

## Work Package 3: "Modeling"

# openETCS Architecture and Design Specification

## Software Component Design and Internal Interface Specification

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**Work Package 3: “Modeling”****OETCS/WP3/D3.5.3  
September 2015**

# openETCS Architecture and Design Specification

## Software Component Design and Internal Interface Specification

## Document approbation

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Architecture and Design Specification

**Abstract:** This document describes the architecture and design specification of the openETCS onboard unit (OBU) model. The functional scope of the openETCS OBU model is to cover the functionality required for running on the ETCS level 2 Utrecht Amsterdam track. The OBU model is developed iteratively and the system model is documented in D3.5.x and the functional model is documented in D3.5.x, where x denotes the iteration.

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## Modification History

| Version | Sections | Modification / Description                                     | Author         | Date       |
|---------|----------|--|----------------|------------|
| 0.1     | all      | Initial document providing structure                           | Peter Mahlmann | 27.05.2015 |
| 0.2     | 2        | New template for design descriptions                           | Peter Mahlmann | 10.06.2015 |
| 0.3     | all      | Transferred existing documentation to new template             | Peter Mahlmann | 22.06.2015 |
| 0.4     | 4        | Updated component hierarchy to match current SCADE Suite model | Peter Mahlmann | 15.09.2015 |

# Table of Contents

|   |           |
|---|-----------|
| <b>Modification History</b>                           | <b>iv</b> |
| <b>List of Figures</b>                                | <b>ix</b> |
| <b>Todo list</b>                                      | <b>x</b>  |
| <b>1 Introduction</b>                                 | <b>1</b>  |
| 1.1 Input Documents                                   | 1         |
| 1.2 Software and Tools used for Development           | 1         |
| 1.3 General Remarks on the openETCS OBU Model         | 2         |
| <b>I System Architecture and Functional Breakdown</b> | <b>3</b>  |
| <b>2 System Architecture</b>                          | <b>4</b>  |
| 2.1 Top Level Architecture and External Interfaces    | 4         |
| 2.2 Functional breakdown of the ETCS OBU              | 4         |
| <b>II Design Description</b>                          | <b>8</b>  |
| <b>3 General Design Decisions</b>                     | <b>9</b>  |
| <b>4 F1: Receive Information from Trackside</b>       | <b>10</b> |
| 4.1 ETCS Messaging: TrackMessages                     | 10        |
| 4.1.1 Component Requirements                          | 10        |
| 4.1.2 Interface                                       | 11        |
| 4.1.2.1 Inputs  | 11        |
| 4.1.2.2 Outputs                                       | 12        |
| 4.1.3 Subcomponents                                   | 14        |
| 4.1.3.1 Read_Packets                                  | 14        |
| 4.1.3.2 Extract Packet 5                              | 15        |
| <b>5 F2: ETCS Kernel</b>                              | <b>17</b> |
| 5.1 ETCS Kernel Overview                              | 17        |
| 5.2 F2.1: Manage_TrackSideInformation_Integration     | 17        |
| 5.2.1 Component Requirements                          | 17        |
| 5.2.2 Interface                                       | 17        |
| 5.2.2.1 Inputs  | 18        |
| 5.2.2.2 Outputs                                       | 25        |
| 5.2.3 Subcomponents                                   | 33        |
| 5.2.3.1 Receive_TrackSide_Msg                         | 33        |
| 5.2.3.2 CheckBGConsistency                            | 34        |
| 5.2.3.3 CheckEuradioMessage                           | 36        |
| 5.2.3.4 ValidateDataDirection                         | 36        |
| 5.2.3.5 InformationFilter                             | 37        |
| 5.3 F2.2: Manage_ETCS_Procedures                      | 38        |
| 5.3.1 Component Requirements                          | 38        |
| 5.3.2 Interface                                       | 40        |

|          |                                  |    |
|----------|----------------------------------|----|
| 5.3.2.1  | Inputs                           | 40 |
| 5.3.2.2  | Outputs                          | 45 |
| 5.3.3    | Subcomponents                    | 49 |
| 5.3.3.1  | Awakness_of_Train                | 49 |
| 5.3.3.2  | NP                               | 49 |
| 5.3.3.3  | SoM_L2_3_FS_SR_OS_LS_SH          | 50 |
| 5.3.3.4  | SoM_NTC_SN                       | 50 |
| 5.4      | F2.3: trainData                  | 51 |
| 5.4.1    | Component Requirements           | 51 |
| 5.4.2    | Interface                        | 52 |
| 5.4.2.1  | Inputs                           | 52 |
| 5.4.2.2  | Outputs                          | 56 |
| 5.4.3    | Subcomponents                    | 57 |
| 5.5      | F2.4: TrackAtlas                 | 57 |
| 5.5.1    | Component Requirements           | 57 |
| 5.5.2    | Interface                        | 58 |
| 5.5.2.1  | Inputs                           | 58 |
| 5.5.2.2  | Outputs                          | 59 |
| 5.5.3    | Subcomponents                    | 59 |
| 5.5.3.1  | StoreRaw_NV                      | 60 |
| 5.5.3.2  | Build_GradientProfile            | 60 |
| 5.5.3.3  | Build_MA                         | 61 |
| 5.5.3.4  | Build_MRSP                       | 61 |
| 5.5.3.5  | Manage_EmergencyStop             | 62 |
| 5.5.3.6  | C_P003V1_OBU_P003_OBU            | 62 |
| 5.5.3.7  | GradientProfile_to_DMI           | 63 |
| 5.5.3.8  | Manage_MA_Request                | 63 |
| 5.5.3.9  | TA_to_ML                         | 64 |
| 5.5.3.10 | SSP_to_MRSP                      | 64 |
| 5.5.3.11 | MRSP_to_MRSP_to_DMI              | 65 |
| 5.6      | F2.5: Mode_and_Level             | 65 |
| 5.6.1    | Component Requirements           | 65 |
| 5.6.2    | Interface                        | 65 |
| 5.6.2.1  | Inputs                           | 66 |
| 5.6.2.2  | Outputs                          | 70 |
| 5.6.3    | Subcomponents                    | 71 |
| 5.6.3.1  | Level_Management                 | 71 |
| 5.6.3.2  | Mode_Management                  | 72 |
| 5.6.3.3  | Check_and_Provide_Mode_and_Level | 73 |
| 5.7      | F2.6: calculateTrainPosition     | 74 |
| 5.7.1    | Component Requirements           | 74 |
| 5.7.2    | Interface                        | 75 |
| 5.7.2.1  | Inputs                           | 75 |
| 5.7.2.2  | Outputs                          | 80 |
| 5.7.3    | Subcomponents                    | 85 |
| 5.7.3.1  | msg_2_passedBG                   | 85 |
| 5.7.3.2  | calculateBGLocations             | 85 |
| 5.7.3.3  | delDispensableBGs                | 86 |
| 5.7.3.4  | addAnnounceBGs                   | 86 |
| 5.7.3.5  | calculateTrainpositionInfo       | 87 |
| 5.7.3.6  | calculateTrainPositionAttributes | 87 |
| 5.7.3.7  | linkedBG_missed                  | 88 |



|          |                                    |     |
|----------|------------------------------------|-----|
| 5.7.3.8  | twoconsecutiveLinkedBGs_missed     | 88  |
| 5.8      | F2.7: SpeedSupervision_Integration | 89  |
| 5.8.1    | Component Requirements             | 89  |
| 5.8.2    | Interface                          | 90  |
| 5.8.2.1  | Inputs                             | 90  |
| 5.8.2.2  | Outputs                            | 96  |
| 5.8.3    | Subcomponents                      | 99  |
| 5.8.3.1  | SDM_InputWrapper                   | 99  |
| 5.8.3.2  | TargetManagement                   | 100 |
| 5.8.3.3  | CalcBrakingCurves_Integration      | 101 |
| 5.8.3.4  | SDMLimitLocations                  | 102 |
| 5.8.3.5  | CalcSpeeds                         | 103 |
| 5.8.3.6  | ReleaseSpeed_Selection             | 104 |
| 5.8.3.7  | SDM_Commands                       | 104 |
| 5.8.3.8  | SDM_OutputWrapper                  | 105 |
| 5.9      | F2.8: Provide_Position_Report      | 106 |
| 5.9.1    | Component Requirements             | 106 |
| 5.9.2    | Interface                          | 106 |
| 5.9.2.1  | Inputs                             | 107 |
| 5.9.2.2  | Outputs                            | 108 |
| 5.9.3    | Subcomponents                      | 109 |
| 5.9.3.1  | ReceiveReportParameters            | 109 |
| 5.9.3.2  | PosReport_Supervision              | 110 |
| 5.9.3.3  | ErrorManager                       | 110 |
| 5.9.3.4  | Build_Packets0_1                   | 111 |
| 5.9.3.5  | Build_PosReport                    | 111 |
| 5.9.3.6  | AddBGToFIFO                        | 112 |
| 5.10     | F2.9: Manage_Radio_Communication   | 112 |
| 5.10.1   | Component Requirements             | 112 |
| 5.10.2   | Interface                          | 113 |
| 5.10.2.1 | Inputs                             | 113 |
| 5.10.2.2 | Outputs                            | 114 |
| 5.10.3   | Subcomponents                      | 115 |
| 5.10.3.1 | Management_of_Radio_Communication  | 115 |
| 5.10.3.2 | genMSGToRBC                        | 116 |
| 5.11     | F2.10: ManageDMIInput              | 117 |
| 5.11.1   | Component Requirements             | 117 |
| 5.11.2   | Interface                          | 117 |
| 5.11.2.1 | Inputs                             | 117 |
| 5.11.2.2 | Outputs                            | 118 |
| 5.11.3   | Subcomponents                      | 119 |
| 5.12     | F2.11: ManageDMIOutput             | 119 |
| 5.12.1   | Component Requirements             | 119 |
| 5.12.2   | Interface                          | 120 |
| 5.12.2.1 | Inputs                             | 120 |
| 5.12.2.2 | Outputs                            | 121 |
| 5.12.3   | Subcomponents                      | 122 |
| 5.12.3.1 | cyclicReportToDMI                  | 122 |
| 5.12.3.2 | ManageTextMessages                 | 122 |
| 5.12.3.3 | copyTrackDescription               | 123 |
| 5.12.3.4 | toEntryRequest                     | 123 |
| 5.12.3.5 | sendBrakesToDMI                    | 124 |

|          |                                       |            |
|----------|---------------------------------------|------------|
| 5.12.3.6 | manageDMI_Output                      | 124        |
| 5.12.3.7 | sendTrainData                         | 125        |
| 5.12.3.8 | sendVersion                           | 125        |
| 5.12.3.9 | sendLevelListPkg                      | 126        |
| 5.13     | F2.12: ManageTIUInput                 | 126        |
| 5.13.1   | Component Requirements                | 126        |
| 5.13.2   | Interface                             | 127        |
| 5.13.2.1 | Inputs                                | 127        |
| 5.13.2.2 | Outputs                               | 128        |
| 5.13.3   | Subcomponents                         | 129        |
| 5.13.3.1 | mergeTIU_Info                         | 129        |
| 5.13.3.2 | getTIUStatusFromData                  | 129        |
| 5.14     | F2.13: ManageTIUOutput                | 130        |
| 5.14.1   | Component Requirements                | 130        |
| 5.14.2   | Interface                             | 130        |
| 5.14.2.1 | Inputs                                | 131        |
| 5.14.2.2 | Outputs                               | 131        |
| 5.14.3   | Subcomponents                         | 132        |
| 5.14.3.1 | handleTraction                        | 132        |
| 5.14.3.2 | manageTIU_output                      | 133        |
| 6        | <b>F3: Measure Train Movement</b>     | <b>134</b> |
| 7        | <b>F4: Manage Radio Communication</b> | <b>135</b> |
| 8        | <b>F5: Manage JRU</b>                 | <b>136</b> |
| 9        | <b>F6: DMI Controller</b>             | <b>137</b> |
| 9.1      | DMI                                   | 137        |
| 9.1.1    | Component Requirements                | 137        |
| 9.1.2    | Interface                             | 137        |
| 9.1.2.1  | Inputs                                | 137        |
| 9.1.2.2  | Outputs                               | 142        |
|          | <b>References</b>                     | <b>146</b> |

## List of Figures

|  |     |
|--|-----|
| Figure 1. Scope of openETCS OBU model system according to ERA TSI Chapter 2.5..... | 5   |
| Figure 2. Top level architecture with external interfaces.....                     | 6   |
| Figure 3. DMI Interfaces.....  | 6   |
| Figure 4. 2nd level system architecture view.....                                  | 7   |
| Figure 5. TrackMessages SysML diagram.....   | 11  |
| Figure 6. Manage_TrackSideInformation_Integration component SysML diagram.....     | 18  |
| Figure 7. High level overview of the InformationFilter components.....             | 39  |
| Figure 8. Manage_ETCS_Procedures component SysML diagram.....                      | 40  |
| Figure 9. trainData component SysML diagram.....                                   | 52  |
| Figure 10. TrackAtlas component SysML diagram.....                                 | 58  |
| Figure 11. Mode_and_Level component SysML diagram.....                             | 66  |
| Figure 12. calculateTrainPosition SysML diagram.....                               | 76  |
| Figure 13. Structure of component SpeedSupervision_Integration.....                | 94  |
| Figure 14. Provide_Position_Report component SysML diagram.....                    | 107 |
| Figure 15. Manage_Radio_Communication component SysML diagram.....                 | 113 |
| Figure 16. ManageDMIInput SysML diagram.....                                       | 118 |
| Figure 17. ManageDMIOutput SysML diagram.....                                      | 120 |
| Figure 18. ManageTIUInput SysML diagram.....                                       | 127 |
| Figure 19. ManageTIUOutput SysML diagram.....                                      | 131 |
| Figure 20. DMI component SysML diagram.....  | 140 |

## Todo list

|   |    |
|---|----|
| list has to be completed.....   | 1  |
| list and descriptions have to be checked for completeness.....  | 1  |
| Hashtag has to be updated once the model and document are ready for release.....                                    | 2  |
| has to be completed .....   | 4  |
| paragapoh has to be checked and extended to be more clear.....  | 4  |
| check if figure is correct. Do we need this figure anyway? If so, make it more appealing.....                       | 4  |
| Figure is incomplete and erroneous... F2 is not connected, F2 exists twice .....                                    | 4  |
| Should this block be described using the new component description template? Section<br>needs to be completed ..... | 4  |
| section needs to be completed .....   | 10 |
| Figure: [Put SysML diagram of component here] .....   | 11 |
| components should be listed here .....  | 12 |
| to be checked.....  | 12 |
| Clarify detail for documentation with the trackMessages concept.....  | 17 |
| Manage_TrackSideInformation_Integration SysML diagram needs to be updated.....                                      | 17 |
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| consider using the exact component name in the SCADE model..... | 24 |
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| Information filter component description needs to be checked, i.e. is the description still<br>up to date? Should more documentation provided for this component in the ADD<br>(please check with Bernd Hekele)? ..... | 37 |
| Figure: [Put SysML diagram of component here] .....  | 40 |
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| exact name of component in the SCADE model has be used .....   | 47 |
| exact name of component in the SCADE model has be used .....   | 47 |
| exact name of component in the SCADE model has be used .....   | 48 |
| Figure: [Put SysML diagram of component here] .....  | 52 |
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| Looking at this input this seems to be a complex structure. Consider describing the structure instead of referring to the valid flag only. ....             | 54 |
| Looking at this input this seems to be a complex structure. Consider describing the structure instead of referring to the valid flag only. ....             | 54 |
| Looking at this input this seems to be a complex structure. Consider describing the structure instead of referring to the valid flag only. ....             | 55 |
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| Figure: [Put SysML diagram of component here] .....   | 58 |
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| Please use exact component name from SCADE model. ....   | 70 |
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| Description of outputs needs to be completed .....   | 70 |
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| To be updated since there is no parent component anymore.....  | 75 |
| Figure: [Put SysML diagram of component here] .....  | 76 |
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|---|----|
| needs to be updated.....  | 80 |
| To be completed.....  | 80 |
| calculateTrainPosition subcomponents need to be documented..... | 85 |
| Exact name of SCADE component shall be used.....                | 90 |
| To be completed.....  | 90 |
| To be completed, explicitly describe behaviour.....             | 90 |
| Exact name of SCADE component shall be used.....                | 91 |
| To be completed.....  | 91 |
| Exact name of SCADE component shall be used.....                | 92 |
| Exact name of SCADE component shall be used.....                | 92 |
| Exact name of SCADE component shall be used.....                | 93 |
| To be completed.....  | 93 |
| To be completed.....  | 93 |
| To be completed.....  | 93 |
| To be checked.....  | 95 |
| To be completed.....  | 95 |
| How can can this be checked at compile time?.....               | 95 |
| How can can this be checked at compile time?.....               | 95 |
| To be completed.....  | 95 |
| To be completed.....  | 96 |
| How can can this be checked at compile time?.....               | 96 |
| How can can this be checked at compile time?.....               | 96 |
| should this be ManageDMIOutput?.....                            | 96 |
| to be completed.....  | 96 |
| To be completed.....  | 97 |
| To be completed.....  | 97 |

|  |     |
|--|-----|
| To be completed.....   | 97  |
| To be completed.....   | 97  |
| To be completed.....   | 98  |
| To be completed.....   | 98  |
| To be completed.....   | 98  |
| To be completed.....   | 99  |
| To be completed.....   | 99  |
| Link has to be provided.....   | 106 |
| To be completed.....   | 106 |
| To be completed.....   | 106 |
| section has to be completed .....  | 107 |
| section has to be completed .....  | 108 |
| section has to be completed .....  | 109 |
| section has to be completed. The level of this component in final architecture has been fixed..... | 112 |
| Figure: [Put SysML diagram of component here] .....  | 113 |
| to be checked.....   | 113 |
| Maybe more subcomponents have to be added. Please check this.....                                  | 115 |
| to be checked.....   | 116 |
| to be completed.....   | 117 |
| section and corresponding subsections have to be completed.....                                    | 117 |
| Figure: [Put SysML diagram of component here] .....  | 118 |
| section and corresponding subsections have to be completed.....                                    | 119 |
| Figure: [Put SysML diagram of component here] .....  | 120 |
| section and corresponding subsections have to be completed.....                                    | 126 |
| Figure: [Put SysML diagram of component here] .....  | 127 |
| section and corresponding subsections have to be completed.....                                    | 130 |

|  |     |
|--|-----|
| Figure: [Put SysML diagram of component here] .....                                      | 131 |
| This chapter needs to be completed and a responsible developer has to be identified..... | 137 |

# 1 Introduction

A primary goal of the openETCS ITEA2 project is to provide a formal specification and a non-vital reference implementation of an ETCS onboard unit (OBU) according to the specification described in Subset-026 [1], defined by the European Railway Agency (ERA).

This deliverable, i.e. D3.5.x, describes the architecture and design specification of the openETCS onboard (OBU) model. As the development of the OBU model is done iteratively according to a SCRUM process, the last digit of the deliverable identifier, i.e. x, denotes the current iteration of the model. This document should be considered as a complement to the following project outcomes respectively deliverables:

- the corresponding SysML and SCADE models, available at <https://github.com/openETCS/modeling/tree/master/model/Scade/System>,
- the corresponding functional design description, i.e. D3.6.x, and
- the documentation of the generic openETCS Application Programming Interface (API), available at <https://github.com/openETCS/modeling/blob/master/API/description/api-description.pdf>.

## 1.1 Input Documents

The following documents have been the basis for the analysis, functional decomposition, and design of the openETCS OBU model:

- ERA Subset-026 [1]
- ERA TSI CCS Documents
- openETCS API documentation, available at <https://github.com/openETCS/modeling/blob/master/API/description/api-description.pdf>
- openETCS requirements, i.e. D2.1...9, available at <https://github.com/openETCS/requirements/tree/master/Reference>

list has to be completed

## 1.2 Software and Tools used for Development

The following software and tools have been used in the openETCS development process:

**SCADE System** Version 16.1b of SCADE System has been used for the the generation of SysML models.

**SCADE Suite** Version 16.1b of SCADE Suite has been used for the functional modelling of the openETCS OBU components. Executable models are generated via the SCADE Suite code generator (KCG), which has been certified for CENELEC EN 50128 at SIL 3/4.

list and descriptions have to be checked for completeness

- 32 **SCADE Display** Version 16.1b of SCADE Display has been used for the development of the  
33 Driver Machine Interface (DMI).
- 34 **GitHub** The web based Git repository hosting service GitHub has been used for distributed  
35 revision control and source code respectively model management.

### 1.3 36 General Remarks on the openETCS OBU Model

- 37 The openETCS OBU model has been developed according the specification given in ERA Subset-  
38 026 [1]. The software release of the openETCS OBU documented and described in this document  
39 is publicly available at <https://github.com/openETCS/modeling/tree/master/model>  
40 and refers to the commit corresponding to the following hashtag:

41 1c06cc2d4a0d8f27569e065e2a9edf924b453ff1

- 42 In particular, the root of the SCADE System SysML model is located at [https://github.com/](https://github.com/openETCS/modeling/tree/master/model/system)  
43 [openETCS/modeling/tree/master/model/system](https://github.com/openETCS/modeling/tree/master/model/system) and the root of the functional SCADE  
44 Suite model is located at [https://github.com/openETCS/modeling/tree/master/model/](https://github.com/openETCS/modeling/tree/master/model/Scade)  
45 [Scade](https://github.com/openETCS/modeling/tree/master/model/Scade).

- 46 Note that all components of the openETCS OBU have been developed from scratch, no existing  
47 components have been reused.

Hashtag has to be updated once the model and document are ready for release



48

## **Part I**

49

# **System Architecture and Functional Breakdown**

50

## 2 System Architecture

has to be completed

The system architecture of the openETCS OBU is adopted from the system structure defined in ERA Subset-026, Chapter 2.5 [1]. Figure 1 shows which parts of the reference architecture are in the scope of the openETCS OBU model. Note that also specific parts of the ETCS trackside (e.g. Eurobalise and RBC blocks) have been modeled to have an integrated test environment, cf. dashed blue line in Figure 1.

### 2.1 Top Level Architecture and External Interfaces

Figure 2 shows the top level architecture with external interfaces E1, E2, ..., E9. The external interfaces are used for the communication between the openETCS OBU (dashed red line) and systems out of the scope of the openETCS project and the ETCS Onboard Unit System. In the following we give brief overview of the interfaces:

paragaphoh has to be checked and extended to be more clear

**E1:** In- and out flow between the Interlocking and the Eurobalise. Only relevant for controlled Eurobalises.

**E2:** In- and out flow between the Interlocking and Radio Block Control. This interface ensures the states or logics directly to the Radio Block Control and the other way back from the train to the interlocking.

**E3:** Input flow from the Eurobalise to the Balise Transmission Module or Antenna Unit (BTM) into the ETCS OBU.

**E4:** In- and out flow between the Radio Block Control and the Euroradio modul into the ETCS OBU. This interface is not active in ETCS levels 0 and 1 since there is no ETCS radio interaction between track and train in these levels.

**E5:** This interface is used for the interaction between the driver and the display (Driver Machine Interface, DMI), cf. Figure 3.

check if figure is correct. Do we need this figure anyway? If so, make it more appealing.

**E6:** This interface is a compound structure and combines the interfaces E3 and E4.

**E7:** Input interface to the odometry subsystem of the ETCS OBU. Used for sending information to the train if there is any movement outside the ETCS System, e.g. "cold movement".

