



EULYNX Initiative



Europe's Rail Joint Undertaking

Interface definition and specification SMI

Contents

1	Introduction	1
1.1	Release information	1
1.2	Impressum	1
1.3	Purpose	2
1.4	Applicable standards and regulations	3
1.5	Applicable documents	3
1.6	Appendix	3
1.7	Terms and abbreviations	3
1.8	Variability management	3
1.9	Definition of object types	4
2	Requirements	4
2.1	Definition of the SMI	4
2.2	Functional requirements	4
3	Loading procedure for Configuration data and Engineering data and for device software	4
3.1	Overview	4
3.2	Standard Maintenance Interface: MDM – connected system	5
3.2.1	Communication requirements	5
3.2.2	General OPC UA requirements	6
3.2.3	Information model	7
3.3	Standard Maintenance Interface: MDM – Subsystem - Electronic Interlocking (SMI-EIL)	13

ID	Type	Requirement
Eu.SMI.5	Head	1 Introduction
Eu.SMI.155	Head	1.1 Release information
Eu.SMI.194	Info	[Eu.Doc.76] Interface definition and specification SMI CENELEC Phase: 5 Version: 2.2 (0.A) Approval date: 29.05.2024
Eu.SMI.206	Info	Version history
Eu.SMI.255	Info	version number: 2.0 (0.A) date: 18.05.2022 author: Andreas Strahm, Nico Hurman review: CCB changes: EUAR-508, EUAR-520, EUAR-526, EUAR-528, EUAR-529, EUAR-537
Eu.SMI.259	Info	version number: 2.0 (1.A) date: 27.06.2023 author: Nico Hurman review: TCCS+TACS Mirror Group changes: EUAR-564, EUAR-589, EUAR-594, EUAR-610, EUAR-612, EUAR-613
Eu.SMI.261	Info	version number: 2.1 (0.A) date: 29.04.2024 author: Nico Hurman, Ibtihel Cherif review: cluster changes: EUAR-641, EUAR-645, EUAR-680, EUAR-681, EUAR-687, EUAR-688, EUAR-697, EUAR-712, EUAR-713, EUAR-714, EUAR-715
Eu.SMI.289	Info	version number: 2.2 (0.A) date: 18.06.2024 author: Nico Hurman, Ibtihel Cherif review: TCCS+TACS Mirror Group changes: EUAR-740, EUAR-746, EUAR-747, EUAR-701
Eu.SMI.154	Head	1.2 Impressum

ID	Type	Requirement
Eu.SMI.193	Info	<p>Publishers:</p> <p>Europe's Rail Joint Undertaking https://rail-research.europa.eu/</p> <p>EULYNX Initiative https://eulynx.eu/</p>
Eu.SMI.192	Info	<p>Responsible for this document: EU-Rail System Pillar Transversal CCS Components domain</p>
Eu.SMI.208	Info	<p>This document is drafted by and belongs to EU Rail.</p> <p>EU Rail encourages the distribution and re-use of this document, the technical specifications and the information it contains. EU Rail holds several intellectual property rights, such as copyright and trade mark rights, which need to be considered when this document is used.</p> <p>EU Rail authorizes you to re-publish, re-use, copy and store this document without changing it, provided that you indicate its source and include the following mention [EU Rail trade mark, title of the document, year of publication, version of document].</p> <p>EU Rail makes no representation or warranty as to the accuracy or completeness of the information contained within these documents. EU Rail shall have no liability to any party as a result of the use of the information contained herein. EU Rail will have no liability whatsoever for any indirect or consequential loss or damage, and any such liability is expressly excluded.</p> <p>You may study, research, implement, adapt, improve and otherwise use the information, the content and the models in this document for your own purposes. If you decide to publish or disclose any adapted, modified or improved version of this document, any amended implementation or derivative work, then you must indicate that you have modified this document, with a reference to the document name and the terms of use of this document. You may not use EU Rail's trade marks or name in any way that may state or suggest, directly or indirectly, that EU Rail is the author of your adaptations. EU Rail cannot be held responsible for your product, even if you have used this document and its content. It is your responsibility to verify the quality, completeness and the accuracy of the information you use, for your own purposes.</p>
Eu.SMI.153	Head	1.3 Purpose
Eu.SMI.191	Info	This document describes the Standard Maintenance Interface for the service functions Loading procedure between the Subsystem - Maintenance and Data Management (MDM) and the EULYNX field element subsystems.
Eu.SMI.190	Info	The service function Loading procedure is designed to provide both safety-critical and non-safety-critical configuration and engineering data, as well as updates of device software.
Eu.SMI.189	Info	This document contains general communication requirements and technical specifications (e.g. protocols and telegram definition) for the SMI (Standard Maintenance Interface) and forms the basis for manufacturer implementation.

