<table>
<tr><td colspan="2">ERTMS/ETCS</td></tr>
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Methodology for testing FFFIS STM

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3.1.0 16.12.2015	-	Baseline 3 2nd release version	Thomas Mandry (Alstom)

2. TABLE OF CONTENTS

3. REFERENCES

Ref. N°	Document Reference	Title
[1]	SUBSET-023	Glossary of Terms and Abbreviations
[2]	SUBSET-026	System Requirements Specification
[3]	SUBSET-035	Specific Transmission Module FFFIS
[4]	SUBSET-056	STM FFFIS Safe Time Layer
[5]	SUBSET-057	STM FFFIS Safe Link Layer
[6]	SUBSET-058	FFFIS STM Application Layer
[7]	SUBSET-059	Performance requirements for STMs
[8]	SUBSET-074-2	FFFIS STM Test Cases
[9]	SUBSET-074-3	FFFIS STM Test Specification Traceability of Test Cases with Specific Transmission Module FFFIS
[10]	SUBSET-074-4	FFFIS STM Test Specification Traceability of testing the packets specified in the FFFIS STM Application Layer
[11]	SUBSET-094	Functional Requirements for an on board Reference Test Facility
[12]	ERA_ERTMS_015560	ETCS Driver Machine Interface

4. DEFINITIONS

4.1 Functional identity

4.1.1.1 Group of requirements related to the same functionality of the system, e.g. Start of Mission.

4.2 Test Case

4.2.1.1 Sequence of steps with starting & end conditions that test the fulfilment of requirements (or a subset of requirements) by the ERTMS/ETCS on-board and/or by the STM.

4.3 Intentionally deleted

4.4 DUT (Device under test)

4.4.1.1 The DUT shall be the STM or the ERTMS/ETCS on-board.

4.5 General

4.5.1.1 General abbreviations are found in [1].

4.5.1.2 Other abbreviations:

- BIU: Brake Interface Unit
- BTS: EuroBalise Telegram Simulator
- CO: Configuration (state)
- CS: Cold Standby (state)
- DA: Data Available (state)
- DE: Data Entry (state)
- DIS: DMI Interface Simulator
- DUT: Device Under Test
- EMS: ERTMS/ETCS on-board Messages Simulator
- FA: Failure (state)
- GPS: Global Positioning System
- HS: Hot Standby (state)
- JD: Juridical Data
- JRS: Juridical Recording Simulator

- LER: Laboratory Event Recorder
- LSC: Laboratory Scenario Controller
- LSE: Laboratory Scenario Editor
- NA: National Adapter
- NP: No Power (state)
- NTS: National Track Simulator
- ODO: Odometry
- PO: Power On (state)
- PROF: PROFIBUS
- RMS: EuroRadio Messages Simulator
- RTM: EuroRadio Transmission Module
- SCS: STM Communication Simulator
- SLL: Safe Link Layer
- SMS: STM Messages Simulator
- SSS: Speed Sensor Simulator
- STL: Safe Time Layer
- TIS: Train Interface Simulator
- TMS: Train Motion Simulator

5. INTRODUCTION

5.1.1.1 The FFFIS STM ([3], [4], [5], [6]) specifies the requirements necessary for interoperability between ERTMS/ETCS on-board systems and STM systems.

5.1.1.2 This document specifies the methodology followed for the creation of the Test Specification and gives information about the test environment for the FFFIS STM Specification.

5.1.1.3 The purpose of this Test Specification is to ensure the interoperability between ERTMS/ETCS on-board systems and STM systems according to the FFFIS STM specifications. The validation of the STM interface of the ERTMS/ETCS on-board and/or the STMs is not the scope of this Test Specification.

5.1.1.4 Intentionally deleted

5.1.1.5 It is not the purpose of this Test Specification to test national systems behaviour. Therefore, STM tests are limited to test the interoperability, which is just focussed on the functionality of the start-up, establishing the connections and the correct interaction with ERTMS/ETCS on-board. But for the ERTMS/ETCS on-board, a set of Test Cases for all FFFIS STM services is provided.

5.1.1.6 The traceability between the FFFIS STM requirements and the packets defined in the FFFIS STM Application Layer and the corresponding Test Cases is documented. All testable requirements defined in [3] and all the packets defined in [6] are included in at least one Test Case. Not all possible combinations of values within a packet or a variable are tested, in order to limit the number of Test Cases.

5.1.1.7 No specific Test Cases for the safety layers ([4] and [5]) are provided. However, the Test Cases performed for the application layer rely on the nominal behaviour of the safety layers (connection establishment, transmission of application data, etc).

5.1.1.8 It is not the purpose of this Test Specification to test the performance requirements of the FFFIS STM ([7]). If there is no time-out stated in the Test Case, a default time-out of 5 seconds shall be used for the expected reaction of the DUT. If there is a time-out stated in the Test Case, it can be either specified with an explicit value or as supplier-specific (Ts1, Ts2…).

5.1.1.9 Times specified in the Test Cases are measured on the interfaces to the DUT.

5.1.1.10 In addition to FFFIS STM requirements, this Test Specification also tests compliance of ERTMS/ETCS on-board to a few SRS ([2]) requirements related to Level NTC functionality. These SRS requirements are indicated in the Test Case headers.

