DB InfraGO

Digitalisierung Bahnsystem (DBS)

Automated Rail@DKS
Generic TIMS specification
High-level functional specification

Train Integrity Monitoring System (TIMS)

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Table of contents

List of tables

List of figures

1 Goal and Scope

1.1 Goal of the system

The Train Integrity Monitoring System (TIMS) is to be used on railroad vehicles to monitor train integrity (Train Integrity Monitoring, TIM) during operation and to determine the train length. This data is the basis for the calculation of the train length and confirmed train length by the European Vital Computer (EVC).

The basis for this is the latest valid technical specification for interoperability **[TSI CCS]**.

After the initial confirmation of train integrity by the TIMS, the EVC can monitor the integrity of the train (Train Integrity Status Information) and detect a possible unintended coupling and uncoupling of the train as well as an intended change of the train length due to shunting or coupling manoeuvres. The train length provided by the TIMS is used as input by the EVC. The train length information L_TRAIN is determined by the EVC based on this input and is transmitted to the RBC as part of the validated train data. Based on the confirmed train integrity and the train length determined by the TIMS, the EVC can calculate the variable L_TRAININT (Confirmed Train Length) and report it to the Radio Block Centre (RBC) in the Position Report.

This enables the following applications of higher-level systems:

- No track-side train detection system (track vacancy detection) and eventually no train tail signal (especially for freight trains)
- The correct route release, shunting route release and block sections release
- The operation of vehicles in ETCS L2 with train detection and train separation performed by the RBC based on information received from the train (e.g. train integrity information, previously “Level 3”) with "Moving blocks" or "Virtual fixed blocks “
- Implementation of the sequence of trains protection function (train order) by the RBC

1.2 Scope of the system

The application is to be integrated as part of the control and safety technology for trains with an ERTMS/ETCS onboard unit (OBU) and an EVC.

Not intended for use with TIMS:

- Auxiliary vehicles (e.g. work and special rail vehicles), tram vehicles and other rail vehicles
- Shunting (except in mode SM (Supervised Manoeuvre))
- Clearance of level crossings

1.3 Abbreviations

General abbreviations are listed in the ERTMS Glossary **[SS023]**. In addition, the following abbreviations are used in this document:

DAC	Digital Automatic Coupler
EVC	ERTMS/ETCS European Vital Computer
OBU	ERTMS/ETCS Onboard Unit
TIM	Train Integrity Monitoring
TIMS	Train Integrity Monitoring System
TSI CCS	Technical specification for interoperability of the control-command and signalling subsystem.

1.4 Definitions

1.4.1 Train Length (L_TRAIN)

The train length (see Train length ERTMS/ETCS SRS **[SS026]** 7.5.1.56 L_TRAIN) is determined by the nominal distance from the train head to the very end of the train in the longitudinal direction of the vehicle (X-axis). In a train set, the train length is the sum of the length of all coupled consists (safe consist length incl. the engine for DAC related TIMS). The train length information can be determined by the TIMS and provided as input for the train length (ERTMS/ETCS SRS [SS026] 7.5.1.56 L_TRAIN) to the EVC. The EVC transmits the train length as part of the valid Train Data to the RBC.

The train length determined by TIMS may additionally be validated by the EVC. The train length shall reach the required sufficient safety integrity level (e.g. SIL 4) to be used by the EVC regarding the confirmed train length calculation. If the required safety level can´t be reached by train length determined by the onboard TIMS alone, additional information, inputs or validations are required and to be used to determine the train length with the sufficient safety integrity level. The TIMS does not calculate the train length (L_TRAIN).

1.4.2 Overall consist length and Safe Consist Length for Mode SM

Overall Consist Length is defined in ERTMS/ETCS SRS **[SS034]** 2.6.2.

If Mode SM (Supervised Manoeuvre) should be used (e.g. for trains equipped with the DAC), the Safe Consist Length is required.

The Overall Consist Length is consisting of the lengths of the consists in front and in rear of the engine, excluding the engine length. The Overall Consist Length information below shall be provided by an external source (e.g. TIMS).

The following lengths information shall be provided via the train interface:

- L_CONSISTFRONTCABAMAX
- L_CONSISTFRONTCABAMIN
- L_CONSISTFRONTCABANOM
- L_CONSISTREARCABAMAX
- L_CONSISTREARCABAMIN
- L_CONSISTREARCABANOM

according to ERTMS/ETCS SRS (**[SS119]** 2.2.2 Signals on the Serial Interface).

Based on the Overall Consist Length, the EVC can compute the Safe Consist Length by considering length of the engine and direction and side of the active cab (which defines the front of the engine). Thereby, it can be noted that max safe rear consist length (L_CONSISTREARENGINEMAX) is equal to the train length L_TRAIN, only if captured as part of valid Train Data with the leading engine/cab being located at the very front of the train (see Train length ERTMS/ETCS SRS **[SS026]** 7.5.1.16).

Only if Q_SAFECONSISTLENGTH = 1, the following variables are used by the EVC and provided to the RBC for SM:

- L_CONSISTFRONTENGINENOM
- L_CONSISTFRONTENGINEMIN
- L_CONSISTFRONTENGINEMAX
- L_CONSISTREARENGINENOM
- L_CONSISTREARENGINEMIN
- L_CONSISTREARENGINEMAX

according to ERTMS/ETCS SRS **[SS026]** 7.4.3.4.3 Packet Number 10: Safe consist length information for Supervised Manoeuvre.

1.4.3 Confirmed train length (L_TRAININT)

The confirmed train length (Confirmed Train Length ERTMS/ETCS SRS **[SS026]** 7.5.1.57 L_TRAININT) results from the distance between the estimated position of the train front end (Estimated Front End) at time T and the last farthest possible position of the train rear end (Min Safe Rear End) at time T_0. The last farthest possible position of the train end in the direction of travel (Min Safe Rear End) is calculated from the last farthest possible position of the train front end in the direction of travel at time T_0, subtracting the train length at the same Time T_0 of the last confirmed completeness (Train Integrity) by the EVC.

For this purpose, the EVC uses the inputs of the TIMS (Train Length (L_TRAIN) and confirmation of Train Integrity (Q_INTEGRITY)) for the calculation. It is important to note that the confirmed train length (L_TRAININT) is not calculated by TIMS.

