PD CLC/TR 50624:2014

BSI Standards Publication

Railway applications — Functional Interface Specification — Pantograph System

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The UK participation in its preparation was entrusted to Technical Committee GEL/9, Railway Electrotechnical Applications.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2014

ISBN 978 0 580 76617 6
ICS 35.240.60

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 July 2014.

Amendments/corrigenda issued since publication

Date	Text affected

TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CLC/TR 50624

June 2014

ICS 35.240.60

English Version

Railway applications - Functional Interface Specification - Pantograph System

Applications ferroviaires - Spécification d'interface fonctionnelle - Système de pantographe

To be completed

This Technical Report was approved by CENELEC on 2014-06-02.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (CLC/TR 50624:2014) has been prepared by WG15 of CLC/TC 9X "Electrical and electronic applications for railways".

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1 Scope

This Technical Report is covering the description of the pantograph system and the functional interface between the pantograph system itself and the TCMS, including the context of multiple units.

The pantograph system contains the pantograph and the pantograph control. The internal interface between pantograph and pantograph control is not in the scope of this document.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50367, *Railway applications - Current collection systems - Technical criteria for the interaction between pantograph and overhead line (to achieve free access)*

EN 61131-3:2013, *Programmable controllers - Part 3: Programming languages (IEC 61131-3:2013)*

UIC 556, *Information transmission in the train (train-bus)*

3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply.

3.1 Terms

3.1.1
configuration
action that affects the system function

3.1.2
parameterisation
action that affects the system behaviour

3.2 Abbreviations

All the abbreviations used in this document are listed in Table 1, in alphabetic order referenced to their term.

Table 1 - Abbreviation table

Abbreviation	Term
FBS	Functional Breakdown Structure
FIS	Functional Interface Specification
MAC	Media Access Control (related to data transmission in networks)
MPU	Main Processing Unit
PBS	Product Breakdown Structure
PTU	Pantograph Control Unit
QoS	Quality of Service (related to data transmission in networks)
RAMS	Reliability, Availability, Maintainability, Safety
TCMS	Train Control & Monitoring System
UML	Unified Modelling Language
UTC	Universal Time Coordinated (time scale)

4 Pantograph reference architecture

The pantograph reference architecture is shown in Figure 1.

The pantograph system has a network interface with the TCMS for the purpose of control and monitoring, as well as for service and diagnostics. This document describes the interface between TCMS and one single Pantograph system with regard to the context of multiple units.

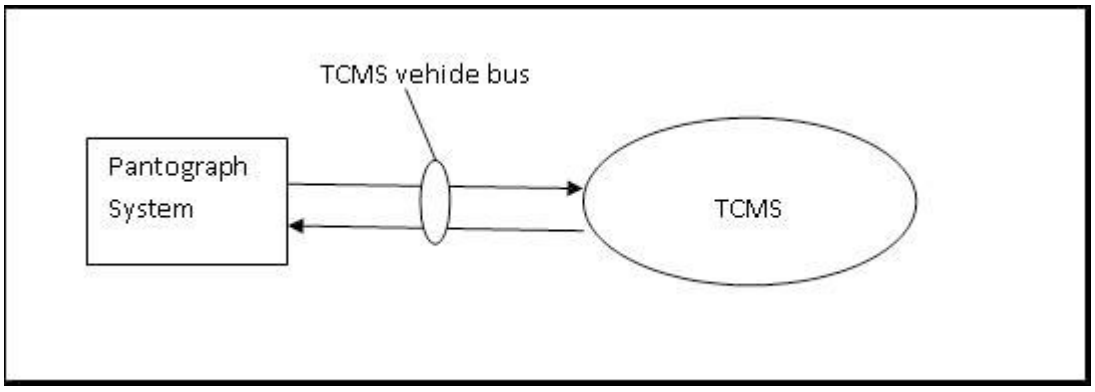

Figure 1 - pantograph system and TCMS interface

In addition to the pantograph control reference overview, as it is described in the subsequent clauses, the scope of this FIS for controlling a pantograph is shown in Figure 2. It is to be noted that PBS 4.1.1 is the reference to the original MODTRAIN document from which this document is derived and PBS 9.2 is the reference to the original MODTRAIN document describing TCMS.

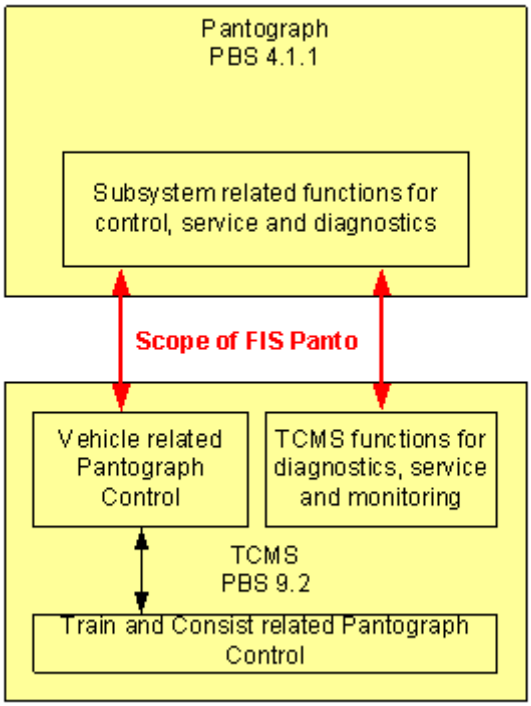

Figure 2 - interaction between Pantograph system and TCMS

5 Functional description

5.1 General

In this clause are described the pantograph functions external to the TCMS, which exchange information with the TCMS over the interface.

The here described interface is a basic standard interface with possibilities of extension (parameters and services can be added).

If not especially mentioned for each parameter a Set and a Get service is provided.

The function types which are considered are the following:

- Functions for parameterisation
- Functions for control
- Functions for monitoring
- Functions for diagnostics
- Functions for service

5.2 Specific requirements on functional interfaces

If deemed useful, the static description of data are completed by:

- Dynamic description, with sequence diagrams, possibly using several interfaces identified in the reference architecture, for normal and degraded modes. These diagrams may contains timing requirements (such as time between the command set to TCMS and notification to remote actuators)

- RAMS requirements to the communication and processing in the TCMS
- Any other relevant item
- The physical layer shall be defined later

5.3 Interface between pantograph and TCMS

5.3.1 General

Figure 3 shows the UML diagram of the TCMS control interface related to the pantograph system.

Figure 4 shows the UML diagram of the diagnostic common interface between the pantograph and TCMS.

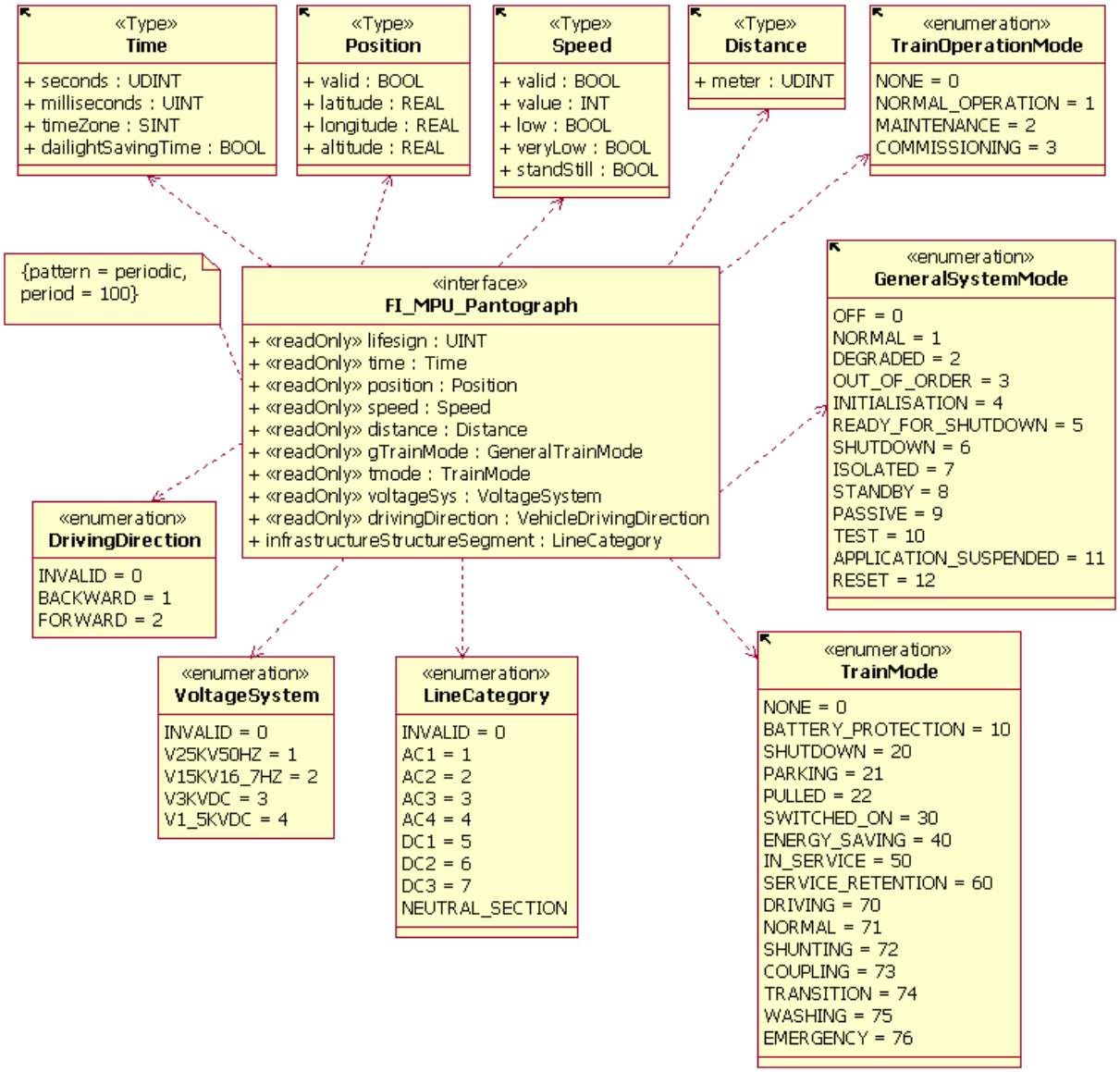

Figure 3 - TCMS control interface related to the pantograph system

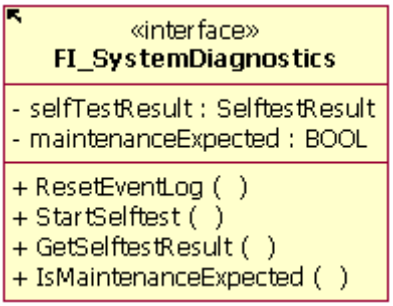

Figure 4 - Common Diagnostics TCMS interface

5.3.2 <Interface> FI_MPU_Pantograph

Table 2 lists the attribute of the central interface of the TCMS providing data for the Pantograph

Table 2 - MPU functional interface - attributes

Attribute	Visibility	Type	Description
lifesign	0 - PUBLIC	UINT	<<readOnly>> refer to CommonDefinitions - Types
time	0 - PUBLIC	Time	<<readOnly>> refer to CommonDefinitions - Types
position	0 - PUBLIC	Position	<<readOnly>> refer to CommonDefinitions - Types
speed	0 - PUBLIC	Speed	<<readOnly>> refer to CommonDefinitions - Types; for vehicle pantograph control
distance	0 - PUBLIC	Distance	<<readOnly>> refer to CommonDefinitions - Types
gTrainMode	0 - PUBLIC	GeneralTrainMode	<<readOnly>> refer to CommonDefinitions - Types
tmode	0 - PUBLIC	TrainMode	<<readOnly>> refer to CommonDefinitions - Types
voltageSys	0 - PUBLIC	VoltageSystem	<<readOnly>> voltage system detected for vehicle pantograph control; types according to MODPOWER FRS/SyFRS MP01
drivingDirection	0 - PUBLIC	VehicleDrivingDirection	<<readOnly>> driving direction in accordance with UIC 556 for vehicle pantograph control
infrastructureStructureSegment	0 - PUBLIC	LineCategory	optional: actual category of infrastructure (EN 50367) at the train's location for vehicle pantograph control

5.3.3 <Enumeration> VoltageSystem

Table 3 lists the voltage systems managed by the pantograph.