ID	Type	Requirement
Eu.SMI.187	Info	<p>This document does not specify the behaviour of the respective communication partner (e.g. the system reaction in the event of a communication failure), and in particular it does not define when which telegram should be sent. This behaviour is the subject of the Maintenance and data management specification [Eu.Doc.18], the Generic interface and subsystem requirements for SMI [Eu.Doc.120] and further national requirements.</p> <p>Note: In future phases of the System Pillar, national specifications will be replaced by harmonised specifications.</p>
Eu.SMI.186	Info	<p>This document is intended for the following users:</p> <ul style="list-style-type: none"> • safety authorities • infrastructure managers • safety assessors • signalling system suppliers • validators
Eu.SMI.260	Info	<p>This document is applicable for both the EU-Rail System Pillar target architecture and the EULYNX architecture. The document is delivered as a single specification fitting both the System Pillar documentation sets and the EULYNX documentation sets. EU-Rail System Pillar is the technical authority for this document.</p>
Eu.SMI.152	Head	1.4 Applicable standards and regulations
Eu.SMI.184	Info	<p>A list of applicable standards and regulations used in EULYNX is listed in the EULYNX Reference Document List [Eu.Doc.12].</p>
Eu.SMI.205	Info	<p>The references listed in the EULYNX Reference Document List [Eu.Doc.12] shall be considered where they are indicated as being applicable to SMI in the "Applies to" column of the EULYNX Reference Document List [Eu.Doc.12]</p>
Eu.SMI.151	Head	1.5 Applicable documents
Eu.SMI.183	Info	<p>The current versions of documents used as input or related to this document are listed in the EULYNX Documentation Plan [Eu.Doc.11]. The relationships between the documents are displayed in the Appendix A1 Documentation plan and structure [Eu.Doc.11_A1].</p>
Eu.SMI.150	Head	1.6 Appendix
Eu.SMI.175	Info	<i>- intentionally left blank -</i>
Eu.SMI.149	Head	1.7 Terms and abbreviations
Eu.SMI.169	Info	<p>The terms and abbreviations are listed in the EULYNX Glossary [Eu.Doc.9].</p>
Eu.SMI.209	Head	1.8 Variability management
Eu.SMI.210	Info	<p>This document describes harmonised requirements. Variability management is not applicable.</p>

ID	Type	Requirement
Eu.SMI.147	Head	1.9 Definition of object types
Eu.SMI.162	Info	The following definition for object types is applied in this document:
Eu.SMI.161	Info	<ul style="list-style-type: none"> • "Req" - This denotes a mandatory requirement.
Eu.SMI.158	Info	<ul style="list-style-type: none"> • "Info" - This denotes additional information to help understand the specification. These objects do not specify any additional requirements.
Eu.SMI.157	Info	<ul style="list-style-type: none"> • "Head" - This denotes chapter headings.
Eu.SMI.4	Head	2 Requirements
Eu.SMI.258	Req	All references to [Eu.Doc.120] refer to Generic interface and subsystem requirements for SMI version 1.1 (0.A).
Eu.SMI.141	Head	2.1 Definition of the SMI
Eu.SMI.145	Info	The SMI is a message-based interface. It is composed of the transport layer and the application layer.
Eu.SMI.144	Info	The application protocols and the application-related functional requirements associated with it are described in detail in the following chapter titled "Loading procedure".
Eu.SMI.143	Info	The transport layer of the SMI required in line with the application is specified in the chapter titled "Loading procedure".
Eu.SMI.142	Info	The lower layers (network layer, data link layer and physical layer) are defined by the PoS-Signalling [Eu.Doc.100].
Eu.SMI.51	Info	The Standard Maintenance Interface (SMI) is identical for all connected systems in terms of functionality.
Eu.SMI.256	Head	2.2 Functional requirements
Eu.SMI.257	Info	The functional requirements for SMI-XX are described in [Eu.Doc.120].
Eu.SMI.3	Head	3 Loading procedure for Configuration data and Engineering data and for device software
Eu.SMI.45	Head	3.1 Overview
Eu.SMI.212	Info	The service function Loading procedure supports the provision of configuration data and engineering data and of device software to the connected systems.