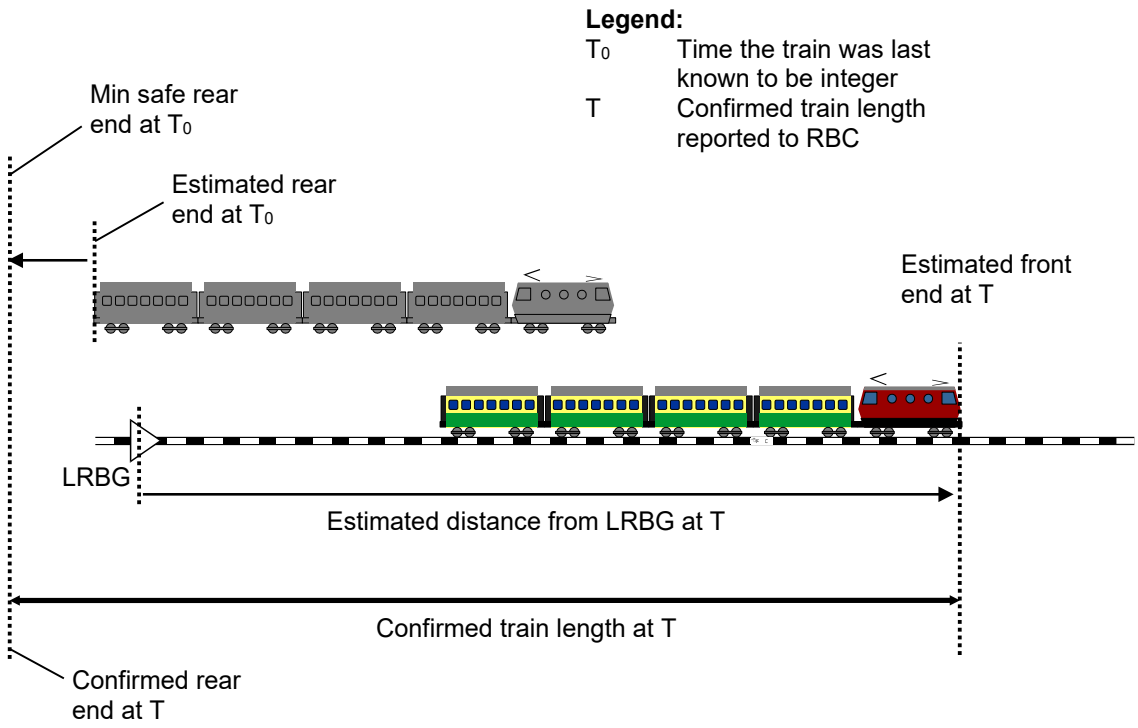

Figure 1: Definition of confirmed train length

1.4.4 Train integrity (Q_INTEGRITY)

Train integrity (Qualifier for train integrity status - ERTMS/ETCS SRS **[SS026]** 7.5.1.112 Q_INTEGRITY) is determined by the unchanged number and arrangement of coupled consists or vehicles after confirmation or initialization (train inauguration) of the train or train composition. This implies that all coupled consists are mechanically connected and move coherently (at approximately the same speed and in the same direction).

For the on-board train protection and control system, confirmed train integrity means that the train length (L_TRAIN) can be used to determine the Min Safe Rear End using this as the distance to the Estimated Front End. This allows determination of the confirmed train length, which is transmitted to the RBC. This information can be used by the trackside as the last farthest possible position of the rear end of the train for sequence of trains protection function.

1.4.5 TIMS Definition

A train integrity monitoring system (TIMS) is an essential component for train protection and control systems (e.g. ERTMS/ETCS) in which trackside track vacancy detection systems are to be dispensed with or reduced. The TIMS determines the train length as input to the EVC, monitors the train integrity and detects possible (intended or unintended) train separations and coupling or splitting. It fulfils a fundamental requirement for the train to be able to clear the track on lines without track vacancy. The train integrity is determined by the TIMS and provided as input

(for Train Integrity - ERTMS/ETCS SRS **[SS026]** 7.5.1.112 Q_INTEGRITY) to the EVC. The Train Integrity Information, which is transmitted by the EVC with the Position Report to the RBC, is composed of:

1. Train Integrity Status (Variable Q_INTEGRITY)
(0) No train integrity information
(1) Train integrity confirmed by external source
(2) Train integrity confirmed (entered) by driver
(3) Train integrity lost

2. Confirmed train length (Variable L_TRAININT)

Figure 2: Overview of TIMS and TIM modules shows the terminology of the TIMS components that will be used in the following.

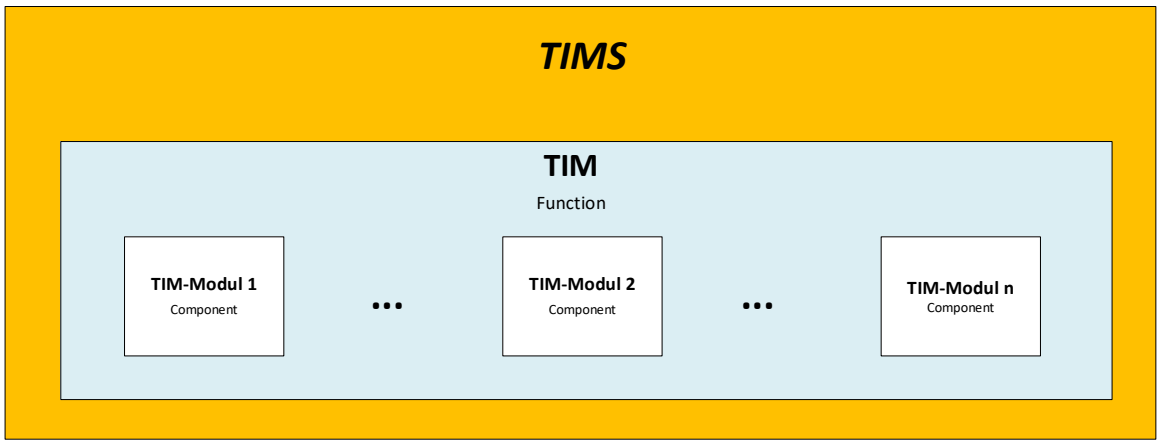

Figure 2: Overview of TIMS and TIM modules

1.4.6 Definitions of the terms train, consist, vehicle

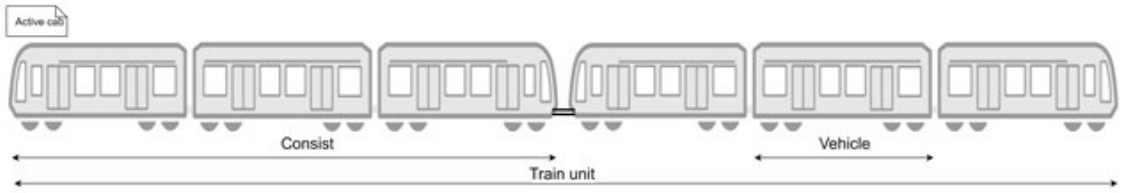

Figure 3: Definitions of terms train, consist, vehicle

The following definitions are in accordance with IEC **[IEC61375-2-3]** and will be used in the following:

Train Chapter 3.1.72

Composition of one or a set of consists, whose configuration can change during operation, and which can be operated as an autonomous unit, e.g. containing drives and at least one driver's cab.