**E8:** Input interface to the ETCS OBU to set configuration data such as fixed values, system values, national values and train configuration.

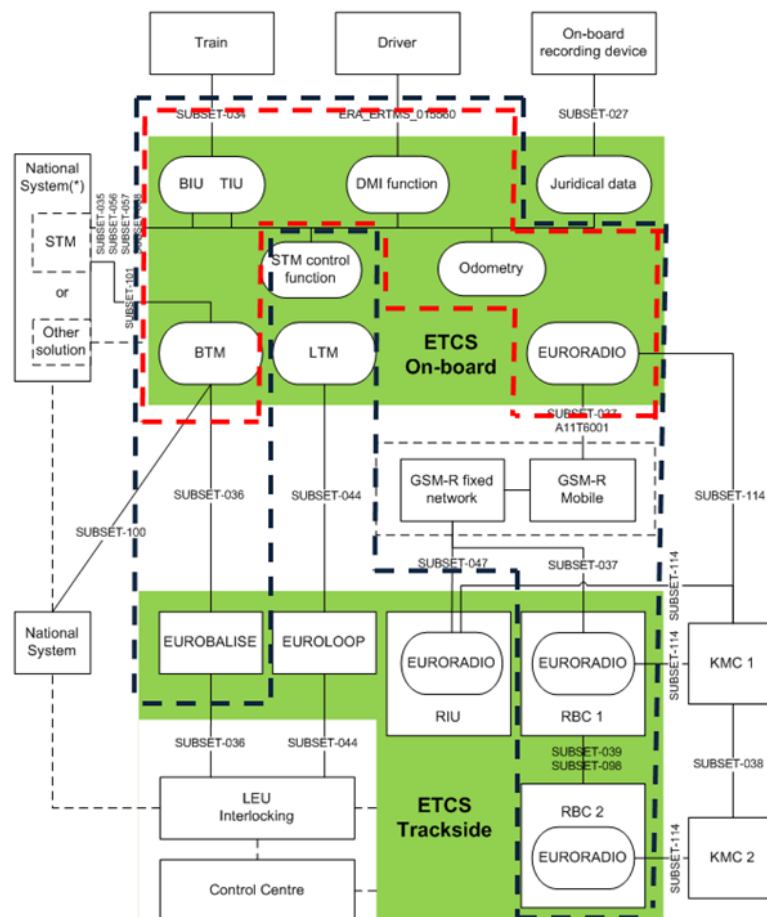
**E9:** In- and Out flow between the ETCS OBU and the train. This interface is used for the interaction between the Train and the ETCS OBU such as brake control, traction control, door control, etc.

### 2.2 Functional breakdown of the ETCS OBU

Figure 4 depicts the functional breakdown of the ETCS OBU block shown in Figure 2. The internal interfaces

Figure is incomplete and erroneous... F2 is not connected, F2 exists twice

Should this block be described using the new compo-



**Figure 1. Scope of openETCS OBU model system according to ERA TSI Chapter 2.5. Functional blocks in the scope of openETCS have been marked by the dashed blue line. The dashed red line shows the OBU blocks in the scope of openETCS.**

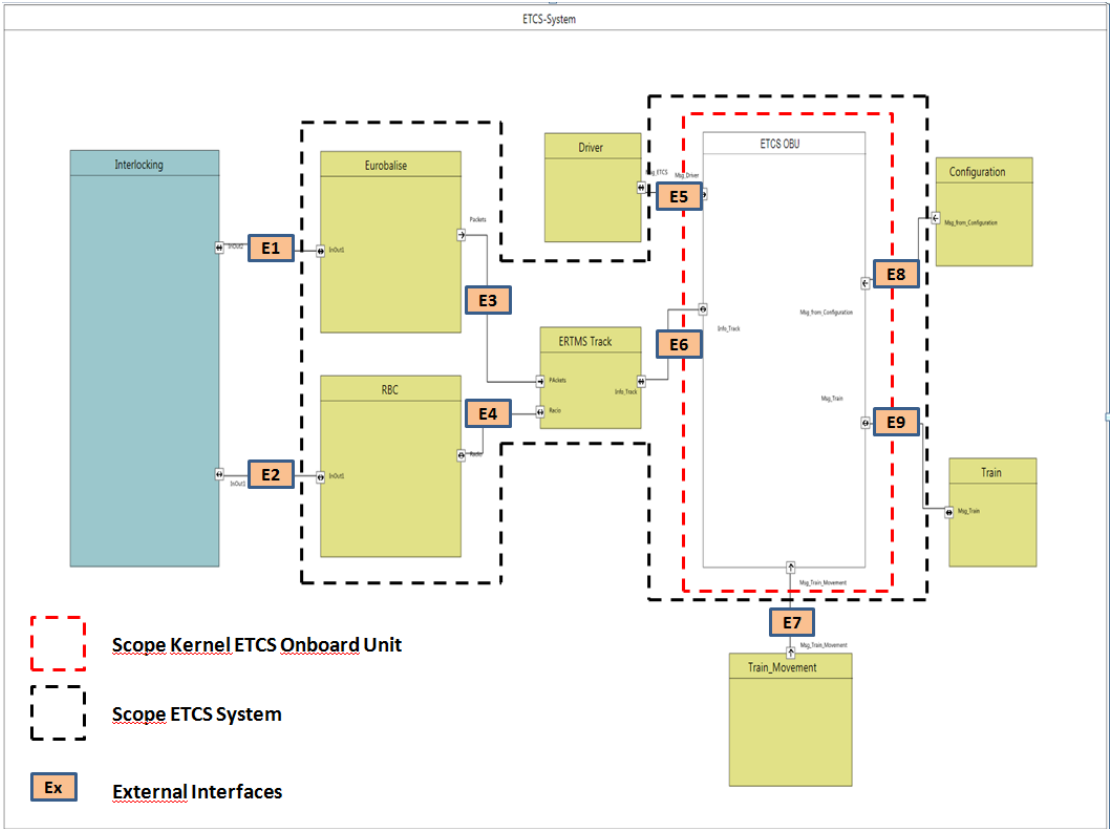


Figure 2. Top level architecture with external interfaces.

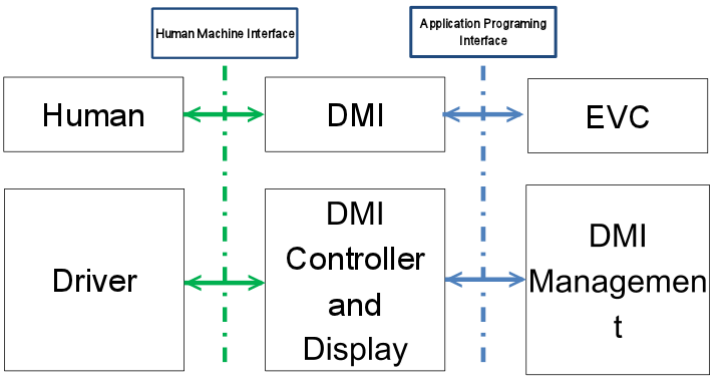


Figure 3. DMI Interfaces.

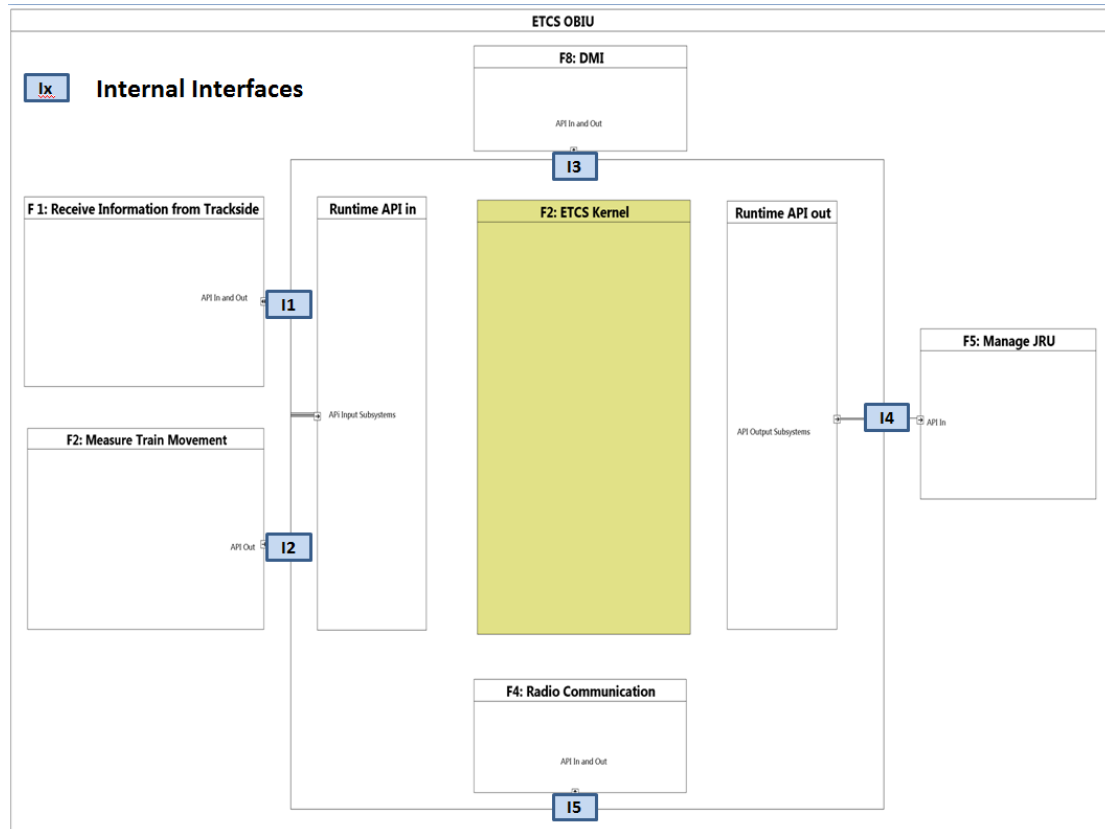


Figure 4. 2nd level system architecture view.

- 86 **I1:** In flow from the Balise Transmission Module (BTM or Antenna) to the "F2 ETCS Kernel"  
 87 through Runtime API in. Transmitted data are information from the Eurobalise.
- 88 **I2:** In flow from the Odometrie (ODO) to the "F2 ETCS Kernel" through Runtime API in.  
 89 Transmitted data are information from the movement of the train.
- 90 **I3:** In- and Out flow between the DMI Controller and the "F2 ETCS Kernel" through Runtime  
 91 API in and out. Transmitted data are information of driver action and display. See description  
 92 in figure of "External Interface E5".
- 93 **I4:** Out flow from "F2 ETCS Kernel" to the JRU manager through Runtime API out. Transmitted  
 94 data are all necessary information for a juridical recorder unit "black box".
- 95 **I5:** In- and Out flow between the Euroradio and "F2 ETCS Kernel" through Runtime API in and  
 96 out. Transmitted data are radio track information (RBC) and information to the track (RBC).

## **Part II**

# **Design Description**

### 3<sup>99</sup> General Design Decisions

# 4 F1: Receive Information from Trackside

## 4.1 ETCS Messaging: TrackMessages

section needs to be completed

### 4.1.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | TrackMessages::Read_P005  |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ETCS_Messaging/TrackMessages">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ETCS_Messaging/TrackMessages</a>   |
| SCADE designer      | Jakob Gärtner, LEA Railergy<br>Mairamou Haman Adj, LEA Railergy   |
| Description         | <p>TrackMessages is a library containing functionality to:</p> <ul style="list-style-type: none"><li>• Transport TrainToTrack and TrackToTrain messages and packets using a compressed format which is conceptually close to the ETCS language as defined in Subset-026</li><li>• Compress trackside information and decompress it in the on-board unit, taking into account different baseline versions and providing transparent translation.</li><li>• Compress trainside information and decompress it in the track-side simulation models, taking into account different baseline versions and providing transparent translation.</li></ul> <p>As TrackMessages is a library with various components supporting all packets and messages defined in Subset-026, we have selected one exemplary function to document the concept. As only the packet/ message- related functionality is specific, this approach will allow a first understanding of the concept and the related interfaces. For a full discussion of the library, refer to the [specific chapter? document?]</p> <p>The function Read_P005 extracts a packet 5 (Gradient Profile) from the compressed packets data flow, if present. It translates the integer-coded compressed data with the help of the metadata in the header section of the CompressedPackets_T formatted data flow. After performing variable-level translation and exception detection, a baseline-3 conformal packet 5 is available for use within the relevant OBU functions.</p> |



|                        |   |
|------------------------|---|
| Input documents        | Subset-026, Chapter 6<br>Subset-026, Chapter 7<br>Subset-026, Chapter 8<br><br>The objective of this component (the full TrackMessages library) is to provide a full formalisation of above chapters in Subset-026                |
| Safety integrity level | 4   |
| Time constraints       | n/a (for the provided example function)   |
| API requirements       | In the demonstrator context, the API is fully defined on SCADE model level. For integration with external systems (BTM, Radio, Subset-076 or Subset-94), additional conversion to/ from bit-level representation will be required |

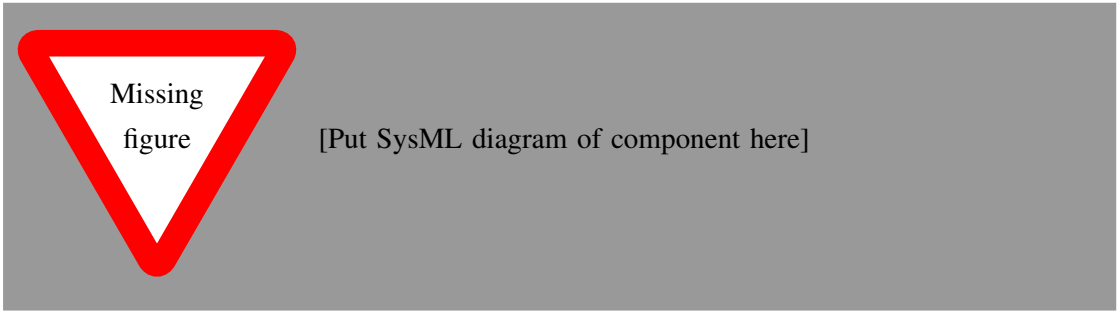
104 **4.1.2 Interface**

105 An overview of the interface of component [component name] is shown in Figure 5. The inputs  
106 and outputs are described in detail in Section 4.1.2.1 respectively 4.1.2.2.

107 **4.1.2.1 Inputs**

108 **4.1.2.1.1 Message\_In**

|             |   |
|-------------|---|
| Input name  | Message_In  |
| Description | Message_In takes the compressed track-to-train messages that have either been compressed by the trackside simulation components of the TrackMessages library, or have been filled by the API. All packets that are part of the same message are transmitted within one cycle of the model's execution. Message_IN is taking the compressed packet information from the track to train dataflow. |
| Source      | Manage_TrackSideInformation_Integration   |
| Type        | Common_Types_Pkg::CompressedPackets_T   |



**Figure 5. TrackMessages SysML diagram**

|   |  |
|---|--|
| Valid range of values                   | The consistency of the metadata is checked at the input side. The ranges of the transported variables are checked at the conversion step (from integer format to SRS-conform format)   |
| Behaviour when value is at boundary     | n/a  |
| Behaviour for values out of valid range | The content of this input is not checked, as any issues will be found at conversion level. If the metadata are not matching the search criteria the packet will be considered as non existent and will therefore be ignored. |

#### 109 4.1.2.2 Outputs

##### 110 4.1.2.2.1 received

|   |  |
|---|--|
| Output name   | received   |
| Description   | Flag to indicate reception of a packet 5 from trackside in the current cycle.  |
| Destination   | Any calling component.<br>components should be listed here   |
| Type  | bool   |
| Valid range of values   | to be checked<br><br><b>true</b> Packet 5 has been received in the current cycle.<br><b>false</b> Packet 5 has not been received in the current cycle. |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a  |

##### 111 4.1.2.2.2 P005\_OBU\_out

|             |  |
|-------------|--|
| Output name | P005_OBU_out                                     |
| Description | Gradient Profile (Packet 5) according to 7.4.2.2 |
| Destination | Any calling operator                             |

| Type                  | TM::P005_OBU_T  |
|-----------------------|---|
| Valid range of values | <p>TM::P005_OBU_T is a complex data type. Values are given for each element. Format is: Type Name: range/list of values</p> <ul style="list-style-type: none"> <li>• bool valid: [true   false]</li> <li>• q_dir Q_DIR:<br/>[Q_DIR_Both_directions  <br/>Q_DIR_Nominal  <br/>Q_DIR_Reverse]</li> <li>• l_packet L_PACKET: (0-8191)</li> <li>• q_scale Q_SCALE:<br/>[ENUM_Q_SCALE_10cm  <br/>ENUM_Q_SCALE_1m  <br/>ENUM_Q_SCALE_10m]</li> <li>• n_iter N_ITER: (0-33) (<i>Remark: start section from the original packet is integrated into the list of sections</i>)</li> </ul> <p>The structured element sections is an array of type P005_section_enum_T. For each element, the valid range of values is as follows:</p> <ul style="list-style-type: none"> <li>• bool valid: [true   false] (<i>Remark: Check for consistency with the value of n_iter</i>)</li> <li>• d_link D_LINK: (0-32767)</li> <li>• q_newcountry Q_NEWCOUNTRY:<br/>[TM_conversions::ENUM_Q_NEWCOUNTRY_same  <br/>TM_conversions::ENUM_Q_NEWCOUNTRY_not_same]</li> <li>• nid_c NID_C: (0-1023)</li> <li>• nid_bg NID_BG: (0-16383)</li> <li>• q_linkorientation Q_LINKORIENTATION:<br/>[TM_conversions::ENUM_Q_LINKORIENTATION_reverse  <br/>TM_conversions::ENUM_Q_LINKORIENTATION_nominal]</li> <li>• q_linkreaction Q_LINKREACTION:<br/>[TM_conversions::ENUM_Q_LINKREACTION_Train_trip  <br/>TM_conversions::ENUM_Q_LINKREACTION_Apply_service_brake<br/>TM_conversions::ENUM_Q_LINKREACTION_No_Reaction]</li> <li>• q_locacc Q_LOCACC: (0-63)</li> </ul> <p><i>Only an output structure with the structured element "valid" set to "true" is to be considered as received. If this field is set to true, the Output 1 (received) must equally be set to "true".</i></p> |

Behaviour when value is at boundary n/a

Behaviour for values out of valid range

The component is prepared for the upcoming error/exception handling concept. An error flag is, at the moment, raised internally if any of the compressed input values is out of range. A hierarchical error processing is foreseen.

The types that have been defined in the package S026\_7 do not provide any default/ invalid value. The following fields are therefore set to an arbitrary value upon reception of an out-of-range value from track side, and the internal error flag is raised:

- q\_dir Q\_DIR:  
set to: Q\_DIR\_Both\_directions
- q\_scale Q\_SCALE:  
set to: ENUM\_Q\_SCALE\_10cm
- q\_newcountry Q\_NEWCOUNTRY:  
set to:[TM\_conversions::ENUM\_Q\_NEWCOUNTRY\_same | TM\_conversions::ENUM\_Q\_NEWCOUNTRY\_not\_same]
- q\_newcountry Q\_NEWCOUNTRY:  
set to: TM\_conversions::ENUM\_Q\_NEWCOUNTRY\_not\_same
- q\_linkorientation Q\_LINKORIENTATION:  
set to: TM\_conversions::ENUM\_Q\_LINKORIENTATION\_reverse
- q\_linkreaction Q\_LINKREACTION:  
set to: TM\_conversions::ENUM\_Q\_LINKREACTION\_Train\_trip

Behaviour when value is erroneous, absent or unwanted (i.e. spurious) n/a

### 112 4.1.3 Subcomponents

#### 113 4.1.3.1 Read\_Packets

##### 114 4.1.3.1.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | TM_lib_internal::RECV_ReadPackets   |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ETCS_Messaging/TrackMessages">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ETCS_Messaging/TrackMessages</a> |
| SCADE designer      | Jakob Gärtner, LEA Railergy   |

|             |  |
|-------------|--|
| Description | <p>RECV_ReadPackets extracts packet data information and raw compressed packet data from the compressed packets data flow, using filter criteria provided through parameter inputs:</p> <ul style="list-style-type: none"> <li>• NID_PACKET: search for a specific packet.</li> <li>• Version Number: search for a specific version number.</li> <li>• Q_DIR: search for packets that are only valid for a specific direction.</li> <li>• Serial number: search for a specific packet instance, if several instances of a given packet type exist.</li> <li>• F_Version: Flag to decide whether to evaluate or ignore packet version information.</li> <li>• F_id: Flag whether to evaluate or ignore packet serial number information.</li> </ul> <p>The operator TM_lib_internal::RECV_ReadPackets takes a set of parameter data to:</p> <ol style="list-style-type: none"> <li>1. Search the metadata of the compressed packets data flow using the provided parameters to determine if a matching packet is contained in any given cycle.</li> <li>2. Output the flag "received" exactly in any cycle a matching packet is found</li> <li>3. Output an array of compressed packet data that is filled with the data from the identified packet.</li> </ol> |
|-------------|--|

|                        |   |
|------------------------|---|
| Input documents        | <p>Subset-026, Chapter 7</p> <p>This function is not directly traceable to Subset-026, but is built from derived requirements.</p>  |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | <p>In the demonstrator context, the API is fully defined on SCADE model level. For integration with external systems (BTM, Radio, Subset-076 or Subset-94), additional conversion to/ from bit-level representation will be required.</p> |

#### 115 4.1.3.1.2 Interface

116 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
117 above) respectively the SCADE generated documentation.

#### 118 4.1.3.2 Extract Packet 5

##### 119 4.1.3.2.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | TM_conversions::trackside.C_P005_compr_onboard  |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ETCS_Messaging/TrackMessages">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ETCS_Messaging/TrackMessages</a>             |
| SCADE designer         | Jakob Gärtner, LEA Railergy   |
| Description            | If a matching packet 5 has been received, TM_conversions::trackside.C_P005_compr_onboard: takes the compressed packet data and converts them to an SRS conformal onboard packet format. Trailing 0 beyond the valid length of the packet are ignored. |
| Input documents        | Subset-026, Chapter 7   |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 120 4.1.3.2.2 Interface

121 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
 122 above) respectively the SCADE generated documentation.

