ERTMS/ETCS – Class 1

Specific Transmission Module
FFFIS

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Company	Technical Approval	Management approval
ALCATEL		
ALSTOM		
ANSALDO SIGNAL		
BOMBARDIER		
INVENSYS RAIL		
SIEMENS		

1. MODIFICATION HISTORY

Issue Number Date	Section Number	Modification / Description	Author
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1.1.0 24-02-00		Preliminary release for ECSAG.	J. Näsström
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A.0.3 24-05-2002	All	Online changes during the WP meeting in Paris	J-Y Riou

Issue Number Date	Section Number	Modification / Description	Author
A.0.4 19.06.2002	Chapter 1-10 for text, 15 only picture	Including of eliminated Pictures within chapter 15 and some of the agreed changes according to the list of comments for Subset 035 issue C.0.2. The included changes are marked within C.0.2.M. No text changes at chapter 13 and following.	U. Dräger
A.0.5 2002-07-11	All	Online changes during the WP meeting in Brussels	Peter Lührs
A.0.6 2002-07-30	All	Online changes during the WP meeting in Stuttgart	U. Däger
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A.0.11 2002-11-21	Basis for this issue was the clean draft issue of A.0.10 Chapter 4.1.1, 5.2.3, 5.2.5, 5.2.6, 8, 10	Online changes during the WP meeting in Stuttgart and the inclusion of the modifications made in the separately reviewed chapters 8 and 10	U. Dräger
A.0.12 2002-12-04		Online changes during the WP meeting in Braunschweig	P. Lührs (Siemens)
2002-12-18		Online changes during the WP meeting in Brussels	R. Ramos (Invensys)
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A.0.17 2003-02-11		Modified after STM review meeting in Stuttgart	R. Ramos (Invensys Rail)

Issue Number Date	Section Number	Modification / Description	Author
A.0.18 2003-02-18	Chapter 5,2.5; chapter 14 and 15; chapter 16; chapter 17; chapter 21; chapter 22	Modified as homework according to the agreements at the STM meeting in Stuttgart	U. Dräger (Alcatel)
A.0.19 2003-02-25		Online changes during the WP meeting in Madrid	P. Lührs (Siemens) R. Ramos (Invensys Rail)
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A.0.25 2003-05-09	Chapter 8.5.1.3		U. Dräger Alcatel
A.0.26 2003-05-26	Content of Odometry chapter removed, Transmission of national air gap information deleted	Version for internal WP review	U. Dräger Alcatel
A.0.27 2003-06-11	New 5.3.14 Others	Online changes during the WP meeting in Brussels: Review process for version A.0.26	U. Dräger Alcatel P. Lührs Siemens

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A.0.28 2003-06-19		Homework changes as agreed during the WP meeting in Brussels (2003-06-11)	P. Lührs (Siemens)
A.0.29 2003-06-23		Online changes as agreed during the WP meeting in Stockholm	R. Ramos (Invensys Rail)
A.0.30 2003-06-26	16.2, 16.3, 16.8 (Annex B)	Figures updated as agreed during the WP meeting in Stockholm (2003-06-25)	P. Lührs (Siemens)
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A.0.32 2003-07-14		Preparation for the final delivery issue Chapter 10 included: Updated after pending comments from Brussels meeting. Also includes solution on the different needs for non-statistical and statistical. ETCS shall send either non-stochastical only, or both statistical and non-statistical	U. Dräger Alcatel
2.1.0 2003-07-15		Updated during the WP meeting in Brussels (2003-07-15)	P. Lührs (Siemens)
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Every Time the Version Number of this document is changed the Compatibility Number shall be updated, see chapter 15.2.

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3. GENERAL

3.1 References

3.1.1.1 /1/ SUBSET-026; SRS Version 2.2.2

3.1.1.2 /2/ SRS Version 2.2.2; SUBSET-026.1; Introduction

3.1.1.3 /3/ SRS Version 2.2.2; SUBSET-026.2; Basic System Description

3.1.1.4 /4/ SRS Version 2.2.2; SUBSET-026.3; Principles

3.1.1.5 /5/ SRS Version 2.2.2; SUBSET-026.4; Modes and Transitions

3.1.1.6 /6/ SRS Version 2.2.2; SUBSET-026.5; Procedures

3.1.1.7 /7/ SRS Version 2.2.2; SUBSET-026.7; ERTMS/ETCS language

3.1.1.8 /8/ SRS Version 2.2.2; SUBSET-026.8; Messages

3.1.1.9 /9/ SUBSET-033; FIS – Man Machine Interface

3.1.1.10 /10/ SUBSET-056 STM FFFIS Safe Time Layer

3.1.1.11 /11/ SUBSET-057 STM FFFIS Safe Link Layer

3.1.1.12 /12/ SUBSET-059 STM Performance

3.1.1.13 /13/ SUBSET-058 STM Application Layer

3.1.1.14 /14/ CENELEC 50170-2 (1996) Profibus

3.1.1.15 /15/ CENELEC prEN 50xx6 (October 2000) ERTMS Driver Machine Interface

3.1.1.16 /16/ SUBSET-034 FIS for the Train Interface

3.1.1.17 /17/ SUBSET-041 Performance Requirements for Interoperability

3.1.1.18 /18/ SUBSET-054 Assignment of values to ETCS variables

3.1.1.19 /19/ CENELEC EN 50159-1 (2001) Safety related communication in closed transmission systems

3.2 Scope

3.2.1.1 FFFIS STM specifies the interface between an STM and ETCS on-board.

3.2.1.2 The acronym FFFIS stands for “Form Fit Functional Interface Specification”. This means an interface specification for interoperability and covering all protocol levels of communication, and including connector and physical level.

3.2.1.3 This document has to be linked to the ERTMS/ETCS System Requirement Specification (SUBSET-026) Ref. /1/ SUBSET-026; SRS Version 2.2.2

3.2.1.4 The lowest level boundary of this standard is to the FDL layer of Profibus. Referenced Profibus specifications cover the lowest communication layers, physical layer including connector see /14/ CENELEC 50170-2 (1996) Profibus.

3.2.1.5 The upper boundary of the specification describes the functions linked to the interface between an ERTMS/ETCS On-board and an STM.

3.2.1.6

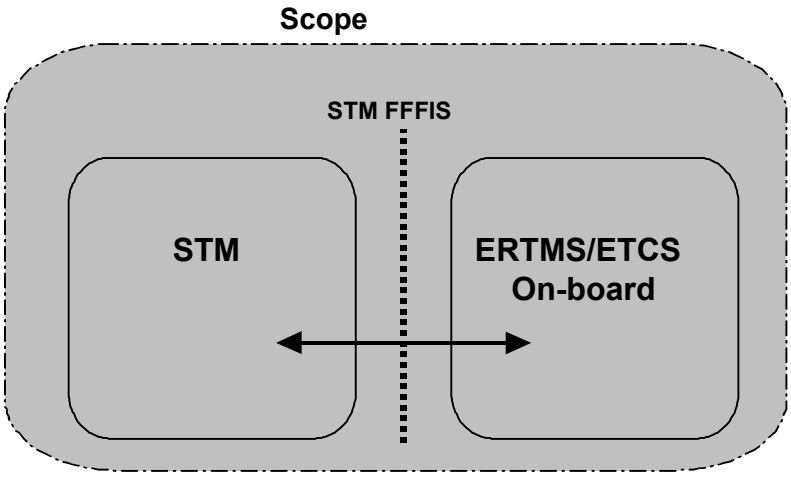


Figure 1: Scope of STM FFFIS

4. INTRODUCTION

4.1 Definitions

4.1.1 STM

4.1.1.1 The STM associated to an ETCS on-board is able to perform train movement supervision on national fitted lines, using the national train control infrastructure information. The national train control system shall be called the target system.

4.1.1.2 It interfaces with ETCS on-board through the STM FFFIS interface. The combination of STM and ETCS on-board realises a set of functionality that shall fulfil the requirements for the target system.

4.1.1.3 The connection of an STM to an ETCS onboard shall not require functional extensions of ETCS on-board or DMI beyond what is included in UNISIG specifications to support STMs.

4.1.1.4 The STM shall be identified by a unique number NID_STM as specified in the UIC list (see /18/ SUBSET-054 Assignment of values to ETCS variables).

4.1.1.5 STM shall use the common Time & Odometer information from ETCS onboard distributed through the STM interface.

4.1.1.5.1 Exception: A direct interface of the STM to the odometer sensor shall be allowed only if required due to performance reasons

4.1.1.6 The functionality related to train supervision shall fully comply with the national requirements for the target system.

4.1.1.7 STM shall control brakes and other train based functions (TIU) through the Brake or Train Interface of the ETCS on-board.

4.1.1.7.1 Exception: A direct interface of the STM to the emergency brake and the traction cut-off shall be allowed only if required due to performance reasons

4.1.1.7.2 The STM may have a direct interface to functions that are national and not defined on a European level.

4.1.1.8 The STM shall monitor its own technical ability to function safely. The safe state shall be reported to the ETCS onboard.

4.1.1.9 The ETCS onboard is responsible for supervision of STM safety integrity and to take safe action in case of failure.

4.1.2 STM of European type

4.1.2.1 When an STM of the European type is active, the ETCS on-board shall operate in Level STM and the technical mode **STM European (SE)** as described in Ref: /1/ SUBSET-026; SRS Version 2.2.2.

4.1.2.2 The European STM shall use the supervision functions available in the ETCS on-board. This includes braking curve calculation, selection of Most Restrictive Speed Profile, and speed supervision. (SRS see Ref.: /4/ SRS Version 2.2.2; SUBSET-026.3; Principles)

4.1.2.3 An STM using the European mode shall transform received infrastructure data into STM Profile data and transmit to the ETCS on-board. The ETCS on-board shall be responsible for the safe train movement within the STM Profile.

4.1.2.4 STM Profile definition

4.1.2.4.1 The STM Profile Data is the data needed to define safe train movement in space, speed and time.

4.1.2.4.2 The STM Profile is defined as:

a) Movement Authority

b) Static Speed Profile

c) Gradient profile

d) STM Reference Location for the beginning of STM Profile

4.1.2.4.3 Note: The SRS uses the term Profile only for static aspects of the track, such as Static Speed Profile. In the STM scope the STM Profile also involves the dynamic aspects such as Movement Authority.

4.1.2.4.4 When transmitting an STM Profile, all these four information mentioned above (4.1.2.4.2) shall be transmitted together in the same message.

4.1.2.4.5 The STM Reference Location provided shall be used as origin point for Movement Authority, Static Speed Profile and Gradient Profile.

4.1.3 STM of National type

4.1.3.1 When an STM of the National type is active, the ETCS on-board shall operate in Level STM and the technical mode **STM National (SN)** as described in Ref: /1/ SUBSET-026; SRS Version 2.2.2.

4.1.3.2 An STM using the National mode shall perform and be responsible for the train supervision. The ETCS on-board is still active, but shall only be responsible for the interfacing and communication with resources such as DMI, Odometer and Train Interface.

4.1.4 Target System mode

4.1.4.1 The Target System modes and definition is depending on the target system.

4.1.4.2 The Target System modes shall be implemented in the STM and not transmitted to the ETCS onboard

4.1.4.2.1 Note: It is the national correspondence to the ETCS Technical Modes.

4.1.4.2.2 Note: Target System mode is a purely national matter. But it has a different term for each target system. A harmonised term is helpful for understanding and to make a clear distinction from ETCS Technical Modes.

4.1.4.2.3 Note: Some target systems have defined fallback actions for degraded situations. Such fallback modes are defined among the Target System modes. They are typically related to trackside failures or transmission disturbances.

4.1.5 Group of STMs

4.1.5.1 Background: Some infrastructures have implemented more than one target system in parallel for train protection purposes. Typically the target systems complement each other (in functionality or availability).

4.1.5.2 The target systems may operate simultaneously or one at a time, depending on installation and system functionality.

4.1.5.3 To avoid complexity and national rules in the ETCS onboard, the STM FFFIS requires that only one STM can be active (supervising) at a time. Change of active STM shall only take place at Level Transitions.

4.1.5.4 For infrastructures with more than one target system the concept of STM Group shall be used. One target system On-board equipment shall take the role of master, having communication with ETCS onboard. The other target system On-board equipment(s) shall communicate with ETCS On-board via the master.

4.1.5.5 Thus, multiple target systems in a group shall appear as one STM to the ETCS on-board. The target system On-board equipments in a group shall internally manage issues such as priority, safety and output conflicts.

4.1.5.6 An STM Group can be of European or National type.

4.1.5.7 Switching between the target systems in a group is controlled within the group. ETCS On-board takes no part in this.

4.2 Other technical requirements

4.2.1.1 The ETCS On-board if not in the ETCS technical modes No Power, Isolation or System Failure Mode shall accept STMs entering the bus at any time, except if there was a final disconnection with the entering STM.

4.2.1.1.1 Note: This allows to restart an STM without restarting the ETCS onboard.

4.2.1.1.2 Note: To recover from failure modes considered as severe, it may also be necessary to restart the ETCS onboard equipment.

4.2.1.2 The ETCS on-board is in all technical modes responsible for monitoring safety integrity of connected STMs and take safe action in case of lost safety integrity.

4.2.1.3 If a passive STM (an STM which is not in State Data Available) fails or loses safety integrity, the ETCS onboard shall not brake due to the STM failure.

4.2.1.3.1 Justification: The failure of a passive STM is not critical to train safety. Restart can be planned at next trainstop location, See Ref.: 7.4.1.6.1.

4.3 STM Isolation

4.3.1.1 It shall be possible to isolate an STM from the rest of the ETCS On-board equipment on the interface. The isolation shall ensure that the function of the bus is not disturbed by the isolated STM.

4.3.1.1.1 Note: All possible direct interfaces with the train and the driver are out of the scope of the FFFIS Specification.

5. PRINCIPLES

5.1 Functional architecture

5.1.1.1 STM shall use the STM FFFIS to communicate with functions and resources within ETCS on-board, including:

- DMI
- Supervision
- STM Control
- Reference clock
- BIU
- TIU
- JRU
- DRU (optional)
- Odometer

5.1.1.2 In addition to the connection with ETCS onboard via STM FFFIS, the STM can have a direct connection with:

- National trackside equipment via antenna
- Separate DMI (optional)
- Separate JRU (optional)
- Separate DRU (optional)
- Separate TIU (optional)
- Separate BIU (if required due to performance reasons)
- Odometer (if required due to performance reasons)

5.1.2 European STM

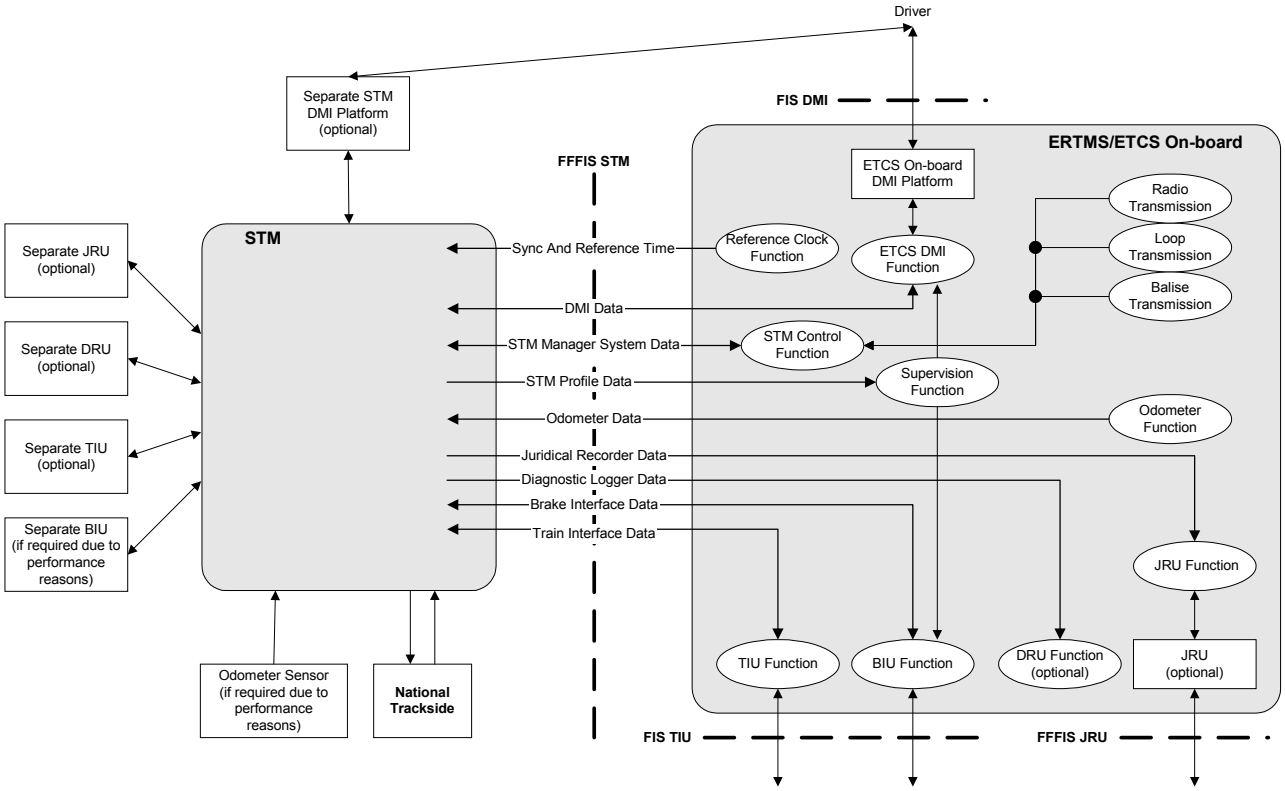


Figure 2: European configuration of STM and ETCS onboard: Data flow

5.1.2.1 Supervision shall be done within the ETCS on-board.

5.1.3 National STM

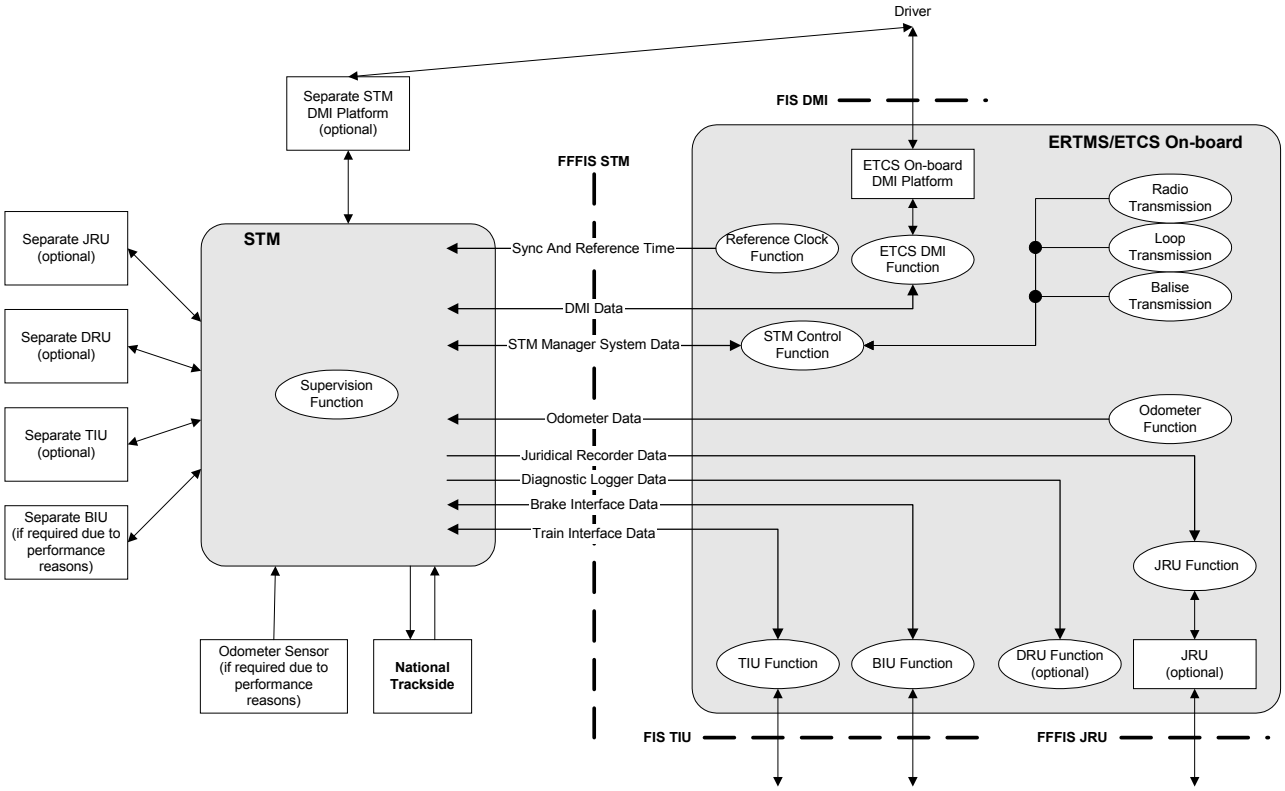


Figure 3: National configuration of STM and ETCS onboard: Data flow

5.1.3.1 Supervision shall be done within the STM.

5.2 Data and ERTMS/ETCS functions for both European and National modes

5.2.1.1 The following paragraphs describe the ERTMS/ETCS functions that are available for STM and the data that shall be transmitted over the interface both for National and European configurations.

5.2.1.2 The data is transmitted over the STM bus using Multicast or Point-to-Point Connections, see chapter 14.5.

5.2.2 Reference time

5.2.2.1 ETCS onboard is responsible for providing common reference time to all STMs. This is defined in /10/ SUBSET-056 STM FFFIS Safe Time Layer.

5.2.3 Odometry via ETCS and optional direct sensor access from STM

5.2.3.1 ETCS odometry shall include distance, speed, confidence interval for distance and speed, and time stamp for odometer data.

5.2.3.2 Odometry data shall be sent by the ERTMS/ETCS On-board to all STMs.

5.2.3.2.1 Exception: A direct interface of the STM to the odometer sensor shall be allowed only if required due to performance reasons.

5.2.3.2.1.1 Note: Due to project dependant implementations of the direct odometer interface according to different train / locomotive equipments, it is not possible to specify one solution for the direct interface which has to be used by all STMs.

5.2.3.3 An STM needing a direct interface to an odometer sensor shall not impose modifications on the ETCS On-board due to the need of the direct interface.

5.2.3.4 The STM supplier may seek for a solution with either ETCS supplier or the train manufacturer on a case-by-case decision, as it is not mandatory for the ETCS On-board to provide a direct interface to an odometer sensor.

5.2.4 Train Interface

5.2.4.1 A subset of the train interface signals specified in the TIU FIS (see /16/ SUBSET-034 FIS for the Train Interface), Status / Availability and Command are transmitted via the FFFIS STM. These train interface signals transmitted via the FFFIS STM are called Train Interface FFFIS STM signals.

5.2.4.2 The TIU function is described as the exchange of information between the train interface and the STM, in this case:

- Status: is a functional information coming from the train interface to the STM.
- Command: is a functional information coming from the STM to the train interface.

5.2.4.3 Train Interface FFFIS STM command signals shall be:

Name of function	Comments
Regenerative Brake	
Magnetic Shoes	
Eddy Current Brake	
Inhibit Passenger Emergency Brake	
Pantograph	
Air Tightness	
Main Switch / Circuit Breaker	This is considered as only one command.
Traction Cut Off	

5.2.4.3.1 Note: Service and Emergency Brake command are handled in the BIU interface see chapter 5.2.5.

5.2.4.4 Train Interface FFFIS STM status signals shall be:

Name of function	Comments
Sleeping	This information is part of the ETCS On-board technical mode
Traction Cut Off	
Direction Controller Position	
Cab Status (Desk Status)	

5.2.4.4.1 Note: Service and Emergency Brake status are handled in the BIU interface see chapter 5.2.5.

5.2.4.5 The STM shall have the possibility to have a direct interface to train interface signals that are not specified in the FFFIS STM.

5.2.4.6 The STM shall have the possibility to open a communication session to a specific ETCS On-board function by using a spare SAP in order to transmit train interface signals not included in the FFFIS STM.

5.2.5 Brake Interface (BIU) via ETCS and optional direct access from STM

5.2.5.1 The Brake Interface via ETCS is formally a part of the Train Interface. It shall include the brake interface parameters, command and status / availability of the Emergency Brake access and the Service Brake access.

5.2.5.2 The Brake Interface is separated to allow physical separation between Train Interface and Brake Interface.

5.2.5.2.1 Justification: The safety and performance requirements on brake versus other train interface signals are different. The command of the Emergency Brake is required to be fail-safe.

5.2.5.3 The ETCS onboard shall accept a brake command from an STM only when the following conditions are fulfilled:

- The STM is in state Data Available.
- The ETCS onboard is in mode STM European (SE) or STM National (SN).

5.2.5.4 A direct interface of the STM to the emergency brake and the traction cut-off (both optional) shall be allowed only if required due to performance reasons.

5.2.5.4.1 Note: The direct interface to the traction cut-off may have to be included in this direct interface because of the technical requirements of some trains / locomotives which do not allow an emergency brake application while the traction is not cut-off, because this may lead to problems / failures of the train /locomotive equipment.

5.2.5.4.2 Note: Due to project dependant implementations of the direct brake interface according to different train / locomotive equipments, it is not possible to specify one solution for the direct interface which has to be used by all STMs.

5.2.5.5 The STM shall be allowed to apply the emergency brake using the direct interface only when the STM is active (in state “Data Available”) and the ETCS technical mode is SN or SE.

5.2.5.6 The STM shall release the emergency brake using the direct interface when the STM is no more active (Transition from DA to any other state).

5.2.5.7 The STM shall be allowed to apply the traction cut-off using the direct interface only when the emergency brake application is allowed over the direct interface (see chapter 5.2.5.5).

5.2.5.8 In case of some (hardware) failures within the STM the above requirements may not be fulfilled. To cover this situation the STM isolation shall also isolate the STM from the brakes and traction cut-off in addition to the current requirements to the isolation of the STM see chapter 4.3.

5.2.5.8.1 Justification: This requirement is to release a brake application and traction cut-off of an STM in case of a failed STM.

5.2.6 Juridical Recorder (JRU)

5.2.6.1 The STM shall be allowed to transmit through the FFFIS the national data to be recorded in the ETCS JRU.

5.2.6.2 An optional separate national juridical recorder is allowed. It is directly connected to the STM. This is out of the scope of this specification.

5.2.6.2.1 Justification: The National Authority may require the national juridical recorder for existing recording media and routines for a period until the European JRU is accepted.

5.2.6.3 For more details see chapter 11.

5.2.7 Diagnostic Recorder (DRU)

5.2.7.1 The STM shall be allowed to transmit through the FFFIS the national data to be recorded in an ETCS DRU.

5.2.7.1.1 Note: The ETCS DRU is optional for the ERTMS/ETCS On-Board equipment.

5.2.7.2 An optional separate national diagnostic recorder is allowed. It is directly connected to the STM. This is out of the scope of this specification.

5.2.7.3 For more details see chapter 12.

5.2.8 STM control function

5.2.8.1 The STM control function shall control the STM state, the STM safety integrity and the compatibility of the ETCS On-board and STM version.

5.2.8.2 The STM control function shall handle the transmission of the ETCS data for STM and the specific Data Entry for STM see chapter 5.2.11, 5.2.12 and 13.1.1.

5.2.8.3 The STM control function shall handle the test procedure for STMs see chapter13.2.

5.2.8.4 The STM control function shall handle the override procedure for STMs see chapter 13.3.

5.2.9 DMI

5.2.9.1 The STM shall be allowed to use the ETCS DMI function as interface to the driver. This includes:

5.2.9.1.1 Management of button object.

5.2.9.1.2 Setting indicator status.

5.2.9.1.3 Control/inhibition over some objects in the DMI (see chapter 10.7.2.5 and chapter 10.7.3.5).

5.2.9.1.4 Sounds and text commands.

5.2.9.2 Separate DMI is an option for DMI components that are part of STM hardware. The usage of this option shall be kept to a minimum.

5.2.9.3 For further details see chapter 10.

5.2.10 ETCS On-board Functions available for STMs

5.2.10.1 The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														x	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x
13	Service Brake command														x	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x

5.2.11 ETCS data and Data Entry

5.2.11.1 The ETCS On-board STM Control Function shall transmit a subset of ETCS Train Data, ETCS Additional Data and ETCS National Values to the STM (see /4/ SRS Version 2.2.2; SUBSET-026.3; Principles).

5.2.11.1.1 Note: Data may be fixed stored data or manually entered data.

5.2.11.2 The ERTMS/ETCS onboard shall transmit a subset of the ETCS train data to all STMs as described below.

a) Train category

b) Train length

c) Deceleration data (referring to the traction/brake models)

d) Maximum permitted speed for the train, taking into account the maximum speed of every vehicle contained in the train.

e) Loading gauge

f) Axle load

g) Power supply accepted by the train

h) Train fitted with airtight system

i) Train running number

5.2.11.2.1 Note: Extra data for the available STMs are handled in the Specific STM Data Entry Procedure see chapter 5.2.12.

5.2.11.3 The ERTMS/ETCS onboard shall transmit a subset of the ETCS additional data and date / time to all STMs as described below.

a) Driver_id

b) ERTMS/ETCS Level

c) ETCS on-board identity

d) Adhesion factor

e) Date and Time (UTC Time)

5.2.11.4 The ERTMS/ETCS onboard shall transmit a subset of the ETCS National / Default Values to all STMs as described below.

a) Modification of adhesion factor by driver.

b) Shunting mode (permitted) speed limit

c) Staff Responsible mode (permitted) speed limit

d) On Sight mode (permitted) speed limit

e) Unfitted mode (permitted) speed limit

f) Release Speed value

g) Distance to be used in Roll Away protection, Reverse movement protection and Standstill supervision

h) Max. speed limit for triggering the override end of authority function

i) Permitted speed limit to be supervised when the ”override EOA” function is active

j) Distance for train trip suppression when override end of authority function is triggered

k) Max. time for train trip suppression when override end of authority function is triggered

l) Distance to be allowed for reversing in Post Trip mode.

m) Max permitted distance to run in Staff Responsible mode.

5.2.11.5 The Fixed Values (defined in /4/ SRS Version 2.2.2; SUBSET-026.3; Principles) are not transmitted.

5.2.12 Specific STM data and Data Entry

5.2.12.1 The STM shall be allowed to request (nationally) specific STM data from ETCS.

5.2.12.2 Specific STM data are the national data that are not provided by ETCS data or that cannot be translated from ETCS data.

5.2.12.2.1 Note: The entry of Specific STM Data shall be avoided. Where possible, automatic translation shall be implemented.

5.2.12.3 Specific STM data shall be requested by STM only. It shall be possible at start-up and later on during mission in order to modify or review train data.

5.2.13 Transmission of ETCS air gap messages for STMs

5.2.13.1 This subchapter will be only valid if there are ETCS air gap messages for STMs defined within the SRS.

5.2.13.1.1 Definition: ETCS air gap messages for STMs are messages which are specified within the “/7/ SRS Version 2.2.2; SUBSET-026.7; ERTMS/ETCS language” that have to be forwarded to an STM.

5.2.13.2 When the ETCS receives data to be transmitted to an STM the data shall be transmitted by the STM Control Function to the identified STM via the STM control connection.

5.2.13.3 If data to be forwarded to an STM are received by the ETCS On-board then the STM Control Function shall add an odometer reading of the LRBG to the transmitted data.

5.2.13.4 The odometer reading shall correspond to the location of the LRBG using the FFFIS STM odometer function as common reference (nominal odometer value).

5.2.14 Supervision (for European STM only)

5.2.14.1 This function shall perform the train movement supervision according to the STM profile transmitted by the STM (see chapter 9).

6. TECHNICAL MODES OF ETCS

6.1.1.1 This chapter intends to highlight some already existing requirements from /1/ SUBSET-026; SRS Version 2.2.2 that are important for the understanding of the interaction between the STMs and the ETCS onboard.

6.1.2 Sleeping and Non-leading modes

6.1.2.1 The ETCS onboard can be in Sleeping under Level STM.

6.1.2.2 The ETCS onboard can be in Non-leading under Level STM.

6.1.2.3 ETCS onboard allows access to train interface functions in Sleeping and/or Non-leading mode. This is requested by some target systems.

6.1.2.4 The ETCS onboard is in mode Sleeping or Non-Leading because it is in a slave engine. This is independent from the ETCS Level.

6.1.2.5 So when ETCS onboard in mode Sleeping or Non-Leading enters into a level STM area, the ETCS onboard remains in its current technical mode, but it activates the corresponding STM. This allows the STM to perform national functions in these ETCS technical modes.

6.1.3 Stand By mode

6.1.3.1 The ETCS onboard can be in Stand By under Level STM.

6.1.3.2 The ETCS onboard while in the technical mode Stand By performs standstill supervision.

6.1.3.3 An STM may be active while the ETCS onboard is in the technical mode Stand By and under the corresponding STM Level, but according to the standstill supervision of the ETCS onboard it is not possible to move the train.

7. STM MANAGER SYSTEM (SMS)

7.1 Scope

7.1.1.1 The scope of this chapter is to define how the STM (the "state machine" internal to the STM) handles its state and how the ETCS On-board (the STM control function) handles the states of the connected STM(s).

7.2 General principles

7.2.1.1 The scope of the "General Principles" chapter is to give an overview of the relations between STMs and ETCS On-board. This chapter contains no requirements.

7.2.1.2 The number and identification of the STMs (and STM Groups) connected to the ETCS On-board is known by ETCS On-board when STMs connect themselves to the "STM control function".

7.2.1.3 The STM reports every change of its state to the STM control function, except if the connection with "STM control function" is closed due to a connection failure.

7.2.1.4 STM can either be from European or National type, the STM type is announced by the STM itself at the initialisation phase as identification.

7.2.1.5 Following the STM type the responsibilities of the STM and of the ERTMS/ETCS on-board are different and only have effect in the “Data Available” state (see /4/ SRS Version 2.2.2; SUBSET-026.3; Principles)

7.3 Requirements on STM

7.3.1 STM states definition

7.3.1.1 No Power (NP)

7.3.1.1.1 The NP state means that the STM is unpowered.

7.3.1.1.1.1 Note: This is not a "software" state since no STM software is running when the STM is unpowered.

7.3.1.2 Power On (PO)

7.3.1.2.1 This state is the default state immediately entered by the STM after the STM is switched on.

7.3.1.2.2 Once in PO state, the STM shall perform its self-tests and synchronisation of the Safe Time Layer.

7.3.1.2.3 Once in PO state, the STM shall establish a communication session with the ETCS on-board STM Control function as soon as possible.

7.3.1.2.3.1 Note: The term "as soon as possible" is used in the above requirement to take into account the fact that some STMs may have to wait for their self-test result before being able to start the communication session with ETCS, while other STMs may immediately start the communication session.

7.3.1.2.4 The STM shall send its type (European or National) when the STM has established the connection to the STM Control Function.

7.3.1.2.5 When the STM has established the connection to the STM Control Function, the STM shall send a “Specific STM Data Need” information to the STM Control Function (see13.1.1.1.10).

7.3.1.2.6 The STM shall send its product identity (vendor id, specific supplier software and hardware version) once the connection from the STM to the STM Control Function is established.

7.3.1.2.7 It is not mandatory for the ETCS to process the STM product identity. The ETCS may use this STM product identity for diagnostics or recording purposes or for filtering some STMs versions.

7.3.1.2.8 Once the STM knows the bus addresses and safety levels of all available ETCS On-board functions (see 7.4.1.1.11), the STM shall establish a connection with all required ETCS On-board functions.

7.3.1.2.9 Once all connections are established, the STM shall request CO state to the STM control function.

7.3.1.3 Configuration (CO)

7.3.1.3.1 The STM state “Configuration” is used for the exchange of configuration data between STM and ETCS On-board. "Configuration data" means data that is necessary for the national operation.

7.3.1.3.2 List of exchanged data

7.3.1.3.2.1 Data from ETCS On-board to STMs

- ETCS data (see chapter 5.2.11)
- Odometer parameters (See Chapter 8.7)
- Status / availability of the train interface FFFIS STM signals (TIU)
- Brake interface (BIU)
  - Status / Availability of the Service Brake command
  - Status / Availability of the Emergency and Service Brake States
  - Parameter(s):
    - Maximum time delay for the ETCS to process the STM Emergency and the STM Service Brake commands. This is the time from receiving the brake command from the STM until the ETCS commands the brake

7.3.1.3.3 Once the exchange of configuration data is finished, and if the STM has received enough configuration information thanks to this process, then the STM shall request CS state to the STM control function.

7.3.1.3.4 If an STM in Configuration State detects that the ETCS On-board is in the technical mode Non-Leading or Sleeping, the STM shall request to go to CS state.

7.3.1.3.4.1 Justification: This allows STM operation on Non-Leading or Sleeping cab without data entry.

7.3.1.3.5 Once the exchange of configuration data is finished, and if the STM needs more information than what it has received thanks to this process, then the STM shall request DE state to the STM control function.

7.3.1.3.6 When an STM exits CO state, this STM

- shall have the possibility to close the connection with the JRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the DRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the TIU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the BIU (up to the STM to decide it or not).
- shall maintain the connection with the STM Control Function.
- shall close the connections with all other ETCS On-board functions

7.3.1.4 Data Entry (DE)

7.3.1.4.1 The state DE is required for any STM that needs Specific STM Data entry information in order to have all the required national information for operating the train with the STM.

7.3.1.4.1.1 Note: This state is only entered once at the start up process. If the ETCS data entry is requested during the mission, the Specific STM Data Entry will be requested by the STM at any possible state without any transition to Data Entry State.