Table 3 - Voltage systems managed by the pantograph

Literal	Value	Description
INVALID	0	Invalid value
V25KV50HZ	1	25 kV, 50 Hz
V15KV16_7HZ	2	15 kV, 16,7 Hz
V3KVDC	3	3 kV, DC
V1_5KVDC	4	1,5 kV, DC

5.3.4 <Enumeration> DrivingDirection

Table 4 lists the train driving direction according to UIC 556

Table 4 - Driving directions

Literal	Value	Description
INVALID	0	Signal is invalid
BACKWARD	1	driving direction in accordance with UIC 556 is backward
FORWARD	2	driving direction in accordance with UIC 556 is forward

5.4 Pantograph Overview

Figure 5 shows the UML model of the pantograph control unit reference architecture.

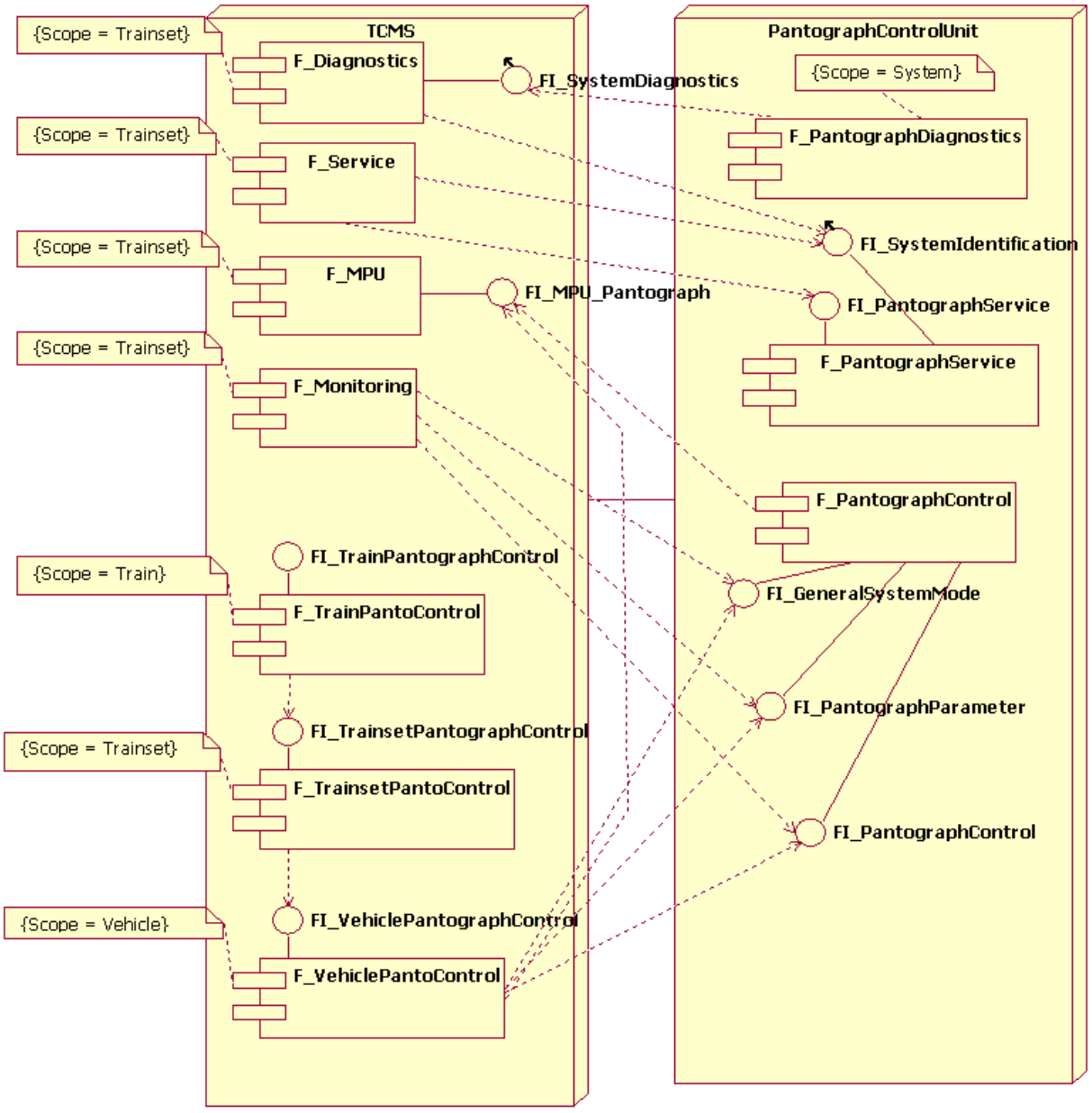

Figure 5 - Pantograph control reference architecture overview

5.5 Types

5.5.1 General

Figure 6 special Pantograph system data types.

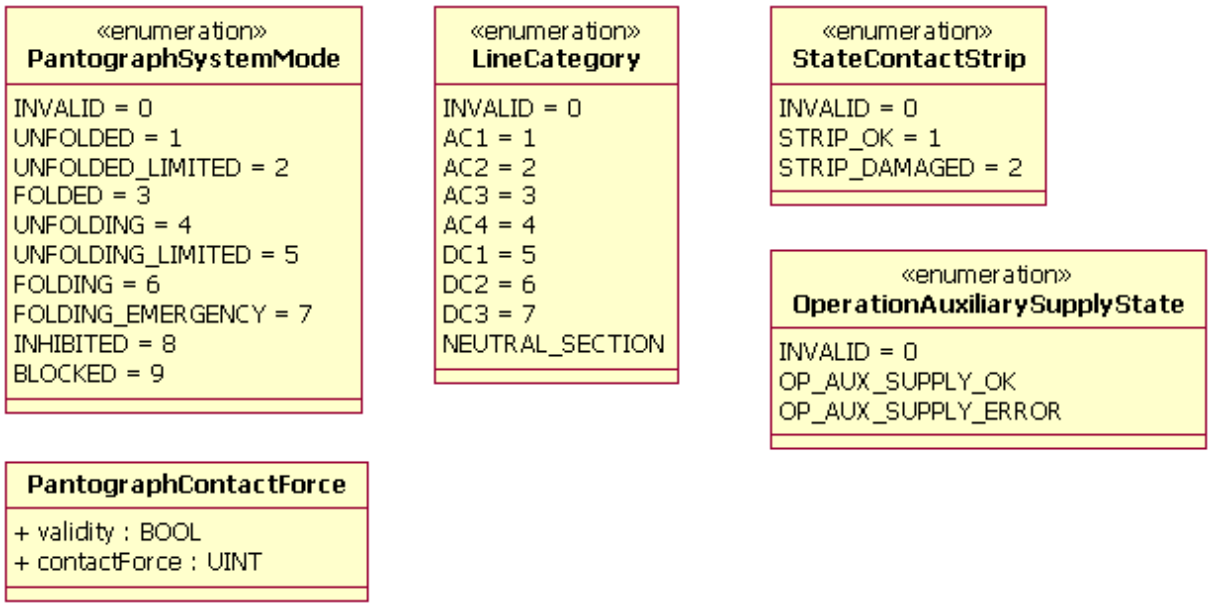

Figure 6 - Pantograph system data types

5.5.2 <Enumeration> PantographSystemMode

Table 5 lists system operation mode typically as an additional specific mode inside the general system modes. The parameters listed are read only by the other systems.

Table 5 - Pantograph system modes

Literal	Value	Description
INVALID	0	Signal is invalid
UNFOLDED	1	Pantograph is unfolded
UNFOLDED_LIMITED	2	Pantograph is unfolded with height limitation
FOLDED	3	Pantograph is folded
UNFOLDING	4	Pantograph is actually unfolding
UNFOLDING_LIMITED	5	Pantograph is actually unfolding to a height limit
FOLDING	6	Pantograph is actually folding
FOLDING_EMERGENCY	7	Pantograph is actually folding in an emergency way
INHIBITED	8	Unfolding of the pantograph is actually inhibited because

Literal	Value	Description
		of a detected damage of its contact strip
BLOCKED	9	Pantograph is actually manually blocked

5.5.3 <Enumeration> OperationAuxiliarySupplyState

Table 6 lists the status of Operation Auxiliary Supply and reports if it is sufficient or not for the pantograph's unfold/fold operation.

Table 6 - Status of the operation auxiliary supply

Literal	Value	Description
INVALID	0	Signal is invalid
OP_AUX_SUPPLY_OK		e.g pressure in the air supply of the pantograph system is sufficient for operation.
OP_AUX_SUPPLY_ERROR		e.g. pressure level of the air supply of the pantograph system is insufficient for operation

5.5.4 <Enumeration> StateContactStrip

Table 7 lists the status of contact strip and reports if it is damaged or not.

Table 7 - Status of the contact strip

Literal	Value	Description
INVALID	0	Signal is invalid
STRIP_OK	1	No strip damage detected
STRIP_DAMAGED	2	Strip damage detected

5.5.5 <Class> PantographContactForce

Table 8 lists the parameters relevant to definition of the contact force between the pantograph contact strip and the catenary.

Table 8 - Contact force of the pantograph

Attribute	Visibility	Type	Description
validity	0 - PUBLIC	BOOL	Indicates the validity of the value contactForce: TRUE: value of contactForce is valid FALSE: value of contactForce is not valid
contactForce	0 - PUBLIC	UINT	Contact force between the pantograph contact strip and the catenary in units of 0,1 N.

5.5.6 <Enumeration> LineCategory

Table 9 lists the contact line categories according to EN 50367, defining parameters for pantograph operation, like overhead voltage system, maximum speed, current at standstill, collector head parameters, catenary parameters and contact force parameters.

Table 9 - Contact line categories

Literal	Value	Description
INVALID	0	value invalid
AC1	1	EN 50367: category for conventional and connecting lines - a.c.; v = 160 km/h
AC2	2	EN 50367: upgraded lines around 200 km/h - a.c.; 160 km/h < v = 220 km/h
AC3	3	EN 50367: upgraded lines around 200 km/h - a.c.; 220 km/h < v < 250 km/h
AC4	4	EN 50367: high-speed lines - a.c.; v = 250 km/h
DC1	5	EN 50367: conventional and connecting lines - d.c.; v = 160 km/h
DC2	6	EN 50367: upgraded lines around 200 km/h - d.c.; 160 km/h < v = 220 km/h
DC3	7	EN 50367: high-speed lines - d.c.; 220 km/h < v = 250 km/h
NEUTRAL_SECTION		neutral section

5.6 Control and Parameterisation

5.6.1 General

Figure 7 shows the pantograph control and parameterisation interfaces.

