FFFIS ETCS Train Interface Unit

D x.x. – Design, Architecture and System Interface Document

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| --- | --- | --- | --- | --- | --- | --- |
| Open source project | | | | | | |
| Dissemination Level | | | | | | |
| PU | | Public | | | | X |
| CO | | Confidential, restricted under conditions set out in Model Grant Agreement | | | |  |
| CI | | Classified, information as referred to in Commission Decision 2001/844/EC | | | |  |
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## Executive Summary

To be done

## Abbreviations and Acronyms

|  |  |
| --- | --- |
| AoE | ATO over ETCS |
| ATO | Automated Train Operation |
| ATSM | Automatic Train Stopping Management |
| cDAS | connected DAS |
| DAS | Driver Advisory System |
| GoA1 | Grade of Automation 1 – non automated train operation |
| GoA2 | Grade of Automation 2 – semi automated train operation |
| GoA2+ | Grade of Automation 2 – semi automated train operation with obstacle detection |
| GoA3 | Grade of Automation 3 – driverless train operation |
| GoA4 | Grade of Automation 4 – unattended train operation |
| JP | Journey Profile |
| MVB | On Board (unit) |
| OB/OBU | Optimum Speed Profile algorithm |
| OSP | Optimum Speed Profile algorithm |
| SP | Segment Profile |
| SPC | Speed Profile Check |
| SSEM | Supervised Speed Envelope Management |
| StP | Stopping Point |
| TCMS | Train Control Management System |
| TMS | Traffic Management System |
| TP | Timing Point |
| TRDP | Train Real Time Data Protocol |
| TTSM | Timetable Speed Management |
| VTP | Virtual Timing Point |

## Definitions [Reference SS119]

|  |  |
| --- | --- |
| CAN | Controller Area Network |
| CCS | Control-Command and Signalling |
| CR | Change Request |
| ECN | Ethernet Consist Network |
| FDT | Fault Detection Time as used in Subset 120 |
| MVB | Multifunction Vehicle Bus |
| MSFE | Maximum Safe Front End |
| mSRE | Minimum Safe Rear End |
| NID | National Identification |
| OBU | On Board Unit |
| Parallel Interface | An interface where each signal is transmitted by a separate pair of wires. |
| RST | Rolling Stock |
| 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. |
| SID | Safety Identifier |
| TCMS | Train Control and MonitoringSystem |
| TCO | Traction Cut Off |
| TFR | Tolerable Failure Rate |
| THR | Tolerable Hazard Rate |
| TI | Train interface |
| TR | Train side |
| TSI | Technical Specification for Interoperability |

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Lead: DB Cargo

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## Introduction

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## References

|  |  |  |  |
| --- | --- | --- | --- |
| Reference | Dokument | Version  Date | Type[[1]](#footnote-2) |
| [SS119] | Subset-119  ERTMS Train Interface FFFIS | 0.1.13  2014-10-16 | I |
| [SS120] | Subset-120  FFFIS TI – Safety Analysis | 0.2.11  2014-10-27 | I |
|  |  |  | I |
|  |  |  | I |

## Scope [Reference SS119]

* 1. The 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 [X]. The references for each function specified in [X] are shown in Table 1‑1.
  2. Moreover, current practice of the integration of the ERTMS/ETCS on-board into the vehicle led to some additional implementation requirements. Examples for these are: emergency brake feedback, emergency brake status and test in progress etc

Table 1-1 Cross References between Subset 034, Version 3.0.0 and subset-119 version 0.0.13-2

| **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 | Station platform | 2.4.6 |
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| 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 |
| 5.4.4 | Traction status | 2.5.4 |
| 5.5.1 | Type of train data entry | 2.6.1 |
| 5.5.2.2 | Train category (Cant Deficiency) | 2.6.2 |
| 5.5.2.3 | Train length | 2.6.2 |
| 5.5.2.4 | Traction/Brake model parameters | 2.6.2 |
| 5.5.2.5 | Maximum train speed | 2.6.2 |
| 5.5.2.6 | Loading gauge | 2.6.2 |
| 5.5.2.7 | Axle load category | 2.6.2 |
| 5.5.2.8 | Axle number | 2.6.2 |
| 5.5.2.9 | Train fitted with airtight system | 2.6.2 |
| 5.6 | National System isolation | 2.7 |

* 1. This interface specification allows minimising the number of interfaces/components needed for the integration of each on-board unit into a vehicle.
  2. In order to cover different applications, from basic diesel locomotives to high tech train sets, and from existing rolling stock to new trains, a limited number of options for technical solutions are specified.
  3. Any other technical solution for interfacing an on-board unit to a vehicle is out of the scope of this document.

## Terms and Abbreviations

|  |  |
| --- | --- |
| CAN | Controller Area Network |
| CCS | Control-Command and Signalling |
| CR | Change Request |
| ECN | Ethernet Consist Network |
| FDT | Fault Detection Time as used in Subset 120 |
| MVB | Multifunction Vehicle Bus |
| MSFE | Maximum Safe Front End |
| mSRE | Minimum Safe Rear End |
| NID | National Identification |
| OBU | On Board Unit |
| Parallel Interface | An interface where each signal is transmitted by a separate pair of wires. |
| RST | Rolling Stock |
| 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. |
| SID | Safety Identifier |
| TCMS | Train Control and MonitoringSystem |
| TCO | Traction Cut Off |
| TFR | Tolerable Failure Rate |
| THR | Tolerable Hazard Rate |
| TI | Train interface |
| TR | Train side |
| TSI | Technical Specification for Interoperability |

* 1. Naming conventions for the signals on the parallel interface
     1. The naming conventions are used to ensure identification of each single signal inside of this specification and the associated subsets 120 and 117.
     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)
     3. Character 1: Signal source

T = Train side

O = (ERTMS/ETCS) On-board unit

* + 1. 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 | Mag. shoes brake |
| MSO | Main switch off |
| NL | Non leading |
| PG | Pantograph |
| PD | Passenger Doors |
| PS | Passive Shunting |
| RB | Regenerative Brake |
| SB | Service Brake |
| SL | Sleeping |
| TCO | Traction cut-off at warning limit |
| TRI | Train integrity |
| TP | Test in Progress |
| TR | Traction (Status) |
| TT1, TT2 | Type of train data entry |

* + 1. Character 5: signal class

|  |  |
| --- | --- |
| A | Status Cab A |
| B | Status Cab B |
| C | Command |
| E | Enable (of a function of the input’s side) |
| F | Feedback |
| I | Inhibition (of a function of the input’s side) |
| S | Status (of a function of the output’s side) |

* + 1. 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 (see section 5). |
| N | The Non-inverted signal of an antivalent pair. |
| I | The Inverted signal of an antivalent pair. |

* + 1. Examples:

O\_EB1\_C\_3 means “Emergency brake 1 command signal contact number 3”.

T\_SL\_E\_N means “Sleeping enable inverted signal.

* 1. Naming conventions for the signals on the serial interface
     1. The naming conventions are used to ensure identification of the signals on the serial interface inside of this specification and the associated subsets 120 and 117.
     2. The name of each signal has the following structure, where each digit indicates the position: 1\_2\_3(\_4\_5)
     3. 1: Signal source

TR = Train side

OBU= ERTMS/ETCS on-board unit

* + 1. 2: Signal sink

TR = Train side

OBU = ERTMS/ETCS on-board unit

* + 1. 3: signal name in a readable form, giving information about the corresponding function
    2. 4\_5: if necessary, more detailed information about the signal/function (Status, Feedback, information about possible iterations, additional names, explanation if signal is inverted)

## Glossary

## General Requirements and Goals

## Development of the ETCS Onbard Unit – TCS Rollng Stock Interface

Lead: DB Cargo

## Definition o the Design Requirements

Lead: DB Cargo

## Definition of the Architecture and the System Boundaries

## ETCS Onboard Unit – Rolling Stock Integration Architecture

## ATO Onboard – ETCS Onboard System Integration Architecture

## ATO Onboard – Rolling Stock Integration Architecture

## Definition of the System Interfaces

Lead: DB Cargo

To be defined:

Interface ETCS Onboard Unit – TCS Rolling Stock via Ethernet Bus

## Reference Input and Output Architecture (RIO) [Reference SS119]

* + 1. Output is the source of information.
    2. Input is the receiver of information.
    3. For binary inputs and outputs the following architecture is defined:

Table 2- Reference I/O pair



* + 1. Note1: Figure represents the functionality of an isolated output, but it is not restricted to a specific design.
    2. Note2: ERTMS/ETCS on-board may provide isolated inputs as well, since existing vehicles might not provide isolation for outputs.
    3. Voltage values for input signals are specified by the ERTMS/ETCS on-board power supply, whereas the voltage value for the output signal is specified by the vehicle power supply.
    4. Definition of signal states:

Table 3- Definiton of signal states

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

# Requirements

## Requirements on the Design

## Requirements on the Architecture [Reference SS119]

* + 1. The Train Interface consists of serial interface and parallel interface.
    2. Some signals are only supported over serial interface due to the type of data.
    3. Some signals can be transmitted over parallel or serial interface.
       1. Note: for those signals, the vehicle on which the on-board unit is implemented it is allowed o support them either via parallel or serial interface.
    4. Selection between parallel and serial interface shall be done, signal by signal.
    5. Serial data shall not be distributed over more than one type of BUS.
    6. Figure 2‑1 shows the OBU (green colour) interfaced to the vehicle (blue colour) via Parallel and/or Serial Interface. The interface itself is drawn in red colour.

Table 4- Parallel and Serial Links between vehicle and ETCS on-board unit



* + 1. Parallel interfaces are defined according to the standardized Reference Input Output (RIO) circuits defined in Chapter x
    2. The on-board unit shall only support as serial interface the following types of bus: CAN, MVB and ECN as defined in chapter x.
    3. Note: Support can be limited to only one of the x types of bus.
    4. Definition: A numerical signal is a signal on the serial interface.. A two-state signal refers to a binary signal.

Table 5- Reference to all functional I/O

| **No** | **Functional I/O as per [7]** | **Source** | **Signal type** | **Par** | **Ser** |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| 1 | Sleeping | TR | Multiple two-state signal | X | X |
| 2 | Passive Shunting | TR | Two-state signal | X | X |
| 3 | Non-Leading | TR | Two-state signal | X | X |
| 4 | Isolation | OBU | Two-state signal | X | X |
| 5 | Service Brake Command | OBU | Two-state signal | X | X |
| 6 | Brake pressure | TR | Numerical signal |  | X |
| 7 | Emergency brake Command | OBU | Multiple two-state signal | X | X |
| 8 | Emergency brake feedback (implementation requirement. Not part of subset-034) | TR | Two-state signal | X | X |
| 9 | Test in progress (implementation requirement. Not part of subset-034) | OBU | Two-state signal | X | X |
| 10 | Emergency Brake Command Status (Implementation requirement. Not part of subset-034) | OBU | Two-state signal | X | X |
| 11 | Regenerative Brakes | OBU | Two-state signal | X | X |
| 12 | Magnetic Shoe Brakes | OBU | Two-state signal | X | X |
| 13 | Eddy Current Brakes for Service Brake | OBU | Two-state signal | X | X |
| 14 | Eddy Current Brakes for Emergency Brake | OBU | Two-state signal | X | X |
| 15 | Special Brake Inhibit – STM Orders | OBU | The same signal to be used as for ETCS orders | X | X |
| 16 | Special Brake Status | TR | This information is transmitted by the Train Data Information interface | ­- | - |
| 17 | Additional Brake Status |  | see above | ­- | - |
| 19 | Change of Traction System (Variant 1) | OBU, TR | Numerical signal |  | X |
| 20 | Change of Traction System (Variant 2) | OBU, TR | Multiple two-state signal | X | X |
| 21 | Pantograph-Trackside orders (Variant 1) | OBU, TR | Numerical signal |  | X |
| 22 | Pantograph-Trackside orders (Variant 2) | OBU, TR | Multiple two-state signal | X | X |
| 23 | Pantograph- STM orders | OBU | Multiple two-state signal | X | X |
| 24 | Air Tightness-Trackside orders (Variant 1) | OBU, TR | Numerical signal |  | X |
| 25 | Air Tightness-Trackside orders (Variant 2) | OBU, TR | Multiple two-state signal | X | X |
| 26 | Air Tightness-STM order | OBU | Multiple two-state signal | X | X |
| 27 | Station platform | OBU, TR | Numerical signal and two-state signal | X | X |
| 28 | Main Power Switch- trackside orders (Variant 1) | OBU, TR | Numerical signal |  | X |
| 29 | Main Power Switch- trackside orders (Variant 2) | OBU, TR | Multiple two-state signal | X | X |
| 30 | Main Power Switch- STM orders | OBU | Multiple two-state signal | X | X |
| 31 | Traction Cut Off at Warning limit | OBU | Two-state signal | X | X |
| 32 | Change of allowed Power Consumption (Variant 1) | OBU, TR | Numerical signal |  | X |
| 33 | Cab Status | TR | Two-state signal (per cab) | X | X |
| 34 | Direction Controller | TR | Two-state signal (per direction) | X | X |
| 35 | Train integrity | TR | Multiple two- state signal | X | X |
| 36 | Traction Status | TR | Two-state signal | X | X |
| 37 | Type of Train Data Entry | TR | Multiple two-state signal | X | X |
| 38 | Train Data information | TR | Numerical signal and two-state signal | X | X |
| 39 | National System Isolation | TR | Two-state signal (per NTC) | X | X |

Table 5- Reference to all functional I/O

* + 1. Note: Table 2‑1 gives an overview of the functional I/O, whether the information can be transmitted over parallel or serial interface or both. Technical requirements for the implementation are described in Chapters 4 and 5.