7.3.1.4.2 In the state DE the Specific STM Data Entry procedure (see chapter 13.1.1) shall be performed.

7.3.1.4.3 Once specific STM data entry is completed, the STM shall request CS state to the STM control function.

7.3.1.5 Cold Standby (CS)

7.3.1.5.1 Being in the state CS, the STM was initialised, tested, configured and is in possession of all required information for operating, but not able to receive a message from the trackside, because the reception is turned off.

7.3.1.5.2 In the case the STM receives the ETCS Train Data, the STM shall perform the relevant exchange of data with the ETCS STM Control Function (see chapter13.1.1).

7.3.1.6 Hot Standby (HS)

7.3.1.6.1 Being in the state HS, the STM shall be able to process the information from or to the national trackside.

7.3.1.6.1.1 Note: In HS state, when receiving national trackside information, the STM shall treat this information to be prepared to take in charge the train movement supervision once its state will switch to DA state.

7.3.1.6.2 The STM in HS shall have the possibility to send a "STM max speed" to the STM control function.

7.3.1.6.2.1 Note: This "STM max speed" is to allow the STM, for national reasons unknown to the ETCS On-board or ERTMS Trackside, to request a given train speed at the level transition border in order to have a smooth transition.

7.3.1.6.3 The STM in HS shall have the possibility to send an "STM system speed" together with an "STM system distance" to the STM control function.

7.3.1.6.3.1 Note: This "STM system speed" together with the "STM system distance" is to allow the STM, to request a given train speed at a given position ("STM system distance") before the level transition border in order to be able to detect its national trackside.

7.3.1.6.4 In the case the STM receives the ETCS Train Data, the STM shall perform the relevant exchange of data with the ETCS STM Control Function (see chapter13.1.1).

7.3.1.7 Data Available (DA)

7.3.1.7.1 In DA state, a National STM is responsible for the train movement supervision, according to the received national trackside information. A European STM is also responsible for the train movement supervision, according to the received national trackside information, but some parts of the calculations are performed by the ETCS On-board.

7.3.1.7.2 A STM in “Data Available” state can have two different behaviours, respects to its type: National or European (As specified in Subset-026).

7.3.1.7.2.1 Note: a European STM translates the national information into a STM profile (MA, SSP & gradients) and lets the ERTMS/ETCS on-board (in SE mode) supervise the train movement (EB brake when overpassing the EOA).

7.3.1.7.2.2 Note: a National STM uses the national air-gap information for supervising the train movement according to the national rules (at least EB command and release) and the ERTMS/ETCS on-board (in SN mode) acts as an access provider to the ERTMS/ETCS functions (e. g. DMI, odometer, JRU & TIU).

7.3.1.7.3 A European STM shall provide the STM profile (MA, SSP & Gradients, as defined in Subset-026, v2.2.2, chapter 4.8.3.2) to the ETCS on-board.

7.3.1.7.4 A European STM shall acknowledge the EB command (issued by ERTMS/ETCS on-board when overpassing STM EOA) with the transmission of the new STM profile.

7.3.1.7.5 In the case the STM receives the ETCS Train Data, the STM shall perform the relevant exchange of data with the ETCS STM Control Function (see chapter13.1.1).

7.3.1.8 Failure (FA)

7.3.1.8.1 Being in this state, the STM is not able to work any more, due to internal or external reasons.

7.3.1.8.1.1 Note: STM failures that do not prevent the STM to perform the train supervision according to the national rules are handled internally by the STM and do not lead to FA state.

7.3.1.8.2 If the STM has a direct access to the emergency brake, the STM shall not command braking via this direct access while in FA state.

7.3.1.8.3 In FA state the STM shall report, if possible, FA state to JRU and any national recorder.

7.3.1.8.4 The STM shall isolate itself from the bus after reporting its failed state to the ETCS On-board STM Control Function and to the JRU.

7.3.2 STM States transitions table

7.3.2.1 Transitions table for STM

NP	< 15	< 15	< 15	< 15	< 15	< 15	< 15
1 >	**PO**						
	2 >	**CO**					
		3 >	**DE**				
		4a >	4a >	**CS**	< 4a	< 4a < 4b	
				6 >	**HS**		
				9 >	9 >	**DA**	
	16 > 17 >	16 > 17 >	16 > 17 >	16 > 17 >	16 > 17 >	16 > 17 >	**FA**

7.3.2.2 Transitions conditions table

7.3.2.2.1 Note: This table only contains the event(s) that triggers the transition. It does not describe the reasons why this event(s) happens.

Condition Id	Content of the conditions
1	STM is powered on
2	ETCS order “Configuration”
3	ETCS order “Data Entry”
4a	ETCS unconditional order “Cold Standby”
4b	ETCS conditional order “Cold Standby”
5	*intentionally deleted*
6	ETCS order “Hot Standby”
7	*intentionally deleted*
8	*intentionally deleted*
9	ETCS order “Data Available”
10	*intentionally deleted*
11	*intentionally deleted*

Condition Id	Content of the conditions
12	*intentionally deleted*
13	*intentionally deleted*
14	*intentionally deleted*
15	STM is powered off
16	ETCS order "Failure"
17	The STM decides itself to go in FA state

7.3.3 Requirements linked to STM States transitions

7.3.3.1 When an STM in DA state receives a "conditional CS state transition order", the STM shall be allowed to stay in DA state as long as a national trip situation is processed by this STM.

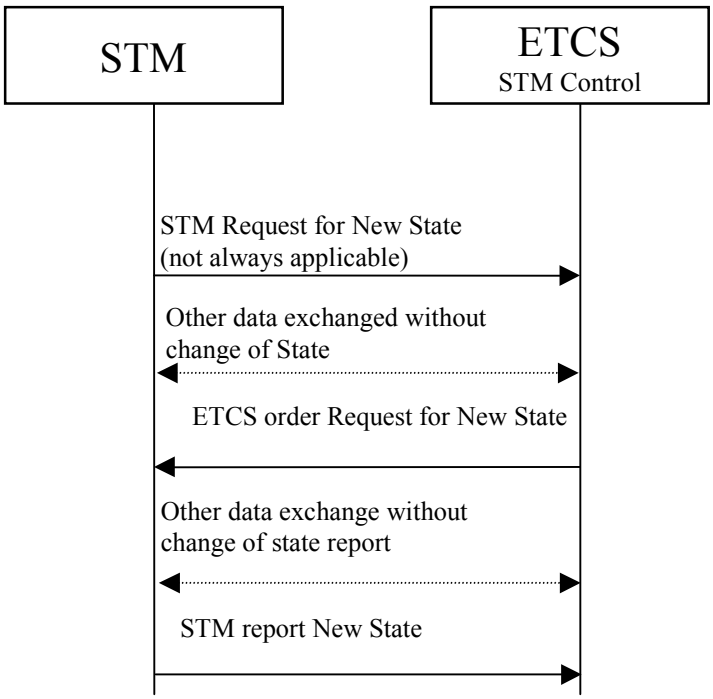
7.3.3.1.1 Justification: When a level transition border is passed, an STM may have to stay active after receiving a deactivation order because the STM is currently processing a national trip situation.

7.3.3.2 When an STM in DA state receives a "conditional CS state transition order" and is not going to change to CS state as soon as possible due to a national trip situation (see 7.3.3.1), the STM shall send a "TRIP" message to the STM Control Function

- Immediately after the STM has received the "conditional CS state transition order, and
- (after sending the first "TRIP" message) every 5 seconds.

7.3.3.2.1 Note: The STM shall send the "TRIP" messages with a cycle time of 5 seconds in order to fulfil the time-out check of 10 seconds starting with sending the "conditional CS state transition order" within the STM Control Function.

7.3.3.3 State Transition Sequence Chart:



7.3.4 General STM requirements

7.3.4.1 The STM shall always turn off its antenna transmission: the antenna shall not energise trackside equipment, and shall not read trackside data, and shall not transmit data to trackside, except

- in HS and DA state,
- in CS state as long as the train is on its national trackside after deactivation by a level transition, and
- for test purpose.

7.3.4.1.1 Note: When exiting DA or HS state (due to the exit of the level STM area, it may happen that the national trackside goes further than the level transition border. In this case, even if the STM is already in CS state, the STM shall have the possibility to continue to communicate with its national trackside as long as the train is located on the national trackside.

7.3.4.1.2 If the STM detects an internal failure that cannot be handled according to the national rules, the STM shall change to “Failure” state.

7.3.4.1.3 Note: Failure that can be handled according to national rules (e. g. consistency of national air-gap information) may not lead to a change to “Failure” state but to a national degraded mode.

7.3.4.2 If the STM receives from the ETCS On-board a state transition order, which is not allowed by the state transition table, then the STM shall go in FA state.

7.3.4.3 The STM shall report its NID_STM to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

7.3.4.4 The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

7.3.4.4.1 Exception: The FA state shall be reported if possible. Due to a failure of the STM itself it may not be possible to report the FA state.

7.3.4.5 It shall not be mandatory for the STM to process the ETCS product identity (see chapter 7.4.1.1.5). The STM may use this ETCS product identity for diagnostics or recording purposes or for filtering some ETCS versions.

7.4 Requirements on ETCS On-board

7.4.1 STM control function - "STM MANAGER SYSTEM" part

7.4.1.1 Forewords

7.4.1.1.1 The present chapter does not specify the whole STM control function, but only the part of the STM control function that manages the states of the connected STM(s).

7.4.1.1.2 For more information on the ETCS On-board behaviour related to STMs, please refer to /1/ SUBSET-026; SRS Version 2.2.2: chapter4.4.16 "STM European (SE) mode" and chapter4.4.17 "STM National (SN) mode".

7.4.1.1.3 The STM Control Function shall maintain a list of "connected" STMs, which includes all STMs that have an established connection to the "STM control function". This list shall be used for the selection of the STM by the driver during the Start of Mission procedure.

7.4.1.1.4 The STM Control Function (in sleeping engine also) shall maintain a list of "available" STMs, which includes all STMs that have an established connection to the "STM control function" and report either CS, HS or DA state. This list shall be used for

- the selection of the STM at the transition border and
- to display the list of “available” STMs to the driver before starting the mission (end of the Start of Mission procedure).

7.4.1.1.5 After starting a mission, every time a new STM is detected as available, the STM Control Function may inform the driver about the new available STM.

7.4.1.1.6 The STM Control Function shall send the product identity of the ETCS On-board (vendor id, specific supplier software and hardware version) to the STM once the connection from the STM to the STM Control Function is established.

7.4.1.1.7 The STM Control Function shall store a list with the target system names associated to the NID_STM values according to the UIC list, see /18/ SUBSET-054 Assignment of values to ETCS variables.

7.4.1.1.8 The STM control function shall use the target system name to identify the STM to the driver.

7.4.1.1.9 When the target system name is not known by the STM Control Function, the STM Control Function shall use the NID_STM value as a fallback target system name.

7.4.1.1.10 The STM control function is responsible, if possible (no failed connection), to manage the STM state transitions.

7.4.1.1.11 The STM Control Function shall send to the STM the following information when the connection to the STM is established:

- The ETCS On-board functions that are available
- The ETCS bus address of all available ETCS On-board functions
- The safety level of all available ETCS On-board functions

7.4.1.1.12 The STM Control Function shall send to the STM the current ETCS technical mode

- when the connection between the STM and the STM Control Function is established, and
- whenever the ETCS technical mode changes.

7.4.1.1.13 The STM Control Function shall transmit the ETCS data (see chapter 5.2.11)

- while the STM is in state Configuration (CO),
- and whenever the ETCS data is changed/re-validated.

7.4.1.2 State transition orders

7.4.1.2.1 The STM Control Function STM state order table is a table that lists all the events that lead to a state order given by the STM Control Function to the STM.

7.4.1.2.2 STM state order table (ETCS On-board STM Control Function)

NP	< A15	< A15	< A15	< A15	< A15	< A15	< A15
A1 >	**PO**	< A1	< A1	< A1	< A1	< A1	< A1
	A2 >	**CO**					
		A3 >	**DE**				
		A4a >	A4a >	**CS**	< C4a	< B4a < A4b	
				A6 > B6 > C6 >	**HS**		
				F9 >	A9 > B9 > C9 > D9 > E9 >	**DA**	
G16 >	A16 > B16 > C16 > H16 > I16 > A17 >	A16 > B16 > C16 > H16 > I16 > A17 >	A16 > B16 > C16 > H16 > I16 > A17 >	A16 > B16 > C16 > D16 > H16 > A17 >	A16 > B16 > C16 > D16 > H16 > A17 >	A16 > B16 > E16 > F16 > G16 > H16 > A17 >	**FA**

7.4.1.2.2.1 The STM Control Function shall consider the STM to be in NP when it has not received any state report from the STM.

7.4.1.2.2.2 Examples:

- The STM is in NP state.
- The STM is powered on but not yet connected.
- The STM is in FA state, but ETCS is not aware of this.
- The STM is not installed but known by ETCS.

7.4.1.2.3 STM state order conditions table (ETCS On-board STM Control Function)

Condition Id	Content of the conditions
A1	(an STM connects to the STM Control Function) AND (the STM reports PO state)
A2	("Request CO state" received from STM)

Condition Id	Content of the conditions
A3	("Request DE state" received from STM) AND (ETCS data entry process terminated)
A4a	("Request CS state" received from STM)
B4a	(Level transition location for an STM to ETCS transition is passed)
C4a	(announcement for a transition to STM X was received) AND (STM X reports "HS state") AND (new announcement for a transition to another STM or ETCS Level is received before the level transition to STM X) see 7.4.1.2.3.3
A4b	(Level transition location for an STM X to STM Y transition is passed)
5	*Intentionally left blank*
A6	(ETCS On-board receives an announcement for a level transition to Level STM X) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3
B6	(ETCS technical mode is SB) AND (the driver has selected STM X) AND (valid level of the ETCS On-board is Level STM) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3
C6	(ETCS technical mode has changed from SB to NL or SL) AND (stored level of the ETCS On-board is Level STM X) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3
7	*Intentionally left blank*
8	*Intentionally left blank*
A9	(Level transition location for a transition from ETCS to STM is passed) AND (ETCS technical mode is not TR)
B9	(Level transition location for a transition from ETCS to STM is passed) AND (ETCS technical mode changes from TR to SN or SE)
C9	(Level transition location for an STM X to STM Y transition is passed) AND (STM X reports "CS state")
D9	(ETCS technical mode changes from SB to SN or SE) AND (valid level of the ETCS On-board is Level STM) AND (STM X reports "HS state")
E9	(ETCS technical mode has changed from SB to NL or SL) AND (stored level of the ETCS On-board is Level STM X) AND (STM X reports "HS state")
F9	(transition ordered by the trackside) AND (no announcement for the level transition was received by the ETCS On-board)
10	*Intentionally left blank*
11	*Intentionally left blank*
12	*Intentionally left blank*

Condition Id	Content of the conditions
13	*Intentionally left blank*
14	*Intentionally left blank*
A15	(the ERTMS/ETCS on-board equipment is NOT powered)
A16	(the STM control function receives from an STM a state request which is not allowed by the state transition table)
B16	(the STM reports a state it must not be in)
C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2
D16	(the STM Control Function has sent a "DA state transition order") AND (the STM does not report the required state within a maximum delay time of 5 seconds) see 7.4.1.2.3.1 and 7.4.1.2.3.2
E16	(the STM Control Function has sent a "conditional CS state transition order") AND (the STM does not report CS state or send a “Trip” message within a maximum delay time of 10 seconds) see 7.4.1.2.3.2
F16	(the STM Control Function has already received a “Trip” message from an STM) AND (the STM does not report CS state or send a “Trip” message within a maximum delay time of 10 seconds) see 7.4.1.2.3.2
G16	(the ETCS On-board does not support the requested DMI object) AND (the default definition of the requested DMI object is not sent by the STM)
H16	(a final disconnection between the ETCS On-board STM Control Function and the STM was detected (see /11/ SUBSET-057 STM FFFIS Safe Link Layer and /10/ SUBSET-056 STM FFFIS Safe Time Layer))
I16	(the ETCS On-board equipment has to switch to the Level STM which is the announced level with the lowest priority) AND (this STM is not available) see 7.4.1.2.3.3
A17	(the STM reports FA state)

7.4.1.2.3.1 Note: The delay is shorter for transition to DA state because this transition is assumed as the most critical one from a safety aspect.

7.4.1.2.3.2 Note: The delay values (5 and 10 seconds) are based on assumptions. The fact that these values are appropriate to real STM implementation has to be confirmed by test tracks or other tests.

7.4.1.2.3.3 Note: The ETCS On-board equipment shall nevertheless make the transition, to the announced level with the lowest priority

- is not fitted for any of the announced levels, or
- if no announced STM is available

(see /6/ SRS Version 2.2.2; SUBSET-026.5; Procedures).

7.4.1.2.3.4 When the STM Control Function has to order an STM to HS state but another STM is currently reporting HS state, the STM Control Function shall send the “HS state transition order” (C4a) only after the STM which currently reports HS state has been ordered to CS state and reports CS state.

7.4.1.2.4 When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

7.4.1.2.4.1 Exception 1: The STM Control Function shall not send an order for NP or PO state.

7.4.1.2.4.2 When the state transition order is going to CS state, the STM Control Function shall send an “unconditional order CS state” for the transition A4a, B4a and C4a and a “conditional order CS state” for the transition A4b.

7.4.1.2.5 If the ETCS Train Data Entry procedure is triggered during the normal operation (the state of the STM is CS or HS or DA) the relevant exchange of data (see chapter 13.1.1) shall take place without changing the STM State.

7.4.1.3 Requirements linked to state transition orders and state reports

7.4.1.3.1 The STM Control Function shall consider a state transition order as effective immediately after sending the state transition order to the STM.

7.4.1.3.2 The STM Control Function shall not send a state transition order to an STM, as long as this STM has not reported the state corresponding to the previous state transition order.

7.4.1.3.3 Exception: The STM Control Function shall be allowed to send an “FA state transition order” at any time.

7.4.1.3.4 After sending a “conditional order CS” the access to ETCS On-board functions shall remain until the STM report CS is received by the ETCS On-board.

7.4.1.3.5 When a STM has failed or is commanded to FA state, the STM control function shall report to the JRU the failed status of the STM.

7.4.1.3.6 When a STM has failed, the STM control function shall report to the driver the failed status of the STM.

7.4.1.4 The STM Control Function shall take the safe action (see /5/ SRS Version 2.2.2; SUBSET-026.4; Modes and Transitions) when

- an active STM reports PO state,
- an active STM reports FA state,
- an active STM is considered by the ETCS in FA state,
- connection between an active STM and the STM Control Function is lost.

7.4.1.5 The safe action shall be released by the STM Control Function when

- the active STM reconnects to the STM Control Function after a non-final disconnection and the reported STM state is still DA,
- another STM or ETCS level is selected.

7.4.1.6 Miscellaneous

7.4.1.6.1 Once the STM Control Function is aware of a failed STM, the ETCS On-board shall behave as if the On-board was not fitted at all with this STM.

7.4.1.6.2 When a failed STM reports PO state to the STM Control Function, the STM Control Function shall no longer behave as if the On-board was not fitted at all with this STM.

7.4.1.6.2.1 Justification: This allows for a restart of the STM.

7.4.2 Other ETCS requirements

7.4.2.1 At the Start of Mission procedure

7.4.2.1.1 At the Start of Mission procedure, the ETCS On-board shall propose the STM mode to be acknowledged by the driver only when the selected STM has reported HS State to the ETCS On-board.

7.4.2.2 After announcement, but before the level transition

7.4.2.2.1 If receiving an "STM max speed" from an STM in HS state, the ETCS On-board shall include the "STM max speed" into the computation of the MRSP beginning at the level transition border and ending when the report “DA state” has been received by the ETCS On-board from the STM to be activated.

7.4.2.2.1.1 Exception: After receiving an announcement for an STM to STM transition, the ETCS On-board shall not consider the "STM max speed”.

7.4.2.2.2 If the STM reports FA state, or is identified by the ETCS On-board as failed, then the ETCS On-board shall consider that STM max speed = 0.

7.4.2.2.2.1 Note: The purpose of the above requirement is to try to prevent the train to enter in an STM area while this STM is failed.

7.4.2.2.3 If the ETCS On-board does not receive an "STM max speed" value from the STM in HS state, the ETCS On-board shall not supervise any “STM max speed” at all and the computation of the MRSP is not affected.

7.4.2.2.3.1 Note: It is not mandatory for the STM to send a "STM max speed" value.

7.4.2.2.4 When receiving an "STM system speed" together with an "STM system distance" from an STM in HS state, the ETCS On-board shall consider the "STM system speed" as a new speed restriction that applies at a location "STM system distance" before the level transition border and ending at the level transition border: The ETCS On-board shall include the "STM system speed" into the computation of the MRSP.

7.4.2.2.4.1 Exception: After receiving an announcement for an STM to STM transition, the ETCS On-board shall not consider the "STM system speed" and "STM system distance".

7.4.2.2.5 If the ETCS On-board does not receive the "STM system speed" together with the "STM system distance" values from the STM in HS state, the ETCS On-board shall not take into account "STM system speed" and "STM system distance" at all and the computation of the MRSP is not affected.

7.4.2.3 After the level transition

7.4.2.3.1 Once the train has passed the level transition border, the ETCS On-board shall supervise the "STM max speed" (previously sent by the STM in HS state).

7.4.2.3.2 Once the STM report “DA state” is received by the ETCS On-board, the ETCS On-board shall stop supervising "STM max speed".

7.4.2.4 ETCS TIU and BIU Function

7.4.2.4.1 The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

7.4.2.4.2 The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

7.5 Engineering Requirements for the Level Transition

7.5.1.1 For the train to be able to enter the new area, the previous STM area must possess information about at least the first section of the new area. The national trackside information may be transmitted to the train such that entry to the new area is possible only when the route status permits this.

7.5.1.1.1 Note: This is in addition to requirements in chapter 5.10.3 of /1/ SUBSET-026; SRS Version 2.2.2 for the Level Transitions from a Level 1, 2 or 3 area into any other area.

7.5.1.2 The ETCS trackside shall transmit a speed profile, which limits the speed from the point where the national trackside equipment starts up to the transition border. The speed limit shall be engineered to respect the maximum system speed of the announced level with the highest priority.

7.5.1.2.1 Note: This is to allow the STM to detect and read its national trackside.

7.5.1.2.2 Definition: The maximum system speed shall be defined as the highest speed at which a (national) train control system is able to detect and read its (national) trackside.

7.5.1.2.3 For a transition from STM area to any other area, the STM may need to be aware of the maximum allowed speed of the new area in order to provide a smooth transition

7.5.1.3 It has to be prevented that one driver override order for one signal can be interpreted as valid for the next signal.

7.6 General requirements linked to the opening of connection between STM and ETCS On-board

7.6.1 Opening of the connection

7.6.1.1 A connection shall be considered as established when the version check is considered as terminated and successful (see chapter 7.6.2).

7.6.1.2 When a STM has to establish a connection with an ETCS On-board function, and fails to establish the connection, the STM shall not retry more than 2 times to establish the connection.

7.6.1.2.1 Note: The limitation of 2 retries is to forbid an STM with incompatible version to overload the bus.

7.6.1.3 When the STM fails to establish a connection to the STM Control Function, the STM shall switch to FA state.

7.6.1.4 When the STM fails to establish a connection to other ETCS Functions than the STM Control Function, the STM shall decide if it can work without the respective connection or not. If it cannot work without the respective connection, the STM shall switch to FA state.

7.6.1.4.1 Exception: If the STM fails to establish a connection with the (main) DMI, the STM may try to establish a connection with the redundant DMI if it is available.

7.6.1.4.2 Note: Due to specific train installation, the DMI(s) in a non-active cab may not be available.

7.6.1.5 When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

7.6.1.5.1 Exception: If the ETCS technical mode is SL, the STM shall not open a connection to the ETCS DMI function.

7.6.2 Check of version

7.6.2.1 Definition: The “STM version number” includes the versions of the following specifications and / or documents, which are implemented in the STM which is sending this information:

- Subset 026 system version
- Subset 035 compatibility version
- Subset-056 compatibility version
- Subset-057 compatibility version
- Subset 058 compatibility version

7.6.2.2 Definition: The “ETCS On-board version number” includes the versions of the following specifications and / or documents, which are implemented in the ETCS On-board which is sending this information:

- Subset 026 system version
- Subset 035 compatibility version
- Subset-056 compatibility version
- Subset-057 compatibility version
- Subset 058 compatibility version

7.6.2.3 Each time STM opens a connection with any ETCS On-board functions, STM shall send its "STM version number" to this ETCS On-board function.

7.6.2.4 When receiving "STM version number" from a STM, the concerned ETCS On-board function shall send its "ETCS function version number" to the STM and check the version compatibility.

7.6.2.5 If the ETCS On-board function detects incompatible version, the ETCS On-board function shall close the connection.

7.6.2.6 If the "STM version number" is compatible with the "ETCS function version number", the ETCS On-board function shall be allowed to transmit application data to the STM.

7.6.2.7 When receiving "ETCS function version number" from ETCS On-board, the STM shall check the version compatibility.

7.6.2.8 If "ETCS function version number" is compatible with the "STM version number", then the version check is considered as terminated and successful.

7.6.2.9 After the version check is considered as terminated and successful by the STM, the STM shall be allowed to transmit application data to the ETCS On-board function.

7.6.2.10 If "ETCS function version number" is not compatible with the "STM version number", then the STM shall close the connection to the concerned ETCS On-board function.

7.6.3 Closing of the connection

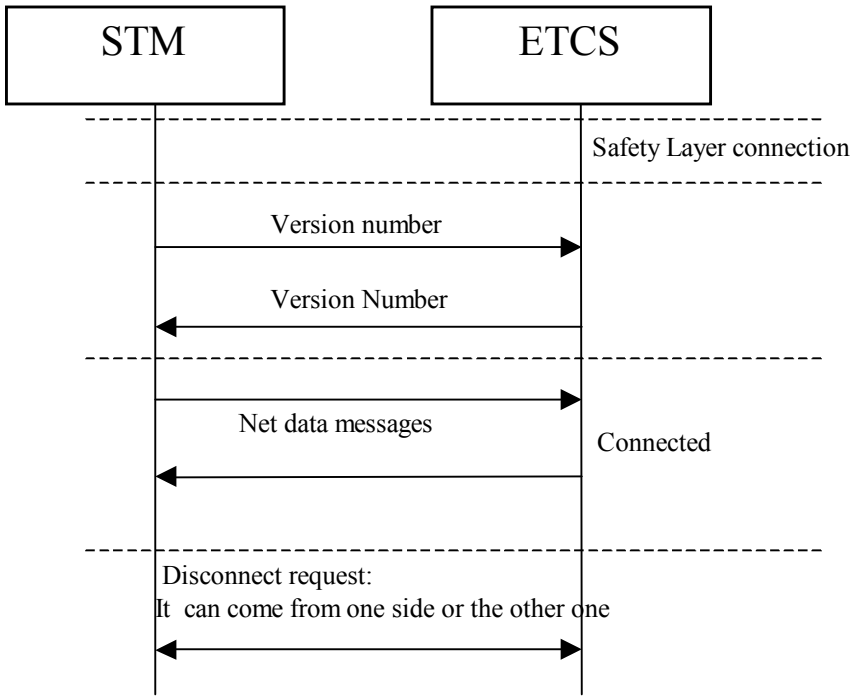
7.6.3.1 Closing a connection on application layer shall be done by requesting the Safety Layers (see 14.6.1.2) to close the connection.

7.6.3.2 When an STM in DA state or HS state receives an order to go in CS state, the STM

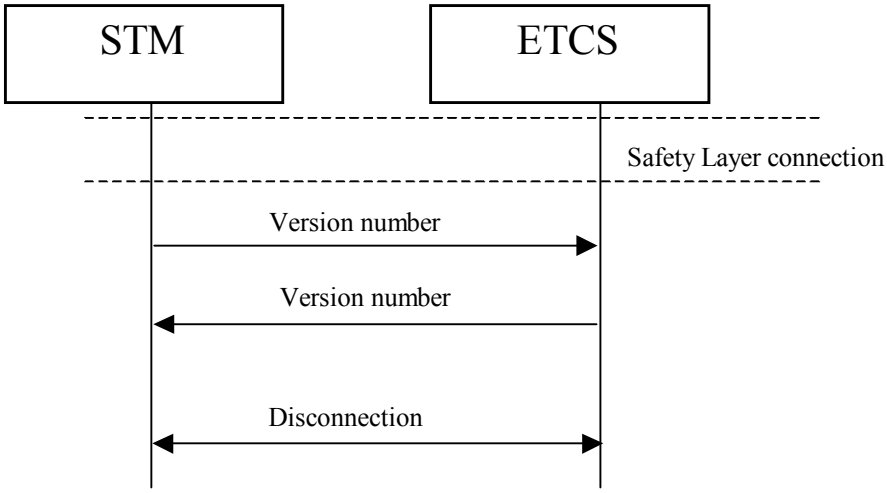
- shall have the possibility to close the connection with the JRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the DRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the TIU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the BIU (up to the STM to decide it or not).
- shall maintain the connection with the STM Control Function.
- shall close the connections with all other ETCS On-board functions

7.6.4 Connection Sequence Charts.

7.6.4.1 Nominal Connection establishment Sequence Chart



7.6.4.2 Bad Version Number detected by application Sequence Chart



8. ODOMETRY

8.1 General

8.1.1.1 The STM FFFIS specifies odometer information to be transmitted from ETCS On-board to all STMs via FFFIS STM. The odometer information of the FFFIS STM is based on measurements from sensors that are part of the ETCS On-board.

8.1.1.2 The implementation issues of the ETCS On-board odometer shall be hidden from the STM, while retaining as large freedom as possible for the implementation and design of the ETCS On-board odometer.

8.1.1.3 The ETCS On-board shall transmit odometer information via the FFFIS STM interface at regular intervals. This information shall include travelled distance, direction, current speed and confidence interval of measurement of distance. This information shall be time stamped with the time when the position and speed was valid.

8.1.1.4 Every transmitted odometer information report shall be time stamped. The time base for timestamp shall be the Reference Time obtained from the Safe Time Layer, see 5.2.2.

8.1.1.5 The odometer information shall be sufficient for the STMs to be able to individually calculate the distance and confidence interval between any two points passed during travelling independently from the STM state (Data Available, Hot Standby, Cold Standby etc.).

8.1.1.6 The confidence interval data shall be transmitted as a mandatory (deterministic) and an optional stochastic part.

8.1.1.7 The STM shall be able to calculate the confidence interval by using the transmitted mandatory (deterministic) part only.

8.1.1.8 The communication shall be unidirectional from ETCS On-board odometer to all STMs using multicast messages.

8.1.1.9 The ETCS On-board odometer function shall not accept any data from STMs.

8.1.1.10 Note: Standstill indication is not provided as an individual parameter. It is a redundant information that can be derived from speed and distance information. The problem is that the criteria on standstill seems to differ substantially between applications. Standstill indication is therefore a responsibility allocated to the STM.

8.1.1.11 Speed and distance information shall be given for both travel directions.

8.1.1.12 **Positive movement direction** is defined as a movements going in the direction of cab B to cab A. It shall be indicated with positive speed and increasing odometer distance values.

8.1.1.13 **Negative movement direction** is defined as movements going in the direction of cab A to cab B. It shall be indicated with negative speed and decreasing odometer distance values.

8.1.1.13.1 Note: Allocation of cab A and cab B on a specific train is a pure ETCS On-board implementation issue.

8.1.1.14 Two's complement shall be used to express values of speed and distance.

8.1.1.15 The ETCS On-board odometer function shall be allowed to reset distance values during ETCS start-up after Power Off. The ETCS On-board odometer shall also be allowed not to reset the odometer distance values during Power Off.

8.1.1.16 The ETCS On-board shall not reset the odometer distance values as long as the ETCS On-board is powered-on.

8.1.1.16.1 Justification: The ETCS odometer information is used as a common reference within the FFFIS STM.

8.1.1.17 An STM shall not require ETCS odometer to reset distance values at STM power on.

8.1.1.17.1 Justification: an STM that is restarted while ETCS On-board is running will find the odometer parameters at current values.

8.1.1.18 It is assumed that the Hazardous Failure Rate of the ETCS Odometer, being sufficiently low for ETCS operation, is also sufficient for any national system.

8.1.1.19 The ETCS On-board shall transmit odometer configuration data to the STMs.

8.1.1.20 The STM shall check the ETCS On-board odometer configuration data and act according to the national rules if the ETCS On-board odometer performance does not fit the national requirements.

8.1.1.21 The ETCS On-board odometer function shall report to the STMs its configuration status. This configuration status indicates whether the configuration is nominal (all odometer sensors available) or not.

8.2 Speed

8.2.1.1 **Nominal speed, V_Nom**, shall be the speed (train speed according to /4/ SRS Version 2.2.2; SUBSET-026.3; Principles) as used by the ETCS On-board.

8.2.1.2 The ETCS Odometer function shall transmit the nominal speed to the STMs.

8.2.1.3 In case of SE mode, the nominal speed shall be used for speed monitoring by the ETCS supervision function.

8.2.1.3.1 Note: This is the same speed that would have been used by ETCS in case of operation in Levels 1, 2 or 3.

8.2.1.4 At standstill the nominal speed shall be zero. However vehicle vibration and jerk is allowed to give sporadic non-zero speed estimations.

8.2.1.5 The nominal speed shall comply with the performance requirements laid out in /17/ SUBSET-041 Performance Requirements for Interoperability, and applicable requirements in /12/ SUBSET-059 STM Performance.

8.2.1.6 **Maximum speed, V_Max,** is defined as the highest possible physical speed including all measurement inaccuracies in case of movement in positive direction. For movements in negative direction V_Max reports the lowest possible speed in absolute value.

8.2.1.7 **Minimum speed, V_Min,** is defined as the lowest possible physical speed including all measurement inaccuracies in case of movement in positive direction. For movements in negative direction V_Min reports the highest possible speed in absolute value.

8.2.1.8 Clarification: For any speed and direction the expression V_Min ≤ V_Max shall be true. For negative movements V_Min has a larger absolute value, but a negative sign.

8.2.1.9 The ETCS Odometer function shall transmit the maximum and the minimum speed to the STMs.

8.2.1.10 At standstill V_Max may have a positive value and V_Min may have a negative value due to the resolution of the sensors.

8.2.1.11 At standstill V_Max and V_Min may have the same sign for short periods of time due to vibration or jerk.

8.2.1.12 To determine standstill V_Nom should be zero and the position (MAX_ODO and MIN_ODO) should not change.

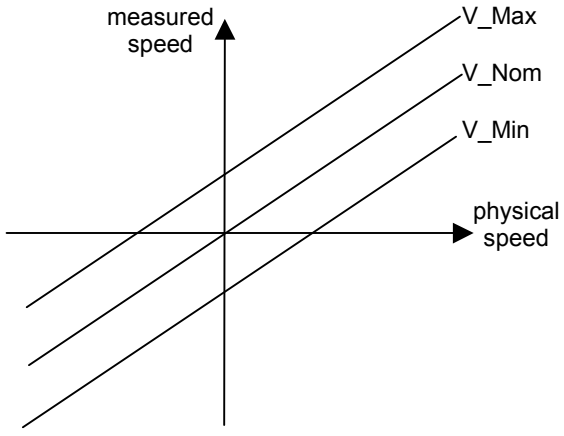


Figure 4 Speed parameters near zero speed

8.3 Distance

8.3.1 General

8.3.1.1 The ETCS Odometer function shall transmit the nominal distance to the STMs.

8.3.1.2 For any train movement, the STM shall be able to compute the most probable distance travelled between any two track positions by using the measurement values of **D_Nom** at both positions.

8.3.1.3 The ETCS Odometer function shall transmit all necessary information for the STM to determine its confidence interval to the STMs.

8.3.1.4 The STM shall be able to determine the distance **confidence interval**, by using the information transmitted by the ETCS On-board.

8.3.1.5 **Max_conf** is defined as the measured distance between any two points counting all inaccuracies, margins and tolerances that add in the positive direction.

8.3.1.6 **Min_conf** is defined as the measured distance between any two points counting all inaccuracies, margins and tolerances that add in the negative direction.

8.3.1.7 The confidence intervals as derived by STMs should not be unnecessarily wide, as this may have an undesirable effect on operational performance.

8.3.1.8 The confidence interval is not transmitted in a direct way, but in parts that can be used to compute confidence intervals. The mandatory parts are

- Resolution part (D_Res),
- Accumulative part (D_Max, D_Min),

and the optional stochastic parts are

- Stochastic model accumulative part (D_Max_Accum, D_Min_Accum)
- Confidence Level (M_K_ETCS)
- Sum of Variances (M_Max_SumVar, M_Min_SumVar)

8.3.1.9 In case no stochastic part is used, K_ETCS = 0 shall be transmitted and the other parameters for the stochastic part shall not be transmitted.

8.3.1.10 The STM shall derive distance and confidence interval by combining the parts according to the formulas and requirements given in section 8.5.

8.3.1.11 An STM may interpolate positions that are between two successive odometer reports. The requirements shall be derived by the STM development.

