

|                                   |   |
|-----------------------------------|---|
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## 1 Scope of Document

This document specifies the requirements for the following BSW modules:

- SAE J1939 Transport Layer module (J1939Tp)
- SAE J1939 Request Manager (J1939Rm)
- SAE J1939 Network Management module (J1939Nm)

## 2 Conventions to be used

- The representation of requirements in AUTOSAR documents follows the table specified in [TPS\_STDT\_00078].
- In requirements, the following specific semantics shall be used (based on the Internet Engineering Task Force IETF).

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:

- **SHALL**: This word 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.
- **MUST**: This word means that the definition is an absolute requirement of the specification due to legal issues.
- **MUST NOT**: This phrase means that the definition is an absolute prohibition of the specification due to legal constraints.
- **SHOULD**: This word, or the adjective "RECOMMENDED", mean 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" mean 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, **MUST** 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, **MUST** be prepared to interoperate with another implementation, which does not include the option (except, of course, for the feature the option provides.)

### 3 Acronyms and Abbreviations

| <b>Abbreviation / Acronym:</b> | <b>Description:</b>  |
|--------------------------------|--|
| CA                             | Controller Application, role of an ECU tied to one address |
| DA                             | J1939 Destination Address                                  |
| J1939Tp N-PDU                  | PDU of J1939 Transport Layer, exchanged with CAN Interface |
| J1939Tp N-SDU                  | SDU of J1939 Transport Layer, exchanged with PDU Router    |
| PG                             | Parameter Group – J1939 message                            |
| PGN                            | Parameter Group Number – J1939 message identifier          |
| SA                             | J1939 Source Address                                       |
| TP.CM                          | J1939 Transport Protocol Connection Management message     |
| TP.DT                          | J1939 Transport Protocol Data Transfer message             |

## 4 General Requirements

### 4.1 Functional Requirements

#### 4.1.1 [SRS\_J1939\_00049] J1939 Modules shall support MetaData

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | The AUTOSAR BSW modules that support the J1939 standard shall support PDUs with MetaData.   |
| <b>Rationale:</b>           | J1939 requires a flexible approach to CAN IDs that must be reflected by all BSW modules supporting J1939 features.  |
| <b>Use Case:</b>            | <ul style="list-style-type: none"> <li>- Request from arbitrary address.</li> <li>- Answer to request via TP.</li> <li>- Request for AddressClaimed.</li> </ul> |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | --  |

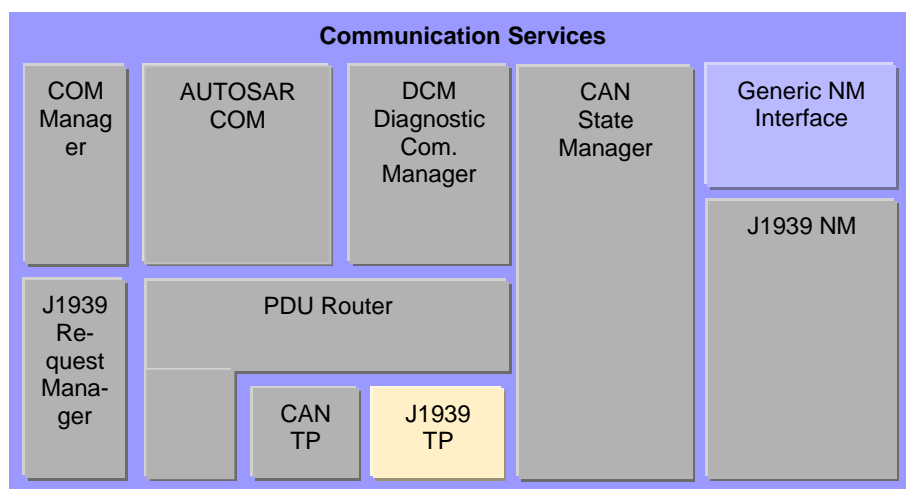
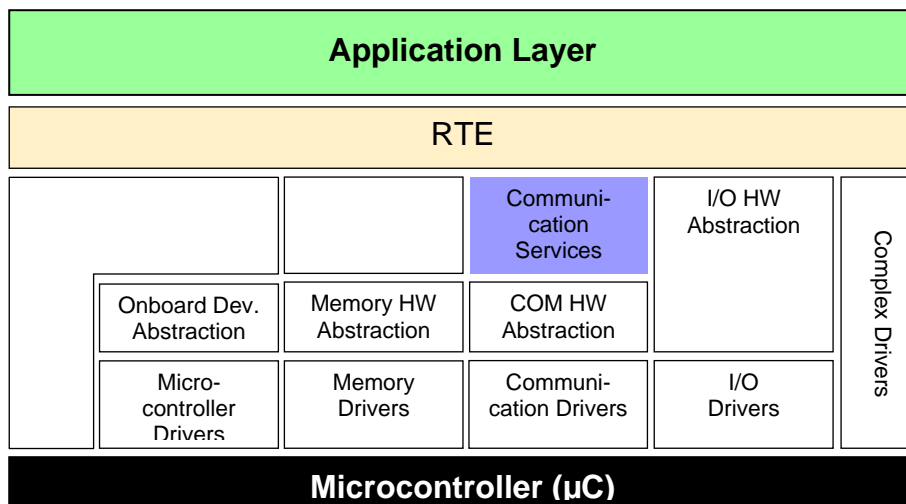
|(RS\_BRF\_01552)

## 5 Requirements for the SAE J1939 Transport Layer module

### 5.1 Functional Overview

This chapter describes the requirements that shall be fulfilled by the AUTOSAR J1939 Transport Layer module, which implements the transport protocol defined by [SAE J1939-21] with the variants BAM (Broadcast Announce Message) for broadcast mode and CMTD (Connection Mode data Transfer, also known as RTS/CTS) for point to point communication.

The following pictures show the parts of the complete AUTOSAR system and in particular the Communication Services in which the J1939 Transport Layer module is situated.