## Requirements on the Interfaces

* + 1. General Requirements [Reference SS119]
       1. Over voltages from inductive loads shall be minimised.
       2. The cabling between the vehicle and the ERTMS/ETCS on-board is within the responsibility of the vehicle.
    2. Reference Input and Output Architecture (RIO) [Reference SS119]
       1. Output is the source of information.
       2. Input is the receiver of information.
       3. For binary inputs and outputs the following architecture is defined:

Table 2- Reference I/O pair



* + - 1. Note1: Figure represents the functionality of an isolated output, but it is not restricted to a specific design.
      2. Note2: ERTMS/ETCS on-board may provide isolated inputs as well, since existing vehicles might not provide isolation for outputs.
      3. Voltage values for input signals are specified by the ERTMS/ETCS on-board power supply, whereas the voltage value for the output signal is specified by the vehicle power supply.
      4. Definition of signal states:

Table 3- Definiton of signal states

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

## Boolean Inputs [Reference SS119]

* + 1. Inputs shall have the following characteristics:

| Characteristic | Value |
| --- | --- |
| Max. voltage between pins\*1 | 24 V + overvoltage acc. EN 50155 |
| 48 V + overvoltage acc. EN 50155 |
| 72 V + overvoltage acc. EN 50155 |
| 96 V + overvoltage acc. EN 50155 |
| 110 V + overvoltage acc. EN 50155 |
| Max. input continuous current in High level\*2 | 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 |
| Max. L/R\*3 | 40ms |
| Min. input current in High state | * 4 mA for 24 V nominal voltage * 4 mA for 48V nominal voltage * 3mA for 72V nominal voltage * 2mA for 96V nominal voltage * 2mA for 110V nominal voltage * Otherwise: 1 mA and transient peak |
| Max. input current that has to be detected as Low level\*4\*2 | 250µA |

Table 3‑2 Characteristics for Boolean Inputs

* 1. \*1: Different voltage variations may be used, refer to EN 50155. In this case compliance  
      with the requirements shall be defined by ERTMS/ETCS on-board manufacturer and  
      integrator.
  2. \*2 Input current is the current that flows through the input pin.
  3. \*3 This is a requirement for the vehicle side.
  4. \*4 Higher currents could also be detected as Low level, but should be avoided by the  
      vehicle output.

## Boolean Outputs [Reference SS119]

* + 1. Outputs shall comply with the following characteristics:

| Characteristic | Value |
| --- | --- |
| Max. voltage between output pins in “Open” state | 24 V + overvoltage acc. EN 50155 |
| 48 V + overvoltage acc. EN 50155 |
| 72 V + overvoltage acc. EN 50155 |
| 96 V + overvoltage acc. EN 50155 |
| 110 V + overvoltage acc. EN 50155 |
| Max. continuous current through output in “Closed” state | 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 nominal voltage |
| 0.2 A for 110 V nominal voltage |
| Lowest possible output current in Closed status\*1 | High Power Outputs |
| 15 mA / 24 V  15 mA / 48 V  13 mA / 72 V  10 mA / 96 V  10 mA / 110 V |
| Low Power Outputs |
|  | 4 mA / 24 V  4 mA / 48 V  3 mA / 72 V  2 mA / 96 V  2 mA / 110 V |
| Max. leakage current in Open status at any voltage | 250µA |
| Max. L/R (of input) \*2 | 40 ms |
| Max. allowed time for a signal with two independent outputs to be invalid in transition phase\*3 | 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 Boolean outputs

* + 1. \*1: The values defined here are the minimum values the output is required to work if a  
        relay is used.
    2. \*2 L/R is the fraction of inductance over the resistance of the load.
    3. \*3 This requirement applies for the Sleeping, Train Integrity, Door Release Left (2 bits) and Door Release Right (2 bits) signals.

## Requirements on HMI/DMI

## Requirements on the Process, Method and Certification

## Requirements on Demonstrator

## Requirements on Interchangeability

All ETCS OBUs from all suppliers should be interchangeable. This means all interfaces (power, Network, subsets 119) should be identical.

## Requirements on Interoperability

# Design

## Design of ETCS OBU System

# Responsibilities

## Track System Design and Integration

## Rolling Stock System Train Control Management System Design and Integration

## ETCS OBU System Design and Integration

## ATO OBU System Design and Integration

# System Interfaces

## Interface ETCS Onboard Unit – Train Control Management System

* + 1. General [Reference SS199]
       1. For the ERTMS/ETCS on-board the serial interface is mandatory. It shall comply with the requirements in this section.
       2. This chapter includes the solutions regarding the MVB, CAN and ECN based on IEC 61375.
          1. **Note:** The information concerning the TI can be transferred via a Parallel interface or via a Serial interface. This gives the possibility of using both Parallel interface and a Serial interface in one installation.
          2. **Note:** If in future other protocols become applicable, the proposed solutions of the already described busses may be used as examples.
          3. **Note:** Upcoming new serial interfaces have to base its structure approach following IEC 61375.
       3. The safety requirements specified in Subset-120 have to be respected.
       4. If a Serial interface is used for safety related communication, the defined bus system in a vehicle can be seen as a Category 1 transmission system according to the definitions in EN 50159.
       5. All data is transmitted cyclically as process data.
    2. Serial architecture [Reference SS 119]
       1. General
          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. It’s up to the applicant to choose for each signal the adequate architecture.
       2. Architecture a)
          1. This architecture allows the use of hardware which is not able to implement requirements defined in EN50159 necessary for safety related communication (e.g. simple I/O-hardware with bus-interface).
          2. Note: The interface on the serial bus regarding port and telegram structure depends on  
              the used I/O module hardware and therefore it can’t be standardized
          3. This architecture is the preferred solution for the migration of signals to the IEC 61375.

#### 

Figure 4‑1 Architecture a)

* + - * 1. The architecture can define information signals using either single contact or antivalent contacts.
        2. When using Architecture a), the following principles shall be used for safety related information:

Information should be derived using antivalent contacts in case of antivalent /redundant input/output information is required separate I/O hardware shall be used.

* + - 1. Architecture b)
         1. This architecture is defined for information signals fully compliant with IEC 61375.
         2. The architecture allows the transmission of both non-safety related and safety related information.
         3. Using safety devices the TFR achievable depends on the TCMS design (Hardware and software)

#### 

Figure 4‑2 Architecture b)

* + - * 1. When using Architecture b) safe data transmission shall be applied according to IEC61375-2-3.
        2. Optionally the TCMS can integrate a gateway to adapt to the bus type defined by the ERTMS/ETCS on-board, presumed that transfer delay is **below 200ms** (worst case).
        3. All information requiring a higher SIL than provided by the TCMS shall be transmitted using the Parallel Interface.
        4. Usage of safe data transmission is only required when the required safety integrity level of a certain functionality cannot be fulfilled with normal serial bus transmission.

The SS119 defines only the data to be exchanged, the definition of OSI Layers 1-7 is missing.

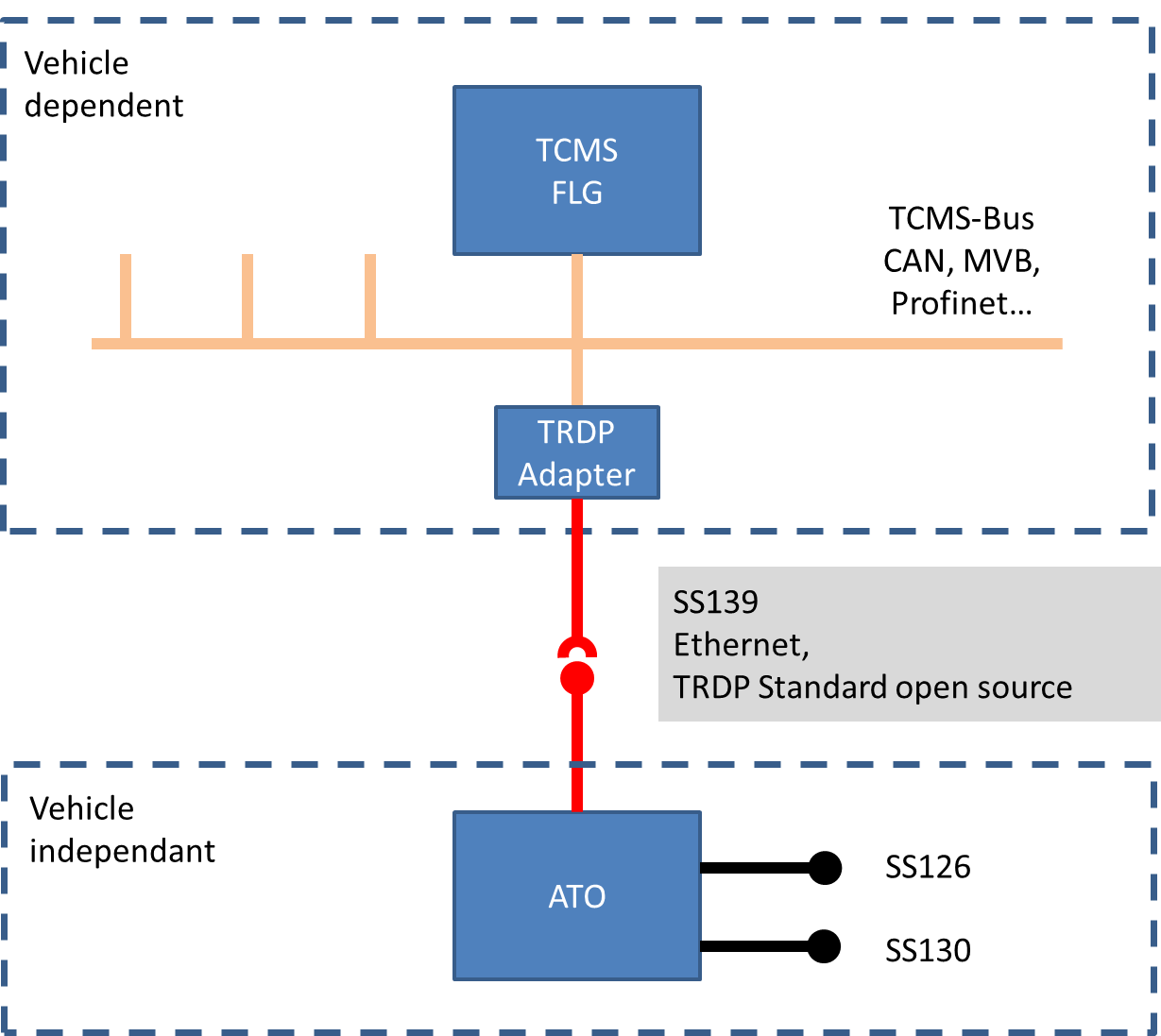
We prefer a standard open source architecture, independent of the actual vehicle TCMS system:

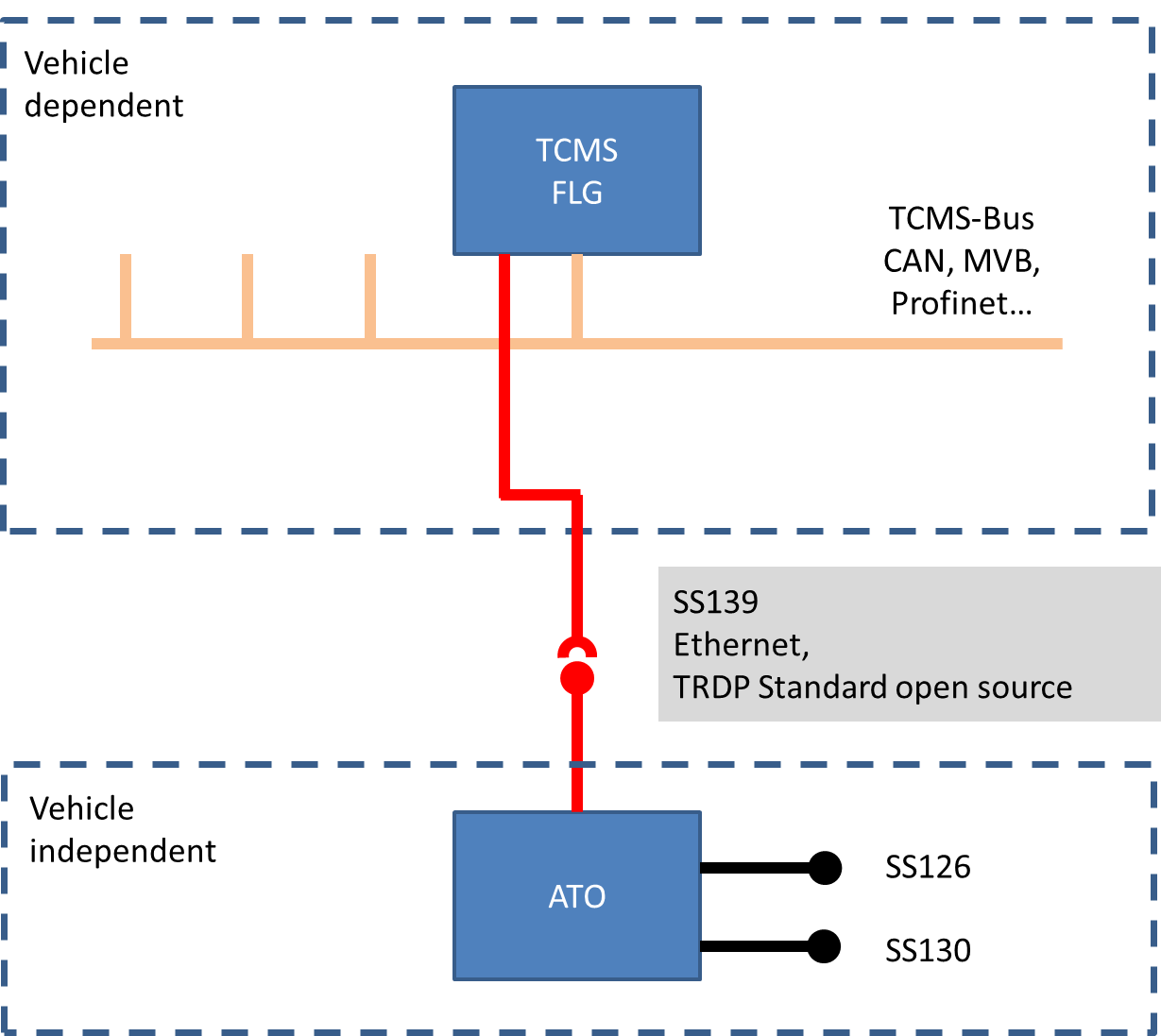
* + Ethernet 100 Mbit or 1 Gbit
  + IP
  + TCP and UDP
  + TRDP (**T**rain **R**eal Time **D**ata **P**rotocol, open source)

Advantages:

* The ATO box is independent of the vehicle architecture. Just one version of an ATO-box for all vehicles
* TRDP is open source
* TRDP is used in first commerical vehicles for TCMS and used by SBB for a TCMS-Gateway
* Standard according IEC 61375-2-3
* Ethernet is an industry standard and available at small costs
* No problems with obsolescences of proprietary hard/software

Two variants of a possible connection of the ATO-box to the vehicle are shown below.