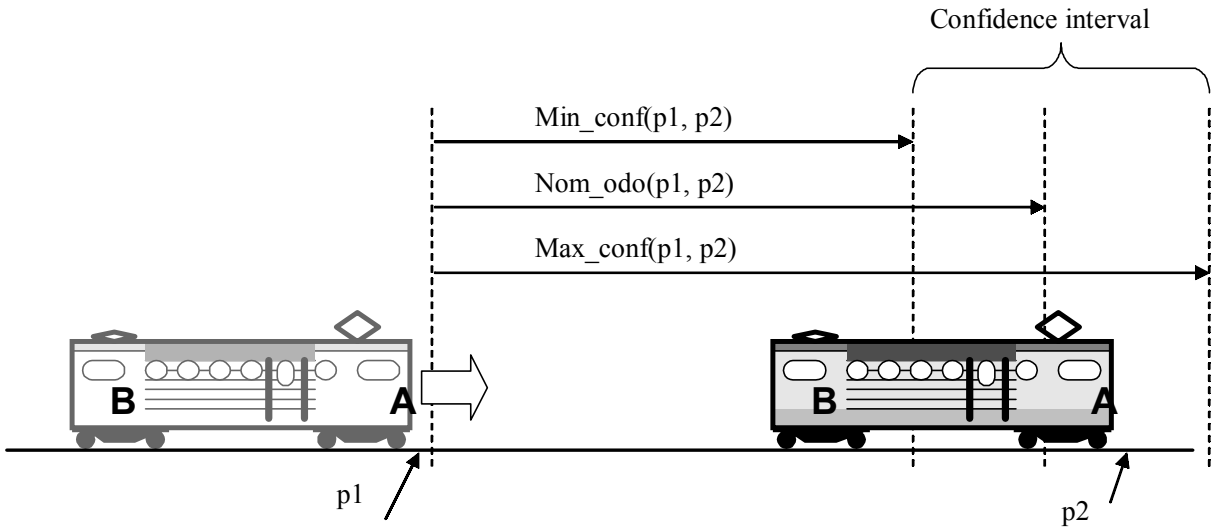


Figure 5 Movement p1 to p2

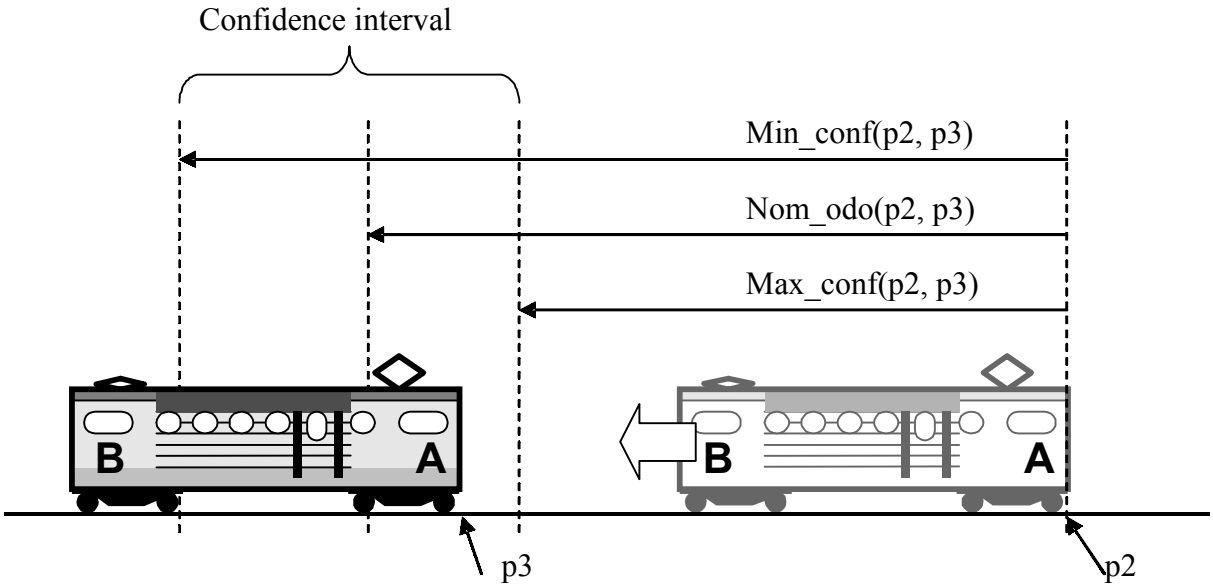


Figure 6 Movement p2 to p3

8.3.1.12 Figure below illustrates how the confidence interval is formed if both negative and positive movements are included. Confidence interval for movement p1 to p3 can be computed according to the formulas even when position p2 is passed as a turning point. This is because the final confidence interval p1 to p3 contains the contributions from p1 to p2 and p2 to p3 without cancellation due to reversing.

8.3.1.12.1 Note: The STM computation of a confidence interval would not need to make extra steps in case of a measurement that includes stopping or changes of movement direction.

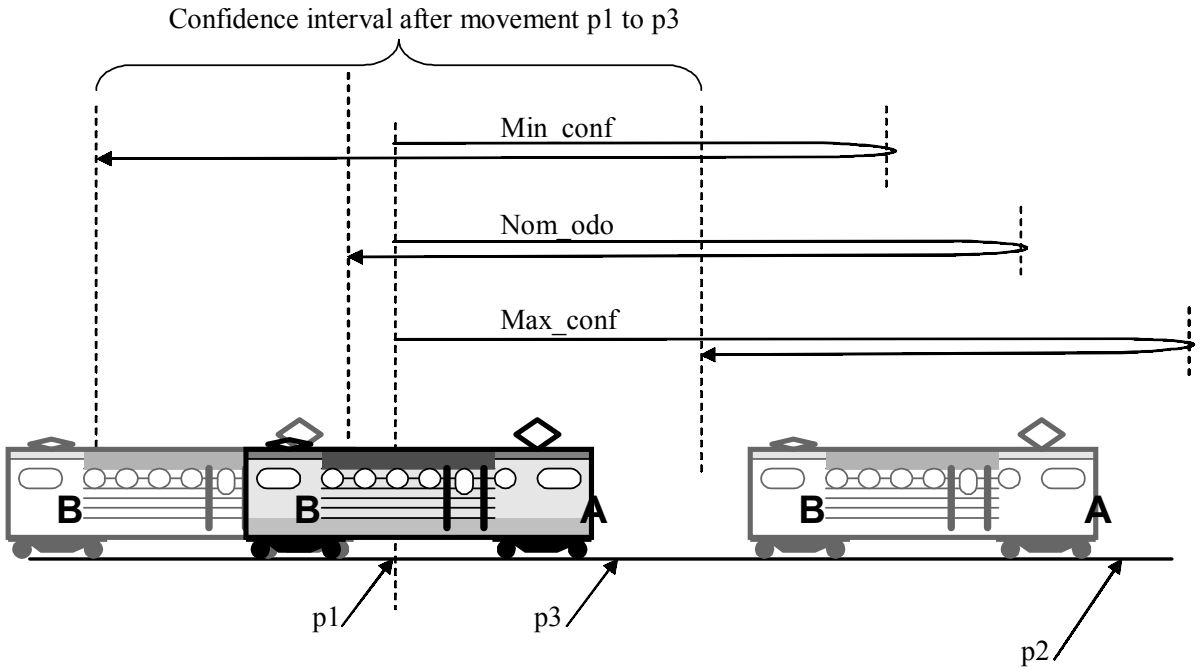


Figure 7 Movement from p1 via p2 to p3

8.3.2 Nominal distance

8.3.2.1 The nominal distance D_Nom transmitted from the ETCS On-board odometer function to the STMs shall have the property:

- D_Nom(p1, p3) = D_Nom(p1, p2) + D_Nom(p2, p3)

8.3.3 Stochastical and non-stochastical confidence intervals

8.3.3.1 An ETCS On-board Odometer function shall transmit information to allow STMs to calculate non-stochastic distance confidence intervals.

8.3.3.2 An ETCS On-board Odometer function shall have the option to transmit information to allow STMs to calculate stochastic distance confidence intervals.

8.3.3.3 An STM shall have the possibility to use only non-stochastical distance confidence intervals.

8.3.3.4 If the ETCS On-board Odometer function transmits stochastical information, the STM may use stochastical distance confidence intervals.

8.3.3.5 Non-stochastic confidence intervals shall have the properties that fulfil the following equalities for any movement from p1 to p3, containing a position p2

- Max_conf(p1, p3) = Max_conf(p1, p2) + Max_conf(p2, p3)
- Min_conf(p1, p3) = Min_conf(p1, p2) + Min_conf(p2, p3)

8.3.3.6 Stochastic confidence intervals shall be allowed to have non-linear properties constrained by the following in-equalities for any movement from p1 to p3, containing a position p2

- Max_conf(p1, p3) ≤ Max_conf(p1, p2) + Max_conf(p2, p3)
- Min_conf(p1, p3) ≥ Min_conf(p1, p2) + Min_conf(p2, p3)

8.4 Distance Parameters

8.4.1 Nominal distance

8.4.1.1 The ETCS Odometer function shall transmit the nominal distance to the STMs in every odometer report.

8.4.2 Resolution part

8.4.2.1 The Resolution part consists of all measurement accuracy limitations which does not grow with distance or time.

8.4.2.2 Resolution part is defined as the non-accumulative limitation in precision of a single report.

8.4.2.3 A distance measurement inaccuracy has contributions only from the reports that are taken at the endpoints of the distance. The resolution parts of intermediate reports are not relevant.

8.4.2.3.1 Example: For odometers based on tachometer sensors the resolution part depends on the distance travelled for a pulse. As the sampling error can be almost one pulse in each direction the resolution part can be rounded to be the length travelled for one pulse counted. Further, a distance includes two endpoints, each adding to the resolution part, hence the distance resolution for this kind of sensor is the distance corresponding to (at least) two pulses.

8.4.2.4 The resolution part of an odometer report shall be given as a parameter in each odometer report from the ETCS odometer function. This allows for sensor technologies with varying resolution.

8.4.2.4.1 Note: Tachometer sensors typically have a constant resolution, as the distance travelled for a pulse is not depending on speed or other factors. This is not necessarily true for other sensor technologies.

8.4.3 Accumulative part (non-stochastic model)

8.4.3.1 **D_Max** is defined as an odometer report parameter that changes in proportion to moved distance, but including all accumulative errors that brings estimation to the positive movement direction.

8.4.3.2 **D_Min** is defined as an odometer report parameter that changes in proportion to moved distance, but including all accumulative errors that brings estimation to the negative movement direction.

8.4.3.3 D_Max and D_Min shall have the properties that fulfil the following equalities for any movement from p1 to p3, containing a position p2

- D_Max(p1, p3) = D_Max(p1, p2) + D_Max(p2, p3)
- D_Min(p1, p3) = D_Min(p1, p2) + D_Min(p2, p3)

8.4.4 Stochastic part (ETCS option)

8.4.4.1 Stochastic model accumulative part

8.4.4.1.1 In case the ETCS On-board Odometer function being stochastical, the stochastical model accumulative part is given by the following two parameters.

8.4.4.1.2 **D_Max_Accum** is defined as an odometer report parameter that changes in proportion to moved distance (accumulative part) and brings estimation to the positive movement direction.

8.4.4.1.3 **D_Min_Accum** is defined as an odometer report parameter that changes in proportion to moved distance (accumulative part) and brings estimation to the negative movement direction.

8.4.4.1.4 D_Max_Accum and D_Min_Accum shall not contain the stochastic part.

8.4.4.1.5 The parameters D_Max_Accum and D_Min_Accum can only be used together with the associated stochastic parameters of the same odometer report.

8.4.4.2 Confidence Level

8.4.4.2.1 In case of a stochastic model, the ETCS Odometer reports shall include a parameter for confidence level.

8.4.4.2.2 The **confidence level (K)** is defined as a level of probability that the true position is inside the confidence interval.

8.4.4.2.2.1 Note: Some literature uses the term confidence interval where this text uses confidence level.

8.4.4.2.3 The confidence level is related to probability according to the table.

Confidence Level, K	Probability %
1	68%
2	95%
3	99,7%
4	99,99%
5	99,9999%
6	99,999999%
7	99,999999999%

8.4.4.2.3.1 Note: The table coincides with the standard deviation values corresponding to a normal distribution, this feature may be useful in analysis and proof of the ETCS odometer.

8.4.4.2.4 The confidence level of the ETCS odometer (M_K_ETCS) shall be given in each report.

8.4.4.2.5 The ETCS shall be allowed to lower the value of K_ETCS at runtime, but shall not increase.

8.4.4.2.5.1 Justification: An (optional) application for this is an ETCS using multiple sensors for its odometer. This may support a high confidence level K_ETCS. In case some sensors become unavailable, the odometer may remain operational but at a lower confidence level. The ETCS can express this by lowering K_ETCS. The STM will still compute proper (safe) confidence intervals also when the distance includes a decrease of K_ETCS. But increasing K_ETCS would not be safe as a distance may then be computed with a K_ETCS that is higher than the K_ETCS of some of the samples in the distance.

8.4.4.3 Variance parameters

8.4.4.3.1 In case of a stochastic model, the ETCS Odometer reports shall include the sum of variance parameter of the stochastic part.

8.4.4.3.2 The ETCS Odometer function shall report the accumulated sum of variance (starting from the power-on of the ETCS Odometer function) to the STMs. One sum for the positive movement direction M_Max_SumVar and another for the negative movement direction M_Min_SumVar.

8.4.4.3.2.1 Note: The two parameters for sum of variance may be equal, for example the internal model may have only one stochastic parameter and in some way accumulate the worst-case side.

8.4.4.3.3 **M_Max_SumVar** is the sum of variance from the side of the confidence interval in the direction of positive movements.

8.4.4.3.4 **M_Min_SumVar** is the sum of variance from the side of the confidence interval in the direction of negative movements.

8.4.4.3.5 The sum of variance shall be reset together with the other odometer parameters (see chapter 8.1.1.15).

8.4.4.3.6 The STM can then compute the standard deviation for a distance p1 to p2 as:

$$\mathrm{Sd}(\mathrm{p1}, \mathrm{p2}) = \sqrt{\mathrm{SumVar(p2)} - \mathrm{SumVar(p1)}}$$

8.5 STM Distance

8.5.1 General

8.5.2 Non-stochastic

8.5.2.1 In case the Odometer reports contains k_ETCS = 0 (non-stochastic model) or the STM does not use the stochastic model, the STM shall compute distance confidence intervals according to the formulas in this section.

8.5.2.1.1 $res\_part(p1, p2) = \max(\mathrm{Re}s\_odo(p1), \mathrm{Re}s\_odo(p2))$

8.5.2.2 The STM shall compute Max_conf for a movement p1 to p2 as:
Max_conf(p1,p2)=Max_odo(p2)-Max_odo(p1)+res_part(p1,p2)

8.5.2.3 The STM shall compute Min_conf for a movement p1 to p2 as:
Min_conf(p1, p2) = Min_odo(p2)-Min_odo(p1)-res_part(p1,p2)

8.5.3 Stochastic

8.5.3.1 In case the Odometer reports contains k_ETCS > 0 (stochastic model) and the STM uses the stochastic model, the STM shall compute distance confidence intervals according to the formulas in this section.

8.5.3.1.1 $res\_part(p1, p2) = \max(\mathrm{Re}s\_odo(p1), \mathrm{Re}s\_odo(p2))$

8.5.3.1.2 $Max\_acc\_part(p1, p2) = Max\_accum(p2) - Max\_accum(p1)$

8.5.3.1.3 $Min\_acc\_part(p1, p2) = Min\_accum(p2) - Min\_accum(p1)$

8.5.3.1.4 $$Max\_stoch\_part(p1, p2) = \frac{k\_STM}{k\_ETCS(p2)} \sqrt{MaxSumVar(p2) - MaxSumVar(p1)}$$

8.5.3.1.5 $$Min\_stoch\_part(p1, p2) = \frac{k\_STM}{k\_ETCS(p2)} \sqrt{MinSumVar(p2) - MinSumVar(p1)}$$

8.5.3.2 The parameter *k_stm* is the confidence level required for the STM. The table defining *k_etcs* applies, see 8.4.4.2.3.

8.5.3.3 The STM shall compute Max_conf for a movement p1 to p2 as:

Max_conf(p1,p2) = Max_acc_part(p1,p2) + res_part(p1,p2) + Max_stoch_part(p1,p2)

8.5.3.4 The STM shall compute Min_conf for a movement p1 to p2 as:

Min_conf(p1,p2) = - Min_acc_part(p1 p2) - res_part(p1,p2) - Min_stoch_part(p1,p2)

8.5.4 Data representation

8.5.4.1 The following requirements apply to distance parameters D_Nom, D_Max, D_Min, M_Max_SumVar and M_Min_SumVar.

8.5.4.2 The distance parameters and the sum of variances are allowed to wrap when exceeding the value range. The parameters wrap individually.

8.6 Direction

8.6.1.1 The ETCS On-board Odometer function shall report to the STMs if the direction information is ambiguous or not.

8.6.1.2 ETCS On-board Odometer function shall give information about direction of movement by the sign of speed, and the change of distance (increase/decrease).

8.7 Configuration information

8.7.1.1 The ETCS On-board odometer function shall transmit performance-related information (configuration data) over the FFFIS STM. The transmission shall be repeated to support restarting STMs.

8.7.1.2 The STM may check the performance-related information (e.g. accuracy, ageing) according to the national requirements.

8.7.1.2.1 Note: The processing of the check results is out of scope of this specification.

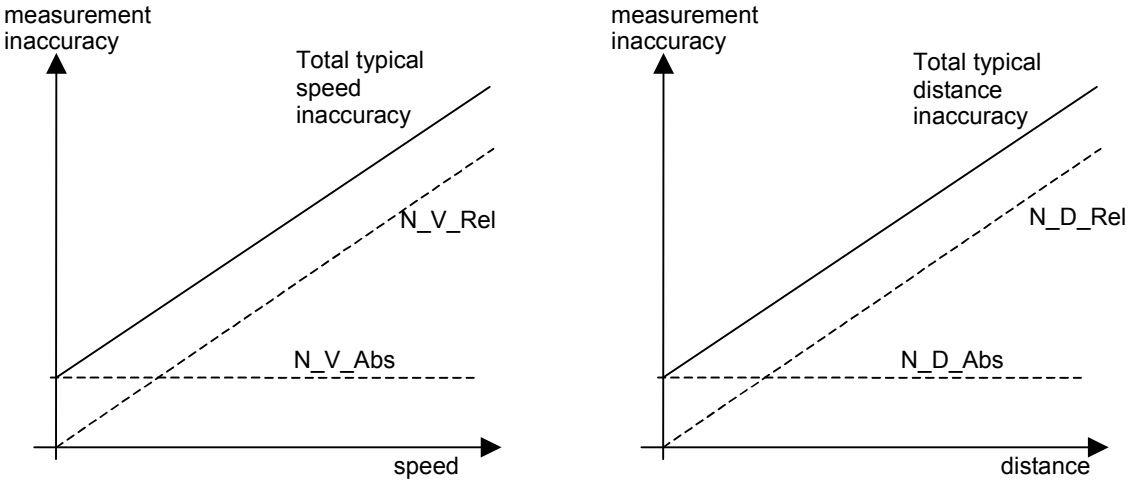


Figure 8 Total inaccuracy of speed and distance

8.7.1.3 Performance parameters defined as “typical” should be thought of as “worst case under nominal conditions” and may well be exceeded under special conditions.

8.7.1.4 Performance parameters defined as “max” should hold under “worst case conditions” and should not exceeded except for improbable conditions.

8.7.1.4.1 Note: The definition of “max” does not necessarily include “worst worst case conditions” such as presence of improbable equipment faults.

8.7.1.5 The **total typical speed inaccuracy** should be within (+/-) the envelope of the sum of Absolute Speed Accuracy and Relative Speed Accuracy.

8.7.1.6 The **total typical distance inaccuracy** should be within (+/-) the envelope of the sum of Absolute Distance Accuracy and Relative Distance Accuracy.

8.7.1.6.1 Note: These total inaccuracies have a comparable format as the odometer inaccuracy performance requirements of /17/ SUBSET-041 Performance Requirements for Interoperability, that apply for Levels 1-3.

8.7.1.7 **Absolute Speed Accuracy, N_V_Abs,** is defined as the typical non-speed dependent limitation of accuracy in speed measurements that are reported by ETCS On-board Odometer function. This is therefore the minimum speed inaccuracy. The parameter unit is km/h.

8.7.1.8 **Relative Speed Accuracy, N_V_Rel,** is defined as the typical speed dependent limitation of accuracy in speed measurements that are reported by ETCS On-board Odometer function. The parameter express percentage (no unit).

8.7.1.9 **Absolute Distance Accuracy, N_D_Abs,** is defined as the typical non-speed dependent limitation of accuracy in distance measurements as calculated by STM. The parameter unit is cm.

8.7.1.9.1 Note: The Absolute Distance Accuracy normally corresponds to the length of confidence intervals of short distances at lower speeds.

8.7.1.9.2 Note: The Absolute Distance Accuracy parameter is at least 2* D_Res, as resolution counts twice in a confidence interval.

8.7.1.9.3 **Relative Distance Accuracy, N_D_Rel,** is defined as the typical speed dependent limitation of accuracy in distance measurements as calculated by STM. The parameter express percentage (no unit).

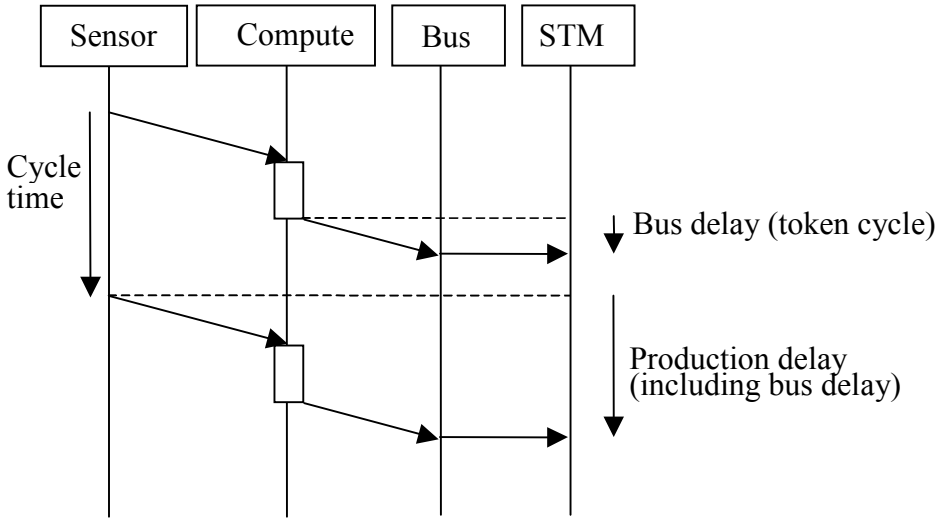


Figure 9 Odometer cycle and delay times

8.7.1.10 **Typical cycle time, T_OdoCycle** is the typical time for the odometer cycle time between each generating of new odometer data.

8.7.1.11 **Maximum production delay time, T_OdoMaxProd** is the maximum ageing of odometer data from when the data was true until the data is available on the bus. This shall include clock synchronisation inaccuracy of the Odometer function.

8.8 Application notes on Stochastic odometry (non-normative and not reviewed)

8.8.1 Introduction

8.8.1.1 The application notes are not normative. They are only intended to help understanding the principles of, and possible ways to apply, the requirements on odometry and the stochastic model in particular.

8.8.1.2 The application notes are mainly intended for the designers of ETCS On-board Odometry function, but may be helpful also for STM designers.

8.8.2 Stochastic Odometer models

8.8.2.1 The ETCS Odometer internal model is defined as some algorithm inside the ETCS On-board Odometer function for processing sensor data into odometer

information. The internal model is purely design and implementation matter and outside scope of this specification. The results from the internal model shall be transformed to odometer reports transmitted to the STMs and that are conforming to the requirements of this specification.

8.8.2.2 Note: The issues treated in this chapter relate in principle also for speed parameters, but will manifest only for distance.

8.8.2.3 The internal model may regard the sensor data to have properties such that the measurement error is bounded to some fixed limits (judged approximations may be part of this). In this case the internal model is said to be **non-stochastic**.

8.8.2.4 Alternatively, the internal model may regard the sensor data to contain some amount of random noise and estimate a noise component of measurements. In this case the internal model is said to be **stochastic**.

8.8.2.5 The STM need not to know details about the odometer internal model and other analysis/design considerations of the ETCS Odometer.

8.8.2.6 In case of a stochastic model, the odometer reports contain additional information such that the STMs can calculate the stochastic part of a distance confidence interval.

8.8.2.7 An ETCS Odometer can only be either non-stochastic or stochastic towards the STMs. This may not change during run-time.

8.8.2.8 In case an Odometer is generally considered non-statistical, but under special conditions has statistical behaviour, such an Odometer should report as being statistical all the time to the STM. But the reported statistical part would be zero except under the special conditions.

8.8.2.9 An Odometer may have a statistical internal model processing noise from sensors, but make purely non-stochastical reports. In this case the Odometer has to either perform some filtering of the sensor noise and/or make safe-side rounding such that odometer reports can be purely non-stochastical, fulfilling the requirements for a non-stochastical odometer at the STM interface and for the STMs.

8.8.2.10 The following diagrams illustrate the two different principles.

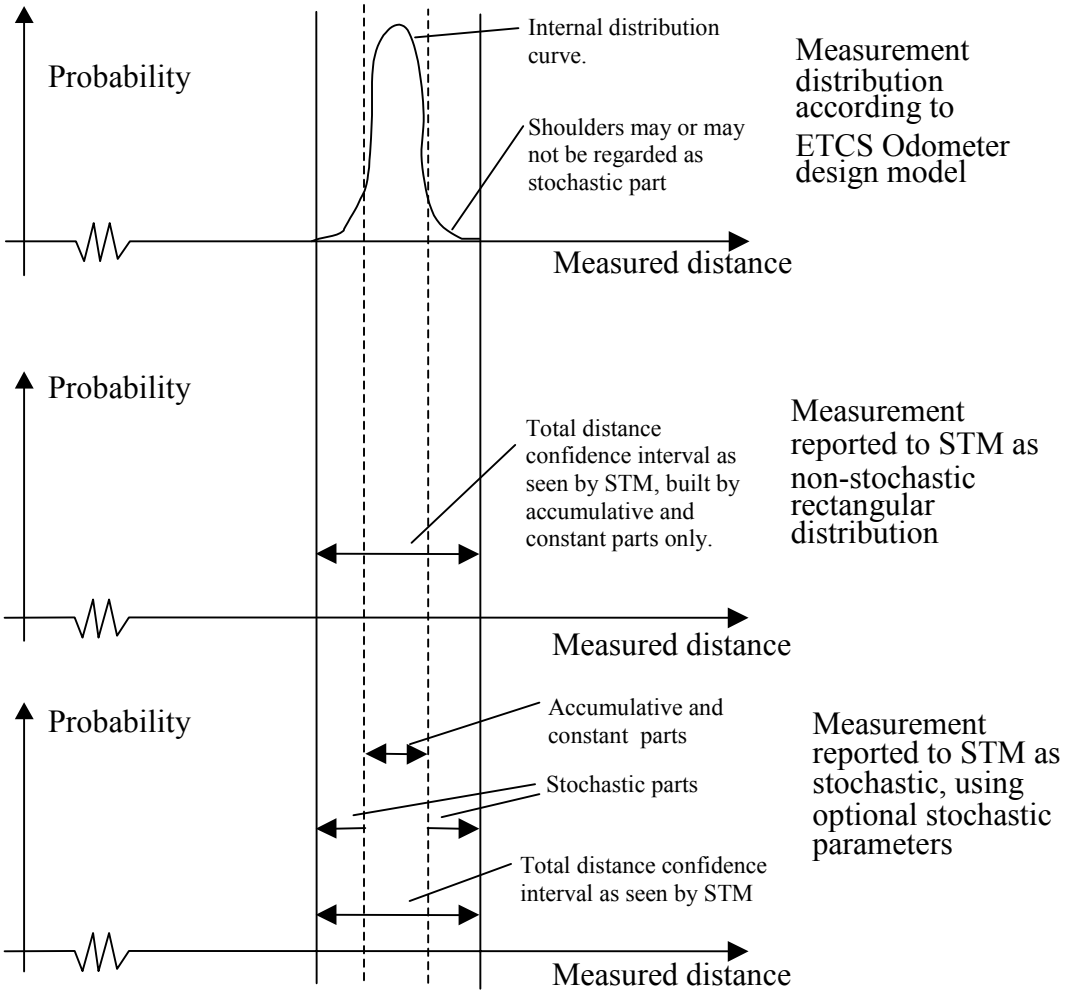


Figure 10 How internal model's distribution can map to either statistical or non-statistical confidence interval

8.8.2.11 The odometer reports from an ETCS Odometer based on a stochastic model contain all the parameters of the non-stochastical, but add some parameters for the stochastic parameters. From the viewpoint of this specification the stochastical model is a pure extension of the non-stochastical model.

8.8.2.12 Example: Chosen Odometer sensor(s) are regarded as noisy. But the calibration tolerance is not stochastic in nature, but rather linear so the calibration tolerance is allocated to the accumulative parameters (defined later). Then the internal distribution curve for a travelled distance is the envelope of the stochastic distribution of the sensor, but with an offset for the tolerance of calibration.

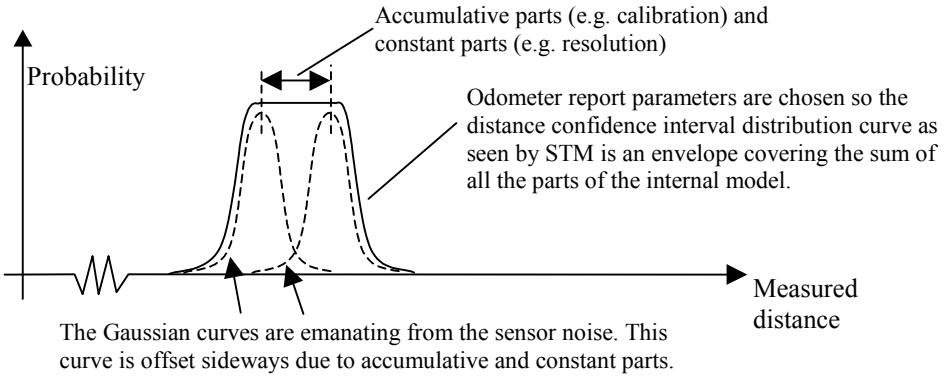


Figure 11 How parts are combined to statistical distribution curve

8.8.3 Confidence intervals with stochastic part

8.8.3.1.1 The choice of a statistical internal model is a design decision of the ETCS odometer.

8.8.3.1.2 A statistical internal model typically leads to a design choice to add a statistical part to the Odometer reports.

8.8.3.1.3 The statistical extension is modelled around normal distribution (Gaussian) and provides the STM data to compute the standard deviation of any distance measurement, and to extend the distance confidence interval with the standard deviation. Definitions and details are given in 58 “Stochastic part (ETCS option)".

8.8.3.1.3.1 Justification 1: The sum of many independent measurements approaches a normal distribution, even when the distribution of the measurements has another shape.

8.8.3.1.3.2 Justification 2: The normal distribution has good properties for analysis, and any other distribution can be made to approximate or fit inside a normal distribution.

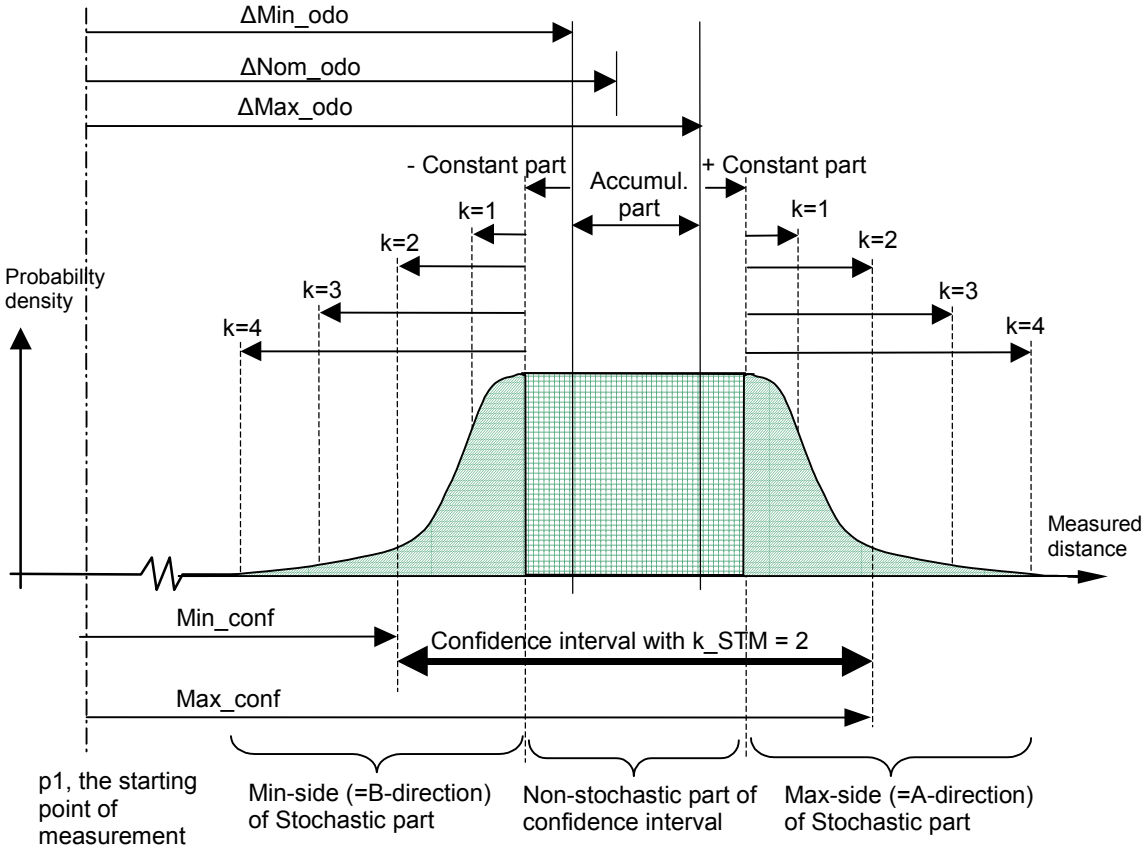


Figure 12 How odometer report parameters build statistical distribution and STM distance confidence interval at k_STM=2

8.8.3.1.4 The STM shall be able to recompute the confidence level to correspond to its safety requirements, in particular an allocated tolerable hazard rate for odometer distance measurements. This allows for trade-offs between safety and accuracy, potentially improving performance of operation. The national systems may have quite different views on the safety of odometry information.

8.8.3.1.5 The ETCS odometer internal model may have any type of distribution curve. If another curve than normal distribution is used, the statistical parameters in the odometer reports shall be made such that the STM will compute the distance confidence interval being equal or larger that the corresponding interval according to the ETCS internal odometer model. This shall be true for any distance and for any valid confidence level of STM (k_STM).

8.8.3.1.6 The statistical extension makes the approximation that the measurements are uncorrelated, as the normal distribution has this as a basic assumption.

8.8.3.1.7 The approximation that all measurement samples are uncorrelated need to be judged for the specific internal model against the arguments below and the need to keep the statistical extension simple.

8.8.3.1.8 Clarification: If the correlation is sufficiently temporary the distance fragment with correlation would not dominate the measured distance. If the measured distance

is short, the probability of large correlation in the population of measurement increases, but the absolute error would not be very large (but possibly the relative error).

8.8.3.1.8.1 Note: The statistical extension should be kept reasonably simple, as there is a need for cross-acceptance of a Notified Body approval by the National Body of the Odometer properties. The Odometer information needs to be sufficiently expressive for even demanding applications, and simple enough to support trust in safety and cross-acceptance. This specification aims at finding an optimum compromise.

8.8.3.1.9 Justification 3: In case the individual measurements have a significant stochastic part, this has to influence the confidence interval. But the contribution due to a sum of stochastic variables does add slower than linearly. By allowing the statistical extension, the confidence interval of a distance measurement may be smaller compared to a linear accumulative calculation.

8.8.3.1.10 Justification 4: Although the ETCS works with a high level of confidence in distance measurements, a national system may be defined to work with a lower level of confidence. The statistical extension allows recalculation to a different confidence level, trading safety for accuracy.

8.8.3.1.11 Justification 5: For a short distance measurement the stochastic contribution may need to be taken on a worst-case basis. The same measurements also being part of a long distance measurement, the stochastic contributions will with a very high probability cancel out or average to some value. The statistical extension can combine safer short measurements with accurate longer distances in presence of stochastics in measurements.

9. SUPERVISION FUNCTION (EUROPEAN MODE ONLY) TBD

9.1.1.1 This function still has to be defined. The requirements listed within this chapter are not normative. They just give basic principles.

9.1.2 STM Profile data

9.1.2.1 STM Profile data (see chapter 4.1.2.4.2) shall be transmitted from the STM in order to allow train movement.

9.1.2.2 The STM Profile issued by the STM shall always represent the allowed train movement for the target system.

9.1.3 EOA Overpass

9.1.3.1 The ETCS on-board shall report to the STM when the train passes EOA (Train Trip).

9.1.3.2 When train is outside the STM Profile (e.g. beyond EOA) the ETCS on-board is responsible for bringing the train to standstill. The STM Profile stored in ETCS on-board shall be erased.

9.1.3.3 The ETCS on-board shall not accept a new STM Profile unless the STM acknowledges the EOA Overpass situation.

9.1.4 Reference Locations

9.1.4.1 Reporting of Reference Location identity shall be with odometer position and time of passage (Reference Time (see chapter 5.2.2)).

9.1.4.2 A Reference Location is a fixed location in the national infrastructure and defined by national trackside transmission equipment. The Reference Location is detected by STM On-board transmission equipment.

9.1.4.2.1 Note: Examples of national trackside transmission equipment are balises, loop crossings, magnets and coils.

9.1.4.2.2 Note: Reference Location for Level STM corresponds to Reference Location and Last Relevant Balise Group, LRBG defined for ETCS Levels 1, 2 and 3.

9.1.4.3 The STM shall take the inaccuracy of the reference location into account while computing the STM profile to be transmitted to the ETCS On-board.

10. DMI, DRIVER MACHINE INTERFACE

10.1 Scope

10.1.1.1 Technical interoperability is required at the STM FFFIS. To achieve this, the functions for accessing DMI through the STM FFFIS shall be defined strictly.