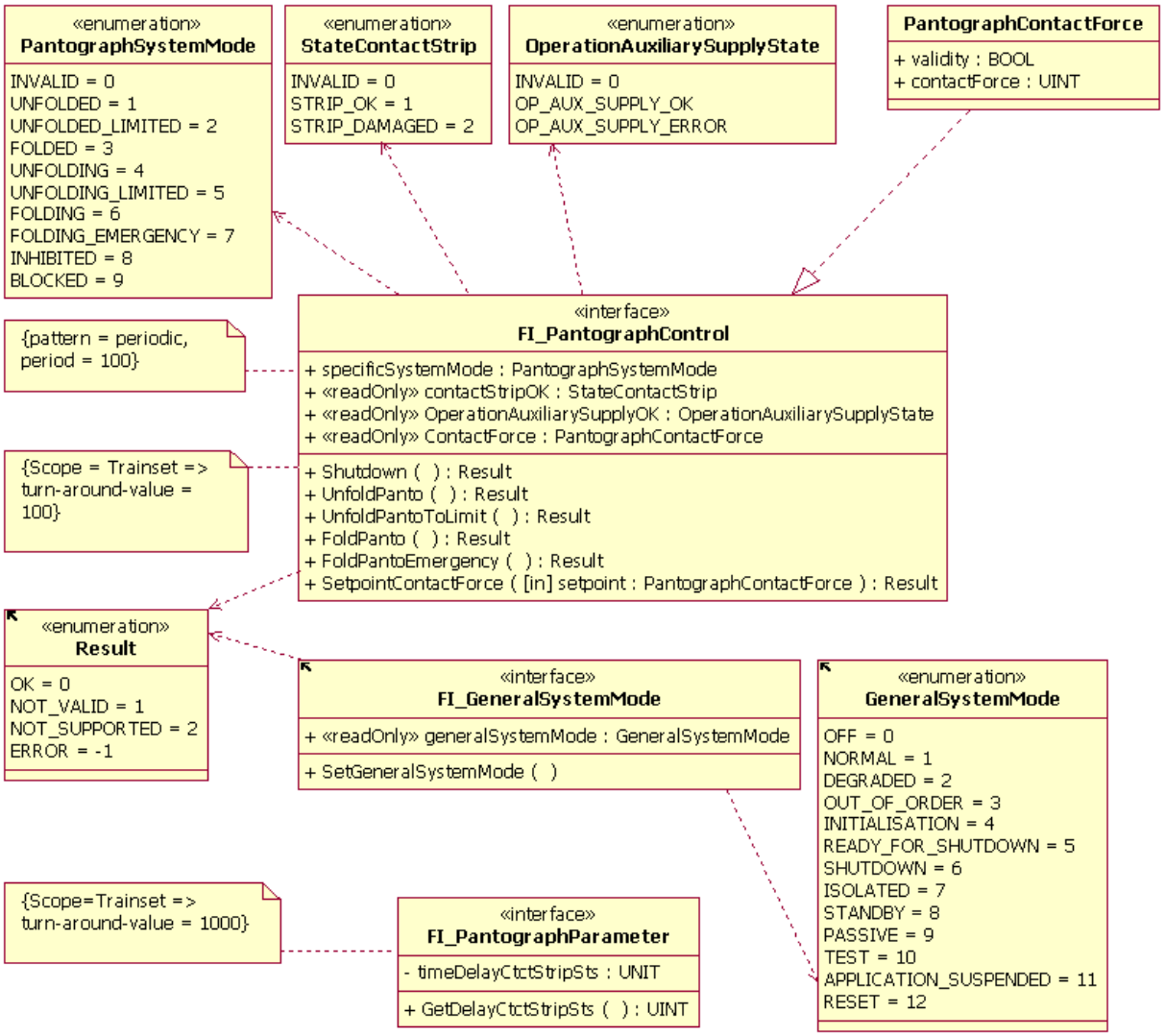

Figure 7 - Pantograph control and parameterisation interfaces

5.6.2 <Interface> FI_PantographControl

Table 10 lists the Pantograph control functional interface attributes.

Table 10 - Pantograph control functional interface attributes

Attribute	Visibility	Type	Description
specificSystemMode	0 - PUBLIC	PantographSystemMode	pantograph system mode
contactStripOK	0 - PUBLIC	StateContactStrip	<<readOnly>> status of the contact strips
OperationAuxiliarySupplyOK	0 - PUBLIC	OperationAuxiliarySupplyState	<<readOnly>> Status of the compressed air supply
ContactForce	0 - PUBLIC	PantographContactForce	<<readOnly>> Actual contact force applied by the pantograph system to press the contact strip upward against the catenary

Table 11 lists the Pantograph control functional interface operations.

Table 11 - Pantograph control functional interface operations

Operation	Visibility	Parameter	Description / Parameter
Shutdown	0 - PUBLIC	(3 - RETURN) : Result	Central organised shut down the system – if required
UnfoldPanto	0 - PUBLIC	(3 - RETURN) : Result	Service for unfolding the pantograph
UnfoldPantoToLimit	0 - PUBLIC	(3 - RETURN) : Result	Service for unfolding the pantograph until a pre-adjusted height. If this service is requested when the pantograph structure is already unfolded above its limited height, the pantograph structure has to be lowered in advance underneath the limited height.
FoldPanto	0 - PUBLIC	(3 - RETURN) : Result	Service for folding the pantograph in normal operation
FoldPantoEmergency	0 - PUBLIC	(3 - RETURN) : Result	Service for folding the pantograph in emergency operation (fast)
SetpointContactForce	0 - PUBLIC	(0 - IN) setpoint: PantographContactForce	Setpoint Value “Contact force” F0 = f(v)

Operation	Visibility	Parameter	Description / Parameter
		(3 - RETURN) : Result	Explanation of F0 = f(v): F0 (v) + Fdyn (v) = Fm (v) Fm (v): Target curve according to infrastructure segment Fdyn (v): physical influence of pantograph type, position, direction and velocity determined during test trials with Fdyn (v=0 km/h) = 0 N F0 (v): resulting setpoint value

5.6.3 <Interface> FI_PantographParameter

Table 12 lists the Pantograph functional interface attributes.

Table 12 - Pantograph functional interface attributes

Attribute	Visibility	Type	Description
timeDelayCtctStripSts	2 - PRIVATE	UNIT	Time delay in seconds between the initiation of the command to unfold the pantograph and the signal ContactStripOK status becomes valid

Table 13 lists the Pantograph functional interface operations.

Table 13 - Pantograph functional interface operations

Operation	Visibility	Parameter	Description / Parameter
GetDelayCtctStripSts	0 - PUBLIC	(3 - RETURN) : UINT	Returns the value of the private parameter

5.6.4 <Class> PantographControl

Figure 8 shows the state chart for the control of a single pantograph.

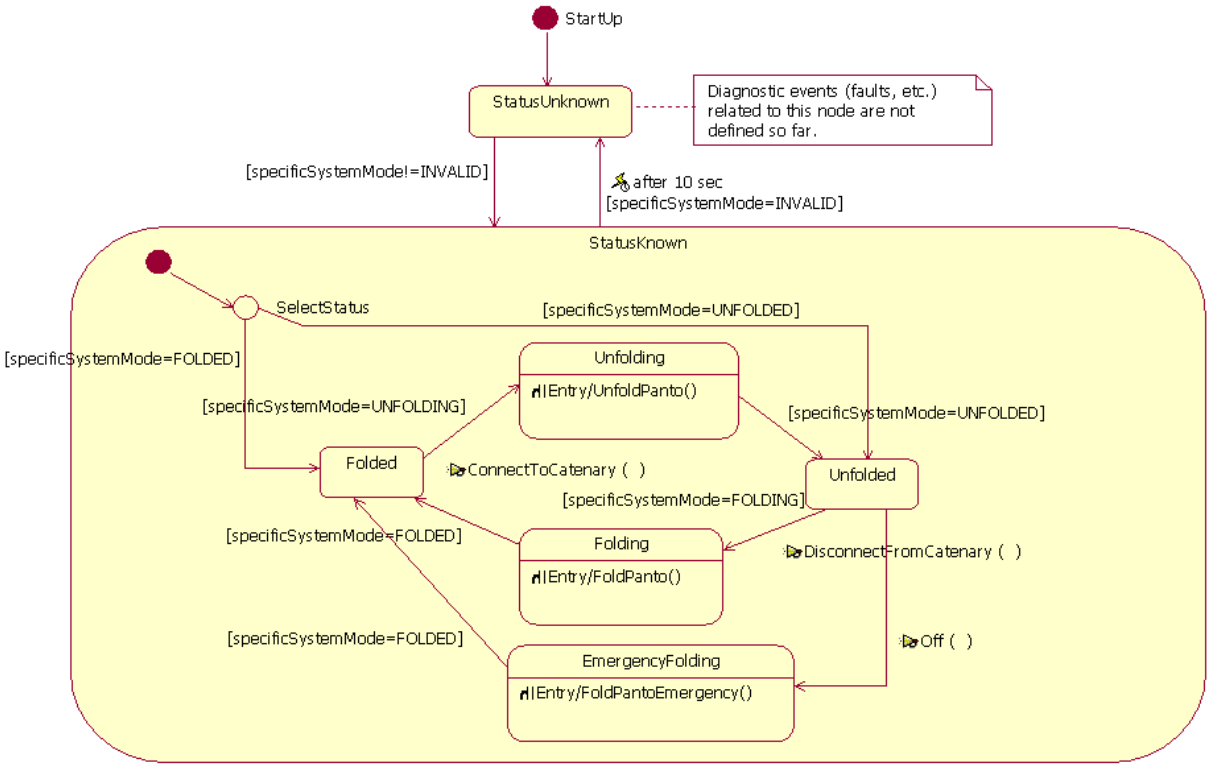

Figure 8 - State chart for the control of a single pantograph

5.7 Diagnostics

5.7.1 General

Figure 9 shows how the diagnostics functionality is supported by functions that identifying a failure of the system by the result of different diagnostic procedures.

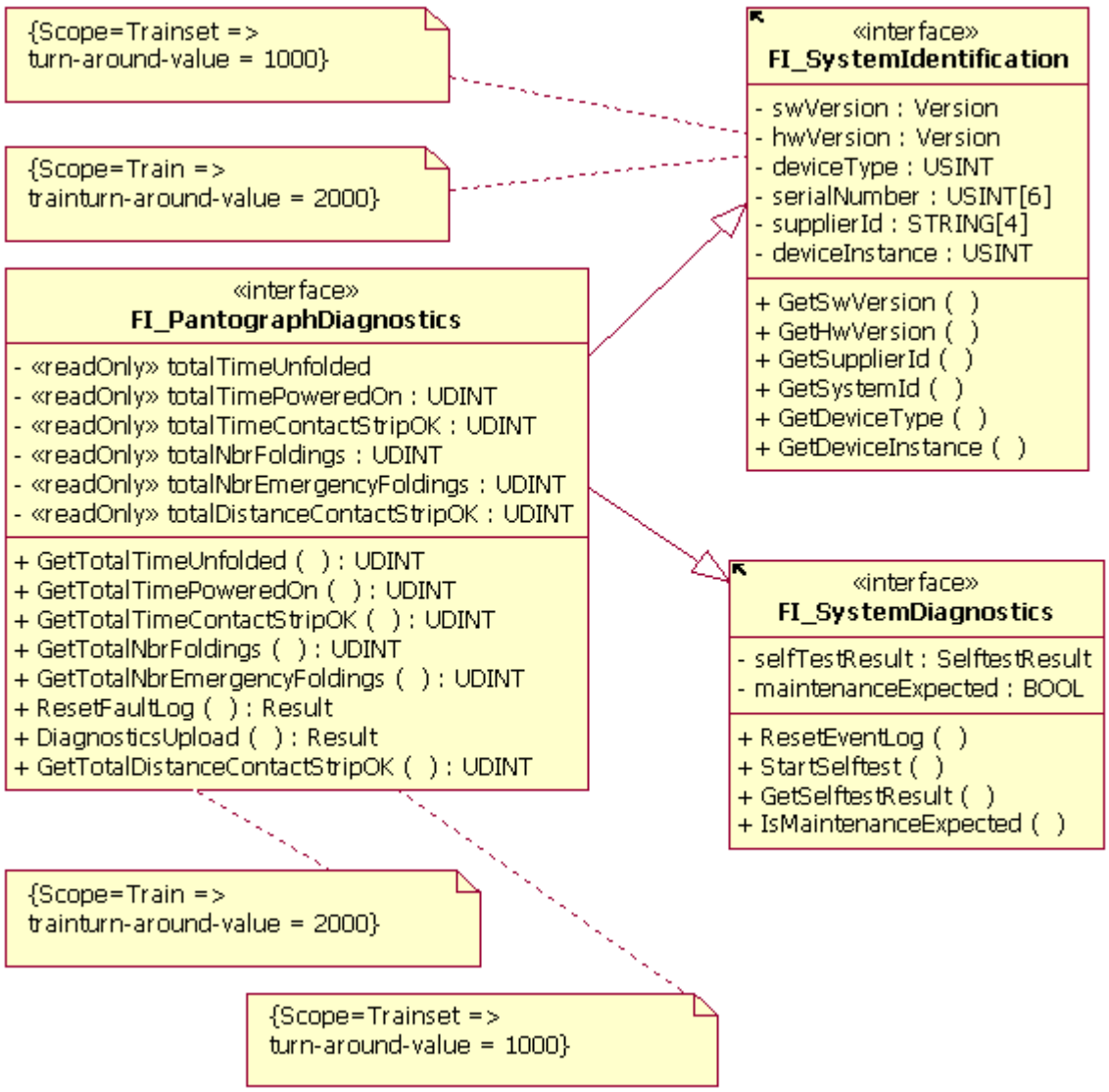

Figure 9 - Pantograph diagnostics interface

5.7.2 <Interface> FI_PantographDiagnostics

Table 14 lists specific diagnostic attributes published by means of the pantograph functional interface.