## Interface ETCS Onboard Unit – ATO Onboard

See SS 139

## Interface ETCS Onboard Unit – National System

See STM Interface

## Coding

* + 1. General
    2. This chapter presents the definition of the data to be transmitted via Bus. If the serial Bus is to be used by the ERTMS/ETCS on-board unit, hereafter it is included whether the signal is mandatory or not. Consequently an assessment authority is able to define depending on the real implementation of the system which item is part of the assessment itself.
    3. The structure of the packets defined below is identical for both safety and non-safety related information.
    4. In case, non-safety information is to be transmitted, redundant information required for safety purposes shall be ignored (Axle to be asked, please set add an example (e.g. …)).
    5. The packets on the serial bus shall provide for each signal a specific validity bit.
    6. Signals not provided from the defined source shall be set to the default value and marked as invalid by setting the related validity bit to FALSE.
    7. The Serial Interface Table describes for each signal (function) whether it is mandatory or optional, minimum cycle, size in bit, type, name on parallel interface, name on serial interface, a comment and the default value. The tables describing the coding for CAN, ECN and MVB are derived from the following

## Constrains for the Interface Design

## Data Exchange and Recording

## Hardware Requirements

## Functional Requirements

## Communiation Monitoring

## Application Availability Monitoring (Hardware Watchdog)

## Communication Protocol

## Protocol Stack Overview

## Transmission Device Layer

The SS119 defines only the data to be exchanged, the definition of OSI Layers 1-7 is missing.

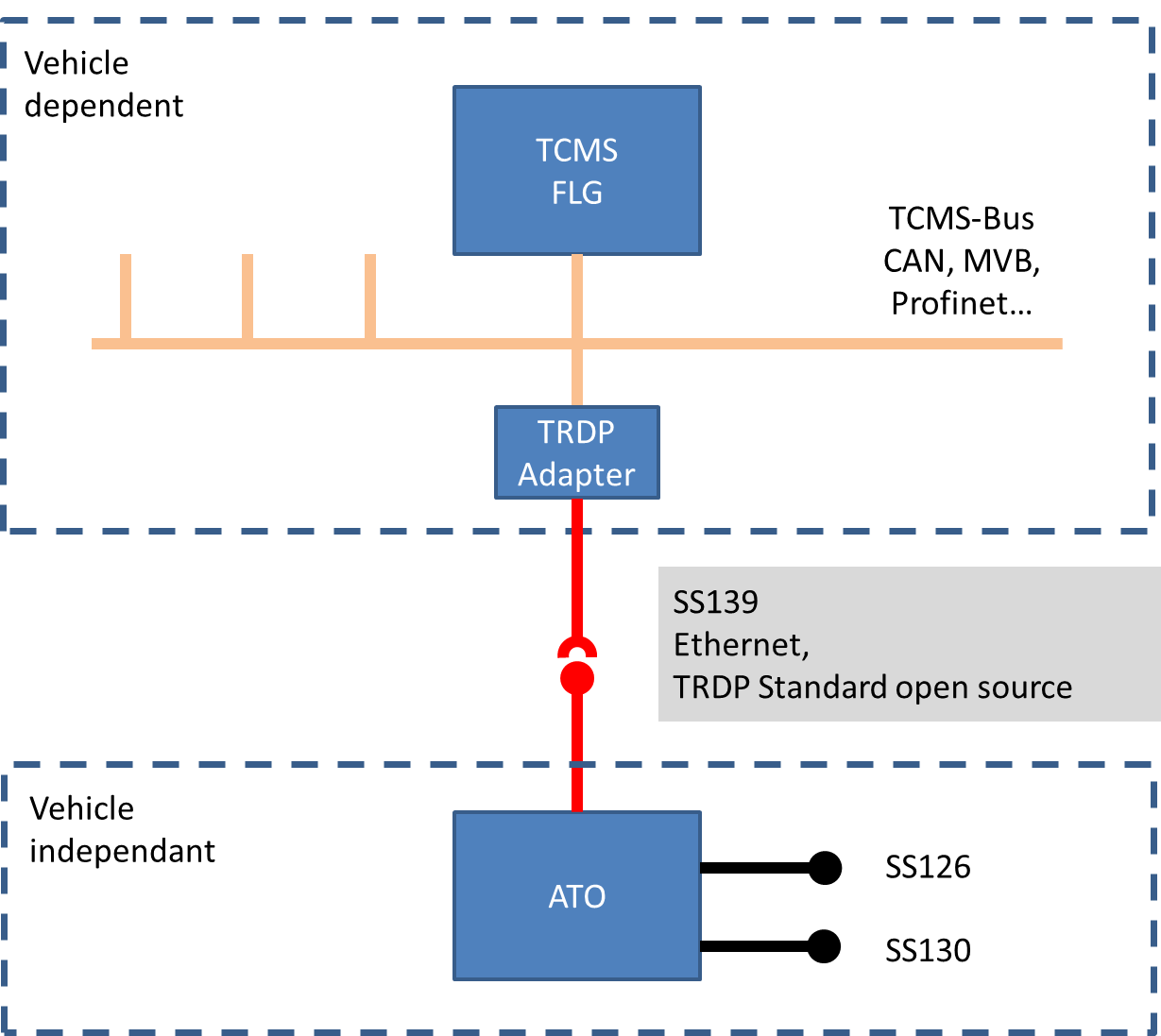
We prefer a standard open source architecture, independent of the actual vehicle TCMS system:

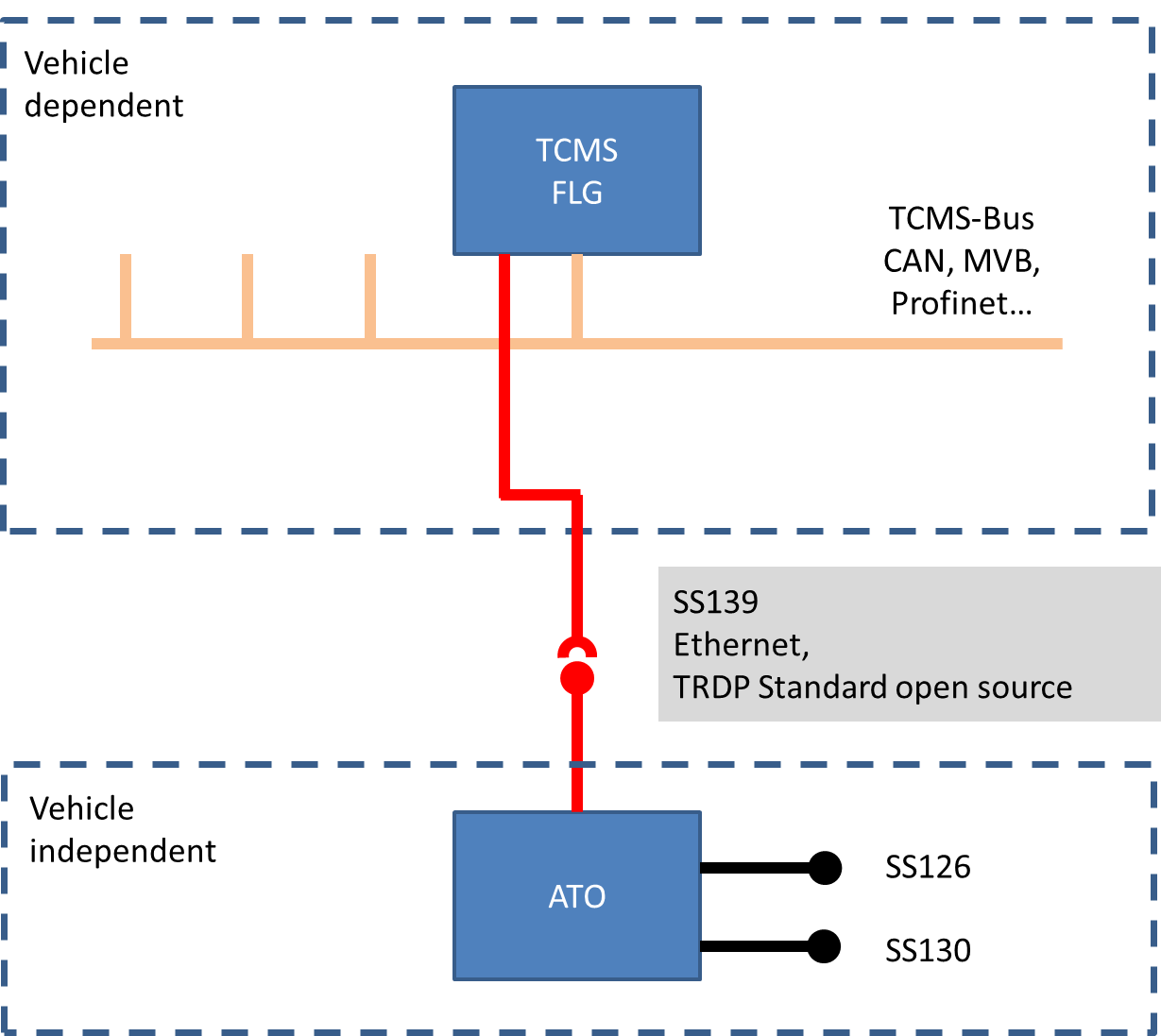
* + Ethernet 100 Mbit or 1 Gbit
  + IP
  + TCP and UDP
  + TRDP (**T**rain **R**eal Time **D**ata **P**rotocol, open source)

Advantages:

* The ATO box is independent of the vehicle architecture. Just one version of an ATO-box for all vehicles
* TRDP is open source
* TRDP is used in first commerical vehicles for TCMS and used by SBB for a TCMS-Gateway
* Standard according IEC 61375-2-3
* Ethernet is an industry standard and available at small costs
* No problems with obsolescences of proprietary hard/software

Two variants of a possible connection of the ATO-box to the vehicle are shown below.





## Safe Half-Duplex Protocol Layer

## Communication Data

## Serial Interface table [Reference SS119]

* + 1. Note: the following table specifies the signals for architecture b)
    2. Note: Mandatory means that the information has to be delivered on the bus either from OBU or vehicle. Optional means that the information can be not delivered either by OBU or vehicle.
    3. Remark: The Table is an example. It is to be finalised after sectors review

