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ERTMS/ETCS – Class 1

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FIS for the Train Interface

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<tr><td colspan="2">
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ISSUE :   2.0.0
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Company	Technical Approval	Management approval
ADTRANZ		
ALCATEL		
ALSTOM		
ANSALDO SIGNAL		
INVENSYS RAIL		
SIEMENS		

1. MODIFICATION HISTORY

Issue Number Date	Section Number	Modification / Description	Author
Draft 27.07.99	All	Initial Draft for class 1	Uwe Dräger
Draft 01 30.08.99	All	After internal review and STM meeting	U.D
0.1.1 24.09.99	All	Including review comments from Siemens, Adtranz	U.D
1.0.0 11.10.99	All	Final Version	U.D.
1.0.1 31.01.2000	All	Update to SRS 2.0.0	U.D.
1.0.2 14.02.2000	All	Including internal and Alstom comments	U.D.
1.0.3 22.02	5.2.1, 5.2.6; 5.3.2, 5.3.3, 5.3.4, 5.3.7, 5.3.8, 5.4.2, 5.4.3, 5.4.4, 5.4.5, 5.5, 6(no5.1.1),6(no5.2.6) 6(no5.3.4), 6(no5.6.2), 7(no5.3.1), 8, 9, 10	Including comments from Adtranz, Alstom	U.D.
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1.1.1a 29.03.2000	3.2.1.2, 3.2.1.3, 4, 5, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.2.2, 5.2.8, 5.3.1, 5.3.4, 5.3.6, 5.3.9, 5.3.10, 5.4.2, 5.4.5, 5.6.3, 6, 7, 8, 9, 10	ECSAG comments	U.D.
2.0.0 30.03.00		Final Issue to ECSAG	U.D.

2. TABLE OF CONTENTS

3. GENERAL

3.1   Scope of this document

3.1.1.1   This document describes the functional interface between the ERTMS/ETCS Onboard system and the train as far as mandatory for an interoperable class 1 system. This may include already some information, which are only necessary for the TSI requested STM's.

3.1.1.2   At the time being the Onboard equipment has to respect different interface requirements of different train types. If in future a standardised interface to the train will be available this specification has to be amended to a full FFFIS.

3.2   Introduction

3.2.1.1   All information, which is exchanged between the constituents, is described on a logical level for the communication only. The extent of functions mentioned within the reference documents can go beyond the scope of the class 1 functionality. If this additional functionality is not part of the interoperability for the ETCS system or for the STM's then they are not part of the standardisation process of UNISIG.

3.2.1.2   All necessary functions are described in section 5 on a functional level and listed as input variables in section 6 and as output variables in section 7 with his logical content.

3.2.1.3   The availability of all mentioned input and output functions on all types of trains or train sets have not been investigated up to now. Therefore, as a first step in chapter 8 are all functions classified by M/O where the function is only mandatory if it is already available onboard.

3.3   References

ECSAG: ERTMS/ETCS FRS v 4.29 Dated 03/12/99

EEIG: 97E117 : TIU FFFIS   Document version : 4- Distribution date: 31/07/98

99E385 : General ERTMS/ETCS « Radio Related Requirements »
            Document version : 3 Distribution date : 09/07/99

UNISIG: SUBSET-026-1 System Requirements Specification (Class 1)
            Chapter 1: Introduction
            Issue 2.0.0 Date: 991222

SUBSET-026-2 System Requirements Specification (Class 1)
            Chapter 2: Basic System Description
            Issue 2.0.0 Date: 991222

SUBSET-026-3 System Requirements Specification (Class 1)
            Chapter 3: Principles
            Issue 2.0.0 Date: 991222

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SUBSET-026-4 System Requirements Specification (Class 1)
Chapter 4: Modes and Transitions
Issue 2.0.0 Date: 991222

SUBSET-026-5 System Requirements Specification (Class 1)
Chapter 5: Procedures
Issue 2.0.0 Date: 991222

EMSET: CB3 Speed Sensor Simulator   Version 1.5 [13]

