Document Title	Requirements on Communication
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	2

Document Status	published
Part of AUTOSAR Standard	Classic Platform
Part of Standard Release	R23-11

Document Change History

Date	Release	Changed by	Description
2023-11-23	R23-11	AUTOSAR Release Management	• Editorial changes
2022-11-24	R22-11	AUTOSAR Release Management	• Editorial changes
2021-11-25	R21-11	AUTOSAR Release Management	• Removed I-PDU counter and I-PDU replication • Added support for independent development of CP Software Clusters
2020-11-30	R20-11	AUTOSAR Release Management	• No content changes
2019-11-28	R19-11	AUTOSAR Release Management	• No content changes • changed Document Status from Final to published
2018-10-31	4.4.0	AUTOSAR Release Management	• editorial changes
2017-12-08	4.3.1	AUTOSAR Release Management	• editorial changes
2016-11-30	4.3.0	AUTOSAR Release Management	• restricted I-PDU groups to contain only PDUs with the same direction • minor corrections / clarifications / editorial changes; For details please refer to the ChangeDocumentation

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2014-10-31	4.2.1	AUTOSAR Release Management	• added support for Large Data COM • added support for Sender/ Receiver Serialization • updated to support CAN FD
2014-03-31	4.1.3	AUTOSAR Release Management	• editorial changes
2013-03-15	4.1.1	AUTOSAR Administration	• Formal updates • Updates with respect to the requirement tracing
2011-12-22	4.0.3	AUTOSAR Administration	• several minor changes and bug-fixes • clarification and minor extensions of transmission mode usage and activation • clarification and extension of transfer properties • added retry mechanism for failed transmission requests
2010-09-30	3.1.5	AUTOSAR Administration	• Added support for large data types • Added support for communication protection • Revised mode management interface • Legal disclaimer revised
2008-08-13	3.1.1	AUTOSAR Administration	• Legal disclaimer revised
2007-12-21	3.0.1	AUTOSAR Administration	• Document meta information extended • Small layout adaptations made
2007-01-24	2.1.15	AUTOSAR Administration	• updated signal group definition • "Advice for users" revised • "Revision Information" added • Legal disclaimer revised
2006-05-16	2.0	AUTOSAR Administration	• Requirements for Transmission Modes changed, • nearly all requirements slightly changed
2005-05-31	1.0	AUTOSAR Administration	• Initial release

Disclaimer

Contents

1 Scope of Document

The following specification is to define the functional and non-functional requirements on the modules AUTOSAR COM and LargeDataCOM.

This Software Requirement Specification (SRS) of AUTOSAR COM is based on the [1] and only defines add-ons to this ISO specification or different behavior.

The location of the AUTOSAR COM and LargeDataCOM modules within the whole AUTOSAR ECU SW Architecture is defined in [2].

The focus of this document is to specify:

- the behavior of the AUTOSAR COM and LargeDataCOM
- the interfaces of the AUTOSAR COM and LargeDataCOM
- the input of the generator and its configuration input
- the rules to check the consistency of the configuration input

The focus is NOT to specify:

- The editor and the rule checker for the input of the AUTOSAR COM and LargeDataCOM modules implementation. However the rule checker must use the rules for the configuration in/out defined by [3] and [4].

Constraints

First scope for specification of requirements on basic software modules is systems which are not safety relevant. For this reason safety requirements are assigned to medium priority.

2 Conventions to be used

2.1 Document Conventions

The representation of requirements in AUTOSAR documents follows the table specified in [TPS_STDT_00078], see Standardization Template, chapter Support for Traceability ([5]).

The verbal forms for the expression of obligation specified in [TPS_STDT_00053] shall be used to indicate requirements, see Standardization Template, chapter Support for Traceability ([5]).

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as follows.

Note that the requirement level of the document in which they are used modifies the force of these words.

- MUST: This word, or the adjective "LEGALLY REQUIRED", means that the definition is an absolute requirement of the specification due to legal issues.
- MUST NOT: This phrase, or the phrase "MUST NOT", means that the definition is an absolute prohibition of the specification due to legal issues.
- SHALL: This phrase, or the adjective "REQUIRED", means that the definition is an absolute requirement of the specification.
- SHALL NOT: This phrase means that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective "RECOMMENDED", means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED", means that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
- MAY: This word, or the adjective "OPTIONAL", means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item.

An implementation, which does not include a particular option, SHALL be prepared to interoperate with another implementation, which does include the option, though perhaps with reduced functionality. In the same vein an implementation, which does include a particular option, SHALL be prepared to interoperate with another implemen-

tation, which does not include the option (except, of course, for the feature the option provides.)

2.2 Requirement structure

The requirement structure is defined in TPS_STDT_00077.

3 Acronyms and abbreviations

The glossary below includes acronyms and abbreviations relevant to SRS COM that are not included in the AUTOSAR Glossary [6].

Abbreviation / Acronym:	Description:
I-PDU	Interaction Layer Protocol Data Unit (assembled and disassembled in AUTOSAR COM), consists of one or more signals (see below and [2]).
I-PDU group	An I-PDU Group is an arbitrary collection of I-PDUs of the same direction (i.e. send or receive) in COM
LOM	Listen Only Mode
L-PDU	Data Link Layer Protocol Data Unit (assembled and disassembled in AUTOSAR Hardware Abstraction layer, see [2]).
signal	A signal in the AUTOSAR COM context is equal to a message in [1]. An AUTOSAR signal is carried by one or more signals in COM. The transformation from an AUTOSAR signal to a signal in COM is carried out by the RTE. Typically the transformation preserves the syntax of the data. However, in the case of complex data types the transformation may change the syntax of the signal. Therefore a signal in AUTOSAR COM is not always the same as an AUTOSAR signal.
signal group	A signal group refers to a set of signals that must always be kept together in a common I-PDU. A Signal group is used to guarantee the consistent transfer of AUTOSAR composite data types. A signal group has the following properties: • A signal can belong to at most one signal group • A signal group can not belong to more than exactly one I-PDU • Signal groups do not overlap each other within an I-PDU • Signal groups are a contiguous set of signals which belong to this group, however it is possible to have unused bits ("holes") within a group. • Signal groups may contain no signals ("may be empty"). The grouping of signals to signal groups is assumed to be provided as an input for the COM generation process.