5<sub>123</sub> F2: ETCS Kernel

5.1<sub>124</sub> ETCS Kernel Overview

5.2<sub>125</sub> F2.1: Manage\_TrackSideInformation\_Integration

126 5.2.1 Component Requirements

127 Clarify detail for documentation with the trackMessages concept

|                        |  |
|------------------------|--|
| Component name         | Manage_TrackSideInformation_Integration  |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/Manage_TrackSideInformation_Integration/Manage_TrackSideInformation_Integration.etp">https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/Manage_TrackSideInformation_Integration/Manage_TrackSideInformation_Integration.etp</a>  |
| SCADE designer         | Bernd Hekele, DB Netz AG   |
| Description            | <p>The block “Manage_TrackSideInformation_Integration” is responsible for receiving Eurobalise telegrams and Euroradio messages from the API and performs several consistency checks on the inputs.</p> <p>The block collects the telegrams of balises in order to build balise group messages. Euroradio messages are always delivered as a whole message. On each message, a consistency check is performed, before the data is validated according to the driving direction of the train. In general, messages not designated for the current driving direction of the train are not forwarded to the further processing. After applying consistency checks, the data direction is validated.</p> |
| Input documents        | See subcomponents.   |
| Safety integrity level | 4  |
| Time constraints       | The component has to be able to receive balise telegrams and radio messages according to the ETCS [? ] performance requirements). In highspeed traffic, a group of 8 balises must be read in about 250 msec. In addition, 1 message per sec. on the radio interface is to be expected.   |
| API requirements       | Interfaces to this unit are defined in the API sections [BTM], [EU-RORADIO], [ODO].In these sections, also a detailed definition of the concepts implemented on those interfaces is documented.  |

128 5.2.2 Interface

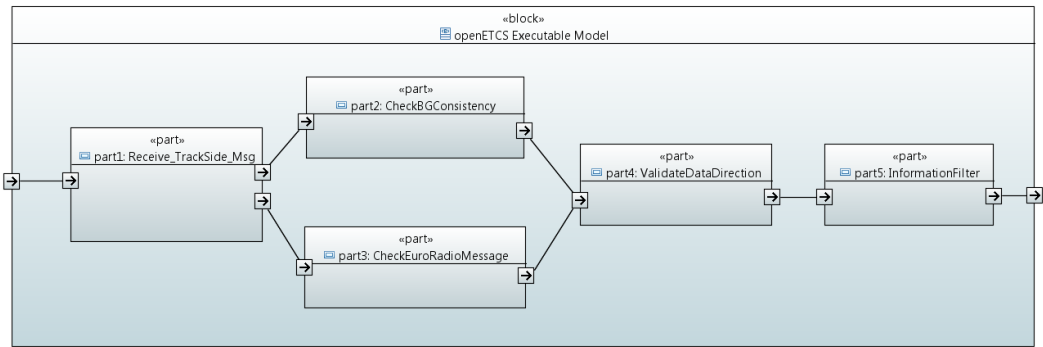


Figure 6. Manage\_TrackSideInformation\_Integration component SysML diagram.

Manage\_TrackSideInformation\_Integration SysML diagram needs to be updated.

An overview of the interface of component Manage\_TrackSideInformation\_Integration is shown in Figure 6. The inputs and outputs are described in detail in Section 5.2.2.1 respectively 5.2.2.2. Subcomponents are described in Section 5.2.3.

5.2.2.1 Inputs

5.2.2.1.1 fullChecks

|   |  |
|---|--|
| Input name  | fullChecks   |
| Description   | Indicates, if all checks on the message should be performed.   |
| Source  | This item is only relevant in verification phases. In a real system checks are always activated.                     |
| Type  | bool   |
| Valid range of values   | <p><b>true</b> All checks are performed.</p> <p><b>false</b> Component InformationFilter is deactivated.</p>         |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

5.2.2.1.2 Receive\_trackSide\_Message

|             |  |
|-------------|--|
| Input name  | API_trackSide_Message  |
| Description | <i>This work</i> Track side message received from the API. The API performs pre-processing of RTM and BTM messages and delivers a maximum of a single message per cycle. The structure of this message is defined in the API [BTM] and [EURORADIO] sections. |



|   |  |
|---|--|
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>To be completed                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>To be completed                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 136 5.2.2.1.3 ActualOdometry

|   |  |
|---|--|
| Input name  | ActualOdometry   |
| Description   | Provided by the external odometry module of the train. It contains relative location information with inaccuracies.  |
| Source  | Odometer   |
| Type  | Obu_BasicTypes_Pkg::odometry_T   |
| Valid range of values   | [Complete list of valid values]<br>To be completed   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>To be completed                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>To be completed                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 137 5.2.2.1.4 reset

|   |   |
|---|---|
| Input name  | reset   |
| Description   | To delete all data stored in the module (e.g. collected balise telegrams, which do not yet form a complete message), a reset input can be used. If the input is set to true, all data kept in the module is deleted and no input is accepted. |
| Source  | Environment   |
| Type  | bool  |
| Valid range of values   | <p><b>true</b> All data kept in the module is deleted and no input is accepted.</p> <p><b>false</b> No action. Data at input is accepted.</p>   |
| Behaviour when value is at boundary                                   | <p>[Description of components behaviour when input value is at boundary]</p> <p>To be completed</p>   |
| Behaviour for values out of valid range                               | <p>[Description of components behaviour when input value is out of valid range]</p> <p>To be completed</p>  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | <p>[Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]</p> <p>To be completed</p>   |

#### 138 5.2.2.1.5 trainPosition

|                                     |   |
|-------------------------------------|---|
| Input name                          | trainPosition   |
| Description                         | Contains the current position of the train.   |
| Source                              | CalculateTrainPosition  |
| Type                                | TrainPosition_Types_Pck::trainPosition_T  |
| Valid range of values               | <p>To be completed</p>  |
| Behaviour when value is at boundary | <p>[Description of components behaviour when input value is at boundary]</p> <p>To be completed</p> |

|   |   |
|---|---|
| Behaviour for values out of valid range | [Description of components behaviour when input value is out of valid range]<br>To be completed |
|---|---|

|   |  |
|---|--|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |
|---|--|

#### 139 5.2.2.1.6 modeAndLevel

|   |  |
|---|--|
| Input name  | modeAndLevel   |
| Description   | Provides the current level and mode of the EVC.  |
| Source  | ModeAndLevel   |
| Type  | BG_Types_Pkg::ModeAndLevelStatus_T   |
| Valid range of values   | [Complete list of valid values]<br>To be completed   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>To be completed                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>To be completed                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 140 5.2.2.1.7 tNvContact

|             |  |
|-------------|--|
| Input name  | tNvContact   |
| Description | For monitoring the safe radio connection, this national value is needed as an input. |
| Source      | Database   |

|   |  |
|---|--|
| Type  | Obu_BasicTypes_Pkg::T_internal_Type  |
| Valid range of values   | [Complete list of valid values]<br>To be completed   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>To be completed                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>To be completed                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 141 5.2.2.1.8 lastRelevantEventTimestamp

|                                     |   |
|-------------------------------------|---|
| Input name                          | lastRelevantEventTimestamp  |
| Description                         | For monitoring the safe radio connection, it is necessary that the time between two packets is less than the value of T_NVCONTACT. In situations like level-changes or announced radio holes, not the timestamp of the last message is relevant for comparison, but the timestamp of the last relevant event. This can for example be the timestamp of the level change or the timestamp of the moment, when the train was passing the end of the radiohole. For performing this check, the timestamp of the last relevant event is provided to the model as an T_internal_Type-type. |
| Source                              | Database  |
| Type                                | Obu_BasicTypes_Pkg::T_internal_Type   |
| Valid range of values               | [Complete list of valid values]<br>To be completed  |
| Behaviour when value is at boundary | [Description of components behaviour when input value is at boundary]<br>To be completed  |

|   |   |
|---|---|
| Behaviour for values out of valid range | [Description of components behaviour when input value is out of valid range]<br>To be completed |
|---|---|

|   |  |
|---|--|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |
|---|--|

#### 142 5.2.2.1.9 connectionStatus

|             |  |
|-------------|--|
| Input name  | connectionStatus   |
| Description | Status information about the radio connection. The information is needed to perform the timing check, which depends on the connection state. |
| Source      | ManageRadioCommunication   |
| Type        | Radio_Types_Pkg::sessionStatus_Type  |

Valid range of values

**DISCONNECTED** The OBU is currently not connected to a RBC.

**CONNECTING** The OBU is currently connecting to the RBC. Received messages belong to the process of establishing a connection.

**CONNECTION\_ESTABLISHED** The connection to the RBC is established.

|                                     |  |
|-------------------------------------|--|
| Behaviour when value is at boundary | [Description of components behaviour when input value is at boundary]<br>To be completed |
|-------------------------------------|--|

|   |   |
|---|---|
| Behaviour for values out of valid range | [Description of components behaviour when input value is out of valid range]<br>To be completed |
|---|---|

|   |  |
|---|--|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |
|---|--|

#### 143 5.2.2.1.10 inSupervisingRbId

|   |   |
|---|---|
| Input name  | inSupervisingRbcId  |
| Description   | For the subcomponent InformationFilter, the information which radio messages are sent by the supervising RBC is needed. To recognize these messages, the identifier of the supervising RBC is needed. |
| Source  | Database<br>consider using the exact component name in the SCADE model  |
| Type  | int   |
| Valid range of values   | [Complete list of valid values]<br>To be completed  |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>To be completed  |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>To be completed   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed  |

#### 144 5.2.2.1.11 inAnnouncedBGs

|                       |  |
|-----------------------|--|
| Input name            | inAnnouncedBGs   |
| Description           | Provides information about balise groups which will be passed by the train soon. This information is generated by Calculate Train Position based on the linking information received from trackside. |
| Source                | CalculateTrainPosition   |
| Type                  | TrainPosition_Types_Pck::positionedBGs_T   |
| Valid range of values | [Complete list of valid values]<br>To be completed   |

|   |  |
|---|--|
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>To be completed                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>To be completed                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 145 5.2.2.1.12 q\_nvlocacc

|   |  |
|---|--|
| Input name  | q_nvlocacc   |
| Description   | The national value determines the location accuracy.   |
| Source  | Database<br>consider using the exact component name in the SCADE model   |
| Type  | Q_NVLOCACC   |
| Valid range of values   | [Complete list of valid values]<br>To be completed   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>To be completed                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>To be completed                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 146 5.2.2.2 Outputs

147 **5.2.2.2.1 outputMessage**

|   |  |
|---|--|
| Output name   | outputMessage  |
| Description   | Combines both balise and radio messages to one common datatype. This datatype contains all variables and packets, which are possible for the given scenario. |
| Destination   | [Name of the destination component(s)]<br>To be completed  |
| Type  | Common_Types_Pkg::ReceivedMessage_T  |
| Valid range of values   | [Complete list of valid values]<br>To be completed   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]<br>To be completed  |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]<br>To be completed   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed   |

148 **5.2.2.2.2 ApplyServiceBrake**

|                       |   |
|-----------------------|---|
| Output name           | ApplyServiceBrake   |
| Description           | Indicates if the balise group the train just passed could not be processed correctly. The check results in the request for a service break. |
| Destination           | [Name of the destination component(s)]<br>To be completed   |
| Type                  | bool  |
| Valid range of values | [Complete list of valid values]<br>To be completed  |



|   |  |
|---|--|
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]<br>To be completed                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]<br>To be completed                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 149 5.2.2.2.3 BadBaliseMessageToDMI

|   |  |
|---|--|
| Output name   | BadBaliseMessageToDMI  |
| Description   | Information to be passed to the DMI to indicate the reception of a “bad balise” to the driver.                       |
| Destination   | DMI  |
| Type  | bool   |
| Valid range of values   | <p><b>true</b> ???</p> <p><b>false</b> ???</p> <p>To be completed</p>  |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]<br>To be completed                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]<br>To be completed                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

150 **5.2.2.2.4 errorLinkedBG**

|   |  |
|---|--|
| Output name   | errorLinkedBG  |
| Description   | [Brief description of the output]<br>To be completed   |
| Destination   | [Name of the destination component(s)]<br>To be completed  |
| Type  | [Type of the output]<br>To be completed  |
| Valid range of values   | <p><b>true</b> An error in a linked balise group was detected.</p> <p><b>false</b> No error in a linked balise group was detected.</p> |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]<br>To be completed  |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]<br>To be completed                                       |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed                   |

151 **5.2.2.2.5 errorUnlinkedBG**

|             |   |
|-------------|---|
| Output name | errorUnlinkedBG   |
| Description | [Brief description of the output]<br>To be completed      |
| Destination | [Name of the destination component(s)]<br>To be completed |

|   |  |
|---|--|
| Type  | bool   |
| Valid range of values   | <p><b>true</b> An error in a unlinked balise group was detected.</p> <p><b>false</b> No error in a unlinked balise group was detected.</p> |
| Behaviour when value is at boundary                                   | <p>[Description of components behaviour when output value is at boundary]</p> <p>To be completed</p>                                       |
| Behaviour for values out of valid range                               | <p>[Description of components behaviour when output value is out of valid range]</p> <p>To be completed</p>                                |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | <p>[Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]</p> <p>To be completed</p>            |

#### 152 5.2.2.2.6 passedBG

|   |  |
|---|--|
| Output name                             | passedBG   |
| Description                             | Provides the received balise group message in a special format needed by the component CalculateTrainPosition. |
| Destination                             | <p>[Name of the destination component(s)]</p> <p>To be completed</p>   |
| Type                                    | BG_Types_Pkg::passedBG_T   |
| Valid range of values                   | <p>[Complete list of valid values]</p> <p>To be completed</p>  |
| Behaviour when value is at boundary     | <p>[Description of components behaviour when output value is at boundary]</p> <p>To be completed</p>           |
| Behaviour for values out of valid range | <p>[Description of components behaviour when output value is out of valid range]</p> <p>To be completed</p>    |

|   |  |
|---|--|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |
|---|--|

#### 153 5.2.2.2.7 outPositionParams

|   |  |
|---|--|
| Output name   | outPositionParams  |
| Description   | Provides the parameters for the position report in a special format needed by the component ProvidePositionReport.   |
| Destination   | [Name of the destination component(s)]<br>To be completed  |
| Type  | Common_Types_Pkg::PositionReportParameter_T<br>To be completed   |
| Valid range of values   | [Complete list of valid values]<br>To be completed   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]<br>To be completed                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]<br>To be completed                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 154 5.2.2.2.8 outRadioManagement

|             |  |
|-------------|--|
| Output name | outRadioManagement   |
| Description | Provides the messages for radio session management in a special format needed by the component ManagementOfRadioCommunication. |

|   |  |
|---|--|
| Destination   | [Name of the destination component(s)]<br>To be completed  |
| Type  | Common_Types_Pkg::radioManagementMessage_T   |
| Valid range of values   | [Complete list of valid values]<br>To be completed   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]<br>To be completed                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]<br>To be completed                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 155 5.2.2.2.9 radioSequenceError

|                       |   |
|-----------------------|---|
| Output name           | radioSequenceError  |
| Description           | [Brief description of the output]<br>To be completed  |
| Destination           | [Name of the destination component(s)]<br>To be completed   |
| Type                  | bool  |
| Valid range of values | <p><b>true</b> A sequence error or a timeout has been detected in the radio message.</p> <p><b>false</b> No error in the radio message sequence was detected.</p> |

|   |  |
|---|--|
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]<br>To be completed                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]<br>To be completed                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed |

#### 156 5.2.2.2.10 radioMessageConsistencyError

|   |  |
|---|--|
| Output name   | radioMessageConsistencyError   |
| Description   | [Brief description of the output]<br>To be completed   |
| Destination   | [Name of the destination component(s)]<br>To be completed  |
| Type  | bool   |
| Valid range of values   | <p><b>true</b> A consistency error has been detected in the radio message.</p> <p><b>false</b> No consistency error in the radio message was detected.</p> |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]<br>To be completed  |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]<br>To be completed   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>To be completed                                       |

---

## 157 5.2.3 Subcomponents

### 158 5.2.3.1 Receive\_TrackSide\_Msg

#### 159 5.2.3.1.1 Component Requirements

|                     |  |
|---------------------|--|
| Component name      | Receive_TrackSide_Msg  |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/Receive_TrackSide_Msg">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/Receive_TrackSide_Msg</a>  |
| SCADE designer      | Bernd Hekele, DB Netz AG   |
| Description         | <p>This function defines the interface of the OBU model to the openETCS generic API for Eurobalise and Euroradio messages. On the interface, either a valid telegram/message is provided or a telegram/message is indicated which could not be received correct when passing the balise or receiving the radio message. The function passes a balise telegram without major changes of the information to the next entity for collecting the balise group information. This entity collects telegrams received via the interface into Balise Group Information. In case of a radio message, the message is converted to an internal format for further processing and passed without changing the information contained.</p> <ul style="list-style-type: none"> <li>• The decoding of balises is done at the API. Also, packets received via the interface are already transformed into a usable shape.</li> <li>• Only packets used inside the current model are passed via the interface.</li> <li>• Treatment of Packet 5: Linking Information. Linking Information is added to the linking array starting from index 0 without gaps. Used elements are marked as valid. Elements are sorted according to the order given by the telegram sequence.</li> <li>• Telegrams received as invalid are passed to the “Check-Function” to process errors in communication with the track side according to the requirements and in a single place. Telegrams are added to the telegram array starting from index 0 without gaps. Used elements are marked as valid. Elements are stored according to the order given by the telegram sequence.</li> <li>• This function does not process information from the packets. The information is passed to the check without further processing of the values.</li> </ul> |

---

|                        |  |
|------------------------|--|
| Input documents        | Subset-026, Chapter 7 and 8: Definition of the Balise Telegram<br>Subset-026, Chapter 4.2.2, 4.2.4, 4.2.9: Interface to the BTM<br>Subset-026, Chapter 3.4.1 - 3.4.3, 3.16.2: Handling of Balise Telegrams<br>Subset-026, Chapter 3.16.2: Check of the balise group<br>Subset-026, Chapter 3.4.2: Determining the orientation<br>Subset-026, Chapter 4.5.2 Active Functions Table<br>Subset-026, Chapter 8.4.4: Rules for Euroradio messages |
| Safety integrity level | 4  |
| Time constraints       | n/a  |
| API requirements       | n/a  |

### 160 5.2.3.1.2 Interface

161 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
 162 above) respectively the SCADE generated documentation.

### 163 5.2.3.2 CheckBGConsistency

#### 164 5.2.3.2.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | CheckBGConsistency  |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/CheckBGConsistency">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/CheckBGConsistency</a> |
| SCADE designer      | Peyman Farhangi, DB Netz AG   |



|                        |   |
|------------------------|---|
| Description            | <p>The function "Receive_TrackSide_Msg" collects the telegrams in an array. If one or more telegrams are received multiple times, either whole the array or single telegram should be deleted.(e.g.if the train moves back.) The balises in a group are to be expected in a certain distance from each other. The function "Receive_TrackSide_Msg" checks if the telegrams has been received in due time and at the right expected location.</p> <p>The function "CheckBGConsistency" verifies the completeness and correctness of the received telegrams from balise groups and composes the balise message from the received telegram array (input from "Receive_TrackSide_Msg"). A balise message is built from at least one telegram and a maximum of 8 telegrams. When linking information is used on-board, only balise groups marked as linked and included in the linking information and balise groups marked as unlinked shall be taken into account.</p> <ul style="list-style-type: none"> <li>• A message is still complete and correct, if a telegram is missing (or not decoded or incompletely decoded), and this telegram is duplicated within the balise group and the duplicating one is correctly read.</li> <li>• In case of multiple balises, the order of the balises must be either ascending (nominal) or descending (reverse).</li> <li>• A message is not correct, if a message counters (M_MCOUNT) equals 254 (that means: The telegram never fits any message of the group). A message counter can equal 255 (that means: The telegram fits with all telegrams of the same balise group) and all other values must be the same.</li> </ul> <p>The orientation of the BG and the running direction of the train are calculated in this block. When linking information is used on-board, the check, if the message of linked balise group has been received in due time and at the expected location, will be performed in "Calculate Train Position". The checks on the validity of the data in the packets and the validity with respect to the direction of motion will be performed in other modules, e.g. "Validate Data Direction".</p> |
| Input documents        | Subset-026, Chapter 7 and 8: Definition of the Balise Telegram<br>Subset-026, Chapter 3.4.1-3, 3.16.2: Handling of Balise Telegrams<br>Subset-026, Chapter 3.16.2: Check of the balise group<br>Subset-026, Chapter 4.5.2: Active Functions Table   |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 165 5.2.3.2.2 Interface

166 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
167 above) respectively the SCADE generated documentation.

### 168 5.2.3.3 CheckEuroradioMessage

#### 169 5.2.3.3.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | CheckEuroradioMessage   |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/b9c31ce6fdf702b412bbeab3032a8a4dc7c92e5c/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/CheckEuroRadioMessage">https://github.com/openETCS/modeling/tree/b9c31ce6fdf702b412bbeab3032a8a4dc7c92e5c/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/CheckEuroRadioMessage</a>   |
| SCADE designer         | Stefan Karg, LEA Railergy   |
| Description            | <p>The component “CheckEuroradioMessage” performs consistency and timing checks on the received radio message. These checks are:</p> <ul style="list-style-type: none"> <li>• checking the message sequence</li> <li>• check if the message violates timing constraints (T_NVCONTACT)</li> <li>• check if all mandatory elements are included</li> <li>• check if no elements are included, which are forbidden for the given message id</li> </ul> <p>Messages, which violate one or more of these criteria are marked as invalid in the message header and the component signals the reason for the invalidation via different flags as described in the SCADE model.</p> |
| Input documents        | Subset-026, Chapter 3.16<br>Subset-026, Chapter 8.4.4   |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 170 5.2.3.3.2 Interface

171 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
172 above) respectively the SCADE generated documentation.

### 173 5.2.3.4 ValidateDataDirection

#### 174 5.2.3.4.1 Component Requirements

|                |                       |
|----------------|-----------------------|
| Component name | ValidateDataDirection |
|----------------|-----------------------|

|                        |   |
|------------------------|---|
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/ValidateDataDirection">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/ValidateDataDirection</a>   |
| SCADE designer         | Stefan Karg, LEA Railergy   |
| Description            | <p>The component filters an input message in order to mark all elements as invalid, which are not designated for the current driving direction of the train.</p> <ul style="list-style-type: none"> <li>• The operator contains two processing paths for different message types. Radio messages and balise group messages are handled in a different way. For validating the data direction of a radio message, the check is performed using the balise group referenced in the radio message header as relevant balise group. For balise group message, the LRBG is used.</li> <li>• The metadata of packets, which are recognized as not valid for the current driving direction, is invalidated.</li> </ul> |
| Input documents        | Subset-026, Chapter 3.6.3   |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 175 5.2.3.4.2 Interface

176 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
177 above) respectively the SCADE generated documentation.

#### 178 5.2.3.5 InformationFilter

##### 179 5.2.3.5.1 Component Requirements

180 Information filter component description needs to be checked, i.e. is the description still up to date? Should more documentation provided for this component in the ADD (please check with Bernd Hekele)?

|                     |   |
|---------------------|---|
| Component name      | CheckEuroradioMessage   |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/InformationFilter">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/InformationFilter</a> |
| SCADE designer      | Christian Stahl, TWT<br>Alexander Stante, FhG   |

**Description** The filter receives track information (balise and radio) and filters them depending of the mode, level and source of the message. Only messages that pass the filter are valid and should be considered by other ETCS subsystems. Figure 7 shows the highlevel decomposition of the functionality. The filter is consists of four components: FirstFilter, SecondFilter, ThirdFilter and TransitionBuffer.

**FirstFilter** This filter performs filtering of messages based on the current ETCS level. The decisions taken process is described via a big decision table which contains rows for every packet and columns for every ETCS level. This table encodes also if certain additional information is necessary to filter a message like pending ETCS Level transitions. Based on this filter packets of an incoming message is either rejected, accepted or the whole message is put in the TransitionBuffer. Messages are put in the TransitionBuffer if there is an announced level transition and the received message is only valid for the upcoming level.

**SecondFilter** The SecondFilter mainly considers messages that are received via Euroradio. Certain messages are directly rejected while other may be stored in the TransitionBuffer. The buffer is used to store messages that are received from non supervising RBCs, but will be reevaluated after a RBC transition.

