFERENCE ON-BOARD EQUIPMENT TEST ARCHITECTURE

6.1 Test basics

6.1.1 Scenario definition

6.1.1.1 The test basic unit shall be the scenario.

6.1.1.2 A scenario shall be composed by the following data:

a) Test sequence (Subset-076-6-3) information: trackside messages to be sent to the equipment under test, basic speed profile, timing and location of the simulation.

b) Track description (track conditions and gradient profiles).

c) Train description, comprising train parameters for the dynamic simulation and train data to be sent to the on-board equipment (see A.2).

d) Simulations details (e.g. list of modules to be used during the simulation and their configuration options).

6.1.1.3 Note: with such a structure, the functional tests, represented by scenarios, gain in flexibility. This architecture makes possible to use the same Test Sequence definition while adapting the test environment to the design choices of the ERTMS/ETCS on-board equipment.

6.1.1.4 Also due to testing circumstances (see [16]), it might be necessary to divide the scenario in several parts in order to guarantee a complete coverage.

6.1.2 Simulation phases

6.1.2.1 The process for performing a test shall go through several phases, summarized in the following requirements.

6.1.2.2 Preparation of the adequate internal states of the ERTMS/ETCS on-board equipment, according to the specific Scenario to be tested. This objective can be achieved by the simulation of a short pre-sequence or, optionally, by means of the Maintenance Module provided by the ERTMS/ETCS on-board equipment supplier.

6.1.2.3 Simulation start. Initialization and synchronization of the lab modules and the Test Adaptor: within this phase the lab modules shall prepare for the simulation and the different communication links with the Test Adaptor shall be established.

6.1.2.4 Initial communication with the Test Adaptor. Within this phase, the train data and the cold movement sensor information shall be provided to the adaptor, if necessary. The initial TIU inputs status shall also be transferred to the Test Adaptor.

6.1.2.5 Scenario run. The scenario starts with the power up of the ERTMS/ETCS on-board equipment under test and finishes when the equipment under test is switched off.

6.1.2.6 Simulation stop. Within this phase, the lab modules and the Test Adaptor shall be stopped. The On-board Recording Device shall be downloaded, if available. Some optional maintenance functions (e.g. deletion of juridical data) can also be performed during this phase.

6.1.3 General overview

6.1.3.1 An overview of the ERTMS/ETCS On-board test architecture is shown in the next figure:

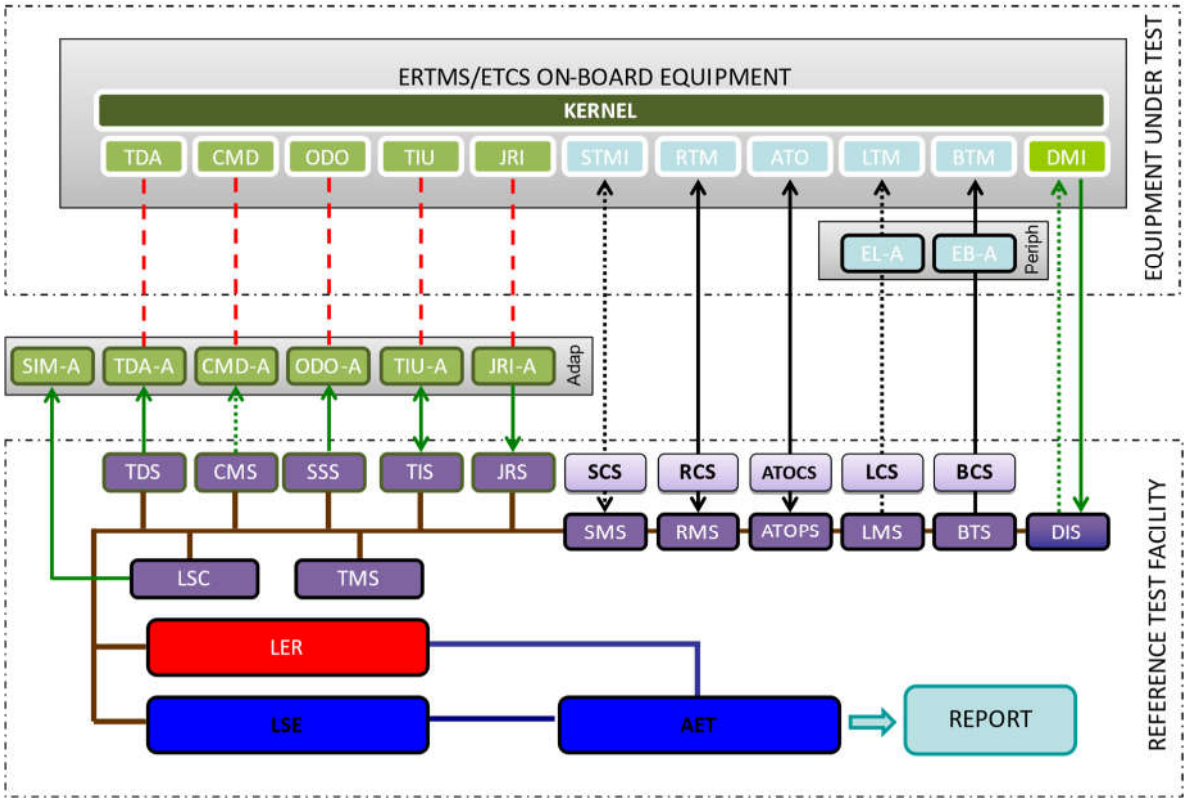

Figure 1: Reference test architecture for ERTMS/ETCS on-board equipment

6.1.3.2 In Table 3, additional information about the different elements in Figure 1 is provided.

Table 3: Drawing convention in Figure 1

Element	Feature	Description	Meaning	Comment
Link	Color	Green	Defined in Subset-094	On-board equipment-Reference Test Facility
Link	Color	Black	Defined in european specifications	On-board equipment-Reference Test Facility
Link	Color	Red	Internal	On-board equipment
Link	Line	Dotted	Optional interface	On-board equipment-Reference Test Facility
Link	Line	Continuous	Mandatory interface	On-board equipment-Reference Test Facility
Link	Line	Discontinuous	Internal	On-board equipment
Link	Color	Brown	Simulation link	Internal Reference Test Facility
Link	Color	Dark Blue	Analysis and evaluation link	Internal Reference Test Facility
Module	Color	Green	Functional module, whose interface, if described, is only at functional level	Internal On-board equipment
Module	Color	Light Blue	Functional module whose interface is described at FFFIS level	Internal On-board equipment
Module	Color	Green	Functional module whose interface with the reference test facility is described at FFFIS level	Internal Test Adaptor
Module	Color	Purple	Functional module with an active role during the simulation	Internal Reference Test Facility
Module	Color	Light purple	Functional module with an active role during the simulation, whose interface is described at FFFIS level	Internal Reference Test Facility

Element	Feature	Description	Meaning	Comment
Module	Color	Red	Functional module with a passive role during the simulation	Internal Reference Test Facility
Module	Color	Blue	Functional module not used during the simulation	Internal Reference Test Facility

6.1.3.3 In Table 2, the meaning of every acronym in Figure 1 is provided. The references to the appropriate specifications for every module are provided in Table 4.

Table 4: Figure 1 references.

Name	Reference	Side
RTM	[2], [7], [9], [21], [22], [24], [25] and [26]	On-board equipment
BTM + EB-A	[2], [6] and [13]	On-board equipment
LTM + EL-A	[2] and [8]	On-board equipment
STMI	[2], [5], [10], [11], [12] and [20]	On-board equipment
JRI	[2] and [3]	On-board equipment
DMI	[2] and [19]	On-board equipment
TIU	[2] and [4]	On-board equipment
ODO	[2]	On-board equipment
CMD	[2]	On-board equipment
TDA	[2]	On-board equipment
TDA-A	Subset-094	TEST ADAPTOR
CMD-A	Subset-094	TEST ADAPTOR
ODO-A	Subset-094	TEST ADAPTOR
TIU-A	Subset-094	TEST ADAPTOR
JRI-A	Subset-094	TEST ADAPTOR
SIM-A	Subset-094	TEST ADAPTOR
RCS	[7], [9], [17], [21], [22], [23], [24], [25] and Subset-094	LAB
BCS	[6], [13], [17] and Subset-094	LAB
LCS	[9], [17] and Subset-094	LAB
SCS	[5], [10], [11], [12], [20] and Subset-094	LAB
DIS	[19] and Subset-094	LAB
TIS	[4] and Subset-094	LAB
SSS	Subset-094	LAB
CMS	Subset-094	LAB
TDS	Subset-094	LAB
JRS	[3] and Subset-094	LAB
RMS	Subset-094	LAB
BTS	Subset-094	LAB
LMS	Subset-094	LAB
SMS	Subset-094	LAB
TMS	Subset-094	LAB
LER	Subset-094	LAB
LSC	Subset-094	LAB
LSE	Subset-094	LAB
AET	Subset-094	LAB
ATOCS	[27], [28], [29] and Subset-094	LAB
ATOPS	Subset-094	LAB

6.1.3.4 The boxes shown in Figure 1, grouped within the *Equipment under test* frame, are just functional modules with the only exception of the peripherals (EL-A and EB-A). The internal implementation details depend exclusively on the ERTMS/ETCS on-board equipment supplier.

6.1.3.5 The boxes shown in Figure 1, grouped within the *Reference Test Facility* frame, are just functional modules. The internal implementation details are out of the scope of this document.

6.1.3.6 For every non-FFFIS interface in the ERTMS/ETCS on-board equipment, this document defines an equivalent FFFIS interface for testing purposes. In case of existing functional specification (ex., see [3] or [4]), this document shall simply add the form fit part. However, in order to avoid contradictions with the current specifications, these test interfaces are moved to the so-called Test Adaptor module.

6.1.3.6.1 Note: the introduction of the FFFIS for the TIU implies slight changes in the Figure 1 and Table 4. The changes are described in section B.

6.2 Equipment under test

6.2.1 General issues

6.2.1.1 As described in Figure 1, the equipment under test shall be composed by the ERTMS/ETCS on-board equipment.

6.2.1.2 With regards to the juridical information, the ERTMS/ETCS on-board unit supplier might decide to provide a complete On-board Recording Device.

6.2.1.2.1 In case an On-board Recording Device is provided, the downloading tool shall also be supplied. Moreover, the ERTMS/ETCS on-board unit supplier shall provide the detailed description about the electronic format used to store the juridical ETCS data in order to make this information available to the reference test architecture.

6.2.1.2.2 In case an On-board Recording Device is provided, the JRI-A and the JRS shall not be necessary.

6.2.2 ERTMS/ETCS on-board equipment

6.2.2.1 The ERTMS/ETCS on-board equipment is defined in Subset-026, section 2.5.2.2 (see [2]).

6.2.2.2 This definition is completed by the Technical Specification for Interoperability relating to the Control Command and Signalling Subsystem, where, in section 5, the basic interoperability constituents for the on-board assembly are defined (see table 5.1). The paragraph 5.2.2 covers the possibility to combine some basic interoperability constituents to form a larger unit.

6.2.2.3 Due to the lack of specifications in certain topics and for testing convenience, the ERTMS/ETCS on-board equipment to be tested in the current reference test architecture shall combine the ETCS on-board and Odometry equipment interoperability constituents, with the following exceptions:

a) The basic Interoperability Constituent *Odometry* shall not be fully implemented, as the odometry sensors providing computable data to the ETCS internal odometry function

shall not be included. In its place an ODO-A shall be used with the ERTMS/ETCS on-board equipment to complete the functionality provided by the Reference Test Facility.

b) The raw data for the *Odometry* shall be provided by the SSS.

c) The odometry related tasks distribution between the ODO-A and the ERTMS/ETCS on-board equipment is out of the scope of this document.

d) The internal function *Cold Movement Detection*, shall not be fully implemented as the device providing this information shall not be included. In its place a CMS-A shall be used with the ERTMS/ETCS on-board equipment to complete the functionality provided by the Reference Test Facility.

e) The raw data for the *Cold Movement Detection* shall be provided by the CMS.

f) The cold movement related tasks distribution between the CMS-A and the ERTMS/ETCS on-board equipment is out of the scope of this document.

g) The internal function *Train Data Acquisition from external sources*, if available, shall not be fully implemented as the train data external source providing this information shall not be included. In its place a TDA-A shall be used with the ERTMS/ETCS on-board equipment to complete the functionality provided by the Reference Test Facility.

h) The raw data for the *Train Data Acquisition from external sources* shall be provided by the TDS.

i) The train data acquisition related tasks distribution between the TDA-A and the ERTMS/ETCS on-board equipment is out of the scope of this document.

j) The *Train Interface Unit* to the Subsystem Rolling Stock is only defined at functional level (see [4]). A TIU-A shall be used with the on-board equipment to complete the functionality provided by the Reference Test Facility.

k) The TIU-A shall exchange the *Train Interface Unit* information with the TIS.

l) The train interface related tasks distribution between the TIU-A and the ERTMS/ETCS on-board equipment is out of the scope of this document.

m) For the communication with the RBC and, optionally, Radio in-fill unit, the on-board internal GSM-R/ETCS interface shall be used, including the EuroRadio protocols.

n) For the interface to the *On-board recording device*, included in the Rolling Stock Subsystem, only the functional description of the information is included in the TSI CCS. A JRI-A shall be used with the on-board equipment to complete the functionality provided by the Reference Test Facility.

o) The JRI-A shall send the Juridical Recording information to the JRS.

p) Alternatively to points n) and o), a complete *On-board recording device* might be supplied with the ERTMS/ETCS on-board equipment (see 6.2.1.2).

6.2.2.4 The remaining ETCS air gap interfaces for Eurobalises and, optionally, Euroloop shall be implemented as defined in the TSI, for the communication between the reference test architecture modules and the ERTMS/ETCS on-board equipment.

6.2.2.5 The STM interface, if available, shall be implemented as defined in the TSI for the communication with the reference test architecture modules.

6.2.2.6 The Key Management system interface, if available, shall be managed internally by the ERTMS/ETCS on-board equipment supplier and is not intended to be connected to the reference test architecture module.

6.2.2.7 The ETCS ID management interface, if available, shall be managed internally by the ERTMS/ETCS on-board equipment supplier and is not intended to be connected to the reference test architecture module.

6.2.2.8 The ETCS Driver Machine Interface shall be implemented as defined in reference [19] and managed by the corresponding reference test architecture module.

6.2.2.9 The ATO on-board interface shall be implemented as defined in the TSI [29][28][27] for the communication with the reference test architecture modules.

6.2.3 The maintenance module

6.2.3.1 The maintenance module is an external module to the ERTMS/ETCS on-board equipment which enables to perform some maintenance functions (e.g. download internal memory logs, set initial configuration, etc) through proprietary interfaces.

6.2.3.2 The use of this module is not mandatory, but recommended, in order to increase the testing efficiency.

6.2.3.3 This module shall not be connected to any reference test architecture module.

6.2.3.4 This module shall never be used for the validation of test results for the Subset-076 (see [14]).

6.3 The Test Adaptor

6.3.1 General issues

6.3.1.1 The Test Adaptor is a module (no matter the implementation details) provided by the ERTMS/ETCS on-board equipment supplier.

6.3.1.1.1 Note: if agreed by both ERTMS/ETCS on-board equipment supplier and the Reference Test Facility, it is allowed to use a combined solution for the test adaptor. In any case, the performance requirements for the Test Adaptor shall be proven.

6.3.1.2 Its main functions shall be to interact with the reference test architecture modules in those interfaces that are not specified at FFFIS level in the European Specifications.

6.3.1.3 The management of the CMD, ODO and TIU interfaces by the Test Adaptor shall be mandatory.

6.3.1.3.1 Exception: the interface related to the train data acquisition from external sources is considered as optional (see 2.6.3.3 in [4]).

6.3.1.3.2 In case no On-board Recording Device is provided with the ERTMS/ETCS on-board equipment to be tested, the JRI shall also be mandatory.

6.3.1.4 The management of the TDA interface shall only be mandatory if this functionality is implemented in the ERTMS/ETCS on-board equipment under test.

6.3.2 Functional description

6.3.2.1 For the ODO interface, the ODO-A shall manage the unidirectional communication with the SSS module. It shall get the location, speed and acceleration information from this module as raw data, and shall transfer this information to the ERTMS/ETCS on-board equipment as computable data in the appropriate internal conditions. See chapter 8 for details.

6.3.2.2 For the TIU interface, the TIU-A shall manage the bidirectional communication with the TIS module. It shall read the status of the TIU implemented inputs from the TIS and shall redirect and write this info in the appropriate format to the TIU. In the other direction, it shall read the status of the TIU implemented outputs from the TIU and shall redirect and write this information in the appropriate format to the TIS. The communication shall not be periodic, but produced upon a change on the TIU signal status. See chapter 8 for details.

6.3.2.3 For the JRI interface, the JRI-A shall manage the unidirectional communication with the JRS module. It shall deliver all the juridical information received from the ERTMS/ETCS on-board equipment to the JRS. See chapter 8 for details.

6.3.2.4 For the CMD interface, the CMD-A shall manage the unidirectional communication with the CMS module. It shall get the cold movement detection status from this link and shall transfer this information to the ERTMS/ETCS on-board equipment in the appropriate internal conditions. See chapter 8 for details.

6.3.2.5 For the TDA interface, the TDA-A shall manage the unidirectional communication with the module TDS. It shall get the train data parameters from this link and shall transfer this information to the ERTMS/ETCS on-board equipment in the appropriate internal conditions. See chapter 8 for details.

6.3.2.6 The Test Adaptor shall also receive simulation management commands from the Reference Test Facility through SIM-A. The commands shall include the possibility to start and stop the test and power up and down the ERTMS/ETCS on-board equipment. See chapter 8 for details.

6.3.2.7 Optionally, the Test Adaptor will be capable to create a System Failure condition to the ERTMS/ETCS on-board equipment. This option shall be commanded by the Reference Test Facility through SIM-A.

6.3.2.8 Optionally, the Test Adaptor will be capable to create a Big Metal Masses alarm condition to the ERTMS/ETCS on-board equipment (which will simulate a Big Metal Masses alarm when such information is received). This option shall be commanded by the Reference Test Facility through SIM-A.

6.3.2.8.1 Note: another possibility to make the ERTMS/ETCS on-board equipment generate such an alarm consists of physically putting metal masses next to the EB-A.

6.3.3 Performance requirements

6.3.3.1 The performance requirements to be fulfilled by the ERTMS/ETCS on-board equipment are already mentioned in reference [18].

6.3.3.2 The performance requirements for interoperability related to TIU (i.e. brake orders) described in the document [18] shall be made extensive to the TIU-A and to every TIU output. That is, the prescribed maximum delays in [18] shall be measured considering the stop event in the interface between the TIU-A and the TIS module.

6.3.3.3 For the TIU inputs, the TIU Adaptor shall not introduce a delay greater than 200 milliseconds between the reception of data coming from the laboratory module TIS and the transmission of this information to the ERTMS/ETCS on-board equipment.

6.3.3.4 Note: the previous requirement is simply a design request for the Test Adaptor supplier, due to the lack of performance specifications related to the management of TIU inputs by the ERTMS/ETCS on-board equipment.

6.3.3.5 For Cold Movement Detection function in Test Adaptor, no performance requirements are necessary since the data flow from CMS to CMD-A and to the ERTMS/ETCS on-board equipment does not need to be synchronized.

6.3.3.6 For Train Data Acquisition function in Test Adaptor, no performance requirements are necessary since the data flow from TDS to TDA-A and to the ERTMS/ETCS on-board equipment does not need to be synchronized.

6.3.3.7 For the JRI outputs, the JRI-A shall not introduce a delay greater than 500 milliseconds between the reception of data coming from the ERTMS/ETCS on-board equipment and the transmission of this information to the laboratory module JRS.

6.3.3.8 Note: the previous requirement is simply a design request for the Test Adaptor supplier, well below the specified value in document [3], requirement 4.1.1.4.

6.3.3.9 The accuracy requirements related to ODO interface (i.e. position and speed accuracy) described in document [18] shall be respected, taking as reference the position and speed generated by the corresponding laboratory module.

6.4 Reference Test Facility

6.4.1 General issues

6.4.1.1 The test to be performed is described in the LSE.

6.4.1.2 The LSC permits the selection of the Scenario to execute and configures the remaining modules before the simulation starts. The LSC module also performs monitoring tasks during the simulation.

6.4.1.3 The simulation start/stop shall be reported not only to the reference test facility modules, but also to the Test Adaptor.

6.4.1.4 The modules in charge of simulating the train dynamic are the SSS, the TIS and the TMS.

6.4.1.5 The SSS calculates the travelled distance and provides this datum to the relevant modules and the odometry information to the ERTMS/ETCS on-board equipment.

6.4.1.6 The TIS manages the TIU signals (see [4]), including the on-board commands affecting the train dynamics.

6.4.1.7 The TMS calculates the speed and acceleration of the train taking into account the interventions read from the TIU and the predefined speed profile.

6.4.1.8 During the simulation, according to the information included in the Scenario, different inputs shall be sent to the on-board equipment to perform the test, while the outputs shall be managed and recorded.

6.4.1.9 The BTS and the LMS manage Eurobalise and Euroloop messages, respectively, according to the travelled distance.

6.4.1.10 The RMS manages the radio messages exchange (also in fill) according to the travelled distance, time constraints and conditions about having received or sent other messages previously.

6.4.1.11 The SMS manages STM messages according to the same kind of conditions as the RMS.

6.4.1.12 The BTS is connected to the BCS which is the module in charge of producing the signals needed to interface with the on-board equipment through the air gap using the corresponding FFFIS (see [6]).

6.4.1.13 The LMS is connected to the LCS which is the module in charge of producing the signals needed to interface with the on-board equipment through the air gap using the corresponding FFFIS (see [8]).

6.4.1.14 The SMS is connected to the SCS which will add all the layers needed to the messages and will send and receive them through a profibus connection, as described in the FFFIS (see [5], [10] & [11]).

6.4.1.15 The RMS is connected to the RCS. This module is connected to the on-board equipment using the interface with the on-board GSM-R mobile equipment, as described in the FFFIS (see [9]). This module also manages the AT commands exchange in the configuration phase (see [9]), and the data encryption/de-encryption in the data transmission phase (see [26]).