5.1.1.11 It is not the purpose of this Test Specification to test compliance of ERTMS/ETCS on-board to ETCS DMI specification ([12]). However, this specification is used as input/reference documentation to specify the check points of Test Case steps. The

DMI is treated as an interface for testing and the DMI inputs/outputs requested in the Test Cases are compliant to this specification.

6.   TEST FACILITY

6.1   Introduction

6.1.1.1   Test Cases are specified by a sequence of steps, the input of each test step and the expected outputs of each test step. The interfaces being observed or used are:

Interface	Simulator	Test Cases	Direction	Abbreviation
PROFIBUS (FFFIS STM)	SMS or EMS	ETCS and STM	input & output	PROF
Train Interface	TIS	ETCS	input & output	TIU
DMI	DIS	ETCS	input & output	DMI
interface to Juridical Recording	JRS	ETCS	output	JD
Balise Transmission Module	BTS	ETCS	input	BTM
Train Motion	TMS	ETCS and STM	input	ODO
National Adapter	NTS	STM	input	NA
Radio Transmission Module	RMS	ETCS	input & output	RTM

6.1.1.2   The test facility for FFFIS STM Test Specification is based on the test facility defined in [11]. However, this facility is extended in order to simulate the behaviour of an STM or an ERTMS/ETCS on-board depending on the DUT (ERTMS/ETCS on-board or STM).

6.2   Test facility for FFFIS STM Test Specification

6.2.1   Test facility for the ERTMS/ETCS on-board

6.2.1.1   The test facility when the DUT is the ERTMS/ETCS on-board is defined within [11].

Figure 1: Intentionally deleted

6.2.1.2   Additional requirements are included in this specification, see 6.2.3, 6.2.4 and 6.2.6.

6.2.2   Test facility for the STM

6.2.2.1   When the DUT is the STM, the test facility is reusing elements defined within [11], but also adds new modules. This test facility is defined by Figure 2:
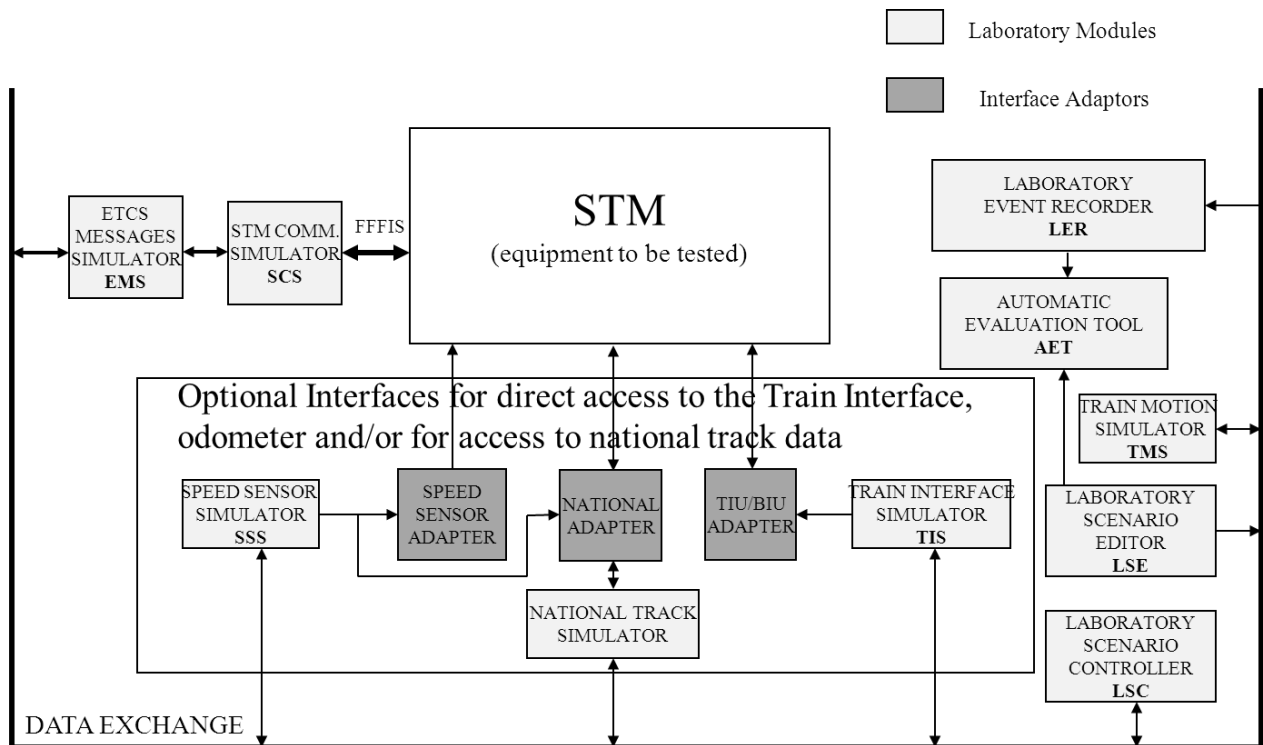
Figure 2: Test facility for the STM test

6.2.2.2 The Speed Sensor Adapter shall be provided by the STM supplier if the STM is using direct interface to speed sensors. National Adapter shall be provided by the STM supplier if the STM has a National Trip Procedure or if the execution of some Test Cases cannot be performed without this module. TIU/BIU Adapter shall be provided by the STM supplier if the STM has direct interface to the Train Interface.