WP 2.5.1.5.1/REN/Board_design   Issue: 0.1, Nov 97

3.4 Abbreviations

ASFA	STM for Spanish national ATP system
AWS	STM for English national ATP system
BACC	STM for Italian national ATP system
EBICAB	STM for Swedish/Finnish/Portuguese/Norwegian ATP system
EEIG	European Economic Interest Group
EMSET	European Madrid Seville ETCS Test
ETCS	European Train Control System
ERTMS	European Rail Traffic Management System
EVC	European Vital Computer (Kernel)
FFFIS	Form Fit Functional Interface Specification
FIS	Functional Interface Specification
Indusi	STM for German national ATP system
KVB	STM for French national ATP system
Kernel	European Vital Computer (EVC)
Loco	Locomotive / Train
LZB	STM for German national ATP system
MMI	Man Machine Interface
RSDD	STM for Italian national ATP system
SDMU	Speed and Distance Measurement Unit
STM	Specific Transmission Module
TI	Train Interface
TSI	Technical Specification for Interoperability
TVM	STM for French national ATP system
UNISIG	Alliance of European Railway Signal Industry

4. SYSTEM ARCHITECTURE

In the following figure the general configuration of the specified interface is shown.

The interface is described on a functional level, the technical and physical details depend on the individual train.

Configuration for the Train:
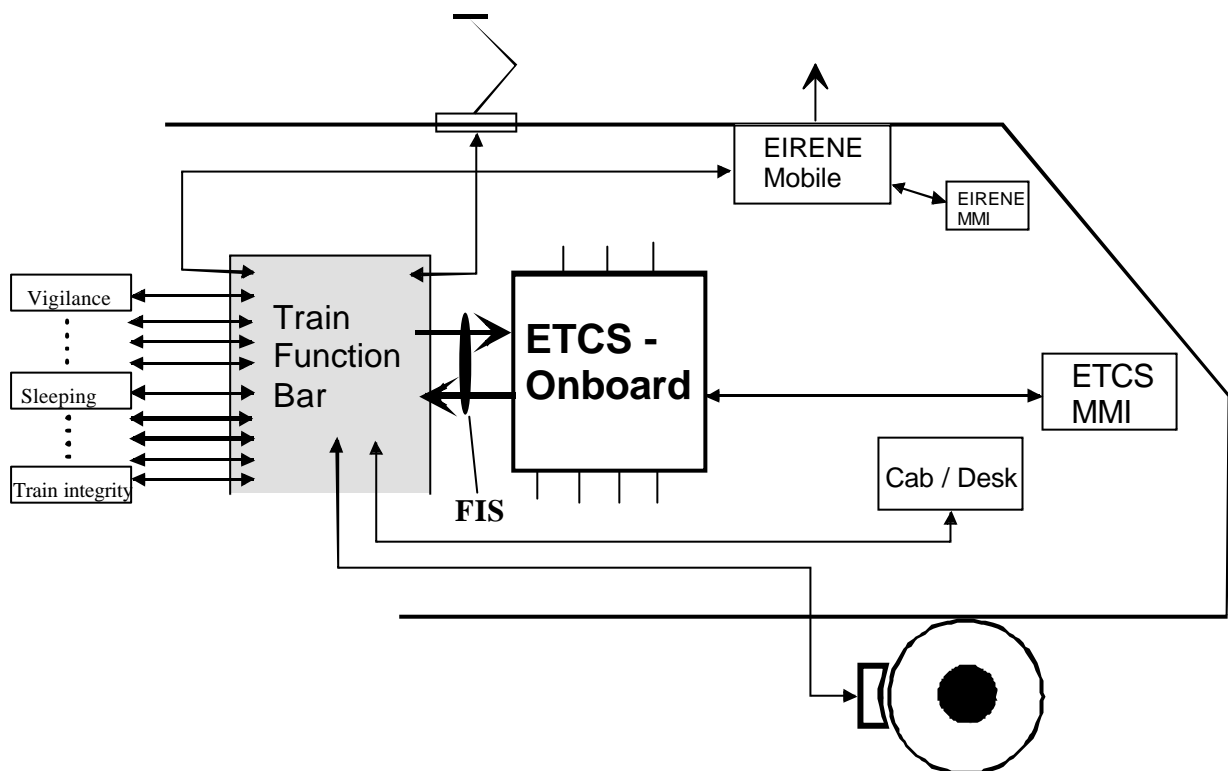
Note: The "Train Function Bar" is an imaginary point in the train where the information of each function can be drawn or given to.

