



ERTMS/ETCS

Train Interface FFFIS

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1. INTRODUCTION

1.1 Scope and Purpose

1.1.1.1 This interface specification defines the form fit functional interface between the ERTMS/ETCS on-board equipment and the vehicle. It is the physical implementation of the interface that is functionally specified in [7]. The references for each function specified in [7] are shown in Table 1-1. The safety analysis for each signal is specified in [8] shall be considered along with this subset.

Section of Subset-119	Name	Section of Subset-034
5.1.1	Sleeping	2.2.1
5.1.2	Passive shunting	2.2.2
5.1.3	Non leading	2.2.3
5.1.4	Isolation	2.2.4
5.2.1	Service brake command	2.3.1
5.2.2	Brake pressure	2.3.2
5.2.3	Emergency brake command	2.3.3
5.2.4	Special brake inhibit-Trackside orders	2.3.4
5.2.5	Special brake inhibit-STM Orders	2.3.5
5.2.6	Special brake status	2.3.6
5.2.7	Additional brake status	2.3.7
5.3.2	Change of traction system	2.4.1
5.3.3	Pantograph-Trackside orders	2.4.2
5.3.4	Pantograph-STM orders	2.4.3
5.3.5	Air tightness-Trackside orders	2.4.4
5.3.6	Air tightness-STM orders	2.4.5
5.3.7	Passenger door	2.4.6
5.3.8	Main Power Switch-Trackside orders	2.4.7
5.3.9	Main Power Switch-STM orders	2.4.8
5.3.10	Change of allowed current consumption	2.4.10
5.3.11	Traction Cut-Off	2.4.9
5.4.1	Cab status	2.5.1
5.4.2	Direction Controller	2.5.2
5.4.3	Train integrity	2.5.3

Section of Subset-119	Name	Section of Subset-034
5.4.4	Traction status	2.5.4
5.5.1	Type of train data entry	2.6.1
5.6	National System isolation	2.7

Table 1-1 Cross references between Subset-034 and Subset-119

- 1.1.1.2 This interface specification aims at minimising the number of interfaces/components needed for the integration of ERTMS/ETCS on-board equipment into a vehicle.
- 1.1.1.3 In order to cover different applications, any Rolling Stock having an ERTMS/ETCS on-board from basic diesel locomotives to high tech train sets, and from existing rolling stock to new trains, several solutions are specified and all shall be supported by ERTMS/ETCS on-board.

1.2 Document Structure

- 1.2.1.1 Chapter 1 describes the scope and purpose of the document, the terms and abbreviations and the references
- 1.2.1.2 Chapter 2 describes the architecture of the interface and the naming conventions.
- 1.2.1.3 Chapter 3 describes the general requirements for the parallel interface.
- 1.2.1.4 Chapter 4 describes the general requirements for the serial interface as well as the specific requirements for the MVB, the CAN and the ECN.
- 1.2.1.5 Chapter 5 describes the requirements for the signals to be exchanged via the TI.

1.3 References

- 1.3.1.1 The following references are used in this document:
 - [1] SUBSET-026 System Requirements Specification
 - [2] ETCS Driver Machine Interface-ERA_ERTMS_015560
 - [3] SUBSET-035 Specific Transmission Module (FFFIS)
 - [4] SUBSET-091 Safety Requirements for the Technical Interoperability of ETCS in Levels 1 & 2
 - [5] TSI LOC&PAS, 2011/291/EU & 2012/464/EU
 - [6] HS TSI RST, 2008/232/EU & 2012/464/EU
 - [7] SUBSET-034 FIS for the Train Interface
 - [8] SUBSET-120 FFFIS TI – Safety Analysis

- [9] SUBSET-080 Failure Modes and Effects Analysis for TIU
- [10] SUBSET-023 Glossary of Terms and Abbreviations
- [11] SUBSET-059 Performance Requirements for STMs
- [12] EN50159 Safety related communication in transmission systems
- [13] IEC61375-1 TCN – Train Communication Network – General Architecture
- [14] IEC61375-2-1 TCN – Train Communication Network - WTB
- [15] IEC61375-2-3 TCN – Train Communication Network – Communication Profile
- [16] IEC61375-3-1 TCN – Train Communication Network – MVB
- [17] IEC61375-3-3 TCN – Train Communication Network – CAN
- [18] IEC61375-3-4 TCN – Train Communication Network – ECN
- [19] EN15734 Railway Applications - Braking Systems of High Speed Trains
- [20] EN16185 Railway Applications - Braking Systems of Multiple Unit Trains
- [21] EN14478 Railway Applications – Brakes
- [22] IEC61158-Serie Profinet
- [23] IEC61784-2/-3-3 Profisafe
- [24] CIP Networks Library from ODVA

1.4 Terms and Abbreviations

1.4.1.1 Only those terms are listed, which are not defined in the ETCS glossary [10]

Option	Option refers to the case in which the parallel interface is used instead of the mandatory serial interface.
Parallel Interface	An interface where each signal is transmitted by a separate pair of wires.
Serial Interface	An interface where multiple signals are transmitted via a bus/network or a point-to-point connection. Three types of busses are considered in section 4.
Solution	Solution refers to a mandatory implementation.
Traction Cut Off	Inhibit positive traction effort (i.e. driving effort).

Brake actuator	Device that physically brakes the train.
Pressure switch	Device that measures pressure in a brake pipe, main pipe or brake cylinder. It is actuated by a change in pressure at a level threshold.
Train integrator	The one responsible for integration of ERTMS/ETCS on-board in the vehicle

Table 1-2 Terms

1.4.1.2 Only those abbreviations are listed, which are not defined in [10].

BW	Backward
CAN	Controller Area Network
CCS	Control-Command and Signalling
CR	Change Request
ECN	Ethernet Consist Network
ECS	Eddy current brake for service brake
ECE	Eddy current brake for emergency brake
FDT	Fault Detection Time as used in [8]
FW	Forward
MG	Magnetic shoe brake
MPU	Main Processor Unit
MVB	Multifunction Vehicle Bus
MSFE	Maximum Safe Front End
mSRE	Minimum Safe Rear End
NID	National Identification
OBU	ERTMS/ETCS On-Board Unit
PG	Pantograph
RIO	Remote Input Output
RB	Regenerative Brake
RST	Rolling Stock

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SDT	Safe Data Transmission like defined in [15]
SID	Safety Identifier
SSC	Safe Sequence Counter
TCMS	Train Control and Monitoring System
TFR	Tolerable Failure Rate
THR	Tolerable Hazard Rate
TR	Train
TSI	Technical Specification for Interoperability

Table 1-3 Abbreviations

2. TRAIN INTERFACE

2.1 Architecture

- 2.1.1.1 The Train Interface specified in this document consists of serial interface and parallel interface.
- 2.1.1.2 Some signals are only supported over serial interface due to the type of data.
- 2.1.1.3 ERTMS/ETCS on-board equipment shall support the serial interface as defined in this specification and the following four signals on the parallel interface: O_EB1_C, O_EB2_C, O_TC1_C, O_IS_S.
- 2.1.1.4 ERTMS/ETCS on-board equipment might also support the signals defined in this specification via the parallel interface. In this case, these signals shall be compliant with this specification.
- 2.1.1.5 Serial data shall not be distributed over more than one type of BUS in one specific application.
- 2.1.1.6 Figure 2-1 shows the OBU (green colour) interfaced to the vehicle (blue colour) via parallel and serial Interface. The interface itself is drawn in red colour.

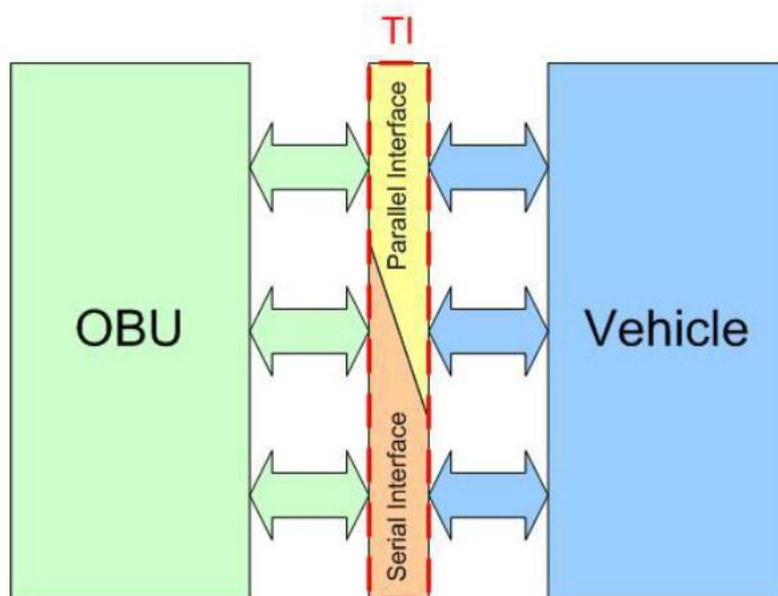


Figure 2-1 Parallel and serial links between vehicle and ERTMS/ETCS on-board equipment

- 2.1.1.7 Parallel interfaces are defined according to the standardized Remote Input Output (RIO) circuits defined in Chapter 3.2
- 2.1.1.8 The ERTMS/ETCS on-board equipment shall support as serial interface one or several of the following types of bus: CAN, MVB and ECN as defined in chapter 4.
- 2.1.1.9 Table 2-1 gives an overview of the functional I/O. Which information shall be transmitted via the serial or parallel interface is marked with “M” for mandatory and which can be transmitted via the parallel interface is marked with ‘O’ for optional. On the other hand ‘-’ refers to a case where it is not supported by the interface. Technical requirements for the implementation are described in Chapters 4 and 5.
- 2.1.1.9.1 The simultaneous use of both parallel and serial interface for the same functionality is only allowed if required to achieve a safety level as defined in [8] (e.g. EB command, solution 3). Otherwise, either serial or parallel interface shall be used for the same function.
- 2.1.1.9.2 If for a given functionality, optionally the parallel interface is used, the corresponding signal on the serial interface shall be provided but shall not be evaluated at the receiving end (either train or ERTMS/ETCS on-board unit according to the source of information).
- 2.1.1.9.3 Exception 1: EB command as described in solution 3 shall use both parallel and serial interface.
- 2.1.1.9.4 Exception 2: TCO command as described in solution 2 shall use both parallel and serial interface.

