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2017-12-08	4.3.1	AUTOSAR Release Management	• Clarification of metadata provision • Extend data length for CAN-FD • Rollout of Runtime errors • Minor corrections
2016-11-30	4.3.0	AUTOSAR Release Management	• Harmonized API functions description • Parallel handling of CAN 2.0 and CAN-FD clarification • Introduction of reliable TxConfirmation • Clarification of addressing in Upper Layers using MetaData
2015-07-31	4.2.2	AUTOSAR Release Management	• File structure correction • FC_OVFL clarification • DET Renaming and Extension Incorporation
2014-10-31	4.2.1	AUTOSAR Release Management	• Introduced support for CAN Flexible Data rate • Minor corrections • Clarifications
2014-03-31	4.1.3	AUTOSAR Release Management	• Revised padding behaviour. • Clarified relation between CanTpMainFunctionPeriod and other timers. • Revised CanTp_RxIndication() prototype. • Extended parameter CanTpTc for receive cancellation.
2013-10-31	4.1.2	AUTOSAR Release Management	• Replace NTFRSLT_OK\NTFRSLT_<other> E_OK\E_NOT_OK • Handling of unexpected arrival of N-PDU table clarification • Editorial changes • Removed chapter(s) on change documentation

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2013-03-15	4.1.1	AUTOSAR Release Management	• Error handling has been improved • PostBuild concept has been refined • Introduction of HDV support • Clarifications of buffer handling
2011-12-22	4.0.3	AUTOSAR Release Management	• CanTp does not report production errors anymore • Metamodel structure changed • Harmonization with the new buffer concept • Change the BlockSize to be statically configurable instead a maximum value
2011-04-15	4.0.2	AUTOSAR Release Management	• Corrections and improvement in errors description; • API services correction; • Clarifications in relation with buffer handling • Updated table in Ch. 6 for half and full duplex support
2009-12-18	4.0.1	AUTOSAR Release Management	• Added Mixed Addressing Mode • CanTp supports Full Duplex Mode • New buffering concept • Added possibility to change CanTp parameters • Legal disclaimer revised
2007-12-21	3.0.1	AUTOSAR Release Management	• Addition of transmit cancellation feature • DataLength check only for too small DLC (CanTp220) • Restriction on mapping of N-Pdu (SWS_CanTp_00248) • Document meta information extended • Small layout adaptations made

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2007-07-24	2.1.16	AUTOSAR Release Management	• "Advice for users" revised • "Revision Information" added
2007-01-24	2.1.15	AUTOSAR Release Management	• Clarification and correction of error management: list of production\development error and behavior in case of error • Addition of SWS_CanTp_00166 and SWS_CanTp_00167 to avoid blocking situation in case of no buffer provided by upper layer • Remove of CanTpRxWftMax of container CanTpTxNSdu • 1 parameter added for the call of Det_ ReportError • Add header files inclusions • Addition of CanTpNSa container in configuration chapter • Legal disclaimer revised
2006-11-28	2.1	AUTOSAR Release Management	• Document structure adapted to common Release 2.0 SWS Template.
2005-05-31	1.0	AUTOSAR Release Management	• Initial Release

Disclaimer

Contents

1 Introduction and functional overview

This specification defines the functionality, API and the configuration of the AUTOSAR Basic Software module CAN Transport Layer (CanTp).

CanTp is the module between the PDU Router and the L-SDU Router module (see Figure 1.1). The main purpose of the CAN TP module is to segment and reassemble CAN I-PDUs longer than 8 bytes or longer than 64 bytes in case of CAN FD.

The PDU Router deploys AUTOSAR COM and DCM I-PDUs onto different communication protocols. The routing through a network system type (e.g. CAN, LIN and Flex Ray) depends on the I-PDU identifier. The PDU Router also determines if a transport protocol has to be used or not. Lastly, this module carries out gateway functionality, when there is no rate conversion.

L-SDU Router Module (LSduR) provides equal mechanisms to access a CAN bus channel regardless of its location (μC internal/external). From the location of CAN controllers (on chip / onboard), it extracts the ECU hardware layout and the number of CAN drivers. Because CanTp only handles transport protocol frames (i.e. SF, FF, CF and FC PDUs), depending on the N-PDU ID, the L-SDU Router module has to forward an I-PDU to CanTp or PduR.

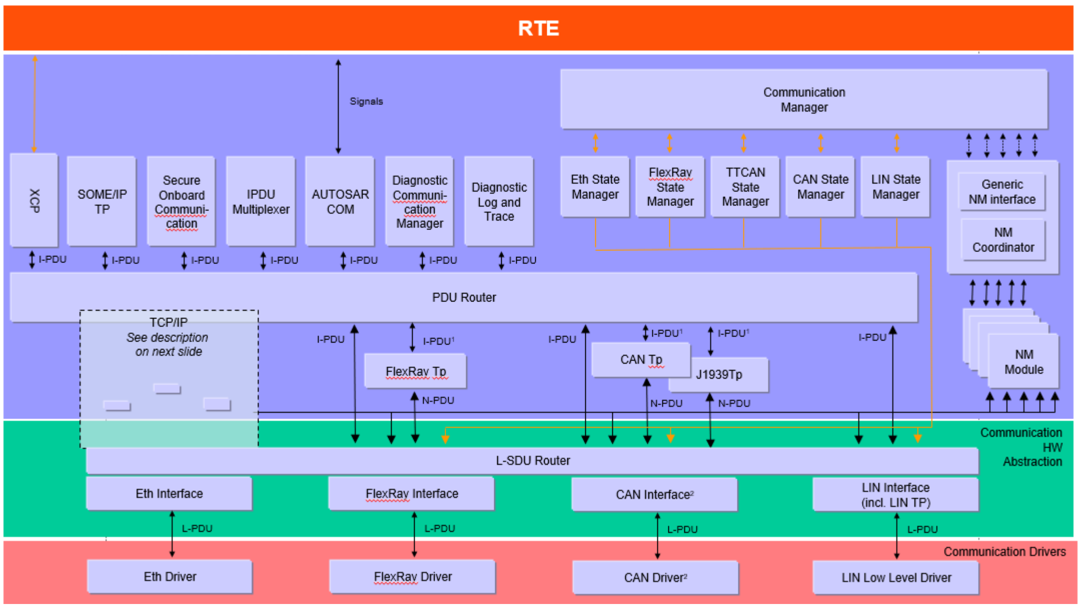

Figure 1.1: AUTOSAR Communication Stack

According to AUTOSAR basic software architecture, CanTp provides services for:

- Segmentation of data in transmit direction
- Reassembling of data in receive direction
- Control of data flow
- Detection of errors in segmentation sessions

- Transmit cancellation
- Receive cancellation

It is an AUTOSAR decision to base basic software module specifications on existing standards, thus this AUTOSAR CAN Transport Layer specification is based on the international standard ISO 15765, which is the most used standard in the automotive domain.

ISO 15765 (containing four sections) describes two applicable CAN Transport Layer specifications: ISO 15765-2 for OEM enhanced diagnostics [1] and ISO 15765-4 for OBD diagnostics [2]. Concerning the transport layer, ISO 15765-4 (the section of ISO 15765 which also covers the data link layer and physical layer) is in accordance with ISO 15765-2 with some restrictions/additions. In order that there is no incompatibility problem between ISO 15765-2 and ISO 15765-4, differences will be solved by the CAN Transport Layer configuration.

Although CAN transport protocol is mainly used for vehicle diagnostic systems, it has also been developed to deal with requirements from other CAN based systems requiring a transport layer protocol.

2 Acronyms and Abbreviations

The glossary below includes acronyms and abbreviations relevant to the CAN Transport Layer module that are not included in the [3, AUTOSAR glossary].

The prefix notation used in this document, is as follows:

Prefix:	***Description:***
I-	Relative to AUTOSAR COM **I**nteraction Layer
L-	Relative to the L-SDU Router module which is equivalent to the **L**ogical Link Control (the upper part of the Data Link Layer - the lower part is called Media Access Control)
N-	Relative to the CAN Transport Layer which is equivalent to the OSI **N**etwork Layer.

All acronyms and abbreviations, which are specific to the CAN Transport Layer and are therefore not contained in the AUTOSAR glossary, are described in the following:

Acronym:	***Description:***
CAN L-SDU	This is the SDU of the L-SDU Router module. It is similar to CAN N-PDU but from the L-SDU Router module point of view.
CAN LSduId	This is the unique identifier of a SDU within the L-SDU Router module. It is used for referencing L-SDU's routing properties. Consequently, in order to interact with the L-SDU Router module through its API, an upper layer uses CAN LSduId to refer to a CAN L-SDU Info Structure.
CAN N-PDU	This is the PDU of the CAN Transport Layer. It contains a unique identifier, data length and data (protocol control information plus the whole N-SDU or a part of it).
CAN N-SDU	This is the SDU of the CAN Transport Layer. In the AUTOSAR architecture, it is a set of data coming from the PDU Router.
CAN N-SDU Info Structure	This is a CAN Transport Layer internal constant structure that contains specific CAN Transport Layer information to process transmission, reception, segmentation and reassembly of the related CAN N-SDU.
CAN NSduId	Unique SDU identifier within the CAN Transport Layer. It is used to reference N-SDU's routing properties. Consequently, to interact with the CAN Transport Layer via its API, an upper layer uses CAN NSduId to refer to a CAN N-SDU Info Structure.
I-PDU	This is the PDU of the AUTOSAR COM module.
PDU	In layered systems, it refers to a data unit that is specified in the protocol of a given layer. This contains user data of that layer (SDU) plus possible protocol control information. Furthermore, the PDU of layer X is the SDU of its lower layer X-1 (i.e. (X)-PDU = (X-1)-SDU).
PduInfoType	This type refers to a structure used to store basic information to process the transmission\reception of a PDU (or a SDU), namely a pointer to its payload in RAM and the corresponding length (in bytes).
SDU	In layered systems, this refers to a set of data that is sent by a user of the services of a given layer, and is transmitted to a peer service user, whilst remaining semantically unchanged.

Abbreviation:	***Description:***
BS	Block Size
Can	CAN Driver module
CAN CF	CAN Consecutive Frame N-PDU
CAN FC	CAN Flow Control N-PDU

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Abbreviation:	***Description:***
CAN FF	CAN First Frame N-PDU
CAN SF	CAN Single Frame N-PDU
LSduR	L-SDU Router
CanTp	CAN Transport Layer
CanTrcv	CAN Transceiver module
CF	See “CAN CF”
Com	AUTOSAR COM module
Dcm	Diagnostic Communication Manager module
DEM	Diagnostic Event Manager
DET	Default Error Tracer
IdsM	Intrusion Detection System Manager
DLC	Data Length Code (part of CAN PDU that describes the SDU length)
FC	See “CAN FC”
FF	See “CAN FF”
FIM	Function Inhibition Manager
MetaData	Meta data transferred alongside a PDU, consisting of a set of meta data items
MetaDataItem	A single item of `MetaData` of defined type and size
Mtype	Message Type (possible value: diagnostics, remote diagnostics)
N_AI	Network Address Information (see ISO 15765-2).
N_AE	Network Address Extension (see ISO 15765-2 [1]).
N_Ar	Time for transmission of the CAN frame (any N-PDU) on the receiver side (see ISO 15765-2 [1]).
N_As	Time for transmission of the CAN frame (any N-PDU) on the sender side (see ISO 15765-2 [1]).
N_Br	Time until transmission of the next flow control N-PDU (see ISO 15765-2 [1]).
N_Bs	Time until reception of the next flow control N-PDU (see ISO 15765-2 [1]).
N_Cr	Time until reception of the next consecutive frame N-PDU (see ISO 15765-2 [1]).
N_Cs	Time until transmission of the next consecutive frame N-PDU (see ISO 15765-2 [1]).
N_Data	Data information of the transport layer
N_PCI	Protocol Control Information of the transport layer
N_SA	Network Source Address (see ISO 15765-2 [1]).
N_TA	Network Target Address (see ISO 15765-2 [1]). It might already contain the N_TAtype(physical/ function) in case of ExtendedAddressing.
N_TAtype	Network Target Address type (see ISO 15765-2 [1]).
OBD	On-Board Diagnostic
PduR	PDU Router
SN	Sequence Number (see ISO 15765-2 [1]).
STmin	The minimum time the sender is to wait between transmission of two `CF`s (see ISO 15765-2 [1]).
FS	Flow Status
CAN FD	CAN flexible data rate
CAN_DL	CAN frame data length
TX_DL	Transmit data link layer data length
RX_DL	Received data link layer data length
SF_DL	SingleFrame data length in bytes
WFTmax	Upper limit to the number of `FC.WAIT` a receiver is allowed to send in a row (see ISO 15765-2 [1]).

The following table contains some of the concepts, which are useful in this work:

Definitions:	***Description:***
Default Error Tracer	The Default Error Tracer is merely a support to SW development and integration and is not contained in the production code. The API is defined, but the functionality can be chosen and implemented by the developer according to his specific needs.
Diagnostic Event Manager	The Diagnostic Event Manager is a standard AUTOSAR module which is available in the production code and whose functionality is specified in the AUTOSAR project.
Intrusion Detection System Manager	The Intrusion Detection Manager is a standardized interface for receiving notifications of security events (SEv). The SEvs can be reported by security sensors implemented in other functional clusters and adaptive applications. The security events are qualified and further handling of the events is done by the IdsM module.
Extended addressing format	A unique CAN identifier is assigned to each combination of N_SA and Mtype. A unique address is filed to each combination of N_TA and N_TAtype in the first data byte of the CAN frame data field. N_PCI and N_Data are filed in the remaining bytes of the CAN frame data field.
Function Inhibition Manager	The Function Inhibition Manager (FIM) stands for the evaluation and assignment of events to the required actions for Software Components (e.g. inhibition of specific “monitoring functions”). The DEM informs and updates the Function Inhibition Manager (FIM) upon changes of the event status in order to stop or release functional entities according to assigned dependencies. An interface to the functional entities is defined and supported by the Mode Manager. The FIM is not part of the DEM.
Functional addressing	In the transport layer, functional addressing refers to N-SDU, of which parameter N_TAtype (which is an extension to the N_TA parameter [1] used to encode the communication model) has the value functional. This means the N-SDU is used in 1 to n communications. Thus with the CAN protocol, functional addressing will only be supported for Single Frame communication. In terms of application, functional addressing is used by the external (or internal) tester if it does not know the physical address of an ECU that should respond to a service request or if the functionality of the ECU is implemented as a distributed server over several ECUs. When functional addressing is used, the communication is a communication broadcast from the external tester to one or more ECUs (1 to n communication). Use cases are (for example) broadcasting messages, such as “ECUReset” or “Communication Control” OBD communication will always be performed as part of functional addressing.
Mixed addressing format	A unique CAN identifier is assigned to each combination of N_SA, N_TA, N_TAtype. N_AE is placed in the first data byte of the CAN frame data field. N_PCI and N_Data are placed in the remaining bytes of the CAN frame data field.
Multiple connection	The CAN Transport Layer should manage several transport protocol communication sessions at a time.
Normal addressing format	A unique CAN identifier is assigned to each combination of N_SA, N_TA, N_TAtype and Mtype. N_PCI and N_Data are filed in the CAN frame data field.
Physical addressing	In the transport layer, physical addressing refers to N-SDU, of which parameter N_TAtype (which is an extension of the N_TA parameter [1] used to encode the communication model) has the value physical. This means the N-SDU is used in 1 to 1 communication, thus physical addressing will be supported for all types of network layer messages. In terms of application, physical addressing is used by the external (or internal) tester if it knows the physical address of an ECU that should respond to a service request. When physical addressing is used, a point to point communication takes place (1 to 1 communication). Use cases are (for example) messages, such as ”ReadDataByIdentifier” or ”InputOutputControl ByIdentifier”
Single connection	The CAN Transport Layer will only manage one transport protocol communication session at a time.
Connection channel	The CAN Transport Layer is handling resources used by multiple connections in order to save RAM. When a connection becames active, the channel that is used by this connection will be unavailable for other connections.

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Definitions:	*Description:*
Connection	A transport protocol session, either is a transmission or a reception session on a N-SDU.

Table 2.1: Concepts of CAN Transport Layer

3 Related documentation

3.1 Input documents & related standards and norms

[1] ISO 15765-2 – Road vehicles – Diagnostics on Controller Area Networks (CAN) – Part2: Network layer services

[2] ISO 15765-4 – Diagnostics on controller area network (CAN) – Part 4: Requirements for emission-related systems (Release 2005 01-04)

[3] Glossary
AUTOSAR_FO_TR_Glossary

[4] General Specification of Basic Software Modules
AUTOSAR_CP_SWS_BSWGeneral

[5] Specification of PDU Router
AUTOSAR_CP_SWS_PDURouter

[6] Specification of Linklayer Sdu Routing Module
AUTOSAR_CP_SWS_LSduRouter

[7] General Requirements on Basic Software Modules
AUTOSAR_CP_RS_BSWGeneral

[8] Requirements on CAN
AUTOSAR_CP_RS_CAN

[9] ISO 11898-1:2015 – Road vehicles – Controller area network (CAN)

3.2 Related specification

AUTOSAR provides a General Specification on Basic Software modules (see [4]), which is also valid for CAN Transport Layer. Thus, the specification SWS BSW General [4] shall be considered as additional and required specification for CAN Transport Layer.