6.4.1.15.1 See [21] and [22] for radio data transmission for radio infill if the functionality is implemented in the ERTMS/ETCS on-board equipment under test.

6.4.1.16 The DIS module shall record the information displayed on the DMI. Due to the lack of specifications for the DMI internal interface, the DMI inputs described in Subset-076 Test Sequences will be introduced directly on the DMI interface (see [19]).

6.4.1.17 If needed (see 6.2.1.2.2), the JRS shall record the juridical ETCS information during the simulation.

6.4.1.18 If needed (see 5.1.1.10) and required by the scenario, the TDS shall provide the train data to the Test Adaptor, at least once, before the ERTMS/ETCS on-board equipment is powered up.

6.4.1.19 If required by the scenario, the CMS shall provide the cold movement information to the Test Adaptor before the ERTMS/ETCS on-board equipment is powered up.

6.4.1.20 The ATOPS manages the ATO packets exchange according to the transmitting cycle (if any), travelled distance, time constraints and conditions about having received or sent other packets previously.

6.4.1.21 The ATOPS is connected to the ATOCS which will add all the layers needed to the packets and will send and receive them through an Ethernet connection, as described in the FFFIS (see [27]). The choice of the allowed protocol shall be agreed between the laboratory and the on-board supplier.

6.4.1.22 The LER collects data from the laboratory modules while the simulation takes place.

6.4.1.23 Once the simulation has finished and all the information from the ERTMS/ETCS on-board equipment has been retrieved by the test facility modules, they can be accessed by the AET, which shall compare the logged data with the Test Sequence description and produce a report with the estimated results.

6.4.1.24 Many of the previous modules require interacting with the test operator (user). In the following sections it shall be specified the mandatory user interface functions associated to every module. However, it is out of the scope of this document to mandate a specific implementation of the graphical user interfaces.

6.4.1.25 In the following sections, every module in Figure 1 is described in detail, from a functional point of view. Performance requirements have been added where considered critical for the simulation. For any other case, the only request is the integrity of the information to be transferred from one module to other.

6.4.2 Laboratory Scenario Editor (LSE)

6.4.2.1 Functional description

6.4.2.1.1 This module shall allow managing the scenarios to be used in the simulation. It shall implement as basic functions to create, edit, delete and save a scenario.

6.4.2.1.2 This module shall allow accessing all the information included in the Subset-076-6-3 Test Sequences databases.

6.4.2.1.3 For the remaining information of the scenario, as defined in 6.1.1.2, this module shall provide the means to create, edit, delete and save such information.

6.4.2.1.4 This module shall also permit to define simulation details (e.g. list of modules to be used during the simulation and their configuration options) for every scenario.

6.4.2.1.5 Once all the information is completed and the scenario is saved, it shall be stored into data sets that shall be available for the other modules for a proper testing.

6.4.2.1.6 Optionally, this module can provide some correctness checks in order to avoid undesired mismatches among all the data to be used for a proper simulation.

6.4.2.2 Performance requirements

6.4.2.2.1 Since this module is used prior to any simulation, it does not need to fulfil special requirements in terms of performance.

6.4.3 Laboratory Scenario Controller (LSC)

6.4.3.1 Functional description

6.4.3.1.1 This module shall manage the synchronization with the modules interfacing the ERTMS/ETCS on-board equipment under test and with the Test Adaptor.

6.4.3.1.2 During the simulation, this module shall perform surveillance tasks to control the right behaviour of the laboratory modules involved.

6.4.3.1.3 The mandatory user interface functions for this module are related to the simulation management. At least, it shall be possible to select the scenario, start,/stop the simulation and power up/down the ERTMS/ETCS on-board equipment.

6.4.3.1.3.1 Optionally, it will be possible to send a signal to the Test Adaptor through SIM-A in order to generate a System Failure condition to the ERTMS/ETCS on-board equipment.

6.4.3.1.3.2 Optionally, it will be possible to send a signal to the Test Adaptor through SIM-A in order to generate a Big Metal Masses alarm condition to the ERTMS/ETCS on-board equipment.

6.4.3.1.4 The optional user interface functions for this module are related to the display of general information during the simulation run, retrieved by the modules interfacing the ERTMS/ETCS on-board equipment under test. This general information comprises, at least, the train speed and location, TIU status and messages or packets exchanged through Eurobalise, EuroRadio, Euroloop, STM or ATO on-board interface.

6.4.3.1.5 Optionally, graphical user interface for specific actions related to the train simulation. Specifically, starting the train movement (SSS) and management of TIU inputs (cab activation, direction controller, etc).

6.4.3.2 Performance requirements

6.4.3.2.1 As this module is in charge of controlling and monitoring the simulation, it must handle several communication links. Although the information exchanged is not time critical for the simulation, it is recommended a real time implementation in order to guarantee a predictable and faulty-free behaviour.

6.4.4 Train Interface Simulator (TIS)

6.4.4.1 Functional description

6.4.4.1.1 The TIS will account for the communication with the Test Adaptor related to Train Interface data. This communication shall be bidirectional and shall cover all the train interface information mentioned on [2] and [4], even when the ERTMS/ETCS on-board interface does not implement part of this information. It is the responsability of the TIU-A to filter out this kind of information in its communication with the ERTMS/ETCS on-board equipment.

6.4.4.1.1.1 Note: the data included in this section is the minimum set affected by the ETCS specifications in [2] and [4], although traditionally, the interface with the train can include more information. To extend the train interface beyond the data set here described is an implementation detail, out of the scope of this specification.

6.4.4.1.2 The TIU inputs status (i.e. generated by TIS) shall be transferred to the TIU-A once, before the ERTMS/ETCS on-board equipment is powered up. Later on, when the scenario is running, TIS shall only update this information upon change.

6.4.4.1.3 A set of TIU inputs are just the feedback to the ERTMS/ETCS on-board equipment of equivalent TIU outputs. That is, this set of TIU data can be classified as dependent data and their status shall be affected by the changes on their equivalent TIU output.

6.4.4.1.4 For the dependent TIU inputs the TIS module behaviour shall be configurable, that is, it shall be possible to predefine an specific reaction time for the update of every TIU input after the change detected in the corresponding TIU output. It shall also be possible to program a faulty behaviour (i.e. the TIU input is not updated after the change in the TIU output).

6.4.4.1.5 The dependent TIU inputs are:

a) Special brakes status.

b) Traction status.

6.4.4.1.6 The other set of TIU input data are independent (e.g. desk open/close, sleeping signal, etc). The change in the status of this kind of TIU input data shall be driven manually (through a graphical user interface) or automatically, following the scenario description related to the TIU information exchange in time and location.

6.4.4.1.7 The independent TIU inputs are:

a) Sleeping.

b) Passive Shunting.

c) Direction Controller Position.

d) Cab status.

e) Train Integrity.
f) Non-Leading.
g) Additional brake status.
h) Brake pressure.
i) Type of train data entry.
j) Set speed.
k) Train Running Number.
l) Overall Consist Length Information (if available).
m) Other train data information (if available).

6.4.4.1.8 Note: the following independent TIU inputs affect the train dynamic simulation and shall be managed accordingly:
a) Direction controller position.
b) Cab status.
c) Additional brake status.

6.4.4.1.9 The TIS module, when detecting a change on this set of TIU inputs, shall report this information to the TMS module.

6.4.4.1.10 The TIU outputs status shall be transferred from the TIU-A to the TIS once, before the ERTMS/ETCS on-board equipment is powered up. Later on, when the scenario is running, the TIU-A shall only update this information if their status is modified by the ERTMS/ETCS on-board equipment.

6.4.4.1.11 The TIU outputs can be classified in two groups: TIU outputs affecting the train dynamic simulation (e.g. the service brake) or not (e.g. air tightness).

6.4.4.1.12 The TIS module, when detecting a change on the first set of TIU outputs, shall report this information to the Train Motion Simulator module.

6.4.4.1.13 Note: The following TIU outputs affect the train dynamic simulation and shall be managed accordingly:
a) Service Brake.
b) Emergency Brake.
c) Regenerative Brake Inhibition (STM order).
d) Magnetic Shoe Brake Inhibition (STM order).
e) Eddy Current Brake for SB Inhibition (STM order).
f) Eddy Current Brake for EB Inhibition (STM order).
g) Change of Traction Power.
h) Pantograph (STM order).
i) Main power switch (STM order).
j) Traction Cut-off.
k) Current Consumption.
l) Special brake inhibition area – Trackside orders (Regenerative Brake, Magnetic Shoe Brake, Eddy Current Brake for SB, Eddy Current Brake for EB).
m) Trackside orders: Powerless section with pantograph to be lowered and Powerless section with main power switch to be switched off.

n) Engine orientation in Supervised Manoeuvre.

6.4.4.1.14 Secondly, in case the TIU output updated has an equivalent feedback TIU input, TIS shall proceed to update the corresponding signal, respecting the programmed delay.

6.4.4.1.15 Note: The following TIU outputs do not affect the train dynamic simulation:

a) Isolation
b) Automatic driving
c) Remote shunting
d) Air tightness area – Trackside orders
e) Air tightness – STM orders
f) Station platform

6.4.4.1.16 All the information exchanged between the TIS and the TIU-A shall be reported to the LER with the corresponding timestamp and location. The module status information shall be reported as well.

6.4.4.1.17 The mandatory user interface functions for this module are related to the management of the independent TIU inputs. It shall be possible to modify the status of this information during the simulation.

6.4.4.2 Performance requirements

6.4.4.2.1 The most critical information to be taken into account is the set of TIU outputs affecting the train dynamic simulation.

6.4.4.2.2 The maximum delay between the detection of a change in the status of the TIU output affecting the train dynamic simulation and the availability of this information for the Train Motion Simulator module shall be 200 milliseconds.

6.4.4.2.3 Note: the proposed value is well below the brake reaction time (in the seconds range) , also bounded by limits to be found on the TSI relating to the Rolling Stock sub-system.

6.4.4.2.4 For this module a real time implementation is requested.

6.4.4.3 Interface description

6.4.4.3.1 A detailed proposal for this interface is provided in chapter 8.

6.4.5 Speed Sensor Simulator (SSS)

6.4.5.1 Functional description

6.4.5.1.1 The SSS will account for the communication with the Test Adaptor related to Odometry data. This communication shall be unidirectional and shall be performed either on a cyclic basis, or in a continuous way.

6.4.5.1.2 This module shall provide speed and acceleration to the ODO-A.

6.4.5.1.3 All these information shall be updated periodically by the TMS.

6.4.5.1.4 This module shall calculate the train location from the dynamic data provided by the TMS.

6.4.5.1.5 The train location shall be updated periodically by the SSS. This data shall be available for the remaining modules included in the reference test architecture.

6.4.5.1.6 The SSS time cycle for the location calculation shall be an integer divisor of the TMS time cycle. Note: the distance change rates are higher than the speed change rates.

6.4.5.1.7 This module shall report to the LER the location information with timestamp on a cyclic basis. The module status information shall be reported as well.

6.4.5.2 Performance requirements

6.4.5.2.1 The time cycle for the SSS location calculation shall be at most 100 milliseconds.

6.4.5.2.2 In case the odometry data is transmitted cyclically to the ODO-A, this communication cycle shall be identical to the time cycle used for the location calculation.

6.4.5.2.3 In case the odometry data is transmitted continuously to the ODO-A, the generated speed shall not deviate more than 1% from the theoretical speed.

6.4.5.2.4 The time cycle for reporting location information to LER module shall be a multiple of the previous time cycle not bigger than 20 (10 is recommended, i.e. 1 second).

6.4.5.2.5 In order to avoid undesired drifts in this time cycle, for this module a real time implementation is requested.

6.4.5.2.6 Further details on performance and accuracy are provided in chapter 8.

6.4.5.3 Interface description

6.4.5.3.1 A detailed proposal for both cyclic and continuous transmission of odometric data through this interface is provided in chapter 8.

6.4.6 Cold Movement Sensor Simulator (CMS)

6.4.6.1 Functional description

6.4.6.1.1 The CMS shall account for the communication with the Test Adaptor related to cold movement data.

6.4.6.1.2 This communication shall be unidirectional and shall be performed once, at the beginning of the scenario, before the ERTMS/ETCS on-board equipment is powered up.

6.4.6.1.3 This module shall provide one of the following status information to the Test Adaptor: not available, train has moved, train has not moved or fail state.

6.4.6.1.4 All the information exchanged between the CMS and the CMD Adaptor shall be reported to the LER with the corresponding timestamp and location. The module status information shall be reported as well.

6.4.6.2 Performance requirements

6.4.6.2.1 Since the data flow from CMS to CMD-A and to the ERTMS/ETCS on-board equipment does not need to be synchronized, CMS does not need to fulfil special requirements in terms of performance.

6.4.6.3 Interface description

6.4.6.3.1 A detailed proposal for this interface is provided in chapter 8.

6.4.7 Train Data Simulator (TDS)

6.4.7.1 Functional description

6.4.7.1.1 The TDS shall account for the communication with the Test Adaptor related to the functionality *train data acquisition from external sources*.

6.4.7.1.2 This communication shall be unidirectional and shall be performed at least once, at the beginning of the scenario, before the ERTMS/ETCS on-board equipment is powered up.

6.4.7.1.3 During the simulation run, if the scenario requests a new delivery, this module shall manage to execute more transmissions (with the same data or modified). These new deliveries shall be driven manually (through a graphical user interface) or automatically, following the scenario description related to the train data exchange in time and location.

6.4.7.1.4 All the information exchanged between the TDS and the TDA-A shall be reported to the LER with the corresponding timestamp and location. The module status information shall be reported as well.

6.4.7.2 Performance requirements

6.4.7.2.1 Since the data flow from TDS to TDA-A and to the ERTMS/ETCS on-board equipment does not need to be synchronized, TDS does not need to fulfil special requirements in terms of performance.

6.4.7.3 Interface description

6.4.7.3.1 A detailed proposal for this interface is provided in chapter 8.

6.4.8 Train Motion Simulator (TMS)

6.4.8.1 Functional description

6.4.8.1.1 The TMS, on a cyclic basis, calculates the train speed, acceleration and main pipe pressure in real time, taking into account by one side the train parameters and the speed profile defined in the scenario and by the other side, the status of different TIU data.

6.4.8.1.2 The first set of information (train parameters and predefined speed profile) shall be loaded in the configuration phase.

6.4.8.1.3 The second set of data (TIU information) shall be considered once the simulation is running.

6.4.8.1.4 This module shall take into account the following TIU data:

a) Emergency Brake Command.

b) Service Brake Command.

c) Regenerative Brake Inhibition (due to STM order or Special brake inhibition area – Trackside orders).

d) Eddy Current Brake for SB and for EB Inhibition (due to STM order or Special brake inhibition area – Trackside orders).

e) Magnetic Shoe Brake Inhibition (due to STM order or Special brake inhibition area – Trackside orders).

f) Change of Traction System.

g) Allowed Current Consumption.

h) Traction Cut off.

i) Pantograph up/down (due to STM order or Trackside orders: Powerless section with pantograph to be lowered).

j) Main power switch open/closed (due to STM order or Trackside orders: Powerless section with main power switch to be switched off).

k) Cab Status.

l) Direction Controller

m) Additional Brake status.

6.4.8.1.5 For a correct dynamic simulation, this module shall use the train location data provided by the Speed Sensor Simulation periodically.

6.4.8.1.6 This module shall provide the dynamic information (speed, acceleration and main pipe pressure) periodically to the other modules on the reference test architecture.

6.4.8.1.7 The TMS shall use for its calculation an integer multiple of the SSS time cycle.

6.4.8.1.8 This module shall report to the LER the odometry information with timestamp and location on a cyclic basis. The module status information shall be reported to the LER as well.

6.4.8.2 Performance requirements

6.4.8.2.1 The time cycle for TMS calculations is recommended to be 2 times the SSS time cycle (i.e. 200 milliseconds, if the limit provided in section 6.4.5.2 is used).

6.4.8.2.2 The time cycle for reporting odometry information to LER module shall be a multiple of the previous time cycle not bigger than 10 (5 is recommended, i.e. 1 second).

6.4.8.2.3 In order to avoid undesired drifts in the time cycle, for this module a real time implementation is requested.

6.4.9 Balise Telegram Simulator (BTS)

6.4.9.1 Functional description

6.4.9.1.1 This module shall manage the list of balise telegrams described in the scenario.

6.4.9.1.2 Note: whether this list is loaded in the configuration phase or updated dynamically as the simulation runs is an implementation detail out of the scope of this document.

6.4.9.1.3 The list of balise telegrams shall include the balise location.

6.4.9.1.4 Note: whether this list is arranged by single balise telegrams or by Balise Groups (identifying the number of balises within each group and the separation between them) is an implementation detail out of the scope of this document.

6.4.9.1.5 This module shall manage the communication with the BCS in such a way the performance requirements for BCS are respected.

6.4.9.1.6 This module shall report to the LER the delivery of a balise telegram with timestamp and location. The module status information shall be reported to the LER as well.

6.4.9.2 Performance requirements

6.4.9.2.1 For a proper testing, the location accuracy to be managed by this module shall be better than 0,1 metres.

6.4.9.2.2 Additional requirements shall be provided in the module BCS section.

6.4.10 Loop Message Simulator (LMS)

6.4.10.1 Functional description

6.4.10.1.1 This module shall manage the list of Euroloop messages described in the scenario.

6.4.10.1.2 Note: whether this list is loaded in the configuration phase or updated dynamically as the simulation runs is an implementation detail out of the scope of this document.

6.4.10.1.3 The list of Euroloop messages shall include the Euroloop start and stop location and the key Q_SSCODE (see [2]) to be used for the correct loop signal generation.

6.4.10.1.4 This module shall manage the communication with the LCS in such a way the performance requirements for LCS are respected.

6.4.10.1.5 This module shall report to the LER the start location for the delivery of a loop message, the stop location and the loop message delivered (with timestamp and location). The module status information shall be reported to the LER as well.

6.4.10.2 Performance requirements

6.4.10.2.1 For a proper testing, the location accuracy to be managed by this module shall be better than 0,1 metres.

6.4.10.2.2 Additional requirements shall be provided in the module LCS section.

6.4.11 Radio Message Simulator (RMS)

6.4.11.1 Functional description

6.4.11.1.1 This module shall simulate the trackside safe application (RBC or Radio in-fill unit).

6.4.11.1.2 This module shall be able to simulate, at least, two trackside safe applications.

6.4.11.1.3 This module shall interface to the RCS through the safe service primitives defined in ref. [26].

6.4.11.1.4 Note: the safe services primitives are intended to support the safe connection set-up, the safe data transfer, the safe connection release, error reporting and high priority data.

6.4.11.1.5 All the safe service primitives shall be managed properly (e.g. considering the ETCS ID included in the primitives), but the safe service primitives for error reporting, which shall be considered as optional.

6.4.11.1.6 This module shall manage the complete list of safe service primitives to be delivered to the ERTMS/ETCS on-board equipment (through the RCS module) described in the scenario.

6.4.11.1.7 Note: whether this list is loaded in the configuration phase or updated dynamically as the simulation runs is an implementation detail out of the scope of this document.

6.4.11.1.8 The list of safe services primitives shall include the following information for every primitive: location, delay and condition.

6.4.11.1.9 In case the safe primitive is for data transfer (normal or high priority), it shall also be attached the ETCS radio message (See [2]), as defined in the scenario.

6.4.11.1.10 The safe connection status shall be checked prior to any data transfer.

6.4.11.1.11 The location shall be used as the first trigger condition for sending safe services primitives.

6.4.11.1.12 The delay time shall be considered as the second trigger condition and shall start when the first trigger condition (location) is fulfilled.

6.4.11.1.13 It shall be possible to make the safe services primitive delivery conditional on the reception of a previous safe service primitive in a given time window.

6.4.11.1.14 Moreover, it shall be possible to make the delivery conditional on the reception of a specific ETCS radio message in a given time window.

6.4.11.1.15 It shall manage the ETCS radio messages timestamp (T_TRAIN) in real time, according to the test sequences description and restrictions.

6.4.11.1.16 It shall also manage dependent variables in the ETCS radio messages (variables that depend on previous messages delivered by the ERTMS/ETCS on-board equipment).

6.4.11.1.17 For a correct dynamic simulation, this module shall use the train location data provided by the SSS periodically.

6.4.11.1.18 The time cycle to be used by this module shall be an integer multiple of the SSS time cycle. In any case, in order to improve the accuracy of this module at very high speed simulation, it is recommended to use a configurable time cycle.

6.4.11.1.19 This module shall report to the LER the delivery and reception of every safe service primitive with timestamp and location. The module status information shall be reported to the LER as well.

6.4.11.2 Performance requirements

6.4.11.2.1 The RMS time cycle is recommended to be 2 times the SSS time cycle (i.e. 200 milliseconds, if the lower limit provided in section 6.4.5.2 is used).

6.4.11.2.2 The maximum delay for RMS to deliver a safe service primitive from the first trigger condition shall be 500 ms.

6.4.11.2.3 In order to avoid undesired drifts in the time cycle, for this module a real time implementation is requested.

6.4.11.2.4 Additional requirements shall be provided in the module RCS section.

6.4.12 STM Messages Simulator (SMS)

6.4.12.1 Functional Description

6.4.12.1.1 This module shall manage the STM messages received from the ERTMS/ETCS on-board equipment (through the SCS).

6.4.12.1.2 This module shall manage the list of STM messages to be delivered to the ERTMS/ETCS on-board equipment (through the SCS) described in the scenario.

6.4.12.1.3 Note: whether this list is loaded in the configuration phase or updated dynamically as the simulation runs is an implementation detail out of the scope of this document.

6.4.12.1.4 The STM messages shall fulfil ref. [12].

6.4.12.1.5 The list of STM messages shall include the following information for every message: location, delay and condition.

6.4.12.1.6 The location shall be used as the first trigger condition for sending STM messages.

6.4.12.1.7 The delay time shall be considered as the second trigger condition and shall start when the first trigger condition (location) is fulfilled.

6.4.12.1.8 It shall be possible to make the STM message delivery conditional on the reception of a previous STM message in a given time window.