**Figure 1: Position of the J1939Tp in the AUTOSAR architecture**



## 5.2 Functional Requirements

### 5.2.1 Configuration

This section describes the requirements on configurability of the module J1939 Transport Layer.

#### 5.2.1.1 [SRS\_J1939\_00001] The J1939 Transport Layer module shall be configurable to support only transport protocol variant BAM

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | The J1939 Transport Layer module shall be configurable to support either both the transport protocol variants BAM and CMTD or only the transport protocol variant BAM. |
| <b>Rationale:</b>           | Some networks do not use CMTD. In these cases, the CMTD protocol shall be omitted completely to save resources.  |
| <b>Use Case:</b>            | ECUs that only support cyclic transmission of DM1 and no other large message.  |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | --   |

|(RS\_BRF\_01728)

#### 5.2.1.2 [SRS\_J1939\_00002] The J1939 Transport Layer module shall identify each N-SDU with a unique identifier

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | The J1939 Transport Layer module shall identify each N-SDU with a unique identifier, so that the upper layer can address an N-SDU without any assumption on the addressing mode configuration of the J1939Tp.<br><br>Furthermore, a symbolic name shall be assigned for each N-SDU identifier value to simplify the API usage. |
| <b>Rationale:</b>           | Independence of upper layer from the J1939Tp configuration.  |
| <b>Use Case:</b>            | The PDU-Router can handle all N-SDUs (FlexRay, CAN and LIN) regardless of addressing mode particularity of its underlying protocols.   |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | --   |

|(RS\_BRF\_01728, RS\_BRF\_01056, RS\_BRF\_01024)

### 5.2.1.3 [SRS\_J1939\_00043] The J1939 Transport Layer module shall support generic channels

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | <p>A channel with fixed DA/SA (either because no MetaData is used by the N-PDUs, or because DA and SA are defined by the channel) is called a specific channel, a channel with variable SA/DA is called a generic channel.</p> <p>The N-PDUs of a generic channel either represent specific PGs (TP.CM, TP.DT, or direct frames with fixed PGN), or are completely generic (direct frames without configured CAN ID, only for transmission).</p> |
| <b>Rationale:</b>           | Save configuration effort and resources by using N-PDUs for more than one channel and a channel for different connections (SA-DA-relations).   |
| <b>Use Case:</b>            | The SA of received frames and the DA of transmitted frames are usually very dynamic in J1939 networks.   |
| <b>Dependencies:</b>        | [SRS_J1939_00049]  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01728)

### 5.2.1.4 [SRS\_J1939\_00044] The J1939 Transport Layer module shall support generic N-SDUs

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | <p>All N-SDUs of J1939 Transport Layer module shall have a fixed PGN, but DA and SA can either be handled dynamically, or be statically configured.</p> <p>The N-SDUs of a generic channel may carry MetaData which transfers the actual SA/DA at runtime. These N-SDUs are called generic N-SDUs.</p> |
| <b>Rationale:</b>           | Save configuration effort and resources by using N-SDUs for more than one connection (SA-DA-relation).   |
| <b>Use Case:</b>            | The SA of received frames and the DA of transmitted frames are usually very dynamic in J1939 networks.   |
| <b>Dependencies:</b>        | [SRS_J1939_00049]  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01728)

### 5.2.1.5 [SRS\_J1939\_00003] The N-PDUs used to transport a J1939Tp N-SDUs shall be statically configured

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | <p>Each N-SDU shall have a 1:n statically configured association to N-PDUs, where:</p> <ul style="list-style-type: none"> <li>- n=1 if the N-SDU Data Length &lt;= 8 Bytes (not handled by J1939Tp),</li> <li>- n=2 for BAM with fixed length – TP.CM / TP.DT,</li> <li>- n=3 for BAM with dynamic length – TP.CM / TP.DT / direct,</li> <li>- n=3 for CMTD with fixed length – TP.CM (Tx) / TP.CM (Rx) / TP.DT, and</li> <li>- n=4 for CMTD with dynamic length – TP.CM (Tx) / TP.CM (Rx) / TP.DT / direct.</li> </ul> <p>Each N-PDU shall have a 1:m statically configured association to N-SDUs, where m=number of different N-SDUs (generic or specific) that use that N-PDU.</p> |
| <b>Rationale:</b>           | Simplification of configuration.  |
| <b>Use Case:</b>            | A channel that only supports BAM does not need TP.CM in reverse direction.  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | [SAE J1939-21]  |

] (RS\_BRF\_01728)

### 5.2.1.6 [SRS\_J1939\_00004] The J1939 Transport Layer module shall identify each N-PDU with a unique identifier

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | <p>The J1939 Transport Layer module shall identify each N-PDU with a unique identifier.</p> <p>Furthermore, a symbolic name may be assigned for each identifier value to simplify the implementation.</p> |
| <b>Rationale:</b>           | Independence of upper layer from the J1939Tp configuration.   |
| <b>Use Case:</b>            | The CanIf can handle all N-PDUs regardless of actual upper layer module.  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | --  |

] (RS\_BRF\_01728, RS\_BRF\_01056, RS\_BRF\_01024)

### 5.2.1.7 [SRS\_J1939\_00006] The properties of a J1939Tp N-SDU shall be statically configured

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | The configuration shall statically assign the following properties to each J1939Tp N-SDU: <ul style="list-style-type: none"> <li>- unique N-SDU identifier</li> <li>- Communication direction: sender or receiver</li> <li>- Maximum N-SDU length</li> <li>- N-SDU Length Type: Variable/Fixed</li> <li>- J1939 Parameter Group Number (PGN)</li> <li>- Associated N-PDU identifiers</li> <li>- Optionally: SA and/or DA for generic channels</li> <li>- Optionally: Transport protocol variant</li> </ul> |
| <b>Rationale:</b>           | At runtime the J1939 Transport Layer module must have all the needed information to manage a transport connection.   |
| <b>Use Case:</b>            | The properties are required for the runtime decision which N-PDU identifiers have to be used for the N-SDU.<br>The effective length of the transmitted data determines whether a transport protocol is required.<br>For generic N-SDUs, the destination address determines the used protocol variant.  |
| <b>Dependencies:</b>        | [SRS_J1939_00002], [SRS_J1939_00003]   |
| <b>Supporting Material:</b> | --   |

] (RS\_BRF\_01728)

## 5.2.2 Initialization

This section describes the requirements on the initialization phase of the module J1939 Transport Layer.