6.2.2.3 The Speed Sensor Adapter shall manage the unidirectional communication with the "Speed Sensor Simulator" (SSS) module. It shall get the location, speed and acceleration information from this module as raw data, and shall transfer this information to the STM equipment as computable data in the appropriate internal format.

6.2.2.4 The National Adapter shall manage the unidirectional communication with the "National Track Simulator" module and with the "Speed Sensor Simulator" (SSS) module. It shall get the location, speed and acceleration information from the "Speed Sensor Simulator" module. It shall get the following events from the "National Track Simulator" module:

- "National Trip Procedure start"
- "National Trip Procedure end"

6.2.2.5 It shall simulate to the STM equipment the pre-conditions for the requested events as computable data in the appropriate internal protocol.

6.2.2.6 It shall also simulate to the STM equipment the environment it needs to work properly, e.g. simulated GPS data, signals from national trackside providing input for STM max speed…

6.2.2.7 Note: to avoid huge complexity of the National Adapter, for some STMs, specific interactions, e.g. data entry on a specific DMI, will have to be performed by the test operator.

6.2.2.8 The TIU/BIU Adapter shall manage the unidirectional communication with the module "Train Interface Simulator" (TIS). It shall read the status of the TIU inputs implemented within the STM from the TIS and shall redirect and write this info in the appropriate format to the STM.

6.2.3 Additional general requirements for the test facility

6.2.3.1 When the Test Case requires it, the test facility shall handle several output actions of the same input action without a defined sequence, see 7.3. This requirement is applicable whatever the DUT.

6.2.4 Additional functional requirements for the Laboratory Scenario Editor (LSE)

6.2.4.1 The Laboratory Scenario Editor (LSE) shall calculate automatically the values of the variables L_MESSAGE and L_PACKET and the number of padding bits, for messages used by SMS, EMS, RMS and BTS (this automatic computation avoids errors in the Test Case specification). This requirement is applicable whatever the DUT.

6.2.4.2 When the Test Case requires it, the LSE shall add the events "National Trip Procedure start" & ""National Trip Procedure stop" to the National Track Simulator (as defined in 6.2.2.4) at defined location or time. This requirement is applicable when the DUT is an STM.

6.2.5 Additional functional requirements for the Laboratory Scenario Controller (LSC)

6.2.5.1 When the STM is the DUT, the Laboratory Scenario Controller shall manage the synchronization with the modules interfacing the STM equipment under test.

6.2.5.2 Additionally to the modules managed for ERTMS/ETCS on-board tests, the EMS (instead of the SMS) and the NTS modules shall be managed.

6.2.6 Additional functional requirements for the STM Messages Simulator (SMS)

6.2.6.1 When the Test Case requires it, the SMS shall simulate two STMs connected to the ERTMS/ETCS on-board at the same time, e.g. to test transition between two different Level NTCs.

6.2.6.2   The SMS shall monitor the status of all connections to the ERTMS/ETCS on-board. Every time the status of a connection changes, the new state of the connection shall be recorded in the LER.

6.2.6.3   The SMS shall provide a command for the opening and closing (final and non-final) of each connection between the SMS and the ERTMS/ETCS on-board on SLL, STL as well as Application Layer. With this command, all necessary telegrams (including the FFFIS STM version number) to open or close a connection shall be transmitted via the FFFIS STM.

6.2.6.4   The SMS shall provide a command for the opening of each connection between the SMS and the ERTMS/ETCS on-board on SLL and STL only. With this command, all necessary telegrams (excluding the FFFIS STM version number) to open or close a connection shall be transmitted via the FFFIS STM. This command enables to test the version check made by the ERTMS/ETCS on-board.

6.2.6.5   When the Test Case requires it, the SMS shall detect a defined packet (see 7.3.1.4.3.9) in a received message and use its transmission time to define a triggering time of a following input action.

6.2.6.6   The SMS shall open connection with the STM Control Function with Safety Level 4 and with any other Function with the Safety Level indicated by the ERTMS/ETCS on-board for this Function, if not specified otherwise in the test case.

6.2.7   Functional requirements for the ETCS Messages Simulator (EMS)

6.2.7.1   The EMS shall simulate an ERTMS/ETCS on-board equipment in the same way that the SMS simulates one or several STMs, with following exceptions:

a) When the Test Case requires it for a specific packet, the EMS shall write the time stamp in application messages using the reference time.

b) The EMS has not to provide services to open or close connections, but shall accept connections with Safety Levels 0, 2 and 4 from the STM.

6.2.8   Functional requirements for the National Track Simulator (NTS)

6.2.8.1   The NTS shall generate the events defined in 6.2.2.4 at test steps defined in the scenario.

6.2.8.2   The signal transmission from NTS to National Adapter shall work on a range of 0-24 Volts and shall be optically isolated. Its coding shall be:

1-bit signal (input)	Electrical Level 0 volts	Electrical Level 24 volts
National Trip Procedure status	National Trip Procedure not active	National Trip Procedure active

7. FFFIS STM TEST SPECIFICATION

7.1 General

7.1.1.1 In order to create the Test Specification for the FFFIS STM, [3] has been analysed to extract the requirements which have to be tested (see SUBSET-074-3 which is part of the FFFIS STM Test Specification). Each statement in [3] was classified as a "Requirement" or "No Requirement" (e. g. titles of the chapters and definitions are no requirements) and as "Testable" or "Not Testable" (e. g. requirement that STM antenna shall not energise trackside equipment under some conditions is not testable on the FFFIS STM interface). This leads to a list of requirements which shall be tested in this Test Specification (all statements which are classified as "Requirement" and "Testable").

