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1 Introduction and Functional Overview

This specification describes the functionality, the API, and the configuration of the AUTOSAR Basic Software module SAE J1939 Transport Layer, which implements a transport layer for AUTOSAR which is compatible to SAE J1939-21. The terms SAE J1939 Transport Layer module and J1939Tp are used synonymously in this document.

SAE J1939 has a broad acceptance in the truck domain, and consists of several documents describing the layers of the communication protocol from the physical layer to diagnostics and the application layer. SAE J1939-21 describes the data link and transport layer, which includes two transport protocol variants:

BAM (Broadcast Announce Message) for broadcast messages, and

CMDT (Connection Mode Data Transfer) for point-to-point connections.

This specification defines how the transport protocol of SAE J1939-21 can be implemented in the AUTOSAR architecture. It only describes those parts of the implementation that are relevant to the AUTOSAR architecture. Protocol specific details like exact timings are not part of this specification. Therefore, to be able to implement the SAE J1939 Transport Layer module, the reader of this specification needs to read also the original SAE J1939-21 specification document.

The module J1939Tp interfaces to the PDU Router and the CAN Interface (via the L-SDU Router), as shown in the following figure:

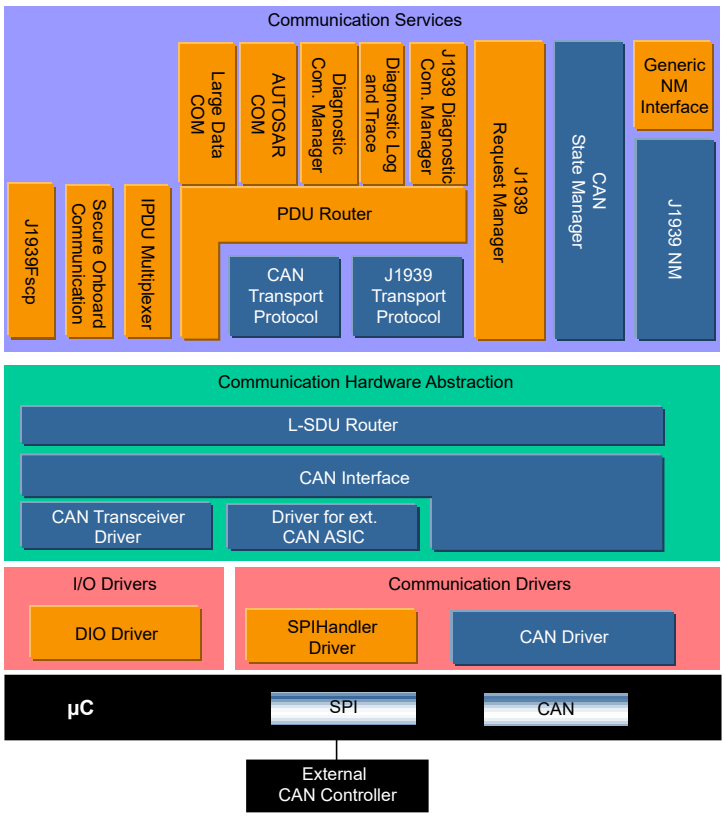

Figure 1.1: AUTOSAR Communication Stack

The purpose of J1939Tp is to segment and reassemble J1939 PGNs (N-SDUs) that are longer than 8 bytes. The segmented messages are sent and received via the L-SDU Router.

The PDU Router (PduR) deploys AUTOSAR COM and DCM I-PDUs onto different communication protocols (e.g. CAN or J1939, segmented via transport layer or directly). At run-time, the PduR decides where to route I-PDUs based on the I-PDU (L-SDU or N-SDU) identifier. In the same way, the LSduR uses the L-SDU (I-PDU or N-PDU) identifier to decide whether a received message must be processed by one of the available transport layer modules or may be forwarded directly to the PduR.

J1939Tp supports fixed and variable size N-SDUs (I-PDUs) with more than 8 bytes. I-PDUs that do not exceed 8 bytes are exchanged directly between PduR and CanIf via LSduR.

Fixed size N-SDUs are always segmented by the J1939Tp, while variable size N-SDUs are only segmented when they exceed 8 bytes. J1939Tp forwards variable size N-SDUs with an actual size of 8bytes or less and a configured maximum size of more than 8 bytes directly to the LSduR. The transport protocol variant (BAM or CMDT) is chosen based on received N-PDUs when a large N-SDU is received, and on the configuration and the actual DA when a large N-SDU is transmitted.

J1939Tp supports handling of N-PDUs and N-SDUs with variable SA, DA, and Priority. In this case, the N-PDUs and N-SDUs will contain parts of the CAN ID in the meta data.

In summary, J1939Tp provides the following functionality:

- Segmentation and direct transmission of data in transmit direction
- Reassembling and direct reception of data in receive direction
- Control of data flow
- Timeout supervision
- Detection of errors during segmentation or reassembly

2 Acronyms, Abbreviations, and Terms

2.1 Definition of Acronyms and abbreviations

The table below contains all acronyms, abbreviations or initialisms that are component-specific and not available in the AUTOSAR glossary [1].

Acronym/ Abbreviation	Description
AC	SAE J1939 AddressClaimed PG (PGN = 0x0EE00), which contains the NAME and is used for the SAE J1939 address claiming, CannotClaimAddress when SA = 0xFE
BAM	Broadcast Announce Message, broadcast variant of SAE J1939 transport protocol
CA	Controller Application, role of an ECU tied to one address
Can	CAN Driver, abstracting from CAN controller hardware, see [2, SWS CAN Driver]
CanIf	CAN Interface, abstracting from CAN drivers and transceivers, see [3, SWS CAN Interface]
CanTp	CAN Transport Layer, see [4, SWS CAN Transport Layer]
CMDT	Connection Mode Data Transfer, a.k.a. RTS/CTS, peer-to-peer variant of SAE J1939 transport protocol
DA	Destination Address, the address of the receiving CA of a PG. Part of the 29 bit CAN identifier of SAE J1939 PGs.
DP	Data Page, the most significant bit (MSB) of the 18 bit PGN
EcuM	ECU State Manager, mainly responsible for startup and shutdown of the ECU, see [5, SWS ECU State Manager]
EDP	Extended Data Page, the second bit (after MSB) of the 18 bit PGN
FrTp	FlexRay ISO Transport Layer, see [6, SWS FlexRay ISO Transport Layer]
J1939Dcm	SAE J1939 Diagnostic Communication Manager, implementing the SAE J1939 Diagnostics, see [7, SWS SAE J1939 Diagnostic Communication Manager]
J1939Tp	SAE J1939 Transport Layer, this BSW module, implementing the SAE J1939 Transport Protocol
LSduR	L-SDU Router, establishes communication between bus interface and other BSW modules, see [8, SWS L-SDU Router]
NAME	The 64 bit NAME of a CA used in the AddressClaimed PG
PDU1	SAE J1939 PDU Type 1, this kind of PG can be sent to a specific destination address
PDU2	SAE J1939 PDU Type 2, this kind of PG can only be sent as broadcast
PDUF	PDU Format, the middle byte of the 18 bit PGN which identifies the PG and determines the layout (PDU1/PDU2) of the PGN

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Acronym/ Abbreviation	Description
PduR	PDU Router, establishes communication between BSW modules, see [9, SWS PDU Router]
PDUS	PDU Specific, the lower byte of the 18 bit PGN which further identifies PDU2 PGs which cannot have a destination address
PG	Parameter Group, corresponds to an N-SDU of J1939Tp
PGN	Parameter Group Number
SA	Source Address, the address of the transmitting CA of a PG. Part of the 29 bit CAN identifier of SAE J1939 PGs.
SchM	Basic Software Schedule Manager, part of the RTE
SNA	Signal Not Available, all bits set to 1 in SAE J1939 PGs/Parameters
SPN	Suspect Parameter Number, unique identifier of an SAE J1939 Parameter
TP.CM	Connection Management message (PGN = 0x0EC00) used by SAE J1939 transport protocol, corresponds to an N-PDU of J1939Tp
TP.CM_BAM	Broadcast Announce Message, variant of TP.CM that initiates a BAM transmission
TP.CM_CTS	Connection Mode Clear To Send, variant of TP.CM that is used for handshake during CMDT transmission
TP.CM_EOMAck	End Of Message Acknowledge, variant of TP.CM that acknowledges correct reception of a CMDT transmission
TP.CM_RTS	Connection Mode Request To Send, variant of TP.CM that initiates a CMDT transmission
TP.Conn_Abort	Connection Abort, variant of TP.CM that terminates a CMDT transmission
TP.DT	Data Transfer message (PGN = 0x0EB00) used by SAE J1939 transport protocol, corresponds to an N-PDU of J1939Tp

Table 2.1: Acronyms and Abbreviations

The table below contains all document-independant acronyms or abbreviations that are defined in the AUTOSAR glossary [1].

Acronym/ Abbreviation	Description
BSW	Basic Software
DET	Default Error Tracer, supports development and runtime error reporting, see [10, Specification of Default Error Tracer]
PDU	Protocol Data Unit

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Acronym/ Abbreviation	Description
RTE	Run-Time Environment, provides the infrastructure services that enable communication to occur between AUTOSAR SWCs as well as acting as the means by which AUTOSAR SWCs access basic software modules including the OS and communication service. This includes the RTE's responsibility for the realization of the scheduling of the SWCs. See [11, Specification of RTE Software]
SAE	Society of Automotive Engineers, see: `SAE J1939`
SDU	`Service Data Unit`

Table 2.2: Acronyms and Abbreviations used from AUTOSAR Glossary

2.2 Definition of Terms

The table below contains all definitions of terms that are used in this document.

Glossary Term	Explanation
Basic Software module (BSW)	A module of the AUTOSAR stack below the RTE
Meta Data	Meta data transferred alongside a PDU, consisting of a set of `meta data items`
Meta Data Item	A single item of `meta data` of defined type and size
Parameter	A parameter is a signal of the `SAE J1939` application layer. The Parameter definition includes defined scale, limits, offset, and physical unit. Parameters are uniquely identified by the SPN.
Parameter Group	A Parameter Group is a message of the `SAE J1939` application layer. Each Parameter Group contains several `Parameters` (signals), and is uniquely identified by the PGN.
Parameter Group Number	Unique identifier (18 bits: EDP, DP, PDUF, PDUS) of an `SAE J1939 Parameter Group` that is contained in the payload of many `SAE J1939` protocol messages and in the 29bit CAN identifier of `SAE J1939` PGs.
SAE J1939	Serial control and communications standard for heavy duty vehicle networks created by the SAE, see [12, SAE J1939]
SAE J1939-21	Data link layer for CAN 2.0 created by the SAE, see [13, SAE J1939-21]
SAE J1939-73	Diagnostics application layer created by the SAE, see [14, SAE J1939-73]

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Glossary Term	Explanation
SAE J1939-81	Network management layer created by the SAE, see [15, SAE J1939-81]
SAE J1939 Address Claiming	The SAE J1939 address claiming procedure is the core feature of the network management of SAE J1939 defined in the standard document SAE J1939-81. Address claiming assigns a temporary 8-bit identifier to each CAs connected to an SAE J1939 network, based on the NAME of the CAs. Within each network, the 8-bit identifier is required to be unique. The 8-bit identifier is used as SA and DA of Parameter Groups (messages) transferred via the SAE J1939 network. The address claiming procedure is based on the exchange of AddressClaimed messages.
SAE J1939 Diagnostics	The SAE J1939 diagnostic layer is defined in the standard document SAE J1939-73. The SAE J1939 diagnostics is functionally similar to the UDS diagnostics, and has recently been extended to support OBD for emission related values.
SAE J1939 Transport Protocol	The SAE J1939 transport protocol is used for the segmented transmission of PGs with more than 8 bytes of data. The transport protocol is defined in the network layer standard document SAE J1939-21.

Table 2.3: Definition of terms in the scope of this Document

3 Related Documentation

3.1 Input Documents & Related Standards and Norms

[1] Glossary
AUTOSAR_FO_TR_Glossary

[2] Specification of CAN Driver
AUTOSAR_CP_SWS_CANDriver

[3] Specification of CAN Interface
AUTOSAR_CP_SWS_CANInterface

[4] Specification of CAN Transport Layer
AUTOSAR_CP_SWS_CANTransportLayer

[5] Specification of ECU State Manager
AUTOSAR_CP_SWS_ECUStateManager

[6] Specification of FlexRay ISO Transport Layer
AUTOSAR_CP_SWS_FlexRayISOTransportLayer

[7] Specification of a Diagnostic Communication Manager for SAE J1939
AUTOSAR_CP_SWS_SAEJ1939DiagnosticCommunicationManager

[8] Specification of Linklayer Sdu Routing Module
AUTOSAR_CP_SWS_LSduRouter

[9] Specification of PDU Router
AUTOSAR_CP_SWS_PDURouter

[10] Specification of Default Error Tracer
AUTOSAR_CP_SWS_DefaultErrorTracer

[11] Specification of RTE Software
AUTOSAR_CP_SWS_RTE

[12] SAE J1939 – Serial Control and Communications Heavy Duty Vehicle Network

[13] SAE J1939-21 Data Link Layer

[14] SAE J1939-73 Application Layer – Diagnostics

[15] SAE J1939-81 Network Management

[16] General Specification of Basic Software Modules
AUTOSAR_CP_SWS_BSWGeneral

[17] Layered Software Architecture
AUTOSAR_CP_EXP_LayeredSoftwareArchitecture

[18] General Requirements on Basic Software Modules
AUTOSAR_CP_RS_BSWGeneral

[19] Specification of Communication Stack Types
AUTOSAR_CP_SWS_CommunicationStackTypes

[20] Specification of Standard Types
AUTOSAR_CP_SWS_StandardTypes

[21] System Template
AUTOSAR_CP_TPS_SystemTemplate

[22] Specification of ECU Configuration
AUTOSAR_CP_TPS_ECUConfiguration

3.2 Related Specification

AUTOSAR provides a General Specification on `Basic Software` modules [16, SWS BSW General], which is also valid for the `SAE J1939 Transport Layer` module.

Thus, the specification [16, SWS BSW General] shall be considered as additional and required specification for the `SAE J1939 Transport Layer` module.

4 Constraints and Assumptions

4.1 Limitations

The AUTOSAR architecture contains several communication system specific transport layers (J1939Tp, CanTp, FrTp, etc.). All of these modules need to have identical APIs, with the exception of API functions for which the PduR has separate configuration abilities.

The J1939Tp module does not implement the TriggerTransmit API, because it is only needed for time triggered bus architectures.

4.2 Applicability to Automotive Domains

The SAE J1939 Transport Layer supports the implementation of ECUs that are designed to operate in a J1939 network.

5 Dependencies to Other Modules

The [17, EXP Layered Software Architecture] shows an overview of the neighboring modules of the SAE J1939 Transport Layer module.

Besides the standard modules Default Error Tracer (DET), ECU State Manager (EcuM), and Basic Software Scheduler (SchM), which have interfaces to all BSW modules, J1939Tp only interacts with the PDU Router (PduR) and the L-SDU Router (LSduR), and indirectly with the CAN Interface (CanIf). The interfaces of J1939Tp are similar to the interfaces of CAN Transport Layer (CanTp).

The figure below shows the interactions between J1939Tp, PduR, and CanIf, omitting LSduR, CAN Driver, and potential upper layers, which are not relevant to understand these interactions.

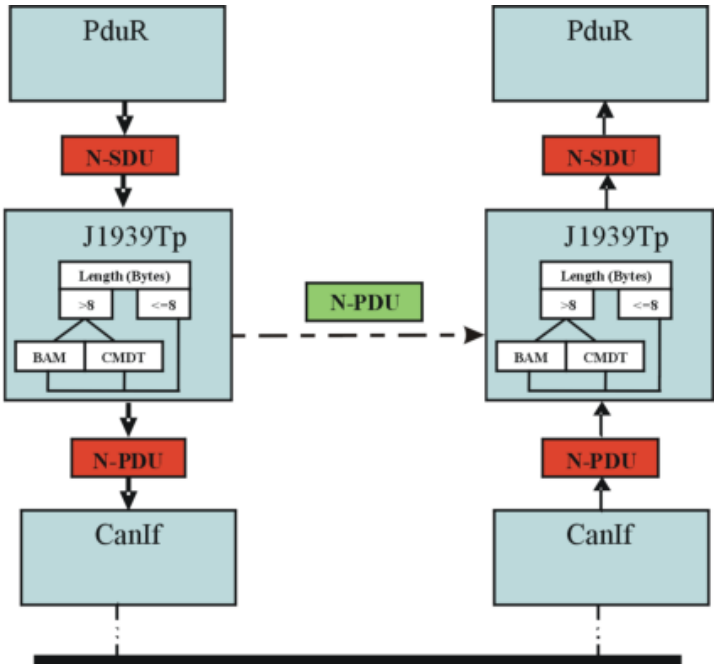

Figure 5.1: J1939 Transport Layer interactions

The J1939Tp's upper interface offers the PduR module access to transmitted and received N-SDUs corresponding to J1939 PGs with a maximum length of more than 8 bytes of data.

J1939 PGs with a maximum length of 8 bytes or less are exchanged directly between PduR and CanIf via LSduR.

5.1 File Structure

AUTOSAR specifies that an ECU can be created from modules provided as object code, source code (generated or static), or both.

The decision to provide a module as object code or source code is based on a compromise between IP protection, test coverage, code efficiency and configurability at system generation time. Depending on the configurability requirements of the OEM, suppliers may deliver the J1939Tp module as object code or source code.

The file hierarchy defined in this section allows the separation of platform, compiler, and implementation specific definitions and declarations from general definitions, as well as the separation of source code and configuration.

5.1.1 Code File Structure

For details, refer to [16, SWS BSW General] Chapter 5.1.6 *"Code file structure"*.

[SWS_J1939Tp_00007] ⌈Internally used data types and functions shall be defined locally in the implementation source files.⌋

This prevents visibility of these symbols outside of the J1939Tp module.

5.1.2 Header File Structure

For details, refer to [16, SWS BSW General] Chapter 5.1.7 *"Header file structure"*.

6 Requirements Tracing

The following table references the requirements specified in [18, RS BSW General] and links to the fulfillment of these.

