EVC2 - Train Recorder Unit

# REQUIREMENTS SPECIFICATION

TRV1429000478

| | | | | |
|---|---|---|---|---|
| 11/10/2019 | | | | |
| | Y. TETAUD | Y. TETAUD | S. GASMI | S. PENVEN |
| **Date** | **Established** | **Checked** | **Validated** | **Approved** |

| **DISTRIBUTION** | Confidentiality Category | | Control Category | |
|---|---|---|---|---|
| | *Restricted* | *Normal* | *Controlled* | *Not Controlled* |
| | ☐ | ☒ | ☐ | ☒ |

ALSTOM

**VILLEURBANNE**

3 Rue Henri Legay



| **TRV1429000478** | Rel. | Lang. | N.Shts |
|---|---|---|---|
| | **1B** | **en** | **65** |

## REVISIONS

| Release | Author | Date | Page / Paragraph | Comments |
|---|---|---|---|---|
| 1A | C. BACCICHETTI | 22 July. 2013 | | First version |
| 2A | C. BACCICHETTI | 26 July. 2013 | 4.17.2.2 | Possibility to adress both CPM partitions in the same message |
| 3A | C. BACCICHETTI | 30 Augu. 2013 | | Added tag for tracability activities |
| 4A | C. BACCICHETTI | 15 Oct. 2013 | 1.1.1, 4.1, 5.2.1, 5.2.1.1, 5.2.2.1, 5.2.3.1, 7 | Review_TRV1429000478-SyRSAD_TRU_TM_CB_2. Modification of JRU-Packet 14 for STM. Functions "Reception of the juridical messages from STM" and "Reception of the SDMU debug data "removed. Clarification on the operating modes. Add a file for the Diagnostic codes to be recorded. |
| 5A | C. BACCICHETTI | 21 Oct. 2013 | 1.3.3, 2.9, 4.17.5 | Revision of reference documents updated. Some tags added for tracability. |
| A | C. BACCICHETTI | 28 Feb. 2014 | 4.3.2.2, 4.11.2.2, 4.15.2.2, 4.17.5, 7.1 | Modification on following requirements : [SyRS_TRU_0003], [SyRS_TRU_0031], [SyRS_TRU_0047], [SyRS_TRU_0053], [SyRS_TRU_0077].<br>New requirements : [SyRS_TRU_0079], [SyRS_TRU_0080], [SyRS_TRU_0081] |
| A1 | C. BACCICHETTI | 17 Avril.2014 | [Ref.27], 1.1.1, 4.6.3, 4.8.2, 4.9.2, 4.10.2, 4.14.2, 4.15.2.3, 5.2.3, 5.3.1, 7.1, | Review_TRV1429000478-SyRSAD_TRU_MB_CB. |
| 1B | Y. TETAUD | 11/10/2019 | §4.2.1.2<br>§4.2.2.1<br>§4.2.2.2<br>§4.15.2.2<br>§4.15.2.3<br>§4.16.2<br>§4.21.2 | Update with regards to the ETCS BSL3 R2. |
| | | | §3.2 | Update of documentation reference |
| | | | §4.14.2 | Deletion of SyRS_TRU_0043 in favour of SyRS_TRU_0044 and SyRS_TRU_0058. |
| | | | §4.22 | Deletion of paragraph "4.22 Description of function Conversion of the reference time to the UTC time" and merged with function "F1.9 - Time stamping of messages with UTC" at paragraph 4.14<br>Deletion of SyRS_TRU_0060 in favour of SyRS_TRU_0042 |

# CONTENTS

# 1 INTRODUCTION

## 1.1 Purpose

The purpose of the System Requirements Specification (SyRS) is to define the functional requirements which apply to the system to be developed.

This document references, the functions to be performed and the interfaces of the system; its various modes of operation; the required performance and the constraints on the system.

## 1.2 Scope

This document concerns the Train Recorder Unit for ATC System that is the dedicated solution for Railways applications of the ALSTOM generic ERTMS platform.

Evolutions of ALSTOM ERTMS platform require a new way to manage juridical recorder. The recorder becomes an embedded part of the European Vital Computer.

This new Train Recorder system will be based on the existing TRU functionalities and will be installed on the Comet board of EVC. The scope of the system is to develop Juridical and Diagnostic recorder for ERTMS applications. However, the system will be modular to accept in the future the data recording of national ATC system.

## 1.3 Applicable and reference documents

### 1.3.1 Reference Standards

| Title | | Reference | Issue |
|---|---|---|---|
| **[Ref.1]** | Railway applications, Electronic equipment used on rolling stock | EN 50155 | 2007 |
| **[Ref.2]** | Railway applications, Electronic equipment used on rolling stock | IEC60571 | 2012 |
| **[Ref.3]** | Railway applications, Environmental conditions for equipment-Part 1 : Equipment on board rolling stock | IEC62498-1 | 2010 |
| **[Ref.4]** | Railway applications-Safety-related electronic systems for Signalling | EN 50129 | 2003 |
| **[Ref.5]** | Railway applications-Software for railway control and protection system | EN 50128 | 2011 |
| **[Ref.6]** | Railway applications-The specification & demonstration of Reliability, Availability, Maintainability & Safety (RAMS) | EN 50126 | 1999 |
| **[Ref.7]** | Reliability data handbook. Universal model for reliability prediction of electronics components, PCBs and equipment | EC62380 | 2004 |
| **[Ref.8]** | Analysis techniques for system reliability – procedure for failure mode and effect analysis (FMEA) | IEC60812 | 2006 |
| **[Ref.9]** | Railway applications - Fire protection on railway vehicles | Pr EN45545 | 2010 |
| **[Ref.10]** | Standard for Rail Transit Vehicle event recorder | IEEE 1482-1 | 1999 |
| **[Ref.11]** | On board driving data recording system | Pr IEC62625-1 | 2012 |
| **[Ref.12]** | International Standard IEEE 802.2-1998 IEEE Standard for Information technology. Telecommunications and information exchange between systems. Local and metropolitan area networks. Specific requirements Part 2: Logical Link Control | IEEE 802.2 | 1998 |
| **[Ref.13]** | International Standard IEEE 802.3-2005 – Section One IEEE Standard for Information technology—Telecommunications and information exchange between systems–Local and metropolitan area networks–Specific requirements – Part 3 : Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications | IEEE 802.3 – Section One | 2005 |
| **[Ref.14]** | International Standard IEEE 802.3-2005 – Section One IEEE Standard for Information technology—Telecommunications and information exchange between systems–Local and metropolitan area networks– | IEEE 802.3 – Section Two | 2005 |

| Title | | Reference | Issue |
|---|---|---|---|
| | Specific requirements – Part 3 : Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications | | |
| **[Ref.15]** | Volume 1 – Common Industrial Protocol | CIP Vol 1 – ODVA | |
| **[Ref.16]** | Volume 2 – EtherNet/IP adaptation of CIP | CIP Vol 2 – ODVA | |
| **[Ref.17]** | Electric railway equipment – Train bus – Part1: Train communication network | IEC61375-1 | |

### 1.3.2 Reference Specifications

| Title | | Reference | Issue |
|---|---|---|---|
| **[Ref.18]** | FIS Juridical recording | Subset 027 | 3.3.0 |
| **[Ref.19]** | ERTMS – System Requirement Specification | Subset 026 | 3.6.0 |
| **[Ref.20]** | Specific Transmission Module FFFIS | Subset 035 | 3.2.0 |
| **[Ref.21]** | STM FFFIS Safe Time Layer | Subset 056 | 3.0.0 |
| **[Ref.22]** | STM FFFIS Safe Link Layer | Subset 057 | 3.1.0 |
| **[Ref.23]** | FFFIS STM Application Layer | Subset 058 | 3.2.0 |
| **[Ref.24]** | FFFIS STM Application Layer | Subset 058 | 2.1.1 |
| **[Ref.25]** | EVC2 – COMET Sub-system Architecture Description | TRV1176001864 | L |
| **[Ref.26]** | EVC2 – External Interfaces description of the COMET board | TRV1176003994 | F2 |

### 1.3.3 Applicable Documents

| Title | | Reference | Issue |
|---|---|---|---|
| **[Ref.27]** | TRU Configuration Data Description | GATC/BSI/SPEC/0151 | V4.6 |
| **[Ref.28]** | Product Requirement Specification – JDRMDR | GATC/BSI/SPEC/0205 | V4.0 |
| **[Ref.29]** | Maintenance TRU – Spécification des exigences | TRV1184ES086 | B1 |
| **[Ref.30]** | Crash Protected Memory – Requirement specification | TRV1184ES0102 | B4 |
| **[Ref.31]** | Descriptif technique du besoin TBL1+ | TRV1184ES0079 | D |
| **[Ref.32]** | TRU function – Configuration Data | TRV1429000511 | 04 |
| **[Ref.33]** | Interface Description of Juridical Data Messages | TRV1429001180 | A |
| **[Ref.34]** | DRU Maintenance Interface Definition | GATC/CRL/DESG/0652 | 2.0 |

## 1.4 Abbreviations and definitions

| | |
|---|---|
| ATC | Automatic Train Control |
| ATP | Automatic Train Protection |
| BSL | Baseline |
| CIP | Common Industrial Protocol |
| CPM | Crash Protected Memory |
| DMI | Driver-Machine Interface |
| DRU | Diagnostic Recording Unit |
| ERTMS | European Rail Traffic Management System |
| ETCS | European Train Control System |
| EVC | European Vital Computer |

| | |
|---|---|
| FFFIS | Form Fit & Functional Interface Specification |
| FIS | Functional Interface Specification |
| FMEA | Failure Mode and Effect Analysis |
| GPS | Global Positioning System |
| GSM-R | Global System for Mobile communication - Railways |
| ID | identification |
| JRU | Juridical Recording Unit |
| KVB | One of the French national ATP |
| LCC | Life Cycle Cost |
| LRU | Line Replaceable Unit |
| MTBF | Main Time Between Failure |
| NTP | Network Time protocol |
| POE | Power Over Ethernet |
| RAM | Random Access Memory |
| RBC | Radio Block Center |
| ROM | Read Only memory |
| SSIL | Software Safety Integrity Level |
| STM | Specific Transmission Unit (ETCS definition) |
| TRB | Trainborne |
| TRU | Train Recording Unit (combines JRU & DRU) |
| UTC | Universal Time Coordinated |

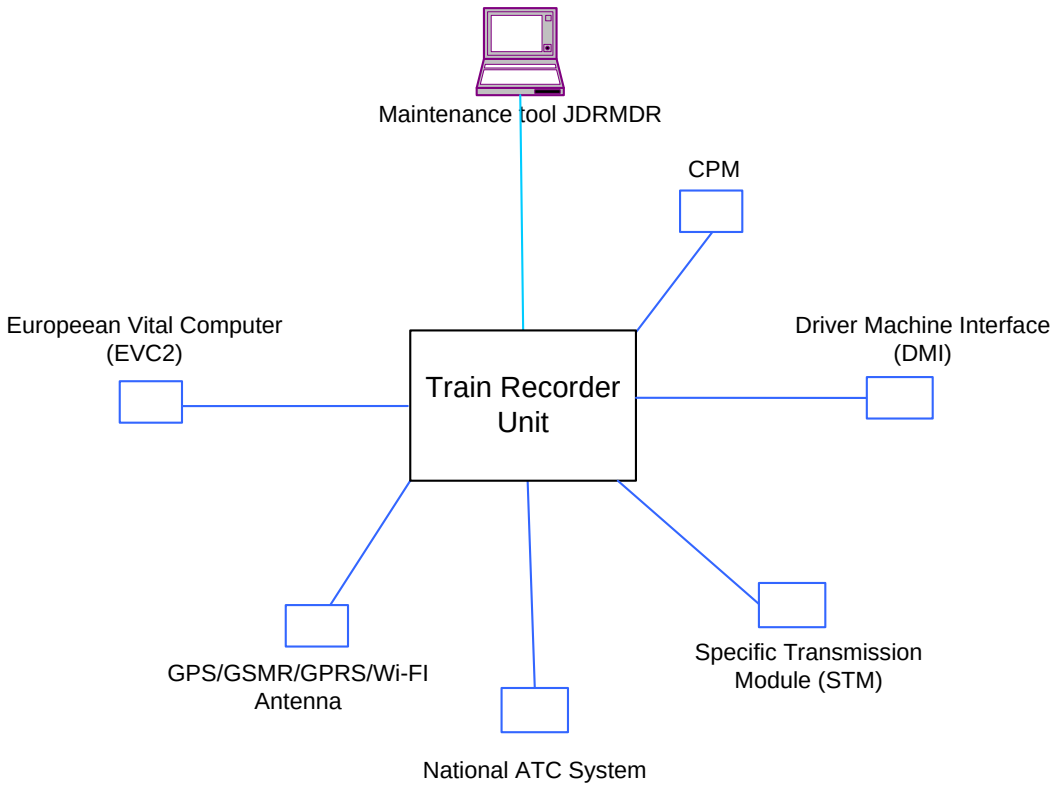
# 2 GENERAL CONSTRAINTS

## 2.1 Integration in existing systems

The Train Recorder Unit (TRU) is a sub-system of the generic ERTMS/ETCS Trainborne system. This sub-system is connected internally with the EVC and externally with the DMI, STM and CPM equipment. It is also interfaced with others ATC system via digital inputs or a network like MVB or Ethernet.

The TRU is connected to a tri-band model antenna in order to receive the UTC time. The power supply for the TRU function is provided by EVC. The nominal voltage is 24V.

The juridical and diagnostic data are decoded via the Juridical and Maintenance Data Reader (JDRMDR).




## 2.2 User characteristics

The users of the TRU are:

- The commission test engineer who is authorised to carry out first line maintenance for LRU replacement and to access to configuration and maintenance data for system integration.
- The maintenance agent who is authorised to carry out first line maintenance for LRU replacement and to download the data from the system.
- The incident investigator who is an authorised person or organisation that could get all data and information available in the TRU.

## 2.3 Assumptions

ERTMS and STM data will be recorded into the EVC equipment.

Juridical Data of ERTMS system will be recorded into the internal Flash Memory and in the Crash protected Memory. The CPM module is connected to the TRU via the Ethernet network.

According to each project requirement, the CPM is not mandatory to perform the Juridical Recorder. In this case, the juridical recorder is assumed alone by the TRU function.

In the future, it is planned to develop national recorder data for other ATC systems.

The Data of each National ATC can be recorded from different interfaces:

- Battery Digital Inputs
- Serial links
- Network like MVB or Ethernet

In order to have an evaluative product, each ATC data recording can be configured by a parameter file. (XML format)

## 2.4 Environmental conditions

The system shall be compliant to IEC 60571 (see document [Ref.2]).

The System should satisfy the environmental conditions defined by IEC 62498-1 (see document [Ref.3])

## 2.5 Reliability, Availability and Maintainability

A failure mode and effects analysis of the system shall be done according to the IEC 60812 standard (see document [Ref.8]).