Consist Chapter 3.1.12

Single vehicle or a group of vehicles which are not separated during operation.

Vehicle Chapter 3.1.90

Single wagon or locomotive.

1.4.7 Definition of the operational train direction

The definition is made according to **[IEC61375-2-3]**, chapter 3.1.48:

In this document, the train direction is defined by the train direction seen by the driver or conductor, i.e. by the active cab at the very end.

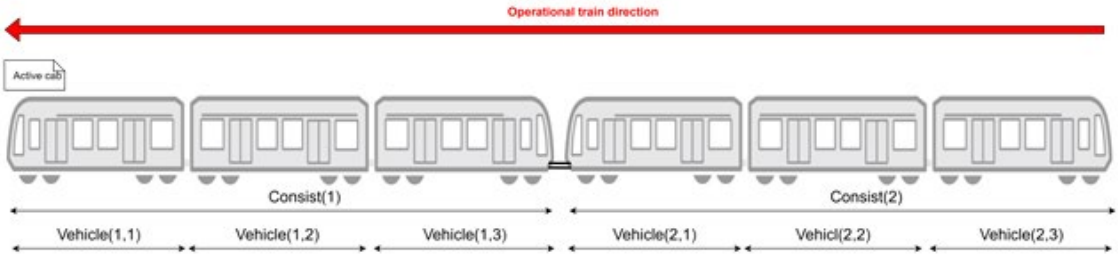

Figure 4: Definition of operational train direction and driving direction

1.4.8 Definition of the orientation of a vehicle

The respective ends of a vehicle are fixed and statically defined as "end 1" or "end 2". The alignment of a vehicle is defined in relation to the operational train direction as follows:

- The alignment of a vehicle corresponds to the operational train direction if the vehicle end "end 1" is oriented in the operational train direction.
- The orientation of a vehicle is opposite to the operational train direction if the vehicle end "end 2" oriented in the operational train direction.

1.4.9 Definition of Master and Slave

In a TIMS implementation, a distinction is made between a TIM-master-module and the TIM-slave-module(s).

Master: A TIM module enters the master state when the driver's cab is activated (active cab). There shall be only one master per train set. The master executes the TIM functions.

Slave: All other TIM modules shall be remaining in the Slave state.

1.4.10 Definition of Head, Trunk, and Tail

The position of the consists in the train formation are defined as Head, Trunk, and Tail.

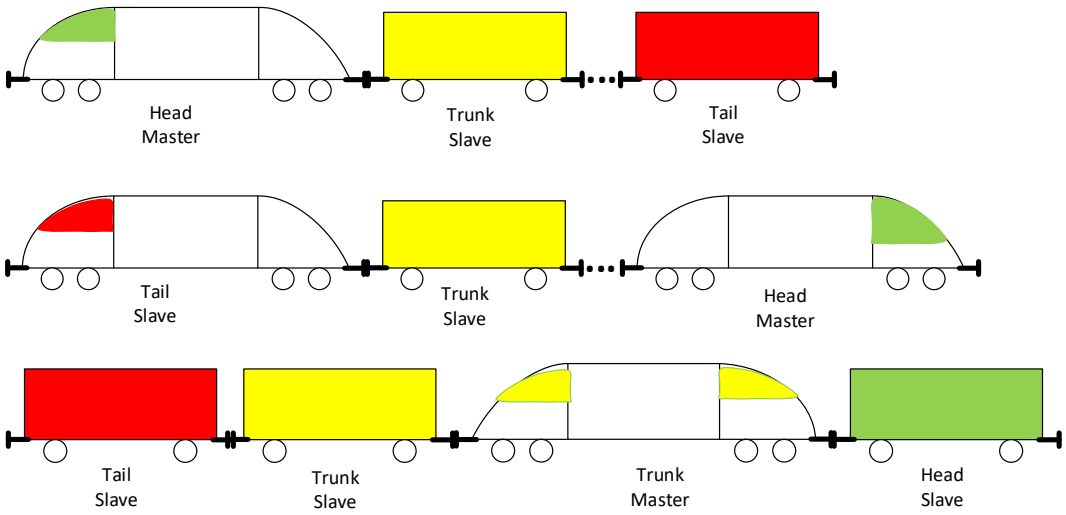

Figure 5: Examples of Head, Trunk, and Tail definition

Head (n = 1): (green) Head is the position of the consist, which is uncoupled on both sides or coupled only on exactly one side, and which is at the front end of the train with regard to the operational train direction. The Head can only occur at the end of the train. The Head is unique in the train formation and shall only exist once.

Trunk (n = 0 to n): (yellow) Trunk is the position of the consist, which is coupled on both sides. The Trunk can occur any number of times in the train (any consist that is neither Head nor Tail).

Tail (n = 0 or n = 1): (red) Tail is the position of the consist, which is coupled only on one side, and which is at the rear end of the train with regard to the operational train direction. The Tail can only occur at one end of the train and shall only exist once.

2 TIMS specification

2.1 High level TIMS functions

Two high level functions shall be implemented:

ID	Request	Category
<F1>	**Confirmation and continuous monitoring of train integrity**: TIM shall monitor the integrity status of the entire train. TIM shall continuously verify the train integrity at Start of Mission and afterwards during train operation and provide the integrity status of the train to the EVC.	Mandatory
<F2>	**Determination of the train length:** TIM determines the train length before the start of the mission. The train length information is determined as an input for the train length parameter of the train data to the EVC of the leading traction unit. (see **[SS026]**, 3.18.3.2)	Mandatory

Table 1: TIMS basic functions

2.2 TIMS subfunctions

The higher-level TIMS functions can be divided into the following TIMS sub-functions:

- **<SF01> Monitoring the integrity status of the train between vehicle units (consists):**

  TIMS continuously determines and monitors the integrity of a train if it consists of several (two or more) vehicle units (consists). If the integrity of the train cannot be confirmed (e.g. the information about the integrity of the train is not available or the train integrity is lost), corresponding information shall be generated and provided in time.

- **<SF02> Monitoring the integrity status of the train within a vehicle unit (consist):**

  TIMS continuously determines and monitors the integrity of each vehicle unit consisting of several (two or more) subunits (vehicles or wagons) that could separate unintendedly.

  This sub-function is not required if the failure of the mechanical coupling system between two wagons is considered very rare **[DIN VDE V 0831-103]** (e.g. Jacobs bogies).

- **<SF03> Calculation of the train length:**

  TIMS calculates and determines the length of the entire train at Start of Mission.