| **Mandatory/Optional** | **Function** | **minimum cycle [ms]** | **size[Bit]** | **signal type** | **name on parallel interface** | **name on serial interface** | **comment** | **default value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| M | Sleeping | 128 | 2 | BOOL | T\_SL\_E\_N, T\_SL\_E\_I | TR\_OBU\_TrainSleep, TR\_OBU\_TrainSleep\_Not | **Enable sleeping function** 0/0: Sleeping not requested (fault)  0/1: Sleeping not requested  1/0: Sleeping requested 1/1: Sleeping not requested (fault) | 0/1 |
| M | Isolation | 128 | 1 | BOOL | O\_IS\_S | OBU\_TR\_Isolation | Status of the Isolation-Switch Coding: 1: ETCS OBU isolated  0: ETCS OBU is not isolated | 1 |
| M | Passive shunting | 128 | 1 | BOOL | T\_PS\_E | TR\_OBU\_PassiveSh | **Enable passive shunting** Coding: 1:Passive shunting permitted 0: Passive shunting not permitted | 0 |
| O | Service brake | 128 | 1 | BOOL | O\_SB\_C | OBU\_TR\_EServiceBrake | **Commands** the activation of the **service brake.** Coding: 1: Service brake commanded  0: Service brake not commanded | 0 |
| O | Emergency brake | 128 | 1 | BOOL | O\_EB2\_C | OBU\_TR\_EB\_Cmd | ETCS has commanded the **emergency brake.** Coding: 1: Emergency brake not commanded  0: Emergency brake commanded | 1 |
| O | Emergency brake | 128 | 1 | BOOL | O\_EB\_S | OBU\_TR\_EB\_Status | **Status**, ETCS has commanded the **emergency brake.** Coding: 1: EB has been commanded by ETCS  0: No EB has been commanded by ETCS | 0 |
| M | Emergency brake | 128 | 1 | BOOL | T\_EB1\_F | TR\_OBU\_EB\_Feedback1 | **Feedback** of the **emergency brake.** Coding: 1: EB detected 0: No EB detected | 0 |
| O | Emergency brake | 128 | 1 | BOOL | T\_EB2\_F | TR\_OBU\_EB\_Feedback2 | **Feedback** of the **emergency brake.** Coding: 1: EB detected 0: No EB detected | 0 |
| O | Emergency brake | 128 | 1 | BOOL | O\_TP\_S | OBU\_TR\_TP | **EB test in progress**  Coding:  0: No EB test in progress  1: EB test in progress | 0 |
| M | Traktion Cut Off | 128 | 1 | BOOL | O\_TCO\_C | OBU\_TR\_TCO | **Traction cut off at warning limit**  Coding:  0: TCO not commanded  1: TCO commanded | 0 |
| M | Non Leading | 128 | 1 | BOOL | T\_NL\_E | TR\_OBU\_NL | **Enabling of NL-Mode**, Drivers brake valve isolated. Coding: 1: Non-Leading permitted  0: Non-Leading not permitted | 0 |
| M | Direction Controller | 128 | 2 | BOOL2 | T\_FW\_S, T\_BW\_S | TR\_OBU\_DC | **Status of Direction controller relative to occupied cab** Coding:T\_FW\_S,/T\_BW\_S 00: **Neutral (no direction selected)**  **10: Forward (relative to occupied cab)**  **01: Backward (relative to occupied cab)**  **11: Invalid** | 00 |
| M | Cab Status | 128 | 2 | BOOL2 | T\_CS\_A, T\_CS\_B | TR\_OBU\_CStat\_Cab | **Status of Cabs.** Coding: T\_CS\_A/T\_CS\_B 00: no cab activated  10: cab A activated  01: cab B activated  11: both cabs activated (fault, the OBU shall stay in old state and indicate a diagnostic message to the driver) | 00 |
| M | BrakePressure | 128 | 8 | UINT8 | T\_BP\_S | TR\_OBU\_BrPressure | **T\_BP\_S is an unsigned 8 bit signal**  Coding:  0: 0.0 bar air pressure in brake cylinders or UIC main brake pipe, depending on OBU configuration  1-100: Transient Pressure values in steps of 0.1 bar up to 10 bar  101-255: faulty values | 0 |
| O | Special Brake Inhibit | 128 | 1 | BOOL | O\_RB\_I | OBU\_TR\_RB inhibit | **StatusETCS has commanded inhibition of the Regenerative Brakes.** Coding: 1: Regenerative Brakes shall be inhibited  0: Regenerative Brakes shall not be inhibited | 0 |
| O | Special Brake Inhibit | 128 | 1 | BOOL | O\_MG\_I | OBU\_TR\_MG inhibit | **StatusETCS has commanded inhibition of the Magnetic Shoe Brakes.** Coding: 1: Magnetic Shoe Brakes shall be inhibited  0: Magnetic Shoe Brakes shall not be inhibited | 0 |
| O | Special Brake Inhibit | 128 | 1 | BOOL | O\_ES\_I | OBU\_TR\_ES inhibit | **Status ETCS has commanded inhibition of the Eddy Current Brakes for Service Brake.** Coding: 1: Eddy Current Brakes for Service Brake shall be inhibited 0: Eddy Current Brakes for Service Brake shall not be inhibited | 0 |
| O | Special Brake Inhibit | 128 | 1 | BOOL | O\_CB\_I | OBU\_TR\_CB inhibit | **Status ETCS has commanded inhibition of the Eddy Current Brakes for Emergency Brake.** Coding: 1: Eddy Current Brakes for Emergency Brake shall be inhibited  0: Eddy Current Brakes for Emergency Brake shall not be inhibited | 0 |
| O | Train Data | 128 | 2 | BOOL2 | T\_TRT\_S1,  T\_TRT\_S2 | TR\_OBU\_TrainType | **Status Type of train data entry.** Coding: 00: Neutral  10 : Fixed  01 : Flexible  11 : Switchable | 00 |
| O | Train Data | 128 | 8 | UINT8 | T\_TRC\_S | TR\_OBU\_TrainCategory | **Status Train category (ies)** Coding: see Subset 026-7.5.1.82.1 |  |
| O | Train Data | 128 | 16 | UINT16 | T\_TRL\_S | TR\_OBU\_TrainLength | **Status Train length** Coding: see Subset 026-7.4.3.5 |  |
| O | Train Data | 128 | 8 | UINT8 | T\_BRM\_S | TR\_OBU\_BrakeModel | **Status Traction/Brake model parameters** Coding:  Application dependent |  |
| O | Train Data | 128 | 8 | UINT8 | T\_MTS\_S | TR\_OBU\_MaxTrainSpeed | **Status Maximum train speed** Coding: see Subset 026-7.4.3.5 |  |
| O | Train Data | 128 | 8 | UINT8 | T\_LoG\_S | TR\_OBU\_LoadingGauge | **Status Loading gauge** Coding: see Subset 026-7.4.3.5 |  |
| O | Train Data | 128 | 8 | UINT8 | T\_ALC\_S | TR\_OBU\_AxleLoadCat | **Status Axle load category** Coding: see Subset 026-7.4.3.5 |  |
| O | Train Data | 128 | 16 | UINT16 | T\_ANO\_S | TR\_OBU\_AxelNo | **Status Axle number** Coding: see Subset 026-7.4.3.5 |  |
| O | Train Data | 128 | 1 | BOOL | T\_ATS\_S | TR\_OBU\_AirTight | **Status airtight system** Coding:  1: Airtightsystem available 0: Airtight system not available |  |
| O | National Train Control System, | 128 | 8 | UINT8 | T\_NSI\_S | TR\_OBU\_NatSysIS | **Status National System Isolation** Coding for each bit:  1: NTC isolated 0: NTC not isolated |  |
| O | Control Train Function | 128 | 16 | UINT16 | O\_VE\_S | OBU\_TR\_V\_est | **Current estimated speed of the train as status in cm/s**  Coding:  1 = 1cm/s  Note: the maximum speed in this solution will be 1179km/h |  |
| O | Control Train Function | 128 | 16 | UNIT16 | O\_TL\_S | OBU\_TR\_Train\_Length | **Length of the complete train as status in m**  Coding:  1 = 1 m |  |
| O | Control Train Function | 128 | 1 | BOOL | O\_ST\_S | OBU\_TR\_Standstill | **Train Standstill**  Coding:  1: Train IS at Standstill  0: Train is NOT at Standstill |  |
| O | Change of Traction System | 128 | 16 | UINT16, 2’s complement | O\_CT\_S0 | OBU\_TR\_D\_CTS | **Information about status, distance to and length of the TrackCondition‘Changing the traction system’ used by the TCMS**  Coding:  8000h (special value): No track condition of particular type announced / active.  If set for at least 2 seconds the announced / active condition has been cancelled.  7FFFh to 0000h (32767 m to 0 m): This value represents the remaining distance to the location where the change of traction system has to be done (only positive values are used). If the value is within this range a track condition is announced and distance to reference area is counting down.  1 bit ≡ 1 m  Used in variant 1 |  |
| O | Change of Traction System | 128 | 16 | UINT16 | O\_CT\_S1 | OBU\_TR\_L\_CTS\_Area  (option overlap traction system) | **The fixed length of the section where both traction feeds are available.**  Coding:  1 bit ≡ 1 m.  Used in variant 1 |  |
| O | Change of Traction System | 128 | 16 | UINT16 | O\_CT\_S2 | OBU\_TR\_NID\_CTS\_System | **The new traction system (NID\_CTRACTION).**  Coding:refer to subset 026 chapter 7  1: Train IS at the related country  0: Train is NOT at the related country  Note: For the serial interface: 16 Bits for the country  Used in variant 1 and 2 |  |
| O | Change of Traction System | 128 | 4 | BOOL4 | O\_CT\_S3 | OBU\_TR\_NID\_CTS\_Voltage | **The new traction voltage (M\_VOLTAGE).**  4 bit for new voltage  [for Coding refer to subset 026 chapter 7]  Used in variant 1 and 2 |  |
| O | Change of Traction System | 128 | 1 | BOOL | O\_CT\_S4 | O\_CTS\_Standstill | **Change of traction system allowed onlyat standstill**  Coding:  0 = allowed only at standstill  1 = allowed not only at standstill  Used in variant 1 |  |
| O | Change of Traction System | 128 | 1 | BOOL | O\_CT\_S5 | OBU\_TR\_ChgTracPwr\_Activation | **Changing the traction system commanded by the EVC**  Coding:  1: Change of Traction Power System IS allowed  0: Change of Traction Power System IS NOT allowed  Used in variant 2 |  |
| O | Pantograph | 128 | 16 | UINT16, 2’s complement | O\_PA\_S0 | OBU\_TR\_D\_Panto | **Information about status, distance to and length of the TrackCondition‘Passing a powerless section with pantograph to be lowered’ used by the TCMS**  Coding:  8000h (special value): No track condition of particular type announced / active.  If set for at least 2 seconds the announced / active condition has been cancelled.  7FFFh to 0000h (32767 m to 0 m): This value represents the remaining distance to the beginning of the area (only positive values are used). If the value is within this range a track condition is announced and distance to reference area is counting down.  8002h to FFFFh  (-32766 m to -1 m): This value represents the remaining distance until the train has cleared the area (only negative values are used). If the value is within this range the train has already passed an entry point.  1 bit ≡ 1 m  Used in variant 1 |  |
| O | Pantograph | 128 | 16 | UINT16 | O\_PA\_S1 | OBU\_TR\_L\_Panto\_Area | **The fixedlength of the section where pantograph has to remain in low position**. Coding:  1 bit ≡ 1 m.  Used in variant 1 |  |
| O | Pantograph | 128 | 1 | BOOL | T\_PA\_S2 | TR\_OBU\_PD\_S | **Status of all pantograph(s) within the relevant section (used for ETCS DMI).**  Coding:  0: Not all pantographs lowered  1: All pantographs lowered  Used in variant 1 and 2 |  |
| O | Pantograph | 128 | 1 | BOOL | O\_PA\_C3 | OBU\_TR\_EPanto | **Command to enter in the lower pantograph sequence**  Coding:  1: Enter in lower pantograph sequence  0: Exit of the lower pantogarph sequence  Note: Coherent to the DMI display  Used in variant 2 |  |
| O | Pantograph | 128 | 1 | BOOL | O\_PA\_C4 | OBU\_TR\_Panto\_RET | **Command to reduce the traction**  Coding:  1: Traction has to be disabled  0: Traction to be enabled  Used in variant 2 |  |
| O | Pantograph | 128 | 1 | BOOL | O\_PA\_C5 | OBU\_TR\_Panto\_OCB | **Command to open the Main Circuit Breaker**  Coding:  1: Main circuit breaker open command  0: Main circuit brake enabled to close  Used in variant 2 |  |
| O | Pantograph | 128 | 1 | BOOL | O\_PA\_C6 | OBU\_TR\_Panto\_DPT | **Commandto lower pantograph**  Coding:  1: Lower pantograph command  0: Raise Pantograph command enabled  Used in variant 2 |  |
| O | Pantograph | 128 | 1 | BOOL | O\_PA\_S7 | OBU\_TR\_Panto\_PLA(Power Less Area | **Status, whether train is in Powerless area or not**  Coding:  1: Train inside the powerless area  0: Train outside the powerless area  Used in variant 2 |  |
| O | Air Tightness | 128 | 16 | UINT16, 2’s complement | O\_AT\_S0 | OBU\_TR\_D\_AirTight | **Information about status, distance to and length of the TrackCondition‘Air Tightness’ used by the TCMS**  Coding:  8000h (special value): No track condition of particular type announced / active.  If set for at least 2 seconds the announced / active condition has been cancelled.  7FFFh to 0000h (32767 m to 0 m): This value represents the remaining distance to the beginning of the area (only positive values are used). If the value is within this range a track condition is announced and distance to reference area is counting down.  8002h to FFFFh  (-32766 m to -1 m): This value represents the remaining distance until the train has cleared the area (only negative values are used). If the value is within this range the train has already passed an entry point.  1 bit ≡ 1 m  Used in variant 1 |  |
| O | Air Tightness | 128 | 16 | UINT16 | O\_AT\_S1 | OBU\_TR\_L\_AirTight\_Area | **The fixed length of the section where air tightness has to be provided.** Resolution: see OBU\_TR\_L\_ATA\_Sc |  |
| O | Air Tightness | 128 | 2 | BOOL2 | O\_AT\_S2 | OBU\_TR\_L\_ATA\_Scale | **Scale related of the length of the section where air tightness has to be provided**  Coding:  00: 10 cm  01: 1 m  10: 10 m  11: spare |  |
| O | Air Tightness | 128 | 1 | BOOL | T\_AT\_S3 | TR\_OBU\_SAirTightness  (option) | **Status of air conditioning intake within the relevant section (used for ETCS DMI)**  Coding:  0: Not all air conditioning intake closed  1: All air conditioning intake closed |  |
| O | Air Tightness | 128 | 1 | BOOL | O\_AT\_S4 | OBU\_TR\_S\_AirTight | **Status Passing an air tightness area computed by the EVC**  Coding:  1: Enter in air tightness area  0: Outside the air tightness area  Used in variant 2 |  |
| O | Air Tightness | 128 | 1 | BOOL | O\_AT\_C5 | OBU\_TR\_Com\_AirTight | **Command air tightness open/close**  Coding:  1: Close (air conditioning intake)  0: Open (air conditioning intake)  Used in variant 2 |  |
| O | Station platform | 128 | 32 | UINT32 | O\_PD\_S0 | OBU\_TR\_NID\_Station  (optional via Package 44) | **Station code of the next station.**  The NID\_STOP\_STATION identifies the next station of a route that is assigned to a train running number (NID\_OPERATIONAL).  Format:  Bit [0 – 3] = ‘platform track in station’ ID  Bit [4 – 10] = station ID  Bit [11 – 15] = line ID  0 = undefined used outside the station area  Note: Coding is project specific |  |
| O | Station platform | 128 | 5 | UINT8 | O\_PD\_S1 | OBU\_TR\_KITER | **Number ofiterations of the following variables**  Coding (only 5 bits used:  K= number of iterations  K= maximum 5  0y01= first iteration is valid  0y02= second iteration is valid  0y04= thitditeration is valid  0y08= forth iteration is valid  0x10= fifth iteration is valid |  |
| O | Station platform | 128 | 3 | UINT8 | O\_PD\_S2 | OBU\_TR\_DOS(1)  (optional via Package 44) | **Door open strategy at the platform track referenced by the NID\_STATION**  Coding (only 3 bits used):  0 = door release - disabled  1 = door release left  2 = door release - right  3 = door release - both  4 = door release - first left then right (option)  5 = door release - first right then left (option) |  |
| O | Station platform | 128 | 16 | UINT16,  2’s complement | O\_PD\_S3 | OBU\_TR\_D\_Platform(1) | See table in 4.5.4.3. Resolution: 1 bit ≡ 1 m. |  |
| O | Station platform | 128 | 16 | UINT16 | O\_PD\_S4 | OBU\_TR\_L\_Platform(1) | **The length of the platform** (L\_TRACKCOND). Resolution in m |  |
| O | Station platform | 128 | 16 | UINT16 | O\_PD\_S5 | OBU\_TR\_H\_Platform(1) | **The height of the platform** (M\_PLATFORM). Resolution in mm |  |
| O | Station platform | 128 | 2 | BOOL2 | O\_PD\_C1 | OBU\_TR\_Door\_Release\_L (K) | **Door release command left** (according to DOS).  Coding:  00: invalid  01: released  10: not released  11: invalid |  |
| O | Station platform | 128 | 2 | BOOL2 | O\_PD\_C2 | OBU\_TR\_Door\_Release\_R(K) | **Door release command right**( according to DOS).  Coding:  00: invalid  01: released  10: not released  11: invalid |  |
| O | Station platform | 128 | 1 | BOOL | O\_PD\_S6 | O\_Platform\_Standstill (optional) | **Door release only at standstill at the correct location.**  Coding:  0 = Release of Doors at standstill  1 = Release of Doors at standstill and correct location |  |
| O | Main Power Dwitch | 128 | 16 | UINT16 | O\_MP\_S0 | OBU\_TR\_D\_MPSO | **Information about status, distance to and length of the TrackCondition‘Main Power Switch off’ used by the TCMS**  Coding:  8000h (special value): No track condition of particular type announced / active.  If set for at least 2 seconds the announced / active condition has been cancelled.  7FFFh to 0000h (32767 m to 0 m): This value represents the remaining distance to the beginning of the area (only positive values are used). If the value is within this range a track condition is announced and distance to reference area is counting down.  8002h to FFFFh  (-32766 m to -1 m): This value represents the remaining distance until the train has cleared the area (only negative values are used). If the value is within this range the train has already passed an entry point.  1 bit ≡ 1 m  Used in variant 1 |  |
| O | Main Power Switch | 128 | 16 | UINT16 | O\_MP\_S1 | OBU\_TR\_L\_MPSO\_Area | **The fixed length of the section where the main power switch has to be switched off.**Coding:  Resolution: 1 bit ≡ 1 m. |  |
| O | Main Power Switch | 128 | 1 | BOOL | T\_MP\_C2 | TR\_OBU\_SMPSO | **Status of all main power switches on train within the relevant section (used for ETCS DMI).**  Coding:  0: Not all main power switches are off  1: All main power switches are off |  |
| O | Main Power Switch | 128 | 1 | BOOL | O\_MP\_C3 | OBU\_TR\_EMPS | **Enter Main power switch sequence**  Coding:  1: Enter in Main Power Switch Off sequence  0: Exit the Main Power Switch Off sequence |  |
| O | Main Power Switch | 128 | 1 | BOOL | O\_MP\_C4 | OBU\_TR\_MPS\_RET | **Command to reduce the traction**  Coding:  1: Traction has to be disabled  0: Traction has to be enabled |  |
| O | Main Power Switch | 128 | 1 | BOOL | O\_MP\_C5 | OBU\_TR\_MPS\_OCB | **Command to open the Main Circuit Breaker**  Coding:  1: Main Circuit Breaker Open command  0: Main Circuit Breaker enabled to close |  |
| O | Main Power Switch | 128 | 1 | BOOL | O\_MP\_S6 | OBU\_TR\_MPS\_PLA | **Status, indicating whether the train is in the powerless area**  Coding:  1: Train inside the powerless area  0: Train outside the powerless area |  |
| O | Main Power Switch | 128 | 1 | BOOL | T\_MP\_S7 | TR\_OBU\_MPS\_Status | **Status of all main power switches on train within the relevant section (used for ETCS DMI).**  Coding:  0: Not all main power switches are off  1: All main power switches are off |  |
| O | Allowed Current Consumption | 128 | 16 | UINT16, 2’s complement | O\_CC\_S0 | OBU\_TR\_D\_ACC | **Information about status, distance to and length of the track condition change of allowed current consumption’ used by the TCMS**  Coding:  8000h (special value): No track condition of particular type announced / active.  If set for at least 2 seconds the announced / active condition has been cancelled.  7FFFh to 0000h (32767 m to 0 m): This value represents the remaining distance to the location where the allowed current consumption changes (only positive values are used). If the value is within this range a track condition is announced and distance to reference area is counting down.  8002h to FFFFh  (-32766 m to -1 m): This value represents the remaining distance until the train has cleared the area (only negative values are used). If the value is within this range the train has already passed an entry point.  1 bit ≡ 1 m  Used in variant 1 |  |
| O | Allowed Current Consumption | 128 | 10 | UINT16 | O\_CC\_S1 | OBU\_TR\_D\_ACC\_Limit | **New current limit**  Coding:  See Subset-026 chapter 7.5.1.62.1 (M\_CURRENT) |  |
| O | Train Integrity | 128 | 2 | BOOL2 | O\_TRI\_S-1, O\_TRI\_S-2 | TR\_OBU\_TRI | **Trainintegrity**  Coding:  00: Train integrity lost  01: No train integrity information available  10: Fault  **11: Train integrity confirmed** | 00 |