No	Functional I/O as per [7]	Source	Parallel interface	Serial interface
1	Sleeping	TR	O	M
2	Passive Shunting	TR	O	M
3	Non-Leading	TR	O	M
4	Isolation	OBU	M	-
5	Service Brake Command	OBU	O	M
6	Brake pressure	TR	-	M
7	Emergency brake Command	OBU	M	M
10	Regenerative Brake Inhibit (to be harmonized)	OBU	to be harmonized	to be harmonized

11	Magnetic Shoe Brake Inhibit (to be harmonized)	OBU	to be harmonized	to be harmonized
12	Eddy Current Brakes for Service Brake Inhibit (to be harmonized)	OBU	to be harmonized	to be harmonized
13	Eddy Current Brakes for Emergency Brake Inhibit (to be harmonized)	OBU	to be harmonized	to be harmonized
14	Special Brake Inhibit – STM Orders	OBU	O	M
15	Special Brake Status	TR	O	M
16	Additional Brake Status	TR	O	M
17	Change of Traction System (to be harmonized)	OBU	to be harmonized	to be harmonized
18	Pantograph – Trackside orders (to be harmonized)	OBU	to be harmonized	to be harmonized
19	Pantograph – STM orders	OBU	O	M
20	Air Tightness – Trackside orders (to be harmonised)	OBU	to be harmonized	to be harmonized
21	Air Tightness – STM orders	OBU	O	M
223	Passenger door (to be harmonised)	OBU	to be harmonized	to be harmonized
23	Main Power Switch – trackside orders (to be harmonised)	OBU	to be harmonized	to be harmonized
24	Main Power Switch – STM orders	OBU	O	M
25	Change of allowed current consumption (to be harmonised)	OBU	to be harmonized	to be harmonized
26	Traction Cut-Off	OBU	M	M
27	Cab Status	TR	O	M
28	Direction Controller	TR	O	M

29	Train Integrity (to be harmonized)	TR	to be harmonized	to be harmonized
30	Traction Status	TR	O	M
32	Type of Train Data Entry	TR	O	M
33	Train Data Information (to be harmonized)	TR	to be harmonized	to be harmonized
34	National System Isolation	TR	O	M

Table 2-1 Reference to all functional I/O

2.2 Naming Conventions

2.2.1 Signals on the Parallel Interface

2.2.1.1 The naming conventions are used to ensure identification of each single signal inside of this specification and the associated [8].

2.2.1.2 The name of each signal has the following character structure, where each digit indicates the position of a character: 1_23(4)_5_(6)

2.2.1.3 Character 1: Signal source

T = Train

O = ERTMS/ETCS on-board equipment

2.2.1.4 Character 2+3(+4): Function or signal short name

AT	Air tightness
BM	Brake model
BP	Brake pressure
BW	Backward
CS	Cab status
CT	Change of traction system
EB1	Emergency Brake 1
EB2	Emergency brake 2
ECS	Eddy current brake for service brake
ECE	Eddy current brake for emergency brake

FW	Forward
IS	Isolation
MG	Magnetic shoe brake
NL	Non leading
PG	Pantograph
PD	Passenger Doors
PS	Passive Shunting
RB	Regenerative Brake
SB	Service Brake
SL	Sleeping
TC1	Traction cut-off 1
TC2	Traction cut-off 2
TRI	Train integrity
TR	Traction (Status)
TT1, TT2	Type of train data entry

2.2.1.5 Character 5: Signal class

A	Status Cab A
B	Status Cab B
C	Command
E	Enable
F	Feedback of a command
I	Inhibition
S	Status

2.2.1.6 Character 6 (optional): Contact index or number of relay (1 to m) or type of logic for the signal (non-inverted or inverted):

1	First contact related to the same signal
m	m contact index related to the same signal
N	The non-inverted signal of an antivalent pair.
I	The inverted signal of an antivalent pair.

2.2.1.7 Examples:

O_EB1_C_3 means “Emergency brake 1 command signal contact number 3”.

T_SL_E1_N means “Sleeping enable not inverted signal”.

2.2.2 Signals on the Serial Interface

- 2.2.2.1 The naming conventions are used to ensure identification of the signals on the serial interface inside of this specification and the associated [8].
- 2.2.2.2 The name of each signal has the following structure, where each digit indicates the position: 1_2_3(_4_5)
- 2.2.2.3 1: Signal source
 - TR = Train side
 - OBU = ERTMS/ETCS on-board equipment
- 2.2.2.4 2: Signal sink
 - TR = Train
 - OBU = ERTMS/ETCS on-board equipment
- 2.2.2.5 3: signal name in a readable form, giving information about the corresponding function
- 2.2.2.6 4_5: if necessary, more detailed information about the signal/function (Status, Feedback, information about possible iterations, additional names, explanation if signal is inverted)

3. GENERAL REQUIREMENTS FOR THE PARALLEL INTERFACE

3.1 General Requirements

- 3.1.1.1 For the ERTMS/ETCS on-board the parallel interface for the signals specified in clause 2.1.1.3 is mandatory. It shall comply with the requirements in this section.
- 3.1.1.2 The cabling between the vehicle and the ERTMS/ETCS on-board is within the responsibility of the vehicle.

3.2 Reference Input and Output Architecture (RIO)

- 3.2.1.1 Output refers to the information from the OBU to the vehicle.
- 3.2.1.2 Input refers to the information from the vehicle to the OBU.
- 3.2.1.3 For binary inputs and outputs the following architecture is defined:

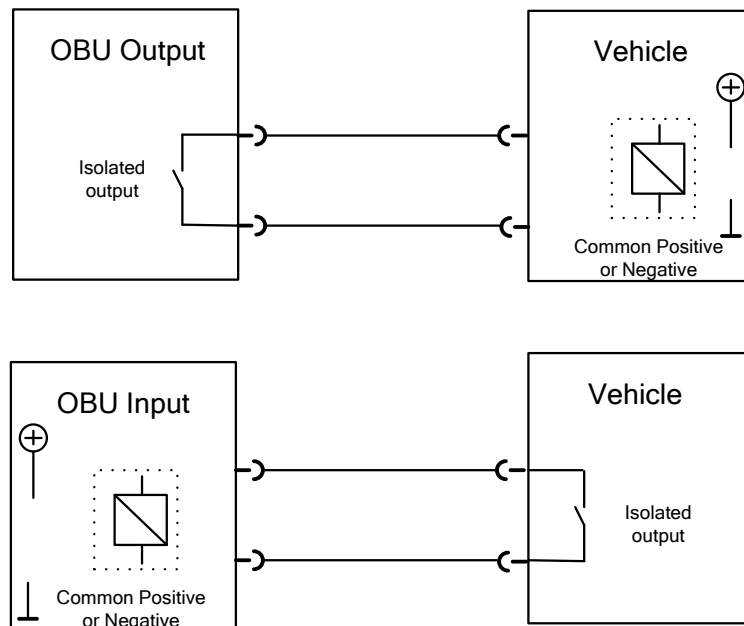


Figure 3-1 Reference I/O pair

- 3.2.1.3.1 Note1: Figure represents the functionality of an isolated output, but it is not restricted to a specific design.

3.2.1.3.2 Characteristics for input signals are specified by the ERTMS/ETCS on-board power supply, whereas the characteristics for the output signals are specified by the vehicle power supply.