  Nominal/regular mode of operation: TIMS determines the train length independently. The input provided by the TIMS is at least SIL 2. (The overall function of train length determination L_TRAIN is SIL 4). A higher requirement for the input provided by the TIMS can be demanded as a safety level for specific projects. Afterwards, a confirmation of train integrity by the TIMS enables the calculation of the confirmed train length by the EVC. The (onboard) technically determined L_TRAIN is displayed in the Data validation window. (If necessary, an additional input/determination/validation by the driver or the track may be required)

- **<SF04> Determine the TIMS master module:**

TIMS shall be able to identify and determine the unique TIMS master module based on the available input information, e.g. the cab status (open) and the ETCS operating mode (not in NL/SL).

- **<SF05> Identify leading consist (Head):**

  TIMS shall be able to identify and determine the Head based on the available input information, e.g. the coupling status (on none or on one side coupled vehicle unit), driving direction and active cab status or if applicable a Neighbour-TIMS module on the coupled side.

- **<SF06> Identify last consist (Tail):**

  TIMS shall be able to identify and determine the last consist at the very end of a train (Tail). This shall be based on available input information, e.g. the coupling status (unit coupled on one side only), driving direction and active cab status and a Neighbour-TIMS module on the coupled side.

- **<SF07> Identify intermediate consist (Trunk):**

  TIMS shall be able to identify and determine all additional consists in the train (Trunks). This shall be based on available input information, e.g. the coupling status on both sides (consist coupled on both sides) and the presence of Neighbour-TIMS modules on both sides.

- **<SF08> Generate output of integrity status to EVC:**

  TIMS shall provide an output with the information that:

a) the integrity of the train is confirmed or

b) the integrity of the train has been lost if an intentional or unintentional train separation occurs, or

c) the integrity of the train is unknown if the integrity of the train cannot be confirmed and no train separation has been detected.

  The train integrity status can only be confirmed if the train length has been safely determined previously, see <SF03>. The confirmed train length may only be determined and transmitted by the EVC, if the train integrity status has been safely determined as confirmed.

- **<SF09> Provide train length as input to the EVC:**

  TIMS shall provide the train length as input to the EVC. This train length input can be used by the EVC as ETCS train length parameter within the train data.

- **<SF10> Receiving input values (e.g. from train interface or EVC):**

  TIMS receives train specific data (e. g. length information of each consist) to calculate the train length. TIMS may receive train specific data (e.g. driving direction, active cab status, Neighbour-TIMS modules, cable loop, mechanical coupling status and electrical coupling status, with regard to the train configuration determined by TCMS) to check if the consist is coupled to another and which side (cab A/B) is coupled (e.g. the mechanical coupling states) to determine the end of the train.

- **<SF11> TIMS self-test function:**

  The TIMS shall have a dedicated test function, which enables to verify the correct and fault-free system functionalities.

2.3 Transitions (High Level TIMS FSM, TIMS Monitoring States)

The High Level TIMS FSM (Finite State Machine) and TIMS Monitoring States are defined here as following.

2.3.1 High Level TIMS FSM

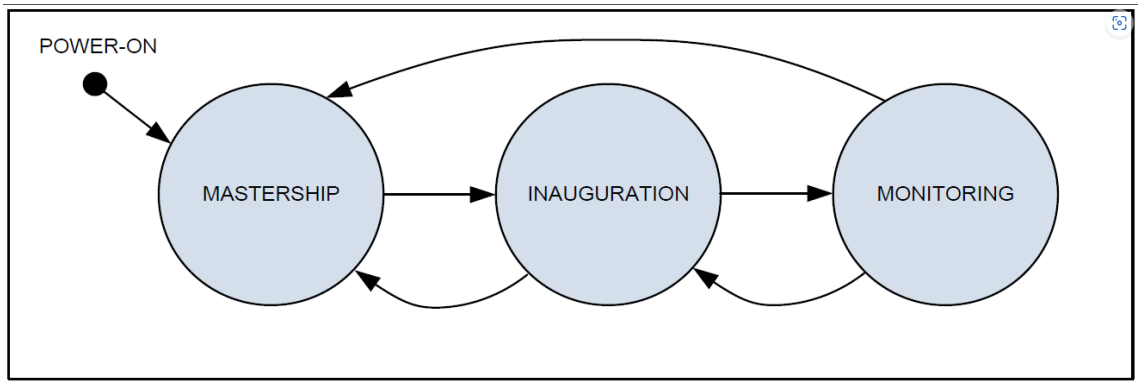

Figure 6: Generic High-Level FSM

The **MASTERSHIP** state serve the identification the role of the TIM module (i.e. master or slave).

The **INAUGURATION** state serves the discovery and pairing of the TIM master module and TIM slave module at the train inauguration.

The **MONITORING** state serves the monitoring of the train integrity.