Table 3.1: Acronyms and abbreviations used in the scope of this Document

4 Requirements Specification

This chapter describes all requirements driving the work to define the AUTOSAR COM and LargeDataCOM.

4.1 Functional Overview

The AUTOSAR COM and LargeDataCOM are located between RTE and the PDU Router.

Main-Features of AUTOSAR COM are:

- provision of signal oriented data interface for its users (e.g. RTE [7], SwCluC-ComProxy [8])
- communication transmission control (start/stop of I-PDU groups)
- sending of signals according to transmission type as specified in the VFB specification
- guarantee of minimum distances between transmission requests
- monitoring of receive signals (signals timeout)
- monitoring of transmit confirmations
- filter mechanisms for incoming signals
- different notification mechanisms
- provision of initialization-values and update-Indications
- endianness conversion + sign extension
- packing and unpacking of AUTOSAR signals to I-PDUs to be transmitted
- supporting large and dynamical length data types

Main-Features of AUTOSAR LargeDataCOM are:

- provision of dedicated signal oriented data interface for its users (e.g. RTE, SwCluCLdComProxy)
- support of large and dynamic signals
- supports just one signal per I-PDU
- supports just opaque byte arrays
- support of IF- and TP-communication

4.2 Functional Requirements applicable for AUTOSAR COM and LargeDataCOM

4.2.1 Configuration

The chapter Configuration deals with the configurable parameters / functionalities of the AUTOSAR COM and LargeDataCOM.

This chapter deals only with general configuration requirements, the requirements for configuration of a single feature are defined within the requirement of the feature itself.

[SRS_Com_02040] AUTOSAR COM and LargeDataCOM shall be configured by using XML as configuration language ⌈

Description:	AUTOSAR COM and LargeDataCOM shall be configured by using XML as configuration language as defined by ECU Configuration Template. It is up to the [3] and [4] to define the configuration parameters themselves.
Rationale:	Having a unique configuration language within AUTOSAR.
Use Case:	Configuration of AUTOSAR COM and LargeDataCOM
Dependencies:	–
Supporting Material:	[9]

⌋(*RS_BRF_01616*, *RS_BRF_01544*)

[SRS_Com_00177] AUTOSAR COM and LargeDataCOM shall support multiple configuration stages ⌈

Description:	AUTOSAR COM and LargeDataCOM shall allow the configuration of communication at the following different stages: • Pre-Compile-Time • Link Time • Post-build-Time – Load-able Configuration – Multiple configuration sets The configuration parameters must be organized in a way to be able to be changed in all the different stages, e.g. one OEM might select to configure pre-compile time while another will configure post-build time. The concrete set of parameters which are configurable in which state shall be defined in [3].
Rationale:	Guarantee flexibility of using the AUTOSAR COM and LargeDataCOM.
Use Case:	It must be possible to configure the handled bus frames after compile- or build-time, for example when reusing an ECU within another vehicle product line with different and incompatible communication layouts.

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Dependencies:	–
Supporting Material:	–

⌋(*RS_BRF_01544*, *RS_BRF_01120*)

[SRS_Com_02067] AUTOSAR COM and LargeDataCOM shall define rules for checking the consistency of configuration data ⌈

Description:	A set of rules needs to be specified that enable the Configuration Editor to reject inconsistent configurations or configurations that cannot be implemented. These rules shall be defined in the SWS and shall be implemented by the Configuration Editor.
Rationale:	Needed to make sure that the generator only works with correct configuration files.
Use Case:	The configuration must not contain overlapping signals within one I-PDU. The period of I-PDUs must not be negative.
Dependencies:	–
Supporting Material:	–

⌋(*RS_BRF_01544*)

4.2.2 Interface between AUTOSAR COM and LargeDataCOM and the lower layer (PDU-Router)

[1] leaves the interface between COM and the lower layers undefined. In AUTOSAR the only lower layer that COM and LargeDataCOM interfaces to is the PDU Router. The interfaces refer to the definitions in [10]. The requirements are derived from [10].

[SRS_Com_02043] AUTOSAR COM and LargeDataCOM shall provide a receive indication function ⌈

Description:	AUTOSAR COM and LargeDataCOM shall provide a function that is called by the lower layer (PDU-Router) after an I-PDU has been received. The name of the function has to be Com_RxIndication for COM and LdCom_RxIndication for LargeDataCOM.
Rationale:	Basic functionality of a communication layer
Use Case:	Receiving a PDU by the lower layer
Dependencies:	–
Supporting Material:	[10]

⌋(*RS_BRF_01056*, *RS_BRF_01544*)

[SRS_Com_02044] AUTOSAR COM and LargeDataCOM shall provide a transmit confirmation function ⌈

Description:	AUTOSAR COM and LargeDataCOM shall provide a function that is called by the lower layer (PDU-Router) after an I-PDU has been transmitted on the network. The name of the function has to be Com_TxConfirmation for COM and LdCom_TxConfirmation for LargeDataCOM.
Rationale:	Basic functionality of a communication layer
Use Case:	Transmitting a PDU on the network.
Dependencies:	–
Supporting Material:	[10]