Table 14 - Pantograph functional interface diagnostic attributes

Attribute	Visibility	Type	Description
totalTimeUnfolded	2 - PRIVATE		<<readOnly>> Time in seconds the pantograph is unfolded
totalTimePoweredOn	2 - PRIVATE	UDINT	<<readOnly>> Counter to specify the powerd on time of the pantograph in seconds
totalTimeContactStripOK	2 - PRIVATE	UDINT	<<readOnly>> Total of time in seconds the contact strip(s) of the pantograph indicated the status OK; Has to be reset after the maintenance exchange of the contact strip(s)
totalNbrFoldings	2 - PRIVATE	UDINT	<<readOnly>> Total number of the pantograph's unfolding
totalNbrEmergencyFoldings	2 - PRIVATE	UDINT	<<readOnly>> Total number of the pantograph's emergency unfolding
totalDistanceContactStripOK	2 - PRIVATE	UDINT	<<readOnly>> Integrated distance of the pantograph strip(s) being operated: Has to be reset after maintenace exchange of the contact strip(s).

Table 15 lists specific diagnostic operations offered by the pantograph functional interface.

Table 15 - Pantograph functional interface diagnostic operations

Operation	Visibility	Parameter	Description / Parameter
GetTotalTimeUnfolded	0 - PUBLIC	(3 - RETURN) : UDINT	Returns the value of the private parameter
GetTotalTimePoweredOn	0 - PUBLIC	(3 - RETURN) : UDINT	Returns the value of the private parameter
GetTotalTimeContactStripOK	0 - PUBLIC	(3 - RETURN) : UDINT	Returns the value of the private parameter
GetTotalNbrFoldings	0 - PUBLIC	(3 - RETURN) : UDINT	Returns the value of the private parameter
GetTotalNbrEmergencyFoldings	0 - PUBLIC	(3 - RETURN) : UDINT	Returns the value of the private parameter
ResetFaultLog	0 - PUBLIC	(3 - RETURN) : Result	Reset of the fault log
DiagnosticsUpload	0 - PUBLIC	(3 - RETURN) : Result	Upload of diagnostics data
GetTotalDistanceContactStripOK	0 - PUBLIC	(3 - RETURN) : UDINT	Returns the value of the private parameter

5.8 Service

5.8.1 General

Figure 10 shows the service functionality which includes services for commissioning and maintenance of the system such as e.g. software download and unit self test.

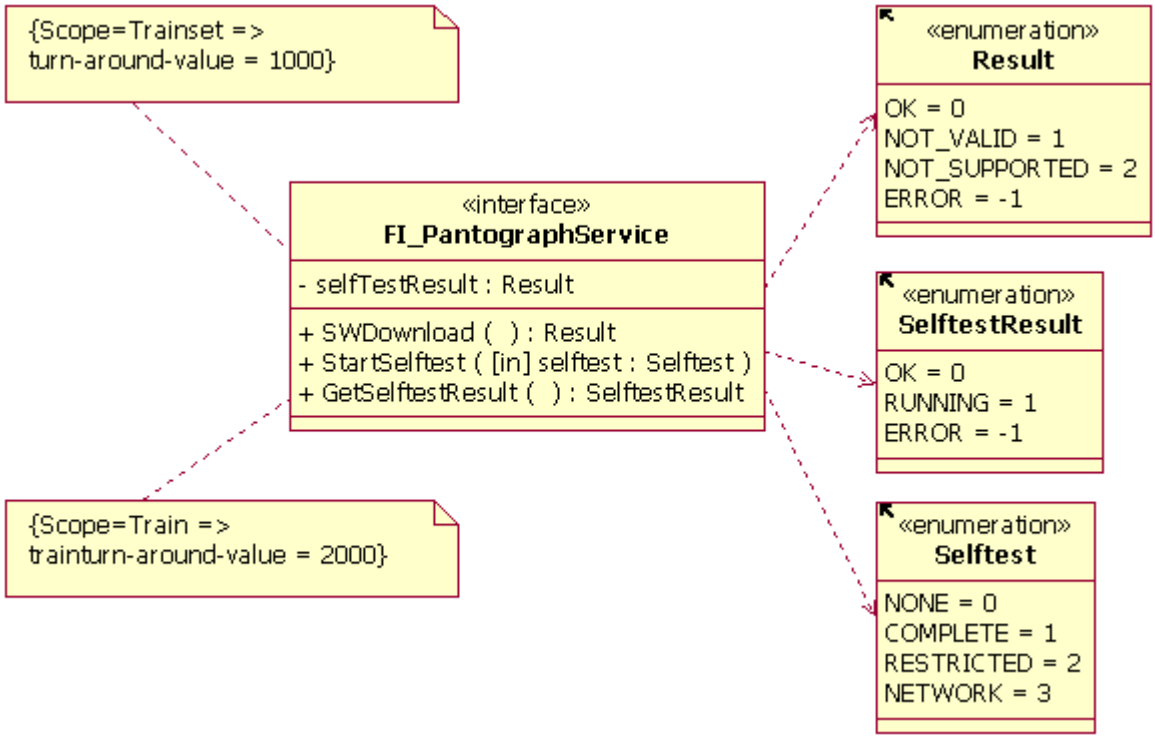

Figure 10 - Pantograph system service interface

5.8.2 <Interface> FI_PantographService

Table 16 lists Pantograph functional interface service attributes.

Table 16 - Pantograph functional interface service attributes

Attribute	Visibility	Type	Description
selfTestResult	2 - PRIVATE	Result	result of selftest

Table 17 lists Pantograph functional interface service operations.

Table 17 - Pantograph functional interface service operations

Operation	Visibility	Parameter	Description / Parameter
SWDownload	0 - PUBLIC	(3 - RETURN) : Result	Download the specified system software (OS, application, configuration, …)
StartSelftest	0 - PUBLIC	(0 - IN) selftest: Selftest	Service to start different system depending selftests indicated by the parameter selftest
GetSelftestResult	0 - PUBLIC	(3 - RETURN) : SelftestResult	Returns result of self test

Annex A
(informative)
UML common definitions

A.1 Common definitions

This annex describes common types and interfaces used by the different systems (e.g. Door, HVAC, Battery).

The following functions are considered:
- Functions for parameterisation
- Functions for control
- Functions for monitoring
- Functions for diagnostics
- Functions for service

The rules for UML modelling are listed in Figure A.1.

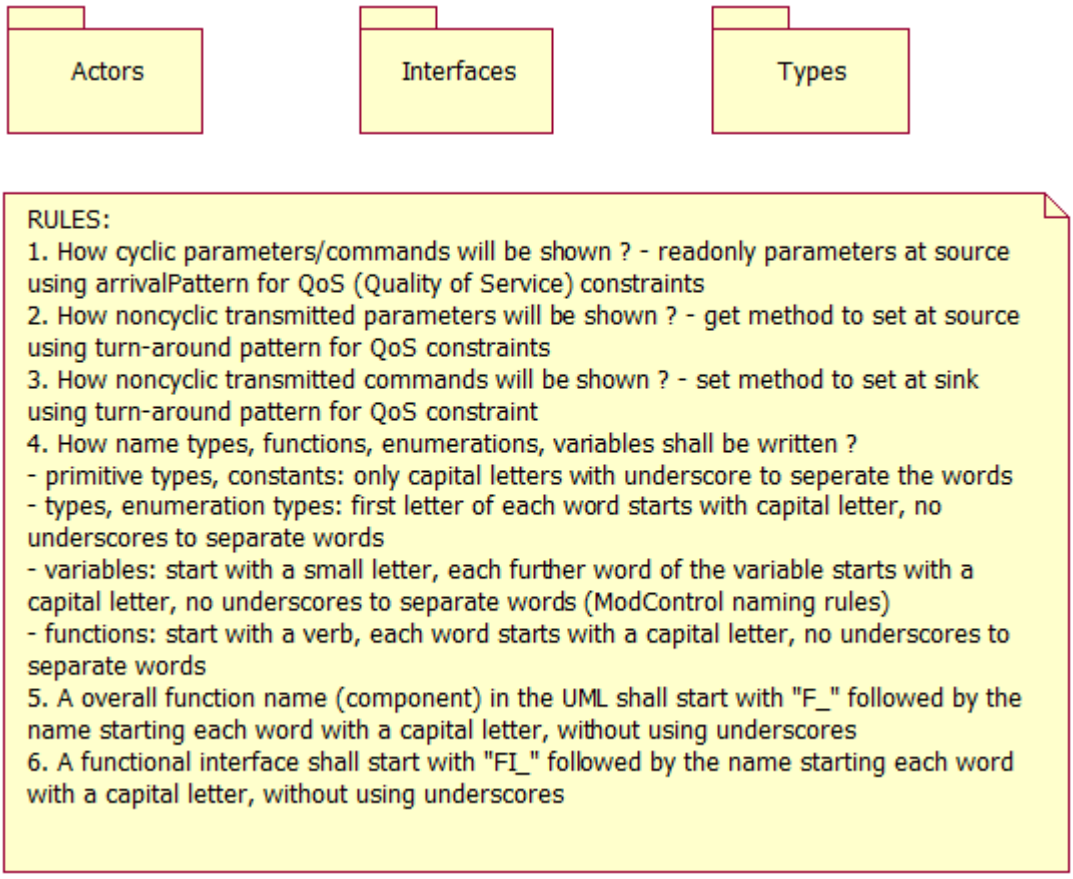

Figure A.1 - Rules for UML modelling

A.2 UML description

A.2.1 UML component diagram

Figure A.2 shows the structure of a generic UML component diagram

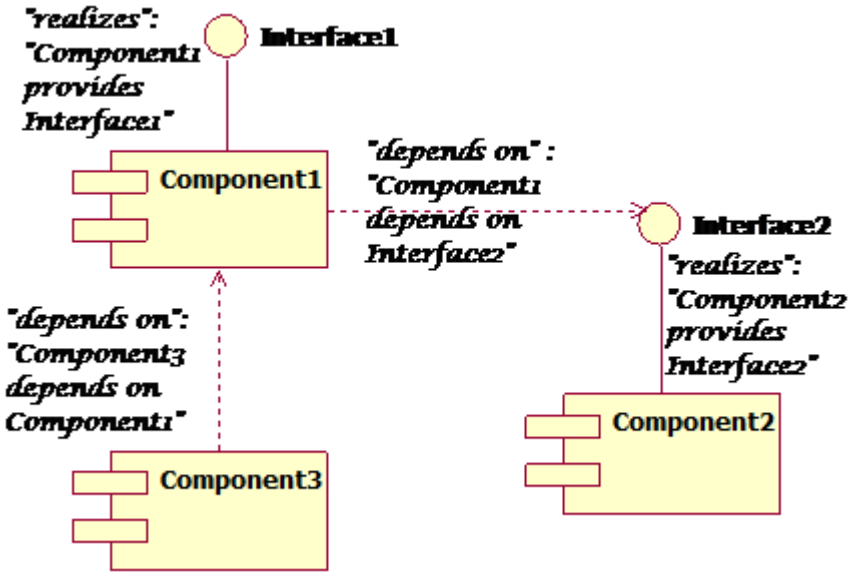

Figure A.2 - UML component diagram structure

A.2.2 UML deployment diagram

Figure A.3 shows the structure of a generic UML deployment diagram.