A detailed predicted failure rate of the product shall be supplied according to the IEC 62380 standard (see document [Ref.7]).

The MTBF calculation must be performed according to IEC TR 62380 standard, taking into account the following parameters:

- Ambient temperature : 40 °C
- Number of cycles per year : 365 cycles / year
- Operating duration : 19h / day
- Number of power-up : 1 / day

Two calculations have to be realized, one with the external CPM and the other one without the CPM.

The System shall have a Mean Time Between Total Failure greater than 50.000 hours. A total failure is defined as a total loss of recording capacity.

The probability of the device recording a different data that the incoming one shall be less than 10-5 for a train operation of one hour in recorded conditions.

The probability of an out coming recorded data different than the recorder one when retrieval shall be less than 10-5 for a train operation of one hour in recorded conditions.

The duration necessary to replace the system shall no exceed 0.25H.

## 2.6 Safety

The equipment is not safety related. The software shall be developed in compliance with EN50128 at SIL-0.

Tables CENELEC of the appendix A will have to be completed to prove the conformity.

## 2.7 Portability

Not applicable.

## 2.8 Others quality factors

Not applicable.

## 2.9 Critical resources reserve

The basic capacity of the Diagnostic Memory Module is 1 GB.

[SyRS_TRU_0078]

The basic capacity of the Protected Memory Module is 512 MB.

## 2.10 Production constraints

The TRU function shall be configurable with a configuration file in order to address several projects. (cf.§ 4.6)

The development of each National recording system shall be modular to authorize the Data registered from different physical interfaces. (Choice made by Dataprep configuration)

## 2.11 Performance

### 2.11.1 Operational performance

The TRU shall be operational in less than 25 seconds after power-up.

No message shall be lost at the reception from the EVC or the National ATP systems.

The flow of data messages between the JRU and the EVC is assumed to be less than 2kBytes per JRU cycle (200 ms).

In addition, the flow of data messages between the DRU and the EVC is assumed to be less than 256 Bytes/cycle (200 ms).

The system shall offer a transmission rate of 20 MB/s to download the data via Ethernet network.

The system shall offer the possibility to download the Data directly on a USB stick.

It shall be possible to upload the TRU software through Ethernet or USB within a time inferior to five minutes.

### 2.11.2 Non tampering, non-alteration and security of records

The recorder data shall be completed with the measures to safeguard data integrity (e.g. checksum)

The integrity of the data shall be ensured by an error detecting code applied on the recorded data and on the out coming recorder data.

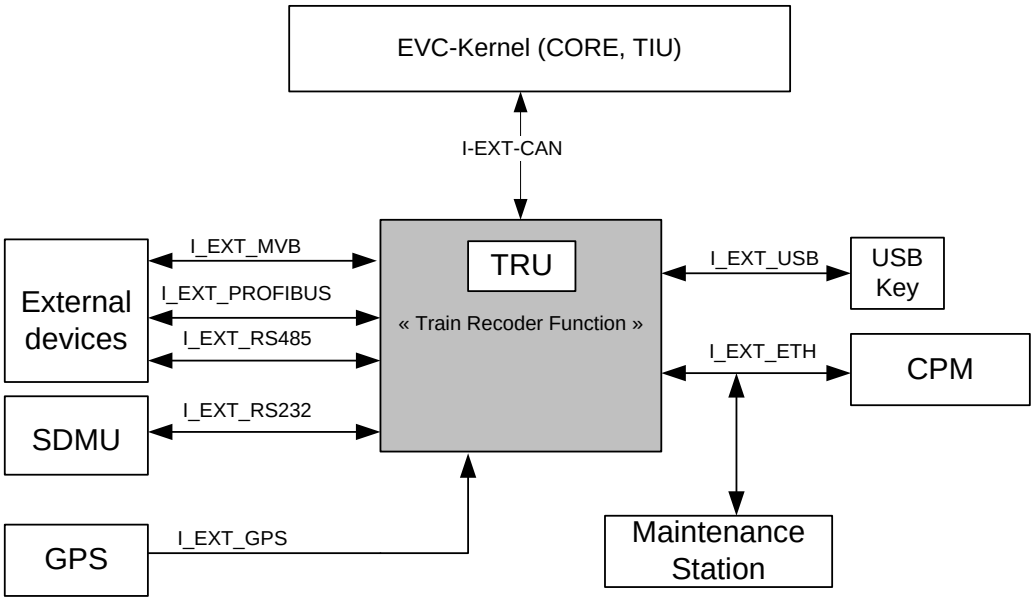
The Software tool enabling out coming data analysis shall use the error detecting code to detect any altering data.

Countermeasures shall be taken in order to ensure that the recorded data is equal to the incoming data.

Stored data shall be protected by authorization against misuse (e.g. by a login process before establishing a connection to the System by its interfaces).

# 3 INTERFACE SPECIFICATION

## 3.1 List of external interfaces




## 3.2 Description of external interface I_EXT_CAN

### 3.2.1 Role of external interface

This interface is used to exchange data with EVC-kernel (CORE, TIU).

### 3.2.2 Physical level

See document [Ref.26].

### 3.2.3 Protocol level

See document [Ref.26].

### 3.2.4 Application level

The data exchanged between the TRU and the EVC are the control messages, juridical data messages and diagnostic messages (see paragraph 4.2).

### 3.2.5 Software compatibility

Not applicable.

### 3.2.6 Hardware compatibility

Not applicable.

### 3.2.7 Implicit choices and justification

Not applicable.

## 3.3 Description of external interface I_EXT_USB

### 3.3.1 Role of external interface

This interface is used to download juridical and diagnostic data into an USB key.

### 3.3.2 Physical level

See document [Ref.26].

### 3.3.3 Protocol level

See document [Ref.26].

### 3.3.4 Application level

See document [Ref.26].

### 3.3.5 Software compatibility

Not applicable.

### 3.3.6 Hardware compatibility

Not applicable.

### 3.3.7 Implicit choices and justification

Not applicable.

## 3.4 Description of external interface I_EXT_GPS

### 3.4.1 Role of external interface

The interface provides to the system the UTC time to timestamp the data messages.

### 3.4.2 Physical level

See document [Ref.26].

### 3.4.3 Protocol level

See document [Ref.26].

### 3.4.4 Application level

See document [Ref.26].

### 3.4.5 Software compatibility

Not applicable.

### 3.4.6 Hardware compatibility

Not applicable.

### 3.4.7 Implicit choices and justification

Not applicable.

## 3.5 Description of external interface I_EXT_ETH

### 3.5.1 Role of external interface

This interface is used to communicate with external equipment (DMI, CPM, Maintenance Station…)

### 3.5.2 Physical level

See document [Ref.26].

### 3.5.3 Protocol level

See document [Ref.26].

### 3.5.4 Application level

See document [Ref.26].

### 3.5.5 Software compatibility

Not applicable.

### 3.5.6 Hardware compatibility

Not applicable.

### 3.5.7 Implicit choices and justification

Not applicable.

## 3.6 Description of external interface I_EXT_RS232

### 3.6.1 Role of external interface

This interface is used for the reception of SDMU debug data information recording.

### 3.6.2 Physical level

See description of the interface I_INT_SERVICES_ODO in the document [Ref.26].

### 3.6.3 Protocol level

See description of the interface I_INT_SERVICES_ODO in the document [Ref.26].

### 3.6.4 Application level

See description of the interface I_INT_SERVICES_ODO in the document [Ref.26].

### 3.6.5 Software compatibility

Not applicable.

### 3.6.6 Hardware compatibility

Not applicable.

### 3.6.7 Implicit choices and justification

Not applicable.

## 3.7 Description of external interface I_EXT_RS485

### 3.7.1 Role of external interface

This interface is used to communicate with the external devices (ATB cubicle).

This interface is optional (Project and train configuration dependant).

### 3.7.2 Physical level

See document [Ref.26].

### 3.7.3 Protocol level

See document [Ref.26].

### 3.7.4 Application level

See document [Ref.26].

### 3.7.5 Software compatibility

Not applicable.

### 3.7.6 Hardware compatibility

Not applicable.

### 3.7.7 Implicit choices and justification

Not applicable.

## 3.8 Description of external interface I_EXT_PROFIBUS

### 3.8.1 Role of external interface

This interface Provide a bi-directional Profibus interface between TRU function and trainborne peripherals (Alstom DMI and STM).

This interface is optional (Project and train configuration dependant).

### 3.8.2 Physical level

See document [Ref.26].

### 3.8.3 Protocol level

See document [Ref.26].

### 3.8.4 Application level

See document [Ref.26].

The data exchanged between the Comet and the Profibus peripherals are the control messages, juridical data messages and diagnostic messages (see paragraph 4.2).

### 3.8.5 Software compatibility

Not applicable.

### 3.8.6 Hardware compatibility

Not applicable.

### 3.8.7 Implicit choices and justification

Not applicable.

## 3.9 Description of external interface I_EXT_MVB

### 3.9.1 Role of external interface

This interface is a network to communicate with external devices (National ATC, TCMS ...)
This interface is optional (project and train configuration dependant).

### 3.9.2 Physical level

See document [Ref.26].

### 3.9.3 Protocol level

See document [Ref.26].

### 3.9.4 Application level

See document [Ref.26].
The data exchanged between the TRU function and the MVB peripherals are the juridical data messages and diagnostic messages (see paragraph 4.2).

### 3.9.5 Software compatibility

Not applicable.

### 3.9.6 Hardware compatibility

Not applicable.

### 3.9.7 Implicit choices and justification

Not applicable.

## 3.10 Description of human-machine interface

### 3.10.1 Role

This interface gives visual information to user/maintainer/operator about the status of the System.

### 3.10.2 Physical level

States are provided through coloured lights present on the front panel, to allow information reading in dark environment.
States of the system can also be provided through digital output to inform the driver.

### 3.10.3 Protocol level

Status diodes on the front panel could indicated

- Green light : JRU Operational (No faults detected, Self-tests OK)
- Orange Led : JRU memory capacity warning

### 3.10.4 Application level

Not applicable.

### 3.10.5 Software compatibility

Not applicable.

### 3.10.6 Hardware compatibility

Not applicable.

### 3.10.7 Implicit choices and justification

Not applicable.

# 4 FUNCTIONAL REQUIREMENTS

## 4.1 Description of functions

**F1 -** TRU functions

**F1.1 -** Reception of the UTC (cf.§4.3)

**F1.2 -** Perform self-test and diagnostic (cf.§4.4)

**F1.3 -** Interface with the maintenance web site of the TRU (cf.§4.5)

**F1.4 -** Data preparation (cf.§4.6)

**F1.5 -** Interface with the JDRMDR Tool (cf.§4.7)

**F1.6 -** Data downloading (cf.§4.8)

**F1.7 -** Memory filling rate (cf.§4.9)

**F1.8 -** CPM configuration (cf.§4.10)

**F1.9 -** Time stamping of messages with UTC (cf.§4.14)

**F2 -** JRU functions

**F2.1 -** Management of the control messages from/to EVC (cf. § 4.11)

**F2.2 -** Transmission of the UTC time to the EVC (cf. §4.12)

**F2.3 -** Transmission of the local time (LT) to the EVC (cf.§4.13)

**F2.4 -** Intentionally deleted

**F2.5 -** Reception of the juridical messages from EVC (cf.§4.15)

**F2.6 -** Monitoring of the EVC isolation status (cf.§4.16)

**F2.7 -** Memorisation of the juridical messages on a Crash Protected Memory (cf.§4.17)

**F2.8 -** Control connection with the STM (cf.§4.18)

**F3 -** DRU functions

**F3.1 -** Recording of the juridical messages from EVC in DRU memory (cf.§4.19)

**F3.2 -** Reception of the diagnostic messages from the EVC or DMI (cf.§4.20)

**F3.3 -** Reception of the diagnostic messages from the STM(s) (cf.§4.21)

**F3.4 -** Intentionally deleted

**F3.5 -** Memory organization (cf.§4.22)

## 4.2 Description of data

### 4.2.1 JRU Message Definition

The below Table 1 lists every JRU message that TRU must handle. For each message, the table specifies its identifier (TRU_NID_MESSAGE), its formal name and its type.

| TRU_NID_MESSAGE | MESSAGE NAME | TYPE OF MESSAGE |
|---|---|---|
| 0 | DATA MESSAGE | Data Message |
| 1 | TRU STATE | Control Message |
| 2 | TRU STATE REQUEST | Control Message |
| 3 | JRU FAILURE | Control Message |

| TRU_NID_MESSAGE | MESSAGE NAME | TYPE OF MESSAGE |
|---|---|---|
| 4 | JRU UTC TIME REQUEST | Control Message |
| 5 | JRU UTC TIME | Control Message |
| 6 | JRU LOCAL TIME REQUEST | Control Message |
| 7 | JRU LOCAL TIME | Control Message |

Table 1: JRU message definition

Only Juridical Data messages shall be recorded in the juridical protected memory. The control messages are exchanged with the EVC but not recorded by the JRU.

#### 4.2.1.1 JRU Control Message (EVC↔JRU)

##### 4.2.1.1.1 Message 1: TRU State Response (JRU→EVC)

| Field N° | VARIABLE | Bits | Remarks |
|---|---|---|---|
| 1 | TRU_NID_MESSAGE | 8 | Type of message (= 1) |
| 2 | TRU_M_STATUS | 8 | State of TRU |

##### 4.2.1.1.2 Message 2: TRU State Request (EVC→JRU)

| Field N° | VARIABLE | Bits | Remarks |
|---|---|---|---|
| 1 | TRU_NID_MESSAGE | 8 | Type of message (=2) |

##### 4.2.1.1.3 Message 3: JRU Failure (JRU→EVC)

| Field N° | VARIABLE | Bits | Remarks |
|---|---|---|---|
| 1 | TRU_NID_MESSAGE | 8 | Type of message (=3) |

##### 4.2.1.1.4 Message 4: JRU UTC Request (EVC→JRU)

| Field N° | VARIABLE | Bits | Remarks |
|---|---|---|---|
| 1 | TRU_NID_MESSAGE | 8 | Type of message (=4) |
| 2 | JRU_T_TRAIN | 32 | EVC Clock |

##### 4.2.1.1.5 Message 5: JRU UTC Response (JRU→EVC)

| Field N° | VARIABLE | Bits | Remarks |
|---|---|---|---|
| 1 | TRU_NID_MESSAGE | 8 | Type of message (=5) |
| 2 | JRU_T_UTC | 38 | Universal time |
| 3 | JRU_T_TRAIN | 32 | EVC Clock |
| 4 | Padding bit | 2 | Fix value (=0) |

##### 4.2.1.1.6 Message 6 : JRU Local Time Request (EVC→JRU)

| Field N° | VARIABLE | Bits | Remarks |
|---|---|---|---|
| 1 | TRU_NID_MESSAGE | 8 | Type of message (=6) |
| 2 | JRU_NID_C | 10 | Identifier of country |
| 3 | JRU_T_TRAIN | 32 | EVC Clock |
| 4 | Padding bit | 6 | Fix value (=0) |

##### 4.2.1.1.7 Message 7: JRU Local Time Response (JRU→EVC)

| Field N° | VARIABLE | Bits | Remarks |
|---|---|---|---|
| 1 | TRU_NID_MESSAGE | 8 | Type of message |
| 2 | JRU_T_LOCAL_TIME | 32 | Local time |
| 3 | JRU_T_TRAIN | 32 | EVC Clock |

#### 4.2.1.2 JRU Data Message (EVC→JRU)

Juridical Data messages are specified in document [Ref.33].