5. FUNCTIONAL INTERFACE DESCRIPTION

In the following chapter the functions are described which exchange information between the Kernel (ETCS Onboard equipment) and the train based on the interoperability requirements. The exchange of data between the Kernel (ETCS Onboard equipment) and the train will take place by Boolean input or output information.

- Output means that the date flows from the ETCS Onboard equipment to the train

- Input means that the data flows from the train to the ETCS Onboard equipment

A summarising table of all mentioned functions with a reference in the FRS and SRS is given in chapter 8

5.1 Mode control functions

5.1.1 Sleeping

Input information to the Onboard equipment will be preferably derived from the remote control of the engine. It may be requested from the driver to select this information manually (outside the scope of the ERTMS MMI). The Onboard equipment will not make any distinction how this information is created. If ever possible it shall be automatically detected by the remote control coupling of the slave engine and controlled from the leading engine.

This is only an input information.

5.1.2 Isolation

This will be used as an input information to the Onboard equipment. It just informs the Onboard equipment that it has been switched into isolation. The Onboard system will use this information for recording purpose Onboard and if a communication is available it will be send to the trackside. The information is derived from outside ETCS.

This is only an input information.

5.1.3 LZB Störschalter

This information indicates to the onboard system that the LZB STM is isolated from his communication path. He will therefore not be available in case if activation requested from the onboard system.

This is an input information only.

5.1.4 Indusi Störschalter

This information indicates to the onboard system that the Indusi STM is isolated from his communication path. He will therefore not be available in case if activation requested from the onboard system.

This is an input information only.

5.2 Control of brakes

5.2.1 Service Brake

In case of applying the service brake, the "apply service brake" command shall be transmitted to the train (e.g. actual speed exceeds the service brake intervention curve by the trains speed in the Onboard equipment).

When the Onboard equipment no longer requests the application of the service brake, the "apply service brake" command shall be revoked.

This is an input (status information) and output information (command) of the Onboard system.

Note: It is dependent on the braking system of the train if this revocation triggers the brake release, or if the driver has to release the brakes.

5.2.2 Emergency Brake

In case of applying the emergency brake, the "apply emergency brake" command shall be transmitted to the train.

When the Onboard equipment no longer requests the application of the emergency brake, the "apply emergency brake" command shall be revoked.

This is an output information of the Onboard system. If a status information is available in the train then it will be also an input information for the recording. In any cases where this information about the reaction of the emergency brake can be derived from other already available information it is not requested to use this additional information.

Note: It is dependent on the braking system of the train if this revocation triggers the brake release, or if the driver has to release the brakes.

5.2.3 Regenerative brake

The use of a regenerative brake can be suppressed or allowed based on the track information. This information shall be given with a starting point and the length to the train logic.

This is an output information from the Onboard system.

5.2.4 Magnetic shoes

The use of a magnetic shoes system (magnetic brake system) can be suppressed or allowed based on the track information. This information shall be given with a starting point and the length to the train logic.

This is an output information from the Onboard system.

5.2.5 Eddy current brake

The use of an Eddy current brake system can be suppressed or allowed based on the track information. This information shall be given with a starting point and the length to the train logic.

This is an output information from the Onboard system.

5.2.6 Brake pressure

This information from the brake pipes needs to be logged in certain countries and STM's.

This is an input information to the Onboard system to be recorded in the JRU.

5.2.7 Brake handle

This information is the status of the drivers brake handle. It contains the information if the driver requested a brake. This will be requested by some STM's.

This is an input information to the Onboard system.

5.2.8 Inhibit passenger emergency brake

The passenger requested emergency brake application should be evaluated by the Onboard system. Based on the known track description a passenger emergency brake is allowed or not allowed. The passenger emergency brake request will be indicated to the driver. This information will be given with a starting point and the length to the train logic.