2.3.2 TIMS Monitoring States

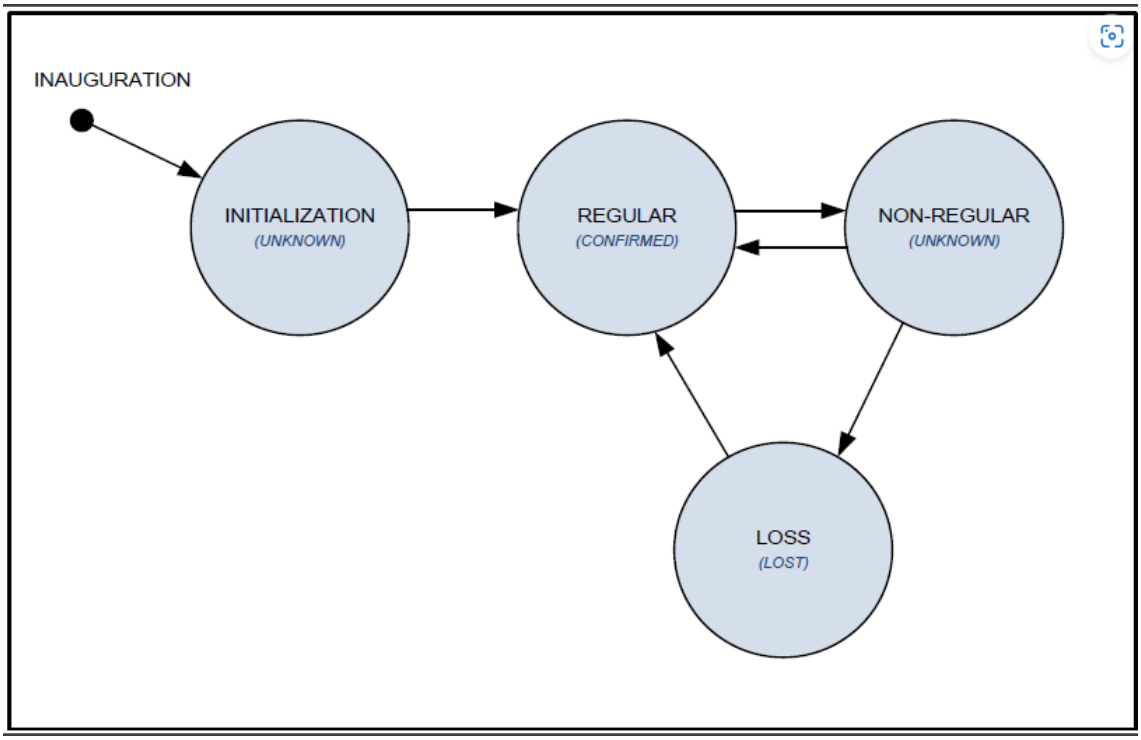

Figure 7: TIMS Master FSM - monitoring states

INITIALIZATION (I): State **(I)** is the initialization state of state **(R)**. State **(I)** only changes to state **(R)** if the master module receives a certain number of consistent and valid confirmations from the paired slave modules within a certain period. In this state, the value "Unknown" is sent to the EVC as train integrity status.

REGULAR (R): After the initialization phase **(I)**, the FSM enters the regular state **(R)**, i.e. the state in which the train integrity is confirmed cyclically. In this state, the train integrity status "Confirmed" is sent to the EVC.

NOT REGULAR (NR): If the master module does not receive a confirmation from the coupled slave modules within a certain period (timeout **(R)** to **(NR)**) or receives a confirmation that is not consistent and valid, the FSM enters the **(NR)** state. In this state, the train integrity status "Unknown" is sent to the EVC.

LOSS (L): If the master module does not receive a consistent and valid message from the coupled slave modules within a certain period (timeout **(L)** to **(NR)**) or if a train separation is technically detected by the TIMS, the FSM goes into state **(L)**. In this state, the train integrity status "Lost" is sent to the EVC.

2.4 Risk assessment

2.4.1 Objects of the risk assessment

The following two functions **<F>** of the TIMS are object of the risk assessment:

- **<F1>: Determination of the train integrity status**
- **<F2>: Determination of train length**

The **train composition detection function** to detect intended coupling and uncoupling events may be realized separately or by using the train length determination function or train integrity status function, if implemented with a sufficient safety level.

2.4.2 High level fault tree: TIMS with SIL 4 train length determination

The fault tree defines the high-level fault:

- **ID1**: Incorrect confirmed train length **SIL 4 [TSI CCS]** (according to **[SS091]** 9.8 EXT_SR07)

The fault tree contains the secondary faults; **ID2**: **Incorrect train length**, **ID3**: **Undetected unintended train separation** and **ID4**: **Undetected intended train composition change**, which are relevant for the vehicle ETCS equipment to determine the confirmed train length correctly.

- **ID2:** Incorrect train length: **SIL 4** through ID5:
  - **ID5:** Incorrect determination of consist length by external source (onboard): **SIL 4**
- **ID3**: Undetected unintended train separation: **SIL 4** through ID6 and ID7:
  - **ID6:** Train integrity monitoring failure: **SIL 2** according to **[TSI CCS]** (**[SS091]** 9.9 EXT_SR08)
  - **ID7:** Unintended loss of train integrity: **SIL 2** e.g., THR <= $2.61 \times 10^{-6}/h^{-1}$ according to **[TSI CCS]** (**[SS091]** 10.3.2.10)
- **ID4:** Undetected intended train composition change: **SIL 4** (e.g. undetected train splitting and joining operations) through ID8 and ID9:
  - **ID8:** Undetected intended train coupling event: **SIL 4***
  - **ID9:** Undetected intended train uncoupling event: **SIL 4***

*These dedicated functions may be realized separately with SIL 4 (e.g. by monitoring the coupler state within a train); or by using the train length determination function or train integrity status function, if these implemented with a sufficient safety level. Additionally, these functions may rely on additional triggers (e.g. uncoupling commands or driver actions) and/or operational or technical rules (e.g. at/after standstill or at specific and designated areas only).

2.4.3 High level fault tree: TIMS with SIL 2 train length determination

If the **SIL 4** requirement for **ID2** (determination of train length) is not fulfilled by the (external) onboard train system or the TIMS itself, additional measures can be implemented in **ID10** as mitigation or validation of the train length. This may allow a **SIL 2** train length determination function in **ID5** as shown in Figure 10 and Figure 11:

- **ID2:** Incorrect train length: **SIL 4** through **ID5** and **ID10**:
  - **ID5:** Incorrect determination of consist length by external source: **SIL 2**
  - **ID10**: Incorrect plausibility check of the determined consist length: **SIL 2**
    - **ID11**: Incorrect validation of the consist length: **SIL 2**
      - e.g. with driver validation of Train Length or additional information of Train Length from driver/shunter.
    - **ID12**: Additional independent source of information to determine consist length: **SIL 2**
      - e.g. trackside specific measures based on other external entities (e.g. Axle counter providing the number of axles)