10.1.1.2 Operational interoperability is out of scope. Therefore, this specification does not specify any layout or look-and-feel of the interface to the driver

10.1.1.3 The specification allows for some different design of DMI.

10.1.1.4 There may be different approaches for the DMI. We shall consider the DMI from three different aspect:

- Hardware aspect
- Functional aspect
- Layout aspect

10.2 DMI from the hardware aspect

10.2.1.1 Two types of DMI hardware platform may be used by the STM:

10.2.2 The ETCS On-board DMI platform

10.2.2.1 This hardware DMI platform is the one used by the ETCS On-board while operating in ETCS level 0, 1, 2, and 3.

10.2.2.2 This shall be the preferred hardware DMI platform to be used also by the STM while the ETCS On-board is in level STM.

10.2.2.3 This hardware DMI platform shall be called within this specification: ”ETCS On-board DMI platform”.

10.2.2.4 The ETCS On-board DMI platform shall be considered as part of the ETCS On-board.

10.2.3 The separate STM DMI platform

10.2.3.1 If for RAMS or ergonomic reasons, the ETCS On-board DMI platform can not be used, a separate hardware dedicated to the STM can be used. This separate hardware DMI platform shall be called within this document: “Separate STM DMI platform”.

10.2.3.2 The use of Separate STM DMI platform shall be optional.

10.2.3.3 A Separate STM DMI platform shall be connected directly to the STM and is part of the STM installation.

10.2.3.4 The activation conditions and usage of the separate STM DMI platform is fully under responsibility of the STM and shall not be restricted by the ETCS On-board.

10.2.3.5 The Separate STM DMI platform shall be considered as part of the STM hardware and shall be controlled by the STM itself.

10.2.3.6 The usage of Separate STM DMI platform shall be minimised. The STM shall be designed as far as possible to work without requiring Separate STM DMI platform.

10.2.3.6.1 Examples: The Separate STM DMI platform may be a single lamp, button or moving coil meter that cannot be supported by the ETCS On-board DMI platform.

10.2.3.7 There shall be no connection and no shared hardware between the separate STM DMI platform and the ETCS On-board.

10.2.3.8 As the separate STM DMI platform is part of the STM design, it shall not be considered anymore within this specification.

10.3 DMI from the functional aspect

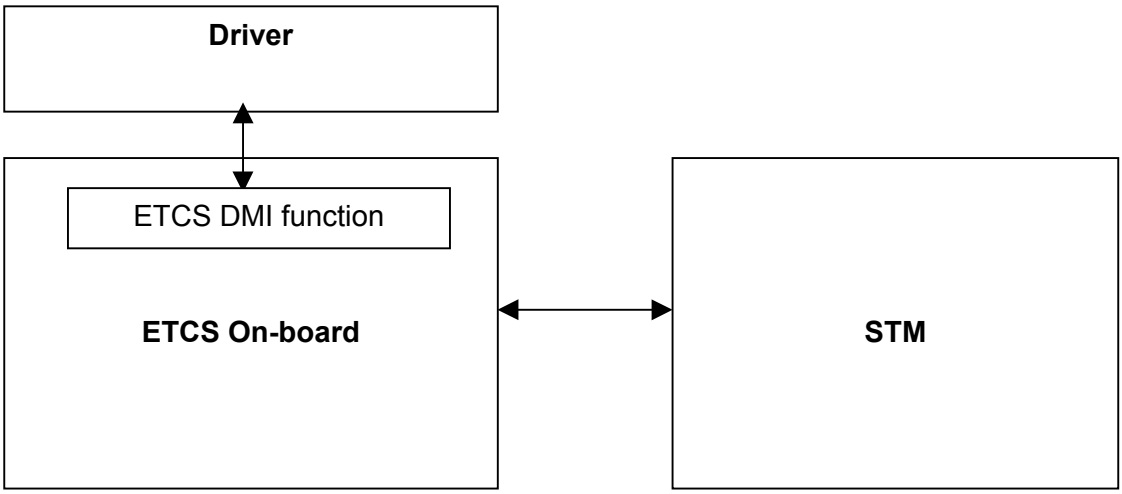


Figure 13: Functional DMI aspect

10.3.1.1 The ETCS DMI function is the interface of the ETCS On-board to the driver. That means that all inputs from the driver to the ETCS On-Board and all outputs from the ETCS On-board to the driver are controlled by this function.

10.3.1.2 The ETCS DMI function uses the ETCS On-board DMI platform to interact with the driver.

10.3.1.3 The DMI function is described as the control / inhibition (see chapter 10.7.2.5 and 10.7.3.5) of DMI objects.

10.3.1.4 To allow the STM to interact with the driver, the ETCS DMI function shall give the STM access to the defined objects listed within chapter 10.6.

10.3.1.5 There are three categories of objects:

- Objects which are controlled by the ETCS only,
- Objects which are controlled by the STM only,
- Objects which are controlled by either ETCS or STM.

10.3.1.6 The control of the DMI objects means that the ETCS and/or STM is able to activate (to request display) or deactivate (to request not to display) the DMI objects and to change their attributes (colour, icon, …). Refer to chapter 10.6.

10.3.1.7 Some “objects controlled by the ETCS only” can be inhibited by the STM (request to not display whatever is the control of this object).

10.3.1.8 Objects which are controlled by the ETCS only and cannot be inhibited by the STM are not part of the FFFIS STM.

10.3.1.9 The STM access to DMI objects shall depend on ETCS technical mode (STM European or STM National). See chapter 10.7.

10.3.1.10 The objects that can be controlled by the STM are:

- For driver inputs to the STM: buttons, text message acknowledgements,
- For STM outputs to driver: indicators, text messages, supervision information (targets speed and distance, speed related indications, distance related indications: permitted speed, permitted distance, warnings…) and sounds.

10.3.1.11 The DMI function may have the knowledge of STM specific object definition or not.

10.3.1.12 **Remark**: Data entry is not a direct interface between the STM and the ETCS DMI function. It shall not be considered within this chapter. Refer to chapter 13.1.1.

10.4 DMI from the layout aspect

10.4.1.1 A layout shall be considered as the way of presenting information to the driver.

10.4.1.2 The possibility to use several types of layouts shall be considered within this specification.

10.4.1.3 The DMI function may have the knowledge of STM specific layout definition or not.

10.4.2 Interoperable DMI

10.4.2.1 Different layouts shall be considered to present the information from the STM to the driver. At least, one layout may be considered for each of the possible STM.

10.4.2.2 An interoperable DMI is a DMI that shall be configured for all STMs. It means:

- that the DMI is able to present information in the way required (layout) for all respective national systems,
- and that the DMI knows the definition of all DMI objects used by the respective STM and by the ETCS On-board.

10.4.3 Customised DMI

10.4.3.1 A customised DMI is a strict subset of the Interoperable DMI.

10.4.3.2 A customised DMI is a DMI, which is configured for at least one STM. It means:

- that the DMI is able to present information in the way required (layout) for at least one national system,
- and that the DMI knows the definition of all DMI objects used by the respective STM and by the ETCS On-board.

10.4.4 Unified DMI

10.4.4.1 A unified DMI is a DMI based on the DMI layout used by the ETCS On-board while operating in Level 0, 1, 2, and 3.

10.4.4.2 The unified DMI shall not have STM specific layout.

10.4.4.3 The Unified DMI shall reserve areas to be used by the STM: area for buttons, area for indicators (see also chapter 10.6.4.5 and 10.6.5.7).

10.4.4.4 The unified DMI shall share the text area between the STM and the ETCS On-board.

10.4.4.5 STM supervision information shall be displayed in the way it is done while operating in Level 0, 1, 2 and 3.

10.4.4.6 The Unified DMI shall have the knowledge of STM specific object definition or not.

10.4.4.6.1 Note: If the Unified DMI doesn't know the STM specific object definition, a default definition of the DMI object given by the STM will be used.

10.5 General requirements regarding DMI function

10.5.1 ETCS On-board and STM requirements regarding DMI function

10.5.1.1 Independently of the DMI design, communication on the STM FFFIS shall be the same (see 4.1)

10.5.1.2 Due to availability reasons, the ETCS on-board may provide a redundant DMI per cab.

10.5.1.3 The STM shall be able to open or not the communication with the redundant DMI depending on its own availability targets.

10.5.2 ETCS On-board requirements regarding DMI function

10.5.2.1 The ETCS On-board shall allow only one STM to have access to the DMI at one time.

10.5.2.2 After the transition from an STM to another system (ETCS or STM), the ETCS On-board shall delete all DMI objects controlled by the previous active STM.

10.5.2.3 When the ETCS on-board receives a request for a DMI object from the STM and does not know the object definition, the ETCS on-board shall use the default definition of the object as sent by the STM.

10.5.2.4 If the ETCS on-board does not support the requested object and the default definition was not sent by the STM, the ETCS on-board shall order the STM to Failure State.

10.5.2.5 The ETCS On-board shall give the STM the possibility to request objects (indicators and buttons) to be displayed always at a fixed position.

10.5.2.6 The ETCS On-board shall be able to receive preliminary request for DMI objects from an STM being in HS state. The ETCS On-board shall be allowed to ignore this information.

10.5.2.6.1 Note: The sending of preliminary request is to allow the DMI function to prepare in background the information to be presented to the driver once the STM switches to Data Available state.

10.5.2.6.2 Note: This is to avoid a gap of the display at level transition and to have a one shot up-date of the screen to display STM information at level transition.

10.5.2.7 While the ETCS On-board is in the Sleeping (SL) technical mode, the ETCS On-board shall ignore all STM request for DMI objects even if the STM is in Data Available (DA) State.

10.5.2.8 The ETCS DMI function shall transmit the selected language to the STM, when a new connection from the STM to the ETCS DMI function is established and to all STMs connected to the ETCS DMI function whenever the language is changed.

10.5.3 STM requirements regarding DMI function

10.5.3.1 When the STM requests a DMI object (button, indicator, and sound) to the ETCS DMI function, this request shall contain a default definition of the objects.

10.5.3.2 The STM can request necessary buttons and indicators by referencing object identifiers (see chapter 10.6.2).

10.5.3.3 The STM in Hot Standby shall be allowed to send preliminary request for DMI objects to the ETCS On-board.

10.5.3.4 If the ETCS technical mode is SL, the STM shall not send any request for DMI objects to the ETCS On-board DMI function (including preliminary requests).

10.5.3.5 The STM shall send a request with the required status of all DMI objects to the ETCS On-board after switching from CS or HS to DA state.

10.5.3.6 When receiving the language selected by the driver, the STM may use this information or not.

10.6 DMI Objects

10.6.1 General

10.6.1.1 When in Level STM, the STM can use the DMI objects also used by the ETCS On-board. If so, the semantics and actions associated with the DMI objects shall be the same as for Levels 0, 1, 2 and 3.

10.6.1.1.1 Note: The appearance and technology for implementing the DMI Objects are not specified within the STM FFFIS. The use of a DMI object (button, indicator,

sounds, text message, etc.) by an STM has to be consistent regardless of which STM is active. The look-and-feel or meaning of DMI objects are not allowed to alter during mission with different STMs at different time of operation.

10.6.1.2 DMI objects like buttons, indicators, sounds and supervision information have a default definition which shall be used by the ETCS DMI function if those object are not configured within the DMI.

10.6.2 DMI Object identities

10.6.2.1 All DMI objects (indicators, buttons etc.) used by all the different target systems are assigned a unique object identity made of STM Identifier and Object Identifier.

10.6.2.2 The maximum entries for a set of buttons/Indicators/sounds of a target system (STM Identifier + Object Identifier) shall be 255.

10.6.2.3 All icons (graphic symbols) used by all the different target systems are assigned a unique graphic identity made of STM Identifier and Icon Identifier.

10.6.2.4 The maximum entries for a set of icons of a target system (STM Identifier + Object Identifier) shall be 255.

10.6.2.5 The object identities and graphic identities are used in the communication between STM and the ETCS On-board DMI function.

10.6.2.6 For each target system, Buttons and Indicators share the same set of icons (Buttons and Indicators may display the same icon).

10.6.2.7 An object identity provides an identity of a national DMI function. This allows for customisation related to this object. This is only a possibility, not a requirement.

10.6.2.8 The various DMI Object types are defined here below.

10.6.3 Text messages, Acknowledgement

10.6.3.1 All text messages from STMs are displayed in the order of their reception by the ETCS On-board.

10.6.3.1.1 Exception: A message, which requires driver acknowledgement shall not be hidden behind a message, which does not require a driver acknowledgement.

10.6.3.2 The STM can request a text message by supplying the ETCS DMI function with a string of text to be shown to the driver.

10.6.3.3 The STM can request an Acknowledgement by supplying the ETCS DMI function with a string of text to be shown to the driver and a request for acknowledgement.

10.6.3.4 The STM shall be able to request a background colour for text messages and the display colour of the text message (font) itself.

10.6.3.5 The ETCS DMI function shall report to the STM the acknowledgement of messages (which were required to be acknowledged) from the driver.

10.6.3.6 At any time, only one message to be acknowledged shall be displayed to the driver by the ETCS DMI function.

10.6.3.6.1 Justification: This is for ergonomic reason.

10.6.3.7 If more than one message are pending for acknowledgement, the ETCS On-board shall store those messages to be acknowledged and display them in the order they have been received. (FIFO)

10.6.3.8 All text messages from STMs shall be deleted only by the STM which requested the text message. The only exception from this requirement is when the STM is no more active (see 10.5.2.2).

10.6.3.8.1 Note: In case of a message that has to be acknowledged, this is to indicate to the driver that the STM has properly taken into account the acknowledgement.

10.6.3.9 The interoperable character code shall be Latin Alphabet #1, also known as ISO 8859-1 and Codepage 850.

10.6.3.9.1 Justification: This supports all Western European countries, parts of Eastern Europe and is widely used in PC's and workstations.

10.6.4 Indicators

10.6.4.1 Indicators shall correspond to lamps or small displays of short text and/or short numbers.

10.6.4.2 ETCS DMI indicator shall be able to present icons or caption text to the driver within the same screen area.

10.6.4.3 Indicators are not safe by themselves.

10.6.4.4 A maximum of 24 indicators shall be visible at the same time.

10.6.4.5 Exception: For the Unified DMI, a maximum of 10 indicators shall be visible at the same time.

10.6.4.6 STM shall request an indicator by means of the following definition:

- an object identity code made of STM Identifier and Object Identifier,
- a unique graphic identity made of STM Identifier and Icon Identifier,
- a caption text.

10.6.4.7 The caption text shall be visible only when

- the graphic identity code is not known in the DMI Function or
- a special value for the graphic identity code telling that no icon is requested by the STM is transmitted.

10.6.4.8 If the caption text is visible, the STM shall be able to request a background colour for the whole indicator and the display colour of the caption text (font).

10.6.4.9 The STM shall be able to request a flashing of the whole indicator (no flashing, slow / fast / counterphase flashing).

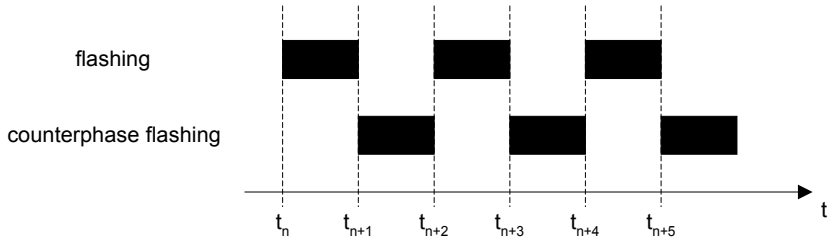


Figure 14: Counterphase flashing

10.6.4.10 The caption text can be up to two lines of 6 characters each.

10.6.4.10.1 Note: The caption text associated to an object identity can be updated at any time by the active STM. This way, the Indicator can serve as a small alphanumeric display.

10.6.4.11 The caption text, the background colour and the caption text colour shall be used as default definition for indicators.

10.6.5 Buttons

10.6.5.1 Buttons are a pure functional extension of Indicators.

10.6.5.2 ETCS DMI buttons shall be able to present icons and/or caption text to the driver within the same screen area.

10.6.5.3 The extension is transmission of button events from ETCS DMI to STM. The ETCS DMI function shall make a distinction between push event (button activated by the driver) and release event (button activation is ended by the driver).

10.6.5.4 ETCS DMI shall report button push and release events to the STM. ETCS DMI function shall timestamp those event reports to reflect the sequence of events.

10.6.5.4.1 Note: The same button may be reported more than once in the same message, if DMI has registered more than one event during the cycle.

10.6.5.5 The ETCS DMI function shall use the Reference Time (see chapter 5.2.2) for timestamping the button events reports.

10.6.5.6 A maximum of 10 buttons shall be visible at the same time.

10.6.5.7 Exception: For the Unified DMI, a maximum of 5 buttons shall be visible at the same time.

10.6.5.7.1 Note: Buttons that are controlled by the ETCS only are excluded from those numbers.

10.6.5.8 STM shall request a button by means of the following definition:

- an object identity code made of STM Identifier and Object Identifier,
- a unique graphic identity made of STM Identifier and Icon Identifier,
- a caption text.

10.6.5.9 The caption text shall be visible only when

- the graphic identity code is not known in the DMI Function or
- a special value for the graphic identity code telling that “no icon is requested by the STM” is transmitted.

10.6.5.10 If the caption text is visible, the STM shall be able to request a background colour for the whole button and the display colour of the caption text (font).

10.6.5.11 The STM shall be able to request a flashing of the whole button (no flashing, slow / fast / counterphase flashing).

10.6.5.12 The button can have a caption text of up to two lines of 6 characters each.

10.6.5.13 A changing state (icon, colour) of a button shall only come from the STM.

10.6.5.14 If a local feedback from the DMI is implemented, it shall give to the driver the information that the button is pressed.

10.6.5.14.1 Note: Local feedback is when the DMI makes a direct response to the driver when a button is pressed.

10.6.5.15 The DMI itself shall not change the state of the button (icon, colour).

10.6.5.15.1 Exception: Customisation may override this requirement.

10.6.5.15.2 Justification: This indicates the processing in the STM.

10.6.5.15.3 Note: The normal procedure for every button is that the STM provides all responses (feedback), but it may have a too slow response from an ergonomical aspect.

10.6.5.15.4 Note: When using the DMI, the driver has to check that the DMI behaves as expected.

10.6.5.16 The caption text, the background colour and the caption text colour shall be used as default definition for buttons.

10.6.6 Sounds

10.6.6.1 STM shall request a sound by means of the following definition:

- an object identity code made of STM Identifier and Object Identifier,
- a sequence of segments defined by a duration and an associated frequency,

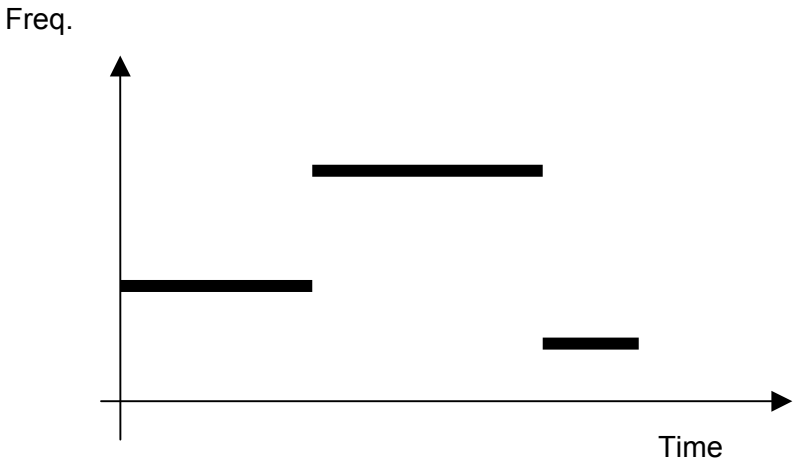


Figure 15: Example of sound definition

- an indication if the sound has to be repeated continuously or not or to be stopped.

10.6.6.2 The sequence of segments shall be used as default definition for sounds.

10.6.6.3 The ETCS DMI function shall be able to manage two STM requests for sounds at the same time.

10.6.6.3.1 Note: This will allow an STM to request a long sound and a short sound simultaneously.

10.6.7 Supervision information

10.6.7.1 There shall be two types of supervision information:

- ETCS supervision information
- STM-customized supervision information

10.6.7.2 ETCS supervision information consists of :

- Permitted Speed
- Target Speed
- Target distance
- Release speed
- Intervention speed

  Intervention speed is the speed at which the intervention occurs.
- Warning status (Refer to “warning limit” within /4/ SRS Version 2.2.2; SUBSET-026.3; Principles)
- Indication status (Refer to “indication limit” within /4/ SRS Version 2.2.2; SUBSET-026.3; Principles)

10.6.7.3 The STM shall always send the ETCS supervision information, which shall be used as a default definition of the supervision information to be displayed by the ETCS On-board.

10.6.8 DMI Object inhibition

10.6.8.1 The STM shall be able to select a restricted number of objects to be enabled or inhibited (see 10.7.2.5 and 10.7.3.5).

10.6.8.1.1 An inhibited DMI Object shall not be shown at the DMI whatever is the source of the data.

10.6.8.1.2 Justification: National rules may demand some data not to be shown to the driver. The driver may be required to drive according to tables and optical signals independently of protection from national on-board system.

10.7 DMI and ETCS On-board mode

10.7.1.1 While the ETCS On-board is in the Sleeping (SL) technical mode, the STM shall have no access to the DMI function.

10.7.1.2 For the European mode, the ETCS DMI shall display the supervision data based on the STM Profile.

10.7.1.3 For the National mode, the ETCS DMI shall display the supervision data received from the STM.

10.7.2 Driver input to the On-board system

10.7.2.1 The following table gives all the driver inputs available depending on ETCS mode STM National (SN) or STM European (SE).

10.7.2.2 This information is coming from the /5/ SRS Version 2.2.2; SUBSET-026.4; Modes and Transitions. It is repeated here for information and to ease the understanding. It has been completed for STM objects.

10.7.2.2.1 X = active: For a DMI input, this means that the driver has the possibility to enter this information when the ERTMS/ETCS On-board equipment is in the mode indicated in the column.

10.7.2.2.2 A = available: This means that the input becomes active ONLY if another condition(s) is (are) fulfilled. This condition(s) are not described here.

10.7.2.3 The information “active” or “available” doesn’t means that the STM has direct access to those information.

10.7.2.4 Two type of access to the information shall be considered:

- The control of the information itself (see chapter 10.3.1.6). Information can be controlled by the ETCS On-board or by the STM.
- The inhibition of the information (see chapter 10.6.8). Information can be inhibited or not by the STM.

10.7.2.5

Input information	STM European mode			STM National mode		
	X/A	Control	Inhibition by STM	X/A	Control	Inhibition by STM
Data entry request	X	ETCS	NO	X	ETCS	NO
Train Data - Max train speed - Train length - train category - Deceleration capacity - Time to cut off traction - Brake delay time - loading gauge - axle load - power supply - train running number	A	ETCS	NO	A	ETCS	NO
Selection of language	A	ETCS	NO	A	ETCS	NO
Which STM to be activated	A	ETCS	NO	A	ETCS	NO
Specific STM Data Entry	A	ETCS	NO	A	ETCS	NO
Train data confirmation	A	ETCS	NO	A	ETCS	NO

Input information	STM European mode			STM National mode		
	X/A	Control	Inhibition by STM	X/A	Control	Inhibition by STM
Additional data - Driver id - ERTMS/ETCS level - Track Adhesion factor	A	ETCS	NO	A	ETCS	NO
Additional data re-validation - Driver id - ERTMS/ETCS level	A	ETCS	NO	A	ETCS	NO
Start	A	ETCS	NO	A	ETCS	NO
ETCS Override request	X	ETCS	YES	X	ETCS	YES
Ack of fixed text information	A	ETCS	NO	A	ETCS	NO
Ack of plain text information	A	ETCS + STM	NO	A	ETCS + STM	NO
Ack of level transition	A	ETCS	NO	A	ETCS	NO
STM buttons	A	STM	NO	A	STM	NO

10.7.2.6 To resume: The STM shall only have the control of the STM buttons and acknowledgements of plain text messages regarding the driver input to the On-board.

10.7.3 On-board outputs to the Driver

10.7.3.1 The following table gives all the On-board outputs to the Driver available depending on ETCS mode STM National (SN) or STM European (SE).

10.7.3.2 This information is coming from the /5/ SRS Version 2.2.2; SUBSET-026.4; Modes and Transitions. It is repeated here for information and to ease the understanding. It has been completed for STM objects.

10.7.3.2.1 X = active: For a DMI output, this means that the output information is shown to the driver when the ERTMS/ETCS On-board equipment is in the mode indicated in the column.

10.7.3.2.2 A = available: This means that the output becomes active ONLY if another condition(s) is (are) fulfilled. This condition(s) are not described here.

10.7.3.3 The information “active” or “available” doesn’t mean that the STM has direct access to those information.

10.7.3.4 Two type of access to the information shall be considered:

- The control of the information itself (see chapter 10.3.1.6). Information can be controlled by the ETCS On-board or by the STM.
- The inhibition of the information (see chapter 10.6.8). Information can be inhibited or not by the STM.

10.7.3.5

Output information	STM European mode			STM National mode		
	X/A	Control	Inhibition by STM	X/A	Control	Inhibition by STM
ERTMS/ETCS Mode	X	ETCS	NO	X	ETCS	NO
Current ERTMS/ETCS level	X	ETCS	NO	X	ETCS	NO
ETCS Train Speed	X	ETCS	NO	X	ETCS	NO
STM Permitted Speed	A	ETCS	YES	A	STM	YES
STM Target Speed	A	ETCS	YES	A	STM	YES
STM Target distance	A	ETCS	YES	A	STM	YES
STM Release speed	A	ETCS	YES	A	STM	YES
STM Intervention speed[1]	A	ETCS	YES	A	STM	YES
STM Warning status / Indication status[2]	A	ETCS	YES	A	STM	YES
Train Data - Max train speed - Train length - train category - deceleration capacity - time to cut off traction - brake delay time - loading gauge - axle load - power supply - train running number	A	ETCS	NO	A	ETCS	NO
Additional data - Driver id - ERTMS/ETCS level - Track Adhesion factor	A	ETCS	NO	A	ETCS	NO
Specific STM Data Entry	A	ETCS	NO	A	ETCS	NO
Service brake intervention	A	ETCS	NO	A	ETCS	NO
Emergency brake intervention	A	ETCS	NO	A	ETCS	NO
Fixed text information	A	ETCS	NO	A	ETCS	NO

[1] This is not part of the SRS Subset-026 V2.2.2 and is given here to be complete.

[2] This is not part of the SRS Subset-026 V2.2.2 and is given here to be complete

Output information	STM European mode			STM National mode		
	X/A	Control	Inhibition by STM	X/A	Control	Inhibition by STM
Plain text information	A	ETCS + STM	NO	A	ETCS + STM	NO
Track data & track condition - Balise transmission control	A	ETCS	YES	A	ETCS	YES
Override Status	A	ETCS	YES	A	ETCS	YES
Level transition announcement	A	ETCS	NO	A	ETCS	NO
Slippery track selected indication	A	ETCS	YES	A	ETCS	YES
STM Sounds	A	STM	NO	A	STM	NO
STM buttons	A	STM	NO	A	STM	NO
STM indicators	A	STM	NO	A	STM	NO

11. JRU STM COMMUNICATION

11.1 Recording concept

11.1.1.1 The JRU receives data from the STM for logging purpose. The main aim of recording this information is to determine the responsibility between the different ERTMS/ETCS on-board devices, trackside data, driver actions and STM. Therefore all information having an impact on the safety of train movement shall be recorded.

11.1.1.2 This chapter deals only with the added information provided by the STM(s).

11.1.1.3 In order to determine the responsibilities it is necessary to record the order of events and be able to reconcile this order with real time.

11.2 General requirements

11.2.1.1 The ETCS JRU shall be able to receive and store data from an STM.

11.2.1.2 The STM shall be able to send all relevant national juridical data to the ETCS JRU.

11.2.1.3 The definition of the relevant national juridical data is a national concern, so it is out of the scope of this specification.

11.2.1.4 The STM shall use the Reference Time (see chapter 5.2.2) for time stamping the data sent to the ETCS JRU.

11.2.1.5 The time stamp of the data sent to the ETCS JRU shall represent the time the sent data was valid.

11.2.1.5.1 Justification: This is in order to define the event chronology.

11.2.1.6 The ETCS JRU shall perform the correlation between the UTC and the Reference Time (see chapter 5.2.2).

12. DIAGNOSTIC RECORDER (DRU)

12.1.1.1 The Diagnostic message has the purpose of supporting operator and maintenance staff to quickly find and isolate sources of faults.

12.1.1.2 It is not mandatory to the ETCS on-board to implement the Diagnostic Recorder function.

12.1.1.3 If the Diagnostic recorder is not available in the ETCS on-board, the ETCS on board shall always send a default unused address to the STM.

12.1.1.3.1 Justification: This allows connection of a diagnostics recorder when needed without modifying the ETCS on-board configuration.

12.1.1.4 If the Diagnostic Recorder is not available in the ETCS on-board (no connection can be established) the STM shall not send diagnostic data.

12.1.2 Unambiguous message

12.1.2.1 The diagnostic messages shall be made unique by including the following information:

- Provider of the STM,
- STM identifier,
- Diagnostic message.

12.1.2.1.1 Note: Diagnostic messages may contain the timestamp information (Reference Time).

12.1.2.2 For a combination of the Provider of the STM and STM identifier, there is a product specific list of diagnostic messages. The owner of the product or system maintains this list.

13. PROCEDURES

13.1 Specific STM Data Entry/Data View

13.1.1 Specific STM Data Entry

13.1.1.1 General requirements and Definitions

13.1.1.1.1 The STM shall use the transmitted ETCS data: ETCS Train Data, ETCS Additional Data and ETCS National Values as far as possible.

13.1.1.1.2 If it is not possible to transform the ETCS Data into national format, the STM is allowed to request (nationally) specific STM data from ETCS On-board. Those specific data shall be called “Specific STM Data”. “Specific STM data” are the national data that are not ETCS data or that cannot be translated from ETCS data.

13.1.1.1.2.1 Note: The entry of Specific STM Data should be avoided. Where possible, automatic translation shall be implemented on the STM side.

13.1.1.1.3 For each NID_STM it is possible to define up to 255 Specific STM Data. This is referred to as the palette of Specific STM Data.

13.1.1.1.4 Each Specific STM Data variable shall be uniquely identified by NID_STM + Data Identifier.

13.1.1.1.5 An STM may refer to other palettes than its own.

13.1.1.1.6 The process to deliver those “Specific STM Data” to the STM is called “Specific STM Data Entry”.

13.1.1.1.6.1 Note: The Specific STM Data are called “Additional STM Data” within /1/ SUBSET-026; SRS Version 2.2.2.

13.1.1.1.7 The ETCS On-board shall be responsible for the data consistency between the external source of Specific STM Data and the Specific STM Data transmitted to the STM.

13.1.1.1.8 Specific STM data entry shall be possible at start-up and later on during mission in order to modify or review the Specific STM Data.

13.1.1.1.9 The Specific STM Data Entry process may require or not the driver to enter the data manually. This manual entry is called the “Driver Interaction”.

13.1.1.1.9.1 Note: Driver Interaction is mandatory for the test procedure, as it has to be processed in real time.

13.1.1.1.10 At PO state of the STM, the “Specific STM Data Need” shall indicate whether the STM needs Specific STM Data or not. See 7.3.1.2.5.

13.1.1.1.11 The “Specific STM Data Need” shall include if there is a manual entry process requested or not for at least one Specific STM Data of the STM. This need for manual entry is called the “Driver Interaction Need”.

13.1.1.1.12 The STM request for Specific STM data entry shall include if there is a driver interaction requested or not and for each Specific STM Data, the following information: labelling, with optional default value, and optional pick-up list. This request shall be send by the STM to the ETCS STM Control Function. The request for driver interaction is called the “Driver Interaction Request”.

13.1.1.1.13 The STM shall not be allowed to send an STM request for Specific STM data entry with a Driver Interaction Request without having sent a Driver Interaction Need within the latest Specific STM Data Need.

13.1.1.1.14 The STM shall be allowed to send an STM request for Specific STM data entry without a Driver Interaction Request while having sent a Driver Interaction Need within the latest Specific STM Data Need.

13.1.1.1.15 Depending on STM implementation, the STM request for Specific STM Data entry shall contain all the data needed by the STM or a subset of data needed by the STM or one data needed by the STM at a time.

13.1.1.1.16 The number of data within one STM request for Specific STM Data entry shall be limited to 5 data.

13.1.1.1.17 When the STM receives the Specific STM Data, the STM shall be allowed to send another request for Specific STM Data.

13.1.1.1.18 An STM request for Specific STM Data shall be allowed to be the same or different from the previous one (i.e. request for another set of data).

13.1.1.1.19 When the STM receives the Specific STM Data, the STM shall check the data according to its national criteria (e.g. range check, cross checks). Depending on the check result of the STM :

- the STM shall send an ”END of Specific Data entry” to the ETCS STM Control Function if the checks are OK and the STM has all the requested data.
- the STM shall request again Specific STM Data entry to the ETCS STM Control Function.

13.1.1.1.20 The Specific STM data transmitted by the ETCS STM Control Function to the STM shall be composed of text string only. Each element of a text string contains a single character encoded as ISO 8859-1, also known as Latin alphabet #1.

13.1.1.1.21 Driver text entry functionality of the ETCS On-board shall support at least 0-9 and A-Z (capital letters only) characters.

13.1.1.1.22 Specific STM Data Entry shall not require the driver to enter characters beyond 0-9 and A-Z. (capital letters only).

13.1.1.1.23 The label and elements in the pick-up list shall be allowed to use the whole set of characters of ISO 8859-1.

13.1.1.2 Specific STM Data Entry Procedure

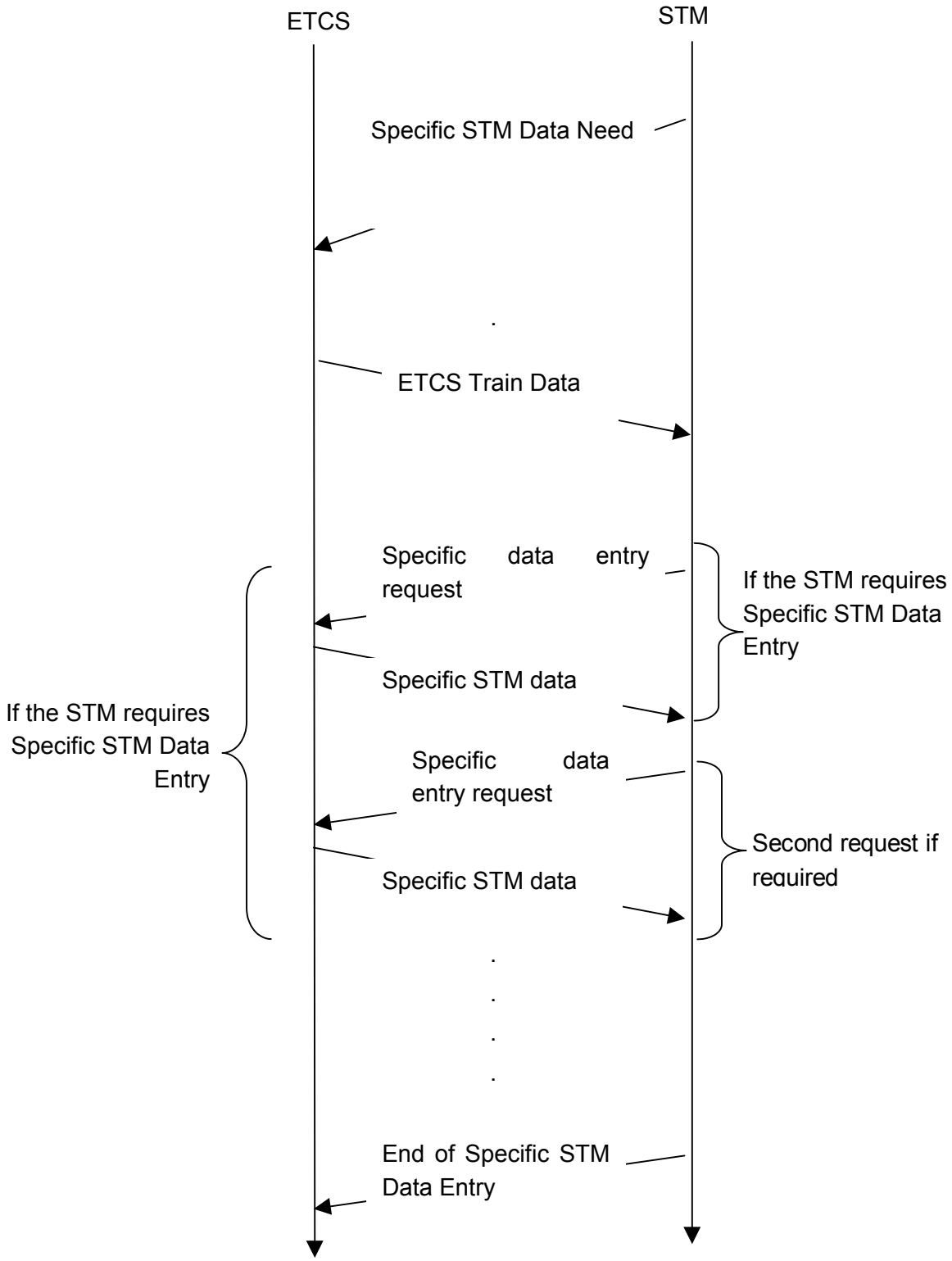


Figure 16: Specific STM Data Entry procedure: Data exchange

13.1.1.2.1 When the STM needs Specific STM Data, it shall send an “Specific STM Data Need” to the ETCS On-board STM Control Function.