Depending on the national solution this can be an input and/or an output information to or from the onboard system.

Note: It is dependent on the brake system of the train if the driver has to release the passenger emergency brake if applied within a forbidden zone or to activate the brake as stated in the (national) operating rules.

5.3 Control of Train / Engine

5.3.1 Change of traction power

This order from the Onboard equipment to the Train will be given in case of handling several traction powers or frequencies. This command will include the location and distance. If available the kind of traction power the train must switch to can be included. Railways may decide that this is driver's duty to handle this.

This is an output information from the Onboard system.

5.3.2 Pantograph

The control of the pantograph can be made manually by the driver or based on the track description from the Onboard equipment to the dedicated train device, which handles this function automatically.. The Onboard equipment shall transmit, to the driver and to the train device, the "Powerless section" track condition which defines the area (starting point and length) where the pantograph must be in the low position (the initial state is : pantograph up). The driver (or the train device) is responsible for commanding the pantograph in advance, such that the pantograph is correctly lowered when the train reaches the "powerless section" area. The reaction time of the pantograph depends on the train type. The requested activity will be displayed on the MMI.

This is an output information of the Onboard system.

5.3.3 Air tightness / Flap control (Air condition)

This function can be requested on certain parts of a line (e.g. in tunnels). The order to close or open the flaps is given from ETCS to protect passengers from air pressure shocks when passing through tunnels at high speed etc. or similar. The order includes the location and the length. Railways may decide that it is drivers duty to handle this.

This is an output information of the Onboard system.

This TIU data flow is out of the scope of class 1

5.3.4 Door control

If the door control is supported by the Onboard equipment it will allow opening or locking the doors. The door opening command is linked to the platform side based on the information in the track description. The door device gives his status back to the Onboard equipment. Railways may decide that it is drivers duty to handle this.

This is an input and output information of the Onboard system.

This TIU data flow is out of the scope of class 1

5.3.5 Tilting

Information is the status from an external tilting device to the Onboard equipment.

This is an input information of the Onboard system.

5.3.6 Main switch / Circuit breaker

If there is the necessity at a certain location of the track to shut down the power of the train this function will be performed by the Onboard equipment or manually by the driver based on the received track data.

This is only an output information from the Onboard system.

This function is only an option and out of the scope of class 1

5.3.7 Traction cut off

This is a command from the ETCS Onboard equipment to the train. This data flow is part of the braking model. Railways may decide that it is drivers duty to handle this.

This is an output information.

5.3.8 Automatic Train Driving

This function is intended to allow ETCS to operate the train in conjunction with an automatic driving control system. It includes half and full service brake commands which will be implemented by the ATO. An external device will perform this function. Railways may decide that it is drivers duty to handle this.

This is only an output information from the Onboard system.

This TIU data flow is out of the scope of class 1

5.3.9   Coupling Status

This Information into the Onboard system indicates that the train part is coupled to another train. It should give clear information which end of the train is coupled or uncoupled. The information is requested for STM only.

This is only an input information to the onboard system.

5.3.10 Cold Movement Detector

This is an information from outside the ETCS system that the train was moved or not moved during the period the ETCS Onboard system was not powered.

This is only an input information to the Onboard system.

5.4 Cab Status information

5.4.1 Direction controller position

This information from the train to the Onboard equipment is needed for the Roll Away protection of the train. There are three main states available (Forward, Neutral, Backward).

This is only an input information to the Onboard system.

5.4.2 Cab Status (Desk status)

This "Desk status" allows the detection if a driving desk is active (open) in cabin A or B of the train.

This is only an input information to the Onboard system.

5.4.3 Vigilance action

Vigilance is for running trains in most countries necessary and needs to be implemented as an information from the train. It is also requested for various STM's. The information will be received from an external device of driver supervision. The Onboard equipment will not perform the supervision of the driver reaction but it will distribute the information to the STM's.

This is an input information of the Onboard system.

This function is not part of Class 1.

5.4.4 Vigilance Disable

Vigilance is not required under certain national conditions. The signal allows external vigilance device to become idle.