⌋*(RS_BRF_01544, RS_BRF_01072)*

[SRS_Com_02045] AUTOSAR COM and LargeDataCOM shall provide a function to request the transmit buffer data for lower layer triggered transmission ⌈

Description:	AUTOSAR COM and LargeDataCOM shall provide a function that is called by the lower layer (PDU-Router) when an I-PDU shall be transmitted. Within this function, AUTOSAR COM and LargeDataCOM shall copy the contents of its I-PDU transmit buffer to the L-PDU buffer given by the calling layer. The name of the function has to be Com_TriggerTransmit for COM and LdCom_TriggerTransmit for LargeDataCOM.
Rationale:	Basic functionality of a communication layer
Use Case:	This function is used e.g. by the LIN Master for sending out a LIN frame. In this case, the trigger transmit can be initiated by the Master schedule table it self or a received LIN header. This function is also used by the FlexRay Interface for requesting PDUs to be sent in the static part (synchronous to the FlexRay global time).
Dependencies:	–
Supporting Material:	[10]

⌋*(RS_BRF_01544)*

4.2.3 Support of Large Data Types

AUTOSAR COM and LargeDataCOM shall support signals larger than the N-PDUs of the underlying busses. For these large signals also a dynamic length shall be supported. The requirements of this chapter define the support of these data types.

[SRS_Com_02091] AUTOSAR COM and LargeDataCOM shall not support splitting of large signals into different I-PDUs ⌈

Description:	Large signals supported by AUTOSAR COM and LargeDataCOM shall never be split into different I-PDUs, but it shall be supported that an I-PDU can be split into different N-PDUs
Rationale:	The I-PDU shall be transported by the TP. The TP will work on N-PDU level, and therefore can fragment the I-DPU into a number of N-PDUs
Use Case:	There is no use-case to have fragmentation on I-PDU level.
Dependencies:	[SRS_Com_02092], [SRS_Com_02093]
Supporting Material:	–

⌋*(RS_BRF_01648, RS_BRF_01568, RS_BRF_01544)*

[SRS_Com_02094] Dynamic length signals must be of type UINT8n ⌈

Description:	AUTOSAR COM and LargeDataCOM shall only support dynamic length signals of type UINT8[n].
Rationale:	It would be possible to also add support for bit length dynamical length signals, but this will introduce unnecessary complexity
Use Case:	This restriction is made because actually there is no strong use-case that requires non byte-array data for large signals.
Dependencies:	[SRS_Com_02091], [SRS_Com_02092], [SRS_Com_02093]
Supporting Material:	[11]

⌋*(RS_BRF_01648, RS_BRF_01544)*

[SRS_Com_02095] AUTOSAR COM and LargeDataCOM shall use the TP to fragment and reassemble large signals ⌈

Description:	All large signals must be transported using the TP. Note that large signals does not mean "normal signals" (e.g. UINT8[n] type). Therefore AUTOSAR COM and LargeDataCOM shall route all large signals via the PduR to the underlying TPs using the PduR's TP-APIs. Note: Signals with static length and equal or less length than 8 bytes are transported in L-PDUs on CAN and LIN. In case of CAN FD this range is extended up to 64 bytes. On FlexRay this is valid for signals with length equal to or less than 254 bytes. Also dynamic length signals may be transported without TP as long as the maximum length does not exceed the bus specific limits.
Rationale:	There is no need to reinvent fragmentation since the existing TP modules already supports this.

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Use Case:	For CAN TP it is no problem to have multiple users (DCM and COM) of the TP. On LIN TP there will be a problem sharing the TP since all TP communication is done through two specific (specified by LIN) frames. A workaround may be to use a specific NAD to differ between diagnostic communication and normal signal communication (containing large signal or dynamic length signal). For FlexRay TP it is no problem to have multiple users (DCM and COM) of the TP.
Dependencies:	[SRS_Com_02096]
Supporting Material:	–

⌋(*RS_BRF_01648*, *RS_BRF_01544*)

[SRS_Com_02097] AUTOSAR COM and LargeDataCOM shall support dynamical signals with a static maximum length ⌈

Description:	The maximum length of this type of signal must be set in the configuration
Rationale:	If not given all dynamic length signals can only be considered to be maximum length supported by the used TP and therefore buffers cannot be handled efficient.
Use Case:	If LIN is used and if not maximum length is given, it must be assumed that the dynamical length signal is 4095 bytes.
Dependencies:	[SRS_Com_02098]
Supporting Material:	–

⌋(*RS_BRF_01648*, *RS_BRF_01544*)

4.2.4 CP Software Clusters

[SRS_Com_02114] AUTOSAR COM and LargeDataCOM shall support independent development of CP Software Clusters ⌈

Description:	The AUTOSAR COM and LargeDataCOM modules support independent and flexible implementation of CP Software Clusters. So it shall be possible to add/remove/change Signals without the need to rebuild the Software Cluster(s) in which they are used.
Rationale:	–
Use Case:	Change of Ids w.r.t LdComIPdus/Com(Signal)Groups in Host Software Clusters without rebuild of the Application Software Cluster.
Dependencies:	–
Supporting Material:	–

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4.3 AUTOSAR COM specific functional requirements

4.3.1 General requirements

[SRS_Com_02037] AUTOSAR COM module shall be based on the functionality and APIs of ISO-17356-4 ⌈

Description:	The AUTOSAR COM module shall be based on the functionality and APIs specified in [1]. Specifications not done there, respectively specifications of functionality different from that specified in the above mentioned document shall be defined in the AUTOSAR COM SRS and SWS specifications. Features of [1] which are not provided by the AUTOSAR COM module shall be defined in [3].
Rationale:	This SRS is only an add-on to [1] as an existing standard.
Use Case:	–
Dependencies:	–
Supporting Material:	[11], [1]