7.1.1.2 In order to facilitate the creation of the Test Cases, and the splitting of the work, the requirements were assigned to **Functional Identities**.

7.1.1.3 Several requirements belong to different Functional Identities. The requirements are not tested in all assigned Functional Identities, but at least in one.

7.1.1.4 For each Functional Identity, different Test Cases are provided covering all the assigned requirements to be tested in this Functional Identity.

7.1.1.5 The functional identities are:

1. **Start of Mission ((CO → DE →) CS → HS → DA)**: This Functional Identity is linked to the Start of Mission of the ERTMS/ETCS on-board (excluding the Specific NTC Data Entry).

2. **Application Start Up (NP → PO → CO (→ DE) → CS)**: This Functional Identity is linked to the start-up of the STM (excluding the Specific NTC Data Entry).

3. **Level Transitions ETCS→STM (CS → HS → DA)**: Level Transitions ordered by the trackside or triggered by the driver. This Functional Identity covers the transitions from CS to HS, CS to DA and HS to DA

4. **Level Transitions STM→ETCS (DA → CS)**: Level Transitions ordered by the trackside or triggered by the driver.

5. **Level Transitions STM→STM**: Level Transitions ordered by the trackside or triggered by the driver. This Functional Identity covers the association between STM X and Level NTC X.

6. **Data Available functionality**: For testing requirements on transmission of airgap data or on odometry for example.

7. **DMI Function**: All requirements related to DMI Function

8. **BTM**: Requirements related to transmission of information related to ERTMS/ETCS on-board Balise Transmission Module

9. **Failure (including the state transitions PO/CO/DE/CS/HS/DA → FA)**

10. **Procedure Specific Data Entry/Data View (including the state transitions CO → DE, DE → CS)**

11. **Procedure STM Operational Tests**

12. **Procedures Override & Shunting**

7.1.1.6 For each Functional Identity, **test diagrams** showing the different test paths, according to the requirements assigned to the Functional Identity are provided (see 7.2).

7.1.1.7 The **Test Cases** are based on the diagrams (see 7.2.2).

7.1.1.8 The starting and the end conditions in the Test Cases enable creation of sequences of Test Cases to be tested.

7.2 Test Diagram creation

7.2.1.1 For every Functional Identity, test diagrams are provided. These diagrams give an indication in which order the requirements are executed by the equipment. They include numbered branches in case different conditions imply different behaviour of the systems. A branch is numbered "0" in the case where there is no specific condition.

7.2.1.2 The test diagram for a Functional Identity includes the requirements assigned to the Functional Identity (copied from the specifications). Requirements from [2], [12] and requirements which are not assigned to the Functional Identity may be included to give a better overview of the Functional Identity.

7.2.1.3 Requirements or parts of requirements which are tested in the Functional Identity are written in bold letters.
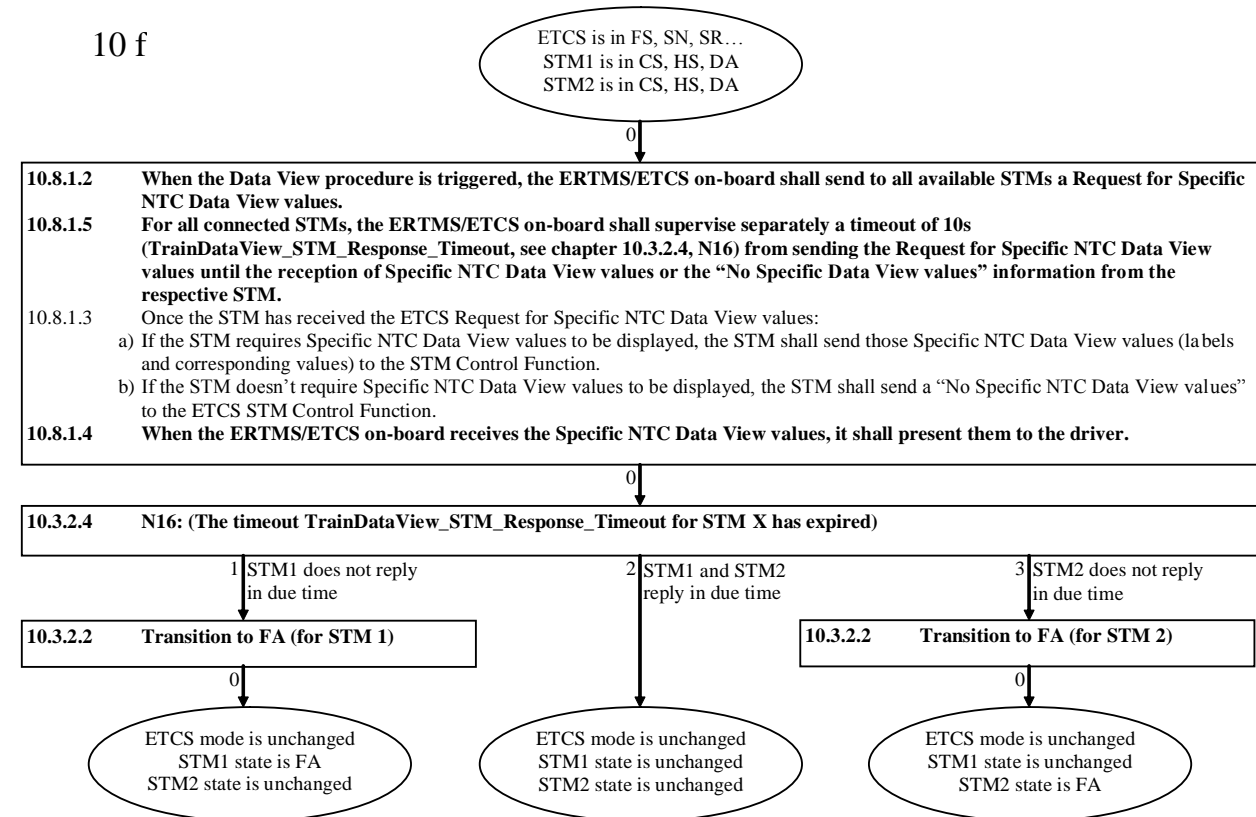
7.2.2 Example for a Test Diagram

