



**EULYNX Initiative**



**Europe's Rail Joint Undertaking**

## **Interface definition SDI**

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ID	Type	Requirement
Eu.SDI.1	Head	<b>1 Introduction</b>
Eu.SDI.2	Head	<b>1.1 Release information</b>
Eu.SDI.13	Info	[Eu.Doc.77] Interface definition SDI CENELEC Phase: 5 Version: 3.3 (1.A) Approval date: 02.06.2025
Eu.SDI.3	Info	<b>Version history</b>
Eu.SDI.202	Info	version number: 3.0 (0.A) date: 17.05.2022 author: Nico Hurman review: CCB changes: -
Eu.SDI.203	Info	version number: 3.0 (1.A) date: 27.06.2023 author: Nico Hurman review: TCCS+TACS Mirror Group changes: EUAR-564, EUAR-584, EUAR-589, EUAR-594, EUAR-610, EUAR-612, EUAR-613
Eu.SDI.205	Info	version number: 3.1 (0.A) date: 29.04.2024 author: Nico Hurman review: cluster changes: EUAR-635, EUAR-681, EUAR-686, EUAR-687, EUAR-713, EUAR-717
Eu.SDI.240	Info	version number: 3.2 (0.A) date: 18.06.2024 author: Nico Hurman review: TCCS+TACS Mirror Group changes: EUAR-697, EUAR-740, EUAR-746, EUAR-747

ID	Type	Requirement
Eu.SDI.242	Info	version number: 3.3 (0.A) date: 25.03.2025 author: Nico Huurman, Philipp Wolber review: cluster changes: EUAR-759, EUAR-766, EUAR-768, EUAR-769, EUAR-774
Eu.SDI.247	Info	version number: 3.3 (1.A) date: 20.06.2025 author: Nico Huurman, Philipp Wolber review: TCCS+TACS Mirror Group changes: EUAR-766, EUAR-778, EUAR-788, EUAR-790, EUAR-791
Eu.SDI.14	Head	<b>1.2 Impressum</b>
Eu.SDI.15	Info	Publishers:  <b>Europe's Rail Joint Undertaking</b> <a href="https://rail-research.europa.eu/">https://rail-research.europa.eu/</a>  <b>EULYNX Initiative</b> <a href="https://eulynx.eu/">https://eulynx.eu/</a>
Eu.SDI.16	Info	Responsible for this document: EU-Rail System Pillar Transversal CCS Components domain

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Eu.SDI.141	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.SDI.17	Head	<b>1.3 Purpose</b>
Eu.SDI.18	Info	The document defines the Standard Diagnostic Interface for communication between the service functions Diagnostics collector and Time synchronisation and the EULYNX field element subsystems.
Eu.SDI.19	Info	The service function Diagnostics collector is designed to receive and store diagnostic data from the EULYNX field element subsystems and adjacent systems in the network, and forward this data to the central diagnostics system.
Eu.SDI.20	Info	The document defines the general requirements for communication and the technical specification (e.g. protocols and telegram definition) for the SDI interface. The diagnostic messages (data point IDs and values) relevant to each EULYNX field element subsystem or adjacent system are defined in the generic and specific interface specifications SDI.
Eu.SDI.21	Info	<p>This specification does not define the detailed behaviour of the communication partners (e.g. the system reaction in the event of a communication failure), nor the situations in which the defined telegrams are sent. This behaviour is the subject of the individual system specifications or national specifications.</p> <p>Note: In future phases of the System Pillar, national specifications will be replaced by harmonised specifications.</p>