Requirement	Description	Satisfied by
[SRS_BSW_00101]	The Basic Software Module shall be able to initialize variables and hardware in a separate initialization function	[SWS_J1939Tp_00087]
[SRS_BSW_00167]	All AUTOSAR Basic Software Modules shall provide configuration rules and constraints to enable plausibility checks	[SWS_J1939Tp_00084]
[SRS_BSW_00171]	Optional functionality of a Basic-SW component that is not required in the ECU shall be configurable at pre-compile-time	[SWS_J1939Tp_00125]
[SRS_BSW_00323]	All AUTOSAR Basic Software Modules shall check passed API parameters for validity	[SWS_J1939Tp_00188]
[SRS_BSW_00327]	Error values naming convention	[SWS_J1939Tp_00115]
[SRS_BSW_00333]	For each callback function it shall be specified if it is called from interrupt context or not	[SWS_J1939Tp_00110] [SWS_J1939Tp_00114]
[SRS_BSW_00335]	Status values naming convention	[SWS_J1939Tp_00019]
[SRS_BSW_00336]	Basic SW module shall be able to shutdown	[SWS_J1939Tp_00093]
[SRS_BSW_00337]	Classification of development errors	[SWS_J1939Tp_00115]
[SRS_BSW_00357]	For success/failure of an API call a standard return type shall be defined	[SWS_J1939Tp_00096]
[SRS_BSW_00358]	The return type of init() functions implemented by AUTOSAR Basic Software Modules shall be void	[SWS_J1939Tp_00087]
[SRS_BSW_00359]	Callback Function Return Types for AUTOSAR BSW	[SWS_J1939Tp_00108] [SWS_J1939Tp_00112]
[SRS_BSW_00360]	AUTOSAR Basic Software Modules callback functions are allowed to have parameters	[SWS_J1939Tp_00108] [SWS_J1939Tp_00112]
[SRS_BSW_00373]	The main processing function of each AUTOSAR Basic Software Module shall be named according the defined convention	[SWS_J1939Tp_00104]
[SRS_BSW_00385]	List possible error notifications	[SWS_J1939Tp_00115]
[SRS_BSW_00386]	The BSW shall specify the configuration and conditions for detecting an error	[SWS_J1939Tp_00026] [SWS_J1939Tp_00071] [SWS_J1939Tp_00188]
[SRS_BSW_00400]	Parameter shall be selected from multiple sets of parameters after code has been loaded and started	[SWS_J1939Tp_00187]
[SRS_BSW_00405]	BSW Modules shall support multiple configuration sets	[SWS_J1939Tp_00187]
[SRS_BSW_00406]	API handling in uninitialized state	[SWS_J1939Tp_00023]



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Requirement	Description	Satisfied by
[SRS_BSW_00414]	Init functions shall have a pointer to a configuration structure as single parameter	[SWS_J1939Tp_00187]
[SRS_BSW_00438]	Configuration data shall be defined in a structure	[SWS_J1939Tp_00187]
[SRS_BSW_00441]	Naming convention for type, macro and function	[SWS_J1939Tp_00019] [SWS_J1939Tp_00115]
[SRS_BSW_00450]	A Main function of a un-initialized module shall return immediately	[SWS_J1939Tp_00023]
[SRS_BSW_00478]	Timing limits of main functions	[SWS_J1939Tp_00106]

Table 6.1: Requirements Tracing

7 Functional Specification

This chapter defines the behavior of the SAE J1939 Transport Layer. The API of the module is defined in Chapter 8, while the configuration is defined in Chapter 10.

7.1 Basic Principles of SAE J1939

The SAE J1939 standard defines a set of Parameter Groups (PGs), each containing signals with defined content and semantics. The following information is provided for each PG:

- Payload length type: maximal number of bytes, fixed or variable size.
- Parameter Group Number (PGN): 18 bit value containing the following fields:
  - 2 bit data page information (EDP and DP)
  - 8 bit PDU Format (PDUF)
  - 8 bit PDU Specific (PDUS)

PGNs with PDU Format < 240 (PDU1 format) identify point-to-point messages, while PGNs with PDU Format >= 240 (PDU2 format) identify broadcast messages. The PDU Specific field is only relevant for broadcast messages (PDU2 format); it is always zero for point-to-point messages (PDU1 format).

J1939 uses 29-bit CAN identifiers to identify each message. The CAN identifier contains a 3-bit-priority, the PGN, the Source Address (SA), and the Destination Address (DA, only for point-to-point messages).

Usually, an ECU has just one node address, which is used as DA in received messages and as SA in transmitted messages. However, a single ECU can also implement several different J1939 nodes at once, each with its own node address. In this case, the ECU accepts any of these node addresses as DA and sends with any of the defined node addresses as SA.

The SAE J1939 Transport Layer module uses two special point-to-point messages identified by PGNs of PDU1 format to transport segmented messages, both with a fixed length of 8 bytes. These messages are called transport frames in the context of this document.

TP.CM is used for connection management. The first byte of the payload identifies its role, which may be one of the following:

TP.CM_BAM is used to initiate a BAM transfer.

TP.CM_RTS is transmitted to initiate a CMDT transfer.

TP.CM_CTS is used for flow control during a CMDT transfer.

TP.CM_EOMAck indicates the end of a CMDT transfer.

TP.Conn_Abort indicates an error and terminates the CMDT transfer.

TP.DT contains a sequence number in the first byte and 7 bytes of data, used for both BAM and CMDT transfers.

A single TP.CM or TP.DT frame, identified by a certain CAN Identifier, is used for different PGs. The PGN of the transported PG is contained in the payload of the TP.CM frames as specified in SAE J1939-21.

The destination address (DA) of CMDT related transport frames contains a valid node address and thus allows a point-to-point connection, while the DA of BAM related transport frames is always set to 0xFF to create a broadcast connection.

[SWS_J1939Tp_00018] ⌈The J1939Tp module shall follow the recommendations of SAE J1939-21 if they are not explicitly excluded in this document.⌋

7.2 Basic Functionality of J1939Tp

This section describes aspects of the functionality of J1939Tp that are not related to neighboring modules.

[SWS_J1939Tp_00071]

Upstream requirements: SRS_BSW_00386

⌈On errors and exceptions, the J1939Tp module shall not modify its current module state but shall simply report the error event.⌋

See Figure 7.1 for the J1939Tp module states.

To assure a unique PDU Router handling of all J1939 PGs which is independent of the Payload Length type (variable or fixed), the J1939Tp is used for the transmission of all Parameter Groups that are longer than 8 Bytes, independent of their length being fixed or variable.

This means that PGs with variable length that have a configured maximum size of more than 8 bytes but do not exceed 8 bytes at run-time shall be transported using J1939Tp even though no segmentation is necessary and a direct transmission from PDU Router to CAN Interface via L-SDU Router would be possible.

[SWS_J1939Tp_00155] ⌈The SAE J1939 Transport Layer module shall implement the following two J1939 transport protocol variants defined in SAE J1939-21:

- BAM for broadcast transmission
- CMDT for point-to-point transmission

⌋

[SWS_J1939Tp_00125]

Upstream requirements: SRS_BSW_00171

⌈The SAE J1939 Transport Layer module shall be configurable to either use both BAM and CMDT transport protocol variants, or only BAM, or only CMDT.⌋

[SWS_J1939Tp_00198] ⌈The SAE J1939 Transport Layer module shall use meta data items of type SOURCE_ADDRESS_16, TARGET_ADDRESS_16, and PRIORITY_8 of all N-SDUs, and meta data items of type CAN_ID_32 for all N-PDUs.⌋

[SWS_J1939Tp_00236] Configurable N-PDU Priorities ⌈The SAE J1939 Transport Layer shall consider J1939TpTxUseNonDefaultTpPriority, J1939TpTxPriority, and J1939TpTxDirectPriority together with meta data item PRIORITY_8 (see [SWS_J1939Tp_00198]) if these are configured.⌋

[SWS_J1939Tp_00231] ⌈The SAE J1939 Transport Layer module shall support several connections for the same PGN in parallel as long as they can be received or transmitted independently.⌋

For the definition of connections see Chapter 7.5.7.

[SWS_J1939Tp_00233] ⌈If several receiving connections are configured with identical PGNs and matching channel parameters, the J1939Tp shall allocate an arbitrary free connection with matching parameters.⌋

Note: This scenario is typically only useful if all of these similar connections are configured to end up at the same upper layer module.

7.3 Initialization and Shutdown

The following figure summarizes all the requirements concerning initialization and shut down:

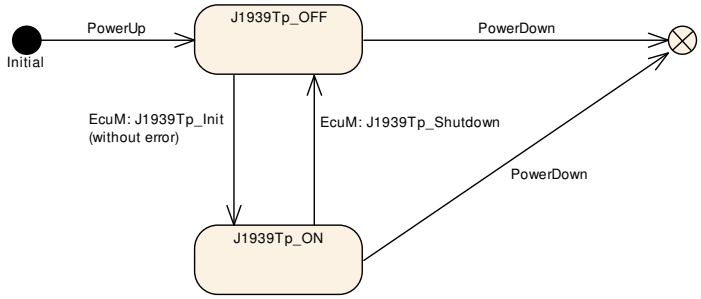

Figure 7.1: J1939 Transport Layer life cycle

[SWS_J1939Tp_00019]

Upstream requirements: SRS_BSW_00335, SRS_BSW_00441

⌈The J1939Tp module shall have two global states, `J1939TP_ON` and `J1939TP_OFF`.⌋

[SWS_J1939Tp_00020] ⌈The J1939Tp module shall be in the `J1939TP_OFF` state after power up.⌋

In the state `J1939TP_OFF`, the J1939Tp allows for an update of the post build configuration.

[SWS_J1939Tp_00023]

Upstream requirements: SRS_BSW_00406, SRS_BSW_00450

⌈The J1939Tp module shall perform segmentation and reassembly tasks only when the J1939Tp is in the `J1939TP_ON` state.⌋

[SWS_J1939Tp_00076] ⌈The global state (see [SWS_J1939Tp_00019]) shall be used to check if the module has been initialized before calling an API.⌋

7.4 Communication with the Lower Layer

[SWS_J1939Tp_00157] ⌈All service interfaces provided to the lower layer shall be independent of the internal communication configuration and implementation of the J1939Tp.⌋

[SWS_J1939Tp_00041] ⌈J1939Tp shall send the transport frames TP.CM and TP.DT and direct frames using the service function `LSduR_J1939TpTransmit()`.⌋

7.4.1 Transmission Confirmation

The transmission confirmation `J1939Tp_TxConfirmation()` is called by CanIf via LSduR to notify J1939Tp of successful or failed transmission of an N-PDU.

[SWS_J1939Tp_00035] ⌈When `J1939Tp_TxConfirmation()` is called with `result` `E_NOT_OK`, the J1939Tp module shall abort the corresponding session.⌋

For transmitting sessions, the session abort is defined in [SWS_J1939Tp_00032], while [SWS_J1939Tp_00031] defines the behavior in case of a receiving session. The J1939Tp shall not try to send an abort frame (as defined by [SWS_J1939Tp_00097]) in this case.

7.4.2 Reception Indication

The J1939Tp module shall provide a `J1939Tp_RxIndication()` API to allow the CanIf to notify via the LSduR that a new N-PDU has been received (see [SWS_J1939Tp_00108]).

CanIf shall perform the Reception Indication according to its configuration (i.e. in ISR context if configured so).

7.5 Internal Behavior

7.5.1 Session Handling

7.5.1.1 Close Transmission

[SWS_J1939Tp_00119] ⌈When the transport transmission session is successfully completed, the J1939Tp module shall call a notification service of the upper layer, `PduR_J1939TpTxConfirmation()`, with the `result` `E_OK`, to notify that the N-SDU transfer is successfully processed.⌋

7.5.1.2 Abort Transmission

[SWS_J1939Tp_00032] ⌈An Abort Transmission feature shall indicate the upper layer that the transmission of a given N-SDU has been aborted. It uses the callback function `PduR_J1939TpTxConfirmation()` with `E_NOT_OK`.⌋

7.5.1.3 Close Reception

[SWS_J1939Tp_00118] ⌈A close connection feature shall indicate the upper layer that the transport reception session is completed. It uses the `PduR_J1939TpRx-Indication()` with `E_OK` to indicate that the N-SDU reception is successfully processed.⌋

7.5.1.4 Abort Reception

[SWS_J1939Tp_00031] ⌈An Abort Reception feature shall indicate the upper layer that the reception of a given N-SDU has been aborted. It uses the `PduR_J1939Tp-RxIndication()` with state `E_NOT_OK`.⌋

7.5.1.5 Abort CMDT Connection

[SWS_J1939Tp_00097] ⌈An Abort CMDT Connection feature shall indicate to the other ECU participating in the concerned connection that the current CMDT session (transmission or reception) cannot be completed successfully. A TP.Conn_Abort abort message shall be transmitted to the other ECU via CAN as specified by SAE J1939-21.⌋

Sending a TP.Conn_Abort is necessary every time an error happens after TP.CM_CTS has been successfully sent or received, and is advisable already after transmission or reception of TP.CM_RTS. The connection abort reason of the TP.Conn_Abort shall be set according to SAE J1939-21.

7.5.2 N-SDU Reception

Reception of an N-SDU is always initiated by the reception of a TP.CM message. In case of CMDT, this is a TP.CM_RTS, in case of BAM a TP.CM_BAM.

[SWS_J1939Tp_00043] ⌈Depending on the control byte of the initializing TP.CM frame (TP.CM_BAM or TP.CM_RTS), the J1939Tp module shall use the variant BAM or CMDT of the J1939 transport protocol to handle the data reception.⌋

[SWS_J1939Tp_00038] ⌈When receiving an N-PDU containing a TP.CM_BAM or a TP.CM_RTS the J1939Tp module shall first notify the upper layer (PDU Router) before processing the frame reassembly. It uses the PduR_J1939TpStartOfReception() function with the following parameters:

- the Identifier of the corresponding N-SDU,
- depending on the configured meta data items: the SA, DA and Priority,
- the total Data Length (after reassembly) and
- a pointer to a location where the upper layer stores its currently available buffer size.

⌋

[SWS_J1939Tp_00162] ⌈After the reception of an N-PDU containing a TP.DT frame, the function PduR_J1939TpCopyRxData() shall be called with the following parameters:

- the Identifier of the corresponding N-SDU,
- info with max. 7 bytes of data,
- a pointer to a location where the upper layer stores its currently available buffer size.

⌋

[SWS_J1939Tp_00173] ⌈The J1939Tp module shall abort the reception silently if any of the following conditions occurs:

- The `PduR_J1939TpStartOfReception()` function returns `BUFREQ_E_NOT_OK` or `BUFREQ_E_OVFL` or
- the protocol chosen in [SWS_J1939Tp_00043] does not match the transport protocol configured for the transported PGN (see `J1939TpRxProtocolType`) or
- the SA/DA of N-PDUs with `meta data` do not match the configured SA/DA (see `J1939TpRxSa`/`J1939TpRxDa`).

In case of a BAM connection, no further activity is required.

In case of a CMDT connection, a CMDT `Connection Abort` shall be performed as described in [SWS_J1939Tp_00097], and the connection abort reason shall be set to 1 (Already in one or more connection managed sessions and cannot support another).⌋

[SWS_J1939Tp_00040] ⌈The J1939Tp module shall abort the reception like indicated in [SWS_J1939Tp_00031] if any of the following conditions occurs:

- The value returned by `PduR_J1939TpStartOfReception()` via bufferSizePtr is smaller than the total data length of the N-SDU when received via the direct N-PDU,
- the `PduR_J1939TpCopyRxData()` function returns `BUFREQ_E_NOT_OK`, or
- the `J1939Tp_CancelReceive()` function is called.

In case of a BAM connection, no further activity is required.

In case of a CMDT connection, a CMDT `Connection Abort` shall be performed as described in [SWS_J1939Tp_00097], and the connection abort reason shall be set to 1 (Already in one or more connection managed sessions and cannot support another) after the call to `PduR_J1939TpStartOfReception()`, and to 2 (System resources were needed for another task so this connection managed session was terminated) in the other two cases.⌋

7.5.3 N-SDU Transmission

The upper layer (`PDU Router`) asks for the transmission of an N-SDU by calling `J1939Tp_Transmit()`. The parameters of `J1939Tp_Transmit()` describe the Identifier of the N-SDU (`TxPduId`) and a reference to a `PduInfoType` that indicates the full length of the N-SDU to transmit (full Tx N-SDU data length) and a pointer to the payload N-SDU, which may contain `meta data` with SA, DA and Priority depending on the `meta data` configuration of the N-SDU.

[SWS_J1939Tp_00039] ⌈When configured, the `transport protocol` variant (BAM/CMDT, see `J1939TpTxProtocolType`) and the SA/DA (see `J1939TpTxSa`/`J1939TpTxDa`) shall be used for transmission. For N-SDUs with `meta data`,

these parameters are optional. If SA or DA is not configured, the value provided via the meta data shall be used. If the transport protocol is not configured, it shall be chosen based on the actual DA: BAM when DA is 0xFF, CMDT otherwise.⌋

[SWS_J1939Tp_00045] ⌈The function J1939Tp_Transmit() shall use the TxPduId and the SduLength provided in the PduInfoType structure. It shall not use the payload of N-SDUs, only the contained meta data.⌋

[SWS_J1939Tp_00047] ⌈After a transmission request from the upper layer, the J1939Tp module shall initiate the transmission by sending:

- For CMDT: a TP.CM_RTS frame
- For BAM: a TP.CM_BAM frame

⌋

[SWS_J1939Tp_00046] ⌈For each TP.DT frame to be sent, the J1939Tp module shall previously call PduR_J1939TpCopyTxData() with the following parameters:

- the Identifier of the corresponding N-SDU,
- PduInfoType structure with up to 7 bytes as SduLength,
- the retry parameter, and
- a pointer to a location where the upper layer stores its currently available data.

⌋

[SWS_J1939Tp_00228] ⌈When PduR_J1939TpCopyTxData() returns BUFREQ_E_BUSY, the J1939Tp shall retry the call to PduR_J1939TpCopyTxData() until the data is available or a timeout occurs.⌋

[SWS_J1939Tp_00218] ⌈If J1939TpTxRetrySupport is disabled, the parameter retry of PduR_J1939TpCopyTxData() shall always be set to the NULL_PTR.⌋

[SWS_J1939Tp_00219] ⌈For BAM transmissions, the parameter retry of PduR_J1939TpCopyTxData() shall always be set to the NULL_PTR.⌋

[SWS_J1939Tp_00220] ⌈If J1939TpTxRetrySupport is enabled, a valid RetryInfoType struct shall be provided via the parameter retry of PduR_J1939TpCopyTxData() during CMDT transmissions.⌋

See Chapter 7.5.4.2 for a description how the SAE J1939 Transport Layer module uses the RetryInfoType during CMDT transmission.

[SWS_J1939Tp_00048] ⌈The J1939Tp module shall abort the transmission session like specified in [SWS_J1939Tp_00032] if any of the following conditions occur:

- The upper Layer returns the PduR_J1939TpCopyTxData() function call with BUFREQ_E_NOT_OK or

- the J1939Tp_CancelTransmit() function is called.

In case of a CMDT connection, a CMDT Connection Abort shall be performed as described in [SWS_J1939Tp_00097], and the connection abort reason shall be set to 2 (System resources were needed for another task so this connection managed session was terminated).⌋

7.5.4 Data Flow on the CAN Bus

7.5.4.1 Data Flow using Direct Transmission

The following figure shows an example of direct message transmission between two ECUs using J1939Tp. This is the only case of transmission of a J1939Tp N-SDU using no TP.CM or TP.DT frame. The SA is always included in the CAN identifier. Depending on the PDU Format of the PGN, the CAN Identifier might contain the DA.

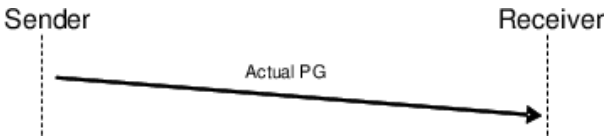

Figure 7.2: Example of direct data flow for PGs of variable length <= 8 Bytes

7.5.4.2 Data Flow using CMDT

The following figure shows an example of segmented message transmission between two ECUs using CMDT as transport protocol variant. The CMDT transport protocol variant is used for peer-to-peer communication (i.e. 1 to 1 communication, like physical addressing in UDS diagnostics). In the example, the transmitted PG has a total length of 16 bytes, which corresponds to 3 blocks of 7 bytes.