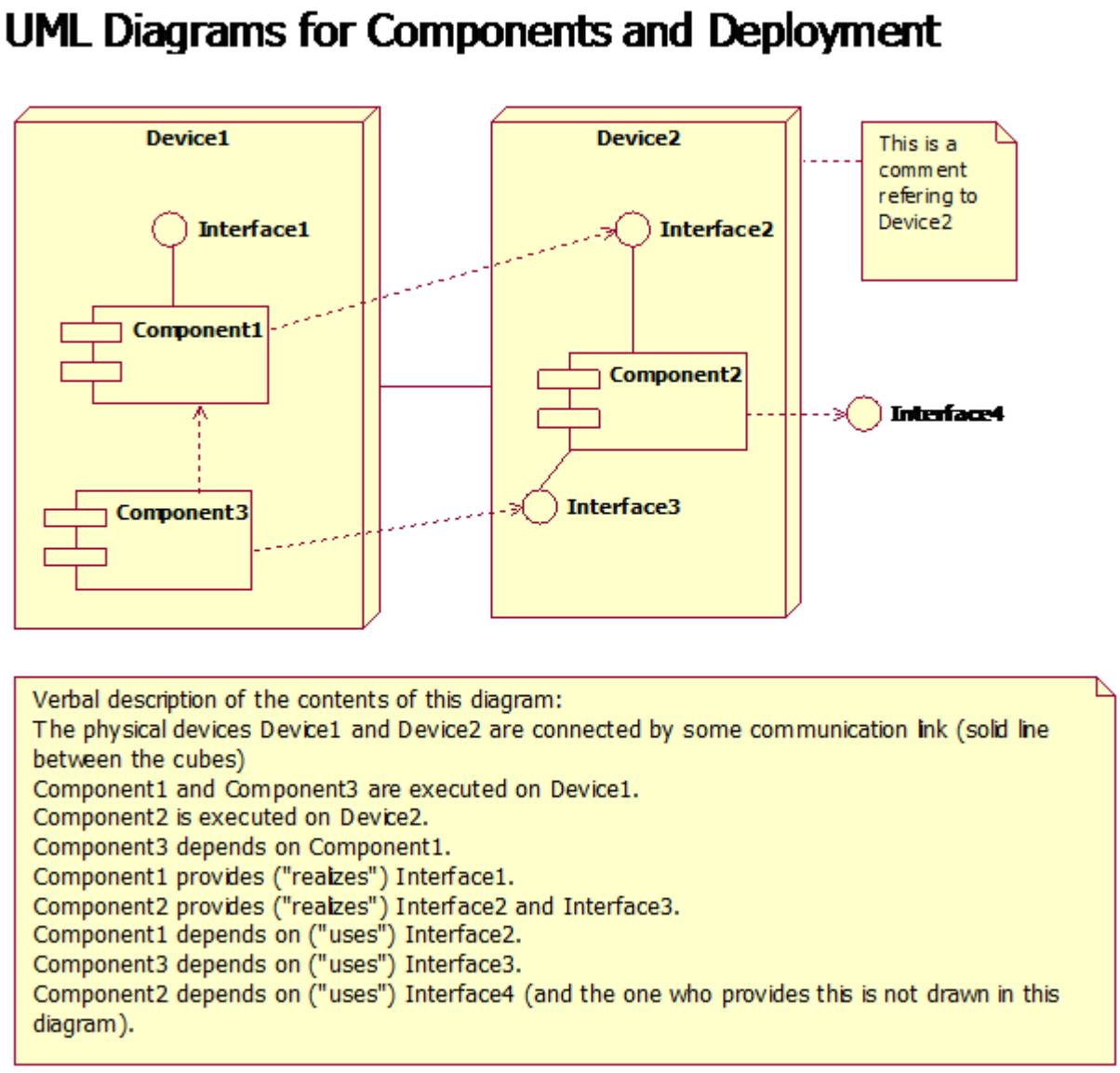

Figure A.3 - UML deployment diagram structure

A.2.3 UML class diagram

A.2.3.1 General

Figure A.4 shows the structure of a generic UML class diagram.

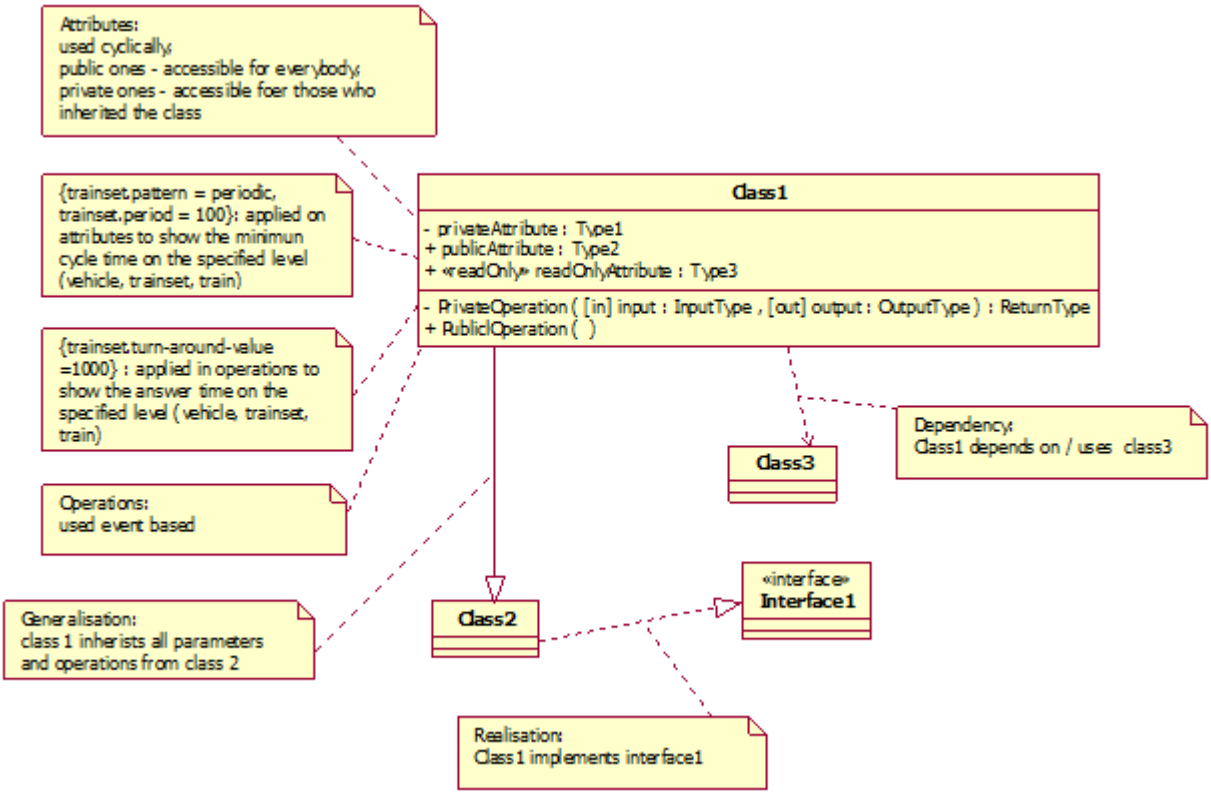

Figure A.4 - UML class diagram description

A.2.3.2 <Class> Class1

Table A.1 lists the attribute of Class1.

Table A.1 - Class 1 attribute

Attribute	Visibility	Type	Description
privateAttribute	2 - PRIVATE	Type1	Private attribute of type "Type1".
publicAttribute	0 - PUBLIC	Type2	Public attribute of type "Type2".
readOnlyAttribute	0 - PUBLIC	Type3	<<readOnly>> Readonly public attribute of type "Type3".

Table A.2 lists the attribute of Class1.

Table A.2 - Class 1 operation

Operation	Visibility	Parameter	Description
PrivateOperation	2 - PRIVATE	(0 - IN) input: InputType (1 - OUT) output: OutputType (3 - RETURN) : ReturnType	input: Input parameter of type "InputType". output: Output parameter of type "OutputType". : Return value of type "ReturnType".
PublicIOperation	0 - PUBLIC		

A.2.3.3 Types

A.2.3.3.1 General

Figure A.5 lists common primitive types and constants.

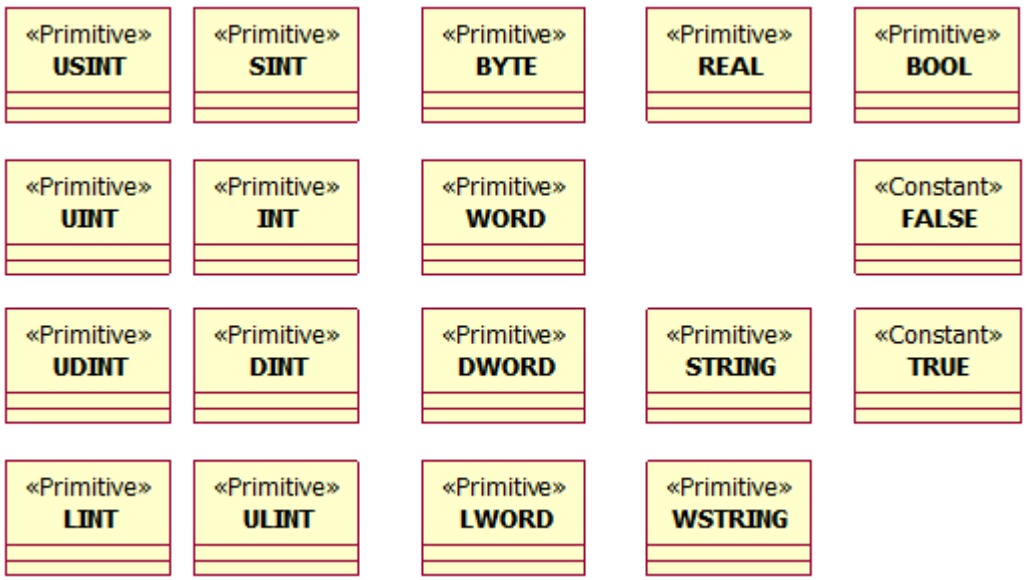

Figure A.5 - Common primitive types and constants

Figure A.6 lists common enumeration types.

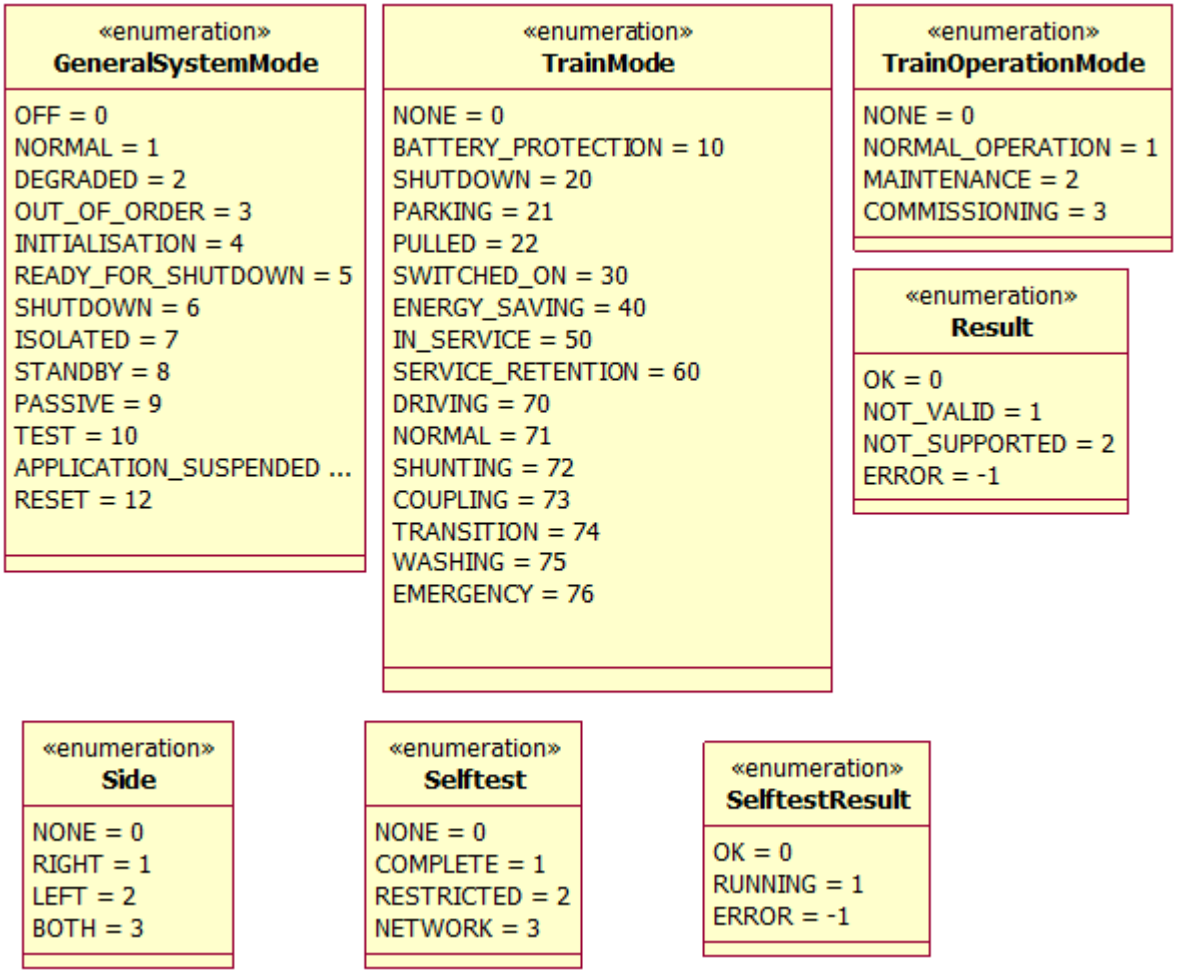

Figure A.6 - Common enumeration types

Figure A.7 lists common data types.