### 4.2.2 DRU Message Definition

The below Table 2 lists DRU messages that TRU must handle. For each message, the table specifies its identifier (TRU_NID_MESSAGE), its formal name and its type.

| TRU_NID_MESSAGE | MESSAGE NAME | TYPE OF MESSAGE |
|---|---|---|
| 8 | STM diagnostic message | Data Message |
| 9 | ETCS Diagnostic message | Data Message |

Table 2: DRU message definition

#### 4.2.2.1 STM diagnostic message

The DRU must be able to process a STM diagnostic message as specified in the Table 3. This STM diagnostic message is built based on the diagnostic message, received from the STM, made of a STM header and a STM packet #77 as specified in the Subset 058 revision 2.1.1.

| **Description** | This message contains the information coming from the STM that must be recorded in the DRU. | | |
|---|---|---|---|
| **Content** | **Variable** | **Length** | **Comment** |
| | NID_STM | 8 | STM identification from general header STM |
| | NID_PACKET | 8 | Packet identifier<br>Value=77 |
| | L_PACKET | 13 | Packet length |
| | L_TEXT | 8 | Number of characters in text string<br>Maximum value=10 |
| | X_TEXT (k) | 8 | STM provider identity in ASCII |
| | N_L_ITER | 8 | Number of data bytes |
| | M_DATA (k) | 8 | STM proprietary data |

Table 3: STM Diagnostic Message

Notes:

- A STM diagnostic message as specified in the Subset-058 revision 2.1.1 with a STM packet #77 (see [Ref.24] § 7.6.1 as part of the ETCS BSL2) is no longer defined from the ETCS BSL3 (see Subset 058 [Ref.23] as part of the ETCS BSL3). Thus a STM compliant to the ETCS BSL 3 should not send such message to the DRU. However, the DRU could still receive such STM diagnostic message from the EVC to manage diagnostic data of a STM of type TBL1+ as specified in the document [Ref.31][1]. In this case, the DRU shall be still able to build and process a STM diagnostic message as defined in the Table 3 based on the STM diagnostic message received from the EVC even if the on-board system is operating in ETCS BSL3.

#### 4.2.2.2 ETCS Diagnostic message

The DRU must be able to handle ETCS Diagnostic messages received from all ETCS subsystems other than STM (meaning EVC, DMI,TRU…). ETCS Diagnostic messages are all formatted on the same basis whatever the transmitter.

For more details about ETCS Diagnostic message structure, see document [Ref.34].

[1] TBL1+ STM doesn't fulfil the Subset 058 specification, which requires a specific process in some case as specified in the document [Ref.31].

## 4.3 Description of function Reception of the UTC

The TRU needs the UTC time to time stamp the messages it receives.

The UTC source is provided from a GPS receiver located on the TRU.

### 4.3.1 Inputs

I_EXT_GPS

### 4.3.2 Processing

#### 4.3.2.1 Initialisation mode

Not applicable.

#### 4.3.2.2 Normal mode

[SyRS_TRU_0001]

At start-up, after the initialisation phase, the function "reception of the UTC" has to communicate with the GPS receiver to obtain the UTC time.

[SyRS_TRU_0002]

UTC time is used internally by the TRU to adjust and synchronise its RTC time.

[SyRS_TRU_0003]

UTC time is used to time-stamping the juridical and diagnostic events.

[SyRS_TRU_0004]

If the communication is not established with the GPS receiver 5 minutes after the power-up, the TRU shall record an event "UTC time is not synchronised" and use its non-synchronised RTC time for time-stamping the events.

A comparison between UTC time and RTC time is done every 15 minutes. If the difference between the both is greater than 40ms, the RTC time is resynchronise with UTC time value. In this way, the error between the RTC time and UTC time is almost null.

[SyRS_TRU_0005]

When the TRU retrieved the UTC time after recording the event "UTC time is not synchronised", it shall record an event "UTC time is synchronised anew". Otherwise, it is not necessary to record an event when RTC time is resynchronised with UTC time.

In parallel, the function asks the Geo-localization Data (Longitude, Latitude and height values) to the GPS receiver every x second. (Configurable value: 5 sec by default). This information will be later used by DRU localization function.

[SyRS_TRU_0006]

It shall be also possible to configure manually the internal RTC with a user interface. An event will be recorded in the DRU memory to inform the operator that the RTC time is adjusted manually.

Afterward, the RTC will run with this value until a new value is entered or automatically resynchronised with the GPS receiver.

According to GPS supplier specification, other events could be recorded in DRU memory to help the maintenance operator. The TRU shall record at least an event to inform the operator that the GPS cable is disconnected from the Antenna.

#### 4.3.2.3 Degraded mode

[SyRS_TRU_0007]

The internal clock shall be kept up to date even in case of interruption of power supply during eight days.

However, when the interruption is greater than eight days, the RTC value will be equal to the default value (1.Jan.1970 or 1.Jan.2000 according the type of RTC used).

It means that while RTC time is not synchronised again with the UTC time, the time reference used for the time-stamping is wrong.

[SyRS_TRU_0008]

An event shall be recorded in the DRU memory to inform the operator that the RTC time value used for the time-stamping is a wrong value.

Once the TRU has established the communication with the GPS and resynchronised its RTC time with the right value, an event shall be recorded in the DRU memory to inform the operator that the RTC time is now synchronised.

### 4.3.3 Outputs

RTC synchronised

Geo-Localization parameters received

### 4.3.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.3.5 Performance

[SyRS_TRU_0009]

The RTC accuracy shall be at least of 10ms.

### 4.3.6 Other attributes

Not applicable.

## 4.4 Description of function Perform self-test and diagnostic

The Self-test are composed of :

The power-up self-tests, which are performed once at the initialisation of the TRU,

The continuous self-tests, which are performed continuously while the TRU is running.

### 4.4.1 Inputs

Interfaces defined in sections 3.

### 4.4.2 Processing

#### 4.4.2.1 Initialisation mode

At least, the following components shall be tested:

- RAM and ROM memories,
- All electrical interfaces defined in sections 3.

All the faults shall be recorded in the DRU memory with complementary context data if necessary.

Optional interfaces that are not used on the project shall raise a minor fault with no effect on the TRU function.

A failure of one of the following interfaces I_EXT_CAN or I_EXT_ETH shall raise a Major fault and the TRU function will not be operational.

#### 4.4.2.2 Normal mode

The continuous tests are performed cyclically on the electrical interfaces.

[SyRS_TRU_0010]

If a fault occurs during the tests, a diagnostic code is recorded in the DRU memory.

[SyRS_TRU_0011]

The function will also recorded the results of the Self-Tests and continuous Tests of Crash protected Memory.

[SyRS_TRU_0012]

If a major fault occurs during the continuous tests or on the CPM device, the JRU function will be in failure.

When the JRU is in failure (Major fault is raised by the function), the corresponding LED status shall be switch off.

#### 4.4.2.3 Degraded mode

When minor events are detected during the tests, the main functionality of the recorder is still operational. Then, a signalling of the problem shall be done for the maintenance operator but the JRU function is still operational.

This signalling shall be visible on the maintenance site of the TRU function.

### 4.4.3 Outputs

Self-Tests are done.

Status of TRU function is up to date.

### 4.4.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.4.5 Performance

Not applicable.

### 4.4.6 Other attributes

Not applicable.

## 4.5 Description of function Interface with the maintenance web site of the TRU

An embedded web site is required to configure and maintain TRU functions.

### 4.5.1 Inputs

Parameter file,

TRU software.

### 4.5.2 Processing

[SyRS_TRU_0013]

It shall be possible with a laptop to access to the TRU web site. The site shall be organised to perform maintenance and configuration operations.

The following operations shall be available for the user:

TRU software update,

Parameter file update,

Self-Tests results,

Error log,

TRU Date and Time update,

TRU Hardware and Software information,

TRU internal Status as memory filling rate, status of each interface…

Select and Download JRU data or DRU data.

[SyRS_TRU_0014]

The tool shall include access control with minimum two levels of password protection. The first shall be for the access to the technical functions, the second shall secure the access to the data recorded.

### 4.5.3 Outputs

Configuration is updated

Data are downloaded.

### 4.5.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.5.5 Performance

[SyRS_TRU_0015]

The downloading shall respect a minimum rate of 10 Mbytes by second.

### 4.5.6 Other attributes

Not applicable.

## 4.6 Description of function Data Preparation

The TRU shall accept a configuration file in xml format.

The configuration will be based on the TRU Configuration Data Description [Ref.27]. The specific parameters required for the embedded TRU function are defined in the TRU function – Configuration Data [Ref.32]

### 4.6.1 Inputs

Configuration file in xml format.

### 4.6.2 Processing

[SyRS_TRU_0016]

The TRU function shall be configurable with a configuration file in order to address the needs of several projects.

The configuration file contains a parameters list to configure each recording system.(ETCS, optional ATC system like ATB or LZB/PZB)

The physical interfaces of each recording system are also configurable (Digital input, Serial links, MVB or Ethernet network)

The TRU function shall be modular to record other national recording systems in the future.

### 4.6.3 Outputs

Configuration is taken account.

### 4.6.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.6.5 Performance

Not applicable.

### 4.6.6 Other attributes

Not applicable.

## 4.7 Description of function interface with JDRMDR tool

The tool for decode the juridical and diagnostic messages is the JDRMDR.

### 4.7.1 Inputs

Recorded Data

### 4.7.2 Processing

[SyRS_TRU_0017]

The TRU shall read the Juridical and diagnostic data recorded in the memory and build a file compliant to the format described in the following document. [Ref.28]

A mechanism shall be implemented between the system and the tool to verify the integrity of the data included in the file.

[SyRS_TRU_0018]

Whatever the interface used for the downloading (Ethernet or USB), the format of the file shall be the same.

Only the extension file will be different to recognise the origin of the data. (JRU or DRU)

### 4.7.3 Outputs

JDRMDR file.

### 4.7.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.7.5 Performance

Not applicable.

### 4.7.6 Other attributes

Not applicable.

## 4.8 Description of function Data downloading

There is several ways to download the Data.

### 4.8.1 Inputs

Recorded Data,
I_EXT_ETH,
I_EXT_USB,
Configuration file

### 4.8.2 Processing

[SyRS_TRU_0019]

The TRU function shall offer the possibility to download the data recorded of the internal memories and of the CPM module if present.

[SyRS_TRU_0020]

Each memory partition can be downloaded from the embedded web site or from the USB stick.

Whatever the interface used for the downloading (Ethernet or USB), the format of the file shall be the same.

Only the extension file will be different to recognise the origin of the data.

According to each project configuration file, the memories partitions that have to be downloaded are:

- Juridical Data 24H (Internal or from the CPM module),
- Juridical Data 8d (Internal or from the CPM module),
- Diagnostic Data,
- SDMU Data,
- ATC Data (ATB, LZB ...)

[SyRS_TRU_0021]

When the operator is connected directly to the embedded web site, he shall have the choice of the type of file to download between the different data partitions.

He has also the possibility to download only the recorded data since the last downloading. (Default solution)

A specific command or menu will be necessary to download all the recorded data in the partition memory.

[SyRS_TRU_0022]

When the operator uses an USB stick to download the data, the type of memory partitions copied on the stick depends of the authorisation level read on the key.

[SyRS_TRU_0023]

Each time than a memory partition is downloaded, the system shall compute the new filling level of the memory partition.

This level will be dynamic and based on the total size available to record the data. (Total size available = free memory space and data already downloaded).

Each partition has its own memory filling level.

[SyRS_TRU_0024]

According to the configuration file, each partition can be downloaded through remote equipment (Communication box). In this case, the according memory file will be transferred to this equipment on Ethernet network. The frequency of this transfer shall be configurable. (A file by day or by week in example)

Option: If a connection with the TrainTracer tool is required for the remote maintenance, the system will transfer the diagnostic codes included in the packet 3. The format that has to be respected is defined in the document [Ref.29].

### 4.8.3 Outputs

Juridical and diagnostic data are transferred to the ground.

### 4.8.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.8.5 Performance

Not applicable.

### 4.8.6 Other attributes

Not applicable.

## 4.9 Description of function Memory filling rate

### 4.9.1 Inputs

I_EXT_ETH,

Configuration file

### 4.9.2 Processing

[SyRS_TRU_0025]

According to the parameters defined in the configuration file, the TRU shall manage the memory filling rate for each partition.

A level between 0 and 100% is associated to each partition memory size.

[SyRS_TRU_0026]

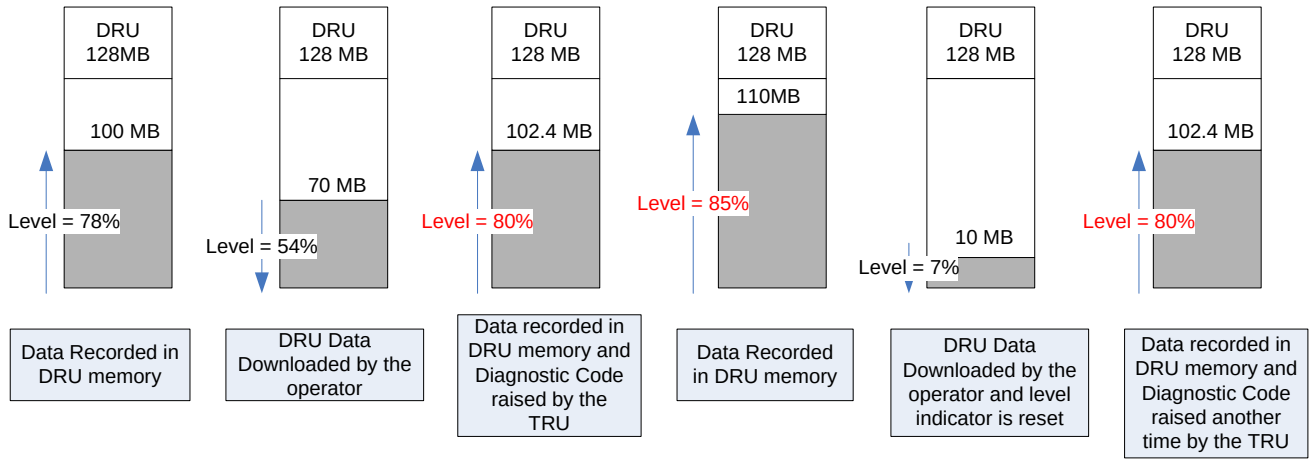
When the data recorded inside this partition reach this level, a diagnostic code is recorded by the TRU.