4 Constraints and assumptions

4.1 Limitations

The AUTOSAR architecture defines communication system specific transport layers (CanTp, LinTp including LinIf, FlexRayTp). Thus the CAN Transport Layer only covers CAN transport protocol specifics.

The CAN Transport Layer has an interface to a single underlying L-SDU Router module and a single upper PDU Router module.

According to the AUTOSAR release plan, this CAN Transport Layer specification has the following restriction:

- CAN Transport Layer runs only in an event triggered mode

4.2 Applicability in automotive domain

The CAN Transport Layer can be used for all domains whenever the CAN communication system is connected to the appropriate ECU.

5 Dependencies to other modules

This section sets out relations between the CanTp and other AUTOSAR basic software modules. It contains short descriptions of some AUTOSAR basic concepts, configuration information and services, which are required by the CanTp from other modules.

5.1 AUTOSAR architecture basic concepts

5.1.1 CAN Transport Layer connection(s)

In the AUTOSAR architecture final release, transport protocol facilities will be used to transport both diagnostic (e.g. OBD and UDS protocols) and AUTOSAR COM I-PDUs. Therefore, the CanTp module is able to deal with multiple connections simultaneously (i.e. multiple segmentation sessions in parallel).

The maximum number of simultaneous connections is statically configured. This configuration has an important impact on complexity and resource consumption (CPU, ROM and RAM) of the code generated, because resources (e.g. Rx and Tx state machines, variables used to work on N-PCI data and so on) have to be reserved for each simultaneous access.

To allow the user to choose which I-PDUs could be received (or sent) simultaneously, each N-SDU identifier will be internally routed through a configured CanTp "connection channel". Since a "connection channel" is not accessible externally, all necessary information (see Chapter 10.2) to transfer an N-SDU will be linked to the N-SDU identifier (e.g. "connection channel" number, timeouts, addressing format, and so on).

Depending on the Meta Data configuration, an N-SDU acts either as a specific connection with defined N_AI, or as a generic connection, where the N_TA, N_SA, and N_AE vary at runtime, while N_TAtype, MType, and the addressing format are statically defined.

5.1.2 CAN Transport Layer interactions

The figure below shows the interactions between CanTp, PduR and LSduR modules.

The CanTp's upper interface offers the PduR module global access, to transmit and receive data. This access is achieved by CAN N-SDU identifier (CAN NSduId). CAN NSduId refers to a constant data structure which consists of attributes describing CAN N-SDU. Each CAN N-SDU specific data structure may contain attributes such as: type of N-SDU (Tx or Rx), its addressing format, L-SDU identifier of this message or other attributes that are useful for implementation.

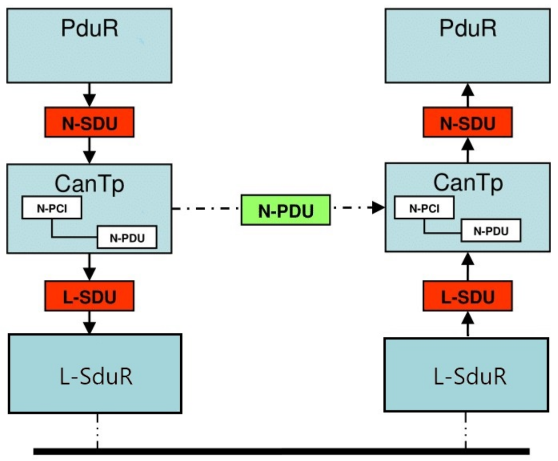

Figure 5.1: CAN Transport Layer interactions

5.1.3 Processing mode

The AUTOSAR communication stack supports both polling and event triggering mode. Therefore, each communication layer can receive information from its lower layer and propagate information to its upper layer by different mechanisms.

In the case of the CAN Transport Layer, only the event triggering mode is supported.

5.1.4 Data consistency

To optimize the communication stack, AUTOSAR limits the CAN Transport Layer buffering capacity. Therefore, the CanTp copies N-SDU payload directly from the upper layer (DCM, COM or PDU Router - in the case of 1:1 TP routing) to the CAN driver and vice-versa. Thus to guarantee data consistency, the upper layer will observe the following rules:

- At transmission time, the N-SDU data payload will remain unchanged, from transmit request until transmit confirmation has been received
- At reception time, the N-SDU data access will be locked, from start of reception until the reception indication has been received.

5.1.5 Static configuration

At runtime the CAN Transport module must have all information required to manage transport connection. Therefore, the following properties should be statically configured:

- Number of CAN N-SDU

- Unique identifier of each CAN N-SDU
- Communication direction of each CAN N-SDU (Tx or Rx)
- Addressing format of each connection (normal, extended, mixed 11bit, normal fixed, or mixed 29 bit) and, depending on the addressing format, additionally:
  - Normal: none
  - Extended: `N_TA`
  - Mixed 11 bit: `N_AE`
  - Normal fixed: `N_TA`, `N_SA`
  - Mixed 29 bit: `N_TA`, `N_SA`, `N_AE`

The static addressing information may be omitted for generic connections that use N-SDUs with `MetaData`.

- Addressing format of each connection (normal, extended or mixed) and, in the case of extended addressing format, the `N_TA` value or in case of mixed addressing format the `N_AE` value.
- Associated CAN L-SDU identifier of each CAN N-SDU identifier and if necessary (multiple frame segmentation session) the CAN L-SDU identifier used to transmit the CAN FC N-PDU
- Classic CAN frames and CAN FD frames

The configuration of the CAN Transport Layer can be performed during compilation or post-build (See Chapter 10).

5.1.6 PDU Router services

The CAN Transport Layer uses callback functions of the PDU Router to copy transmit data and to confirm transmission, to initiate reception, copy received data and to indicate reception of a message:

- `PduR_CanTpRxIndication`
- `PduR_CanTpStartOfReception`
- `PduR_CanTpCopyRxData`
- `PduR_CanTpCopyTxData`
- `PduR_CanTpTxConfirmation`

For more information about these functions, refer to the PDU Router module specification [5].

5.1.7 L-SDU Router services

The CAN Transport Layer uses the following services of the L-SDU Router module to transmit CAN N-PDUs:

- `LSduR_CanTpTransmit`

For more information about this function, refer to the L-SDU Router module specification [6].

5.2 File structure

5.2.1 Code file structure

For details refer to the chapter 5.1.6 “Code file structure” in SWS_BSWGeneral.

5.2.2 Header file structure

AUTOSAR specifies that an ECU can be created from modules provided as object code, source code (generated or not) and even mixed.

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. Thus depending on the configurability requirements of the OEM, suppliers may deliver the CanTp module as object code, generated code or source code.

5.2.3 Version check

[SWS_CanTp_00267] ⌈Version number macros can be used for checking and reading out the software version of a software module, during compile-time and run-time.⌋

5.2.4 Design Rules

For details refer to the chapters 7.1.4, 7.1.8, 7.1.9 in SWS_BSWGeneral.

6 Requirements Tracing

The following tables reference the requirements specified in [7] and [8] and links to the fulfillment of these. Please note that if column "Satisfied by" is empty for a specific requirement this means that this requirement is not fulfilled by this document.

Requirement	Description	Satisfied by
[RS_Ids_00810]	Basic SW security events	[SWS_CanTp_00371] [SWS_CanTp_00372] [SWS_CanTp_00373] [SWS_CanTp_00374] [SWS_CanTp_00375] [SWS_CanTp_00376] [SWS_CanTp_00377] [SWS_CanTp_00378] [SWS_CanTp_00379] [SWS_CanTp_00380] [SWS_CanTp_00381] [SWS_CanTp_00382] [SWS_CanTp_00383]
[SRS_BSW_00101]	The Basic Software Module shall be able to initialize variables and hardware in a separate initialization function	[SWS_CanTp_00208]
[SRS_BSW_00159]	All modules of the AUTOSAR Basic Software shall support a tool based configuration	[SWS_CanTp_00146]
[SRS_BSW_00167]	All AUTOSAR Basic Software Modules shall provide configuration rules and constraints to enable plausibility checks	[SWS_CanTp_00147]
[SRS_BSW_00336]	Basic SW module shall be able to shutdown	[SWS_CanTp_00010]
[SRS_BSW_00339]	Reporting of production relevant error status	[SWS_CanTp_00008]
[SRS_BSW_00353]	All integer type definitions of target and compiler specific scope shall be placed and organized in a single type header	[SWS_CanTp_00002]
[SRS_BSW_00358]	The return type of init() functions implemented by AUTOSAR Basic Software Modules shall be void	[SWS_CanTp_00208]
[SRS_BSW_00373]	The main processing function of each AUTOSAR Basic Software Module shall be named according the defined convention	[SWS_CanTp_00164]
[SRS_BSW_00406]	API handling in uninitialized state	[SWS_CanTp_00161]
[SRS_BSW_00414]	Init functions shall have a pointer to a configuration structure as single parameter	[SWS_CanTp_00208]
[SRS_BSW_00424]	BSW module main processing functions shall not be allowed to enter a wait state	[SWS_CanTp_00164]
[SRS_Can_01065]	The AUTOSAR CAN Transport Layer shall be based on ISO 15765-2 and 15765-4 specifications	[SWS_CanTp_00033] [SWS_CanTp_00350]
[SRS_Can_01066]	The AUTOSAR CAN Transport Layer shall be statically configurable to support either single or multiple connections in an optimizing way	[SWS_CanTp_00096] [SWS_CanTp_00120] [SWS_CanTp_00121] [SWS_CanTp_00122] [SWS_CanTp_00123] [SWS_CanTp_00124]
[SRS_Can_01068]	The CAN Transport Layer shall identify each N-SDU with a unique identifier.	[SWS_CanTp_00035]

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Requirement	Description	Satisfied by
[SRS_Can_01069]	CAN address information and N-SDU identifier mapping	[SWS_CanTp_00035]
[SRS_Can_01071]	The CAN Transport Layer shall identify each N-PDU (also called L-SDU) with a unique identifier	[SWS_CanTp_00035] [SWS_CanTp_00231] [SWS_CanTp_00232]
[SRS_Can_01073]	The CAN Transport Layer shall be statically configured to pad unused bytes of PDU	[SWS_CanTp_00116] [SWS_CanTp_00344] [SWS_CanTp_00345] [SWS_CanTp_00346] [SWS_CanTp_00348] [SWS_CanTp_00351]
[SRS_Can_01074]	The Transport connection properties shall be statically configured	[SWS_CanTp_00231] [SWS_CanTp_00232]
[SRS_Can_01075]	The CAN Transport Layer shall implement an interface for initialization	[SWS_CanTp_00030] [SWS_CanTp_00170]
[SRS_Can_01076]	The CAN Transport Layer services shall not be operational before initializing the module	[SWS_CanTp_00031]
[SRS_Can_01078]	The AUTOSAR CAN Transport Layer shall support the ISO 15765-2 addressing formats	[SWS_CanTp_00035]
[SRS_Can_01079]	The CAN Transport Layer shall be compliant with the CAN Interface module notifications	[SWS_CanTp_00086]
[SRS_Can_01082]	Error handling	[SWS_CanTp_00057]
[SRS_Can_01086]	Data padding value of unused bytes	[SWS_CanTp_00059]
[SRS_Can_01163]	The AUTOSAR CAN Transport Layer shall support classic CAN and CAN FD communication as specified by ISO 15765-2	[SWS_CanTp_00354]

Table 6.1: Requirements Tracing

7 Functional specification

This section provides a description of the CAN Transport Layer functionality. It explains the services provided to the upper and lower layers and the internal behavior of the CAN Transport Layer.

The CanTp module offers services for segmentation, transmission with flow control, and reassembly of messages. Its main purpose is to transmit and receive messages that may or may not fit into a single CAN frame. Messages that do not fit into a single CAN frame are segmented into multiple parts, such that each can be transmitted in a single CAN frame.

While reading this document, it is necessary to bear in mind, that this module will follow the recommendations ISO 15765-2 (OEM enhanced diagnostics [1]) and should be able to fulfill ISO 15765-4 (Requirements for emissions-related systems [2]).

[SWS_CanTp_00033]

Upstream requirements: SRS_Can_01065

⌈If a recommendation of ISO 15765-2 is not explicitly excluded in the SWS, the CanTp module shall follow this recommendation.⌋

For further descriptions of SF, FF, CF and FC frames, network layer timing parameters, and further functionalities of CAN Transport Layer please refer to the ISO 15765-2 specification [1].

ISO 15765-4 is a particular case of ISO-15765-2. Therefore, the CAN Transport Layer will be configurable in order to be able to adapt the module to all ISO 15765-4 use cases (e.g. specific timing, padding configuration, addressing mode). See chapter 10, Configuration specification, for details.

7.1 Services provided to upper layer

The service interface of the CanTp module can be divided into the following main categories:

- Initialization and shutdown
- Communication services

The following paragraphs describe the functionality of each services category.

7.1.1 Initialization and shutdown

[SWS_CanTp_00027] ⌈The CanTp module shall have two internal states, `CANTP_OFF` and `CANTP_ON`.⌋

[SWS_CanTp_00168] ⌈The CanTp module shall be in the `CANTP_OFF` state after power up.⌋

[SWS_CanTp_00169] ⌈In the state `CANTP_OFF`, the CanTp shall allow an update of the postbuild configuration.⌋

[SWS_CanTp_00170]

Upstream requirements: SRS_Can_01075

⌈The CanTp module shall change to the internal state `CANTP_ON` when the CanTp has been successfully initialized with `CanTp_Init()`.⌋

[SWS_CanTp_00238] ⌈The CanTp module shall perform segmentation and reassembly tasks only when the CanTp is in the `CANTP_ON` state.⌋

[SWS_CanTp_00030]

Upstream requirements: SRS_Can_01075

⌈The function `CanTp_Init` shall initialize all global variables of the module and sets all transport protocol connections in a sub-state of `CANTP_ON`, in which neither segmented transmission nor segmented reception are in progress (Rx thread in state `CANTP_RX_WAIT` and Tx thread in state `CANTP_TX_WAIT`).⌋

[SWS_CanTp_00031]

Upstream requirements: SRS_Can_01076

⌈If development error detection for the CanTp module is enabled the CanTp module shall raise an error (`CANTP_E_UNINIT`) when the PDU Router or the L-SDU Router module tries to use any function (except `CanTp_GetVersionInfo`) before the function `CanTp_Init` has been called.⌋

[SWS_CanTp_00111] ⌈If called when the CanTp module is in the global state `CANTP_ON`, the function `CanTp_Init` shall return the module to state Idle (state = `CANTP_ON`, but neither transmission nor reception are in progress).⌋

[SWS_CanTp_00273] ⌈The CanTp module shall loose all current connections if `CanTp_Init` is called when CanTp module is in the global state `CANTP_ON`.⌋

[SWS_CanTp_00010]
Upstream requirements: SRS_BSW_00336

⌈The function `CanTp_Shutdown` shall stop the CanTp module properly.⌋

The following figure summarizes all of the above requirements:

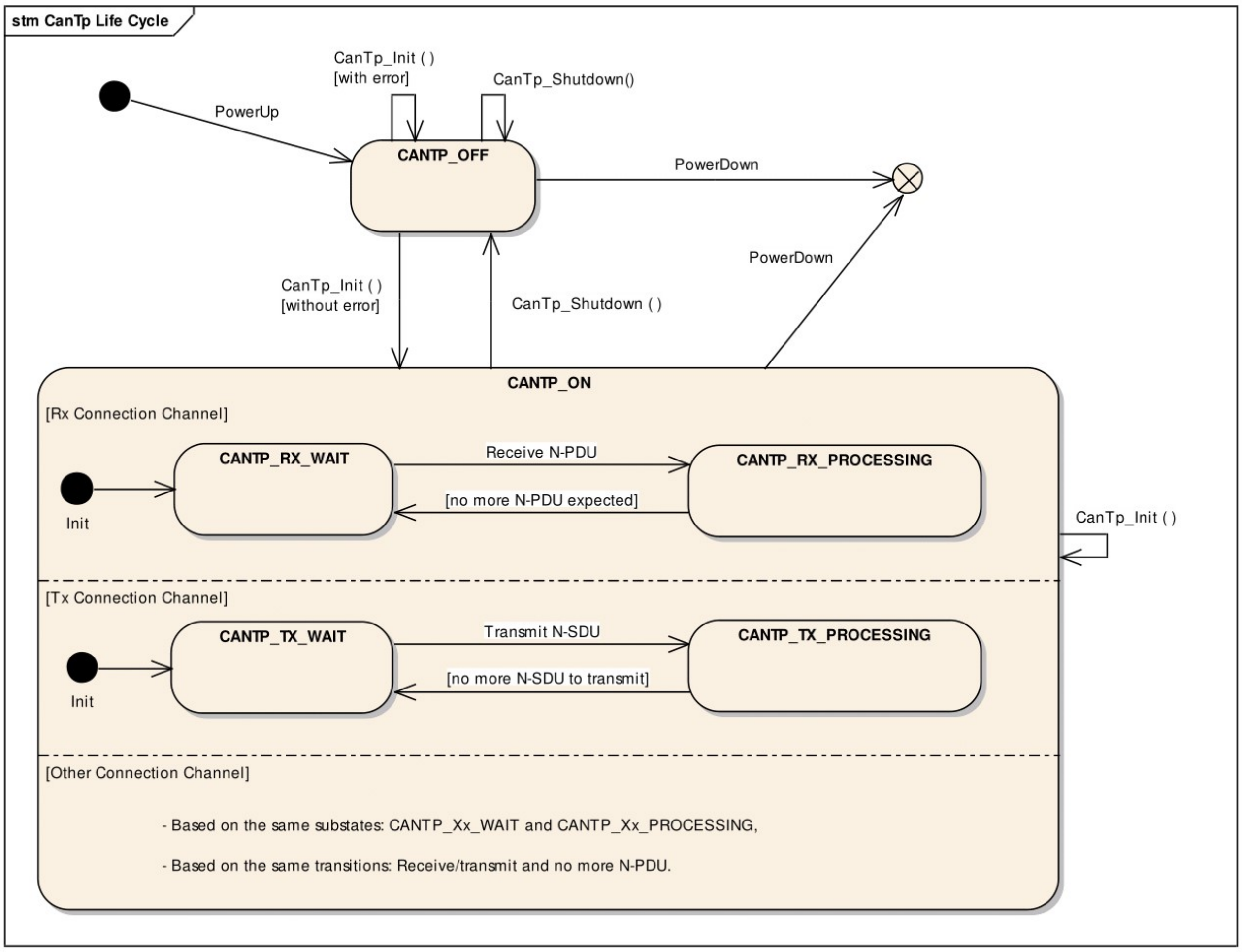


Figure 7.1: CAN Transport Layer life cycle

7.1.2 Transmit request

The transmit operation, `CanTp_Transmit()`, will allow upper layers to ask for data transfer using CAN transport protocol facilities (segmentation, extended addressing format and so on).