3.2.1.3.3 Characteristics for input and output signals are listed in the Table 3-2 and Table 3-3.

3.2.1.4 Definition of signal states:

Signal	Output	Level
0	Open (high impedance)	Low
1	Closed (low impedance)	High

Table 3-1 Definition of signal states

3.3 Boolean OBU Inputs

3.3.1.1 Inputs shall have the following characteristics:

Characteristic	Value
Max. voltage between pins	<ul style="list-style-type: none"> • 24 V + overvoltage according EN 50155 • 48 V + overvoltage according EN 50155 • 72 V + overvoltage according EN 50155 • 96 V + overvoltage according EN 50155 • 110 V + overvoltage according EN 50155
Max. input current in High level ^{*1}	<ul style="list-style-type: none"> • 200 mA for 24 V nominal voltage • 100 mA for 48 V nominal voltage • 60 mA for 72 V nominal voltage • 50 mA for 96 V and 110 V nominal voltage
Max. L/R ^{*2}	<ul style="list-style-type: none"> • 40ms
Min. input current in High level ^{*1}	<ul style="list-style-type: none"> • 4 mA for 24 V nominal voltage • 4 mA for 48V nominal voltage • 3 mA for 72V nominal voltage • 2 mA for 96V nominal voltage • 2 mA for 110V nominal voltage • Otherwise: 1 mA and transient peak
Max. input current that has to be detected as Low level ^{*3*1}	<ul style="list-style-type: none"> • 250µA

Table 3-2 Characteristics for OBU Boolean Inputs

3.3.1.1.1 *1: Input current is the current that flows through the input pin.

3.3.1.1.2 *2: L/R is the fraction of inductance over the resistance of the load.

3.3.1.1.3 *3: Higher currents could also be detected as Low level, but should be avoided by the vehicle output.

3.4 Boolean OBU Outputs

3.4.1.1 Outputs shall comply with the following characteristics:

Characteristic	Value
Max. voltage between output pins in “Open” state	<ul style="list-style-type: none"> • 24 V + over-voltage according EN 50155 • 48 V + over-voltage according EN 50155 • 72 V + over-voltage according EN 50155 • 96 V + over-voltage according EN 50155 • 110 V + over-voltage according EN 50155
Max. continuous current through output in “Closed” state	<ul style="list-style-type: none"> • 1 A for 24 V nominal voltage • 0.5 A for 48 V nominal voltage • 0.3 A for 72 V nominal voltage • 0.2 A for 96 V and 110 V nominal voltage
Lowest possible output current in Closed status	High Power Outputs
	<ul style="list-style-type: none"> • 15 mA for 24 V nominal voltage • 15 mA for 48 V nominal voltage • 13 mA for 72 V nominal voltage • 10 mA for 96 V nominal voltage • 10 mA for 110 V nominal voltage
	Low Power Outputs
	<ul style="list-style-type: none"> • 4 mA for 24 V nominal voltage • 4 mA for 48 V nominal voltage • 3 mA for 72 V nominal voltage • 2 mA for 96 V nominal voltage • 2 mA for 110 V nominal voltage
Max. leakage current in Open status at any voltage	250µA
Max. L/R* ¹	40 ms

Characteristic	Value
Max. allowed time for a signal with two independent outputs to be invalid in transition phase	100 ms (this time covers switching time between independent outputs and contact bouncing time)
Output durability (in operating cycles)	≥ 100.000 electrically at 20 VA load and 40 ms L/R

Table 3-3 Characteristics for OBU Boolean outputs

3.4.1.1.1 *1 L/R is the fraction of inductance over the resistance of the load.

4. GENERAL REQUIREMENTS FOR THE SERIAL INTERFACE

4.1 General Requirements

- 4.1.1.1 For the ERTMS/ETCS on-board the serial interface is mandatory. It shall comply with the requirements in this section.
- 4.1.1.2 This chapter includes the solutions regarding the ECN, MVB and CAN based on [15], [16], [17], [18], [22], [23], [24].
- 4.1.1.3 All data is transmitted cyclically as process data (see [13] for process data definition).
- 4.1.1.4 Transmission cycle time for the process data on the serial bus shall be the one defined in Table 4-1.

4.2 Serial Architectures

4.2.1 General

- 4.2.1.1 There are two possible architectures for the transmission of information via a serial bus -architecture a) and b). Both architectures are fit for the transmission of safety related and non-safety related information as defined [8]. It's up to the train integrator to choose for each signal the adequate architecture.

4.2.2 Architecture a)

- 4.2.2.1 Note: This architecture allows the use of hardware which is not able to implement requirements defined in [12] necessary for safety related communication.
- 4.2.2.1.1 Note: The interface on the serial bus regarding port and telegram structure depends on the used I/O module hardware. As the frames on the serial bus of an I/O module hardware depends of its design and is not standardised the interface cannot be standardised.

4.2.2.2 The following figure describes architecture a).

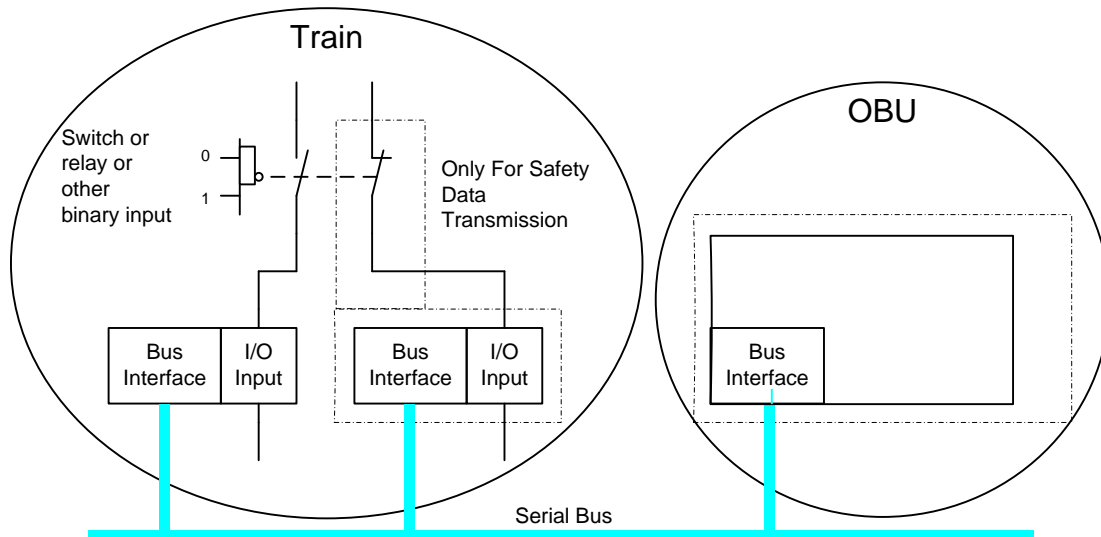


Figure 4-1 Architecture a)

- 4.2.2.3 The architecture can define information signals using either single contact or antivalent contacts.
- 4.2.2.4 When using Architecture a), the following principles shall be used for safety related information:
 - 4.2.2.4.1 Information should be derived using antivalent contacts.
 - 4.2.2.4.2 In case of antivalent/redundant input/output information is required separate I/O hardware shall be used.

4.2.3 Architecture b)

- 4.2.3.1 Note: This architecture allows the use of hardware which is able to implement requirements defined in [12] necessary for safety related communication.
- 4.2.3.2 This architecture is defined for information signals fully compliant with [15].
- 4.2.3.3 The architecture allows the transmission of both non-safety related and safety related information.
- 4.2.3.4 Using safety devices the TFR achievable depends on the TCMS design (Hardware and software)

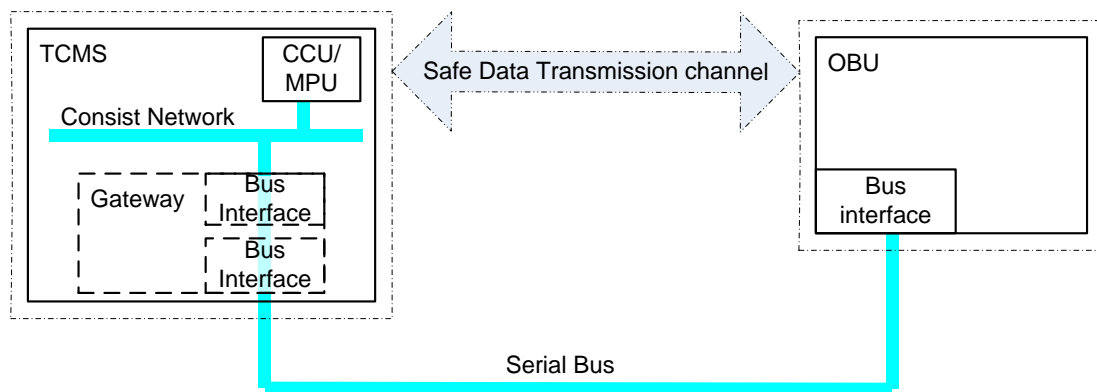


Figure 4-2 Architecture b)



- 4.2.3.5 When using Architecture b) safe data transmission shall be applied according to [15] when the required safety integrity level of certain functionality cannot be fulfilled with safety integrity level provided by the serial bus transmission.
- 4.2.3.6 Optionally the TCMS can integrate a gateway to adapt to the bus type defined by the ERTMS/ETCS on-board. The transfer delay shall be below 200ms (worst case).