According to the parameters defined in the configuration file, this diagnostic code can be used to light on the front LED or display to the driver via the DMI.

The filling rate of each partition is the size of recorded data that have not been downloaded.

Example: the DRU partition memory is defined to 128MB and the associated level is defined to 80%. (The diagnostic code will be raised when the size of the record data will reach 128 * 0.8 = 102.4 MB).

The diagram below shows the evolution of the memory filling rate for the DRU partition.




[SyRS_TRU_0027]

If the level reaches 100%, the oldest data will be automatically overwritten by the newest data. In this case, the TRU shall log a diagnostic code in DRU memory.

The same behaviour is requested for the others memory partitions. When the memory partition is inside the Crash Protected Memory, the CPM will send its filling level to the TRU.

[SyRS_TRU_0028]

In the case of the level reaches the value defined in the configuration file, the DRU shall log a diagnostic code and perform the associated actions (light on the front LED or display to the driver via the DMI).

### 4.9.3 Outputs

Filling levels are managed by the TRU.

### 4.9.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.9.5 Performance

Not applicable.

### 4.9.6 Other attributes

Not applicable.

## 4.10 Description of function CPM Configuration

### 4.10.1 Inputs

I_EXT_ETH,

Configuration file

### 4.10.2 Processing

The System shall read the configuration file to obtain CPM data configuration.

[SyRS_TRU_0029]

According to the parameters defined in the configuration, the TRU shall build a configuration file for the CPM module.

The CPM configuration file shall be constituted at least of:

- the number of memory partitions used on the CPM
- the size and the name of each partition
- The level of the memory filling rate for each partition

Once the configuration file is completed, it shall be transferred to the CPM.

The CPM will answer to the TRU that the configuration has been taken in account.

[SyRS_TRU_0030]

The CPM configuration file will be send to the CPM only if the TRU configuration file has changed.

#### 4.10.3 Outputs

CPM configuration file sent to the CPM.

#### 4.10.4 Safety

The function is not safety and developed according to SSIL0 level.

#### 4.10.5 Performance

Not applicable.

#### 4.10.6 Other attributes

Not applicable.

### 4.11 Description of function Management of the control messages from/to EVC

The TRU exchanged control messages with the EVC kernel through the CAN network.

The Control messages are used to exchange status information between the both equipment.

The format of the control message exchanged between the EVC and the JRU is given in the paragraph 4.2.1.1

#### 4.11.1 Inputs

I_EXT_CAN

#### 4.11.2 Processing

##### 4.11.2.1 Initialisation mode

Not applicable.

##### 4.11.2.2 Normal mode

[SyRS_TRU_0031]

After the power-up, the TRU sends its status to the EVC (Control message 1 – TRU_STATUS). The message is also sent to the EVC each time the TRU status changes or on request from the EVC (Control message 2: TRU state request).

The TRU modes and status are:

- Initialisation mode: TRU mode at the power-on of the unit until completion of the self-tests and booting of the application software. (Note: This status value is not sent to the EVC)
- Normal mode: When the TRU application software is running.

- Downloading mode: When the USB stick or a laptop has established a connection with the TRU and the data are downloaded. When the TRU is in this mode, it is still able to record new messages. No messages received are lost.
- Service mode: The TRU is in service mode, when laptop is connected to the TRU and the software or configuration update is on-going. When the TRU is in this mode, no new message is recorded by the TRU. Any messages received are discarded.
- Failure status: This status is the consequence of an internal system fault detected at the completion of the self-diagnostic tests at power-on or if error condition has happened during operation.

[SyRS_TRU_0079]

Status shall be sent according to the format of TRU_M_STATUS.

For more details about variable TRU_M_STATUS, see paragraph 7.1.3.

[SyRS_TRU_0032]

Each time the TRU status changes, the DRU records a diagnostic message giving the new mode of the TRU.

[SyRS_TRU_0033]

A specific diagnostic message is created by the TRU at the power-on of the JRU. The identifier for this code is fixed to 2000 (0x7D0).

[SyRS_TRU_0034]

If the JRU detects an internal recording problem, the JRU sends immediately an error message JRU-failure to the EVC (Control message 3 – JRU failure).

The JRU is in failure mode when it loses its recording capacity.

### 4.11.3 Outputs

Control messages are sent over the CAN network.

### 4.11.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.11.5 Performance

Not applicable.

### 4.11.6 Other attributes

Not applicable.

## 4.12 Description of function Transmission of the UTC time to the EVC

The TRU exchanged control messages with the EVC kernel through the CAN network.

The transmission of the UTC time to the EVC is managed by the control messages number 4 and 5. (See paragraph 4.2.1.1)

### 4.12.1 Inputs

I_EXT_CAN

UTC Time

### 4.12.2 Processing

#### 4.12.2.1 Initialisation mode

Not applicable.

#### 4.12.2.2 Normal mode

The EVC will send a request to obtain the UTC time (Control message 4 –UTC request).

The EVC sends the message 4 with the time information T_TRAIN

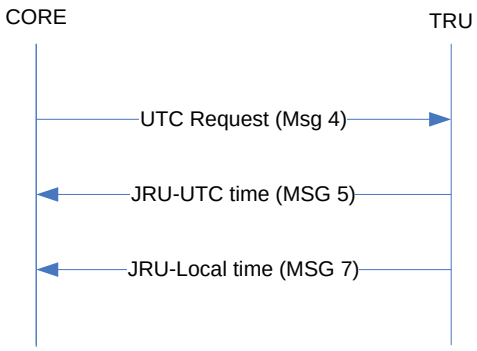
[SyRS_TRU_0035]

As the TRU knows the Δt between T_TRAIN and T_UTC (see §4.14.2), it will answer (Control message 5- JRU-UTC Time) with the T_UTC corresponding to the T_TRAIN sent in message 4. Then the EVC can perform its resynchronisation according to T_TRAIN and T_UTC received.

[SyRS_TRU_0036]

To enable EVC to receive Local Time from TRU on tack without beacon, the UTC time and LT time (Control message 7- JRU-Local Time) are sent to the EVC on request of the EVC with message 4. In the case of no beacon on tack (no NID_C received), the TRU use the first Country_ID define in dataprep. In current use, the TRU use the received NID_C to send the Local Time.

The general sequence is defined as below:




[SyRS_TRU_0037]

Each time the JRU send the Local Time to the EVC, the TRU records a diagnostic message giving the Country_ID received from EVC.

### 4.12.3 Outputs

UTC and Local time sent to the EVC.

### 4.12.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.12.5 Performance

Not applicable.

### 4.12.6 Other attributes

Not applicable.

## 4.13 Description of function Transmission of the Local time to the EVC

The TRU exchanged control messages with the EVC kernel through the CAN network.

The transmission of the local time to the EVC is managed by the control messages number 6 and 7. (See paragraph 4.2.1.1)

### 4.13.1 Inputs

I_EXT_CAN

UTC Time

### 4.13.2 Processing

#### 4.13.2.1 Initialisation mode

Not applicable.

#### 4.13.2.2 Normal mode

The EVC will send a request to obtain the local time (Control message 6 –Local Time request).

This message 6 contains the EVC time reference T_TRAIN and the identifier of the country : JRU_NID_C.

[SyRS_TRU_0038]

The JRU calculates the local time from the UTC time, the JRU_NID_C and the summer/winter correction timetable defined in the Data Preparation.

As the TRU knows the Δt between T_TRAIN and T_UTC (see §4.14.2), it can deduce the corresponding T_UTC.

In the data preparation file, to each JRU_NID_C (so each Country_ID), is associated the corresponding time difference between the UTC time and the Local Time of the country.

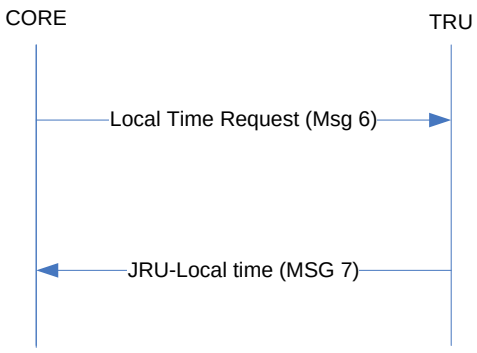
[SyRS_TRU_0039]

So the TRU knowing the Country_ID and the UTC time, can deduce the Local Time in the country. The TRU will automatically store the last ETCS Country_ID received in it's flash memory. If the TRU did not receive a Country_ID from the EVC, it takes the first Country_ID of the dataprep.

[SyRS_TRU_0040]

The JRU sends the Local Time (LT) to the EVC as part of the message 7 – JRU local time

The general sequence is defined as below:




[SyRS_TRU_0041]

Each time the JRU send the Local Time to the EVC, the TRU records a diagnostic message giving the Country_ID received from EVC.

### 4.13.3 Outputs

Local time sent to the EVC.

### 4.13.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.13.5 Performance

Not applicable.

### 4.13.6 Other attributes

Not applicable.

## 4.14 Description of function Time stamping of messages with UTC

The TRU is in charge to time stamped the message received from the EVC.

### 4.14.1 Inputs

I_EXT_CAN

UTC Time

### 4.14.2 Processing

The data messages sent by the EVC and STM(s) include the time information as the local clock value at when the event was triggered and captured by the EVC and STM (see paragraph 4.2).

[SyRS_TRU_0042]

Before being recorded, the TRU shall timestamp EVC and STM messages with the UTC time corresponding to the clock value supplied in the message at when the event was triggered by the EVC or the STM.

Therefore, the TRU shall perform the synchronisation between the reference local clock and the UTC.

As the TRU knows the UTC time (from the GPS), it can deduce the difference $\Delta t$ between the UTC time and the reference local clock.

Accordingly, when the EVC (or the STM) sends a message with its time reference as the current clock value at when the event happened, the TRU can deduce the corresponding UTC time and timestamp the message with the UTC time (T_UTC).

### 4.14.3 Outputs

Delta t between EVC time and UTC time is defined.

Each data message that TRU must record is timestamped with the UTC time.

### 4.14.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.14.5 Performance

Not applicable.

### 4.14.6 Other attributes

The STM diagnostic messages received by the DRU have no time reference. Accordingly, the DRU adds a DRU header to the received STM diagnostic message which includes the UTC time. In this case, the UTC time will be the date and time at which the message has been received by the DRU (for more details on the DRU header of STM diagnostic messages, see paragraph 4.21).

## 4.15 Description of function Reception of Juridical Data messages from EVC

This function read the messages put on the CAN network by the EVC Kernel.

Different kind of messages are sent by the EVC Kernel through the CAN network : Juridical, diagnostic and control messages. The list of juridical messages is given at §4.2.1.

### 4.15.1 Inputs

I_EXT_CAN

### 4.15.2 Processing

#### 4.15.2.1 Initialisation mode

Not applicable.

#### 4.15.2.2 Normal mode

The function has to determine the type of message sent by the EVC. Each type of message is based on a unique identifier named TRU_NID_MESSAGE. The Juridical Data messages are identified with a value of TRU_NID_MESSAGE equal to 0.

Each Juridical Data Message received from the EVC is made of:

- A common header (as defined in the document [Ref.33]).
- A set of predefined packets (as an option).

The transmission order shall respect the order of data elements listed in the message format (from top to bottom).

The total length of a message must be always a multiple of bytes. Thus, if needed, padding bits must be added at the end of the message (including packets if any).

The JRU_NID_PACKET, JRU_L_PACKET and JRU_T_TRAIN variables in the Juridical common header (as specified in the document [Ref.33]) are the only fields to be read by the JRU to process the message as expected, from its reception from the EVC up to its transmission to the JDR. Content of the packets as well as their structure has to be considered by the JRU as 'transparent'.

[SyRS_TRU_0044]

Before recording a Juridical Data message from the EVC, the JRU shall convert the JRU_T_TRAIN into the corresponding T_UTC, meaning DATE and TIME as illustrated in the Table 4 (see document [Ref.18]).

| Field No | Timestamp of Juridical Messages as received from the EVC[2] | | Timestamp of Juridical Messages as recorded by JRU | | | |
|---|---|---|---|---|---|---|
| | Variable | Length in bits | Variable | | | Length in bits |
| 1 | JRU_T_TRAIN | 32 | T_UTC | DATE | YEAR | 7 |
| 2 | | | | | MONTH | 4 |
| 3 | | | | | DAY | 5 |
| 4 | | | | TIME | HOUR | 5 |

[2] See document [Ref.33]

| Field No | Timestamp of Juridical Messages as received from the EVC[2] | | Timestamp of Juridical Messages as recorded by JRU | | | |
|---|---|---|---|---|---|---|
| | Variable | Length in bits | Variable | | | Length in bits |
| 5 | | | | | MINUTES | 6 |
| 6 | | | | | SECONDS | 6 |
| 7 | Reserved | 8 | | | TTS[3] | 5 |
| | | = 40 | | | | = 38 |

Table 4: Translation of JRU_T_TRAIN into T_UTC

[SyRS_TRU_0045]

A Juridical Data message containing several packets shall be separated by the JRU, as illustrated in the Figure 1, prior to the recording in memory (with duplication of the header for each packet).