[SWS_CanTp_00177] ⌈After the transmit request was accepted, the CanTp module shall notify its upper layer if the N-SDU transfer is fully processed (successfully or not).⌋

7.1.3 Transmit cancellation

The transmit cancellation feature allows the upper layer to cancel a transmission in progress.

Use case: Cancel a diagnostic transmission due to the reception of another diagnostic protocol with higher priority.

[SWS_CanTp_00242] ⌈This feature shall be (de)activated by static configuration (parameter `CanTpTc`).⌋

[SWS_CanTp_00274] ⌈Transmit Cancellation is triggered by the call of `CanTp_CancelTransmit()`.⌋

[SWS_CanTp_00243] ⌈After the call of the service `CanTp_CancelTransmit()`, the transfer on this connection shall be aborted.⌋

Note: The Api `PduR_CanTpTxConfirmation`() shall be called after a transmit cancellation with value `E_NOT_OK`. (see also [SWS_CanTp_00255])

Note that if a transfer is in progress, that will generate a time-out error on the receiver side.

7.2 Services provided to the lower layer

According to the AUTOSAR specification of the communication stack, the CAN Transport Layer provides the following two callback functions to the L-SDU Router module: `CanTp_TxConfirmation()` and `CanTp_RxIndication()`.

7.2.1 Transmit confirmation

The LSduR module shall call the transmit confirmation function to notify the CAN Transport Layer that a CAN frame transmission, requested by the CanTp, has been performed successfully or not. The L-PDU identifier is associated with the call in order to identify the corresponding transmission.

[SWS_CanTp_00075] ⌈When the transmit confirmation is not received after a maximum time (equal to `N_As`), the CanTp module shall abort the corresponding session. The N-PDU remains unavailable to other concurrent sessions until the `TxConfirmation` is received, successful or not.⌋

[SWS_CanTp_00076] ⌈For confirmation calls, the CanTp module shall provide the function `CanTp_TxConfirmation()`.⌋

[SWS_CanTp_00355] ⌈CanTp shall abort the corrensponding session, when `CanTp_TxConfirmation()` is called with the result `E_NOT_OK`.⌋

7.2.2 Reception indication

The LSduR module shall call the reception indication function to notify the CanTp module that a new CAN N-PDU frame (i.e. a transport protocol frame) has been received.

The reception indication can be performed in ISR context.

[SWS_CanTp_00078] ⌈For reception indication, the CanTp module shall provide `CanTp_RxIndication()`.⌋

7.3 Internal behavior

The internal operation of the CAN Transport Layer provides basic mechanisms in order to perform the main purpose of this module, which is to transfer messages in a single CAN frame or in multiple CAN frames.

The entire behavior of the CAN Transport Layer will be event triggered, so that CanTp can processes transfer of N-SDU (respectively L-SDU) coming from the PDU Router (respectively the L-SDU Router module) directly.

7.3.1 N-SDU Reception

[SWS_CanTp_00079] ⌈When receiving an SF or an FF N-PDU, the CanTp module shall notify the upper layer (PDU Router) about this reception using the `PduR_CanTpStartOfReception` function.⌋

Note: The upper layer will reserve and lock a buffer for reception of the N-SDU.

[SWS_CanTp_00329] ⌈CanTp shall provide the content of the FF/SF to PduR using the parameter `TpSduInfoPtr` of `PduR_CanTpStartOfReception()`.⌋

[SWS_CanTp_00350]

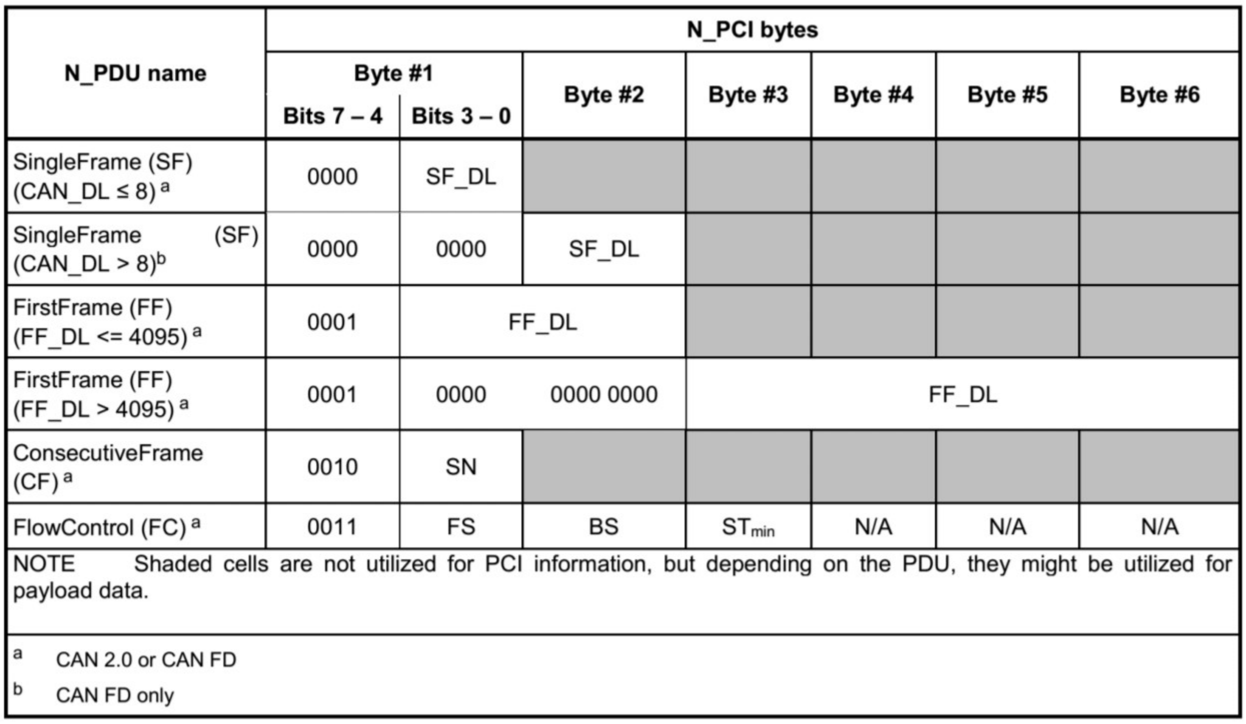
Upstream requirements: SRS_Can_01065

⌈The received data link layer data length (RX_DL) shall be derived from the first received payload length of the CAN frame/PDU (CAN_DL) as follows:

- For CAN_DL values less than or equal to eight bytes the RX_DL value shall be eight.
- For CAN_DL values greater than eight bytes the RX_DL value equals the CAN_DL value.

⌋

Note: ISO frame overview table:



N_PDU name	N_PCI bytes						
	Byte #1		Byte #2	Byte #3	Byte #4	Byte #5	Byte #6
	Bits 7 – 4	Bits 3 – 0					
SingleFrame (SF) (CAN_DL ≤ 8) [a]	0000	SF_DL	▨	▨	▨	▨	▨
SingleFrame (SF) (CAN_DL > 8)[b]	0000	0000	SF_DL	▨	▨	▨	▨
FirstFrame (FF) (FF_DL <= 4095) [a]	0001	FF_DL		▨	▨	▨	▨
FirstFrame (FF) (FF_DL > 4095) [a]	0001	0000	0000 0000	FF_DL			
ConsecutiveFrame (CF) [a]	0010	SN	▨	▨	▨	▨	▨
FlowControl (FC) [a]	0011	FS	BS	ST_{min}	N/A	N/A	N/A
NOTE Shaded cells are not utilized for PCI information, but depending on the PDU, they might be utilized for payload data.							
[a] CAN 2.0 or CAN FD [b] CAN FD only							

Figure 7.2: Summary of N_PCI bytes

[SWS_CanTp_00330] ⌈When CanTp_RxIndication is called for a SF or FF N-PDU with MetaData (indicating a generic connection), the CanTp module shall store the addressing information contained in the MetaData of the PDU and use this information for the initiation of the connection to the upper layer, for transmission of FC N-PDUs and for identification of CF N-PDUs. The addressing information in the MetaData depends on the addressing format:

- Normal, Extended, Mixed 11 bit: none
- Normal fixed, Mixed 29 bit: N_SA, N_TA

⌋

[SWS_CanTp_00331] ⌈When calling PduR_CanTpStartOfReception() for a generic connection (N-SDU with MetaData), the CanTp module shall forward the extracted addressing information via the MetaData of the N-SDU. The addressing information in the MetaData depends on the addressing format:

- Normal: none
- Extended: N_TA
- Mixed 11 bit: N_AE
- Normal fixed: N_SA, N_TA
- Mixed 29 bit: N_SA, N_TA, N_AE

⌋

[SWS_CanTp_00332] ⌈When calling LSduR_CanTpTransmit() for an FC on a generic connection (N-PDU with MetaData), the CanTp module shall provide the stored addressing information via the MetaData of the N-PDU. The addressing information in the MetaData depends on the addressing format:

- Normal, Extended, Mixed 11 bit: none
- Normal fixed, Mixed 29 bit: N_SA (saved N_TA), N_TA (saved N_SA)

⌋

[SWS_CanTp_00333] ⌈When CanTp_RxIndication is called for a CF on a generic connection (N-PDU with MetaData), the CanTp module shall check the addressing information contained in the MetaData of the N-PDU against the stored values from the FF.⌋

[SWS_CanTp_00166] ⌈At the reception of a FF or last CF of a block (except the last CF of the message), the CanTp module shall start a time-out N_Br before calling PduR_CanTpStartOfReception or PduR_CanTpCopyRxData.⌋

[SWS_CanTp_00080] ⌈The available Rx buffer size is reported to the CanTp in the output pointer parameter of the PduR_CanTpStartOfReception() service. The available Rx buffer can be smaller than the expected N-SDU data length.⌋

Note: If the upper layer cannot make a buffer available because of an error (e.g. in the gateway case it may indicate that the transport session to the destination network has been broken) or a resource limitation (e.g. N-SDU length exceeds the maximum buffer size of the upper layer), the PduR_CanTpStartOfReception() function returns BUFREQ_E_NOT_OK or BUFREQ_E_OVFL.

[SWS_CanTp_00081] ⌈After the reception of a First Frame or Single Frame, if the function PduR_CanTpStartOfReception() returns BUFREQ_E_NOT_OK to the Can Tp module, the CanTp module shall abort the reception of this N-SDU. No Flow Control will be sent and PduR_CanTpRxIndication() will not be called in this case.⌋

[SWS_CanTp_00318] ⌈After the reception of a First Frame, if the function PduR_CanTpStartOfReception() returns BUFREQ_E_OVFL to the CanTp module, the CanTp module shall send a Flow Control N-PDU with overflow status (FC(OVFLW)) and abort the N-SDU reception.⌋

[SWS_CanTp_00353] ⌈After the reception of a Single Frame, if the function PduR_CanTpStartOfReception() returns BUFREQ_E_OVFL to the CanTp module, the CanTp module shall abort the N-SDU reception.⌋

[SWS_CanTp_00339] ⌈After the reception of a First Frame or Single Frame, if the function PduR_CanTpStartOfReception() returns BUFREQ_OK with a smaller available buffer size than needed for the already received data, the CanTp module shall abort the reception of the N-SDU and call PduR_CanTpRxIndication() with the result E_NOT_OK.⌋

[SWS_CanTp_00082] ⌈After the reception of a First Frame, if the function PduR_CanTpStartOfReception() returns BUFREQ_OK with a smaller available buffer size than needed for the next block, the CanTp module shall start the timer N_Br.⌋

[SWS_CanTp_00325] ⌈If the function PduR_CanTpCopyRxData() called after reception of the last Consecutive Frame of a block returns BUFREQ_OK, but the remaining buffer is not sufficient for the reception of the next block, the CanTp module shall start the timer N_Br.⌋

[SWS_CanTp_00222] ⌈While the timer N_Br is active, the CanTp module shall call the service PduR_CanTpCopyRxData() with a data length 0 (zero) and NULL_PTR as data buffer during each processing of the MainFunction.⌋

Note: ISO 15765-2 specification defines the following performance requirement: (N_Br + N_Ar) < 0.9 * N_Bs timeout.

[SWS_CanTp_00341] ⌈If the N_Br timer expires and the available buffer size is still not big enough, the CanTp module shall send a new FC(WAIT) to suspend the N-SDU reception and reload the N_Br timer.⌋

[SWS_CanTp_00223] ⌈The CanTp module shall send a maximum of WFTmax consecutive FC(WAIT) N-PDU. If this number is reached, the CanTp module shall abort the reception of this N-SDU (the receiver did not send any FC N-PDU, so the N_Bs timer expires on the sender side and then the transmission is aborted) and a receiving indication with E_NOT_OK occurs.⌋

[SWS_CanTp_00311] ⌈In case of N_Ar timeout occurrence (no confirmation from CAN driver for any of the FC frame sent) the CanTp module shall abort reception and notify the upper layer of this failure by calling the indication function PduR_CanTpRxIndication() with the result E_NOT_OK.⌋

[SWS_CanTp_00224] ⌈When the Rx buffer is large enough for the next block (directly after the First Frame or the last Consecutive Frame of a block, or after repeated calls to PduR_CanTpCopyRxData() according to [SWS_CanTp_00222]), the CanTp module shall send a Flow Control N-PDU with ClearToSend status (FC(CTS)) and shall then expect the reception of Consecutive Frame N-PDUs.⌋

[SWS_CanTp_00269] ⌈After reception of each Consecutive Frame the CanTp module shall call the PduR_CanTpCopyRxData() function with a PduInfo pointer containing data buffer and data length:

- 6 or 7 bytes or less in case of the last CF for CAN 2.0 frames

- DLC-1 or DLC-2 bytes for CAN FD frames (see [SWS_CanTp_00351]).

The output pointer parameter provides CanTp with available Rx buffer size after data have been copied.⌋

Note: For details refer to Figure 7.3.

[SWS_CanTp_00312] ⌈The CanTp module shall start a time-out N_Cr at each indication of CF reception (except the last one in a block) and at each confirmation of a FC transmission that initiate a CF transmission on the sender side (FC with FS=CTS).⌋

[SWS_CanTp_00313] ⌈In case of N_Cr timeout occurrence the CanTp module shall abort reception and notify the upper layer of this failure by calling the indication function PduR_CanTpRxIndication() with the result E_NOT_OK.⌋

[SWS_CanTp_00271] ⌈If the PduR_CanTpCopyRxData() returns BUFREQ_E_NOT_OK after reception of a Consecutive Frame in a block the Can Tp shall abort the reception of N-SDU and notify the PduR module by calling the PduR_CanTpRxIndication() with the result E_NOT_OK.⌋

[SWS_CanTp_00314] ⌈The CanTp shall check the correctness of each SN received during a segmented reception. In case of wrong SN received the CanTp module shall abort reception and notify the upper layer of this failure by calling the indication function PduR_CanTpRxIndication() with the result E_NOT_OK.⌋

[SWS_CanTp_00084] ⌈When the transport reception session is completed (successfully or not) the CanTp module shall call the upper layer notification service PduR_CanTpRxIndication().⌋

[SWS_CanTp_00277] ⌈With regard to FF N-PDU reception, the content of the Flow Control N-PDU depends on the PduR_CanTpStartOfReception() service result.⌋

[SWS_CanTp_00064] ⌈Furthermore, it should be noted that when receiving a FF N-PDU, the Flow Control shall only be sent after having the result of the PduR_CanTpStartOfReception() service.⌋

[SWS_CanTp_00278] ⌈It is important to note that FC N-PDU will only be sent after every block, composed of a number BS (Block Size) of consecutive frames.⌋

[SWS_CanTp_00067] ⌈The CanTp shall use the same value for the BS and STmin parameters on each FC sent during a segmented reception. Different values of these parameters can be used on different N-SDUs reception.⌋

[SWS_CanTp_00342] ⌈CanTp shall terminate the current reception connection when LSduR_CanTpTransmit() returns E_NOT_OK when transmitting an FC.⌋

7.3.2 N-SDU Transmission

As described in chapter 7.1.2, the upper layer asks for the transmission of a N-SDU by calling CanTp_Transmit(). The parameters of CanTp_Transmit() describe the CAN NSduId and the full Tx N-SDU length to be sent .