⌋(*RS_BRF_01544*)

[SRS_Com_02078] The AUTOSAR COM module shall support endianness conversion ⌈

Description:	The AUTOSAR COM module shall support endianness conversion for the following data types defined in [7] Table "C/C++ mapping from primitive AUTOSAR data-types" • uint16 • uint32 • sint16 • sint32 • float32 • float64
Rationale:	ensure end to end data consistency
Use Case:	–
Dependencies:	–
Supporting Material:	[12], [7]

⌋(*RS_BRF_01624*)

[SRS_Com_02086] The AUTOSAR COM module shall support sign-extension ⌈

Description:	Sign-Extension means, to map negative values of signed signals correctly, if the bit-size of the signal in an I-PDU received and the bit-size of the signal used in the interface of the receiving software component differ from each other. In this case, the size of the signal received shall be extended to the size of the receiver interface. The AUTOSAR COM module shall support Sign-Extension for the following data types defined in [7] Table "C/C++ mapping from primitive": • sint8 • sint16 • sint32
Rationale:	ensure end to end data consistency
Use Case:	–
Dependencies:	–
Supporting Material:	[12], [7]

⌋*(RS_BRF_01624)*

4.3.2 Initialization

[SRS_Com_02042] The AUTOSAR COM module shall fill unused areas/ bits within an I-PDU with a configurable value ⌈

Description:	The AUTOSAR COM module shall fill unused areas/ bits within an I-PDU with a configurable value (e.g. 0xFF). This value shall be configurable per I-PDU.
Rationale:	Limit impact of a wrong configuration, if a not used area of an I-PDU is wrongly assigned to a signal this can be detected by the application SW component.
Use Case:	For error detection purposes, all data values must be filled with a defined value.
Dependencies:	–
Supporting Material:	–

⌋*(RS_BRF_01616, RS_BRF_01544)*

4.3.3 Signal and I-PDU Transmission

This chapter deals with the add-ons to [1] related to signal and I-PDU transmission.

[SRS_Com_02083] The AUTOSAR COM module shall support multiple transmission modes ⌈

Description:	The AUTOSAR COM module shall provide the transmission modes given in the following tabular for each I-PDU. It shows the transmission modes available and a short description of those transmission modes. • **Periodic:** Transmissions occur indefinitely with a fixed period between them. • **Direct / n-times:** Event driven transmission with n-1 repetitions • **Mixed:** Periodic transmission with direct/n-times transmissions in between • **None:** No transmission
Rationale:	These modes are commonly used by all existing automotive bus systems.
Use Case:	–
Dependencies:	[SRS_Com_02082], [SRS_Com_02084], [SRS_Com_02080]
Supporting Material:	Transmission modes "periodic", "mixed" are the same as already defined in [1]. See also Use Cases in [11].

⌋*(RS_BRF_01592, RS_BRF_01544)*

[SRS_Com_02082] The AUTOSAR COM module shall support defining two different transmission modes for each I-PDU ⌈

Description:	The AUTOSAR COM module shall provide the possibility to define two different transmission modes for each I-PDU. This shall also include the situation where only the parameters of a transmission mode are changed, e.g. different cycle times. It shall be possible to switch between both Transmission Modes during runtime.
Rationale:	This is commonly used by many existing automotive bus systems.
Use Case:	–
Dependencies:	[SRS_Com_02083], [SRS_Com_02084], [SRS_Com_02080]
Supporting Material:	–

⌋*(RS_BRF_01544, RS_BRF_01592)*

[SRS_Com_02084] The AUTOSAR COM module shall support a configurable signal data based selection mechanism of the two transmission modes ⌈

Description:	To select one of the two transmission modes, the AUTOSAR COM module shall provide the possibility to attach a condition to each signal within an I-PDU separately. The possibilities to define those conditions shall be the same as defined in [1] reception filter algorithms (see [1], Section 3.2.3). If all conditions defined for signals within one specific I-PDU evaluate to TRUE, one transmission mode shall be used for this I-PDU. In all other cases, the other transmission mode shall be used. The conditions shall be evaluated immediately every time a related signal or signal group is sent by RTE and the new transmission request shall be sent using the new transmission mode already.
Rationale:	These modes are commonly used by many existing automotive bus systems.
Use Case:	–
Dependencies:	[SRS_Com_02082], [SRS_Com_02083], [SRS_Com_02080]
Supporting Material:	–

⌋*(RS_BRF_01592, RS_BRF_01544)*

[SRS_Com_02113] AUTOSAR COM shall support signal data based transmission modes for configured serialized data ⌈

Description:	The functionality of signal data based selection mechanism of the two transmission modes (see SRS_Com_02084) shall also be available when the data is provided via the uint8-array based API (see [SRS_Com_02112]).
Rationale:	When the serialization of the data is done outside of the Com module and the uint8-array representation is passed to Com the transmission modes need to be selected as well.
Use Case:	Usage of transformer with Com-based serialization and Com Interaction to enable the communication with a fixed communication matrix.
Dependencies:	[SRS_Com_02082], [SRS_Com_02083], [SRS_Com_02084], [SRS_Com_02112]
Supporting Material:	–

⌋*(RS_BRF_01544, RS_BRF_01560, RS_BRF_01592, RS_BRF_01632)*

[SRS_Com_02080] The AUTOSAR COM module shall cancel outstanding repetitions in case of a new send request ⌈

Description:	A new send request called while existing repetitions are in progress shall cancel those outstanding repetitions and the transmission shall be started with the new signal/signal group.
Rationale:	These modes are commonly used by many existing automotive bus systems.
Use Case:	–
Dependencies:	[SRS_Com_02082], [SRS_Com_02083], [SRS_Com_02084]