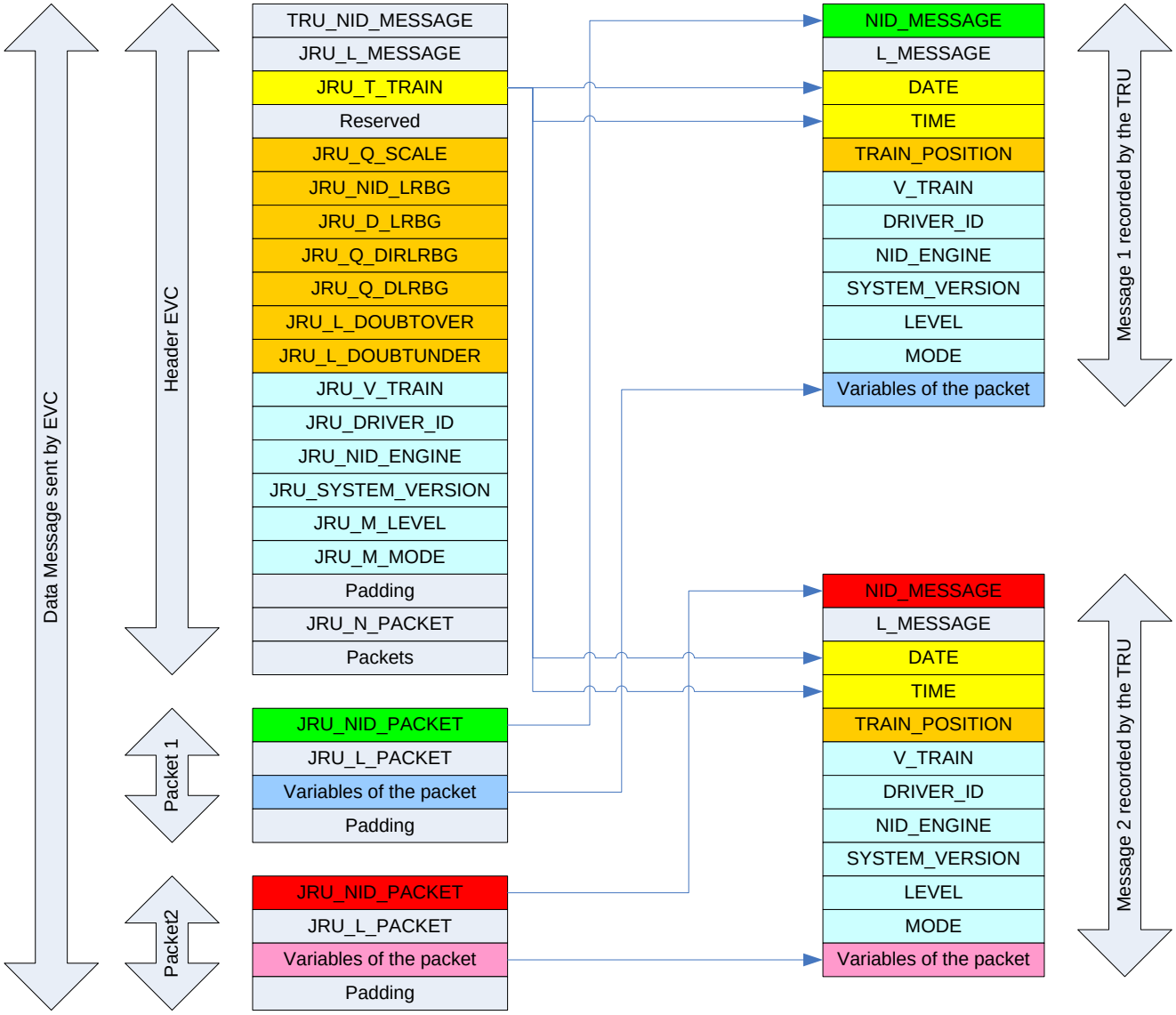



Figure 1: Split of JRU packets before recording Juridical Data messages

[3] Hundredth of second

The memory size allowed to the JRU function is divided in two memory partitions.

[SyRS_TRU_0046]

The 24H memory partition has to store each juridical message. This memory is based on a FIFO memory and its size is defined in the configuration file.

[SyRS_TRU_0047]

The 8d memory partition has to store only packets 3 and 11.

So, when a juridical packet 3 or 11 is received from the EVC, the function shall record this packet in the both partitions memories.

[SyRS_TRU_0080]

This memory is based on a FIFO memory and its size is defined in the configuration file.

[SyRS_TRU_0048]

When an external CPM is used, the juridical messages are not recorded in the internal memory partitions but sent individually over the Ethernet network for be recorded in the CPM memories.

[SyRS_TRU_0049]

Each juridical packet shall be duplicated in the DRU memory (not protected memory). Packets 3 and 11 are recorded only one time in the DRU.

#### 4.15.2.3 Unknown and pre-set value for the common header of Juridical Data message

See document [Ref.33].

### 4.15.3 Outputs

EVC message recorded in one or several juridical messages or ready to be transferred to the CPM (depending on the configuration file).

### 4.15.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.15.5 Performance

No information shall be lost.

### 4.15.6 Other attributes

Not applicable.

## 4.16 Description of function Monitoring of the EVC isolation status

This function records a message when the status of the digital signal “Isolation switch” changes.

### 4.16.1 Inputs

Digital input: Isolation switch

### 4.16.2 Processing

The digital signal is to inform the JRU of the isolation status of the EVC.

[SyRS_TRU_0050]

Each time the status of this signal changes, the JRU shall record the EVC status by recording a Juridical General message. If after the power-up, the isolation switch is activated, a Juridical General message shall be also recorded.

The related message is built on basis of the Juridical common header as defined in the document [Ref.33].

[SyRS_TRU_0051]

The message shall be timestamped with the T_UTC by the JRU, at the time of the event.

[SyRS_TRU_0052]

The variables of the Juridical common header shall be set with default values (or preset values) as specified in the document [Ref.33].

The JRU_M_MODE variable is coded with the value 10 for 'Isolation'.

### 4.16.3 Outputs

EVC isolation status recorded in the juridical memory.

### 4.16.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.16.5 Performance

The monitoring of the input status shall be with a scanning frequency of min. 100 ms.

### 4.16.6 Other attributes

Not applicable.

## 4.17 Description of function Memorisation of the juridical messages on a Crash Protected Memory

This function has to send the juridical message to the external Crash Protected Memory.

### 4.17.1 Inputs

Configuration file,

Juridical messages built in § 4.15

### 4.17.2 Processing

#### 4.17.2.1 Initialisation mode

This function is active only if the CPM is defined into the Configuration file.

#### 4.17.2.2 Normal mode

The Crash Protected Memory module shall store, without any loss of information, the juridical data relevant for at least 8 days in service.

From the last 24 hours in service all data must be stored. It means that all juridical packets shall be recorded in the 24Hours partition memory.

From the last 8 days only packets 3 and 11 are to be stored in the 8Days partition memory.

Each juridical message built by the function 4.15 shall be transferred in the right partition of the Crash Protected Memory.

According to the document [Ref.30], the function will add the recipient partition for each message. It is possible to indicate several recipient partitions in the same message. When a packet 3 or 11 has to be transferred, it could be sent twice on the network or only one time with two different memory locations (ETCS_24H and ETCS_8d).

[SyRS_TRU_0054]

For each packet sent to the CPM, a mechanism shall be implemented in order to be sure that the message has been correctly transferred.

The functionality is described in detail in the document [Ref.30].

### 4.17.3 Outputs

Juridical messages are recorded by the CPM.

### 4.17.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.17.5 Performance

[SyRS_TRU_0077]

The TRU shall decide to generate a message to be recorded according to a detected event in less than 250 ms.

[SyRS_TRU_0081]

The TRU shall record a generated message in its non-volatile memory in less than 250 ms

### 4.17.6 Other attributes

Not applicable.

## 4.18 Description of function Control connection with the STM

This function has to manage the connexion with a STM on the Profibus network.

### 4.18.1 Inputs

Configuration file,
I_EXT_CAN,
I_EXT_PROFIBUS

### 4.18.2 Processing

#### 4.18.2.1 Initialisation mode

This function is active only if a STM is defined into the Configuration file. Each SAP address of the STM is defined in the configuration file.

#### 4.18.2.2 Normal mode

When the JRU has to exchange data with a STM on the Profibus network, a connection has to be established before.

As the STM is the master equipment in that process, it will manage the connection.

It will send a request for connection to the JRU and this one has then to answer by a connect confirm.

The message exchanged between the STM and the JRU is made of a general header and the Packet STM-1 as defined in the FFFIS STM Application Layer [Ref.23].

[SyRS_TRU_0055]

The JRU shall check the version numbers defined in the STM-1 packet to validate the connection with the STM.

[SyRS_TRU_0056]

If the version numbers sent by the STM in the packet are not the same than the JRU expect, the JRU shall close the Probibus connection and recorded in the Diagnostic memory the event "STM connection closed"

The version numbers and the STM address are defined in the Configuration file.

### 4.18.3 Outputs

Connection established with the STM.

### 4.18.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.18.5 Performance

Not applicable.

### 4.18.6 Other attributes

Not applicable.

## 4.19 Description of function Recording of the juridical messages from EVC or STM in DRU memory

This function has to record juridical messages in the internal memory called "DRU"

### 4.19.1 Inputs

Juridical messages from 4.15.3.

### 4.19.2 Processing

[SyRS_TRU_0057]

Once a juridical message is recorded in the JRU 24H memory partition, the same information shall also be simultaneously copied in the DRU memory.

Juridical message duplicated in the DRU memory are all juridical messages from EVC and STM.

### 4.19.3 Outputs

Juridical messages are recorded in the DRU memory.

### 4.19.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.19.5 Performance

Not applicable.

### 4.19.6 Other attributes

Not applicable.

## 4.20 Description of function Reception of the diagnostic messages from the EVC or DMI

This function has to record diagnostic messages sent by the EVC and the DMI. The diagnostic information sent by the EVC are not only related to the EVC. It can be related to equipment but the information has to transit through the EVC.

### 4.20.1 Inputs

Configuration file,

I_EXT_CAN,

I-EXT-ETH

### 4.20.2 Processing

All the diagnostic messages coming from the EVC have the same header but with different packet format. (Messages received via the CAN network)

Each diagnostic messages generated by the EVC is composed of a common header with a set of predefined packets (see paragraph § 4.2.2).

[SyRS_TRU_0058]

Before recording of the diagnostic messages, the DRU shall convert the DRU_T_TRAIN into the corresponding T_UTC (DATE and TIME) as illustrated in the Table 5.

| Field No | Timestamp of Juridical Messages as received from the EVC[4] | | Timestamp of Juridical Messages as recorded by JRU | | | |
|---|---|---|---|---|---|---|
| | Variable | Length in bits | Variable | | | Length in bits |
| 8 | DRU_T_TRAIN | 32 | T_UTC | DATE | YEAR | 7 |
| 9 | | | | | MONTH | 4 |
| 10 | | | | | DAY | 5 |
| 11 | | | | TIME | HOUR | 5 |
| 12 | | | | | MINUTES | 6 |
| 13 | | | | | SECONDS | 6 |
| 14 | Reserved | 8 | | | TTS[5] | 5 |
| | | = 40 | | | | = 38 |

Table 5: Translation of DRU_T_TRAIN into T_UTC

[SyRS_TRU_0059]

Messages containing several packets shall be separated by the DRU, as illustrated in the Figure 2, prior to the recording in memory (with duplication of the header for each packet).

[4] See document [Ref.33]

[5] Hundredth of second

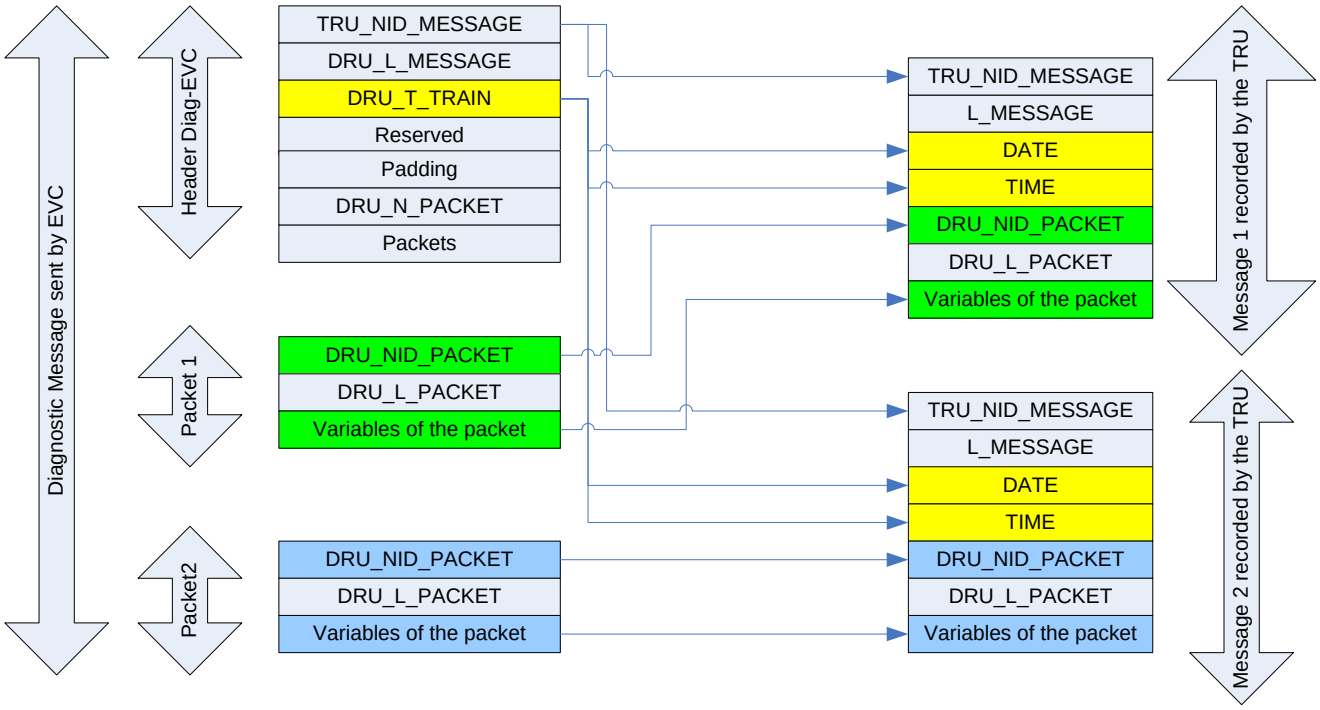



Figure 2: Split of DRU packets before recording Diagnostic messages

Each diagnostic messages coming from the DMI have the same header and packet format. The messages are received through Ethernet network according the protocol CIP.

Each diagnostic message contains the diagnostic code and its source to recognise the sender (EVC, DMI, ODO…)

### 4.20.3 Outputs

Each diagnostic message is recorded in the DRU memory.

### 4.20.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.20.5 Performance

Not applicable.

### 4.20.6 Other attributes

Not applicable.

## 4.21 Description of function Reception of the diagnostic messages from the STM

### 4.21.1 Inputs

Configuration file,

I_EXT_CAN,

I_EXT_PROFIBUS

### 4.21.2 Processing

The Diagnostic messages generated by the STM and transmitted to the DRU are defined by the FFFIS-STM Subset 058.

STM equipment on Profibus network sent its diagnostic message with the packet 77.

[SyRS_TRU_0063]

The DRU function shall build a DRU STM message with the STM general header + packet 77 received.

A specific header is added to the STM messages.

| Field No. | Variable | | | Bits | Remarks |
|---|---|---|---|---|---|
| 1 | TRU_NID_MESSAGE | | | 8 | Message identification number (= 8) |
| 2 | DRU_L_MESSAGE | | | 16 | Total message length |
| 3 | DRU_T_UTC | DATE | YEAR | 7 | UTC time when the message was triggered. |
| | | | MONTH | 4 | |
| | | | DAY | 5 | |
| | | TIME | HOUR | 5 | |
| | | | MINUTES | 6 | |
| | | | SECONDS | 6 | |
| | | | TTS | 5 | |

The STM message is defined in chapter 4.2.2.

[SyRS_TRU_0064]

As the compatibility with TBL1+ system is required, the DRU shall implement the variations defined in the document [Ref.31].