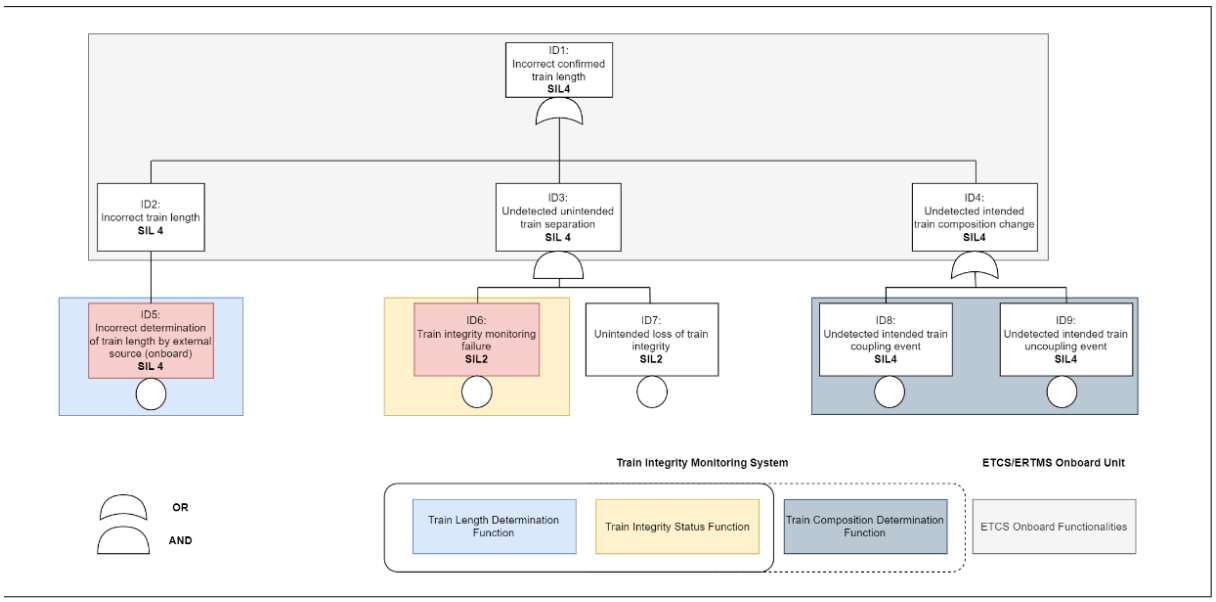

Figure 8: High level fault tree: TIMS with SIL 4 train length determination

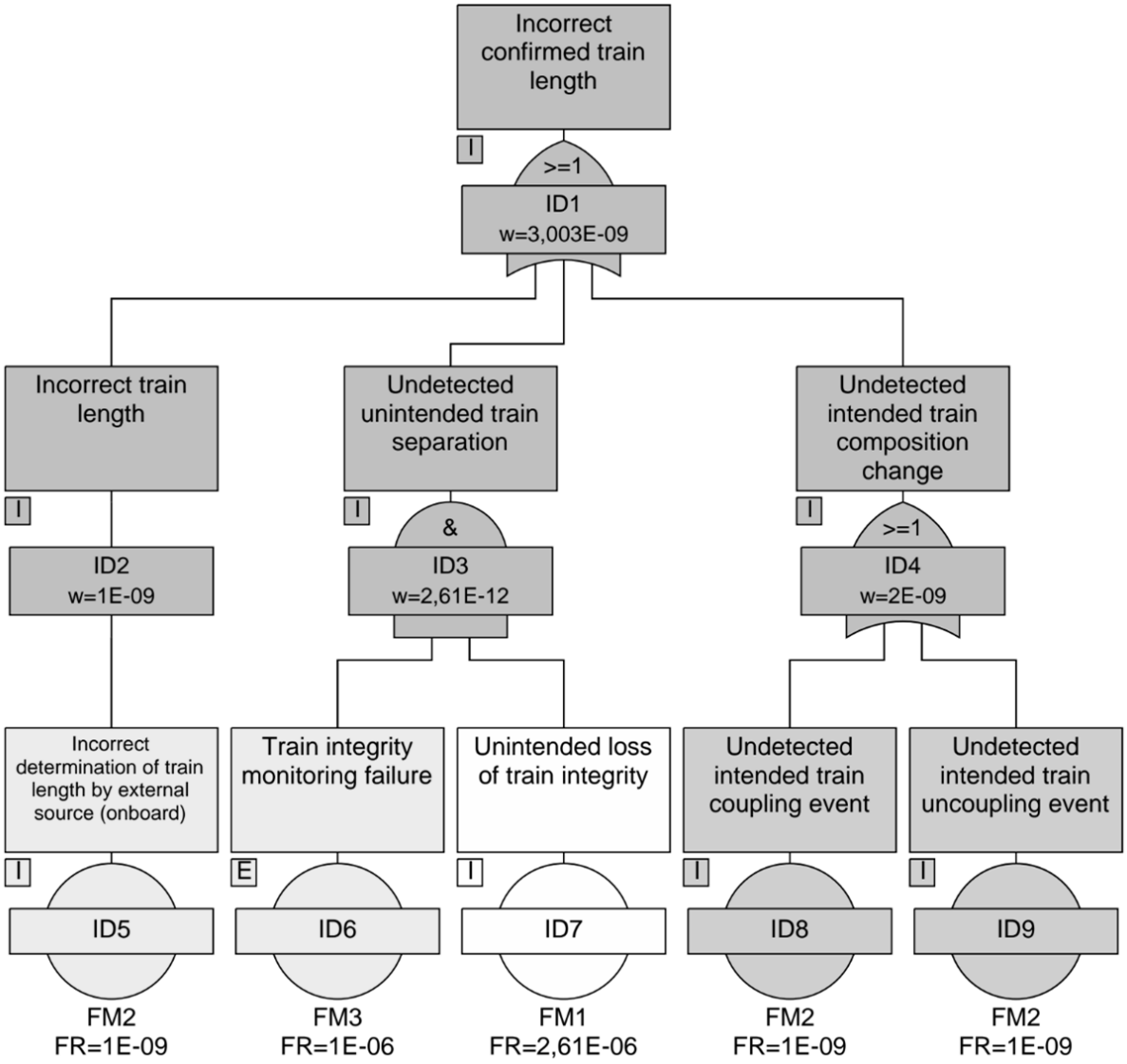

Figure 9: High level fault tree: THR/TFFR allocation for TIMS with SIL 4 train length determination

