OETCS/WP3/D3.5.3

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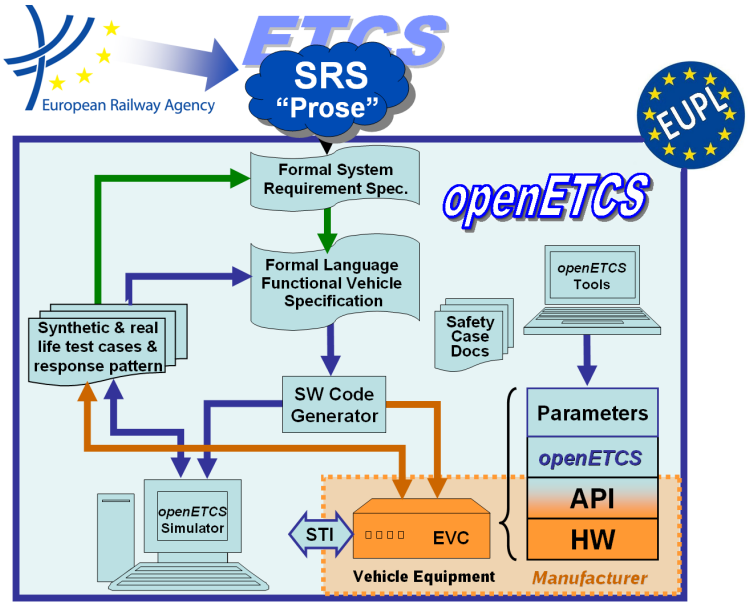
Work Package 3: “Modeling”

openETCS Architecture and Design Specification

Software Component Design and Internal Interface Specification

Peter Mahlmann, Bernd Hekele, Baseliyos Jacob, Peyman Farhangi, Stefan Karg, Valerio D´Angelo, Uwe Steinke, Christian Stahl, Jakob Gärtner, Jos Holtzer, Jan Welvaarts, Vincent Nuhaan, Thorsten Schulz, Benjamin Beichler, Marielle Petit-Doche, Matthias Güdemann, Veronique Gontier, Christian Giraud, Fausto Cochetti, Alexander Stante and David Mentre

June 2015



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Document approbation

Lead author:	Technical assessor:	Quality assessor:	Project lead:
location / date	location / date	location / date	location / date
signature Peter Mahlmann (DB Netz AG)	signature Jan Welte (Technische Universität Braunschweig)	signature Izaskun de la Torre (SQS)	signature Klaus-Rüdiger Hase (DB Netz)

Peter Mahlmann, Bernd Hekele, Baseliyos Jacob, Peyman Farhangi, Stefan Karg, Valerio D´Angelo

DB Netz AG

Uwe Steinke

Siemens AG

Christian Stahl

TWT GmbH

Jakob Gärtner

LEA Railergy

Jos Holtzer, Jan Welvaarts, Vincent Nuhaan

Nederlandss Spoorwegen

Thorsten Schulz, Benjamin Beichler

University of Rostock

Marielle Petit-Doche, Matthias Güdemann

Systerel

Veronique Gontier

All4Tec

Christian Giraud, Fausto Cochetti

Alstom

Alexander Stante

Fraunhofer ESK

David Mentre

MERCE

Architecture and Design Specification

Prepared for openETCS@ITEA2 Project

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.

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

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Figures and Tables

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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 given in the so called Subset-026 [1] defined 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. It 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:

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SCADE System Version 16.1 of SCADE System has been used for the the genereation of SysML models.

SCADE Suite Version 16.1 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 EN 50128 at SIL 3/4.

SCADE Display Version 16.1 of SCADE Display has been used for the development of the Driver Machine Interface (DMI).

GitHub The web based Git repository hosting service GitHub has been used for distributed revision control and source code respectively model management.

1.3 General Remarks on the openETCS OBU Model

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

1c06cc2d4a0d8f27569e065e2a9edf924b453ff1.

In particular, the root of the SCADE System SysML model is located at https://github.com/openETCS/modeling/tree/master/model/system and the root of the functional SCADE Suite model is located at https://github.com/openETCS/modeling/tree/master/model/Scade.

Note that all components of the openETCS OBU have been newly developed, no existing components have been reused.

Part I

System Architecture and Functional Breakdown

2 System Architecture

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The system architecture of the openETCS OBU is adapted 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, c.f. dashed blue line in Figure 1.

2.1 Top Level Architecture and External Interfaces

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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:

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.

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

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.

!!Rest of this chapter is outdated!!

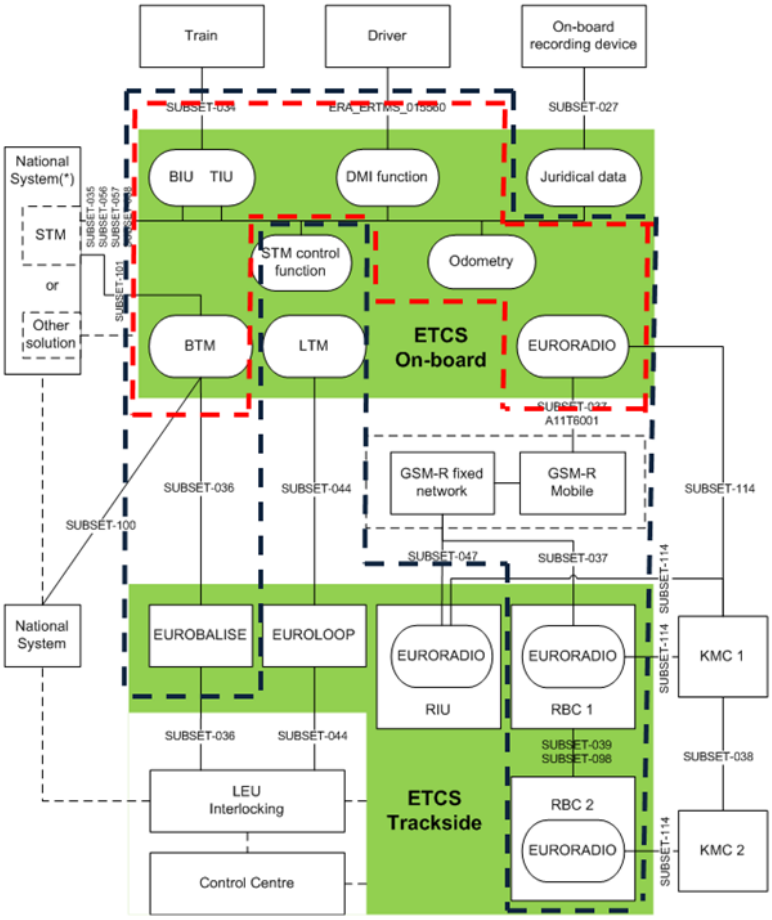

Figure 1. Scope of openETCS OBU model system according to ERA TSI Chapter 2.5. Functional blocks in the scope of openETCS have been marked by the dashed blue line. The dashed red line shows the OBU blocks in the scope of openETCS.

