EULYNX Initiative

Europe's Rail Joint Undertaking

Specification of Point of Service-Signalling

Document number: Eu.Doc.100
Version: 2.2 (0.A)

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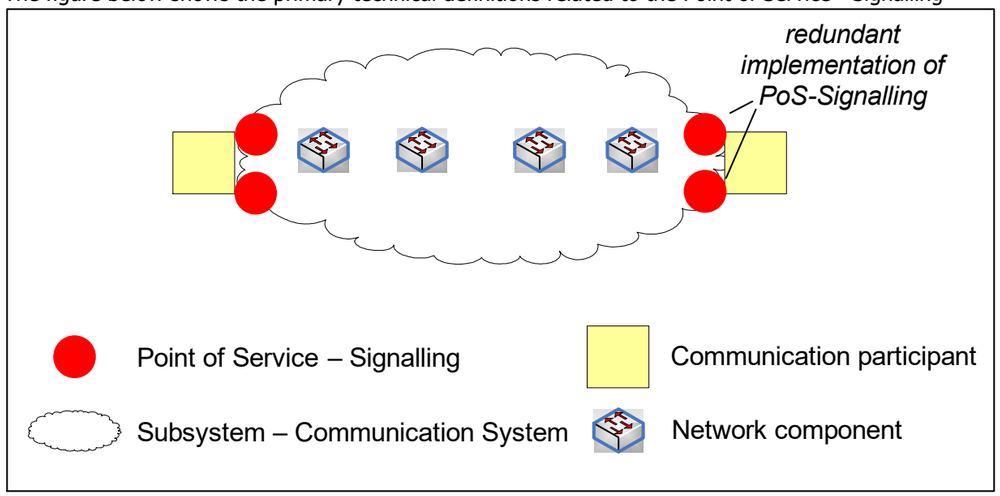
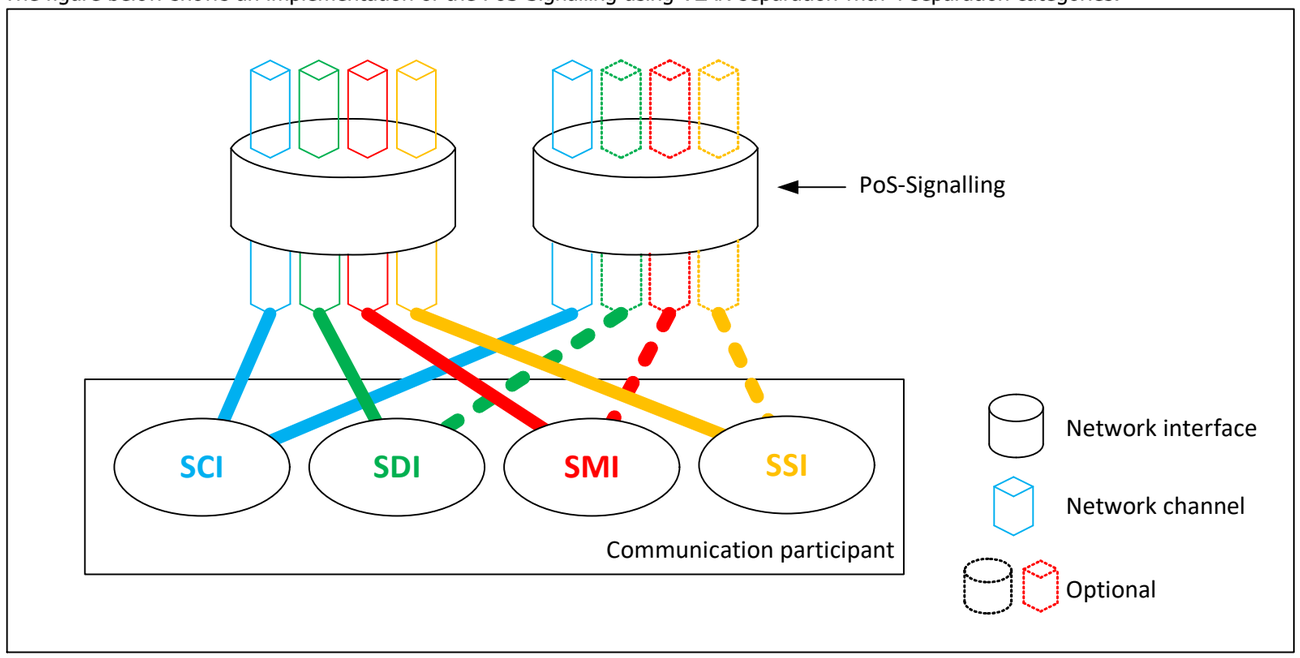
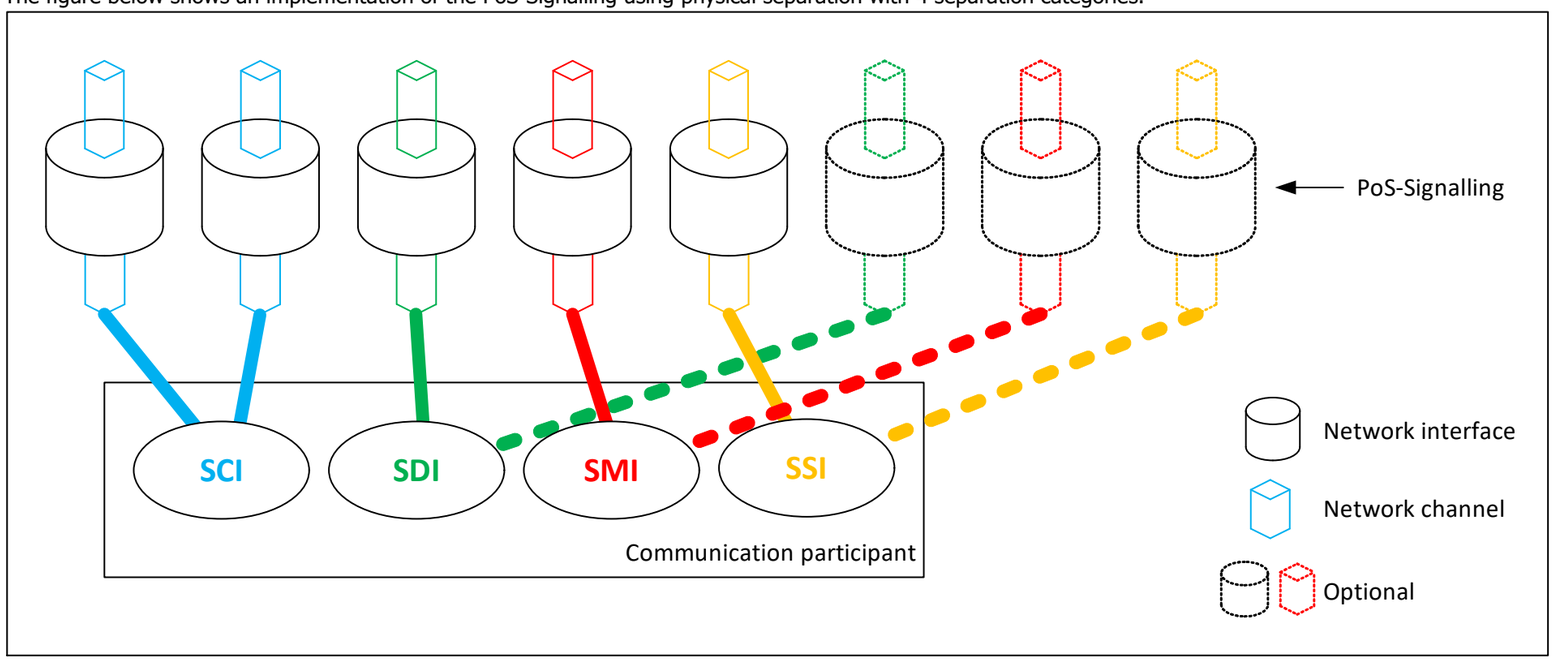
ID	Type	Requirement	Valid for
Eu.PoS.9	Head	**1 Introduction**	--
Eu.PoS.848	Head	**1.1 Release information**	--
Eu.PoS.948	Info	[Eu.Doc.100] Specification of Point of Service-Signalling CENELEC Phase: 4 Version: 2.2 (0.A) Approval date: 29.05.2024	--
Eu.PoS.967	Info	**Version history**	--
Eu.PoS.1121	Info	version number: 1.0 (0.A) date: 09.07.2019 author: review: CCB changes: EUAR-310, EUAR-311	--
Eu.PoS.1123	Info	version number: 1.1 (0.A) date: 29.10.2019 author: Nico Huurman review: RA cluster changes: EUAR-319, EUAR-330	--
Eu.PoS.1128	Info	version number: 1.2 (0.A) date: 13.12.2019 author: Nico Huurman review: CCB changes: EUAR-335	--
Eu.PoS.1129	Info	version number: 1.2 (1.A) date: 25.03.2020 author: Nico Huurman review: changes: EUAR-357	--
Eu.PoS.1130	Info	version number: 1.2 (2.A) date: 23.06.2020 author: Nico Huurman review: CCB changes: EUAR-375, EUAR-376, EUAR-377	--
Eu.PoS.1138	Info	version number: 1.3 (0.A) date: 17.12.2021 author: Package working group 4, Nico Huurman review: cluster changes: EUAR-413, EUAR-423, EUAR-426, EUAR-440, EUAR-446, EUAR-450, EUAR-452, EUAR-453, EUAR-454, EUAR-455, EUAR-456, EUAR-458	--
Eu.PoS.1215	Info	version number: 2.0 (0.A) date: 16.05.2022 author: Package working group 4, Nico Huurman review: CCB changes: EUAR-477, EUAR-484, EUAR-514, EUAR-525	--
Eu.PoS.1216	Info	version number: 2.1 (0.A) date: 20.02.2024 author: Nico Huurman review: cluster changes: EUAR-564, EUAR-604, EUAR-607, EUAR-618, EUAR-677, EUAR-689	--