### 5.2.2.1 [SRS\_J1939\_00010] The J1939 Transport Layer module shall implement an interface for initialization

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | The J1939 Transport Layer module implements an interface for initialization.<br><br>This service shall initialize all global variables of the module and set all transport protocol connections in a default state (Idle). |
| <b>Rationale:</b>           | Basic functionality.   |
| <b>Use Case:</b>            | Set Transport Layer module to a defined state.   |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | --   |

] (RS\_BRF\_01728, RS\_BRF\_01096, RS\_BRF\_01136, SRS\_BSW\_00101)

### 5.2.2.2 [SRS\_J1939\_00011] The J1939 Transport Layer services shall not be operational before initializing the module

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | Before using the transmission capabilities of the J1939 Transport Layer module, it shall be initialized. If it is not initialized, the services of J1939Tp have to return an error and a development error shall be reported. |
| <b>Rationale:</b>           | Basic functionality.  |
| <b>Use Case:</b>            | To avoid usage of the module without a complete initialization - this could cause the transmission of corrupted frames.   |
| <b>Dependencies:</b>        | [SRS_J1939_00010]   |
| <b>Supporting Material:</b> | --  |

] (RS\_BRF\_01728, RS\_BRF\_01096)

## 5.2.3 Normal Operation

This section describes the requirements on the “normal” functionality of the module J1939 Transport Layer.

### 5.2.3.1 [SRS\_J1939\_00018] The AUTOSAR J1939 Transport Layer module shall support concurrent connections

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | <p>The number of concurrent connections supported by the AUTOSAR J1939 Transport Layer module depends on the used transport protocol and the transmitting direction.</p> <p>In the sending direction:</p> <ul style="list-style-type: none"> <li>- If BAM is used: Only one connection shall be possible per local address (SA).</li> <li>- If CMDT is used: Parallel connections from all local addresses (SA) to all remote nodes (DA) shall be possible.</li> </ul> <p>In the receiving direction:</p> <ul style="list-style-type: none"> <li>- If BAM has been used: One connection per remote node (SA) shall be possible.</li> <li>- If CMDT has been used: Parallel connections from all remote nodes (SA) to all local addresses (DA) are possible.</li> </ul> <p>These restrictions are imposed by the way J1939 models multi packet communication via TP.CM and TP.DT.</p> |
| <b>Rationale:</b>           | An ECU must support parallel reception of N-SDUs that are issued either from different ECUs or shall be sent to different ECUs. So the AUTOSAR J1939 Transport Layer module shall allow concurrent connections.  |
| <b>Use Case:</b>            | Communication with more than one remote node at the same time.   |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | [SAE J1939-21]   |

] (RS\_BRF\_01728)

### 5.2.3.2 [SRS\_J1939\_00019] The J1939 Transport Layer module shall support the transport protocol variant BAM

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | <p>The J1939 Transport Layer module shall support the transport protocol variant BAM for I-PDUs with large payload (length &gt; 8 Bytes) or variable length according to [SAE J1939-21].</p> <p>Depending on the length and the N-SDU identifier (specific N-SDU) or the provided DA (generic N-SDU), the J1939 Transport Layer module shall decide whether BAM must be used for transmission.</p> <p>During reception, the transport protocol variant is determined by the type of the initial TP.CM frame: BAM is used when a TP.CM_BAM is received.</p> |
| <b>Rationale:</b>           | The transport protocol variant BAM is specified in [SAE J1939-21].   |
| <b>Use Case:</b>            | Transmission of DM1.   |
| <b>Dependencies:</b>        | [SRS_J1939_00002], [SRS_J1939_00006], [SRS_J1939_00044]  |
| <b>Supporting Material:</b> | [SAE J1939-21]   |

] (RS\_BRF\_01728)

### 5.2.3.3 [SRS\_J1939\_00020] The AUTOSAR J1939 Transport Layer module shall support the transport protocol variant CMDT

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | <p>The AUTOSAR J1939 Transport Layer module shall support the transport protocol variant CMDT for I-PDUs with large payload (length &gt; 8 Bytes) or variable length according to [SAE J1939-21].</p> <p>Depending on the length and the N-SDU identifier (specific N-SDU) or the provided DA (generic N-SDU), the J1939 Transport Layer module shall decide whether CMDT must be used for transmission.</p> <p>During reception, the transport protocol variant is determined by the type of the initial TP.CM frame: CMDT is used when a TP.CM_RTS is received.</p> |
| <b>Rationale:</b>           | The transport protocol variant CMDT is specified in [SAE J1939-21].   |
| <b>Use Case:</b>            | Transmission of DM2 after request.  |
| <b>Dependencies:</b>        | [SRS_J1939_00002], [SRS_J1939_00006], [SRS_J1939_00044]   |
| <b>Supporting Material:</b> | [SAE J1939-21]  |

] (RS\_BRF\_01728)

#### 5.2.3.4 [SRS\_J1939\_00021] The J1939 Transport Layer module shall be compliant with the CAN Interface module notifications

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | The J1939 Transport Layer module shall use the CAN Interface notification services reception notification and transmission confirmation. |
| <b>Rationale:</b>           | In AUTOSAR architecture, the J1939 Transport Layer module is placed between the PDU Router and the CAN Interface.                        |
| <b>Use Case:</b>            | The J1939 Transport Layer module has to support the notification services called by the CAN Interface.                                   |
| <b>Dependencies:</b>        | [SRS_Can_01003], [SRS_Can_01009]   |
| <b>Supporting Material:</b> | --   |

] (RS\_BRF\_01728, RS\_BRF\_01056)