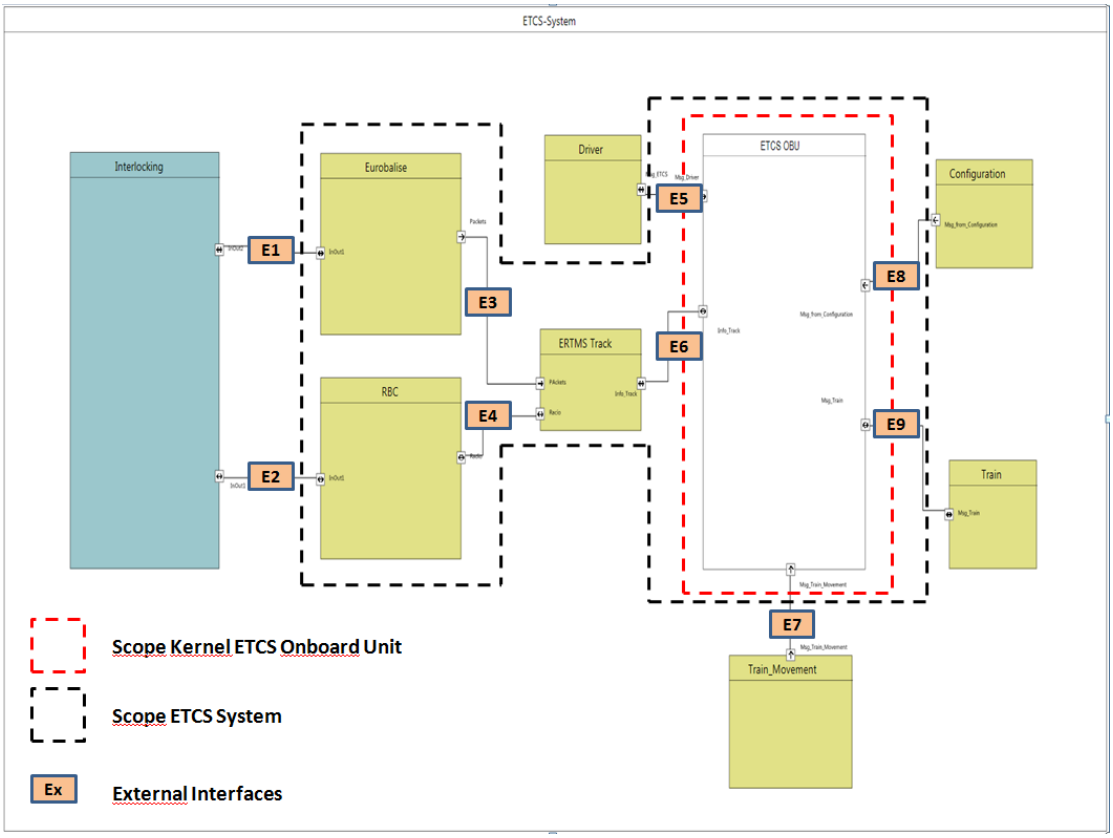

Figure 2. Top level architecture with external interfaces.

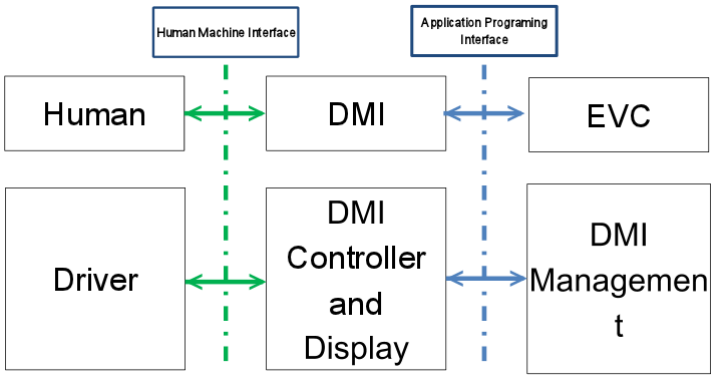

Figure 3. DMI Interfaces.

2.2 System Architecture SysML View

The SysML System view of the architecture will reflect the scope accorgin to 4.1 and is a top down breakdown to the design layer. The functional breakdown has been done in Scade System and is part of the design model. Furthermore it will reflect all the external and internal interface that will will be described in 4.3. Another goal of the System Architecture SysML view is to explain and set the boundaries for the ETCS Kernel development "F2 Kernel" as the main design part of the openETCS@ITEA2 project.

2.2.1 1st Level System Architecture View

All subystem of the ETCS/ERTMS Basic Sytem according in the scope of the openETCS@ITEA2 project will be reflected in this 1st level view. Furthermore the interlocking as part of a full Rail Signalling System, but not part of the openETCS scope, will be highlighted in this view.

Interlocking = interlocking is an arrangement of signal apparatus that prevents conflicting movements through an arrangement of tracks such as junctions or crossings. The signalling appliances and tracks are sometimes collectively referred to as an interlocking plant. An interlocking is designed so that it is impossible to display a signal to proceed unless the route to be used is proven safe.

2.2.2 2nd Level System Architecture View

The 2nd level system view will provide a decopmosition of the ETCS on-board unit systems and the Kernerl of the ETCS. The kernel is the main part of the ETCS Onboard Unit system and reflects the functions specified in the ERA TSI Subset 26. Therefore, the boundaries and interfaces to the other subasystems of the ETCS on-bard unit needs to be fully described and formal. At least the formalisation kernel functions and boundaries should be realized in the openETCS project.

2.2.3 3rd Level System Architecture View

The 3rd level system view will provide a decopmosition of the ETCS Kernel of the ETCS Onboard Unit Systems. The decomposition and further design of the subfunctions of the kernel are part of the chapter 6 in this document. In chapter 6 we will consider the design description that will be completed by every designer itself. The designer can decided in this layer about the decomposition and boundaries of his subsystem, but need to describe the design choices.

2.3 Interfaces

This section will consider the external and internal interfaces as described in the system decomposition figures in 4.2.1 and 4.2.2.

2.3.1 Internal Interfaces

Internal interfaces will describe the data flow between the ETCS Onboard Unit Kernel and ETCS Onboard Unit Subsystems within the ETCS Onboard Unit System.

I1: In flow from the Balise Transmission Module (BTM or Antenna) to the "F2 ETCS Kernel" trough Runtime API in. Transmitted data are information from the Eurobalise.