13.1.1.2.2 When receiving the “Specific STM data need” and

- the ETCS STM Control function doesn’t know the validated Specific STM data,
- or the Specific STM Data Need includes a Driver Interaction Need,

then the ETCS STM Control Function shall inform the driver that at least one STM needs Specific STM Data.

13.1.1.2.3 The ETCS STM Control Function shall delete this information to the driver when the driver starts the ETCS train data entry procedure.

13.1.1.2.4 Once the STM has received the ETCS train data :

- If the STM requires specific STM data entry, the STM shall request Specific STM Data entry to the ETCS STM Control Function.
- If the STM doesn’t require Specific STM Data entry, the STM shall send an “END of Specific Data entry” to the ETCS STM Control Function.

13.1.1.2.5 When the ETCS STM Control Function receives the STM request for Specific STM data entry

- with a driver interaction or
- if the ETCS STM Control Function doesn’t know the validated Specific STM data,

the ETCS STM Control Function shall perform the Specific STM data entry exchanges with the driver and send the Specific STM data to the STM.

13.1.1.2.6 The STM Control Function may send Specific STM data without Driver Interaction when:

- the ETCS STM Control Function knows the validated Specific STM Data and,
- the STM doesn’t request for Driver Interaction.

13.1.1.2.7 The ETCS On-board shall not end the ETCS train data entry/Specific STM Data entry procedure before having received the “END of Specific Data entry” from all connected STMs.

13.1.2 Specific STM Data View

13.1.2.1 This procedure shall allow the driver to view the Specific STM data values currently known by the STM.

13.1.2.2 When the view procedure of ETCS train data is triggered, the ETCS On-board STM Control Function shall send a request to all connected STMs for their Specific STM Data values.

13.1.2.3 Once the STM has received the ETCS request for Specific STM Data values:

- If the STM requires Specific STM data entry, the STM shall send Specific STM Data Values (labels and corresponding values) to the ETCS STM Control Function. Those data shall be called " Specific STM Data View values".
- If the STM doesn't require Specific STM data entry, the STM shall send a «NO Specific Data values» to the ETCS STM Control Function.

13.1.2.4 The Specific STM Data View Values transmitted by the STM to the ETCS STM Control Function shall be composed of text string only. Each element of a text string contains a single character encoded as ISO 8859-1, also known as Latin alphabet #1.

13.1.2.5 When the ETCS STM Control Function receives the Specific STM Data View Values, the ETCS STM Control Function shall present the Specific STM Data View Values to the driver.

13.1.2.6 The ETCS On-board shall use the received Specific STM Data View Values only for displaying purpose during the data view procedure.

13.1.2.7 The ETCS On-board shall not used the Specific STM Data Entry Values for displaying purpose during the data view procedure.

13.1.2.7.1 Justification: This is important for the safety integrity of the Specific STM Data Entry process and the safety proof for STM.

13.2 STM Specific Test Procedure

13.2.1 General

13.2.1.1.1 This chapter includes the procedure to perform the operational test of STMs.

13.2.1.1.2 For all STMs that need to be tested (due to a required test of e. g. the national transmission channel and / or the direct brake access) and the test has to be manually activated by the driver, the ETCS On-board shall provide one standard test procedure as described within this chapter.

13.2.1.1.2.1 Justification: For some tests of the STM neither the ETCS On-board nor the STM itself can decide, if the test is allowed within the current area, at the current time or not. It is up to the driver to activate the test of the STM.

13.2.1.1.3 The STM shall not require a test of functions provided by the ETCS On-board through the FFFIS STM. These functions shall be in the responsibility of the ETCS On-board and are therefore out of scope for the STM test procedure.

13.2.1.1.3.1 Note: This includes any TIU function defined within the FFFIS STM Train and Brake Interface.

13.2.1.1.4 If the STM is not able to perform its test due to STM internal rules for the execution of the tests, the STM shall be allowed to abort the test procedure.

13.2.1.1.4.1 Justification: An STM may not be allowed to perform all or some of its tests while the train is moving.

13.2.2 Test request from an STM to the driver

13.2.2.1.1 If an STM needs to be tested, it may send a test request to the STM Control Function. This test request shall contain a plain text message.

13.2.2.1.1.1 Justification: Some STMs need to be tested when a specified time since the last test has expired. This has to be indicated to the driver so that the driver can activate the test at the next opportunity.

13.2.2.1.1.2 Note: The test request should be given early enough from the STM to the driver to allow the driver to perform the test procedure at a stopping location where time and other conditions are suitable prior to deactivation of the STM because no test was performed.

13.2.2.1.2 The plain text message shall be composed of up to 20 characters encoded as ISO 8859-1, also known as Latin alphabet #1.

13.2.2.1.3 The STM shall not send a test request information while the ETCS On-board is in mode TR, PT, RV, or SL.

13.2.2.1.3.1 Note: This is to avoid disturbing the driver in critical situations or when no driver is present in the cab.

13.2.2.1.4 At any time a test request is received from an STM, the ETCS On-board (STM Control Function) shall display the plain text message of the test request to the driver.

13.2.2.1.5 The ETCS On-board STM Control Function shall delete the text message indication to the driver when the test procedure for the corresponding STM is triggered by the driver.

13.2.2.2 The test request from an STM shall be only an information to the driver.

13.2.3 Test procedure

13.2.3.1.1 An STM that requires its own operational test will allow the driver to perform these tests through the Specific STM Data Entry procedure.

13.2.3.1.2 The STM shall request the test procedure while the ETCS On-board is in SB mode only.

13.2.3.1.3 If the STM has an STM operational test, the STM shall send the test activation request as an Specific STM Data request to the ETCS On-board STM Control Function during the Specific STM Data entry procedure.

13.2.3.1.3.1 Note: If the STM that has a STM operational test has no Specific STM Data, the STM should ask at least for the test activation from the driver.

13.2.3.1.3.2 Note: The Specific STM Data for the test activation may be implemented with a pick up list to select if the test is needed or not.

13.2.3.1.4 The STM shall start the test procedure when it receives the activation from the driver through the corresponding received Specific STM Data.

13.2.3.1.4.1 Note: It should be up to the driver to know if it is allowed to test more than one STM at the same time.

13.2.3.1.4.2 Note: Some ETCS specific implementations may not allow to perform two STM tests at the same time because the Specific STM Data Entry is performed as a sequence (One STM after the other).

13.2.3.1.4.3 Note: During its own test procedure, the STM may ask the driver for extra confirmation by means of Specific STM Data entry request.

13.2.3.1.5 Once the STM has finished its test procedure, it shall send the test result (OK, not OK or test aborted) as an Specific STM Data request to the ETCS On-board STM Control Function.

13.2.3.1.5.1 Note: The Specific STM Data for the test result may be implemented with a default value or pick up list to allow the driver to select if the test result is accepted.

13.2.3.1.6 When the test result acceptance by the driver is received by the STM, the STM operational test shall be finished.

13.2.3.1.7 When the STM operational test is finished, the STM shall be allowed to request a new STM operational test.

13.2.3.1.8 If the STM requires information from the ETCS On-board TIU and/or BIU to perform its test, the STM may open the connection to the ETCS TIU and/or BIU functions as long as the test procedure is running.

13.2.3.1.8.1 Justification: An STM may need e. g. the current state of the emergency brake to check the brake activation.

13.2.3.1.9 If the STM opens the connection to the ETCS TIU and/or BIU functions while the test procedure is running and the STM is not in data available (DA) state, the STM shall not give any output information for the ETCS On-board TIU and BIU.

13.2.4 Test results

13.2.4.1.1 The handling of the test result of an STM is out of scope for the ETCS On-board except for displaying the test result.

13.2.4.1.1.1 Note: If the STM fails the test, it may e.g. enter FA state or apply the brakes if in state DA. This is STM implementation.

13.3 Override, Functional behaviour between STM / ETCS

13.3.1 Philosophy (non-normative)

13.3.1.1.1 Each system, when active informs the other ones about the activation of the override function. According to this activation the override function of all systems is activated but every system is allowed to end its internal override function according to the national rules. The ETCS On-board STM Control Function reports to all STMs about the ETCS override status: activated or deactivated.

13.3.2 Requirements

13.3.2.1.1 The ETCS override status shall be activated when:

13.3.2.1.1.1 While in ETCS Level 0, 1, 2 or 3, and the ETCS override is activated according to the ERTMS/ETCS rules (see ref /1/ SUBSET-026; SRS Version 2.2.2)

13.3.2.1.1.2 While in Level STM and the active STM has reported the activation of its own override procedure to the STM Control Function.

13.3.2.1.1.3 While in Level STM and the ETCS override request is not inhibited by the active STM, and the ETCS override is activated according to the ERTMS/ETCS rules (see ref /1/ SUBSET-026; SRS Version 2.2.2).

13.3.2.1.2 While in Level STM and the national rules to activate the override function are fulfilled, the active STM shall report the activation of its own override procedure to the STM Control Function.

13.3.2.1.3 The ETCS On-board STM Control Function shall report to all STMs about the ETCS override status (activated or deactivated) whenever it changes.

13.3.2.1.4 The ETCS override Status is deactivated according to the ERTMS/ETCS rules. (see ref /1/ SUBSET-026; SRS Version 2.2.2)

13.3.2.1.5 All non-active STMs may activate their own override procedure when they receive the ETCS override Status activation from the STM Control Function.

13.3.2.1.6 All STMs may deactivate their own override procedure according to their national rules.

14. BUS

14.1 The Profibus

14.1.1.1 The bus used for the interface between STM and ETCS On-Board functions shall be the Profibus, defined by /14/ CENELEC 50170-2 (1996) Profibus.

14.1.1.2 The Profibus protocol is used up to the FDL layer.

14.1.1.2.1 Note: The use of the FDL layer is specified in /11/ SUBSET-057 STM FFFIS Safe Link Layer, chapter 4 Profibus Interface (FDL).

14.1.1.3 The bus configuration parameters for the PROFIBUS shall be:

- Baud Rate: 1500 Kbps
- Minimum Station Delay of Responders (min T_{SDR}): 11 tBit
- Maximum Station Delay of Responders (max T_{SDR}): 150 tBit
- Slot Time (T_{SL}): 300 tBit
- Quiet Time (T_{QUI}): 0 tBit
- Setup Time (T_{SET}): 1 tBit
- Time Target Rotation (T_{TR}): 30000 tBit (20 ms)
- GAP Actualisation Factor (G): 10
- Highest Station Address (HSA): 126
- Max Retry Limit (max_retry_limit): 1

14.1.1.3.1 Note: This allows for a maximum permissible line length (Profibus length) of 200 m per segment and a maximum number of 32 stations when using cable type A. In case a greater length or more stations are required, repeaters can be used without changing the configuration.

14.1.1.4 The communication via the Profibus shall be possible for STM and STM group internal purposes. This is out of the scope of this specification.

14.1.1.5 Note: The Profibus is allowed, but not required, for STM internal communication.The communication via the Profibus shall be possible for ETCS internal purposes. This is out of the scope of this specification.

14.1.1.5.1 Note. The Profibus is allowed, but not required for ERTMS/ETCS On-board internal communication.

14.1.1.6 The bus shall not unnecessarily restrict the architectural freedom for STMs or ETCS on-board.

14.1.2 Physical connection

14.1.2.1 The default physical medium shall be RS-485 twisted pair shielded copper cable.

14.1.2.2 The default connectors of the different equipments (ETCS On-Board functions and STMs) shall be 9-pin female D-SUB and cabling according to Profibus specifications.

14.1.2.3 Exception: An equipment is allowed to fulfil the Profibus specification for optical media instead of copper cable. In this case a media converter to the copper media and 9-pin D-SUB shall be the responsibility of the supplier of optical media based equipment.

14.1.3 Bus redundancy and retransmission

14.1.3.1 Retransmission is specified in /11/ SUBSET-057 STM FFFIS Safe Link Layer

14.1.3.2 Regarding bus redundancy, the STM and ETCS on-board shall have at least one bus interface each, and may have two interfaces.

14.1.3.3 In case STM and ETCS on-board does not have the same number of buses, only one bus shall be connected. This shall only have availability implications.

14.1.3.4 The dual bus configuration shall be managed by the “Redundancy Supervisor” see Ref.: /11/ SUBSET-057 STM FFFIS Safe Link Layer.

14.2 Safety

14.2.1.1 To allow communication between equipments with different Safety Integrity Levels (SIL), the FFFIS STM shall provide communication with three levels of safety protocol (SL):

- Safety Level 4 (SL 4)
- Safety Level 2 (SL 2)
- Safety Level 0 (SL 0)

14.2.1.1.1 Justification: According to the requirements for Safety-related communication in closed transmission systems (see /19/ CENELEC EN 50159-1 (2001) Safety related communication in closed transmission systems), an equipment with no or a low Safety Integrity Level shall not masquerade as an equipment with a higher Safety Integrity Level. This requirement shall be fulfilled by using the defined Safety Levels.

14.2.1.1.2 Note: The three levels of safety are specified in /11/ SUBSET-057 STM FFFIS Safe Link Layer and /10/ SUBSET-056 STM FFFIS Safe Time Layer.

14.2.1.2 All equipments shall not implement any Safety Level corresponding to a higher Safety Integrity Level (SIL).

14.2.1.3 STMs with a Safety Integrity Level higher than SIL 0 may implement and simultaneously use more than one safety level in parallel.

14.2.1.4 ETCS On-Board functions shall implement all the safety protocols up to the Safety Level (SL) corresponding to the SIL of the function.

14.3 On-board Architecture

14.3.1.1 Each STM shall only have one physical bus address (Station/Node address) towards the ETCS On-board.

14.3.1.2 The ETCS on-board may use one or several physical bus addresses. This is depending on architecture.

14.3.1.3 The STM shall be able to handle various configurations of physical addressing in the ETCS on-board.

14.3.1.4 STM shall take the initiative to open communication.

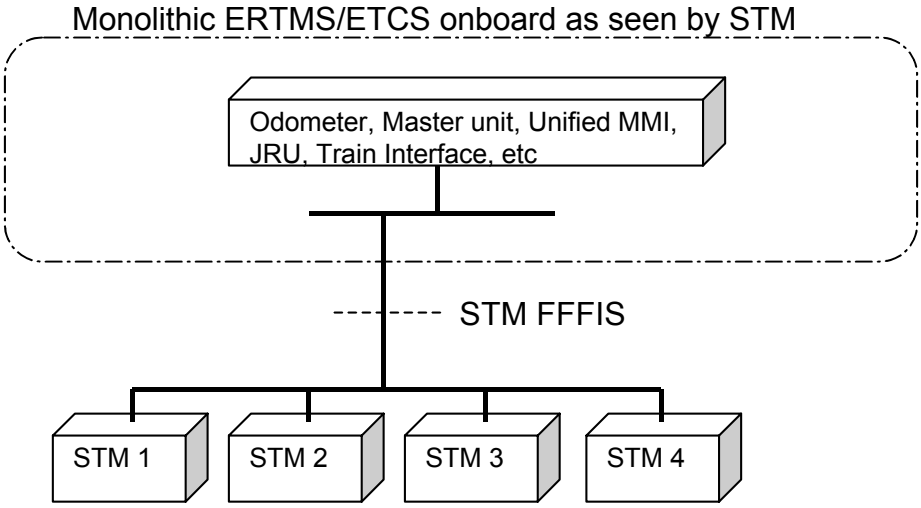


Figure 17: Monolithic architecture of ETCS on-board

14.3.1.5 In case of monolithic architecture, only one physical address is required by the ETCS on-board.

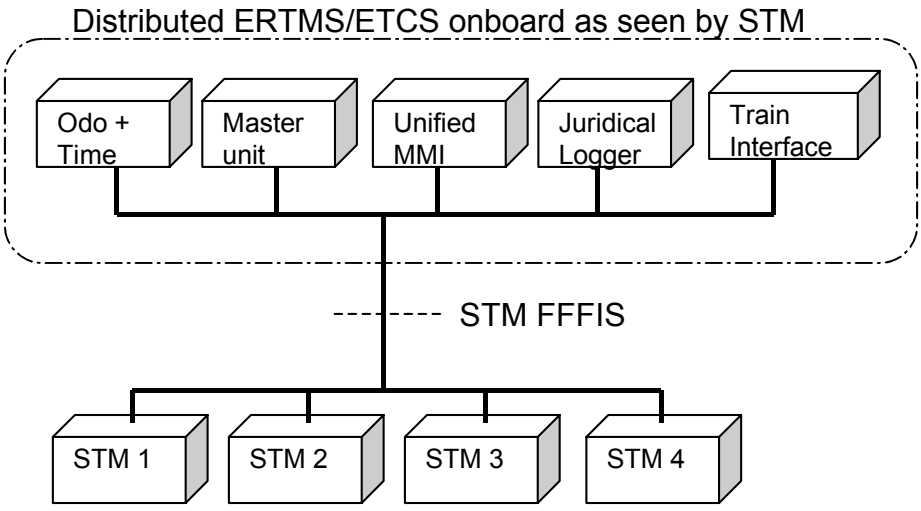


Figure 18: Distributed architecture of ETCS on-board

14.3.1.6 In case of a fully distributed architecture, several physical addresses are used by ETCS on-board.

14.3.1.7 An STM communicating with a distributed ETCS on-board shall be able to handle one different physical address for each ETCS On-board function.

14.3.1.8 Intermediate architectures shall be allowed. Functions can be combined in the nodes arbitrarily.

14.3.1.9 The implementation of more than one STM in the same hardware using the same physical address shall be allowed.

14.3.1.9.1 Note: This does not apply to STM groups as they appear to the ETCS On-board as one STM (see 4.1.5).

14.3.1.10 In case of an implementation of more than one STM in the same hardware using the same physical address, the STMs shall share the same connection at Profibus FDL Layer, Safe Link Layer and Safe Time Layer to the ETCS On-board functions.

14.3.1.11 In case of an implementation of more than one STM in the same hardware using the same physical address, each STM shall establish its own connection at Application Layer.

14.4 Physical Addressing (Station/Nodes addresses)

14.4.1.1 The physical addresses shall be allocated according to the following table.

Physical Address	Device
2	ETCS STM Control Function
0, 1, 3 . . 19	ETCS Functions
20 . . 49	Non ETCS nor STM Functions
50 . . 69	STM Configurable addresses range
70 . . 126	STMs (NID_STM+70)
127	Reserved for Broadcast and Multicast

14.4.1.2 By default the Physical address of an STM (or STM group) shall be the NID STM value + 70.

14.4.1.3 STM Configurable addresses range shall be used:

- For STMs for which the sum of NID_STM value +70 goes out of the Profibus physical address range
- For STM internal functions.
- For systems not in the UIC list of NID_STM.

14.4.1.4 In case several STMs are implemented in one hardware this device shall use the physical address of any of its included STMs or a configurable physical address.

14.4.1.5 Every device which uses a physical address in the STM Configurable addresses range shall have a configurable physical address in order to solve address conflicts.

14.5 Function Addressing

14.5.1.1 The FFFIS STM requires communication between different functions in the ETCS On-board (implemented with a monolithic or distributed architecture) and the STMs as e. g. Odometer, DMI and JRU.

14.5.1.2 To address different stations (equipment) in case of a distributed architecture, the Profibus supports physical addresses (Station/Node addresses).

14.5.1.3 To address different functions in a station (equipment) the Profibus supports “Service Access Points” (SAPs).

14.5.1.4 The FFFIS STM shall use physical ”addresses (Station/Node addresses) to support a distributed architecture of the ETCS On-board.

14.5.1.5 The FFFIS STM shall use Service Access Points (SAPs) to support communication between STMs and the different ETCS On-board functions.

14.5.1.6 All ETCS Functions shall have a defined fixed SAP.

14.5.1.6.1 Note: The SAP is fixed regardless of the chosen architecture (monolithic or distributed). Different equipments (stations) are addressed via the physical address (Station/Node address).

14.5.1.7 For transmitting data between ETCS On-board and the STMs, the local (Source) Service Access Point (SSAP) and partner (Destination) Service Access Point (DSAP) shall have the same value.

14.5.1.8 One STM shall have no more than one logical connection per ETCS On-board function.

14.5.1.9 The SAP number shall be defined according to the following table:

Logical connections	**SAP# (binary)**	**# of SAP**	**Comment**
DMI Cab A redundant	000000	1	Point to Point
DMI Cab B redundant	000001	1	Point to Point
Juridical Recorder	000010	1	Point-to-point
Reserved for FFFIS STM	000011	1	Not used (reserved for backward compatibility).

Logical connections	SAP# (binary)	# of SAP	Comment
DMI Cab A main	000100	1	Point-to-point
DMI Cab B main	000101	1	Point-to-point
Diagnostic Recorder	000110	1	Point-to-point
Reserved for FFFIS STM	000111	1	Reserved for future extension of the specification
ETCS On-board internal	001XXX	8	To be defined by on-board implementers
On-board	01XXXX	16	To be defined by on-board implementers
Reference Clock	100000	1	Multicast
STM Control	100001	1	Point-to-point
European Supervision	100010	1	Point-to-point
Reserved for FFFIS STM	100011	1	Not used (reserved for backward compatibility).
Odometer	100100	1	Multicast
Train Interface	100101	1	Point-to-point
Brake Interface	100110	1	Point-to-point
Reserved for FFFIS STM	100111	1	Reserved for future extension of the specification
STM (Group) internal	101XXX	8	Defined by each implementer.
Reserved for FFFIS STM	11XXXX Except 111111 reserved for broadcast	15	Reserved for future extension of the specification
Broadcast	111111	1	Reserved due to profibus specification

14.5.1.10 There shall be only one source (one station/node address) which shall transmit messages using the SAP reserved for the reference clock function.

14.5.1.11 There shall be only one source (one station/node address) which shall transmit messages using the SAP reserved for the odometer function.

14.6 Protocol Layers

14.6.1.1 The protocol layers are Application Layer (see Ref.: /13/ SUBSET-058 STM Application Layer), Safe Time Layer (see Ref.:/10/ SUBSET-056 STM FFFIS Safe Time Layer), Safe Link Layer (see Ref.:/11/ SUBSET-057 STM FFFIS Safe Link Layer) and Profibus FDL layer (see Ref.: /14/ CENELEC 50170-2 (1996)).

14.6.1.2 The Safe Time Layer and Safe Link Layer together shall be considered as the Safety Layers.

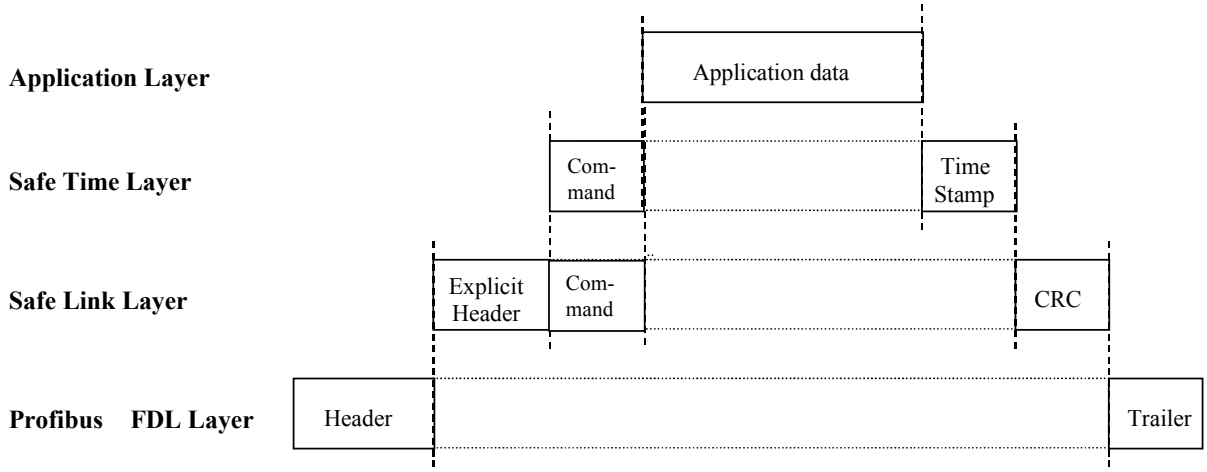


Figure 19: Application Data encapsulation by the layers in Profibus telegram

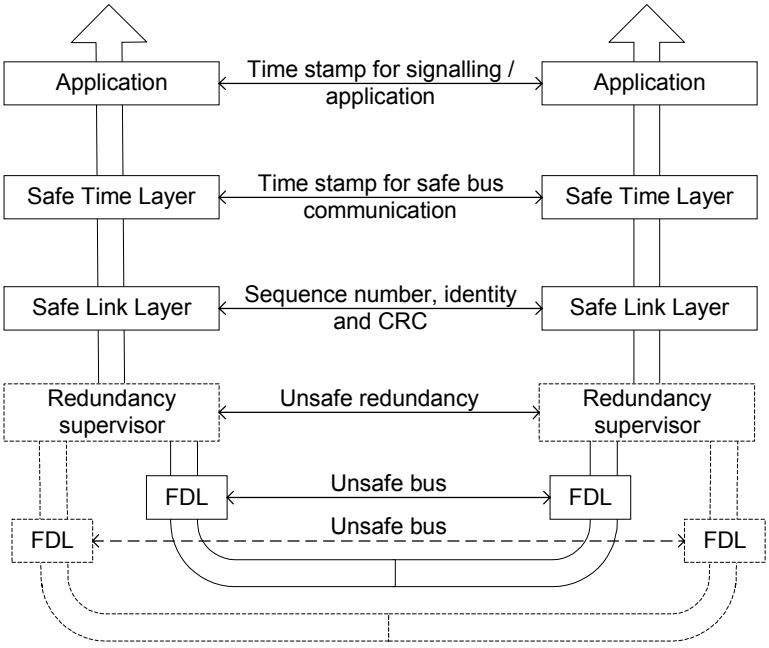


Figure 20: FFFIS STM Protocol Layers

15. CONFIGURATION MANAGEMENT

15.1 General

15.1.1 Aim and Objectives

15.1.1.1 During the life time of the FFFIS STM there may be several versions of the specification.

15.1.1.2 The objective of the interoperability configuration is to define principles to be applied in situations where different nodes have been certified to different versions.

15.1.1.3 Note: The handling of different software versions is out of the scope of the system configuration management.

15.1.2 Evolution of the versions

15.1.2.1 The evolution of the versions of the FFFIS STM shall be sequential, i. e. there shall only be a direct upgrade of an existing version and no branch is accepted.

15.1.2.2 The versions of the FFFIS STM shall be identified by a compatibility number which complies with the following:

15.1.2.2.1 Each Compatibility Number will have the following format: X.Y.Z, where X, Y and Z are any number between 0 and 255 (examples: 1.12.0, 6.8.203, 65.0.15).

15.1.2.2.2 The first number (X) distinguishes not compatible versions.

15.1.2.2.3 The second number (Y) indicates compatibility within a version X.

15.1.2.2.4 If the first number of two versions is the same, that indicates that those versions are compatible, independently of the second number (e. g. version 3.5 is compatible with 3.3, 3.14).

15.1.2.2.5 The third number (Z) is a vendor-specific (version) number that indicates the implemented version X.Y.

15.2 Compatibility Numbers

15.2.1.1 All nodes which have implemented the FFFIS STM shall transmit the Compatibility Number (7.5) according to 15.2.1.3.

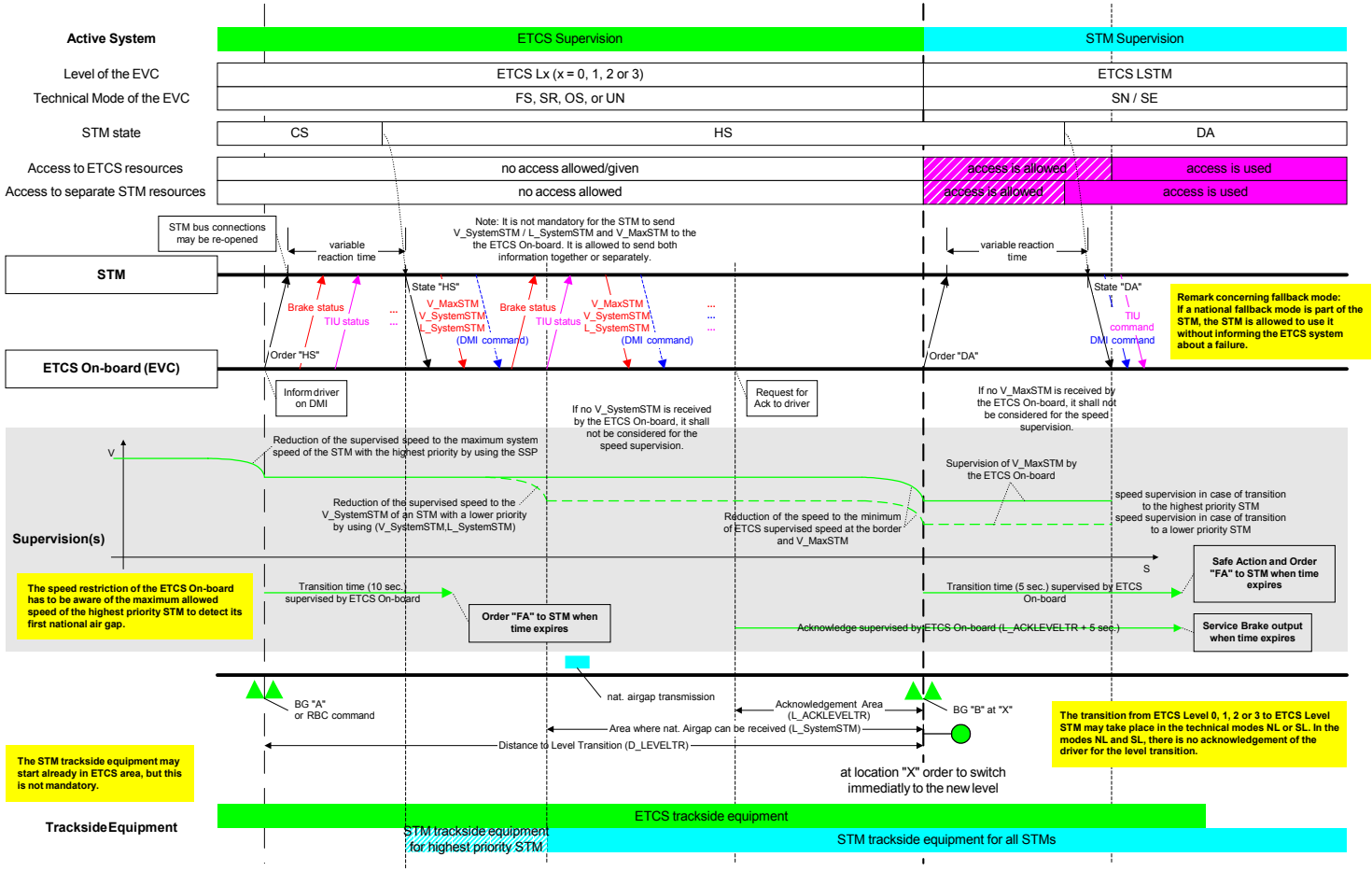
15.2.1.2 The Compatibility Number shall be changed with every official release of this document.

15.2.1.3 Compatibility Table

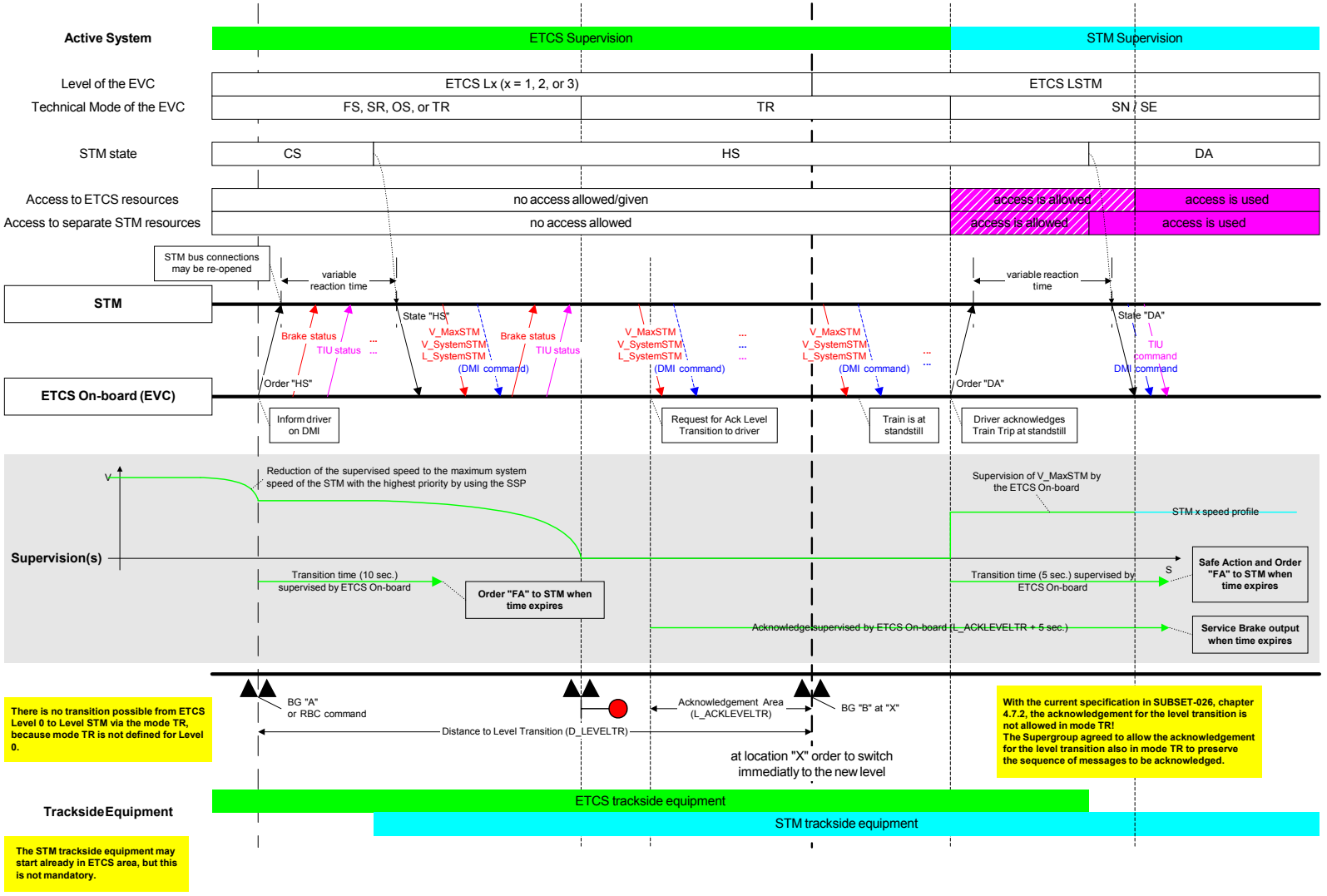
FFFIS STM (Subset-035)		
Version of this Document	**Compatibility Number**	**Difference to previous version (overview)**
2.0.0	X=2, Y=0, Z=0	Initial Revision.
2.1.1	X=3, Y=0, Z	General revision of the specification: Z is vendor specific