ID	Type	Requirement
Eu.SMI.44	Head	3.2 Standard Maintenance Interface: MDM – connected system
Eu.SMI.50	Head	3.2.1 Communication requirements
Eu.SMI.136	Req	The OPC UA protocol with binary binding via OPC UA Secure Conversation [OPC] via TCP shall be used for the Loading procedure.
Eu.SMI.228	Req	OPC UA uses a strict client server model. The server shall run on the connected system. The client shall be contained in the service function Loading procedure.
Eu.SMI.229	Req	The connection shall always be established through the service function Loading procedure.
Eu.SMI.247	Req	The service function Loading procedure may establish the connection as soon as communication on the PoS-Signalling is possible.
Eu.SMI.239	Req	The establishing of the OPC UA connection shall be triggered when the connected system is entering the sub-state "Waiting for data update" within the state "Initialising".
Eu.SMI.238	Req	<p>If no connection is available when the connected system expects to interact with the service function Loading procedure, the OPC UA server on the connected system shall trigger the opening of the OPC UA connection by the client via reverse connect.</p> <p>Note: Interaction with the service function Loading procedure is expected when the connected system is entering the sub-state "Waiting for data update" within the state "Initialising".</p>
Eu.SMI.262	Req	In case the service function Loading procedure does not start with the establishment of the OPC UA connection as a reaction to the reverse connect within 5 seconds, the connected system shall resend the reverse connect.
Eu.SMI.223	Req	If two network channels are used for the service function Loading procedure:
Eu.SMI.138	Req	<ul style="list-style-type: none"> • the Loading procedure shall always take place via one of the two network channels
Eu.SMI.215	Req	<ul style="list-style-type: none"> • when the service function Loading procedure does not start with the establishment of the OPC UA connection as a reaction to the reverse connect within 5 second, the connected system shall retry using the other network channel.
Eu.SMI.248	Info	After the event MaintainingFinished the OPC UA connection may be either closed by the client or remains open.
Eu.SMI.286	Req	If no connection is available when the service function Loading procedure expects to interact with the OPC UA server, the service function Loading procedure shall establish the OPC UA connection.
Eu.SMI.230	Req	<p>The communication between the OPC UA client and the OPC UA server shall be session-oriented.</p> <p>For OPC UA, a "telegram" consists of a communication session in which several OPC UA-specific messages are exchanged between the client and the server. The individual messages follow the OPC UA standard [OPC] and are not described here.</p>
Eu.SMI.126	Req	The SubS_ID (see Eu.SAS.77) shall be used to identify the connected system in the service function Loading procedure accordingly.