#### 5.2.3.5 [SRS\_J1939\_00022] The timeout values of the J1939 transport protocol variants shall be supervised

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | All the timeout values of the J1939 transport protocols specified in [SAE J1939-21] shall be supervised by the J1939 Transport Layer module. |
| <b>Rationale:</b>           | Timeout supervision is required by [SAE J1939-21].   |
| <b>Use Case:</b>            | The J1939 Transport Layer module shall be able to abort when a timeout occurs.   |
| <b>Dependencies:</b>        | [SRS_J1939_00045]  |
| <b>Supporting Material:</b> | [SAE J1939-21]   |

] (RS\_BRF\_01728, RS\_BRF\_01600)

#### 5.2.3.6 [SRS\_J1939\_00024] Unused Bytes in N-PDUs shall be padded

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | All unused bytes must be initialized to the value specified in [SAE J1939-21] for TP.DT PGN (0xFF). |
| <b>Rationale:</b>           | TP.DT shall always be transmitted with 8 bytes of data.   |
| <b>Use Case:</b>            | --  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | [SAE J1939-21]  |

] (RS\_BRF\_01728)

### 5.2.3.7 [SRS\_J1939\_00025] The J1939 Transport Layer module shall be able to manage connections via BAM and CMDT in parallel

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | The J1939 Transport Layer module shall be able to support more than one connection. Therefore it shall deal with BAM and CMDT connections in parallel. The J1939 transport protocol variant that must be used is determined as described in [SRS_J1939_00019] and [SRS_J1939_00020]. |
| <b>Rationale:</b>           | Even though BAM and CMDT share the same TP frames, they are clearly discernible by the TP.CM frame types and the DA (always 0xFF for BAM).   |
| <b>Use Case:</b>            | A J1939 network supports the parallel transport of BAM and CMDT frames.  |
| <b>Dependencies:</b>        | [SRS_J1939_00019], [SRS_J1939_00020]   |
| <b>Supporting Material:</b> | [SAE J1939-21]   |

] (RS\_BRF\_01728)

### 5.2.3.8 [SRS\_J1939\_00046] The J1939 Transport Layer module shall support automatic calculation of block sizes

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | The block size values transmitted in TP.CM_RTS and TP.CM_CTS shall be calculated automatically. Configured values shall be interpreted as maximum values. |
| <b>Rationale:</b>           | The J1939 transport protocol supports completely dynamic block sizes.   |
| <b>Use Case:</b>            | Use actually available buffer to reduce protocol overhead.  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | --  |

] (RS\_BRF\_01728)

### 5.2.3.9 [SRS\_J1939\_00047] The J1939 Transport Layer module shall support retransmission of lost TP.DT frames

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | When the receiver of a CMDT connection has a timeout after transmission of TP.CM_CTS or reception of previous TP.DT, or when a sequence error is encountered in a TP.DT, the J1939 Transport Layer module shall initiate retransmission of the failed block. |
| <b>Rationale:</b>           | To avoid loss of a complete message after protocol errors.   |
| <b>Use Case:</b>            | When a TP.DT frame is lost, it shall be retransmitted instead of terminating the connection.   |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | [SAE J1939-21]   |

] (RS\_BRF\_01728)



### 5.2.3.10 [SRS\_J1939\_00048] The J1939 Transport Layer module shall support cancellation of ongoing reception and transmission

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | When triggered by the PduR, the J1939 Transport Layer module shall cancel an ongoing reception or transmission. In case of CMTD, an abort message shall be sent. |
| <b>Rationale:</b>           | Support complete API presented to PduR.  |
| <b>Use Case:</b>            | Connections may be cancelled because of changed vehicle states.  |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | --   |

] (RS\_BRF\_01728, RS\_BRF\_01640)

## 5.2.4 Shutdown Operation

### 5.2.4.1 [SRS\_J1939\_00038] The J1939 Transport Layer module shall provide an API to shut down operation of the module

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | <p>When the J1939 Transport Layer module needs to be re-initialized, the system is already running. It would lead to severe problems if a state variable is initialized in the same moment in which it is updated e.g. by a callback function. And it would lead to severe overhead, if the system must be protected against these problems.</p> <p>A safe workaround is to de-initialize the module first, then wait for any callback function to terminate, and finally initialize the module again.</p> |
| <b>Rationale:</b>           | Clean handling of initialized state.   |
| <b>Use Case:</b>            | Before re-initialization, the J1939 Transport Layer module should be de-initialized so that no operation is ongoing during initialization.   |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | --   |

] (RS\_BRF\_01728, RS\_BRF\_01096)

## 5.2.5 Fault Operation

### 5.2.5.1 [SRS\_J1939\_00023] The J1939 Transport Layer module shall handle unexpected PDUs according to the SAE J1939 specification

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | <p>The handling of an unexpected received N-PDU by the J1939 Transport Layer module depends on the configured N-PDU type:</p> <ul style="list-style-type: none"> <li>- Unexpected TP.DT frames shall be ignored.</li> <li>- Unexpected TP.CM_BAM frames shall terminate an active connection and start a new one.</li> <li>- Unexpected TP.CM_RTS frames shall terminate an active connection and start a new one if the PGN is the same. Otherwise they shall be answered by a TP.Conn_Abort frame.</li> <li>- Unexpected TP.CM_CTS and TP.CM_EndOfMsgACK frames shall be ignored.</li> <li>- Unexpected TP.Conn_Abort frames for a different PGN shall be ignored.</li> </ul> |
| <b>Rationale:</b>           | Protocol behavior on error.   |
| <b>Use Case:</b>            | A TP.CM_CTS is received while the receiver still waits for data.  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | [SAE J1939-21]  |

] (RS\_BRF\_01728)

### 5.2.5.2 [SRS\_J1939\_00039] The J1939 Transport Layer module shall be able to cope with invalid values in received TP frames