4.3 Coding

4.3.1 General

- 4.3.1.1 This chapter presents the definition of the data to be transmitted via Bus.
- 4.3.1.2 The structure of the packets defined below is identical for both safety and non-safety related information.
- 4.3.1.3 The packets on the serial bus shall provide for each signal a specific validity bit to be set at source side.
- 4.3.1.4 Signals not provided from the defined source shall be marked as invalid by setting the related validity bit to FALSE at source side.
- 4.3.1.4.1 In case EB command is performed as described in Solution 1 or Solution 2, the signal OBU_TR_EB3_Cmd shall not be used.
- 4.3.1.4.2 In case TCO command is performed as described in Solution 1, default value shall not be applicable.
- 4.3.1.5 The Serial Interface Table 4-1, provided in section 4.3.2, describes for each function its minimum refreshment cycle, signal size in bit, data type for transmission, name on parallel interface, name on serial interface, a comment and the default value.
- 4.3.1.6 The tables in chapter 4.3.3 to 4.3.4 describing the coding of the different telegrams sent from OBU and TR are derived from Table 4-1. The telegrams for MVB, CAN and ECN differ only in the additional trailer necessary for safe data transmission.
- 4.3.1.7 The telegrams are defined in big endian byte order. Bit 0 means the least significant bit, byte 0 the least significant byte.
- 4.3.1.8 Spare bits and bytes in the telegrams shall be set to 0.



4.3.2 Serial Interface Table

4.3.2.1 Note: The signal types used in the following table are defined in [12], table 19.

Function	minimum cycle [ms]	signal size[Bit]	signal type for transmission	name on parallel interface	name on serial interface	Comment	
Sleeping	128	2	2*BOOLEAN1	T_SL_E1_N, T_SL_E2_I	TR_OBU_TrainSleep TR_OBU_TrainSleep_Not	Enable sleeping function <u>Coding (T_SL_E1_N/T_SL_E2_I):</u> See Table 5-1	
Passive shunting	128	1	BOOLEAN1	T_PS_E	TR_OBU_PassiveShunting	Passive shunting <u>Coding:</u> See Table 5-2	
Service brake	128	1	BOOLEAN1	O_SB_C	OBU_TR_ServiceBrake	Service brake command <u>Coding:</u> See Table 5-5	
Emergency brake	128	1	BOOLEAN1	-	OBU_TR_EB3_Cmd	Emergency brake command 3 <u>Coding:</u> See Table 5-7. Note: the EB command via the serial interface refers to Figure 5-6	
Traction Cut Off	128	1	BOOLEAN1	O_TC2_C	OBU_TR_TCO_Cmd	Traction cut-off 2 <u>Coding:</u> See Table 5-20	
Non Leading	128	1	BOOLEAN1	T_NL_E	TR_OBU_NLEnabled	Non Leading <u>Coding:</u> See Table 5-3	

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Function	minimum cycle [ms]	signal size[Bit]	signal type for transmission	name on parallel interface	name on serial interface	Comment	
Direction Controller	128	2	2*BOOLEAN1	T_FW_S, T_BW_S	TR_OBU_DirectionFW, TR_OBU_DirectionBW	Status of Direction controller relative to occupied cab <u>Coding (T_FW_S,/T_BW_S):</u> See Table 5-22	
Cab Status	128	2	2*BOOLEAN1	T_CS_A, T_CS_B	TR_OBU_CabStatusA, TR_OBU_CabStatusB	Status of Cabs <u>Coding (T_CS_A/T_CS_B):</u> See Table 5-21	
BrakePressure	128	8	UNSIGNED8	-	TR_OBU_BrakePressure	Brake pressure <u>Coding:</u> See Table 5-6	
Special Brake Inhibit – Trackside orders						To be harmonized	
Special Brake Inhibit – STM orders	128	1	BOOLEAN1	O_RB_I	OBU_TR_RBInhibit_Cmd	Regenerative brake inhibition command <u>Coding:</u> See Table 5-9	
Special Brake Inhibit – STM orders	128	1	BOOLEAN1	O_MG_I	OBU_TR_MGInhibit_Cmd	Magnetic shoe brake inhibition command <u>Coding:</u> See Table 5-10	
Special Brake Inhibit – STM orders	128	1	BOOLEAN1	O_ECS_I	OBU_TR_ECSEInhibit_Cmd	Eddy current brake inhibition command for service brake <u>Coding:</u> See Table 5-11	
Special Brake Inhibit – STM orders	128	1	BOOLEAN1	O_ECE_I	OBU_TR_ECEInhibit_Cmd	Eddy current brakes inhibition command for emergency brake. <u>Coding:</u> See Table 5-12	

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Function	minimum cycle [ms]	signal size[Bit]	signal type for transmission	name on parallel interface	name on serial interface	Comment	
Brake Status	128	8	BITSET8	T_EP_S T_EC_S T_RB_S T_MG_S	TR_OBU_Brake_Status	Brake status. <u>Coding for each bit:</u> Bit0: Electro Pneumatic Brake Status (T_EP_S), see Table 5-13 Bit1: Eddy Current Brake Status (T_EC_S), see Table 5-14 Bit2: Regenerative Brake Status (T_RB_S), see Table 5-15 Bit3: Magnetic Shoe Brake Status (T_MG_S), see Table 5-16 Bit4: Reserved Bit5: Reserved Bit6: Reserved Bit7: Reserved	
Train Data	128	2	ENUM4	T_TT_S1, T_TT_S2	TR_OBU_TrainType	Train data: type of train data entry. <u>Coding:</u> bit 0/1 see Table 5-24 bit 2/3 set to 0	
National System Isolation	128	8	BITSET8	T_IS_S1 T_IS_S2 T_IS_S3 T_IS_S4 T_IS_S5 T_IS_S6 T_IS_S7 T_IS_S8	TR_OBU_NTClisolated	National System Isolation <u>Coding:</u> See Table 5-25	
Change of Traction System						To be harmonized.	
Pantograph – Trackside orders						To be harmonized.	



Function	minimum cycle [ms]	signal size[Bit]	signal type for transmission	name on parallel interface	name on serial interface	Comment	
Pantograph – STM orders	128	1	BOOLEAN1	O_PG_C	OBU_TR_PG_Cmd	Pantograph command <u>Coding:</u> See Table 5-17	
Air Tightness – Trackside orders						To be harmonized.	
Air Tightness – STM orders	128	1	BOOLEAN1	O_AT_C	OBU_TR_AirTight_Cmd	Command air tightness command <u>Coding:</u> See Table 5-18	
Passenger door						To be harmonized.	
Main Power Switch – Trackside orders						To be harmonized.	
Main Power Switch – STM orders	128	1	BOOLEAN1	O_MPS_C	OBU_TR_MPS_Cmd	MPS open command <u>Coding:</u> See Table 5-19	
Allowed Current Consumption						To be harmonized.	
Traction Status	128	1	BOOLEAN1	T_TR_S	TR_OBU_Traction_Status	Traction status <u>Coding:</u> See Table 5-23	

Table 4-1 Generic Serial Interface Table

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4.3.2.2 All signals are transmitted over the networks in telegrams according to reference [13]. The list of the various telegrams is given hereafter in the following paragraphs.

4.3.3 TR Telegram 1

TR Telegram 1			
Data name	Type	Description (as not already given in Table 4-1)	Byte.Bit Offset
TR_OBU_TrainSleep	BOOLEAN1		0.0
TR_OBU_TrainSleep_Not	BOOLEAN1		0.1
TR_OBU_PassiveShunting	BOOLEAN1		0.2
TR_OBU_NLEnabled	BOOLEAN1		0.3
TR_OBU_DirectionFW	BOOLEAN1		0.4
TR_OBU_DirectionBW	BOOLEAN1		0.5
TR_OBU_CabStatusA	BOOLEAN1		0.6
TR_OBU_CabStatusB	BOOLEAN1		0.7
TR_OBU_TrainType	ENUM4		1.0
TR_OBU_Traction_Status	BOOLEAN1		1.4
Spare1	BOOLEAN1		1.5
Spare2	BOOLEAN1		1.6
Spare3	BOOLEAN1		1.7
TR_OBU_BrakePressure	UNSIGNED8		2.0
TR_OBU_NTCTIsolated	BITSET8		3.0

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TR Telegram 1			
Data name	Type	Description (as not already given in Table 4-1)	Byte.Bit Offset
TR_OBU_Brake_Status	BITSET8		4.0
Spare4	UNSIGNED8		5.0
Spare5	UNSIGNED16		6.0
Spare6	UNSIGNED16		8.0
Spare7	UNSIGNED16		10.0
Spare8	UNSIGNED8		12.0
Spare9	UNSIGNED8		13.0
Spare10	UNSIGNED16		14.0
Spare11	UNSIGNED8		16.0
Spare12	UNSIGNED8		17.0
Spare13	UNSIGNED16		18.0
Spare14	UNSIGNED16		20.0
Validity1	UNSIGNED16	Validity of the boolean values in the first two bytes of the telegram. The validity of the signal with offset 0.0 is in bit 0. The validity of the signal with offset 1.0 is in bit 8. The validity of the signal with offset 1.7 is in bit 15.	22.0
Validity2	UNSIGNED16	Validity of values in byte 2-21 in the telegram. The validity of the 1 st signal is in bit 0. The validity of the 16 th signal is in bit 15.	24.0