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Supporting Material:	–

⌋(*RS_BRF_01544*)

[SRS_Com_02046] The AUTOSAR COM module shall support immediate and deferred signal based notification to its users (e.g. RTE, SwCluCComProxy) ⌈

Description:	It shall be configurable whether the signal based notification to its users is done either immediately within the I-PDU RxIndication/ TxConfirmation made by the PduRouter or is deferred to the COM main function context.
Rationale:	To allow unpacking of signals in interrupt and polled modes
Use Case:	Unpacking of signals out of an I-PDU
Dependencies:	–
Supporting Material:	UML diagram: • Polling Mode only in Com (R3b-R1a-R1a) and • Interrupt mode (R1b-R1a-R1a) (For decryption of the codes in brackets refer to UML Model)

⌋(*RS_BRF_01544*)

[SRS_Com_02089] The AUTOSAR COM module shall provide two configurable options to handle signal timeouts ⌈

Description:	Receiver-side the AUTOSAR COM module shall provide two (configurable) options if a signal timeout is detected • Indication to its users (RTE, SwCluCComProxy) -> AUTOSAR Software Component can use "spare values" • No indication to its users (RTE, SwCluCComProxy)
Rationale:	The Com Users (RTE, SwCluCComProxy) shall have the opportunity to notify their environments about timeouts or the application shall be provided with a default value to avoid using outdated values.
Use Case:	see rationale
Dependencies:	–
Supporting Material:	–

⌋(*RS_BRF_01600*)

4.3.4 Signal invalidation

[SRS_Com_02077] The AUTOSAR COM module shall support invalidation of signals at sender side ⌈

Description:	It shall be possible for the Com Users (RTE, SwCluCComProxy) on sender side to indicate that they are not able to provide a valid value (e.g. sensor is faulty). This shall be done by writing a per signal configurable invalid value (outside of the range of the valid values) into the I-PDU which is handled like a valid value in the further processing. Therefore a special API shall be provided on the sender side AUTOSAR COM module.
Rationale:	The AUTOSAR Software Component shall have (via the RTE and / or SwCluCComProxy) the opportunity to notify its environment about reduced functionality (e.g. sensor is faulty).
Use Case:	See rationale, Starting a fail-safe routine if a sensor is broken.
Dependencies:	[SRS_Com_02079]
Supporting Material:	–

⌋*(RS_BRF_01544)*

[SRS_Com_02079] The AUTOSAR COM module shall support an optional notification when receiving invalidated data ⌈

Description:	Receiver-side the AUTOSAR COM module shall provide two (configurable) options if a sender indicates that it is not able to provide a valid value • Indication to its users (RTE, SwCluCComProxy) -> AUTOSAR Software Component can use "spare values" • No indication to its users (RTE, SwCluCComProxy)
Rationale:	The RTE shall have the opportunity to notify its environment about reduced functionality (e.g. sensor is faulty)
Use Case:	See rationale, Starting a fail-safe routine if a sensor is broken.
Dependencies:	[SRS_Com_02077], [SRS_Com_02087]
Supporting Material:	–

⌋*(RS_BRF_01544)*

[SRS_Com_02087] The AUTOSAR COM module shall support an optional substitution of received invalidated data ⌈

Description:	In case a signal is invalidated on sender-side and the receiver-side is configured in that way, that no indication is given to the upper layer, the AUTOSAR COM module shall substitute the invalid value by the init value. Whether this substitution takes place shall be configurable.
Rationale:	It shall be possible to provide the application with a configurable value in case the signal value received is invalid and no indication is given up to the upper layer.
Use Case:	See rationale
Dependencies:	[SRS_Com_02077], [SRS_Com_02079]
Supporting Material:	–

⌋*(RS_BRF_01544)*

[SRS_Com_02088] The AUTOSAR COM module shall support substituting the last received value by the init value in case of a signal timeout ⌈

Description:	In case a signal timeout is configured in that way, that no indication is given to the upper layer, the AUTOSAR COM module shall substitute the last received value by the init value. Whether this substitution takes place shall be configurable.
Rationale:	It shall be possible to provide the application with a configurable value in case of a signal timeout and no indication is given up to the upper layer.
Use Case:	see rationale
Dependencies:	–
Supporting Material:	–

⌋*(RS_BRF_01600)*

4.3.5 I-PDU Groups and Mode Changes

This chapter collects the requirements for the definition and starting / stopping of I-PDU groups.

[SRS_Com_02090] The AUTOSAR COM module shall define a data-structure allowing efficiently starting and stopping of I-PDU groups ⌈

Description:	The AUTOSAR COM module shall define a data-structure that allows efficiently • starting and stopping of transmission and reception of multiple I-PDU groups • enabling or disabling the reception deadline monitoring of multiple I-PDU groups The maximum number of I-PDU groups within one ECU shall be compile time configurable. Conceptually and per configuration it shall be allowed that one I-PDU group contains arbitrary other I-PDU groups containing I-PDUs of the same direction (i.e. send or receive).
Rationale:	To allow efficient mode changes, especially with respect to the AMM/ VMM concept, it is required to change the state of multiple I-PDU groups within one function call to the AUTOSAR COM module. The arbitrary nesting of I-PDU groups is no problem, since this can be resolved by the configuration tool, thus that each I-PDU only has to store an I-PDU group vector that declares to which I-PDU group it belongs.
Use Case:	AMM/VMM
Dependencies:	[SRS_Com_00218], [SRS_Com_00192]
Supporting Material:	–

⌋*(RS_BRF_01544)*

[SRS_Com_00218] The AUTOSAR COM module shall support starting and stopping multiple I-PDU groups during runtime ⌈

Description:	The AUTOSAR COM module shall be able to start and to stop sending and receiving for multiple I-PDU groups during runtime. The corresponding API to this service shall take an I-PDU group vector reflecting the new state as input parameter. The minimum delay time and deadline monitoring shall be respected for started groups of I-PDUs. It shall be parameter driver if the corresponding timers of the I-PDUs shall be reset or not. After a reset of the AUTOSAR COM module (normally reset of the ECU) all I-PDUs are stopped per default.
Rationale:	[1] can only start/ stop communication (StartCOM and StopCOM services) as a whole. Such a limitation is too restrictive.