[SWS_CanTp_00225] ⌈For specific connections that do not use MetaData, the function CanTp_Transmit shall only use the full SduLength information and shall not use the available N-SDU data buffer in order to prepare Single Frame or First Frame PCI.⌋

[SWS_CanTp_00334] ⌈When CanTp_Transmit is called for an N-SDU with MetaData, the CanTp module shall store the addressing information contained in the MetaData of the N-SDU and use this information for transmission of SF, FF, and CF N-PDUs and for identification of FC N-PDUs. The addressing information in the MetaData depends on the addressing format:

- Normal: none

- Extended: N_TA
- Mixed 11 bit: N_AE
- Normal fixed: N_SA, N_TA
- Mixed 29 bit: N_SA, N_TA, N_AE.

⌋

[SWS_CanTp_00335] ⌈When calling LSduR_CanTpTransmit() for an SF, FF, or CF of a generic connection (N-PDU with MetaData), the CanTp module shall provide the stored addressing information via MetaData of the N-PDU. The addressing information in the MetaData depends on the addressing format:

- Normal, Extended, Mixed 11 bit: none
- Normal fixed, Mixed 29 bit: N_SA, N_TA.

⌋

[SWS_CanTp_00336] ⌈When CanTp_RxIndication is called for an FC on a generic connection (N-PDU with MetaData), the CanTp module shall check the addressing information contained in the MetaData against the stored values.⌋

[SWS_CanTp_00167] ⌈After a transmission request from upper layer, the CanTp module shall start time-out N_Cs before the call of PduR_CanTpCopyTxData. If no data is available before the timer elapsed, the CanTp module shall abort the communication.⌋

[SWS_CanTp_00086]

Upstream requirements: SRS_Can_01079

⌈The CanTp module shall call the PduR_CanTpCopyTxData service for each segment that is sent (SF, FF and CF). The upper layer copy the transmit data on the PduInfoType structure.⌋

[SWS_CanTp_00272] ⌈The API PduR_CanTpCopyTxData() contains a parameter used for the recovery mechanism - 'retry'. Because ISO 15765-2 does not support such a mechanism, the CAN Transport Layer does not implement any kind of recovery. Thus, the parameter is always set to NULL pointer.⌋

If the upper layer cannot make Tx data available because of an error (e.g. in gateway case it may indicate that the transport session from the source network was terminated), the PduR_CanTpCopyTxData() function returns BUFREQ_E_NOT_OK.

[SWS_CanTp_00087] ⌈If PduR_CanTpCopyTxData() returns BUFREQ_E_NOT_OK, the CanTp module shall abort the transmit request and notify the upper layer of this failure by calling the callback function PduR_CanTpTxConfirmation() with the result E_NOT_OK.⌋

Note: If upper layer temporarily has no Tx buffer available, the PduR_CanTpCopyTxData() function returns BUFREQ_E_BUSY.

[SWS_CanTp_00184] ⌈If the PduR_CanTpCopyTxData() function returns BUFREQ_E_BUSY, the CanTp module shall later (implementation specific) retry to copy the data.⌋

Note: If no data is available before the expiration of the N_Cs timer (ISO 15765-2 specification defines the following performance requirement: (N_Cs + N_As) < 0.9* N_Cr timeout), the CanTp module shall abort this transmission session.

[SWS_CanTp_00280] ⌈If data is not available within N_Cs timeout the CanTp module shall notify the upper layer of this failure by calling the callback function PduR_CanTpTxConfirmation with the result E_NOT_OK.⌋

[SWS_CanTp_00089] ⌈When Tx data is available, the CanTp module shall resume the transmission of the N-SDU.⌋

[SWS_CanTp_00310] ⌈In case of N_As timeout occurrence (no confirmation from CAN driver) the CanTp module shall notify the upper layer by calling the callback function PduR_CanTpTxConfirmation() with the result E_NOT_OK.⌋

[SWS_CanTp_00309] ⌈If a FC frame is received with the FS set to OVFLW the Can Tp module shall abort the transmit request and notify the upper layer by calling the callback function PduR_CanTpTxConfirmation() with the result E_NOT_OK.⌋

[SWS_CanTp_00317] ⌈If a FC frame is received with an invalid FS the CanTp module shall abort the transmission of this message and notify the upper layer by calling the callback function PduR_CanTpTxConfirmation() with the result E_NOT_OK.⌋

[SWS_CanTp_00315] ⌈The CanTp module shall start a timeout observation for N_Bs time at confirmation of the FF transmission, last CF of a block transmission and at each indication of FC with FS=WT (i.e. time until reception of the next FC).⌋

[SWS_CanTp_00316] ⌈In case of N_Bs timeout occurrence the CanTp module shall abort transmission of this message and notify the upper layer by calling the callback function PduR_CanTpTxConfirmation() with the result E_NOT_OK.⌋

[SWS_CanTp_00090] ⌈When the transport transmission session is successfully completed, the CanTp module shall call a notification service of the upper layer, `PduR_CanTpTxConfirmation`(), with the result `E_OK`.⌋

[SWS_CanTp_00343] ⌈CanTp shall terminate the current transmission connection when `LSduR_CanTpTransmit`() returns `E_NOT_OK` when transmitting an SF, FF or CF.⌋

7.3.3 Buffer strategy

Because CanTp has no buffering capability, the N-SDU payload, which is to be transmitted, is not copied internally and the N-PDU received is not reassembled internally.

The CAN Transport Layer works directly on the memory area of the upper layers (e.g. PduR, DCM, or COM). To access these memory areas, the CAN Transport Layer uses the `PduR_CanTpCopyTxData`() or `PduR_CanTpCopyRxData`() functions.

Thus, to guarantee data consistency, the upper layer should lock this memory area until an indication occurs.

When a transmit buffer is locked, the upper layer must not write data inside the buffer area.

When a receiving buffer is locked the CAN Transport Layer does not guarantee data consistency of the buffer. The upper layer should neither read nor write data in the buffer area.

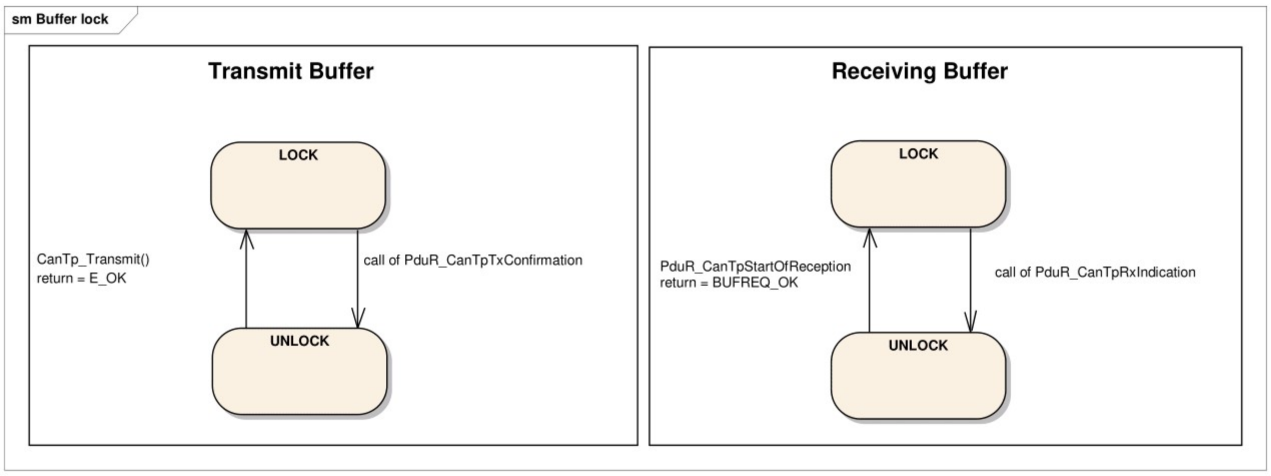


Figure 7.3: Tx and Rx Buffer locking

It is assumed that upper layer module has locked the buffer when it returns a status `BUFREQ_OK` to a `PduR_CanTpStartOfReception`() call or when `CanTp_Transmit()` returns `E_OK` and shall keep the buffer locked until a confirmation or indication (`PduR_CanTpTxConfirmation`() or `PduR_CanTpRxIndication`() call) occurs.

The following figure provides an example, to summarize the process of sending a frame, with a length of 50 bytes utilizing CAN 2.0 frames.

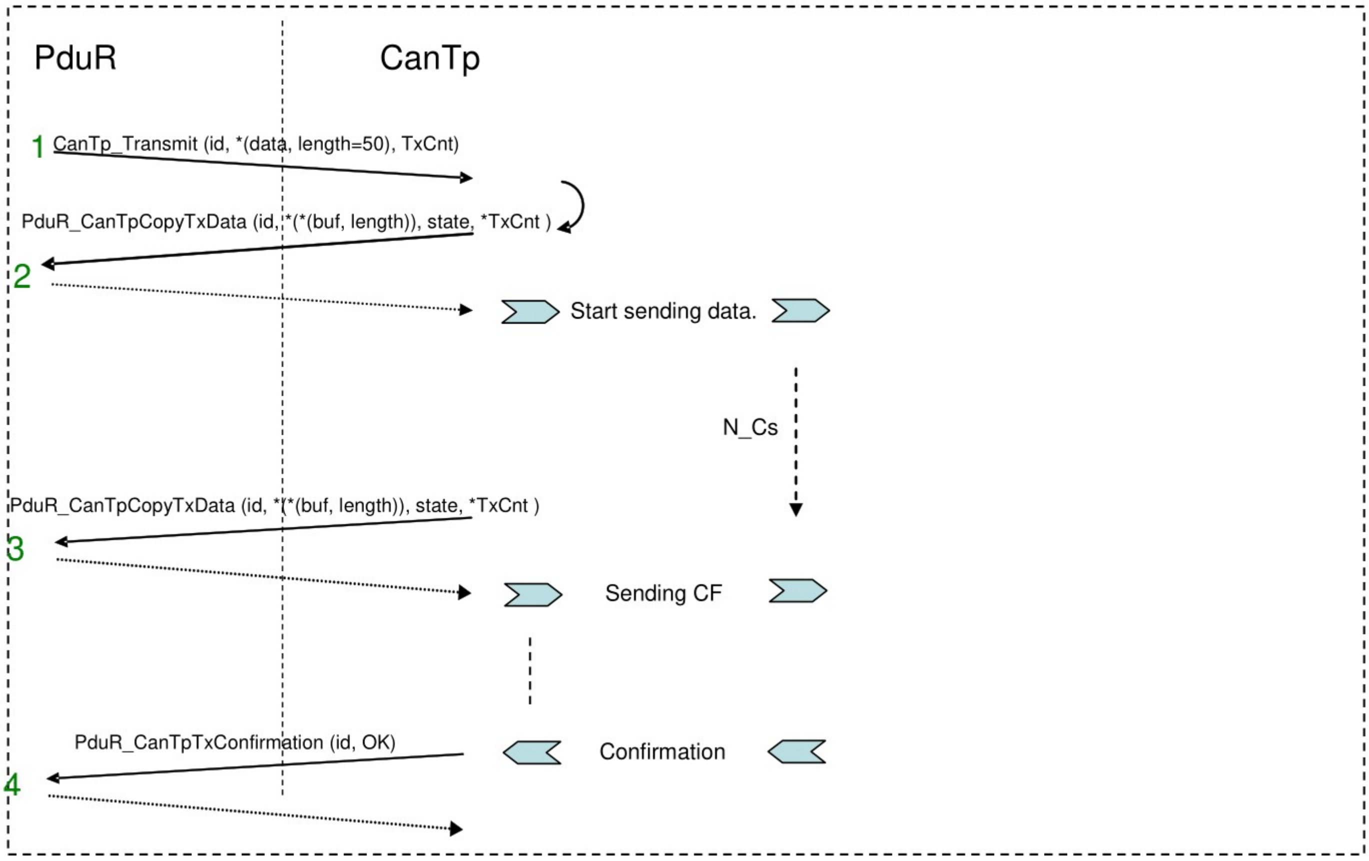

PduR
CanTp
1 CanTp_Transmit (id, *(data, length=50), TxCnt)
PduR_CanTpCopyTxData (id, *(*(buf, length)), state, *TxCnt)
2
Start sending data.
N_Cs
PduR_CanTpCopyTxData (id, *(*(buf, length)), state, *TxCnt)
3
Sending CF
PduR_CanTpTxConfirmation (id, OK)
Confirmation
4

Figure 7.4: Example of transmit process

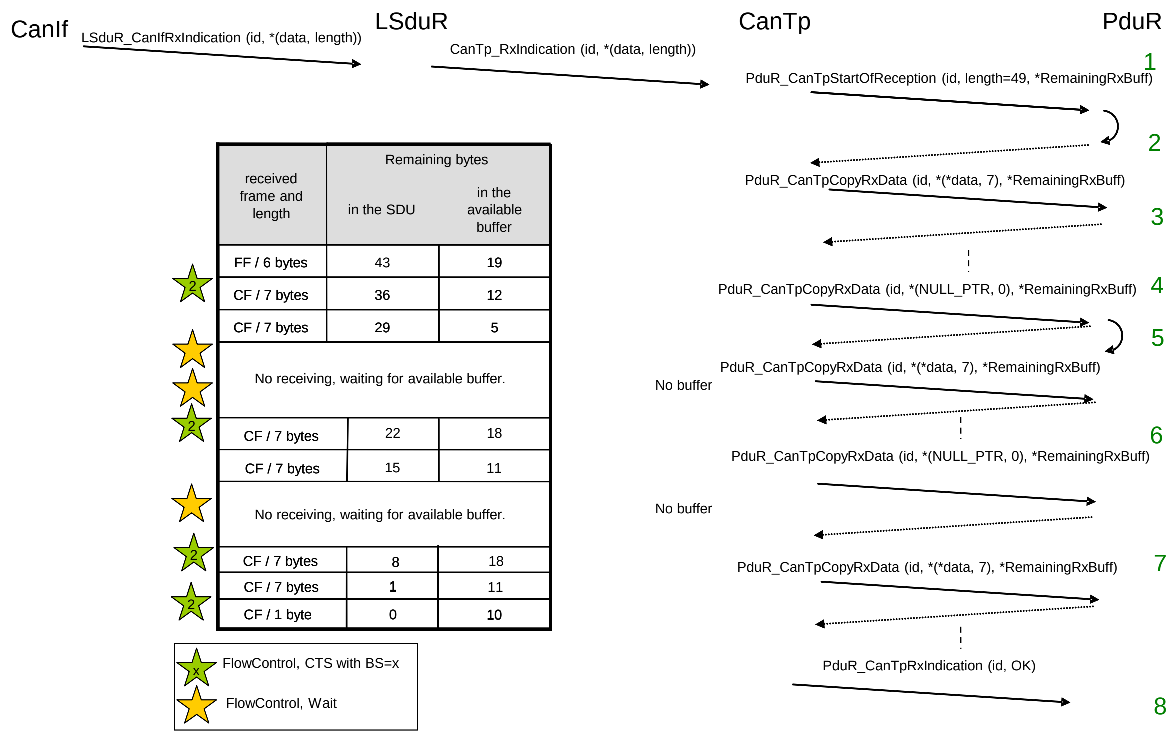
1: The PduR asks for the transmission of 50 data bytes;

2: The CanTp asks the PduR for the payload data; the CanTp send the First Frame;

3: The CanTp send the rest of payload data as sequences of Consecutive Frames; 6 or 7 payload data bytes are copied by the upper layer on each CF;

4: The CanTp confirms transmission of the payload data.

The next figure is an example of an N-SDU receiving 49 bytes; the upper layer reports 25 bytes as available Rx buffer.