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | <p>The J1939 Transport Layer module shall be able to cope with invalid values in received TP frames (TP.CM, TP.DT). There are different possibilities of invalid values in TP frames.</p> <p>TP.DT:</p> <ul style="list-style-type: none"> <li>- Wrong sequence value: Abort connection (BAM) or retry transmission (CMDT).</li> </ul> <p>TP.CM:</p> <ul style="list-style-type: none"> <li>- Contradicting number of frames and total size in TP.CM_RTS or TP.CM_BAM: Ignore this frame.</li> <li>- DA in contained PDU1 PGN set: Ignore.</li> <li>- Wrong number of next block or wrong number of frames to transmit in TP.CM_CTS: Abort connection.</li> <li>- Wrong PGN in any TP.CM: Ignore.</li> <li>- Different values in TP.CM_EndOfMsgACK from initial TP.CM_RTS: Ignore.</li> </ul> |
| <b>Rationale:</b>           | Defined behavior when invalid values are received in TP frames.   |
| <b>Use Case:</b>            | When a TP.CM_BAM is received indicating a total length of 22 bytes in two packets or 17 bytes in 5 packets, the J1939 Transport Layer module should not crash, independent of the actual number of received packets.  |
| <b>Dependencies:</b>        | [SRS_J1939_00047]   |
| <b>Supporting Material:</b> | [SAE J1939-21]  |

] (RS\_BRF\_01728)

### 5.2.5.3 [SRS\_J1939\_00045] The J1939 Transport Layer module shall handle protocol timeout

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | <p>When a timeout occurs, the J1939 Transport Layer module shall abort the connection or retry transmission:</p> <p>When BAM is used, the connection is always silently aborted.</p> <p>When CMDT is used, the sender shall always send a TP.Conn_Abort frame with abort reason 3, while the receiver shall initiate retransmission of expected packets if possible.</p> |
| <b>Rationale:</b>           | Defined behavior after timeout.  |
| <b>Use Case:</b>            | Timeout after reception of TP.CM_BAM or TP.DT, or timeout after transmission of TP.CM_RTS, TP.CM_CTS, TP.CM_EndOfMsgACK or TP.DT.  |
| <b>Dependencies:</b>        | [SRS_J1939_00022], [SRS_J1939_00047]   |
| <b>Supporting Material:</b> | [SAE J1939-21]   |

] (RS\_BRF\_01728, RS\_BRF\_01600)

## 5.3 Non-Functional Requirements (Qualities)

### 5.3.1 [SRS\_J1939\_00040] The AUTOSAR J1939 Transport Layer module shall be based on SAE J1939 specifications

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | If no requirement is explicitly added or excluded, the implementation of the AUTOSAR J1939 Transport Layer module shall follow the [SAE J1939-21] specification for the transport protocol (section 5.10 and appendix C of SAE J1939-21 of December 2010).   |
| <b>Rationale:</b>           | <p>Reuse of existing standards for AUTOSAR BSW.</p> <p>The SAE J1939-21 specifications is the most used CAN related Transport Layer in Trucks.</p>   |
| <b>Use Case:</b>            | <p>Transport protocol on CAN according to SAE J1939:</p> <ul style="list-style-type: none"> <li>- Segmentation of data in transmit direction</li> <li>- Collection of data in receive direction</li> <li>- Control of data flow</li> <li>- Detection of errors (message loss/doubling/sequence)</li> </ul> |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | [SAE J1939-21]   |

] (RS\_BRF\_01728)

### 5.3.2 [SRS\_J1939\_00041] The J1939 Transport Layer module shall implement transport protocol functionalities in the layered software architecture

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | The J1939 Transport Layer module shall handle segmentation and reassembling of large PDUs. For this task, it shall have interfaces to the PDU Router and the CAN Interface. |
| <b>Rationale:</b>           | Interfaces and interaction  |
| <b>Use Case:</b>            | --  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | --  |

] (RS\_BRF\_01728)

### 5.3.3 [SRS\_J1939\_00042] The J1939 Transport Layer interface shall be independent of its internal configuration

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | The J1939 Transport Layer module shall offer the PDU Router an interface that is independent from its internal communication configuration and implementation. The only exception shall be the cancellation API which is configurable. |
| <b>Rationale:</b>           | Layered Software Architecture. Information hiding. Common interface for all applications   |
| <b>Use Case:</b>            | --   |
| <b>Dependencies:</b>        | [SRS_J1939_00048]  |
| <b>Supporting Material:</b> | --   |

] (RS\_BRF\_01728)

## 6 Requirements for the SAE J1939 Request Manager

### 6.1 Functional Overview

This chapter describes the requirements that shall be fulfilled by the AUTOSAR J1939 Request Manager, which implements the request management protocol defined by [SAE J1939-21] using the Request and the Acknowledgement PG.

The following pictures show the parts of the complete AUTOSAR system and in particular the Communication Services in which the J1939 Request Manager is situated.