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Use Case:	Such configurable groups of I-PDUs provide for example the possibility to disable the transmission of all I-PDUs on a single channel, and enable only their reception (Silent Mode). Such configurable groups of I-PDUs provide for example the possibility to start/ stop communication per logical channel of a single channel (e.g. FlexRay applications). Start sending and receiving on the body domain (e.g. use of the radio and multi-function screen), while powertrain is not still powered on. Stop the transmission of I-PDUs but not the reception when bus load is too high. This feature is also needed for Bus Off handling.
Dependencies:	[SRS_Com_00192], [SRS_Com_02090]
Supporting Material:	–

⌋(*RS_BRF_01544*)

[SRS_Com_00192] The AUTOSAR COM module shall support enabling and disabling reception deadline monitoring of I-PDU groups ⌈

Description:	The AUTOSAR COM module shall provide the functionality to enable and disable reception deadline monitoring for multiple configurable I-PDU groups. The corresponding API to this service shall take an I-PDU group vector reflecting the new state as input parameter. After a reset of the AUTOSAR COM module (normally reset of the ECU), the configured state (enabled/ disabled) shall be active.
Rationale:	This is needed to suppress wrong error handling in Listen Only Mode (LOM, see use case). It is assumed that at least a second ECU on the same channel is also in LOM and does not provide the expected signals to the first one.
Use Case:	For the LOM the transmission of all I-PDU groups is switched off, reception (maybe of only one I-PDU group) is still active but without supervision of the reception timeouts (reception deadline monitoring). For example all ECUs on one channel (e.g. on CAN network) are in LOM, so there are no more periodic send signals on this channel, but the ECU has to be able to receive changes of the ECU state management.
Dependencies:	[SRS_Com_00218], [SRS_Com_02090]
Supporting Material:	–

⌋(*RS_BRF_01544*)

4.3.6 Packing signals into I-PDUs

[SRS_Com_02041] The AUTOSAR module shall handle complex data types as a consistent set of data ⌈

Description:	It is required by AUTOSAR to handle complex data types as a consistent set of data. Therefore, it is necessary to pass the data elements from the RTE to the AUTOSAR COM module consistently.
Rationale:	AUTOSAR provides complex data types; those have to be sent and received atomically via RTE, COM, etc.
Use Case:	Complex AUTOSAR data types, data consistency of signal groups.
Dependencies:	–
Supporting Material:	For guarantee data consistency of complex AUTOSAR data types, signal groups are introduced. For definition of signal group see [6].

⌋*(RS_BRF_01632, RS_BRF_01544)*

[SRS_Com_02112] AUTOSAR COM shall provide a uint8-array based API for signal groups ⌈

Description:	AUTOSAR COM shall provide an API to pass the serialized uint8-array representation of a signal group to COM.
Rationale:	The AUTOSAR transformer chain provides means to serialize composite data into a uint8-array representation. This serialized uint8-array shall be passed as one entity to COM.
Use Case:	Usage of transformer with Com-based serialization and Com Interaction to enable the communication with a fixed communication matrix.
Dependencies:	[SRS_Com_02082], [SRS_Com_02083], [SRS_Com_02084], [SRS_Com_02113]
Supporting Material:	–

⌋*(RS_BRF_01632, RS_BRF_01544, RS_BRF_01560)*

4.3.7 Interface between the AUTOSAR COM module and the lower layer (PDU-Router)

[1] leaves the interface between COM and the lower layers undefined. In AUTOSAR the only lower layer that AUTOSAR COM module interfaces is the PDU Router. The interfaces refer to the definitions in [10]. The requirements are derived from [10].

[SRS_Com_02107] The AUTOSAR COM module shall cancel transmission requests in case of expired transmissions ⌈

Description:	The AUTOSAR COM module shall cancel the transmission request of an I-PDU in case a violation of the transmission deadline monitoring of an I-PDU is detected.
Rationale:	Needed to free buffers in the FlexRay interface.
Use Case:	Cancellation of outdated I-PDU
Dependencies:	–
Supporting Material:	–

⌋(*RS_BRF_01544*)

4.3.8 Support of Large Data Types

The AUTOSAR COM module shall support signals larger than the N-PDUs of the underlying busses. For these large signals also a dynamic length shall be supported. The requirements of this chapter define the support of these data types.

[SRS_Com_02092] The AUTOSAR COM module shall support at most one dynamic length signal per I-PDU ⌈

Description:	At most one dynamic length signal shall be supported per I-PDU.
Rationale:	If only one signal per I-PDU is allowed then the dynamical length does not have to be coded into the I-PDU. The receiver will calculate the length of the signal from the length of the IPDU. This is the same approach as in [11].
Use Case:	Sending textual messages e.g. SMS.
Dependencies:	[SRS_Com_02091], [SRS_Com_02093]
Supporting Material:	[11]

⌋(*RS_BRF_01648, RS_BRF_01544*)

[SRS_Com_02093] Dynamic length signal must be placed last in I-PDU ⌈

Description:	The dynamic length signal must be placed last in the dynamic length I-PDU. This is the same approach as in [11]. All other signals and update-bits must be packed in front of the dynamical length signal.
Rationale:	Placing the signal last in the frame removes the need of coding the dynamical length into the IPDU. The receiving COM can directly derive the length of the dynamic length signal from the length of the IPDU Signal groups may still be used to contain (one) dynamic length signal and other signals.