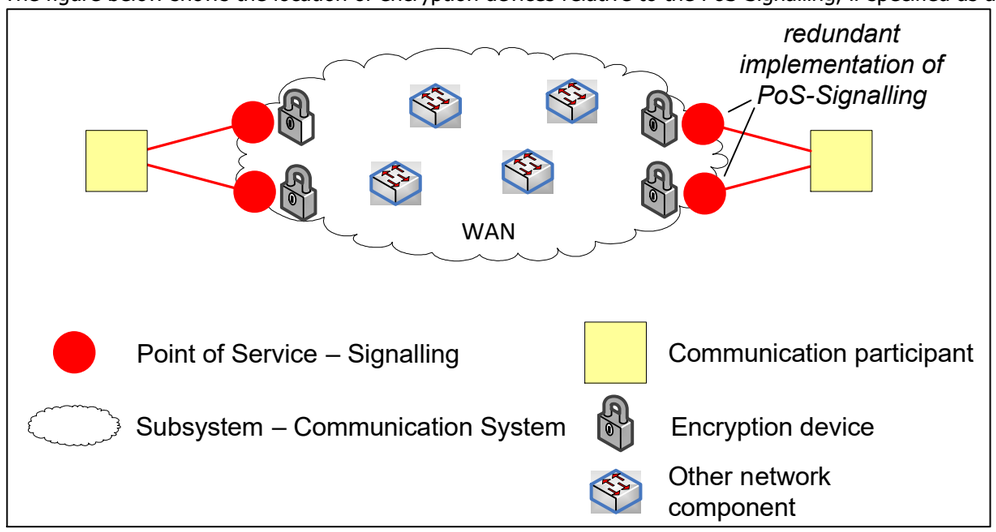
ID	Type	Requirement	Valid for
Eu.PoS.1218	Info	version number: 2.2 (0.A) date: 18.06.2024 author: Nico Huurman review: TACS Mirror Group changes: EUAR-681, EUAR-697, EUAR-710, EUAR-740, EUAR-743, EUAR-744	--
Eu.PoS.847	Head	**1.2 Impressum**	--
Eu.PoS.946	Info	Publisher: **Europe's Rail Joint Undertaking** https://rail-research.europa.eu/ **EULYNX Initiative** https://eulynx.eu/	--
Eu.PoS.945	Info	Responsible for this document: EU-Rail System Pillar Transversal CCS Components domain	--
Eu.PoS.949	Info	This document is drafted by and belongs to EU Rail. 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. 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]. 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. 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.	--
Eu.PoS.846	Head	**1.3 Purpose**	--
Eu.PoS.944	Info	This specification describes the requirements for the Point of Service - Signalling for its network and security components and their interfaces with communication participants and other participants needed in this context.	--
Eu.PoS.942	Info	This document does not examine a potential network within a communication participant.	--
Eu.PoS.979	Info	This document does not define the specific network structure. This is subject to national requirements.	--
Eu.PoS.941	Info	The functional and architectural requirements for the Point of Service - Signalling are defined in order to ensure maximum availability of the information provided by fail-safe systems specifically for operational purposes.	--
Eu.PoS.1122	Info	The applicability of each requirement for either the Subsystem - Communication System, the Communication participant or for both is indicated by the column "Valid for".	--
Eu.PoS.845	Head	**1.4 Applicable standards and regulations**	--
Eu.PoS.940	Info	A list of applicable standards and regulations used in EULYNX is listed in the EULYNX Reference Document List [Eu.Doc.12].	--
Eu.PoS.969	Head	**1.5 Applicable documents**	--
Eu.PoS.970	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.PoS.844	Head	**1.6 Terms and abbreviations**	--