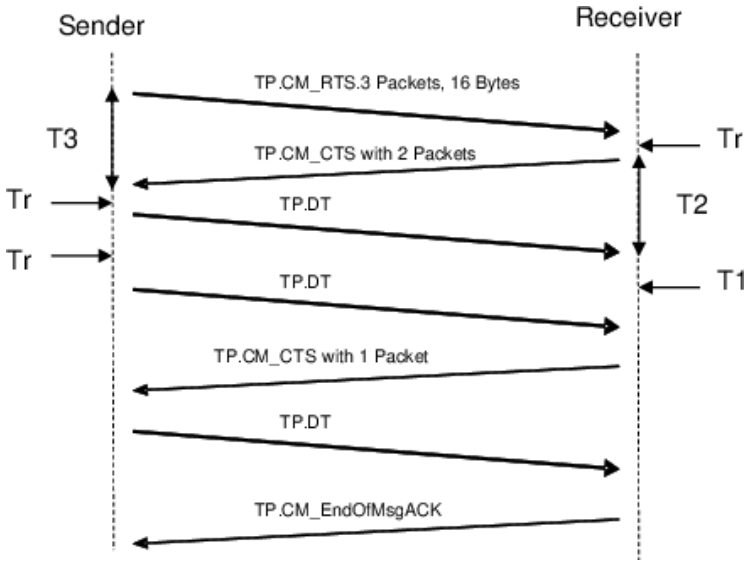

Figure 7.3: Example of data flow without error using CMDT as transport protocol variant

The J1939 transport protocol uses the initial sequence of RTS and CTS to determine the number of packets per block.

[SWS_J1939Tp_00165] ⌈If J1939TpTxDynamicBlockCalculation is enabled, after J1939Tp_Transmit() has been called, the J1939Tp shall call PduR_J1939TpCopyTxData() once with info->SduLength set to 0 and retry set to NULL_PTR to obtain the available amount of data via availableDataPtr.⌋

[SWS_J1939Tp_00207] ⌈If J1939TpTxDynamicBlockCalculation and J1939TpTxMaxPacketsPerBlock are enabled, the J1939Tp shall compare the available amount of data returned by PduR_J1939TpCopyTxData() to J1939TpTxMaxPacketsPerBlock and use use the smaller of these two values to calculate the maximum number of packets field of the TP.CM_RTS message.⌋

[SWS_J1939Tp_00208] ⌈If J1939TpTxDynamicBlockCalculation is enabled but J1939TpTxMaxPacketsPerBlock is disabled, the J1939Tp shall use the available amount of data returned by PduR_J1939TpCopyTxData() to calculate the maximum number of packets field of the TP.CM_RTS message.⌋

[SWS_J1939Tp_00209] ⌈If J1939TpTxDynamicBlockCalculation is disabled, the J1939Tp shall use J1939TpTxMaxPacketsPerBlock for the maximum number of packets field of the TP.CM_RTS message.⌋

[SWS_J1939Tp_00210] ⌈If J1939TpRxDynamicBlockCalculation and J1939TpRxPacketsPerBlock are enabled, the J1939Tp shall compare the value returned by PduR_J1939TpStartOfReception() for the available buffer size to J1939TpRxPacketsPerBlock and use the lower value to calculate the number of packets field of the TP.CM_CTS message.⌋

[SWS_J1939Tp_00211] ⌈If J1939TpRxDynamicBlockCalculation is enabled but J1939TpRxPacketsPerBlock is disabled, the J1939Tp shall use the value returned by PduR_J1939TpStartOfReception() for the available buffer size to calculate the number of packets field of the TP.CM_CTS message.⌋

[SWS_J1939Tp_00226] ⌈After reception of the TP.CM_RTS and after reception of the last N-PDU of a block, if the reported buffer size is large enough for the next block, the J1939Tp shall transmit a TP.CM_CTS message requesting the next block. The number of packets requested by TP.CM_CTS shall be constant during the complete reception of one N-SDU, only in the last TP.CM_CTS this number shall be reduced to the number of remaining packets.⌋

[SWS_J1939Tp_00227] ⌈When there is not enough buffer reported by PduR_J1939TpStartOfReception() or PduR_J1939TpCopyRxData() for the reception of a complete block, the J1939Tp shall call PduR_J1939TpCopyRxData() with info->SduLength set to 0 until the buffer is large enough for one block, or a timeout occurs.⌋

Please note: A timeout can be a timeout of an expected message (e.g. T1) or a timeout during transmission of a message (e.g. Tr).

[SWS_J1939Tp_00229] ⌈While monitoring the buffer state as defined by [SWS_J1939Tp_00227], the J1939Tp shall send TP.CM_CTS wait frames (number of packets set to 0, see also SAE J1939-21) according to the timing requirements defined in SAE J1939-21.⌋

[SWS_J1939Tp_00212] ⌈If J1939TpRxRetrySupport is enabled, the J1939Tp shall adapt the value returned by PduR_J1939TpStartOfReception() for the available buffer size according to J1939TpRxDynamicBufferRatio before using it to calculate the number of packets field of the TP.CM_CTS message as specified in [SWS_J1939Tp_00210] and [SWS_J1939Tp_00211].⌋

[SWS_J1939Tp_00213] ⌈If J1939TpRxDynamicBlockCalculation is disabled, the J1939Tp shall use J1939TpRxPacketsPerBlock to calculate the number of packets field of the TP.CM_CTS message.⌋

[SWS_J1939Tp_00217] ⌈If J1939TpTxRetrySupport is enabled, the J1939Tp shall call PduR_J1939TpCopyTxData() with

- TpDataState set to TP_DATACONF for the first call after reception of a TP.CM_CTS, and
- TpDataState set to TP_CONFPENDING for the following calls.

⌋

[SWS_J1939Tp_00195] ⌈If a TP.CM_CTS wait frame (number of packets set to 0, see also SAE J1939-21) is received, the J1939Tp shall wait for another TP.CM_CTS frame.⌋

[SWS_J1939Tp_00223] ⌈When the J1939Tp receives a TP.CM_CTS frame that requests data beyond the current position or preceding the position where the last TP.CM_CTS was received, it shall abort the transmission using the mechanisms described by [SWS_J1939Tp_00032] and [SWS_J1939Tp_00097] with reason 255 (SNA).⌋

[SWS_J1939Tp_00221] ⌈If J1939TpTxRetrySupport is enabled, when the J1939Tp receives a TP.CM_CTS frame requesting already sent data, it shall call PduR_J1939TpCopyTxData() with TpDataState set to TP_DATARETRY and TxTpDataCnt set to the number of bytes to be retransmitted.⌋

The number of bytes that need to be retransmitted is calculated from the position of the requested package relative to the current package.

[SWS_J1939Tp_00194] ⌈If J1939TpTxRetrySupport is disabled, when the J1939Tp receives a TP.CM_CTS frame requesting already sent data, it shall abort the transmission using the mechanisms described by [SWS_J1939Tp_00032] and [SWS_J1939Tp_00097] with reason 255 (unassigned).⌋

[SWS_J1939Tp_00222] ⌈If `J1939TpRxRetrySupport` is enabled, when a sequence error occurs during reception, the J1939Tp module shall, after the last TP.DT message of the block was received, send a TP.CM_CTS frame requesting the packages that follow the last correctly received package of the current block.⌋

[SWS_J1939Tp_00232] ⌈The content of a TP.DT message with a sequence error and of the TP.DT messages following a sequence error in the same block shall be discarded.⌋

Note: This means that for such messages `PduR_J1939TpCopyRxData()` shall not be called.

[SWS_J1939Tp_00216] ⌈If `J1939TpRxRetrySupport` is disabled, when a sequence error occurs during reception, the J1939Tp module shall abort the reception session

- as specified in [SWS_J1939Tp_00031] and
- as specified in [SWS_J1939Tp_00097] with connection abort reason 255 (SNA).

⌋

[SWS_J1939Tp_00123] ⌈J1939Tp shall implement all CMDT related timing constraints (Tr, Th, T1, T2, T3, T4) as described in `SAE J1939-21`. They supervise the CMDT data flow.⌋

[SWS_J1939Tp_00100] ⌈If a timeout occurs during CMDT transmission (see `SAE J1939-21` for details) then the J1939Tp module shall abort the transmission session

- as specified in [SWS_J1939Tp_00032] and
- as specified in [SWS_J1939Tp_00097] with connection abort reason 3 (a timeout occurred and this is the connection abort to close the session) when the timeout occurred after successful transmission of the TP.CM_RTS frame.

⌋

[SWS_J1939Tp_00159] ⌈If a timeout occurs during reception (see `SAE J1939-21` for details) then the J1939Tp module shall abort the reception session

- as specified in [SWS_J1939Tp_00031] and
- as specified in [SWS_J1939Tp_00097] with connection abort reason 3 (A timeout occurred and this is the connection abort to close the session).

⌋

[SWS_J1939Tp_00098] ⌈If a TP.Conn_Abort frame is received after a TP.CM_RTS frame has been successfully sent by the ECU, the transmission shall be aborted like indicated in [SWS_J1939Tp_00032]. No transmission of TP.Conn_Abort is necessary.⌋

[SWS_J1939Tp_00163] ⌈If a TP.Conn_Abort frame is received after a TP.CM_RTS frame has been received, the reception shall be aborted like indicated in [SWS_J1939Tp_00031]. No transmission of TP.Conn_Abort is necessary.⌋

7.5.4.3 Data Flow using BAM

[SWS_J1939Tp_00121] ⌈J1939Tp shall implement the BAM related timing constraints (50ms or `J1939TpTxBamTiming`, Tr, T1) as described in `SAE J1939-21`. They supervise the BAM data flow.⌋

[SWS_J1939Tp_00160] ⌈If a timeout occurs during the BAM reception, the J1939Tp module shall abort the reception session as specified in [SWS_J1939Tp_00031].⌋

[SWS_J1939Tp_00192] ⌈After a sequence error, J1939Tp shall abort BAM connections as specified in [SWS_J1939Tp_00031].⌋

The following figure shows an example of segmented message transmission between two ECUs using BAM as `transport protocol` variant according to `SAE J1939-21`. The BAM `transport protocol` variant is used for a broadcast communication (i.e. 1 to n communication, like functional addressing in UDS diagnostics). In the example, the transmitted PG has a total length of 3 blocks of 7 bytes that have to be successively transmitted.

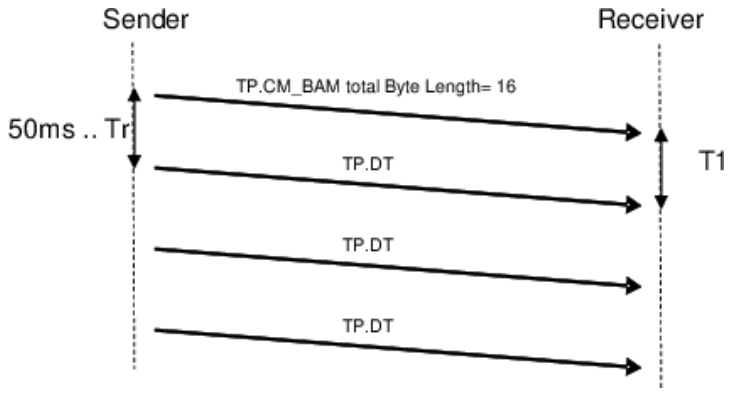

Figure 7.4: Example of data flow using BAM as transport protocol variant

7.5.5 N-SDU Buffer Management

J1939Tp shall have no internal PDU buffers. It requests data for sending directly from the upper layers via `PduR_J1939TpCopyTxData()` and provides received data directly to the upper layers via `PduR_J1939TpCopyRxData()`.

To guarantee data consistency, the complete buffer of the upper layers must be locked during the whole data transmission or reception.

Data transmission is initialized when the PduR calls `J1939Tp_Transmit()` and is active after J1939Tp executed this call successfully until J1939Tp calls `PduR_J1939TpTxConfirmation()`:

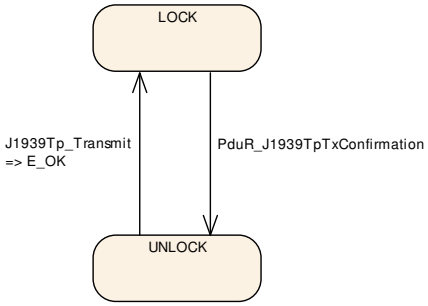

Figure 7.5: Tx Buffer locking

Data reception is initialized when J1939Tp calls `PduR_J1939TpStartOfReception()` and is active after the PduR executed this call successfully until J1939Tp calls `PduR_J1939TpRxIndication()`:

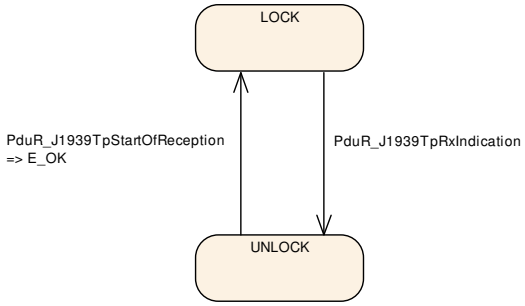

Figure 7.6: Rx Buffer locking

7.5.6 Relationship between N-SDU and N-PDU in J1939Tp

This subsection describes the relation that exists between an N-SDU and the set of N-PDUs that is required to transport the N-SDU data, as shown in the following figure.

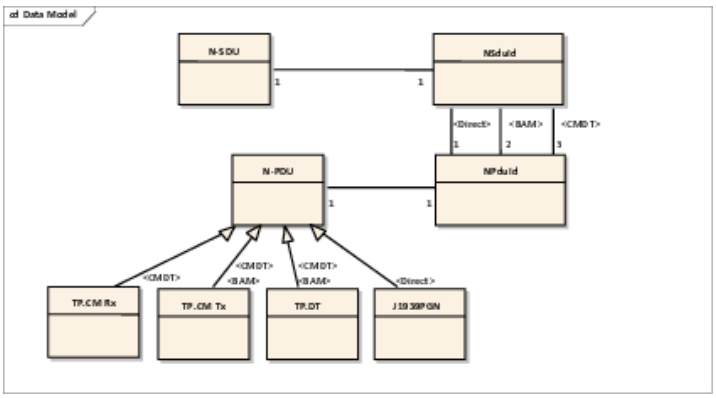

Figure 7.7: Relation between N-SDU and N-PDU

The N-PDUs as well as the N-SDU may use meta data. In that case, the N-SDU stands for a certain PGN, and the N-PDUs stand for TP.CM, TP.DT, and direct PG, regardless of source and/or destination addresses.

[SWS_J1939Tp_00057] ⌈During reception, the N-SDU is identified by a combination of the PGN included in the payload of TP.CM and, when the N-SDU has no meta data, from the addressing information implicitly encoded in the NPduIds or explicitly provided via the meta data of the N-PDUs.⌋

[SWS_J1939Tp_00199] ⌈During transmission, the relevant set of N-PDUs is identified by the configured SA/DA of N-SDUs without meta data, or by the SA/DA explicitly provided in the meta data by the upper layer.⌋

7.5.7 Concurrent Connections

Connections only concern internal J1939Tp purposes. They are transparent for the upper and lower layers of J1939Tp but influence the handling of J1939Tp.

A J1939Tp connection is characterized by its direction (Receiving /Sending) and its type (BAM / CMDT / Direct). A J1939Tp connection of type BAM or CMDT uses the following transport related frames:

- control (TP.CM)
- data (TP.DT)

The CAN identifier corresponding to those transport specific frames is the same for all J1939 PGs longer than 8 bytes that are

- sent from a given SA in the case of BAM, or
- sent from a given SA to a given DA in the case of CMDT.

This constrains the possibility for J1939Tp to process concurrent connections.

[SWS_J1939Tp_00120] ⌈The J1939Tp shall be able to handle connections in parallel for all N-SDUs that do not interfere in the usage of TP.DT frames with the same SA and DA. For channels with defined SA/DA and protocol type, only one TP connection and one direct connection for each PG can be open at any time. For channels with variable SA/DA, the maximum number of parallel connections is limited by the number of N-SDUs assigned to this channel.⌋

J1939Tp shall only support concurrent connections as described in subsection 5.10.5 of SAE J1939-21. Note that one AUTOSAR ECU can represent several J1939 nodes and thus may have more than one address (used as SA or DA) assigned to it.

[SWS_J1939Tp_00062] ⌈Each connection shall be independent of the other connections.⌋

This means that a connection shall use its own resources, such as timer or state machine.

[SWS_J1939Tp_00237] Deferred Transmission ⌈If the J1939Tp cannot start a transmission because the N-SDU interferes with another currently transmitted N-SDU due to identical SA/DA and protocol type, the transmission of the TP.CM_RTS or TP.CM_BAM frame shall be deferred until the interfering N-SDU transmission is finished.⌋

[SWS_J1939Tp_00238] Prioritization of Deferred Transmission ⌈If several deferred N-SDUs interfere with each other because of identical SA/DA and protocol type, a numerically lower PGN shall take precedence.⌋

7.5.8 N-PDU Padding

[SWS_J1939Tp_00200] ⌈The `SAE J1939 Transport Layer` module shall send TP.DT frames always with 8 bytes according to `SAE J1939-21`.⌋

[SWS_J1939Tp_00068] ⌈According to `SAE J1939-21`, all unused data bytes within the last TP.DT frame or the direct frame shall be set to `0xFF` (SNA).⌋

7.5.9 Handling of Unexpected N-PDU Arrivals

[SWS_J1939Tp_00064] ⌈The J1939Tp shall ignore unexpected N-PDUs that do not correspond to a currently active connection.⌋

[SWS_J1939Tp_00224] ⌈If `J1939TpTxRetrySupport` is disabled, when a TP.CM_CTS is received while TP.DT messages are being transmitted, J1939Tp shall abort the connection as specified in [SWS_J1939Tp_00032] and in [SWS_J1939Tp_00097] with connection abort reason 4 (CTS messages received when data transfer is in progress).⌋

[SWS_J1939Tp_00225] ⌈When a TP.CM_RTS is received for a currently active connection, the J1939Tp shall stop this connection as specified in [SWS_J1939Tp_00031] and start a new connection as described in [SWS_J1939Tp_00038].⌋

7.6 Error Classification

Chapter [16, General Specification of Basic Software Modules] Chapter 7.2 *"Error Handling"* describes the error handling of the `Basic Software` in detail. Above all, it constitutes a classification scheme consisting of following error types which may occur in BSW modules.

Based on this foundation, this section specifies particular errors arranged in the respective subsections below.