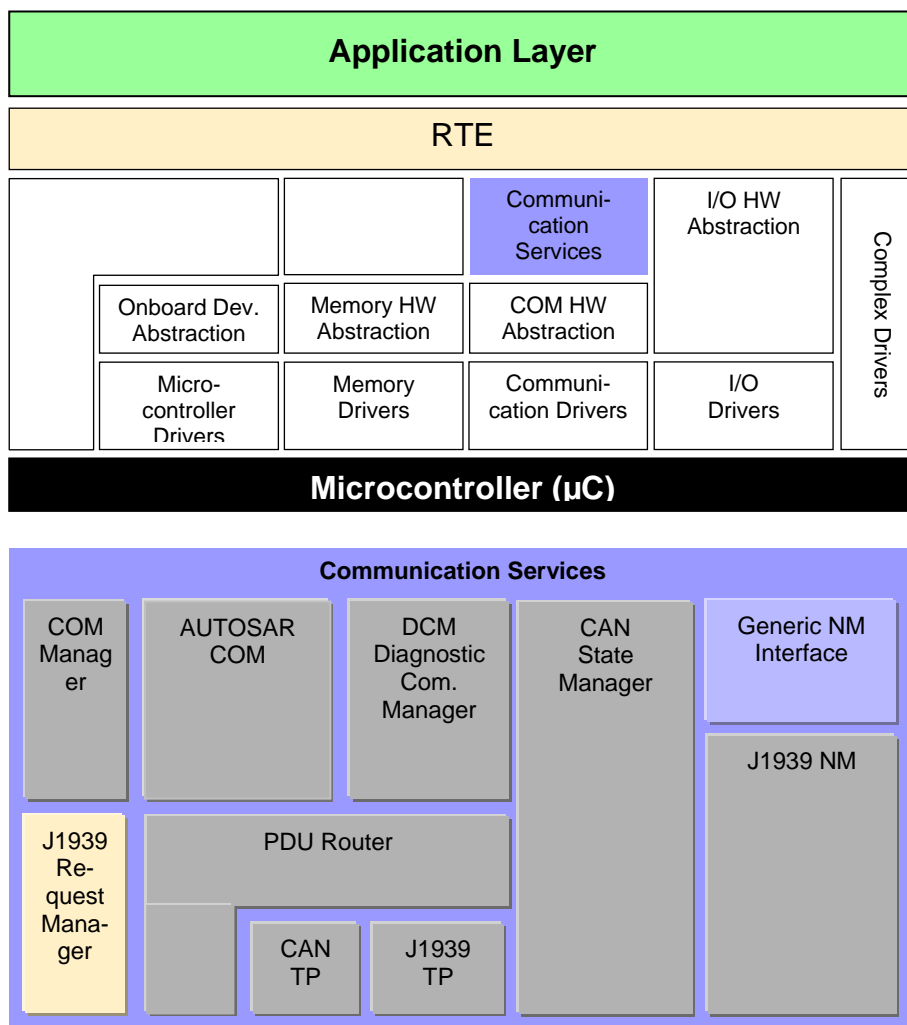


Figure 2: Position of the J1939Rm in the AUTOSAR architecture

## 6.2 Functional Requirements

### 6.2.1 Configuration

#### 6.2.1.1 [SRS\_J1939\_00005] The local addresses of the ECU shall be configurable

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | The addresses which are accepted by the J1939 Request Manager when used as destination address of received messages or as source addresses of transmitted messages shall be configurable. |
| <b>Rationale:</b>           | The ECU needs to be able to support more than one function.   |
| <b>Use Case:</b>            | An engine ECU might also control the retarder.  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01592, RS\_BRF\_01736)

#### 6.2.1.2 [SRS\_J1939\_00007] The queue size for transmitted PGs shall be configurable

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | valid   |
| <b>Description:</b>         | The size of the queues for the transmitted PGs Request and Acknowledgment shall be configurable separately. |
| <b>Rationale:</b>           | The number of outgoing Request or Acknowledgement PGs strongly depends on the use case.                     |
| <b>Use Case:</b>            | Adaptation to actual use case.  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01592)

#### 6.2.1.3 [SRS\_J1939\_00008] Requestable PGNs shall be configurable

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | The J1939 Request Manager shall support configuration of the PGNs for which a request shall be accepted. |
| <b>Rationale:</b>           | The set of PGNs that need to be requested is strongly use case dependent.                                |
| <b>Use Case:</b>            | Adaptation to actual use case.   |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01592)

#### 6.2.1.4 [SRS\_J1939\_00009] The upper layers using J1939 Request Manager services shall be configurable

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | The J1939 Request Manager shall be able to configure used APIs and callbacks/callouts for arbitrary upper layer modules.  |
| <b>Rationale:</b>           | The J1939 Request Manager needs to support requests for AddressClaimed, diagnostic messages, and application messages. Not all upper layer modules need all features of J1939 Request Manager.                              |
| <b>Use Case:</b>            | The J1939 Network Management module and J1939 Diagnostic Communication Manager will not always be present, and the PGNs supported by J1939 Diagnostic Communication Manager or the application are also use case dependent. |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01592)

### 6.2.2 Initialization

#### 6.2.2.1 [SRS\_J1939\_00012] The J1939 Request Manager shall provide an interface for module initialization

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | valid   |
| <b>Description:</b>         | The J1939 Request Manager shall provide and implement an interface for initialization of all states and all global variables of the module. |
| <b>Rationale:</b>           | Basic functionality   |
| <b>Use Case:</b>            | ECU initialization  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01592, RS\_BRF\_01096, RS\_BRF\_01136, SRS\_BSW\_00101)

### 6.2.3 Normal Operation

#### 6.2.3.1 [SRS\_J1939\_00014] The J1939 Request Manager shall forward incoming requests to configured destinations

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | The J1939 Request Manager shall filter incoming Request PGs (destination address, PGN) and call the request indication of the modules configured for that PGN. |
| <b>Rationale:</b>           | Request handling   |
| <b>Use Case:</b>            | Dispatching of received requests to the correct destination module.  |
| <b>Dependencies:</b>        | Configuration of request destinations, see [SRS_J1939_00005], [SRS_J1939_00008], and [SRS_J1939_00009]   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01592)

### 6.2.3.2 [SRS\_J1939\_00015] The J1939 Request Manager shall forward incoming acknowledgements to configured destinations

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | valid   |
| <b>Description:</b>         | The J1939 Request Manager shall filter incoming Acknowledgement PGs (acknowledged address, PGN) and call the acknowledgement indication of the modules configured for that PGN. |
| <b>Rationale:</b>           | Acknowledgement handling  |
| <b>Use Case:</b>            | Dispatching of received acknowledgements to the correct destination module.   |
| <b>Dependencies:</b>        | Configuration of acknowledgement destinations, see [SRS_J1939_00005], [SRS_J1939_00008], and [SRS_J1939_00009]  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01592)

### 6.2.3.3 [SRS\_J1939\_00016] The J1939 Request Manager shall provide an interface for transmission of request messages

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | The J1939 Request Manager shall provide and implement an interface for transmission of requests for arbitrary PGNS from a configured set of source addresses to arbitrary destination addresses. |
| <b>Rationale:</b>           | Request handling   |
| <b>Use Case:</b>            | Transmission of requests   |
| <b>Dependencies:</b>        | Configuration of source addresses and request functionality, see [SRS_J1939_00005] and [SRS_J1939_00009]   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01592, RS\_BRF\_01056)

### 6.2.3.4 [SRS\_J1939\_00017] The J1939 Request Manager shall provide an interface for transmission of acknowledgement messages