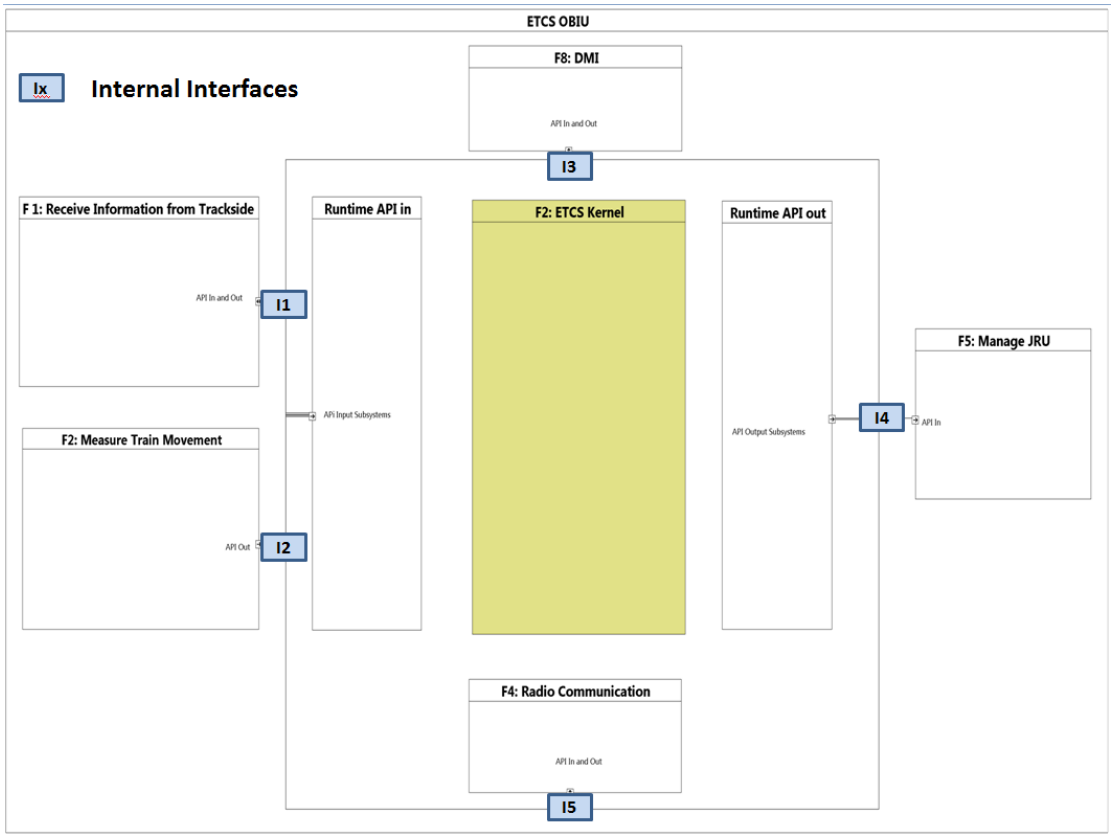

Figure 4. 2nd level system architecture view.

I2: In flow from the Odometrie (ODO) to the "F2 ETCS Kernel" trough Runtime API in. Transmitted data are information from the Movement of the train.

I3: In- and Out flow between the DMI Controller and the "F2 ETCS Kernel" trough Runtime API in and out. Transmitted data are information of driver action and display. See description in figure of "External Interface E5".

I4: Out flow from "F2 ETCS Kernel" to the JRU Manager trough Runtime API out. Transmitted data are all necessary information for a juridical recorder unit "black box".

I5: In- and Out flow between the Euroradio and "F2 ETCS Kernel" trough Runtime API in and out. Transmitted data are radio track information (RBC) and information to the track (RBC).

Part II

Design Description

3 F1: Receive Information from Trackside

4 F2: ETCS Kernel

4.1 Manage_TrackSideInformation_Integration

135 4.1.1 Component Requirements

Clarify detail f documentation with the trackMessages concept

Component name	Manage_TrackSideInformation_Integration
Link to SCADE model	https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/Manage_TrackSideInformation_Integration/Manage_TrackSideInformation_Integration.etp
SCADE designer	Bernd Hekele, DB Netz AG
Description	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. 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.
Input documents	See sub-components.
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], [EURORADIO], [ODO].In these sections, also a detailed definition of the concepts implemented on those interfaces is documented.

4.1.2 Interface

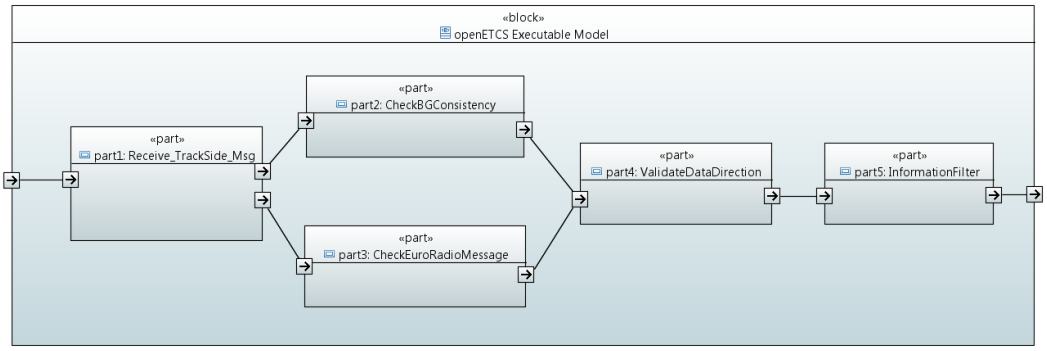

Figure 5. Manage_TrackSideInformation_Integration component SysML diagram.

An overview of the interface of component Manage_TrackSideInformation_Integration is shown in Figure 5. The inputs and outputs are described in detail in Section 4.1.2.1 respectively 4.1.2.2. Sub components are described in Section 4.1.3.

4.1.2.1 Inputs

4.1.2.1.1 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	**true** All checks are performed. **false** Component InformationFilter is deactivated.
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)]

4.1.2.1.2 Receive_trackSide_Message

Input name	API_trackSide_Message
Description	Track side message received from the API. The API performs pre-processing of RTM and BTM messages and deliveres a maximum of a single message per cycle. The structure of this message is defined in the API [BTM] and [EURORADIO] sections.
Source	API
Type	API_Msg_Pkg::API_TrackSideInput_T

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)]

4.1.2.1.3 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]
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)]

145 #### 4.1.2.1.4 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	**true** All data kept in the module is deleted and no input is accepted. **false** No action. Data at input is accepted.
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)]

4.1.2.1.5 trainPosition

Input name	trainPosition
Description	Contains the current position of the train.
Source	CalculateTrainPosition
Type	TrainPosition_Types_Pck::trainPosition_T
Valid range of values	
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)]

4.1.2.1.6 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]
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)]

4.1.2.1.7 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]
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)]

4.1.2.1.8 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]
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)]

4.1.2.1.9 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]
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)]

4.1.2.1.10 inSupervisingRbcId

Input name	inSupervisingRbcId
Description	For the sub component 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
Type	int
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)]

4.1.2.1.11 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]
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)]

4.1.2.1.12 q_nvlocacc

Input name	q_nvlocacc
Description	The national value determines the location accuracy.
Source	Database
Type	Q_NVLOCACC
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)]

4.1.2.2 Outputs

155 #### 4.1.2.2.1 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)]
Type	Common_Types_Pkg::ReceivedMessage_T
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)]

4.1.2.2.2 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)]
Type	bool
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)]

4.1.2.2.3 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	**true** ??? **false** ???
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)]

4.1.2.2.4 errorLinkedBG

Output name	errorLinkedBG
Description	[Brief description of the output]
Destination	[Name of the destination component(s)]
Type	[Type of the output]
Valid range of values	**true** An error in a linked balise group was detected. **false** No error in a linked balise group was detected.
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)]

4.1.2.2.5 errorUnlinkedBG

Output name	errorUnlinkedBG

Description	[Brief description of the output]
Destination	[Name of the destination component(s)]
Type	bool
Valid range of values	**true** An error in a unlinked balise group was detected. **false** No error in a unlinked balise group was detected.
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)]

4.1.2.2.6 passedBG

Output name	passedBG
Description	Provides the received balise group message in a special format needed by the component CalculateTrainPosition.
Destination	[Name of the destination component(s)]
Type	BG_Types_Pkg::passedBG_T
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)]