CanIf
LSduR
CanTp
PduR
LSduR_CanIfRxIndication (id, *(data, length))
CanTp_RxIndication (id, *(data, length))
1
PduR_CanTpStartOfReception (id, length=49, *RemainingRxBuff)
2
PduR_CanTpCopyRxData (id, *(*data, 7), *RemainingRxBuff)
3
PduR_CanTpCopyRxData (id, *(NULL_PTR, 0), *RemainingRxBuff)
4
5
No buffer
PduR_CanTpCopyRxData (id, *(*data, 7), *RemainingRxBuff)
6
PduR_CanTpCopyRxData (id, *(NULL_PTR, 0), *RemainingRxBuff)
No buffer
PduR_CanTpCopyRxData (id, *(*data, 7), *RemainingRxBuff)
7
PduR_CanTpRxIndication (id, OK)
8
FlowControl, CTS with BS=x
FlowControl, Wait

received frame and length	Remaining bytes in the SDU	Remaining bytes in the available buffer
FF / 6 bytes	43	19
CF / 7 bytes	36	12
CF / 7 bytes	29	5
No receiving, waiting for available buffer.		
CF / 7 bytes	22	18
CF / 7 bytes	15	11
No receiving, waiting for available buffer.		
CF / 7 bytes	8	18
CF / 7 bytes	1	11
CF / 1 byte	0	10

Figure 7.5: Example of receiving process

1: The LSduR notifies a new reception with `CanTp_RxIndication()`. The CanTp forwards this notification to the PduR;

2: The PduR returns an available buffer size of 25 bytes, CanTp sends a FlowControl CTS to the originator;

3: The CanTp provides the data of each received frame to the PduR and monitors the remaining buffer size. After the second consecutive frame, the remaining buffer size is not enough for the next block (two Consecutive Frames);

4: The CanTp asks the PduR for the remaining buffer size by calling `PduR_CanTpCopyRxData`() with 0 as data length and `NULL_PTR` as data, and sends a FlowControl Wait to the originator. This is done until sufficient buffer for the next block is available;

5: When the buffer size is finally sufficient for the next block, the CanTp will send a FlowControl CTS to the originator and continues the reception of the next Consecutive Frames block;

6: After copying the last consecutive frame of the block, the remaining buffer is too low for the next block, so CanTp again sends wait frames and monitors the remaining buffer size;

7: When the buffer for the last block is available, CanTp will continue the reception;

8: The CanTp informs the PduR of the end of reception by a call to `PduR_CanTpRxIndication`().

7.3.4 Protocol parameter setting services

[SWS_CanTp_00091] ⌈The CanTp module shall support optional primitives (proposed in ISO 15765-2 specification) for the dynamic setting of some transport protocol internal parameters (`STmin` and `BS`) by application.

The `BS` value is only a maximum value. For reasons of buffer length, the CAN Transport Layer can adapt the `BS` value within the limit of the configured maximum value.⌋

7.3.5 Tx and Rx data flow

The following figures show examples of an un-segmented message transmission and a segmented one.

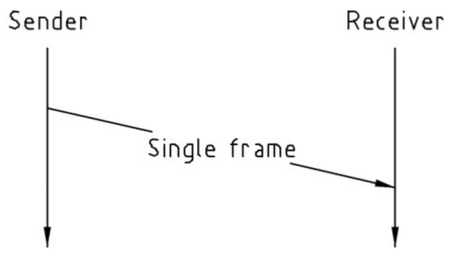


Figure 7.6: Example of single part message

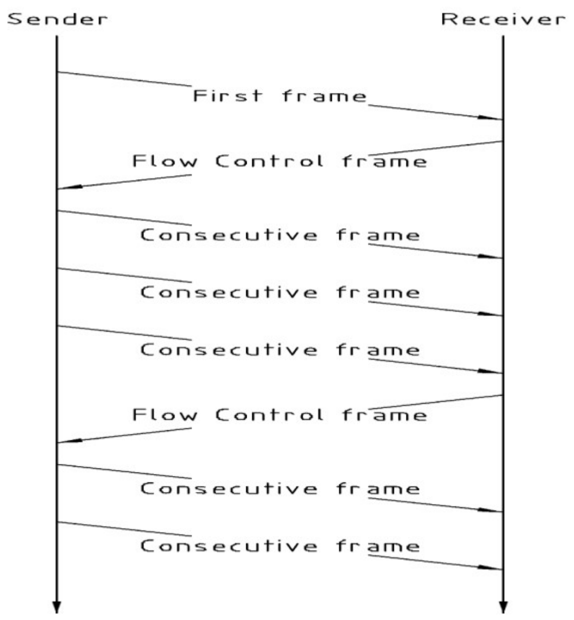


Figure 7.7: Example of multiple parts message

Flow control is used to adjust the sender to the capabilities of the receiver. The main usage of this transport protocol is peer-to-peer communication (i.e. 1 to 1 communication - physical addressing [1]).

[SWS_CanTp_00092] ⌈The CanTp module shall provide 1 to n communication (i.e. functional addressing [1]), in the form of functionality to SF N-PDUs (and only SF N-SDU).⌋

The configuration tool shall check whether it is only SF N-PDUs that have been configured with a functional addressing property.

[SWS_CanTp_00093] ⌈If a multiple segmented session occurs (on both receiver and sender side) with a handle whose communication type is functional, the CanTp module shall reject the request and report the runtime error code `CANTP_E_INVALID_TATYPE` to the Default Error Tracer.⌋

7.3.6 Relationship between CAN NSduId and CAN LSduId

This chapter describes the connection that exists between CAN NSduId and CAN LSdu Id, in order to make transmission and reception of transport protocol data units possible.

[SWS_CanTp_00035]

Upstream requirements: SRS_Can_01068, SRS_Can_01069, SRS_Can_01071, SRS_Can_-01078

⌈A CAN NSduId shall only be linked to one CAN LSduId that is used to transmit SF, FF, FC and CF frames.⌋

[SWS_CanTp_00281] ⌈However, if the message is configured to use an extended or a mixed addressing format, the CanTp module must fill the first byte of each transmitted segment (SF, FF and CF) with the `N_TA` (in case of extended addressing) or `N_AE` (in case of mixed addressing) value. Therefore a CAN NSduId may also be related to a `N_TA` or `N_AE` value.⌋

[SWS_CanTp_00282] ⌈FC protocol data units give receivers the possibility of controlling senders' data flow by authorizing or delaying transmission of subsequent CF N-PDUs.⌋

[SWS_CanTp_00283] ⌈For extended addressing format, the first data byte of the FC also contains the `N_TA` value or a unique combination of `N_TA` and `N_TAtype` value. For mixed addressing format, the first data byte of the FC contains the `N_AE` value.⌋

[SWS_CanTp_00094] ⌈Thus the CAN LSduId of a FC frame combined with its `N_TA` value (e.g. the `N_AI`) or with `N_AE` value shall only identify one CAN NSduId.⌋

[SWS_CanTp_00284] ⌈In the reception direction, the first data byte value of each (SF, FF or CF) transport protocol data unit will be used to determine the relevant N-SDU.⌋

[SWS_CanTp_00095] ⌈Therefore, in extended addressing N-PDU reception, the Can Tp module shall extract the `N_TA` value to establish the related N-SDU. The same process shall be applied for mixed addressing mode in relation with `N_AE` value.⌋

The following figure summarizes these discussions.

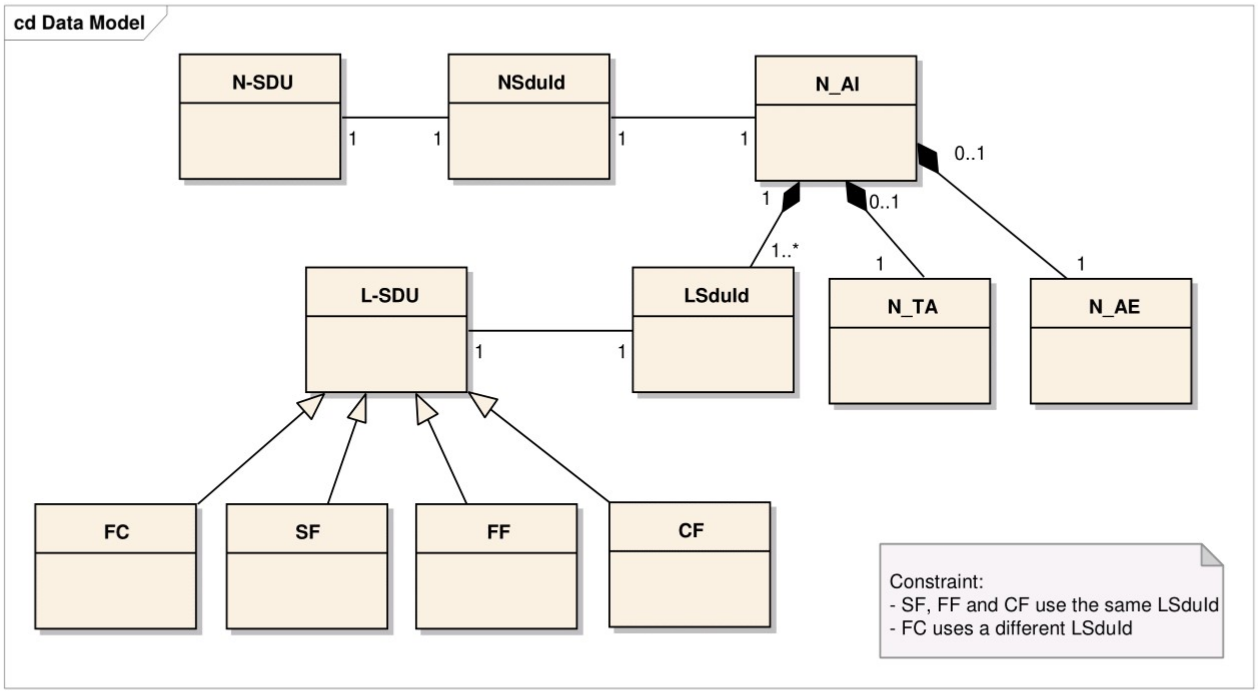


Figure 7.8: Possible links between NSduId and LSduId

7.3.7 Concurrent connection

The CAN Transport Layer is able to manage several connections simultaneously (e.g. a UDS and an OBD request can be received at the same time).

[SWS_CanTp_00096]

Upstream requirements: SRS_Can_01066

⌈The CanTp module shall support several connections simultaneously.⌋

[SWS_CanTp_00120]

Upstream requirements: SRS_Can_01066

⌈It shall be possible to configure concurrent connections in the CanTp module.⌋

[SWS_CanTp_00285] ⌈The connection channels are only destined for CAN TP internal use, so they are not accessible externally.⌋

[SWS_CanTp_00286] ⌈All the necessary information (Channel number, Timing parameter . . .) is configured inside the CAN Transport Layer module.⌋

[SWS_CanTp_00121]

Upstream requirements: SRS_Can_01066

⌈Each N-SDU is statically linked to one connection channel. This connection channel represents an internal path, for the transmission or receiving of the N-SDU. A connection channel is attached to one or more N-SDU.⌋

[SWS_CanTp_00122]

Upstream requirements: SRS_Can_01066

⌈Each connection channel is independent of the other connection channels. This means that a connection channel uses its own resources, such as internal buffer, timer, or state machine.⌋

[SWS_CanTp_00190] ⌈The CanTp module shall route the N-SDU through the correctly configured connection channel.⌋

[SWS_CanTp_00287] ⌈The CanTp module shall not accept the receiving or the transmission of N-SDU with the same identifier in parallel, because otherwise the received frames cannot be assigned to the correct connection. When only specific connections (without `MetaData`) are used, this requirement is enforced by the configuration, because each N-SDU is linked to only one connection channel.⌋

If a user wants to dedicate a specific connection channel to only one N-SDU, they should assign this connection channel to one N-SDU only during the configuration process.

[SWS_CanTp_00288] ⌈If a connection channel is assigned to multiple N-SDUs, then resources are shared between different N-SDUs, and the CAN Transport Layer will reject transmission or abort receiving, if no free connection channels are available.⌋

[SWS_CanTp_00289] ⌈The number of connection channels is not directly configurable. It will be determined by the configuration tools during the configuration process, by analyzing the N-SDU/Channel routing table.⌋

[SWS_CanTp_00123]

Upstream requirements: SRS_Can_01066

⌈If the configured transmit connection channel is in use (state `CANTP_TX_PROCESSING`), the CanTp module shall reject new transmission requests linked to this channel. To reject a transmission, CanTp returns `E_NOT_OK` when the upper layer asks for a transmission with the `CanTp_Transmit()` function.⌋

[SWS_CanTp_00124]

Upstream requirements: SRS_Can_01066

⌈When an SF or FF N-PDU without MetaData is received, and the corresponding connection channel is currently receiving the same connection (state CANTP_RX_PROCESSING, same N_AI), the CanTp module shall abort the reception in progress and shall process the received frame as the start of a new reception.

When an SF or FF N-PDU without MetaData is received for another connection (different N_AI) on an active connection channel, the SF or FF shall be ignored.⌋

[SWS_CanTp_00337] ⌈When an SF or FF N-PDU with MetaData (indicating a generic connection) is received, and the corresponding connection channel is currently receiving, the SF or FF shall be ignored.⌋

[SWS_CanTp_00248] ⌈When a Tx N-PDU is used by two or more different connections on different channels, access to this N-PDU shall be serialized by using the TxConfirmation. An Rx N-PDU can only be used on two or more different connection channels if extended or mixed addressing is used in relation with this N-PDU or when it has MetaData (and thus belongs to a generic connection).⌋

Note: CAN FD and CAN frames will be mapped to different PDUs by LSduR depending on the frame format (CAN FD or CAN 2.0). Therefore, it is possible to distinguish between CAN FD and classic CAN communication.

7.3.8 N-PDU padding

To guarantee complete compatibility with all upper layer requirements concerning the frame data length (e.g. OBD requires data length to always be set to 8 bytes, however UDS does not), the padding activation is configurable at pre-compile time per N-SDU by using either CanTpRxPaddingActivation for a Rx N-SDU or CanTpTxPaddingActivation for a Tx N-SDU.

[SWS_CanTp_00116]

Upstream requirements: SRS_Can_01073

⌈In both padding and no padding modes, the CanTp module shall only transfer used data bytes to the upper layer.⌋

[SWS_CanTp_00059]

Upstream requirements: SRS_Can_01086

⌈The value used for padding bytes is configurable via configuration parameter CANTP_PADDING_BYTE (see CanTpPaddingByte).⌋

[SWS_CanTp_00344]

Upstream requirements: SRS_Can_01073

⌈If frames with a payload <= 8 (either CAN 2.0 frames or small CAN FD frames) are used for a Rx N-SDU and `CanTpRxPaddingActivation` is equal to `CANTP_ON`, then CanTp shall only accept SF Rx N-PDUs or last CF Rx N-PDUs, belonging to that N-SDU, with a length of eight bytes (i.e. PduInfoPtr.SduLength = 8).⌋

[SWS_CanTp_00345]

Upstream requirements: SRS_Can_01073

⌈If frames with a payload <= 8 (either CAN 2.0 frames or small CAN FD frames) are used for a Rx N-SDU and `CanTpRxPaddingActivation` is equal to `CANTP_ON`, then CanTp receives by means of `CanTp_RxIndication()` call an SF Rx N-PDU belonging to that N-SDU, with a length smaller than eight bytes (i.e. PduInfoPtr.SduLength < 8), CanTp shall reject the reception. The runtime error code `CANTP_E_PADDING` shall be reported to the Default Error Tracer.⌋

[SWS_CanTp_00346]

Upstream requirements: SRS_Can_01073

⌈If frames with a payload <= 8 (either CAN 2.0 frames or small CAN FD frames) are used for a Rx N-SDU and `CanTpRxPaddingActivation` is equal to `CANTP_ON`, and CanTp receives by means of `CanTp_RxIndication()` call a last CF Rx N-PDU belonging to that N-SDU, with a length smaller than eight bytes (i.e. PduInfoPtr. SduLength != 8), CanTp shall abort the ongoing reception by calling `PduR_CanTpRxIndication()` with the result `E_NOT_OK`. The runtime error code `CANTP_E_PADDING` shall be reported to the Default Error Tracer.⌋

[SWS_CanTp_00347] ⌈If `CanTpRxPaddingActivation` is equal to `CANTP_ON` for an Rx N-SDU, the CanTp module shall transmit FC N-PDUs with a length of eight bytes. Unused bytes in N-PDU shall be updated with `CANTP_PADDING_BYTE` (see `CanTpPaddingByte`).⌋

[SWS_CanTp_00348]

Upstream requirements: SRS_Can_01073

⌈If frames with a payload <= 8 (either CAN 2.0 frames or small CAN FD frames) are used for a Tx N-SDU and if `CanTpTxPaddingActivation` is equal to `CANTP_ON`, CanTp shall transmit by means of `LSduR_CanTpTransmit()` call, SF Tx N-PDU or last CF Tx N-PDU that belongs to that Tx N-SDU with the length of eight bytes(i.e. PduInfoPtr.SduLength = 8). Unused bytes in N-PDU shall be updated with `CANTP_PADDING_BYTE` (see `CanTpPaddingByte`).⌋