10 f

Figure 3: Test Diagram example

7.3 Test Case creation

7.3.1.1 The Test Cases are based on the Test Diagrams. Every branch of the Test Diagrams is included in at least one Test Case.

7.3.1.2 As all branches of the Test Diagram "y" are numbered, the sequence of the numbers in the Test Diagram "y" defines the path of the Test Cases (the example in 7.2.2 leads to the Test Cases "0.0.1.0", "0.0.2" and "0.0.3.0").

7.3.1.3 The identifier of the Test Case is given by the number of the Functional Identity, the letter of the Test Diagram and an additional number, e.g. "Xy.Z" where "X" is the number of the Functional Identity, "y" is a letter identifying the diagram and Z the additional number.

7.3.1.4 Every Test Case includes the following information:

7.3.1.4.1 Test Case header

7.3.1.4.1.1 This includes a description of the Test Case, its path on the Test Diagram, a list of the tested requirements, a list of the transmitted packets on the PROFIBUS and the ERTMS/ETCS on-board needed configuration if relevant.

7.3.1.4.1.2 The possible special situation or constraints that are relevant for the Test Case are also clearly specified (e. g. the STM under test will not send any STM max speed at the level transition).

7.3.1.4.2 <u>Starting condition</u>

7.3.1.4.2.1 The starting conditions which are relevant for the test itself are clearly specified (e. g. STM state, TIU Cab Status), so it is possible to execute the Test Case if the DUT (STM or ERTMS/ETCS on-board) state is the one defined in the starting conditions.

7.3.1.4.2.2 Instead of a single value of a starting condition, a list can be given with instruction to test all values or to select a suitable one.

7.3.1.4.3 <u>Test Case description (sequence of Test Steps to be performed)</u>

7.3.1.4.3.1 A complete sequence of steps describes all the relevant events necessary for the test in the order their input actions occur. The description of these events includes the interface where the action is initiated and the action on this input interface (if relevant) and a clear description of the output interface(s) and action(s) which have to be checked.

7.3.1.4.3.2 An input action can also be a time-out of an expected input (no action on the input interface).

7.3.1.4.3.3 The different test steps are indicated by numbers.

7.3.1.4.3.4 In case one input action causes several output actions without a defined order, no new number is used.

7.3.1.4.3.5 Each input action is associated to a time at which this action is triggered automatically by a Test Facility module. In the case the DIS Test Facility module needs manual actions (actions on DMI), the input times have to be considered as lower time limits to trigger the actions (except in case anticipation of trigger of some actions is justified by the test operator). For a few actions on DMI (e.g. acknowledgment of level transition), there is also a maximum time to be considered by the test operator for manual actions.

7.3.1.4.3.6 If the input action is depending on the track layout or a distance, the tester has to select a suitable speed to pass the position at the expected input time.

7.3.1.4.3.7 Each output action is associated to a time limit during which this action shall be detected to pass the test. The time limit shall be counted from the time the input action is triggered or, when no input action is requested for the test step, from the input time. Time limits could be supplier-specific, in this case they are written as "Ts1", "Ts2", "Ts3"… These supplier-specific time limits could be used to compute the input times.

7.3.1.4.3.8 One step has only one input action and one input time but could have several output actions with different time limits.

7.3.1.4.3.9 The time of an expected PROFIBUS output message from the DUT may be used as reference time for the input time of a following step, but only for input actions related to PROFIBUS interface. The time shall be measured on the PROFIBUS as the time when the last bit of the message is sent. The relevant output message shall be identified by the expected packets including the packet identifier and the complete content (excluding variables marked as NOT RELEVANT in the message definition).

7.3.1.4.3.10 Instead of checking an expected output action detection, the check of an output action may also request that a specific event does not occur within the specified output time limit.

7.3.1.4.3.11 If the Input interface is the PROFIBUS and the DUT is the ERTMS/ETCS on-board, the message comes from the SMS. If the Input interface is the PROFIBUS and the DUT is the STM, the message comes from the EMS.

7.3.1.4.3.12 The event on the Output interface always comes from the DUT.

7.3.1.4.4   Transmitted messages

7.3.1.4.4.1 All the messages sent between the ERTMS/ETCS on-board and the STM as well as airgap messages are specified, indicating as much as possible the real values that the different variables should have for the correct execution of the Test Case.