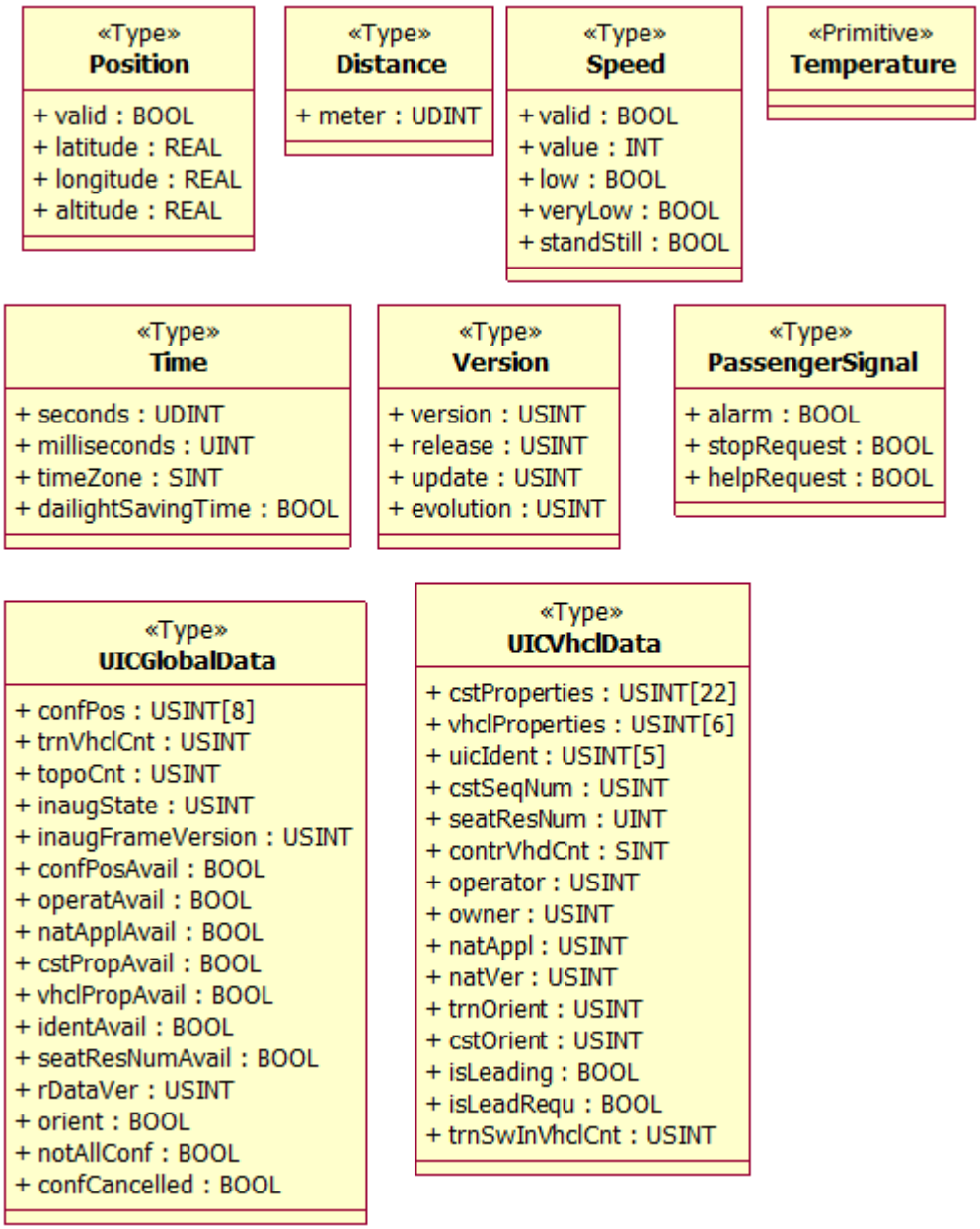

Figure A.7 - Common data types

A.2.3.3.2 <<Type>> <Class> UICGlobalData

Table A.3 lists the UIC556 global data.

Table A.3 - UIC global data

Attribute	Visibility	Type	Description
confPos	0 - PUBLIC	USINT[8]	Confirmed position of unreachable vehicles (UIC556, Appendix 3.3 byte 13...20).
trnVhclCnt	0 - PUBLIC	USINT	Vehicles in train (UIC556, Appendix 3.1 Composition of NADI, global part)
topoCnt	0 - PUBLIC	USINT	Topology counter (UIC556, Appendix 3.1 Composition of NADI, global part).
inaugState	0 - PUBLIC	USINT	Inauguration state.
inaugFrameVersion	0 - PUBLIC	USINT	Inauguration frame version.
confPosAvail	0 - PUBLIC	BOOL	0 if data for confirmed position of unreachable vehicles not available.
operatAvail	0 - PUBLIC	BOOL	0 if operator identification not available.
natApplAvail	0 - PUBLIC	BOOL	0 if no national application available.
cstPropAvail	0 - PUBLIC	BOOL	0 if consist properties are not available.
vhclPropAvail	0 - PUBLIC	BOOL	0 if vehicle properties not available.
identAvail	0 - PUBLIC	BOOL	0 if UIC identification is not available.
seatResNumAvail	0 - PUBLIC	BOOL	0 - seat reservation numbers not available
rDataVer	0 - PUBLIC	USINT	R telegram version number (UIC556, Appendix 3.3 byte 21).
orient	0 - PUBLIC	BOOL	0 - if UIC orientation is opposite to train bus (UIC556, Appendix 3.1 Composition of NADI, global part)
notAllConf	0 - PUBLIC	BOOL	0 if train configuration is not confirmed (UIC556, Appendix 3.1 Composition of NADI, global part).
confCancelled	0 - PUBLIC	BOOL	0 if confirmation of train configuration by driver not cancelled.

A.2.3.3.3 <<Type>> <Class> UICVhclData

Table A.4 lists the UIC556 vehicle data.

Table A.4 - UIC vehicle data

Attribute	Visibility	Type	Description
cstProperties	0 - PUBLIC	USINT[22]	Consist properties as defined in UIC 556 (UIC556, Appendix 3.3 byte 22..44).
vhclProperties	0 - PUBLIC	USINT[6]	Vehicle properties as defined in UIC 556 (UIC556, Appendix 3.3 byte 50...55/64...69/78...83/92...97/106...111/120...125).
uicIdent	0 - PUBLIC	USINT[5]	Vhcl unique UIC identification number (UIC556, Appendix 3.3 byte 45...49/59...63/73...77/87...91/101...105/115...119).
cstSeqNum	0 - PUBLIC	USINT	Consist sequence number in UIC train (UIC556, Appendix 3.3 byte 11).
seatResNum	0 - PUBLIC	UINT	Vehicle seat reservation number (UIC556, Appendix 3.3 byte 57,58/71,72/85,85/99,100/113,114/127,128).
contrVhclCnt	0 - PUBLIC	SINT	Number of controlled vehicles in consist (UIC556, Appendix 3.3 byte 9).
operator	0 - PUBLIC	USINT	Consist operator identification as defined in UIC 556 (UIC556, Appendix 3.3 byte 5).
owner	0 - PUBLIC	USINT	Consist owner identification as defined in UIC 556 (UIC556, Appendix 3.3 byte 6).
natAppl	0 - PUBLIC	USINT	National application type, e.g. UIC556 (UIC556, Appendix 3.3 byte 7).
natVer	0 - PUBLIC	USINT	National application version (UIC556, Appendix 3.3 byte 8).
trnOrient	0 - PUBLIC	USINT	Vehicle orientation in relation to train orientation - 0 - opposite(UIC556, Appendix 3.1, vehicle add on information bit 0).
cstOrient	0 - PUBLIC	USINT	Vehicle orientation in relation to consist orientation - 0 - opposite (UIC556, Appendix 3.1, vehicle add

Attribute	Visibility	Type	Description
			on information bit 1).
isLeading	0 - PUBLIC	BOOL	Not leading vehicle - 0 (UIC556, Appendix 3.1, vehicle add on information bit 2).
isLeadRequ	0 - PUBLIC	BOOL	Vehicle not requested lead - 0 (UIC556, Appendix 3.1, vehicle add on information bit 3).
trnSwInVhclCnt	0 - PUBLIC	USINT	Number of train bus gateways in vehicle (UIC556, Appendix 3.3 byte 9).

A.2.3.3.4 <<Primitive>> <Class> REAL

This class includes REAL32 as defined by EN 61131-3.

A.2.3.3.5 <<Primitive>> <Class> Temperature

Temperature is expressed in degrees Celsius and temperature difference in Kelvin. Both data are expressed by INT as defined by EN 61131-3.

A.2.3.3.6 <<Type>> <Class> PassengerSignal

Table A.5 lists the passenger signals.

Table A.5 - Passenger signals

Attribute	Visibility	Type	Description
alarm	0 - PUBLIC	BOOL	Passenger alarm: depending on the train position and speed it will lead to an emergency brake.
stopRequest	0 - PUBLIC	BOOL	Stop at next station requested.
helpRequest	0 - PUBLIC	BOOL	Help request for PRM..

A.2.3.3.7 <<Primitive>> <Class> BOOL

This class includes 1 bit BOOL as defined by EN 61131-3.

A.2.3.3.8 <<Constant>> <Class> TRUE

This class includes a constant as defined by EN 61131-3.

This class includes TRUE as defined by EN 61131-3.

A.2.3.3.9 <<Constant>> <Class> FALSE

This class includes a constant as defined by EN 61131-3.

This class includes FALSE as defined by EN 61131-3.

A.2.3.3.10 <<Primitive>> <Class> BYTE

This class includes 8 bit data as defined by EN 61131-3.

This class includes BYTE (8 bit) as defined by EN 61131-3.

A.2.3.3.11 <<Primitive>> <Class> WORD

This class includes 16 bit data as defined by EN 61131-3.

A.2.3.3.12 <<Primitive>> <Class> DWORD

This class includes 32 bit data as defined by EN 61131-3.

This class includes DWORD (32 bit) as defined by EN 61131-3.

A.2.3.3.13 <<Primitive>> <Class> LWORD

This class includes 64 bit data as defined by EN 61131-3.

This class includes LWORD (64 bit) as defined by EN 61131-3.

A.2.3.3.14 <<Primitive>> <Class> SINT

This class includes 8 bit integer data as defined by EN 61131-3.

This class includes SINT (8 bit integer) as defined by EN 61131-3.

A.2.3.3.15 <<Primitive>> <Class> INT

This class includes 16 bit integer data as defined by EN 61131-3.

This class includes INT (16 bit integer) as defined by EN 61131-3.

A.2.3.3.16 <<Primitive>> <Class> DINT

This class includes 32 bit integer data as defined by EN 61131-3.

This class includes DINT (32 bit integer) as defined by EN 61131-3.

A.2.3.3.17 <<Primitive>> <Class> LINT

This class includes 64 bit integer data as defined by EN 61131-3.

This class includes LINT (64 bit integer) as defined by EN 61131-3.

A.2.3.3.18 <<Primitive>> <Class> USINT

This class includes unsigned 8 bit integer data as defined by EN 61131-3.

This class includes USINT (8 bit unsigned integer) as defined by EN 61131-3.

A.2.3.3.19 <<Primitive>> <Class> UINT

This class includes unsigned 8 bit integer data as defined by EN 61131-3.

This class includes UINT (16 bit unsigned integer) as defined by EN 61131-3.

A.2.3.3.20 <<Primitive>> <Class> UDINT

This class includes unsigned 16 bit integer data as defined by EN 61131-3.

This class includes UDINT (32 bit unsigned integer) as defined by EN 61131-3.

A.2.3.3.21 <<Primitive>> <Class> ULINT

This class includes unsigned 32 bit integer data as defined by EN 61131-3.

This class includes ULINT (64 bit unsigned integer) as defined by EN 61131-3.

A.2.3.3.22 <<Primitive>> <Class> STRING

This class includes STRING, 8 bit character string as defined by EN 61131-3. NULL terminated 8 bit character string.

A.2.3.3.23 <<Primitive>> <Class> WSTRING

NULL terminated 16 bit character string.

A.2.3.3.24 <Enumeration> GeneralSystemMode

Table A.6 lists the Enumeration types for general system mode provided by each system.