[SWS_CanTp_00349] ⌈If `CanTpTxPaddingActivation` is equal to `CANTP_ON` for a Tx N-SDU, and if a FC N-PDU is received for that Tx N-SDU on a ongoing transmission, by means of CanTp_RxIndication() call, and the length of this FC is smaller than eight bytes (i.e. PduInfoPtr.SduLength <8) the CanTp module shall abort the transmission session by calling PduR_CanTpTxConfirmation() with the result E_NOT_OK. The runtime error code CANTP_E_PADDING shall be reported to the Default Error Tracer.⌋

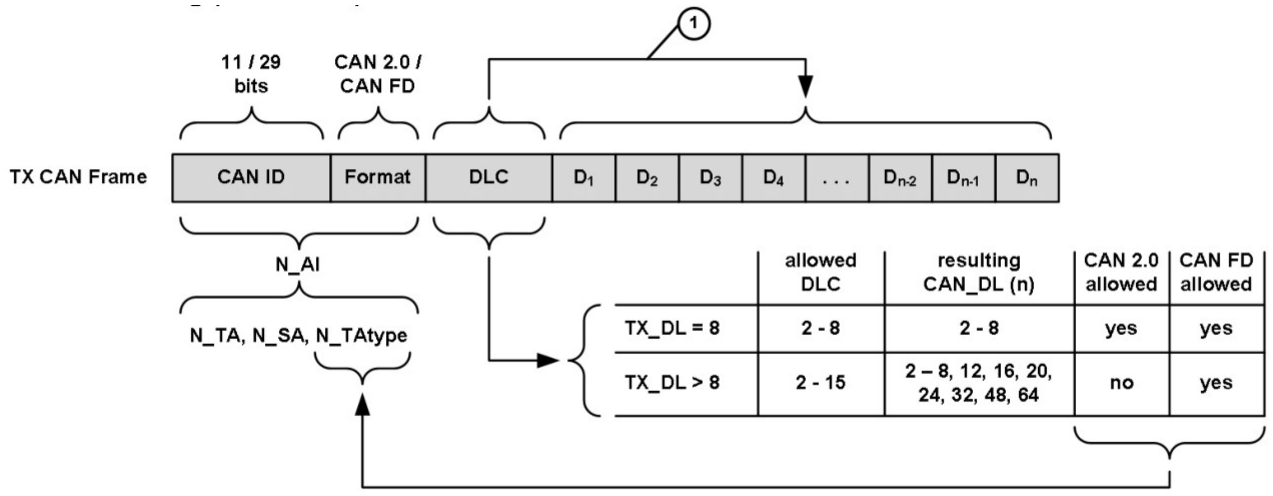
[SWS_CanTp_00351]

Upstream requirements: SRS_Can_01073

⌈If the data length which shall be transmitted via LSduR_CanTpTransmit() does not match possible DLC values (0..8, 12, 16, 20, 24, 32, 48, or 64), CanTp shall use the next higher valid DLC for transmission with initialization of unused bytes to the value of CANTP_PADDING_BYTE (see CanTpPaddingByte).⌋

Rationale: The ISO 11898-1:2015 [9] DLC values from 9 to 15 are assigned to non-linear discrete values for CAN frame payload length up to 64 byte. To prevent the transmission of uninitialized data the padding of CAN frame data is mandatory for DLC values greater than eight when the length of the N_PDU size to be transmitted is not equal to one of the discrete length values defined in the [9] DLC table. For DLC values from 9 to 15 only the mandatory padding should be used.

The following picture represents an ISO frame:



	allowed DLC	resulting CAN_DL (n)	CAN 2.0 allowed	CAN FD allowed
TX_DL = 8	2 - 8	2 - 8	yes	yes
TX_DL > 8	2 - 15	2 – 8, 12, 16, 20, 24, 32, 48, 64	no	yes

Figure 7.9: ISO frame construction

7.3.9 Handling of unexpected N-PDU arrival

The behavior of the CAN Transport Layer on unexpected N-PDU arrival is greatly dependent on the communication direction type of the processing N-SDU.

[SWS_CanTp_00057]

Upstream requirements: SRS_Can_01082

⌈If unexpected frames are received, the CanTp module shall behave according to the table below. This table specifies the N-PDU handling considering the current CanTp internal status (CanTp status).⌋

It must be understood, that the received N-PDU contains the same address information (N_AI) as the reception or transmission, which may be in progress at the time the N_PDU is received.

CanTp	**Reception of**				
status	**SF N-PDU**	**FF N-PDU**	**CF N-PDU**	**FC N-PDU**	**Unknown N-PDU**
Segmented Transmit in progress	If a reception is in progress process it according to the cell below, otherwise process the SF N-PDU as the start of a new reception	If a reception is in progress process it according to the cell below, otherwise process the FF N-PDU as the start of a new reception	If a reception is in progress process it according to the cell below, otherwise ignore it.	If awaited, process the FC N-PDU, otherwise ignore it.	Ignore
Segmented Receive in progress	Terminate the current reception, report an indication, with parameter Result set to E_NOT_OK, to the upper layer, and process the SF N-PDU as the start of a new reception	Terminate the current reception, report an indication, with parameter Result set to E_NOT_OK, to the upper layer, and process the FF N-PDU as the start of a new reception	Process the CF N-PDU in the on-going reception and perform the required checks (e.g. SN in right order)	If a transmission is in progress process it according to the cell above, otherwise ignore it.	Ignore
Idle[1]	Process the SF N-PDU as the start of a new reception	Process the FF N-PDU as the start of a new reception	Ignore	Ignore	Ignore

1

Table 1: Handling of N-PDU arrivals

7.4 Error Classification

This section describes how the CanTp module has to manage the several error classes that may occur during the life cycle of this basic software.

[1] Idle = CANTP_ON.CANTP_RX_WAIT and CANTP_ON.CANTP_TX_WAIT

[SWS_CanTp_00008]

Upstream requirements: SRS_BSW_00339

⌈On errors and exceptions, the CanTp module shall not modify its current module state (see Figure 3: CAN Transport Layer life cycle) but shall simply report the error event.⌋

[SWS_CanTp_00291] ⌈In case of production error, the Diagnostic Event Manager module (via the Function Inhibition Manager) will perform the appropriate action (e.g. status modification of the calling module).⌋

7.4.1 Development Errors

[SWS_CanTp_00293] Definiton of development errors in module CanTp ⌈

Type of error	*Related error code*	*Error value*
API service called with wrong parameter(s): When CanTp_ChangeParameter is called with invalid value.	CANTP_E_PARAM_CONFIG	0x01
API service called with wrong parameter(s): When CanTp_ChangeParameter or CanTp_Read Parameter is called with invalid parameter ID.	CANTP_E_PARAM_ID	0x02
API service called with a NULL pointer.	CANTP_E_PARAM_POINTER	0x03
Module initialization has failed, e.g. CanTp_Init() called with an invalid pointer in postbuild.	CANTP_E_INIT_FAILED	0x04
API service used without module initialization : On any API call except CanTp_Init(), CanTp_Get VersionInfo() and CanTp_MainFunction() if CanTp is in state CANTP_OFF	CANTP_E_UNINIT	0x20
Invalid Transmit PDU identifier (e.g. a service is called with an inexistent Tx PDU identifier)	CANTP_E_INVALID_TX_ID	0x30
Invalid Receive PDU identifier (e.g. a service is called with an inexistent Rx PDU identifier)	CANTP_E_INVALID_RX_ID	0x40

⌋

7.4.2 Runtime Errors

[SWS_CanTp_00352] Definiton of runtime errors in module CanTp ⌈

Type of error	*Related error code*	*Error value*
PDU received with a length smaller than 8 bytes. (i.e. PduInfoPtr.SduLength < 8)	CANTP_E_PADDING	0x70
CanTp_Transmit() is called for a configured Tx I-Pdu with functional addressing and the length parameter indicates, that the message can not be sent with a SF	CANTP_E_INVALID_TATYPE	0x90
Requested operation is not supported - a cancel transmission/reception request for an N-SDU that it is not on transmission/reception process	CANTP_E_OPER_NOT_SUPPORTED	0xA0
Event reported in case of an implementation specific error other than a protocol timeout error during a reception or a transmission	CANTP_E_COM	0xB0
Event reported in case of a protocol timeout error during reception	CANTP_E_RX_COM	0xC0
Event reported in case of a protocol timeout error during transmission	CANTP_E_TX_COM	0xD0

⌋

[SWS_CanTp_00229] ⌈If the task was aborted due to As, Bs, Cs, Ar, Br, Cr timeout, the CanTp module shall raise the development error CANTP_E_RX_COM (in case of a reception operation) or CANTP_E_TX_COM (in case of a transmission operation). If the task was aborted due to any other protocol error, the CanTp module shall raise the runtime error code CANTP_E_COM to the Default Error Tracer.⌋

7.4.3 Production Errors

There are no production errors.

7.4.4 Extended Production Errors

[SWS_CanTp_00361] ⌈

Error Name:	CANTP_E_CANTPNAS_TIMEOUT_OCCURRED
Short Description:	A N_As timeout is detected
Long Description:	CanTp shall report a CANTP_E_CANTPNAS_TIMEOUT_OCCURRED Extended Production Error to DEM when a N_As timeout is detected.

▽

△

Detection Criteria:	Fail	N_As timer expired
	Pass	CanTp_Init function call
Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None	
Time Required:	Not applicable	
Monitor Frequency:	on event	

⌋

[SWS_CanTp_00362] ⌈

Error Name:	CANTP_E_CANTPNAR_TIMEOUT_OCCURRED	
Short Description:	A N_Ar timeout is detected	
Long Description:	CanTp shall report a CANTP_E_CANTPNAR_TIMEOUT_OCCURRED Extended Production Error to DEM when a N_Ar timeout is detected.	
Detection Criteria:	Fail	N_Ar timer expired
	Pass	CanTp_Init function call
Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None	
Time Required:	Not applicable	
Monitor Frequency:	on event	

⌋

[SWS_CanTp_00363] ⌈

Error Name:	CANTP_E_CANTPNBS_TIMEOUT_OCCURRED	
Short Description:	A N_Bs timeout is detected	
Long Description:	CanTp shall report a CANTP_E_CANTPNBS_TIMEOUT_OCCURRED Extended Production Error to DEM when a N_Bs timeout is detected.	
Detection Criteria:	Fail	N_Bs timer expired
	Pass	CanTp_Init function call
Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None	
Time Required:	Not applicable	
Monitor Frequency:	on event	

⌋

[SWS_CanTp_00364] ⌈

Error Name:	CANTP_E_CANTPNBR_TIMEOUT_OCCURRED	
Short Description:	A N_Br timeout is detected	
Long Description:	CanTp shall report a CANTP_E_CANTPNBR_TIMEOUT_OCCURRED Extended Production Error to DEM when a N_Br timeout is detected.	
Detection Criteria:	Fail	N_Br timer expired
	Pass	CanTp_Init function call
Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None	
Time Required:	Not applicable	
Monitor Frequency:	on event	

⌋

[SWS_CanTp_00365] ⌈

Error Name:	CANTP_E_CANTPNCS_TIMEOUT_OCCURRED	
Short Description:	A N_Cs timeout is detected	
Long Description:	CanTp shall report a CANTP_E_CANTPNCS_TIMEOUT_OCCURRED Extended Production Error to DEM when a N_Cs timeout is detected.	
Detection Criteria:	Fail	N_Cs timer expired
	Pass	CanTp_Init function call
Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None	
Time Required:	Not applicable	
Monitor Frequency:	on event	

⌋

[SWS_CanTp_00366] ⌈

Error Name:	CANTP_E_CANTPNCR_TIMEOUT_OCCURRED	
Short Description:	A N_Cr timeout is detected	
Long Description:	CanTp shall report a CANTP_E_CANTPNCR_TIMEOUT_OCCURRED Extended Production Error to DEM when a N_Cr timeout is detected.	
Detection Criteria:	Fail	N_Cr timer expired
	Pass	CanTp_Init function call

▽

△

Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None
Time Required:	Not applicable
Monitor Frequency:	on event

⌋

[SWS_CanTp_00367] ⌈

Error Name:	CANTP_E_SWAPPED_CONSECUTIVE_FRAMES_RECEIVED	
Short Description:	A swapped Consecutive Frame is received	
Long Description:	CanTp shall report a `CANTP_E_SWAPPED_CONSECUTIVE_FRAMES_RECEIVED` Extended Production Error to DEM when swapped Consecutive Frames are received.	
Detection Criteria:	Fail	Swapped Consecutive Frames are received
	Pass	`CanTp_Init` function call
Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None	
Time Required:	Not applicable	
Monitor Frequency:	on event	

⌋

[SWS_CanTp_00368] ⌈

Error Name:	CANTP_E_DROPPED_CONSECUTIVE_FRAMES_DETECTED	
Short Description:	Missing Consecutive Frame is detected	
Long Description:	CanTp shall report a `CANTP_E_DROPPED_CONSECUTIVE_FRAMES_DETECTED` Extended Production Error to DEM when missing Consecutive Frames are detected.	
Detection Criteria:	Fail	Missing Consecutive Frame is detected
	Pass	`CanTp_Init` function call
Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None	
Time Required:	Not applicable	
Monitor Frequency:	on event	

⌋

[SWS_CanTp_00369] ⌈

Error Name:	CANTP_E_FC_OVERFLOW_RECEIVED	
Short Description:	Flow Control with status Overflow is received	
Long Description:	CanTp shall report a CANTP_E_FC_OVERFLOW_RECEIVED Extended Production Error to DEM when Flow Control with status Overflow is received.	
Detection Criteria:	Fail	Flow Control with status Overflow is received
	Pass	CanTp_Init function call
Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None	
Time Required:	Not applicable	
Monitor Frequency:	on event	

⌋

[SWS_CanTp_00370] ⌈

Error Name:	CANTP_E_FC_OVERFLOW_TRANSMITTED	
Short Description:	Flow Control with status Overflow is transmitted	
Long Description:	CanTp shall report a CANTP_E_FC_OVERFLOW_TRANSMITTED Extended Production Error to DEM when Flow Control with status Overflow is transmitted.	
Detection Criteria:	Fail	Flow Control with status Overflow is transmitted
	Pass	CanTp_Init function call
Secondary Parameters:	The condition under which the FAIL and/or PASS detection is active: None	
Time Required:	Not applicable	
Monitor Frequency:	on event	

⌋

7.5 Security Events

[SWS_CanTp_00371] Security events

Upstream requirements: RS_Ids_00810

⌈

Name	***Description***	***ID***
SEV_CAN_ERROR_WFT_OVRN	The Flow Control WAIT frame exceeded the maximum counter N_WFTmax received.	77
SEV_CAN_ERROR_TIMEOUT_A	N_Ar timeout.	78
SEV_CAN_ERROR_TIMEOUT_CR	N_Cr timeout.	79
SEV_CAN_ERROR_WRONG_SN	Invalid sequence number value received.	80
SEV_CAN_ERROR_NO_BUFFER	Flow Control with OVFLW Flow Status received.	81
SEV_CAN_ERROR_INVALID_FS	Flow Control with invalid Flow Status received.	82
SEV_CAN_ERROR_TIMEOUT_BS	N_Bs timeout.	83
SEV_CAN_ERROR_UNEXP_PDU	Unexpected protocol data unit received (segmented reception in progress).	84
SEV_CAN_ERROR_PADING	PDU received with a length smaller than 8 bytes.	86
SEV_CAN_INVALID_TATYPE	Reception requested on an I-PDU with functional addressing but the lenght indicates that the message not a SF.	87

⌋

[SWS_CanTp_00372] Enable IdsM security event reporting

Upstream requirements: RS_Ids_00810

⌈If security event reporting has been enabled for the CanTp module (`CanTpEnableSecurityEventReporting` = true) the respective security events shall be reported to the IdsM via the interfaces defined in SWS_BSWGeneral [4].⌋

[SWS_CanTp_00373] IdsM security event - WFT exceeded

Upstream requirements: RS_Ids_00810

⌈When the maximum number of `WFTmax` consecutive FC(WAIT) N-PDUs is reached, the CanTp module shall report the security event `SEV_CAN_ERROR_WFT_OVRN`.⌋

[SWS_CanTp_00374] IdsM security event - N_Ar timeout

Upstream requirements: RS_Ids_00810

⌈In case of `N_Ar` timeout occurence, the CanTp module shall report the security event `SEV_CAN_ERROR_TIMEOUT_A`.⌋

[SWS_CanTp_00375] IdsM security event - N_Cr timeout

Upstream requirements: RS_Ids_00810

⌈In case of `N_Cr` timeout occurence, the CanTp module shall report the security event `SEV_CAN_ERROR_TIMEOUT_CR`.⌋

[SWS_CanTp_00376] IdsM security event - wrong SN

Upstream requirements: RS_Ids_00810

⌈If a wrong SN is received during a segmented reception, the CanTp module shall report the security event SEV_CAN_ERROR_WRONG_SN.⌋

[SWS_CanTp_00377] IdsM security event - overflow FS received

Upstream requirements: RS_Ids_00810

⌈If a FC frame with FS set to OVFLW is received, the CanTp module shall report the security event SEV_CAN_ERROR_NO_BUFFER.⌋

[SWS_CanTp_00378] IdsM security event - invalid FS received

Upstream requirements: RS_Ids_00810

⌈If a FC frame with an invalid FS is received, the CanTp module shall report the security event SEV_CAN_ERROR_INVALID_FS.⌋

[SWS_CanTp_00379] IdsM security event - N_Bs timeout

Upstream requirements: RS_Ids_00810

⌈In case of N_Bs timeout occurence, the CanTp module shall report the security event SEV_CAN_ERROR_TIMEOUT_BS.⌋

[SWS_CanTp_00380] IdsM security event - unexpected PDU

Upstream requirements: RS_Ids_00810

⌈If a new SF or FF is received during an ongoing segmented reception, the CanTp module shall report the security event SEV_CAN_ERROR_UNEXP_PDU.⌋

[SWS_CanTp_00381] IdsM security event - SF error padding

Upstream requirements: RS_Ids_00810

⌈If frames with a payload <= 8 (either CAN 2.0 frames or small CAN FD frames) are used for a Rx N-SDU and CanTpRxPaddingActivation is equal to CANTP_ON and CanTp receives a SF Rx N-PDU belonging to that N-SDU, with a length smaller than eight bytes (i.e. PduInfoPtr.SduLength < 8), the CanTp module shall report the security event SEV_CAN_ERROR_PADDING.⌋

[SWS_CanTp_00382] IdsM security event - CF error padding

Upstream requirements: RS_Ids_00810

⌈If frames with a payload <= 8 (either CAN 2.0 frames or small CAN FD frames) are used for a Rx N-SDU and CanTpRxPaddingActivation is equal to CANTP_ON and CanTp receives a last CF Rx N-PDU belonging to that N-SDU, with a length smaller than eight bytes (i.e. PduInfoPtr.SduLength < 8), the CanTp module shall report the security event SEV_CAN_ERROR_PADDING.⌋

[SWS_CanTp_00383] IdsM security event - CF error padding

Upstream requirements: RS_Ids_00810

⌈If a multi-frame message reception occurs with a handle whose communication type is functional, the CanTp module shall report the security event SEV_CAN_INVALID_TATYPE.⌋

8 API specification

8.1 Imported types

In this chapter, all types included from the following modules are listed:

[SWS_CanTp_00209] Definition of imported datatypes of module CanTp ⌈

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	TPParameterType
	ComStack_Types.h	TpDataStateType
IdsM	IdsM_Types.h	IdsM_SecurityEventIdType
Std	Std_Types.h	Std_ReturnType
	Std_Types.h	Std_VersionInfoType

⌋

In order to receive a consistent API for the AUTOSAR communication stack, basic types have been defined. These types are used by the CAN Transport Layer to communicate with the Pdu-Router and with the L-SDU Router.