4.1.2.2.7 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)]
Type	Common_Types_Pkg::PositionReportParameter_T
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)]

4.1.2.2.8 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)]
Type	Common_Types_Pkg::radioManagementMessage_T
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)]

4.1.2.2.9 radioSequenceError

Output name	radioSequenceError
Description	[Brief description of the output]
Destination	[Name of the destination component(s)]
Type	bool

Valid range of values	**true** A sequence error or a timeout has been detected in the radio message. **false** No error in the radio message sequence was detected.
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)]

4.1.2.2.10 radioMessageConsistencyError

Output name	radioMessageConsistencyError
Description	[Brief description of the output]
Destination	[Name of the destination component(s)]
Type	bool
Valid range of values	**true** A consistency error has been detected in the radio message. **false** No consistency error in the radio message was detected.
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)]

4.1.3 Sub Components

4.1.3.1 Receive_TrackSide_Msg

4.1.3.1.1 Component Requirements

Component name	Receive_TrackSide_Msg

Link to SCADE model	https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/Receive_TrackSide_Msg
SCADE designer	[Name, affiliation]
Description	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. • The decoding of balises is done at the API. Also, packets received via the interface are already transformed into a usable shape. • Only packets used inside the current model are passed via the interface. • 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. • 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. • This function does not process information from the packets. The information is passed to the check without further processing of the values.
Input documents	Subset-026, Chapter 7 and 8: Definition of the Balise Telegram Subset-026, Chapter 4.2.2, 4.2.4, 4.2.9: Interface to the BTM Subset-026, Chapter 3.4.1 - 3.4.3, 3.16.2: Handling of Balise Telegrams Subset-026, Chapter 3.16.2: Check of the balise group Subset-026, Chapter 3.4.2: Determining the orientation Subset-026, Chapter 4.5.2 Active Functions Table Subset-026, Chapter 8.4.4: Rules for Euroradio messages
Safety integrity level	4
Time constraints	n/a

API requirements	n/a

4.1.3.1.2 Interface

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

4.1.3.2 CheckBGConsistency

4.1.3.2.1 Component Requirements

Component name	CheckBGConsistency
Link to SCADE model	https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/CheckBGConsistency
SCADE designer	[Name, affiliation]
Description	This function verifies the completeness and correctness of the received messages from balise groups. A message consists of at least a telegram and a maximum of 8 telegrams. • A message is still complete and correct, if a telegram is missing (or not decoded or incomplete decoded), and this telegram is duplicated within the balise group and the duplicating one is correctly read. • By more than one telegram, the order of the telegrams must be either ascending (nominal) or descending(reverse). • A message is correct, if all message counters (M MCUNT) do not equal 254 (that means: The telegram never fits any message of the group). A message counter can be equal 255 (that means: The telegram fits with all telegrams of the same balise group) and all other values must be the same. The orientation of the BG will also be calculated in this block. The check, if the message has been received in due time and the right at the right 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".
Input documents	Subset-026, Chapter 7 and 8: Definition of the Balise Telegram Subset-026, Chapter 3.4.1-3, 3.16.2: Handling of Balise Telegrams Subset-026, Chapter 3.16.2: Check of the balise group Subset-026, Chapter 4.5.2: Active Functions Table
Safety integrity level	4
Time constraints	n/a
API requirements	n/a

4.1.3.2.2 Interface

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

4.1.3.3 CheckEuroradioMessage

4.1.3.3.1 Component Requirements

Component name	CheckEuroradioMessage
Link to SCADE model	https://github.com/openETCS/modeling/tree/b9c31ce6fdf702b412bbeab3032a8a4dc7c92e5c/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/CheckEuroRadioMessage
SCADE designer	Stefan Karg, DB Netz AG
Description	The component “CheckEuroradioMessage” performs several checks on the received radio message. These checks include checking of the message sequence, completeness of messages. Invalid messages are marked as invalid in the message header.
Input documents	Subset-026, Chapter 3.16 Subset-026, Chapter 8.4.4
Safety integrity level	4
Time constraints	n/a
API requirements	n/a

4.1.3.3.2 Interface

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

4.1.3.4 ValidateDataDirection

4.1.3.4.1 Component Requirements

Component name	CheckEuroradioMessage
Link to SCADE model	https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/ValidateDataDirection
SCADE designer	???

Description	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. • The operator contains two processing paths for different message types. Radio messages and balise group messages are handeled 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. • The metadata of packets, which are recognized as not valid for the current driving direction, is invalidated.

Input documents	Subset-026, Chapter 3.6.3
Safety integrity level	4
Time constraints	n/a
API requirements	n/a

4.1.3.4.2 Interface

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

4.1.3.5 InformationFilter

4.1.3.5.1 Component Requirements

Component name	CheckEuroradioMessage
Link to SCADE model	https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLocationRelatedInformation/BaliseGroup/InformationFilter
SCADE designer	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 6 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