ID	Type	Requirement
Eu.SMI.263	Req	The target address(es) and the corresponding communication ports of the OPC UA client for initiating the reverse connect shall be configurable in the connected system. Note: If two network channels are used for the service function Loading procedure, two target addresses need to be configurable.
Eu.SMI.264	Req	The allowed communication ports of the OPC UA server for establishment of the OPC UA connection by the service function Loading procedure shall be configurable in the connected system.
Eu.SMI.265	Head	3.2.2 General OPC UA requirements
Eu.SMI.266	Info	An OPC UA NodeClass can be an Object, a Method or a Variable. The Objects have a TypeDefinition that behave similarly to classes in object-oriented programming languages. Through TypeDefintitions and DataTypes predefined by the OPC UA information models, a semantic clarification of the implementation is achieved. The use of the OPC UA information models is needed to make possible the namespace aggregation of field elements.
Eu.SMI.267	Req	OPC UA node IDs of system parts in the OPC UA server of the connected system shall remain unchanged after a reset of the connected system or of the OPC UA server, unless an OPC UA Node ID has been explicitly changed during a configuration update.
Eu.SMI.287	Req	All nodes in the information model that share the same parent must have a unique browse name. Note: This allows the use of simplified browse paths without namespace indices.
Eu.SMI.268	Req	Changes to the OPC UA Information model structure at runtime shall be communicated to the OPC UA client via model change events, as specified in [OPC].
Eu.SMI.269	Req	The OPC UA server in the connected system shall implement the "Embedded 2017 UA Server Profile". The binary protocol defined in the "Standard 2017 UA Server Profile" is used for communication.
Eu.SMI.270	Req	The following facets shall be implemented in addition:
Eu.SMI.271	Req	• Reverse Connect Server Facet
Eu.SMI.272	Req	• Method Server Facet
Eu.SMI.273	Req	The OPC UA server on the connected system shall allow at least 5 subscriptions per session.
Eu.SMI.274	Req	The data contents and further functionality of the OPC UA server on the connected system shall only be provided after the security setup, as defined in the EULYNX Security Parameter Specification [Eu.Doc.115]. Note: In future phases, the EULYNX security specifications will be replaced by harmonised specifications published by the EU-Rail System Pillar Cyber Security domain.

ID	Type	Requirement
Eu.SMI.290	Req	<p>The OPC UA server on the connected system shall respect the security permissions.</p> <p>The following security permissions are used:</p> <ul style="list-style-type: none"> • Data-distribute • Data-activate • Component-reset <p>Note: In future phases, these security permissions will be defined by harmonised specifications published by the EU-Rail System Pillar Cyber Security domain.</p>
Eu.SMI.231	Head	3.2.3 Information model
Eu.SMI.241	Info	The information model, as defined in [OPC], to be used is shown in the figure below.

ID	Type	Requirement
Eu.SMI.233	Info	<p>Information model</p> <ul style="list-style-type: none"> ▼ Configuration <ul style="list-style-type: none"> ▼ Subsystem1 <ul style="list-style-type: none"> ▼ Items <ul style="list-style-type: none"> ▼ Item1 <ul style="list-style-type: none"> ✦ AbortUpdateProcess ✦ ActivateItem ✦ ActivationState ✦ CurrentVersion ✦ PreloadedVersion > PreloadFile <ul style="list-style-type: none"> ✦ PreloadItemFinished ✦ PreloadItemStarted ✦ PreloadState ▼ Item2 <ul style="list-style-type: none"> ✦ AbortUpdateProcess ✦ ActivateItem ✦ ActivationState ✦ CurrentVersion ✦ PreloadedVersion > PreloadFile <ul style="list-style-type: none"> ✦ PreloadItemFinished ✦ PreloadItemStarted ✦ PreloadState ✦ MaintainingFinished ✦ MDMRequestReset ✦ MDMSafeMaintenance ✦ OperationState ✦ RegistrationsReady

ID	Type	Requirement				
Eu.SMI.244	Req	The table below contains clarifications regarding the information model in Eu.SMI.233				
		Name	NodeClass	Parent	Additional Information	Description
		Subsystem 1, .. , Subsystem n	Object	Configuration (global)		Contains all Configuration Items (CIs), methods and status variables used for maintaining a specific EULYNX field element Subsystem.
		Version	Variable	Configuration (global)	DataType: String Value: "M.m (E.A)"	Version of the SMI information model expressed as the document version of the Interface definition and specifications SMI [Eu.Doc.76]. This is used for version handling.
		Items	Object	Subsystem(n)		Group that contains all Configuration Items (data) for EULYNX field element Subsystem n.
		Item 1, ..., Item n	Object	Items		CIs can contain configuration and engineering data or device software. There can be 1..n CIs.