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Use Case:	see Rationale
Dependencies:	[SRS_Com_02091], [SRS_Com_02092]
Supporting Material:	[11]

⌋(*RS_BRF_01648*, *RS_BRF_01544*)

[SRS_Com_02096] The AUTOSAR COM module shall not support fragmentation towards its users(RTE, SwCluCComProxy) ⌈

Description:	The AUTOSAR COM module will always send and receive a complete signal (no fragmentation supported above TP). The COM/RTE/application or/and COM/ComProxy/Application Software Cluster will always receive/transmit complete large signals and dynamic length signals. Modules above TP are not involved in the fragmentation process.
Rationale:	Fragmentation should be hidden in the BSW architecture and should not be put to the application
Use Case:	It was discussed to have fragmentation for transmit/receive on application level to be able to find a more efficient implementation. This was however not approved since it would make the port-concept complex and bus-aware (it is not required for intra-ECU communication).
Dependencies:	[SRS_Com_02095]
Supporting Material:	–

⌋(*RS_BRF_01648*, *RS_BRF_01544*)

[SRS_Com_02098] The AUTOSAR COM module shall distinct normal and large signals via its configuration ⌈

Description:	There must be a configuration parameter that states if the signal has dynamic length or predefined length (i.e. a "normal" signal or a large signal)
Rationale:	There is no use-case where a fixed length signal becomes a dynamic length signal in run-time
Use Case:	see Rationale
Dependencies:	[SRS_Com_02097]
Supporting Material:	–

⌋(*RS_BRF_01648*, *RS_BRF_01544*)

4.3.9 Signal status information

[SRS_Com_02030] The AUTOSAR COM module shall support to detect if a received signal or signal group was updated by the sender ⌈

Description:	It shall be possible for the receiver to identify and indicate to the upper layer if a signal/ signal group has been updated by the sender. Whether this feature is provided shall be configurable per signal.
Rationale:	When multiple signals /signal groups are placed in the same I-PDU, and that I-PDU is sent more frequently than a signal/ signal group is update, the update bit provides a mechanism to detect only those signals/ signal groups that have changed values.
Use Case:	–
Dependencies:	[SRS_Com_02058]
Supporting Material:	Implementation proposal: An update bit is optionally attached to a signal/ signal group and can only be attached at configuration time. When COM is started all update bits in all I-PDUs are cleared. In the sending ECU, when a signal/signal group is sent by the application, the update bit is set automatically by COM as part of the SendMessage() call. In the sending ECU, once the call to the lower layers to transmit the ECU has completed, all update bits in the recently sent I-PDU are cleared. In the receiving ECU, when an I-PDU is received, a signal/signal group with an associated update bit is only processed by COM if its update bit is set. Therefore filtering and informing the RTE etc. will only take place if the update bit is set. In the receiving ECU, for a signal/signal group with an update bit, the reception deadline monitor for that signal/signal group (if configured) is only reset if the update bit is set. Update bits do not have to reside in the I-PDU in a fixed relationship to the signal/signal group with which they are associated. The update bits could reside anywhere in the I-PDU subject to the same restrictions as any other signal/signal group.

⌋*(RS_BRF_01544)*

[SRS_Com_02058] The AUTOSAR COM module shall support deadline monitoring for updated signals/signal groups on receiver side ⌈

Description:	The AUTOSAR COM module shall monitor on receiver-side, if an updated value for a specific signal/signal group has been received within a configurable, signal/signal group specific deadline, i.e. the AUTOSAR COM module shall check, whether the sender-side upper layers have explicitly sent the signal/signal group. If a deadline violation of a specific signal/signal group is detected, the AUTOSAR COM module shall notify the upper receiving layers (the SWC via the RTE and/or SwCluCComProxy) about that fact. This information given to the upper receiving layers shall be signal/signal group specific. The AUTOSAR COM module shall not do any substitution of signal/signal group values. If upper layers read signals/signal groups that have violated their deadline, the AUTOSAR COM module shall return the last value received.
Rationale:	Due to latency times of communication systems or interrupts data might be not received in a pre-defined time (e.g. jitter of period to big, older than max age).
Use Case:	Detect delays in communication system to make sure the application works on up-to-date data.
Dependencies:	[SRS_Com_02030]
Supporting Material:	If no update bits are used, the AUTOSAR COM module provides the deadline monitoring defined in [1] (Section 3.5.1). Here, deadline monitoring is done on the reception of I-PDUs but deadline violations are notified per signal to the upper layer.

⌋*(RS_BRF_01544, RS_BRF_00113)*

4.4 AUTOSAR LargeDataCOM specific functional requirements

[SRS_Com_02108] Support of Large Data COM ⌈

Description:	In addition to AUTOSAR COM Module AUTOSAR shall offer a Module called Large Data COM (LargeDataCOM). LargeDataCOM shall provide support of a reduced set of features targeting communication of large and dynamic data in a mainly event oriented way. It shall be possible to omit either one of the COM and LargeDataCOM modules if not needed.
Rationale:	Efficiently support large and dynamic data.
Use Case:	Communication of data produced by serializers/transformers like for example Some/IP.
Dependencies:	–
Supporting Material:	–

⌋*(RS_BRF_01649)*

[SRS_Com_02109] Large Data COM shall support Transport Protocol-like communication ⌈

Description:	Large Data COM shall support reception/ transmission via TP-APIs
Rationale:	Support of communication via transport protocols.
Use Case:	Efficient communication via e.g. FrTp. Efficient communication of very large data not fitting in an Ethernet frame using TCP.
Dependencies:	–
Supporting Material:	–