ID	Type	Requirement
Eu.SDI.22	Info	This document is intended for the following users: <ul style="list-style-type: none"> <li>• safety authorities</li> <li>• infrastructure managers</li> <li>• safety assessors</li> <li>• signalling system suppliers</li> <li>• validators</li> </ul>
Eu.SDI.204	Info	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.
Eu.SDI.24	Head	<b>1.4 Applicable standards and regulations</b>
Eu.SDI.12	Info	The applicable standards and regulations used in EULYNX are listed in the EULYNX Reference Document List [Eu.Doc.12].
Eu.SDI.25	Info	The references listed in the EULYNX Reference Document List [Eu.Doc.12] shall be considered where they are indicated as being applicable to SDI in the "Applies to" column of the EULYNX Reference Document List [Eu.Doc.12].
Eu.SDI.26	Head	<b>1.5 Applicable documents</b>
Eu.SDI.27	Info	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].
Eu.SDI.34	Head	<b>1.6 Appendices</b>
Eu.SDI.35	Info	<i>- intentionally left blank -</i>
Eu.SDI.38	Head	<b>1.7 Terms and abbreviations</b>
Eu.SDI.39	Info	The terms and abbreviations are listed in the EULYNX Glossary [Eu.Doc.9].
Eu.SDI.36	Head	<b>1.8 Variability management</b>
Eu.SDI.37	Info	This document describes harmonised requirements. Variability management is not applicable. The specific applicability of requirements is captured in individual interface specifications.
Eu.SDI.40	Head	<b>1.9 Definition of object types</b>
Eu.SDI.41	Info	The following definition for object types is applied in this document:
Eu.SDI.42	Info	<ul style="list-style-type: none"> <li>• "Req" - This denotes a mandatory requirement.</li> </ul>

ID	Type	Requirement
Eu.SDI.45	Info	<ul style="list-style-type: none"> <li>• "Info" - This denotes additional information to help understand the specification. These objects do not specify any additional requirements.</li> </ul>
Eu.SDI.46	Info	<ul style="list-style-type: none"> <li>• "Head" - This denotes chapter headings.</li> </ul>
Eu.SDI.52	Head	<b>2 Requirements</b>
Eu.SDI.53	Head	<b>2.1 Definition of the SDI</b>
Eu.SDI.51	Info	The Standard Diagnostic Interface (SDI) is a message based interface. It is composed of the transport layer and the application layer.
Eu.SDI.152	Info	The application protocols and the application-related functional requirements associated with it are described in detail in the following chapters titled "Diagnostics collector" and "Time synchronisation".
Eu.SDI.153	Info	The transport layer of the SDI required in line with the application is specified in the chapters titled "Diagnostics collector" and "Time synchronisation".
Eu.SDI.154	Info	The lower layers (network layer, data link layer and physical layer) are defined by the PoS-Signalling [Eu.Doc.100].
Eu.SDI.55	Info	The Standard Diagnostic Interface (SDI) is identical for all connected systems in terms of functionality.
Eu.SDI.54	Head	<b>3 Service function Diagnostics collector</b>
Eu.SDI.155	Head	<b>3.1 Overview</b>
Eu.SDI.156	Info	The service function Diagnostics collector supports collecting and processing event-based and preventive diagnostic data of the connected systems.
Eu.SDI.148	Info	<p>The service function Diagnostics collector may be realised in the Subsystem – Maintenance and Data Management or in a system defined by national requirements.</p> <p>Note: In future phases of the System Pillar, national specifications will be replaced by harmonised specifications.</p>
Eu.SDI.56	Head	<b>3.2 Communication requirements</b>
Eu.SDI.57	Req	The OPC UA protocol with binary binding via OPC UA Secure Conversation [OPC] via [TCP] shall be used to transfer diagnostic data from the connected systems to the service function Diagnostics collector.
Eu.SDI.120	Info	OPC UA uses a strict client server model. The server runs on the connected system. The client is contained in the service function Diagnostics collector.