ID	Type	Requirement	Valid for
Eu.PoS.893	Info	The terms and abbreviations are listed in the EULYNX Glossary [Eu.Doc.9].	--
Eu.PoS.976	Head	**1.7 Variability management**	--
Eu.PoS.977	Info	This document is valid for the complete EULYNX System. Variability management is not used in this document. The specific applicability of requirements is captured in individual Requirements specifications. In implementation projects that apply the EULYNX specifications, it is possible to implement only parts of the architecture of the EULYNX System described in this document. The Infrastructure Manager initiating an implementation project, can use project documentation to indicate which parts of the architecture of the EULYNX System are applicable in a specific project.	--
Eu.PoS.972	Head	**1.8 Definition of object types**	--
Eu.PoS.947	Info	The following definition for object types is applied in this document:	--
Eu.PoS.973	Info	• "Req" - This denotes a mandatory requirement.	--
Eu.PoS.974	Info	• "Info" - This denotes additional information to help understand the specification. These objects do not specify any additional requirements.	--
Eu.PoS.975	Info	• "Head" - This denotes chapter headings.	--
Eu.PoS.8	Head	**2 Technical definitions for the Point of Service - Signalling**	--
Eu.PoS.813	Head	**2.1 Point of Service - Signalling**	--
Eu.PoS.980	Info	The Point of Service – Signalling (PoS-Signalling) provides the contact between the Subsystem – Communication System and the other subsystems in the EULYNX system and adjacent systems. Through the PoS-Signalling, the subsystems in the EULYNX system and the adjacent systems communicate with each other. Note: The PoS-Signalling is located where the cable from the EULYNX system or adjacent system plugs into the first network device that is part of the Subsystem - Communication System. In case of integrated wireless communication, the PoS-Signalling is located inside the EULYNX system or adjacent system at the antenna.	--
Eu.PoS.981	Info	The definition of the PoS-Signalling provides the lower layers (network layer, data link layer and physical layer) of the protocol stacks of the standardised interfaces of the EULYNX system. The PoS-Signalling is part of the protocol stack of the process data interface, the diagnostics interface and the maintenance interface.	--
Eu.PoS.828	Info	The PoS-Signalling definition is based on the ISO/OSI model and specifies both functional and non-functional characteristics. Functional characteristics correspond to the definition of the layer model and non-functional characteristics relate to technical parameters, such as Quality of Service requirements.	--
Eu.PoS.1131	Info	One implementation of the PoS-Signalling may support several instances of the higher layers of the protocol stacks of the standardised interfaces of the EULYNX system (SCI-XX, SDI-XX, SMI-XX and SSI-XX).	--
Eu.PoS.982	Head	**2.2 Subsystem - Communication System**	--
Eu.PoS.983	Info	The Subsystem - Communication System ensures the transmission of information, exchanged over the process data interfaces, maintenance interfaces, diagnostic interfaces and security interfaces of the EULYNX system.	--
Eu.PoS.984	Info	The Subsystem – Communication System provides the PoS-Signalling as a point of contact for the other subsystems of the EULYNX system and for adjacent systems.	--
Eu.PoS.986	Info	The communication between Points of Service – Signalling is handled by the Subsystem – Communication System. The implementation of the Subsystem - Communication System shall be defined by national specifications. The PoS-Signalling is part of the Subsystem – Communication System.	--
Eu.PoS.987	Info	This document specifies quality of service requirements (chapter 5) that shall be met by the implementation of the Subsystem – Communication System at the PoS-Signalling.	--
Eu.PoS.988	Head	**2.3 Communication participant**	--
Eu.PoS.989	Info	A communication participant is any system that sends and receives information via the Subsystem – Communication System. All EULYNX subsystems and adjacent systems that are connected to the Subsystem – Communication System via the PoS-Signalling are considered communication participants.	--
Eu.PoS.999	Info	All components of the implementation of the Subsystem - Communication System, for example routers, switches or encryption devices, are called network components.	--

ID	Type	Requirement	Valid for
Eu.PoS.1024	Info	The figure below shows the primary technical definitions related to the Point of Service - Signalling 	--
Eu.PoS.985	Head	**2.4 Data networks**	--
Eu.PoS.991	Info	The national specific implementation of the Subsystem – Communication System consists of one or more data networks.	--
Eu.PoS.834	Info	As a general rule, communication participants are connected to the PoS-Signalling of a data network and the data network facilitates any-to-any communication between communication participants across different sites as required.	--
Eu.PoS.1041	Info	A communication path between two communication participants via one or more data networks that enables communication is called a network channel.	--
Eu.PoS.1111	Info	A physical connection between a communication participant and the Subsystem - Communication System is called a network interface.	--
Eu.PoS.1006	Head	**3 Main characteristics of the Point of Service - Signalling**	--
Eu.PoS.1022	Head	**3.1 Redundancy and diversity**	--
Eu.PoS.1023	Info	The standardised interfaces of EULYNX, specifically the safety-relevant process data interface, require a high availability of the PoS-Signalling.	--
Eu.PoS.1014	Req	The high availability shall be reached by providing two network interfaces to connect to the data network(s) that form the Subsystem - Communication System to form a redundant implementation of the PoS-Signalling. These two network interfaces shall be independent to provide a redundant implementation of the PoS-Signalling.	Communication participant Subsystem - Communication System
Eu.PoS.1015	Req	Independence of the two network interfaces shall be reached by using separate switches and other network components.	Subsystem - Communication System
Eu.PoS.1112	Req	The two independent network interfaces shall be available for communication on the process data interface (SCI).	Communication participant Subsystem - Communication System
Eu.PoS.1113	Info	For communication on the maintenance (SMI), diagnostic (SDI) and security (SSI) interfaces, using both available network interfaces is optional.	--
Eu.PoS.1016	Info	Using separate cable ducts for the two network interfaces is recommended. Strict duplication of cable ducts might not be economically feasible for the last stretch of cabling to field elements that are on remote locations along a railway line.	--
Eu.PoS.1139	Info	If multiple radio access modules are implemented and active concurrently, it is recommended to consider the antenna situation to avoid radio disturbances.	--
Eu.PoS.1007	Head	**3.2 Separation and QoS marking**	--
Eu.PoS.1009	Info	The PoS-Signalling provides the lower layers of the protocol stacks (layers 1,2 and 3) of four types of standardised interfaces (process data (SCI), maintenance (SMI), diagnostic (SDI) and security (SSI)). These four interfaces have different characteristics in terms of required quality of service and availability.	--
Eu.PoS.1140	Req	The differences in quality of service shall be managed for four traffic categories: SCI, SMI, SDI and SSI. Note: This can be done by marking network traffic, by separation or by both.	Subsystem - Communication System Communication participant