7.3.1.4.4.2 By default all the values in the messages are specified in decimal. Binary values are indicated with a 'b' at the end of the number. Hexadecimal values are indicated with a 'h' at the end of the number. Characters are specified between quotation marks (e. g. "X").

7.3.1.4.4.3 The messages given in the output actions list all packets that are expected from the DUT for the fulfilment of these output actions. However, the way these packets are sent, i.e. their sequence and/or their splitting within several messages, is generally undefined and shall have no impact on the test execution and test result, except stated otherwise in the Test Case. Exception for STM Test Cases: the packet STM-15 "State report from STM" shall be present in every message that is sent by the STM.

7.3.1.4.4.4 Conversely, it is possible that different messages defined as output actions of one step are merged by the DUT in a single message: this shall also have no impact on the test execution and test result, except stated otherwise in the Test Case.

7.3.1.4.4.5 It is also allowed that packets not indicated in the Test Case are received, except if explicitly stated as not allowed in the Test Case (see 7.3.1.4.3.10).

7.3.1.4.5   End conditions

7.3.1.4.5.1 The end conditions of the Test Case are clearly specified (e.g. STM state, connection status).

7.3.2 Example for a Supplier-specific delays table

#	Supplier of	Start time	End time
Ts1	ETCS	Time-stamp of message including STM-179 with N_ITER > 0	Reference time at which the "NTC X" button is enabled in "National data entry selection" window
Ts2	STM	Time-stamp of message including STM-184, STM-175 & STM-176	Time-stamp of message including STM-13 "DE" (from CO)

7.3.3 Example for a Test Case

7.3.3.1 The format of the Test Cases is as follows:

Test Case 1a.1

TEST CASE HEADER	
Test Case identification	*[Functional Identity]*
	[Path on the Test Diagram]
	[Description of the Test Case]
ERTMS/ETCS on-board requirements tested	Subset-035 *[Subset-035 requirements]* Subset-026 *[Optionally: SRS requirement]* ERA ERTMS 015560 (DMI Spec) *[Optionally ETCS DMI requirements]*
STM requirements tested	Subset-035 *[Subset-035 requirements]* Subset-026 *[Optionally: SRS requirements]*
Packets transmitted via FFFIS STM	STM-2, STM-15, …
ERTMS/ETCS on-board configuration	*[If needed, way to configure the ERTMS/ETCS on-board:* 　- *list of STMs installed on-board* 　- *association of STMs to Level NTC* 　- *customisable DMI service data]*
Comments and constraints	*[Comments to the Test Case* *Constraint could be e.g. indication that ERTMS/ETCS on-board shall use Touch Screen Technology for the DMI.]*

Starting Conditions	Value	Comments
STM State	NP/PO/CO/CS/HS/DA/FA	As seen by the DUT
ETCS Mode	NP/SB/SR/FS/OS/NL/SL/UN/SN/TR/PT/RV/SH/PS/LS	IS & SF are not included, because no relevant Test Case could start from these modes.
ETCS Level	0/1/2/NTC	Level 3 is not included, because assumed equivalent to Level 2 from FFFIS STM point of view
Train State	Standstill/Moving/Not Relevant	

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Starting Conditions	Value	Comments
ETCS Train Data	Valid/Not valid/Not Relevant	"Not valid" includes the cases where ETCS Train Data is invalid or unknown Note: Specific NTC Data status is not relevant for the starting/end conditions
Active DMI channel Connection	Established/Not Established/Not Relevant	Includes application layer connection
Other DMI channels Connections	Established/Not Established/Not Relevant	Includes application layer connection
TIU Connection	Established/Not Established/Not Relevant	Includes application layer connection
BIU Connection	Established/Not Established/Not Relevant	Includes application layer connection
JD Connection	Established/Not Established/Not Relevant	Includes application layer connection
TIU Regenerative Brake Command	Allow/Suppress/Not Relevant	
TIU Magnetic Shoes Brake Command	Allow/Suppress/Not Relevant	
TIU Eddy Current Brake Command for Emergency Brake	Allow/Suppress/Not Relevant	
TIU Eddy Current Brake Command for Service Brake	Allow/Suppress/Not Relevant	
TIU Pantograph Command	Lift/Lower/Not Relevant	
TIU Air Tightness Command	Open/Closed/Not Relevant	
TIU Main Switch / Circuit Breaker Command	Open/Closed/Not Relevant	
TIU Traction Cut Off Command	Cut/Not Cut/Not Relevant	
TIU Traction Status	On/Off/Fail status/Not Relevant	
TIU Direction Controller Position Status	Forward/Neutral/Backward/Fail status/Not available/Not Relevant	

Starting Conditions	Value	Comments
TIU Cab Status	Cab A active/Cab B active/No cab active/Fail status/Not Relevant	
BIU Emergency Brake Command	Apply/Release/Not Relevant	The BIU EB command only relates to the commands provided by the active STM to the BIU Function.
BIU Service Brake Command	Apply with EB fall-back/Apply without EB fall-back/Release/Not Relevant	The BIU SB command only relates to the commands provided by the active STM to the BIU Function.
BIU Emergency Brake Status	Available/Not available/Fail status/Not Relevant	
BIU Service Brake Status	Available/Not available/Fail status/Not Relevant	
NTC isolation status	Not isolated/Isolated/Not Relevant	If this status is relevant, it has to be given for each STM of the Test Case