For more information, these basic types are presented in depth in the AUTOSAR COM stack API specification.

These AUTOSAR standard types will be used without any type redefinition.

[SWS_CanTp_00002]

Upstream requirements: SRS_BSW_00353

⌈If, for implementation reasons, some additional types have to be defined, the CanTp module shall label these types as follows: `CanTp_<TypeName>Type`, where `<TypeName>` is the name of this type adhering to the rules:

- No underscore usage
- First letter of each word upper case, consecutive letters lower case.

⌋

[SWS_CanTp_00296] ⌈The CanTp module shall ensure that implementation-specific types are not "visible" outside of CanTp. Otherwise, the complete architecture would be corrupted.⌋

8.2 Type definitions

8.2.1 CanTp_ConfigType

[SWS_CanTp_00340] Definition of datatype CanTp_ConfigType ⌈

Name	CanTp_ConfigType
Kind	Structure
Description	Data structure type for the post-build configuration parameters.
Available via	CanTp.h

⌋

Implementation specific data structure type for the post-build configuration parameters.

8.3 Function definitions

This is a list of functions provided for upper layer modules

8.3.1 CanTp_Init

[SWS_CanTp_00208] Definition of API function CanTp_Init

Upstream requirements: SRS_BSW_00101, SRS_BSW_00358, SRS_BSW_00414

⌈

Service Name	CanTp_Init	

Syntax	`void CanTp_Init (`
	`  const CanTp_ConfigType* CfgPtr`
	`)`	

Service ID [hex]	0x01	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	CfgPtr	Pointer to the CanTp post-build configuration data.
Parameters (inout)	None	
Parameters (out)	None	
Return value	None	
Description	This function initializes the CanTp module.	
Available via	CanTp.h	

⌋

After power up, CanTp is in a state called `CANTP_OFF` (see [SWS_CanTp_00168]). In this state, the CanTp is not yet configured and therefore cannot perform any communication task.

The function `CanTp_Init` initializes all global variables of the CAN Transport Layer with the given configuration set and set it in the idle state (state = `CANTP_ON` but neither transmission nor reception are in progress) (see [SWS_CanTp_00170] and [SWS_CanTp_00030]).

The function `CanTp_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.

[SWS_CanTp_00199] ⌈The CanTp module's environment shall call `CanTp_Init` before using the CanTp module for further processing.⌋

Parameter checking for the initialization function is specified within BSW General [4].

[SWS_CanTp_00161]

Upstream requirements: SRS_BSW_00406

⌈A static status variable, denoting whether a BSW module is initialized, should be initialized with value 0 before any APIs of the BSW module are called.

The initialization function of the BSW modules will set the static status variable to a value not equal to 0.

This variable is used to check if the module has been initialized before calling an API.⌋

8.3.2 CanTp_ GetVersionInfo

[SWS_CanTp_00210] Definition of API function CanTp_GetVersionInfo ⌈

Service Name	CanTp_GetVersionInfo	

Syntax	`void CanTp_GetVersionInfo (`
	`  Std_VersionInfoType* versioninfo`
	`)`	

Service ID [hex]	0x07	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	None	
Parameters (inout)	None	
Parameters (out)	versioninfo	Indicator as to where to store the version information of this module.

▽

△

Return value	None
Description	This function returns the version information of the CanTp module.
Available via	CanTp.h

⌋

[SWS_CanTp_00319] ⌈If development error detection is enabled the function `CanTp_GetVersionInfo` shall raise `CANTP_E_PARAM_POINTER` error if the argument is a NULL pointer.⌋

8.3.3 CanTp_Shutdown

[SWS_CanTp_00211] Definition of API function CanTp_Shutdown ⌈

Service Name	CanTp_Shutdown

Syntax	`void CanTp_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 called to shutdown the CanTp module.
Available via	CanTp.h

⌋

[SWS_CanTp_00202] ⌈The function `CanTp_Shutdown` shall close all pending transport protocol connections, free all resources and set the CanTp module into the `CANTP_OFF` state.⌋

[SWS_CanTp_00200] ⌈The function `CanTp_Shutdown` shall not raise a notification about the pending frame transmission or reception.⌋

8.3.4 CanTp_Transmit

[SWS_CanTp_00212] Definition of API function CanTp_Transmit ⌈

Service Name	CanTp_Transmit	
Syntax	`Std_ReturnType CanTp_Transmit ( PduIdType TxPduId, const PduInfoType* PduInfoPtr )`	
Service ID [hex]	0x49	
Sync/Async	Synchronous	
Reentrancy	Reentrant for different PduIds. Non reentrant for the same PduId.	
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	CanTp.h	

⌋

[SWS_CanTp_00231]

Upstream requirements: SRS_Can_01071, SRS_Can_01074

⌈If data does fit into the associated N-PDU, the function `CanTp_Transmit()` shall send a SF N-PDU.⌋

[SWS_CanTp_00232]

Upstream requirements: SRS_Can_01071, SRS_Can_01074

⌈If data does not fit into the associated N-PDU, the function `CanTp_Transmit()` shall initiate a multiple frame transmission session.⌋

[SWS_CanTp_00354]

Upstream requirements: SRS_Can_01163

⌈The maximum Tx length of the N-PDU shall be derived from the PduLength configuration parameter of EcuC. This parameter is equivalent to `TX_DL` of ISO 15765-2.⌋

[SWS_CanTp_00204] ⌈The CanTp module shall notify the upper layer by calling the `PduR_CanTpTxConfirmation` callback when the transmit request has been completed.⌋

[SWS_CanTp_00205] ⌈The CanTp module shall abort the transmit request and call the PduR_CanTpTxConfirmation callback function with E_NOT_OK result value if an error occurred (over flow, N_As timeout, N_Bs timeout and so on).⌋

[SWS_CanTp_00206] ⌈The function CanTp_Transmit shall reject a request if the CanTp_Transmit service is called for a N-SDU identifier which is being used in a currently running CAN Transport Layer session.⌋

[SWS_CanTp_00298] ⌈CanTp has limited buffering capability, and hence the N-SDU payload to be transmitted is not copied internally. The CAN Transport Layer obtains the data directly from the upper layer via the PduR_CanTpCopyTxData service.⌋

Thus, to guarantee the data consistency, the upper layer (e.g. DCM, PduRouter or AUTOSAR COM) must lock this memory area until the confirmation notification occurs.

[SWS_CanTp_00299] ⌈When the upper layer calls this function for an N-SDU without MetaData, only the data length information of the structure indicated by PduInfoPtr has to be used. Its value indicates the payload length of the N-SDU, which is to be transmitted.

For an N-SDU with MetaData, besides the length information also the MetaData provided via the PduInfoPtr is relevant. To obtain actual Tx data, the CAN Transport Layer shall call the PduR_CanTpCopyTxData service.⌋

[SWS_CanTp_00321] ⌈If development error detection is enabled the function CanTp_Transmit shall raise CANTP_E_PARAM_POINTER error if the argument PduInfoPtr is a NULL pointer.⌋

[SWS_CanTp_00356] ⌈If development error detection is enabled the function CanTp_Transmit shall check the validity of function parameter TxPduId. If its value is invalid, the CanTp_Transmit function shall raise the development error CANTP_-E_INVALID_TX_ID.⌋

8.3.5 CanTp_CancelTransmit

[SWS_CanTp_00246] Definition of API function CanTp_CancelTransmit ⌈

Service Name	CanTp_CancelTransmit	
Syntax	`Std_ReturnType CanTp_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	CanTp.h	

⌋

This service cancels the transmission of an N-SDU that has already requested for transmission by calling CanTp_Transmit service.

[SWS_CanTp_00254] ⌈If development error detection is enabled the function CanTp_CancelTransmit shall check the validity of function parameter TxPduId. If its value is invalid, the CanTp_CancelTransmit function shall raise the development error CANTP_E_INVALID_TX_ID.

If the parameter value indicates a cancel transmission request for an N-SDU that it is not on transmission process the CanTp module shall report a runtime error code CANTP_E_OPER_NOT_SUPPORTED to the Default Error Tracer and the service shall return E_NOT_OK.⌋

[SWS_CanTp_00256] ⌈The CanTp shall abort the transmission of the current N-SDU if the service returns E_OK.⌋

[SWS_CanTp_00255] ⌈If the CanTp_CancelTransmit service has been successfully executed the CanTp shall call the PduR_CanTpTxConfirmation with notification result E_NOT_OK.⌋

8.3.6 CanTp_CancelReceive

[SWS_CanTp_00257] Definition of API function CanTp_CancelReceive ⌈

Service Name	CanTp_CancelReceive	

Syntax	`Std_ReturnType CanTp_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	CanTp.h	

⌋

The service `CanTp_CancelReceive` cancels the reception of an N-SDU initiated by the reception of a First Frame and consequently calls of `PduR_StartOfReception`. When the function returns, no reception is in progress anymore with the given N-SDU identifier.

[SWS_CanTp_00260] ⌈If development error detection is enabled the function `CanTp_CancelReceive` shall check the validity of function parameter `RxPduId`. If its value is invalid, the `CanTp_CancelReceive` function shall raise the development error `CANTP_E_INVALID_RX_ID`.

If the parameter value indicates a cancel reception request for an N-SDU that it is not on reception process the CanTp module shall report the runtime error code `CANTP_E_OPER_NOT_SUPPORTED` to the Default Error Tracer and the service shall return `E_NOT_OK`.⌋

[SWS_CanTp_00261] ⌈The CanTp shall abort the reception of the current N-SDU if the service returns `E_OK`.⌋

[SWS_CanTp_00262] ⌈The CanTp shall reject the request for receive cancellation in case of a Single Frame reception or if the CanTp is in the process of receiving the last Consecutive Frame of the N-SDU (i.e. the service is called after N-Cr timeout is started for the last Consecutive Frame). In this case the CanTp shall return `E_NOT_OK`.⌋

[SWS_CanTp_00263] ⌈If the CanTp_CancelReceive service has been successfully executed the CanTp shall call the PduR_CanTpRxIndication with notification result E_NOT_OK.⌋

8.3.7 CanTp_ChangeParameter

[SWS_CanTp_00302] Definition of API function CanTp_ChangeParameter ⌈

Service Name	CanTp_ChangeParameter	

Syntax	`Std_ReturnType CanTp_ChangeParameter (`
	`  PduIdType id,`
	`  TPParameterType parameter,`
	`  uint16 value`
	`)`	

Service ID [hex]	0x4b	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	id	Identification of the PDU which the parameter change shall affect.
	parameter	ID of the parameter that shall be changed.
	value	The new value of the parameter.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	E_OK: The parameter was changed successfully. E_NOT_OK: The parameter change was rejected.
Description	Request to change a specific transport protocol parameter (e.g. block size).	
Available via	CanTp.h	

⌋

The service CanTp_ChangeParameter is used to change the value of the reception parameter BS and STmin associated to each received N-SDU.

Implementation of this service depends on the configuration parameter CanTpChangeParameterApi (i.e. the service shall be implemented when the parameter is set to TRUE).

[SWS_CanTp_00303] ⌈A parameter change is only possible if the related N-SDU is not in the process of reception - i.e. a change of parameter value it is not possible after reception of FF until indication for last CF reception of the related N-SDU.⌋

[SWS_CanTp_00304] ⌈If the change of a parameter is requested for an N-SDU that is on reception process the service CanTp_ChangeParameter immediately returns E_NOT_OK and no parameter value is changed⌋

[SWS_CanTp_00338] ⌈When CanTp_ChangeParameter is called for an N-SDU with MetaData (indicating a generic connection), the change shall be applied to all generic connections, so that it is used for all following receptions.⌋

[SWS_CanTp_00305] ⌈If development error detection is enabled, the function CanTp_ChangeParameter shall check the validity of function parameters (parameter and value). If the parameter parameter is invalid, the CanTp_ChangeParameter function shall raise the development error CANTP_E_PARAM_ID. If the value parameter is invalid, the CanTp_ChangeParameter function shall raise the development error CANTP_E_PARAM_CONFIG.⌋

[SWS_CanTp_00357] ⌈If development error detection is enabled the function CanTp_ChangeParameter shall check the validity of function parameter id. If its value is invalid, the CanTp_ChangeParameter function shall raise the development error CANTP_E_INVALID_RX_ID.⌋

8.3.8 CanTp_ReadParameter

[SWS_CanTp_00323] Definition of API function CanTp_ReadParameter ⌈

Service Name	CanTp_ReadParameter	
Syntax	`Std_ReturnType CanTp_ReadParameter ( PduIdType id, TPParameterType parameter, uint16* value )`	
Service ID [hex]	0x0b	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	id	Identifier of the received N-SDU on which the reception parameter are read.
	parameter	Specify the parameter to which the value has to be read (BS or STmin).
Parameters (inout)	None	
Parameters (out)	value	Pointer where the parameter value will be provided.
Return value	Std_ReturnType	`E_OK`: request is accepted. `E_NOT_OK`: request is not accepted.
Description	This service is used to read the current value of reception parameters BS and STmin for a specified N-SDU.	
Available via	CanTp.h	

⌋

Implementation of this service depends on the configuration parameter CanTpChangeParameterApi (i.e. the service shall be implemented when the parameter is set to TRUE).

[SWS_CanTp_00324] ⌈If development error detection is enabled the function CanTp_ReadParameter shall check the validity of function parameter parameter. If its value is invalid, the CanTp_ReadParameter function shall raise the development error CANTP_E_PARAM_ID.⌋

[SWS_CanTp_00358] ⌈If development error detection is enabled the function CanTp_ReadParameter shall check the validity of function parameter id. If its value is invalid, the CanTp_ReadParameter function shall raise the development error CANTP_E_INVALID_RX_ID.⌋

8.3.9 Main Function

[SWS_CanTp_00213] Definition of scheduled function CanTp_MainFunction ⌈

Service Name	CanTp_MainFunction
Syntax	`void CanTp_MainFunction ( void )`
Service ID [hex]	0x06
Description	The main function for scheduling the CAN TP.
Available via	SchM_CanTp.h

⌋

[SWS_CanTp_00164]

Upstream requirements: SRS_BSW_00424, SRS_BSW_00373

⌈The main function for scheduling the CAN TP (Entry point for scheduling)

The main function will be called by the Schedule Manager or by the Free Running Timer module according of the call period needed. CanTp_MainFunction is involved in handling of CAN TP timeouts N_As, N_Bs, N_Cs, N_Ar, N_Br,

N_Cr and STmin.⌋

[SWS_CanTp_00300] ⌈The function CanTp_MainFunction is affected by configuration parameter CanTpMainFunctionPeriod.⌋

8.4 Callback notifications

The following is a list of functions provided for lower layer modules.