4.1.3.5.2 Interface

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

4.2 Train_Supervision

4.2.1 Component Requirements

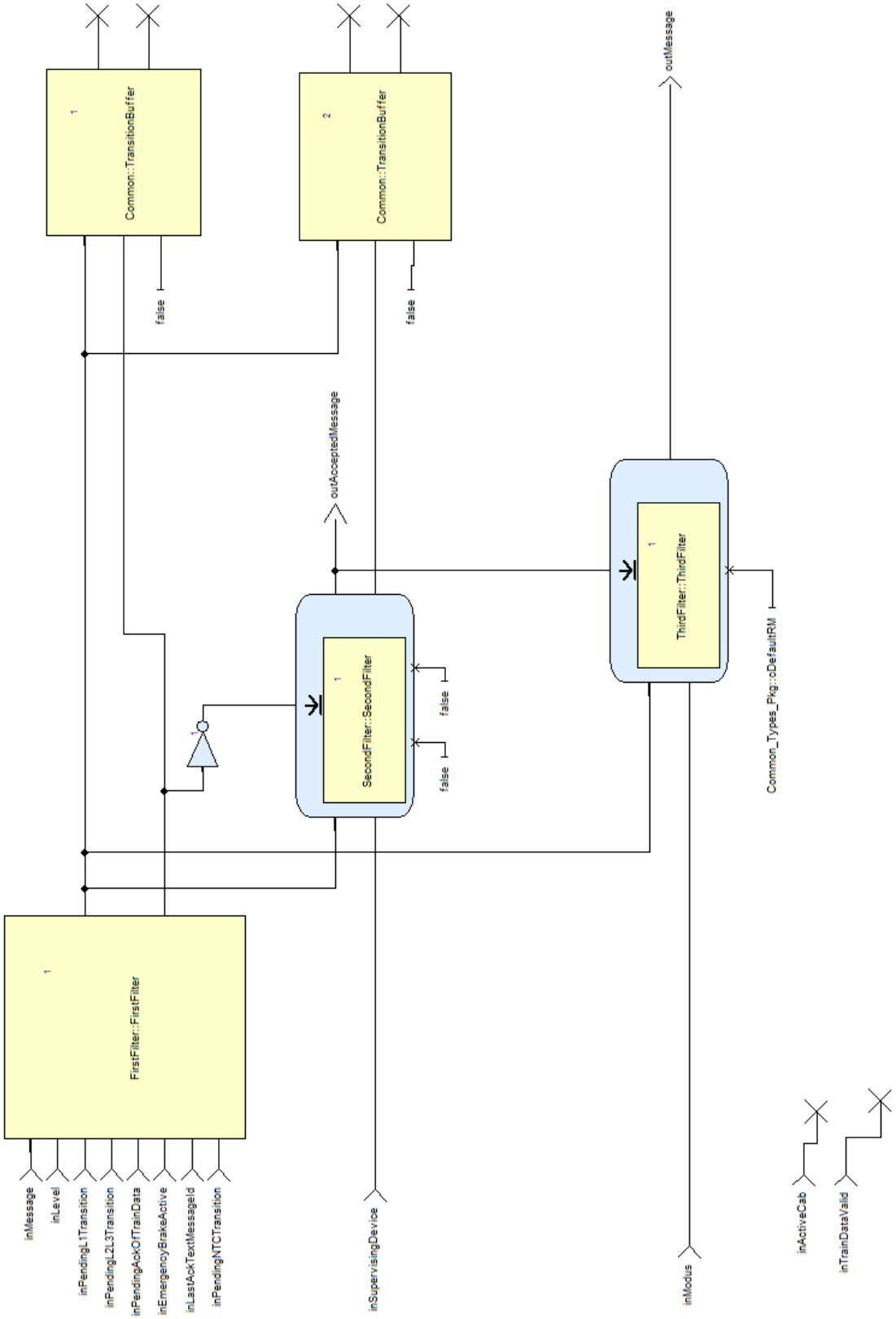

Figure 6. High level overview of the InformationFilter components.

Component name	TrainSupervision
Link to SCADE model	???
SCADE designer	Christian Stahl, TWT
Description	The task of block “Train Supervision” 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 mainly based on [1, Chapt. 3.13]. The block “Train Supervision” 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. 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 perform 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. The functionality is modeled using eight operators, as shown in Figure 7, which are explained below. The current status of the analysis of “Train Supervision” and a functional breakdown can be found in a separate document, `SpeedSupervision_analysis.pdf`.
Input documents	Subset-026, Chapter 3.13: Speed and distance monitoring
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]

4.2.2 Interface

An overview of the interface of component [component name] is shown in Figure 7. The inputs
195 and outputs are described in detail in Section 4.2.2.1 respectively 4.2.2.2. Sub components are described in Section 4.2.3.

4.2.2.1 Inputs

4.2.2.1.1 NationalValues

Input name	NationalValues
Description	This input is packet 3 of [1, Chapt. 8], describing the national values.
Source	???

Type	P3_NationalValues_T
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)]

4.2.2.1.2 TrainPosition

Input name	TrainPosition
Description	This input is the current train position.
Source	Manage Track Data
Type	trainPosition_T
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)]

4.2.2.1.3 odometry

Input name	odometry
Description	This input is the odometry data.
Source	Odometry
Type	odometry_T
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)]

4.2.2.1.4 m_level

Input name	m_level
Description	This input is the current level of the train.
Source	Mode and Level
Type	M_LEVEL
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)]

4.2.2.1.5 trainProps

Input name	trainProps
Description	This input is a set of train related properties.
Source	Database
Type	trainProperties_T
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)]

4.2.2.1.6 MRSP

Input name	MRSP

Description	This input is the most restrictive speed profile.
Source	???
Type	MRSP_Profile_t
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)]

4.2.2.1.7 MA

Input name	MA
Description	This input is a movement authority.
Source	???
Type	MAs_t
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)]

205 #### 4.2.2.1.8 MA_updated

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
Type	bool
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)]

4.2.2.1.9 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
Type	bool
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)]

4.2.2.2 Outputs

4.2.2.2.1 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	[Name of the destination component(s)]
Type	speedSupervisionForDMI_T
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)]

4.2.2.2.2 target

Output name	target
Description	This output is the most restrictive displayed target (MRDT).
Destination	[Name of the destination component(s)]
Type	Target_T
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)]

4.2.2.2.3 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)]
Type	SDM_Commands_T
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)]

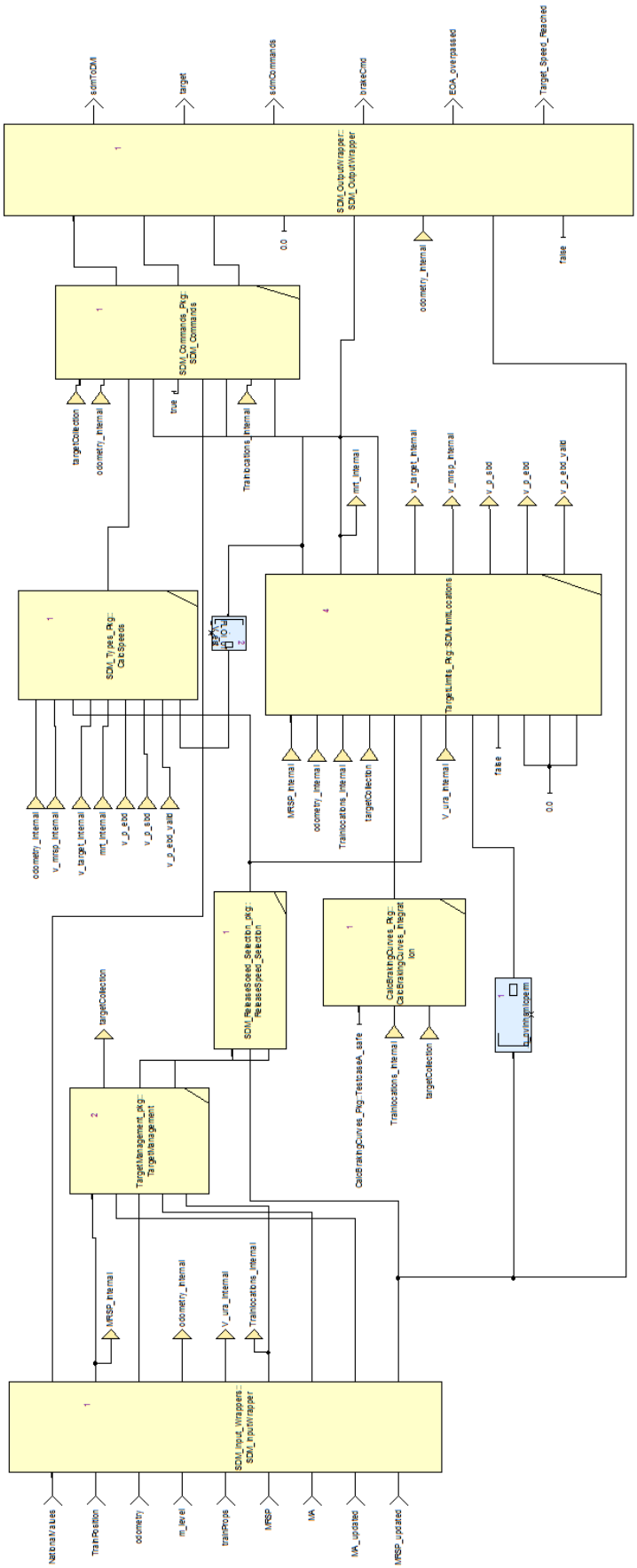

Figure 7. Structure of component ProvidePositionReport.