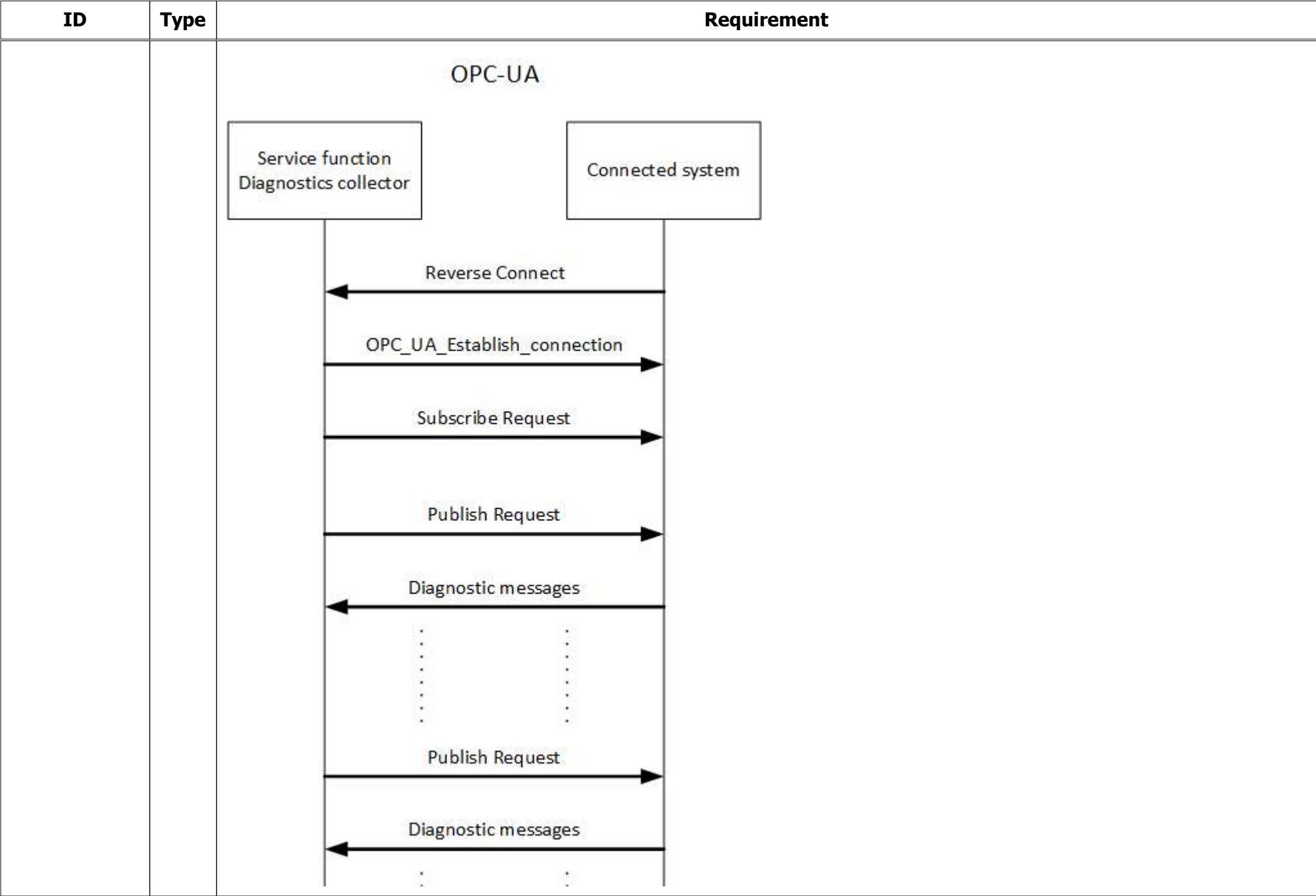
ID	Type	Requirement
Eu.SDI.121	Req	The OPC UA server on the connected system shall trigger the opening of the OPC UA connection by the client via reverse connect.
Eu.SDI.206	Req	In case the service function Diagnostics collector does not start with the establishment of the OPC UA connection as a reaction to the reverse connect within 5 seconds, the connected system shall resend the reverse connect.
Eu.SDI.248	Req	In case the connected system receives, directly after sending a reverse connect, a connection establishment from the service function Loading procedure that is not a reaction to the sent reverse connect, it shall accept the connection.
Eu.SDI.249	Req	In case the service function Loading procedure receives, directly after sending a connection establishment, a reverse connect from the connected system, it shall ignore the reverse connect.
Eu.SDI.192	Info	If two network channels are used for the service function Diagnostics collector:
Eu.SDI.125	Req	<ul style="list-style-type: none"> <li>• it shall be possible to establish the connection to the service function Diagnostics collector via both network channels</li> </ul>
Eu.SDI.126	Req	<ul style="list-style-type: none"> <li>• the establishment of the connection shall first be tried via the first address of the service function Diagnostics collector configured on the connected system</li> </ul>
Eu.SDI.127	Req	<ul style="list-style-type: none"> <li>• when there is no reply from the service function Diagnostics collector 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 by sending the reverse connect using the other network channel</li> </ul>
Eu.SDI.236	Req	If no connection is available when the service function Diagnostics collector expects to interact with the OPC UA server, the service function Diagnostics collector shall establish the OPC UA connection.
Eu.SDI.207	Req	<p>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.</p> <p>Note: If two network channels are used for the service function Diagnostics Collector, two target addresses need to be configurable.</p>
Eu.SDI.208	Req	The allowed communication ports of the OPC UA server for establishment of the OPC UA connection by the service function Diagnostics collector shall be configurable in the connected system.
Eu.SDI.209	Head	<b>3.3 General OPC UA requirements</b>
Eu.SDI.210	Info	Diagnostic messages are expressed as data points which are provided in nodes on the OPC UA server of the connected system. The data points can be subscribed to or unsubscribed from at runtime according to the OPC UA specification.
Eu.SDI.211	Info	To keep the data volume low in the case of frequently changing measured values, these may be only subscribed to when required, or the OPC UA client set restrictions for transmission via so-called "deadbands" (threshold values).