### 4.21.3 Outputs

Each STM diagnostic message is recorded in the DRU memory.

### 4.21.4 Safety

The function is not safety and developed according to SSIL0 level.

### 4.21.5 Performance

Not applicable.

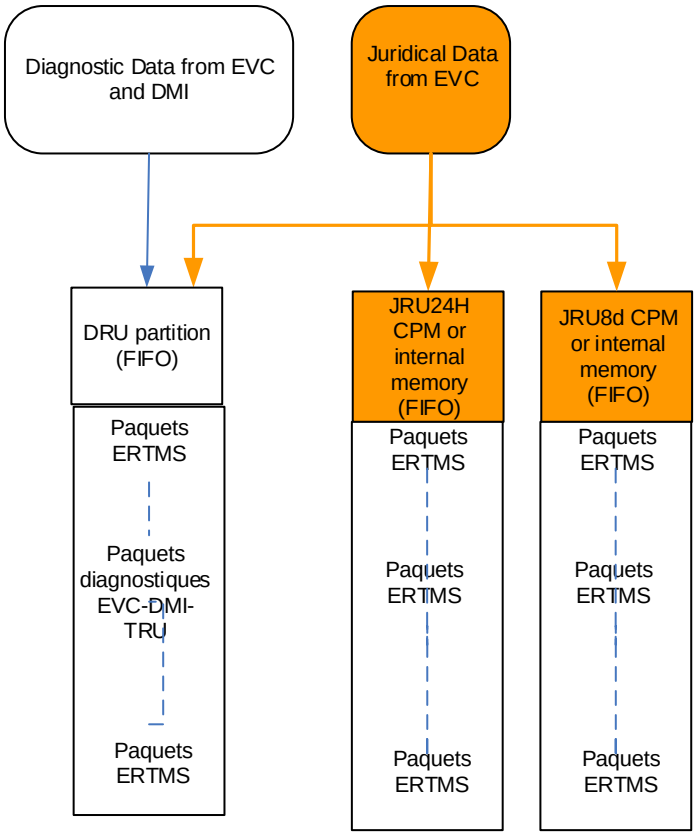
### 4.21.6 Other attributes

Not applicable.

## 4.22 Description of Memory organisation

According to the number of partitions defined in the configuration file, the system shall record the juridical and the diagnostic data in the appropriate memory partition.

The scheme below show the memory organization for the ERTMS TRU function:



# 5 OPERATIONAL REQUIREMENTS

## 5.1 Use by the Operator

[SyRS_TRU_0061]

The operator shall be able to configure the TRU and to download the recorded data from the memory partitions.

The TRU will propose an embedded web site to facilitate the configuration and maintenance operations.

The operator will access to the site via an Ethernet explorer and will have the possibility to navigate between different menus.

One menu will be dedicated to the TRU configuration where the operator will have the possibility to upgrade the TRU software, the TRU Data Configuration file and to adjust the date and time of the system.

Another menu will propose to download the data recorded by the TRU. One page could be dedicated to juridical data where the operator will find the data recorded from juridical 24H and 8d partitions. The page could propose:

- a list of file that have not been downloaded
- The possibility to download directly all the files available since the last data downloading
- All the juridical memories

Another page could be dedicated to the Diagnostic data where the operator will find the DRU and SDMU partitions. The page management could be done as the juridical page with the same options to download the files. (Incremental or total downloading)

During the commissioning tests, the operator shall have the possibility to download several times by day the data from the juridical and diagnostic memories. It means that the file management system shall be designed with this constraint.

Another menu shall indicate the status of the TRU system including the status of the CPM module. The operator will find the health status of the system with the self-test results, the memory filling level of each partition and all other useful information for the maintenance agent.

The operator has also the possibility to download the data from the USB connector. In this case, the operator wants to download the data as soon as possible. Then only the data that have not been downloaded since the last time will be copied on the USB key.

[SyRS_TRU_0062]

The operator is informed by the way of LED that the USB downloading is on-going and when the downloading is finished.

## 5.2 Normal operating modes

### 5.2.1 Initialization mode

After the Self-tests, the TRU will parse the configuration file and will determine if this one has changed since the last Power-up.

[SyRS_TRU_0065]

In the case of a new TRU configuration file has been downloaded, the TRU will initialize these internal functions, prepare the internal memory partitions, complete the CPM configuration file and inform the CPM (if present) that a new configuration file is available on the ftp server.

The CPM is connect to the server and retrieves the configuration file. As the parameters of the configuration file are taken in account only at the start-up, the CPM informs the TRU that it will switch to reset mode.

The TRU is waiting for 65 seconds before asked the status of the CPM. The CPM will answer with the message CPM_HOST_STATUS for indicated the version of the current configuration file used.

[SyRS_TRU_0066]

Each time a new configuration file is downloaded, the TRU shall record a diagnostic code to indicate that the new configuration has been taken in account.

[SyRS_TRU_0067]

If a problem occurs to establish the communication with the CPM or to transfer the configuration file, the TRU will log an appropriate diagnostic code in the DRU memory.

If a problem is detected by the CPM during the ftp transfer, it informs the TRU with a dedicated field of the message CPM_HOST_STATUS (ftp transfer management).

It is the responsibility of the TRU to send a new demand to the CPM. (No automatic retry is managed at CPM side)

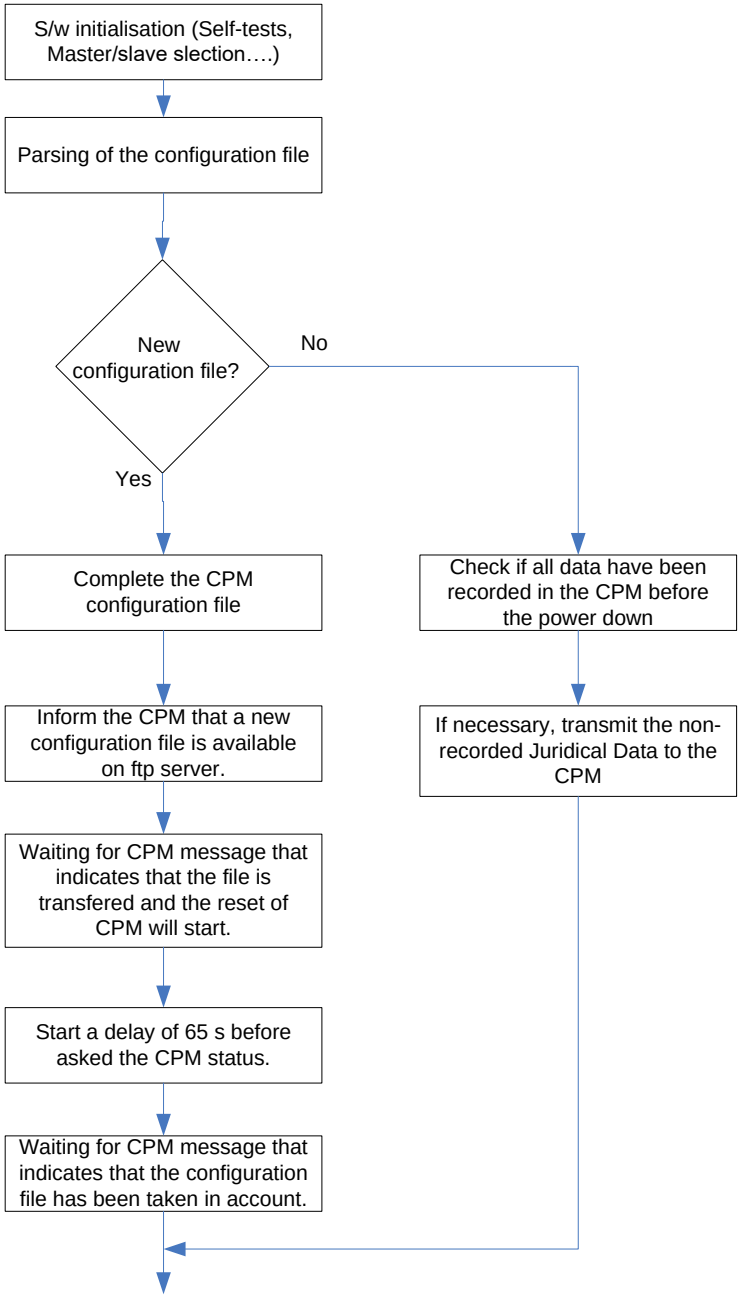
[SyRS_TRU_0068]

If the configuration is identical to the previous one, the TRU shall not overwriting the internal memory partitions and not send the CPM configuration file.

If the memories partitions defined in the configuration file are different from the previous one, the CPM have to format its memory. This operation can be up to 20 minutes. During this period, the CPM mode sends to the TRU is "formatting in progress". It means that the TRU has to wait the end of the formatting operation before to switch in recording mode.

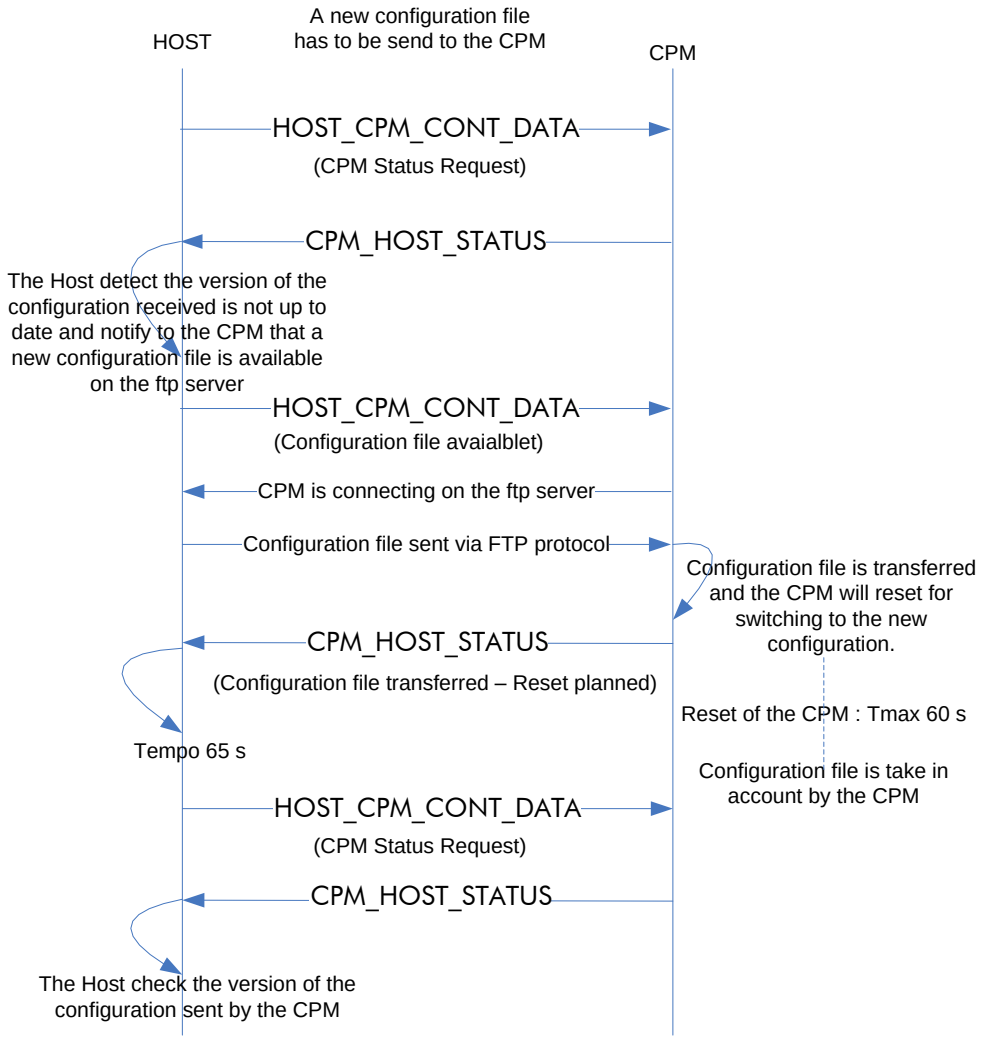
[SyRS_TRU_0069]

Before switching to the recording mode, the TRU shall check if all the juridical data have been recorded inside the CPM. If not, the TRU shall retransmit to the CPM the un-receipted messages. See SyRS CPM document [Ref.30] for detailed procedure.




#### 5.2.1.1 Configuration file and CPM status: Interface with the CPM.

After the Self-tests of the equipment, the CPM is waiting for an opening communication message from the HOST. Once the communication is established, the CPM will be able to access to the ftp server of the HOST and retrieve the configuration file.

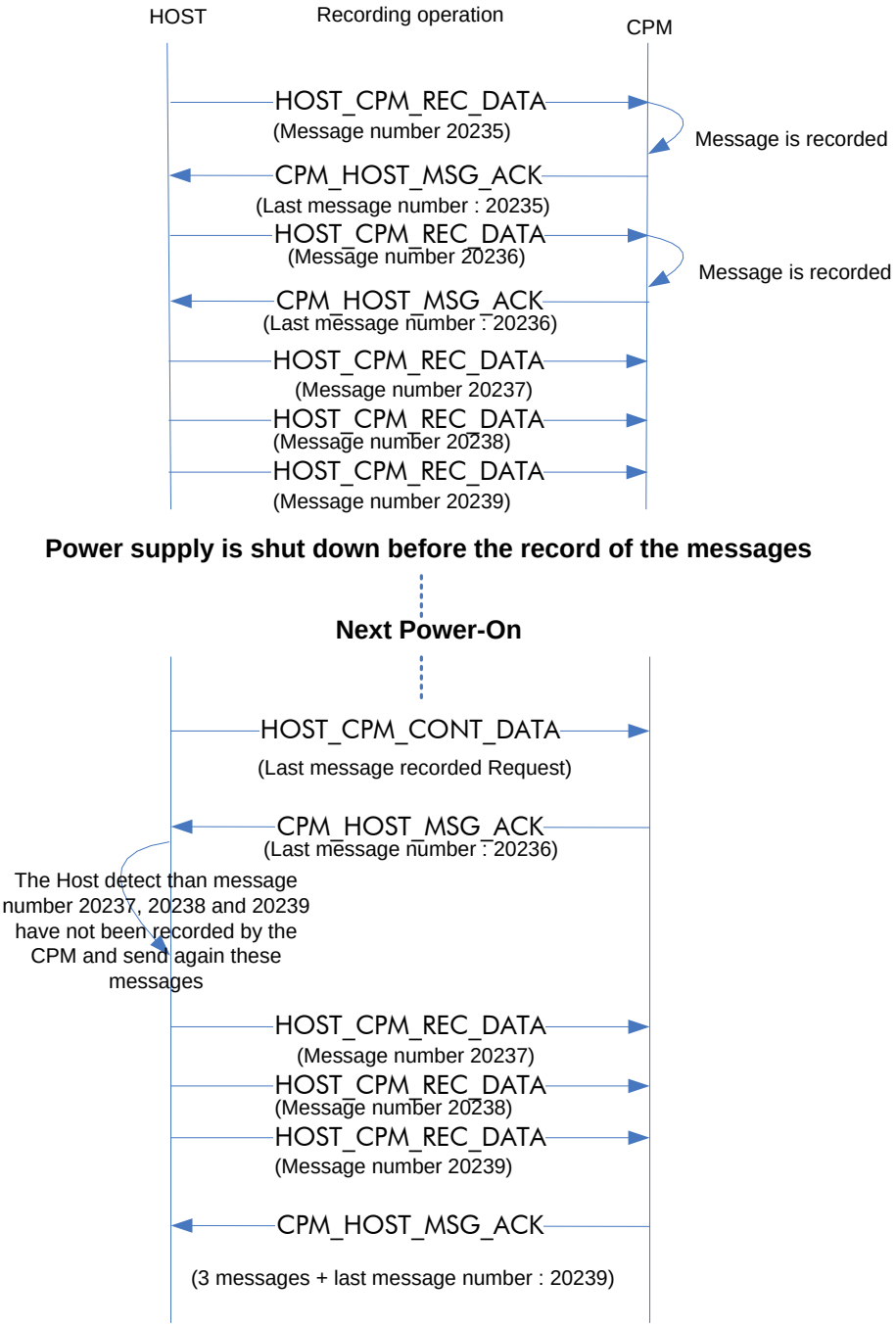



#### 5.2.1.2 Recording checking process: Interface with the CPM

After a loss of power supply (CPM or/and the HOST), the HOST have to check if the last message sent have been recorded by the CPM.