7.6.1 Development Errors

[SWS_J1939Tp_00115] Definition of development errors in module J1939Tp

Upstream requirements: SRS_BSW_00327, SRS_BSW_00337, SRS_BSW_00385, SRS_BSW_00441

⌈

Type of error	*Related error code*	*Error value*
API service used in state J1939TP_OFF	J1939TP_E_UNINIT	0x01
J1939Tp_Init() called in state J1939TP_ON.	J1939TP_E_REINIT	0x02
J1939Tp_Init() was called with an invalid configuration pointer	J1939TP_E_INIT_FAILED	0x03
API service called with null pointer.	J1939TP_E_PARAM_POINTER	0x10
API service called with wrong ID.	J1939TP_E_INVALID_PDU_SDU_ID	0x11

⌋

7.6.2 Runtime Errors

[SWS_J1939Tp_00234] Definition of runtime errors in module J1939Tp ⌈

Type of error	*Related error code*	*Error value*
Timeout occurred on receiver side after reception of an intermediate TP.DT frame of a block.	J1939TP_E_TIMEOUT_T1	0x30
Timeout occurred on receiver side after transmission of a TP.CM/CTS frame.	J1939TP_E_TIMEOUT_T2	0x31
Timeout occurred on transmitter side after transmission of the last TP.DT frame of a block.	J1939TP_E_TIMEOUT_T3	0x32
Timeout occurred on transmitter side after reception of a TP.CM/CTS(0) frame.	J1939TP_E_TIMEOUT_T4	0x33
Timeout occurred on transmitter or receiver side while trying to send the next TP.DT or TP.CM frame.	J1939TP_E_TIMEOUT_TR	0x34
Timeout occurred on receiver side while trying to send the next TP.CM/CTS frame after a TP.CM/CTS(0) frame.	J1939TP_E_TIMEOUT_TH	0x35
Invalid value for "total message size" in received TP.CM/RTS frame.	J1939TP_E_INVALID_TMS	0x40
Value for "total number of packets" in received TP.CM/RTS frame does not match the "total message size".	J1939TP_E_INVALID_TNOP	0x41
Invalid value for "maximum number of packets" in received TP.CM/RTS frame.	J1939TP_E_INVALID_MNOP	0x42
Unexpected PGN in received TP.CM frame.	J1939TP_E_INVALID_PGN	0x43
Invalid value for "number of packets" in received TP.CM/CTS frame.	J1939TP_E_INVALID_NOP	0x44

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Type of error	*Related error code*	*Error value*
Invalid value for "next packet number" in received TP.CM/CTS frame.	J1939TP_E_INVALID_NPN	0x45
Invalid value for "connection abort reason" in received TP.Conn_Abort frame.	J1939TP_E_INVALID_CAR	0x46
Unexpected serial number in received TP.DT frame.	J1939TP_E_INVALID_SN	0x47

⌋

7.6.3 Production Errors

There are no production errors.

8 API Specification

8.1 API Parameter Checking

J1939TP_E_PARAM_POINTER shall be reported as specified in [16, SWS BSW General] by [SWS_BSW_00212].

[SWS_J1939Tp_00188]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00386

⌈If development error detection for the J1939Tp is enabled via J1939TpDevErrorDetect, all APIs using a SDU- or PDU-Identifier shall check the input Identifier and raise the development error J1939TP_E_INVALID_PDU_SDU_ID in case the API has been called for a not configured PDU or SDU.⌋

8.2 Imported Types

This section lists all types used by the SAE J1939 Transport Layer module together with the defining module.

[SWS_J1939Tp_00230] Definition of imported datatypes of module J1939Tp ⌈

Module	*Header File*	*Imported Type*
Comtype	ComStack_Types.h	BufReq_ReturnType
	ComStack_Types.h	PduIdType
	ComStack_Types.h	PduInfoType
	ComStack_Types.h	PduLengthType
	ComStack_Types.h	RetryInfoType
	ComStack_Types.h	TpDataStateType
Std	Std_Types.h	Std_ReturnType

⌋

The types that are declared in ComStack_Types.h (Module Comtype) are defined in [19, SWS Communication Stack Types], while the types declared in Std_Types.h (Module Std) are defined in [20, SWS Standard Types].

8.3 Type Definitions

8.3.1 J1939Tp_ConfigType

[SWS_J1939Tp_00175] Definition of datatype J1939Tp_ConfigType ⌈

Name	J1939Tp_ConfigType	
Kind	Structure	
Elements	implementation specific	
	Type	–
	Comment	The content of the initialization data structure is implementation specific.
Description	Data structure containing post-build configuration data of J1939-TP.	
Available via	J1939Tp.h	

⌋

The `J1939Tp_ConfigType` defines a structure that contains configuration parameters J1939Tp uses at run time. It is provided as an argument to `J1939Tp_Init()`.

8.4 Function Definitions

This chapter contains all APIs provided by the module.

8.4.1 J1939Tp_Init

[SWS_J1939Tp_00087] Definition of API function J1939Tp_Init

Upstream requirements: SRS_BSW_00101, SRS_BSW_00358

⌈

Service Name	J1939Tp_Init	
Syntax	`void J1939Tp_Init ( const J1939Tp_ConfigType* ConfigPtr )`	
Service ID [hex]	0x01	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	ConfigPtr	Pointer to configuration data structure.
Parameters (inout)	None	
Parameters (out)	None	
Return value	None	
Description	This function initializes the J1939Tp module.	
Available via	J1939Tp.h	

⌋

After power up, J1939Tp is in a state called `J1939TP_OFF`. In this state, J1939Tp is not yet configured, and therefore cannot perform any communication task. The J1939Tp

module's environment (usually the ECU Manager) will call J1939Tp_Init() before using the J1939Tp module for further processing.

[SWS_J1939Tp_00024] ⌈The function J1939Tp_Init() shall initialize all global variables of the module and reset all transport protocol connections.⌋

[SWS_J1939Tp_00022] ⌈J1939Tp_Init() shall change to the internal state J1939TP_ON after successful initialization.⌋

[SWS_J1939Tp_00026]

Upstream requirements: SRS_BSW_00386

⌈If called when the J1939Tp module is in the global state J1939TP_ON, the function J1939Tp_Init() shall raise the development error J1939TP_E_REINIT and do nothing.⌋

[SWS_J1939Tp_00187]

Upstream requirements: SRS_BSW_00400, SRS_BSW_00405, SRS_BSW_00414, SRS_BSW_00438

⌈The provided ConfigPtr shall only be used, when post-build configuration is enabled, or when different configuration variants must be supported. Otherwise, the parameters should be accessed directly to avoid indirection via the ConfigPtr.⌋

The structure of type J1939Tp_ConfigType pointed to by the ConfigPtr contains post-build parameters of the J1939Tp module. In link time or pre-compile configured environments, the structure may contain a set of post-build parameters that differ between several configuration variants. It is expected that link time and pre-compile parameters may not change for different configuration variants.

J1939Tp_Init() has no return value because configuration data errors should be detected during configuration time (e.g. by the configuration tools). Furthermore, if a hardware error occurs, it will be reported via the error manager modules.

J1939TP_E_INIT_FAILED shall be reported as specified in [16, SWS BSW General] by [SWS_BSW_00050].

8.4.2 J1939Tp_Shutdown

[SWS_J1939Tp_00093] Definition of API function J1939Tp_Shutdown

Upstream requirements: SRS_BSW_00336

⌈

Service Name	J1939Tp_Shutdown

Syntax	`void J1939Tp_Shutdown (`
	`  void`
	`)`

Service ID [hex]	0x02
Sync/Async	Synchronous
Reentrancy	Non Reentrant
Parameters (in)	None
Parameters (inout)	None
Parameters (out)	None
Return value	None
Description	This function is used to shutdown the J1939Tp module.
Available via	J1939Tp.h

⌋

To close down communication, the state handling (usually the ECU Manager) calls `J1939Tp_Shutdown()`.

[SWS_J1939Tp_00094] ⌈`J1939Tp_Shutdown()` shall close all pending `transport protocol` connections, free all resources and set the J1939Tp module into the global state `J1939TP_OFF` state.⌋

[SWS_J1939Tp_00095] ⌈`J1939Tp_Shutdown()` shall not raise a notification about the pending frame transmission or reception.⌋

8.4.3 J1939Tp_Transmit

[SWS_J1939Tp_00096] Definition of API function J1939Tp_Transmit

Upstream requirements: SRS_BSW_00357

⌈

Service Name	J1939Tp_Transmit

Syntax	`Std_ReturnType J1939Tp_Transmit (`
	`  PduIdType TxPduId,`
	`  const PduInfoType* PduInfoPtr`
	`)`

Service ID [hex]	0x49
Sync/Async	Synchronous
Reentrancy	Reentrant for different PduIds. Non reentrant for the same PduId.

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Parameters (in)	TxPduId	Identifier of the PDU to be transmitted
	PduInfoPtr	Length of and pointer to the PDU data and pointer to MetaData.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	`E_OK`: Transmit request has been accepted. `E_NOT_OK`: Transmit request has not been accepted.
Description	Requests transmission of a PDU.	
Available via	J1939Tp.h	

⌋

As described in [SWS_J1939Tp_00119] and [SWS_J1939Tp_00032], the J1939Tp module will notify the upper layer by calling the `PduR_J1939TpTxConfirmation()` callback when the transmit request has been completed.

[SWS_J1939Tp_00101] ⌈The function `J1939Tp_Transmit()` shall reject a request, if the `J1939Tp_Transmit()` service is called for an N-SDU identifier that is being used in a currently running `SAE J1939 Transport Layer` session.⌋

8.4.4 J1939Tp_CancelTransmit

[SWS_J1939Tp_00177] Definition of API function J1939Tp_CancelTransmit ⌈

Service Name	J1939Tp_CancelTransmit	
Syntax	`Std_ReturnType J1939Tp_CancelTransmit ( PduIdType TxPduId )`	
Service ID [hex]	0x4a	
Sync/Async	Synchronous	
Reentrancy	Reentrant for different PduIds. Non reentrant for the same PduId.	
Parameters (in)	TxPduId	Identification of the PDU to be cancelled.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	`E_OK`: Cancellation was executed successfully by the destination module. `E_NOT_OK`: Cancellation was rejected by the destination module.
Description	Requests cancellation of an ongoing transmission of a PDU in a lower layer communication module.	
Available via	J1939Tp.h	

⌋

[SWS_J1939Tp_00203] ⌈`J1939Tp_CancelTransmit()` shall return `E_NOT_OK` if `TxPduId` is invalid, if `TxPduId` is currently not active, if currently a direct frame is transmitted, if the last TP.DT frame has already been transmitted during BAM transmission, or if the TP.CM_EOMAck frame has already been received during CMDT transmission.⌋

[SWS_J1939Tp_00214] ⌈The `J1939Tp_CancelTransmit()` API shall only be available when `J1939TpCancellationSupport` is enabled.⌋

8.4.5 J1939Tp_CancelReceive

[SWS_J1939Tp_00176] Definition of API function J1939Tp_CancelReceive ⌈

Service Name	J1939Tp_CancelReceive	
Syntax	`Std_ReturnType J1939Tp_CancelReceive ( PduIdType RxPduId )`	
Service ID [hex]	0x4c	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	RxPduId	Identification of the PDU to be cancelled.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	`E_OK`: Cancellation was executed successfully by the destination module. `E_NOT_OK`: Cancellation was rejected by the destination module.
Description	Requests cancellation of an ongoing reception of a PDU in a lower layer transport protocol module.	
Available via	J1939Tp.h	

⌋

[SWS_J1939Tp_00204] ⌈`J1939Tp_CancelReceive()` shall return `E_NOT_OK` if `RxPduId` is invalid, if `RxPduId` is currently not active, if currently a direct frame is received, if the last TP.DT frame has already been received during BAM reception, or if the TP.CM_EOMAck frame has already been sent during CMDT reception.⌋

[SWS_J1939Tp_00215] ⌈The `J1939Tp_CancelReceive()` API shall only be available when `J1939TpCancellationSupport` is enabled.⌋

8.4.6 J1939Tp_RxIndication

[SWS_J1939Tp_00108] Definition of callback function J1939Tp_RxIndication

Upstream requirements: SRS_BSW_00359, SRS_BSW_00360

⌈

Service Name	J1939Tp_RxIndication
Syntax	`void J1939Tp_RxIndication ( PduIdType RxPduId, const PduInfoType* PduInfoPtr )`
Service ID [hex]	0x42

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Sync/Async	Synchronous	
Reentrancy	Reentrant for different PduIds. Non reentrant for the same PduId.	
Parameters (in)	RxPduId	ID of the received PDU.
	PduInfoPtr	Contains the length (SduLength) of the received PDU, a pointer to a buffer (SduDataPtr) containing the PDU, and the MetaData related to this PDU.
Parameters (inout)	None	
Parameters (out)	None	
Return value	None	
Description	Indication of a received PDU from a lower layer communication interface module.	
Available via	J1939Tp.h	

⌋

The J1939Tp module provides the `J1939Tp_RxIndication()` API to allow the CanIf to notify via the LSduR that a new N-PDU has been received.

[SWS_J1939Tp_00110]

Upstream requirements: SRS_BSW_00333

⌈The function `J1939Tp_RxIndication()` shall be callable in interrupt context (it could be called from the CAN receive interrupt).⌋

8.4.7 J1939Tp_TxConfirmation

[SWS_J1939Tp_00112] Definition of callback function J1939Tp_TxConfirmation

Upstream requirements: SRS_BSW_00359, SRS_BSW_00360

⌈

Service Name	J1939Tp_TxConfirmation	
Syntax	`void J1939Tp_TxConfirmation ( PduIdType TxPduId, Std_ReturnType result )`	
Service ID [hex]	0x40	
Sync/Async	Synchronous	
Reentrancy	Reentrant for different PduIds. Non reentrant for the same PduId.	
Parameters (in)	TxPduId	ID of the PDU that has been transmitted.
	result	`E_OK`: The PDU was transmitted successfully. `E_NOT_OK`: Transmission of the PDU failed.
Parameters (inout)	None	
Parameters (out)	None	
Return value	None	
Description	The lower layer communication interface module confirms the transmission of a PDU, or the failure to transmit a PDU.	
Available via	J1939Tp.h	

⌋

The J1939Tp module implements the `J1939Tp_TxConfirmation()` API to allow the CanIf module to confirm via the LSduR that a TP related frame (TP.CM, TP.DT) or direct frame has been successfully transmitted to the J1939 network.

[SWS_J1939Tp_00114]

Upstream requirements: SRS_BSW_00333

⌈The function `J1939Tp_TxConfirmation()` shall be callable in interrupt context (it could be called from the CAN transmit interrupt).⌋

8.5 Scheduled Functions

This function is directly called by the `Basic Software Scheduler` (SchM).

8.5.1 J1939Tp_MainFunction

[SWS_J1939Tp_00104] Definition of scheduled function J1939Tp_MainFunction

Upstream requirements: SRS_BSW_00373

⌈

Service Name	J1939Tp_MainFunction
Syntax	`void J1939Tp_MainFunction ( void )`
Service ID [hex]	0x04
Description	Main function of the J1939Tp. Used for scheduling purposes and timeout supervision.
Available via	SchM_J1939Tp.h

⌋

[SWS_J1939Tp_00106]

Upstream requirements: SRS_BSW_00478

⌈The calling frequency of the function `J1939Tp_MainFunction()` is determined by the configuration parameter `J1939TpMainFunctionPeriod`.⌋

8.6 Expected Interfaces

This section lists all interfaces required from other modules.

8.6.1 Mandatory Interfaces

This section defines all interfaces that are required to fulfill the core functionality of the module.

[SWS_J1939Tp_00116] Definition of mandatory interfaces required by module J1939Tp ⌈

API Function	*Header File*	*Description*
Det_ReportRuntimeError	Det.h	Service to report runtime errors. If a callout has been configured then this callout shall be called.
LSduR_J1939TpTransmit (draft)	LSduR_J1939Tp.h	Requests transmission of a PDU.
PduR_J1939TpCopyRxData	PduR_J1939Tp.h	This function is called to provide the received data of an I-PDU segment (N-PDU) to the upper layer. Each call to this function provides the next part of the I-PDU data. The size of the remaining buffer is written to the position indicated by bufferSizePtr.
PduR_J1939TpCopyTxData	PduR_J1939Tp.h	This function is called to acquire the transmit data of an I-PDU segment (N-PDU). Each call to this function provides the next part of the I-PDU data unless retry->TpDataState is TP_DATARETRY. In this case the function restarts to copy the data beginning at the offset from the current position indicated by retry->TxTpDataCnt. The size of the remaining data is written to the position indicated by availableDataPtr.
PduR_J1939TpRxIndication	PduR_J1939Tp.h	Called after an I-PDU has been received via the TP API, the result indicates whether the reception was successful or not.
PduR_J1939TpStartOfReception	PduR_J1939Tp.h	This function is called at the start of receiving an N-SDU. The N-SDU might be fragmented into multiple N-PDUs (FF with one or more following CFs) or might consist of a single N-PDU (SF). The service shall provide the currently available maximum buffer size when invoked with TpSdu Length equal to 0.
PduR_J1939TpTxConfirmation	PduR_J1939Tp.h	This function is called after the I-PDU has been transmitted on its network, the result indicates whether the transmission was successful or not.

⌋

8.6.2 Optional Interfaces

This section defines all interfaces that are required to fulfill an optional functionality of the module.

[SWS_J1939Tp_00060] Definition of optional interfaces requested by module J1939Tp ⌈

API Function	*Header File*	*Description*
Det_ReportError	Det.h	Service to report development errors.

⌋

9 Sequence Diagrams

The following sequence diagrams shall give an impression of the way the SAE J1939 Transport Layer module shall behave and interoperate with other BSW modules. They are not complete and not binding for the implementation.

9.1 Reception of Direct PG

The following diagram shows the interaction of the SAE J1939 Transport Layer module with the L-SDU Router and the PDU Router during reception of a direct PG, i.e. an N-SDU with dynamic length that is not larger than 8 bytes.

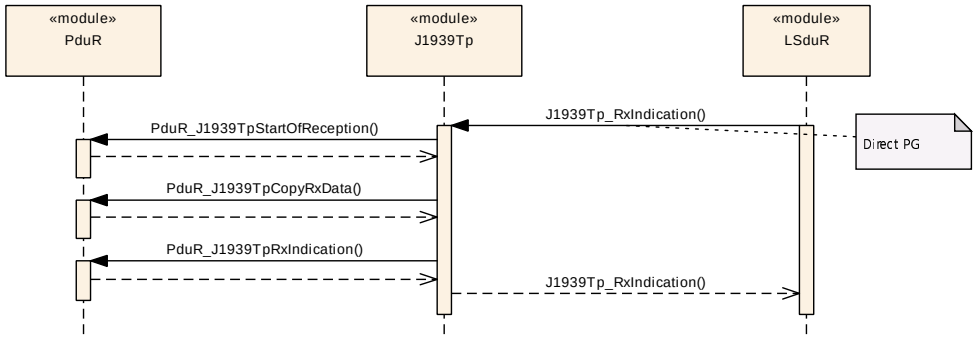

Figure 9.1: Reception of Direct PG

9.2 Reception via BAM

The following diagram shows the interaction of the SAE J1939 Transport Layer module with the L-SDU Router and the PDU Router during reception of a PG via BAM, i.e. an N-SDU that is larger than 8 bytes and is sent to the whole network.