## Packets Overview

* + 1. List of Packets
       1. Definition

Packets are multiple variables grouped into a single unit, with a defined internal structure.

This structure consists of a packet header with a unique packet number, the length of the packet in bits, optionally the distance scale and an information section containing a defined set of variables. The packet structure is as follows:

|  |  |  |
| --- | --- | --- |
| Number | NID\_PACKET | Packet identifier |
| Length | L\_PACKET | Number of bits in the packet |
| Scale | Q\_SCALE | Specifies which distance scale is used for all distance information within the packet.  There is no Q\_SCALE variable in packets that do not contain distance information. |
| Information | ...... | Well-defined set(s) of variables. |

The packet definition does not change when transmitted over different transmission media.

All currently not defined packet identifiers are reserved for future use. All future packet definitions shall follow the above defined structure.

N\_ITER specifies the number of iterations of a variable or group of variables that follow.

If N\_ITER is 0 then no variables follow.

Two nested levels of iterations can exist.

Indented variables are optional, depending on the value of the previous qualifier variable in the packet.

* + - 1. Packets TIU to ETCS Onboard Unit

| Packet Number | Packet Name |
| --- | --- |
| 0 | Inputs from train devices |
| 1 | Plain text message |
| 2 | Fixed text message |
| 3 | brake models |
| 4 | *Not used* |
| 5 | *Not used* |
| 6 | Test and failure detection |
| 7 | STMs specific behaviour |
| 8 | Specific from MVB (Specific to Alstom implementation) |
| 12 | Diagnostic |
| 13 | Inhibition Level (Specific to Alstom implementation) |

* + - 1. ETCS Onboard to TIU

| Packet Number | Packet Name |
| --- | --- |
| 0 | Commands |
| 1 | Track conditions |
| 2 | Odometric data |
| 3 | Other information |
| 4 | Train type |
| 5 | Track condition change of traction power |
| 6 | Location reference update |
| 7 | Sporadic commands |
| 8 | STMs states |
| 9 | Train information |
| 10 | Doors control section |
| 11 | Track description deletion information |
| 14 | Gradients |
|  |  |

## Packets Application

Packet Number 0 : Inputs from train devices

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Gives the state of the train devices, received from the I/O board inputs, or from the optional CAN/train bus. | | |
| ***Sent*** | Sporadically | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  |  |  |  |
|  | V\_TIU\_EB\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_SB\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_TRACTION\_CUT\_OFF\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_ISOLATION\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_SLEEPING\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_TILTING\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_DIRCONT\_STATE\_FILTERED | 3 |  |
|  | V\_TIU\_DESKS\_STATE\_FILTERED | 3 |  |
|  | V\_TIU\_INTEGRITY\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_DRIVEREM\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_VIGIL\_ACTION\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_VIGIL\_DISABLE\_STATE\_FILTERED | 2 |  |
|  | V\_TIU\_COLD\_MOVE\_STATE\_FILTERED | 2 |  |
|  |  |  |  |
|  | V\_TIU\_EB\_STATE | 2 |  |
|  | V\_TIU\_SB\_STATE | 2 |  |
|  | V\_TIU\_TRACTION\_CUT\_OFF\_STATE | 2 |  |
|  | V\_TIU\_ISOLATION\_STATE | 2 |  |
|  | V\_TIU\_SLEEPING\_STATE | 2 |  |
|  | V\_TIU\_TILTING\_STATE | 2 |  |
|  | V\_TIU\_DIRCONT\_STATE | 3 |  |
|  | V\_TIU\_DESKS\_STATE | 3 |  |
|  | V\_TIU\_INTEGRITY\_STATE | 2 |  |
|  | V\_TIU\_DRIVEREM\_STATE | 2 |  |
|  | V\_TIU\_VIGIL\_ACTION\_STATE | 2 |  |
|  | V\_TIU\_VIGIL\_DISABLE\_STATE | 2 |  |
|  | V\_TIU\_COLD\_MOVE\_STATE | 2 |  |
|  |  |  |  |
|  | CIRCUIT\_BREAKER\_COHERENCY | 3 |  |
|  | PANTOGRAPH\_COHERENCY | 3 |  |
|  | V\_TIU\_COMMANDING\_EB | 1 |  |
|  | V\_TIU\_COMMANDING\_SB | 1 |  |
|  | V\_TIU\_TRACTION\_STATUS | 3 |  |
|  |  |  |  |

Packet Number 1 : Plain text message

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Plain text given by TIU, to be displayed on the MMI by the Core CPU | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | Q\_SCALE | 2 |  | |
|  | TIU\_Q\_TEXTCLASS | 2 |  |
|  | TIU\_Q\_TEXTDISPLAY | 1 |  | |
|  | TIU\_L\_TEXTDISPLAY | 15 | End condition | |
|  | TIU\_T\_TEXTDISPLAY | 10 | End condition | |
|  | TIU\_Q\_TEXTCONFIRM | 2 |  | |
|  | TIU\_L\_TEXT | 5 |  |
|  | TIU\_X\_TEXT (TIU\_L\_TEXT) | 8 |  |

Packet Number 2 : Fixed text message

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Fixed text given by TIU, to be displayed on the MMI by the Core CPU | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | Q\_SCALE | 2 |  | |
|  | TIU\_Q\_TEXTCLASS | 2 |  |
|  | TIU\_Q\_TEXTDISPLAY | 1 |  | |
|  | TIU\_L\_TEXTDISPLAY | 15 | End condition | |
|  | TIU\_T\_TEXTDISPLAY | 10 | End condition |
|  | TIU\_Q\_TEXTCONFIRM | 2 |  | |
|  | TIU\_Q\_TEXT | 8 |  |

Packet Number 3 : Brake models

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Model of the emergency brake, traction, and service brake (if present), to be used by the Core CPU | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | TIU\_MODEL\_BEGIN\_BRAKE | 8 | Part of EB model |
|  | TIU\_MODEL\_FULL\_BRAKE | 11 | Part of EB model |
|  | N\_ITER | 5 | Part of EB model  In this case range=0..5 |
|  | TIU\_MODEL\_SPEED(k) | 8 | Part of EB model |
|  | TIU\_MODEL\_DECELER(k) | 8 | Part of EB model |
|  | TIU\_CUT\_TRACT\_DELAY | 8 | Part of traction model |
|  | TIU\_TRAIN\_MAX\_ACC | 10 | Part of traction model |
|  | TIU\_ACC\_COEF\_SB\_UNUSED | 7 | Part of traction model |
|  | TIU\_ACC\_COEF\_SB\_USED | 7 | Part of traction model |
|  | Q\_SB\_MODEL\_PRESENT | 1 | Part of SB model |
|  | TIU\_MODEL\_BEGIN\_BRAKE | 8 | Part of SB model |
|  | TIU\_MODEL\_FULL\_BRAKE | 11 | Part of SB model |
|  | N\_ITER | 5 | Part of SB model  In this case range=0..5 |
|  | TIU\_MODEL\_SPEED(k) | 8 | Part of SB model |
|  | TIU\_MODEL\_DECELER(k) | 8 | Part of SB model |
|  | TIU\_MIN\_ROT\_MASS\_PERCENT | 8 | Part of rot mass model |
|  | TIU\_NOM\_ROT\_MASS\_PERCENT | 8 | Part of rot mass model |
|  | TIU\_MAX\_ROT\_MASS\_PERCENT | 8 | Part of rot mass model |
|  | TIU\_T\_W | 13 | Part of driver delay |
|  | TIU\_T\_P | 13 | Part of driver delay |
|  | TIU\_T\_I\_P | 13 | Part of driver delay |
|  | TIU\_T\_RSMA | 13 | Part of driver delay |

Packet Number 6 : Test and failure detection

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Result of EB tests on demand and safety failure detection | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | TIU\_EB\_TESTS\_ON\_DEMAND\_RESULT | 3 |  |
|  | TIU\_SAFETYFAIL\_DETECT | 2 |  |

Packet Number 7 : STMs specific behavior

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | List of STMs identified by the TIU as "having an inappropriate behavior" or "having a specific behavior after an inappropriate behavior"  This packet is related to the management of the TI and BI units for STM interfaces. | | |
| ***Sent*** | Sporadically | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | N\_ITER | 5 |  |
|  | NID\_STM | 8 |  |
|  | NID\_STMSPECIFICSTATE | 3 |  |

Packet Number 8 : Specific\_from\_MVB (Specific to Alstom implementation)

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | "non discrete" info coming from MVB and to be sent to the Core CPU | | |
| ***Sent*** | At each computer cycle | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | Q\_SET\_TARGET\_SPEED | 1 |  |
|  | SET\_TARGET\_SPEED | 16 | if Q\_SET\_TARGET\_SPEED = 1 |

Packet Number 12: Diagnostic

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Description*** | The packet gives reason information about diagnostic : emergency and service braking. | | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** | |
|  | NID\_PACKET | 8 |  | |
|  | L\_PACKET | 13 |  | |
|  | N\_ITER\_EVENT | 5 |  |
|  | TIU\_MAINTENANCE\_EVENT\_ID | 8 |  | |

Packet Number 13: Inhibition Level (Specific to Alstom implementation)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Description*** | The packet gives the command of inhibition of level. | | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** | |
|  | NID\_PACKET | 8 |  | |
|  | L\_PACKET | 13 |  | |
|  | N\_ITER | 5 |  |
|  | CCPU\_LEVEL(k) | 3 |  | |
|  | NID\_NTC(k) (if CCPU\_LEVEL = NTC) | 8 |  | |
|  | LEVEL\_CHANGE\_ORIGIN(k) | 2 |  | |

### PACKETS: ETCS Onobard Unit application to TIU

Packet Number 0 : Cyclic Commands

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Any command given by the Core CPU | | |
| ***Sent*** | At each computer cycle | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | CCPU\_EB\_COMMAND | 1 |  |
|  | CCPU\_SB\_COMMAND | 2 |  |
|  | CCPU\_TRACTION\_CUT\_OFF | 1 |  |
|  | CCPU\_VIGIL\_DISABLE\_ORDER | 1 |  |
|  |  |  |  |

Packet Number 1: Track Conditions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Description*** | The packet gives details concerning the track ahead to support the driver when e.g. lower pantograph | | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** | |
|  | NID\_PACKET | 8 |  | |
|  | L\_PACKET | 13 |  | |
|  | Q\_SCALE | 2 |  | |
|  | CCPU\_NID\_C | 10 |  | |
|  | CCPU\_NID\_BG | 14 |  | |
|  | Q\_LINK | 1 |  | |
|  | Q\_TRACKINIT | 1 |  | |
|  | D\_TRACKINIT | 16 | Only if Q\_TRACKINIT = 1 | |
|  | D\_TRACKCOND | 16 | Only if Q\_TRACKINIT = 0 | |
|  | L\_TRACKCOND | 16 | Only if Q\_TRACKINIT = 0 | |
|  | M\_TRACKCOND | 4 | Only if Q\_TRACKINIT = 0 | |
|  | N\_ITER | 5 | Only if Q\_TRACKINIT = 0 | |
|  | D\_TRACKCOND(k) | 15 |  | |
|  | L\_TRACKCOND(k) | 16 |  | |
|  | M\_TRACKCOND(k) | 4 |  | |