6.4.12.1.9 It shall be able to manage the list of messages of, at least, one STM.

6.4.12.1.10 For a correct dynamic simulation, this module shall use the train location data provided by the SSS periodically.

6.4.12.1.11 The time cycle to be used by this module shall be an integer multiple of the SSS time cycle. In any case, in order to improve the accuracy of this module at very high speed simulation, it is recommended to use a configurable time cycle.

6.4.12.1.12 This module shall report to the LER the delivery and reception of every STM message with timestamp and location. The module status information shall be reported to the LER as well.

6.4.12.2 Performance requirements

6.4.12.2.1 The SMS time cycle is recommended to be 2 times the SSS time cycle (i.e. 200 milliseconds, if the lower limit provided in section 6.4.5.2 is used).

6.4.12.2.2 The maximum delay for SMS to deliver a STM message from the first trigger condition shall be 500 ms.

6.4.12.2.3 In order to avoid undesired drifts in the time cycle, for this module a real time implementation is requested.

6.4.12.2.4 Additional requirements shall be provided in the module SCS section.

6.4.13 ATO on-board Packets Simulator (ATOPS)

6.4.13.1 Functional Description

6.4.13.1.1 This module shall manage the ATO on-board packets received from the ERTMS/ETCS on-board equipment (through the ATOCS).

6.4.13.1.2 On the one hand, this module shall manage the list of event-based ATO on-board packets to be delivered to the ERTMS/ETCS on-board equipment (through the ATOCS) described in the scenario. Event-based ATO on-board packets are defined in [28]. This module shall only deliver event-based ATO packets to the ERTMS/ETCS on-board equipment (through the ATOCS) once.

6.4.13.1.3 Note: whether this list is loaded in the configuration phase or updated dynamically as the simulation runs is an implementation detail out of the scope of this document.

6.4.13.1.4 On the other hand, this module shall automatically generate the ATO on-board packets to be delivered to the ERTMS/ETCS on-board equipment (through the ATOCS) cyclically. Cyclic ATO on-board packets and associated expected transmitting cycle are defined in [28].

6.4.13.1.5 The ATO on-board packets shall fulfil ref. [28].

6.4.13.1.6 The content of the (event-based or cyclic) ATO on-board packets to be delivered to the ERTMS/ETCS on-board equipment (through the ATOCS) shall be consistent with the expected behavior of the ATO on-board equipment (see [29]) depending on the test scenario.

6.4.13.1.7 The list of event-based ATO on-board packets described in the scenario shall include the following information for every packet: location, delay and condition.

6.4.13.1.8 The cyclic ATO on-board packets described in the scenario shall include the following information: initial values of variables and then location, delay and condition for each modification of value(s) of variable(s).

6.4.13.1.9 The location shall be used as the first trigger condition for sending event-based ATO on-board packets or for modifying the value(s) of variable(s) of cyclic ATO on-board packets.

6.4.13.1.10 The delay time shall be considered as the second trigger condition for sending event-based ATO on-board packets or for modifying the value(s) of variable(s) of cyclic ATO on-board packets and shall start when the first trigger condition (location) is fulfilled.

6.4.13.1.11 It shall be possible to make the event-based ATO on-board packet delivery or modification of the value(s) of variable(s) of cyclic ATO on-board packet conditional on the reception of a previous ATO on-board packet in a given time window.

6.4.13.1.12 After all the triggering conditions have been fulfilled, the modification of the value(s) of variable(s) of a cyclic ATO on-board packet shall be effective the next time this module transmit this packet to the ERTMS/ETCS on-board equipment through the ATOCS (i.e. at the end of the current transmitting cycle).

6.4.13.1.13 It shall be able to manage the list of ATO on-board packets of one ATO on-board equipment.

6.4.13.1.14 For a correct dynamic simulation, this module shall use the train location data provided by the SSS periodically.

6.4.13.1.15 The time cycle to be used by this module shall be an integer multiple of the SSS time cycle. In any case, in order to improve the accuracy of this module at very high speed simulation, it is recommended to use a configurable time cycle.

6.4.13.1.16 This module shall report to the LER the delivery and reception of every ATO on-board packet with timestamp and location. The module status information shall be reported to the LER as well.

6.4.13.2 Performance requirements

6.4.13.2.1 The ATOPS time cycle is recommended to be 1 time the SSS time cycle (i.e. 100 milliseconds, if the lower limit provided in section 6.4.5.2 is used) in order to not be greater than the lowest transmitting cycle of ATO on-board packets.

6.4.13.2.2 The maximum delay for ATOPS to deliver an ATO on-board packet from the first trigger condition shall be 500 ms.

6.4.13.2.3 In order to avoid undesired drifts in the time cycle, for this module a real time implementation is requested.

6.4.13.2.4 Additional requirements shall be provided in the module ATOCS section.

6.4.14 Laboratory Event Recorder (LER)

6.4.14.1 Functional description

6.4.14.1.1 This module shall manage the logging information sent by all the reference test facility modules participating in the simulation.

6.4.14.1.2 The logging information shall be organized by simulation (i.e. scenario run).

6.4.14.1.3 The entries shall be identified by the name of the module sending the information.

6.4.14.2 Performance requirements

6.4.14.2.1 Since this module is not critical for the simulation, it does not need to fulfil special requirements in terms of performance.

6.4.15 Radio Communication Simulator (RCS)

6.4.15.1 Functional description

6.4.15.1.1 It shall emulate at least two class B GSM-R mobile terminals, at physical and logical level (fully compliant with ref. [7] and [9]). The behaviour at logical level shall be programmable and shall include the registration in radio networks and the operation in Circuit-Switched or Packet Switched-Transmission Mode (see [7] and [9]).

6.4.15.1.2 With the GSM-R connection established, it shall implement the EuroRadio protocols described in ref. [7] (It shall be possible to modify the parameters described as optional or configurable in this document).

6.4.15.1.3 This module shall manage an editable table of Keys (Kmac) for encryption, together with the ETCS ID couples (trackside and on-board equipment) affected.

6.4.15.1.4 Finally, for the interface with the RMS, the RCS shall be a Safe Services Provider (see [26]).

6.4.15.1.5 Taking into account the requirements on the RMS, the RCS shall be able to provide as many Safe Services Access Points as Safe Applications are implemented in the RMS.

6.4.15.1.6 This module shall allow generating connection losses at predefined locations and distances. It shall manage predefined radio hole sections.

6.4.15.1.7 This module shall comply with [21] and [22] if radio data transmission for radio infill is implemented in the ERTMS/ETCS on-board equipment under test.

6.4.15.2 Performance requirements

6.4.15.2.1 In order to avoid undesired drifts in the time cycle, for this module a real time implementation is requested.

6.4.15.3 Interface description

6.4.15.3.1 For the physical connection with the ERTMS/ETCS on-board equipment, V.11/RS-422 shall be used (see [9]).

6.4.15.3.2 Some additional recommendations are given in chapter 9.

6.4.16 Juridical Recording Simulator (JRS)

6.4.16.1 Functional description

6.4.16.1.1 The JRS shall account for the communication with the Test Adaptor related to the functionality *juridical data recording*.

6.4.16.1.2 This communication shall be unidirectional, from the ERTMS/ETCS on-board equipment to the JRS, through the JRI-A.

6.4.16.1.3 All the information exchanged between the JRI-A and the JRS shall be reported to the LER with the corresponding timestamp and location. The module status information shall be reported as well.

6.4.16.2 Performance requirements

6.4.16.2.1 In order to avoid undesired drifts in this time cycle, for this module a real time implementation is requested.

6.4.16.3 Interface description

6.4.16.3.1 A detailed proposal for this interface is provided in chapter 8.

6.4.16.3.2 The application messages shall be compliant to reference [3].

6.4.17 Balise Communication Simulator (BCS)

6.4.17.1 Functional description

6.4.17.1.1 It shall generate in the right time and format the balise telegram (fully compliant with ref. [6]).

6.4.17.1.2 The balise telegram shall be modulated with a balise shape which width shall depend on the speed.

6.4.17.1.3 It shall manage at least two different separation distances within the balise groups.

6.4.17.2 Performance requirements

6.4.17.2.1 This module shall be able to dispatch telegrams within the limits described in ref. [17] for the balise positioning at the maximum train speed (500 Km/h).

6.4.17.3 Interface description

6.4.17.3.1 The balise telegram shall be delivered to the ERTMS/ETCS on-board equipment through the air-gap, fully described in ref. [6].

6.4.17.3.2 Some simulation choices (balise shape, power level, test balise description) are provided in chapter 10.

6.4.18 Loop Communication Simulator (LCS)

6.4.18.1 Functional description

6.4.18.1.1 It shall generate in the right time and format the Euroloop message (fully compliant with ref. [8]).

6.4.18.1.2 The message shall be encrypted using the corresponding Q_SSCODE, as specified in the Test Sequence.

6.4.18.2 Performance requirements

6.4.18.2.1 This module shall be able to dispatch loop messages within the limits described in ref. [17] for the Euroloop positioning at the maximum train speed (500 Km/h).

6.4.18.3 Interface description

6.4.18.3.1 The loop message shall be delivered to the ERTMS/ETCS on-board equipment through the air-gap, fully described in ref. [8].

6.4.19 STM Communication Simulator (SCS)

6.4.19.1 Functional description

6.4.19.1.1 It shall emulate the communication layer of an STM, at physical and logical level (compliant with ref. [5]).

6.4.19.1.2 It shall apply the protocols described in ref. [10] (Safe Time Layer STM FFFIS) and ref. [11] (Safe Link Layer STM FFFIS) for encoding/decoding the STM application messages to be delivered/received to/from the ERTMS/ETCS on-board equipment.

6.4.19.1.3 The PROFIBUS configuration shall be editable.

6.4.19.2 Performance requirements

6.4.19.2.1 Ref. [20] shall be used for performance requirements of the module.

6.4.19.3 Interface description

6.4.19.3.1 The messages exchange with the ERTMS/ETCS on-board equipment shall be done through a profibus interface, as defined in ref. [5].

6.4.20 ATO on-board Communication Simulator (ATOCS)

6.4.20.1 Functional description

6.4.20.1.1 It shall emulate the communication layer of an ATO on-board equipment, at physical and logical level (compliant with ref. [27]).

6.4.20.2 Performance requirements

6.4.20.2.1 Ref. [29] shall be used for performance requirements of the module.

6.4.20.3 Interface description

6.4.20.3.1 The messages exchange with the ERTMS/ETCS on-board equipment shall be done through an Ethernet interface, as defined in ref. [27].

6.4.21 DMI Interface Simulator (DIS)

6.4.21.1 Functional description

6.4.21.1.1 It shall record every input and output on the DMI device in digital format.

6.4.21.1.2 It shall be synchronized with the lab tools.

6.4.21.1.3 Optionally, it shall manage in an autonomous way the DMI inputs described in the Test Sequence, permitting in this way an automatic simulation with no operator.

6.4.21.1.4 By default, the DMI inputs shall be introduced manually, by trained staff, following specific procedures for every scenario.

6.4.21.2 Performance requirements

6.4.21.2.1 In order to avoid undesired drifts in the time cycle, for this module a real time implementation is recommended.

6.4.21.2.2 In case the automatic DMI inputs are implemented, the real time implementation shall be requested.

6.4.22 Automatic Evaluation Tool (AET)

6.4.22.1 Functional description

6.4.22.1.1 This is an off line module used to compare the data logged during the simulation with the expected behaviour of the ERTMS/ETCS on-board equipment described in the Test Sequences (ref. [14]).

6.4.22.1.2 The data logged shall comprise the data recorded by LER and the data recorded by DIS.

6.4.22.1.3 In order to ease that comparison, this module shall allow translating the generic description included in ref. [14] into a clear defined observable.

6.4.22.1.4 The observables shall be directly traced to a specific record within the whole set recorded by the different reference test facility modules.

6.4.22.1.5 The comparison mechanism shall be in fact a search of the defined observable within the Test Sequence description in the correct time and location window.

6.4.22.1.6 The automatic evaluation shall provide additional algorithms in order to avoid duplicated matches and solve the dependencies among consecutive steps.

7. SYSTEM INTEGRITY AND VALIDATION

7.1.1.1 The implementation of a test facility shall be used to test an ERTMS/ETCS on-board equipment which shall be SIL 4, although it can include components with a lower SIL.

7.1.1.2 The test facility shall be calibrated before and after testing an ERTMS/ETCS on-board equipment. The calibration shall be done according to the laboratories own procedures.

8. REFERENCE TEST FACILITY INTERFACES

8.1 Introduction

8.1.1.1 This section describes in detail the interfaces of the Reference Test Facility modules with the ERTMS/ETCS on-board equipment.

8.1.1.2 The information here provided is complementary to the existing specifications. Table 4 summarizes the specifications affecting to every interface. The level of detail can be classified as:

a) In cases where the available specifications reach the functional form fit level (ex, the Eurobalise interface), this section shall simply provide some implementation details.

b) In cases where the available specifications reach only the functional level, this section shall provide the form fit part.

c) In cases where no interface specification is available (ex. the internal functions, like *odometry*), this section shall provide a functional form fit specification.

8.1.1.3 Only in case a), the Reference Test Facility shall communicate directly with the ERTMS/ETCS on-board equipment. In cases b) and c) the communication shall be through the Test Adaptor.

8.1.1.3.1 Note: the interfaces through the Test Adaptor (case b) and c)) shall be called Test Interfaces.

8.1.1.4 The data classified as Input shall be transmitted from the Reference Test Facility to the Test Adaptor.

8.1.1.5 The data classified as Output shall be transmitted from the Test Adaptor to the Reference Test Facility.

8.1.1.6 For the communication with the Test Adaptor, two main technologies are recommended: digital I/O and bus driven communication.

8.1.1.7 Only bus driven communication covers completely all the interfaces with the Test Adaptor. However, digital I/O is still recommended, where suitable, since its performance is better and it also simplifies the ERTMS/ETCS on-board equipment integration into the test facility.

8.1.1.8 For the bus driven communication, a complete application layer (messages and variables) is defined within this section. For the lower communication layers, detailed technologies are recommended, depending on the interface.

8.1.1.9 For the digital I/O communication, detailed technologies at physical level are recommended, depending on the interface.

8.1.1.10 For the particular case of the TIU interface, and following the TIU data classification in [4], it has been decided to split the information exchanged in five blocks, described in Table 5.

Table 5: TIU interface blocks

Name	Description	I/O
TIU-1	Mode control and Train status info	Input and Output
TIU-2	Control of brakes info	Input and Output

TIU-3	Train data info	Input
TIU-4	Train functions type I	Output
TIU-5	Train functions type II	Output

8.1.1.11 Taking into account Table 5 and the remaining interfaces, in Table 6 it is summarized the complete set of interfaces with the Test Adaptor, the suitable technologies for implementation in the reference test facility and its use, depending on the particular implementation of the ERTMS/ETCS on-board equipment.

Table 6: Test Interfaces description.

Name	Description	Digital I/O	Bus	Use
CMD	Cold Movement Detection	Yes	Yes	Mandatory
ODO	Odometry interface	Yes	Yes	Mandatory
JRI	Juridical Recording Interface	No	Yes	See 6.2.1.2.2
SIM	Simulation Management	Yes	Yes	Mandatory
TDA	Train Data Acquisition through external sources	No	Yes	If implemented
TIU-1	Mode control and Train status	Yes [1]	Yes	Mandatory
TIU-2	Control of brakes	Yes [2]	Yes	Mandatory
TIU-3	Train data	No	Yes	If implemented
TIU-4	Train functions type I	Yes [3]	Yes	Mandatory
TIU-5	Train functions type II	No	Yes	If implemented

[1] Train status information (Set Speed) is not available in Digital I/O

[2] Special Brake inhibition area – Trackside orders is not available in Digital I/O

[3] Track condition with distance is not available in Digital I/O

8.1.1.12 The specific implementation of a reference test facility shall decide which technology will be used for every specific ERTMS/ETCS on-board equipment. It is out of the scope of this specification to mandate an specific choice for the test interfaces.

8.1.1.13 Independently of the choice for the Test Interfaces, once the ERTMS/ETCS on-board equipment is connected and ready for testing, the test facility shall prove, following its internal procedures, that the performance requirements included in this document are fulfilled.

8.2 Digital Input/Output technology

8.2.1 CMD interface

8.2.1.1 Physical characteristics

8.2.1.1.1 The signal exchange shall work on a range of 0-24 Volts and shall be optically isolated.

8.2.1.1.2 Logical 0 corresponds to 0 Volts, while logical 1 corresponds to 24 Volts.

8.2.1.2 Signals summary

8.2.1.2.1 Two physical input signals are needed to transfer this information, with the meaning indicated in Table 7.

Table 7: CMD digital input meaning.

Data	Meaning	MSB Logical Value	LSB Logical Value
Cold Movement Detection	Information not available	0	0
	Train has moved	0	1
	Train has not moved	1	0
	Fail State	1	1

8.2.2 ODO interface

8.2.2.1 Physical characteristics

8.2.2.1.1 The odometry digital interface shall consist, by one side, on a main square waveform signal. Each period of this signal represents a distance increment. Dividing this distance by the elapsed time, the real speed of the train can be obtained.

8.2.2.1.2 The square wave frequency is, thus, proportional to the speed of the train, according to the following equation:

$$Frequency = \frac{Speed}{I}$$, where I is the increment of distance;

8.2.2.1.3 For the direction information, another signal is needed. This second signal could be a digital signal (0 forward and 1 backward) or the same incremental signal as the first one but with a difference of phase of plus or minus 90 degrees.

8.2.2.1.4 The I parameter will be configurable to some extend. If a too high or a too low value is chosen, the frequency could result in a strange value to be produced by the hardware. The highest value of the frequency of the square signal will be 10 KHz. If the train is moving at 500 Km/h (v=138.9 m/s, worst case scenario), the diameter of the wheel is 1 m (D=1m), and the wheel has 20 teeth (k=20), the frequency needed would be:

$$f = \frac{k \cdot v}{\pi \cdot D} = 884Hz$$

8.2.2.1.5 Although 1 KHz would be enough for a typical case, having a maximum value of 10 KHz ensures that strange combinations of diameter of the wheel and number of teeth will be able to be reproduced in the test facility.

8.2.2.1.6 With this value, for example, if the train is running at 100 m/s (360 Km/h) the increment would be:

$$I = \frac{v}{f} = \frac{100m/s}{10000Hz} = 1cm$$, which is accurate enough.

8.2.2.1.7 The way in which the direction is given will also be configurable. There are two possibilities:

a) Digital output signal:

   i. Logical 0: forward.

ii. Logical 1: backward.

b) Same incremental signal as the first one but with a difference of phase:

i. + 90º: forward.

ii. - 90º: backward.

8.2.2.1.8 The voltage amplitude of the signals shall be TTL (from 0 to 5 Volts).

8.2.2.1.9 Logical 0 corresponds to 0 Volts, while logical 1 corresponds to 5 Volts.

8.2.3 SIM interface

8.2.3.1 Physical characteristics

8.2.3.1.1 The signal exchange shall work on a range of 0-24 Volts and shall be optically isolated.

8.2.3.1.2 Logical 0 corresponds to 0 Volts, while logical 1 corresponds to 24 Volts.

8.2.3.2 Signals summary

8.2.3.2.1 The signals associated to this interface are summarized in Table 8.

Table 8: SIM interface digital signals.

Data	I/O	Nr. physical signals
Start/stop the test	Input	1
Power up/down the on-board equipment	Input	1
System Failure condition	Input	1
Isolate the on-board equipment	Input	1
Big Metal Masses alarm condition	Input	1

8.2.3.2.2 The data encoding is described in Table 9.

Table 9: SIM digital inputs meaning.

Data	Logical 0	Logical 1
Start/stop the test	Start test	Stop test
Power up/down the on-board equipment	Power up on-board equipment	Power down on-board equipment
System Failure condition	Enable SF condition	Disable SF condition
Isolate the on-board equipment	Activate the on-board equipment isolation	Deactivate the on-board equipment isolation
Big Metal Masses alarm condition	Enable BMM alarm condition	Disable BMM alarm condition

8.2.4 TIU interface

8.2.4.1 Physical characteristics

8.2.4.1.1 The signal exchange shall work on a range of 0-24 Volts and shall be optically isolated.

8.2.4.1.2 Logical 0 corresponds to 0 Volts, while logical 1 corresponds to 24 Volts.

8.2.4.2 Signals summary

8.2.4.2.1 The signals associated to this interface are summarized in Table 10.

Table 10: TIU interface digital signals.

Data	I/O	Nr. physical signals
(TIU-1) Sleeping	Input	1
(TIU-1) Passive Shunting	Input	1
(TIU-1) Non Leading	Input	1
(TIU-1) Cab (Desk) A Status	Input	1
(TIU-1) Cab (Desk) B Status	Input	1
(TIU-1) Direction Controller Position	Input	2
(TIU-1) Train Integrity	Input	1
(TIU-1) Traction Status	Input	1
(TIU-1) Isolation	Output	1
(TIU-1) Automatic Driving	Output	1
(TIU-1) Remote Shunting	Output	1
(TIU-2) Service Brake command	Output	1
(TIU-2) Emergency Brake command	Output	1
(TIU-2) Regenerative Brake inhibition [1]	Output	1
(TIU-2) Magnetic Shoe Brake inhibition [1]	Output	1
(TIU-2) Eddy Current Brake for SB inhibition [1]	Output	1
(TIU-2) Eddy Current Brake for EB inhibition [1]	Output	1
(TIU-2) Regenerative Brake status	Input	1
(TIU-2) Magnetic Shoe Brake status	Input	1
(TIU-2) Eddy Current Brake status	Input	1
(TIU-2) Electro-pneumatic Brake status	Input	1
(TIU-2) Additional Brake status	Input	1
(TIU-2) Brake pressure	Input	6
(TIU-4) Pantograph [1]	Output	1
(TIU-4) Air Tightness [1]	Output	1
(TIU-4) Main power switch [1]	Output	1
(TIU-4) Traction Cut-off	Output	1
(TIU-4) Engine orientation in Supervised Manoeuvre	Output	1

[1] Optional: only used for STM order (not needed for Subset-076 test campaigns)

8.2.4.2.2 The encoding of data with just one physical signal is described in Table 11.

Table 11: TIU data with 1 physical signal meaning.