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | The J1939 Request Manager shall provide and implement an interface for transmission of acknowledgements for arbitrary PGNS from a configured set of source addresses for arbitrary acknowledged addresses. |
| <b>Rationale:</b>           | Acknowledgement handling   |
| <b>Use Case:</b>            | Transmission of acknowledgements   |
| <b>Dependencies:</b>        | Configuration of source addresses and acknowledgement functionality, see [SRS_J1939_00005] and [SRS_J1939_00009]   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01592, RS\_BRF\_01056)



### 6.2.3.5 [SRS\_J1939\_00026] The J1939 Request Manager shall support timeout supervision for outgoing requests

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | Valid  |
| <b>Description:</b>         | The J1939 Request Manager shall be configurable to supervise timeout of outgoing requests. The timeout shall be stopped when a suitable acknowledgement was received, when the requested PGN was received by COM, or when a dedicated interface of the J1939 Request Manager is called. When not stopped, a configurable callback function shall be invoked. |
| <b>Rationale:</b>           | Request handling   |
| <b>Use Case:</b>            | Monitor timeout of the response to a transmitted request message.  |
| <b>Dependencies:</b>        | Configuration of timeout supervision functionality, see [SRS_J1939_00009]  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01592, RS\_BRF\_01600)

## 6.2.4 Shutdown Operation

### 6.2.4.1 [SRS\_J1939\_00013] The J1939 Request Manager shall provide an interface for module shutdown

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | valid   |
| <b>Description:</b>         | The J1939 Request Manager shall provide and implement an interface for de-initialization of the module. |
| <b>Rationale:</b>           | Basic functionality   |
| <b>Use Case:</b>            | ECU shutdown, ECU degradation   |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01592, RS\_BRF\_01096)

## 7 Requirements for the SAE J1939 Network Management

### 7.1 Functional Overview

This chapter describes the requirements that shall be fulfilled by the AUTOSAR J1939 Network Management, which implements the request management protocol defined by [SAE J1939-81].

The following pictures show the parts of the complete AUTOSAR system and in particular the Communication Services in which the J1939 Network Management module is situated.

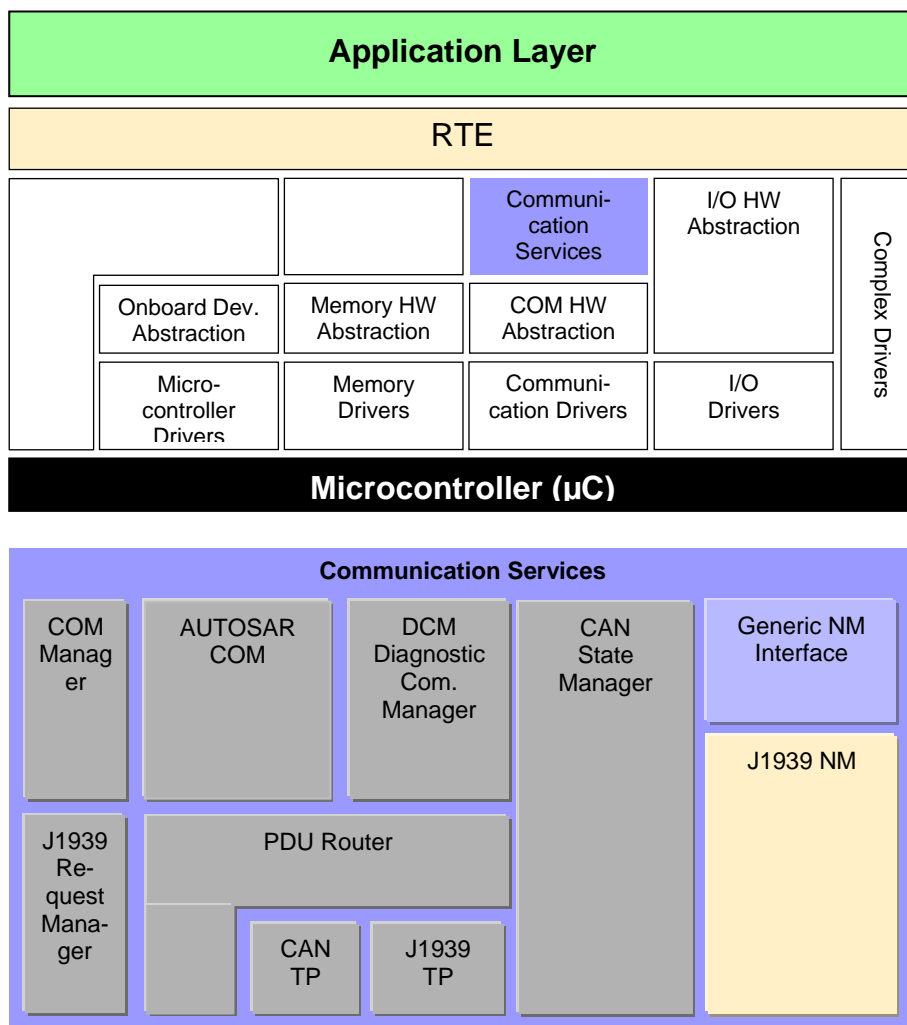


Figure 3: Position of the J1939Nm in the AUTOSAR architecture

## 7.2 Functional Requirements

### 7.2.1 Configuration

#### 7.2.1.1 [SRS\_J1939\_00027] The channels on which the J1939 Network Management module is active shall be configurable

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | The channels on which the J1939 Network Management module performs address claiming shall be configurable. |
| <b>Rationale:</b>           | Address claiming is not required for all channels.   |
| <b>Use Case:</b>            | Gateway ECU with J1939 and proprietary channels.   |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01736)

#### 7.2.1.2 [SRS\_J1939\_00028] The local addresses of the ECU shall be configurable

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | Valid   |
| <b>Description:</b>         | The addresses which are claimed by the J1939 Network Management module shall be configurable. |
| <b>Rationale:</b>           | The ECU needs to be able to support more than one function.                                   |
| <b>Use Case:</b>            | An engine ECU might also control the retarder.  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01736)