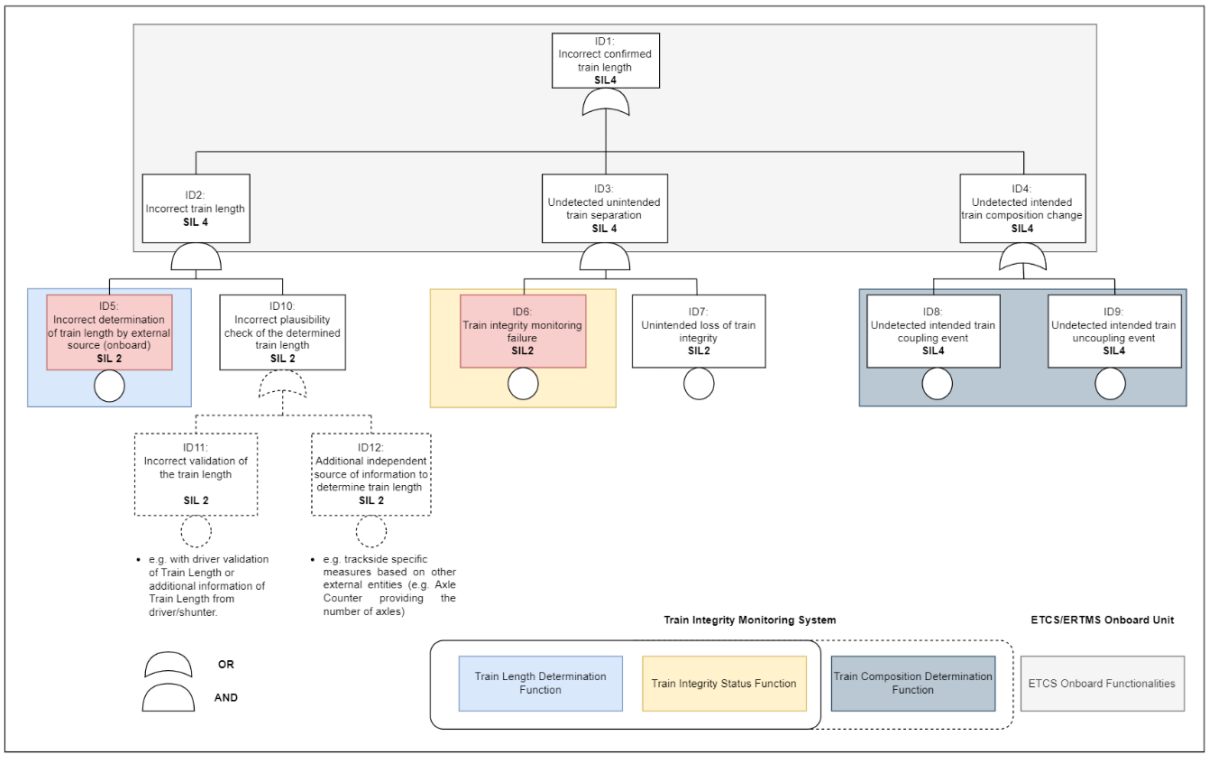

Figure 10: High level fault tree: TIMS with SIL 2 train length determination

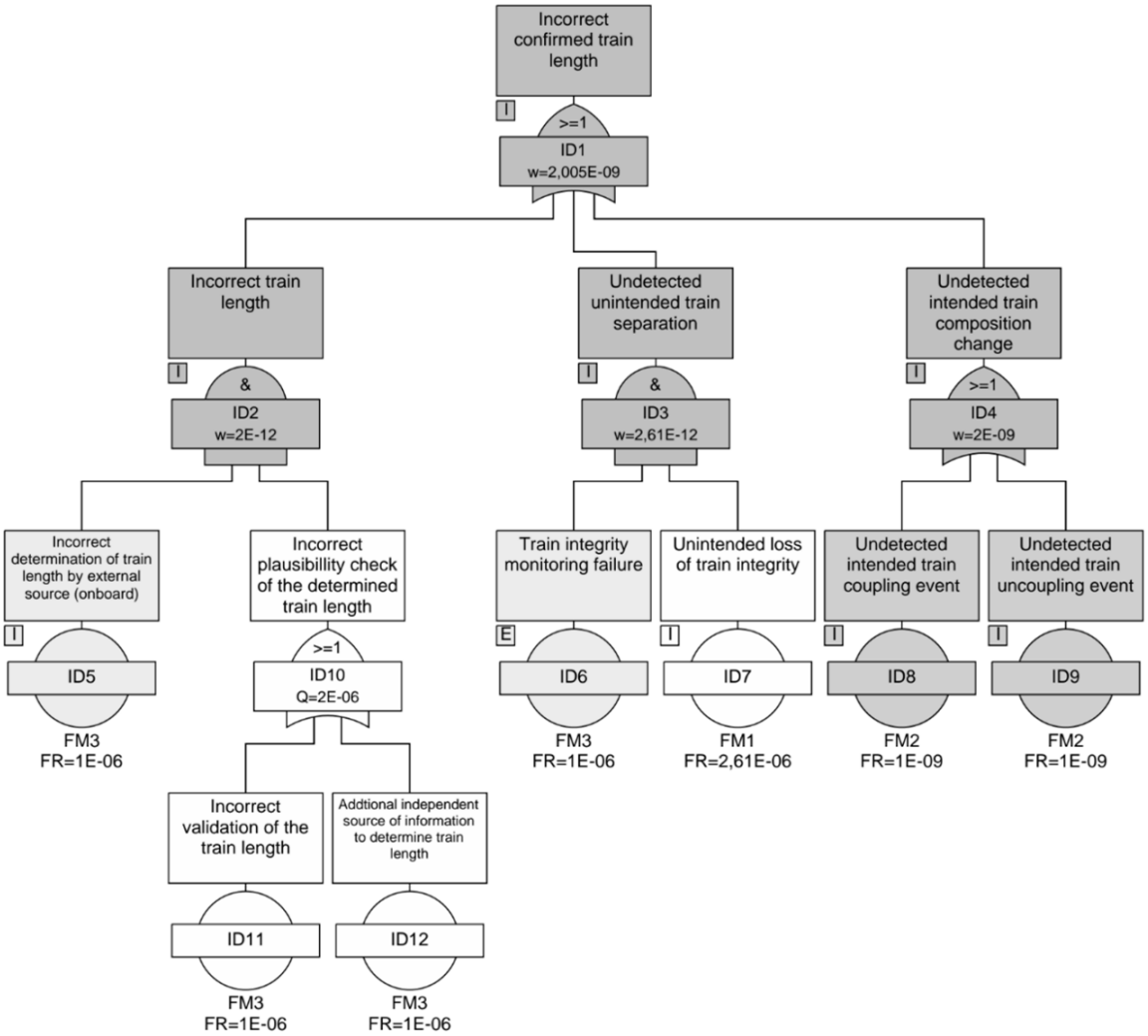

Figure 11: High level fault tree: THR/TFFR allocation for TIMS with SIL 2 train length determination

3 Generic TIMS requirements

ID	Requirement	Category	Generic	Functional
<GA01>	As a minimum, the CCS 2023 TSI and its accompanying CRs shall be implemented.	Required	X	
<GA02>	Monitoring of train integrity: The Train Integrity Monitoring System (TIMS) continuously confirms and monitors the completeness (integrity) of a train consisting of several (two or more) consists (vehicles or wagons) that could separate unintendedly.	Info	X	
<GA03>	Monitoring of train integrity: If the train integrity cannot be confirmed by TIMS (e.g., train integrity information is not available, or train integrity is lost), a confirmed train integrity status (Q_INTEGRITY == 1) shall not be send by the TIMS.	Info	X	
<GA04>	Monitoring of train integrity status (Q_INTEGRITY): The overall train integrity monitoring function shall achieve at least SIL 2.	Required	X	
<GA05>	Determination of train length: An external system or TIMS determines and calculates the train length of the entire train, no later than until the validation of the train data input.	Required	X	
<GA06>	Determination of train length: If the overall function for train length determination is at least SIL 4 (independently or by validation of a SIL 2 input to achieve overall SIL 4 for L_TRAIN), the confirmed train integrity status determined by TIMS (Q_INTEGRITY) allows the calculation of the confirmed train length (L_TRAININT) in the EVC.	Required	X	
<GA07>	Determination of train length: If the overall function for train length determination is not SIL 4 (independently or by validation of a SIL 2 input to achieve overall SIL 4 for L_TRAIN), then no confirmation of the train integrity status (Q_INTEGRITY) and thus no calculation of the confirmed train length (L_TRAININT) is allowed to be performed by the EVC.	Required	X	
<GA08>	The train integrity monitoring system (TIMS) consists of the train's TIM modules (TIM-Master modul und TIM-Slave-modul(es)) and associated components.	Info		X