**ThirdFilter** The last filter is functionally very similiar the the FirstFilter, however it filters depending on the mode. It also contains a decision table with rows for every packet but the columns are modes.

**TransitionBuffer** The InformationFilter uses two TransitionBuffers. One is used to store up to three messages for the ETCS level transition and the other buffer is used for RBC transitions. The buffer is designed as a ring buffer and message are read in FIFO order.

|                        |                         |
|------------------------|-------------------------|
| Input documents        | Subset-026, Chapter 4.8 |
| Safety integrity level | 4                       |
| Time constraints       | n/a                     |
| API requirements       | n/a                     |

### 181 5.2.3.5.2 Interface

182 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
183 above) respectively the SCADE generated documentation.

## 5.3<sub>184</sub> F2.2: Manage\_ETCS\_Procedures

### 185 5.3.1 Component Requirements

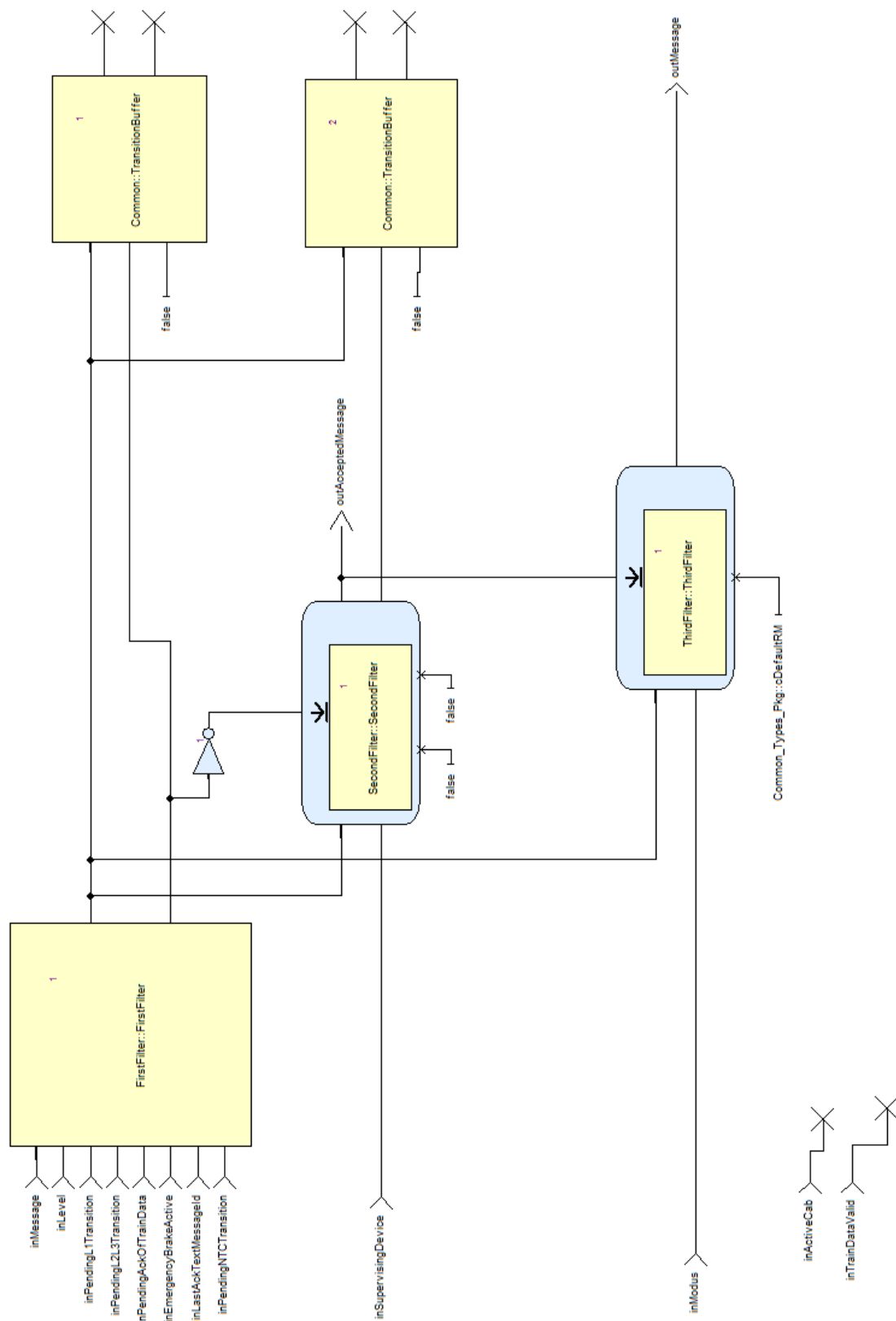


Figure 7. High level overview of the InformationFilter components.



Figure 8. Manage\_ETCS\_Procedures component SysML diagram

|                        |   |
|------------------------|---|
| Component name         | Manage_ETCS_Procedures  |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/Procedures">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/Procedures</a> |
| SCADE designer         | Baseliyos Jacob, DB Netz AG   |
| Description            | This function describes the Start of Mission procedure of the train until the current status will change to another mode, level or other procedure.   |
| Input documents        | Subset-026, Chapter 5.4   |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

5.3.2 Interface

An overview of the interface of component Manage\_ETCS\_Procedures is shown in Figure 8. The inputs and outputs are described in detail in Section 5.3.2.1 respectively 5.3.2.2. Subcomponents are described in Section 5.3.3.

5.3.2.1 Inputs

5.3.2.1.1 statusDMI\_from\_DMI

|                       |   |
|-----------------------|---|
| Input name            | statusDMI_from_DMI                        |
| Description           | Input interface of DMI Controller status. |
| Source                | manageDMI                                 |
| Type                  | DMI_Types_Pkg::DMI_EVC_status_T           |
| Valid range of values | To be completed                           |

|                                     |     |
|-------------------------------------|-----|
| Behaviour when value is at boundary | n/a |
|-------------------------------------|-----|

|   |                                 |
|---|---------------------------------|
| Behaviour for values out of valid range | Function will not be triggered. |
|---|---------------------------------|

|   |                                 |
|---|---------------------------------|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | Function will not be triggered. |
|---|---------------------------------|

#### 192 5.3.2.1.2 Status\_MA\_FS\_SR\_OS\_LS\_SH\_from\_MA\_L2\_Management

|             |  |
|-------------|--|
| Input name  | Status_MA_FS_SR_OS_LS_SH_from_MA_L2_Management               |
| Description | Status of MA, Mode and Level from Level and Mode Management. |
| Source      | ManageLevelsAndModes   |
| Type        | bool   |

Valid range of values

**true** Movement Authority for Level 2 FS is valid

**false** Movement Authority for Level 2 FS is not valid

|                                     |     |
|-------------------------------------|-----|
| Behaviour when value is at boundary | n/a |
|-------------------------------------|-----|

|   |     |
|---|-----|
| Behaviour for values out of valid range | n/a |
|---|-----|

|   |     |
|---|-----|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a |
|---|-----|

#### 193 5.3.2.1.3 systemtime

|                                     |  |
|-------------------------------------|--|
| Input name                          | systemtime   |
| Description                         | Standardized system time used for all internal calculations. |
| Source                              | Obu_BasicTypes   |
| Type                                | Obu_BasicTypes_Pkg::T_internal_Type                          |
| Valid range of values               | [0, maximum positive int value of target platform]           |
| Behaviour when value is at boundary | System time is assumed to be valid.                          |

Behaviour for values out of valid range      System time is assumed to be valid.

Behaviour when value is erroneous, absent or unwanted (i.e. spurious)      System time is assumed to be valid.

#### 194 5.3.2.1.4 StatusModeandLevel\_from\_Level\_and\_Mode\_Management

|   |   |
|---|---|
| Input name  | StatusModeandLevel_from_Level_and_Mode_Management |
| Description   | Status of Mode and Level.                         |
| Source  | ManageLevelsAndModes                              |
| Type  | Level_And_Mode_Types_Pkg::T_Mode_Level            |
| Valid range of values   | To be completed                                   |
| Behaviour when value is at boundary                                   | To be completed                                   |
| Behaviour for values out of valid range                               | To be completed                                   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | To be completed                                   |

#### 195 5.3.2.1.5 mobileSwStatus\_p\_from\_MoRC

|                                     |  |
|-------------------------------------|--|
| Input name                          | mobileSwStatus_p_from_MoRC   |
| Description                         | Information about SW status from Management of Radio Communication function. |
| Source                              | MoRC   |
| Type                                | MoRC_Pck::mobileSWStatus_Type  |
| Valid range of values               | To be completed  |
| Behaviour when value is at boundary | To be completed  |



Behaviour for values out of valid range

To be completed

Behaviour when value is erroneous, absent or unwanted (i.e. spurious)

To be completed

#### 196 5.3.2.1.6 statusRBCSessionEstablished\_status\_from\_MoRC

|   |   |
|---|---|
| Input name  | statusRBCSessionEstablished_status_from_MoRC  |
| Description   | Information about RBC Session status from the Management of Radio Communication function. |
| Source  | MoRC<br>exact name of component in the SCADE model has be used                            |
| Type  | Radio_Types_Pkg::sessionStatus_Type   |
| Valid range of values   | To be completed   |
| Behaviour when value is at boundary                                   | To be completed   |
| Behaviour for values out of valid range                               | To be completed   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | To be completed   |

#### 197 5.3.2.1.7 cabStatus\_from\_TIU

|             |   |
|-------------|---|
| Input name  | cabStatus_from_TIU  |
| Description | Information about cab desk status from Train Interface Unit function. |
| Source      | manageTIUInput  |
| Type        | TIU_Types_Pkg::TIU_trainStatus_T                                      |

Valid range of values

To be completed

Behaviour when value is at boundary

To be completed

Behaviour for values out of valid range

To be completed

Behaviour when value is erroneous, absent or unwanted (i.e. spurious)

To be completed

198

**5.3.2.1.8 statusValid\_Position\_from\_Position\_Calculation**

|   |  |
|---|--|
| Input name  | statusValid_Position_from_Position_Calculation   |
| Description   | Information about validity status of the train position calculation.   |
| Source  | TrainPosition<br>exact name of component in the SCADE model has be used  |
| Type  | bool   |
| Valid range of values   | <p><b>true</b> Calculated train position is valid</p> <p><b>false</b> Calculated train position is not valid</p> |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a  |

199

**5.3.2.1.9 status\_DMIIlevel\_from\_DMI**

|             |   |
|-------------|---|
| Input name  | status_DMIIlevel_from_DMI   |
| Description | Information about the status of DMI menu and level request from DMIController function. |

|   |   |
|---|---|
| Source  | ManageDMIInput                                    |
| Type  | DMI_Messages_DMI_to_EVC_Pkg::DMI_Driver_Request_T |
| Valid range of values   | To be completed                                   |
| Behaviour when value is at boundary                                   | To be completed                                   |
| Behaviour for values out of valid range                               | To be completed                                   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | To be completed                                   |

#### 200 5.3.2.1.10 LevelValid\_from\_Level\_and\_Mode\_Management

|   |   |
|---|---|
| Input name  | LevelValid_from_Level_and_Mode_Management   |
| Description   | Information about the validity status of the StatusModeandLevel_from_Level_and_Mode_Management input.     |
| Source  | ManageLevelsAndModes<br>exact name of component in the SCADE model has be used                            |
| Type  | bool  |
| Valid range of values   | <b>true</b> Level and Mode information are valid<br><b>false</b> Level and Mode information are not valid |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | n/a   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a   |

201 **5.3.2.2 Outputs**202 **5.3.2.2.1 DMI\_Entry\_Request\_to\_DMI**

|   |  |
|---|--|
| Output name   | DMI_Entry_Request_to_DMI                         |
| Description   | Information about input request to the driver.   |
| Destination   | ManageDMIOutput                                  |
| Type  | DMI_Messages_EVC_to_DMI_Pkg::DMI_Entry_Request_T |
| Valid range of values   | To be completed                                  |
| Behaviour when value is at boundary                                   | To be completed                                  |
| Behaviour for values out of valid range                               | To be completed                                  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | To be completed                                  |

203 **5.3.2.2.2 request\_Start\_Mobile\_Terminal\_and\_RBC\_Registration\_to\_MoRC**

|                                     |   |
|-------------------------------------|---|
| Output name                         | request_Start_Mobile_Terminal_and_RBC_Registration_to_MoRC  |
| Description                         | This output is a trigger to start the mobile terminal and RBC session registration within the Management of Radio Communication function. |
| Destination                         | MoRC<br>exact name of component in the SCADE model has be used  |
| Type                                | Common_Types_Pkg::radioManagementMessage_T  |
| Valid range of values               | To be completed   |
| Behaviour when value is at boundary | To be completed   |

Behaviour for values out of valid range

To be completed

Behaviour when value is erroneous, absent or unwanted (i.e. spurious)

To be completed

#### 204 5.3.2.2.3 powerUp\_to\_MoRC

|   |  |
|---|--|
| Output name   | powerUp_to_MoRC  |
| Description   | This output is the trigger to activate the Management of Radio Communication function. |
| Destination   | MoRC<br>exact name of component in the SCADE model has be used                         |
| Type  | bool   |
| Valid range of values   | <b>true</b> MoRC will be activated<br><b>false</b> no action                           |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a  |

#### 205 5.3.2.2.4 statusstartofmissionongoing\_to\_MoRC

|             |  |
|-------------|--|
| Output name | statusstartofmissionongoing_to_MoRC  |
| Description | This output gives the information about the start of mission status procedure to the Management of Radio Communication function. |
| Destination | MoRC<br>exact name of component in the SCADE model has be used   |
| Type        | bool   |

Valid range of values

**true** Start of mission procedure is currently ongoing

**false** Start of mission procedure is currently not ongoing

Behaviour when value is at boundary n/a

Behaviour for values out of valid range n/a

Behaviour when value is erroneous, absent or unwanted (i.e. spurious) n/a

#### 206 5.3.2.2.5 powerOff\_to\_MoRC

Output name powerOff\_to\_MoRC

Description This output is the trigger to de-activate the Management of Radio Communication function.

Destination MoRC  
exact name of component in the SCADE model has be used

Type bool

Valid range of values

**true** MoRC will be deactivated

**false** no action

Behaviour when value is at boundary n/a

Behaviour for values out of valid range n/a

Behaviour when value is erroneous, absent or unwanted (i.e. spurious) n/a

#### 207 5.3.2.2.6 start\_ack\_to\_TIU

Output name start\_ack\_to\_TIU

Description This output indicates that the start of mission procedure is completed.

|   |   |
|---|---|
| Destination   | ManageTIUOutput                                     |
| Type  | bool  |
| Valid range of values   | <b>true</b> Start of mission procedure is completed |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | n/a   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a   |

### 208 5.3.3 Subcomponents

#### 209 5.3.3.1 Awakness\_of\_Train

##### 210 5.3.3.1.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | Awakness_of_Train   |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/ManageProcedure_Pkg.xscade">https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/ManageProcedure_Pkg.xscade</a> |
| SCADE designer         | Baseliyos Jacob, DB Netz AG   |
| Description            | This component describes the Start of Mission procedure of the train until the status of the awakening is completed. From this point on the train will be able to switch to further modes, levels and procedures.   |
| Input documents        | Subset-026, Chapter 5, § 5.4  |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

##### 211 5.3.3.1.2 Interface

212 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
213 above) respectively the SCADE generated documentation.

##### 214 5.3.3.2 NP

### 215 5.3.3.2.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | NP  |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/ManageProcedure_Pkg.xscade">https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/ManageProcedure_Pkg.xscade</a> |
| SCADE designer         | Baseliyos Jacob, DB Netz AG   |
| Description            | This component implements the No Power status of the train before the driver opens the cab desk.  |
| Input documents        | Subset-026, Chapter 5, § 5.4  |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

### 216 5.3.3.2.2 Interface

217 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
218 above) respectively the SCADE generated documentation.

### 219 5.3.3.3 SoM\_L2\_3\_FS\_SR\_OS\_LS\_SH

#### 220 5.3.3.3.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | SoM_L2_3_FS_SR_OS_LS_SH   |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/ManageProcedure_Pkg.xscade">https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/ManageProcedure_Pkg.xscade</a> |
| SCADE designer         | Baseliyos Jacob, DB Netz AG   |
| Description            | This component switch to Level 2 or 3 and Mode FS, SR, OS, LS and SH after completion of the awakening of the train.  |
| Input documents        | Subset-026, Chapter 5, § 5.4  |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 221 5.3.3.3.2 Interface

222 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
223 above) respectively the SCADE generated documentation.

### 224 5.3.3.4 SoM\_NTC\_SN



#### 225 5.3.3.4.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | SoM_NTC_SN  |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/ManageProcedure_Pkg.xscade">https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/ManageProcedure_Pkg.xscade</a> |
| SCADE designer         | Baseliyos Jacob, DB Netz AG   |
| Description            | This component switch to Level NTC and Mode SN after completion of the awakening of the train.  |
| Input documents        | Subset-026, Chapter 5, § 5.4  |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 226 5.3.3.4.2 Interface

227 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
228 above) respectively the SCADE generated documentation.

### 5.4<sub>229</sub> F2.3: trainData

#### 230 5.4.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | trainData   |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/manageData/trainData/trainData.etp">https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/manageData/trainData/trainData.etp</a> |
| SCADE designer      | Bernd Hekele, DB Netz AG  |



Figure 9. trainData component SysML diagram

|                        |   |
|------------------------|---|
| Description            | <p>Implementation of the train data with the corresponding interfaces to track, driver and RBC.</p> <p>Data first is received from the train (TIU).</p> <p>Second step: train data is sent to the driver (DMI). The part relevant for driver interface is confirmed by the driver and sent back to the EVC.</p> <p>Data received via this interface is merged with the data received via TIU. Message Flow:</p> <ul style="list-style-type: none"><li>• sending Message 129 (Validated Train Data)</li><li>• receiving Message 8 (Acknowledgment of Train Data) is processed as apart of the validation procedure with the RBC.</li><li>• sending Message 146 (Acknolwedement) in the context of this message flow. T_TRAIN parameter of the messages is used to confirm the association of the messages.</li></ul> <p>The trainData component uses a dedicated state for controlling the reception of the acknowledgement.</p> |
| Input documents        | Subset-026, Chapter 3.18.3  |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | Train Data needs systemtime for stamping messages, access to input from the track messages and access to the output of RBC messages.  |

5.4.2 Interface

An overview of the interface of component trainData is shown in Figure 9. The inputs and outputs are described in detail in Section 5.4.2.1 respectively 5.4.2.2. Subcomponents are described in Section 5.4.3.

5.4.2.1 Inputs

5.4.2.1.1 reset

|            |       |
|------------|-------|
| Input name | reset |
|------------|-------|

|   |   |
|---|---|
| Description   | Triggers the reset of the train data and the train data status data.  |
| Source  | Persistent data status management.  |
| Type  | bool  |
| Valid range of values   | <p><b>true</b> Perform reset of train data and train data status.</p> <p><b>false</b> No reset of data in this cycle.</p> |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | n/a   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a   |

#### 237 5.4.2.1.2 trainDatafromTIU

|   |   |
|---|---|
| Input name  | trainDatafromTIU  |
| Description   | Train data received via TIU. The availability of data is indicated with the valid flag. This data is expected to be received in the first place. In the current implementation it is not supported to change data after a mission has been started. |
| Source  | Train Interface Unit (TIU)  |
| Type  | TIU_Types_Pkg::trainData_T  |
| Valid range of values   | <p>Input with valid information is indicated with the valid flag.</p> <p>Looking at this input this seems to be a complex structure. Consider describing the structure instead of referring to the valid flag only.</p>                             |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | When valid flag indicates false the data to be used is assumed to be default values. The component is not used when valid flag is false.  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | Information is only expected at Start of Mission Procedure. Once the information is successfully received it is not considered any more. Change of train data by train during mission is not supported by this version of the openETCS OBU model.   |

238 **5.4.2.1.3 trainDatafromDriver**

|   |   |
|---|---|
| Input name  | trainDatafromDriver   |
| Description   | Train data received via DMI from the driver. The availability of data is indicated with the valid flag. This data is expected to be received in the first place. In the current implementation it is not supported to change data after a mission has been started. |
| Source  | Driver Machine Interface (DMI)  |
| Type  | DMI_Messages_Bothways_Pkg::DMI_Train_Data_T   |
| Valid range of values   | Input with valid information is indicated with the valid flag.<br>Looking at this input this seems to be a complex structure. Consider describing the structure instead of referring to the valid flag only.  |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | When valid flag indicates false the data to be used is assumed to be default values. The component is not used when valid flag is false.  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | No checks on individual values is done in this part of the openETCS EVC. We assume - if necessary - appropriate checks are part of the interface layer (e.g., CRC checks) This type of checks is not in the scope of the openETCS project.                          |

239 **5.4.2.1.4 trainDataAckfromDriver**

|   |   |
|---|---|
| Input name                              | trainDataAckfromDriver  |
| Description                             | During start of mission the driver has to validate the train data. The confirmation is visible based on this input. Presence of the input is indicated with the valid flag.<br>Looking at this input this seems to be a complex structure. Consider describing the structure instead of referring to the valid flag only. |
| Source                                  | Driver Machine Interface (DMI)  |
| Type                                    | DMI_Messages_DMI_to_EVC_Pkg::DMI_Train_Data_Ack_T   |
| Valid range of values                   | Input with valid information is indicated with the valid flag. In addition, the ack parameter has to be evaluated in order to recognise the decision of the driver.   |
| Behaviour when value is at boundary     | n/a   |
| Behaviour for values out of valid range | when valid flag indicates false the data to be used is assumed to be default values. The component is not used when valid flag is false.  |

|   |  |
|---|--|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | no checking on individual values is done in this part of the openETCS EVC. We assume - if necessary - appropriate checks are part of the interface layer (e.g., CRC checks) This type of checks is not in the scope of the openETCS project. |
|---|--|

#### 240 5.4.2.1.5 trackMessages

|   |   |
|---|---|
| Input name  | trackMessages   |
| Description   | Information carries the message received from RBC. Information is only used when the valid flag is true and the message source is Radio. Other information is not relevant. Information is evaluated as long as the validation procedure is not completed and a validation request with the RBC is pending. |
| Source  | Radio Transmission Module (RTM)   |
| Type  | Common_Types_Pkg::ReceivedMessage_T   |
| Valid range of values   | Input with valid information is indicated with the valid flag.<br>Looking at this input this seems to be a complex structure. Consider describing the structure instead of referring to the valid flag only.  |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | When valid flag indicates false the data to be used is assumed to be default values. The component is not used when valid flag is false.  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | No checking on individual values is done in this part of the openETCS EVC. We assume - if necessary - appropriate checks are part of the interface layer (e.g., CRC checks) This type of checks is not in the scope of the openETCS project.  |

#### 241 5.4.2.1.6 timeStamp

|   |   |
|---|---|
| Input name                              | timeStamp   |
| Description                             | Timestamp for messaging to the RBC.   |
| Source                                  | Derived from train time.  |
| Type                                    | T_TRAIN   |
| Valid range of values                   | Positive non-zero real  |
| Behaviour when value is at boundary     | Parameter is not used for computation or addressing. No impact in this model. |
| Behaviour for values out of valid range | No impact in the EVC. Communication to the RBC will be broken.                |

|   |  |
|---|--|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | Communication to the RBC will be broken. No safety issue in the EVC since RBC connection errors are covered by the EVC function. |
|---|--|

#### 242 5.4.2.1.7 eventsForTrainData

|   |  |
|---|--|
| Input name  | eventsForTrainData   |
| Description   | <p>Timestamp for messaging to the RBC. Information of the EVC relevant for train data handling according to Section 3.18.3. In the current state of implementation the following events are evaluated:</p> <ul style="list-style-type: none"> <li>• train stand-still</li> <li>• communication Session established</li> </ul> <p>The MoRC ready input is used to indicate the evc:more function is ready with acknowledgment of the communication session.</p> |
| Source  | EVC model.   |
| Type  | trainData_Types_pkg::trainData_Events_T  |
| Valid range of values   | Structure of a set of bool. Each component may be true or false.   |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a  |

#### 243 5.4.2.2 Outputs

244 section needs to be completed

##### 245 5.4.2.2.1 [Output 1 name]

|                       |  |
|-----------------------|--|
| Output name           | [Name of the output]                   |
| Description           | [Brief description of the output]      |
| Destination           | [Name of the destination component(s)] |
| Type                  | [Type of the output]                   |
| Valid range of values | [Complete list of valid values]        |

|   |   |
|---|---|
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 246 5.4.2.2.2 [Output 2 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 247 5.4.3 Subcomponents

248 section needs to be completed

### 5.5<sub>249</sub> F2.4: TrackAtlas

250 Section needs to be completed

#### 251 5.5.1 Component Requirements

|                     |                         |
|---------------------|-------------------------|
| Component name      | TrackAtlas              |
| Link to SCADE model | ???                     |
| SCADE designer      | Jakob Gärtner, LEA      |
| Description         | ???                     |
| Input documents     | Subset-026, Chapter ??? |



Figure 10. TrackAtlas component SysML diagram

|                        |  |
|------------------------|--|
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a] |
| API requirements       | [If applicable description of API requirements, otherwise n/a] |

5.5.2 Interface

An overview of the interface of component TrackAtlas is shown in Figure 10. The inputs and outputs are described in detail in Section 5.5.2.1 respectively 5.5.2.2. Subcomponents are described in Section 5.5.3.