ERTMS/ETCS on-board Test Case

Step	Description/Comments	Input I/F	Input time	Input Action	Output I/F	Output time limit	Output action
Initial Conditions for the Test Case (e.g. the National Values have to have a specific value to perform the Test Case correctly) are indicated by a '-' in the "Step" column and the inclusion of 'Initial Condition:' in the "Description/Comments" column.							
-	Initial Condition: Set the National Values for the "Override" procedure to defined values suitable for this Test Case.	BTM		Telegram-B1 (3 – National Values) Telegram-B2	-		-
1	The STM establishes the communication session with the STM Control Function	PROF	T0	The STM establishes the safety layers connection	PROF	Ts1	Communication established between the STM and the STM Control Function on safety layers

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Step	Description/Comments	Input I/F	Input time	Input Action	Output I/F	Output time limit	Output action
2	STM Control Function sends its version number after the STM has sent its version number	PROF	T1=T0+Ts1	STM Control Connection: Message-1 Packet STM-1 STM/ETCS function version number	PROF	Ts2	STM Control Connection: Message-2 Packet STM-1 STM/ETCS function version number
	Once the version number of the STM is checked the ERTMS/ETCS on-board sends its current technical mode to the STM				PROF	Ts3	STM Control Connection: Message-3 Packet STM-5 ETCS status data
	ETCS sends its addresses and safety levels				PROF	Ts4	STM Control Connection: Message-5 Packet STM-2 ETCS On-board physical addresses and safety levels
3	ERTMS/ETCS on-board sends the order to CO state after receiving the request for CO state	PROF	T2=T1+max(Ts2, Ts3, Ts4)	STM Control Connection: Message-7 Packet STM-13 State request from STM	PROF	Ts5	STM Control Connection: Message-6 Packet STM-14 State order to STM
The following steps shows the way for time-stamp use							
4	Note: Ts5 may be greater than 5s		T2+5s	Input action	PROF		Output action Message-8 Time: T3
5		PROF	T4=T3+5s	Input action 2 Message-9			Output action 2
Step for checking ETCS MRSP							
6	STM max speed is received and processed (supervised) by the ERTMS/ETCS on-board.	PROF	T4+10s	STM Control Connection: Message-10 Packet STM-16 Transition variables STM max speed from STM	DMI	Ts6	The target speed / target distance is updated

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Ts1, Ts2, Ts3, Ts4, Ts5 and Ts6 are supplier-specific times.

STM Test Case

Step	Description/Comments	Input I/F	Input time	Input Action	Output I/F	Output time limit	Output action
1	STM establishes the communication with the STM Control Function	Power Supply	T0	The STM is switched on	PROF	Ts7	Communication established between the STM and the STM Control Function on safety layers Time-out: supplier specific
2	STM sends its version number	-	T1=T0 +Ts7	-	PROF	Ts8	STM Control Connection: Message-1 Packet STM-1 STM/ETCS function version number Time-out: supplier specific
3	STM checks the version number after receiving the version number from the ETCS considering the communication as established. It sends its state to the STM Control Function	PROF	T2=T1 +Ts8	STM Control Connection: Message-2 Packet STM-1 STM/ETCS function version number	PROF	Ts9	Message-2 Packet STM – 15 STM state Time-out: supplier specific
For the cases that an input triggers several actions without a defined order, the structure of the steps should be as follows (see that the step number is only relevant in the first one, there is no step numbering in the triggered actions)							
4	-	I/F X	T3=T2 +Ts9	Input event that triggers several actions, without an specified order	-		-
-	STM action1 due to previous input	-		-	I/F Y	Ts10	Action1
-	STM action2 due to previous input	-		-	I/F Z		Action2

Message 1 (Packet STM-1): STM → ETCS			
VARIABLE	Length	VALUE	COMMENTS
NID_STM	8	FINITE VALUE	The NID_STM which the ERTMS/ETCS on-board is connected to
L_MESSAGE	8	COMPUTED	Message length
NID_PACKET	8	15	State report from STM
L_PACKET	13	COMPUTED	Packet length
NID_STMSTATE	4	1	Power On (PO)
NID_PACKET	8	1	STM/ETCS function version number
L_PACKET	13	COMPUTED	Packet length
N_VERMAJOR	8	3	FFFIS STM version number, major number: X
N_VERMINOR	8	0	FFFIS STM version number, minor number: Y
PADDING_BITS	COMPUTED	NOT RELEVANT	

Message 2 (Packet STM-1): ETCS → STM			
VARIABLE	Length	VALUE	COMMENTS
NID_STM	8	FINITE VALUE	The NID_STM which the ERTMS/ETCS on-board is connected to
L_MESSAGE	8	COMPUTED	
NID_PACKET	8	1	STM/ETCS function version number
L_PACKET	13	COMPUTED	Packet length
N_VERMAJOR	8	3	FFFIS STM version number, major number: X
N_VERMINOR	8	0	FFFIS STM version number, minor number: Y
PADDING_BITS	COMPUTED	NOT RELEVANT	