Then, the HOST will send the “Last message recorded request” with the message HOST_CPM_CONT_DATA and the CPM will respond with the message CPM_HOST_MSG_ACK.

The field “Last message number recorded by the CPM” shall be always up to date. It means that the value is valid each time the CPM sends the message CPM_HOST_MSG_OK in recording mode.



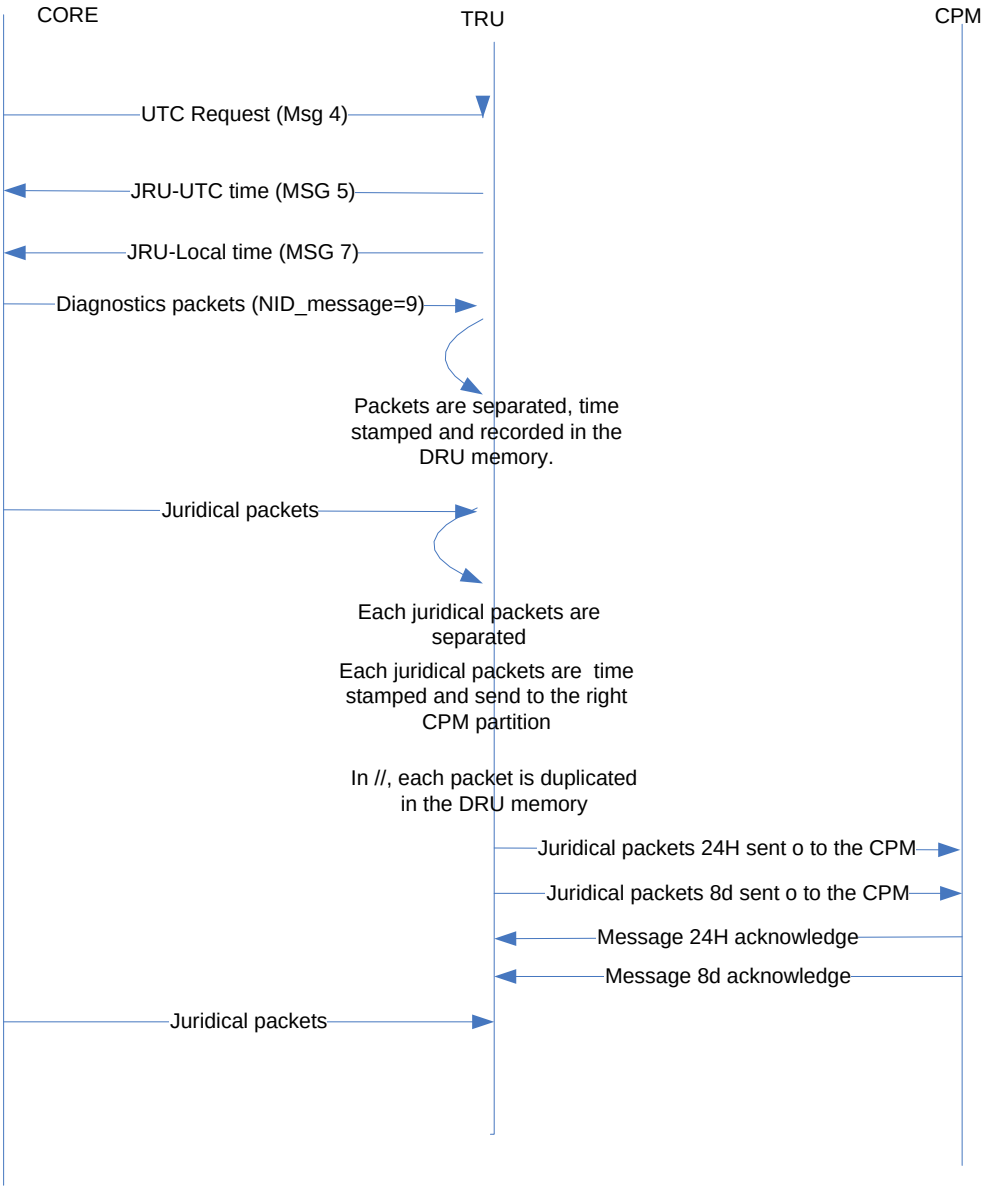

### 5.2.2 Recording mode

In this mode, the TRU is ready to record juridical and diagnostic data. It is the main mode of the system.

The TRU function has to obtain the UTC time form the GPS receiver to synchronise its internal clock. After that, the function is able to receive control message from the EVC kernel and exchanged time information on request.

It is possible to receive diagnostic data before to receive the UTC and Local time request. In this case, as the TRU didn't know the time difference with the EVC time reference, it will time stamped the message directly with its internal clock.

Each time the TRU received a message from the EVC kernel or the DMI, he has to determine the type and the number of each packet included in the message. According the type of message detected, the TRU will record this in the corresponding memory partition. This partition can be an internal partition or an external CPM memory partition.




#### 5.2.2.1 Recording operation: Interface with the CPM

In recording operation, the TRU send the data to be recorded to the CPM with a dedicated message.

The CPM will record the message into the appropriate memory and send acknowledge to the HOST. (It is possible to acknowledge several applicative messages in the same message).

The first field "Number of the message" of HOST_CPM_REC_DATA is not the identity number of each applicative message but the identity number of the HOST_CPM_REC_DATA.

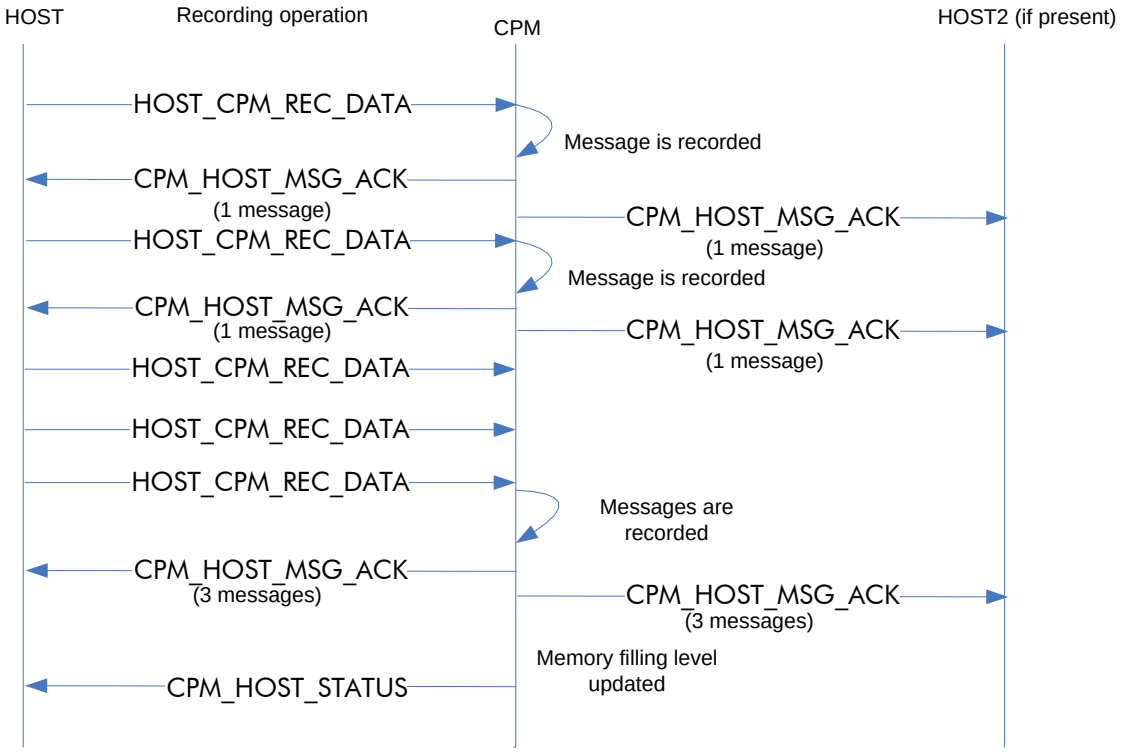
[SyRS_TRU_0070]

This number is a counter from the last power-on of the HOST. Values of the counter are defined between 1 and 65565. When the counter reached 65565, the next value of the counter will be 1. (Value 0 is not authorised)

This counter will be used between the HOST and the CPM in the "recording checking" function.

If a HOST redundancy is defined in the parameter files, the CPM shall send the acknowledge message to the second HOST.

If the CPM responds that a message is incorrect, it is the TRU responsibility to take appropriate actions and to resend the corresponding message.




### 5.2.3 Downloading mode

[SyRS_TRU_0071]

If the TRU detect a demand of Data downloading, it shall continue the recording of the incoming data and prepare the file requested at the same time.

The priority is the recording data then the function "data downloading" is done with a low priority during the recording mode.

[SyRS_TRU_0072]

According to the request, the TRU will manage the Data downloading for the JRU or/and the DRU memory. If the request concerns the CPM memories and that the corresponding files are not available on the TRU side, the TRU will send a corresponding request to the CPM for obtaining the juridical data.

Obviously, data that are still recorded after the demand are not involved by the downloading.

#### 5.2.3.1 Data Downloading: Interface with the CPM

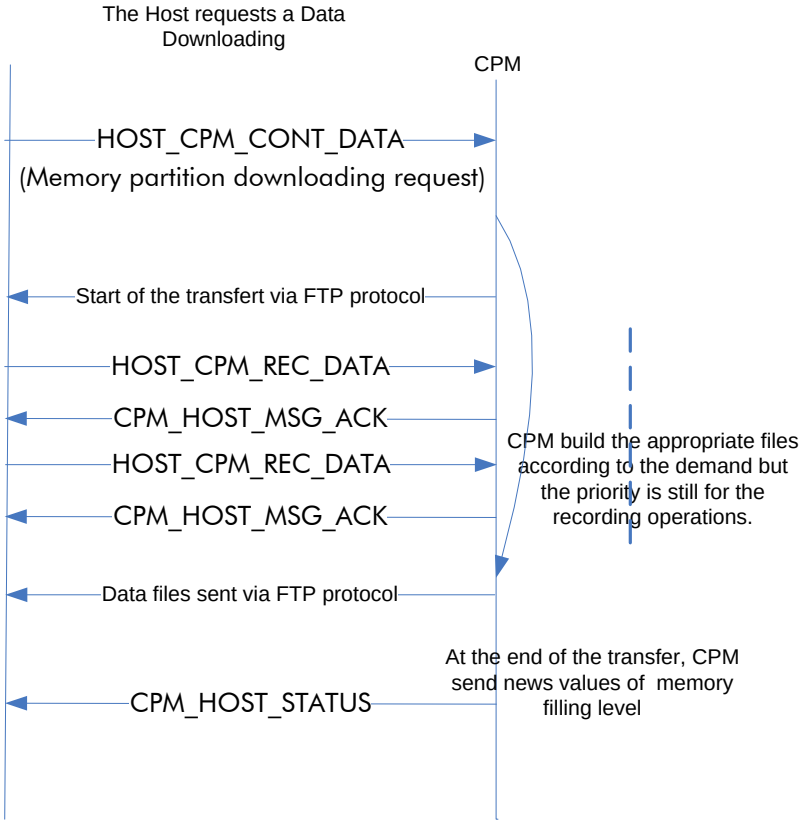
The HOST can request the Data downloading of one or several partitions in the same message. The second and the third byte of the message contain the request. The second byte indicates the numbers of the partitions and the third byte indicates the type of downloading chooses.

The last byte contain the ftp number (defined in the configuration file) where the files shall be downloaded.

Priority is given to the recording operation, and then the downloading request shall be performed without any consequence on the data recording.

At the end of the data transfer, the CPM will send to the HOST the new memory filling level of each partition.

In the case of it is not possible to transfer the requested files to the server, the CPM shall notify the problem to the HOST (field "ftp transfer management" of CPM_HOST_STATUS message) and waiting for a new command before to restart the transfer. (A fault code is also be logged by the CPM.)




## 5.3 Degraded operating modes

### 5.3.1 Degraded initialization mode

After the TRU has parsed the configuration file, he can detect a problem with the configuration parameters read. If parameters are linked to sensitive part of the system like memory partition, the TRU will not be able to perform correctly its recording function.

[SyRS_TRU_0073]

It has to switch off the green LED "JRU operational" and log a diagnostic code.

[SyRS_TRU_0074]

As the problem is linked to the configuration file upgraded by the operator, the system shall inform him directly on the appropriate menu of the web site. (I.e. with a red colour on the downloading file menu)

In this case, as long as the TRU didn't receive a right configuration file, he can't switch on the LED "JRU operational".

### 5.3.2 Degraded recording mode

The main function of the system is the recording of all events from the EVC kernel and the DMI. If the TRU lose its juridical recording capacity, he shall inform immediately the EVC with the control message 3 "JRU failure".

The juridical capacity is loosed when the CPM is in failure or when the TRU detects an internal problem for sending the juridical packets to the CPM. The diagnostic recording function is still active, so the TRU continues to record the diagnostic data in the DRU memory.

[SyRS_TRU_0075]

As the juridical function is no more assumed by the TRU, the LED "JRU operational" shall be switch-off.

As long as the juridical recording capacity is not recovered, the TRU shall maintain the JRU failure information for the EVC and the operator.