Packet Number 2 : Odometric data

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Periodic transmission of odometric data | | |
| ***Sent*** | At each computer cycle | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | Q\_LOCATION\_PRESENT | 1 |  |
|  | Q\_SCALE | 2 | present only if Q\_LOCATION\_PRESENT = 1 |
|  | CCPU\_NID\_C | 10 | idem |
|  | CCPU\_NID\_BG | 14 | idem |
|  | CCPU\_L\_MAX\_SAFE\_FRONT\_END | 16 | idem |
|  | CCPU\_L\_MIN\_SAFE\_FRONT\_END | 16 | idem |
|  | CCPU\_L\_ESTIMATED\_FRONT\_END | 16 | idem |
|  | CCPU\_L\_MIN\_SAFE\_REAR\_END | 16 | idem |
|  | CCPU\_NO\_MOTION | 2 |  |
|  | CCPU\_TRAIN\_MOVEMENT | 2 |  |
|  | CCPU\_V\_TRAIN\_NOMINAL | 15 |  |
|  | CCPU\_A\_TRAIN\_NOMINAL | 11 |  |
|  | CCPU\_D\_TRAIN\_NOMINAL | 32 |  |

Packet Number 3 : Other information

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Other information required by the TIU from the Core CPU | | |
| ***Sent*** | At each computer cycle | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | CCPU\_MODE | 4 |  |
|  | CCPU\_LEVEL | 3 |  |
|  | NID\_NTC | 8 | If CCPU\_LEVEL = NTC |

Packet Number 4 : Train type

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Information used by the TIU smart board, to select appropriate models to be sent to the Core CPU | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | CCPU\_DECELERATION\_CLASS\_ID | 8 |  |
|  | CCPU\_BRAKE\_DELAY\_CLASS\_ID | 8 |  |

Packet Number 5: Track Condition Change of traction power

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Description*** | The packet gives information about change of the traction power system. | | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** | |
|  | NID\_PACKET | 8 |  | |
|  | L\_PACKET | 13 |  | |
|  | Q\_SCALE | 2 |  |
|  | CCPU\_NID\_C | 10 |  |
|  | CCPU\_NID\_BG | 14 |  |
|  | Q\_LINK | 1 |  | |
|  | Q\_TRACKINIT | 1 |  | |
|  | D\_TRACKINIT | 16 | Only if Q\_TRACKINIT = 1 | |
|  | D\_TRACTION\_MAX | 16 | Only if Q\_TRACKINIT = 0  Related to max safe front end | |
|  | D\_TRACTION\_MIN | 16 | Only if Q\_TRACKINIT = 0  Related to min safe rear end | |
|  | M\_VOLTAGE | 4 | Type of traction, only if Q\_TRACKINIT = 0. | |
|  | NID\_CTRACTION | 10 | Only if M\_VOLTAGE <> 0 | |

Packet Number 6: Location reference update

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Description*** | The packet gives information about the new reference location balise group to be used by the TIU | | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** | |
|  | NID\_PACKET | 8 |  | |
|  | L\_PACKET | 13 |  | |
|  | Q\_SCALE | 2 |  | |
|  | CCPU\_NID\_C\_OLD | 10 |  | |
|  | CCPU\_NID\_BG\_OLD | 14 |  | |
|  | CCPU\_NID\_C\_NEW | 10 |  | |
|  | CCPU\_NID\_BG\_NEW | 14 |  | |
|  | CCPU\_D\_OLD\_TO\_NEW\_LINKED\_ESTI | 16 |  | |
|  | CCPU\_D\_OLD\_TO\_NEW\_LINKED\_MIN | 16 |  | |
|  | CCPU\_D\_OLD\_TO\_NEW\_LINKED\_MAX | 16 |  | |
|  | CCPU\_D\_OLD\_TO\_NEW\_NOT\_LINKED\_ESTI | 16 |  | |
|  | CCPU\_D\_OLD\_TO\_NEW\_NOT\_LINKED\_MIN | 16 |  | |
|  | CCPU\_D\_OLD\_TO\_NEW\_NOT\_LINKED\_MAX | 16 |  | |

Packet Number 7 : Sporadic commands

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Any sporadic command given by the Core CPU | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | CCPU\_START\_EB\_TESTS\_ON\_DEMAND | 2 |  |
|  | CCPU\_VIGIL\_RESET\_ORDER | 1 |  |
|  | CCPU\_SB\_MONITORING\_STATE | 1 |  |

Packet Number 8 : STMs states

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | States of STMs given by the Core CPU | | |
| ***Sent*** | Sporadically | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | N\_ITER | 5 |  |
|  | NID\_STM | 8 |  |
|  | NID\_STMSTATE | 4 |  |
|  | NID\_STMSTATEORDER | 4 |  |

Packet Number 9 : Train information

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Other information required by the TIU from the Core CPU | | |
| ***Sent*** | Sporadically | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  |  |  |  |
|  | CCPU\_CORE\_INHIBITION | 1 |  |
|  | CCPU\_NID\_OPERATIONAL | 32 |  |
|  | CCPU\_RUNNING\_DIRECTION\_CHANGE\_FOR\_DATA | 1 |  |
|  | CCPU\_TRAIN\_LENGTH | 12 |  |

Packet Number 10 : Doors control section

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | Information required by the TIU from the Core CPU to manage a doors control section | | |
| ***Sent*** | Sporadically | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | Q\_SCALE | 2 |  |
|  | CCPU\_NID\_C | 10 |  |
|  | CCPU\_NID\_BG | 14 |  |
|  | Q\_LINK | 1 |  | |
|  | D\_DOORS\_SECTION\_START | 16 |  |
|  | D\_DOORS\_SECTION\_END | 16 |  |
|  | CCPU\_M\_SIDE\_DOOR | 2 |  |

Packet Number 11: Track description deletion information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Description*** | The packet gives deletion information about track description. | | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** | |
|  | NID\_PACKET | 8 |  | |
|  | L\_PACKET | 13 |  | |
|  | Q\_SCALE | 2 |  |
|  | CCPU\_NID\_C | 10 |  |
|  | CCPU\_NID\_BG | 14 |  |
|  | TRACK\_DESC\_DELETION\_LOCATION\_ESTI | 16 | not used by the TIU | |
|  | TRACK\_DESC\_DELETION\_LOCATION\_MIN | 16 |  | |
|  | TRACK\_DESC\_DELETION\_LOCATION\_MAX | 16 | not used by the TIU | |

Packet Number 14: Gradients information

|  |  |  |  |
| --- | --- | --- | --- |
| ***Description*** | The packet gives gradient information about track description. | | |
| ***Sent*** | Sporadically (sending triggered by event) | | |
| ***Content*** | **Variable** | **Length** | **Comment** |
|  | NID\_PACKET | 8 |  |
|  | L\_PACKET | 13 |  |
|  | Q\_SCALE | 2 |  |
|  | CCPU\_NID\_C | 10 |  |
|  | CCPU\_NID\_BG | 14 |  |
|  | N\_GRADIENTS | 6 |  |
|  | D\_GRADIENT(k) | 16 |  |
|  | G\_GRADIENT(k) | 9 |  |

## Variables Overview

* + 1. Definiton

Variables shall be used to encode single data values. Variables cannot be split in minor units. The whole variable has one type (meaning).

Variables may have special values that are related to the basic meaning of the variable.

Signed values shall be encoded as 2’s complement.

One bit variables (Boolean) shall always use 0 for false and 1 for true.

Offsets for numerical values shall be avoided (0 shall be used for 0, 1 for 1, etc.) except where justified.

When transmitting over the transmission media, the most significant bit must be transmitted first.

All Variables have one of the following prefixes:

|  |  |
| --- | --- |
| A\_ | Acceleration |
| D\_ | distance |
| G\_ | Gradient |
| L\_ | length |
| M\_ | Miscellaneous |
| N\_ | Number |
| NC\_ | class number |
| NID\_ | identity number |
| Q\_ | Qualifier |
| T\_ | time/date |
| V\_ | Speed |
| X\_ | Text |
| CCPU\_ | Data generated by Core CPU board |
| TIU\_ | Data generated by TIU board |

#### Variables Application

CCPU\_A\_TRAIN\_NOMINAL

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Nominal train acceleration | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 11 bits | -10.24 [m/s²] | 10.23 [m/s²] | 0.01 |
| ***Special/Reserved Values*** |  |  | |

CCPU\_BRAKE\_DELAY\_CLASS\_ID

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | brake delay class ID | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 | 255 | 1 |
| ***Special/Reserved Values*** |  |  | |

CCPU\_CORE\_INHIBITION

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Core signal to inhibit pantograph optimization in powerless section and change of traction power | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | Do\_not\_inhibit | |
|  | 1 | Inhibit | |

CCPU\_D\_OLD\_TO\_NEW\_LINKED\_ESTI

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Estimated distance between the old (the previous) reference balise group and the new reference balise group with information linked to the balise | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_D\_OLD\_TO\_NEW\_LINKED\_MAX

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Maximum distance maximum between the old (the previous) reference balise group and the new reference balise group with information linked to the balise | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_D\_OLD\_TO\_NEW\_LINKED\_MIN

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Minimum distance between the old (the previous) reference balise group and the new reference balise group with information linked to the balise | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_D\_OLD\_TO\_NEW\_NOT\_LINKED\_ESTI

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Estimated distance between the old (the previous) reference balise group and the new reference balise group with information not linked to the balise | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_D\_OLD\_TO\_NEW\_NOT\_LINKED\_MAX

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Maximum distance between the old (the previous) reference balise group and the new reference balise group with information not linked to the balise | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_D\_OLD\_TO\_NEW\_NOT\_LINKED\_MIN

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Minimum distance between the old (the previous) reference balise group and the new reference balise group with information not linked to the balise | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_D\_TRAIN\_NOMINAL

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Absolute distance moved | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 32 bits | -15 000 000.00 m | 15 000 000.00 m | 0.01 m |
| ***Special/Reserved Values*** |  |  | |

CCPU\_DECELERATION\_CLASS\_ID

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | deceleration class ID | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 | 255 | 1 |
| ***Special/Reserved Values*** |  |  | |

CCPU\_EB\_COMMAND

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Emergency brake command | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | Do\_no\_apply\_EB | |
|  | 1 | Apply\_EB | |

CCPU\_L\_ESTIMATED\_FRONT\_END

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Absolute location of the estimated front end of the train | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_L\_MAX\_SAFE\_FRONT\_END

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Absolute location of the maximum safe front end of the train | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_L\_MIN\_SAFE\_FRONT\_END

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Absolute location of the minimum safe front end of the train | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_L\_MIN\_SAFE\_REAR\_END

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Absolute location of the minimum safe rear end of the train | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327680 m | 327 670 m | 10cm, 1m or 10m, depending on Q\_SCALE |

CCPU\_LEVEL

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Current Operating Level | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Level 0 | |
|  | 1 | Level NTC specified by NID\_NTC | |
|  | 2 | Level 1 | |
|  | 3 | Level 2 | |
|  | 4 | Level 3 | |
|  | 5-7 | Spare | |

CCPU\_M\_SIDE\_DOOR

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Side(s) authorized to be opened inside the allowed area | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Door side to open : left | |
|  | 1 | Door side to open : right | |
|  | 2 | Door side to open : both | |
|  | 3 | Spare | |

CCPU\_M\_TRACTION

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Type of traction | | |
| ***Description*** | See subset 026, chapter 7, variable M\_TRACTION | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 | 255 | 1 |
| ***Special/Reserved Values*** |  |  | |

CCPU\_MODE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Generic Onboard operating mode | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 4 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Full Supervision | |
|  | 1 | On Sight | |
|  | 2 | Staff Responsible | |
|  | 3 | Shunting | |
|  | 4 | Unfitted | |
|  | 5 | Sleeping | |
|  | 6 | Stand By | |
|  | 7 | Trip | |
|  | 8 | Post Trip | |
|  | 9 | System Failure | |
|  | 10 | Isolation | |
|  | 11 | Non Leading | |
|  | 12 | Limited\_Supervision | |
|  | 13 | STM National | |
|  | 14 | Reversing | |
|  | 15 | Passive Shunting | |

CCPU\_NID\_BG

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Identity number of the balise group used as reference for the related distances/locations | | |
| ***Description*** | Identity number of a balise group or loop within the country or region defined by NID\_C. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 14 bits | 0 | 16382 | 1 |
| ***Special/Reserved Values*** | / | / | |

CCPU\_NID\_BG\_NEW

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Identity number of the new balise group to use as reference for the related distances/locations | | |
| ***Description*** | Identity number of a balise group or loop within the country or region defined by NID\_C. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 14 bits | 0 | 16382 | 1 |
| ***Special/Reserved Values*** | / | / | |

CCPU\_NID\_BG\_OLD

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Identity number of the current (old) balise group used as reference for the related distances/locations | | |
| ***Description*** | Identity number of a balise group or loop within the country or region defined by NID\_C. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 14 bits | 0 | 16382 | 1 |
| ***Special/Reserved Values*** | / | / | |

CCPU\_NID\_C

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Identity number of the country or region where is located the reference balise group | | |
| ***Description*** | Code used to identify the country or region in which the balise group is situated. These need not necessarily follow administrative or political boundaries. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 10 bits | 0 | 1023 | 1 |
| ***Special/Reserved Values*** |  |  | |

CCPU\_NID\_C\_NEW

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Identity number of the country or region where is located the new reference balise group | | |
| ***Description*** | Code used to identify the country or region in which the balise group is situated. These need not necessarily follow administrative or political boundaries. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 10 bits | 0 | 1023 | 1 |
| ***Special/Reserved Values*** |  |  | |

CCPU\_NID\_C\_OLD

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Identity number of the country or region where is located the current (old) reference balise group | | |
| ***Description*** | Code used to identify the country or region in which the balise group is situated. These need not necessarily follow administrative or political boundaries. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 10 bits | 0 | 1023 | 1 |
| ***Special/Reserved Values*** |  |  | |

CCPU\_NID\_OPERATIONAL

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Train Running Number | | |
| ***Description*** | See subset 026, chapter 7, variable NID\_OPERATIONAL | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 32 bits | 0 | 9999 9999 | Binary Coded Decimal |

CCPU\_NO\_MOTION

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Movement state of train | | |
| ***Description*** | Indicates if a movement of the train is detected or if a no mortion state can be considered. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Motion | |
|  | 1 | No Motion | |
|  | 2 | Unknown | |
|  | 3 | Spare | |