4.3.4 OBU Telegram 1

OBU Telegram 1			
Data name	Type	Description (as not already given in Table 4-1)	Byte.Bit Offset
OBU_TR_ServiceBrake	BOOLEAN1		0.0
OBU_TR_EB3_Cmd	BOOLEAN1		0.1
OBU_TR_TCO_Cmd	BOOLEAN1		0.2
OBU_TR_RBInhibit_Cmd	BOOLEAN1		0.3
OBU_TR_MGInhibit_Cmd	BOOLEAN1		0.4
OBU_TR_ECSInhibit_Cmd	BOOLEAN1		0.5
OBU_TR_ECEInhibit_Cmd	BOOLEAN1		0.6
OBU_TR_AirTight_Cmd	BOOLEAN1		0.7
OBU_TR_MPS_Cmd	BOOLEAN1		1.0
OBU_TR_PG_Cmd	BOOLEAN1		1.1
Spare1			1.2
Spare2			1.3
Spare3			1.4
Spare4			1.5
Spare5			1.6
Spare6			1.7

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OBU Telegram 1			
Data name	Type	Description (as not already given in Table 4-1)	Byte.Bit Offset
Spare7	UNSIGNED16		2.0
Spare8	UNSIGNED16		4.0
Spare9	UNSIGNED16		6.0
Spare10	UNSIGNED16		8.0
Spare11	UNSIGNED16		10.0
Spare12	UNSIGNED16		12.0
Spare13	UNSIGNED16		14.0
Spare14	UNSIGNED16		16.0
Spare15	UNSIGNED16		18.0
Spare16	UNSIGNED16		20.0
Validity1	UNSIGNED16	Validity of the boolean values in the first two bytes of the telegram. The validity of the signal with offset 0.0 is in bit 0. The validity of the signal with offset 1.0 is in bit 8, The validity of the signal with offset 1.7 is in bit 15.	22.0
Validity2	UNSIGNED16	Validity of values in byte 2-21 in the telegram. The validity of the 1 st signal is in bit 0. The validity of the 16 th signal is in bit 15.	24.0



4.4 MVB

4.4.1 General

4.4.1.1 The physical layer shall be ESD+ or EMD.

4.4.1.2 The interface shall be implemented in accordance with [16].

4.4.1.3 The safe data transmission shall be implemented in accordance with [15].

4.4.2 Coding

4.4.2.1 TR Telegram 1

Properties:

Port address: configurable

Source device: TR

Sink device: OBU

Data class: Process data, 32 bytes

Cycle time: 128 ms

TRTelegram1			
Data name	Type	Description	Byte.Bit Offset
Content according to TR Telegram 1 (see chapter 4.3.3)			0.0
Safe data transmission trailer according to [15]			26.0



4.4.2.2 OBU Telegram 1

Properties:

Port address: configurable

Source device: OBU

Sink device: TR

Data class: Process data, 32 bytes

Cycle time: 128 ms

OBUTelegram1			
Data name	Type	Value Interpretation	Byte.Bit Offset
Content according to OBU Telegram 1 (see chapter 4.3.4)			0.0
Safe data transmission trailer according to [15],			26.0

4.5 CAN

4.5.1 General

4.5.1.1 The interface shall be implemented in accordance with [17],

4.5.1.2 The safe data transmission shall be implemented in accordance with [15] (MVB).

4.5.1.2.1 An MVB telegram shall be constructed at sender side to calculate the CRC and shall be split for transmission in 5 CAN telegrams, each with a different CAN telegram identifier, see Figure 4-3.

4.5.1.2.2 At receiver side the CAN telegrams shall be merged again to an MVB telegram to check the CRC.

4.5.1.2.3 All telegrams (CAN and MVB) of the same sequence shall use the same SSC value taken over from the MVB telegram.

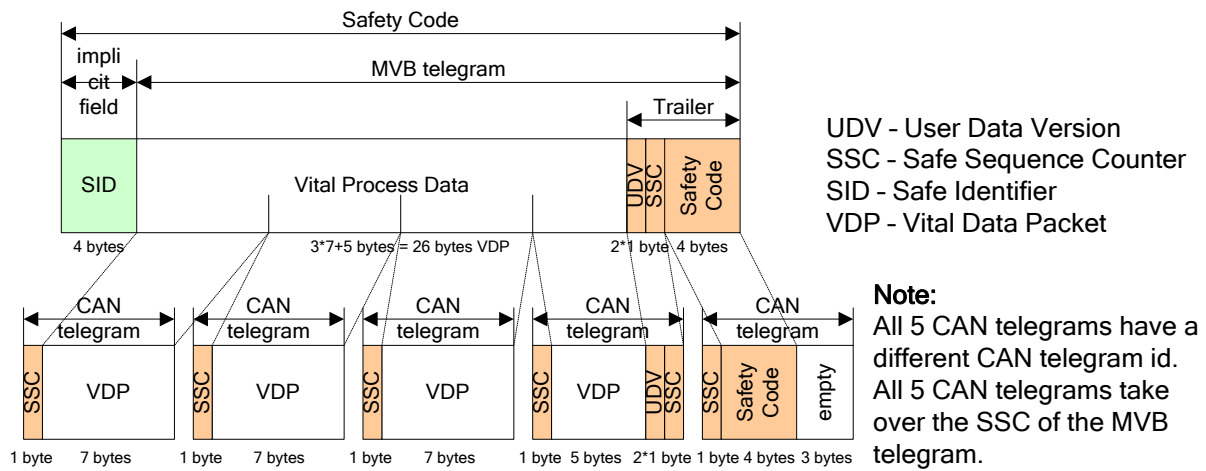


Figure 4-3 Safe Data Transmission via CAN



4.5.2 Coding

4.5.2.1 CAN is using MVB coding, see chapter 4.4.2.

4.5.2.2 CAN telegram numbers are configurable according to [17].

4.6 ECN

4.6.1 General

4.6.1.1 The interface shall be implemented in accordance with [18].

4.6.1.2 The safe data transmission shall be implemented in accordance with [15].

4.6.2 Coding

4.6.2.1 TR Telegram 1

Properties:

ComId: configurable

Source device: TR

Sink device: OBU

Data class: Process data

Cycle time: 128 ms

Dataset ID: configurable

TRTelegram1			
Data name	Type	Description	Byte.Bit Offset
Content according to TR Telegram 1 (see chapter 4.3.3)			0.0
Padding	UNSIGNED16	SDT trailer needs to start at 4 byte alignment	26.0
Safe data transmission trailer according to [15],			28.0



4.6.2.2 OBU Telegram 1

Properties:

ComId: configurable

Source device: OBU

Sink device: TR

Data class: Process data

Cycle time: 128 ms

Dataset ID: configurable

OBUTelegram1			
Data name	Type	Value Interpretation	Byte.Bit Offset
Content according to OBU Telegram 1 (see chapter 4.3.4)			0.0
Padding	UNSIGNED16	SDT trailer needs to start at 4 byte alignment	26.0
Safe data transmission trailer according to [15],			28.0

5. REQUIREMENTS FOR THE SIGNALS TO BE EXCHANGED AT THE TRAIN INTERFACE

5.1 Mode Control

5.1.1 Sleeping

5.1.1.1 Architecture

5.1.1.1.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed

5.1.1.2 Coding

T_SL_E1_N	T_SL_E2_I	Meaning
0	0	Invalid
0	1	Sleeping not requested
1	0	Sleeping requested
1	1	Invalid

Table 5-1 Coding for sleeping

5.1.1.3 Safety Requirements

5.1.1.3.1 Safety requirements shall apply as defined in [8].

5.1.2 Passive Shunting

5.1.2.1 Architecture

5.1.2.1.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed.

5.1.2.2 Coding

T_PS_E	Meaning
0	Passive shunting not permitted
1	Passive shunting permitted

Table 5-2 Coding for passive shunting

5.1.2.3 Safety Requirements

5.1.2.3.1 Safety requirements according to [8]

5.1.3 Non Leading

5.1.3.1 Architecture

5.1.3.1.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed

5.1.3.2 Coding

T_NL_E	Meaning
0	Non-leading not permitted
1	Non-leading permitted

Table 5-3 Coding for non leading

5.1.3.3 Safety Requirements

5.1.3.3.1 Safety requirements shall apply as defined in [8].

5.1.4 Isolation

5.1.4.1 Architecture

5.1.4.1.1 Reference architecture as defined in Chapter 3 is allowed.

5.1.4.1.2 The signal shall be generated directly by the ERTMS/ETCS isolation device.

5.1.4.2 Coding

O_IS_S	Meaning
0	ERTMS/ETCS on-board not isolated
1	ERTMS/ETCS on-board isolated

Table 5-4 Coding for isolation

5.1.4.3 Safety Requirements

5.1.4.3.1 Safety requirements shall apply as defined in [8].

5.2 Signals for the Control of Brakes

5.2.1 Service Brake Command

5.2.1.1 Architecture

5.2.1.1.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed.