ID	Type	Requirement	Valid for
Eu.PoS.1141	Info	QoS marking may be used to manage quality of service. Two options are used: a. DSCP/traffic class marking on the network layer (IP) b. No DSCP/traffic class marking	--
Eu.PoS.1142	Req	If DSCP/traffic class marking is used, the four traffic categories (SCI, SMI, SDI and SSI) shall be marked distinctly.	Subsystem - Communication System Communication participant
Eu.PoS.1143	Info	Traffic separation may be used to manage quality of service. Three options are used: i. VLAN separation (data link layer) ii. Physical separation (physical layer) iii. No separation	--
Eu.PoS.1144	Req	If DSCP/traffic class marking is not used, VLAN or Physical separation shall be used.	Subsystem - Communication System Communication participant
Eu.PoS.1145	Info	The number of separation categories used for VLAN or physical separation may differ. Three options are used: A. 2 separation categories (1 for SCI; 1 for SMI+SDI+SSI) B. 3 separation categories (1 for SCI; 1 for SMI; 1 for SDI+SSI) C. 4 separation categories (1 for SCI; 1 for SMI; 1 for SDI; 1 for SSI)	--
Eu.PoS.1146	Req	If the number of separation categories is lower than four, DSCP/traffic class marking shall be used.	Subsystem - Communication System Communication participant
Eu.PoS.1119	Info	The figure below shows an implementation of the PoS-Signalling using VLAN separation with 4 separation categories. 	--
Eu.PoS.1114	Head	**3.2.1 Optional support of physical separation**	--
Eu.PoS.1010	Info	If the required physical hardware is available both at the communication participant and at the Subsystem - Communication System, the EULYNX Point of Service - Signalling may be implemented using physically separated network interfaces to provide the communication for the interfaces implemented as SCI, SMI, SDI and SSI. The functionality of this implementation option may be offered in addition to the option for VLAN separation and DSCP/traffic class marking.	--
Eu.PoS.1115	Info	In the implementation with physical separation with 4 separation categories, the PoS-Signalling needs at least 5 network interfaces, as at least for the process data interface two network interfaces are required. Two out of these five network interfaces must be a pair that forms a redundant implementation of the PoS-Signalling (see Eu.PoS.1044, Eu.PoS.1034 and Eu.PoS.1060).	--
Eu.PoS.1116	Info	In the implementation with physical separation, a redundant implementation of PoS-Signalling with two network interfaces may optionally be provided also for the maintenance interface. This adds one network interface, which must be paired to form a redundant implementation of the PoS-Signalling (see Eu.PoS.1044, Eu.PoS.1034 and Eu.PoS.1060).	--

ID	Type	Requirement	Valid for
Eu.PoS.1117	Info	In the implementation with physical separation, a redundant implementation of PoS-Signalling with two network interfaces may optionally be provided also for the diagnostics interface. This adds one network interface, which must be paired to form a redundant implementation of the PoS-Signalling (see Eu.PoS.1044, Eu.PoS.1034 and Eu.PoS.1060).	--
Eu.PoS.1147	Info	In the implementation with physical separation, a redundant implementation of PoS-Signalling with two network interfaces may optionally be provided also for the security interface. This adds one network interface, which must be paired to form a redundant implementation of the PoS-Signalling (see Eu.PoS.1044, Eu.PoS.1034 and Eu.PoS.1060).	--
Eu.PoS.1120	Info	The figure below shows an implementation of the PoS-Signalling using physical separation with 4 separation categories.  	--
Eu.PoS.1148	Info	When DSCP/traffic class marking is used, the number of physical separation categories may be lower than four. The number of required network interfaces for physical separation is also lower in those cases.	--
Eu.PoS.7	Head	**3.3 IT Security**	--
Eu.PoS.1029	Info	The life cycle concepts for IT security on one hand, and railway safety on the other hand, have conflicting needs. IT security requires quick "patches" (ideally, within few days); the complex approval process for safe railway applications, however, does not allow more than one change per year, with the approval process taking at least half a year. For this reason, EULYNX separates these two domains as much as possible.	--
Eu.PoS.1031	Req	IT security measures in EULYNX shall be separated from safe applications.	Subsystem - Communication System Communication participant
Eu.PoS.1149	Info	The EULYNX Security Concept [Eu.Doc.15] defines different security solutions, depending on the properties of the Subsystem - Communication system. Note: In future phases, the EULYNX security specifications will be replaced by harmonised specifications published by the EU-Rail System Pillar Cyber Security domain.	--
Eu.PoS.1030	Info	The corresponding IT security requirements for the different security solutions are defined in the EULYNX Security Specifications [Eu.Doc.114]. Note: In future phases, the EULYNX security specifications will be replaced by harmonised specifications published by the EU-Rail System Pillar Cyber Security domain.	--
Eu.PoS.1062	Req	If the chosen security solution relies on a network connection of category 2 according to [EN 50159], national specifications shall ensure that the Subsystem - Communication System delivers at the PoS-Signalling a network connection of category 2 according to [EN 50159] over its full lifetime.	Subsystem - Communication System
Eu.PoS.1028	Req	If the chosen security solution relies on encryption provided by dedicated encryption devices, national specifications shall ensure that communication between communication participants (i.e. SCI-XX, SMI-XX, SDI-XX and SSI-XX) shall be uniformly encrypted by means of dedicated encryption devices situated in close vicinity of the communication participants.	Subsystem - Communication System Communication participant

ID	Type	Requirement	Valid for
Eu.PoS.1036	Info	The figure below shows the location of encryption devices relative to the PoS-Signalling, if specified as applicable by national specifications.  	--
Eu.PoS.1150	Req	If the chosen security solution relies on the use of TLS for encryption, national specifications shall ensure that the Subsystem - Communication System delivers at the PoS-Signalling a network connection of category 3 according to [EN 50159] over its full lifetime. Note: The use of the security solution with TLS over TCP is also allowed over a network connection of category 2 according to [EN 50159]	Subsystem - Communication System Communication participant
Eu.PoS.1125	Info	In case non-EULYNX equipment is connected on the same data network, this equipment shall not compromise the security integrity of the network.	--
Eu.PoS.1008	Head	**3.4 Network architecture**	--
Eu.PoS.1017	Info	The architecture of the network that implements the Subsystem - Communication system is defined by national specifications. EULYNX provides a Guideline for network architecture in [Eu.Doc.25], which proposes a possible network architecture.	--
Eu.PoS.816	Head	**3.5 Safety**	--
Eu.PoS.843	Info	The implementation of the Subsystem – Communication System itself plays no part in signalling safety. Please note: Safety is a property of the EULYNX system. The EULYNX system will have safety requirements towards the network and the safety of the system will rely on the network to fulfil the relevant security requirements defined in the EULYNX Security Specifications [Eu.Doc.114]. Note: In future phases, the EULYNX security specifications will be replaced by harmonised specifications published by the EU-Rail System Pillar Cyber Security domain.	--
Eu.PoS.1132	Head	**3.6 Wireless/radio**	--
Eu.PoS.1133	Info	Wireless/radio technology may be used inside the Subsystem - Communication System and/or on the PoS-Signalling according to national specifications. Note: See section 5.2 (Eu.PoS.1079) for different performance profiles that may be used.	--
Eu.PoS.1151	Info	There are two possibilities to implement wireless/radio technology: a) as a separate modem b) integrated into the communication participant In case a) the radio/wireless modem is part of the Subsystem - Communication System. In case b) the radio/wireless modem is integrated in and part of the communication participant. The related mobile network is part of the Subsystem - Communication System. The PoS-Signalling is located inside the communication participant, at the antenna.	--
Eu.PoS.1152	Info	The requirements related to using wireless/radio technology on the PoS-Signalling are described in section 4.1 Protocol stack of the PoS-Signalling [Eu.Pos.993]	--
Eu.PoS.1134	Info	Independent from the implementation of the PoS-Signalling (wireless or wired), wireless/radio technology can be used inside the Subsystem - Communication System. Note: If a wired variant of the PoS-Signalling is used, the wireless/radio communication may be implemented in a separate modem, as part of the Subsystem - Communication System.	--