Data	Logical 0	Logical 1
(TIU-1) Sleeping	Sleeping requested	Sleeping not requested
(TIU-1) Passive Shunting	Passive shunting permitted	Passive shunting not permitted
(TIU-1) Non Leading	Non leading permitted	Non leading not permitted
(TIU-1) Cab (Desk) A Status	Cab A active	Cab A not active
(TIU-1) Cab (Desk) B Status	Cab B active	Cab B not active
(TIU-1) Train Integrity	Train integrity OK	Train integrity lost
(TIU-1) Traction Status	Traction On	Traction Off
(TIU-1) Isolation	On-board equipment isolated	On-board equipment not isolated
(TIU-1) Automatic Driving	ERTMS/ETCS on-board is in AD mode	ERTMS/ETCS on-board is not in AD mode

Data	Logical 0	Logical 1
(TIU-1) Remote Shunting	ERTMS/ETCS on-board is in a mode permitting remote shunting	ERTMS/ETCS on-board is not in a mode permitting remote shunting
(TIU-2) Service Brake command	SB commanded	SB not commanded
(TIU-2) Emergency Brake command	EB commanded	EB not commanded
(TIU-2) Regenerative Brake inhibition [1]	Regenerative brake inhibited	Regenerative brake not inhibited
(TIU-2) Magnetic Shoe Brake inhibition [1]	Magnetic Shoe Brake inhibited	Magnetic Shoe Brake not inhibited
(TIU-2) Eddy Current Brake for SB inhibition [1]	Eddy Current Brake for SB inhibited	Eddy Current Brake for SB not inhibited
(TIU-2) Eddy Current Brake for EB inhibition [1]	Eddy Current Brake for EB inhibited	Eddy Current Brake for EB not inhibited
(TIU-2) Regenerative Brake status	Regenerative Brake active	Regenerative Brake not active
(TIU-2) Magnetic Shoe Brake status	Magnetic Shoe Brake active	Magnetic Shoe Brake not active
(TIU-2) Eddy Current Brake status	Eddy Current Brake active	Eddy Current Brake not active
(TIU-2) Electro-pneumatic Brake status	Electro-pneumatic Brake active	Electro-pneumatic Brake not active
(TIU-2) Additional Brake status	Additional Brake active	Additional Brake not active
(TIU-4) Pantograph [1]	Lower pantograph	Raise pantograph
(TIU-4) Air Tightness [1]	Air tightness active (close air conditioning intake)	Air tightness not active (open air conditioning intake)
(TIU-4) Main power switch [1]	Main power switch open	Main power switch close
(TIU-4) Traction Cut-off	Traction cut-off commanded	Traction cut-off not commanded
(TIU-4) Engine orientation in Supervised Manoeuvre	Same as the one of the SM authorisation	Opposite to the one of the SM authorisation

[1] Optional: only used for STM order (not needed for Subset-076 test campaigns)

8.2.4.2.3 The encoding of data with two physical signals is described in Table 12.

Table 12: TIU data with 2 physical signals meaning.

Data	Meaning	MSB Logical Value	LSB Logical Value
(TIU-1) Direction Controller Position	Neutral	0	0
	Forward	0	1
	Backward	1	0
	Not relevant	1	1

8.2.4.2.4 The encoding of data with six physical signals is described in Table 13.

Table 13: TIU data with 6 physical signals meaning.

Data	Meaning	Signal 5 (MSB)	Signal 4	Signal 3	Signal 2	Signal 1	Signal 0 (LSB)

(TIU-2) Brake pressure	0.0 bar	0	0	0	0	0	0
	0.1 bar	0	0	0	0	0	1
	0.2 bar	0	0	0	0	1	0
	0.3 bar	0	0	0	0	1	1
	…	…	…	…	…	…	…
	5.9 bar	1	1	1	0	1	1
	6.0 bar	1	1	1	1	0	0
	Spare	1	1	1	1	0	1
	Spare	1	1	1	1	1	0
	Spare	1	1	1	1	1	1

8.2.4.2.5 Note: the “Spare” value is considered invalid. Its use is forbidden.

8.3 Bus driven communication

8.3.1 Introduction

8.3.1.1 For the bus driven communication of the Reference Test Facility with the Test Adaptor, a complete language has been defined. This language is structured in messages and variables.

8.3.1.2 The language uses variables defined in section 7 of Subset-026 (see [2]) and section 4 of Subset-027 (see [3]). In those cases, only the reference shall be provided. For all the other cases, a complete definition of the variable shall be provided within this document.

8.3.1.3 If needed to obtain an integer number of bytes, padding (bit=1) shall be added at the end of the message.

8.3.2 Test messages

8.3.2.1 Every test message begins with a variable to identify it in a unique way. In Table 14, the complete set of test messages, its direction and the interface associated, is provided.

Table 14: List of test messages

Interface	NID_TEST_MESSAGE	Name	Meaning	I/O	Delivery
SIM	1	SIM-1	Start/stop the test	I	Upon Change
	2	SIM-2	Power up/down the on-board equipment	I	Upon Change
	3	SIM-3	System failure request	I	Upon Change
	4	SIM-4	Ack. message	O	Upon Change
	5	SIM-5	Isolate the on-board equipment	I	Upon Change
	6	SIM-6	Big Metal Masses alarm request	I	Upon Change
TIU-1	10	TIU-1-I-1	Mode control and train status information	I	Upon Change
	11	TIU-1-O-1	Mode control information I	O	Upon Change
	12	TIU-1-I-2	Train status information (Set Speed)	I	Upon Change

	13	TIU-1-O-2	Mode control information II	O	Upon Change
	14	TIU-1-O-3	Mode control information III	O	Upon Change
TIU-2	20	TIU-2-I-1	Brakes status	I	Upon Change
	21	TIU-2-I-2	Brake pressure	I	Upon Change
	22	TIU-2-O-1	Brakes command	O	Upon Change
	23	TIU-2-O-2	Brakes inhibition [1]	O	Upon Change
	24	TIU-2-O-3	Special brake inhibition area	O	Upon Change
TIU-3	30	TIU-3-I-1	Type of train data entry	I	Upon Change
	31	TIU-3-I-2	Train data info	I	Upon Change
	32	TIU-3-I-3	Train interface configuration	I	Upon Change
	33	TIU-3-I-4	Train Running Number	I	Upon Change
	34	TIU-3-I-5	Overall Consist Length	I	Upon Change
TIU-4	40	TIU-4-O-1	Train functions type I [2]	O	Upon Change
	41	TIU-4-O-2	Track conditions with distance	O	Upon Change
	42	TIU-4-O-3	Engine orientation in SM	O	Upon Change
TIU-5	50	TIU-5-O-1	Change of traction system	O	Upon Change
	51	TIU-5-O-2	Station platform	O	Upon Change
	52	TIU-5-O-3	Change of allowed current consumption	O	Upon Change
ODO	60	ODO-1	Odometry information	I	Cyclically
CMD	70	CMD-1	Cold movement status	I	Upon Change
TDA	80	TDA-1	Type of train data entry	I	Upon Change
	81	TDA-2	Train data info	I	Upon Change
	82	TDA-3	Train interface configuration	I	Upon Change
	83	TDA-4	Train Running Number	I	Upon Change
	84	TDA-5	Overall Consist Length	I	Upon Change
JRI	90	JRI-1	Juridical data information	O	Upon Change

[1] Optional: only used for STM order (not needed for Subset-076 test campaigns)

[2] Partially optional: some variables are only used for STM order (not needed for Subset-076 test campaigns)

8.3.2.2 Message number 1: SIM-1

Description	This message shall be used to start and stop the tests		
Transmitted by	LSC		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	T_TEST	32 bits	
	M_STARTTEST	2 bits	

8.3.2.3 Message number 2: SIM-2

Description	This message shall be used to power up and down the on-board equipment		
Transmitted by	LSC		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	T_TEST	32 bits	
	M_POWERUPEVC	2 bits	

8.3.2.4 Message number 3: SIM-3

Description	This message shall be used to create a system failure condition on the on-board equipment		
Transmitted by	LSC		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	T_TEST	32 bits	
	M_SYSTEMFAILURE	2 bits	

8.3.2.5 Message number 4: SIM-4

Description	This message shall be used to acknowledge the reception of SIM messages		
Transmitted by	SIM-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	T_TEST	32 bits	
	NID_TEST_MESSAGE_ACK	8 bits	

8.3.2.6 Message number 5: SIM-5

Description	This message shall be used to isolate the on-board equipment		
Transmitted by	LSC		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	T_TEST	32 bits	
	M_ISOLATION_CM	2 bits	

8.3.2.7 Message number 6: SIM-6

Description	This message shall be used to create a Big Metal Masses alarm condition on the on-board equipment
Transmitted by	LSC

Content	*Variable*	*Length*	*Comments*
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	T_TEST	32 bits	
	M_BMMALARM	2 bits	

8.3.2.8 Message number 10: TIU-1-I-1

Description	This message shall be used to transmit the mode control and train status information to the Test Adaptor		
Transmitted by	TIS		
Content	*Variable*	*Length*	*Comments*
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_SLEEPING_ST	2 bits	
	M_PASSIVESHUNTING_ST	2 bits	
	M_NONLEADING_ST	2 bits	
	M_CAB_ST	3 bits	
	M_DIRECTIONCONTROLLER_ST	3 bits	
	M_TRAININTEGRITY_ST	2 bits	
	M_TRACTION_ST	2 bits	

8.3.2.9 Message number 11: TIU-1-O-1

Description	This message shall be used to transmit the Mode Control information I from the Test Adaptor		
Transmitted by	TIU-A		
Content	*Variable*	*Length*	*Comments*
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_ISOLATION_ST	2 bits	

8.3.2.10 Message number 12: TIU-1-I-2

Description	This message shall be used to transmit the Set Speed information to the Test Adaptor		
Transmitted by	TIS		
Content	*Variable*	*Length*	*Comments*
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_SETSPEED_ST	2 bits	
	V_SETSPEED	10 bits	Defined in Chapter 4 of [3]

8.3.2.11 Message number 13: TIU-1-O-2

Description	This message shall be used to transmit the Mode Control information II from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_AUTOMATICDRIVING_ST	2 bits	

8.3.2.12 Message number 14: TIU-1-O-3

Description	This message shall be used to transmit the Mode Control information III from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_REMOTESHUNTING_ST	2 bits	

8.3.2.13 Message number 20: TIU-2-I-1

Description	This message shall be used to transmit the brakes status to the Test Adaptor		
Transmitted by	TIS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_REGENERATIVEBRAKE_ST	2 bits	
	M_EDDYCURRENTBRAKE_ST	2 bits	
	M_MAGNETICSHOEBRAKE_ST	2 bits	
	M_ELECTROPNEUMATICBRAKE_ST	2 bits	
	M_ADDITIONALBRAKE_ST	2 bits	

8.3.2.14 Message number 21: TIU-2-I-2

Description	This message shall be used to transmit the brake pressure to the Test Adaptor		
Transmitted by	TIS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	P_BRAKEPRESSURE	6 bits	

8.3.2.15 Message number 22: TIU-2-O-1

Description	This message shall be used to transmit the brakes command from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***

	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_SERVICEBRAKE_CM	2 bits	
	M_EMERGENCYBRAKE_CM	2 bits	

8.3.2.16 Message number 23: TIU-2-O-2

Description	This message shall be used to transmit the brakes inhibition commands due to STM order (not needed for Subset-076 test campaigns) from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_REGENERATIVEBRAKE_CM	2 bits	
	M_EDDYCURRENTBRAKE_CM	3 bits	
	M_MAGNETICSHOEBRAKE_CM	2 bits	

8.3.2.17 Message number 24: TIU-2-O-3

Description	This message shall be used to transmit the special brake inhibition area from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_SPECIALBRAKE_CM	3 bits	
	D_TEST_TO_START	32 bits	
	D_TEST_TO_END	32 bits	

8.3.2.18 Message number 30: TIU-3-I-1

Description	This message shall be used to transmit the type of train data entry to the Test Adaptor		
Transmitted by	TIS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_TRAINDATAENTRYTYPE	3 bits	

8.3.2.19 Message number 31: TIU-3-I-2

Description	This message shall be used to transmit the train data info to the Test Adaptor		
Transmitted by	TIS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	V_MAXTRAIN	7 bits	Defined in Chapter 7 of [2]
	NC_CDTRAIN	4 bits	Defined in Chapter 7 of [2]
	NC_TRAIN	15 bits	Defined in Chapter 7 of [2]

	L_TRAIN	12 bits	Defined in Chapter 7 of [2]
	T_TRACTION_CUT_OFF	12 bits	Defined in Chapter 4 of [3]
	M_BRAKE_POSITION	2 bits	Defined in Chapter 4 of [3]
	M_NOM_ROT_MASS	5 bits	Defined in Chapter 4 of [3]
	Q_BRAKE_CAPT_TYPE	1 bit	Defined in Chapter 4 of [3]
	M_BRAKE_PERCENTAGE	8 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Defined in Chapter 4 of [3]
	N_BRAKE_CONF	4 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Defined in Chapter 4 of [3]
	M_BRAKE_LAMBDA_CONF(k)	3 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE_REACT(k)	12 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Service Brake reaction time. Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE(k)	12 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Service Brake equivalent brake build up time for target speed = 0. Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE(k)	12 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Service Brake equivalent brake build up time for target speed > 0. Defined in Chapter 4 of [3]
	N_BRAKE_CONF	4 bits	Only if Q_BRAKE_CAPT_TYPE = 1 (gamma type), N_BRAKE_CONF and the following variables follow until A_BRAKE_SERVICE_COMP inclusive. Defined in Chapter 4 of [3]
	M_BRAKE_GAMMA_CONF(k)	4 bits	Defined in Chapter 4 of [3]
	T_BRAKE_EMERGENCY_REACT(k)	12 bits	Defined in Chapter 4 of [3]
	T_BRAKE_EMERGENCY(k)	12 bits	Defined in Chapter 4 of [3]
	N_BRAKE_SECTIONS(k)	3 bits	Defined in Chapter 4 of [3]
	V_BRAKE_EMERGENCY_COMP(k, m)	10 bits	Defined in Chapter 4 of [3]
	A_BRAKE_EMERGENCY_COMP(k, m)	8 bits	Defined in Chapter 4 of [3]

	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 0)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 1)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 2)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 3)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 4)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 5)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 6)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 7)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 8)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 9)	5 bits	Defined in Chapter 4 of [3]
	M_KWET_RST(A_BRAKE_EMERGENCY_COMP(k, m))	5 bits	Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE_REACT(k)	12 bits	Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE(k)	12 bits	Defined in Chapter 4 of [3]
	N_BRAKE_SECTIONS(k)	3 bits	Defined in Chapter 4 of [3]
	V_BRAKE_SERVICE_COMP(k, m)	10 bits	Defined in Chapter 4 of [3]
	A_BRAKE_SERVICE_COMP(k, m)	8 bits	Defined in Chapter 4 of [3]
	M_LOADINGGAUGE	8 bits	Defined in Chapter 7 of [2]
	N_AXLE	10 bits	Defined in Chapter 7 of [2]
	M_AXLELOADCAT	7 bits	Defined in Chapter 7 of [2]
	N_ITER	5 bits	Defined in Chapter 7 of [2]
	M_VOLTAGE(k)	4 bits	Defined in Chapter 7 of [2]
	NID_CTRACTION(k)	10 bits	Only if M_VOLTAGE(k) ≠ 0. Defined in Chapter 7 of [2]
	N_ITER	5 bits	Defined in Chapter 7 of [2]
	NID_NTC(k)	8 bits	Defined in Chapter 7 of [2]
	M_AIRTIGHT	2 bits	Defined in Chapter 7 of [2]

8.3.2.20 Message number 32: TIU-3-I-3

Description	This message shall be used to transmit the train interface configuration to the Test Adaptor		
Transmitted by	TIS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_REGENERATIVEBRAKE	2 bits	Defined in Chapter 4 of [3]
	M_EDDYCURRENTBRAKE	2 bits	Defined in Chapter 4 of [3]
	M_MAGNETICSHOEBRAKE	2 bits	Defined in Chapter 4 of [3]
	M_ELECTROPNEUMATICBRAKE	2 bits	Defined in Chapter 4 of [3]
	Q_SPECADDBRAKEINDADH	1 bit	Defined in Chapter 4 of [3]
	Q_TRACTIONCUTOFFINTERFACE	1 bit	Defined in Chapter 4 of [3]
	Q_SERVICEBRAKEINTERFACE	1 bit	Defined in Chapter 4 of [3]
	Q_SERVICEBRAKEFEEDBACK	1 bit	Defined in Chapter 4 of [3]

8.3.2.21 Message number 33: TIU-3-I-4

Description	This message shall be used to transmit the Train Running Number to the Test Adaptor		
Transmitted by	TIS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	NID_OPERATIONAL	32 bits	Defined in Chapter 7 of [2]

8.3.2.22 Message number 34: TIU-3-I-5

Description	This message shall be used to transmit the Overall Consist Length to the Test Adaptor		
Transmitted by	TIS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8	
	L_TEST_MESSAGE	12	
	Q_OVERALLCONSISTLENGTH	1	0: No Overall consist length information available 1: Overall consist length information available
	L_CONSISTFRONTCABAMAX	12	Only if Q_OVERALLCONSISTLENGTH = 1, L_CONSISTFRONTCABAMAX and the following variables follow

			Max Consist Length on the side of the engine corresponding to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTFRONTCABAMIN	12	Min Consist Length on the side of the engine corresponding to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTFRONTCABANOM	12	Nominal Consist Length on the side of the engine corresponding to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTREARCABAMAX	12	Max Consist Length on the side of the engine opposite to Cab A and counted from the end of the engine

			corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTREARCABAMIN	12	Min Consist Length on the side of the engine opposite to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTREARCABANOM	12	Nominal Consist Length on the side of the engine opposite to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].

8.3.2.23 Message number 40: TIU-4-O-1

Description	This message shall be used to transmit immediate type I train commands from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_PANTOGRAPH_CM	2 bits	Only used for STM order (not needed for Subset-076 test campaigns)

	M_AIRTIGHTNESS_CM	2 bits	Only used for STM order (not needed for Subset-076 test campaigns)
	M_MAINPOWERSWITCH_CM	2 bits	Only used for STM order (not needed for Subset-076 test campaigns)
	M_TRACTIONCUTOFF_CM	2 bits	

8.3.2.24 Message number 41: TIU-4-O-2

Description	This message shall be used to transmit type I train commands with distance from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_TEST_TRACKCOND	3 bits	
	D_TEST_TO_START	32 bits	
	D_TEST_TO_END	32 bits	

8.3.2.25 Message number 42: TIU-4-O-3

Description	This message shall be used to transmit the Engine orientation in Supervised Manoeuvre from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_ENGINEORIENTATION_ST	2 bits	

8.3.2.26 Message number 50: TIU-5-O-1

Description	This message shall be used to transmit the change of traction system from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_VOLTAGE	4 bits	Defined in Chapter 7 of [2]
	NID_CTRACTION	10 bits	Only if M_VOLTAGE ≠ 0. Defined in Chapter 7 of [2]
	D_TEST_TO_START	32 bits	

8.3.2.27 Message number 51: TIU-5-O-2

Description	This message shall be used to transmit the Station platform info from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	

	M_PLATFORM	4 bits	Defined in Chapter 7 of [2]
	Q_PLATFORM	2 bits	Defined in Chapter 7 of [2]
	D_TEST_TO_START	32 bits	
	D_TEST_TO_END	32 bits	

8.3.2.28 Message number 52: TIU-5-O-3

Description	This message shall be used to transmit the change of allowed current consumption from the Test Adaptor		
Transmitted by	TIU-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_CURRENT	10 bits	Defined in Chapter 7 of [2]
	D_TEST_TO_START	32 bits	

8.3.2.29 Message number 60: ODO-1

Description	This message shall be used to transmit the odometry information to the Test Adaptor		
Transmitted by	SSS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	T_TEST	32 bits	
	Q_TEST_DIST	2 bits	
	D_TEST	32 bits	
	Q_TEST_VEL	2 bits	
	V_TEST	18 bits	
	Q_TEST_ACC	2 bits	
	A_TEST	12 bits	

8.3.2.30 Message number 70: CMD-1

Description	This message shall be used to transmit the cold movement status to the Test Adaptor		
Transmitted by	CMS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_COLDMOVEMENT	2 bits	

8.3.2.31 Message number 80: TDA-1

Description	This message shall be used to transmit the type of train data entry to the Test Adaptor		
Transmitted by	TDS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	

	M_TRAINDATAENTRYTYPE	3 bits	

8.3.2.32 Message number 81: TDA-2

Description	This message shall be used to transmit the train data info to the Test Adaptor		
Transmitted by	TDS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	V_MAXTRAIN	7 bits	Defined in Chapter 7 of [2]
	NC_CDTRAIN	4 bits	Defined in Chapter 7 of [2]
	NC_TRAIN	15 bits	Defined in Chapter 7 of [2]
	L_TRAIN	12 bits	Defined in Chapter 7 of [2]
	T_TRACTION_CUT_OFF	12 bits	Defined in Chapter 4 of [3]
	M_BRAKE_POSITION	2 bits	Defined in Chapter 4 of [3]
	M_NOM_ROT_MASS	5 bits	Defined in Chapter 4 of [3]
	Q_BRAKE_CAPT_TYPE	1 bit	Defined in Chapter 4 of [3]
	M_BRAKE_PERCENTAGE	8 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Defined in Chapter 4 of [3]
	N_BRAKE_CONF	4 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Defined in Chapter 4 of [3]
	M_BRAKE_LAMBDA_CONF(k)	3 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE_REACT(k)	12 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Service Brake reaction time. Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE(k)	12 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Service Brake equivalent brake build up time for target speed = 0. Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE(k)	12 bits	Only if Q_BRAKE_CAPT_TYPE = 0. Service Brake equivalent brake build up time for target speed > 0. Defined in Chapter 4 of [3]
	N_BRAKE_CONF	4 bits	Only if Q_BRAKE_CAPT_TYPE = 1 (gamma type), N_BRAKE_CONF and the following variables follow until A_BRAKE_SERVICE_COMP inclusive. Defined in Chapter 4 of [3]