This is an output information from the Onboard system given by an active STM.

5.4.5 Vigilance Reset

Vigilance reset is a signal from the ETCS Onboard to an external vigilance device in order to avoid requesting unnecessary actions by the driver. This functionality is only requested in STM mode of operation for some national STM's. If the driver manipulates the ETCS or STM MMI, the external vigilance device is notified by this signal. It may then reset its internal timer. The signal has the same effect as an action on the vigilance manipulator (pedal). Timeout value is not affected.

This is an output information from the Onboard system.

5.5 Train integrity

This is not part of the mandatory class 1 functionality.

This information can be delivered from an external device of the train to the Onboard equipment or if not available replaced by an manual operation by the driver. It is necessary for Level 3 functionality.

This information is not available on existing train sets or traction units.

This is only an input information to the Onboard system.

5.6 EIRENE-Radio related functions

5.6.1 Train running number

The train running number (train operational number) has to be exchanged between the EIRENE mobile station and the Onboard system. They both have to use the same number during a mission.

This is an input or output information of the Onboard system.

5.6.2 Juridical recording data

For recording purposes juridical data from the EIRENE mobile station have to be stored within the Onboard juridical recorder. Further details see at Subset 027 FFFIS for the Juridical Recorder / Download Tool.

This is only an input information to the Onboard system.

5.6.3 Emergency button/ Radio Alert

The Emergency button at the EIRENE MMI is a radio related function and can be operated by the driver in any cases of danger he detects on a track. This Radio Alert information will be received or transmitted by the radio system. This is a EIRENE function only and not part of the ETCS Onboard system.

The Onboard system will only record (JRU) this function;

This is only an input information to the Onboard system

6. INPUT VARIABLES TO THE ONBOARD EQUIPMENT

In the following list only these input information listed which are necessary for the class 1 functionality or already known for the STM's

Name of Function No 5.1.1	Sleeping
Data Characteristics	Boolean input;
Values	Information not Available Go to Sleeping Do not go to Sleeping Fail State

Name of Function No 5.1.2	Isolation
Data Characteristics	Boolean input;
Values	Information not Available Isolated (ETCS equipment is isolated) Not Isolated Fail State

Name of Function No 5.1.3	LZB Störschalter
Data Characteristics	Boolean input;
Values	Information not Available LZB is isolated) LZB is not isolated Fail State

Name of Function No 5.1.4	Indusi Störschalter
Data Characteristics	Boolean input;
Values	Information not Available Indusi is isolated) Indusi is not isolated Fail State

Name of Function No 5.2.1	Input from service brake
Data Characteristics	Boolean input;
Values	Information not Available Service brake applied Service brake released Fail State

Name of Function No 5.2.2	Input from emergency brake
Data Characteristics	Boolean input;
Values	Information not Available Emergency brake applied Emergency brake released Fail State

Name of Function No 5.2.6	Brake pressure
Data Characteristics	Boolean input;
Values	Information not Available Brakes not applied Brakes applied (at a level less than half service brake) Rest tbd

Name of Function No 5.2.7	Brake handle
Data Characteristics	Boolean input;
Values	Information Brake handle not Available Brake handle in Neutral position Brake handle in Brake position Fail state

Name of Function No 5.2.8	Inhibit Passenger Emergency Brake
Data Characteristics	Boolean input;
Values	Information not Available
	Passenger emergency brake is inhibited
	Passenger emergency brake is not inhibited
	Fail State

Name of Function No 5.3.4	Input from Door control
Data Characteristics	Boolean input;
Values	Information not Avail
	Both side doors unlocked/open
	Left side unlocked/open
	Right side unlocked/open
	Doors locked on both sides
	Fail State

Name of Function No 5.3.5	Input from Tilting
Data Characteristics	Boolean input;
Values	Information not Available
	Tilting system is active
	Tilting system is passive
	Fail State

Name of Function No 5.3.9	Coupling Status
Data Characteristics	Boolean input;
Values	Information not Available
	Cab A is coupled
	Cab B is coupled
	Both sides uncoupled
	Both side coupled
	Fail State