16. ANNEX A (SYSTEM DIAGRAMS LINKED TO THE LEVEL TRANSITIONS WITH STMS)

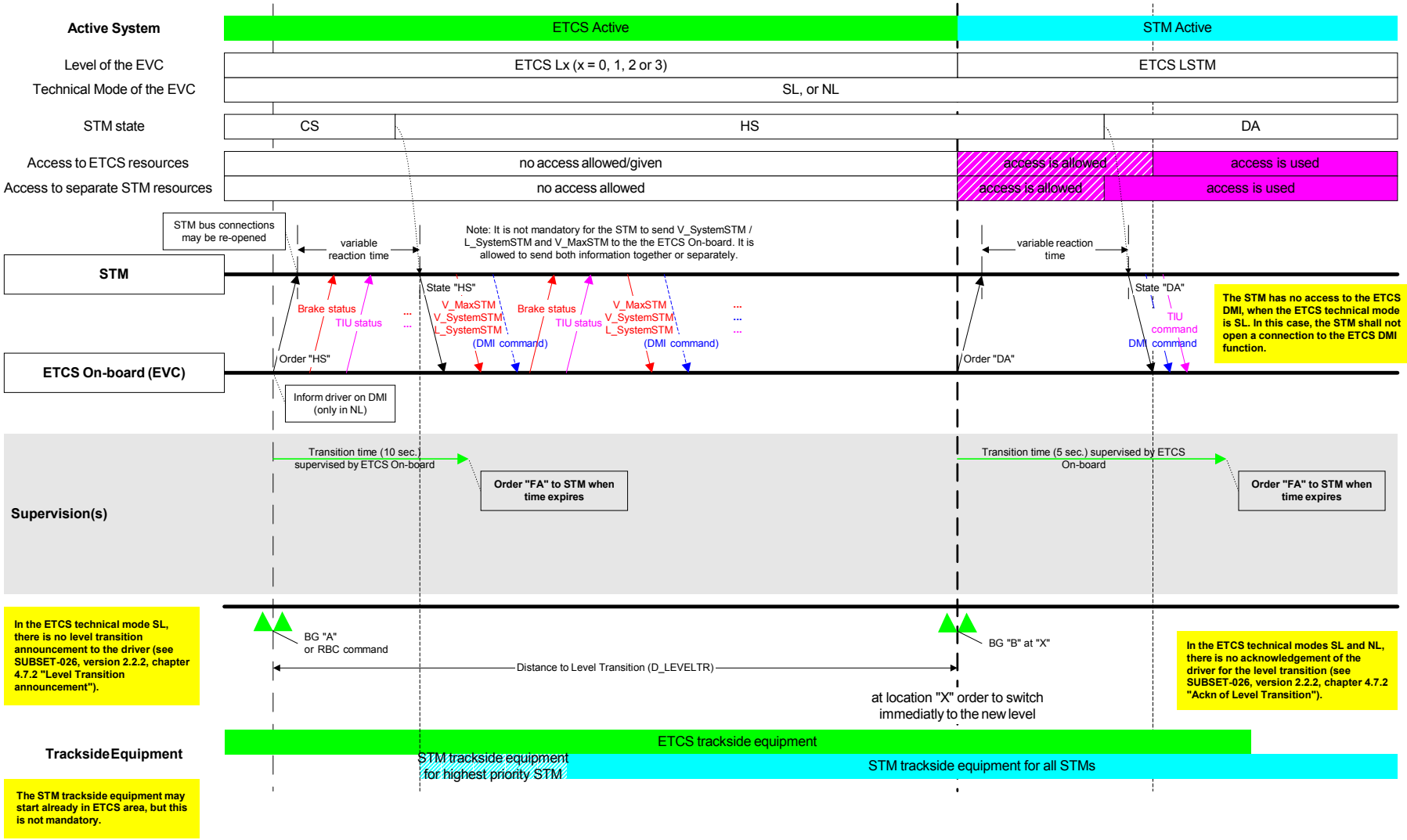
16.1 ETCS -> STM



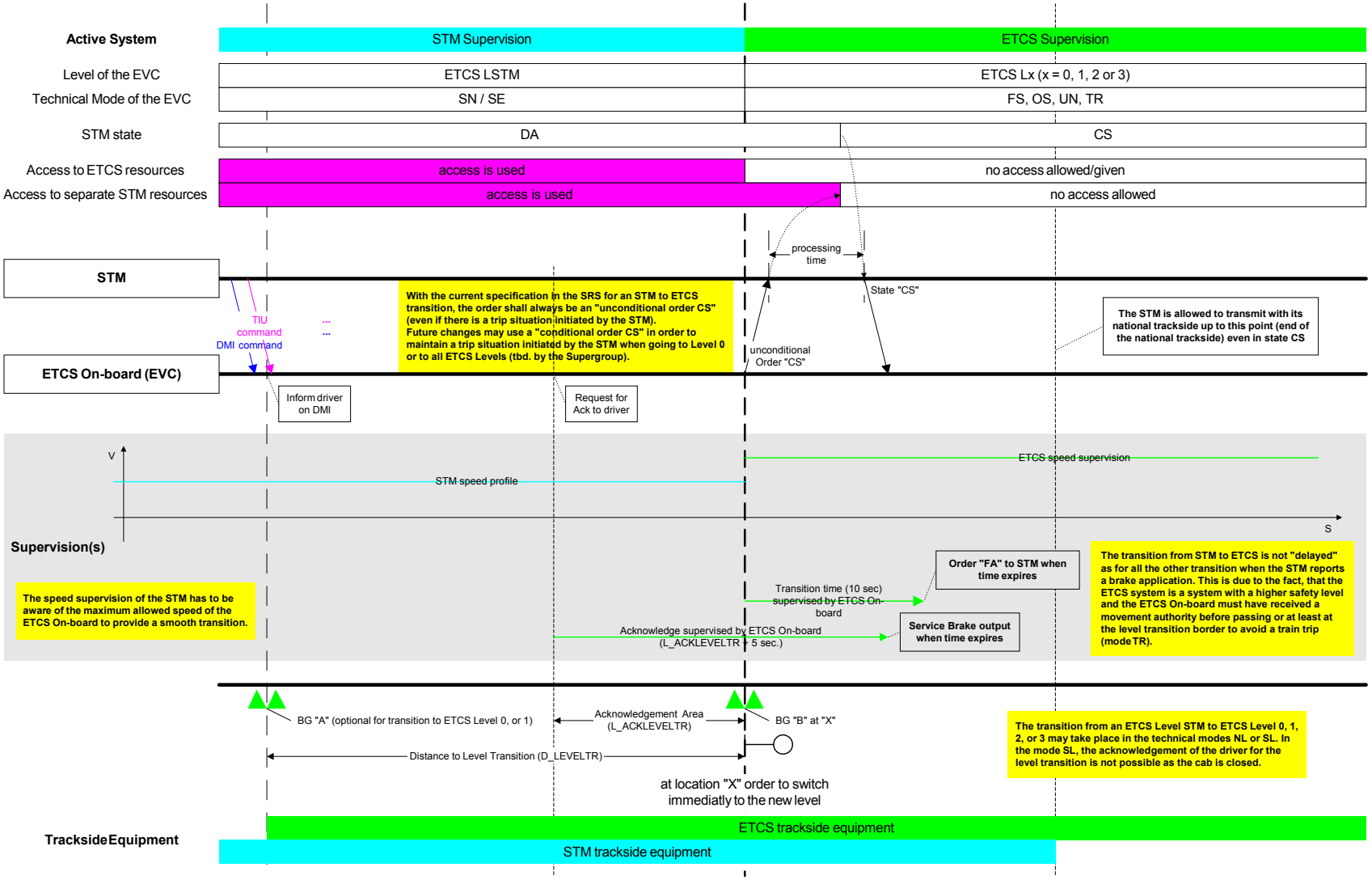
16.2 ETCS - >STM (Trip mode)



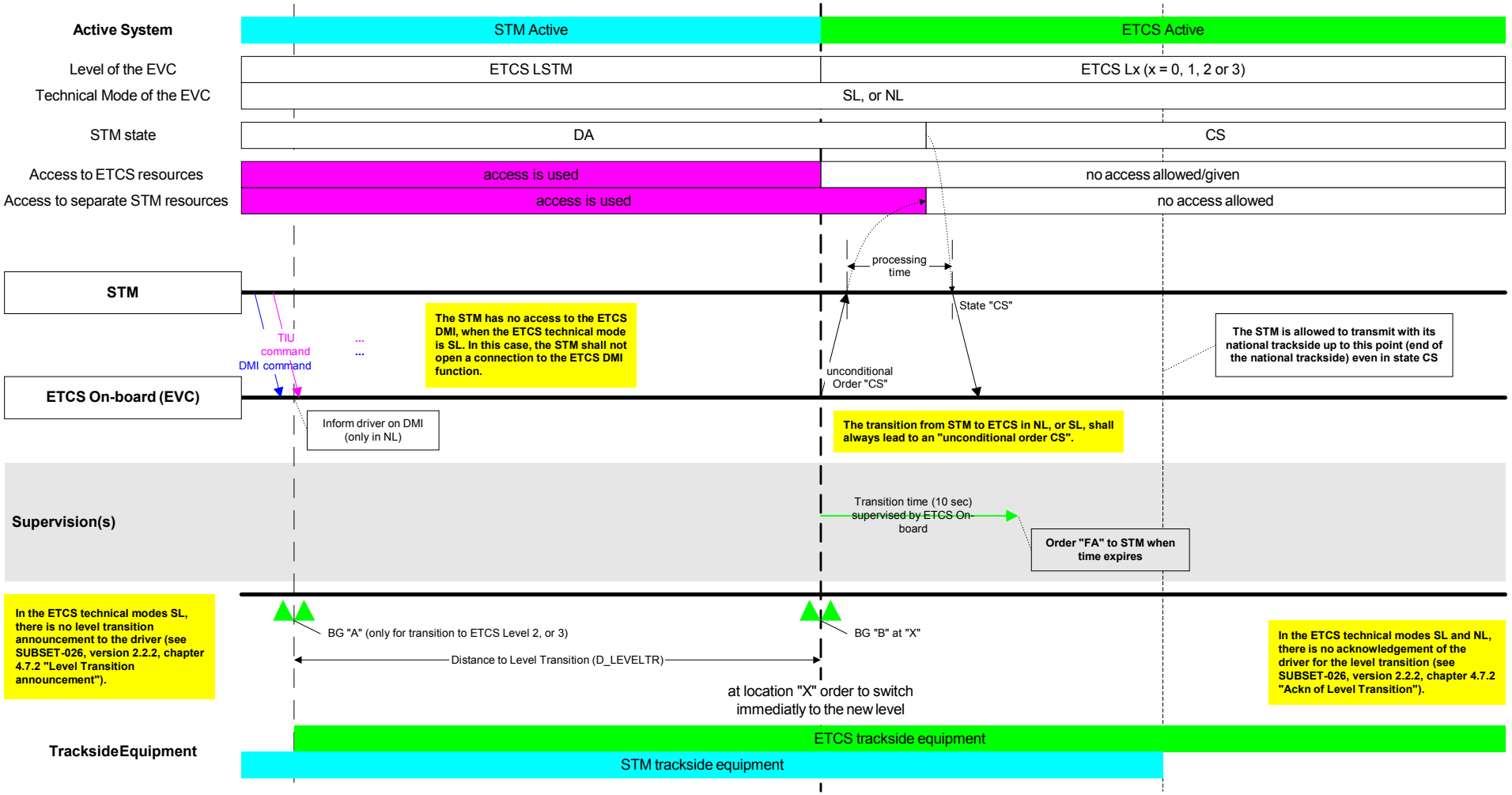
16.3 ETCS -> STM (NL/SL)



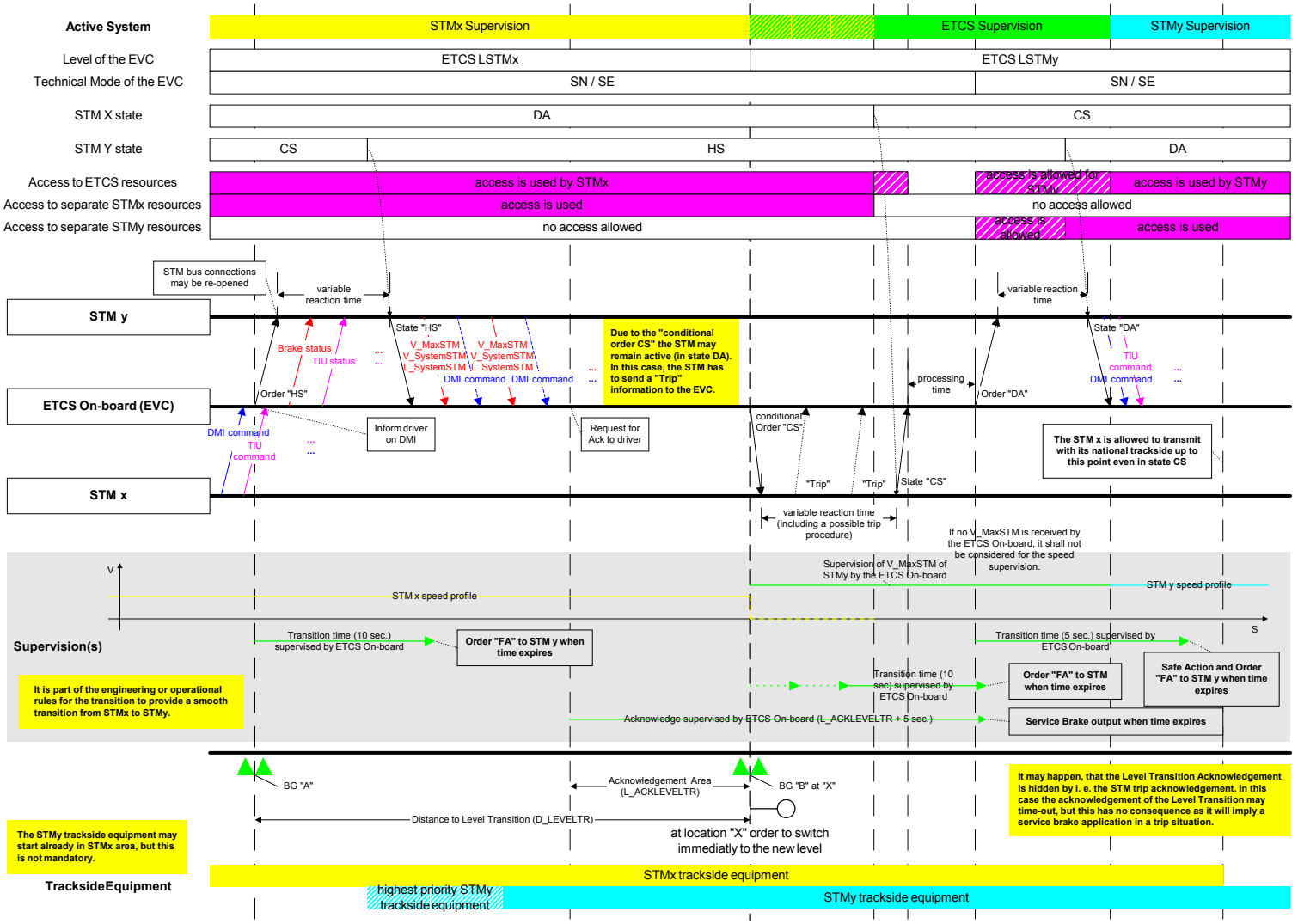
16.4 STM -> ETCS



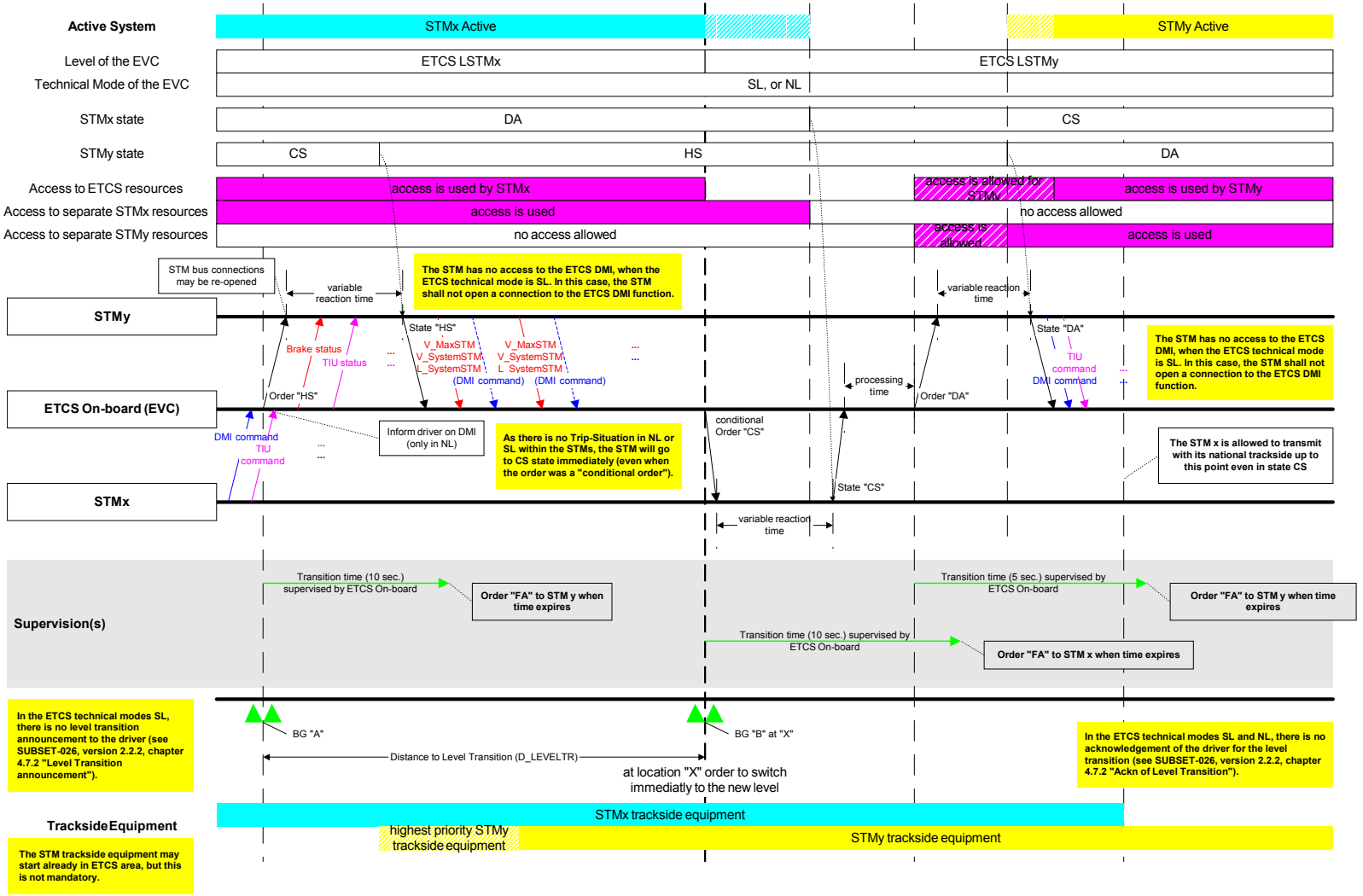
16.5 STM -> ETCS (NL/SL)



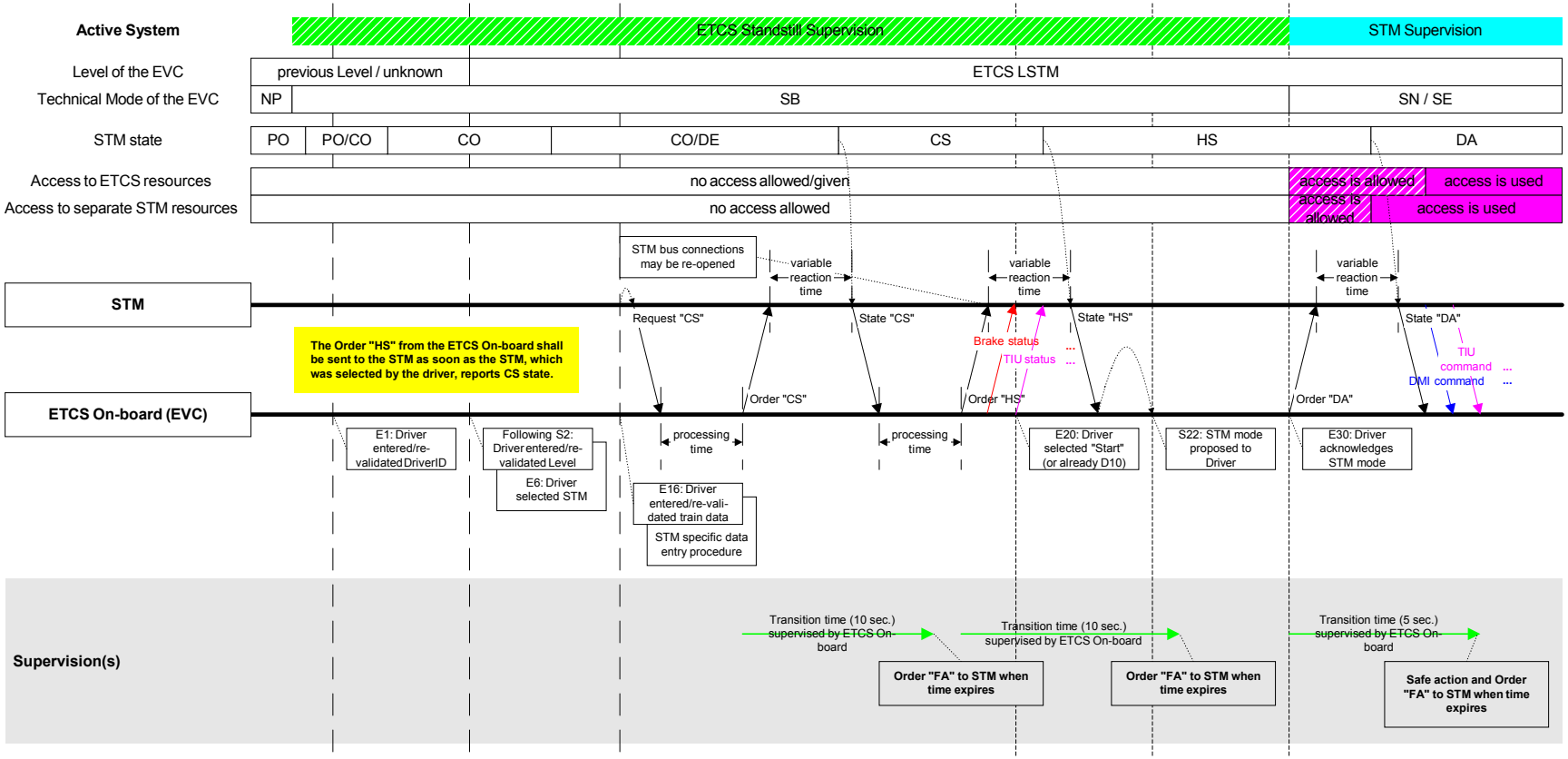
16.6 STMx -> STMy



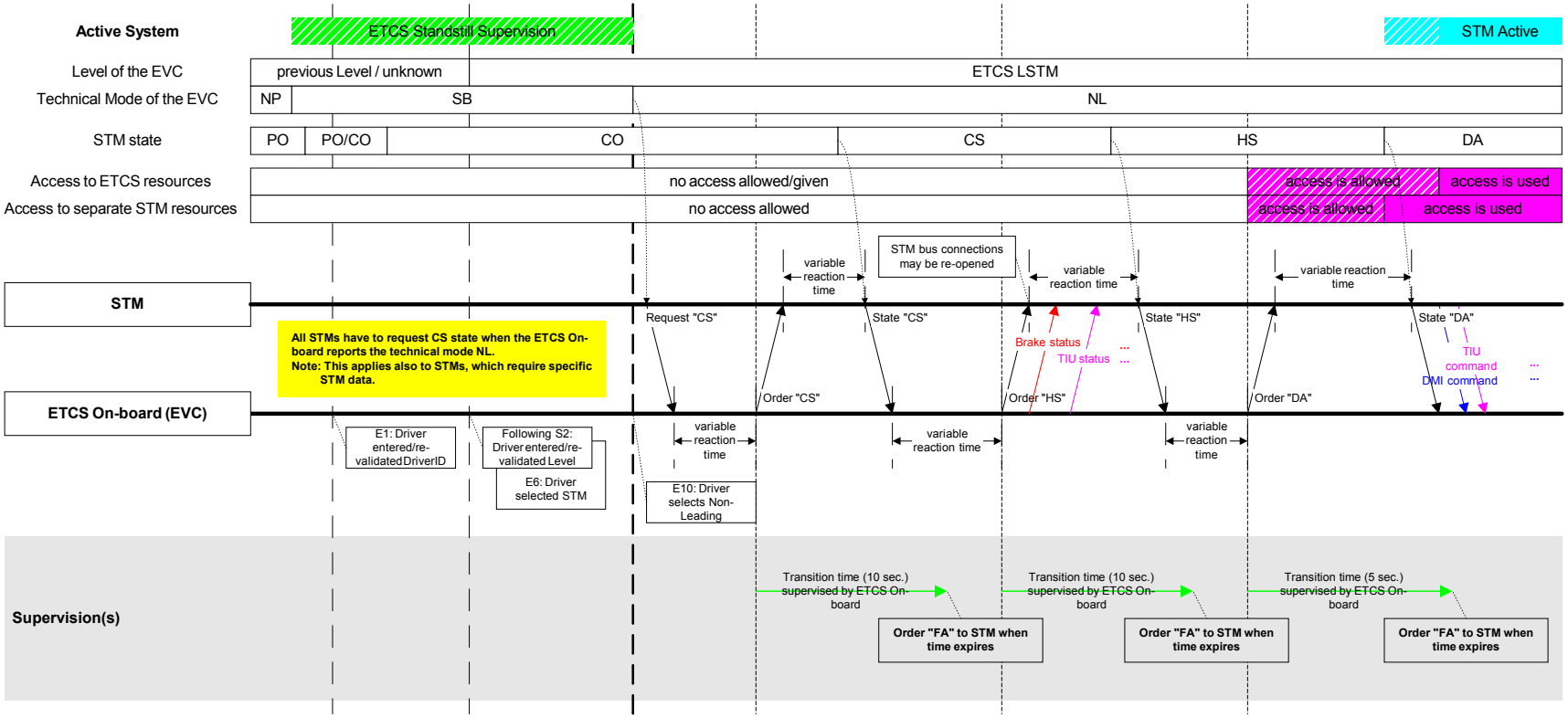
16.7 STMx -> STMy (NL/SL)



16.8 Power-On in Level STM



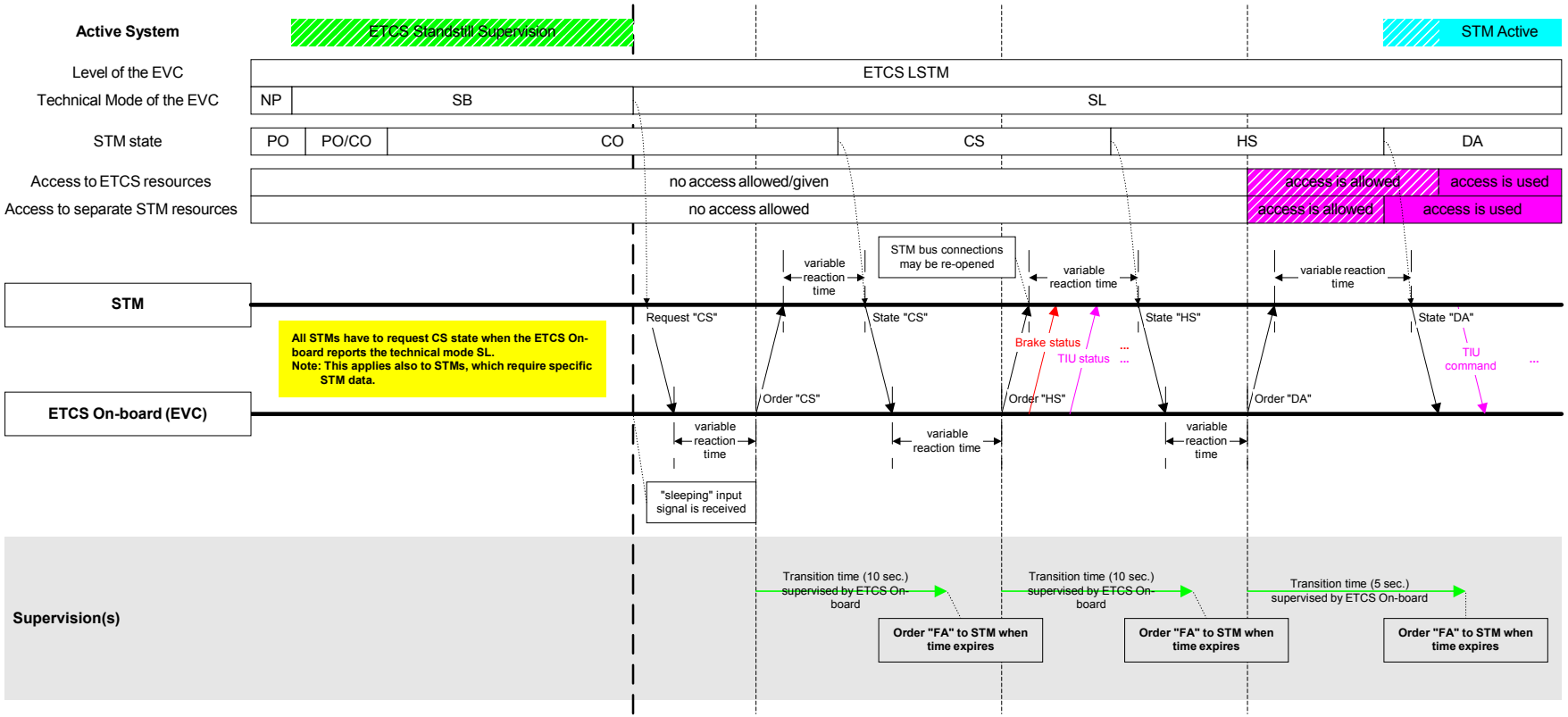
16.9 Power-On in Level STM (NL)



Four possibilities to end NL are defined (see SUBSET-026, version 2.2.2, chapter 4.6.2):
- the ETCS On-board is switched off
- the ETCS On-board is isolated
- desks are closed
- NL is ended and train is at standstill (new wording according to CR119: "(driver selects "end of NL mode") and (train is at standstill)")
If an STM has to be activated after leaving NL,
- a power-on will occur for the first two possibilities which includes a Start of Mission procedure,
- the Start of Mission procedure will be performed after the last two possibilities, because these two actions lead to transition to the technical mode SB which is an "End of Mission" (see SUBSET-026, version 2.2.2, chapter 5.5.2.1.1).

According to the Start of Mission procedure, all STMs will have their Train Data in order to perform the supervision even when the train was started up in NL.

16.10 Power-On in Level STM (SL)



Four possibilities to end SL are defined (see SUBSET-026, version 2.2.2, chapter 4.6.2):
- the ETCS On-board is switched off,
- the ETCS On-board is isolated,
- a desk is open, and
- no "sleeping" input signal is received any more and train is at standstill.
If an STM has to be activated after leaving SL,
- a power-on will occur for the first two possibilities which includes a Start of Mission procedure,
- the Start of Mission procedure will be performed after the last two possibilities, because the entry into the technical mode SL is considered as an "End of Mission" (see SUBSET-026, version 2.2.2, chapter 5.5.2.2.1).

According to the Start of Mission procedure, all STMs will have their Train Data in order to perform the supervision even when the train started up in SL and then the cab becomes an active cab.

17. ANNEX B REQUIREMENTS FOR THE TRANSITIONS (NON NORMATIVE)

17.1.1.1 This non-normative chapter includes copies of the requirements listed in /1/ SUBSET-026; SRS Version 2.2.2 as well as in this specification and is intended to give the sequence of the actions for the transitions from and to STMs.

17.1.1.2 Together with the copy of the requirements, the origin of the requirement is included in this chapter:

- SRS: /1/ SUBSET-026; SRS Version 2.2.2
- FFFIS STM: this specification

17.1.1.3 Requirements for ETCS On-board are written in blue and the requirements for STMs are written in red to indicate if a requirement has to be implemented in the ETCS On-board or the STMs.

17.2 Transition ETCS to STM (except for non-leading / sleeping and trip situation)

17.2.1 Requirements for the announcement of the transition

17.2.1.1 (SRS: 5.10.3.9.1 (Level 1), 5.10.3.10.1 (Level 2/3)) For the train to be able to enter the new area, the old area must possess information about at least the first section of the new area. The information may be transmitted to the train either

a) as an MA and track description information into the new area, or

b) as a target speed at the border location i.e. as an LOA.

17.2.1.2 (FFFIS STM: 7.5.1.2) The ETCS trackside shall transmit a speed profile, which limits the speed from the point where the national trackside equipment starts up to the transition border. The speed limit shall be engineered to respect the maximum system speed of the announced level with the highest priority.

17.2.1.3 (FFFIS STM: 7.5.1.2.1) Note: This is to allow the STM to detect and read its national trackside.

17.2.1.4 (FFFIS STM 7.5.1.2.2) Definition: The maximum system speed shall be defined as the highest speed at which a (national) train control system is able to detect and read its (national) trackside.

17.2.1.5 (SRS: 5.10.1.1) Every level transition into levels 2, 3, or STM shall be announced to the ERTMS/ETCS on-board equipment via balise group or via the RBC.

17.2.1.6 (SRS: 5.10.1.2) A level transition announcement to the ERTMS/ETCS on-board equipment shall consist of an order to execute the level transition at a further location corresponding to the border.

17.2.1.7 (SRS: 5.10.2.2) When going to a mixed level area, the level transition announcement and the level transition order at the border shall contain all the supported ERTMS/ETCS levels with a table of priority.

17.2.1.8 (SRS: 5.10.2.3) The table of priority shall list all the supported levels from the highest priority level to the lowest one.

17.2.1.8.1 (SRS: 5.10.2.3.1) Examples: table gives 3, 2, STM X, 1, STM Y, 0. Train is fitted for level 1 and STM X, it will select STM X level. Train is fitted for level 1 and STM Y, it will select level 1. Train is level 2 fitted, it will select level 2.

17.2.1.9 (SRS: 5.10.2.4) When receiving the information about all ERTMS/ETCS levels that are available, the ERTMS/ETCS on-board equipment shall select in the table the level with the highest priority that the onboard equipment allows to use.

17.2.1.10 (SRS: 5.10.2.7) If the ERTMS/ETCS on-board equipment is not fitted for any of the announced levels it shall nevertheless make the transition, to the announced level with the lowest priority.

17.2.1.11 (SRS: 5.10.1.3) When the ERTMS/ETCS on-board equipment receives a level transition announcement, it shall immediately inform the driver about the announced level transition.

17.2.1.12 (SRS: 5.10.2.6) The ERTMS/ETCS on-board equipment shall inform the driver only about the selected level transition.

17.2.1.13 (SRS: 5.10.1.7) As soon as the announcement of the level transition has been received, some data (mainly movement authority and track description data) from the transmission media of the new level shall be accepted, but shall not be used until the level transition is effective.

17.2.1.14 (SRS: 5.10.3.9.2, and 5.10.3.10.2) When the announcement is received, a signal shall be sent by the ERTMS/ETCS on-board equipment to the STM specified in the announcement meaning that the STM shall prepare for immediate activation when the level transition location is passed with the estimated front end.

17.2.1.15 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A6	(ETCS On-board receives an announcement for a level transition to Level STM X) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3

17.2.1.15.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for HS

17.2.1.16 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.2.1.17 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.2.1.17.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.2.1.18 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.2.1.19 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.2.1.20 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.2.1.21 (FFFIS STM: 7.3.2.2) Transitions conditions table

6	ETCS order “Hot Standby”

17.2.1.21.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.2.1.22 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.2.1.23 (FFFIS STM: 7.3.1.6.1) Being in the state HS, the STM shall be able to process the information from or to the national trackside.

17.2.1.24 (FFFIS STM: 7.3.1.6.1.1) Note: In HS state, when receiving national trackside information, the STM shall treat this information to be prepared to take in charge the train movement supervision once its state will switch to DA state.

17.2.2 Requirements for the area between announcement and transition border

17.2.2.1 (SRS: 5.10.4.1) If defined so for the level transition (see table below), the driver shall be asked to acknowledge the transition when the max safe front end of the train passes a trackside defined location in rear of the level transition border.

Note: The table which is referenced in 17.2.2.1 (SRS) is not included here. The table gives the requirement to have an acknowledgement from the driver for every level transition to Level STM.

17.2.2.2 (FFFIS STM: 7.3.1.6.2) The STM in HS shall have the possibility to send a "STM max speed" to the STM control function.

17.2.2.2.1 (FFFIS STM: 7.3.1.6.2.1) Note: This "STM max speed" is to allow the STM, for national reasons unknown to the ETCS On-board or ERTMS Trackside, to request a given train speed at the level transition border in order to have a smooth transition.

17.2.2.3 (FFFIS STM: 7.4.2.2.1) If receiving an "STM max speed" from an STM in HS state, the ETCS On-board shall include the "STM max speed" into the computation of the MRSP beginning at the level transition border and ending when the report “DA state” has been received by the ETCS On-board from the STM to be activated.

17.2.2.4 (FFFIS STM: 7.4.2.2.2) If the STM reports FA state, or is identified by the ETCS On-board as failed, then the ETCS On-board shall consider that STM max speed = 0.

17.2.2.5 (FFFIS STM: 7.4.2.2.2.1) Note: The purpose of the above requirement is to try to prevent the train to enter in an STM area while this STM is failed.

17.2.2.6 (FFFIS STM: 7.4.2.2.3) If the ETCS On-board does not receive an "STM max speed" value from the STM in HS state, the ETCS On-board shall not supervise any “STM max speed” at all and the computation of the MRSP is not affected.

17.2.2.7 (FFFIS STM: 7.3.1.6.3) The STM in HS shall have the possibility to send an "STM system speed" together with an "STM system distance" to the STM control function.

17.2.2.7.1 (FFFIS STM: 7.3.1.6.3.1) Note: This "STM system speed" together with the "STM system distance" is to allow the STM, to request a given train speed at a given position ("STM system distance") before the level transition border in order to be able to detect its national trackside.

17.2.2.8 (FFFIS STM: 7.4.2.2.4) When receiving an "STM system speed" together with an "STM system distance" from an STM in HS state, the ETCS On-board shall consider the "STM system speed" as a new speed restriction that applies at a location "STM system distance" before the level transition border and ending at the level transition border: The ETCS On-board shall include the "STM system speed" into the computation of the MRSP.

17.2.2.9 (FFFIS STM: 7.4.2.2.5) If the ETCS On-board does not receive the "STM system speed" together with the "STM system distance" values from the STM in HS state, the ETCS On-board shall not take into account "STM system speed" and "STM system distance" at all and the computation of the MRSP is not affected.

17.2.2.10 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.2.2.11 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.2.2.12 (FFFIS STM: 10.5.3.3) The STM in Hot Standby shall be allowed to send preliminary request for DMI objects to the ETCS On-board.

17.2.2.13 (FFFIS STM: 10.5.2.6) The ETCS On-board shall be able to receive preliminary request for DMI objects from an STM being in HS state. The ETCS On-board shall be allowed to ignore this information.

17.2.2.14 (FFFIS STM: 10.5.2.6.1) Note: The sending of preliminary request is to allow the DMI function to prepare in background the information to be presented to the driver once the STM switches to Data Available state.

17.2.2.15 (FFFIS STM: 10.5.2.6.2) Note: This is to avoid a gap of the display at level transition and to have a one shot up-date of the screen to display STM information at level transition.

17.2.3 Requirements for the transition

17.2.3.1 (SRS: 5.10.1.4) At the level transition border a balise group with an order to switch to the new level immediately shall be placed.

17.2.3.2 (SRS: 5.10.1.5) If the message from the border balise group is not received, the level transition shall still be executed when the estimated front end passes the location given in the announcement.

17.2.3.3 (SRS: 4.6.3) Transitions Conditions Table:

[55]	(the ERTMS/ETCS level is “STM”) AND (SE mode is required for the STM)
[56]	(the ERTMS/ETCS level is “STM”) AND (SN mode is required for the STM)

17.2.3.3.1 (SRS: 4.6.2) Transition Table.