ID	Type	Requirement	Valid for
Eu.PoS.6	Head	**4 General requirements**	--
Eu.PoS.993	Head	**4.1 Protocol stack of the PoS-Signalling**	--
Eu.PoS.1000	Info	The PoS-signalling provides the lower layers of the protocol stacks of the standardised interfaces of the EULYNX system: • ISO/OSI layer 1 (Physical layer) • ISO/OSI layer 2 (Data link layer) • ISO/OSI layer 3 (Network layer)	--
Eu.PoS.656	Head	**4.1.1 ISO/OSI layer 1**	--
Eu.PoS.1003	Info	For the physical layer, one of three implementation options may be used: • the standard [IEEE 802.3] Ethernet protocol over copper RJ45 interfaces [IEC 60603-7] • the standard [IEEE 802.3] Ethernet protocol over SFP cages • integrated wireless/radio communication	Subsystem - Communication System Communication participant
Eu.PoS.1217	Req	If the physical implementation with RJ45 is used, the interface shall implement BASE-T (RJ45, copper dual twisted pair, reach of 100 m, as specified by [IEEE 802.3ab]) with a bandwidth of 100 Mbit/s (100BASE-T) or more. Note: The bandwidth must be chosen such that the QoS-Parameter are met.	Subsystem - Communication System Communication participant
Eu.PoS.1153	Req	If the physical implementation with SFP cages is used, the following list of SFP type transceivers shall be supported:	Subsystem - Communication System Communication participant
Eu.PoS.1203	Req	• 1000BASE-T (RJ45 [IEC 60603-7], copper dual twisted pair, reach of 100 m, as specified by [IEEE 802.3ab])	Subsystem - Communication System Communication participant
Eu.PoS.1204	Req	• 1000BASE-LX10 (LC [IEC 61754-20], single-mode fiber pair, reach of 10 km, as specified by [IEEE 802.3ah])	Subsystem - Communication System Communication participant
Eu.PoS.1205	Req	• 1000BASE-BX10 (LC [IEC 61754-20], single-mode fiber strand, reach of 10 km, as specified by [IEEE 802.3ah])	Subsystem - Communication System Communication participant
Eu.PoS.1206	Req	• 1000BASE-BX40 (LC [IEC 61754-20], single-mode fiber strand, reach of 40 km, TX/RX λ=1310 nm (typical), RX/TX λ=1550 nm (typical), Power Budget >= 18 dB)	Subsystem - Communication System Communication participant
Eu.PoS.1207	Req	• 1000BASE-BX80-A (LC [IEC 61754-20], single-mode fiber strand, reach of 80 km, TX/RX λ=1490 nm (typical), RX/TX λ=1570 nm (typical), Power Budget >= 23 dB)	Subsystem - Communication System Communication participant
Eu.PoS.1208	Req	• 1000BASE-BX80-B (LC [IEC 61754-20], single-mode fiber strand, reach of 80 km, TX/RX λ=1490 nm (typical), RX/TX λ=1550 nm (typical), Power Budget >= 23 dB)	Subsystem - Communication System Communication participant
Eu.PoS.1209	Req	• 1000BASE-EX (LC [IEC 61754-20], single-mode fiber pair, reach of 40 km, λ=1310 nm (typical), power budget >= 21 dB)	Subsystem - Communication System Communication participant
Eu.PoS.1210	Req	• 1000BASE-ZX (LC [IEC 61754-20], single-mode fiber pair, reach of >= 70 km, λ=1550 nm (typical), Power Budget >= 23 dB)	Subsystem - Communication System Communication participant
Eu.PoS.1154	Req	If the physical implementation with integrated wireless/radio communication is used, the communication participant's integrated wireless must support European frequencies for public and railway mobile radio for 4G and 5G.	Communication participant
Eu.PoS.1155	Info	The communications participant's integrated wireless may support different frequency in addition.	--
Eu.PoS.1156	Req	To ensure redundancy of network interfaces, the communication participant shall provide at least two instances of the physical layer.	Communication participant
Eu.PoS.1157	Info	The required combination of network interfaces that must be available at the communication participant shall be defined by national specifications.	--
Eu.PoS.655	Head	**4.1.2 ISO/OSI layer 2**	--
Eu.PoS.1004	Req	For the data link layer, the Ethernet [IEEE 802.3] protocol shall be used for the copper and SFP cage variants of ISO/OSI layer 1.	Subsystem - Communication System Communication participant