	M_BRAKE_GAMMA_CONF(k)	4 bits	Defined in Chapter 4 of [3]
	T_BRAKE_EMERGENCY_REACT(k)	12 bits	Defined in Chapter 4 of [3]
	T_BRAKE_EMERGENCY(k)	12 bits	Defined in Chapter 4 of [3]
	N_BRAKE_SECTIONS(k)	3 bits	Defined in Chapter 4 of [3]
	V_BRAKE_EMERGENCY_COMP(k, m)	10 bits	Defined in Chapter 4 of [3]
	A_BRAKE_EMERGENCY_COMP(k, m)	8 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 0)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 1)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 2)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 3)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 4)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 5)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 6)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 7)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 8)	5 bits	Defined in Chapter 4 of [3]
	M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 9)	5 bits	Defined in Chapter 4 of [3]
	M_KWET_RST(A_BRAKE_EMERGENCY_COMP(k, m))	5 bits	Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE_REACT(k)	12 bits	Defined in Chapter 4 of [3]
	T_BRAKE_SERVICE(k)	12 bits	Defined in Chapter 4 of [3]
	N_BRAKE_SECTIONS(k)	3 bits	Defined in Chapter 4 of [3]
	V_BRAKE_SERVICE_COMP(k, m)	10 bits	Defined in Chapter 4 of [3]

	A_BRAKE_SERVICE_COMP(k, m)	8 bits	Defined in Chapter 4 of [3]
	M_LOADINGGAUGE	8 bits	Defined in Chapter 7 of [2]
	N_AXLE	10 bits	Defined in Chapter 7 of [2]
	M_AXLELOADCAT	7 bits	Defined in Chapter 7 of [2]
	N_ITER	5 bits	Defined in Chapter 7 of [2]
	M_VOLTAGE(k)	4 bits	Defined in Chapter 7 of [2]
	NID_CTRACTION(k)	10 bits	Only if M_VOLTAGE(k) ≠ 0. Defined in Chapter 7 of [2]
	N_ITER	5 bits	Defined in Chapter 7 of [2]
	NID_NTC(k)	8 bits	Defined in Chapter 7 of [2]
	M_AIRTIGHT	2 bits	Defined in Chapter 7 of [2]

8.3.2.33 Message number 82: TDA-3

Description	This message shall be used to transmit the train interface configuration to the Test Adaptor		
Transmitted by	TDS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	M_REGENERATIVEBRAKE	2 bits	Defined in Chapter 4 of [3]
	M_EDDYCURRENTBRAKE	2 bits	Defined in Chapter 4 of [3]
	M_MAGNETICSHOEBRAKE	2 bits	Defined in Chapter 4 of [3]
	M_ELECTROPNEUMATICBRAKE	2 bits	Defined in Chapter 4 of [3]
	Q_SPECADDBRAKEINDADH	1 bit	Defined in Chapter 4 of [3]
	Q_TRACTIONCUTOFFINTERFACE	1 bit	Defined in Chapter 4 of [3]
	Q_SERVICEBRAKEINTERFACE	1 bit	Defined in Chapter 4 of [3]
	Q_SERVICEBRAKEFEEDBACK	1 bit	Defined in Chapter 4 of [3]

8.3.2.34 Message number 83: TDA-4

Description	This message shall be used to transmit the Train Running Number to the Test Adaptor		
Transmitted by	TDS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	NID_OPERATIONAL	32 bits	Defined in Chapter 7 of [2]

8.3.2.35 Message number 84: TDA-5

Description	This message shall be used to transmit the Overall Consist Length to the Test Adaptor		
Transmitted by	TDS		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8	
	L_TEST_MESSAGE	12	

	Q_OVERALLCONSISTLENGTH	1	0: No Overall consist length information available 1: Overall consist length information available
	L_CONSISTFRONTCABAMAX	12	Only if Q_OVERALLCONSISTLENGTH = 1, L_CONSISTFRONTCABAMAX and the following variables follow Max Consist Length on the side of the engine corresponding to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTFRONTCABAMIN	12	Min Consist Length on the side of the engine corresponding to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTFRONTCABANOM	12	Nominal Consist Length on the side of the engine corresponding to Cab A and counted from the end of the engine corresponding to the

			orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTREARCABAMAX	12	Max Consist Length on the side of the engine opposite to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTREARCABAMIN	12	Min Consist Length on the side of the engine opposite to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].
	L_CONSISTREARCABANOM	12	Nominal Consist Length on the side of the engine opposite to Cab A and counted from the end of the engine corresponding to the orientation of this cab A, and considering the coupling play and/or any other uncertainties in the consist length information, transmitted to the ERTMS/ETCS on-board in [m].

8.3.2.36 Message number 90: JRI-1

Description	This message shall be used to transmit the juridical data information from the Test Adaptor		
Transmitted by	JRI-A		
Content	***Variable***	***Length***	***Comments***
	NID_TEST_MESSAGE	8 bits	
	L_TEST_MESSAGE	12 bits	
	<JRU MESSAGE>	8 bits	Defined in Chapter 4 of [3]

8.3.3 Test variables

8.3.3.1 A_TEST

Name	Simulated train absolute acceleration		
Description	Instantaneous value of the simulated train acceleration		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
12 bits	0 mm/s²	4094 mm/s²	1 mm/s²
Special/Reserved Values	4095	Unknown	

8.3.3.2 D_TEST

Name	Absolute test distance sign		
Description	Absolute distance managed by the laboratory for every simulation		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
32 bits	0 mm	42949672940 mm	10 mm
Special/Reserved Values	4294967295	Unknown	

8.3.3.3 D_TEST_TO_END

Name	Test distance to the end of a track condition area		
Description	The test distance from the appropiate train reference location to the location where the track condition ends.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
32 bits	-21474836480 mm	21474836470 mm	10 mm

8.3.3.4 D_TEST_TO_START

Name	Test distance to the beginning of a track condition area		
Description	The test distance from the appropiate train reference location to the location where the track condition starts.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
32 bits	-21474836470 mm	21474836470 mm	10 mm
Special/Reserved Values	-2147483648	Not relevant	

8.3.3.5 L_TEST_MESSAGE

Name	Message length in bytes		
Description	Length of the message in bytes, including the needed padding bits rounding up to the nearest greater integer.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
12 bits	0	4095	1 Byte

8.3.3.6 M_ADDITIONALBRAKE_ST

Name	Additional brake status		
Description	Status of the additional brake signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	Na	na
Special/Reserved Values	00	Information not available	
	01	Additional brake is active	
	10	Additional brake is not active	
	11	Fail state	

8.3.3.7 M_AIRTIGHTNESS_CM

Name	Air tightness command		
Description	Indicates the actions on the air-tightness system		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	Na	na
Special/Reserved Values	00	Information not available	
	01	Tunnel condition active (close air conditioning intake)	
	10	Tunnel condition not active (open air conditioning intake)	
	11	Fail state	

8.3.3.8 M_AUTOMATICDRIVING_ST

Name	Automatic driving signal status		
Description	Status of the Automatic driving signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	Na	na
Special/Reserved Values	00	Information not available	
	01	On-board equipment is in AD mode	
	10	On-board equipment is not in AD mode	
	11	Fail state	

8.3.3.9 M_BMMALARM

Name	Variable to enable/disable a Big Metal Masses alarm situation in the ERTMS/ETCS on-board unit
Description	

Length of variable	*Minimum Value*	*Maximum Value*	*Resolution/formula*
2 bits	na	Na	na
Special/Reserved Values	00	Information not available	
	01	Enable a BMM alarm state in the ERTMS/ETCS on-board unit	
	10	Disable a BMM alarm state in the ERTMS/ETCS on-board unit	
	11	Fail state	

8.3.3.10 M_CAB_ST

Name	Cab (Desk) activation status		
Description	Status of the cab (desk) activation signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
3 bits	na	na	na
Special/Reserved Values	000	Information not available	
	001	Both desks are closed	
	010	Desk A is open	
	011	Desk B is open	
	100	Both desks are open	
	101	Spare	
	110	Spare	
	111	Fail state	

8.3.3.11 M_COLDMOVEMENT

Name	Cold Movement Status		
Description	Indicates the status provided by the Cold Movement Detector		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Train has moved	
	10	Train has not moved	
	11	Fail state	

8.3.3.12 M_DIRECTIONCONTROLLER_ST

Name	Direction controller status		
Description	Status of the direction controller signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
3 bits	na	na	na
Special/Reserved Values	000	Information not available	
	001	Direction controller in neutral	
	010	Direction controller in forward	

	011	Direction controller in backward
	100	Spare
	101	Spare
	110	Spare
	111	Fail state

8.3.3.13 M_EDDYCURRENTBRAKE_CM

Name	Eddy current brake inhibition		
Description	Status of the eddy current brake inhibition signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
3 bits	na	na	na
Special/Reserved Values	000	Information not available	
	001	Inhibit eddy current brake for service brake	
	010	Inhibit eddy current brake for emergency brake	
	011	Inhibit eddy current brake for both service and emergency brake	
	100	Do not inhibit eddy current brake for service brake	
	101	Do not inhibit eddy current brake for emergency brake	
	110	Do not inhibit eddy current brake for both service and emergency brake	
	111	Fail state	

8.3.3.14 M_EDDYCURRENTBRAKE_ST

Name	Eddy Current brake status		
Description	Status of the eddy current brake signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Eddy current brake is active	
	10	Eddy current brake is not active	
	11	Fail state	

8.3.3.15 M_ELECTROPNEUMATICBRAKE_ST

Name	Electropneumatic brake status		
Description	Status of the electro pneumatic brake signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Electro pneumatic brake is active	
	10	Electro pneumatic brake is not active	

	11	Fail state

8.3.3.16 M_EMERGENCYBRAKE_CM

Name	Emergency Brake signal command		
Description	Status of the emergency brake command signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Apply emergency brake	
	10	Release emergency brake	
	11	Fail state	

8.3.3.17 M_ENGINEORIENTATION_ST

Name	Engine Orientation signal status		
Description	Status of the engine orientation signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Same as the one of the SM authorisation	
	10	Opposite to the one of the SM authorisation	
	11	Fail state	

8.3.3.18 M_ISOLATION_CM

Name	Isolation signal status		
Description	Status of the isolation signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Isolate the on-board equipment	
	10	Do not isolate the on-board equipment	
	11	Fail state	

8.3.3.19 M_ISOLATION_ST

Name	Isolation signal status		
Description	Status of the isolation signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	On-board equipment is isolated	

	10	On-board equipment is not isolated
	11	Fail state

8.3.3.20 M_MAGNETICSHOEBRAKE_CM

Name	Magnetic shoe brake inhibition		
Description	Status of the magnetic shoe brake inhibition signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Inhibit magnetic shoe brake	
	10	Do not inhibit magnetic shoe brake	
	11	Fail state	

8.3.3.21 M_MAGNETICSHOEBRAKE_ST

Name	Magnetic Shoe brake status		
Description	Status of the magnetic shoe brake signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Magnetic shoe brake is active	
	10	Magnetic shoe brake is not active	
	11	Fail state	

8.3.3.22 M_MAINPOWERSWITCH_CM

Name	Main power switch command		
Description	Indicates the actions on the main power switch		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Open main power switch	
	10	Close main power switch	
	11	Fail state	

8.3.3.23 M_NONLEADING_ST

Name	Non Leading Information		
Description	Status of the non leading signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Non Leading permitted	

	10	Non Leading not permitted
	11	Fail state

8.3.3.24 M_PANTOGRAPH_CM

Name	Pantograph command		
Description	Indicates the actions on the pantograph		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Lower pantograph	
	10	Raise pantograph	
	11	Fail state	

8.3.3.25 M_PASSIVESHUNTING_ST

Name	Passive Shunting signal status		
Description	Status of the passive shunting signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Passive Shunting permitted	
	10	Passive Shunting not permitted	
	11	Fail state	

8.3.3.26 M_POWERUPEVC

Name	Variable to power up/down the ERTMS/ETCS on-board unit		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Power up the ERTMS/ETCS on-board unit	
	10	Power down the ERTMS/ETCS on-board unit	
	11	Fail state	

8.3.3.27 M_REGENERATIVEBRAKE_CM

Name	Regenerative brake inhibition		
Description	Status of the regenerative brake inhibition signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Inhibit regenerative brake	

	10	Do not inhibit regenerative brake
	11	Fail state

8.3.3.28 M_REGENERATIVEBRAKE_ST

Name	Regenerative brake status		
Description	Status of the regenerative brake signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Regenerative brake is active	
	10	Regenerative brake is not active	
	11	Fail state	

8.3.3.29 M_REMOTESHUNTING_ST

Name	Remote Shunting signal status		
Description	Status of the Remote Shunting signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	On-board equipment is in a mode permitting Remote Shunting	
	10	On-board equipment is not in a mode permitting Remote Shunting	
	11	Fail state	

8.3.3.30 M_SERVICEBRAKE_CM

Name	Service Brake signal command		
Description	Status of the service brake command signal (TIU-2)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Apply service brake	
	10	Release service brake	
	11	Fail state	

8.3.3.31 M_SETSPEED_ST

Name	Set Speed display		
Description	Indicates whether the Set Speed value has to be displayed on the DMI		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Display set speed information	

	10	Do not display set speed information
	11	Fail state

8.3.3.32 M_SLEEPING_ST

Name	Sleeping signal status		
Description	Status of the sleeping signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Signal active	
	10	Signal not active	
	11	Fail state	

8.3.3.33 M_SPECIALBRAKE_CM

Name	Special brakes inhibition		
Description	Indicates the track condition type related to inhibition of special brakes		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
3 bits	na	na	na
Special/Reserved Values	000	Information not available	
	001	Track condition: inhibition of regenerative brake	
	010	Track condition: inhibition of magnetic shoe brake	
	011	Track condition: inhibition of eddy current brake for emergency brake	
	100	Track condition: inhibition of eddy current brake for service brake	
	101	Spare	
	110	Spare	
	111	Fail state	

8.3.3.34 M_STARTTEST

Name	Variable to start/stop the test		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Start Test	
	10	Stop Test	
	11	Fail state	

8.3.3.35 M_SYSTEMFAILURE

Name	Variable to enable/disable a system failure situation in the ERTMS/ETCS on-board unit		
Description			
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***

2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Enable a SF state in the ERTMS/ETCS on-board unit	
	10	Disable a SF state in the ERTMS/ETCS on-board unit	
	11	Fail state	

8.3.3.36 M_TEST_TRACKCOND

Name	Track condition indication		
Description	Indicates the track condition type related to train functions		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
3 bits	na	na	na
Special/Reserved Values	000	Information not available	
	001	Powerless section: pantograph	
	010	Powerless section: main switch	
	011	Air tightness area	
	100	Spare	
	101	Spare	
	110	Spare	
	111	Fail state	

8.3.3.37 M_TRACTION_ST

Name	Traction status information		
Description	Status of the train traction signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Traction on	
	10	Traction off	
	11	Fail state	

8.3.3.38 M_TRACTIONCUTOFF_CM

Name	Traction cut-off command		
Description	Indicates the actions on the traction cut-off system		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Apply traction cut-off	
	10	Release traction cut-off	
	11	Fail state	

8.3.3.39 M_TRAINDATAENTRYTYPE

Name	Train data entry type
Description	Indicates the type of train data entry (TIU-3)

Length of variable	*Minimum Value*	*Maximum Value*	*Resolution/formula*
3 bits	na	na	na
Special/Reserved Values	000	Information not available	
	001	Fixed train data entry type	
	010	Flexible train data entry type	
	011	Switchable train data entry type	
	100	Spare	
	101	Spare	
	110	Spare	
	111	Fail state	

8.3.3.40 M_TRAININTEGRITY_ST

Name	Train Integrity Information		
Description	Status of the train integrity signal (TIU-1)		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Train is not integer	
	10	Train is integer	
	11	Fail state	

8.3.3.41 NID_TEST_MESSAGE

Name	Test message identifier		
Description	Test message identifier. For the defined values of NID_TEST_MESSAGE, please see Table 14.		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
8 bits	0	255	Numbers
Special/Reserved Values	0	Not Used	

8.3.3.42 NID_TEST_MESSAGE_ACK

Name	Identifier of the test message to be acknowledged		
Description	Only valid for simulation management test messages		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
8 bits	1	3	Numbers
Special/Reserved Values	0	Not Used	
	4-255	Not Used	

8.3.3.43 P_BRAKEPRESSURE

Name	Brake pressure value
Description	Indicates the value of the brake main pipe pressure (TIU-2)

Length of variable	*Minimum Value*	*Maximum Value*	*Resolution/formula*
6 bits	0 bar	6 bar	0.1 bar
Special/Reserved Values	61	Spare	
	62	Information not available	
	63	Fail state	

8.3.3.44 Q_TEST_ACC

Name	Acceleration sign		
Description	Indicates whether the train is accelerating or braking		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Train is braking	
	10	Train is accelerating	
	11	Fail state	

8.3.3.45 Q_TEST_DIST

Name	Absolute test distance sign		
Description	Indicates the sign of the distance overrun from the begining of the test		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Positive sign	
	10	Negative sign	
	11	Fail state	

8.3.3.46 Q_TEST_VEL

Name	Test speed sign		
Description	Indicates the sense of movement, considering which cabine of the train is being tested		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
2 bits	na	na	na
Special/Reserved Values	00	Information not available	
	01	Forward movement	
	10	Backwards movement	
	11	Fail state	

8.3.3.47 T_TEST

Name	Laboratory clock
Description	Time of the laboratory clock

Length of variable	*Minimum Value*	*Maximum Value*	*Resolution/formula*
32 bits	0 ms	42949672940 ms	10 ms
Special/Reserved Values	4294967295	Unknown	

8.3.3.48 V_TEST

Name	Simulated train speed		
Description	Instantaneous value of the simulated train speed		
Length of variable	***Minimum Value***	***Maximum Value***	***Resolution/formula***
18 bits	0 mm/s	262142 mm/s	1 mm/s
Special/Reserved Values	262143	Unknown	

8.3.4 Physical layer

8.3.4.1 For the bus driven communication, two main physical interfaces are recommended: Ethernet or Serial.

8.3.4.2 Ethernet

8.3.4.2.1 Ethernet interface will use TCP/IP protocols for the communication between the Reference Test Laboratory and the Test Adaptor.

8.3.4.2.2 The Test Adaptor shall work as the server, while the Reference test facility module shall works as clients.

8.3.4.2.3 Every interface in Table 6 shall be managed with a different TCP/IP socket.

Table 15: Test message example.

Variable	*Length*	*Value (decimal)*	*Value (hex)*	*Comments*
NID_TEST_MESSAGE	8 bits	1	01	SIM-1
L_TEST_MESSAGE	12 bits	7	0 07	7 bytes
T_TEST	32 bits	1	00 00 00 01	10 milliseconds
M_STARTTEST	2 bits	2	2	Stop the test

8.3.4.2.4 Example: the datagram to be sent through the TCP/IP socket, corresponding to the message SIM-1 shown in Table 15, in hexadecimal, is:

01 00 70 00 00 00 1B

8.3.4.3 Serial

8.3.4.3.1 Serial interface shall be compliant to RS-422/V.11 specifications. Only TX, RX and GND lines shall be employed. The baud rate for transmission shall be 1 Mb/s.

8.3.4.3.2 Messages shall be encapsulated in order to ensure completeness and validity of data. Encapsulation is described in Table 16 .

Table 16: Test message encapsulation for serial transmission

Size	Description	Range

1 byte	Header of the frame	STX (0x02)
N bytes	Test messages (see 8.3.2): the text data are included in the frame with no modification. The value of each byte of a binary stream is converted in 2 ASCII characters (“00” to “FF”).	String
2 bytes	Checksum: it is calculated only on the N bytes (STX is excluded). The calculation consists on a XOR operation with each ASCII character: The checksum is initialized at zero.	“00” to “FF”
1 byte	Footer of the frame	ETX (0x03)

8.3.4.3.3 It shall be possible to share the same physical link by several interfaces of Table 6. In any case, once the ERTMS/ETCS on-board equipment is connected and ready for testing, the test facility shall prove, following its internal procedures, that the performance requirements included in this document are fulfilled.

8.3.4.3.4 Example: the datagram to be sent through the serial interface, corresponding to the message SIM-1 shown in Table 15, in hexadecimal, is:

02 30 31 30 30 37 30 30 30 30 30 30 30 31 42 37 35 03

9. RCS DETAILS

9.1.1.1 For a correct encryption of the EuroRadio communication, every ERTMS/ETCS on-board equipment shall be configured to work with the following RBCs.

Table 17: RBC parameters for testing

RBC #	NID_C	NID_RBC	ETCS_ID (dec)	ETCS_ID (hex)
1	352	1515	5768683	0x5805EB
2	352	1616	5768784	0x580650
3	64	1515	1050091	0x1005EB
4	64	1616	1050192	0x100650

9.1.1.1.1 The RBC ETCS identifiers are calculated as a concatenation of variables NID_C and NID_RBC

9.1.1.2 The Kmac to be used with RBCs (1) and (3) (in hexadecimal) is the following one:

6D 16 79 98 98 6B 3D 54

FD AD 4A B5 07 0E C2 3B

6D 16 79 98 98 6B 3D 54

9.1.1.3 The Kmac to be used with RBCs (2) and (4) (in hexadecimal) is the following one:

01 02 04 07 08 0B 0D 0E
10 13 15 16 19 1A 1C 1F
20 23 25 26 29 2A 2C 2F

9.1.1.4 For GSM-R communications, the on-board equipment shall support at least the following GSM-R radio networks.

Table 18 - GSM-R radio networks

GSM-R Radio Network #	NID_MN (hex)
1	0x654321
2	0x654322

10. BCS DETAILS

10.1.1.1 In order to calibrate correctly the laboratory devices which shall transmit the Eurobalise signal to the engine antenna, it is recommended:

10.1.1.1.1 Use of reduced size reference loop as defined in Annex H2 in Subset-085 (see [13]).

10.1.1.1.2 Use of Current Sense Balun (CS Balun) as defined in Annex H5.4 in Subset-085 (see [13]).

10.1.1.1.3 Use of High Power Low Pass Filter (HPLP Filter) as defined in Annex F2 in Subset-085 (see [13]).

10.1.1.2 The reduced size reference loop shall be installed in longitudinal position with respect to the engine antenna (see [13]).