⌋*(RS_BRF_01649)*

[SRS_Com_02110] Large Data COM shall support Interface-like communication ⌈

Description:	Large Data COM shall support reception/ transmission via If-APIs
Rationale:	Support of communication without transport protocols.
Use Case:	Efficient communication of long signals, still fitting into one frame of the according target bus. For example a 500 byte signal via SoAd.
Dependencies:	–
Supporting Material:	–

⌋*(RS_BRF_01649)*

[SRS_Com_02111] Large Data COM shall support Transmission Triggered by lower layer ⌈

Description:	Large Data COM shall support Transmission being Triggered by lower layer
Rationale:	Support of TriggerTransmit API.
Use Case:	Provide current signal data to a new subscriber without waiting for the next transmission request of the application
Dependencies:	–
Supporting Material:	–

⌋*(RS_BRF_01649)*

4.5 Non-Functional Requirements (Qualities)

None.

5 Requirements Tracing

The following table references the features specified in [13] and links to the fulfillments of these.

Requirement	Description	Satisfied by
[RS_BRF_00113]	AUTOSAR shall detect signal time-outs	[SRS_Com_02058]
[RS_BRF_01056]	AUTOSAR BSW modules shall provide standardized interfaces	[SRS_Com_02043]
[RS_BRF_01072]	AUTOSAR BSW shall provide callout functions in order to implement certain functionality in integrator code	[SRS_Com_02044]
[RS_BRF_01120]	AUTOSAR shall support re-flashing of configured BSW data	[SRS_Com_00177]
[RS_BRF_01544]	AUTOSAR communication shall define transmission and reception of communication data	[SRS_Com_00177] [SRS_Com_00192] [SRS_Com_00218] [SRS_Com_02030] [SRS_Com_02037] [SRS_Com_02040] [SRS_Com_02041] [SRS_Com_02042] [SRS_Com_02043] [SRS_Com_02044] [SRS_Com_02045] [SRS_Com_02046] [SRS_Com_02058] [SRS_Com_02067] [SRS_Com_02077] [SRS_Com_02079] [SRS_Com_02080] [SRS_Com_02082] [SRS_Com_02083] [SRS_Com_02084] [SRS_Com_02087] [SRS_Com_02090] [SRS_Com_02091] [SRS_Com_02092] [SRS_Com_02093] [SRS_Com_02094] [SRS_Com_02095] [SRS_Com_02096] [SRS_Com_02097] [SRS_Com_02098] [SRS_Com_02107] [SRS_Com_02112] [SRS_Com_02113]
[RS_BRF_01560]	AUTOSAR communication shall support mapping of signals into transferrable protocol data units	[SRS_Com_02112] [SRS_Com_02113]
[RS_BRF_01568]	AUTOSAR communication stack shall support fixed size and dynamic size signals	[SRS_Com_02091]
[RS_BRF_01592]	AUTOSAR communication shall offer data transfer on user request, time based, and requested via the underlying bus	[SRS_Com_02082] [SRS_Com_02083] [SRS_Com_02084] [SRS_Com_02113]
[RS_BRF_01600]	AUTOSAR communication shall support time-out handling	[SRS_Com_02088] [SRS_Com_02089]
[RS_BRF_01616]	AUTOSAR communication shall support initial values for signals	[SRS_Com_02040] [SRS_Com_02042]
[RS_BRF_01624]	AUTOSAR communication shall support data conversion between big endian and little endian data representation	[SRS_Com_02078] [SRS_Com_02086]
[RS_BRF_01632]	AUTOSAR communication shall support data consistency of groups of signals	[SRS_Com_02041] [SRS_Com_02112] [SRS_Com_02113]
[RS_BRF_01648]	AUTOSAR communication shall support transfer of data sizes larger than the maximum transmission unit of the underlying bus	[SRS_Com_02091] [SRS_Com_02092] [SRS_Com_02093] [SRS_Com_02094] [SRS_Com_02095] [SRS_Com_02096] [SRS_Com_02097] [SRS_Com_02098]

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Requirement	Description	Satisfied by
[RS_BRF_01649]	AUTOSAR communication shall support communication of large and dynamic data in a dedicated optimized module	[SRS_Com_02108] [SRS_Com_02109] [SRS_Com_02110] [SRS_Com_02111]

Table 5.1: RequirementsTracing

6 References

[1] ISO 17356-4:Road vehicles – Open interface for embedded automotive applications – Part 4:OSEK/VDX Communication (COM)

[2] Layered Software Architecture
AUTOSAR_CP_EXP_LayeredSoftwareArchitecture

[3] Specification of Communication
AUTOSAR_CP_SWS_COM

[4] Specification of Large Data COM
AUTOSAR_CP_SWS_LargeDataCOM

[5] Standardization Template
AUTOSAR_FO_TPS_StandardizationTemplate

[6] Glossary
AUTOSAR_FO_TR_Glossary

[7] Specification of RTE Software
AUTOSAR_CP_SWS_RTE

[8] Specification of Software Cluster Connection module
AUTOSAR_CP_SWS_SoftwareClusterConnection

[9] Specification of ECU Configuration
AUTOSAR_CP_TPS_ECUConfiguration

[10] Specification of Communication Stack Types
AUTOSAR_CP_SWS_CommunicationStackTypes

[11] ISO 17356-1:Road vehicles – Open interface for embedded automotive applications – Part 1:General structure and terms, definitions and abbreviated terms

[12] Software Component Template
AUTOSAR_CP_TPS_SoftwareComponentTemplate

[13] Requirements on AUTOSAR Features
AUTOSAR_CP_RS_Features