ID	Type	Requirement	Valid for
Eu.PoS.1124	Info	The Subsystem - Communication System may be capable of providing End-to-end Layer 2 connectivity using Layer 3 based transport networks.	--
Eu.PoS.1158	Req	The maximum transmission unit (MTU) shall be 1280 bytes.	Subsystem - Communication System Communication participant
Eu.PoS.654	Head	**4.1.3 ISO/OSI layer 3**	--
Eu.PoS.1107	Req	For the network layer, both IPv4 [RFC0791] and IPv6 [RFC8200] shall be used Note: The choice between IPv4 and IPv6 is configured when assigning network addresses to the communication participant.	Subsystem - Communication System Communication participant
Eu.PoS.1108	Req	• The Subsystem - Communication System shall support at least one of the two options, IPv4 [RFC0791] or IPv6 [RFC8200].	Subsystem - Communication System
Eu.PoS.1005	Req	• The communication participant shall support both IPv4 [RFC0791] and IPv6 [RFC8200].	Communication participant
Eu.PoS.1053	Req	IP addresses and port numbers at the transport layer shall be adjustable.	Subsystem - Communication System Communication participant
Eu.PoS.1051	Req	The Subsystem - Communication System shall be capable of providing End-to-end Layer 3 connectivity.	Subsystem - Communication System
Eu.PoS.594	Head	**4.2 General requirements for the Subsystem - Communication System**	--
Eu.PoS.653	Req	The same Quality of Service characteristics shall apply to all data on one standardised interface. E.g. all data on SMI-XX is transported with the same priority.	Subsystem - Communication System
Eu.PoS.647	Req	The same bandwidth shall be provided for the send and receive direction between two participants in all bandwidth versions.	Subsystem - Communication System
Eu.PoS.1044	Req	The Subsystem - Communication System shall deliver two redundant and independent network channels between the communication participants	Subsystem - Communication System
Eu.PoS.1159	Info	On lines with a low traffic intensity, where provision of a redundant implementation of the PoS-Signalling is not feasible, an IM may decide to provide only one network interface to the Subsystem - Communication System. Note: The absence of redundancy and diversity has an important impact on the reliability, which must be taken into account in a safety case specifically targeted for lines with a very low traffic intensity.	--
Eu.PoS.1127	Req	The connectivity provided by the Subsystem - Communication System (End-to-end Layer 2 or End-to-end Layer 3) shall be defined by national specifications.	Subsystem - Communication System Communication participant
Eu.PoS.1160	Req	The implementation option used for QoS marking shall be defined by national specifications.	Subsystem - Communication System Communication participant
Eu.PoS.1161	Req	The implementation option used for separation shall be defined by national specifications.	Subsystem - Communication System Communication participant
Eu.PoS.1162	Req	The Subsystem - Communication System shall ensure that no packet fragmentation occurs for packets up to and including 1280 bytes.	Subsystem - Communication System
Eu.PoS.591	Head	**4.3 General requirements for communication participants**	--
Eu.PoS.1164	Req	Communication participants shall be able to support DSCP (IPv4, [RFC 3260]) or traffic class (IPv6, RFC 8200]) marking as an implementation option, as defined in [RFC 2474]. The DSCP or traffic class shall be adjustable for SCI, SMI, SDI and SSI traffic and IPv4 / IPv6.	Communication participant
Eu.PoS.1033	Req	Communication participants shall be able to support VLAN separation as an implementation option. [IEEE 802.1Q] shall be used. The VLAN settings for each network interface shall be adjustable.	Communication participant
Eu.PoS.1034	Req	Communication participants shall be connected to the Subsystem - Communication System with a redundant implementation of the PoS-Signalling to avoid a single point of failure. Note: Unless in those cases where the Subsystem - Communication System does not provide a redundant implementation of the PoS-Signalling, see Eu.PoS.1159	Communication participant
Eu.PoS.1060	Req	Communication participants shall not disrupt the mutual independence between the two network channels that form the redundant implementation of the PoS-Signalling.	Communication participant
Eu.PoS.1126	Req	Communication participants shall support both End-to-end layer 2 and End-to-end layer 3 connectivity.	Communication participant
Eu.PoS.1054	Req	Communication participants shall not perform any networking task (routing or switching functions/protocols).	Communication participant
Eu.PoS.597	Req	Communication participants shall support the persistent configuration of static routes.	Communication participant

ID	Type	Requirement	Valid for
Eu.PoS.1165	Head	**4.4 Additional general requirements for integrated wireless/radio communication**	--
Eu.PoS.1166	Info	These additional requirements are only applicable if the communication participant or the Subsystem - Communication System provide the physical implementation option of integrated wireless/radio communication	--
Eu.PoS.1167	Req	The mobile network of the Subsystem - Communication System shall provide APN (for 4G) and DNN (for 5G) to support QoS bits.	Subsystem - Communication System
Eu.PoS.1168	Req	The APN shall be structured to reflect the VLAN separation categories as used for wired connections.	Subsystem - Communication System
Eu.PoS.1169	Req	Communication participants shall be able to support APN (4G) or DNN (5G) to support QoS bits.	Communication participant
Eu.PoS.1170	Req	The mobile network shall perform cell handover within less than 0.5 s.	Subsystem - Communication System
Eu.PoS.1171	Req	The mobile network shall perform a reconnection in less than 0.5 s.	Subsystem - Communication System
Eu.PoS.1173	Req	Communication participants shall take no more than 4 s from ECM-Idle to ECM-Connected mode. The communication participant shall initiate the required Service Request Procedure.	Communication participant
Eu.PoS.1174	Req	Communication participants shall use optimized network search. This shall include preferred frequency scanning of the last successful connect to the respective mobile network and shall include at least 5 mobile networks.	Communication participant
Eu.PoS.428	Head	**4.5 General requirements for data networks**	--
Eu.PoS.1035	Info	Detailed requirements for data networks are governed by national specifications. EULYNX provides a Guideline for network architecture in [Eu.Doc.25].	--
Eu.PoS.4	Head	**5 Quality of Service**	--
Eu.PoS.405	Head	**5.1 General requirements**	--
Eu.PoS.426	Info	The Quality of Service (QoS) describes the quality of a communication service from the perspective of the communication participants, i.e. to what extent the quality of the service meets their requirements. QoS can be achieved by prioritising data traffic, reserving resources and limiting the data rate.	--
Eu.PoS.98	Req	The Subsystem - Communication System shall ensure that network channels with a higher QoS requirement are not displaced by network channels with a lower QoS requirement.	Subsystem - Communication System
Eu.PoS.97	Req	The Subsystem - Communication System shall fulfil an identified QoS requirement at the PoS-Signalling between two communication participants.	Subsystem - Communication System
Eu.PoS.96	Req	An appropriate performance analysis shall be performed (e.g. in accordance with measuring instruction [ITU-T Y.1564] for Ethernet transmission, [RFC 6349] for throughput measurement) to verify the required transmission characteristics (QoS) between two PoS-Signalling of communication participants. Note: The configuration tests of [ITU-T Y.1564] are not required.	Subsystem - Communication System
Eu.PoS.1079	Head	**5.2 Performance profiles**	--
Eu.PoS.1080	Info	Three performance profiles have been defined for the quality of service requirements.	--
Eu.PoS.1081	Info	The *standard wired profile* is meant for normal use of the PoS-Signalling.	--
Eu.PoS.1175	Info	The *high-performance wireless/radio profile* is meant for use of the PoS-Signalling with high-performance wireless/radio technology used inside the Subsystem - Communication and/or on the PoS-Signalling. Note: The reduced QoS performance has impact on the overall safety response time, which must be taken into account in a safety case for lines on which this profile is used.	--
Eu.PoS.1201	Info	The *high-performance wireless/radio profile* has a reduced performance regarding the packet loss rate. This may have impact on the reliability of the Process Data Interface. It is therefore recommended to only use this profile in combination with the variant of SCI-XX that uses TLS over TCP. If this profile is used in combination with the variant of SCI-XX that uses UDP, the impact on the reliability of the Process Data Interface must be taken into account in a safety case for lines on which this profile is used. Note: When using TCP, the higher packet loss rate is deemed acceptable, as TCP performs faster re-transmission than RaSTA.	--
Eu.PoS.1082	Info	The *low-performance/regional wireless/radio profile* is meant to enable the use of the PoS-Signalling also on regional lines with a very low traffic intensity where a coverage with a wired network or high performance wireless connection is not feasible. Its QoS requirements can be met using 2G radio connections. Note: The low QoS performance of this profile has an important impact on the overall safety response time, which must be taken into account in a safety case specifically targeted for lines with a very low traffic intensity.	--