4.2.2.2.4 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)]
Type	Brake_command_T
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)]

4.2.2.2.5 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)]
Type	bool
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)]

4.2.2.2.6 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)]
Type	bool
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)]

4.2.3 Sub Components

4.2.3.1 Receive_TrackSide_Msg

4.2.3.1.1 Component Requirements

Component name	SDM_InputWrapper
Link to SCADE model	???
SCADE designer	Christian Stahl, TWT
Description	The motivation for this operator is to convert all inputs of block "Speed Supervision" 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. 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 ?.? Subset-026, Chapter ?.? 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]

4.2.3.1.2 Interface

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

4.2.3.2 TargetManagement

4.2.3.2.1 Component Requirements

Component name	TargetManagement
Link to SCADE model	???
SCADE designer	Christian Stahl, TWT
Description	This operator calculates/updates the list of targets to be supervised by the block "Train Supervision". 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 single End of Authority target, a list of all MRSP-Targets and a list of all LoA-Targets. **Derivation of Targets from Movement Authority Sections** The sections of the *Movement Authority* could cause two types of targets: **End Of Authority(EoA)** only one could exist and this is only in the *end section* of the *MA* **Limit of Authority (LoA)** is possibly in every section of the *MA* except the end section In every cycle in which the MA is updated, the operator iterates through the entire MA and puts all speed limitations by *LoA*s into a list of targets. The end section is used to derived the *EoA* target. All LoA targets are sorted by location. **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 max safe front end position with the target position.
Input documents	Subset-026, Chapter 3.13.8.2: Determination of the supervised targets
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]

4.2.3.2.2 Interface

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

4.2.3.3 CalcBrakingCurves_Integration

4.2.3.3.1 Component Requirements

Component name	CalcBrakingCurves_Integration
Link to SCADE model	???
SCADE designer	Christian Stahl, TWT
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 after the estimated front end position of the train has been passed.
Input documents	Subset-026, Chapter 3.13.8.3: Emergency Brake Deceleration curves (EBD) Subset-026, Chapter 3.13.8.4: Service Brake Deceleration curves (SBD) Subset-026, Chapter 3.13.8.5: Guidance curves (GUI)
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]

4.2.3.3.2 Interface

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

4.2.3.4 SDMLimitLocations

4.2.3.4.1 Component Requirements

Component name	SDMLimitLocations
Link to SCADE model	???
SCADE designer	???

Description	This operator calculates the various locations needed to determine the speed and distance monitoring commands. The current implementation of functionality is stateless and requires a complete recalculation each cycle. This operator gathers all necessary input values and computes some frequently used intermediate values in the operators `surplusTractionDeltas` and v_{bec}. The other input preparation operator is the `TargetSelector` 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. 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.
Input documents	Subset-026, Chapter 3.13.9: Supervision Limits Subset-026, Chapter 5.3.1.2: f_{41} – accuracy of speed known onboard Subset-026, Chapter 3.13.10: Monitoring Commands as reference for required outputs of this module
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]

4.2.3.4.2 Interface

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

4.2.3.5 CalcSpeeds

4.2.3.5.1 Component Requirements

Component name	CalcSpeeds
Link to SCADE model	???
SCADE designer	???
Description	This operator calculates the various 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	[If applicable description of time constraints, otherwise n/a]
API requirements	[If applicable description of API requirements, otherwise n/a]

4.2.3.5.2 Interface

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

4.2.3.6 ReleaseSpeed_Selection

4.2.3.6.1 Component Requirements

Component name	ReleaseSpeed_Selection
Link to SCADE model	???
SCADE designer	???
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	[If applicable description of time constraints, otherwise n/a]
API requirements	[If applicable description of API requirements, otherwise n/a]

4.2.3.6.2 Interface

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

4.2.3.7 SDM_Commands

4.2.3.7.1 Component Requirements

Component name	SDM_Commands
Link to SCADE model	???
SCADE designer	???

Description	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. 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.
Input documents	Subset-026, Chapter 3.13.10: Speed and distance monitoring commands
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]

4.2.3.7.2 Interface

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

4.2.3.8 SDM_OutputWrapper

4.2.3.8.1 Component Requirements

Component name	SDM_OutputWrapper
Link to SCADE model	???
SCADE designer	???
Description	This operator is the counterpart to operator SDM_OutputWrapper—that is, it converts all internal outputs of block “Speed Supervision” 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. This operator forwards input messages and transforms inputs messages into an internal type thereby converting real to int.
Input documents	Subset-026, Chapter 3.13: Speed and distance monitoring
Safety integrity level	4
Time constraints	[If applicable description of time constraints, otherwise n/a]

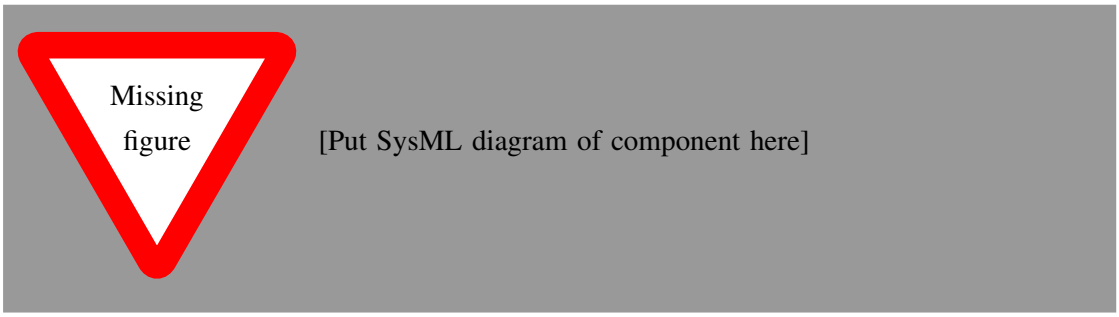

Figure 8. Manage_ETCS_Procedures component SysML diagram

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

4.2.3.8.2 Interface

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

4.3 Manage_ETCS_Procedures

4.3.1 Component Requirements

Component name	Manage_ETCS_Procedures
Link to SCADE model	???
SCADE designer	???
Description	???
Input documents	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]

4.3.2 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 4.3.2.1 respectively 4.3.2.2. Sub components are described in Section 4.3.3.

4.3.2.1 Inputs

4.3.2.1.1 [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)]

4.3.2.1.2 [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)]

4.3.2.2 Outputs

265 #### 4.3.2.2.1 [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)]

4.3.2.2.2 [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)]

4.3.3 Sub Components

4.3.3.1 Awakening_of_train

4.3.3.1.1 Component Requirements

Component name	Manage_ETCS_Procedures
Link to SCADE model	https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/ManageProcedure_Pkg.xscade
SCADE designer	???