5.5.2.1 Inputs

5.5.2.1.1 [Input 1 name]

|   |   |
|---|---|
| Input name  | [Name of the input]   |
| Description   | [Brief description of the input]  |
| Source  | [Name of the source component]  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

5.5.2.1.2 [Input 2 name]

|             |                                  |
|-------------|----------------------------------|
| Input name  | [Name of the input]              |
| Description | [Brief description of the input] |
| Source      | [Name of the source component]   |
| Type        | [Type of the input]              |



|   |   |
|---|---|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |
|---|---|

## 259 5.5.2.2 Outputs

### 260 5.5.2.2.1 [Output 1 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

### 261 5.5.2.2.2 [Output 2 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

### 262 5.5.3 Subcomponents

#### 263 5.5.3.1 StoreRaw\_NV

##### 264 5.5.3.1.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | StoreRaw_NV   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

##### 265 5.5.3.1.2 Interface

266 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
267 above) respectively the SCADE generated documentation.

#### 268 5.5.3.2 Build\_GradientProfile

##### 269 5.5.3.2.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | Build_GradientProfile   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

##### 270 5.5.3.2.2 Interface

271 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
272 above) respectively the SCADE generated documentation.

### 273 5.5.3.3 Build\_MA

#### 274 5.5.3.3.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | Build_MA  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 275 5.5.3.3.2 Interface

276 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
277 above) respectively the SCADE generated documentation.

### 278 5.5.3.4 Build\_MRSP

#### 279 5.5.3.4.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | Build_MRSP  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 280 5.5.3.4.2 Interface

281 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
282 above) respectively the SCADE generated documentation.

### 283 5.5.3.5 Manage\_EmergencyStop

#### 284 5.5.3.5.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | Manage_EmergencyStop  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 285 5.5.3.5.2 Interface

286 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
287 above) respectively the SCADE generated documentation.

### 288 5.5.3.6 C\_P003V1\_OBU\_P003\_OBU

#### 289 5.5.3.6.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | C_P003V1_OBU_P003_OBU   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 290 5.5.3.6.2 Interface

291 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
292 above) respectively the SCADE generated documentation.

### 293 **5.5.3.7 GradientProfile\_to\_DMI**

#### 294 **5.5.3.7.1 Component Requirements**

|                        |   |
|------------------------|---|
| Component name         | GradientProfile_to_DMI  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 295 **5.5.3.7.2 Interface**

296 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
297 above) respectively the SCADE generated documentation.

### 298 **5.5.3.8 Manage\_MA\_Request**

#### 299 **5.5.3.8.1 Component Requirements**

|                        |   |
|------------------------|---|
| Component name         | Manage_MA_Request   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 300 **5.5.3.8.2 Interface**

301 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
302 above) respectively the SCADE generated documentation.

### 303 5.5.3.9 TA\_to\_ML

#### 304 5.5.3.9.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | TA_to_ML  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 305 5.5.3.9.2 Interface

306 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
307 above) respectively the SCADE generated documentation.

### 308 5.5.3.10 SSP\_to\_MRSP

#### 309 5.5.3.10.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | SSP_to_MRSP   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 310 5.5.3.10.2 Interface

311 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
312 above) respectively the SCADE generated documentation.

### 313 5.5.3.11 MRSP\_to\_MRSP\_to\_DMI

#### 314 5.5.3.11.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | MRSP_to_MRSP_to_DMI   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Jakob Gärtner, LEA  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 315 5.5.3.11.2 Interface

316 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
317 above) respectively the SCADE generated documentation.

## 5.6<sub>318</sub> F2.5: Mode\_and\_Level

### 319 5.6.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | Mode_and_Level  |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLevelsAndModes">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLevelsAndModes</a> |
| SCADE designer         | Marielle Petit-Doche and Matthias Güdemann, Systerel  |
| Description            | Modes and levels define the status of the ETCS regarding on-board functional status and track infrastructure.   |
| Input documents        | Subset-026, Chapter 4<br>Subset-026, Chapter 5  |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |



Figure 11. Mode\_and\_Level component SysML diagram

5.6.2 Interface

An overview of the interface of component Mode\_and\_Level is shown in Figure 11. The inputs and outputs are described in detail in Section 5.6.2.1 respectively 5.6.2.2. Subcomponents are described in Section 5.6.3.

5.6.2.1 Inputs

5.6.2.1.1 Data\_From\_TIU

table has been truncated. Please do not remove rows from the table template. Just use "n/a" if a row is not relevant for a particular input or output.

|   |   |
|---|---|
| Input name                              | Data_From_TIU   |
| Description                             | Set of data providing by TIU  |
| Source                                  | input_from_TIU_API_Pkg::manageTIU_input   |
| Type                                    | TIU_Types_Pkg::Message_Train_Interface_to_EVC_T   |
| Valid range of values                   | It is a complex type<br>more detail should be given here  |
| Behaviour when value is at boundary     | [Description of components behaviour when input value is at boundary]<br>to be completed        |
| Behaviour for values out of valid range | [Description of components behaviour when input value is out of valid range]<br>to be completed |



|   |  |
|---|--|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>to be completed |
|---|--|

#### 327 5.6.2.1.2 Cab\_In

328 table has been truncated. Please do not remove rows from the table template. Just use "n/a" if a row is not relevant for a particular input or output.

|   |  |
|---|--|
| Input name  | Cab_In   |
| Description   | Identification of the cabine where the EVC is implemented  |
| Source  | ???<br>to be completed   |
| Type  | TIU_Types_Pkg::cab_ID_T  |
| Valid range of values   | [CabUndefined, CabA, CabB]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>to be completed                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>to be completed                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>to be completed |

#### 329 5.6.2.1.3 Data\_From\_DMI

330 table has been truncated. Please do not remove rows from the table template. Just use "n/a" if a row is not relevant for a particular input or output.

|             |   |
|-------------|---|
| Input name  | Data_From_DMI   |
| Description | Set of data transmitted from DMI (driver acknowledgements and requests to switch modes and level) |
| Source      | manage_DMI_Input_Pkg::manageDMI_Input   |

|   |  |
|---|--|
| Type  | DMI_Types_Pkg::DMI_To_Modes_T  |
| Valid range of values   | It is a complex type : <ul style="list-style-type: none"> <li>• valid : bool, flag to inform of the freshness of the information</li> <li>• DriverAck : DMI_DriverAck_T, indicate which mode is acknowledged</li> <li>• DriverRequest : DMI_DriverRequest_T, table of boolean values for all the driver request related to mode changes.</li> <li>• LevelAck : bool, indication of Level change acknowledgement</li> </ul> |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>to be completed   |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>to be completed  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>to be completed   |

#### 331 5.6.2.1.4 driver\_level\_transition\_in

332 table has been truncated. Please do not remove rows from the table template. Just use "n/a" if a row is not relevant for a particular input or output.

|                                     |  |
|-------------------------------------|--|
| Input name                          | driver_level_transition_in   |
| Description                         | Request of level transition given by the driver for example at start of mission          |
| Source                              | manage_DMI_Input_Pkg::manageDMI_Input  |
| Type                                | Level_And_Modes_Types_Pkg::T_LevelTransition   |
| Valid range of values               | It is a complex type   |
| Behaviour when value is at boundary | [Description of components behaviour when input value is at boundary]<br>to be completed |

|   |   |
|---|---|
| Behaviour for values out of valid range | [Description of components behaviour when input value is out of valid range]<br>to be completed |
|---|---|

|   |  |
|---|--|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>to be completed |
|---|--|

#### 333 5.6.2.1.5 Data\_From\_Track\_Packets

334 table has been truncated. Please do not remove rows from the table template. Just use "n/a" if a row is not relevant for a particular input or output.

|   |  |
|---|--|
| Input name  | Data_From_Track_Packets  |
| Description   | Packets received from trackside containing information for modes and levels switches                                 |
| Source  | ????<br>to be completed  |
| Type  | Level_And_Mode_Types_Pkg::T_Data_From_Track_Packet   |
| Valid range of values   | It is a complex type containing the information of packets : 12, 15, 21, 27, 41, 46, 63, 80, 135, 137, 138 and 139   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]<br>to be completed                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]<br>to be completed                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]<br>to be completed |

#### 335 5.6.2.1.6 Data\_From\_speed\_and\_Supervision

336 table has been truncated. Please do not remove rows from the table template. Just use "n/a" if a row is not relevant for a particular input or output.

|   |  |
|---|--|
| Input name  | Data_From_speed_and_Supervision  |
| Description   | Data provided by the speed and supervision function  |
| Source  | Speed and Supervision function<br>Please use exact component name from SCADE model.  |
| Type  | Level_And_Mode_Types_Pkg::T_Data_From_Speed_Supervision  |
| Valid range of values   | <p>Input type a complex type</p> <ul style="list-style-type: none"> <li>• <i>Estim_front_End_overpass_SR_Dist : bool</i>: the train overpass the SR distance with its estimated front end (from SR to trip mode condition 42)</li> <li>• <i>Estim_Front_End_Rear_SSP : bool</i>: estimated front end is rear of the start location of either SSP or gradient profile stored on-board (from FS, LS, OS to trip mode condition 69)</li> <li>• <i>Override_Function_Active</i>: boolean to indicate the state of the activation function</li> <li>• <i>EOA_Antenna_Overpass : bool</i>: the train overpasses the EOA with min safe antenna position Level 1 (from FS, LS, OS to trip mode condition 12)</li> <li>• <i>EOA_Front_End : bool</i> the train overpasses the EOA with min safe front end, Level 2 or 3 (from FS, LS, OS to trip mode condition 16)</li> <li>• <i>Train_Speed_Under_Override_Limit : bool</i> supervision when override function is active (to SR mode condition 37)</li> </ul> |
| Behaviour when value is at boundary                                   | <p>[Description of components behaviour when input value is at boundary]</p> <p>to be completed</p>  |
| Behaviour for values out of valid range                               | <p>[Description of components behaviour when input value is out of valid range]</p> <p>to be completed</p>   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | <p>[Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]</p> <p>to be completed</p>  |

Description of outputs needs to be completed

338

#### 339 5.6.2.2.1 [Output 1 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 340 5.6.2.2.2 [Output 2 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

### 341 5.6.3 Subcomponents

#### 342 5.6.3.1 Level\_Management

##### 343 5.6.3.1.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | Level_Management  |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/openETCSArchitectureAndDesign/WorkGroups/Group3/SCADE/LevelManagement/">https://github.com/openETCS/modeling/tree/master/openETCSArchitectureAndDesign/WorkGroups/Group3/SCADE/LevelManagement/</a>   |
| SCADE designer         | Marielle Petit-Doche and Matthias Güdemann, Systerel  |
| Description            | <p>The level management subsystem receives level transition order tables and selects the order with the highest probability. It stores the information about the selected transition order and transits to the requested level once the train passes the location of the level transition.</p> <p>If required, the driver is asked to acknowledge the transition, in case of no acknowledgment or if conditions for the level transition are not fulfilled, the train gets tripped.</p> <p>On the most abstract level the design consists of the <i>manage_priorities</i> function which takes the level transition order priority tables as inputs and computes the highest priority transition.</p> <p>This transition order is the fed to the <i>computeLevelTransitions</i> operator. This operator consists of three main parts. The <i>ComputeTransitionConditions</i> operator that emits the fulfilled conditions to change from a given level to a new level, the <i>LevelStateMachine</i> that stores the current level and takes the computed change conditions as input for possible level transitions and finally the <i>driverAck</i> operator which contains a state machine that stores the information whether the system is currently waiting for a driver acknowledge and emits the train trip information if necessary.</p> |
| Input documents        | Subset-026, Chapter 5.10  |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]<br>to be completed   |
| API requirements       | [If applicable description of API requirements, otherwise n/a]<br>to be completed   |

### 344 5.6.3.1.2 Interface

345 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
346 above) respectively the SCADE generated documentation.

## 347 5.6.3.2 Mode\_Management

### 348 5.6.3.2.1 Component Requirements

|                |                 |
|----------------|-----------------|
| Component name | Mode_Management |
|----------------|-----------------|

|                        |  |
|------------------------|--|
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLevelsAndModes/Modes">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLevelsAndModes/Modes</a>  |
| SCADE designer         | Marielle Petit-Doche, Systerel   |
| Description            | <p>This function is in charge of the computation of new mode to apply according to conditions from inputs (track information, driver interactions, train data,...) and other functions.</p> <p>Three subfunctions are defined:</p> <p><b>Inputs</b> proceeds to inputs check and preparation.</p> <p><b>ComputeModesCondition</b> performs all specific procedure linked to mode management and defined in [1] sections 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.11, 5.12, 5.13, 5.19 and specifies the conditions to define a mode transition according condition table of section 4.6.3 of [1]</p> <p><b>SwitchModes</b> performs the mode selection according the conditions and priorities defined in transition table section 4.6.2 of [1]</p> <p><b>Outputs</b> prepares packet of outputs.</p> |
| Input documents        | Subset-026, Chapter 4.4, 4.6, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.11, 5.12, 5.13, 5.19   |
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]<br>to be completed  |
| API requirements       | [If applicable description of API requirements, otherwise n/a]<br>to be completed  |

### 349 5.6.3.2.2 Interface

350 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
351 above) respectively the SCADE generated documentation.

### 352 5.6.3.3 Check\_and\_Provide\_Mode\_and\_Level

#### 353 5.6.3.3.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | Check_and_Provide_Mode_and_Level  |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLevelsAndModes/Modes">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLevelsAndModes/Modes</a> |

|                        |   |
|------------------------|---|
| SCADE designer         | Marielle Petit-Doche, Systerel  |
| Description            | Checks compatibility between mode and level and provides outputs.                 |
| Input documents        | Subset-026, Chapter 3.6.5   |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]<br>to be completed |
| API requirements       | [If applicable description of API requirements, otherwise n/a]<br>to be completed |

### 354 5.6.3.3.2 Interface

355 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
356 above) respectively the SCADE generated documentation.

## 5.7<sub>357</sub> F2.6: calculateTrainPosition

### 358 5.7.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | calculateTrainPosition  |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/TrainPosition/CalculateTrainPosition">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/TrainPosition/CalculateTrainPosition</a> |
| SCADE designer      | Uwe Steinke, Siemens AG   |



|             |   |
|-------------|---|
| Description | <p>The main purpose of the function is to calculate the locations of linked and unlinked balise groups (BGs) and the current train position while the train is running along the track. In detail, the calculateTrainPosition function provides a couple of essential subfunctions for the onboard unit. These are mainly:</p> <ul style="list-style-type: none"> <li>• Creating and maintaining an obu internal coordinate system for all types of location based data.</li> <li>• Storing all linked and unlinked balise groups resulting from over passing or from announcements (linking information) from the track.</li> <li>• Calculating and maintaining the locations of all stored balise groups during the train trip, based on odometry and linking information.</li> <li>• Permanently calculating the current train position based on odometry and passed balise group information.</li> <li>• Providing the last recently passed linked balise group as the LRBG.</li> <li>• Providing additional position attribute information.</li> <li>• Deleting stored balise groups, when appropriate.</li> <li>• Detecting linking consistency errors.</li> <li>• Determining, if linking is used on board.</li> </ul> <p>The calculation algorithms for locations and positions are implemented as specified in <a href="https://github.com/openETCS/SRS-Analysis/blob/master/System%20Analysis/WorkingRepository/Group4/SUBSET_26_3-6/DetermineTrainLocationProcedures.pdf">https://github.com/openETCS/SRS-Analysis/blob/master/System%20Analysis/WorkingRepository/Group4/SUBSET_26_3-6/DetermineTrainLocationProcedures.pdf</a></p> |
|-------------|---|

|                        |  |
|------------------------|--|
| Input documents        | Subset-026, Chapter 3.6  |
| Safety integrity level | 4  |
| Time constraints       | n/a  |
| API requirements       | <p>Cf. interface description of parent component.</p> <p>To be updated since there is no parent component anymore.</p> |

## 359 5.7.2 Interface

360 An overview of the interface of component calculateTrainPosition is shown in Figure 12. The  
 361 inputs and outputs are described in detail in Section 5.7.2.1 respectively 5.7.2.2. Subcomponents  
 362 are described in Section 5.7.3.

### 363 5.7.2.1 Inputs



Figure 12. calculateTrainPosition SysML diagram

364 5.7.2.1.1 currentOdometry

|             |   |
|-------------|---|
| Input name  | currentOdometry   |
| Description | currentOdometry is the actual odometry information as known by the whole EVC model and provided by the models external interface. |
| Source      | External model interface input  |
| Type        | Obu_BasicTypes_Pkg::odometry_T  |

|   |   |
|---|---|
| Valid range of values   | <p>Obu_BasicTypes_Pkg::odometry_T is a complex data type. Values are given for each element. Format is: Type Name: range / list of values.</p> <ul style="list-style-type: none"> <li>• bool valid: [true   false]. Must be permanently set to "true".</li> <li>• timestamp: (0 - 2147483647). Current time in ms, must be monotonically increasing.</li> <li>• odo: Obu_BasicTypes_Pkg::OdometryLocations_T: current odometry log values with uncertainties; must behave according to <a href="https://github.com/openETCS/SRS-Analysis/blob/master/System%20Analysis/WorkingRepository/Group4/SUBSET_26_3-6/DetermineTrainLocationProcedures.pdf">https://github.com/openETCS/SRS-Analysis/blob/master/System%20Analysis/WorkingRepository/Group4/SUBSET_26_3-6/DetermineTrainLocationProcedures.pdf</a> [[ 3.1 ]]. Members of OdometryLocations_T are: <ul style="list-style-type: none"> <li>– o_nominal: L_internal_Type: nominal value in cm.</li> <li>– o_min: L_internal_Type:<br/>min. distance = o_min2 - o_min1</li> <li>– o_max: L_internal_Type:<br/>max distance = o_max2 - o_max1</li> </ul> </li> <li>• speed: Obu_BasicTypes_Pkg::OdometrySpeeds_T: not used by calculateTrainPosition</li> <li>• acceleration: Obu_BasicTypes_Pkg::A_internal_Type: not used by calculateTrainPosition</li> <li>• motionState: [noMotion   Motion]</li> <li>• motionDirection: Obu_BasicTypes_Pkg::odoMotionDirection_T [ unknownDirection   cabAFirst   cabBFirst ]</li> </ul> <p><i>calculateTrainPosition requires consistent value sets of currentOdometry. calculateTrainPosition itself does not check.</i></p> |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | Enumerated values out of range prohibit code generation. In all other cases, calculateTrainPosition does not have the knowledge for out-of-range checks.  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | To be completed   |

#### 365 5.7.2.1.2 msgFromTrack

|             |   |
|-------------|---|
| Input name  | msgFromTrack  |
| Description | With msgFromTrack calculateTrainPosition receives datagrams from balise groups and RBC. |

|                                     |   |
|-------------------------------------|---|
| Source                              | Manage_TrackSideInformation_Integration_Pkg::<br>Manage_TrackSideInformation_Integration/   |
| Type                                | Common_Types_Pkg::ReceivedMessage_T   |
| Valid range of values               | <p>Common_Types_Pkg::ReceivedMessage_T is a complex data type. Values are given for each element. Format is: Type Name: range / list of values.</p> <ul style="list-style-type: none"> <li>• bool valid: [true   false]. "true" flags a datagram as received and to be evaluated by calculateTrainPosition. Must be set for exactly 1 clock for each received datagram and stay unset otherwise.</li> <li>• source: Common_Types_Pkg::MsgSource_T: Designates the source of the datagram:<br/>( msrc_undefined   msrc_Euroradio   msrc_Eurobalise   msrc_RadioInfillUnit   msrc_OBU )</li> <li>• radioMetaData: Common_Types_Pkg::radioMetaData_T: not used by calculateTrainPosition.</li> <li>• BG_Common_Header: BG_Types_Pkg::BG_Header_T: Header information received from balise groups, refer to Manage_TrackSideInformation_Integration_Pkg::<br/>Manage_TrackSideInformation_Integration</li> <li>• Radio_Common_Header: Radio_Types_Pkg::Radio_TrackTrain_Header_T: Header information received from RBC via radio, refer to Manage_TrackSideInformation_Integration_Pkg::<br/>Manage_TrackSideInformation_Integration</li> <li>• packets: Common_Types_Pkg::CompressedPackets_T: datagram packets, refer to Manage_TrackSideInformation_Integration_Pkg::<br/>Manage_TrackSideInformation_Integration. calculates-TrainPosition extracts packet 5 (linking information), if available.</li> <li>• sendingRBC: Common_Types_Pkg::RBC_Id_T: designates the origin RBC and the mobile modem channel used onboard, if received via radio. Refer to Manage_TrackSideInformation_Integration_Pkg::<br/>Manage_TrackSideInformation_Integration for more detailed information.</li> </ul> <p><i>calculateTrainPosition expects the received information to be consistent and validated before applied to. It does not check, if the information is appropriate due to current EVC mode, level, train or balise orientation. Received balise group or linking information already known by calculateTrainPosition overrides former data.</i></p> |
| Behaviour when value is at boundary | n/a   |

|   |  |
|---|--|
| Behaviour for values out of valid range                               | Enumerated values out of range prohibit code generation. In all other cases, calculateTrainPosition does not have the knowledge for out-of-range checks. |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | To be completed  |

### 366 5.7.2.1.3 trainProperties

|                       |  |
|-----------------------|--|
| Input name            | trainProperties  |
| Description           | Supplies calculateTrainPosition with train specific properties required for position calculation.  |
| Source                | EVC_Support_Pkg::maintainTrainProperties   |
| Type                  | TrainPosition_Types_Pck::trainProperties_T   |
| Valid range of values | <p>TrainPosition_Types_Pck::trainProperties_T is a complex data type. Values are given for each element. Format is: Type Name: range / list of values.</p> <ul style="list-style-type: none"> <li>• nid_engine:: NID_ENGINE as defined by subset 026-7.</li> <li>• nid_operational: NID_OPERATIONAL as defined by subset 026-7.</li> <li>• l_train: L_TRAIN as defined by subset 026-7.</li> <li>• d_baliseAntenna_2_frontend: Obu_BasicTypes_Pkg::LocWithInAcc_T: Distance from the trains balise antenna to the trains front end, in cm with uncertainties.</li> <li>• d_frontend_2_rearend: Obu_BasicTypes_Pkg::LocWithInAcc_T: Distance from the trains Distance from the trains front end to rear end, in cm with uncertainties.</li> <li>• locationAccuracy_DefaultValue: Obu_BasicTypes_Pkg::LocWithInAcc_T: Default location accuracy of balise groups (subset 026, 3.6.4.3.2), in cm with uncertainties.</li> <li>• centerDetectionAcc_DefaultValue: Obu_BasicTypes_Pkg::LocWithInAcc_T: Default accuracy of balise groups detection of the BTM, in cm with uncertainties. Will be applied, if centerDetectionInaccuracy from BTM is not available, especially for announced and not yet passed BGs.</li> </ul> <p><i>calculateTrainPosition expects this information to be consistent and validated before applied to.</i></p> |

Behaviour when value is at boundary n/a

Behaviour for values out of valid range Enumerated values out of range prohibit code generation. In all other cases, calculateTrainPosition does not have the knowledge for out-of-range checks.