- Mode transition [55] from FS, SR, OS, and UN to SE
- Mode transition [56] from FS, SR, OS, and UN to SN

17.2.3.4 (SRS: 5.10.3.9.3 (Level 1)) When the level transition location is passed with the estimated front end, the STM specified shall be activated by the ERTMS/ETCS on-board equipment.

17.2.3.5 (SRS: 5.10.3.10.5 (Level 2/3), 5.10.3.13.2 (Level 0)) When the level transition location is passed the STM specified shall be activated.

17.2.3.6 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A9	(Level transition location for a transition from ETCS to STM is passed) AND (ETCS technical mode is not TR)

17.2.3.6.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for DA

17.2.3.7 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.2.3.8 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

D16	(the STM Control Function has sent a "DA state transition order") AND (the STM does not report the required state within a maximum delay time of 5 seconds) see 7.4.1.2.3.1 and 7.4.1.2.3.2

17.2.3.8.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.2.3.9 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.2.3.10 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.2.3.11 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.2.3.12 (FFFIS STM: 7.3.2.2) Transitions conditions table

9	ETCS order “Data Available”

17.2.3.12.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.2.3.13 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.2.3.14 (FFFIS STM: 7.3.1.7.1) In DA state, a National STM is responsible for the train movement supervision, according to the received national trackside information. A European STM is also responsible for the train movement supervision, according to the received national trackside information, but some parts of the calculations are performed by the ETCS On-board.

17.2.3.15 (SRS: 4.4.17.1.1) The SN mode shall enable an STM to access the following resources via the ERTMS/ETCS on-board equipment; MMI, odometer, train interface and brakes. No supervision functionality is provided by the ERTMS/ETCS on-board equipment.

17.2.3.16 (SRS: 4.4.16.1.1) The SE mode shall permit reuse of supervision functionality in the ERTMS/ETCS on-board equipment such as MA, most restrictive speed profile and gradient. Furthermore, the SE mode shall enable the STM to access the following resources via the ERTMS/ETCS Onboard; MMI, odometer, train interface and brakes.

17.2.3.17 (FFFIS STM: 5.2.5.5) The STM shall be allowed to apply the emergency brake using the direct interface only when the STM is active (in state “Data Available”) and the ETCS technical mode is SN or SE.

17.2.3.18 (FFFIS STM: 5.2.5.7) The STM shall be allowed to apply the traction cut-off using the direct interface only when the emergency brake application is allowed over the direct interface (see chapter 5.2.5.5).

17.2.3.19 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														x	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x
13	Service Brake command														x	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x

17.2.3.20 (SRS: 5.10.4.2) If the driver has not yet acknowledged 5 seconds after the level transition, a service brake command shall be initiated.

17.2.3.21 (SRS: 5.10.4.3) The driver shall then acknowledge the level transition in order to release the service brake command.

17.2.3.22 (FFFIS STM: 7.4.2.3.1) Once the train has passed the level transition border, the ETCS On-board shall supervise the "STM max speed" (previously sent by the STM in HS state).

17.2.3.23 (FFFIS STM: 7.4.2.3.2) Once the STM report “DA state” is received by the ETCS On-board, the ETCS On-board shall stop supervising "STM max speed".

17.2.3.24 (FFFIS STM: 7.4.2.2.3) If the ETCS On-board does not receive an "STM max speed" value from the STM in HS state, the ETCS On-board shall not supervise any “STM max speed” at all and the computation of the MRSP is not affected.

17.2.3.25 (FFFIS STM: 10.5.3.5) The STM shall send a request with the required status of all DMI objects to the ETCS On-board after switching from CS or HS to DA state.

17.3 Transition ETCS to STM (trip situation)

17.3.1 Requirements for the announcement of the transition

17.3.1.1 See chapter 17.2.1.

17.3.2 Requirements for the area between announcement and transition border

17.3.2.1 (SRS: 5.10.4.1) If defined so for the level transition (see table below), the driver shall be asked to acknowledge the transition when the max safe front end of the train passes a trackside defined location in rear of the level transition border.

Note: The table which is referenced in 17.3.2.1 (SRS) is not included here. The table gives the requirement to have an acknowledgement from the driver for every level transition to Level STM.

17.3.2.2 (FFFIS STM: 7.3.1.6.2) The STM in HS shall have the possibility to send a "STM max speed" to the STM control function.

17.3.2.2.1 (FFFIS STM: 7.3.1.6.2.1) Note: This "STM max speed" is to allow the STM, for national reasons unknown to the ETCS On-board or ERTMS Trackside, to request a given train speed at the level transition border in order to have a smooth transition.

17.3.2.3 (FFFIS STM: 7.4.2.2.1) If receiving an "STM max speed" from an STM in HS state, the ETCS On-board shall include the "STM max speed" into the computation of the MRSP beginning at the level transition border and ending when the report “DA state” has been received by the ETCS On-board from the STM to be activated.

17.3.2.4 (FFFIS STM: 7.4.2.2.2) If the STM reports FA state, or is identified by the ETCS On-board as failed, then the ETCS On-board shall consider that STM max speed = 0.

17.3.2.5 (FFFIS STM: 7.4.2.2.2.1) Note: The purpose of the above requirement is to try to prevent the train to enter in an STM area while this STM is failed.

17.3.2.6 (FFFIS STM: 7.4.2.2.3) If the ETCS On-board does not receive an "STM max speed" value from the STM in HS state, the ETCS On-board shall not supervise any “STM max speed” at all and the computation of the MRSP is not affected.

17.3.2.7 (FFFIS STM: 7.3.1.6.3) The STM in HS shall have the possibility to send an "STM system speed" together with an "STM system distance" to the STM control function.

17.3.2.7.1 (FFFIS STM: 7.3.1.6.3.1) Note: This "STM system speed" together with the "STM system distance" is to allow the STM, to request a given train speed at a given position ("STM system distance") before the level transition border in order to be able to detect its national trackside.

17.3.2.8 (FFFIS STM: 7.4.2.2.4) When receiving an "STM system speed" together with an "STM system distance" from an STM in HS state, the ETCS On-board shall consider the "STM system speed" as a new speed restriction that applies at a location "STM system distance" before the level transition border and ending at the level transition border: The ETCS On-board shall include the "STM system speed" into the computation of the MRSP.

17.3.2.9 (FFFIS STM: 7.4.2.2.5) If the ETCS On-board does not receive the "STM system speed" together with the "STM system distance" values from the STM in HS state, the ETCS On-board shall not take into account "STM system speed" and "STM system distance" at all and the computation of the MRSP is not affected.

17.3.2.10 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.3.2.11 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.3.2.12 (FFFIS STM: 10.5.3.3) The STM in Hot Standby shall be allowed to send preliminary request for DMI objects to the ETCS On-board.

17.3.2.13 (FFFIS STM: 10.5.2.6) The ETCS On-board shall be able to receive preliminary request for DMI objects from an STM being in HS state. The ETCS On-board shall be allowed to ignore this information.

17.3.2.14 (FFFIS STM: 10.5.2.6.1) Note: The sending of preliminary request is to allow the DMI function to prepare in background the information to be presented to the driver once the STM switches to Data Available state.

17.3.2.15 (FFFIS STM: 10.5.2.6.2) Note: This is to avoid a gap of the display at level transition and to have a one shot up-date of the screen to display STM information at level transition.

17.3.2.16 (SRS: 4.6.3) Transitions Conditions Table:

[16]	The train/engine overpasses the EOA/LOA of its MA.
[17]	The onboard reacts according to a linking reaction set to “trip”.
	Other

17.3.2.16.1 (SRS: 4.6.2) Transition Table.

- Mode transition [16] from FS, and OS to TR
- Mode transition [17] from FS, and OS to TR
- Other mode transitions to TR

17.3.3 Requirements for the transition

17.3.3.1 (SRS: 5.10.1.4) At the level transition border a balise group with an order to switch to the new level immediately shall be placed.

17.3.3.2 (SRS: 5.10.1.5) If the message from the border balise group is not received, the level transition shall still be executed when the estimated front end passes the location given in the announcement.

17.3.3.3 (SRS: 4.6.3) Transitions Conditions Table:

[63]	(the driver acknowledges the train trip) AND (the train is at standstill) AND (the ERTMS/ETCS level is STM) AND (STM is National)
[64]	(the driver acknowledges the train trip) AND (the train is at standstill) AND (the ERTMS/ETCS level is STM) AND (STM is European)

17.3.3.3.1 (SRS: 4.6.2) Transition Table.

- Mode transition [63] from TR to SN
- Mode transition [64] from TR to SE

17.3.3.4 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

B9	(Level transition location for a transition from ETCS to STM is passed) AND (ETCS technical mode changes from TR to SN or SE)
F9	(transition ordered by the trackside) AND (no announcement for the level transition was received by the ETCS On-board)

17.3.3.4.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for DA

17.3.3.5 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.3.3.6 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

D16	(the STM Control Function has sent a "DA state transition order") AND (the STM does not report the required state within a maximum delay time of 5 seconds) see 7.4.1.2.3.1 and 7.4.1.2.3.2

17.3.3.6.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.3.3.7 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.3.3.8 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.3.3.9 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.3.3.10 (FFFIS STM: 7.3.2.2) Transitions conditions table

9	ETCS order “Data Available”

17.3.3.10.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.3.3.11 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.3.3.12 (FFFIS STM: 7.3.1.7.1) In DA state, a National STM is responsible for the train movement supervision, according to the received national trackside information. A European STM is also responsible for the train movement supervision, according to the received national trackside information, but some parts of the calculations are performed by the ETCS On-board.

17.3.3.13 (SRS: 4.4.17.1.1) The SN mode shall enable an STM to access the following resources via the ERTMS/ETCS on-board equipment; MMI, odometer, train interface and brakes. No supervision functionality is provided by the ERTMS/ETCS on-board equipment.

17.3.3.14 (SRS: 4.4.16.1.1) The SE mode shall permit reuse of supervision functionality in the ERTMS/ETCS on-board equipment such as MA, most restrictive speed profile and gradient. Furthermore, the SE mode shall enable the STM to access the following resources via the ERTMS/ETCS Onboard; MMI, odometer, train interface and brakes.

17.3.3.15 (FFFIS STM: 5.2.5.5) The STM shall be allowed to apply the emergency brake using the direct interface only when the STM is active (in state “Data Available”) and the ETCS technical mode is SN or SE.

17.3.3.16 (FFFIS STM: 5.2.5.7) The STM shall be allowed to apply the traction cut-off using the direct interface only when the emergency brake application is allowed over the direct interface (see chapter 5.2.5.5).

17.3.3.17 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														X	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x
13	Service Brake command														X	x	

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x

17.3.3.18 (SRS: 5.10.4.2) If the driver has not yet acknowledged 5 seconds after the level transition, a service brake command shall be initiated.

17.3.3.19 (SRS: 5.10.4.3) The driver shall then acknowledge the level transition in order to release the service brake command.

17.3.3.20 (FFFIS STM: 7.4.2.3.1) Once the train has passed the level transition border, the ETCS On-board shall supervise the "STM max speed" (previously sent by the STM in HS state).

17.3.3.21 (FFFIS STM: 7.4.2.3.2) Once the STM report “DA state” is received by the ETCS On-board, the ETCS On-board shall stop supervising "STM max speed".

17.3.3.22 (FFFIS STM: 7.4.2.2.3) If the ETCS On-board does not receive an "STM max speed" value from the STM in HS state, the ETCS On-board shall not supervise any “STM max speed” at all and the computation of the MRSP is not affected.

17.3.3.23 (FFFIS STM: 10.5.3.5) The STM shall send a request with the required status of all DMI objects to the ETCS On-board after switching from CS or HS to DA state.

17.4 Transition ETCS to STM (non-leading / sleeping)

17.4.1 Requirements for the announcement of the transition

17.4.1.1 (SRS: 5.10.1.1) Every level transition into levels 2, 3, or STM shall be announced to the ERTMS/ETCS on-board equipment via balise group or via the RBC.

17.4.1.2 (SRS: 5.10.1.2) A level transition announcement to the ERTMS/ETCS on-board equipment shall consist of an order to execute the level transition at a further location corresponding to the border.

17.4.1.3 (SRS: 5.10.2.2) When going to a mixed level area, the level transition announcement and the level transition order at the border shall contain all the supported ERTMS/ETCS levels with a table of priority.

17.4.1.4 (SRS: 5.10.2.3) The table of priority shall list all the supported levels from the highest priority level to the lowest one.

17.4.1.4.1 (SRS: 5.10.2.3.1) Examples: table gives 3, 2, STM X, 1, STM Y, 0. Train is fitted for level 1 and STM X, it will select STM X level. Train is fitted for level 1 and STM Y, it will select level 1. Train is level 2 fitted, it will select level 2.

17.4.1.5 (SRS: 5.10.2.4) When receiving the information about all ERTMS/ETCS levels that are available, the ERTMS/ETCS on-board equipment shall select in the table the level with the highest priority that the onboard equipment allows to use.

17.4.1.6 (SRS: 5.10.2.7) If the ERTMS/ETCS on-board equipment is not fitted for any of the announced levels it shall nevertheless make the transition, to the announced level with the lowest priority.

17.4.1.7 (SRS: 5.10.1.3) When the ERTMS/ETCS on-board equipment receives a level transition announcement, it shall immediately inform the driver about the announced level transition.

17.4.1.8 (SRS: 5.10.2.6) The ERTMS/ETCS on-board equipment shall inform the driver only about the selected level transition.

17.4.1.9 (SRS: 4.7.2) MMI versus mode table (outputs).

Output information	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
Level transition announcement				A	A	A		A	A	A	A			A	A	A

17.4.1.10 (SRS: 5.10.1.7) As soon as the announcement of the level transition has been received, some data (mainly movement authority and track description data) from the transmission media of the new level shall be accepted, but shall not be used until the level transition is effective.

17.4.1.11 (SRS: 5.10.3.9.2, and 5.10.3.10.2) When the announcement is received, a signal shall be sent by the ERTMS/ETCS on-board equipment to the STM specified in the announcement meaning that the STM shall prepare for immediate activation when the level transition location is passed with the estimated front end.

17.4.1.12 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A6	(ETCS On-board receives an announcement for a level transition to Level STM X) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3

17.4.1.12.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for HS

17.4.1.13 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.4.1.14 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.4.1.14.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.4.1.15 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.4.1.16 (FFFIS STM: 7.6.1.5.1) Exception: If the ETCS technical mode is SL, the STM shall not open a connection to the ETCS DMI function.

17.4.1.17 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.4.1.18 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.4.1.19 (FFFIS STM: 7.3.2.2) Transitions conditions table

6	ETCS order “Hot Standby”

17.4.1.19.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.4.1.20 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.4.1.21 (FFFIS STM: 7.3.1.6.1) Being in the state HS, the STM shall be able to process the information from or to the national trackside.

17.4.1.22 (FFFIS STM: 7.3.1.6.1.1) Note: In HS state, when receiving national trackside information, the STM shall treat this information to be prepared to take in charge the train movement supervision once its state will switch to DA state.

17.4.2 Requirements for the area between announcement and transition border

17.4.2.1 (FFFIS STM: 7.3.1.6.2) The STM in HS shall have the possibility to send a "STM max speed" to the STM control function.

17.4.2.2 (FFFIS STM: 7.3.1.6.3) The STM in HS shall have the possibility to send an "STM system speed" together with an "STM system distance" to the STM control function.

17.4.2.2.1 (SRS: 4.4.6.1.3 (Sleeping)) As the engine is remote controlled by the leading engine, its ERTMS/ETCS on-board equipment shall not perform any train movement supervision.

17.4.2.2.2 (SRS: 4.4.15.1.2 (Non-Leading)) The ERTMS/ETCS on-board equipment shall not perform any train movement supervision in Non-Leading mode.

17.4.2.3 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.4.2.4 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.4.2.5 (FFFIS STM: 10.5.3.3) The STM in Hot Standby shall be allowed to send preliminary request for DMI objects to the ETCS On-board.

17.4.2.6 (FFFIS STM: 10.5.2.6) The ETCS On-board shall be able to receive preliminary request for DMI objects from an STM being in HS state. The ETCS On-board shall be allowed to ignore this information.

17.4.2.7 (FFFIS STM: 10.5.2.6.1) Note: The sending of preliminary request is to allow the DMI function to prepare in background the information to be presented to the driver once the STM switches to Data Available state.

17.4.2.8 (FFFIS STM: 10.5.2.6.2) Note: This is to avoid a gap of the display at level transition and to have a one shot up-date of the screen to display STM information at level transition.

17.4.2.8.1 (SRS: 4.4.6.1.2 (Sleeping)) The desk of a sleeping engine must be closed (since there is no driver, no information shall be shown).

17.4.3 Requirements for the transition

17.4.3.1 (SRS: 5.10.1.4) At the level transition border a balise group with an order to switch to the new level immediately shall be placed.

17.4.3.2 (SRS: 5.10.1.5) If the message from the border balise group is not received, the level transition shall still be executed when the estimated front end passes the location given in the announcement.

17.4.3.3 (SRS: 5.10.3.9.3 (Level 1)) When the level transition location is passed with the estimated front end, the STM specified shall be activated by the ERTMS/ETCS on-board equipment.

17.4.3.4 (SRS: 5.10.3.10.5 (Level 2/3), 5.10.3.13.2 (Level 0)) When the level transition location is passed the STM specified shall be activated.

17.4.3.5 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A9	(Level transition location for a transition from ETCS to STM is passed) AND (ETCS technical mode is not TR)

17.4.3.5.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for DA

17.4.3.6 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.4.3.7 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

D16	(the STM Control Function has sent a "DA state transition order") AND (the STM does not report the required state within a maximum delay time of 5 seconds) see 7.4.1.2.3.1 and 7.4.1.2.3.2

17.4.3.7.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.4.3.8 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.4.3.9 (FFFIS STM: 7.6.1.5.1) Exception: If the ETCS technical mode is SL, the STM shall not open a connection to the ETCS DMI function.

17.4.3.10 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.4.3.11 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.4.3.12 (FFFIS STM: 7.3.2.2) Transitions conditions table

9	ETCS order “Data Available”

17.4.3.12.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.4.3.13 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.4.3.14 (FFFIS STM: 7.3.1.7.1) In DA state, a National STM is responsible for the train movement supervision, according to the received national trackside information. A European STM is also responsible for the train movement supervision, according to the received national trackside information, but some parts of the calculations are performed by the ETCS On-board.

17.4.3.15 (SRS: 4.4.6.1.9 (Sleeping)) When the ERTMS/ETCS level is STM, the ERTMS/ETCS Onboard equipment shall be responsible for providing the STM with access to various resources such as ~~MMI,~~ Odometer, Juridical Recorder and train interface.

17.4.3.16 (SRS: 4.4.15.1.7 (Non-Leading)) When the ERTMS/ETCS level is STM, the ERTMS/ETCS Onboard equipment shall be responsible for providing the STM with access to various resources such as MMI, Odometer, Juridical Recorder and train interface.

17.4.3.17 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														X	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x
13	Service Brake command														X	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x

17.4.3.18 (FFFIS STM: 10.5.3.5) The STM shall send a request with the required status of all DMI objects to the ETCS On-board after switching from CS or HS to DA state.

17.4.3.18.1 (SRS: 4.4.6.1.2 (Sleeping)) The desk of a sleeping engine must be closed (since there is no driver, no information shall be shown).

17.5 Transition STM to ETCS (except for non-leading / sleeping and trip situation)

17.5.1 Requirements for the announcement of the transition

17.5.1.1 (FFFIS STM: 7.5.1.1) For the train to be able to enter the new area, the previous STM area must possess information about at least the first section of the new area. The national trackside information may be transmitted to the train such that entry to the new area is possible only when the route status permits this.

17.5.1.2 (SRS: 5.10.1.1) Every level transition into levels 2, 3, or STM shall be announced to the ERTMS/ETCS on-board equipment via balise group or via the RBC.

17.5.1.3 (SRS: 5.10.1.2) A level transition announcement to the ERTMS/ETCS on-board equipment shall consist of an order to execute the level transition at a further location corresponding to the border.

17.5.1.4 (SRS: 5.10.2.2) When going to a mixed level area, the level transition announcement and the level transition order at the border shall contain all the supported ERTMS/ETCS levels with a table of priority.

17.5.1.5 (SRS: 5.10.2.3) The table of priority shall list all the supported levels from the highest priority level to the lowest one.

17.5.1.5.1 (SRS: 5.10.2.3.1) Examples: table gives 3, 2, STM X, 1, STM Y, 0. Train is fitted for level 1 and STM X, it will select STM X level. Train is fitted for level 1 and STM Y, it will select level 1. Train is level 2 fitted, it will select level 2.

17.5.1.6 (SRS: 5.10.2.4) When receiving the information about all ERTMS/ETCS levels that are available, the ERTMS/ETCS on-board equipment shall select in the table the level with the highest priority that the onboard equipment allows to use.

17.5.1.7 (SRS: 5.10.1.3) When the ERTMS/ETCS on-board equipment receives a level transition announcement, it shall immediately inform the driver about the announced level transition.

17.5.1.8 (SRS: 5.10.2.6) The ERTMS/ETCS on-board equipment shall inform the driver only about the selected level transition.

17.5.1.9 (SRS: 5.10.1.7) As soon as the announcement of the level transition has been received, some data (mainly movement authority and track description data) from the transmission media of the new level shall be accepted, but shall not be used until the level transition is effective.

17.5.2 Requirements for the area between announcement and transition border

17.5.2.1 (SRS: 5.10.4.1) If defined so for the level transition (see table below), the driver shall be asked to acknowledge the transition when the max safe front end of the train passes a trackside defined location in rear of the level transition border.

Note: The table which is referenced in 17.5.2.1 (SRS) is not included here. The table gives the requirement to have an acknowledgement from the driver for every level transition from Level STM.

17.5.3 Requirements for the transition

17.5.3.1 (SRS: 5.10.1.4) At the level transition border a balise group with an order to switch to the new level immediately shall be placed.

17.5.3.2 (SRS: 5.10.1.5) If the message from the border balise group is not received, the level transition shall still be executed when the estimated front end passes the location given in the announcement.

17.5.3.3 (SRS: 4.6.3) Transitions Conditions Table:

[21]	(ERTMS/ETCS level switches to 0) **see {2} here under**
[25]	(ERTMS/ETCS level switches to 1,2 or 3) AND (MA+SSP+gradient are on-board) AND (no specific mode is required by a Mode Profile)
[34]	(A Mode Profile defining an On Sight area is on-board) AND (The train passes the beginning of the On Sight area with its front end) AND (The ERTMS/ETCS level switches to 1,2 or 3)
[39]	(The ERTMS/ETCS level switches to 1,2 or 3) AND (no MA has been received)
[44]	("override" function is active) AND (ERTMS/ETCS level switches to 1 or 2 or 3) **see {3} here under**
[56]	(the ERTMS/ETCS level is "STM") AND (SN mode is required for the STM)
[67]	(The ERTMS/ETCS level switches to level 1) AND (a trip order has been received) AND (override is not active)

17.5.3.3.1 (SRS: 4.6.2) Transition Table.

- Mode transition [21] from SN / SE to UN
- Mode transition [25] from SN / SE to FS
- Mode transition [34] from SN / SE to OS
- Mode transition [44] from SN / SE to SR
- Mode transitions [56], [39], and [67] from SN / SE to TR

17.5.3.3.2 (SRS: 5.10.3.7.5 (Level 2/3)) When the level transition location is passed with the estimated front end a position report shall be sent to the RBC and the active STM shall be set to standby.

17.5.3.3.3 (SRS: 5.10.3.8.3 (Level 1)) When the level transition location is passed with the estimated front end, the active STM shall be set to standby.

17.5.3.3.4 (SRS: 5.10.3.12.1 (Level 0)) When the level transition location is passed the active STM shall be set to standby.

17.5.3.4 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

B4a	(Level transition location for an STM to ETCS transition is passed)

17.5.3.4.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for CS

17.5.3.5 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.5.3.6 (FFFIS STM: 7.4.1.2.4.2) When the state transition order is going to CS state, the STM Control Function shall send an “unconditional order CS state” for the transition A4a, B4a and C4a and a “conditional order CS state” for the transition A4b.

17.5.3.7 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.5.3.7.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.5.3.8 (FFFIS STM: 7.3.2.2) Transitions conditions table

4a	ETCS unconditional order “Cold Standby”

17.5.3.8.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from DA to CS

17.5.3.9 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.5.3.10 (FFFIS STM: 7.3.1.5.1) Being in the state CS, the STM was initialised, tested, configured and is in possession of all required information for operating, but not able to receive a message from the trackside, because the reception is turned off.

17.5.3.11 (FFFIS STM: 7.3.4.1) The STM shall always turn off its antenna transmission:-the antenna shall not energise trackside equipment, and shall not read trackside data, and shall not transmit data to trackside, except

- in HS and DA state,
- in CS state as long as the train is on its national trackside after deactivation by a level transition, and
- for test purpose.

17.5.3.12 (FFFIS STM: 7.3.4.1.1) Note: When exiting DA or HS state (due to the exit of the level STM area, it may happen that the national trackside goes further than the level transition border. In this case, even if the STM is already in CS state, the

STM shall have the possibility to continue to communicate with its national trackside as long as the train is located on the national trackside.

17.5.3.13 (SRS: 4.4.17.1.1) The SN mode shall enable an STM to access the following resources via the ERTMS/ETCS on-board equipment; MMI, odometer, train interface and brakes. No supervision functionality is provided by the ERTMS/ETCS on-board equipment.

17.5.3.14 (SRS: 4.4.16.1.1) The SE mode shall permit reuse of supervision functionality in the ERTMS/ETCS on-board equipment such as MA, most restrictive speed profile and gradient. Furthermore, the SE mode shall enable the STM to access the following resources via the ERTMS/ETCS Onboard; MMI, odometer, train interface and brakes.

17.5.3.15 (FFFIS STM: 5.2.5.5) The STM shall be allowed to apply the emergency brake using the direct interface only when the STM is active (in state “Data Available”) and the ETCS technical mode is SN or SE.

17.5.3.16 (FFFIS STM: 5.2.5.6) The STM shall release the emergency brake using the direct interface when the STM is no more active (Transition from DA to any other state).

17.5.3.17 (FFFIS STM: 5.2.5.7) The STM shall be allowed to apply the traction cut-off using the direct interface only when the emergency brake application is allowed over the direct interface (see chapter 5.2.5.5).

17.5.3.18 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														X	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x
13	Service Brake command														X	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x

17.5.3.19 (FFFIS STM: 7.6.3.2) When an STM in DA state or HS state receives an order to go in CS state, the STM

- shall have the possibility to close the connection with the JRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the DRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the TIU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the BIU (up to the STM to decide it or not).
- shall maintain the connection with the STM Control Function.
- shall close the connections with all other ETCS On-board functions

17.5.3.20 (SRS: 5.10.4.2) If the driver has not yet acknowledged 5 seconds after the level transition, a service brake command shall be initiated.

17.5.3.21 (SRS: 5.10.4.3) The driver shall then acknowledge the level transition in order to release the service brake command.

17.6 Transition STM to ETCS (trip situation)

17.6.1.1 The transition STM to STM in trip situation is covered by the description in chapter 17.5: According to the current version of the SRS (/1/ SUBSET-026; SRS Version 2.2.2), the supervision of the STM ends at the transition border. Therefore the ETCS sends an “unconditional order CS” and the STM ends the supervision and goes to state CS as soon as possible.
If for further changes of the SRS for the STM to ETCS transition (especially for a transition from STM to ETCS Level 0), the STM shall supervise and keep a trip situation, the ETCS may send a “conditional order CS” and the STM will be allowed to keep a trip situation.

17.7 Transition STM to ETCS (non-leading / sleeping)

17.7.1 Requirements for the announcement of the transition

17.7.1.1 (SRS: 5.10.1.1) Every level transition into levels 2, 3, or STM shall be announced to the ERTMS/ETCS on-board equipment via balise group or via the RBC.

17.7.1.2 (SRS: 5.10.1.2) A level transition announcement to the ERTMS/ETCS on-board equipment shall consist of an order to execute the level transition at a further location corresponding to the border.

17.7.1.3 (SRS: 5.10.2.2) When going to a mixed level area, the level transition announcement and the level transition order at the border shall contain all the supported ERTMS/ETCS levels with a table of priority.

17.7.1.4 (SRS: 5.10.2.3) The table of priority shall list all the supported levels from the highest priority level to the lowest one.

17.7.1.4.1 (SRS: 5.10.2.3.1) Examples: table gives 3, 2, STM X, 1, STM Y, 0. Train is fitted for level 1 and STM X, it will select STM X level. Train is fitted for level 1 and STM Y, it will select level 1. Train is level 2 fitted, it will select level 2.

17.7.1.5 (SRS: 5.10.2.4) When receiving the information about all ERTMS/ETCS levels that are available, the ERTMS/ETCS on-board equipment shall select in the table the level with the highest priority that the onboard equipment allows to use.

17.7.1.6 (SRS: 5.10.1.3) When the ERTMS/ETCS on-board equipment receives a level transition announcement, it shall immediately inform the driver about the announced level transition.

17.7.1.7 (SRS: 5.10.2.6) The ERTMS/ETCS on-board equipment shall inform the driver only about the selected level transition.

17.7.1.8 (SRS: 4.7.2) MMI versus mode table (outputs).

Output information	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
Level transition announcement				A	A	A		A	A	A	A			A	A	A

17.7.1.9 (SRS: 5.10.1.7) As soon as the announcement of the level transition has been received, some data (mainly movement authority and track description data) from the transmission media of the new level shall be accepted, but shall not be used until the level transition is effective.

17.7.2 Requirements for the transition

17.7.2.1 (SRS: 5.10.1.4) At the level transition border a balise group with an order to switch to the new level immediately shall be placed.

17.7.2.2 (SRS: 5.10.1.5) If the message from the border balise group is not received, the level transition shall still be executed when the estimated front end passes the location given in the announcement.

17.7.2.2.1 (SRS: 5.10.3.7.5 (Level 2/3)) When the level transition location is passed with the estimated front end a position report shall be sent to the RBC and the active STM shall be set to standby.

17.7.2.2.2 (SRS: 5.10.3.8.3 (Level 1)) When the level transition location is passed with the estimated front end, the active STM shall be set to standby.

17.7.2.2.3 (SRS: 5.10.3.12.1 (Level 0)) When the level transition location is passed the active STM shall be set to standby.

17.7.2.3 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

B4a	(Level transition location for an STM to ETCS transition is passed)

17.7.2.3.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for CS

17.7.2.4 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.7.2.5 (FFFIS STM: 7.4.1.2.4.2) When the state transition order is going to CS state, the STM Control Function shall send an “unconditional order CS state” for the transition A4a, B4a and C4a and a “conditional order CS state” for the transition A4b.

17.7.2.6 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.7.2.6.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.7.2.7 (FFFIS STM: 7.3.2.2) Transitions conditions table

4a	ETCS unconditional order “Cold Standby”

17.7.2.7.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from DA to CS

17.7.2.8 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.7.2.9 (FFFIS STM: 7.3.1.5.1) Being in the state CS, the STM was initialised, tested, configured and is in possession of all required information for operating, but not able to receive a message from the trackside, because the reception is turned off.

17.7.2.10 (FFFIS STM: 7.3.4.1) The STM shall always turn off its antenna transmission:-the antenna shall not energise trackside equipment, and shall not read trackside data, and shall not transmit data to trackside, except

- in HS and DA state,
- in CS state as long as the train is on its national trackside after deactivation by a level transition, and
- for test purpose.

17.7.2.11 (FFFIS STM: 7.3.4.1.1) Note: When exiting DA or HS state (due to the exit of the level STM area, it may happen that the national trackside goes further than the level transition border. In this case, even if the STM is already in CS state, the STM shall have the possibility to continue to communicate with its national trackside as long as the train is located on the national trackside.

17.7.2.12 (SRS: 4.4.17.1.1) The SN mode shall enable an STM to access the following resources via the ERTMS/ETCS on-board equipment; MMI, odometer, train interface and brakes. No supervision functionality is provided by the ERTMS/ETCS on-board equipment.

17.7.2.13 (SRS: 4.4.16.1.1) The SE mode shall permit reuse of supervision functionality in the ERTMS/ETCS on-board equipment such as MA, most restrictive speed profile and gradient. Furthermore, the SE mode shall enable the STM to access the following resources via the ERTMS/ETCS Onboard; MMI, odometer, train interface and brakes.

17.7.2.14 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														X	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x
13	Service Brake command														X	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x

17.7.2.15 (FFFIS STM: 7.6.3.2) When an STM in DA state or HS state receives an order to go in CS state, the STM

- shall have the possibility to close the connection with the JRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the DRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the TIU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the BIU (up to the STM to decide it or not).
- shall maintain the connection with the STM Control Function.
- shall close the connections with all other ETCS On-board functions

17.8 Transition STM X to STM Y (except for non-leading / sleeping and trip situation)

17.8.1 Requirements for the announcement of the transition

17.8.1.1 (SRS: 5.10.1.1) Every level transition into levels 2, 3, or STM shall be announced to the ERTMS/ETCS on-board equipment via balise group or via the RBC.

17.8.1.2 (SRS: 5.10.1.2) A level transition announcement to the ERTMS/ETCS on-board equipment shall consist of an order to execute the level transition at a further location corresponding to the border.

17.8.1.3 (SRS: 5.10.2.2) When going to a mixed level area, the level transition announcement and the level transition order at the border shall contain all the supported ERTMS/ETCS levels with a table of priority.

17.8.1.4 (SRS: 5.10.2.3) The table of priority shall list all the supported levels from the highest priority level to the lowest one.

17.8.1.4.1 (SRS: 5.10.2.3.1) Examples: table gives 3, 2, STM X, 1, STM Y, 0. Train is fitted for level 1 and STM X, it will select STM X level. Train is fitted for level 1 and STM Y, it will select level 1. Train is level 2 fitted, it will select level 2.

17.8.1.5 (SRS: 5.10.2.4) When receiving the information about all ERTMS/ETCS levels that are available, the ERTMS/ETCS on-board equipment shall select in the table the level with the highest priority that the onboard equipment allows to use.

17.8.1.6 (SRS: 5.10.2.7) If the ERTMS/ETCS on-board equipment is not fitted for any of the announced levels it shall nevertheless make the transition, to the announced level with the lowest priority.

17.8.1.7 (SRS: 5.10.1.3) When the ERTMS/ETCS on-board equipment receives a level transition announcement, it shall immediately inform the driver about the announced level transition.

17.8.1.8 (SRS: 5.10.2.6) The ERTMS/ETCS on-board equipment shall inform the driver only about the selected level transition.

17.8.1.9 (SRS: 5.10.1.7) As soon as the announcement of the level transition has been received, some data (mainly movement authority and track description data) from the transmission media of the new level shall be accepted, but shall not be used until the level transition is effective.

17.8.1.10 (SRS: 5.10.3.11.1) When the announcement is received, a signal shall be sent by the ERTMS/ETCS onboard to the STM specified in the announcement meaning that the STM shall prepare for immediate activation when the level transition location is passed with the maximum safe front end.

17.8.1.11 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A6	(ETCS On-board receives an announcement for a level transition to Level STM X) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3

17.8.1.11.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for HS

17.8.1.12 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.8.1.13 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.8.1.13.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.8.1.14 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.8.1.15 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.8.1.16 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.8.1.17 (FFFIS STM: 7.3.2.2) Transitions conditions table

6	ETCS order “Hot Standby”

17.8.1.17.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.8.1.18 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.8.1.19 (FFFIS STM: 7.3.1.6.1) Being in the state HS, the STM shall be able to process the information from or to the national trackside.

17.8.1.20 (FFFIS STM: 7.3.1.6.1.1) Note: In HS state, when receiving national trackside information, the STM shall treat this information to be prepared to take in charge the train movement supervision once its state will switch to DA state.

17.8.2 Requirements for the area between announcement and transition border

17.8.2.1 (SRS: 5.10.4.1) If defined so for the level transition (see table below), the driver shall be asked to acknowledge the transition when the max safe front end of the train passes a trackside defined location in rear of the level transition border.

Note: The table which is referenced in 17.8.2.1 (SRS) is not included here. The table gives the requirement to have an acknowledgement from the driver for every level transition to Level STM.

17.8.2.2 (FFFIS STM: 7.3.1.6.2) The STM in HS shall have the possibility to send a "STM max speed" to the STM control function.

17.8.2.2.1 (FFFIS STM: 7.3.1.6.2.1) Note: This "STM max speed" is to allow the STM, for national reasons unknown to the ETCS On-board or ERTMS Trackside, to request a given train speed at the level transition border in order to have a smooth transition.

17.8.2.3 (FFFIS STM: 7.4.2.2.1) If receiving an "STM max speed" from an STM in HS state, the ETCS On-board shall include the "STM max speed" into the computation of the MRSP beginning at the level transition border and ending when the report “DA state” has been received by the ETCS On-board from the STM to be activated.

17.8.2.4 (FFFIS STM: 7.4.2.2.1.1) Exception: After receiving an announcement for an STM to STM transition, the ETCS On-board shall not consider the "STM max speed”.

17.8.2.5 (FFFIS STM: 7.4.2.2.3) If the ETCS On-board does not receive an "STM max speed" value from the STM in HS state, the ETCS On-board shall not supervise any “STM max speed” at all and the computation of the MRSP is not affected.

17.8.2.6 (FFFIS STM: 7.3.1.6.3) The STM in HS shall have the possibility to send an "STM system speed" together with an "STM system distance" to the STM control function.

17.8.2.6.1 (FFFIS STM: 7.3.1.6.3.1) Note: This "STM system speed" together with the "STM system distance" is to allow the STM, to request a given train speed at a given position ("STM system distance") before the level transition border in order to be able to detect its national trackside.