Description	This component describes the Start of Mission procedure of the train until the status of the awakeness. From this point of the awakness the train will be able to start different modes, levels and further procedure. See scope of the Start of Mission - Awakness of train in the figure below. For the third iteration just a part of the Scope has been design. To complete the scenario in the third iteration the ideal path to the awakness of train until the state "waiting for Driver selection of "Start"" have been realized. Furthermore the initial data from the persistend database such as Level, Driver ID, Train Number, Train Data, Radio Number, RBC ID hase been consider as constants.
Input documents	Subset-026, Chapter 5, § 5.4
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]

4.3.3.1.2 Interface

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

4.3.3.2 SOM_Level_2_3

4.3.3.2.1 Component Requirements

Component name	SOM_Level_2_3
Link to SCADE model	https://github.com/openETCS/modeling/blob/master/model/Scade/System/ObuFunctions/Procedures/SoM_SR_FS_OS_LS_SH_SN_UN.xscade
SCADE designer	???
Description	This functionality describes the Start of Mission procedure of the train in Level 2 or 3 and the Modes SR FS OS LS SH where the train under the defined Mode Level supervision starts running. For the this iteration just a part of the Scope has been design. To complete the scenario in the third iteration the path "Full Supervision Movement Authority received from RBC" has been realized. The state will end after the train receives the Change Authority to FS and will be ready to run.
Input documents	Subset-026, Chapter 5, § 5.4
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]

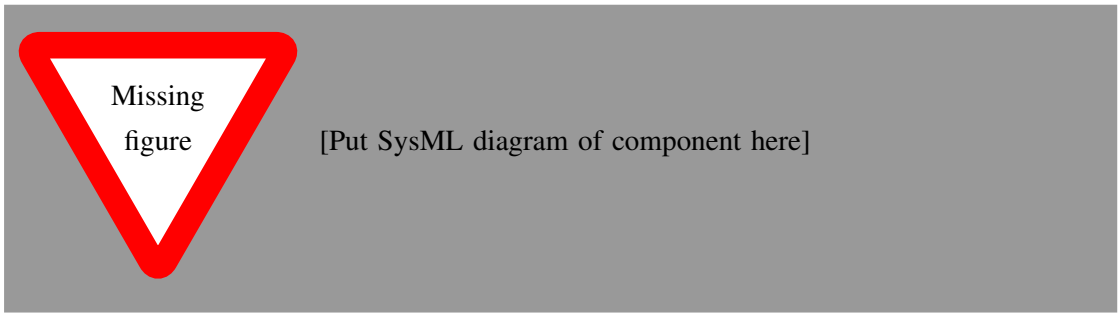

Figure 9. Manage_Track_Data component SysML diagram

4.3.3.2.2 Interface

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

4.4 Manage_Track_Data

4.4.1 Component Requirements

Component name	Manage_Track_Data
Link to SCADE model	???
SCADE designer	???
Description	???
Input documents	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]

4.4.2 Interface

An overview of the interface of component Manage_Track_Data is shown in Figure 9. The inputs and outputs are described in detail in Section 4.4.2.1 respectively 4.4.2.2. Sub components are described in Section 4.4.3.

4.4.2.1 Inputs

4.4.2.1.1 [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)]

4.4.2.1.2 [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)]

4.4.2.2 Outputs

4.4.2.2.1 [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)]

4.4.2.2.2 [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)]

290 ### 4.4.3 Sub Components

4.4.3.1 Calculate_Train_Position

4.4.3.1.1 Component Requirements

Component name	Calculate_Train_Position
Link to SCADE model	???
SCADE designer	???

Description	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 • creating and maintaining an obu internal coordinate system for all types of location based data • storing all linked and unlinked balise groups resulting from over passing or from announcements (linking information) from the track • calculating and maintaining the locations of all stored balise groups during the train trip, based on odometry and linking information • permanently calculating the current train position based on odometry and passed balise group information • providing the last recently passed linked balise group as the LRBG • providing additional position attribute information • deleting stored balise groups, when appropriate • detecting linking consistency errors • determining, if linking is used on board The calculation algorithms for locations and positions are implemented as specified in https://github.com/openETCS/SRS-Analysis/blob/master/System%20Analysis/WorkingRepository/Group4/SUBSET_26_3-6/DetermineTrainLocationProcedures.pdf
Input documents	Subset-026, Chapter 3.6
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]

4.4.3.1.2 Interface

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

4.4.3.2 Provide_Position_Report

4.4.3.2.1 Component Requirements

Component name	Provide_Position_Report

Link to SCADE model	???
SCADE designer	???
Description	This function takes the current train position and generates a position report which is sent to the RBC. The point in time when such a report is sent is determined by events, on the one hand, and position report parameters—which are basically triggers—provided by the RBC or a balise group passed, on the other hand. The functionality is modeled using four operators, which are explained below. **CalculateSafeTrainLength** Calculates the the safeTrainLength and the MinSafeRearEnd according to [1, Chapter 3.6.5.2.4/5]. `safeTrainLength = absolute(EstimatedFrontEndPosition - MinSafeR` where `MinSafeRearEnd = minSafeFrontEndPosition - L_TRAIN`. **EvaluateTriggerAndEvents** Returns a Boolean modelling whether the sending of the next position report is triggered or not. This value is the conjunction of the evaluation of all triggers (PositionReportParameters, i.e., Packet 58) and events (see [1, Chapter 3.6.5.1.4]). **ErrorManager** Takes a boolean flag for each possible error that has been occurred and outputs the respective error using type `M_ERROR` **CollectData** This operation aggregates data of Packet 0, . . . , Packet 5 and the header to a position report.
Input documents	Subset-026, Chapter 3.6.5
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]

4.4.3.2.2 Interface

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

4.5 Mode_and_Level

4.5.1 Component Requirements

Component name	Mode_and_Level
Link to SCADE model	???
SCADE designer	???
Description	???

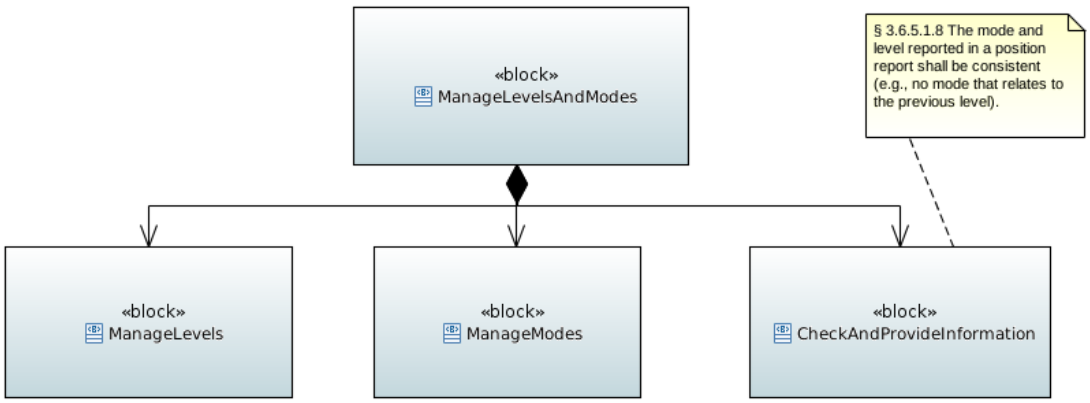

Figure 10. Mode_and_Level component SysML diagram

Input documents	Subset-026, Chapter 4 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]

4.5.2 Interface

An overview of the interface of component Mode_and_Level is shown in Figure 10. The inputs
305 and outputs are described in detail in Section 4.5.2.1 respectively 4.5.2.2. Sub components are described in Section 4.5.3.