Table A.6 - General System mode enumeration types

Literal	Value	Description
OFF	0	system switched off
NORMAL	1	normal operation
DEGRADED	2	system is not fully operational due to a minor fault (not available as a set parameter for external application)
OUT_OF_ORDER	3	system is out of order (with working communication) (not available as a set parameter for external application)
INITIALISATION	4	startup sequence (if applicable) (not available as a set parameter for external application)
READY_FOR_SHUTDOWN	5	in case system needs a longer procedure to prepare a shutdown
SHUTDOWN	6	system shut down (if applicable)
ISOLATED	7	no control processing, system is waiting for a command to change mode, change mode command only possible by maintenance personal
STANDBY	8	no control processing, system waiting for a command to change mode
PASSIVE	9	system mode for the non active redundant device (not available as a set parameter for external application)
TEST	10	system tests running
APPLICATION_SUSPENDED	11	Mode for the download of SW
RESET	12	system reset

A.2.3.3.25 <Enumeration> TrainOperationMode

Table A.7 lists the Enumeration types for train operation modes.

Table A.7 - Train operation mode enumeration types

Literal	Value	Description
NONE	0	Undefined, Initialisation
NORMAL_OPERATION	1	normal operational mode
MAINTENANCE	2	maintenance mode with possible special functions like marking of occurred events
COMMISSIONING	3	commissioning mode with possible extended access to parameters

A.2.3.3.26 <Enumeration> TrainMode

Table A.8 lists the Enumeration types for train mode.

Table A.8 - Train mode enumeration types

Literal	Value	Description
NONE	0	Initial state.
BATTERY_PROTECTION	10	
SHUTDOWN	20	
PARKING	21	
PULLED	22	
SWITCHED_ON	30	
ENERGY_SAVING	40	
IN_SERVICE	50	
SERVICE_RETENTION	60	
DRIVING	70	
NORMAL	71	
SHUNTING	72	

Literal	Value	Description
COUPLING	73	
TRANSITION	74	
WASHING	75	
EMERGENCY	76	

A.2.3.3.27 <Enumeration> Selftest

Table A.9 lists the Enumeration types for self test functionality.

Table A.9 - Self test enumeration types

Literal	Value	Description
NONE	0	No option given
COMPLETE	1	Complete selftest including all tests, often only allowed in standstill without passengers.
RESTRICTED	2	Partially selftest e.g. for a train in passenger operation
NETWORK	3	Network connection test.

A.2.3.3.28 <Enumeration> SelftestResult

Table A.10 lists the Enumeration types for self test result.

Table A.10 - Self test result enumeration types

Literal	Value	Description
OK	0	Self test passed without errors
RUNNING	1	Self test still running
ERROR	-1	Self test not passed

A.2.3.3.29 <Enumeration> Side

Table A.11 lists the Enumeration types for train sides.

Table A.11 - Train side enumeration types

Literal	Value	Description
NONE	0	
RIGHT	1	
LEFT	2	
BOTH	3	

A.2.3.3.30 <Enumeration> Result

Table A.12 lists the Enumeration types for results given back from functions.

Table A.12 - Result enumeration types

Literal	Value	Description
OK	0	No errors
NOT_VALID	1	Invalid parameters
NOT_SUPPORTED	2	Function not supported
ERROR	-1	Unspecified error

A.2.3.3.31 <<Type>> <Class> Distance

Table A.13 reports the integrating counter for calculating distance, having a resolution of 1m. The counter is set to 0 with power up

Table A.13 - distance

Attribute	Visibility	Type	Description
meter	0 - PUBLIC	UDINT	integrating 1 m pulses

A.2.3.3.32 <<Type>> <Class> Position

Table A.14 lists the data for coding the geographical position of the train which is sent by TCMS e.g. for optional local diagnostics support.

Table A.14 - train position

Attribute	Visibility	Type	Description
valid	0 - PUBLIC	BOOL	
latitude	0 - PUBLIC	REAL	+/- ddmmss,ss (d - degree, m - minutes, s - seconds, + - north, - south, for seconds and minutes < 10 leading zeros will be added) (ISO 6709)
longitude	0 - PUBLIC	REAL	dddmmss,sss (d - degree, m - minutes, s - seconds, + east, - west, for seconds and minutes < 10 leading zeros will be added) (ISO 6709)
altitude	0 - PUBLIC	REAL	+/- mmmm,mm (m - meter) (ISO 6709), optional parameter

A.2.3.3.33 <<Type>> <Class> Speed

Table A.15 lists the data for coding the train speed.

Table A.15 - train speed

Attribute	Visibility	Type	Description
valid	0 - PUBLIC	BOOL	
value	0 - PUBLIC	INT	Proposal: speed in +/- 1/10 km/h
low	0 - PUBLIC	BOOL	Optional: Low speed signal if v < vlow (e.g. vlow = 10 kmph, project depending) Signal parallel via network and direct input, leading signal is hard wired to door control Operational parameter provided from TCMS. Used for door emergency unlocking.
veryLow	0 - PUBLIC	BOOL	Very low speed signal if v < vverylow (e.g. vverylow = 5 kmph, project depending) Operational parameter provided from TCMS. Used e.g. for door release handling.
standStill	0 - PUBLIC	BOOL	Stand still signal if v = vstandstill (e.g. vstandstill = 0, project depending) Signal for non movement of the train which may be a signal generated by a

Attribute	Visibility	Type	Description
			device or by the driver itself. Operational parameter provided from TCMS. Used e.g for ramp and step control.

A.2.3.3.34 <<Type>> <Class> Time

Table A.16 lists UTC time coding, including time zone and daylight saving time information sent by TCMS in Unix format for local diagnostics support. Optional for diagnostics.

Table A.16 - UTC time

Attribute	Visibility	Type	Description
seconds	0 - PUBLIC	UDINT	32 bit time, see EN 61131-3.
milliseconds	0 - PUBLIC	UINT	optional
timeZone	0 - PUBLIC	SINT	-48 ... +48, in 15 min steps
dailightSavingTime	0 - PUBLIC	BOOL	

A.2.3.3.35 <<Type>> <Class> Version

Table A.17 lists the coding of the information useful to identify software versions.

Table A.17 - Software version

Attribute	Visibility	Type	Description
version	0 - PUBLIC	USINT	incremented after incompatible changes.
release	0 - PUBLIC	USINT	incremented after functional extension.
update	0 - PUBLIC	USINT	incremented after bugfixes.
evolution	0 - PUBLIC	USINT	incremented in developement process.

A.2.3.4 Interfaces

A.2.3.4.1 General

Figure A.8 shows general standard interfaces with their data and functions.

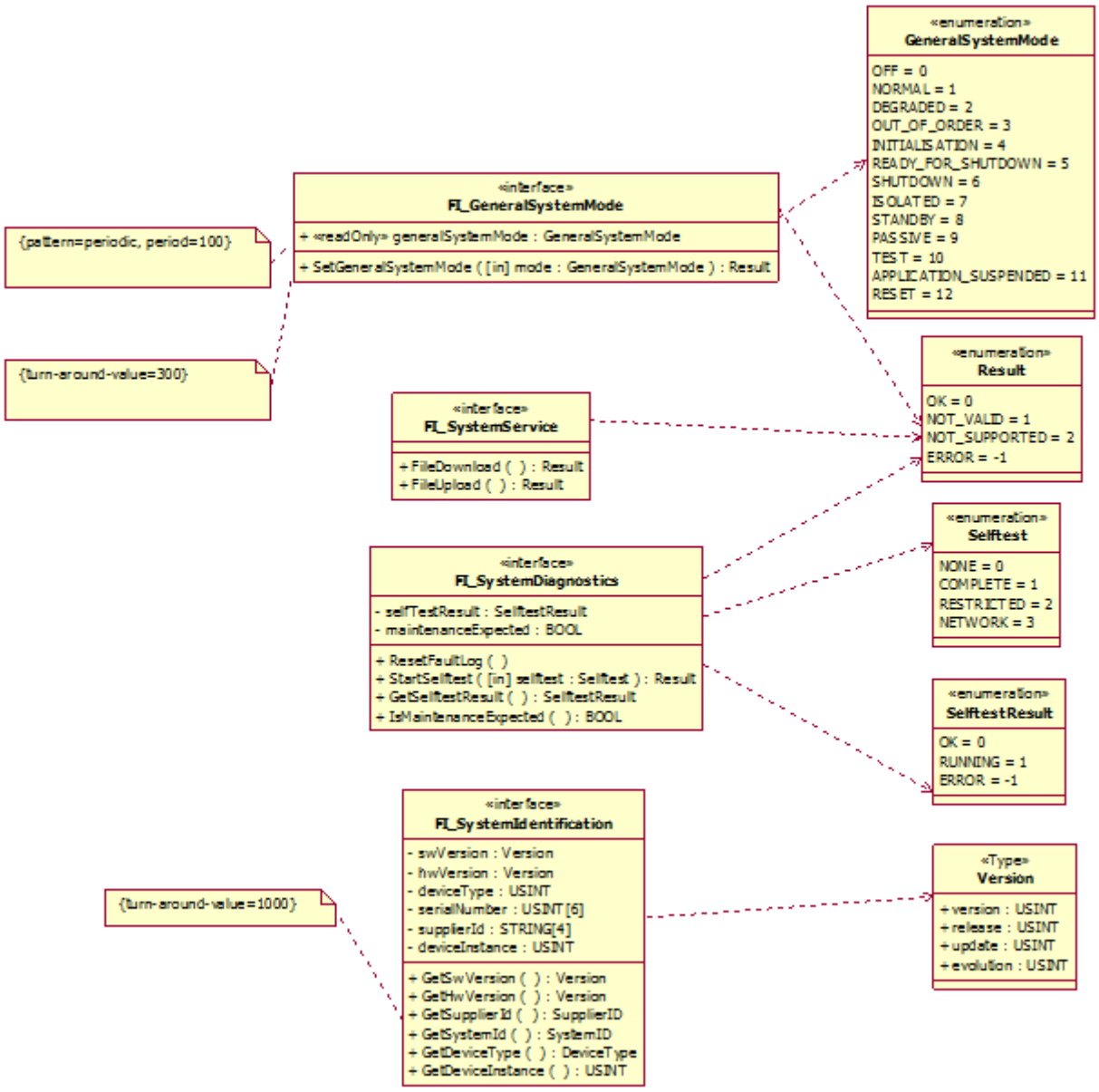

Figure A.8 - Common standard interfaces for all systems

Figure A.9 shows common TCMS interfaces with their data and functions offered to all systems.

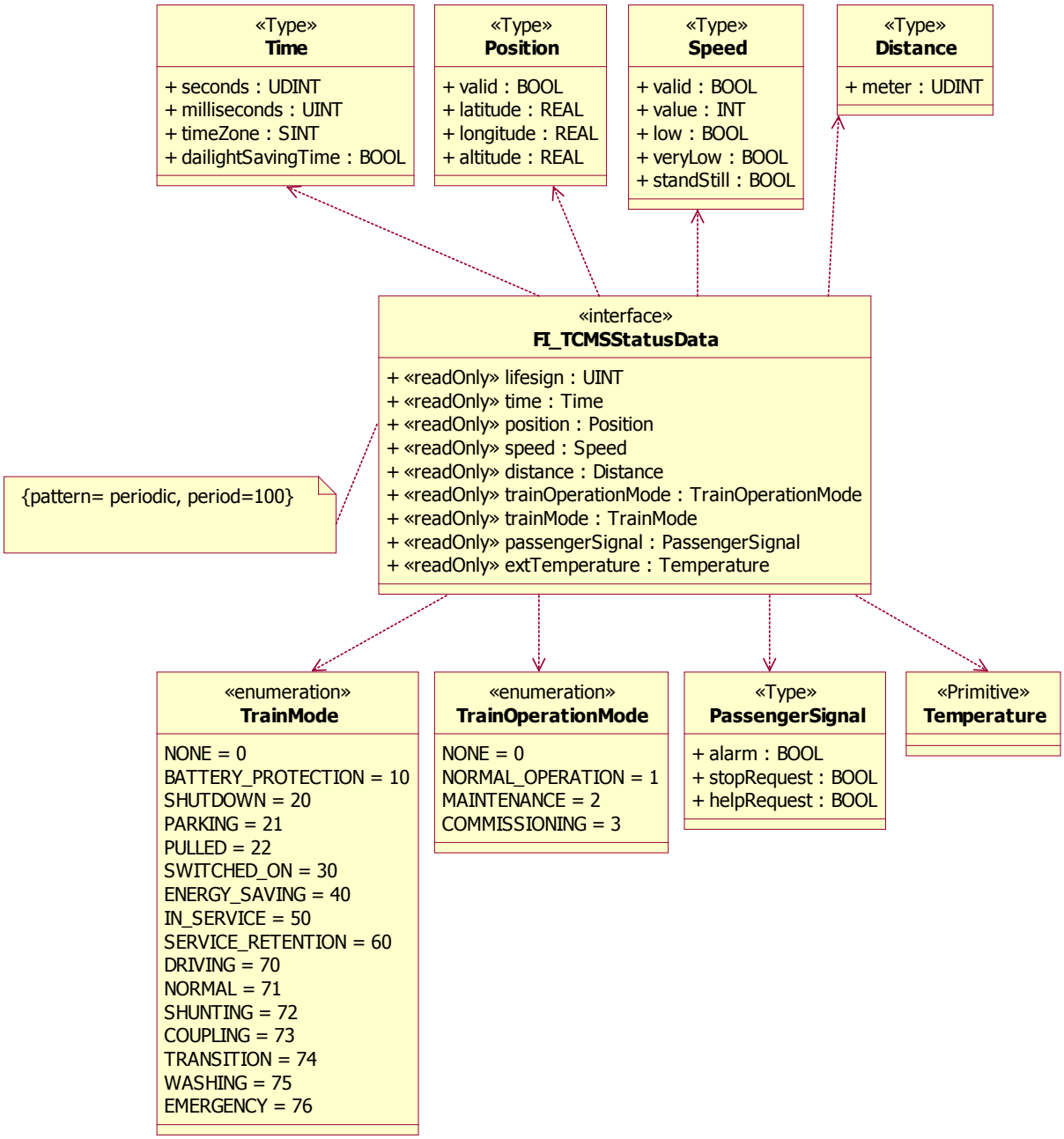

Figure A.9 - Common standard TCMS interface

Figure A.10 shows common train configuration and data interfaces offered to all systems.