ID	Type	Requirement
Eu.SDI.212	Info	<p>Due to the naming conventions, there are some changes in the conversion of the class diagrams contained in the generic and specific Interface specifications for SDI into the OPC UA information models.</p> <p>These changes include:</p> <ul style="list-style-type: none"> <li>- Variable and method names are capitalised with the first letter (instead of lower case in the class diagram).</li> <li>- Class names additionally receive the ending "Type".</li> <li>- References are called differently if necessary</li> <li>- An exact upper limit of cardinality &gt;1 cannot be specified in the OPC information model</li> <li>- Data types can be adapted to use advantageous concepts of OPC UA (e.g. MultiStateDiscreteType)</li> <li>- A data type can have synonym names in modeling tools and OPC UA information models <ul style="list-style-type: none"> <li>- real is synonym to float</li> </ul> </li> </ul>
Eu.SDI.213	Info	<p>An OPC UA NodeClass can be an Object, a Method or a Variable.</p> <p>The Objects have a TypeDefinition that behave similarly to classes in object-oriented programming languages.</p> <p>Through TypeDefinitions 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.</p>
Eu.SDI.238	Req	<p>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.</p>
Eu.SDI.214	Req	<p>The OPC UA Information model in the connected system shall be derived from the generic OPC UA information models as provided together with the specifications using the "HasSubtype" relationship.</p> <p>The instantiated objects derived from manufacturer-specific types created in this way shall be stored in the folders of the object model provided for this purpose - e.g. the product group model of a point in the "PointProductGroupSet" and the associated equipment model in the "PointEquipmentSet".</p>
Eu.SDI.215	Req	<p>The OPC UA Information model in the connected system shall respect the semantics, i.e. use the diagnostic attributes according to their meaning and unit specified in the Interface specifications for SDI.</p>
Eu.SDI.216	Req	<p>The OPC UA Information model shall contain at least all mandatory attributes.</p> <p>The OPC UA server on the connected system shall receive the attribute values according to the accuracy and update frequency as specified in the Interface specifications for SDI.</p>
Eu.SDI.237	Req	<p>All nodes in the information model that share the same parent must have a unique browse name.</p> <p>Note: This allows the use of simplified browse paths without namespace indices.</p>
Eu.SDI.250	Req	<p>The overall OPC UA Information model on the connected systems shall be composed of two OPC UA Information models, a generic and a specific part.</p>
Eu.SDI.246	Req	<p>The version number of the OPC UA Information model shall consist of 3 levels, M.m.c., expressing Major, minor and compatible changes in the information model. The upper two levels, M.m., shall be marked in the namespaceURI. All three levels, M.m.c., shall be marked in the OPC UA variable 'version'.</p>