10.1.1.3 The distance between engine antenna and Reference Loop shall be 220mm.

10.1.1.4 The measured power in the current sense balun equivalent to Current beween Iu2 and Iu3 (defined in the input/output characteristics tests) shall be around

Iu2 = 59mA (equiv) -11.10 dBm
Iu3 = 186 mA (equiv) -1.12 dBm

10.1.1.5 The equivalence in power is calculated taken into account the measured parameters of the current sense balun, summarized below

Table 19 - Parameters of the current sense balun

Parameter	Value
Iu2 current (mA)	59
Reference Loop B factor at 4.2MHz	0,94
Impedance of CS Balun	50,044
CS Balun Transfer Ratio	3,94E-04
Calculated Plc (dBm)	-11,10

10.1.1.6 For the balise shape the following form is proposed. It was extracted from chapter 5.2.3.1 of Subset-085 (see [13]). The times correspond to speed = 100Km/h.

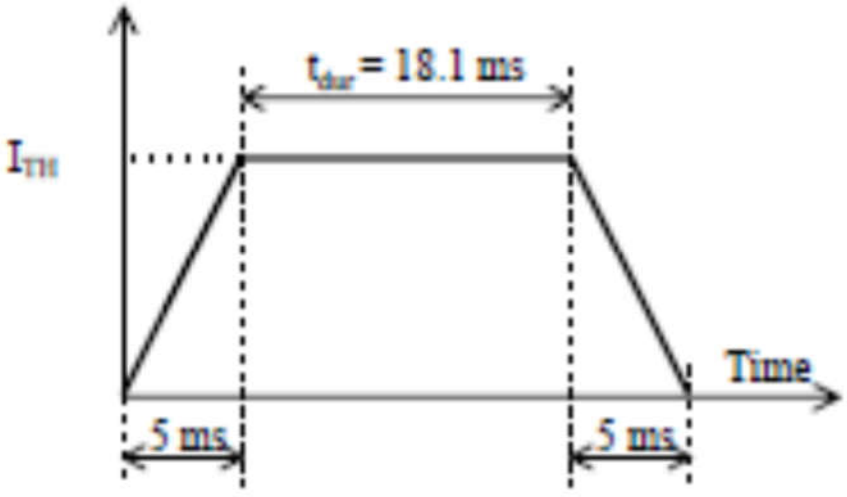

Figure 2 – BCS balise shape

10.1.1.7 The final test configuration shall comply with the following schema

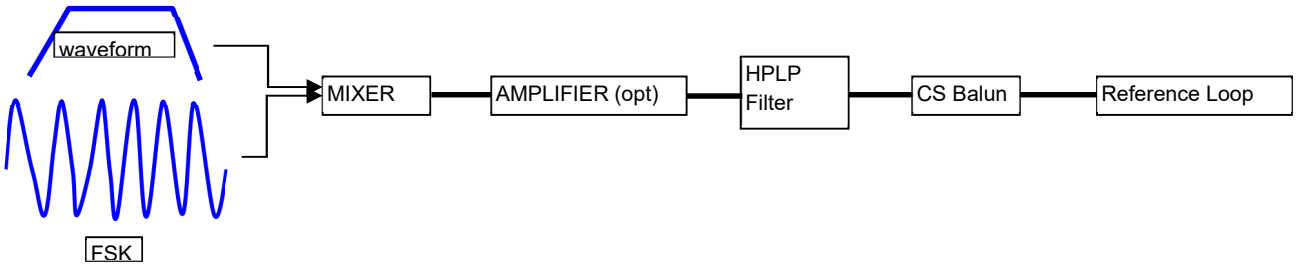

Figure 3 - BCS test configuration

10.1.1.8 After measurement and calibration, the Current Sense Balun can be replaced by a Reference Loop Balun (defined in Annex H5.3 of Subset-085 [13]) for normal operation.

A. Train parameters and requested information

A.1 Introduction

A.1.1.1 The on-board equipment shall comply to the configurations presented in this appendix for the execution of the tests specified in Subset-076-6-3 (see [14]).

A.1.1.2 The on-board equipment supplier shall provide the testing laboratory with the information requested in this appendix prior to a Subset-076 test campaign execution.

A.2 Train parameters for Test Sequences

A.2.1 Introduction

A.2.1.1 This chapter describes the train parameters which shall be used for the test sequences specified in [14].

A.2.1.2 The reference test facility shall be able to simulate the train behaviour according to the train parameters specified within this document.

A.2.1.3 The list of needed train parameters shall be provided by the testing laboratory to the supplier in advance of the test campaign in order to properly engineer the configurations of the OBU.

A.2.2 Generic train data set

A.2.2.1 By default, the on-board equipment under test shall respect the generic train data set specified in Table 20.

A.2.2.2 Note: It should be possible to acquire optionally the brake percentage as train data (see Subset-026 3.13.3.2.2). Input value in such a case: M_BRAKE_PERCENTAGE = 100.

Table 20: Generic train data set

Variable	Value
MAXIMUM TRAIN SPEED	400 km/h (V_MAXTRAIN=80)
CANT DEFICIENCY TRAIN CATEGORY	Cant Deficiency 225 mm (NC_CDTRAIN=7)
OTHER INTERNATIONAL TRAIN CATEGORY	Passenger train (NC_TRAIN=4)
TRAIN LENGTH	40 m (L_TRAIN=40)
TRACTION CUT-OFF TIME DELAY	0 s (T_TRACTION_CUT_OFF=0)
BRAKE POSITION	Passenger train in P (M_BRAKE_POSITION=0)
NOMINAL ROTATING MASS OF THE TRAIN	Unknown (M_NOM_ROT_MASS=16)
M_REGENERATIVEBRAKE	11(Interface exists and affects EB and SB)

Table 20: Generic train data set

Variable	Value
M_EDDYCURRENTBRAKE	11(Interface exists and affects EB and SB)
M_MAGNETICSHOEBRAKE	01(Interface exists and affects only EB)
M_ELECTROPNEUMATICBRAKE	00(No interface)
Q_TRACTIONCUTOFFINTERFACE	1 (Implemented)
Q_SERVICEBRAKEINTERFACE	1 (Implemented)
Q_SERVICEBRAKEFEEDBACK	1 (Implemented)
QUALIFIER FOR GAMMA/LAMBDA DISCRIMINATION	Gamma type: all other captures (Q_BRAKE_CAPT_TYPE=1)
SPECIAL BRAKES CONFIGURATION NUMBER	4 (N_BRAKE_CONF = 3)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR GAMMA TRAINS	M_BRAKE_GAMMA_CONF(1) = 0111 (Regenerative brake interface exists and status is active Eddy current brake interface exists and status is active Magnetic shoe brake interface exists and status is active Ep brake: no interface exists)
EMERGENCY BRAKE REACTION TIME	1 s (T_BRAKE_EMERGENCY_REACT(1)=20)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_EMERGENCY(1)=50)
NUMBER OF EMERGENCY BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(1)=1)
EMERGENCY BRAKE DECELERATION COMPONENT	1 m/s^2 (A_BRAKE_EMERGENCY_COMP(1,1)=100)
SERVICE BRAKE REACTION TIME	1.2 s (T_BRAKE_SERVICE_REACT(1)=24)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_SERVICE(1)=50)
NUMBER OF SERVICE BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(1)=1)
SERVICE BRAKE DECELERATION COMPONENT	1 m/s^2

Table 20: Generic train data set

Variable	Value
	(A_BRAKE_SERVICE_COMP(1,1)=100)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR GAMMA TRAINS	M_BRAKE_GAMMA_CONF(2) = 0101 (Regenerative brake interface exists and status is active Eddy current brake interface exists and status is inactive Magnetic shoe brake interface exists and status is active Ep brake: no interface exists)
EMERGENCY BRAKE REACTION TIME	1 s (T_BRAKE_EMERGENCY_REACT(2)=20)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_EMERGENCY(2)=50)
NUMBER OF EMERGENCY BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(2)=1)
EMERGENCY BRAKE DECELERATION COMPONENT	0,8 m/s^2 (A_BRAKE_EMERGENCY_COMP(2,1)=80)
SERVICE BRAKE REACTION TIME	1.2 s (T_BRAKE_SERVICE_REACT(2)=24)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_SERVICE(2)=50)
NUMBER OF SERVICE BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(2)=1)
SERVICE BRAKE DECELERATION COMPONENT	0,8 m/s^2 (A_BRAKE_SERVICE_COMP(2,1)=80)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR GAMMA TRAINS	M_BRAKE_GAMMA_CONF(3) = 0110 (Regenerative brake interface exists and status is inactive Eddy current brake interface exists and status is active Magnetic shoe brake interface exists and status is active Ep brake: no interface exists)
EMERGENCY BRAKE REACTION TIME	1 s (T_BRAKE_EMERGENCY_REACT(3)=20)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_EMERGENCY(3)=50)

Table 20: Generic train data set

Variable	Value
NUMBER OF EMERGENCY BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(3)=1)
EMERGENCY BRAKE DECELERATION COMPONENT	0,8 m/s^2 (A_BRAKE_EMERGENCY_COMP(3,1)=80)
SERVICE BRAKE REACTION TIME	1.2 s (T_BRAKE_SERVICE_REACT(3)=24)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_SERVICE(3)=50)
NUMBER OF SERVICE BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(3)=1)
SERVICE BRAKE DECELERATION COMPONENT	0,8 m/s^2 (A_BRAKE_SERVICE_COMP(3,1)=80)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR GAMMA TRAINS	M_BRAKE_GAMMA_CONF(4) = 0011 (Regenerative brake interface exists and status is active Eddy current brake interface exists and status is active Magnetic shoe brake interface exists and status is inactive Ep brake: no interface exists)
EMERGENCY BRAKE REACTION TIME	1 s (T_BRAKE_EMERGENCY_REACT(4)=20)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_EMERGENCY(4)=50)
NUMBER OF EMERGENCY BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(4)=1)
EMERGENCY BRAKE DECELERATION COMPONENT	0,8 m/s^2 (A_BRAKE_EMERGENCY_COMP(4,1)=80)
SERVICE BRAKE REACTION TIME	1.2 s (T_BRAKE_SERVICE_REACT(4)=24)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_SERVICE(4)=50)
NUMBER OF SERVICE BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(4)=1)
SERVICE BRAKE DECELERATION COMPONENT	1 m/s^2 (A_BRAKE_SERVICE_COMP(4,1)=100)

Table 20: Generic train data set

Variable	Value
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 50%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 0)=20) (for all brake configurations: from k=1 to k=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 90%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 1)=20) (for all brake configurations: from k=1 to k=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 2)=20) (for all brake configurations: from k=1 to k=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 3)=20) (for all brake configurations: from k=1 to k=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 4)=20) (for all brake configurations: from k=1 to k=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 5)=20) (for all brake configurations: from k=1 to k=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 6)=20) (for all brake configurations: from k=1 to k=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 7)=20) (for all brake configurations: from k=1 to k=4)

Table 20: Generic train data set

Variable	Value
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 8)=20) (for all brake configurations: from k=1 to k=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, 1), 9)=20) (for all brake configurations: from k=1 to k=4)
ROLLING STOCK CORRECTION FACTOR ON WET RAIL	1 (M_KWET_RST(A_BRAKE_EMERGENCY_COMP(k, 1))=20) (for all brake configurations: from k=1 to k=4)
LOADING GAUGE	G1 (M_LOADINGGAUGE=1)
AXLE LOAD CATEGORY	D2 (M_AXLELOADCAT=7) (20 t < Axle Load ≤ 22.5 t)
TRACTION SYSTEM VOLTAGE	DC 3 kV (M_VOLTAGE=3)
COUNTRY IDENTIFIER OF THE TRACTION SYSTEM	Spain, conventional lines 220 km/h, 3 kV DC (NID_CTRACTION=15)
AIRTIGHT SYSTEM	FITTED (M_AIRTIGHT=1)
LIST OF NATIONAL SYSTEMS AVAILABLE ON-BOARD	ASFA AVE (NID_NTC=2) and LZB Spain (NID_NTC=3)
AXLE NUMBER	4 (N_AXLE=4)

A.2.3 Generic without traction system train data set

A.2.3.1 For applicable test sequences requiring an engine able to run on a line not fitted with any traction system (see [15]), the on-board equipment under test shall respect the generic without traction system train data set.

A.2.3.2 The generic without traction system train data set is identical to the Generic train data set specified in Table 20 except that TRACTION SYSTEM VOLTAGE shall be equal to “Line not fitted with any traction system” (M_VOLTAGE=0) and therefore no COUNTRY IDENTIFIER OF THE TRACTION SYSTEM (NID_CTRACTION) shall defined.

A.2.3.3 Note: It should be possible to acquire optionally the brake percentage as train data (see Subset-026 3.13.3.2.2). Input value in such a case: M_BRAKE_PERCENTAGE = 100.

A.2.4 Generic with Safe consist length information train data set

A.2.4.1 For several applicable test sequences testing the Supervised Manoeuvre functionality (see [15]), the on-board equipment under test shall respect the generic with Safe consist length information train data set specified in Table 21.

A.2.4.2 Note: It should be possible to acquire optionally the brake percentage as train data (see Subset-026 3.13.3.2.2). Input value in such a case: M_BRAKE_PERCENTAGE = 100.

Table 21: Generic with Safe consist length information train data set

Variable	Value
MAXIMUM TRAIN SPEED	400 km/h (V_MAXTRAIN=80)
CANT DEFICIENCY TRAIN CATEGORY	Cant Deficiency 225 mm (NC_CDTRAIN=7)
OTHER INTERNATIONAL TRAIN CATEGORY	Passenger train (NC_TRAIN=4)
NOMINAL SAFE CONSIST LENGTH IN REAR OF THE ENGINE	40 m (L_CONSISTREARENGINENOM =40)
MAX SAFE CONSIST LENGTH IN REAR OF THE ENGINE	45 m (L_CONSISTREARENGINEMAX =45)
MIN SAFE CONSIST LENGTH IN REAR OF THE ENGINE	35 m (L_CONSISTREARENGINEMIN =35)
NOMINAL SAFE CONSIST LENGTH IN FRONT OF THE ENGINE	0 m (L_CONSISTFRONTENGINENOM =0)
MAX SAFE CONSIST LENGTH IN FRONT OF THE ENGINE	0 m (L_CONSISTFRONTENGINEMAX =0)
MIN SAFE CONSIST LENGTH IN FRONT OF THE ENGINE	0 m (L_CONSISTFRONTENGINEMIN =0)
TRACTION CUT-OFF TIME DELAY	0 s (T_TRACTION_CUT_OFF=0)
BRAKE POSITION	Passenger train in P (M_BRAKE_POSITION=0)
NOMINAL ROTATING MASS OF THE TRAIN	Unknown (M_NOM_ROT_MASS=16)
Q_TRACTIONCUTOFFINTERFACE	1 (Implemented)
Q_SERVICEBRAKEINTERFACE	1 (Implemented)

Table 21: Generic with Safe consist length information train data set

Variable	Value
Q_SERVICEBRAKEFEEDBACK	1 (Implemented)
QUALIFIER FOR GAMMA/LAMBDA DISCRIMINATION	Gamma type: all other captures (Q_BRAKE_CAPT_TYPE=1)
SPECIAL BRAKES CONFIGURATION NUMBER	1 (no iteration due to N_BRAKE_CONF)
EMERGENCY BRAKE REACTION TIME	1 s (T_BRAKE_EMERGENCY_REACT(k)=20)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_EMERGENCY(k)=50)
NUMBER OF EMERGENCY BRAKE SECTIONS	1 (N_BRAKE_SECTIONS=1)
EMERGENCY BRAKE DECELERATION COMPONENT	1 m/s^2 (A_BRAKE_EMERGENCY_COMP(k,m)=100)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 50%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 0)=20)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 90%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 1)=20)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 2)=20)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 3)=20)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 4)=20)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 5)=20)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 6)=20)

Table 21: Generic with Safe consist length information train data set

Variable	Value
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 7)=20)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 8)=20)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999999%	1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(k, m), 9)=20)
ROLLING STOCK CORRECTION FACTOR ON WET RAIL	1 (M_KWET_RST(A_BRAKE_EMERGENCY_COMP(k, m))=20)
SERVICE BRAKE REACTION TIME	1.2 s (T_BRAKE_SERVICE_REACT (k)=24)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_SERVICE(k)=50)
NUMBER OF SERVICE BRAKE SECTIONS	1 (N_BRAKE_SECTIONS=1)
SERVICE BRAKE DECELERATION COMPONENT	1 m/s^2 (A_BRAKE_SERVICE_COMP(k,m)=100)
LOADING GAUGE	G1 (M_LOADINGGAUGE=1)
AXLE LOAD CATEGORY	D2 (M_AXLELOADCAT=7) (20 t < Axle Load ≤ 22.5 t)
TRACTION SYSTEM VOLTAGE	DC 3 kV (M_VOLTAGE=3)
COUNTRY IDENTIFIER OF THE TRACTION SYSTEM	Spain, conventional lines 220 km/h, 3 kV DC (NID_CTRACTION=15)
AIRTIGHT SYSTEM	FITTED (M_AIRTIGHT=1)
LIST OF NATIONAL SYSTEMS AVAILABLE ON-BOARD	ASFA AVE (NID_NTC=2) and LZB Spain (NID_NTC=3)
AXLE NUMBER	4 (N_AXLE=4)

A.2.5 Train data sets for braking curves test sequences

A.2.5.1 Introduction

A.2.5.1.1 Apart from the generic train data sets defined in Table 20 and Table 21, the on-board equipment under test shall respect the train data set specified in the Tables of this section A.2.5 for the applicable test sequences testing the braking curves.

A.2.5.2 Braking curves Gamma 1 train data set

A.2.5.2.1 This set includes the parameters for the braking model for a Gamma train.

A.2.5.2.2 Note: It should be possible to acquire optionally the brake percentage as train data (see Subset-026 3.13.3.2.2). Input value in such a case: M_BRAKE_PERCENTAGE = 100.

Table 22: Braking curves Gamma 1 train data set

Variable	Value
MAXIMUM TRAIN SPEED	400 km/h (V_MAXTRAIN=80)
CANT DEFICIENCY TRAIN CATEGORY	Cant Deficiency 225 mm (NC_CDTRAIN=7)
OTHER INTERNATIONAL TRAIN CATEGORY	Passenger train (NC_TRAIN=4)
TRAIN LENGTH	200 m (L_TRAIN=200)
TRACTION CUT-OFF TIME DELAY	0,5 s (T_TRACTION_CUT_OFF=110010b)
BRAKE POSITION	Passenger train in P (M_BRAKE_POSITION=0)
NOMINAL ROTATING MASS OF THE TRAIN	Unknown (M_NOM_ROT_MASS=16)
M_REGENERATIVEBRAKE	11(Interface exists and affects EB and SB)
M_EDDYCURRENTBRAKE	11(Interface exists and affects EB and SB)
M_MAGNETICSHOEBRAKE	01(Interface exists and affects only EB)
M_ELECTROPNEUMATICBRAKE	00(No interface)
Q_TRACTIONCUTOFFINTERFACE	1 (Implemented)
Q_SERVICEBRAKEINTERFACE	1 (Implemented)
Q_SERVICEBRAKEFEEDBACK	1 (Implemented)
QUALIFIER FOR GAMMA/LAMBDA DISCRIMINATION	Gamma type: all other captures (Q_BRAKE_CAPT_TYPE=1)
SPECIAL BRAKES CONFIGURATION NUMBER	4 (N_BRAKE_CONF = 3)

Table 22: Braking curves Gamma 1 train data set

Variable	Value
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR GAMMA TRAINS	M_BRAKE_GAMMA_CONF(1) = 0111 (Regenerative brake interface exists and status is active Eddy current brake interface exists and status is active Magnetic shoe brake interface exists and status is active Ep brake: no interface exists)
EMERGENCY BRAKE REACTION TIME	1 s (T_BRAKE_EMERGENCY_REACT(1)=20)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_EMERGENCY(1)=50)
NUMBER OF EMERGENCY BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(1)=1)
EMERGENCY BRAKE DECELERATION COMPONENT (1)	1 m/s^2 (A_BRAKE_EMERGENCY_COMP(1,1)=100)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 50%	0,5 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 0)=10)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 90%	0,6 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 1)=12)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 2)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 3)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 4)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 5)=16)

Table 22: Braking curves Gamma 1 train data set

Variable	Value
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 6)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 7)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 8)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 9)=16)
ROLLING STOCK CORRECTION FACTOR ON WET RAIL	0,8 (M_KWET_RST(A_BRAKE_EMERGENCY_COMP(1, 1))=16)
SERVICE BRAKE REACTION TIME	1.2s (T_BRAKE_SERVICE_REACT(1)=24)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2,5 s (T_BRAKE_SERVICE(1)=50)
NUMBER OF SERVICE BRAKE SECTIONS	2 (N_BRAKE_SECTIONS(1)=2)
SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_SERVICE_COMP(1,1)=0)
SERVICE BRAKE SPEED COMPONENT (2)	100 km/h (V_BRAKE_SERVICE_COMP(1,2)=100)
SERVICE BRAKE DECELERATION COMPONENT (1)	0,8 m/s^2 (A_BRAKE_SERVICE_COMP(1,1)=80)
SERVICE BRAKE DECELERATION COMPONENT (2)	0,6 m/s^2 (A_BRAKE_SERVICE_COMP(1,2)=60)
NUMBER OF NORMAL SERVICE BRAKE SECTIONS	2 (N_BRAKE_NORMAL_SERVICE_SECTIONS(1)=2)
NORMAL SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_NORMAL_SERVICE_COMP(1,1)=0)
NORMAL SERVICE BRAKE SPEED COMPONENT (2)	100 km/h