CCPU\_RUNNING\_DIRECTION\_CHANGE\_FOR\_DATA

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Running direction change for data | | |
| ***Description*** | That flag indicates if a modification of orientation has to be taken into account for the data supervision. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | no running direction change for data supervision | |
|  | 1 | a running direction change occurred at this cycle for data supervision | |

CCPU\_SB\_COMMAND

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Service brake command | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Do\_no\_apply\_SB | |
|  | 1 | Apply\_SB | |
|  | 2 | Apply\_SB\_not\_protected | |
|  | 3 | spare | |

CCPU\_SB\_MONITORING\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of SB monitoring by CORE | | |
| ***Description*** | Result of SB monitoring by CORE | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | NOT\_RELEVANT (no monitoring running or running in order) | |
|  | 1 | FAILED (monitoring running and failed) | |

CCPU\_START\_EB\_TESTS\_ON\_DEMAND

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | EB tests on demand start | | |
| ***Description*** | Triggers the EB tests on demand | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | NO\_TEST : do not start brake tests (but do not stop them if already started) | |
|  | 1 | start EB tests | |
|  | 2 | start SB tests | |
|  | 3 | spare | |

CCPU\_TRACTION\_CUT\_OFF

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Cut off traction command | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | False (=Release traction cut off command) | |
|  | 1 | True (=Cut off traction) | |

CCPU\_TRAIN\_LENGTH

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Train length deduced from validated train data. The train length takes the value “Unknown” if the train data are not validated or not correct. | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 12 bits | 0 | 4094 [m] | 1 |
| ***Special/Reserved Values*** | 4095 | Unknown | |

CCPU\_TRAIN\_MOVEMENT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Direction of train movement in relation to the LRBG orientation | | |
| ***Description*** | Indicates the running direction of the train, with respect to the active cab | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Backward | |
|  | 1 | Forward | |
|  | 2 | Unknown | |
|  | 3 | Spare | |

CCPU\_V\_TRAIN\_NOMINAL

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Nominal train speed | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 15 bits | 0 | 327.67 [m/s] | 0.01 |
| ***Special/Reserved Values*** |  |  | |

CCPU\_VIGIL\_DISABLE\_ORDER

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Order to disable the external driver vigilance device | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | False (do not disable the device) | |
|  | 1 | True (disable the device) | |

CCPU\_VIGIL\_RESET\_ORDER

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Order to reset the external driver vigilance device | | |
| ***Description*** | When the driver touches the MMI, this can be considered as a vigilance action by the external driver vigilance device | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | False (do not reset) | |
|  | 1 | True (reset) | |

CIRCUIT\_BREAKER\_COHERENCY

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the circuit breaker device | | |
| ***Description*** | Information from the sensor of the circuit breaker state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | CIRCUIT\_BREAKER\_CLOSED\_OK | |
|  | 1 | CIRCUIT\_BREAKER\_CLOSED\_NOT\_OK | |
|  | 2 | CIRCUIT\_BREAKER\_OPEN\_OK | |
|  | 3 | CIRCUIT\_BREAKER\_OPEN\_NOT\_OK | |
|  | 4 | FAIL\_STATE | |
|  | 5 | INFORMATION\_NOT\_AVAILABLE | |

D\_DOORS\_SECTION\_END

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Distance to the end location of the doors control section | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

D\_DOORS\_SECTION\_START

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Distance to the start location of the doors control section | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

D\_GRADIENTS

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Distance to the start location of next gradient | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

D\_TRACKCOND

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Track condition distance | | |
| ***Description*** | The incremental distance to where the track conditions change. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

D\_TRACKINIT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Distance to start of empty profile | | |
| ***Description*** | Distance to where initial states of the related track description in the packet shall be resumed | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

G\_GRADIENTS

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Value of gradient of the given gradient segment | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 9 bits | -254 | 254 | 0.1 % |

TRACK\_DESC\_DELETION\_LOCATION\_ESTI

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Estimated distance to whom every track descriptions shall be truncated | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

TRACK\_DESC\_DELETION\_LOCATION\_MAX

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Maximum distance to whom every track descriptions shall be truncated | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

TRACK\_DESC\_DELETION\_LOCATION\_MIN

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Minimum distance to whom every track descriptions shall be truncated | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

D\_TRACTION\_MAX

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Distance to the start location of the track condition change of traction power | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

D\_TRACTION\_MIN

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Distance to the end location of the track condition change of traction power | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

LEVEL\_CHANGE\_ORIGIN

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | **Level change origin** | | |
| ***Description*** | Indicate the origin to which the level is inhibitid for | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits | 0 | 2 | 0 = FOR\_DRIVER  1 = FOR\_TRACKSIDE  2 = FOR\_DRIVER\_AND\_TRACKSIDE  3 = SPARE |

L\_PACKET

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Packet **length** | | |
| ***Description*** | L\_PACKET indicates the **length** of the packet in bits, including all bits of the packet header | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 13 | 0 | 8191 | 1 bit |
| ***Special/Reserved Values*** |  |  | |

L\_TRACKCOND

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | **Length** for which the defined track condition is valid | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | -327.680 km | 327.670 km | 10 cm, 1m or 10 m depending on Q\_SCALE |

M\_TRACKCOND

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Type of track condition | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 4 bits |  |  |  |
| ***Special/Reserved Values*** | 0000 | Non stopping area. Initial state: stopping permitted | |
|  | 0001 | Tunnel stopping area. Initial state: no tunnel stopping area | |
|  | 0010 | Sound horn. Initial state: no request for sound horn | |
|  | 0011 | Powerless section – lower pantograph. Initial state: not powerless section | |
|  | 0100 | Radio hole (stop supervising T\_NVCONTACT). Initial state: supervise T\_NVCONTACT | |
|  | 0101 | Air tightness. Initial state: no request for air tightness | |
|  | 0110 | Switch off regenerative brake. Initial state: regenerative brake on | |
|  | 0111 | Switch off eddy current brake for service brake. Initial state: eddy current brake for service brake on | |
|  | 1000 | Switch off magnetic shoe brake. Initial state: magnetic shoe brake on | |
|  | 1001 | Powerless section – switch off the main power switch. Initial state: not powerless section | |
|  | 1010 | Switch off eddy current brake for emergency brake. Initial state: eddy current brake for emergency brake on | |
|  | 1011 –1111 | Spare | |

M\_TRACTION

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Traction System Type | | |
| ***Description*** | It defines the traction system to be used on a specific line (diesel/electric/kind of power pickup etc.) | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits |  |  |  |

N\_GRADIENTS

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Number of iterations of a data set following this variable in a packet | | |
| ***Description*** | If N\_GRADIENTS is 0 then no data set is following. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 6 bits | 0 | 50 | integers |

N\_ITER

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Number of iterations of a data set following this variable in a packet | | |
| ***Description*** | If N\_ITER is 0 then no data set is following. Two nested levels of iterations can exist. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 5 bits | 0 | 31 | integers |

N\_ITER\_EVENT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Number of iterations of a data set following this variable in a packet | | |
| ***Description*** | If N\_ITER\_EVENT is 0 then no data set is following. Two nested levels of iterations can exist. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 5 bits | 0 | 31 | integers |

NID\_NTC

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | STM identity | | |
| ***Description*** | One value of this variable represents the identity of an NTC reflecting each composition of national infrastructure. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 | 255 | Numbers |

NID\_PACKET

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Packet identifier | | |
| ***Description*** | This is used in the header for each packet, allowing the receiving equipment to identify the data that follows. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 | 255 | Numbers |

NID\_STM

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | STM identity | | |
| ***Description*** | One value of this variable represents the identity of an STM equipment designed for operation on national infrastructures. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 | 255 | Numbers |

NID\_STMSPECIFICSTATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Current specific behavior of a given STM. | | |
| ***Description*** | Indicates a specific state of a STM (disconnected, temporary disconnected, again connected after temporary disconnection, STM not in correct mode) | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | CONNECTED (after versions validation) | |
|  | 1 | DISCONNECTED (at TIU request if no validation of the versions included in STM packet 1 or at STM request) | |
|  | 2 | TEMPORARY\_DISCONNECTED | |
|  | 3 | CONNECTED\_AGAIN (end of temporary disconnection) | |
|  | 4 | FAILURE\_REQUESTED (STM not in correct state, packet 15 lack,...) | |
|  | 5-7 | Spare | |

NID\_STMSTATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Actual STM state | | |
| ***Description*** | Tell the STM state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 4 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | NO\_ORDER | |
| 1 | Reserved (mapped to PO for consistency) | |
| 2 | Configuration (CO) | |
| 3 | Data Entry (DE) | |
| 4 | Unconditional Cold Standby (U-CS) | |
| 5 | Conditional Cold Standby (C-CS) | |
| 6 | Hot Standby (HS) | |
| 7 | Data Available (DA) | |
| 8 | Failure (FA) | |
| 9 | Data Available\_For\_Test (DA\_FOR\_TEST) | |
| 10 | *Spare value* | |
| 11 | *Spare value* | |
| 12 | *Spare value* | |
| 13 | *Spare value* | |
| 14 | *Spare value* | |
| 15 | *Spare value* | |

NID\_STMSTATEORDER

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | STM state order | | |
| ***Description*** | Tell the STM state ordered by the ERTMS/ETCS on-board | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 4 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | NO\_ORDER | |
| 1 | Reserved (mapped to PO for consistency) | |
| 2 | Configuration (CO) | |
| 3 | Data Entry (DE) | |
| 4 | Unconditional Cold Standby (U-CS) | |
| 5 | Conditional Cold Standby (C-CS) | |
| 6 | Hot Standby (HS) | |
| 7 | Data Available (DA) | |
| 8 | Failure (FA) | |
| 9 | Data Available\_For\_Test (DA\_FOR\_TEST) | |
| 10 | *Spare value* | |
| 11 | *Spare value* | |
| 12 | *Spare value* | |
| 13 | *Spare value* | |
| 14 | *Spare value* | |
| 15 | *Spare value* | |

PANTOGRAPH\_COHERENCY

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Coherency of the pantograph state according to currently expected state | | |
| ***Description*** | Information computed only when pantograph is inside the track condition. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | PANTO\_UP\_OK | |
|  | 1 | PANTO\_UP\_NOT\_OK | |
|  | 2 | PANTO\_DOWN\_OK | |
|  | 3 | PANTO\_DOWN\_NOT\_OK | |
|  | 4 | INFO\_NOT\_AVAILABLE | |

Q\_LINK

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Qualifier indicating if the track conditions defined in the packet 1 or 5 are linked to the balise or not | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | not linked | |
|  | 1 | linked | |

Q\_LOCATION\_PRESENT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Qualifier indicating if train location information is present in the packet or not | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | not present | |
|  | 1 | present | |

Q\_SB\_MODEL\_PRESENT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | / | | |
| ***Description*** | Qualifier for indicate if a SB model has been found or not | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | Model is not found | |
|  | 1 | Model is found | |

Q\_SCALE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Qualifier for the distance scale. | | |
| ***Description*** | Qualifier to indicate the scale used for describing all distances inside the packet that contains Q\_SCALE. Exception is made for variable CCPU\_LRBG\_ABSOLUTE\_LOC that is always in [m] | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | 10 cm scale | |
|  | 1 | 1 m scale | |
|  | 2 | 10 m scale | |
|  | 3 | Spare | |

Q\_SET\_TARGET\_SPEED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Qualifier for presence of set target speed | | |
| ***Description*** | Qualifier to tell if the packet contains the variable SET\_TARGET\_SPEED or not | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | variable SET\_TARGET\_SPEED is NOT present in the packet | |
|  | 1 | variable SET\_TARGET\_SPEED is present in the packet | |

Q\_TRACKINIT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Qualifier for resuming the initial states of the related track description of the packet. | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | No initial states to be resumed, profile to follow | |
|  | 1 | Empty profile, initial states to be resumed | |

SET\_TARGET\_SPEED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | set target speed | | |
| ***Description*** | speed which is set by the driver (on an external cruise control system) | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 16 bits | 0 km/h | 600 km/h | 1 km/h |
| ***Special/Reserved Values*** | 601- 2^16 - 1 | spare | |

TIU\_ACC\_COEF\_SB\_UNUSED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Acceleration coefficient when the service brake is not present or not available. | | |
| ***Description*** | Ponderation coefficient to be applied on maximum train acceleration when the service brake is not available. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 7 bits | 0 | 1,00 | 0,01 |
| ***Special/Reserved Values*** | 1,01 to 1,27 | Spare values, non significant. | |

TIU\_ACC\_COEF\_SB\_USED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Acceleration coefficient when the service brake is available. | | |
| ***Description*** | Ponderation coefficient to be applied on maximum train acceleration acceleration when the service brake is available.. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 7 bits | 0 | 1,00 | 0,01 |
| ***Special/Reserved Values*** | 1,01 to 1,27 | Spare values, non significant. | |

TIU\_CUT\_TRACT\_DELAY

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Delay to cut off traction | | |
| ***Description*** | Delay between the ordering of traction cut off and the effective cut off of the traction | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 s | 25,5 s | 0,1 s |
| ***Special/Reserved Values*** |  |  | |

TIU\_EB\_TESTS\_ON\_DEMAND\_RESULT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | EB tests on demand result | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | EB tests on demand not OK on both EV (fatal error(s) has been detected during EB tests on demand) | |
|  | 1 | EB tests on demand not OK on EV1 (fatal error(s) has been detected during EB tests on demand) | |
|  | 2 | EB tests on demand not OK on EV2 (fatal error(s) has been detected during EB tests on demand) | |
|  | 3 | EB tests on demand OK | |
|  | 4 | EB tests on demand aborted | |
|  | 5 | Irrelevant | |
|  | 6 | Reserved | |
|  | 7 | Reserved | |

TIU\_L\_TEXT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | **Length** of text string | | |
| ***Description*** | L\_TEXT defines the **length** of a text string (L\_TEXT \* X\_TEXT) | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 5 bits | 0 | 31 | 1 Text String Element |

TIU\_L\_TEXTDISPLAY

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | **Length** on which a text shall be displayed | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 15 bits | 0 cm | 327.660 km | 10 cm, 1m or 10 m depends on Q\_SCALE |
| ***Special/Reserved Values*** | 32767 | The display of the text shall not be distance limited. | |