#### 7.2.1.3 [SRS\_J1939\_00029] The NAMEs used for claiming of each configured address shall be configurable

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | For each address that is configured to be claimed a separate NAME is required. All fields of the NAME shall be configurable. |
| <b>Rationale:</b>           | NAMEs must be unique for each network.   |
| <b>Use Case:</b>            | An engine ECU might also control the retarder.   |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01736)

## 7.2.2 Initialization

### 7.2.2.1 [SRS\_J1939\_00030] The J1939 Network Management module shall provide an interface for module initialization

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | valid   |
| <b>Description:</b>         | The J1939 Network Management module shall provide and implement an interface for initialization of all states and all global variables of the module. |
| <b>Rationale:</b>           | Basic functionality   |
| <b>Use Case:</b>            | ECU initialization  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01736, RS\_BRF\_01096, RS\_BRF\_01136, SRS\_BSW\_00101)

## 7.2.3 Normal Operation

### 7.2.3.1 [SRS\_J1939\_00033] The J1939 Network Management module shall perform an initial address claim at startup

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | valid   |
| <b>Description:</b>         | For configured channels and ECU addresses, the J1939 Network Management module shall perform an initial address claim at startup. |
| <b>Rationale:</b>           | Address claim is required before communication is allowed on J1939 networks.  |
| <b>Use Case:</b>            | Startup behavior of fully J1939 compliant ECUs.   |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01736)

### 7.2.3.2 [SRS\_J1939\_00034] The J1939 Network Management module shall react correctly to contending address claims

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | When a contending address claim is received, the J1939 Network Management module shall answer with an AddressClaimed or with a CannotClaimAddress PG, depending on the relative priority of the NAMES. |
| <b>Rationale:</b>           | Duplicate addresses in the initial network setup shall not lead to undefined communication states.   |
| <b>Use Case:</b>            | Two ECUs might claim the same addresses, either because of an invalid network setup, or because one of the ECUs chooses its address at runtime.  |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01736)

### 7.2.3.3 [SRS\_J1939\_00035] The J1939 Network Management module shall react to requests for the AddressClaimed PG

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | When a request for the AddressClaimed PG arrives, the J1939 Network Management module shall answer by transmission of AddressClaimed or CannotClaimAddress PGs for all configured addresses. |
| <b>Rationale:</b>           | Correct answer to Request PG.  |
| <b>Use Case:</b>            | A tester sends a request for AddressClaimed to the whole network, or an ECU wants to check whether it desired address is available.  |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01736, RS\_BRF\_01592)

### 7.2.3.4 [SRS\_J1939\_00036] The J1939 Network Management module shall only allow communication after a successful address claim

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | valid   |
| <b>Description:</b>         | The J1939 Network Management module shall start communication for one of its configured addresses when the address claim succeeded, and stop communication when the address was lost due to a contending address claim. |
| <b>Rationale:</b>           | A J1939 ECU may only use its address for communication after this was successfully claimed.   |
| <b>Use Case:</b>            | Correct start-up behavior of a J1939 ECU, and correct reaction to contending address claims.  |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01736)

### 7.2.3.5 [SRS\_J1939\_00037] The J1939 Network Management module shall delay communication after initial address claim

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | The J1939 Network Management module shall delay communication for 250ms to wait for contending address claims. This delay shall be configurable. |
| <b>Rationale:</b>           | The start-up delay may be skipped for single address CAs with addresses in the ranges 0..127 and 248..253.                                       |
| <b>Use Case:</b>            | Correct start-up behavior of J1939 ECUs.   |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01736)

## 7.2.4 Shutdown Operation

### 7.2.4.1 [SRS\_J1939\_00031] The J1939 Network Management module shall provide an interface for module shutdown

|                             |   |
|-----------------------------|---|
| <b>Type:</b>                | valid   |
| <b>Description:</b>         | The J1939 Network Management module shall provide and implement an interface for de-initialization of the module. |
| <b>Rationale:</b>           | Basic functionality   |
| <b>Use Case:</b>            | ECU shutdown, ECU degradation   |
| <b>Dependencies:</b>        | --  |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"   |

] (RS\_BRF\_01736, RS\_BRF\_01096)

## 7.2.5 Fault Operation

### 7.2.5.1 [SRS\_J1939\_00032] The J1939 Network Management module shall report a failed address claim to the Diagnostic Event Manager

|                             |  |
|-----------------------------|--|
| <b>Type:</b>                | valid  |
| <b>Description:</b>         | The J1939 Network Management module shall report to the Diagnostic Event Manager (DEM) when the address claim for one of the configured addresses fails. |
| <b>Rationale:</b>           | Loss of address is critical, because some functionality will then not be available.  |
| <b>Use Case:</b>            | Due to invalid network setup, it can happen that one of the configured addresses cannot be claimed.  |
| <b>Dependencies:</b>        | --   |
| <b>Supporting Material:</b> | Concept 579 "Support for Heavy Duty Vehicles"  |

] (RS\_BRF\_01736)

## 8 References

### 8.1 Deliverables of AUTOSAR

**[J1939Tp]** Specification of a Transport Layer for SAE J1939  
AUTOSAR\_SWS\_SAEJ1939TransportLayer.pdf

**[J1939Rm]** Specification of a Request Manager for SAE J1939  
AUTOSAR\_SWS\_SAEJ1939RequestManager.pdf

**[J1939Nm]** Specification of Network Management for SAE J1939  
AUTOSAR\_SWS\_SAEJ1939NetworkManagement.pdf

**[SRSGeneral]** General Requirements on Basic Software Modules  
AUTOSAR\_SRS\_BSWGeneral.pdf

**[TPS\_STDT\_0078]** Software Standardization Template  
AUTOSAR\_TPS\_StandardizationTemplate.pdf

### 8.2 Related standard and norms

#### 8.2.1 SAE

[SAE J1939-21], Data Link Layer

[SAE J1939-81], Network Management

[SAE J1939-73], Application layer – Diagnostics