Behaviour when value is erroneous, absent or unwanted (i.e. spurious)

To be completed

#### 367 5.7.2.1.4 passedBG

Input name passedBG

Description Deprecated alternative input to msgFromTrack. Must not be used any more and is subject to be removed in subsequent releases.

#### 368 5.7.2.1.5 reset

Input name reset

Description Resets and keeps calculateTrainPosition at its initial state and deletes all internally stored data.

Source

needs to be updated

whom it may concern/

Type bool

Valid range of values [ false | true ]

Behaviour when value is at boundary n/a

Behaviour for values out of valid range Enumerated values out of range prohibit code generation.

Behaviour when value is erroneous, absent or unwanted (i.e. spurious)

To be completed

#### 369 5.7.2.2 Outputs

##### 370 5.7.2.2.1 trainPosition

Output name trainPosition

|             |  |
|-------------|--|
| Description | Provides the current train position and LRBG with its attributes. All distance and location computations of the OBU must be based on this information. |
| Destination | Any drain component which needs the current train position or LRBG.  |
| Type        | TrainPosition_Types_Pck::trainPosition_T   |

|   |  |
|---|--|
| Valid range of values                   | <p>TrainPosition_Types_Pck::trainPosition_T is a complex data type. Values are given for each element. Format is: Type Name: range / list of values.</p> <ul style="list-style-type: none"> <li>• valid: bool: [true   false]. Always true, except for exceptional circumstances.</li> <li>• timestamp: Obu_BasicTypes_Pkg::T_internal_Type: latest time in ms.</li> <li>• trainPositionIsUnknown: bool: true, if the train position is evaluated as "unknownwn" (refer to subset-026, 3.6.3.1.3.1).</li> <li>• noCoordinateSystemHasBeenAssigned: bool: refer to subset 026, 3.4.2, 3.6.3.1.4.</li> <li>• trainPosition: Obu_BasicTypes_Pkg::LocWithInAcc_T: The calculated train position with uncertainties</li> <li>• estimatedFrontEndPosition: Obu_BasicTypes_Pkg::Location_T: Train front end position in cm.</li> <li>• minSafeFrontEndPosition: Obu_BasicTypes_Pkg::Location_T: Train front end position in cm.</li> <li>• maxSafeFrontEndPostion: Obu_BasicTypes_Pkg::Location_T: Train front end position in cm.</li> <li>• LRBG: TrainPosition_Types_Pck::positionedBG_T: the current LRBG.</li> <li>• prvLRBG: TrainPosition_Types_Pck::positionedBG_T: the balise group passed previously to LRBG. For type definition, see below.</li> <li>• nominalOrReverseToLRBG: Q_DLRBG: Orientation of the train in relation to the direction of the LRBG, see subset 026-7.</li> <li>• trainOrientationToLRBG: Q_DIRLRBG: Orientation of the train in relation to the direction of the LRBG, see subset 026-7.</li> <li>• trainRunningDirectionToLRBG: Q_DIRTRAIN: Direction of train movement in relation to the LRBG orientation, see subset 026-7.</li> <li>• linkingIsUsedOnboard: bool: Designates, if at least one announced linked BG is ahead.</li> </ul> <p><i>calculateTrainPosition provides the train position to whom it concerns and recalculates it in every clock cycle.</i></p> |
| Behaviour when value is at boundary     | n/a  |
| Behaviour for values out of valid range | n/a  |



Behaviour when value is erroneous, absent or unwanted n/a

### 371 5.7.2.2.2 BGs

|   |   |
|---|---|
| Output name                             | BGs   |
| Description                             | A list of all linked and unlinked balise groups - known to calculate-TrainPosition - in the order they are arranged on the track.   |
| Destination                             | Any subsequent component which needs the current collection of balises groups.  |
| Type                                    | array of TrainPosition_Types_Pck::positionedBG_T  |
| Valid range of values                   | <p>TrainPosition_Types_Pck::positionedBG_T is a complex data type. Values are given for each array element. Format is: Type Name: range / list of values.</p> <ul style="list-style-type: none"> <li>• valid: bool: [true   false]. "true" for every existing balise group.</li> <li>• nid_c: NID_C: refer to subset 026-7.</li> <li>• nid_bg: NID_BG: refer to subset 026-7.</li> <li>• q_link: Q_LINK: refer to subset 026-7.</li> <li>• location: Obu_BasicTypes_Pkg::LocWithInAcc_T: The best known location (with inaccuracies) calculated from linking and from passing information.</li> <li>• seqNoOnTrack: int: Sequence number, specifies the order of the BG passed or expected to be passed.</li> <li>• infoFromLinking: TrainPosition_Types_Pck::infoFromLinking_T: Describes a linked BG as announced from the linking BG. Mainly, this information is taken from the linking packet.</li> <li>• infoFromPassing: BG_Types_Pkg::passedBG_T: If the balise group has been passed already, this is the relevant information received from the BG.</li> </ul> <p><i>calculateTrainPosition provides the list of balise groups to whom it concerns.</i></p> |
| Behaviour when value is at boundary     | n/a   |
| Behaviour for values out of valid range | n/a   |

Behaviour when value is erroneous, absent or unwanted n/a

### 372 5.7.2.2.3 errors

|                       |   |
|-----------------------|---|
| Output name           | errors  |
| Description           | Provides a collection of error flags, raised by calculateTrainPosition.   |
| Destination           | Error handlers and components which need to know of common and linking consistency errors.  |
| Type                  | TrainPosition_Types_Pck::positionErrors_T   |
| Valid range of values | <p>TrainPosition_Types_Pck::positionErrors_T is a complex data type. Values are given for each array element. Format is: Type Name: range / list of values.</p> <ul style="list-style-type: none"> <li>• outOfMemSpace: bool: Memory overrun: a passed or announced BG could not be stored.</li> <li>• passedBG_foundNotWhereExpected: bool: The currently passed linked BG location does not match its expectation window.</li> <li>• positionCalculation_inconsistent: A consistency problem arose during position calculation.</li> <li>• linkedBGMissed: bool: The expectation window for an announced BG was passed without detecting the BG.</li> <li>• BGpassedInUnexpectedDirection: bool: The BG was passed in a different orientation than announced via linking.</li> <li>• BG_LinkingConsistencyError: bool: Linking consistency error (ref. subset 026, 3.16.2.3).</li> <li>• twoConsecutiveLinkedBGs_missed: bool: 2 consecutive linked balise groups announced by linking are not detected and the end of the expectation window of the second balise group has been passed (subset 026, 3.16.2.7.1).</li> <li>• doubleRepositioningError: bool: Double repositioning error (3.16.2.7.2).</li> <li>• bg: TrainPosition_Types_Pck::positionedBG_T: The corresponding balise group in the case of an error.</li> </ul> |

Behaviour when value is at boundary n/a

Behaviour for values out of valid range n/a

|   |     |
|---|-----|
| Behaviour when value is erroneous, absent or unwanted | n/a |
|---|-----|

### 373 5.7.3 Subcomponents

374 calculateTrainPosition subcomponents need to be documented

#### 375 5.7.3.1 msg\_2\_passedBG

##### 376 5.7.3.1.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | msg_2_passedBG  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Uwe Steinke, Siemens AG   |
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

##### 377 5.7.3.1.2 Interface

378 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
379 above) respectively the SCADE generated documentation.

#### 380 5.7.3.2 calculateBGLocations

##### 381 5.7.3.2.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | calculateBGLocations  |
| Link to SCADE model | <a href="http://???">http://???</a>   |
| SCADE designer      | Uwe Steinke, Siemens AG   |
| Description         | [Brief description of the components functionality]                         |
| Input documents     | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |

|                        |  |
|------------------------|--|
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a] |
| API requirements       | [If applicable description of API requirements, otherwise n/a] |

### 382 5.7.3.2.2 Interface

383 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
384 above) respectively the SCADE generated documentation.

### 385 5.7.3.3 delDispensableBGs

#### 386 5.7.3.3.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | delDispensableBGs   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Uwe Steinke, Siemens AG   |
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

### 387 5.7.3.3.2 Interface

388 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
389 above) respectively the SCADE generated documentation.

### 390 5.7.3.4 addAnnounceBGs

#### 391 5.7.3.4.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | addAnnounceBGs                                      |
| Link to SCADE model | <a href="http://???">http://???</a>                 |
| SCADE designer      | Uwe Steinke, Siemens AG                             |
| Description         | [Brief description of the components functionality] |

|                        |   |
|------------------------|---|
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 392 5.7.3.4.2 Interface

393 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
394 above) respectively the SCADE generated documentation.

#### 395 5.7.3.5 calculateTrainpositionInfo

##### 396 5.7.3.5.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | calculateTrainpositionInfo  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Uwe Steinke, Siemens AG   |
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 397 5.7.3.5.2 Interface

398 For an overview of the interface of this internal component we refer to the SCADE model  
399 (c.f. link above) respectively the SCADE generated documentation.

#### 400 5.7.3.6 calculateTrainPositionAttributes

##### 401 5.7.3.6.1 Component Requirements

|                     |                                     |
|---------------------|-------------------------------------|
| Component name      | calculateTrainPositionAttributes    |
| Link to SCADE model | <a href="http://???">http://???</a> |
| SCADE designer      | Uwe Steinke, Siemens AG             |

|                        |   |
|------------------------|---|
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 402 5.7.3.6.2 Interface

403 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
404 above) respectively the SCADE generated documentation.

#### 405 5.7.3.7 linkedBG\_missed

##### 406 5.7.3.7.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | linkedBG_missed   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Uwe Steinke, Siemens AG   |
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 407 5.7.3.7.2 Interface

408 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
409 above) respectively the SCADE generated documentation.

#### 410 5.7.3.8 twoconsecutiveLinkedBGs\_missed

##### 411 5.7.3.8.1 Component Requirements

|                     |                                     |
|---------------------|-------------------------------------|
| Component name      | twoconsecutiveLinkedBGs_missed      |
| Link to SCADE model | <a href="http://???">http://???</a> |

|                        |   |
|------------------------|---|
| SCADE designer         | Uwe Steinke, Siemens AG   |
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

### 412 5.7.3.8.2 Interface

413 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
414 above) respectively the SCADE generated documentation.

## 5.8<sup>415</sup> F2.7: SpeedSupervision\_Integration

### 416 5.8.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | SpeedSupervision_Integration  |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision</a>   |
| SCADE designer      | Benjamin Beichler, University of Rostock<br>Christian Stahl, TWT<br>Thorsten Schulz, University of Rostock  |
| Description         | <p>The task of SDM is to monitor the speed of the train and the train location and as such to ensure that the speed remains within the given speed and distance limits. This block is based on [1, Chapt. 3.13]. The integration node “SpeedSupervision_Integration” takes as input (1) movement related information such as train speed, train position and acceleration, (2) train related information such as brake information and train length, and (3) track related information such as speed and distance limits and national values.</p> <p>Based on this information a speed profile is calculated. Speed restrictions create target speeds (targets) that have to be followed. For each such target braking curves are generated to supervise at which location of the track the train must apply the brake. In case of no target restrictions the train may accelerate to the supervised maximum speed of the speed profile. These calculations lead to commands being sent to the driver and the brake system.</p> <p>The functionality is modeled using eight subcomponents, as shown in Figure 13, which are explained in Section 5.8.3.</p> <p>The current status of the analysis of “SDM” and a functional breakdown can be found in a separate document, SpeedSupervision_analysis.pdf.</p> |

|                        |   |
|------------------------|---|
| Input documents        | Subset-026, Chapter 3.13: Speed and distance monitoring |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

## 417 5.8.2 Interface

418 An overview of the interface of component SpeedSupervision\_integration is shown in Figure 13.  
 419 The inputs and outputs are described in detail in Section 5.8.2.1 respectively 5.8.2.2. Sub  
 420 components are described in Section 5.8.3.

### 421 5.8.2.1 Inputs

#### 422 5.8.2.1.1 NationalValues

|   |  |
|---|--|
| Input name  | NationalValues   |
| Description   | This input is packet 3 of [1, Chapt. 8], describing the national values. |
| Source  | Track Atlas Data<br>Exact name of SCADE component shall be used          |
| Type  | P3_NationalValues_T  |
| Valid range of values   | P3_NationalValues_T is a complex data type<br>To be completed            |
| Behaviour when value is at boundary                                   | As specified in SRS.<br>To be completed, explicitly describe behaviour   |
| Behaviour for values out of valid range                               | Currently not checked.   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | Not checked; node must not be called without reasonable National Value.  |

#### 423 5.8.2.1.2 TrainPosition

|             |   |
|-------------|---|
| Input name  | TrainPosition                             |
| Description | This input is the current train position. |



|   |  |
|---|--|
| Source  | Manage Track Data<br>Exact name of SCADE component shall be used       |
| Type  | trainPosition_T  |
| Valid range of values   | complex data type<br>To be completed                                   |
| Behaviour when value is at boundary                                   | Not checked, may overflow.   |
| Behaviour for values out of valid range                               | Currently not checked.   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | Not checked; node must not be called without reasonable position data. |

#### 424 5.8.2.1.3 odometry

|   |  |
|---|--|
| Input name  | odometry   |
| Description   | This input is the odometry data.   |
| Source  | Odometry   |
| Type  | odometry_T   |
| Valid range of values   | complex data type<br>used fields are:<br>- acceleration: Obu_BasicTypes_Pkg::A_internal_Type. No valid range defined, neither checked.<br>- motionState: [noMotion   Motion] (enum type) |
| Behaviour when value is at boundary                                   | Possible overflow not evaluated.   |
| Behaviour for values out of valid range                               | Not checked.   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | Not handled, valid data is expected for valid function.  |

#### 425 5.8.2.1.4 m\_level

|            |         |
|------------|---------|
| Input name | m_level |
|------------|---------|

|   |  |
|---|--|
| Description   | This input is the current level of the train. (will be removed in next release!) |
| Source  | Mode and Level<br>Exact name of SCADE component shall be used                    |
| Type  | M_LEVEL  |
| Valid range of values   | Enum type, valid range is ensured at compile time.                               |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a  |

#### 426 5.8.2.1.5 trainProps

|   |   |
|---|---|
| Input name  | trainProps  |
| Description   | This input is a set of train related properties.  |
| Source  | Database<br>Exact name of SCADE component shall be used   |
| Type  | trainProperties_T   |
| Valid range of values   | complex type<br>used fields are:<br>d_baliseAntenna_2_frontend.nominal:<br>Obu_BasicTypes_Pkg::L_internal_Type No valid range defined, neither checked.                               |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | n/a   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | Value is only evaluated in Level 1. Low values (e.g. invalid-default 0) will lead to early trip, brake and alike. Larger values will lead to late braking, possibly numeric overflow. |

#### 427 5.8.2.1.6 MRSP

|   |   |
|---|---|
| Input name  | MRSP  |
| Description   | This input is the most restrictive speed profile.   |
| Source  | Track Atlas<br>Exact name of SCADE component shall be used  |
| Type  | MRSP_Profile_t  |
| Valid range of values   | complex type<br>To be completed   |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | n/a   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | At least one valid entry is expected (the maximum vehicle speed), else a trip shall be commanded. |

428 **5.8.2.1.7 MA**

|   |  |
|---|--|
| Input name  | MA   |
| Description   | This input is a movement authority.                |
| Source  | To be completed                                    |
| Type  | MAs_t  |
| Valid range of values   | complex type<br>To be completed                    |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | On .valid = false, brake/trip should be commanded. |

429 **5.8.2.1.8 MA\_updated**

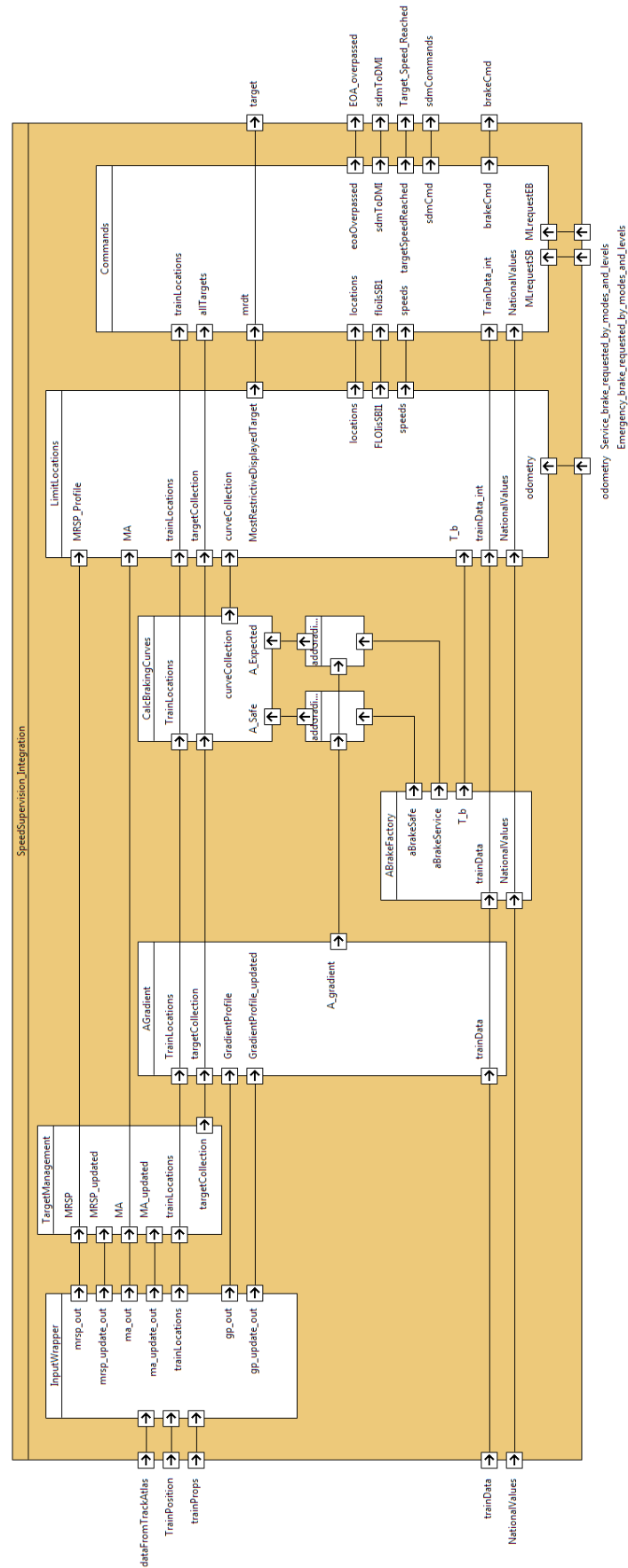


Figure 13. Structure of component SpeedSupervision\_Integration.

|   |   |
|---|---|
| Input name  | MA_updated  |
| Description   | This flag is true if the movement authority has been updated in this clock cycle and false otherwise. |
| Source  | internal<br>To be checked   |
| Type  | bool  |
| Valid range of values   | <b>true</b> ???<br><b>false</b> ???<br>To be completed  |
| Behaviour when value is at boundary                                   | Limited range, check at compile time.<br>How can can this be checked at compile time?                 |
| Behaviour for values out of valid range                               | Limited range, check at compile time.<br>How can can this be checked at compile time?                 |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a   |

430 **5.8.2.1.9 MRSP\_updated**

|             |   |
|-------------|---|
| Input name  | MRSP_updated  |
| Description | This flag is true if the most restrictive speed profile has been updated in this clock cycle and false otherwise. |
| Source      | internal<br>To be completed   |
| Type        | bool  |

Valid range of values

**true** ???

**false** ???

To be completed

Behaviour when value is at boundary

Limited range, check at compile time.

How can can this be checked at compile time?

Behaviour for values out of valid range

Limited range, check at compile time.

How can can this be checked at compile time?