Table 22: Braking curves Gamma 1 train data set

Variable	Value
	(V_BRAKE_NORMAL_SERVICE_COMP(1,2)=100)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (1)	0,5 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(1,1)=50)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (2)	0,3 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(1,2)=30)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR GAMMA TRAINS	M_BRAKE_GAMMA_CONF(2) = 0101 (Regenerative brake interface exists and status is active Eddy current brake interface exists and status is inactive Magnetic shoe brake interface exists and status is active Ep brake: no interface exists)
EMERGENCY BRAKE REACTION TIME	1 s (T_BRAKE_EMERGENCY_REACT(2)=20)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	3,5 s (T_BRAKE_EMERGENCY(2)=70)
NUMBER OF EMERGENCY BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(2)=1)
EMERGENCY BRAKE DECELERATION COMPONENT (1)	0,8 m/s^2 (A_BRAKE_EMERGENCY_COMP(2,1)=80)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 50%	0,5 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 0)=10)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 90%	0,6 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 1)=12)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 2)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 3)=16)

Table 22: Braking curves Gamma 1 train data set

Variable	Value
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 4)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 5)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 6)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 7)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 8)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(2, 1), 9)=16)
ROLLING STOCK CORRECTION FACTOR ON WET RAIL	0,8 (M_KWET_RST(A_BRAKE_EMERGENCY_COMP(2, 1))=16)
SERVICE BRAKE REACTION TIME	1.2s (T_BRAKE_SERVICE_REACT(2)=24)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2,5 s (T_BRAKE_SERVICE(2)=50)
NUMBER OF SERVICE BRAKE SECTIONS	2 (N_BRAKE_SECTIONS(2)=2)
SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_SERVICE_COMP(2,1)=0)
SERVICE BRAKE SPEED COMPONENT (2)	100 km/h (V_BRAKE_SERVICE_COMP(2,2)=100)
SERVICE BRAKE DECELERATION COMPONENT (1)	0,6 m/s^2 (A_BRAKE_SERVICE_COMP(2,1)=60)

Table 22: Braking curves Gamma 1 train data set

Variable	Value
SERVICE BRAKE DECELERATION COMPONENT (2)	0,4 m/s^2 (A_BRAKE_SERVICE_COMP(2,2)=40)
NUMBER OF NORMAL SERVICE BRAKE SECTIONS	2 (N_BRAKE_NORMAL_SERVICE_SECTIONS(2)=2)
NORMAL SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_NORMAL_SERVICE_COMP(2,1)=0)
NORMAL SERVICE BRAKE SPEED COMPONENT (2)	100 km/h (V_BRAKE_NORMAL_SERVICE_COMP(2,2)=100)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (1)	0,4 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(2,1)=40)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (2)	0,25 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(2,2)=25)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR GAMMA TRAINS	M_BRAKE_GAMMA_CONF(3) = 0110 (Regenerative brake interface exists and status is inactive Eddy current brake interface exists and status is active Magnetic shoe brake interface exists and status is active Ep brake: no interface exists)
EMERGENCY BRAKE REACTION TIME	1 s (T_BRAKE_EMERGENCY_REACT(3)=20)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	2,5 s (T_BRAKE_EMERGENCY(3)=50)
NUMBER OF EMERGENCY BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(3)=1)
EMERGENCY BRAKE DECELERATION COMPONENT (1)	0,4 m/s^2 (A_BRAKE_EMERGENCY_COMP(3,1)=40)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 50%	0,5 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 0)=10)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 90%	0,6 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 1)=12)

Table 22: Braking curves Gamma 1 train data set

Variable	Value
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 2)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 3)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 4)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 5)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 6)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 7)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 8)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(3, 1), 9)=16)
ROLLING STOCK CORRECTION FACTOR ON WET RAIL	0,8 (M_KWET_RST(A_BRAKE_EMERGENCY_COMP(3, 1))=16)
SERVICE BRAKE REACTION TIME	1.2s (T_BRAKE_SERVICE_REACT(3)=24)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2,5 s (T_BRAKE_SERVICE(3)=50)
NUMBER OF SERVICE BRAKE SECTIONS	2 (N_BRAKE_SECTIONS(3)=2)
SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_SERVICE_COMP(3,1)=0)

Table 22: Braking curves Gamma 1 train data set

Variable	Value
SERVICE BRAKE SPEED COMPONENT (2)	100 km/h (V_BRAKE_SERVICE_COMP(3,2)=100)
SERVICE BRAKE DECELERATION COMPONENT (1)	0,6 m/s^2 (A_BRAKE_SERVICE_COMP(3,1)=60)
SERVICE BRAKE DECELERATION COMPONENT (2)	0,4 m/s^2 (A_BRAKE_SERVICE_COMP(3,2)=40)
NUMBER OF NORMAL SERVICE BRAKE SECTIONS	2 (N_BRAKE_NORMAL_SERVICE_SECTIONS(3)=2)
NORMAL SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_NORMAL_SERVICE_COMP(3,1)=0)
NORMAL SERVICE BRAKE SPEED COMPONENT (2)	100 km/h (V_BRAKE_NORMAL_SERVICE_COMP(3,2)=100)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (1)	0,4 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(3,1)=40)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (2)	0,25 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(3,2)=25)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR GAMMA TRAINS	M_BRAKE_GAMMA_CONF(4) = 0011 (Regenerative brake interface exists and status is active Eddy current brake interface exists and status is active Magnetic shoe brake interface exists and status is inactive Ep brake: no interface exists)
EMERGENCY BRAKE REACTION TIME	1 s (T_BRAKE_EMERGENCY_REACT(4)=20)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	2,5 s (T_BRAKE_EMERGENCY(4)=50)
NUMBER OF EMERGENCY BRAKE SECTIONS	1 (N_BRAKE_SECTIONS(4)=1)
EMERGENCY BRAKE DECELERATION COMPONENT (1)	0,6 m/s^2 (A_BRAKE_EMERGENCY_COMP(4,1)=60)

Table 22: Braking curves Gamma 1 train data set

Variable	Value
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 50%	0,5 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 0)=10)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 90%	0,6 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 1)=12)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 2)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 3)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 4)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 5)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 6)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 7)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 8)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(4, 1), 9)=16)
ROLLING STOCK CORRECTION FACTOR ON WET RAIL	0,8 (M_KWET_RST(A_BRAKE_EMERGENCY_COMP(4, 1))=16)
SERVICE BRAKE REACTION TIME	1.2s (T_BRAKE_SERVICE_REACT(4)=24)

Table 22: Braking curves Gamma 1 train data set

Variable	Value
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2,5 s (T_BRAKE_SERVICE(4)=50)
NUMBER OF SERVICE BRAKE SECTIONS	2 (N_BRAKE_SECTIONS(4)=2)
SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_SERVICE_COMP(4,1)=0)
SERVICE BRAKE SPEED COMPONENT (2)	100 km/h (V_BRAKE_SERVICE_COMP(4,2)=100)
SERVICE BRAKE DECELERATION COMPONENT (1)	0,8 m/s^2 (A_BRAKE_SERVICE_COMP(4,1)=80)
SERVICE BRAKE DECELERATION COMPONENT (2)	0,6 m/s^2 (A_BRAKE_SERVICE_COMP(4,2)=60)
NUMBER OF NORMAL SERVICE BRAKE SECTIONS	2 (N_BRAKE_NORMAL_SERVICE_SECTIONS(4)=2)
NORMAL SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_NORMAL_SERVICE_COMP(4,1)=0)
NORMAL SERVICE BRAKE SPEED COMPONENT (2)	100 km/h (V_BRAKE_NORMAL_SERVICE_COMP(4,2)=100)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (1)	0,5 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(4,1)=50)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (2)	0,3 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(4,2)=30)
LOADING GAUGE	G1 (M_LOADINGGAUGE=1)
AXLE LOAD CATEGORY	D2 (M_AXLELOADCAT=7) (20 t < Axle Load ≤ 22.5 t)
TRACTION SYSTEM VOLTAGE	AC 25 kV 50 Hz (M_VOLTAGE=1)
COUNTRY IDENTIFIER OF THE TRACTION SYSTEM	Spain, high speed lines, 25 kV AC 50 Hz, 1600/1950 mm (NID_CTRACTION=17)
AIRTIGHT SYSTEM	FITTED (M_AIRTIGHT=1)
LIST OF NATIONAL SYSTEMS AVAILABLE ON-BOARD	None

Table 22: Braking curves Gamma 1 train data set

Variable	Value
AXLE NUMBER	32 (N_AXLE=32)
CORRECTION FACTOR FOR POSITIVE GRADIENTS	Kn+(V) = 2.0 m/s²
CORRECTION FACTOR FOR NEGATIVE GRADIENTS	Kn-(V) = 2.0 m/s²

A.2.5.3 Braking curves Lambda 1 train data set

A.2.5.3.1 This set includes the parameters for the braking model for a Lambda train.

A.2.5.3.2 The service brake reaction and equivalent brake build up times in this train data set are not configuration parameters, but output calculated using the conversion model (see 3.13.3 in Subset-026 [2]). The default values of the coefficients are used for the calculation (see A.3.9.6 in Subset-026 [2]).

Table 23: Braking curves Lambda 1 train data set

Variable	Value
MAXIMUM TRAIN SPEED	200 km/h (V_MAXTRAIN=40)
CANT DEFICIENCY TRAIN CATEGORY	Cant Deficiency 150 mm (NC_CDTRAIN=3)
OTHER INTERNATIONAL TRAIN CATEGORY	Freight train braked in “P (NC_TRAIN=1)
TRAIN LENGTH	750 m (L_TRAIN=750)
TRACTION CUT-OFF TIME DELAY	0,5 s (T_TRACTION_CUT_OFF=110010b)
BRAKE POSITION	Freight train in P (M_BRAKE_POSITION=1)
NOMINAL ROTATING MASS OF THE TRAIN	Unknown (M_NOM_ROT_MASS=16)
M_REGENERATIVEBRAKE	00(No interface)
M_EDDYCURRENTBRAKE	00(No interface)
M_MAGNETICSHOEBRAKE	00(No interface)
M_ELECTROPNEUMATICBRAKE	00(No interface)
Q_TRACTIONCUTOFFINTERFACE	1 (Implemented)
Q_SERVICEBRAKEINTERFACE	1 (Implemented)

Table 23: Braking curves Lambda 1 train data set

Variable	Value
Q_SERVICEBRAKEFEEDBACK	1 (Implemented)
QUALIFIER FOR GAMMA/LAMBDA DISCRIMINATION	Lambda type: the brake percentage is acquired as Train Data and the conversion model is applicable (Q_BRAKE_CAPT_TYPE=0)
M_BRAKE_PERCENTAGE	100
SPECIAL BRAKES CONFIGURATION NUMBER	1 (no iteration due to N_BRAKE_CONF)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR LAMBDA TRAINS	M_BRAKE_LAMBDA_CONF(1)=000 (No interface to special brakes exists or all status are inactive)
SERVICE BRAKE REACTION TIME	2,05 s (T_BRAKE_SERVICE_REACT(1)=41)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME FOR TARGET SPEED =0	23,75 s (T_BRAKE_SERVICE(1)=475)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME FOR TARGET SPEED >0	28,55 s (T_BRAKE_SERVICE(1)=571)
NUMBER OF NORMAL SERVICE BRAKE SECTIONS	3 (N_BRAKE_NORMAL_SERVICE_SECTIONS(1)=3)
NORMAL SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_NORMAL_SERVICE_COMP(1,1)=0)
NORMAL SERVICE BRAKE SPEED COMPONENT (2)	40 km/h (V_BRAKE_NORMAL_SERVICE_COMP(1,2)=40)
NORMAL SERVICE BRAKE SPEED COMPONENT (3)	160 km/h (V_BRAKE_NORMAL_SERVICE_COMP(1,3)=160)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (1)	0,6 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(1,1)=60)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (2)	0,4 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(1,2)=40)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (3)	0,35 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(1,3)=35)
LOADING GAUGE	G1 (M_LOADINGGAUGE=1)
AXLE LOAD CATEGORY	D2 (M_AXLELOADCAT=7) (20 t < Axle Load ≤ 22.5 t)

Table 23: Braking curves Lambda 1 train data set

Variable	Value
TRACTION SYSTEM VOLTAGE	DC 3 kV (M_VOLTAGE=3)
COUNTRY IDENTIFIER OF THE TRACTION SYSTEM	Spain, conventional lines 220 km/h, 3 kV DC (NID_CTRACTION=15)
AIRTIGHT SYSTEM	FITTED (M_AIRTIGHT=1)
LIST OF NATIONAL SYSTEMS AVAILABLE ON-BOARD	None
AXLE NUMBER	120 (N_AXLE=120)
CORRECTION FACTOR FOR POSITIVE GRADIENTS	Kn+(V) = 2.0 m/s²
CORRECTION FACTOR FOR NEGATIVE GRADIENTS	Kn-(V) = 2.0 m/s²

A.2.5.4 Braking curves Gamma 2 train data set

A.2.5.4.1 This set is meant to test the braking behaviour of the train when:

a) the Nominal Rotating Mass is set to a value different from “Unknown”,
b) there is no Traction Cut Off interface,
c) there is no Service Brake interface,
d) the Brake Position is set to “Passenger train in P” and
e) there is no special/additional brakes independent from wheel/rail adhesion.

A.2.5.4.2 Note: It should be possible to acquire optionally the brake percentage as train data (see Subset-026 3.13.3.2.2). Input value in such a case: M_BRAKE_PERCENTAGE = 100.

Table 24: Braking curves Gamma 2 train data set

Variable	Value
MAXIMUM TRAIN SPEED	400 km/h (V_MAXTRAIN=80)
CANT DEFICIENCY TRAIN CATEGORY	Cant Deficiency 225 mm (NC_CDTRAIN=7)
OTHER INTERNATIONAL TRAIN CATEGORY	Passenger train (NC_TRAIN=4)
TRAIN LENGTH	200 m (L_TRAIN=200)
TRACTION CUT-OFF TIME DELAY	2 s (T_TRACTION_CUT_OFF= 11001000b)
BRAKE POSITION	Passenger train in P (M_BRAKE_POSITION=0)

Table 24: Braking curves Gamma 2 train data set

Variable	Value
NOMINAL ROTATING MASS OF THE TRAIN	15% (M_NOM_ROT_MASS=15)
M_REGENERATIVEBRAKE	00(No interface)
M_EDDYCURRENTBRAKE	00(No interface)
M_MAGNETICSHOEBRAKE	00(No interface)
M_ELECTROPNEUMATICBRAKE	00(No interface)
Q_TRACTIONCUTOFFINTERFACE	0 (Not implemented)
Q_SERVICEBRAKEINTERFACE	0 (Not implemented)
Q_SERVICEBRAKEFEEDBACK	0 (Not implemented)
QUALIFIER FOR GAMMA/LAMBDA DISCRIMINATION	Gamma type: all other captures (Q_BRAKE_CAPT_TYPE=1)
SPECIAL BRAKES CONFIGURATION NUMBER	1 (no iteration due to N_BRAKE_CONF)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR GAMMA TRAINS	M_BRAKE_GAMMA_CONF(1) = 0000 (No interface to special brakes exists or all status are inactive)
EMERGENCY BRAKE REACTION TIME	1,5 s (T_BRAKE_EMERGENCY_REACT(1)=30)
EMERGENCY BRAKE EQUIVALENT BRAKE BUILD UP TIME	2.5 s (T_BRAKE_EMERGENCY(1)=50)
NUMBER OF EMERGENCY BRAKE SECTIONS	2 (N_BRAKE_SECTIONS=2)
EMERGENCY BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_EMERGENCY_COMP(1,1)=0)
EMERGENCY BRAKE DECELERATION COMPONENT (1)	1,2 m/s^2 (A_BRAKE_EMERGENCY_COMP(1,1)=120)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 50%	0,1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 0)=2)

Table 24: Braking curves Gamma 2 train data set

Variable	Value
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 90%	0,1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 1)=2)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99%	0,1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 2)=2)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9%	0,2 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 3)=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 4)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 5)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 6)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 7)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 8)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 1), 9)=16)
ROLLING STOCK CORRECTION FACTOR ON WET RAIL	0,8 (M_KWET_RST(A_BRAKE_EMERGENCY_COMP(1, 1))=16)
EMERGENCY BRAKE SPEED COMPONENT (2)	50 km/h (V_BRAKE_EMERGENCY_COMP(1,2)=50)
EMERGENCY BRAKE DECELERATION COMPONENT (2)	0,4 m/s^2 (A_BRAKE_EMERGENCY_COMP(1,2)=40)

Table 24: Braking curves Gamma 2 train data set

Variable	Value
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 50%	0,1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 0)=2)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 90%	0,1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 1)=2)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99%	0,1 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 2)=2)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9%	0,2 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 3)=4)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 4)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 5)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 6)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,99999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 7)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 8)=16)
ROLLING STOCK CORRECTION FACTOR ON DRY RAIL FOR A CONFIDENCE LEVEL EQUAL TO 99,9999999%	0,8 (M_KDRY_RST(A_BRAKE_EMERGENCY_COMP(1, 2), 9)=16)
ROLLING STOCK CORRECTION FACTOR ON WET RAIL	0,8 (M_KWET_RST(A_BRAKE_EMERGENCY_COMP(1, 2))=16)
SERVICE BRAKE REACTION TIME	2 s (T_BRAKE_SERVICE_REACT (1)=40)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME	2,5 s (T_BRAKE_SERVICE(1)=50)
NUMBER OF SERVICE BRAKE SECTIONS	2 (N_BRAKE_SECTIONS(1)=2)

Table 24: Braking curves Gamma 2 train data set

Variable	Value
SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_SERVICE_COMP(1,1)=0)
SERVICE BRAKE SPEED COMPONENT (2)	100 km/h (V_BRAKE_SERVICE_COMP(1,2)=100)
SERVICE BRAKE DECELERATION COMPONENT (1)	0,8 m/s2 (A_BRAKE_SERVICE_COMP(1,1)=80)
SERVICE BRAKE DECELERATION COMPONENT (2)	0,6 m/s2 (A_BRAKE_SERVICE_COMP(1,2)=60)
NUMBER OF NORMAL SERVICE BRAKE SECTIONS	2 (N_BRAKE_NORMAL_SERVICE_SECTIONS(1)=2)
NORMAL SERVICE BRAKE SPEED COMPONENT (1)	0 km/h (V_BRAKE_NORMAL_SERVICE_COMP(1,1)=0)
NORMAL SERVICE BRAKE SPEED COMPONENT (2)	100 km/h (V_BRAKE_NORMAL_SERVICE_COMP(1,2)=100)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (1)	0,4 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(1,1)=40)
NORMAL SERVICE BRAKE DECELERATION COMPONENT (2)	0,25 m/s2 (A_BRAKE_NORMAL_SERVICE_COMP(1,2)=25)
LOADING GAUGE	G1 (M_LOADINGGAUGE=1)
AXLE LOAD CATEGORY	D2 (M_AXLELOADCAT=7) (20 t < Axle Load ≤ 22.5 t)
TRACTION SYSTEM VOLTAGE	AC 25 kV 50 Hz (M_VOLTAGE=1)
COUNTRY IDENTIFIER OF THE TRACTION SYSTEM	Spain, high speed lines, 25 kV AC 50 Hz, 1600/1950 mm (NID_CTRACTION=17)
AIRTIGHT SYSTEM	FITTED (M_AIRTIGHT=1)
LIST OF NATIONAL SYSTEMS AVAILABLE ON-BOARD	None
AXLE NUMBER	32 (N_AXLE=32)

A.2.5.5 Braking curves Lambda 2 train data set

A.2.5.5.1 This set is meant to test the braking behaviour of the train when:

a) the Service Brake command interface exists, but

b) the Service brake feedback is not implemented;

c) T_TRACTION_CUT_OFF=15 s and

d) the Brake Position is set to “Freight train in G”.

A.2.5.5.2 The service brake reaction and equivalent brake build up times in this train data set are not configuration parameters, but output calculated using the conversion model (see 3.13.3 in Subset-026 [2]). The default values of the coefficients are used for the calculation (see A.3.9.6 in Subset-026 [2]).

Table 25: Braking curves Lambda 2 train data set

Variable	Value
MAXIMUM TRAIN SPEED	200 km/h (V_MAXTRAIN=40)
CANT DEFICIENCY TRAIN CATEGORY	Cant Deficiency 150 mm (NC_CDTRAIN=3)
OTHER INTERNATIONAL TRAIN CATEGORY	Freight train braked in “G” position (NC_TRAIN=2)
TRAIN LENGTH	750 m (L_TRAIN=750)
TRACTION CUT-OFF TIME DELAY	15 s (T_TRACTION_CUT_OFF=10111011100b)
BRAKE POSITION	Freight train in G (M_BRAKE_POSITION=2)
NOMINAL ROTATING MASS OF THE TRAIN	Unknown (M_NOM_ROT_MASS=16)
M_REGENERATIVEBRAKE	00(No interface)
M_EDDYCURRENTBRAKE	00(No interface)
M_MAGNETICSHOEBRAKE	00(No interface)
M_ELECTROPNEUMATICBRAKE	00(No interface)
Q_TRACTIONCUTOFFINTERFACE	1 (Implemented)
Q_SERVICEBRAKEINTERFACE	1 (Implemented)
Q_SERVICEBRAKEFEEDBACK	0 (Not implemented)
QUALIFIER FOR GAMMA/LAMBDA DISCRIMINATION	Lambda type: the brake percentage is acquired as Train Data and the conversion model is applicable (Q_BRAKE_CAPT_TYPE=0)
M_BRAKE_PERCENTAGE	100

Table 25: Braking curves Lambda 2 train data set

Variable	Value
SPECIAL BRAKES CONFIGURATION NUMBER	1 (no iteration due to N_BRAKE_CONF)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR LAMBDA TRAINS	M_BRAKE_LAMBDA_CONF(1)=000 (No interface to special brakes exists or all status are inactive)
SERVICE BRAKE REACTION TIME	5,7 s (T_BRAKE_SERVICE_REACT(1)=114)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME FOR TARGET SPEED =0	23,75 s (T_BRAKE_SERVICE(1)=475)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME FOR TARGET SPEED >0	27,6 s (T_BRAKE_SERVICE(1)=552)
LOADING GAUGE	G1 (M_LOADINGGAUGE=1)
AXLE LOAD CATEGORY	D2 (M_AXLELOADCAT=7) (20 t < Axle Load ≤ 22.5 t)
TRACTION SYSTEM VOLTAGE	DC 3 kV (M_VOLTAGE=3)
COUNTRY IDENTIFIER OF THE TRACTION SYSTEM	Spain, conventional lines 220 km/h, 3 kV DC (NID_CTRACTION=15)
AIRTIGHT SYSTEM	FITTED (M_AIRTIGHT=1)
LIST OF NATIONAL SYSTEMS AVAILABLE ON-BOARD	None
AXLE NUMBER	120 (N_AXLE=120)

A.2.5.6 Braking curves Lambda 3 train data set

A.2.5.6.1 This set includes the parameters for the braking model for a Lambda train where the brake position is “Passenger Train in P”.