17.8.2.7 (FFFIS STM: 7.4.2.2.4) When receiving an "STM system speed" together with an "STM system distance" from an STM in HS state, the ETCS On-board shall consider the "STM system speed" as a new speed restriction that applies at a location "STM system distance" before the level transition border and ending at

the level transition border: The ETCS On-board shall include the "STM system speed" into the computation of the MRSP.

17.8.2.8 (FFFIS STM: 7.4.2.2.4.1) Exception: After receiving an announcement for an STM to STM transition, the ETCS On-board shall not consider the "STM system speed" and "STM system distance".

17.8.2.9 (FFFIS STM: 7.4.2.2.5) If the ETCS On-board does not receive the "STM system speed" together with the "STM system distance" values from the STM in HS state, the ETCS On-board shall not take into account "STM system speed" and "STM system distance" at all and the computation of the MRSP is not affected.

17.8.2.10 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.8.2.11 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.8.2.12 (FFFIS STM: 10.5.3.3) The STM in Hot Standby shall be allowed to send preliminary request for DMI objects to the ETCS On-board.

17.8.2.13 (FFFIS STM: 10.5.2.6) The ETCS On-board shall be able to receive preliminary request for DMI objects from an STM being in HS state. The ETCS On-board shall be allowed to ignore this information.

17.8.2.14 (FFFIS STM: 10.5.2.6.1) Note: The sending of preliminary request is to allow the DMI function to prepare in background the information to be presented to the driver once the STM switches to Data Available state.

17.8.2.15 (FFFIS STM: 10.5.2.6.2) Note: This is to avoid a gap of the display at level transition and to have a one shot up-date of the screen to display STM information at level transition.

17.8.3 Requirements for the transition

17.8.3.1 (SRS: 5.10.1.4) At the level transition border a balise group with an order to switch to the new level immediately shall be placed.

17.8.3.2 (SRS: 5.10.1.5) If the message from the border balise group is not received, the level transition shall still be executed when the estimated front end passes the location given in the announcement.

17.8.3.3 (SRS: 5.10.4.2) If the driver has not yet acknowledged 5 seconds after the level transition, a service brake command shall be initiated.

17.8.3.4 (SRS: 5.10.4.3) The driver shall then acknowledge the level transition in order to release the service brake command.

17.8.3.4.1 (SRS: 5.10.3.11.2) When the level transition location is passed with the maximum safe front end the active STM (STM X) shall be set to standby and the STM specified in the border balise group (STM Y) shall be activated.

17.8.3.5 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A4b	(Level transition location for an STM X to STM Y transition is passed)

17.8.3.5.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for CS

17.8.3.6 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.8.3.7 (FFFIS STM: 7.4.1.2.4.2) When the state transition order is going to CS state, the STM Control Function shall send an “unconditional order CS state” for the transition A4a, B4a and C4a and a “conditional order CS state” for the transition A4b.

17.8.3.8 (FFFIS STM: 7.4.1.3.4) After sending a “conditional order CS” the access to ETCS On-board functions shall remain until the STM report CS is received by the ETCS On-board.

17.8.3.9 (FFFIS STM: 7.3.3.1) When an STM in DA state receives a "conditional CS state transition order", the STM shall be allowed to stay in DA state as long as a national trip situation is processed by this STM.

17.8.3.10 (FFFIS STM: 7.3.3.1.1) Justification: When a level transition border is passed, an STM may have to stay active after receiving a deactivation order because the STM is currently processing a national trip situation.

17.8.3.11 (FFFIS STM: 7.3.3.2) When an STM in DA state receives a "conditional CS state transition order" and is not going to change to CS state as soon as possible due to a national trip situation (see 7.3.3.1), the STM shall send a "TRIP" message to the STM Control Function

- Immediately after the STM has received the "conditional CS state transition order, and
- (after sending the first "TRIP" message) every 5 seconds.

17.8.3.12 (FFFIS STM: 7.3.3.2.1) Note: The STM shall send the "TRIP" messages with a cycle time of 5 seconds in order to fulfil the time-out check of 10 seconds starting

with sending the "conditional CS state transition order" within the STM Control Function.

17.8.3.13 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

E16	(the STM Control Function has sent a "conditional CS state transition order") AND (the STM does not report CS state or send a “Trip” message within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.8.3.13.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.8.3.14 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

F16	(the STM Control Function has already received a “Trip” message from an STM) AND (the STM does not report CS state or send a “Trip” message within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.8.3.14.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.8.3.15 (FFFIS STM: 7.3.2.2) Transitions conditions table

4b	ETCS conditional order “Cold Standby”

17.8.3.15.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from DA to CS

17.8.3.16 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.8.3.17 (FFFIS STM: 7.3.1.5.1) Being in the state CS, the STM was initialised, tested, configured and is in possession of all required information for operating, but not able to receive a message from the trackside, because the reception is turned off.

17.8.3.18 (FFFIS STM: 7.3.4.1) The STM shall always turn off its antenna transmission:-the antenna shall not energise trackside equipment, and shall not read trackside data, and shall not transmit data to trackside, except

- in HS and DA state,
- in CS state as long as the train is on its national trackside after deactivation by a level transition, and
- for test purpose.

17.8.3.19 (FFFIS STM: 7.3.4.1.1) Note: When exiting DA or HS state (due to the exit of the level STM area, it may happen that the national trackside goes further than the level transition border. In this case, even if the STM is already in CS state, the STM shall have the possibility to continue to communicate with its national trackside as long as the train is located on the national trackside.

17.8.3.20 (SRS: 4.4.17.1.1) The SN mode shall enable an STM to access the following resources via the ERTMS/ETCS on-board equipment; MMI, odometer, train interface and brakes. No supervision functionality is provided by the ERTMS/ETCS on-board equipment.

17.8.3.21 (SRS: 4.4.16.1.1) The SE mode shall permit reuse of supervision functionality in the ERTMS/ETCS on-board equipment such as MA, most restrictive speed profile and gradient. Furthermore, the SE mode shall enable the STM to access the following resources via the ERTMS/ETCS Onboard; MMI, odometer, train interface and brakes.

17.8.3.22 (FFFIS STM: 5.2.5.5) The STM shall be allowed to apply the emergency brake using the direct interface only when the STM is active (in state “Data Available”) and the ETCS technical mode is SN or SE.

17.8.3.23 (FFFIS STM: 5.2.5.6) The STM shall release the emergency brake using the direct interface when the STM is no more active (Transition from DA to any other state).

17.8.3.24 (FFFIS STM: 5.2.5.7) The STM shall be allowed to apply the traction cut-off using the direct interface only when the emergency brake application is allowed over the direct interface (see chapter 5.2.5.5).

17.8.3.25 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														X	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x
13	Service Brake command														X	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			X	x	x

17.8.3.26 (FFFIS STM: 7.6.3.2) When an STM in DA state or HS state receives an order to go in CS state, the STM

- shall have the possibility to close the connection with the JRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the DRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the TIU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the BIU (up to the STM to decide it or not).
- shall maintain the connection with the STM Control Function.
- shall close the connections with all other ETCS On-board functions

17.8.3.27 (SRS: 4.6.3) Transitions Conditions Table:

[55]	(the ERTMS/ETCS level is “STM”) AND (SE mode is required for the STM)
[56]	(the ERTMS/ETCS level is “STM”) AND (SN mode is required for the STM)

17.8.3.27.1 (SRS: 4.6.2) Transition Table.

- Mode transition [55] from SN to SE
- Mode transition [56] from SE to SN

17.8.3.28 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C9	(Level transition location for an STM X to STM Y transition is passed) AND (STM X reports "CS state")

17.8.3.28.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for DA

17.8.3.29 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.8.3.30 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

D16	(the STM Control Function has sent a "DA state transition order") AND (the STM does not report the required state within a maximum delay time of 5 seconds) see 7.4.1.2.3.1 and 7.4.1.2.3.2

17.8.3.30.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.8.3.31 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.8.3.32 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.8.3.33 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.8.3.34 (FFFIS STM: 7.3.2.2) Transitions conditions table

9	ETCS order “Data Available”

17.8.3.34.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.8.3.35 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.8.3.36 (FFFIS STM: 7.3.1.7.1) In DA state, a National STM is responsible for the train movement supervision, according to the received national trackside information. A European STM is also responsible for the train movement supervision, according to the received national trackside information, but some parts of the calculations are performed by the ETCS On-board.

17.8.3.37 (SRS: 4.4.17.1.1) The SN mode shall enable an STM to access the following resources via the ERTMS/ETCS on-board equipment; MMI, odometer, train interface and brakes. No supervision functionality is provided by the ERTMS/ETCS on-board equipment.

17.8.3.38 (SRS: 4.4.16.1.1) The SE mode shall permit reuse of supervision functionality in the ERTMS/ETCS on-board equipment such as MA, most restrictive speed profile and gradient. Furthermore, the SE mode shall enable the STM to access the following resources via the ERTMS/ETCS Onboard; MMI, odometer, train interface and brakes.

17.8.3.39 (FFFIS STM: 5.2.5.5) The STM shall be allowed to apply the emergency brake using the direct interface only when the STM is active (in state “Data Available”) and the ETCS technical mode is SN or SE.

17.8.3.40 (FFFIS STM: 5.2.5.7) The STM shall be allowed to apply the traction cut-off using the direct interface only when the emergency brake application is allowed over the direct interface (see chapter 5.2.5.5).

17.8.3.41 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														x	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x
13	Service Brake command														x	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x

17.8.3.42 (FFFIS STM: 7.4.2.3.1) Once the train has passed the level transition border, the ETCS On-board shall supervise the "STM max speed" (previously sent by the STM in HS state).

17.8.3.43 (FFFIS STM: 7.4.2.3.2) Once the STM report “DA state” is received by the ETCS On-board, the ETCS On-board shall stop supervising "STM max speed".

17.8.3.44 (FFFIS STM: 7.4.2.2.3) If the ETCS On-board does not receive an "STM max speed" value from the STM in HS state, the ETCS On-board shall not supervise any “STM max speed” at all and the computation of the MRSP is not affected.

17.8.3.45 (FFFIS STM: 10.5.3.5) The STM shall send a request with the required status of all DMI objects to the ETCS On-board after switching from CS or HS to DA state.

17.9 Transition STM X to STM Y (trip situation)

17.9.1.1 The transition STM X to STM Y in trip situation is covered by the description in chapter 17.8: As the ETCS sends a “conditional order CS”, the STM X is allowed to stay active until the trip situation of the STM X ends according to the national rules of the STM X.

17.10 Transition STM X to STM Y (non-leading / sleeping)

17.10.1 Requirements for the announcement of the transition

17.10.1.1 (SRS: 5.10.1.1) Every level transition into levels 2, 3, or STM shall be announced to the ERTMS/ETCS on-board equipment via balise group or via the RBC.

17.10.1.2 (SRS: 5.10.1.2) A level transition announcement to the ERTMS/ETCS on-board equipment shall consist of an order to execute the level transition at a further location corresponding to the border.

17.10.1.3 (SRS: 5.10.2.2) When going to a mixed level area, the level transition announcement and the level transition order at the border shall contain all the supported ERTMS/ETCS levels with a table of priority.

17.10.1.4 (SRS: 5.10.2.3) The table of priority shall list all the supported levels from the highest priority level to the lowest one.

17.10.1.4.1 (SRS: 5.10.2.3.1) Examples: table gives 3, 2, STM X, 1, STM Y, 0. Train is fitted for level 1 and STM X, it will select STM X level. Train is fitted for level 1 and STM Y, it will select level 1. Train is level 2 fitted, it will select level 2.

17.10.1.5 (SRS: 5.10.2.4) When receiving the information about all ERTMS/ETCS levels that are available, the ERTMS/ETCS on-board equipment shall select in the table the level with the highest priority that the onboard equipment allows to use.

17.10.1.6 (SRS: 5.10.2.7) If the ERTMS/ETCS on-board equipment is not fitted for any of the announced levels it shall nevertheless make the transition, to the announced level with the lowest priority.

17.10.1.7 (SRS: 5.10.1.3) When the ERTMS/ETCS on-board equipment receives a level transition announcement, it shall immediately inform the driver about the announced level transition.

17.10.1.8 (SRS: 5.10.2.6) The ERTMS/ETCS on-board equipment shall inform the driver only about the selected level transition.

17.10.1.9 (SRS: 4.7.2) MMI versus mode table (outputs).

Output information	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
Level transition announcement				A	A	A		A	A	A	A			A	A	A

17.10.1.10 (SRS: 5.10.1.7) As soon as the announcement of the level transition has been received, some data (mainly movement authority and track description data) from the transmission media of the new level shall be accepted, but shall not be used until the level transition is effective.

17.10.1.11 (SRS: 5.10.3.11.1) When the announcement is received, a signal shall be sent by the ERTMS/ETCS onboard to the STM specified in the announcement meaning that the STM shall prepare for immediate activation when the level transition location is passed with the maximum safe front end.

17.10.1.12 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A6	(ETCS On-board receives an announcement for a level transition to Level STM X) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3

17.10.1.12.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for HS

17.10.1.13 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.10.1.14 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.10.1.14.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.10.1.15 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.10.1.16 (FFFIS STM: 7.6.1.5.1) Exception: If the ETCS technical mode is SL, the STM shall not open a connection to the ETCS DMI function.

17.10.1.17 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.10.1.18 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.10.1.19 (FFFIS STM: 7.3.2.2) Transitions conditions table

6	ETCS order “Hot Standby”

17.10.1.19.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.10.1.20 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.10.1.21 (FFFIS STM: 7.3.1.6.1) Being in the state HS, the STM shall be able to process the information from or to the national trackside.

17.10.1.22 (FFFIS STM: 7.3.1.6.1.1) Note: In HS state, when receiving national trackside information, the STM shall treat this information to be prepared to take in charge the train movement supervision once its state will switch to DA state.

17.10.2 Requirements for the area between announcement and transition border

17.10.2.1 (FFFIS STM: 7.3.1.6.2) The STM in HS shall have the possibility to send a "STM max speed" to the STM control function.

17.10.2.2 (FFFIS STM: 7.3.1.6.3) The STM in HS shall have the possibility to send an "STM system speed" together with an "STM system distance" to the STM control function.

17.10.2.2.1 (SRS: 4.4.6.1.3 (Sleeping)) As the engine is remote controlled by the leading engine, its ERTMS/ETCS on-board equipment shall not perform any train movement supervision.

17.10.2.2.2 (SRS: 4.4.15.1.2 (Non-Leading)) The ERTMS/ETCS on-board equipment shall not perform any train movement supervision in Non-Leading mode.

17.10.2.3 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.10.2.4 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.10.2.5 (FFFIS STM: 10.5.3.3) The STM in Hot Standby shall be allowed to send preliminary request for DMI objects to the ETCS On-board.

17.10.2.6 (FFFIS STM: 10.5.3.4) If the ETCS technical mode is SL, the STM shall not send any request for DMI objects to the ETCS On-board DMI function (including preliminary requests).

17.10.2.7 (FFFIS STM: 10.5.2.6) The ETCS On-board shall be able to receive preliminary request for DMI objects from an STM being in HS state. The ETCS On-board shall be allowed to ignore this information.

17.10.2.8 (FFFIS STM: 10.5.2.6.1) Note: The sending of preliminary request is to allow the DMI function to prepare in background the information to be presented to the driver once the STM switches to Data Available state.

17.10.2.9 (FFFIS STM: 10.5.2.6.2) Note: This is to avoid a gap of the display at level transition and to have a one shot up-date of the screen to display STM information at level transition.

17.10.2.9.1 (SRS: 4.4.6.1.2 (Sleeping)) The desk of a sleeping engine must be closed (since there is no driver, no information shall be shown).

17.10.3 Requirements for the transition

17.10.3.1 (SRS: 5.10.1.4) At the level transition border a balise group with an order to switch to the new level immediately shall be placed.

17.10.3.2 (SRS: 5.10.1.5) If the message from the border balise group is not received, the level transition shall still be executed when the estimated front end passes the location given in the announcement.

17.10.3.3 (SRS: 5.10.3.11.2) When the level transition location is passed with the maximum safe front end the active STM (STM X) shall be set to standby and the STM specified in the border balise group (STM Y) shall be activated.

17.10.3.4 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A4b	(Level transition location for an STM X to STM Y transition is passed)

17.10.3.4.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for CS

17.10.3.5 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.10.3.6 (FFFIS STM: 7.4.1.2.4.2) When the state transition order is going to CS state, the STM Control Function shall send an “unconditional order CS state” for the transition A4a, B4a and C4a and a “conditional order CS state” for the transition A4b.

17.10.3.7 (FFFIS STM: 7.4.1.3.4) After sending a “conditional order CS” the access to ETCS On-board functions shall remain until the STM report CS is received by the ETCS On-board.

17.10.3.8 (FFFIS STM: 7.3.3.1) When an STM in DA state receives a "conditional CS state transition order", the STM shall be allowed to stay in DA state as long as a national trip situation is processed by this STM.

17.10.3.9 (FFFIS STM: 7.3.3.1.1) Justification: When a level transition border is passed, an STM may have to stay active after receiving a deactivation order because the STM is currently processing a national trip situation.

17.10.3.10 (FFFIS STM: 7.3.3.2) When an STM in DA state receives a "conditional CS state transition order" and is not going to change to CS state as soon as possible due to a national trip situation (see 7.3.3.1), the STM shall send a "TRIP" message to the STM Control Function

- Immediately after the STM has received the "conditional CS state transition order, and
- (after sending the first "TRIP" message) every 5 seconds.

17.10.3.11 (FFFIS STM: 7.3.3.2.1) Note: The STM shall send the "TRIP" messages with a cycle time of 5 seconds in order to fulfil the time-out check of 10 seconds starting with sending the "conditional CS state transition order" within the STM Control Function.

17.10.3.12 (FFFIS STM: 7.3.3.2.1) Note: The STM shall send the "TRIP" messages with a cycle time of 5 seconds in order to fulfil the time-out check of 10 seconds starting with sending the "conditional CS state transition order" within the STM Control Function.

17.10.3.13 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

E16	(the STM Control Function has sent a "conditional CS state transition order") AND (the STM does not report CS state or send a “Trip” message within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.10.3.13.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.10.3.14 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

F16	(the STM Control Function has already received a “Trip” message from an STM) AND (the STM does not report CS state or send a “Trip” message within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.10.3.14.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.10.3.15 (FFFIS STM: 7.3.2.2) Transitions conditions table

4b	ETCS conditional order “Cold Standby”

17.10.3.15.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from DA to CS

17.10.3.16 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.10.3.17 (FFFIS STM: 7.3.1.5.1) Being in the state CS, the STM was initialised, tested, configured and is in possession of all required information for operating, but not able to receive a message from the trackside, because the reception is turned off.

17.10.3.18 (FFFIS STM: 7.3.4.1) The STM shall always turn off its antenna transmission: the antenna shall not energise trackside equipment, and shall not read trackside data, and shall not transmit data to trackside, except

- in HS and DA state,
- in CS state as long as the train is on its national trackside after deactivation by a level transition, and
- for test purpose.

17.10.3.19 (FFFIS STM: 7.3.4.1.1) Note: When exiting DA or HS state (due to the exit of the level STM area, it may happen that the national trackside goes further than the level transition border. In this case, even if the STM is already in CS state, the STM shall have the possibility to continue to communicate with its national trackside as long as the train is located on the national trackside.

17.10.3.20 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														x	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x
13	Service Brake command														x	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x

17.10.3.21 (FFFIS STM: 7.6.3.2) When an STM in DA state or HS state receives an order to go in CS state, the STM

- shall have the possibility to close the connection with the JRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the DRU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the TIU (up to the STM to decide it or not).
- shall have the possibility to close the connection with the BIU (up to the STM to decide it or not).
- shall maintain the connection with the STM Control Function.
- shall close the connections with all other ETCS On-board functions

17.10.3.22 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C9	(Level transition location for an STM X to STM Y transition is passed) AND (STM X reports "CS state")

17.10.3.22.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for DA

17.10.3.23 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.10.3.24 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

D16	(the STM Control Function has sent a "DA state transition order") AND (the STM does not report the required state within a maximum delay time of 5 seconds) see 7.4.1.2.3.1 and 7.4.1.2.3.2

17.10.3.24.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.10.3.25 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.10.3.26 (FFFIS STM: 7.6.1.5.1) Exception: If the ETCS technical mode is SL, the STM shall not open a connection to the ETCS DMI function.

17.10.3.27 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.10.3.28 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.10.3.29 (FFFIS STM: 7.3.2.2) Transitions conditions table

9	ETCS order “Data Available”

17.10.3.29.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.10.3.30 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.10.3.31 (FFFIS STM: 7.3.1.7.1) In DA state, a National STM is responsible for the train movement supervision, according to the received national trackside information. A European STM is also responsible for the train movement supervision, according to the received national trackside information, but some parts of the calculations are performed by the ETCS On-board.

17.10.3.32 (SRS: 4.4.6.1.9 (Sleeping)) When the ERTMS/ETCS level is STM, the ERTMS/ETCS Onboard equipment shall be responsible for providing the STM with access to various resources such as ~~MMI,~~ Odometer, Juridical Recorder and train interface.

17.10.3.33 (SRS: 4.4.15.1.7 (Non-Leading)) When the ERTMS/ETCS level is STM, the ERTMS/ETCS Onboard equipment shall be responsible for providing the STM with access to various resources such as MMI, Odometer, Juridical Recorder and train interface.

17.10.3.34 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														x	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x
13	Service Brake command														x	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x

17.10.3.35 (FFFIS STM: 10.5.3.5) The STM shall send a request with the required status of all DMI objects to the ETCS On-board after switching from CS or HS to DA state.

17.10.3.36 (FFFIS STM: 10.5.3.4) If the ETCS technical mode is SL, the STM shall not send any request for DMI objects to the ETCS On-board DMI function (including preliminary requests).

17.10.3.37 (SRS: 4.4.6.1.2 (Sleeping)) The desk of a sleeping engine must be closed (since there is no driver, no information shall be shown).

17.11 Transition at Start of Mission (except for non-leading / sleeping)

17.11.1 Requirements for the activation of the STM at Start of Mission

Note: The requirements for the ETCS On-board and the STM which are necessary to describe the procedure for the STM to go to CS state are not included here.

17.11.1.1 (FFFIS STM: 7.4.1.1.12) The STM Control Function shall send to the STM the current ETCS technical mode

- when the connection between the STM and the STM Control Function is established, and
- whenever the ETCS technical mode changes.

17.11.1.2 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

B6	(ETCS technical mode is SB) AND (the driver has selected STM X) AND (valid level of the ETCS On-board is Level STM) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3

17.11.1.2.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for HS

17.11.1.3 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.11.1.4 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.11.1.4.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.11.1.5 (FFFIS STM: 7.4.1.3.1) The STM Control Function shall consider a state transition order as effective immediately after sending the state transition order to the STM.

17.11.1.6 (FFFIS STM: 7.4.1.3.2) The STM Control Function shall not send a state transition order to an STM, as long as this STM has not reported the state corresponding to the previous state transition order.

17.11.1.7 (FFFIS STM: 7.3.2.2) Transitions conditions table

6	ETCS order “Hot Standby”

17.11.1.7.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.11.1.8 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.11.1.9 (FFFIS STM: 7.3.1.6.1) Being in the state HS, the STM shall be able to process the information from or to the national trackside.

17.11.1.10 (FFFIS STM: 7.3.1.6.1.1) Note: In HS state, when receiving national trackside information, the STM shall treat this information to be prepared to take in charge the train movement supervision once its state will switch to DA state.

17.11.1.11 (FFFIS STM: 7.4.2.1.1) At the Start of Mission procedure, the ETCS On-board shall propose the STM mode to be acknowledged by the driver only when the selected STM has reported HS State to the ETCS On-board.

17.11.1.12 (SRS: 4.6.3) Transitions Conditions Table:

[57]	(the ERTMS/ETCS level is “STM”) AND (SE mode is required for the STM) AND (driver has selected Start)
[58]	(the ERTMS/ETCS level is “STM”) AND (SN mode is required for the STM) AND (driver has selected Start)

17.11.1.12.1 (SRS: 4.6.2) Transition Table.

- Mode transition [57] from SB to SE
- Mode transition [58] from SB to SN

17.11.1.13 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

D9	(ETCS technical mode changes from SB to SN or SE) AND (valid level of the ETCS On-board is Level STM) AND (STM X reports "HS state")

17.11.1.13.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for DA

17.11.1.14 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.11.1.15 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

D16	(the STM Control Function has sent a "DA state transition order") AND (the STM does not report the required state within a maximum delay time of 5 seconds) see 7.4.1.2.3.1 and 7.4.1.2.3.2

17.11.1.15.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.11.1.16 (FFFIS STM: 7.3.2.2) Transitions conditions table

9	ETCS order “Data Available”

17.11.1.16.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.11.1.17 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.11.1.18 (FFFIS STM: 7.3.1.7.1) In DA state, a National STM is responsible for the train movement supervision, according to the received national trackside information. A European STM is also responsible for the train movement supervision, according to the received national trackside information, but some parts of the calculations are performed by the ETCS On-board.

17.11.1.19 (SRS: 4.4.17.1.1) The SN mode shall enable an STM to access the following resources via the ERTMS/ETCS on-board equipment; MMI, odometer, train interface and brakes. No supervision functionality is provided by the ERTMS/ETCS on-board equipment.

17.11.1.20 (SRS: 4.4.16.1.1) The SE mode shall permit reuse of supervision functionality in the ERTMS/ETCS on-board equipment such as MA, most restrictive speed profile and gradient. Furthermore, the SE mode shall enable the STM to access

the following resources via the ERTMS/ETCS Onboard; MMI, odometer, train interface and brakes.

17.11.1.21 (FFFIS STM: 5.2.5.5) The STM shall be allowed to apply the emergency brake using the direct interface only when the STM is active (in state “Data Available”) and the ETCS technical mode is SN or SE.

17.11.1.22 (FFFIS STM: 5.2.5.7) The STM shall be allowed to apply the traction cut-off using the direct interface only when the emergency brake application is allowed over the direct interface (see chapter 5.2.5.5).

17.11.1.23 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														x	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x
13	Service Brake command														x	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x

17.12 Transition Start of Mission (non-leading)

17.12.1 Requirements for the activation of the STM at Start of Mission

17.12.1.1 (SRS: 4.6.3) Transitions Conditions Table:

[46]	(Driver selects NON LEADING) AND (train is at standstill)

17.12.1.1.1 (SRS: 4.6.2) Transition Table.

- Mode transition [46] from SB to NL

17.12.1.2 (FFFIS STM: 7.4.1.1.12) The STM Control Function shall send to the STM the current ETCS technical mode

- when the connection between the STM and the STM Control Function is established, and
- whenever the ETCS technical mode changes.

17.12.1.3 (FFFIS STM: 7.3.1.3.4) If an STM in Configuration State detects that the ETCS On-board is in the technical mode Non-Leading or Sleeping, the STM shall request to go to CS state.

17.12.1.4 (FFFIS STM: 7.3.1.3.4.1) Justification: This allows STM operation on Non-Leading or Sleeping cab without data entry.

17.12.1.5 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A4a	("Request CS state" received from STM)

17.12.1.5.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for CS

17.12.1.6 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.12.1.7 (FFFIS STM: 7.4.1.2.4.2) When the state transition order is going to CS state, the STM Control Function shall send an “unconditional order CS state” for the transition A4a, B4a and C4a and a “conditional order CS state” for the transition A4b.

17.12.1.8 (FFFIS STM: 7.4.1.3.1) The STM Control Function shall consider a state transition order as effective immediately after sending the state transition order to the STM.

17.12.1.9 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.12.1.9.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.12.1.10 (FFFIS STM: 7.3.2.2) Transitions conditions table

4a	ETCS unconditional order “Cold Standby”

17.12.1.10.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CO to CS

17.12.1.11 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.12.1.12 (FFFIS STM: 7.3.1.5.1) Being in the state CS, the STM was initialised, tested, configured and is in possession of all required information for operating, but not able to receive a message from the trackside, because the reception is turned off.

17.12.1.13 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C6	(ETCS technical mode has changed from SB to NL or SL) AND (stored level of the ETCS On-board is Level STM X) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3

17.12.1.13.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for HS

17.12.1.14 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.12.1.15 (FFFIS STM: 7.4.1.3.1) The STM Control Function shall consider a state transition order as effective immediately after sending the state transition order to the STM.

17.12.1.16 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.12.1.16.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.12.1.17 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.12.1.18 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.12.1.19 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.12.1.20 (FFFIS STM: 7.3.2.2) Transitions conditions table

6	ETCS order “Hot Standby”

17.12.1.20.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.12.1.21 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.12.1.22 (FFFIS STM: 7.3.1.6.1) Being in the state HS, the STM shall be able to process the information from or to the national trackside.

17.12.1.23 (FFFIS STM: 7.3.1.6.1.1) Note: In HS state, when receiving national trackside information, the STM shall treat this information to be prepared to take in charge the train movement supervision once its state will switch to DA state.

17.12.1.24 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

E9	(ETCS technical mode has changed from SB to NL or SL) AND (stored level of the ETCS On-board is Level STM X) AND (STM X reports "HS state")

17.12.1.24.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for DA

17.12.1.25 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.12.1.26 (FFFIS STM: 7.4.1.3.1) The STM Control Function shall consider a state transition order as effective immediately after sending the state transition order to the STM.

17.12.1.27 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

D16	(the STM Control Function has sent a "DA state transition order") AND (the STM does not report the required state within a maximum delay time of 5 seconds) see 7.4.1.2.3.1 and 7.4.1.2.3.2

17.12.1.27.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.12.1.28 (FFFIS STM: 7.3.2.2) Transitions conditions table

9	ETCS order “Data Available”

17.12.1.28.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.12.1.29 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.12.1.30 (FFFIS STM: 7.3.1.7.1) In DA state, a National STM is responsible for the train movement supervision, according to the received national trackside information. A European STM is also responsible for the train movement supervision, according to the received national trackside information, but some parts of the calculations are performed by the ETCS On-board.

17.12.1.31 (SRS: 4.4.15.1.7 (Non-Leading)) When the ERTMS/ETCS level is STM, the ERTMS/ETCS Onboard equipment shall be responsible for providing the STM with access to various resources such as MMI, Odometer, Juridical Recorder and train interface.

17.12.1.32 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														x	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x
13	Service Brake command														x	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x

17.13 Transition Start of Mission (sleeping)

17.13.1 Requirements for the activation of the STM at Start of Mission

17.13.1.1 (SRS: 4.6.3) Transitions Conditions Table:

[14]	(The “sleeping” input signal is received) AND (train is at standstill) AND (all desks connected to the ERTMS/ETCS on-board equipment are closed)

17.13.1.1.1 (SRS: 4.6.2) Transition Table.

- Mode transition [14] from SB to SL

17.13.1.2 (FFFIS STM: 7.4.1.1.12) The STM Control Function shall send to the STM the current ETCS technical mode

- when the connection between the STM and the STM Control Function is established, and
- whenever the ETCS technical mode changes.

17.13.1.3 (FFFIS STM: 7.3.1.3.4) If an STM in Configuration State detects that the ETCS On-board is in the technical mode Non-Leading or Sleeping, the STM shall request to go to CS state.

17.13.1.4 (FFFIS STM: 7.3.1.3.4.1) Justification: This allows STM operation on Non-Leading or Sleeping cab without data entry.

17.13.1.5 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

A4a	("Request CS state" received from STM)

17.13.1.5.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for CS

17.13.1.6 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.13.1.7 (FFFIS STM: 7.4.1.2.4.2) When the state transition order is going to CS state, the STM Control Function shall send an “unconditional order CS state” for the transition A4a, B4a and C4a and a “conditional order CS state” for the transition A4b.

17.13.1.8 (FFFIS STM: 7.4.1.3.1) The STM Control Function shall consider a state transition order as effective immediately after sending the state transition order to the STM.

17.13.1.9 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.13.1.9.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.13.1.10 (FFFIS STM: 7.3.2.2) Transitions conditions table

4a	ETCS unconditional order “Cold Standby”

17.13.1.10.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CO to CS

17.13.1.11 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.13.1.12 (FFFIS STM: 7.3.1.5.1) Being in the state CS, the STM was initialised, tested, configured and is in possession of all required information for operating, but not able to receive a message from the trackside, because the reception is turned off.

17.13.1.13 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C6	(ETCS technical mode has changed from SB to NL or SL) AND (stored level of the ETCS On-board is Level STM X) AND (STM X reports "CS state") AND (no other STM reports HS state) see 7.4.1.2.3.3

17.13.1.13.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for HS

17.13.1.14 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.13.1.15 (FFFIS STM: 7.4.1.3.1) The STM Control Function shall consider a state transition order as effective immediately after sending the state transition order to the STM.

17.13.1.16 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

C16	(the STM Control Function has sent a state transition order except "DA state transition order" and except "conditional CS state transition order") AND (the STM does not report the required state within a maximum delay time of 10 seconds) see 7.4.1.2.3.2

17.13.1.16.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.13.1.17 (FFFIS STM: 7.6.1.5) When an STM in CS state receives an order to go in HS state or in DA state, the STM shall immediately open all connections to the required ETCS On-board functions.

17.13.1.18 (FFFIS STM: 7.6.1.5.1) Exception: If the ETCS technical mode is SL, the STM shall not open a connection to the ETCS DMI function.

17.13.1.19 (FFFIS STM: 7.4.2.4.1) The ETCS TIU Function shall transmit train interface status /availability to any STM which is connected to the ETCS TIU Function on the following events:

- When a connection is established
- Whenever a TIU status / availability changes.

17.13.1.20 (FFFIS STM: 7.4.2.4.2) The ETCS Brake Function (BIU) shall transmit the brakes state to any STM which is connected to the ETCS Brake Function on the following events:

- When a connection is established
- Whenever a Brake status changes.

17.13.1.21 (FFFIS STM: 7.3.2.2) Transitions conditions table

6	ETCS order “Hot Standby”

17.13.1.21.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.13.1.22 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.13.1.23 (FFFIS STM: 7.3.1.6.1) Being in the state HS, the STM shall be able to process the information from or to the national trackside.

17.13.1.24 (FFFIS STM: 7.3.1.6.1.1) Note: In HS state, when receiving national trackside information, the STM shall treat this information to be prepared to take in charge the train movement supervision once its state will switch to DA state.

17.13.1.25 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

E9	(ETCS technical mode has changed from SB to NL or SL) AND (stored level of the ETCS On-board is Level STM X) AND (STM X reports "HS state")

17.13.1.25.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for DA

17.13.1.26 (FFFIS STM: 7.4.1.2.4) When the conditions within the STM Control Function are valid according to 7.4.1.2.2 and 7.4.1.2.3, the STM Control Function shall send the corresponding state transition order to the STM.

17.13.1.27 (FFFIS STM: 7.4.1.3.1) The STM Control Function shall consider a state transition order as effective immediately after sending the state transition order to the STM.

17.13.1.28 (FFFIS STM: 7.4.1.2.3) STM state order conditions table (ETCS On-board STM Control Function)

D16	(the STM Control Function has sent a "DA state transition order") AND (the STM does not report the required state within a maximum delay time of 5 seconds) see 7.4.1.2.3.1 and 7.4.1.2.3.2

17.13.1.28.1 (FFFIS STM: 7.4.1.2.2) STM state order table (ETCS On-board STM Control Function)

- STM state order for FA in case the STM does not change the state within the required time

17.13.1.29 (FFFIS STM: 7.3.2.2) Transitions conditions table

9	ETCS order “Data Available”

17.13.1.29.1 (FFFIS STM: 7.3.2.1) Transitions table for STM

- Transition from CS to HS

17.13.1.30 (FFFIS STM: 7.3.4.4) The STM shall report its current state to any ETCS Function

- when the connection between the STM and the ETCS Function is established, and
- with each transmitted application message from the STM to the ETCS Function.

17.13.1.31 (FFFIS STM: 7.3.1.7.1) In DA state, a National STM is responsible for the train movement supervision, according to the received national trackside information.

A European STM is also responsible for the train movement supervision, according to the received national trackside information, but some parts of the calculations are performed by the ETCS On-board.

17.13.1.32 (SRS: 4.4.6.1.9 (Sleeping)) When the ERTMS/ETCS level is STM, the ERTMS/ETCS Onboard equipment shall be responsible for providing the STM with access to various resources such as ~~MMI,~~ Odometer, Juridical Recorder and train interface.

17.13.1.33 (FFFIS STM: 5.2.10.1) The STM shall be allowed to access the ETCS On-board functions according to the following table:

- x = access is allowed in all Levels
- (x) = access is allowed in all Levels if possible
- s = access is allowed for an active STM (in state “Data Available”) only in the Level STM

No.	ETCS ON-BOARD FUNCTIONS available for STMs	NP	SB	SH	FS	SR	OS	SL	NL	UN	TR	PT	SF	IS	SE	SN	RV
1	STM Control Function		x	x	x	x	x	x	x	x	x	x			x	x	x
2	Reference Clock		x	x	x	x	x	x	x	x	x	x			x	x	x
3	European Supervision														s		
4	DMI								s						s	s	
5	DMI preliminary requests (see 10.5.2.6)		x		x	x	x		x	x	x	x			x	x	x
6	JRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
7	DRU		x	x	x	x	x	x	x	x	x	x	(x)		x	x	x
8	Odometer		x	x	x	x	x	x	x	x	x	x			x	x	x
9	TIU command (Train Interface FFFIS STM signals)							s	s						x	x	
10	TIU status (Train Interface FFFIS STM signals)		x	x	x	x	x	x	x	x	x	x			x	x	x
11	Emergency Brake command														x	x	
12	Emergency Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x
13	Service Brake command														x	x	
14	Service Brake status		x	x	x	x	x	x	x	x	x	x			x	x	x