Behaviour when value is erroneous, absent or unwanted (i.e. spurious)

n/a

## 431 5.8.2.2 Outputs

### 432 5.8.2.2.1 sdmToDMI

|   |  |
|---|--|
| Output name   | sdmToDMI   |
| Description   | This output contains information about different speeds and positions, on the one hand and the current supervision status, on the other hand. This information shall be displayed to the driver. |
| Destination   | DMI<br>should this be ManageDMIOutput?   |
| Type  | speedSupervisionForDMI_T   |
| Valid range of values   | to be completed  |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | Valid can be false.  |

433 **5.8.2.2.2 target**

|   |  |
|---|--|
| Output name   | target   |
| Description   | This output is the most restrictive displayed target (MRDT).   |
| Destination   | [Name of the destination component(s)]<br>To be completed  |
| Type  | Target_T   |
| Valid range of values   | To be completed  |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | .valid may be false if no target is supervised or known, other values of this output must be ignored then. |

434 **5.8.2.2.3 sdmCommands**

|   |  |
|---|--|
| Output name   | sdmCommands  |
| Description   | This output gives some intermediate results of operator SDM_Commands. It is currently used for test purposes only. |
| Destination   | [Name of the destination component(s)]<br>To be completed  |
| Type  | SDM_Commands_T   |
| Valid range of values   | To be completed  |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | Overall .valid is always set, individual speeds have their corresponding valid flag.                               |

435 **5.8.2.2.4 brakeCmd**

|   |  |
|---|--|
| Output name   | brakeCmd   |
| Description   | This output is the brake command, indicating whether performing the service brake or the emergency brake have been commanded.        |
| Destination   | [Name of the destination component(s)]<br>To be completed  |
| Type  | Brake_command_T (enum)   |
| Valid range of values   | <ul style="list-style-type: none"> <li>• brake_signal_command_not_defined</li> <li>• apply_brake</li> <li>• release_brake</li> </ul> |
| Behaviour when value is at boundary                                   | n/a  |
| Behaviour for values out of valid range                               | n/a  |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a  |

436 **5.8.2.2.5 EOA\_overpassed**

|                       |  |
|-----------------------|--|
| Output name           | EOA_overpassed   |
| Description           | This output is true if the end of authority has been overpassed and false otherwise. |
| Destination           | [Name of the destination component(s)]<br>To be completed                            |
| Type                  | bool   |
| Valid range of values | <p><b>true</b> ???</p> <p><b>false</b> ???</p> <p>To be completed</p>                |



|                                     |     |
|-------------------------------------|-----|
| Behaviour when value is at boundary | n/a |
|-------------------------------------|-----|

|   |     |
|---|-----|
| Behaviour for values out of valid range | n/a |
|---|-----|

|   |     |
|---|-----|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a |
|---|-----|

#### 437 5.8.2.2.6 Target\_Speed\_Reached

|   |   |
|---|---|
| Output name   | Target_Speed_Reached  |
| Description   | This output is true if the current speed is greater than or equal the target speed and false otherwise. |
| Destination   | [Name of the destination component(s)]<br>To be completed   |
| Type  | bool  |
| Valid range of values   | <b>true</b> ???<br><b>false</b> ???<br>To be completed  |
| Behaviour when value is at boundary                                   | n/a   |
| Behaviour for values out of valid range                               | n/a   |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | n/a   |

### 438 5.8.3 Subcomponents

#### 439 5.8.3.1 SDM\_InputWrapper

##### 440 5.8.3.1.1 Component Requirements

|                |                  |
|----------------|------------------|
| Component name | SDM_InputWrapper |
|----------------|------------------|

|                        |   |
|------------------------|---|
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SpeedSupervision_Integration">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SpeedSupervision_Integration</a>   |
| SCADE designer         | Benjamin Beichler, University of Rostock<br>Thorsten Schulz, University of Rostock  |
| Description            | The motivation for this operator is to convert all inputs of SDM that contain information about length, speed, distance, and acceleration defined as integer into real to allow automatically the highest precision in the calculations by the meaning of floating point operations. In addition, to ease the modeling, inside block “Speed Supervision” only units meters ( $[m]$ ), seconds ( $[s]$ ), meters per second ( $[\frac{m}{s}]$ ), and meters per square second ( $[\frac{m}{s^2}]$ ) are used.<br>This operator forwards input messages, takes data from complex data types or transforms inputs messages into an internal type thereby converting int to real. |
| Input documents        | Subset-026, Chapter 3.13, (not specific, helper function)   |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 441 5.8.3.1.2 Interface

442 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
443 above) respectively the SCADE generated documentation.

#### 444 5.8.3.2 TargetManagement

##### 445 5.8.3.2.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | TargetManagement  |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/TargetManagement">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/TargetManagement</a> |
| SCADE designer      | Benjamin Beichler, University of Rostock<br>Thorsten Schulz, University of Rostock  |

**Description** This operator calculates/updates the list of targets to be supervised by SDM. Taking the current movement authority, the most restrictive speed profile and the current maximum safe front end position as an input, the operator outputs a list of MRSP-Targets and a Limit-of-Authority-Target (LoA) or, if an End of Authority is known, the End-of-Authority-Target (EoA) and the Supervised Location (SvL). Since LoA and SvL are mutually exclusive but both result in a trip-target, they use the same flow.

#### **Derivation of Targets from Movement Authority**

The *Movement Authority* creates three types of targets:

**Limit of Authority (LoA)** if the End of Authority is not yet known to the RBC and is accompanied by a speed limit for the given location.

**End Of Authority (EoA)** requires the train to stop and creates a Service Brake Target

**Supervised Location (SvL)** is derived from the EoA but results in an emergency brake target and on passing in a trip. The SvL may be offset from the EoA to the Overlap (OL) or the Dangerpoint (DP).

#### **Derivation of Targets from MRSP**

According to [1, Chapt. 3.13.8.2], every speed decrease of the MRSP is used to derive a target. Therefore in every cycle in which the MRSP is updated, the operator iterates through the entire MRSP searching for all MRSP targets. For this purpose, every element of the MRSP is compared with its successor.

#### **Update of Targets**

In every cycle the operator monitors whether all targets are already passed. To this end, it iterates over the list of targets comparing the current front end position with the target's location.

|                        |   |
|------------------------|---|
| Input documents        | Subset-026, Chapter 3.13.8.2: Determination of the supervised targets |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 446 **5.8.3.2.2 Interface**

447 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
448 above) respectively the SCADE generated documentation.

#### 449 **5.8.3.3 CalcBrakingCurves\_Integration**

##### 450 **5.8.3.3.1 Component Requirements**

|                |                               |
|----------------|-------------------------------|
| Component name | CalcBrakingCurves_Integration |
|----------------|-------------------------------|

|                        |  |
|------------------------|--|
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/CalcBrakingCurves">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/CalcBrakingCurves</a>  |
| SCADE designer         | Benjamin Beichler, University of Rostock   |
| Description            | For each type of target a certain braking curve has to be calculated. This curve enables proactive monitoring of the train's speed. A reverse lookup on this braking curve indicates, where the train has to start braking given the current speed. The braking curve does not depend on the actual train status. As a consequence the braking curve stays constant over time. As a legitimate simplification the calculation of the braking curve is not extended past the estimated front end position of the train. |
| Input documents        | Subset-026, Chapter 3.13.8.3: Emergency Brake Deceleration curves (EBD)<br>Subset-026, Chapter 3.13.8.4: Service Brake Deceleration curves (SBD)<br>Subset-026, Chapter 3.13.8.5: Guidance curves (GUI)  |
| Safety integrity level | 4  |
| Time constraints       | n/a  |
| API requirements       | n/a  |

#### 451 5.8.3.3.2 Interface

452 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
453 above) respectively the SCADE generated documentation.

#### 454 5.8.3.4 SDMLimitLocations

##### 455 5.8.3.4.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | SDMLimitLocations   |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SDM_TargetLimits">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SDM_TargetLimits</a> |
| SCADE designer      | Thorsten Schulz, University of Rostock  |

|                        |   |
|------------------------|---|
| Description            | <p>This operator calculates the various locations and speeds needed to determine the speed and distance monitoring commands. The current implementation of functionality is stateless and requires a complete recalculation each cycle.</p> <p>This operator gathers all necessary input values and computes some frequently used intermediate values in the operators <code>surplusTractionDeltas</code> and <math>v_{bec}</math>. The other input preparation operator is the <code>TargetSelector</code> whose main task is to dissect the list of targets to find the Most Restrictive Target. The accompanying braking curves are extracted and promoted to trailing location calculations. Also the special values of the EOA are exposed.</p> <p>The operator creates the requested values for the commands package. These are in particular the preindication locations for EBD and SBD based targets, the release speed monitoring start locations, the locations for target speed monitoring of the I-, W-, P- and FLOI-curve, the related FLOI speed and the location of the permitted speed supervision limit. Included in the output are also certain flags for the validity of linked values.</p> |
| Input documents        | <p>Subset-026, Chapter 3.13.9: Supervision Limits</p> <p>Subset-026, Chapter 5.3.1.2: <math>f_{41}</math> – accuracy of speed known on-board</p> <p>Subset-026, Chapter 3.13.10: Monitoring Commands as reference for required outputs of this module</p>   |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 456 5.8.3.4.2 Interface

457 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
458 above) respectively the SCADE generated documentation.

#### 459 5.8.3.5 CalcSpeeds

##### 460 5.8.3.5.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | CalcSpeeds  |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SpeedSupervision_Integration">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SpeedSupervision_Integration</a> |
| SCADE designer      | Benjamin Beichler, University of Rostock  |
| Description         | This operator calculates some speeds needed to determine the speed and distance monitoring commands. This operator will be integrated into other operators in the next iteration.   |

|                        |   |
|------------------------|---|
| Input documents        | Subset-026, Chapter 3.8: Movement authority |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 461 5.8.3.5.2 Interface

462 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
463 above) respectively the SCADE generated documentation.

#### 464 5.8.3.6 ReleaseSpeed\_Selection

##### 465 5.8.3.6.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | ReleaseSpeed_Selection  |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SpeedSupervision_Integration">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SpeedSupervision_Integration</a> |
| SCADE designer         | Thorsten Schulz, University of Rostock  |
| Description            | This operator outputs the release speed which can be given either by the national values or the movement authority. This operator will be integrated into other operators in the next iteration.  |
| Input documents        | Subset-026, Chapter 3.8: Movement authority   |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 466 5.8.3.6.2 Interface

467 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
468 above) respectively the SCADE generated documentation.

#### 469 5.8.3.7 SDM\_Commands

##### 470 5.8.3.7.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | SDM_Commands  |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SDM_Commands">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SDM_Commands</a> |

|                        |   |
|------------------------|---|
| SCADE designer         | Christian Stahl, TWT<br>Thorsten Schulz, University of Rostock  |
| Description            | <p>This operator models the speed and distance monitoring commands. More precisely, it triggers the service or emergency brake and outputs the current supervision status of the OBU together with information on speeds and locations to the driver.</p> <p>The OBU can be in any of three types of speed and distance monitoring modes: ceiling speed monitoring, release speed monitoring and target speed monitoring. We use a state machine to model the switching between the three modes: each state models a mode and a transition between to states is enabled if the condition two switch between the two corresponding modes is evaluated to true. In each mode, the OBU can be in up to five different supervision stati. The behavior of changing from one status to another is also modeled as a state machine. As a result, the model is a hierarchical state machine.</p> |
| Input documents        | Subset-026, Chapter 3.13.10: Speed and distance monitoring commands   |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 471 5.8.3.7.2 Interface

472 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
473 above) respectively the SCADE generated documentation.

#### 474 5.8.3.8 SDM\_OutputWrapper

##### 475 5.8.3.8.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | SDM_OutputWrapper   |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SpeedSupervision_Integration">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/SpeedSupervision/SpeedSupervision_Integration</a>   |
| SCADE designer      | Benjamin Beichler, University of Rostock<br>Thorsten Schulz, University of Rostock  |
| Description         | <p>This operator is the counterpart to operator SDM_OutputWrapper—that is, it converts all internal outputs of SDM that contain information about length, speed, distance, and acceleration defined as real into int, such that all other blocks can stick to their types and also performs the calculation into units used by the environment.</p> <p>This operator forwards input messages and transforms inputs messages into an internal type thereby converting real to int.</p> |

|                        |   |
|------------------------|---|
| Input documents        | Subset-026, Chapter 3.13.10: Speed and distance monitoring commands |
| Safety integrity level | 4   |
| Time constraints       | n/a   |
| API requirements       | n/a   |

#### 476 5.8.3.8.2 Interface

477 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
478 above) respectively the SCADE generated documentation.

### 5.9<sup>479</sup> F2.8: Provide\_Position\_Report

#### 480 5.9.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | Provide_Position_Report   |
| Link to SCADE model    | ???<br>Link has to be provided.   |
| SCADE designer         | Christian Stahl, TWT GmbH   |
| Description            | <p>The component builds a position report for the RBC, i.e., message 132, and provides it as an output. There are two triggers for sending message 132:</p> <ol style="list-style-type: none"> <li>1. at least one of the triggers of the position report parameters (packet 58) holds or</li> <li>2. one of the events enabling the sending of the report occurs. As the core position report (i.e., packet 0 or 1) is added to other packets, the component also provides in every clock cycle this core position report. At most one of the two packets is valid.</li> </ol> |
| Input documents        | Subset-026, Chapter 3.6.5   |
| Safety integrity level | 4   |
| Time constraints       | <p>[If applicable description of time constraints, otherwise n/a]</p> <p>To be completed.</p>   |
| API requirements       | <p>[If applicable description of API requirements, otherwise n/a]</p> <p>To be completed.</p>   |



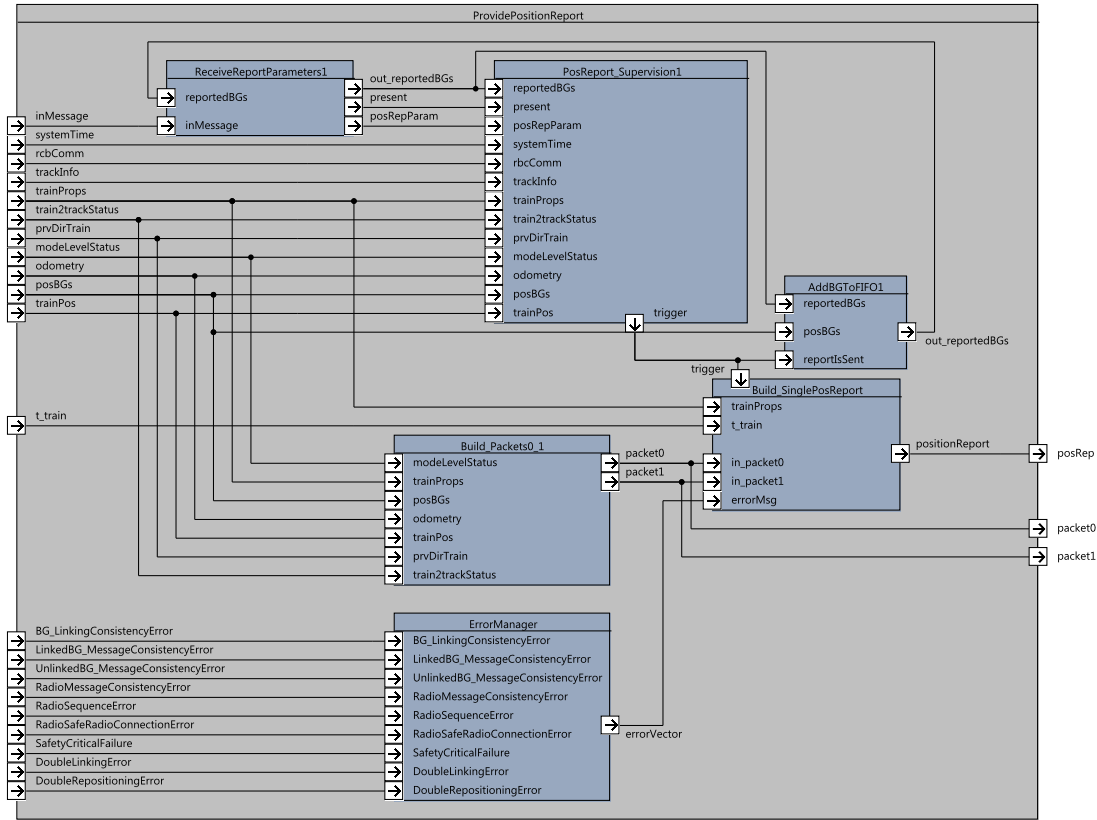


Figure 14. Provide\_Position\_Report component SysML diagram

5.9.2 Interface

An overview of the interface of component Provide\_Position\_Report is shown in Figure 14. The inputs and outputs are described in detail in Section 5.9.2.1 respectively 5.9.2.2. Subcomponents are described in Section 5.9.3.

5.9.2.1 Inputs

section has to be completed

5.9.2.1.1 [Input 1 name]

|   |  |
|---|--|
| Input name                              | [Name of the input]  |
| Description                             | [Brief description of the input]   |
| Source                                  | [Name of the source component]   |
| Type                                    | [Type of the input]  |
| Valid range of values                   | [Complete list of valid values]  |
| Behaviour when value is at boundary     | [Description of components behaviour when input value is at boundary]        |
| Behaviour for values out of valid range | [Description of components behaviour when input value is out of valid range] |

|   |   |
|---|---|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |
|---|---|

#### 488 5.9.2.1.2 [Input 2 name]

|   |   |
|---|---|
| Input name  | [Name of the input]   |
| Description   | [Brief description of the input]  |
| Source  | [Name of the source component]  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 489 5.9.2.2 Outputs

490 section has to be completed

#### 491 5.9.2.2.1 [Output 1 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

492 **5.9.2.2.2 [Output 2 name]**

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

493 **5.9.3 Subcomponents**

494 section has to be completed

495 **5.9.3.1 ReceiveReportParameters**496 **5.9.3.1.1 Component Requirements**

|                        |   |
|------------------------|---|
| Component name         | ReceiveReportParameters   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Christian Stahl, TWT  |
| Description            | The component reads the position report parameters (i.e., packet 58) from the message bus. When a report is received, the BG information provided is used to update the location of respective BG. This BG is being stored in the list of the last 8 BGs. |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ???   |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]  |
| API requirements       | [If applicable description of API requirements, otherwise n/a]  |

497 **5.9.3.1.2 Interface**

498 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
499 above) respectively the SCADE generated documentation.

### 500 **5.9.3.2 PosReport\_Supervision**

#### 501 **5.9.3.2.1 Component Requirements**

|                        |   |
|------------------------|---|
| Component name         | PosReport_Supervision   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Christian Stahl, TWT  |
| Description            | The component supervises trigger (i.e., position report parameter) and events that trigger the sending of a position report. If the output is true, then a report has to be sent. |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ???   |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]  |
| API requirements       | [If applicable description of API requirements, otherwise n/a]  |

#### 502 **5.9.3.2.2 Interface**

503 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
504 above) respectively the SCADE generated documentation.

### 505 **5.9.3.3 ErrorManager**

#### 506 **5.9.3.3.1 Component Requirements**

|                        |   |
|------------------------|---|
| Component name         | ErrorManager  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Christian Stahl, TWT  |
| Description            | The component takes all nine possible error messages as an input and aggregates them to a vector. |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ???                       |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]                                    |
| API requirements       | [If applicable description of API requirements, otherwise n/a]                                    |

### 507 5.9.3.3.2 Interface

508 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
509 above) respectively the SCADE generated documentation.

### 510 5.9.3.4 Build\_Packets0\_1

#### 511 5.9.3.4.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | Build_Packets0_1  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Christian Stahl, TWT  |
| Description            | The component builds packets 0 and 1; at most one of them is valid.         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

### 512 5.9.3.4.2 Interface

513 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
514 above) respectively the SCADE generated documentation.

### 515 5.9.3.5 Build\_PosReport

#### 516 5.9.3.5.1 Component Requirements

|                        |  |
|------------------------|--|
| Component name         | Build_PosReport  |
| Link to SCADE model    | <a href="http://???">http://???</a>  |
| SCADE designer         | Christian Stahl, TWT   |
| Description            | The component builds nine position report messages—there can be up to nine errors, and for each error an individual report has to be sent. |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ???  |
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]   |

|                  |  |
|------------------|--|
| API requirements | [If applicable description of API requirements, otherwise n/a] |
|------------------|--|

### 517 5.9.3.5.2 Interface

518 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
519 above) respectively the SCADE generated documentation.

### 520 5.9.3.6 AddBGToFIFO

#### 521 5.9.3.6.1 Component Requirements

|                        |  |
|------------------------|--|
| Component name         | AddBGToFIFO  |
| Link to SCADE model    | <a href="http://???">http://???</a>  |
| SCADE designer         | Christian Stahl, TWT   |
| Description            | The component adds the current reported BG to the list of BGs for which a report has been sent. Adding of this BG is performed according to the FIFO method. |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ???  |
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]   |
| API requirements       | [If applicable description of API requirements, otherwise n/a]   |

#### 522 5.9.3.6.2 Interface

523 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
524 above) respectively the SCADE generated documentation.

## 5.10<sub>5</sub> F2.9: Manage\_Radio\_Communication

526 section has to be completed. The level of this component in final architecture has been fixed.

### 527 5.10.1 Component Requirements

|                     |                            |
|---------------------|----------------------------|
| Component name      | Manage_Radio_Communication |
| Link to SCADE model | ???                        |
| SCADE designer      | Uwe Steinke, Siemens AG    |



Figure 15. Manage\_Radio\_Communication component SysML diagram

Description

to be checked

The management of radio communication MoRC implements the onboard management part of a single communication session with the track, i.e. a single RBC. It controls the establishing, maintaining and termination process of a radio communication session and steers the underlying communication safety layer and the mobile device. Those and the data transfer itself are not part of the function. The kernel function of the MoRC component is *managementOfRadioCommunication* (figure ???). The implementation is kept close to the prose of Subset-026, chap. 3.5. Since chap. 3.5 rarely refers to terms, variable types, packets and messages of the ETCS language as specified in Subset-026, chap. 7 and 8, *managementOfRadioCommunication* does neither. To be capable of being integrated with other OBU software components, *MoRC* had to be wrapped with a transformer between the ETCS and the "chap. 3.5" language. This is the purpose of the main function of *MoRC*, *MoRC\_Main*.

|                        |  |
|------------------------|--|
| Input documents        | Subset-026, Chapter 4<br>Subset-026, Chapter 5                 |
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a] |
| API requirements       | [If applicable description of API requirements, otherwise n/a] |

528 5.10.2 Interface

529 An overview of the interface of component Manage\_Radio\_Communication is shown in Figure 15.  
530 The inputs and outputs are described in detail in Section 5.10.2.1 respectively 5.10.2.2. Sub  
531 components are described in Section 5.10.3.

532 5.10.2.1 Inputs

533 5.10.2.1.1 [Input 1 name]

|            |                     |
|------------|---------------------|
| Input name | [Name of the input] |
|------------|---------------------|

|   |   |
|---|---|
| Description   | [Brief description of the input]  |
| Source  | [Name of the source component]  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

534 **5.10.2.1.2 [Input 2 name]**

|   |   |
|---|---|
| Input name  | [Name of the input]   |
| Description   | [Brief description of the input]  |
| Source  | [Name of the source component]  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

535 **5.10.2.2 Outputs**

536 **5.10.2.2.1 [Output 1 name]**

|                       |  |
|-----------------------|--|
| Output name           | [Name of the output]                   |
| Description           | [Brief description of the output]      |
| Destination           | [Name of the destination component(s)] |
| Type                  | [Type of the output]                   |
| Valid range of values | [Complete list of valid values]        |



|   |   |
|---|---|
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 537 5.10.2.2.2 [Output 2 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 538 5.10.3 Subcomponents

539 Maybe more subcomponents have to be added. Please check this.

#### 540 5.10.3.1 Management\_of\_Radio\_Communication

##### 541 5.10.3.1.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | Management_of_Radio_Communication   |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/Radio/MoRC">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/Radio/MoRC</a> |
| SCADE designer      | Uwe Steinke, Siemens  |

Description

to be checked

The function *managementOfRadioCommunication* implements the session states establishing, maintaining and termination as described in Subset-026, chap. 3.5. A SCADE state machine reflects this state model (Figure ???) accurately. Within each of the states, the activities needed as long as the state is active, are performed. When there is no communication session (state *NoSession*) currently, the state machine waits for events that initiate a session (subfunction *initiate\_a\_Session*). When the appropriate conditions are fulfilled, the state machine moves to the *Establishing* state. Here in, it runs through the sequence required fore establishing a session (subfunction *establish\_a\_Session*. Dependent on the results, the state machine changes over to the *Maintaining* or *Terminating* state. While in *Maintaining*, the communication connection is monitored. When an event triggering the session termination occurs, the state machine switches to the state *Terminating* with the subfunction *terminating\_a\_CommunicationSession* and performs the session termination sequence.