Name of Function No 5.3.10	Cold Movement Detector
Data Characteristics	Boolean input;
Values	Information not Available
	Train has moved
	Train has not been moved
	Fail State

Name of Function No 5.4.1	Direction controller position
Data Characteristics	Boolean input;
Values	Information not Available
	Direction controller in neutral
	Direction controller in forward
	Direction controller in backward
	Fail State

Name of Function No 5.4.2	Cab Status (Desk status (activation))
Data Characteristics	Boolean input;
Values	Information not Available
	Desk A open
	Desk B open
	Desk A and B open
	Both Desks closed
	Fail State

Name of Function No 5.4.3	Vigilance action
Data Characteristics	Boolean input;
Values	Information not Available
	Driver reaction
	No driver reaction
	Fail State

Name of Function No 5.5.	Train integrity
Data Characteristics	Boolean input;
Values	Information not Available Train integrity ok Train integrity lost Faile state

Name of Function No 5.6.1	Train running number
Data Characteristics	Integer input;
Values	Information not Available Rest tbd

Name of Function No 5.6.2	Juridical recording data from EIRENE
Data Characteristics	Integer input;
Values	Activation of Cab radio emergency call button Receipt of incoming Railway emergency call Termination of outgoing or incoming Railway emergency call Radio faults Driver safety device alarm message transmission Details of conformation of Railway emergency call Rest tbd

Name of Function No 5.6.3	Emergency Alert/Button (Radio Related Function)
Data Characteristics	Boolean input;
Values	Information not Available Rest tbd

7. OUTPUTS VARIABLES TO THE TRAIN

In the following list only these output information listed which are necessary for the class 1 functionality or already known for the STM's

Name of Function No 5.2.1	Service Brake Command
Data Characteristics	Boolean output;
Values	Command apply service brake
	Command release service brake

Name of Function No 5.2.2	Emergency Brake Command
Data Characteristics	Boolean output;
Values	Command apply emergency brake
	Command release emergency brake

Name of Function No 5.2.3	Regenerative brake
Data Characteristics	Integer output;
Values	Command regenerative brake allowed (on) with location, distance, speed and length
	Command regenerative brake passive (off) with location, distance, speed and length

Name of Function No 5.2.4	Magnetic shoes
Data Characteristics	Integer output;
Values	Command magnetic shoes allowed (on) with location, distance, speed and length
	Command magnetic shoes passive (off) with location, distance, speed and length

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Name of Function No 5.2.5	Eddy current brake
Data Characteristics	Integer output;
Values	Command eddy current brake allowed (on) with location, distance, speed and length
	Command eddy current brake passive (off) with location and length

Name of Function No 5.2.8	Inhibit Passenger Emergency Brake
Data Characteristics	Integer output;
Values	Inhibit passenger emergency brake with location, distance, speed and length
	Allow passenger emergency brake

Name of Function No 5.3.1	Change of traction power
Data Characteristics	Integer output;
Values	Keep the current setting (initial state)
	Chance traction power :location, distance, speed and kind
	Rest tbd

Name of Function No 5.3.2	Pantograph
Data Characteristics	Integer output;
Values	Command Pantograph lift
	Command Pantograph lower (with location, distance, speed and length)

Name of Function No 5.3.3	Air tightness / Flap control (Air condition)
Data Characteristics	Integer output;
Values	Command open flap (air condition on) with location, distance, speed and length
	Command close flap (air condition off) with location, distance, speed and length

Name of Function No 5.3.4	Door control
Data Characteristics	Integer output;
Values	Command open both sides with distance
	Command lock all doors
	Command open on the left side with location, distance, speed
	Command open on the right side with location, distance, speed

Name of Function No 5.3.6	Main switch / circuit breaker
Data Characteristics	Integer output;
Values	Command Main switch on with location, distance, speed
	Command Main switch off with location, distance, speed and length

Name of Function No 5.3.7	Traction cut off
Data Characteristics	Integer output;
Values	Command traction cut off with location, distance, speed and length
	Command do not cut traction off

Name of Function No 5.3.8	Automatic Train Driving
Data Characteristics	Integer output;
Values	Tbd