ID	Type	Requirement					
Eu.SMI.253	Req	The table below contains clarifications regarding the information model in Eu.SMI.233					
		Name	NodeClass	Parent	Additional Information	Description	Permission
		AbortUpdateProcess	Method	Item(n)	Inputs: no input arguments Outputs: no output arguments	Abort the currently running update of configuration item n.	Data-distribute Data-activate
		ActivateItem	Method	Item(n)	Inputs: no input arguments Outputs: no output arguments	Activate the previously transferred configuration item n. Activation means that it is to be installed at the EULYNX field element subsystem.	Data-activate
		ActivationState	Variable	Item(n)	DataType: Enumeration Values: NotYetActivatable, ReadyForActivation, Activating, ActivationAborted	Indicates the activation state of Configuration Item n.	Data-activate
		CurrentVersion	Variable	Item(n)	DataType: String	Currently applied version of the Configuration Item. This value is set by the EULYNX field element Subsystem based on the version information read from the installed file.	Data-distribute Data-activate
Eu.SMI.254	Req	The table below contains clarifications regarding the information model in Eu.SMI.233					

ID	Type	Requirement					
		Name	NodeClass	Parent	Additional Information	Description	Permission
		PreloadedVersion	Variable	Item(n)	DataType: String	Version of a preloaded Configuration Item. Preloaded items can be activated immediately or at a later time if a two-step update procedure is applied. This value is set by the EULYNX field element Subsystem based on the version information read from the preloaded file.	Data-distribute Data-activate
		PreloadFile	Object	Item(n)	DataType: FileType (OPC UA)	The preload file for Configuration Item n.	Data-distribute
		PreloadItemFinished	Method	Item(n)	Inputs: no input arguments Outputs: no output arguments	Indicates that the preloading of the Configuration Item has been completed.	Data-distribute
		PreloadItemStarted	Method	Item(n)	Inputs: no input arguments Outputs: no output arguments	Indicates that the preloading of the Configuration Item has been started.	Data-distribute
Eu.SMI.285	Req	The table below contains clarifications regarding the information model in Eu.SMI.233					

ID	Type	Requirement																																					
		<table><tr><th>Name</th><th>NodeClass</th><th>Parent</th><th>Additional Information</th><th>Description</th><th>Permission</th></tr><tr><td>PreloadState</td><td>Variable</td><td>Item(n)</td><td>DataType: Enumeration Values: NotYetPreloadable, ReadyForPreload, Preloading, PreloadingAborted</td><td>Indicates the preload state of Configuration Item n.</td><td>Data-distribute Data-activate</td></tr><tr><td>MaintainingFinished</td><td>Method</td><td>Subsystem(n)</td><td>Inputs: no input arguments Outputs: no output arguments</td><td>Indicates that the maintenance process has been completed.</td><td>Data-activate</td></tr><tr><td>MDMRequestReset</td><td>Method</td><td>Subsystem(n)</td><td>Inputs: no input arguments Outputs: no output arguments</td><td>Request a remote reset of the EULYNX field element Subsystem.</td><td>Component-reset</td></tr><tr><td>MDMSafeMaintenance</td><td>Method</td><td>Subsystem(n)</td><td>Inputs: no input arguments Outputs: no output arguments</td><td>Perform maintenance after the EULYNX field element Subsystem was safely released from railway operation.</td><td>Data-activate</td></tr><tr><td>OperationState</td><td>Variable</td><td>Subsystem(n)</td><td>DataType: Enumeration Values: NotMaintenance, Maintenance</td><td>Indicates the general operation state of the EULYNX field element Subsystem in the context of configurability.</td><td>Data-distribute Data-activate</td></tr></table>	Name	NodeClass	Parent	Additional Information	Description	Permission	PreloadState	Variable	Item(n)	DataType: Enumeration Values: NotYetPreloadable, ReadyForPreload, Preloading, PreloadingAborted	Indicates the preload state of Configuration Item n.	Data-distribute Data-activate	MaintainingFinished	Method	Subsystem(n)	Inputs: no input arguments Outputs: no output arguments	Indicates that the maintenance process has been completed.	Data-activate	MDMRequestReset	Method	Subsystem(n)	Inputs: no input arguments Outputs: no output arguments	Request a remote reset of the EULYNX field element Subsystem.	Component-reset	MDMSafeMaintenance	Method	Subsystem(n)	Inputs: no input arguments Outputs: no output arguments	Perform maintenance after the EULYNX field element Subsystem was safely released from railway operation.	Data-activate	OperationState	Variable	Subsystem(n)	DataType: Enumeration Values: NotMaintenance, Maintenance	Indicates the general operation state of the EULYNX field element Subsystem in the context of configurability.	Data-distribute Data-activate	
		Name	NodeClass	Parent	Additional Information	Description	Permission																																
		PreloadState	Variable	Item(n)	DataType: Enumeration Values: NotYetPreloadable, ReadyForPreload, Preloading, PreloadingAborted	Indicates the preload state of Configuration Item n.	Data-distribute Data-activate																																
		MaintainingFinished	Method	Subsystem(n)	Inputs: no input arguments Outputs: no output arguments	Indicates that the maintenance process has been completed.	Data-activate																																
		MDMRequestReset	Method	Subsystem(n)	Inputs: no input arguments Outputs: no output arguments	Request a remote reset of the EULYNX field element Subsystem.	Component-reset																																
		MDMSafeMaintenance	Method	Subsystem(n)	Inputs: no input arguments Outputs: no output arguments	Perform maintenance after the EULYNX field element Subsystem was safely released from railway operation.	Data-activate																																
		OperationState	Variable	Subsystem(n)	DataType: Enumeration Values: NotMaintenance, Maintenance	Indicates the general operation state of the EULYNX field element Subsystem in the context of configurability.	Data-distribute Data-activate																																
Eu.SMI.288	Req	The table below contains clarifications regarding the information model in Eu.SMI.233																																					