TIU\_MAINTENANCE\_EVENT\_ID

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Current specific reason of an emergency or service braking. | | |
| ***Description*** | Indicates a list of specific reason of a present braking | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 | 255 |  |
| ***Special/Reserved Values*** | 0 | Bowl EB Request | |
|  | 1 | Reception\_from\_STM\_Command\_SB\_Request | |
|  | 2 | Reception\_from\_STM\_Command\_EB\_Request | |
|  | 3 | Bad Pneumatic Insertion\_EB\_Request | |
|  | 4 | Protect\_SB\_by\_EB\_Request | |
|  | 5 | EB\_Failure\_EB\_Request | |
|  | 6 | Use of Failed Port\_SB\_Request | |
|  | 7 | Use of Failed Port\_EB\_Request (reserved) | |
|  | 8 | Error Hamming on port\_SB\_Request | |
|  | 9 | Error Hamming on port\_EB\_Request (reserved) | |
|  | 10 | Monitoring result needs\_SB\_Request | |
|  | 11 | Monitoring result needs\_EB\_Request | |
|  | 12 – 255 | Spare | |

TIU\_MAX\_ROT\_MASS\_PERCENT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | maximum rotating mass percentage | | |
| ***Description*** | maximum rotating mass of the train, expressed as a percentage of the total weight of the train | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 % | 25,5 % | 0,1 % |
| ***Special/Reserved Values*** | / | / | |

TIU\_MIN\_ROT\_MASS\_PERCENT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | minimum rotating mass percentage | | |
| ***Description*** | minimum rotating mass of the train, expressed as a percentage of the total weight of the train | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 % | 25,5 % | 0,1 % |
| ***Special/Reserved Values*** | / | / | |

TIU\_MODEL\_BEGIN\_BRAKE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Delay for beginning of application of brake | | |
| ***Description*** | Delay between ordering a brake application, and when brake begins to be applied (more than 0%) | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 s | 25,5 s | 0,1 s |
| ***Special/Reserved Values*** | / | / | |

TIU\_MODEL\_DECELER

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Brake model deceleration point | | |
| ***Description*** | Coordinate on the Y axis (=train deceleration) of a point of the deceleration model | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 m/s² | 2,55 m/s² | 0,01 m/s² |
| ***Special/Reserved Values*** |  |  | |

TIU\_MODEL\_FULL\_BRAKE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Delay for full application of brake | | |
| ***Description*** | Delay between when the braking effort begins (>0%) and when the full braking effort is reached (100%) | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 11 bits | 0 s | 120,0 s | 0,1 s |
| ***Special/Reserved Values*** | / | / | |

TIU\_MODEL\_SPEED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Brake model speed point | | |
| ***Description*** | Coordinate on the X axis (=train speed) of a point of the deceleration model | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 km/h | 600 km/h | 5 km/h |
| ***Special/Reserved Values*** | 121-255 | spare | |

TIU\_NOM\_ROT\_MASS\_PERCENT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | nominal rotating mass percentage | | |
| ***Description*** | nominal rotating mass of the train, expressed as a percentage of the total weight of the train | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 % | 25,5 % | 0,1 % |
| ***Special/Reserved Values*** | / | / | |

TIU\_Q\_TEXT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Fixed message to be displayed. | | |
| ***Description*** | TIU\_Q\_TEXT is a pointer to select a fixed text message from the defined table. The language selected by the driver for the MMI shall be used additionally as a qualifier to choose the appropriate language table. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits | 0 | 255 |  |
| ***Special/Reserved Values*** | 1 | Emergency brake command error | |
|  | 3 | Pneumatic insertion error | |
|  | 4 | Service brake command error | |
|  | 5 | Service brake release error | |
|  | 6 | Traction cut off error | |
|  | 105 … 135 | IO1\_MONITORING\_ERROR … IO31\_MONITORING\_ERROR | |
|  | 139 | PANTO\_ACTION\_NOT\_OK\_FOR\_TRACK\_CONDITION | |
|  | 140 | CIRCUIT\_BREAKER\_ACTION\_NOT\_OK\_FOR\_TRACK\_CONDITION | |
|  | 141 | TRACTION\_CUT\_OFF\_ACTION\_NOT\_OK\_FOR\_TRACK\_CONDITION | |

TIU\_Q\_TEXTCLASS

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Class of message to be displayed. | | |
| ***Description*** | Q\_TEXTCLASS specifies the class of the text message included in the same packet (either plain or fixed message) | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 00 | Auxiliary Information | |
|  | 01 | Important Information | |
|  | 10 | Spare | |
|  | 11 | Spare | |

TIU\_Q\_TEXTCONFIRM

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Qualifies the need / reaction of text confirmation | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 00 | No confirmation required | |
|  | 01 | Continue display until confirmed | |
|  | 10 | Apply service brake if not confirmed when end conditions reached | |
|  | 11 | Spare | |

TIU\_Q\_TEXTDISPLAY

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Qualifier for the combination of text message conditions | | |
| ***Description*** | Q\_TEXTDISPLAY defines whether the start/end conditions for text message are to be combined or not | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | No, display as soon as / until one of the conditions is fulfilled | |
|  | 1 | Yes, display as soon as / until all conditions are fulfilled | |

TIU\_SAFETYFAIL\_DETECT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Safety failure detected | | |
| ***Description*** | / | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | False : no safety failure is detected | |
|  | 1 | True : a safety failure(s) is(are) detected | |
|  | 2 | Irrelevant : no diagnostic to be expected (diagnostic function is inhibited) | |
|  | 3 | Spare | |

TIU\_T\_I\_P

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | T\_i\_p | | |
| ***Description*** | parameter used by the Core in the braking curve calculation | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 13 bits | 0 | 600 s | 0,1 s |
| ***Special/Reserved Values*** | / |  | |

TIU\_T\_P

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | T\_p | | |
| ***Description*** | parameter used by the Core in the braking curve calculation | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 13 bits | 0 | 600 s | 0,1 s |
| ***Special/Reserved Values*** | / |  | |

TIU\_T\_RSMA

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | T\_rsma | | |
| ***Description*** | parameter used by the Core in the braking curve calculation | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 13 bits | 0 | 600 s | 0,1 s |
| ***Special/Reserved Values*** | / |  | |

TIU\_T\_TEXTDISPLAY

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Time until when a text shall be displayed | | |
| ***Description*** |  | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 10 bits | 0 | 1022 s | 1 s |
| ***Special/Reserved Values*** | 1023 | Display of text not limited by time. | |

TIU\_T\_W

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | T\_w | | |
| ***Description*** | parameter used by the Core for the braking curve calculation | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 13 bits | 0 | 600 s | 0,1 s |
| ***Special/Reserved Values*** | / | / | |

TIU\_TRAIN\_MAX\_ACC

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Maximum train acceleration | | |
| ***Description*** | Maximum acceleration that the train is able to reach | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 10 bits | 0 m/s² | 10,23 m/s² | 0,01 m/s² |
| ***Special/Reserved Values*** | / | / | |

TIU\_X\_TEXT

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Text String Element | | |
| ***Description*** | Text strings are used to transmit plain text messages. Each element of a text string contains a single character encoded as ISO 8859-1, also known as Latin Alphabet #1. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 8 bits |  |  |  |
| ***Special/Reserved Values*** |  |  | |

V\_TIU\_COLD\_MOVE\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the cold movement | | |
| ***Description*** | Information from the sensor of train movement used when the onboard is powered off | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | No movement | |
|  | 1 | Detected movement | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_COLD\_MOVE\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the cold movement | | |
| ***Description*** | Information from the sensor of train movement used when the onboard is powered off | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | No movement | |
|  | 1 | Detected movement | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_COMMANDING\_EB

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | . | | |
| ***Description*** | TIU informs the Core that TIU is commanding EB | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | Do\_no\_apply\_EB | |
|  | 1 | Apply\_EB | |

V\_TIU\_COMMANDING\_SB

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** |  | | |
| ***Description*** | TIU informs the Core that TIU is commanding SB. | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 1 bit |  |  |  |
| ***Special/Reserved Values*** | 0 | Do\_no\_apply\_SB | |
|  | 1 | Apply\_SB | |

V\_TIU\_DESKS\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Desks state | | |
| ***Description*** | Information from the sensor of the desk(s) state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Desk\_A\_open\_only | |
|  | 1 | Desk\_B\_open\_only | |
|  | 2 | Desk\_A\_and\_desk\_B\_open | |
|  | 3 | No\_desk\_open | |
|  | 4-5 | Spare values | |
|  | 6 | Fail\_state (of the sensor) | |
|  | 7 | Information\_not\_available | |

V\_TIU\_DESKS\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered desks state | | |
| ***Description*** | Information from the sensor of the desk(s) state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Desk\_A\_open\_only | |
|  | 1 | Desk\_B\_open\_only | |
|  | 2 | Desk\_A\_and\_desk\_B\_open | |
|  | 3 | No\_desk\_open | |
|  | 4-5 | Spare values | |
|  | 6 | Fail\_state (of the sensor) | |
|  | 7 | Information\_not\_available | |

V\_TIU\_DIRCONT\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Direction controller state | | |
| ***Description*** | Information from the sensor of the direction controller state of the active cab | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Neutral | |
|  | 1 | Forward | |
|  | 2 | Backward | |
|  | 3-5 | Spare values | |
|  | 6 | Fail\_state (of the sensor) | |
|  | 7 | Information\_not available | |

V\_TIU\_DIRCONT\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered direction controller state | | |
| ***Description*** | Information from the sensor of the direction controller state of the active cab | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Neutral | |
|  | 1 | Forward | |
|  | 2 | Backward | |
|  | 3-5 | Spare values | |
|  | 6 | Fail\_state (of the sensor) | |
|  | 7 | Information\_not available | |

V\_TIU\_DRIVEREM\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the driver emergency | | |
| ***Description*** | Information from the sensor of the driver emergency (=emergency button) | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 00 | Emergency\_button\_pushed | |
|  | 01 | Emergency\_button\_released | |
|  | 10 | Fail\_state (of the emergency button) | |
|  | 11 | Information\_not\_available | |

V\_TIU\_DRIVEREM\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the driver emergency | | |
| ***Description*** | Information from the sensor of the driver emergency (=emergency button) | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 00 | Emergency\_button\_pushed | |
|  | 01 | Emergency\_button\_released | |
|  | 10 | Fail\_state (of the emergency button) | |
|  | 11 | Information\_not\_available | |

V\_TIU\_EB\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the emergency brake | | |
| ***Description*** | Information from the sensor of the emergency brake state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | EB\_not\_applied | |
|  | 1 | EB\_applied | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_EB\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the emergency brake | | |
| ***Description*** | Information from the sensor of the emergency brake state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | EB\_not\_applied | |
|  | 1 | EB\_applied | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_INTEGRITY\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the train integrity | | |
| ***Description*** | Information from the sensor of the train integrity state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Train\_integrity\_not\_OK | |
|  | 1 | Train\_integrity\_OK | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_INTEGRITY\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the train integrity | | |
| ***Description*** | Information from the sensor of the train integrity state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Train\_integrity\_not\_OK | |
|  | 1 | Train\_integrity\_OK | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_ISOLATION\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of isolation switch | | |
| ***Description*** | Information from the sensor of the isolation switch state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Isolated | |
|  | 1 | Not\_Isolated | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_ISOLATION\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of isolation switch | | |
| ***Description*** | Information from the sensor of the isolation switch state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Isolated | |
|  | 1 | Not\_Isolated | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_SB\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the service brake | | |
| ***Description*** | Information from the sensor of the service brake state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | SB\_not\_applied | |
|  | 1 | SB\_applied | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_SB\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the service brake | | |
| ***Description*** | Information from the sensor of the service brake state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | SB\_not\_applied | |
|  | 1 | SB\_applied | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_SLEEPING\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the remote control connection | | |
| ***Description*** | Information from the sensor of the remote control connection | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Go\_to\_sleeping | |
|  | 1 | Do\_not\_go\_to\_sleeping | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_SLEEPING\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the remote control connection | | |
| ***Description*** | Information from the sensor of the remote control connection | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Go\_to\_sleeping | |
|  | 1 | Do\_not\_go\_to\_sleeping | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_TILTING\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the tilting device | | |
| ***Description*** | Information from the sensor of the tilting device state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Tilting\_system\_is\_active | |
|  | 1 | Tilting\_system\_is\_passive | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_TILTING\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the tilting device | | |
| ***Description*** | Information from the sensor of the tilting device state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Tilting\_system\_is\_acitve | |
|  | 1 | Tilting\_system\_is\_passive | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_TRACTION\_CUT\_OFF\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the traction cut off | | |
| ***Description*** | Information from the sensor of the traction cut off state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Traction cut off is disabled | |
|  | 1 | Traction cut off is enabled | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_TRACTION\_CUT\_OFF\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the traction cut off | | |
| ***Description*** | Information from the sensor of the traction cut off state | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Traction cut off is disabled | |
|  | 1 | Traction cut off is enabled | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_TRACTION\_STATUS

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Traction status calculated by TIU ASW | | |
| ***Description*** | Information deduced from traction and/or braking type | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 3 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | null | |
|  | 1 | positive | |
|  | 2 | negative | |
|  | 3 | not\_null | |
|  | 4 | Fail\_state | |
|  | 5 | Information\_not\_available | |
|  | 6-7 | Spare | |

V\_TIU\_VIGIL\_ACTION\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the driver vigilance | | |
| ***Description*** | Information from the sensor of the driver vigilance | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Driver\_reaction | |
|  | 1 | No\_driver\_reaction | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_VIGIL\_ACTION\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the driver vigilance | | |
| ***Description*** | Information from the sensor of the driver vigilance | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | Driver\_reaction | |
|  | 1 | No\_driver\_reaction | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_VIGIL\_DISABLE\_STATE

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | State of the external vigilance system | | |
| ***Description*** | Information from the sensor of the driver vigilance | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | External vigilance system active | |
|  | 1 | External vigilance system not active | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

V\_TIU\_VIGIL\_DISABLE\_STATE\_FILTERED

|  |  |  |  |
| --- | --- | --- | --- |
| ***Name*** | Filtered state of the external vigilance system | | |
| ***Description*** | Information from the sensor of the driver vigilance | | |
| ***Length of variable*** | ***Minimum Value*** | ***Maximum Value*** | ***Resolution/formula*** |
| 2 bits |  |  |  |
| ***Special/Reserved Values*** | 0 | External vigilance system active | |
|  | 1 | External vigilance system not active | |
|  | 2 | Fail\_state (of the sensor) | |
|  | 3 | Information\_not\_available | |

* + 1. on

## Variables/Areas Correlation Table

## Identification Procedure

## Error Management

## ETCS OBU – TCS Rolling Stock Autonomous Functions

## Overview

## Default

1. I = Input; O = other; [↑](#footnote-ref-2)