5.2.1.2 Coding

O_SB_C	Meaning
0	Service brake not commanded
1	Service brake commanded

Table 5-5 Coding for service brake command

5.2.1.3 Safety Requirements

5.2.1.3.1 Safety requirements shall apply as defined in [8].

5.2.2 Brake Pressure

5.2.2.1 Architecture

5.2.2.1.1 Only serial connection (bus) as defined in Chapter 4 is allowed.

5.2.2.2 Coding

5.2.2.2.1 T_BP_S is an unsigned 8 bit signal.

T_BP_S	Meaning
0	0.0 bar air pressure in brake cylinders or UIC brake pipe, depending on ERTMS/ETCS on-board configuration.
1 ... 60	Steps of 0.1 bar up to 6 bar
61 ... 255	Invalid values

Table 5-6 Coding for brake pressure

5.2.2.3 Safety Requirements

5.2.2.3.1 Safety requirements shall apply as defined in [8].

5.2.3 Emergency Brake Interface

5.2.3.1 General

5.2.3.1.1 Two standard ways of transfer of the emergency brake command within the vehicle and train consist exist according to [5], [19] and [20]:

- Electrical safety line (Figure 5-1)
- Pneumatic brake pipe according to [21] (Figure 5-2)

5.2.3.2 Emergency Brake Command

5.2.3.2.1 Figure 5-1 shows a possible integration of an ERTMS/ETCS on-board on each end vehicle of a consist into an emergency brake architecture based on an electric safety

line, where the emergency brake command is transmitted by de-energizing electric actors. Relays K1 and K2 are the transfer components.

5.2.3.2.1.1 Note: This is only a principle drawing not showing all details of the safety loop.

5.2.3.2.2 EB lines are redundant for safety reasons. The contacts of the ERTMS/ETCS on-board in each line shall be controlled separately in order to be able to test each line independently.

5.2.3.2.3 Notes to all figures: All contacts are drawn in position “no power” which corresponds to “EB commanded”. Actors 1, m and n are devices (valves, relays, electronic inputs of brake control etc.) either on one vehicle or distributed over the consist or distributed over the train. In addition, “ETCS” refers to ERTMS/ETCS on-board equipment.

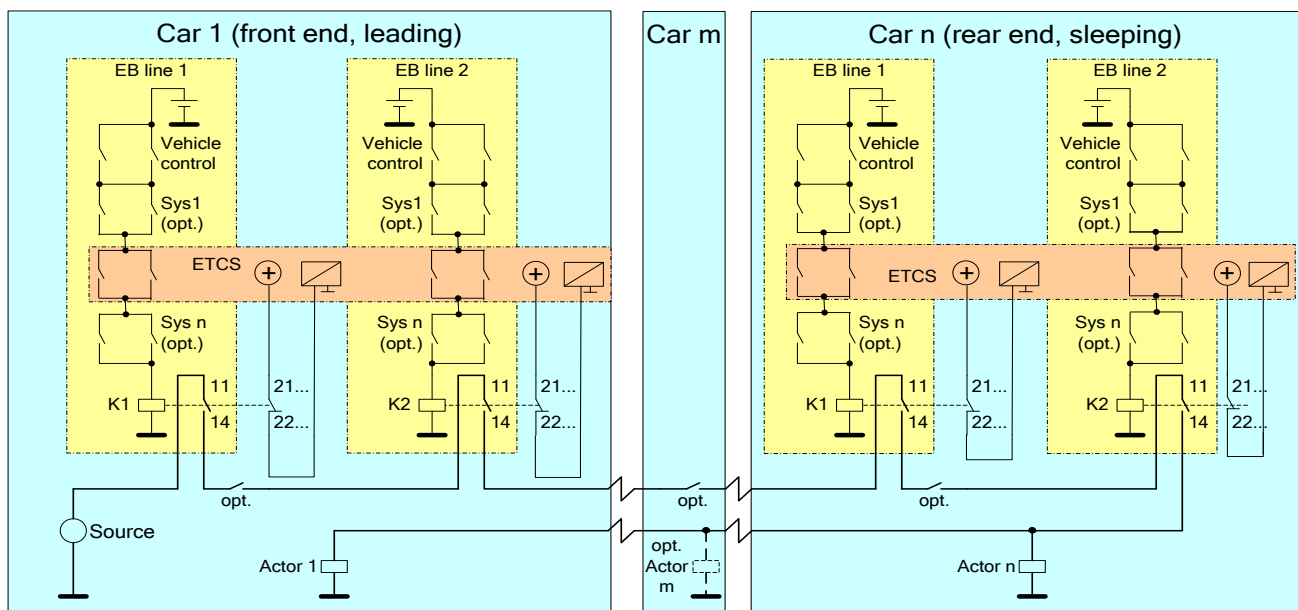


Figure 5-1 EB architecture with electric safety loop

5.2.3.2.4 The following figure shows a possible integration of an ERTMS/ETCS on-board on each end vehicle into an emergency brake architecture based on a brake pipe where the emergency brake command is transmitted by venting a pneumatic pipe. In this architecture the transfer components are the valves controlled by the EB lines and venting the brake pipe.

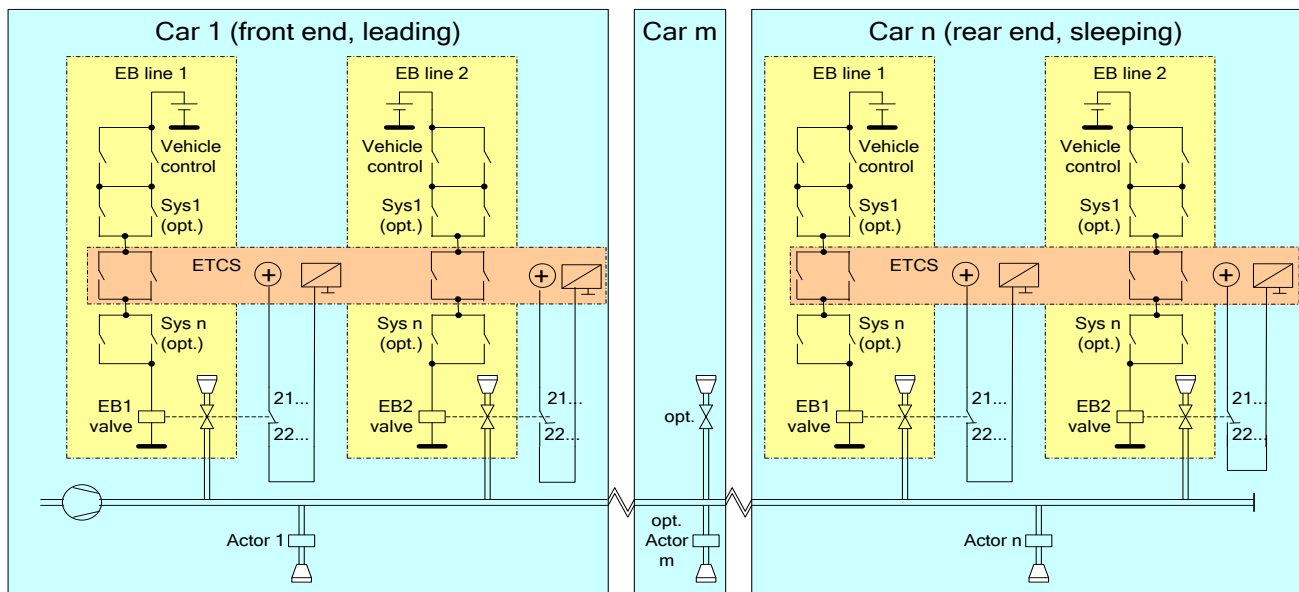


Figure 5-2 EB architecture with brake pipe

5.2.3.2.5 The following figure shows another possible integration of an ERTMS/ETCS on-board on each end vehicle. The second EB line is implemented by using the serial interface to the TCMS. The further transmission from the TCMS to the brake system is out of scope, but needs to be considered in the safety case (see safety requirements referenced in section 5.2.3.2.13)