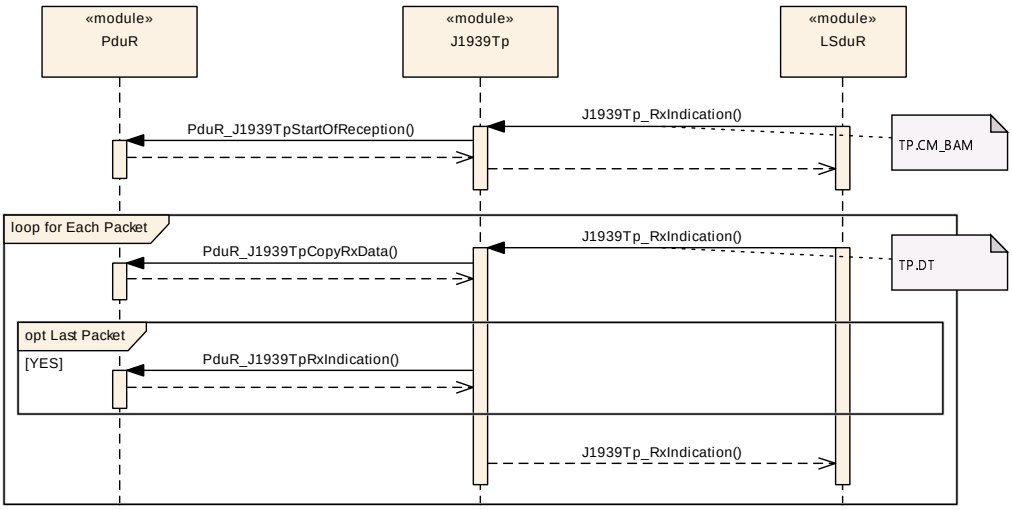

Figure 9.2: Reception via BAM

9.3 Reception via CMDT

The following diagram shows the interaction of the SAE J1939 Transport Layer module with the L-SDU Router and the PDU Router during reception of a PG via CMDT, i.e. an N-SDU that is larger than 8 bytes and is sent directly to the receiving node.

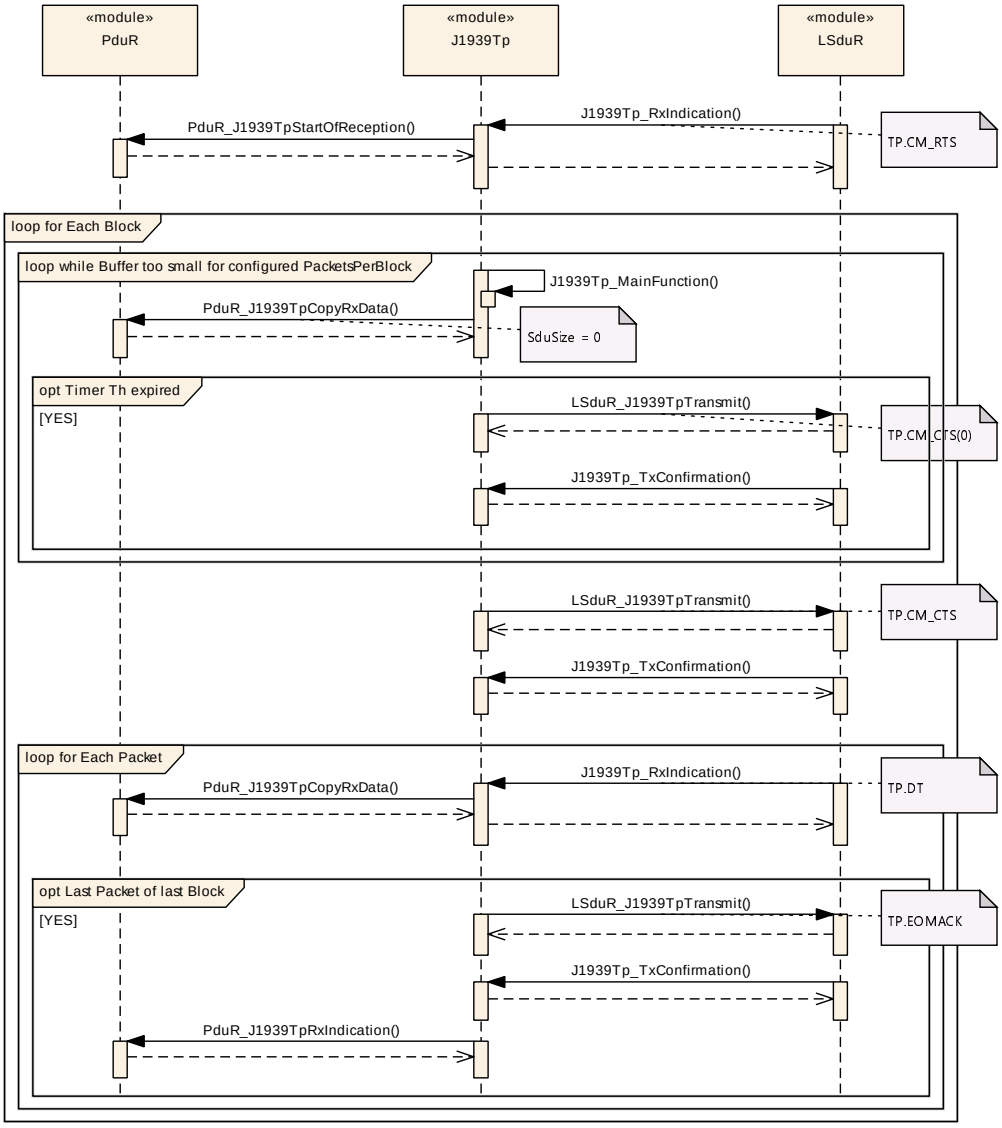

Figure 9.3: Reception via CMDT

9.4 Transmission of Direct PG

The following diagram shows the interaction of the SAE J1939 Transport Layer module with the PDU Router and the L-SDU Router during transmission of a direct PG, i.e. an N-SDU with dynamic length that is not larger than 8 bytes.

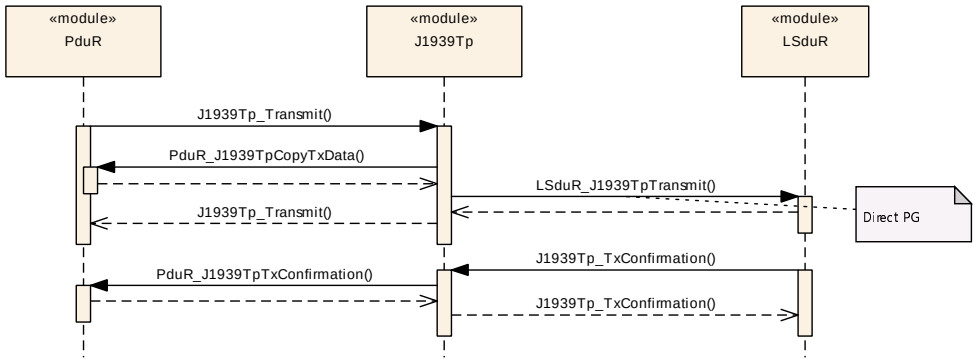

Figure 9.4: Transmission of Direct PG

9.5 Transmission via BAM

The following diagram shows the interaction of the SAE J1939 Transport Layer module with the PDU Router and the L-SDU Router during transmission of a PG via BAM, i.e. an N-SDU that is larger than 8 bytes and is sent to the whole network.

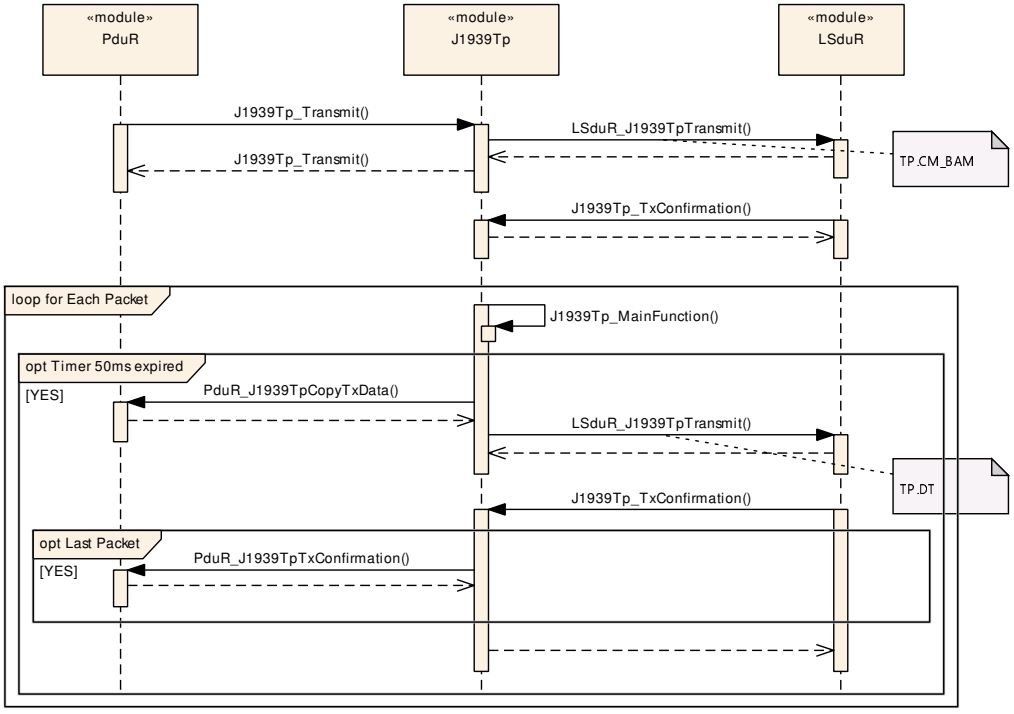

Figure 9.5: Transmission via BAM

9.6 Transmission via CMDT

The following diagram shows the interaction of the SAE J1939 Transport Layer module with the PDU Router and the L-SDU Router during transmission of a PG

via CMDT, i.e. an N-SDU that is larger than 8 bytes and is sent directly to the receiving node.

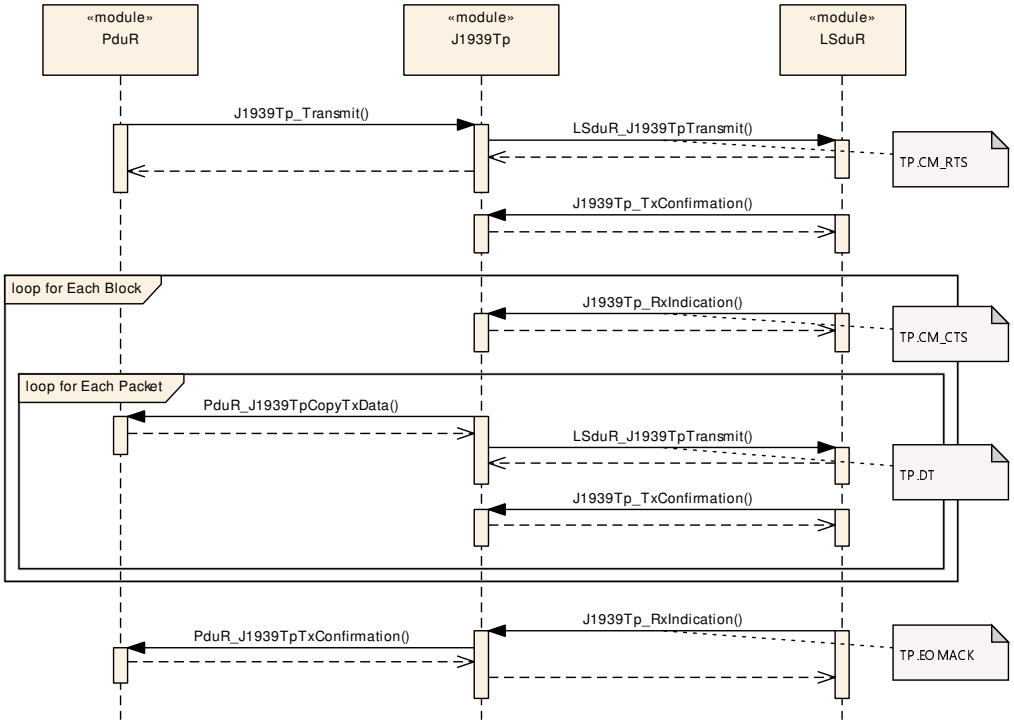

Figure 9.6: Transmission via CMDT

9.7 Handling of Retry during CMDT Transmission

The following diagram shows the interaction of the `SAE J1939 Transport Layer` module with the `PDU Router` in the sender and the receiver node during transmission of a PG via CMDT when a retry is performed because some data is lost.

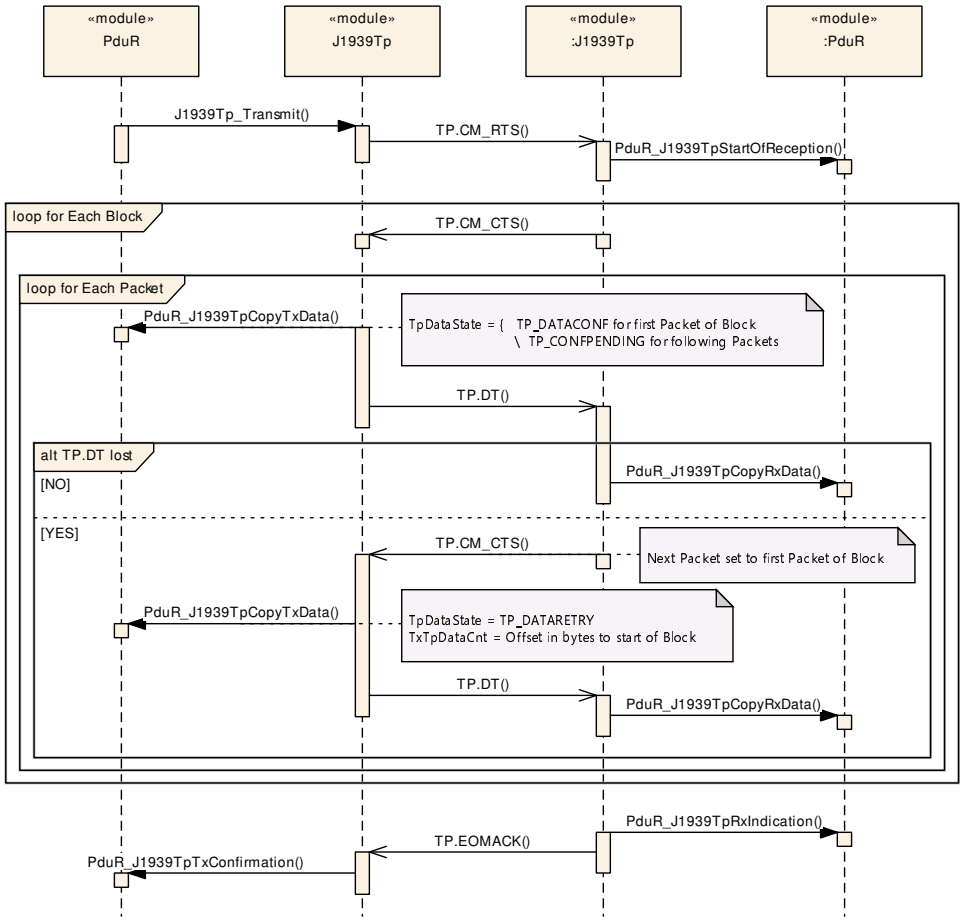

Figure 9.7: Retry Handling

10 Configuration Specification

In general, this chapter defines configuration parameters and their clustering into containers. For general information about the definition of containers and parameters, refer to [16, SWS BSW General] Chapter 10.1 *"Introduction to configuration specification"*. For details about published information of the SAE J1939 Transport Layer module, refer to [16, SWS BSW General] Chapter 10.3 *"Published Information"*.

The Chapter 10.1 specifies the structure (containers) and the parameters of the module J1939Tp.

[SWS_J1939Tp_00084]

Upstream requirements: SRS_BSW_00167

⌈The consistency of the configuration must be checked by the configuration tool at configuration time. Configuration rules and constraints for plausibility checks will be performed where possible, during configuration time.⌋

10.1 Containers and Configuration Parameters

The following sections summarize all configuration parameters of the SAE J1939 Transport Layer module. The detailed meaning of the parameters is described in Chapter 7 and Chapter 8.

Some of these containers and parameters are derived from classes and attributes of the [21, TPS System Template], which also contains the rules for these derivations.

The following pictures show an overview of the configuration parameters available for J1939Tp:

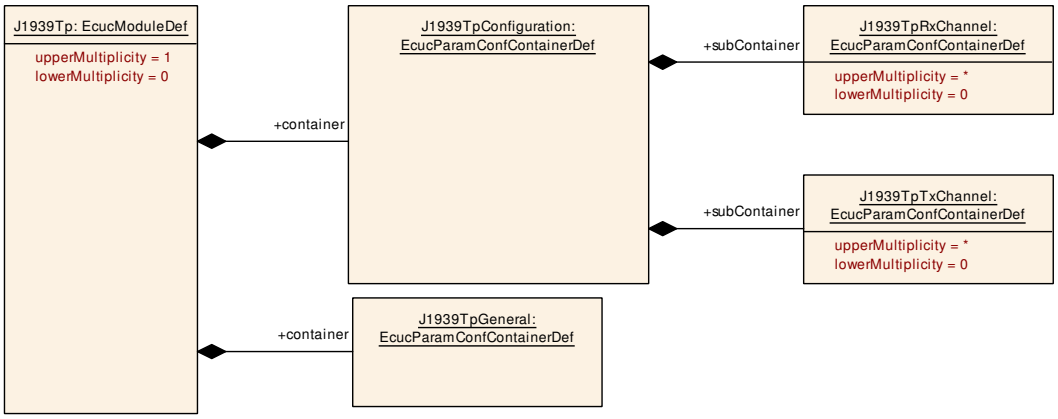

Figure 10.1: Module Configuration

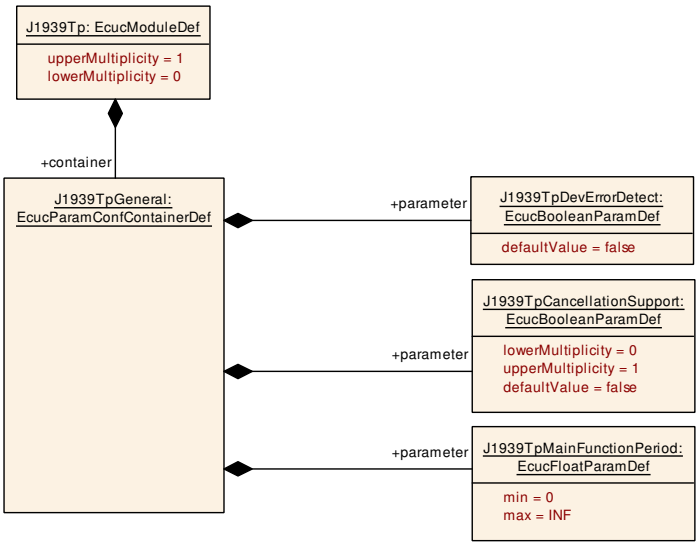

Figure 10.2: General Parameters

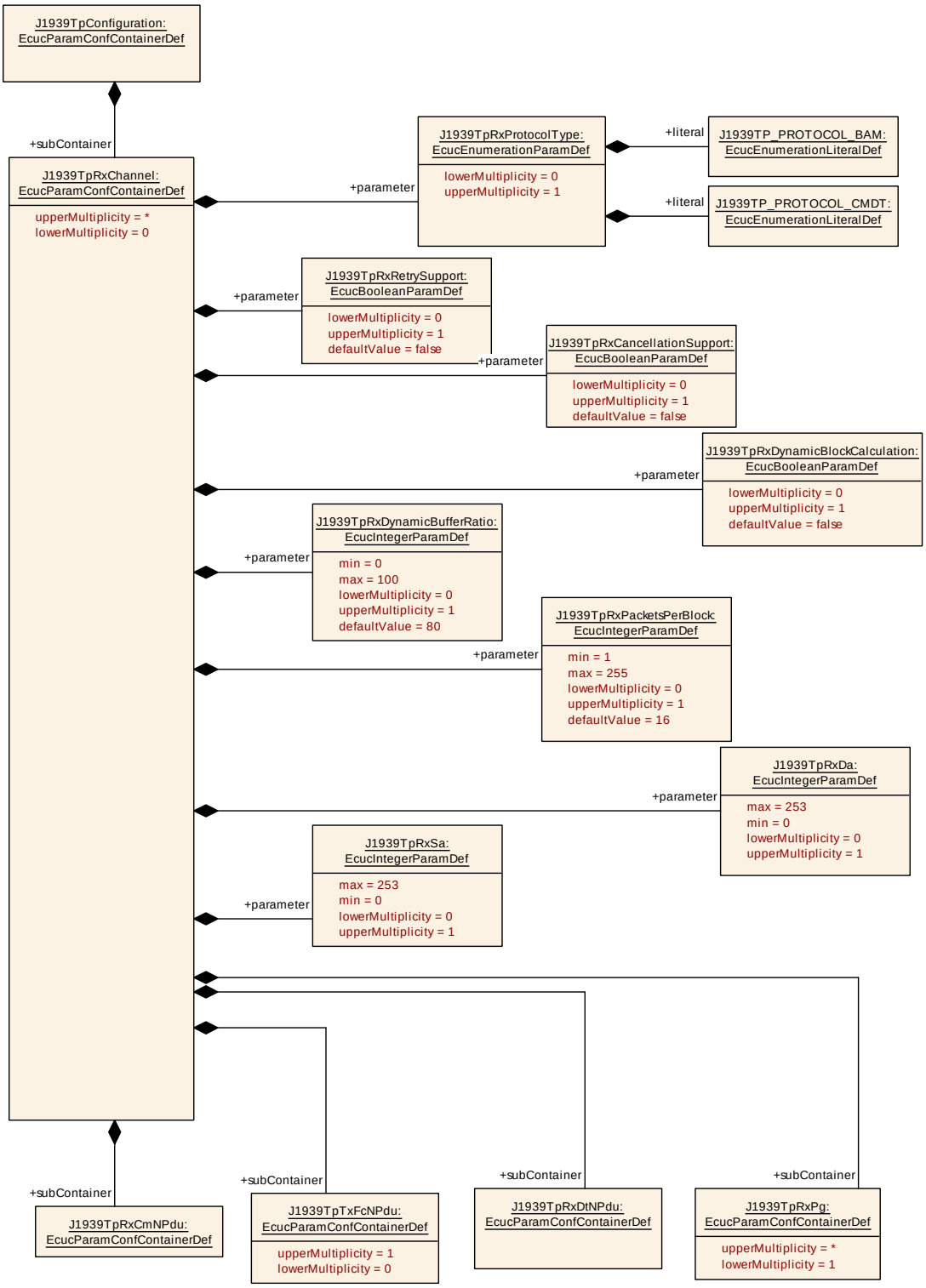

Figure 10.3: Configuration of Rx Channel - Part 1

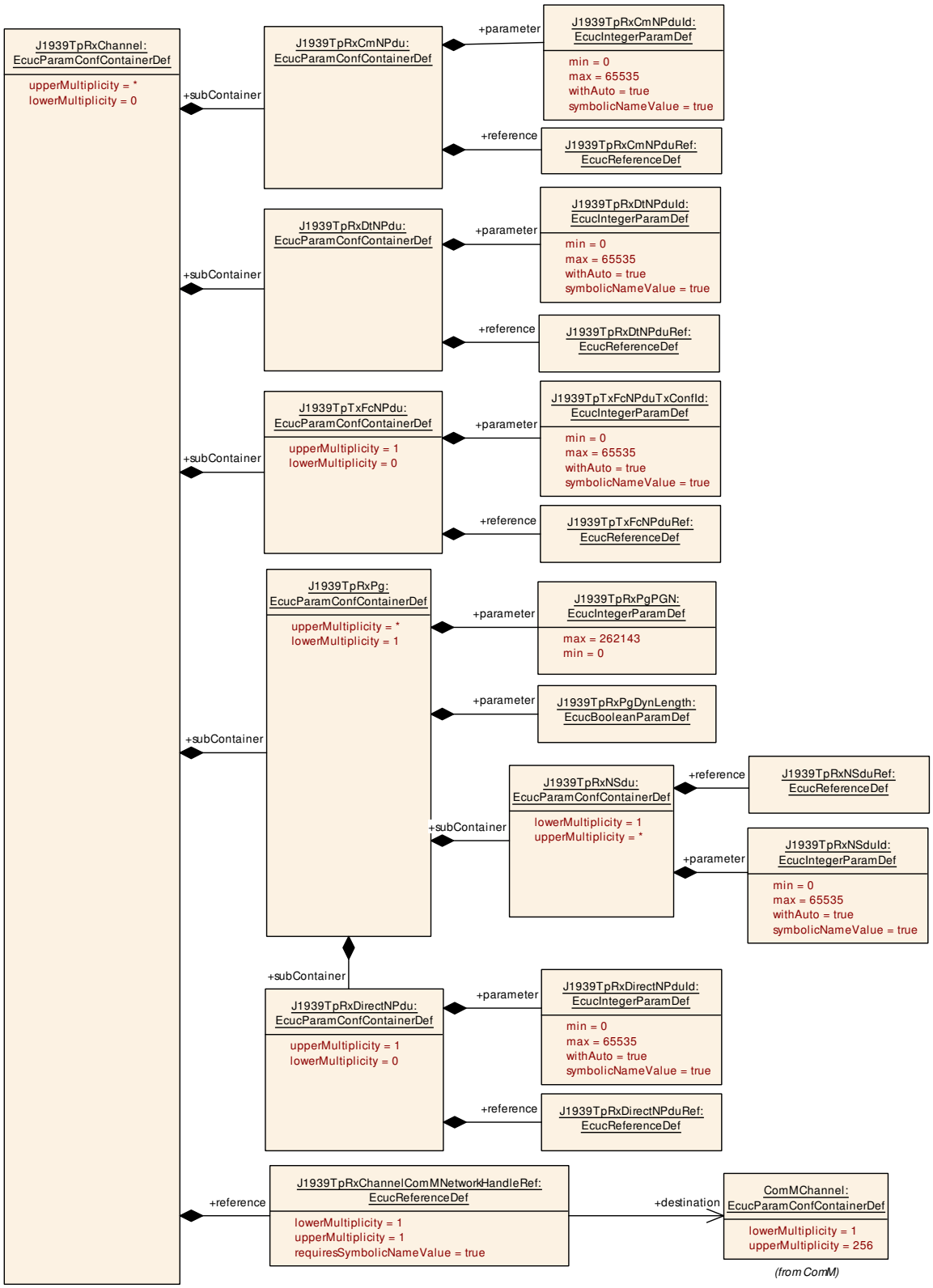

Figure 10.4: Configuration of Rx Channel - Part 2

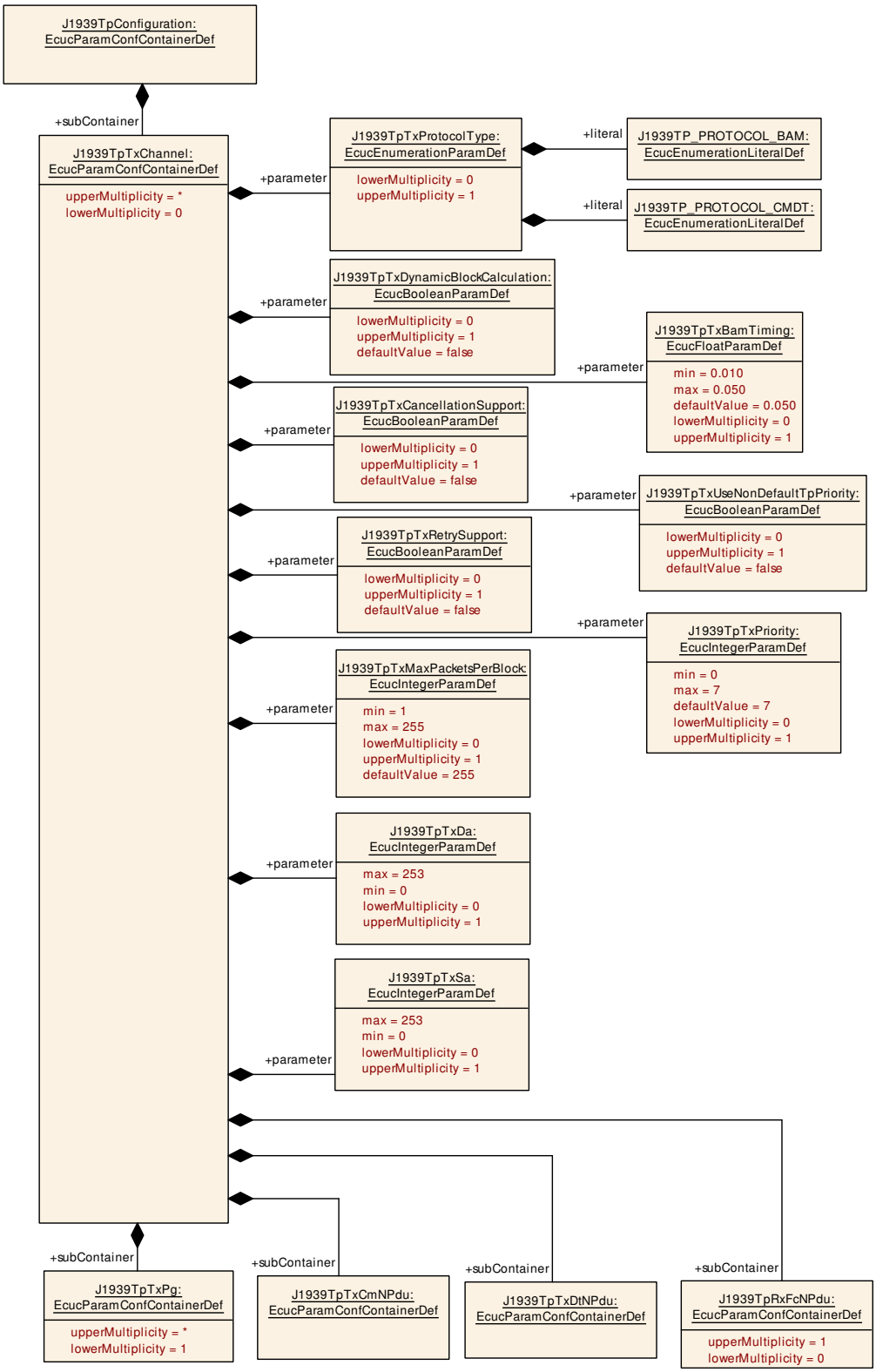

Figure 10.5: Configuration of Tx Channel - Part 1

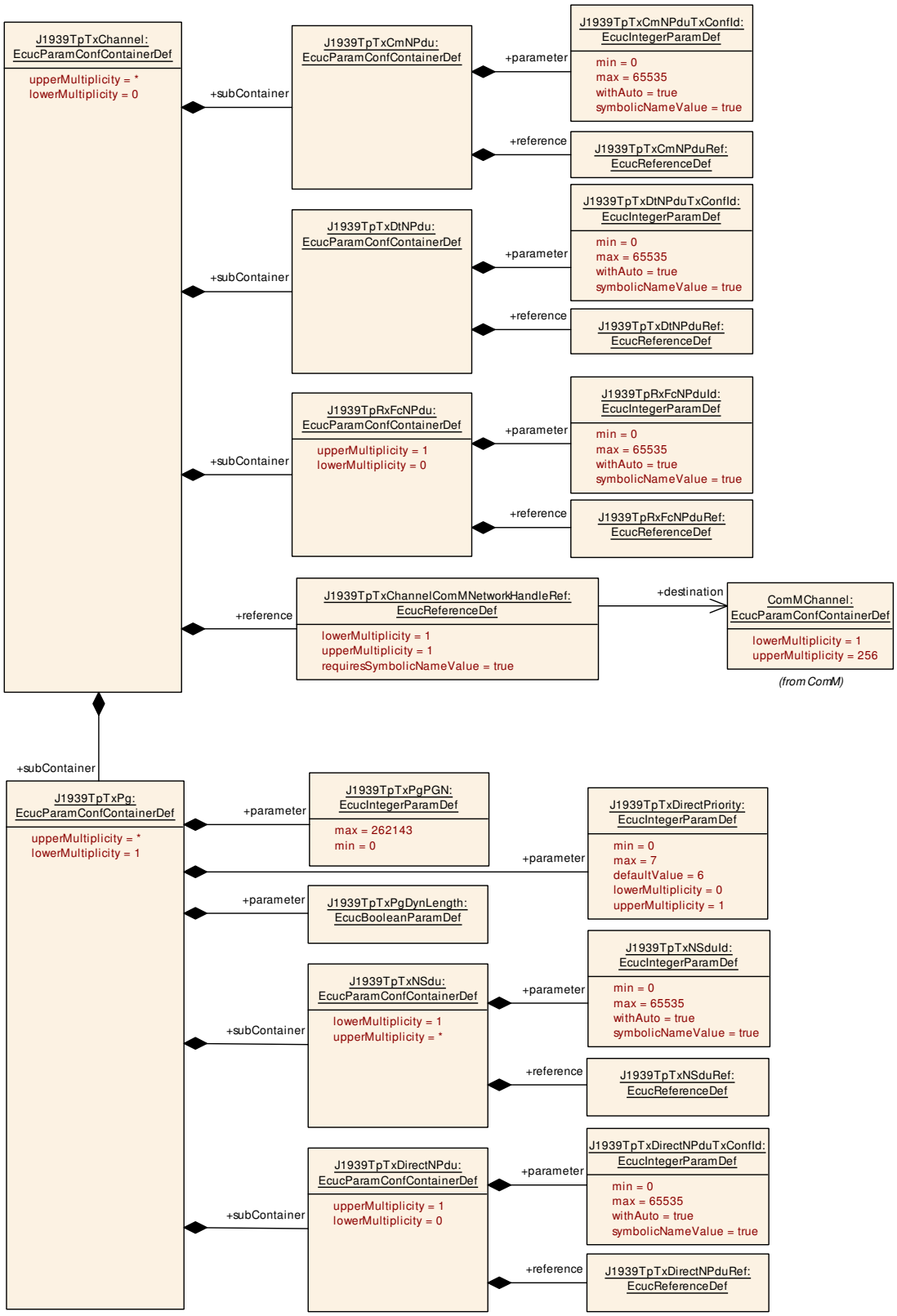

Figure 10.6: Configuration of Tx Channel - Part 2

As the SAE J1939 Transport Layer module has interfaces to the PDU Router, the configuration needs to reference the “global PDUs” (EcucPduCollection.Pdu) of the [22, TPS ECU Configuration].

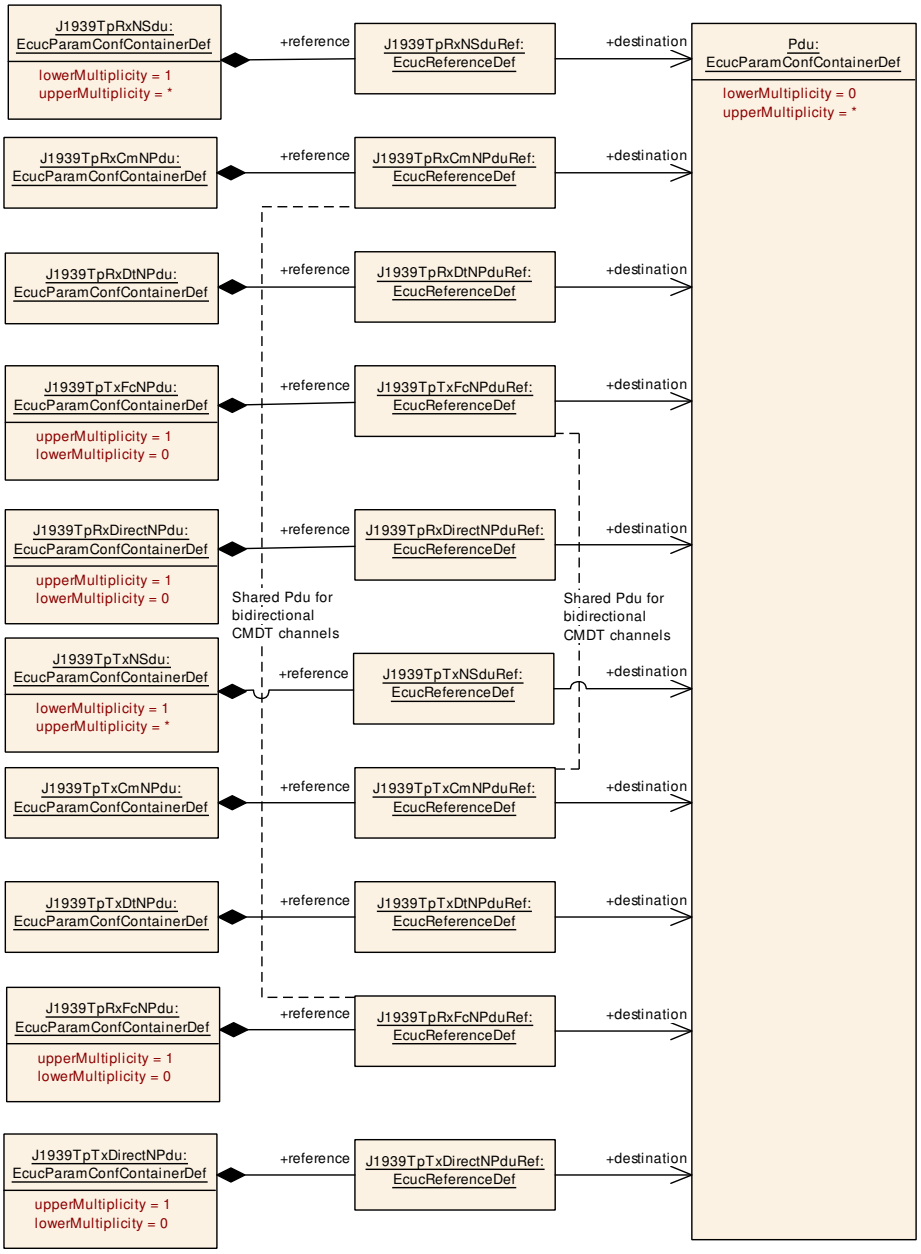

Figure 10.7: References to PDUs

10.1.1 J1939Tp

[ECUC_J1939Tp_00127] Definition of EcucModuleDef J1939Tp ⌈

Module Name	J1939Tp
Description	Configuration of the J1939Tp (J1939 Transport Protocol) module.
Post-Build Selectable Support	true
Post-Build Loadable Support	true

Included Containers		
Container Name	**Multiplicity**	**Description**
J1939TpConfiguration	1	This container contains the configuration parameters and sub containers of the J1939Tp module that define the communication paths.
J1939TpGeneral	1	This container describes the general configuration parameters of the J1939Tp module.