ID	Requirement	Category	Generic	Functional
<GA09>	At least one TIM module is associated with each consist.	Optional		X
<GA10>	Each TIM module should, as a minimum, provide the integrity status and length of the associated consist to the Train Integrity Monitoring System (TIMS).	Optional		X
<GA11>	Identification of the leading consist (Head): TIMS should be able to identify the leading consist of the train as the Head.	Optional		X
<GA12>	Identification of the last consist at the very end (Tail): TIMS should be able to identify the last consist at the very end of the train as Tail. Note: If only one consist is present, then no Tail exists.	Optional		X
<GA13>	Identification of intermediate consists (Trunk): TIMS should be able to identify any additional consists in the train as Trunks. Note: If only the Head and the Tail are present, then no Trunks exist.	Optional		X
<GA14>	Generate output of the train integrity status (Q_INTEGRITY) to the EVC: TIMS shall provide an output with the information, that a) the integrity of the train is confirmed, or b) the integrity of the train has been lost if there is any change in the train composition, or c) the integrity of the train is unknown if the integrity of the train cannot be determined.	Required	X	
<GA15>	Output of the train length to the EVC: An external system or TIMS shall provide an output with the train length information to the EVC so that the train length can be used as the ETCS train length parameter (L_TRAIN) as part of the train data.	Required	X	

ID	Requirement	Category	Generic	Functional
<GA16>	Intended changes to the train configuration (coupling/uncoupling) are detected with SIL 4 (optionally incl. validation, additional trigger, or system of a SIL 2 integrity or length determination to achieve overall SIL 4 for the detection on intended changes of the train configuration). Note: If there is an intended change in the train configuration (coupling or uncoupling), the TIMS determines the resulting train length.	Required	X	
<GA17>	The probability of occurrence of a loss of train integrity (Q_INTEGRITY) is assumed with a THR of <= 2.61*10-6/h (SIL 2) (for passenger trains) [ERTMS/ETCS SRS [SS091] 10.3.2.10 Max. unexpected loss of train integrity]. Note: For freight trains with the use of buffers and chain coupler, the THR shall be <=6.98*10-5/h.	Info	X	
<GA18>	The probability of occurrence of an erroneous confirmation of the train integrity (Q_INTEGRITY), in case of a loss of train integrity, is assumed with a THR of <= 10-9/h (SIL 4). Note: This is in accordance with the safety requirement of the Confirmed Train Length (L_TRAININT).	Info	X	
<GA19>	TIMS self-test function: All faults of the TIMS shall be detected within 24 hours at the latest. Note: To achieve the safety targets of the TIMS, detection of a malfunction of the TIMS by the self-test function is necessary within a dormancy or latency period of 24 hours at the maximum.	Required	X	
<GA20>	All vehicle-specific interfaces of the TIMS and optional external systems should be defined and agreed on a project-specific level. Note: All interfaces that exceed the TSI and are not specified should be harmonized. The goal shall be the definition of generic interfaces.	Optional	X	
<GA21>	The project-specific requirements for IT security shall be implemented.	Required	X	
<GA22>	The presence and use of the TIMS or optional additional systems shall not influence the operation, e.g. coupling or uncoupling, except for the resulting modification of the train data.	Required	X	

ID	Requirement	Cate-gory	Gen-eric	Fun ctio nal
<GA23>	The train length shall be determined by the TIMS or external system with an error of less than.- 0 m to max. +1 m for the overall train consist and rounded up to the nearest integer value.	Re-quired	X	
<GA24>	The maximum duration (t) for determining and transmitting the train integrity status (Q_INTEGRITY) by the TIMS to the EVC, shall not exceed 1.5s for newly built vehicles. The duration t is given by the following formula: $t = t_{DT} + t_{TT} + t_{CT}$ where: Determination time t_{DT}: Maximum time duration to determine train integrity. Transmission time t_{TT}: Maximum time duration required to transmit and process the train integrity status. Cycle time t_{CT}: Maximum period interval with which the train integrity status is provided.	Re-quired	X	
<GA25>	The maximum duration (t) for determining and transmitting the train integrity status (Q_INTEGRITY) by the TIMS to the EVC, shall not exceed 3.5s for existing legacy vehicles. The duration t is given by the following formula: $t = t_{DT} + t_{TT} + t_{CT}$ where: Determination time t_{DT}: Maximum time duration to determine train integrity. Transmission time t_{TT}: Maximum time duration required to transmit and process the train integrity status. Cycle time t_{CT}: Maximum period interval with which the train integrity status is provided.	Re-quired	X	

Table 2: Generic TIMS requirements

References

No.	Title	Description	Version
[1]	**[CR940]**	ERA_solution_for_CR940_upd_271022	2022-10-17 17.10.2022
[2]	**[SS023]**	ERTMS/ETCS, CCS TSI Appendix A – Mandatory specifications (ETCS B4 R1), SUBSET-023 v400, Glossary of Terms and Abbreviations	4.0.0 07.05.2023
[3]	**[SS026]**	ERTMS/ETCS, CCS TSI Appendix A – Mandatory specifications (ETCS B4 R1), SUBSET-026 v400, System Requirements Specification	4.0.0 07.05.2023
[4]	**[SS034]**	ERTMS/ETCS, CCS TSI Appendix A – Mandatory specifications (ETCS B4 R1), SUBSET-034 v400, Train Interface FIS	4.0.0 07.05.2023
[5]	**[SS091]**	ERTMS/ETCS, CCS TSI Appendix A – Mandatory specifications (ETCS B4 R1), SUBSET-091 v400, Safety Requirements for the Technical Interoperability of ETCS in Levels 1 & 2	4.0.0 07.05.2023
[6]	**[SS119]**	ERTMS/ETCS, CCS TSI Appendix A – Mandatory specifications (ETCS B4 R1), SUBSET-119 v400, Train Interface FFFIS	4.0.0 07.05.2023
[7]	**[TSI CCS]**	Technical Specifications for Interoperability - Control Command and Signalling subsystem TSI	Regulation (EU) 2023/1695 of 10 August 2023
[8]	**[IEC61375-2-3]**	IEC 61375-2-3, Electronic railway equipment - Train communication network (TCN) - Part 2-3: TCN communication profile (English version EN61375-2-3:2015 + AC:2016-01 + AC:2016-11)	2017-02 01.02.2017
[9]	**[DIN VDE V 0831-103]**	DIN VDE V 0831-103 (VDE V 0831-103):2020-09 Electric signalling systems for railways Part 103: Identification of safety requirements for technical functions in railway signalling	2020-09 01.09.2020