Another important function is the restitution of the data recording.

[SyRS_TRU_0076]

If the downloading requested by the operator is not possible or if a problem occurs during the downloading, the TRU shall record a diagnostic code and inform the operator that the downloading is failed.

If the failure is detected during the downloading, this latest will not restart automatically. The operator will repeat the same request to obtain the data.

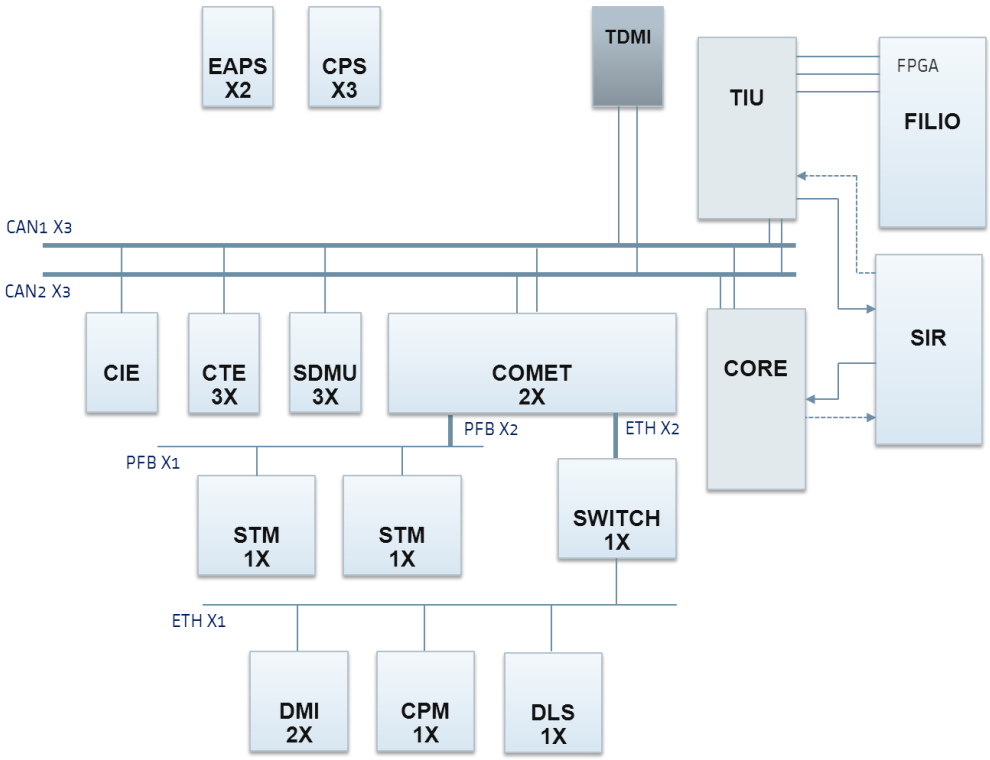
## 5.4 Description of transients

Not applicable.

# 6 ARCHITECTURE DESCRIPTION

The TRU function is embedded on the board COMET of the EVC2 platform.

The general architecture of the EVC2 is the following:



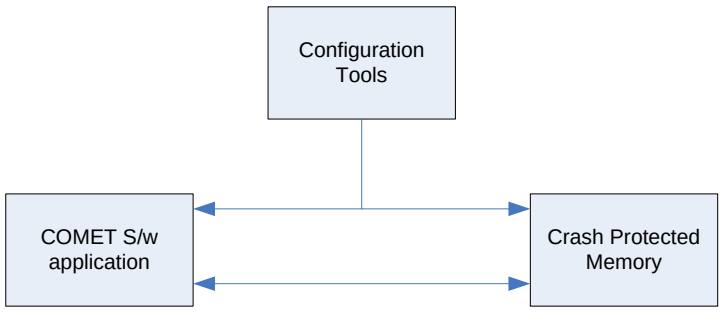

The following configurations are possible for the TRU function:

- Configuration 1 : TRU with no Crash Protected memory module,
- Configuration 2 : TRU with Crash Protected Memory Module

Only the second configuration is described hereafter.

## 6.1 Functional architecture description: F1 – TRU functions

### 6.1.1 Overview




### 6.1.2 Sub-Functional list

| Reference | Function | Description |
|---|---|---|
| F1.1 | Reception of the UTC | Function allows to retrieve UTC time from the GPS |
| F1.2 | Perform Self-test and diagnostic | Monitoring of the TRU function |
| F1.3 | Interface with the maintenance web site of the TRU | Function allows to configure the TRU and to perform the Downloading of data |

| Reference | Function | Description |
|---|---|---|
| F1.4.1 | Generation of the configuration files | Generation of the configuration package for the TRU function |
| F1.4.2 | Parsing the file and activate corresponding functions | The function initializes the software functionalities defined by the user. |
| F1.5 | Interface with the JDRMDR tool | The function prepare the downloading files according to the JDRMDR format file. |
| F1.6.1 | Data downloading of TRU files | Manage the data downloading for all data recorded in the TRU. (JRU, DRU, STM, SDMU, GEOS) |
| F1.6.2 | Data downloading of CPM files | Manage the data downloading for all data recorded in the CPM. |
| F1.7 | Memory filling rate | Manage the filling level of each memory partition. |
| F1.8.1 | Manage CPM revision file | Determine if a new CPM configuration file has to be put in the ftp server |
| F1.8.2 | CPM configuration updating | Get the new configuration fie and initialize accordingly the CPM software. |
| F1.9 | Time stamping of messages with UTC | Function allows timestamping message with the UTC time based on the clock value supplied in the message |

### 6.1.3 Component list

| Component | Description |
|---|---|
| COMET S/w | TRU Application S/w embedded on the COMET board |
| CPM | Crash Protected Memory module connected on the Ethernet network. |
| Configuration tools | GDPP and Alchemist tools used to configure TRU and CPM S/w. |

### 6.1.4 Mapping component vs sub-functions

| Component | Allocated function |
|---|---|
| COMET S/w | F1.1 : Reception of the UTC<br>F1.2 : Perform Self-test and diagnostic<br>F1.3 : Interface with the maintenance web site of the TRU<br>F1.4.1: Generation of the configuration files<br>F1.4.2 : Parsing the file and activate corresponding functions<br>F1.5 : Interface with the JDRMDR tool<br>F1.6.1 : Data downloading of TRU files<br>F1.7 : Memory filling rate<br>F1.8.1 : Manage CPM revision file<br>F1.9: Time stamping of messages with UTC |
| CPM | F1.6.2 : Data downloading of CPM files<br>F1.8.2 : CPM configuration updating |
| Configuration tools | F1.4.1 : Generation of the configuration files |

### 6.1.5 Description of Sub-function F1.4.1: Generation of the configuration files

#### 6.1.5.1 Inputs

Document TRU function – Configuration Data [Ref.32]

#### 6.1.5.2 Processing

GDPP and Alchemist tools are in charge to generate the configuration package for:

- The TRU applicative S/w
- The CPM equipment.

The CPM configuration file shall be compressed to the targz format by Alchemist tool.

The TRU S/W configuration file will be defined according to final configuration process. (On going)

#### 6.1.5.3 Outputs

Configuration files are generated.

#### 6.1.5.4 Safety

The function is not safety and developed according to SSIL0 level.

#### 6.1.5.5 Performance

Not applicable.

#### 6.1.5.6 Other attributes

Not applicable.

### 6.1.6 Description of Sub-function F1.4.2: Parsing the file and activate corresponding functions

#### 6.1.6.1 Inputs

TRU software Configuration file in xml format.

#### 6.1.6.2 Processing

The COMET S/w shall parse the configuration file in order to configure the TRU software functions.

The definition is on-going and will be completed when the configuration process will be fixed.

If the S/W detect that the configuration is correct, the TRU will switch to the recording mode.

If the S/w detects an inconsistence in the configuration file, he records an event “configuration problem detected” and keeps in initialisation mode.

#### 6.1.6.3 Outputs

TRU S/w is in operational mode.

#### 6.1.6.4 Safety

The function is not safety and developed according to SSIL0 level.

#### 6.1.6.5 Performance

Not applicable.

#### 6.1.6.6 Other attributes

Not applicable.

### 6.1.7 Description of Sub-function F1.6.1: Data downloading of TRU files

See § 4.8.2.

### 6.1.8 Description of Sub-function F1.6.2: Data downloading of CPM files.

See § 5.2.3.1

### 6.1.9 Description of Sub-function F1.8.1: Manage CPM revision file

#### 6.1.9.1 Inputs

CPM configuration file compressed in targz format.

#### 6.1.9.2 Processing

The TRU S/w shall read the revision number of the CPM configuration file and compare with the current version number.

The TRU shall add the train identity number to the CPM configuration file.

When the TRU S/w detect that a new CPM configuration file has to be transferred, he send the information to the CPM. (See § 5.2.1)

Once the CPM has retrieved the configuration file, he sends a message to the COMET to indicate the revision number taken in account.

The sub-function checked the CPM revision number and allows the TRU to switch in recording mode. (If function 6.1.6.2 is successful).

If the S/w detects an inconsistence in the CPM revision number, he records an event "CPM revision number incorrect" and keeps in initialisation mode

#### 6.1.9.3 Outputs

CPM configuration file sent to the CPM.

#### 6.1.9.4 Safety

The function is not safety and developed according to SSIL0 level.

#### 6.1.9.5 Performance

Not applicable.

#### 6.1.9.6 Other attributes

Not applicable.

### 6.1.10 Description of Sub-function F1.8.2: CPM configuration updating

#### 6.1.10.1 Inputs

CPM configuration file compressed in targz format.

#### 6.1.10.2 Processing

The configuration file could be put on the CPM maintenance web-site by a laptop or retrieved on the COMET ftp server.

CPM application read the targz file and checks that the CRC of the file is correct. If not, an event shall be record in the CPM.

If the file has been retrieved from the COMET ftp server, the CPM application shall send a message to the COMET with the event code "Erroneous CRC is the configuration file".

If the CRC is correct, the CPM parses the file and initializes its software. At the end of the upgrading operation, the CPM sends the revision number of the configuration file used. (See §5.2.1.1)

#### 6.1.10.3 Outputs

CPM is upgraded with the new configuration file.

#### 6.1.10.4 Safety

The function is not safety and developed according to SSIL0 level.

#### 6.1.10.5 Performance

Not applicable.

#### 6.1.10.6 Other attributes

Not applicable.

## 6.2 Functional architecture description: F2 – JRU functions

### 6.2.1 Overview


### 6.2.2 Sub-Functional list

| Reference | Function | Description |
|---|---|---|
| F2.1 | Management of the control messages from/to EVC | Function allows to exchange control data with the EVC |
| F2.2 | Transmission of the UTC time to the EVC | Sends the UTC time to the EVC |
| F2.3 | Transmission of the Local time to the EVC | Sends the corresponding Local time to the EVC |
| F2.5 | Reception of the juridical messages from EVC | The function receipt and records the juridical messages. |
| F2.6 | Monitoring of the EVC isolation status | The function managed the status of the EVC. |
| F2.7 | Memorisation of the juridical messages on a Crash Protected Memory | The function records the messages in the Crash Protected Memory. |
| F2.8 | Control connection with STM | Function allows exchanging data with the STM on Profibus network. |

### 6.2.3 Component list

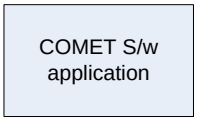
| Component | Description |
|---|---|
| COMET S/w | TRU Application S/w embedded on the COMET board |
| CPM | Crash Protected Memory module connected on the Ethernet network. |

### 6.2.4 Mapping component vs sub-functions

| Component | Allocated function |
|---|---|
| COMET S/w | F2.1 : Management of the control messages from/to EVC<br>F2.2 : Transmission of the UTC time to the EVC<br>F2.3 : Transmission of the Local time to the EVC<br>F2.5 : Reception of the juridical messages from EVC<br>F2.6 : Monitoring of the EVC isolation status<br>F2.8 : Control connection with STM |
| CPM | F2.7 : Memorisation of the juridical messages on a Crash Protected Memory |

## 6.3 Functional architecture description: F3 – DRU functions

### 6.3.1 Overview




### 6.3.2 Sub-Functional list

| Reference | Function | Description |
|---|---|---|
| F3.1 | Recording of the juridical messages from EVC in DRU memory | The function duplicates the juridical data messages in DRU memory. |
| F3.2 | Reception of the diagnostic messages from the EVC or DMI | The function receipt and records the diagnostic messages. |
| F3.3 | Reception of the diagnostic messages from the STM | The function receipt and records the diagnostic messages from STM |
| | | |
| F3.5 | Memory Organisation | Explanation of the memory partition repartitions. |

### 6.3.3 Component list

| Component | Description |
|---|---|
| COMET S/w | TRU Application S/w embedded on the COMET board |

### 6.3.4 Mapping component vs sub-functions

| Component | Allocated function |
|---|---|
| COMET S/w | F3.1 : Recording of the juridical messages from EVC in DRU memory<br>F3.2 : Reception of the diagnostic messages from the EVC or DMI<br>F3.3 : Reception of the diagnostic messages from the STM<br>F3.5 : Memory Organisation |

# 7 APPENDICES

List of diagnostic codes has to be completed according to the software implementation.

DRU_TRU-messages _V541_EVC2.xlsx

## 7.1 Language

### 7.1.1 JRU_T_LOCAL_TIME

| **Name** | local time | | |
|---|---|---|---|
| **Description** | This variable gives the local time<br>The local time changes eventually for each country, and for summer/winter time is managed by the JRU, This is an absolute time, the original date for time 0 is fixed on the 01/01/2000 | | |
| **Source of definition** | TRU definition | | |
| **Length of variable** | **Minimum Value** | **Maximum Value** | **Resolution/formula** |
| 32 bits | 0s | 4294967294 s<br>(> 130 years) | 1s |
| **Special/Reserved Values** | 1111 … 1111 : UNKNOWN | | |

### 7.1.2 JRU_T_TRAIN

| **Name** | EVC Clock | | |
|---|---|---|---|
| **Description** | Value of the EVC clock at which the request is sent | | |
| **Source of definition** | TRU definition | | |
| **Length of variable** | **Minimum Value** | **Maximum Value** | **Resolution/formula** |
| 32 bits | 0 s | 42949672.94 s | 0,01 s |
| **Special/Reserved Values** | | | |

7.1.3 TRU_M_STATUS

| **Name** | TRU Status | | |
|---|---|---|---|
| **Description** | Define the TRU mode | | |
| **Source of definition** | TRU definition | | |
| **Length of variable** | **Minimum Value** | **Maximum Value** | **Resolution/formula** |
| 8 bits | 0 | 255 | |
| **Special/Reserved Values** | 0 On-line mode<br>1 System fault<br>2 Downloading mode<br>3 Service mode<br>4 - 255 Spare | | |