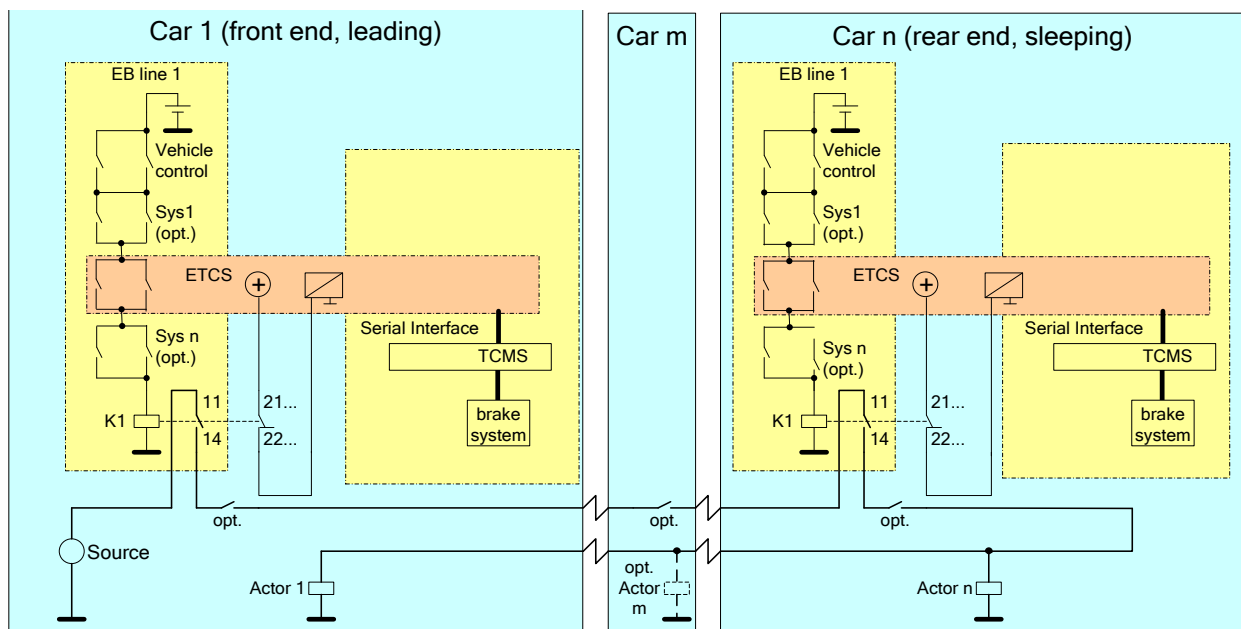


Figure 5-3 EB architecture with one EB line and a serial link

5.2.3.2.6 Following the three harmonized solutions for the EB command interface are defined.

5.2.3.2.7 Architecture Solution 1: Four NO contacts for two EB lines (see figure 5-4).

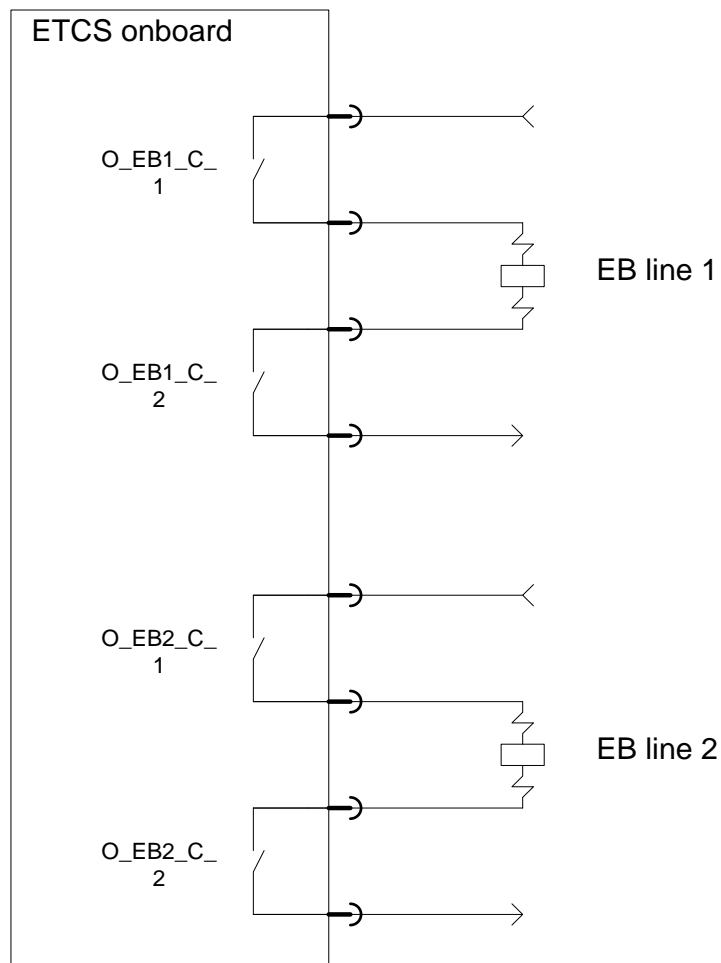


Figure 5-4 EB function, Solution 1: 2 EB lines

5.2.3.2.7.1 The contacts O_EB1_C_1 and O_EB1_C_2 are part of the same relay and form only one signal named O_EB1_C. O_EB2_C_1 and O_EB2_C_2 are part of another single relay and form another signal named O_EB2_C.

5.2.3.2.8 Architecture Solution 2: Two NO contacts for two EB lines

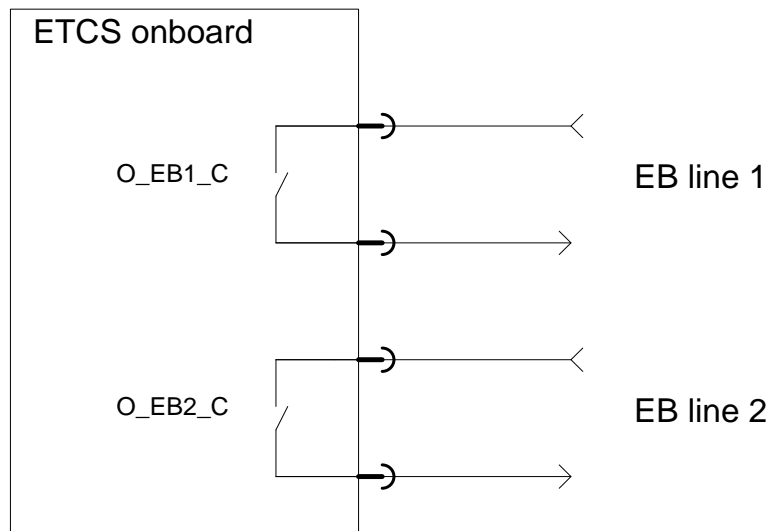


Figure 5-5 EB function, Solution 2: 2 EB lines

5.2.3.2.9 Architecture Solution 3: One NO contact for one EB line and serial interface

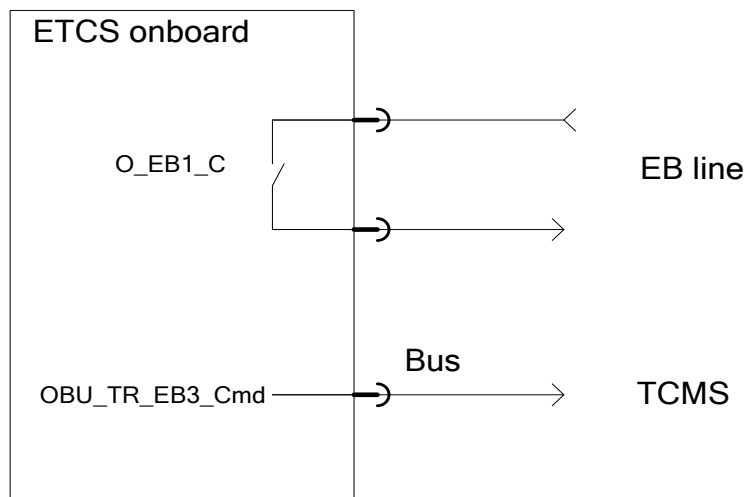


Figure 5-6 EB function, Solution 3: 1 EB line, serial interface

5.2.3.2.10 General Architecture

5.2.3.2.10.1 For O_EB1_C and O_EB2_C only reference architecture as defined in Chapter 3 is allowed.

5.2.3.2.11 For OBU_TR_EB3_Cmd only serial connection (bus) as defined in Chapter 4 is allowed.

5.2.3.2.12 Coding

O_EB1_C	O_EB2_C	Meaning
0	0	EB commanded (vehicle shall apply EB)
0	1	Fault in normal operation (vehicle shall apply EB)
1	0	Fault in normal operation (vehicle shall apply EB)
1	1	EB not commanded from ERTMS/ETCS on-board

Table 5-7 Coding for EB1 and EB2 Command

5.2.3.2.12.1 Vehicle shall apply EB in any cases in which the coding for “EB command” is different from O_EB1_C = 1 and O_EB2_C = 1.

5.2.3.2.12.2 Fault in normal operation is considered whenever the values of O_EB1_C and O_EB2_C remain different for a period greater than 2s. The failure has to be detected by the vehicle.

OBU_TR_EB3_Cmd	Meaning
0	EB commanded (vehicle shall apply EB)
1	EB not commanded from ERTMS/ETCS on-board

Table 5-8 Coding for EB3 Command

5.2.3.2.13 Safety Requirements

5.2.3.2.13.1 Safety requirements shall apply as defined in [8].

5.2.4 Special brake inhibit – Trackside Orders

5.2.4.1 To be harmonized.

5.2.5 Special brake inhibit – STM Orders

5.2.5.1 Architecture

5.2.5.1.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed.

5.2.5.2 Coding

5.2.5.2.1 Regenerative brake inhibit

Name	Size	Meaning
OBU_TR_RBInhibit_Cmd O_RB_I	Binary output or (1 bit on bus)	0: Regenerative Brake is not to be inhibited 1: Regenerative Brake is to be inhibited

Table 5-9 Coding for regenerative brakes inhibit – STM orders

5.2.5.2.2 Magnetic shoes brakes inhibit

Name	Size	Meaning
OBU_TR_MGInhibit_Cmd O_MG_I	Binary output or (1 bit on bus)	0: Magnetic Shoe Brake is not to be inhibited 1: Magnetic Shoe Brake is to be inhibited

Table 5-10 Coding for magnetic shoe brakes inhibit – STM orders

5.2.5.2.3 Eddy current brakes for service brake inhibit

Name	Size	Meaning
OBU_TR_ECSEInhibit_Cmd O_ECS_I	Binary output or (1 bit on bus)	0: Eddy Current Brake for Service Brakes is not to be inhibited 1: Eddy Current Brake for Service Brakes is to be inhibited

Table 5-11 Coding for eddy current brakes for service brake inhibit – STM orders

5.2.5.2.4 Eddy current brakes for emergency brake inhibit

Name	Size	Meaning
OBU_TR_ECEInhibit_Cmd O_ECE_I	Binary output or (1 bit on bus)	0: Eddy Current Brake for Emergency Brake is not to be inhibited 1: Eddy Current Brake for Emergency Brake is to be inhibited

Table 5-12 Coding for eddy current brakes for emergency brake inhibit – STM orders

5.2.6 Special brake status

5.2.6.1 General

- 5.2.6.1.1 Some ERTMS/ETCS on-board units have predefined brake models that are ordered depending on the train configuration and the overall brake status (determined by the brake control system). The inhibition of a special brake results in a different model to be used by the ERTMS/ETCS on-board internally. Hence informing the ERTMS/ETCS on-board about the status of a specific special brake can be relevant to calculate the brake model that has to be used.