Name of Function No 5.4.4	Vigilance Disable
Data Characteristics	Boolean output;
Values	Disable external vigilance device
	Enable external vigilance device

Name of Function No 5.4.5	Vigilance Reset
Data Characteristics	Boolean output;
Values	Driver activity (derived from the STM MMI)
	No driver activity (derived from the STM MMI)

Name of Function No 5.6.1	Train running number
Data Characteristics	Integer output;
Values	T.b.d. Radio related

8. REFERENCE OF FUNCTIONS IN SRS AND FRS

Chapter No	Req	Name of function	Reference in the SRS	FRS
5.1.1	M	Sleeping	4.4.6 / 4.6.3	4.1.6 / 5.2
5.1.2	M	Isolation	4.6.3 / 4.4.3.1.1	3.3.1.4b / 4.1.6
5.1.3	M/O	LZB Störschalter	STM LZB	
5.1.4	M/O	Indusi Störschalter	STM Indusi	
5.2.1	M	Service brake	3.13.4.6	4.3.7/ 3.9.1.2c
5.2.2	M	Emergency brake	3.13.4.7	4.3.2.5
5.2.3	M/O	Regenerative brake	3.12.1.3	4.3.7/ 3.9.1.2c
5.2.4	M/O	Magnetic shoes	3.12.1.3	4.3.7/ 3.9.1.2c
5.2.5	M/O	Eddy current brake	3.12.1.3	4.3.7/ 3.9.1.2c
5.2.6	M/O	Brake pressure	STM EBICAB	4.1.1.10b
5.2.7	M/O	Brake handle	STMEBICAB	
5.2.8	M/O	Inhibit passenger emergency brake	3.12.1.3	
5.3.1	M/O	Change of traction power	3.12.1.3	4.8.1
5.3.2	M/O	Pantograph	3.12.1.3 / 3.12.1.6	4.8.1
5.3.3	M/O	Air tightness / Flap control / Air condition	3.12.1.3	4.8.2
5.3.4	O	Door control		4.8.4 / 4.8.5
5.3.5	M/O	Tilting	3.11.3.3.1	4.3.1
5.3.6	M	Main switch / Circuit breaker	3.12.1.3	4.8.1
5.3.7	M	Traction cut off	3.13.3.1.4	
5.3.8	O	Automatic Train Driving		4.8.7
5.3.9	M/O	Coupling Status	STM KVB/TVM	
5.3.10	M/O	Cold Movement Detector		
5.4.1	M	Direction controller position	5.12.1	4.3.9
5.4.2	M	Cab Status (Desk status)	5.12.2 / 4.4.18.1.7	3.8.1.1 / 4.1.1.2
5.4.3	M/O	Vigilance	STM KVB/TVM/EBI	4.3.8
5.4.4	M/O	Vigilance Disable	STM KVB/TVM/EBI	
5.4.5	M/O	Vigilance Reset	STM KVB/TVM/EBI	
5.5	M/O	Train integrity	3.6.5.2.1	4.3.4 / 4.9.5
5.6.1	M	Train running number	5.4.3.4.4	4.1.2 / 4.7.1
5.6.2	M	Juridical recording data	3.19.1	3.3.1.7 / 4.3.10
5.6.3	M	Emergency button / Radio Alert	3.19.1	4.3.6

Remark: The column "Req" is listing the functions, which are marked as mandatory in the FRS except if in the column "Reference in the SRS" STM is marked. Then this is only requested by the interoperability of a certain STM. If it is marked as M/O it is only "conditional mandatory" and the final

decision depends on the availability on that certain train where the ETCS system is installed. If a function is mentioned as "O" then it is optional for every train.

9. PHYSICAL INTERFACE

Due to the existing trains a physical specification of the interface is not possible or achievable at the moment. Therefore, If a FFFIS will be requested this specification has to be amended later.

At the time being each Onboard equipment has to take care of the relevant existing interfaces at the train side for the different functions.

10. SAFETY REQUIREMENTS TO THE COMMUNICATION

Since there is no common interface to the train available it is not possible to give details to the safety layer.