ID	Type	Requirement	Valid for
Eu.PoS.1136	Info	If the specific conditions of very low traffic intensity are not met, the standard wired profile or high-performance wireless/radio profile should be applied. This is also valid when wireless/radio technology is used inside the Subsystem - Communication System.	--
Eu.PoS.1	Head	**5.3 QoS requirements**	--
Eu.PoS.1083	Info	The quality of service is defined by a set of requirements for the following aspects: - Data throughput according to CIR (committed information rate) in kbit/s - Data throughput according to PIR (peak information rate) in kbit/s - Delay - Packet loss rate - Priority	--
Eu.PoS.103	Req	Every communication participant shall define the following requirements in its specifications in order to guarantee various QoS parameters for an end-to-end network channel via the Subsystem - Communication System: - Data throughput according to CIR (committed information rate) in kbit/s - Data throughput according to PIR (peak information rate) in kbit/s The applicable values for CIR and PIR are defined in Eu.PoS.1085, Eu.PoS.1183 and Eu.PoS.1092 Note: The data throughput is symmetric, meaning the same QoS value is valid for both uplink and downlink, see also Eu.PoS.647.	Communication participant
Eu.PoS.1176	Req	Systems terminating multiple instances of SCI-XX/SDI-XX/SMI-XX/SSI-XX must be designed to handle the combined expected CIR and PIR throughput.	Communication participant
Eu.PoS.1177	Info	It is recommended to sum CIR and PIR for SCI-XX traffic. It is recommended to sum CIR for SDI-XX, SMI-XX and SSI-XX traffic. Note: It can be expected that SMI-XX and SSI-XX traffic will follow a traffic model and might not interfere.	--
Eu.PoS.1084	Head	**5.3.1 Standard wired profile**	--
Eu.PoS.1085	Head	**5.3.1.1 Data throughput**	--
Eu.PoS.1071	Req	The Subsystem - Communication System shall guarantee the following data throughput between the sender at a PoS-Signalling and the recipient at a PoS-Signalling:	Subsystem - Communication System
Eu.PoS.1072	Req	• The data throughput on each SCI-XX is: • Data throughput according to CIR (committed information rate) with 15 kbit/s. • Data throughput according to PIR (peak information rate) with 110 kbit/s.	Subsystem - Communication System
Eu.PoS.1073	Req	• The data throughput on each SDI-XX is: • Data throughput according to CIR (committed information rate) with 30 kbit/s. • Data throughput according to PIR (peak information rate) with 2 Mbit/s.	Subsystem - Communication System
Eu.PoS.1074	Req	• The data throughput on each SMI-XX: • Data throughput according to CIR (committed information rate) with 45 kbit/s. • Data throughput according to PIR (peak information rate) with 2 Mbit/s.	Subsystem - Communication System
Eu.PoS.1178	Req	• The data throughput on each SSI-XX: • Data throughput according to CIR (committed information rate) with 45 kbit/s. • Data throughput according to PIR (peak information rate) with 2 Mbit/s.	Subsystem - Communication System
Eu.PoS.11	Head	**5.3.1.2 Delay**	--
Eu.PoS.102	Req	The Subsystem - Communication System shall guarantee the following max. permitted delay between the sender at a PoS-Signalling and the recipient at a PoS-Signalling: Please note: The delay corresponds to the max. permitted telegram runtime in the end-to-end communication relationship between two PoS-Signalling interfaces.	Subsystem - Communication System
Eu.PoS.1063	Req	• The max. allowed delay on SCI-XX is 50 ms.	Subsystem - Communication System
Eu.PoS.1066	Req	• The max. allowed delay on SDI-XX is 250 ms.	Subsystem - Communication System
Eu.PoS.1064	Req	• The max. allowed delay on SMI-XX is 250 ms.	Subsystem - Communication System
Eu.PoS.1179	Req	• The max. allowed delay on SSI-XX is 250 ms.	Subsystem - Communication System

ID	Type	Requirement	Valid for
Eu.PoS.1086	Head	**5.3.1.3 Packet loss rate**	--
Eu.PoS.101	Req	The Subsystem - Communication System shall guarantee the following max. permitted probability of packet loss between two PoS-Signalling: Please note: The probability of packet loss corresponds to a max. permitted rate of packet loss in the end-to-end communication relationship between two PoS-Signalling interfaces within a period of 5 minutes.	Subsystem - Communication System
Eu.PoS.1067	Req	• The max. allowed packet loss rate between two PoS-Signalling during the communication on SCI-XX is < 1%.	Subsystem - Communication System
Eu.PoS.1070	Req	• The max. allowed packet loss rate between two PoS-Signalling during the communication on SDI-XX is < 5%.	Subsystem - Communication System
Eu.PoS.1068	Req	• The max. allowed packet loss rate between two PoS-Signalling during the communication on SMI-XX is < 5%.	Subsystem - Communication System
Eu.PoS.1180	Req	• The max. allowed packet loss rate between two PoS-Signalling during the communication on SSI-XX is < 5%.	Subsystem - Communication System
Eu.PoS.13	Head	**5.3.1.4 Priority**	--
Eu.PoS.1039	Req	Priority shall be regulated if there is a risk of critical traffic being displaced by non-critical traffic.	Subsystem - Communication System
Eu.PoS.1104	Req	Traffic on SCI-XX (priority 1) has higher priority than traffic on SSI-XX, SMI-XX and SDI-XX.	Subsystem - Communication System
Eu.PoS.1181	Req	Traffic on SSI-XX (priority 2) has higher priority than traffic on SMI-XX and SDI-XX.	Subsystem - Communication System
Eu.PoS.1105	Req	Traffic on SMI-XX (priority 3) has higher priority than traffic on SDI-XX.	Subsystem - Communication System
Eu.PoS.1182	Head	**5.3.2 High-performance wireless/radio profile**	--
Eu.PoS.1183	Head	**5.3.2.1 Data throughput**	--
Eu.PoS.1184	Req	The Subsystem - Communication System shall guarantee the following data throughput between the sender at a PoS-Signalling and the recipient at a PoS-Signalling:	Subsystem - Communication System
Eu.PoS.1185	Req	• The data throughput on each SCI-XX is: • Data throughput according to CIR (committed information rate) with 15 kbit/s. • Data throughput according to PIR (peak information rate) with 110 kbit/s.	Subsystem - Communication System
Eu.PoS.1186	Req	• The data throughput on each SDI-XX is: • Data throughput according to CIR (committed information rate) with 30 kbit/s. • Data throughput according to PIR (peak information rate) with 2 Mbit/s.	Subsystem - Communication System
Eu.PoS.1187	Req	• The data throughput on each SMI-XX: • Data throughput according to CIR (committed information rate) with 45 kbit/s. • Data throughput according to PIR (peak information rate) with 2 Mbit/s.	Subsystem - Communication System
Eu.PoS.1188	Req	• The data throughput on each SSI-XX: • Data throughput according to CIR (committed information rate) with 45 kbit/s. • Data throughput according to PIR (peak information rate) with 2 Mbit/s.	Subsystem - Communication System
Eu.PoS.1189	Head	**5.3.2.2 Delay**	--
Eu.PoS.1190	Req	The Subsystem - Communication System shall guarantee the following max. permitted delay between the sender at a PoS-Signalling and the recipient at a PoS-Signalling: Please note: The delay corresponds to the max. permitted telegram runtime in the end-to-end communication relationship between two PoS-Signalling interfaces.	Subsystem - Communication System
Eu.PoS.1191	Req	• The max. allowed delay on SCI-XX, SDI-XX, SMI-XX and SSI-XX is 250 ms.	Subsystem - Communication System
Eu.PoS.1192	Head	**5.3.2.3 Packet loss rate**	--
Eu.PoS.1193	Req	The Subsystem - Communication System shall guarantee the following max. permitted probability of packet loss between two PoS-Signalling: Please note: The probability of packet loss corresponds to a max. permitted rate of packet loss in the end-to-end communication relationship between two PoS-Signalling interfaces within a period of 5 minutes.	Subsystem - Communication System