Other Message specifications

End Conditions	Value	Comments
STM State	NP/PO/CO/CS/HS/DA/FA/Unchanged	As seen by the DUT
ETCS Mode	NP/SB/SR/FS/OS/NL/SL/UN/SN/TR/PT/RV/SH/PS/LS/Unchanged	IS & SF are not included, because no relevant Test Case could end in these modes.
ETCS Level	0/1/2/NTC/Unchanged	Level 3 is not included, because assumed equivalent to Level 2 from FFFIS STM point of view
Train State	Standstill/Moving/Unchanged/Not Relevant	
ETCS Train Data	Valid/Not valid/Unchanged/Not Relevant	
Active DMI channel Connection	Established/Not Established/Not Relevant/Unchanged	Includes application layer connection
Other DMI channels Connections	Established/Not Established/Not Relevant/Unchanged	Includes application layer connection
TIU Connection	Established/Not Established/Not Relevant/Unchanged	Includes application layer connection
BIU Connection	Established/Not Established/Not Relevant/Unchanged	Includes application layer connection
JD Connection	Established/Not Established/Not Relevant/Unchanged	Includes application layer connection
TIU Regenerative Brake Command	Allow/Suppress/Not Relevant/Unchanged	
TIU Magnetic Shoes Brake Command	Allow/Suppress/Not Relevant/Unchanged	
TIU Eddy Current Brake Command for Emergency Brake	Allow/Suppress/Not Relevant/Unchanged	

End Conditions	Value	Comments
TIU Eddy Current Brake Command for Service Brake	Allow/Suppress/Not Relevant/Unchanged	
TIU Pantograph Command	Lift/Lower/Not Relevant/Unchanged	
TIU Air Tightness Command	Open/Closed/Not Relevant/Unchanged	
TIU Main Switch / Circuit Breaker Command	Open/Closed/Not Relevant/Unchanged	
TIU Traction Cut Off Command	Cut/Not Cut/ Not Relevant/Unchanged	
TIU Traction Status	On/Off/Not Relevant/Fail status/Unchanged	
TIU Direction Controller Position Status	Forward/Neutral/Backward/Not available/Fail status/Not Relevant/Unchanged	
TIU Cab Status	Cab A active/Cab B active/No cab active/Fail status/Not Relevant/Unchanged	
BIU Emergency Brake Command	Apply/Release/Not Relevant/Unchanged	The BIU EB command only relates to the commands provided by the active STM to the BIU Function.
BIU Service Brake Command	Apply with EB fall-back/Apply without EB fall-back/Release/Not Relevant/Unchanged	The BIU SB command only relates to the commands provided by the active STM to the BIU Function.
BIU Emergency Brake Status	Available/Not available/Fail status/Not Relevant/Unchanged	
BIU Service Brake Status	Available/Not available/Fail status/Not Relevant/Unchanged	
NTC isolation status	Not isolated/Isolated/Not Relevant/Unchanged	If this status is relevant, it has to be given for each STM of the Test Case

7.4 Data Dictionary

7.4.1 Special values for variables

7.4.1.1   FINITE VALUE: When the value of a variable has to be defined for a concrete scenario to be run in a lab, "FINITE VALUE" shall be written. For example, NID_STM value.

7.4.1.2   COMPUTED: When the value of a variable needs to be computed or checked by the Test tools, "COMPUTED" shall be included. Can be used for L_MESSAGE & L_PACKET values and for the number of padding bits.

7.4.1.3   NOT RELEVANT: When the value of a variable needs not to be checked or when any value can be used for an input message. For example, padding bits values.

8. TEST SPECIFICATION DOCUMENTATION STRUCTURE

8.1.1.1 The following documents are part of the STM FFFIS Test Specification:

- **SUBSET-074-1** Methodology for testing FFFIS STM

- **SUBSET-074-2** Test Cases:

  o **SUBSET-074-2-1** (FFFIS STM Test Cases of Functional Identity 001 Start of Mission)

  o **SUBSET-074-2-2** (FFFIS STM Test Cases of Functional Identity 002 Application Start up)

  o **SUBSET-074-2-3** (FFFIS STM Test Cases of Functional Identity 003 Level Transitions ETCS to STM)

  o **SUBSET-074-2-4** (FFFIS STM Test Cases of Functional Identity 004 Level Transitions STM to ETCS)

  o **SUBSET-074-2-5** (FFFIS STM Test Cases of Functional Identity 005 Level Transitions STM to STM)

  o **SUBSET-074-2-6** (FFFIS STM Test Cases of Functional Identity 006 Data Available functionality)

  o **SUBSET-074-2-7** (FFFIS STM Test Cases of Functional Identity 007 DMI Function)

  o **SUBSET-074-2-8** (FFFIS STM Test Cases of Functional Identity 008 BTM)

  o **SUBSET-074-2-9** (FFFIS STM Test Cases of Functional Identity 009 Failure)

  o **SUBSET-074-2-10** (FFFIS STM Test Cases of Functional Identity 010 Procedure Specific Data Entry/Data View)

  o **SUBSET-074-2-11** (FFFIS STM Test Cases of Functional Identity 011 Procedure STM Operational Tests)

  o **SUBSET-074-2-12** (FFFIS STM Test Cases of Functional Identity 012 Procedures Override & Shunting)

- **SUBSET-074-3** FFFIS STM Test Specification traceability of Test Cases with Specific Transmission Module FFFIS

- **SUBSET-074-4** FFFIS STM Test Specification traceability of testing the packets specified in the FFFIS STM Application Layer