ID	Type	Requirement
Eu.SDI.251	Req	The applicable value of the version number of the specific part is defined in the specific Interface specification SDI corresponding to type of the EULYNX field element subsystem [Eu.Doc.78], [Eu.Doc.80], [Eu.Doc.81], [Eu.Doc.82] or [Eu.Doc.110]. The applicable value of the version number of the generic part is defined in the Interface specification SDI Generic [Eu.Doc.94].
Eu.SDI.217	Req	Changes to the OPC UA Information model structure at runtime shall be communicated to the OPC UA client via model change events.
Eu.SDI.218	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.SDI.219	Req	The following facets shall be implemented in addition:
Eu.SDI.220	Req	<ul style="list-style-type: none"> <li>• Reverse Connect Server Facet</li> </ul>
Eu.SDI.221	Req	<ul style="list-style-type: none"> <li>• Event Access</li> </ul>
Eu.SDI.222	Req	<ul style="list-style-type: none"> <li>• Historical Data Access</li> </ul>
Eu.SDI.223	Req	The OPC UA server on the connected system shall allow simultaneous connection to at least 3 OPC UA clients. Note: The operational use of OPC UA clients other than the service function Diagnostics Collector is currently not defined.
Eu.SDI.224	Req	The OPC UA server on the connected system shall allow at least 2 sessions per OPC UA client.
Eu.SDI.225	Req	The OPC UA server on the connected system shall allow at least 5 subscriptions per session.
Eu.SDI.226	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 [SP-SEC-CommSpec].
Eu.SDI.227	Req	If the communication on the diagnostics interface fails or is not yet available, all diagnostic data of attribute type diagnosis shall be stored on the connected system for at least 6 hours. Note: The storage does not need to be persistent in case of a reset or re-booting of the connected system. Note: The methodology to calculate the storage capacity and the required inputs are defined by national requirements. Note: In future phases of the System Pillar, national specifications will be replaced by harmonised specifications.
Eu.SDI.228	Req	After the SDI-XX connection has been restored, the stored diagnostic data shall be accessible with OPC UA "Historical Data Access (HDA)".
Eu.SDI.229	Req	If the memory allocated to the storage of diagnostic data is full, the connected system shall discard the respective oldest attribute data and events.
Eu.SDI.231	Req	The sampling interval of the OPC UA server on the connected system shall be 1 second for all diagnostic data related to the hardware status of the connected system.

ID	Type	Requirement
Eu.SDI.234	Req	The sampling interval of the OPC UA server on the connected system shall be 250 ms for all diagnostic data related to the status of the railway system.
Eu.SDI.232	Req	The sampling interval of the OPC UA server on the connected system shall be 50 ms for all data that is sampled as arrays.
Eu.SDI.233	Req	The publishing interval of the OPC UA server on the connected system shall be 1 second.
Eu.SDI.235	Req	The queue size of the OPC UA server on the connected system shall be the ratio between sampling interval and publishing interval.
Eu.SDI.239	Req	The OPC UA server shall use the system time to set the SourceTimeStamp and the ServerTimeStamp for all diagnostic data.
Eu.SDI.241	Req	The OPC UA server on the connected system shall respect the security permissions. The following security permission is used: <ul style="list-style-type: none"> <li>• eu.rail.sdi.diagnostics-read</li> </ul>
Eu.SDI.129	Head	<b>3.4 Telegram definitions OPC UA</b>
Eu.SDI.130	Info	The communication between the OPC UA client and the OPC UA server is session-oriented. 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 and are not described here.
Eu.SDI.143	Info	



ID	Type	Requirement
Eu.SDI.133	Req	The service function Diagnostics collector shall send a "Subscribe Request" via the OPC UA protocol, together with the list of diagnostic messages to be registered.
Eu.SDI.137	Req	The service function Diagnostics collector shall send a "Publish Request" via the OPC UA protocol.
Eu.SDI.138	Req	The connected system shall respond to the telegram "Publish request" with the stored diagnostic messages.
Eu.SDI.157	Head	<b>4 Time synchronisation</b>
Eu.SDI.158	Head	<b>4.1 Overview</b>
Eu.SDI.159	Info	The service function Time synchronisation provides the time for all connected systems.
Eu.SDI.244	Info	The service function Time synchronisation uses the diagnostics interface or the security interface, defined by configuration. This configuration only impacts the traffic separation on the Point of Service-Signalling, as specified in [Eu.Doc.100].
Eu.SDI.160	Head	<b>4.2 Communication requirements</b>
Eu.SDI.245	Req	The service function Time synchronisation and the connected system shall implement the requirements defined in [SP-SEC-ServSpec].
Eu.SDI.161	Req	The connected systems shall use one or both Point of Service-Signalling network channels to synchronise times.