ID	Type	Requirement	Valid for
Eu.PoS.1194	Req	• The max. allowed packet loss rate between two PoS-Signalling during the communication on SCI-XX, SDI-XX, SMI-XX and SSI-XX is < 5%.	Subsystem - Communication System
Eu.PoS.1195	Head	**5.3.2.4 Priority**	--
Eu.PoS.1196	Req	Priority shall be regulated if there is a risk of critical traffic being displaced by non-critical traffic.	Subsystem - Communication System
Eu.PoS.1197	Req	Traffic on SCI-XX (priority 1) has higher priority than traffic on SSI-XX, SMI-XX and SDI-XX.	Subsystem - Communication System
Eu.PoS.1198	Req	Traffic on SSI-XX (priority 2) has higher priority than traffic on SMI-XX and SDI-XX.	Subsystem - Communication System
Eu.PoS.1199	Req	Traffic on SMI-XX (priority 3) has higher priority than traffic on SDI-XX.	Subsystem - Communication System
Eu.PoS.1091	Head	**5.3.3 Low-performance wireless/radio profile**	--
Eu.PoS.1092	Head	**5.3.3.1 Data throughput**	--
Eu.PoS.1093	Req	The Subsystem - Communication System shall guarantee the following data throughput between the sender at a PoS-Signalling and the recipient at a PoS-Signalling:	Subsystem - Communication System
Eu.PoS.1094	Req	The data throughput on each SCI-XX, SDI-XX, SMI-XX and SSI-XX is: • Data throughput according to CIR (committed information rate) with 4 kbit/s. • Data throughput according to PIR (peak information rate) with 13,4 kbit/s.	Subsystem - Communication System
Eu.PoS.1095	Head	**5.3.3.2 Delay**	--
Eu.PoS.1096	Req	The Subsystem - Communication System shall guarantee the following max. permitted delay between the sender at a PoS-Signalling and the recipient at a PoS-Signalling: Please note: The delay corresponds to the max. permitted telegram runtime in the end-to-end communication relationship between two PoS-Signalling interfaces.	Subsystem - Communication System
Eu.PoS.1097	Req	• The max. allowed delay on SCI-XX, SDI-XX, SMI-XX and SSI-XX is 1300 ms.	Subsystem - Communication System
Eu.PoS.1098	Head	**5.3.3.3 Packet loss rate**	--
Eu.PoS.1099	Req	The Subsystem - Communication System shall guarantee the following max. permitted probability of packet loss between two PoS-Signalling: Please note: The probability of packet loss corresponds to a max. permitted rate of packet loss in the end-to-end communication relationship between two PoS-Signalling interfaces within a period of 5 minutes.	Subsystem - Communication System
Eu.PoS.1100	Req	• The max. allowed packet loss rate between two PoS-Signalling during the communication on SCI-XX, SDI-XX, SMI-XX and SSI-XX is < 1%.	Subsystem - Communication System
Eu.PoS.1109	Head	**5.3.3.4 Priority**	--
Eu.PoS.1110	Info	In the regional/radio performance profile it is not required to regulate priority between critical and non-critical traffic.	--
Eu.PoS.1135	Info	In the regional/radio profile, it is not required to use separation or QoS marking to manage the differences in quality of service of the process data interface, maintenance interface, diagnostics interface and security interface.	--
Eu.PoS.12	Head	**5.4 Availability**	--
Eu.PoS.76	Info	The mean availability of the PoS-Signalling is calculated as follows: Availability = [MTBF / (MTBF + MDT)] * 100% MTBF = Mean time between failures MDT = Mean down time	--
Eu.PoS.75	Info	The calculation method of the MTBF shall be defined by national specifications.	--
Eu.PoS.81	Info	The operating period is the time when the PoS-Signalling is available to perform its specified function outside of any scheduled downtime. Scheduled downtime is not included in the MTBF or availability calculations.	--
Eu.PoS.78	Info	A failure means that the PoS-Signalling no longer conforms with the desired QoS requirements.	--
Eu.PoS.77	Req	A Subsystem - Communication System failure shall be rectified through maintenance or repair within a MDT on average in order to guarantee the required mean availability.	Subsystem - Communication System
Eu.PoS.1058	Info	The required mean availability shall be defined by national specifications.	--

ID	Type	Requirement	Valid for
Eu.PoS.72	Info	The network components are not defined by mean availability, but by the MTBF of the components and the design stipulations.	--
Eu.PoS.70	Req	The network components shall be considered in terms of how they interact and shall be able to achieve the availability assigned to them independently of one another.	Subsystem - Communication System
Eu.PoS.10	Head	**5.5 Reliability**	--
Eu.PoS.20	Req	For communication via SCI-XX, the Subsystem - Communication System shall provide a redundant pair of network channels between two communication participants that have a redundant implementation of PoS-Signalling. If a component (or a physical connection) in a path between the redundantly configured PoS-Signalling fails, the logical connections between communication participants are not interrupted. Please note: The failure of an active component (or a physical connection) does not interrupt communication between communication participants at redundantly configured PoS-Signalling. The logical connection between communication participants is guaranteed for an individual failure. This requires the communication participant to have a redundancy function.	Subsystem - Communication System
Eu.PoS.21	Req	For communication via SMI-XX, SDI-XX and SSI-XX, the Subsystem - Communication System shall provide a network channel between two communication participants at the PoS-Signalling. If a component (or a physical connection) fails, the logical connection between communication participants may be interrupted. Please note: The failure of an active component (or a physical connection) interrupts all logical connections between communication participants at the PoS-Signalling.	Subsystem - Communication System
Eu.PoS.1118	Info	Alternatively, for communication via SMI-XX, SDI-XX and SSI-XX, the Subsystem - Communication System may provide a redundant pair of network channels between two communication participants at the PoS-Signalling. If a component (or a physical connection) fails, the logical connection between communication participants may be interrupted. This connection shall be re-established by the communication participants by switching to the alternative network channel. Please note: The failure of an active component (or a physical connection) temporarily interrupts all logical connections between communication participants at the PoS-Signalling.	--
Eu.PoS.15	Req	Hardware failures of the redundant network channels of the Subsystem - Communication System shall not give rise to a common cause failure of network components.	Subsystem - Communication System