ID	Type	Requirement					
		Name	NodeClass	Parent	Additional Information	Description	Permission
		RegistrationsReady	Method	Subsystem(n)	Inputs: no input arguments Outputs: no output arguments	Informs the EULYNX field element Subsystem that the registration of OPC UA status variables has been finished.	Data-distribute Data-activate
		StartAsyncPreload	Method	Subsystem(n)	Inputs: no input arguments Outputs: no output arguments	Start a download that can be performed in parallel to the safe railway operation of an EULYNX field element Subsystem.	Data-distribute
		Subsys_ID	Variable	Subsystem(n)	DataType: String	The unique identifier of the EULYNX field element Subsystem.	Data-distribute Data-activate
		UpdateInitState	Variable	Subsystem(n)	DataType: Boolean	Indicates that initialisation of PreloadState and ActivationState variables has been finished. This is the trigger that allows the MDM to iterate over the items and update them as needed.	Data-distribute Data-activate
Eu.SMI.242	Req	Generic events as defined in [Eu.Doc.120] are implemented by the following mechanisms defined in [OPC], as below:					
Eu.SMI.232	Req	T1in_Maintaining_finished shall be triggered by calling MaintainingFinished					
Eu.SMI.234	Req	T2in_Preload_item_i_started shall be triggered by calling PreloadItemStarted					
Eu.SMI.235	Req	T3in_Preload_item_i_finished shall be triggered by calling PreloadItemFinished					
Eu.SMI.236	Req	T4in_Activating_item_i shall be triggered by calling ActivateItem					
Eu.SMI.237	Req	T6in_Update_process_aborted shall be triggered by calling AbortUpdateProcess					
Eu.SMI.249	Req	T19in_Start_async_preload shall be triggered by calling StartAsyncPreload					
Eu.SMI.250	Req	T30in_MDM_Request_Reset shall be triggered by calling MDMRequestReset					
Eu.SMI.251	Req	T32in_Registrations_Ready shall be triggered by calling RegistrationsReady					
Eu.SMI.252	Req	T36in_MDM_Safe_Maintenance shall be triggered by calling MDMSafeMaintenance					
Eu.SMI.42	Head	3.3 Standard Maintenance Interface: MDM – Subsystem - Electronic Interlocking (SMI-EIL)					
Eu.SMI.46	Info	<i>- The procedure is not currently specified -</i>					