A.2.5.6.2 The service brake reaction and equivalent brake build up times in this train data set are not configuration parameters, but output calculated using the conversion model (see 3.13.3 in Subset-026 [2]). The default values of the coefficients are used for the calculation (see A.3.9.6 in Subset-026 [2]).

Table 26: Braking curves Lambda 3 train data set

Variable	Value
MAXIMUM TRAIN SPEED	200km/h (V_MAXTRAIN=40)
CANT DEFICIENCY TRAIN CATEGORY	Cant Deficiency 150mm (NC_CDTRAIN=3)
OTHER INTERNATIONAL TRAIN CATEGORY	Passenger train (NC_TRAIN=4)
TRAIN LENGTH	400m (L_TRAIN=400)
TRACTION CUT-OFF TIME DELAY	0,5s (T_TRACTION_CUT_OFF=110010b)
BRAKE POSITION	Passenger train in P (M_BRAKE_POSITION=0)
NOMINAL ROTATING MASS OF THE TRAIN	Unknown (M_NOM_ROT_MASS=16)
M_REGENERATIVEBRAKE	00(No interface)
M_EDDYCURRENTBRAKE	00(No interface)
M_MAGNETICSHOEBRAKE	00(No interface)
M_ELECTROPNEUMATICBRAKE	00(No interface)
Q_TRACTIONCUTOFFINTERFACE	1 (Implemented)
Q_SERVICEBRAKEINTERFACE	1 (Implemented)
Q_SERVICEBRAKEFEEDBACK	1 (Implemented)
QUALIFIER FOR GAMMA/LAMBDA DISCRIMINATION	Lambda type: the brake percentage is acquired as Train Data and the conversion model is applicable (Q_BRAKE_CAPT_TYPE=0)
M_BRAKE_PERCENTAGE	100
SPECIAL BRAKES CONFIGURATION NUMBER	1 (no iteration due to N_BRAKE_CONF)
SPECIFIC SPECIAL BRAKES CONFIGURATION FOR LAMBDA TRAINS	M_BRAKE_LAMBDA_CONF(1)=000 (No interface to special brakes exists or all status are inactive)
SERVICE BRAKE REACTION TIME	1,05 s (T_BRAKE_SERVICE_REACT(1)=21)

Table 26: Braking curves Lambda 3 train data set

Variable	Value
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME FOR TARGET SPEED =0	10,6s (T_BRAKE_SERVICE(1)=212)
SERVICE BRAKE EQUIVALENT BRAKE BUILD UP TIME FOR TARGET SPEED >0	12,7 s (T_BRAKE_SERVICE(1)=254)
LOADING GAUGE	G1 (M_LOADINGGAUGE=1)
AXLE LOAD CATEGORY	D2 (M_AXLELOADCAT=7) (20 t < Axle Load ≤ 22.5 t)
TRACTION SYSTEM VOLTAGE	DC 3 kV (M_VOLTAGE=3)
COUNTRY IDENTIFIER OF THE TRACTION SYSTEM	Spain, conventional lines 220 km/h, 3kV DC (NID_CTRACTION=15)
AIRTIGHT SYSTEM	FITTED (M_AIRTIGHT=1)
LIST OF NATIONAL SYSTEMS AVAILABLE ON-BOARD	None
AXLE NUMBER	64 (N_AXLE=64)

A.2.5.7 Braking curves Lambda 4 train data set

A.2.5.7.1 This train data set is applicable for test sequences testing A.3.9.6 in Subset-026 [2].

A.2.5.7.2 The content of this train data set shall be agreed shall be agreed between the ERTMS/ETCS on-board equipment supplier and the laboratory.

A.2.6 Default Train Data for Supervised Manoeuvre

A.2.6.1 The on-board equipment under test shall be configured with the Default Train Data for Supervised Manoeuvre (see 3.18.3.9 and 7.4.3.5.1 in Subset-026 [2]) specified in Table 27.

Table 27: Default Train Data for Supervised Manoeuvre

Variable	Value
MAXIMUM TRAIN SPEED	110 km/h (V_MAXTRAIN=22)
CANT DEFICIENCY TRAIN CATEGORY	Cant Deficiency 225 mm (NC_CDTRAIN=7)

Table 27: Default Train Data for Supervised Manoeuvre

Variable	Value
OTHER INTERNATIONAL TRAIN CATEGORY	Passenger train (NC_TRAIN=4)
LOADING GAUGE	G1 (M_LOADINGGAUGE=1)
AXLE LOAD CATEGORY	D2 (M_AXLELOADCAT=7) (20 t < Axle Load ≤ 22.5 t)
TRACTION SYSTEM VOLTAGE	DC 3 kV (M_VOLTAGE=3)
COUNTRY IDENTIFIER OF THE TRACTION SYSTEM	Spain, conventional lines 220 km/h, 3 kV DC (NID_CTRACTION=15)
AIRTIGHT SYSTEM	FITTED (M_AIRTIGHT=1)
AXLE NUMBER	4 (N_AXLE=4)

A.2.7 Modification of the default values of the train data

A.2.7.1 The on-board equipment shall support all the possible values of the train data contained within the data ranges specified in chapter 7 of Subset-026 [2].

A.2.8 Reception of train data from external sources

A.2.8.1 If this function is implemented (see 5.1.1.10), the on-board equipment shall be configured to accept train data input from an external source (Overall consist length information and/or Other train data, see 5.17 in Subset-026 [2]).

A.2.8.1.1 The on-board equipment shall be configured to require a validation by the driver for some of the train data, but not for all of them.

A.2.8.1.2 The set of train data that do not require a validation by the driver shall contain at least one train data among the train category, the axle load category, the traction system(s) accepted by the engine and the loading gauge and one train data not belonging to these ones.

A.2.9 Reception of train data from the driver

A.2.9.1 The on-board equipment shall be configured to allow the modification of the following train data by the driver:

a) Train category(ies);

b) Train length;

c) Traction / brake parameters, braking models (brake build up time and speed dependent deceleration) or brake percentage;

d) Maximum train speed;

e) Loading gauge;

f) Axle load category;

g) Train fitted with airtight system.

A.2.10 Length of the engine

A.2.10.1 The on-board equipment shall be configured with an engine length set to 15m.

A.2.11 Offset between the front of the engine and the balise antenna

A.2.11.1 One balise antenna shall be configured. The offset between the position of the balise antenna and the front end of the engine corresponding to the first cab open in the sequence shall be set to 5 m.

A.2.12 Default list of levels configured on-board

A.2.12.1 The default list of levels configured on-board shall contain L0, L1, L2 and LNTC.

A.2.12.2 The table of priorities of trackside supported levels shall allow to be configured according to the levels requested in the test sequences.

A.2.13 DMI configuration

A.2.13.1 Languages

A.2.13.1.1 The on-board equipment shall be configured to support at least two languages used to display information to the driver (see 3.12.3.3.1 in Subset-026 [2]).

A.2.13.2 Speed dial

A.2.13.2.1 The on-board equipment shall be configured to display a range of the speed dial from 0 km/h to 400 km/h.

A.2.14 Track conditions

A.2.14.1 Necessary actions

A.2.14.1.1 There are some necessary actions to be performed related to several track conditions:

a) Powerless section (see 5.18.2.2.2, 5.18.2.5.1, 5.18.3.2.2 and 5.18.3.4.1 in Subset-026 [2])

b) Air tightness area (see 5.18.6.2.2 and 5.18.6.4.1 in Subset-026 [2])

c) Inhibition of a defined type of brake (see 5.18.7.3.1 in Subset-026 [2])

d) Change the traction system (see 5.18.10.4 in Subset-026 [2])

A.2.14.1.2 These actions shall be performed automatically or by the driver.

A.2.14.1.3 The on-board equipment supplier shall provide both possible configurations in order to test both of them:

a) By default, when the generic train data set (defined in A.2.2) is used, the on-board equipment shall automatically perform these actions.

b) When the train data sets for braking curves test sequences (defined in A.2.5) are used, the driver shall be requested to act.

A.2.14.2 Time to perform actions

A.2.14.2.1 This section defines the values of the time necessary to perform some actions related to the track conditions:

a) Lower the pantograph (see 5.18.2.2.1 in Subset-026 [2]): 5s
b) Switch off the main power switch (see 5.18.3.2.1 in Subset-026 [2]): 5s
c) Close the air conditioning intake (see 5.18.6.2.1 in Subset-026 [2]): 5s
d) Inhibition of a defined type of brake (see 5.18.7.3.2 in Subset-026 [2]): 5s
e) Change the traction system (see 5.18.10.3 in Subset-026 [2]): 5s

A.2.14.2.2 The on-board equipment shall comply with these values.

A.2.15 Corrections factors for gradient

A.2.15.1 The on-board equipment shall be configured to support the corrections factors for gradient on the normal service brake (see 3.13.2.2.9.2 in Subset-026 [2]) defined in A.2.5.

A.2.16 On-board ETCS identity

A.2.16.1 The on-board equipment ETCS identifier shall be set to NID_ENGINE=76000d (see 7.5.1.88 in Subset-026 [2]).

A.2.17 Radio systems installed on-board

A.2.17.1 The on-board equipment shall be equipped with two GSM-R radios to support the handling of two communication sessions at the same time.

A.2.17.1.1 The radio subscriber number shall be set to NID_RADIO=1111FFFFFFFFFFF for the first radio and NID_RADIO=1112FFFFFFFFFFF for the second radio (see 7.5.1.95 in Subset-026 [2]).

A.2.17.2 The supplier shall provide the laboratory with a configuration of on-board equipment which corresponds to “GSM-R is the only radio system installed on-board”.

A.2.17.3 In addition, if available, the supplier shall provide the laboratory with a configuration of on-board equipment which corresponds to “both radio systems installed on-board” (FRMCS+GSM-R).

A.2.17.3.1 In this case, the supplier shall also provide an FRMCS adaptor that prevents any failure or degraded situation for the on-board equipment when requirements relying on “FRMCS radio system is installed on-board” are tested, considering that no FRMCS simulator is implemented in the test facility by the laboratory.

A.2.17.3.2 This FRMCS adaptor shall ensure that the ERTMS/ETCS on-board equipment always considers that the FRMCS on-board equipment is connected but shall not simulate any registration to the FRMCS Radio Network.

A.2.18 Default GSM-R Radio Network ID

A.2.18.1 If a default GSM-R Radio Network is configured in the ERTMS/ETCS on-board equipment (see 3.5.6.3 and 3.5.6.3.1 in Subset-026 [2]), it shall be set to NID_MN=0x654321 (hexadecimal value).

A.3 Situations requiring a special procedure

A.3.1 Miscellaneous situations

A.3.1.1 Before a test campaign, the supplier shall provide the laboratory with the following information:

a) the procedure for simulating a failure of the SB (see [2], paragraph 3.14.1.2) and in this case, under which conditions the EB shall be commanded.

b) the values of pre-configured train data values that are used when switching from Fixed to Flexible data configuration.

c) the procedure related to the reception of train data from external sources to allow the train data input from the reference test facility to the on-board equipment.

d) the default value used for the Radio Network type when no value is stored on-board or set this default value to a specific value chosen by the laboratory for testing purpose.

e) the procedure to deactivate the second radio of the on-board equipment.

f) the procedure to erase (non-volatile memory) including the Level, the available and allowed networks information…

g) the procedure to perform the switch to SF and IS modes.

h) the procedure to simulate the scenario in which the driver closes a desk A and leaves a cab A of the leading engine of the train, to go to cab B and open desk B of this same engine (change of train orientation). Concerning the DMI, this may be achieved through one or two DMI.

i) the procedure to perform the actions listed in A.2.14.1.1 when the driver is requested to act manually during the tests.

A.3.2 Big metal masses

A.3.2.1 An on-board integrity check alarm reporting a malfunction for the on-board balise transmission function may be triggered by a big metal mass.

A.3.2.2 The on-board equipment supplier shall provide the necessary information to detect such alarms and the possible associated safety reactions (see 3.15.7 in Subset-026 [2]).

A.3.3 Odometry error

A.3.3.1 The on-board equipment supplier shall indicate to the laboratory the value of the fixed distance interval used to supervise the accuracy of the odometer.

A.3.3.2 The on-board equipment supplier shall, either configure the on-board equipment under test to ensure that for every measured distance s, the over-reading amount and the under-reading amount (odometer accuracy plus the error in detection of the balise group location reference) is always equal to or higher than (3m + 3% s) and lower than or equal to (5m + 5% s), or shall provide the laboratory with the procedure to reach such over-reading and under-reading amounts.

A.3.3.3 The on-board equipment supplier shall give the possibility to the laboratory (i.e. provide the necessary information about how to proceed) to have, over a defined total distance s, an accumulated underestimation and/or overestimation in measuring the movements (odometer accuracy) between 5% s and 30% s, for the test of degraded cases.

A.3.3.4 Note: Subset-041 (see 5.3.1.1 in [18]) indicates that for every measured distance s, the accuracy shall be better or equal to ± (5m + 5% s), i.e. the over reading amount and the

under reading amount shall be equal to or lower than (5m + 5% s). This model is valid in nominal conditions but the confidence interval may be greater in degraded situations.

A.3.3.5 The on-board equipment supplier shall give the possibility to the laboratory (i.e. provide the necessary information about how to proceed) to have an accumulated underestimation and/or overestimation in measuring the movements (odometer accuracy) higher than 1500m after having travelled a distance < 4800m, for the test of degraded cases.

B. Subset-094 architecture evolution

B.1 Test Architecture Update

B.1.1.1 The introduction of new specifications can be considered in the present document through the next figure:

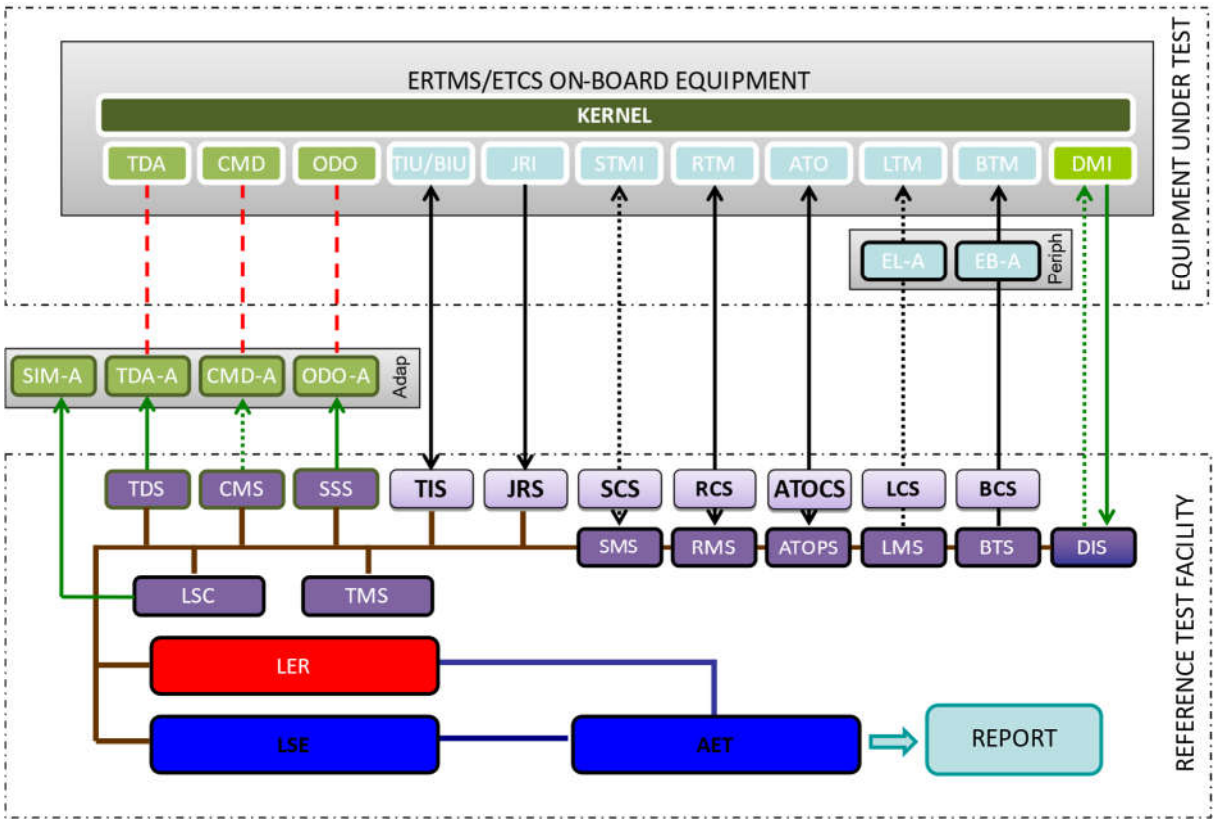

Figure 4 – Reference test architecture updated with new specifications

B.1.1.2 The main difference with regards to Figure 1 is the reduction in the scope of the Test Adaptor, removing the TIU-A and the JRI-A, and keeping exclusively the modules involved with the internal functions.

B.1.1.3 The Table 4 is also affected due to the introduction of the new specifications resulting in the following table:

Table 28: Figure 4 references

Name	Reference	Side
RTM	[2], [7], [9], [21], [22], [24], [25] and [26]	On-board equipment
BTM + EB-A	[2], [6] and [13]	On-board equipment
LTM + EL-A	[2] and [8]	On-board equipment
STMI	[2], [5], [10], [11], [12] and [20]	On-board equipment
JRI	[2], [3] and [30]	On-board equipment
DMI	[2] and [19]	On-board equipment
TIU	[2], [4], [30] and [31]	On-board equipment
ODO	[2]	On-board equipment
CMD	[2]	On-board equipment

Name	Reference	Side
TDA	[2]	On-board equipment
TDA-A	Subset-094	TEST ADAPTOR
CMD-A	Subset-094	TEST ADAPTOR
ODO-A	Subset-094	TEST ADAPTOR
SIM-A	Subset-094	TEST ADAPTOR
RCS	[7], [9], [17], [21], [22], [23], [24], [25], [26] and Subset-094	LAB
BCS	[6], [13], [17] and Subset-094	LAB
LCS	[9], [17] and Subset-094	LAB
SCS	[5], [10], [11], [12], [20] and Subset-094	LAB
DIS	[19] and Subset-094	LAB
TIS	[4], [30], [31] and Subset-094	LAB
SSS	Subset-094	LAB
CMS	Subset-094	LAB
TDS	Subset-094	LAB
JRS	[3], [30] and Subset-094	LAB
RMS	Subset-094	LAB
BTS	Subset-094	LAB
LMS	Subset-094	LAB
SMS	Subset-094	LAB
TMS	Subset-094	LAB
LER	Subset-094	LAB
LSC	Subset-094	LAB
LSE	Subset-094	LAB
AET	Subset-094	LAB
ATOCS	[27], [28], [29] and Subset-094	LAB
ATOPS	Subset-094	LAB

B.1.2 TIS Implementation Details

B.1.2.1 This section is intended to provide implementation details of the Subset-119 Train Interface FFFIS [31] and Subset-147 FFFIS part: CCS Consist Network Communication Layers [30].

B.1.2.2 This section must be understood as a possible alternative for the connection of the ERTMS/ETCS on-board equipment to the Reference Test Facility in case the specifications above mentioned are employed in the design of the ERTMS/ETCS on-board equipment.

B.1.2.3 Subset-119 [31] implementation details

B.1.2.3.1 Given the number of choices to be done for a real implementation of a Subset-119 compliant interface, the use of this interface specification shall be agreed between the ERTMS/ETCS on-board equipment supplier and the laboratory. However, in the following clauses, some recommendations are provided.

B.1.2.3.2 The serial architecture should be Architecture a) (see section 4.2.2 in [31]).

B.1.2.3.3 The serial interface to be used with the Reference Test Facility should be ECN (Ethernet Consist Network).

B.1.2.3.4 For the hard-wired interface, the Tables 3-2 and 3-3 in Subset-119, should be implemented according to the 24 Volts eligible requirements.

B.1.2.3.5 The application of the safety protocol ProfiSafe (according to IEC 61784-3-3) in the transmission through the serial interface is not recommended.

B.1.2.4 Subset-147 [30] implementation details

B.1.2.4.1 The Reference Test Facility shall provide an End Device Interface to the ERTMS/ETCS on-board equipment, acting as End Device in scope (see section 8.3 in [30]).

B.1.2.4.2 The configuration of the Logical Zone enabling the communication of the ERTMS/ETCS on-board equipment and the Rolling Stock related modules (TDS, CMS, TIS, JRS) through the End Device Interface, shall be agreed between the ERTMS/ETCS on-board equipment supplier and the laboratory.

B.1.2.4.3 The requirements at the physical layer stated in section 8.4.2 of [30] shall be respected. Exception: Power-over-Ethernet (PoE) shall not be provided by the Reference Test Facility.

B.1.2.4.4 The assignment of actual VLAN IDs to zones / applications shall be agreed between the ERTMS/ETCS on-board equipment supplier and the laboratory.

B.1.2.4.5 The configuration of the On-board Core Network Ports to be provided by the Reference Test Facility (see 8.3.1.7 in [30]) shall be agreed between the ERTMS/ETCS on-board equipment supplier and the laboratory.

B.1.2.4.6 The Reference Test Facility should use MAC-based port security instead of IEEE 802.1X-2004 EAP-TLS.

B.1.2.4.6.1 Justification: The Reference Test Facility may be considered as an existing device (see 8.4.3.3.3 in [30]) and the implementation of IEEE 802.1X-2004 EAP-TLS may introduce additional constraints for testing. Besides, the tests specified in Subset-076-6-3 (see [14]) are performed in a simulated environment with no direct impact on the security of the real train operation.