⌋

10.1.2 J1939TpGeneral

[ECUC_J1939Tp_00033] Definition of EcucParamConfContainerDef J1939Tp General ⌈

Container Name	J1939TpGeneral
Parent Container	J1939Tp
Upstream mapping defined	–
Description	This container describes the general configuration parameters of the J1939Tp module.
Multiplicity	1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpCancellationSupport	0..1	[ECUC_J1939Tp_00174]
J1939TpDevErrorDetect	1	[ECUC_J1939Tp_00042]
J1939TpMainFunctionPeriod	1	[ECUC_J1939Tp_00044]

No Included Containers

⌋

[ECUC_J1939Tp_00174] Definition of EcucBooleanParamDef J1939TpCancellationSupport ⌈

Parameter Name	J1939TpCancellationSupport
Parent Container	J1939TpGeneral
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Enable transmit and receive cancellation. The APIs J1939Tp_CancelTransmit() and J1939Tp_CancelReceive() will only be available when this parameter is enabled.
Multiplicity	0..1
Type	EcucBooleanParamDef
Default value	false
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00042] Definition of EcucBooleanParamDef J1939TpDevErrorDetect ⌈

Parameter Name	J1939TpDevErrorDetect
Parent Container	J1939TpGeneral
Upstream mapping defined	–
Description	Switches the development error detection and notification on or off. • true: detection and notification is enabled. • false: detection and notification is disabled.
Multiplicity	1
Type	EcucBooleanParamDef
Default value	false
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00044] Definition of EcucFloatParamDef J1939TpMainFunctionPeriod ⌈

Parameter Name	J1939TpMainFunctionPeriod	
Parent Container	J1939TpGeneral	
Upstream mapping defined	–	
Description	Allow to configure the time for the MainFunction (in seconds). Please note: This configuration value shall be equal to the value in the ScheduleManager module.	
Multiplicity	1	
Type	EcucFloatParamDef	
Range	]0 .. INF[	
Default value	–	
Pre-Compile only	true	

⌋

10.1.3 J1939TpConfiguration

[ECUC_J1939Tp_00052] Definition of EcucParamConfContainerDef J1939Tp Configuration ⌈

Container Name	J1939TpConfiguration
Parent Container	J1939Tp
Upstream mapping defined	–
Description	This container contains the configuration parameters and sub containers of the J1939 Tp module that define the communication paths.
Multiplicity	1
Pre-Compile only	true
Configuration Parameters	

No Included Parameters

Included Containers		
Container Name	**Multiplicity**	**Description**
J1939TpRxChannel	0..*	This container describes a reception channel of the J1939Tp module. A channel referencing N-PDUs without MetaData is used for all N-SDUs that share the same source address (SA) and the same destination address (BAM: DA = 0xFF, CMDT: DA != 0xFF). A channel with N-PDUs with MetaData is used for all possible source and destination addresses.
J1939TpTxChannel	0..*	This container describes a transmission channel of the J1939Tp module. A channel referencing N-PDUs without MetaData is used for all N-SDUs that share the same source address (SA) and the same destination address (BAM: DA = 0xFF, CMDT: DA != 0xFF). A channel with N-PDUs with MetaData is used for all possible source and destination addresses.

⌋

10.1.4 J1939TpRxChannel

[ECUC_J1939Tp_00053] Definition of EcucParamConfContainerDef J1939TpRx Channel ⌈

Container Name	J1939TpRxChannel
Parent Container	J1939TpConfiguration
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This container describes a reception channel of the J1939Tp module. A channel referencing N-PDUs without MetaData is used for all N-SDUs that share the same source address (SA) and the same destination address (BAM: DA = 0xFF, CMDT: DA != 0xFF). A channel with N-PDUs with MetaData is used for all possible source and destination addresses.
Multiplicity	0..*
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpRxCancellationSupport	0..1	[ECUC_J1939Tp_00186]
J1939TpRxDa	0..1	[ECUC_J1939Tp_00178]
J1939TpRxDynamicBlockCalculation	0..1	[ECUC_J1939Tp_00187]
J1939TpRxDynamicBufferRatio	0..1	[ECUC_J1939Tp_00188]
J1939TpRxPacketsPerBlock	0..1	[ECUC_J1939Tp_00189]
J1939TpRxProtocolType	0..1	[ECUC_J1939Tp_00029]
J1939TpRxRetrySupport	0..1	[ECUC_J1939Tp_00185]
J1939TpRxSa	0..1	[ECUC_J1939Tp_00179]
J1939TpRxChannelComMNetworkHandleRef	1	[ECUC_J1939Tp_00194]

Included Containers		
Container Name	**Multiplicity**	**Description**
J1939TpRxCmNPdu	1	This N-PDU represents the TP.CM frame of a J1939 transport protocol session. TP.CM is used both by BAM and CMDT to initialize the connection. For CMDT, it is also used to abort the connection. This N-PDU consumes a meta data item of type CAN_ID_32.
J1939TpRxDtNPdu	1	This N-PDU represents the TP.DT frame of a J1939 transport protocol session. TP.DT is used both by BAM and CMDT to transfer the contents of an N-SDU. This N-PDU consumes a meta data item of type CAN_ID_32.
J1939TpRxPg	1..*	Parameter group received by the J1939 transport layer.
J1939TpTxFcNPdu	0..1	This N-PDU represents the TP.CM frame that is used in reverse direction for a J1939 transport protocol session using the CMDT protocol type. TP.CM in reverse direction is used for intermediate and final acknowledgement of received data and to abort the connection. This N-PDU produces a meta data item of type CAN_ID_32. Please note: This sub container is only required when J1939Tp RxProtocolType is J1939TP_PROTOCOL_CMDT or when it is not configured at all.

⌋

[ECUC_J1939Tp_00186] Definition of EcucBooleanParamDef J1939TpRxCancellationSupport ⌈

Parameter Name	J1939TpRxCancellationSupport
Parent Container	J1939TpRxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Enable receive cancellation using the API J1939Tp_CancelReceive() for this channel.
Multiplicity	0..1
Type	EcucBooleanParamDef
Default value	false
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00178] Definition of EcucIntegerParamDef J1939TpRxDa ⌈

Parameter Name	J1939TpRxDa	
Parent Container	J1939TpRxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Destination address (DA) of this channel. This parameter is only required for channels with fixed DA which use N-PDUs with MetaData containing the DA.	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	0 .. 253	
Default value	–	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_J1939Tp_00187] Definition of EcucBooleanParamDef J1939TpRxDynamicBlockCalculation ⌈

Parameter Name	J1939TpRxDynamicBlockCalculation
Parent Container	J1939TpRxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Enable dynamic calculation of "number of packets that can be sent" value in TP.CM_CTS, based on the size of buffers in upper layers reported via StartOfReception and PduR_J1939TpCopyRxData.
Multiplicity	0..1
Type	EcucBooleanParamDef
Default value	false
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00188] Definition of EcucIntegerParamDef J1939TpRxDynamicBufferRatio ⌈

Parameter Name	J1939TpRxDynamicBufferRatio	
Parent Container	J1939TpRxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Percentage of available buffer that shall be used for retry. This parameter is only applicable when "J1939TpRxRetrySupport" and "J1939TpRxDynamicBlockCalculation" are enabled. Dependency: Only applicable when "J1939TpRxRetrySupport" and "J1939TpRx DynamicBlockCalculation" are enabled	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	0 .. 100	
Default value	80	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00189] Definition of EcucIntegerParamDef J1939TpRxPackets PerBlock ⌈

Parameter Name	J1939TpRxPacketsPerBlock	
Parent Container	J1939TpRxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Number of TP.DT frames the receiving J1939Tp module allows the sender to send before waiting for another TP.CM_CTS. This parameter is transmitted in the TP.CM_ CTS frame, and is thus only relevant for reception of messages via CMDT. When J1939 TpRxDynamicBlockCalculation is enabled, this parameter specifies a maximum for the calculated value. For further details on this parameter value see SAE J1939/21.	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	1 .. 255	
Default value	16	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00029] Definition of EcucEnumerationParamDef J1939TpRx ProtocolType ⌈

Parameter Name	J1939TpRxProtocolType	
Parent Container	J1939TpRxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Protocol type used by this channel. This parameter is only required for channels with fixed destination address.	
Multiplicity	0..1	
Type	EcucEnumerationParamDef	
Range	J1939TP_PROTOCOL_BAM	J1939 transport protocol type BAM (Broadcast Announce Message). This protocol uses two N-PDUs: The CmNPdu and the DtNPdu.
	J1939TP_PROTOCOL_CMDT	J1939 transport protocol type CMDT (Connection Mode Data Transfer). This protocol uses three N-PDUs: The CmNPdu, the DtNPdu, and the FcNPdu.
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00185] Definition of EcucBooleanParamDef J1939TpRxRetry Support ⌈

Parameter Name	J1939TpRxRetrySupport
Parent Container	J1939TpRxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Enable support for triggering repetition of failed transmission using TP.CM_CTS with a packet number that has already been sent. Retransmission is triggered when a sequence number is missing or a timeout occurs during reception.
Multiplicity	0..1
Type	EcucBooleanParamDef

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△

Default value	false
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00179] Definition of EcucIntegerParamDef J1939TpRxSa ⌈

Parameter Name	J1939TpRxSa	
Parent Container	J1939TpRxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Source address (SA) of this channel. This parameter is only required for channels with fixed SA which use N-PDUs with MetaData containing the SA.	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	0 .. 253	
Default value	–	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_J1939Tp_00194] Definition of EcucReferenceDef J1939TpRxChannel ComMNetworkHandleRef ⌈

Parameter Name	J1939TpRxChannelComMNetworkHandleRef
Parent Container	J1939TpRxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Reference to the channel defined by the ComMChannel providing access to the unique channel index ComMChannelId.
Multiplicity	1
Type	Symbolic name reference to ComMChannel
Pre-Compile only	true

⌋

10.1.5 J1939TpRxCmNPdu

[ECUC_J1939Tp_00128] Definition of EcucParamConfContainerDef J1939TpRx CmNPdu ⌈

Container Name	J1939TpRxCmNPdu
Parent Container	J1939TpRxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This N-PDU represents the TP.CM frame of a J1939 transport protocol session. TP.CM is used both by BAM and CMDT to initialize the connection. For CMDT, it is also used to abort the connection. This N-PDU consumes a meta data item of type CAN_ID_32.
Multiplicity	1

▽

△

Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpRxCmNPduId	1	[ECUC_J1939Tp_00129]
J1939TpRxCmNPduRef	1	[ECUC_J1939Tp_00158]

No Included Containers

⌋

[ECUC_J1939Tp_00129] Definition of EcucIntegerParamDef J1939TpRxCmNPduId ⌈

Parameter Name	J1939TpRxCmNPduId	
Parent Container	J1939TpRxCmNPdu	
Upstream mapping defined	–	
Description	The N-PDU identifier used for communication with LSduR.	
Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00158] Definition of EcucReferenceDef J1939TpRxCmNPduRef ⌈

Parameter Name	J1939TpRxCmNPduRef	
Parent Container	J1939TpRxCmNPdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-PDU.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

10.1.6 J1939TpRxDtNPdu

[ECUC_J1939Tp_00117] Definition of EcucParamConfContainerDef J1939TpRxDtNPdu ⌈

Container Name	J1939TpRxDtNPdu
Parent Container	J1939TpRxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This N-PDU represents the TP.DT frame of a J1939 transport protocol session. TP.DT is used both by BAM and CMDT to transfer the contents of an N-SDU. This N-PDU consumes a meta data item of type CAN_ID_32.
Multiplicity	1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpRxDtNPduId	1	[ECUC_J1939Tp_00133]
J1939TpRxDtNPduRef	1	[ECUC_J1939Tp_00134]

No Included Containers

⌋

[ECUC_J1939Tp_00133] Definition of EcucIntegerParamDef J1939TpRxDtNPduId ⌈

Parameter Name	J1939TpRxDtNPduId	
Parent Container	J1939TpRxDtNPdu	
Upstream mapping defined	–	
Description	The N-PDU identifier used for communication with LSduR.	
Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00134] Definition of EcucReferenceDef J1939TpRxDtNPduRef ⌈

Parameter Name	J1939TpRxDtNPduRef	
Parent Container	J1939TpRxDtNPdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-PDU.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

10.1.7 J1939TpRxPg

[ECUC_J1939Tp_00050] Definition of EcucParamConfContainerDef J1939TpRxPg ⌈

Container Name	J1939TpRxPg
Parent Container	J1939TpRxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Parameter group received by the J1939 transport layer.
Multiplicity	1..*
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpRxPgDynLength	1	[ECUC_J1939Tp_00066]
J1939TpRxPgPGN	1	[ECUC_J1939Tp_00065]

Included Containers		
Container Name	**Multiplicity**	**Description**
J1939TpRxDirectNPdu	0..1	This N-PDU represents the short frame that is used for a dynamic length PGN when it has a length of less that 8 bytes. This N-PDU consumes a meta data item of type CAN_ID_32. Please note: This sub container is only necessary when J1939 TpRxPgDynLength is TRUE.
J1939TpRxNSdu	1..*	This container describes the parameters that are relevant for the reception of a specific N-SDU. This N-SDU produces meta data items of type SOURCE_ADDRESS_16, TARGET_ADDRESS_16, and PRIORITY_8.

⌋

[ECUC_J1939Tp_00066] Definition of EcucBooleanParamDef J1939TpRxPgDynLength ⌈

Parameter Name	J1939TpRxPgDynLength
Parent Container	J1939TpRxPg
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This flag is set to TRUE when the N-SDU refers to a PGN with variable length. Please note: When this attribute is TRUE, the sub container J1939TpRxDirectNPdu is required.
Multiplicity	1
Type	EcucBooleanParamDef
Default value	–
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00065] Definition of EcucIntegerParamDef J1939TpRxPgPGN ⌈

Parameter Name	J1939TpRxPgPGN
Parent Container	J1939TpRxPg
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	PGN of the referenced N-SDUs.
Multiplicity	1
Type	EcucIntegerParamDef
Range	0 .. 262143
Default value	–
Pre-Compile only	true

⌋

10.1.8 J1939TpRxDirectNPdu

[ECUC_J1939Tp_00130] Definition of EcucParamConfContainerDef J1939TpRx DirectNPdu ⌈

Container Name	J1939TpRxDirectNPdu
Parent Container	J1939TpRxPg
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This N-PDU represents the short frame that is used for a dynamic length PGN when it has a length of less that 8 bytes. This N-PDU consumes a meta data item of type CAN_ID_32. Please note: This sub container is only necessary when J1939TpRxPgDynLength is TRUE.
Multiplicity	0..1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpRxDirectNPduId	1	[ECUC_J1939Tp_00131]
J1939TpRxDirectNPduRef	1	[ECUC_J1939Tp_00132]

No Included Containers

⌋

[ECUC_J1939Tp_00131] Definition of EcucIntegerParamDef J1939TpRxDirect NPduId ⌈

Parameter Name	J1939TpRxDirectNPduId
Parent Container	J1939TpRxDirectNPdu
Upstream mapping defined	–
Description	The N-PDU identifier used for communication with LSduR.

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Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00132] Definition of EcucReferenceDef J1939TpRxDirectNPduRef ⌈

Parameter Name	J1939TpRxDirectNPduRef	
Parent Container	J1939TpRxDirectNPdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-PDU.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

10.1.9 J1939TpRxNSdu

[ECUC_J1939Tp_00063] Definition of EcucParamConfContainerDef J1939TpRxNSdu ⌈

Container Name	J1939TpRxNSdu
Parent Container	J1939TpRxPg
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This container describes the parameters that are relevant for the reception of a specific N-SDU. This N-SDU produces meta data items of type SOURCE_ADDRESS_16, TARGET_ADDRESS_16, and PRIORITY_8.
Multiplicity	1..*
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpRxNSduId	1	[ECUC_J1939Tp_00184]
J1939TpRxNSduRef	1	[ECUC_J1939Tp_00069]

No Included Containers

⌋

[ECUC_J1939Tp_00184] Definition of EcucIntegerParamDef J1939TpRxNSduId ⌈

Parameter Name	J1939TpRxNSduId	
Parent Container	J1939TpRxNSdu	
Upstream mapping defined	–	
Description	This is a unique identifier for a received N-SDU. This Id is used in the CancelReceive API call.	
Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00069] Definition of EcucReferenceDef J1939TpRxNSduRef ⌈

Parameter Name	J1939TpRxNSduRef	
Parent Container	J1939TpRxNSdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-SDU.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

10.1.10 J1939TpTxFcNPdu

[ECUC_J1939Tp_00135] Definition of EcucParamConfContainerDef J1939TpTxFcNPdu ⌈

Container Name	J1939TpTxFcNPdu
Parent Container	J1939TpRxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This N-PDU represents the TP.CM frame that is used in reverse direction for a J1939 transport protocol session using the CMDT protocol type. TP.CM in reverse direction is used for intermediate and final acknowledgement of received data and to abort the connection. This N-PDU produces a meta data item of type CAN_ID_32. Please note: This sub container is only required when J1939TpRxProtocolType is J1939TP_PROTOCOL_CMDT or when it is not configured at all.
Multiplicity	0..1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpTxFcNPduTxConfId	1	[ECUC_J1939Tp_00168]
J1939TpTxFcNPduRef	1	[ECUC_J1939Tp_00136]

No Included Containers

⌋

[ECUC_J1939Tp_00168] Definition of EcucIntegerParamDef J1939TpTxFcNPduTxConfId ⌈

Parameter Name	J1939TpTxFcNPduTxConfId	
Parent Container	J1939TpTxFcNPdu	
Upstream mapping defined	–	
Description	The N-PDU identifier used for Tx confirmation from LSduR.	
Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00136] Definition of EcucReferenceDef J1939TpTxFcNPduRef ⌈

Parameter Name	J1939TpTxFcNPduRef	
Parent Container	J1939TpTxFcNPdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-PDU. Please note: When two channels have identical but exchanged source and destination addresses, the Pdu referenced by this parameter is shared with J1939TpTxCmNPdu Ref of the corresponding J1939TpTxChannel.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

10.1.11 J1939TpTxChannel

[ECUC_J1939Tp_00059] Definition of EcucParamConfContainerDef J1939TpTxChannel ⌈

Container Name	J1939TpTxChannel
Parent Container	J1939TpConfiguration
Upstream mapping defined	[21, CP_TPS_SystemTemplate]

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Description	This container describes a transmission channel of the J1939Tp module. A channel referencing N-PDUs without MetaData is used for all N-SDUs that share the same source address (SA) and the same destination address (BAM: DA = 0xFF, CMDT: DA != 0xFF). A channel with N-PDUs with MetaData is used for all possible source and destination addresses.
Multiplicity	0..*
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpTxBamTiming	0..1	[ECUC_J1939Tp_00197]
J1939TpTxCancellationSupport	0..1	[ECUC_J1939Tp_00192]
J1939TpTxDa	0..1	[ECUC_J1939Tp_00180]
J1939TpTxDynamicBlockCalculation	0..1	[ECUC_J1939Tp_00191]
J1939TpTxMaxPacketsPerBlock	0..1	[ECUC_J1939Tp_00190]
J1939TpTxPriority	0..1	[ECUC_J1939Tp_00199]
J1939TpTxProtocolType	0..1	[ECUC_J1939Tp_00137]
J1939TpTxRetrySupport	0..1	[ECUC_J1939Tp_00193]
J1939TpTxSa	0..1	[ECUC_J1939Tp_00181]
J1939TpTxUseNonDefaultTpPriority	0..1	[ECUC_J1939Tp_00198]
J1939TpTxChannelComMNetworkHandleRef	1	[ECUC_J1939Tp_00195]

Included Containers		
Container Name	**Multiplicity**	**Description**
J1939TpRxFcNPdu	0..1	This N-PDU represents the TP.CM frame that is used in reverse direction for a J1939 transport protocol session using the CMDT protocol type. TP.CM in reverse direction is used for intermediate and final acknowledgement of received data and to abort the connection. This N-PDU consumes a meta data item of type CAN_ID_32. Please note: This sub container is only required when J1939Tp TxProtocolType is J1939TP_PROTOCOL_CMDT or when it is not configured at all.
J1939TpTxCmNPdu	1	This N-PDU represents the TP.CM frame of a J1939 transport protocol session. TP.CM is used both by BAM and CMDT to initialize the connection. For CMDT, it is also used to abort the connection. This N-PDU produces a meta data item of type CAN_ID_32.
J1939TpTxDtNPdu	1	This N-PDU represents the TP.DT frame of a J1939 transport protocol session. TP.DT is used both by BAM and CMDT to transfer the contents of an N-SDU. This N-PDU produces a meta data item of type CAN_ID_32.
J1939TpTxPg	1..*	Parameter group transmitted by the J1939 transport layer.