In parallel to the main state machine, *managementOfRadioCommunication* monitors all the time whether the session has to be terminated (subfunction *initiateTerminatingASession*) or if the session has the be terminated and subsequently established (subfunction *terminateAndEstablishSession*). *registeringToTheRadioNetwork* is responsible for connection to the radio network. *safeRadioConnectionIndication* controls the radio connection indication for the driver.

|                        |  |
|------------------------|--|
| Input documents        | Subset-026, Chapter 3.5  |
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a] |
| API requirements       | [If applicable description of API requirements, otherwise n/a] |

542 5.10.3.1.2 Interface

543 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
544 above) respectively the SCADE generated documentation.

545 5.10.3.2 genMSGToRBC

546 5.10.3.2.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | genMSGToRBC   |
| Link to SCADE model | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/Radio/MoRC">https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/Radio/MoRC</a> |
| SCADE designer      | Uwe Steinke, Siemens  |

Description

to be completed

|                        |  |
|------------------------|--|
| Input documents        | Subset-026, Chapter 3.5  |
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a] |
| API requirements       | [If applicable description of API requirements, otherwise n/a] |

### 5.10.3.2.2 Interface

For an overview of the interface of this internal component we refer to the SCADE model (cf. link above) respectively the SCADE generated documentation.

## 5.11 F2.10: ManageDMIInput

section and corresponding subsections have to be completed

### 5.11.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | ManageDMIInput  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

### 5.11.2 Interface

An overview of the interface of component ManageDMIInput is shown in Figure 16. The inputs and outputs are described in detail in Section 5.11.2.1 respectively 5.11.2.2. Subcomponents are described in Section 5.11.3.

#### 5.11.2.1 Inputs

##### 5.11.2.1.1 [Input 1 name]



Figure 16. ManageDMIInput SysML diagram

|   |   |
|---|---|
| Input name  | [Name of the input]   |
| Description   | [Brief description of the input]  |
| Source  | [Name of the source component]  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                     | [Description of components behaviour when input value is at bound-ary]                            |
| Behaviour for values out of valid range                                 | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or un- wanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

559 5.11.2.1.2 [Input 2 name]

|   |   |
|---|---|
| Input name  | [Name of the input]   |
| Description   | [Brief description of the input]  |
| Source  | [Name of the source component]  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                     | [Description of components behaviour when input value is at bound-ary]                            |
| Behaviour for values out of valid range                                 | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or un- wanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

560 5.11.2.2 Outputs

561 5.11.2.2.1 [Output 1 name]

|   |   |
|---|---|
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 562 5.11.2.2.2 [Output 2 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 563 5.11.3 Subcomponents

564 Currently ManageDMIInput does not have any subcomponents.

### 5.12 F2.11: ManageDMIOutput

566 section and corresponding subsections have to be completed

#### 567 5.12.1 Component Requirements

|                     |   |
|---------------------|---|
| Component name      | ManageDMIOutput                                     |
| Link to SCADE model | <a href="http://???">http://???</a>                 |
| SCADE designer      | Bernd Hekele, DB Netz AG                            |
| Description         | [Brief description of the components functionality] |



Figure 17. ManageDMIOOutput SysML diagram

|                        |   |
|------------------------|---|
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

5.12.2 Interface

An overview of the interface of component ManageDMIOOutput is shown in Figure 17. The inputs and outputs are described in detail in Section 5.12.2.1 respectively 5.12.2.2. Subcomponents are described in Section 5.12.3.

5.12.2.1 Inputs

5.12.2.1.1 [Input 1 name]

|   |   |
|---|---|
| Input name  | [Name of the input]   |
| Description   | [Brief description of the input]  |
| Source  | [Name of the source component]  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

5.12.2.1.2 [Input 2 name]

|            |                     |
|------------|---------------------|
| Input name | [Name of the input] |
|------------|---------------------|

|   |   |
|---|---|
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

### 575 5.12.2.2 Outputs

#### 576 5.12.2.2.1 [Output 1 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 577 5.12.2.2.2 [Output 2 name]

|   |   |
|---|---|
| Output name                             | [Name of the output]  |
| Description                             | [Brief description of the output]   |
| Destination                             | [Name of the destination component(s)]  |
| Type                                    | [Type of the output]  |
| Valid range of values                   | [Complete list of valid values]   |
| Behaviour when value is at boundary     | [Description of components behaviour when output value is at boundary]        |
| Behaviour for values out of valid range | [Description of components behaviour when output value is out of valid range] |

|   |   |
|---|---|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |
|---|---|

### 578 5.12.3 Subcomponents

#### 579 5.12.3.1 cyclicReportToDMI

##### 580 5.12.3.1.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | cyclicReportToDMI   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

##### 581 5.12.3.1.2 Interface

582 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
583 above) respectively the SCADE generated documentation.

#### 584 5.12.3.2 ManageTextMessages

##### 585 5.12.3.2.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | ManageTextMessages  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |



|                  |  |
|------------------|--|
| API requirements | [If applicable description of API requirements, otherwise n/a] |
|------------------|--|

#### 586 5.12.3.2.2 Interface

587 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
588 above) respectively the SCADE generated documentation.

#### 589 5.12.3.3 copyTrackDescription

##### 590 5.12.3.3.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | copyTrackDescription  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 591 5.12.3.3.2 Interface

592 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
593 above) respectively the SCADE generated documentation.

#### 594 5.12.3.4 toEntryRequest

##### 595 5.12.3.4.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | toEntryRequest  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |

|                  |  |
|------------------|--|
| Time constraints | [If applicable description of time constraints, otherwise n/a] |
| API requirements | [If applicable description of API requirements, otherwise n/a] |

#### 596 **5.12.3.4.2 Interface**

597 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
598 above) respectively the SCADE generated documentation.

#### 599 **5.12.3.5 sendBrakesToDMI**

##### 600 **5.12.3.5.1 Component Requirements**

|                        |   |
|------------------------|---|
| Component name         | sendBrakesToDMI   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 601 **5.12.3.5.2 Interface**

602 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
603 above) respectively the SCADE generated documentation.

#### 604 **5.12.3.6 manageDMI\_Output**

##### 605 **5.12.3.6.1 Component Requirements**

|                     |   |
|---------------------|---|
| Component name      | manageDMI_Output  |
| Link to SCADE model | <a href="http://???">http://???</a>   |
| SCADE designer      | Bernd Hekele, DB Netz AG  |
| Description         | [Brief description of functionality]  |
| Input documents     | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |

|                        |  |
|------------------------|--|
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a] |
| API requirements       | [If applicable description of API requirements, otherwise n/a] |

#### 606 **5.12.3.6.2 Interface**

607 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
608 above) respectively the SCADE generated documentation.

#### 609 **5.12.3.7 sendTrainData**

##### 610 **5.12.3.7.1 Component Requirements**

|                        |   |
|------------------------|---|
| Component name         | sendTrainData   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 611 **5.12.3.7.2 Interface**

612 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
613 above) respectively the SCADE generated documentation.

#### 614 **5.12.3.8 sendVersion**

##### 615 **5.12.3.8.1 Component Requirements**

|                     |                                      |
|---------------------|--------------------------------------|
| Component name      | sendVersion                          |
| Link to SCADE model | <a href="http://???">http://???</a>  |
| SCADE designer      | Bernd Hekele, DB Netz AG             |
| Description         | [Brief description of functionality] |

|                        |   |
|------------------------|---|
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 616 5.12.3.8.2 Interface

617 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
618 above) respectively the SCADE generated documentation.

#### 619 5.12.3.9 sendLevelListPkg

##### 620 5.12.3.9.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | sendLevelListPkg  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 621 5.12.3.9.2 Interface

622 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
623 above) respectively the SCADE generated documentation.

### 5.13<sub>4</sub> F2.12: ManageTIUInput

625 section and corresponding subsections have to be completed

#### 626 5.13.1 Component Requirements

|                     |                                     |
|---------------------|-------------------------------------|
| Component name      | ManageTIUInput                      |
| Link to SCADE model | <a href="http://???">http://???</a> |

|                        |   |
|------------------------|---|
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

5.13.2 Interface

An overview of the interface of component ManageTIUInput is shown in Figure 18. The inputs and outputs are described in detail in Section 5.13.2.1 respectively 5.13.2.2. Subcomponents are described in Section 5.13.3.

5.13.2.1 Inputs

5.13.2.1.1 [Input 1 name]

|   |  |
|---|--|
| Input name                              | [Name of the input]  |
| Description                             | [Brief description of the input]   |
| Source                                  | [Name of the source component]   |
| Type                                    | [Type of the input]  |
| Valid range of values                   | [Complete list of valid values]  |
| Behaviour when value is at boundary     | [Description of components behaviour when input value is at bound-ary]       |
| Behaviour for values out of valid range | [Description of components behaviour when input value is out of valid range] |

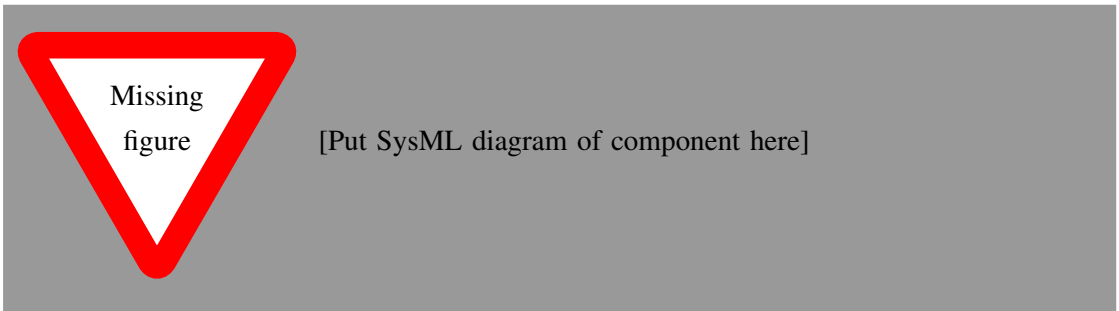


Figure 18. ManageTIUInput SysML diagram

|   |   |
|---|---|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |
|---|---|

#### 633 5.13.2.1.2 [Input 2 name]

|   |   |
|---|---|
| Input name  | [Name of the input]   |
| Description   | [Brief description of the input]  |
| Source  | [Name of the source component]  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 634 5.13.2.2 Outputs

##### 635 5.13.2.2.1 [Output 1 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

##### 636 5.13.2.2.2 [Output 2 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

### 637 5.13.3 Subcomponents

#### 638 5.13.3.1 mergeTIU\_Info

##### 639 5.13.3.1.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | mergeTIU_Info   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

##### 640 5.13.3.1.2 Interface

641 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
642 above) respectively the SCADE generated documentation.

#### 643 5.13.3.2 getTIUStatusFromData

##### 644 5.13.3.2.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | getTIUStatusFromData  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 645 5.13.3.2.2 Interface

646 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
647 above) respectively the SCADE generated documentation.

### 5.14 F2.13: ManageTIUOutput

649 section and corresponding subsections have to be completed

#### 650 5.14.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | ManageTIUOutput   |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of the components functionality]                         |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 651 5.14.2 Interface





Figure 19. ManageTIUOutput SysML diagram

652 An overview of the interface of component ManageTIUOutput is shown in Figure 19. The inputs  
653 and outputs are described in detail in Section 5.14.2.1 respectively 5.14.2.2. Subcomponents are  
654 described in Section 5.14.3.

655 **5.14.2.1 Inputs**

656 **5.14.2.1.1 [Input 1 name]**

|  |   |
|--|---|
| Input name   | [Name of the input]   |
| Description  | [Brief description of the input]  |
| Source   | [Name of the source component]  |
| Type   | [Type of the input]   |
| Valid range of values  | [Complete list of valid values]   |
| Behaviour when value is at boundary                                    | [Description of components behaviour when input value is at bound-ary]                            |
| Behaviour for values out of valid range                                | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or un-wanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

657 **5.14.2.1.2 [Input 2 name]**

|                                     |  |
|-------------------------------------|--|
| Input name                          | [Name of the input]  |
| Description                         | [Brief description of the input]                                       |
| Source                              | [Name of the source component]   |
| Type                                | [Type of the input]  |
| Valid range of values               | [Complete list of valid values]  |
| Behaviour when value is at boundary | [Description of components behaviour when input value is at bound-ary] |

Behaviour for values out of valid range [Description of components behaviour when input value is out of valid range]

Behaviour when value is erroneous, absent or unwanted (i.e. spurious) [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 660 5.14.2.2.2 [Output 2 name]

|   |   |
|---|---|
| Output name   | [Name of the output]  |
| Description   | [Brief description of the output]   |
| Destination   | [Name of the destination component(s)]  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

### 661 5.14.3 Subcomponents

#### 662 5.14.3.1 handleTraction

##### 663 5.14.3.1.1 Component Requirements

|                     |                                     |
|---------------------|-------------------------------------|
| Component name      | handleTraction                      |
| Link to SCADE model | <a href="http://???">http://???</a> |

|                        |   |
|------------------------|---|
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

#### 664 5.14.3.1.2 Interface

665 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
666 above) respectively the SCADE generated documentation.

#### 667 5.14.3.2 manageTIU\_output

##### 668 5.14.3.2.1 Component Requirements

|                        |   |
|------------------------|---|
| Component name         | manageTIU_output  |
| Link to SCADE model    | <a href="http://???">http://???</a>   |
| SCADE designer         | Bernd Hekele, DB Netz AG  |
| Description            | [Brief description of functionality]  |
| Input documents        | Subset-026, Chapter ??<br>Subset-026, Chapter ??<br>Subset-026, Chapter ??? |
| Safety integrity level | 4   |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]              |
| API requirements       | [If applicable description of API requirements, otherwise n/a]              |

##### 669 5.14.3.2.2 Interface

670 For an overview of the interface of this internal component we refer to the SCADE model (cf. link  
671 above) respectively the SCADE generated documentation.

## 6<sup>672</sup> F3: Measure Train Movement

<sup>673</sup> This component is not part of the openETCS OBU currently and therefore no detailed description  
<sup>674</sup> is provided here.

## 7<sup>675</sup> F4: Manage Radio Communication

<sup>676</sup> This component is not part of the openETCS OBU currently and therefore no detailed description  
<sup>677</sup> is provided here.

## 8 <sup>678</sup> F5: Manage JRU

<sup>679</sup> This component is not part of the openETCS OBU currently and therefore no detailed description  
<sup>680</sup> is provided here.

## 9 F6: DMI Controller

This chapter needs to be completed and a responsible developer has to be identified.

### 9.1 DMI

#### 9.1.1 Component Requirements

|                        |  |
|------------------------|--|
| Component name         | DMI  |
| Link to SCADE model    | <a href="https://github.com/openETCS/modeling/tree/master/model/Scade/System/DMI_Control">https://github.com/openETCS/modeling/tree/master/model/Scade/System/DMI_Control</a>  |
| SCADE designer         | Valerio D'Angelo, DB Netz AG   |
| Description            | The DMI controller interacts with the DMI display and is responsible for all procedures between the DMI display and Driver. Furthermore, the DMI controller will interact with the DMI Management to compute the received information (e.g. driver number request, ...) and send, if necessary, data or reports to the DMI Management (acknowledge, text messages...). The DMI Controller is a passive module, this means that all the processing are performed EVC-side, therefore the DMI Controller simply responds to the requests of the EVC or Driver and performs some checks according with the information received from EVC. |
| Input documents        | ERA_ERTMS_015560   |
| Safety integrity level | 4  |
| Time constraints       | [If applicable description of time constraints, otherwise n/a]   |
| API requirements       | [If applicable description of API requirements, otherwise n/a]   |

#### 9.1.2 Interface

An overview of the interface of component DMI is shown in Figure 20. The inputs and outputs are described in detail in Section 9.1.2.1 respectively 9.1.2.2.

##### 9.1.2.1 Inputs

###### 9.1.2.1.1 DMI\_entry\_request

|             |   |
|-------------|---|
| Input name  | DMI_entry_request   |
| Description | Request to input data (e.g. driver id, Train running number etc.) |
| Source      | DMI Management  |

|   |   |
|---|---|
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 690 9.1.2.1.2 DMI\_identifier\_request

|   |   |
|---|---|
| Input name  | DMI_identifier_request  |
| Description   | Request of the DMI informations   |
| Source  | DMI Management  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 691 9.1.2.1.3 DMI\_menu\_request

|   |  |
|---|--|
| Input name                              | DMI_menu_request   |
| Description                             | Request to enable or disable buttons   |
| Source                                  | DMI Management   |
| Type                                    | [Type of the input]  |
| Valid range of values                   | [Complete list of valid values]  |
| Behaviour when value is at boundary     | [Description of components behaviour when input value is at boundary]        |
| Behaviour for values out of valid range | [Description of components behaviour when input value is out of valid range] |



|   |   |
|---|---|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |
|---|---|

#### 692 9.1.2.1.4 DMI\_dynamic

|   |   |
|---|---|
| Input name  | DMI_dynamic   |
| Description   | Contains informations about current speed, current mode etc.                                      |
| Source  | DMI Management  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 693 9.1.2.1.5 DMI\_text\_message

|   |   |
|---|---|
| Input name  | DMI_text_message  |
| Description   | Contains predefined or plain text messages  |
| Source  | DMI Management  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

#### 694 9.1.2.1.6 DMI\_icons

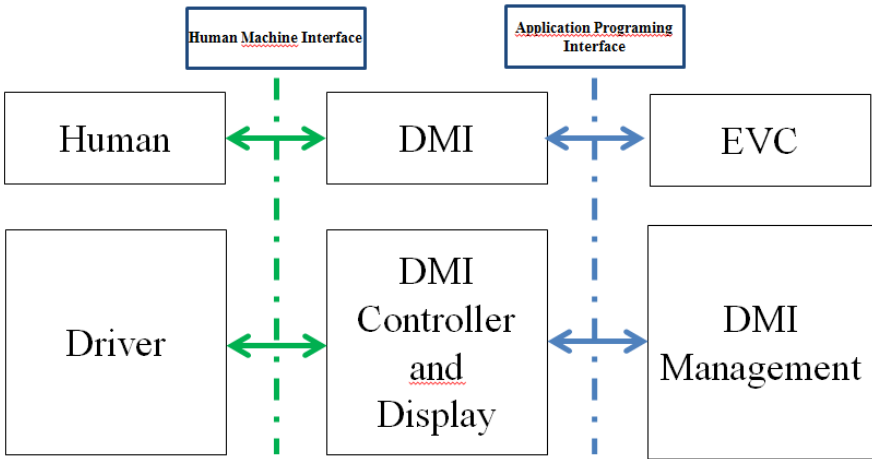


Figure 20. DMI component SysML diagram

|  |   |
|--|---|
| Input name   | DMI_icons   |
| Description  | Request to display one or more icons in any area  |
| Source   | DMI Management  |
| Type   | [Type of the input]   |
| Valid range of values  | [Complete list of valid values]   |
| Behaviour when value is at boundary                                    | [Description of components behaviour when input value is at bound-ary]                            |
| Behaviour for values out of valid range                                | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or un-wanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

695 9.1.2.1.7 DMI\_driver\_identifier

|  |   |
|--|---|
| Input name   | DMI_driver_identifier   |
| Description  | Contains the default or entered driver identifier   |
| Source   | DMI Management  |
| Type   | [Type of the input]   |
| Valid range of values  | [Complete list of valid values]   |
| Behaviour when value is at boundary                                    | [Description of components behaviour when input value is at bound-ary]                            |
| Behaviour for values out of valid range                                | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or un-wanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

|   |   |
|---|---|
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

697 **9.1.2.1.9 DMI\_train\_data**

|   |   |
|---|---|
| Input name  | DMI_train_data  |
| Description   | Contains the default or entered train data  |
| Source  | DMI Management  |
| Type  | [Type of the input]   |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when input value is at boundary]                             |
| Behaviour for values out of valid range                               | [Description of components behaviour when input value is out of valid range]                      |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

698 **9.1.2.1.10 TIU\_trainStatus**

|   |  |
|---|--|
| Input name                              | TIU_trainStatus  |
| Description                             | Open/close Desk signal   |
| Source                                  | TIU  |
| Type                                    | [Type of the input]  |
| Valid range of values                   | [Complete list of valid values]  |
| Behaviour when value is at boundary     | [Description of components behaviour when input value is at boundary]        |
| Behaviour for values out of valid range | [Description of components behaviour when input value is out of valid range] |

|   |   |
|---|---|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |
|---|---|

## 699 9.1.2.2 Outputs

### 700 9.1.2.2.1 DMI\_identifier

|   |   |
|---|---|
| Output name   | DMI_identifier  |
| Description   | Information about DMI (e.g. version, cabin identifier etc.)                                       |
| Destination   | DMI Management  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

### 701 9.1.2.2.2 DMI\_driver\_request

|   |   |
|---|---|
| Output name   | DMI_driver_request  |
| Description   | Driver request or acknowledgement   |
| Destination   | DMI Management  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

### 702 9.1.2.2.3 DMI\_train\_data\_ack

|   |   |
|---|---|
| Output name   | DMI_train_data_ack  |
| Description   | Train data acknowledgement  |
| Destination   | DMI Management  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

703 **9.1.2.2.4 DMI\_status\_report**

|   |   |
|---|---|
| Output name   | DMI_status_report   |
| Description   | The actual status of DMI (keep alive)   |
| Destination   | DMI Management  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

704 **9.1.2.2.5 DMI\_text\_message\_ack**

|                       |                                 |
|-----------------------|---------------------------------|
| Output name           | DMI_text_message_ack            |
| Description           | Text message acknowledgement    |
| Destination           | DMI Management                  |
| Type                  | [Type of the output]            |
| Valid range of values | [Complete list of valid values] |

|   |   |
|---|---|
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

705 **9.1.2.2.6 DMI\_icons\_ack**

|   |   |
|---|---|
| Output name   | DMI_icons_ack   |
| Description   | Icon acknowledgement  |
| Destination   | DMI Management  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

706 **9.1.2.2.7 DMI\_driver\_identifier**

|   |   |
|---|---|
| Output name                             | DMI_driver_identifier   |
| Description                             | Contains the default or entered driver identifier                             |
| Destination                             | DMI Management  |
| Type                                    | [Type of the output]  |
| Valid range of values                   | [Complete list of valid values]   |
| Behaviour when value is at boundary     | [Description of components behaviour when output value is at boundary]        |
| Behaviour for values out of valid range | [Description of components behaviour when output value is out of valid range] |

|   |   |
|---|---|
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |
|---|---|

707 **9.1.2.2.8 DMI\_train\_running\_number**

|   |   |
|---|---|
| Output name   | DMI_train_running_number  |
| Description   | Contains the default or entered train running number  |
| Destination   | DMI Management  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

708 **9.1.2.2.9 DMI\_train\_data**

|   |   |
|---|---|
| Output name   | DMI_train_data  |
| Description   | Contains the default or entered train data  |
| Destination   | DMI Management  |
| Type  | [Type of the output]  |
| Valid range of values   | [Complete list of valid values]   |
| Behaviour when value is at boundary                                   | [Description of components behaviour when output value is at boundary]                            |
| Behaviour for values out of valid range                               | [Description of components behaviour when output value is out of valid range]                     |
| Behaviour when value is erroneous, absent or unwanted (i.e. spurious) | [Description of components behaviour when value is erroneous, absent or unwanted (i.e. spurious)] |

## References

- <sup>710</sup> [1] ERA. *System Requirements Specification, SUBSET-026*, v3.3.0 edition, March 2012.