5.2.6.2 Architecture

5.2.6.2.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed.

5.2.6.3 Coding

5.2.6.3.1 Electro Pneumatic Brake Status

T_EP_S	Meaning
0	Brake not active.
1	Brake active.

Table 5-13 Coding for electro pneumatic brake status

5.2.6.3.2 Eddy Current Brake Status

T_EC_S	Meaning
0	Brake not active.
1	Brake active.

Table 5-14 Coding for eddy current brake status

5.2.6.3.3 Regenerative Brake Status

T_RB_S	Meaning
0	Brake not active.
1	Brake active.

Table 5-15 Coding for regenerative brake status

5.2.6.3.4 Magnetic Shoe Brake Status

T_MG_S	Meaning
0	Brake not active.
1	Brake active.

Table 5-16 Coding for magnetic shoe brake status

5.2.6.4 Safety Requirements

5.2.6.4.1 Safety requirements shall apply as defined in [8].



5.2.7 Additional Brake Status

- 5.2.7.1 Additional brakes shall be handled in the same manner like special brakes.
- 5.2.7.2 Currently no brakes which would qualify for “additional brakes” in the meaning of [1] are known.

5.3 Control of Train Functions

5.3.1 General

- 5.3.1.1 To be harmonized.

5.3.2 Change of Traction System

- 5.3.2.1 To be harmonized.



5.3.3 Pantograph – Trackside Orders (Powerless Section – Lower Pantograph)

5.3.3.1 To be harmonized.

5.3.4 Pantograph – STM Orders

5.3.4.1 Architecture

5.3.4.1.1 Reference architecture as defined in Chapter 3 or serial interface is allowed.

5.3.4.2 Coding

Name	Size	Meaning
OBU_TR_PG_Cmd O_PG_C	Binary output or (1 bit on bus)	0: Lower Pantograph 1: Raise pantograph

Table 5-17 Coding for pantograph command – STM orders

5.3.4.3 Safety requirements

5.3.4.3.1 Safety requirements shall apply as defined in [8].

5.3.5 Air Tightness – Trackside Orders

5.3.5.1 To be harmonized.

5.3.6 Air Tightness – STM orders

5.3.6.1 Architecture

5.3.6.1.1 Reference architecture as defined in Chapter 3 or serial interface is allowed.

5.3.6.2 Coding

Name	Size	Meaning
OBU_TR_AirTight_Cmd O_AT_C	Binary output or (1 bits on bus)	1: air conditioning intake to be closed 0: air conditioning intake to be opened

Table 5-18 Coding for air tightness – STM orders



5.3.6.3 Safety requirements

5.3.6.3.1 Safety requirements shall apply as defined in [8].

5.3.7 Passenger door

5.3.7.1 To be harmonized.

5.3.8 Main Power Switch – Trackside Orders

5.3.8.1 To be harmonized.

5.3.9 Main Power Switch – STM Orders

5.3.9.1 Architecture

5.3.9.1.1 Reference architecture as defined in Chapter 3 or serial interface is allowed.

5.3.9.2 Coding

Name	Size	Meaning
OBU_TR_MPS_Cmd O_MPS_C	Binary output or (1 bit on bus)	0: Main Power Switch to be switched off 1: Main Power Switch NOT to be switched off

Table 5-19 Coding for Main Power Switch – STM orders

5.3.9.3 Safety requirements

5.3.9.3.1 Safety requirements shall apply as defined in [8].

5.3.10 Change of Allowed Current Consumption

5.3.10.1 To be harmonized.

5.3.11 Traction Cut-Off

5.3.11.1 General

5.3.11.1.1 The following signal is defined as the traction cut off as soon as the train passes the warning limit (see Table 1-2 Terms) of the braking curve model as defined in [1].

5.3.11.1.1.1 The Traction Cut-Off command is used as defined in [1] 3.13.9.3.2.3 a).

5.3.11.1.2 Architecture

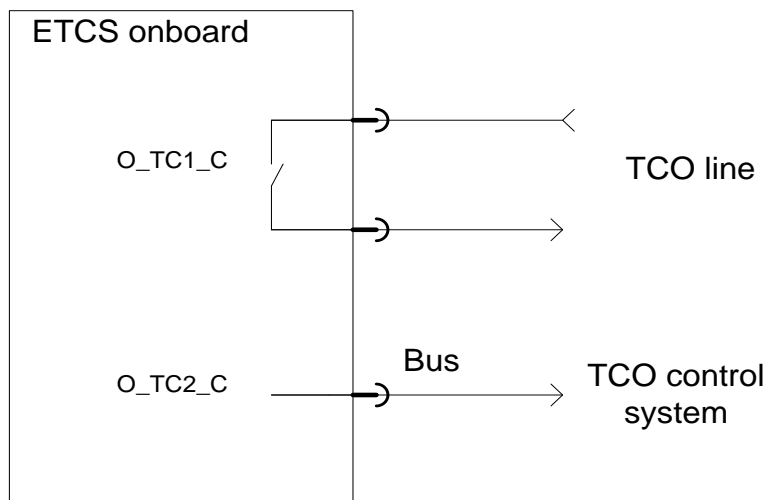


Figure 5-7 TCO function: 1 TCO line and a serial interface

5.3.11.2 Coding

O_TC1_C	O_TC2_C	Meaning
1	1	Traction cut-off not commanded
0	1	Traction cut-off commanded.
1	0	Traction cut-off commanded.
0	0	Traction cut-off commanded.

Table 5-20 Coding for traction cut-off

5.3.11.3 Safety Requirements

5.3.11.3.1 Safety requirements shall apply as defined in [8].

5.4 Signals for Train Status Information

5.4.1 Cab Status

5.4.1.1 Architecture

5.4.1.1.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed

5.4.1.2 Coding

T_CS_A	T_CS_B	Meaning
0	0	no cab activated
1	0	Cab A activated
0	1	Cab B activated
1	1	Invalid

Table 5-21 Coding for cab status

5.4.1.3 Safety Requirements

5.4.1.3.1 Safety requirements shall apply as defined in [8].

5.4.2 Direction Controller

5.4.2.1 Architecture

5.4.2.1.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed.

5.4.2.2 Coding

T_FW_S	T_BW_S	Meaning
0	0	Neutral (no direction selected)
1	0	Forward (relative to active cab)
0	1	Backward (relative to active cab)
1	1	Invalid

Table 5-22 Coding for direction controller

5.4.2.2.1 For handling of invalid value please refer to [8].

5.4.2.3 Safety requirements

5.4.2.3.1 Safety requirements shall apply as defined in [8].

5.4.3 Train Integrity

5.4.3.1 To be harmonized.

5.4.4 Traction Status

5.4.4.1 Architecture

5.4.4.1.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed.

5.4.4.2 Coding

T_TR_S	Meaning
0	Traction is Off
1	Traction is On

Table 5-23 Coding for traction status

5.4.4.2.1 Note: “Traction off” refers to traction zero or negative (electro-dynamic brake) whereas “traction on” refers when traction is positive.

5.4.4.3 Safety Requirements

5.4.4.3.1 Safety requirements shall apply as defined in [8].

5.5 Train Data

5.5.1 Type of Train Data Entry

5.5.1.1 General

5.5.1.1.1 This input indicates the type of train data entry configuration to be applied (see clause 11.3.9.6 of [2] (DMI spec)).

5.5.1.2 Architecture

5.5.1.2.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed

5.5.1.3 Coding

T TT_S1	T TT_S2	Interpretation
0	0	Invalid
1	0	Fixed
0	1	Flexible
1	1	Switchable



Table 5-24 Coding for type of train data entry

5.5.1.4 Safety Requirements

5.5.1.4.1 Safety requirements shall apply as defined in [8].

5.5.2 Train Data Information

5.5.2.1 To be harmonized.

5.6 National System Isolation

5.6.1.1 Architecture

5.6.1.1.1 Reference architecture as defined in Chapter 3 or serial connection (bus) as defined in Chapter 4 is allowed.

5.6.1.2 Coding

5.6.1.2.1 Due to the fact that there are multiple existing NTC systems, it shall be possible to configure up to at least eight (see [3]) signals referring to different national systems.

T_IS_Sx	Meaning
0	NTCx not isolated
1	NTCx isolated

Table 5-25 Coding for national system isolated

5.6.1.3 Safety Requirements

5.6.1.3.1 Safety requirements shall apply as defined in [8].