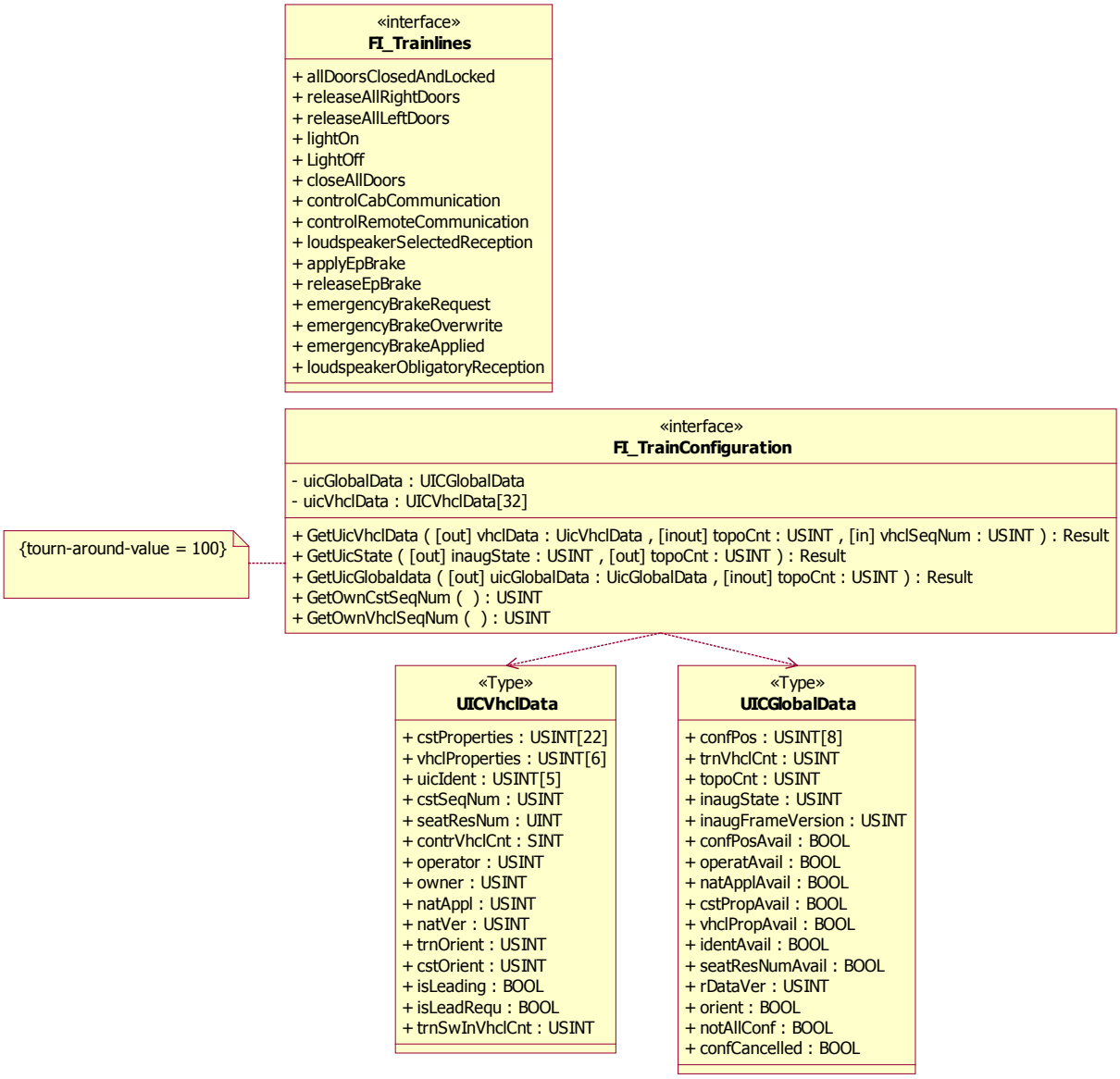

Figure A.10 - Train configuration and data interfaces offered to all systems

A.2.3.4.2 <Interface> FI_SystemDiagnostics

Table A.18 lists an example of attributes of the standard diagnostics interface.

Table A.18 - System diagnostics

Attribute	Visibility	Type	Description
selfTestResult	2 - PRIVATE	SelftestResult	
maintenanceExpected	2 - PRIVATE	BOOL	Parameter to flag that maintenance has to be planned due to evaluation of the system condition. The system is still working properly.

Operation	Visibility	Parameter	Description
ResetFaultLog	0 - PUBLIC		
StartSelftest	0 - PUBLIC	(0 - IN) selftest: Selftest (3 - RETURN) result: Result	
GetSelftestResult	0 - PUBLIC	(3 - RETURN) result: SelftestResult	
IsMaintenanceExpected	0 - PUBLIC	(3 - RETURN) : BOOL	

A.2.3.4.3 <Interface> FI_SystemIdentification

Table A.19 lists system identification interface attributes.

Table A.19 - System identification attributes

Attribute	Visibility	Type	Description
swVersion	2 - PRIVATE	Version	
hwVersion	2 - PRIVATE	Version	
deviceType	2 - PRIVATE	USINT	unique device type identification (e.g. Door1, Door2 ..)
serialNumber	2 - PRIVATE	USINT[6]	unique serial number of systems communication board
supplierId	2 - PRIVATE	STRING[4]	unique 4 ASCII char identification of the supplier
deviceInstance	2 - PRIVATE	USINT	Instance of the device

Table A.20 lists system identification interface operations.

Table A.20 - System identification operations

Operation	Visibility	Parameter	Description
GetSwVersion	0 - PUBLIC	(3 - RETURN) result: Version	
GetHwVersion	0 - PUBLIC	(3 - RETURN) result: Version	
GetSupplierId	0 - PUBLIC	(3 - RETURN) result: SupplierID	
GetSystemId	0 - PUBLIC	(3 - RETURN) result: SystemID	
GetDeviceType	0 - PUBLIC	(3 - RETURN) result: DeviceType	

Operation	Visibility	Parameter	Description
GetDeviceInstance	0 - PUBLIC	(3 - RETURN) : USINT	

A.2.3.4.4 <Interface> FI_Trainlines

Table A.21 lists the Train lines functional interface according to UIC558.

Table A.21 - Train lines functional interface

Attribute	Visibility	Type	Description
allDoorsClosedAndLocked	0 - PUBLIC		UIC 558 16, 12-
releaseAllRightDoors	0 - PUBLIC		UIC558 15+, 12-
releaseAllLeftDoors	0 - PUBLIC		UIC558 14+, 12-
lightOn	0 - PUBLIC		UIC558 10+, 12-
LightOff	0 - PUBLIC		UIC558 11+, 12-
closeAllDoors	0 - PUBLIC		UIC558 9+, 12-
controlCabCommunication	0 - PUBLIC		UIC558 3-, 4+
controlRemoteCommunication	0 - PUBLIC		UIC558 3+, 4-
loudspeakerSelectedReception	0 - PUBLIC		UIC558 5+, 6-
applyEpBrake	0 - PUBLIC		UIC558 10-, 12+
releaseEpBrake	0 - PUBLIC		UIC558 11-, 12+
emergencyBrakeRequest	0 - PUBLIC		UIC558 9, 10
emergencyBrakeOverwrite	0 - PUBLIC		UIC558 9-, 12+
emergencyBrakeApplied	0 - PUBLIC		UIC558 9, 10
loudspeakerObligatoryReception	0 - PUBLIC		UIC558 7+, 8-

A.2.3.4.5 <Interface> FI_GeneralSystemMode

Table A.22 lists the attributes of the general system mode functional interface

Table A.22 - General system mode functional interface - attributes

Attribute	Visibility	Type	Description
generalSystemMode	0 - PUBLIC	GeneralSystemMode	<<readOnly>>

Table A.23 lists the operations of the general system mode functional interface

Table A.23 - General system mode functional interface - operations

Operation	Visibility	Parameter	Description
SetGeneralSystemMode	0 - PUBLIC	(0 - IN) mode: GeneralSystemMode (3 - RETURN) : Result	

A.2.3.4.6 <Interface> FI_SystemService

Table A.24 lists the operation relevant to the system service functional interface.

Table A.24 - System service functional interface - operations

Operation	Visibility	Parameter	Description
FileDownload	0 - PUBLIC	(3 - RETURN) : Result	
FileUpload	0 - PUBLIC	(3 - RETURN) : Result	

A.2.3.4.7 <Interface> FI_TCMSStatusData

Table A.25 lists the status data sent by TCMS which are accessible by all systems.

Table A.25 - TCMS status data

Attribute	Visibility	Type	Description
lifesign	0 - PUBLIC	UINT	<<readOnly>> TCMS lifesign
time	0 - PUBLIC	Time	<<readOnly>> current time
position	0 - PUBLIC	Position	<<readOnly>> current position
speed	0 - PUBLIC	Speed	<<readOnly>> current speed
distance	0 - PUBLIC	Distance	<<readOnly>> distance in meters incremented since power-up
trainOperationMode	0 - PUBLIC	TrainOperationMode	<<readOnly>> current train operation mode
trainMode	0 - PUBLIC	TrainMode	<<readOnly>> current train mode
passengerSignal	0 - PUBLIC	PassengerSignal	<<readOnly>> passenger signals
extTemperature	0 - PUBLIC	Temperature	<<readOnly>> current calculated external temperature average (trainwide)

A.2.3.4.8 <Interface> FI_TrainConfiguration

Table A.26 lists the attributes of the functional interface which provides the access to UIC train inauguration result.

Table A.26 - Train configuration functional interface - attributes

Attribute	Visibility	Type	Description
uicGlobalData	2 - PRIVATE	UICGlobalData	current UIC global data
uicVhclData	2 - PRIVATE	UICVhclData[32]	current UIC vehicle configuration

Table A.27 lists the operation of the functional interface which provides the access to UIC train inauguration result.

Table A.27 - Train configuration functional interface - operations

Operation	Visibility	Parameter	Description
GetUicVhclData	0 - PUBLIC	(1 - OUT) vhclData: UicVhclData (2 - INOUT) topoCnt: USINT (0 - IN) vhclSeqNum: USINT (3 - RETURN) : Result	Retrieve vehicle UIC inauguration data.
GetUicState	0 - PUBLIC	(1 - OUT) inaugState: USINT (1 - OUT) topoCnt: USINT (3 - RETURN) : Result	Retrieve UIC inauguration state.
GetUicGlobaldata	0 - PUBLIC	(1 - OUT) uicGlobalData: UicGlobalData (2 - INOUT) topoCnt: USINT (3 - RETURN) : Result	Retrieve global UIC inauguration data.
GetOwnCstSeqNum	0 - PUBLIC	(3 - RETURN) : USINT	Retrieve own consist UIC sequence number.
GetOwnVhclSeqNum	0 - PUBLIC	(3 - RETURN) : USINT	Retrieve own vehicle UIC sequence number.

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