┘

[ECUC_J1939Tp_00197] Definition of EcucFloatParamDef J1939TpTxBamTiming ⌈

Parameter Name	J1939TpTxBamTiming	
Parent Container	J1939TpTxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	If configured, TP.DT frames of a BAM transmission will be sent with the configured delay in seconds. If not configured, 0,05 seconds will be used.	
Multiplicity	0..1	
Type	EcucFloatParamDef	
Range	[0.01 .. 0.05]	
Default value	0.05	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_J1939Tp_00192] Definition of EcucBooleanParamDef J1939TpTxCancellationSupport ⌈

Parameter Name	J1939TpTxCancellationSupport
Parent Container	J1939TpTxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Enable transmit cancellation using the API J1939Tp_CancelTransmit() for this channel.
Multiplicity	0..1
Type	EcucBooleanParamDef
Default value	false
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00180] Definition of EcucIntegerParamDef J1939TpTxDa ⌈

Parameter Name	J1939TpTxDa	
Parent Container	J1939TpTxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Destination address (DA) of this channel. This parameter is only required for channels with fixed DA which use N-PDUs with MetaData containing the DA.	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	0 .. 253	
Default value	–	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_J1939Tp_00191] Definition of EcucBooleanParamDef J1939TpTxDynamicBlockCalculation ⌈

Parameter Name	J1939TpTxDynamicBlockCalculation
Parent Container	J1939TpTxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Enable dynamic calculation of "maximum number of packets that can be sent" value in TP.CM_RTS, based on the available amount of data in upper layers reported via PduR_J1939TpCopyTxData.
Multiplicity	0..1
Type	EcucBooleanParamDef
Default value	false
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00190] Definition of EcucIntegerParamDef J1939TpTxMaxPacketsPerBlock ⌈

Parameter Name	J1939TpTxMaxPacketsPerBlock	
Parent Container	J1939TpTxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Maximum number of TP.DT frames the transmitting J1939Tp module is ready to send before waiting for another TP.CM_CTS. This parameter is transmitted in the TP.CM_RTS frame, and is thus only relevant for transmission of messages via CMDT. When J1939TpTxDynamicBlockCalculation is enabled, this parameter specifies a maximum for the calculated value. For further details on this parameter value see SAE J1939/21.	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	1 .. 255	
Default value	255	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00199] Definition of EcucIntegerParamDef J1939TpTxPriority ⌈

Parameter Name	J1939TpTxPriority	
Parent Container	J1939TpTxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	If configured, and J1939TpTxUseNonDefaultTpPriority is enabled, this value will be used as priority of transmitted TP.CM and TP.DT frames, otherwise the default priority 7 will be used.	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	0 .. 7	
Default value	7	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_J1939Tp_00137] Definition of EcucEnumerationParamDef J1939TpTx ProtocolType ⌈

Parameter Name	J1939TpTxProtocolType	
Parent Container	J1939TpTxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Protocol type used by this channel. This parameter is only required for channels with fixed destination address.	
Multiplicity	0..1	
Type	EcucEnumerationParamDef	
Range	J1939TP_PROTOCOL_BAM	J1939 transport protocol type BAM (Broadcast Announce Message). This protocol uses two N-PDUs: The CmNPdu and the DtNPdu.
	J1939TP_PROTOCOL_CMDT	J1939 transport protocol type CMDT (Connection Mode Data Transfer). This protocol uses three N-PDUs: The CmNPdu, the DtNPdu, and the FcNPdu.
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00193] Definition of EcucBooleanParamDef J1939TpTxRetry Support ⌈

Parameter Name	J1939TpTxRetrySupport
Parent Container	J1939TpTxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Enable support for repetition of failed transmission using TP.CM_CTS with a packet number that has already been sent. Retransmission is handled via the retry feature of PduR_J1939TpCopyTxData.
Multiplicity	0..1
Type	EcucBooleanParamDef
Default value	false
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00181] Definition of EcucIntegerParamDef J1939TpTxSa ⌈

Parameter Name	J1939TpTxSa	
Parent Container	J1939TpTxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Source address (SA) of this channel. This parameter is only required for channels with fixed SA which use N-PDUs with MetaData containing the SA.	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	0 .. 253	
Default value	–	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_J1939Tp_00198] Definition of EcucBooleanParamDef J1939TpTxUseNonDefaultTpPriority ⌈

Parameter Name	J1939TpTxUseNonDefaultTpPriority	
Parent Container	J1939TpTxChannel	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	Enables/disables non-default priority of transmitted TP.CM and TP.DT frames. If enabled, the priority will be set according to J1939TpTxPriority or to the priority provided by the upper layer via meta data.	
Multiplicity	0..1	
Type	EcucBooleanParamDef	
Default value	false	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_J1939Tp_00195] Definition of EcucReferenceDef J1939TpTxChannelComMNetworkHandleRef ⌈

Parameter Name	J1939TpTxChannelComMNetworkHandleRef
Parent Container	J1939TpTxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Reference to the channel defined by the ComMChannel providing access to the unique channel index ComMChannelId.
Multiplicity	1
Type	Symbolic name reference to ComMChannel
Pre-Compile only	true

⌋

10.1.12 J1939TpRxFcNPdu

[ECUC_J1939Tp_00144] Definition of EcucParamConfContainerDef J1939TpRxFcNPdu ⌈

Container Name	J1939TpRxFcNPdu
Parent Container	J1939TpTxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This N-PDU represents the TP.CM frame that is used in reverse direction for a J1939 transport protocol session using the CMDT protocol type. TP.CM in reverse direction is used for intermediate and final acknowledgement of received data and to abort the connection. This N-PDU consumes a meta data item of type CAN_ID_32. Please note: This sub container is only required when J1939TpTxProtocolType is J1939TP_PROTOCOL_CMDT or when it is not configured at all.
Multiplicity	0..1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpRxFcNPduId	1	[ECUC_J1939Tp_00145]
J1939TpRxFcNPduRef	1	[ECUC_J1939Tp_00146]

No Included Containers

⌋

[ECUC_J1939Tp_00145] Definition of EcucIntegerParamDef J1939TpRxFcNPduId ⌈

Parameter Name	J1939TpRxFcNPduId	
Parent Container	J1939TpRxFcNPdu	
Upstream mapping defined	–	
Description	The N-PDU identifier used for communication with LSduR.	
Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00146] Definition of EcucReferenceDef J1939TpRxFcNPduRef ⌈

Parameter Name	J1939TpRxFcNPduRef	
Parent Container	J1939TpRxFcNPdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-PDU. Please note: When two channels have identical but exchanged source and destination addresses, the Pdu referenced by this parameter is shared with J1939TpRxCmNPdu Ref of the corresponding J1939TpRxChannel.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

10.1.13 J1939TpTxCmNPdu

[ECUC_J1939Tp_00138] Definition of EcucParamConfContainerDef J1939TpTxCmNPdu ⌈

Container Name	J1939TpTxCmNPdu
Parent Container	J1939TpTxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This N-PDU represents the TP.CM frame of a J1939 transport protocol session. TP.CM is used both by BAM and CMDT to initialize the connection. For CMDT, it is also used to abort the connection. This N-PDU produces a meta data item of type CAN_ID_32.
Multiplicity	1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpTxCmNPduTxConfId	1	[ECUC_J1939Tp_00170]
J1939TpTxCmNPduRef	1	[ECUC_J1939Tp_00139]

No Included Containers

⌋

[ECUC_J1939Tp_00170] Definition of EcucIntegerParamDef J1939TpTxCmNPduTxConfId ⌈

Parameter Name	J1939TpTxCmNPduTxConfId	
Parent Container	J1939TpTxCmNPdu	
Upstream mapping defined	–	
Description	The N-PDU identifier used for Tx confirmation from LSduR.	
Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00139] Definition of EcucReferenceDef J1939TpTxCmNPduRef ⌈

Parameter Name	J1939TpTxCmNPduRef	
Parent Container	J1939TpTxCmNPdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-PDU.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

10.1.14 J1939TpTxDtNPdu

[ECUC_J1939Tp_00142] Definition of EcucParamConfContainerDef J1939TpTxDtNPdu ⌈

Container Name	J1939TpTxDtNPdu
Parent Container	J1939TpTxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This N-PDU represents the TP.DT frame of a J1939 transport protocol session. TP.DT is used both by BAM and CMDT to transfer the contents of an N-SDU. This N-PDU produces a meta data item of type CAN_ID_32.
Multiplicity	1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpTxDtNPduTxConfId	1	[ECUC_J1939Tp_00171]
J1939TpTxDtNPduRef	1	[ECUC_J1939Tp_00143]

No Included Containers

⌋

[ECUC_J1939Tp_00171] Definition of EcucIntegerParamDef J1939TpTxDtNPduTxConfId ⌈

Parameter Name	J1939TpTxDtNPduTxConfId	
Parent Container	J1939TpTxDtNPdu	
Upstream mapping defined	–	
Description	The N-PDU identifier used for Tx confirmation from LSduR.	
Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00143] Definition of EcucReferenceDef J1939TpTxDtNPduRef ⌈

Parameter Name	J1939TpTxDtNPduRef	
Parent Container	J1939TpTxDtNPdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-PDU.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

10.1.15 J1939TpTxPg

[ECUC_J1939Tp_00070] Definition of EcucParamConfContainerDef J1939TpTxPg ⌈

Container Name	J1939TpTxPg
Parent Container	J1939TpTxChannel
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	Parameter group transmitted by the J1939 transport layer.
Multiplicity	1..*
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpTxDirectPriority	0..1	[ECUC_J1939Tp_00200]
J1939TpTxPgDynLength	1	[ECUC_J1939Tp_00148]
J1939TpTxPgPGN	1	[ECUC_J1939Tp_00150]

Included Containers		
Container Name	**Multiplicity**	**Description**
J1939TpTxDirectNPdu	0..1	This N-PDU represents the short frame that is used for a dynamic length PGN when it has a length of less that 8 bytes. This N-PDU produces a meta data item of type CAN_ID_32. Please note: This sub container is only necessary when J1939 TpTxPgDynLength is TRUE.
J1939TpTxNSdu	1..*	This container describes the parameters that are relevant for the transmission of a specific N-SDU. This N-SDU consumes meta data items of type SOURCE_ADDRESS_16, TARGET_ ADDRESS_16, and PRIORITY_8.

⌋

[ECUC_J1939Tp_00200] Definition of EcucIntegerParamDef J1939TpTxDirectPriority ⌈

Parameter Name	J1939TpTxDirectPriority	
Parent Container	J1939TpTxPg	
Upstream mapping defined	[21, CP_TPS_SystemTemplate]	
Description	If configured, and J1939TpTxUseNonDefaultTpPriority is enabled for the enclosing J1939TpTxChannel, this value will be used as priority of transmitted direct frames, otherwise the default priority 6 will be used.	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	0 .. 7	
Default value	6	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_J1939Tp_00148] Definition of EcucBooleanParamDef J1939TpTxPgDyn Length ⌈

Parameter Name	J1939TpTxPgDynLength
Parent Container	J1939TpTxPg
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This flag is set to TRUE when the N-SDU refers to a PGN with variable length. Please note: When this attribute is TRUE, the sub container J1939TpTxDirectNPdu is required.
Multiplicity	1
Type	EcucBooleanParamDef
Default value	–
Pre-Compile only	true

⌋

[ECUC_J1939Tp_00150] Definition of EcucIntegerParamDef J1939TpTxPgPGN ⌈

Parameter Name	J1939TpTxPgPGN
Parent Container	J1939TpTxPg
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	PGN of the referenced N-SDUs.
Multiplicity	1
Type	EcucIntegerParamDef
Range	0 .. 262143
Default value	–
Pre-Compile only	true

⌋

10.1.16 J1939TpTxDirectNPdu

[ECUC_J1939Tp_00140] Definition of EcucParamConfContainerDef J1939TpTx DirectNPdu ⌈

Container Name	J1939TpTxDirectNPdu
Parent Container	J1939TpTxPg
Upstream mapping defined	[21, CP_TPS_SystemTemplate]
Description	This N-PDU represents the short frame that is used for a dynamic length PGN when it has a length of less that 8 bytes. This N-PDU produces a meta data item of type CAN_ID_32. Please note: This sub container is only necessary when J1939TpTxPgDynLength is TRUE.
Multiplicity	0..1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpTxDirectNPduTxConfId	1	[ECUC_J1939Tp_00169]
J1939TpTxDirectNPduRef	1	[ECUC_J1939Tp_00141]

No Included Containers

⌋

[ECUC_J1939Tp_00169] Definition of EcucIntegerParamDef J1939TpTxDirectNPduTxConfId ⌈

Parameter Name	J1939TpTxDirectNPduTxConfId	
Parent Container	J1939TpTxDirectNPdu	
Upstream mapping defined	–	
Description	The N-PDU identifier used for Tx confirmation from LSduR.	
Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00141] Definition of EcucReferenceDef J1939TpTxDirectNPduRef ⌈

Parameter Name	J1939TpTxDirectNPduRef	
Parent Container	J1939TpTxDirectNPdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-PDU.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

10.1.17 J1939TpTxNSdu

[ECUC_J1939Tp_00147] Definition of EcucParamConfContainerDef J1939TpTxNSdu ⌈

Container Name	J1939TpTxNSdu
Parent Container	J1939TpTxPg
Upstream mapping defined	[21, CP_TPS_SystemTemplate]

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Description	This container describes the parameters that are relevant for the transmission of a specific N-SDU. This N-SDU consumes meta data items of type SOURCE_ ADDRESS_16, TARGET_ADDRESS_16, and PRIORITY_8.
Multiplicity	1..*
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
J1939TpTxNSduId	1	[ECUC_J1939Tp_00149]
J1939TpTxNSduRef	1	[ECUC_J1939Tp_00151]

No Included Containers

⌋

[ECUC_J1939Tp_00149] Definition of EcucIntegerParamDef J1939TpTxNSduId ⌈

Parameter Name	J1939TpTxNSduId	
Parent Container	J1939TpTxNSdu	
Upstream mapping defined	–	
Description	The N-SDU identifier used for communication with PduR.	
Multiplicity	1	
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)	
Range	0 .. 65535	
Default value	–	
With Auto	true	
Pre-Compile only	true	

⌋

[ECUC_J1939Tp_00151] Definition of EcucReferenceDef J1939TpTxNSduRef ⌈

Parameter Name	J1939TpTxNSduRef	
Parent Container	J1939TpTxNSdu	
Upstream mapping defined	–	
Description	Reference to the Pdu object representing the N-SDU.	
Multiplicity	1	
Type	Reference to Pdu	
Post-Build Value	Loadable	Selectable

⌋

A Not Applicable Requirements

[SWS_J1939Tp_NA_00001] Requirements Not Applicable to this Specification

Upstream requirements: SRS_BSW_00168, SRS_BSW_00170, SRS_BSW_00375, SRS_BSW_00383, SRS_BSW_00384, SRS_BSW_00388, SRS_BSW_00389, SRS_BSW_00390, SRS_BSW_00392, SRS_BSW_00393, SRS_BSW_00395, SRS_BSW_00403, SRS_BSW_00416, SRS_BSW_00417, SRS_BSW_00419, SRS_BSW_00422, SRS_BSW_00423, SRS_BSW_00425, SRS_BSW_00427, SRS_BSW_00433, SRS_BSW_00437, SRS_BSW_00469, SRS_BSW_00471, SRS_BSW_00472, SRS_BSW_00490, SRS_BSW_00491

⌈These requirements are not applicable to this specification.⌋

[SWS_J1939Tp_NA_00002] Only One Main Function

Upstream requirements: SRS_BSW_00432

⌈The `SAE J1939 Transport Layer` module usually does not have much to do in its main function, therefore a single main function is sufficient.⌋

B Change History of AUTOSAR Traceable Items

Please note that the lists in this chapter also include traceable items that have been removed from the specification in a later version. These items do not appear as hyperlinks in the document.

B.1 Traceable Item History of this Document According to AUTOSAR Release R26-11

B.1.1 Added Specification Items in R26-11

none

B.1.2 Changed Specification Items in R26-11

[ECUC_J1939Tp_00033] [SWS_J1939Tp_00230]

B.1.3 Deleted Specification Items in R26-11

[ECUC_J1939Tp_00051] [SWS_J1939Tp_00089] [SWS_J1939Tp_00235]

B.2 Traceable Item History of this Document According to AUTOSAR Release R25-11

B.2.1 Added Specification Items in R25-11

[ECUC_J1939Tp_00197] [ECUC_J1939Tp_00198] [ECUC_J1939Tp_00199] [ECUC_J1939Tp_00200] [SWS_J1939Tp_00236] [SWS_J1939Tp_00237] [SWS_J1939Tp_00238]

B.2.2 Changed Specification Items in R25-11

[ECUC_J1939Tp_00184] [SWS_J1939Tp_00041] [SWS_J1939Tp_00045] [SWS_J1939Tp_00121] [SWS_J1939Tp_00162] [SWS_J1939Tp_00230]

B.2.3 Deleted Specification Items in R25-11

[SWS_J1939Tp_00030] [SWS_J1939Tp_00180] [SWS_J1939Tp_00206]

B.3 Traceable Item History of this Document According to AUTOSAR Release R24-11

B.3.1 Added Specification Items in R24-11

none

B.3.2 Changed Specification Items in R24-11

[SWS_J1939Tp_00041] [SWS_J1939Tp_00116]

B.3.3 Deleted Specification Items in R24-11

none