4.5.2.1 Inputs

4.5.2.1.1 [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)]

4.5.2.1.2 [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]
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)]

4.5.2.2 Outputs

4.5.2.2.1 [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)]

4.5.2.2.2 [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)]

4.5.3 Sub Components

4.5.3.1 Level_Management

315 ##### 4.5.3.1.1 Component Requirements

Component name	Level_Management
Link to SCADE model	https://github.com/openETCS/modeling/tree/master/openETCSArchitectureAndDesign/WorkGroups/Group3/SCADE/LevelManagement/
SCADE designer	Marielle Petit-Doche, Systerel
Description	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. If required, the driver is asked to acknowledge the transition, in case of no acknowledge or if conditions for the level transition are not fulfilled, the train gets tripped. On the most abstract level the design consists of the *manage_priorities* function which takes the level transition order priority tables as inputs and computes the highest priority transition. This transition order is the fed to the *computeLevelTransitions* operator. This operator consists of three main parts. The *ComputeTransitionConditions* operator that emits the fulfilled conditions to change from a given level to a new level, the *LevelStateMachine* that stores the current level and takes the computed change conditions as input for possible level transitions and finally the *driverAck* 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.

Input documents	Subset-026, Chapter 5.10
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]

4.5.3.1.2 Interface

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

4.5.3.2 Mode_Management

4.5.3.2.1 Component Requirements

Component name	Mode_Management
Link to SCADE model	https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLevelsAndModes/Modes
SCADE designer	Marielle Petit-Doche, Systerel
Description	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. Three subfunctions are defined: **Inputs** proceeds to inputs check and preparation. **ComputeModesCondition** 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] **SwitchModes** performs the mode selection according the conditions and priorities defined in transition table section 4.6.2 of [1] **Outputs** prepares packet of outputs.
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]
API requirements	[If applicable description of API requirements, otherwise n/a]

4.5.3.2.2 Interface

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

4.5.3.3 Check_and_Provide_Mode_and_Level

4.5.3.3.1 Component Requirements

Component name	Check_and_Provide_Mode_and_Level
Link to SCADE model	https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/ManageLevelsAndModes/Modes
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]
API requirements	[If applicable description of API requirements, otherwise n/a]

4.5.3.3.2 Interface

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

4.6 Manage_Radio_Communication

4.6.1 Component Requirements

Component name	Mode_and_Level
Link to SCADE model	???
SCADE designer	Uwe Steinke, Siemens AG
Description	???
Input documents	Subset-026, Chapter 4 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]

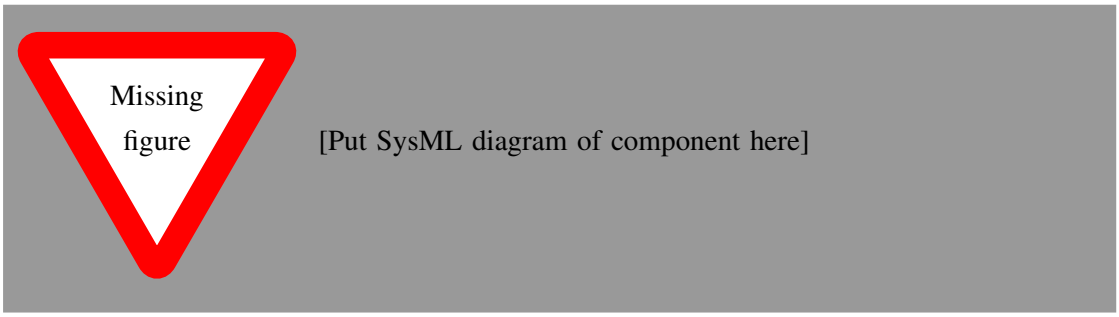

Figure 11. Manage_Radio_Communication component SysML diagram

4.6.2 Interface

An overview of the interface of component Manage_Radio_Communication is shown in Figure 11. The inputs and outputs are described in detail in Section 4.6.2.1 respectively 4.6.2.2. Sub components are described in Section 4.6.3.

335 #### 4.6.2.1 Inputs

4.6.2.1.1 [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)]

4.6.2.1.2 [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]

4.6.2.2.1 [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 #### 4.6.2.2.2 [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)]

4.6.3 Sub Components

4.6.3.1 Management_of_Radio_Communication

4.6.3.1.1 Component Requirements

Component name	Management_of_Radio_Communication

Link to SCADE model	https://github.com/openETCS/modeling/tree/master/model/Scade/System/ObuFunctions/Radio/MoRC
SCADE designer	Marielle Petit-Doche, Systerel
Description	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*. 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]

4.6.3.1.2 Interface

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

5 F3: Measure Train Movement

6 F4: Manage Radio Communication

7 F5: Manage JRU

8 F6: DMI Controller

8.1 DMI

8.1.1 Component Requirements

Component name	DMI
Link to SCADE model	https://github.com/openETCS/modeling/tree/master/model/Scade/System/DMI_Control
SCADE designer	Valerio D'Angelo, DB Netz AG
Description	The DMI controller interacts with the DMI display and is responsible for alls 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]

8.1.2 Interface

An overview of the interface of component DMI is shown in Figure 12. The inputs and outputs are described in detail in Section 8.1.2.1 respectively 8.1.2.2.

8.1.2.1 Inputs

8.1.2.1.1 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)]

8.1.2.1.2 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)]

8.1.2.1.3 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)]

360 #### 8.1.2.1.4 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)]

8.1.2.1.5 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)]

8.1.2.1.6 DMI_icons

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 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)]

8.1.2.1.7 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 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)]

8.1.2.1.8 DMI_train_running_number

Input name	DMI_train_running_number
Description	Contains the default or entered train running number
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)]

365 #### 8.1.2.1.9 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)]

8.1.2.1.10 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)]

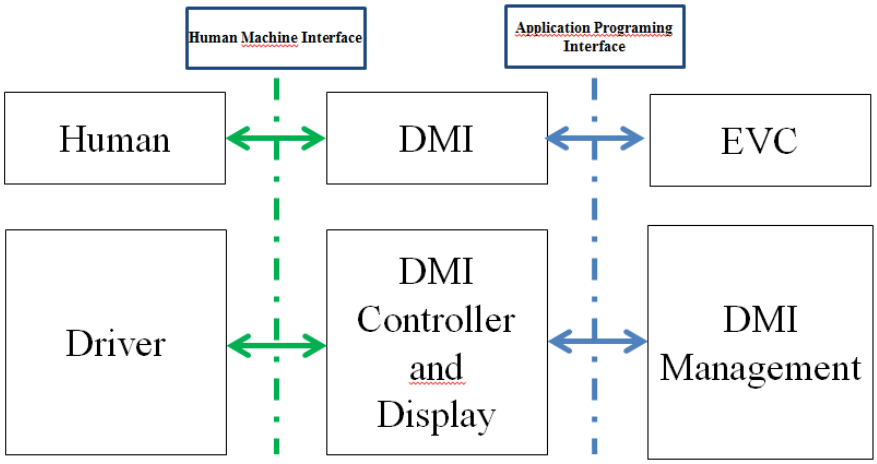

Figure 12. DMI component SysML diagram

8.1.2.2 Outputs

8.1.2.2.1 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)]

8.1.2.2.2 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	[Description of components behaviour when value is erroneous,

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)]

8.1.2.2.4 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)]

8.1.2.2.5 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)]

8.1.2.2.6 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)]

8.1.2.2.7 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)]

375 #### 8.1.2.2.8 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)]

8.1.2.2.9 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

[1] ERA. *System Requirements Specification, SUBSET-026*, v3.3.0 edition, March 2012.