8.4.1 CanTp_RxIndication

[SWS_CanTp_00214] Definition of callback function CanTp_RxIndication ⌈

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

⌋

The LSduR module shall call this function after a successful reception of a Rx CAN L-PDU.

The data will be copied by the CanTp via the PDU structure `PduInfoType`. In this case the L-PDU buffers are not global and are therefore distributed in the corresponding CAN Transport Layer.

Note that `PduInfoPtr` contains also the `MetaData` in case of dynamic Rx N-PDUs.

[SWS_CanTp_00235] ⌈The function `CanTp_RxIndication` shall be callable in interrupt context (it could be called from the CAN receive interrupt).⌋

[SWS_CanTp_00322] ⌈If development error detection is enabled the function `CanTp_RxIndication` shall raise `CANTP_E_PARAM_POINTER` error if the argument `PduInfoPtr` is a NULL pointer.⌋

[SWS_CanTp_00359] ⌈If development error detection is enabled the function `CanTp_RxIndication` shall check the validity of function parameter `RxPduId`. If its value is invalid, the `CanTp_RxIndication` function shall raise the development error `CANTP_E_INVALID_RX_ID`.⌋

8.4.2 CanTp_TxConfirmation

[SWS_CanTp_00215] Definition of callback function CanTp_TxConfirmation ⌈

Service Name	CanTp_TxConfirmation	
Syntax	`void CanTp_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. 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	CanTp.h	

⌋

The LSduR module shall call the function `CanTp_TxConfirmation` after the TP related CAN Frame (SF, FF, CF, FC) has been transmitted through the CAN network.

[SWS_CanTp_00236] ⌈The function `CanTp_TxConfirmation` shall be callable in interrupt context (it could be called from the CAN transmit interrupt).⌋

[SWS_CanTp_00360] ⌈If development error detection is enabled the function `CanTp_TxConfirmation` shall check the validity of function parameter `TxPduId`. If its value is invalid, the `CanTp_TxConfirmation` function shall raise the development error `CANTP_E_INVALID_TX_ID`.⌋

8.5 Expected interfaces

In this chapter, all interfaces required from other modules are listed.

8.5.1 Mandatory Interfaces

This chapter defines all interfaces, which are required, in order to fulfill the core functionality of the module.

[SWS_CanTp_00216] Definition of mandatory interfaces required by module CanTp ⌈

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_CanTpTransmit (draft)	LSduR_<module>.h	Requests transmission of a PDU.
PduR_CanTpCopyRxData	PduR_CanTp.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_CanTpCopyTxData	PduR_CanTp.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_CanTpRxIndication	PduR_CanTp.h	Called after an I-PDU has been received via the TP API, the result indicates whether the transmission was successful or not.
PduR_CanTpStartOfReception	PduR_CanTp.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_CanTpTxConfirmation	PduR_CanTp.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.

⌋

8.5.2 Optional Interfaces

This chapter defines the interface, which is required, in order to fulfill the optional functionality of the module.

[SWS_CanTp_00217] Definition of optional interfaces requested by module CanTp ⌈

API Function	*Header File*	*Description*
Det_ReportError	Det.h	Service to report development errors.
IdsM_SetSecurityEvent (obsolete)	IdsM.h	This API is the application interface to report security events to the IdsM. **Tags:** atp.Status=obsolete

⌋

9 Sequence diagrams

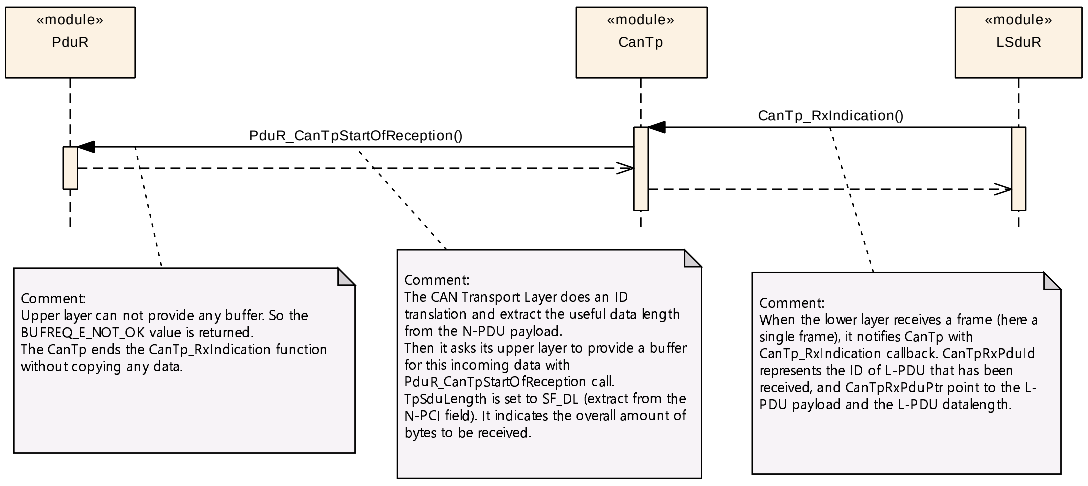
The goal of this chapter is to make it easier to understand the CAN Transport Layer by describing most of the more frequent and complicated use cases. Thus, the following diagram sequences are not exhaustive and do not reflect all the specified API possibilities.

9.1 SF N-SDU received and no buffer available.

9.1.1 Assumptions

- All input parameters are OK;
- The N-SDU data length fits into the associated N-PDU;
- Upper layer can not make an Rx buffer available.

9.1.2 Sequence diagram



Comment:
Upper layer can not provide any buffer. So the BUFREQ_E_NOT_OK value is returned.
The CanTp ends the CanTp_RxIndication function without copying any data.

Comment:
The CAN Transport Layer does an ID translation and extract the useful data length from the N-PDU payload.
Then it asks its upper layer to provide a buffer for this incoming data with PduR_CanTpStartOfReception call.
TpSduLength is set to SF_DL (extract from the N-PCI field). It indicates the overall amount of bytes to be received.

Comment:
When the lower layer receives a frame (here a single frame), it notifies CanTp with CanTp_RxIndication callback. CanTpRxPduId represents the ID of L-PDU that has been received, and CanTpRxPduPtr point to the L-PDU payload and the L-PDU datalength.

Figure 9.1: SF N-SDU received and no buffer available

Note: This sequence diagram demonstrates the working of the CAN_Tp module only. However, if the whole system is considered during such reception, more modules are involved. Since this reception can be triggered in the context of CAN ISR, the CAN_Tp operation should be as short as possible.

9.1.3 Transition description

Transition	Name	Description
1	CanTp_RxIndication (RxPduId, PduInfoPtr)	When the lower layer receives a frame (here a single frame), it notifies CanTp by means of a CanTp_RxIndication callback. RxPduId represents the ID of L-PDU that has been received, and PduInfoPtr indicates the L-PDU payload and the L-PDU data length.
2	PduR_CanTpStartOfReception(id, info, TpSduLength, bufferSizePtr)	The CAN Transport Layer performs an ID translation and extracts the useful data length from the N-PDU payload. It then asks its upper layer to make a buffer available for this incoming data with a PduR_CanTpStartOfReception callback. TpSduLength is set to SF_DL (extracted from the N-PCI field). It indicates the overall amount of bytes to be received.
3	BUFREQ_E_NOT_OK	The upper layer cannot make any buffer available, so the BUFREQ_E_NOT_OK value is returned. The CanTp ends the CanTp_RxIndication function without copying any data.

9.2 Successful SF N-PDU reception

9.2.1 Assumptions

- All input parameters are OK;
- The N-SDU data length fits into the associated N-PDU;
- The SF N-PDU is successfully received.

9.2.2 Sequence diagram

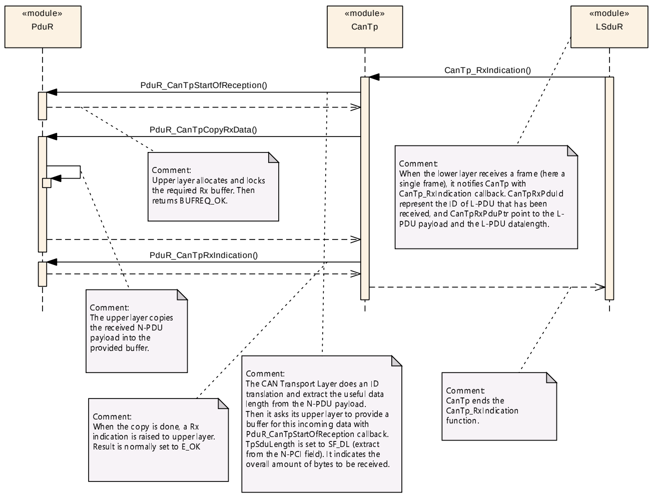

«module» PduR
«module» CanTp
«module» LSduR
CanTp_RxIndication()
PduR_CanTpStartOfReception()
PduR_CanTpCopyRxData()
PduR_CanTpRxIndication()
Comment: Upper layer allocates and locks the required Rx buffer. Then returns BUFREQ_OK.
Comment: When the lower layer receives a frame (here a single frame), it notifies CanTp with CanTp_RxIndication callback. CanTpRxPduId represent the ID of L-PDU that has been received, and CanTpRxPduPtr point to the L-PDU payload and the L-PDU datalength.
Comment: The upper layer copies the received N-PDU payload into the provided buffer.
Comment: When the copy is done, a Rx indication is raised to upper layer. Result is normally set to E_OK
Comment: The CAN Transport Layer does an ID translation and extract the useful data length from the N-PDU payload. Then it asks its upper layer to provide a buffer for this incoming data with PduR_CanTpStartOfReception callback. TpSduLength is set to SF_DL (extract from the N-PCI field). It indicates the overall amount of bytes to be received.
Comment: CanTp ends the CanTp_RxIndication function.

Figure 9.2: Successful SF N-PDU reception

Note: This sequence diagram demonstrates the working of the CAN_Tp module only. However, if the whole system is considered during such reception, more modules are involved. Since this reception can be triggered in the context of CAN ISR, the CAN_Tp operation should be as short as possible.

9.2.3 Transition description

Transition	Name	Description
1	CanTp_RxIndication (RxPduId, PduInfoPtr)	When the lower layer receives a frame (here a single frame), it notifies CanTp by means of a CanTp_RxIndication callback. RxPduId represents the ID of the L-PDU that has been received, and PduInfoPtr indicates the L-PDU payload and the L-PDU data length.
2	PduR_CanTpStartOfReception(id, info, TpSduLength, bufferSizePtr)	The CAN Transport Layer performs an ID translation and extracts the useful data length from the N-PDU payload. It then asks its upper layer to make a buffer available for this incoming data with a PduR_CanTpStartOfReception callback. TpSduLength is set to SF_DL (extracted from the N-PCI field). It indicates the overall amount of bytes to be received.
3	BUFREQ_OK	Upper layer allocates and locks the required Rx buffer. Then returns BUFREQ_OK.

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Transition	Name	Description
4	PduR_CanTpCopyRxData(id, info, bufferSizePtr)	The upper layer copies the received N-PDU payload into the buffer.
5	PduR_CanTpRxIndication (id, result)	When the copy is complete, an Rx indication is sent to the upper layer. The result is set to E_OK.
6		CanTp ends the CanTp_RxIndication function.

9.3 Transmit request of SF N-SDU

9.3.1 Assumptions

- All input parameters are OK;
- The N-SDU data length fits into the associated N-PDU;
- The transmission is successfully processed.

9.3.2 Sequence diagram

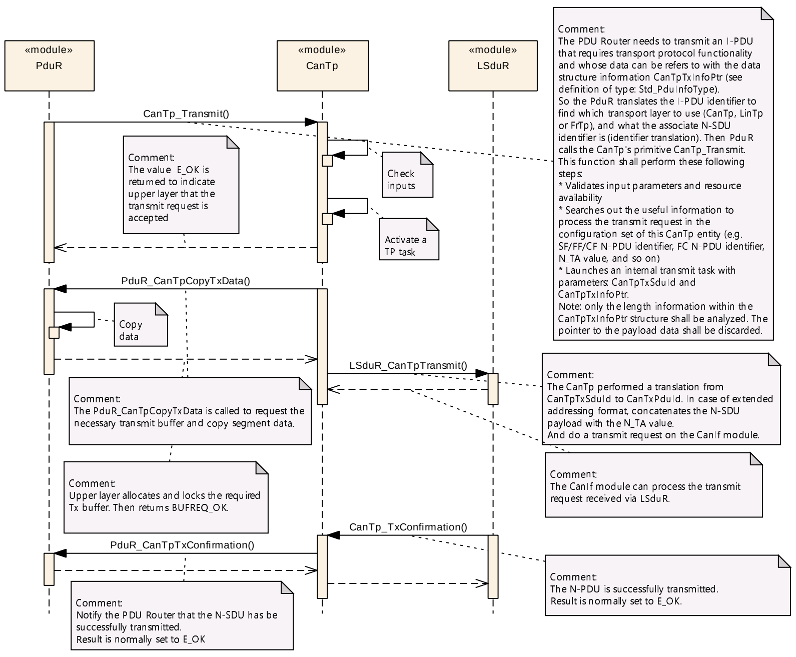
«module» PduR
«module» CanTp
«module» LSduR
CanTp_Transmit()
Comment: The value E_OK is returned to indicate upper layer that the transmit request is accepted
Check inputs
Activate a TP task
Comment: The PDU Router needs to transmit an I-PDU that requires transport protocol functionality and whose data can be refers to with the data structure information CanTpTxInfoPtr (see definition of type: Std_PduInfoType). So the PduR translates the I-PDU identifier to find which transport layer to use (CanTp, LinTp or FrTp), and what the associate N-SDU identifier is (identifier translation). Then PduR calls the CanTp's primitive CanTp_Transmit. This function shall perform these following steps: * Validates input parameters and resource availability * Searches out the useful information to process the transmit request in the configuration set of this CanTp entity (e.g. SF/FF/CF N-PDU identifier, FC N-PDU identifier, N_TA value, and so on) * Launches an internal transmit task with parameters: CanTpTxSduId and CanTpTxInfoPtr. Note: only the length information within the CanTpTxInfoPtr structure shall be analyzed. The pointer to the payload data shall be discarded.
PduR_CanTpCopyTxData()
Copy data
LSduR_CanTpTransmit()
Comment: The PduR_CanTpCopyTxData is called to request the necessary transmit buffer and copy segment data.
Comment: The CanTp performed a translation from CanTpTxSduId to CanTxPduId. In case of extended addressing format, concatenates the N-SDU payload with the N_TA value. And do a transmit request on the CanIf module.
Comment: Upper layer allocates and locks the required Tx buffer. Then returns BUFREQ_OK.
Comment: The CanIf module can process the transmit request received via LSduR.
CanTp_TxConfirmation()
PduR_CanTpTxConfirmation()
Comment: The N-PDU is successfully transmitted. Result is normally set to E_OK.
Comment: Notify the PDU Router that the N-SDU has be successfully transmitted. Result is normally set to E_OK

Figure 9.3: Transmit request of SF N-SDU

9.3.3 Transition description

Transition	Name	Description
1	CanTp_Transmit(TxPduId, PduInfoPtr)	The PDU Router needs to transmit an I-PDU that requires transport protocol functionality and whose data can be refers to with the data structure information PduInfoPtr (see definition of type: Std_PduInfoType). So the PduR translates the I-PDU identifier to find which transport layer to use (CanTp, LinTp or FrTp), and what the associate N-SDU identifier is (identifier translation). Then PduR calls the CanTp's primitive CanTp_Transmit. This function shall perform these following steps: - Validates input parameters and resource availability - Searches out the useful information to process the transmit request in the configuration set of this CanTp entity (e.g. SF/FF/CF N-PDU identifier, FC N-PDU identifier, N_TA value, and so on) - Launches an internal transmit task with parameters: TxPduId and PduInfo Ptr. Note: only the length information within the PduInfoPtr structure shall be analyzed. The pointer to the payload data shall be discarded.
2	E_OK	The value E_OK is returned to indicate to the upper layer that the transmit request is accepted. The upper layer locks the required Tx buffer.
3	PduR_CanTpCopyTxdata (id, info, retry, availableDataPtr)	The PduR_CanTpCopyTxData is called to copy segment data.
4	BUFREQ_OK	Upper layer copy data, then returns BUFREQ_OK.
5	LSduR_CanTpTransmit(TxPduId, PduInfoPtr)	The CanTp performs a translation of the TxPduId. In case of extended addressing format, it concatenates the N-SDU payload with the N_TA value, to perform a transmit request on the LSdu R module.
6	E_OK	The LuSduR module can process the transmit request.

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Transition	Name	Description
7	CanTp_TxConfirmation(TxPduId, result)	The N-PDU is successfully transmitted.
8	PduR_CanTpTxConfirmation (id, result)	Notifies the PDU Router that the N-SDU has been successfully transmitted. Consequently, the PduInfo Type structure has to be unlocked. Result is set to E_OK.

9.4 Transmit request of larger N-SDU

9.4.1 Assumptions

- All input parameters are OK;
- The N-SDU data length does not fit into the associated N-PDU;
- The transmission is successfully processed.

9.4.2 Sequence diagram

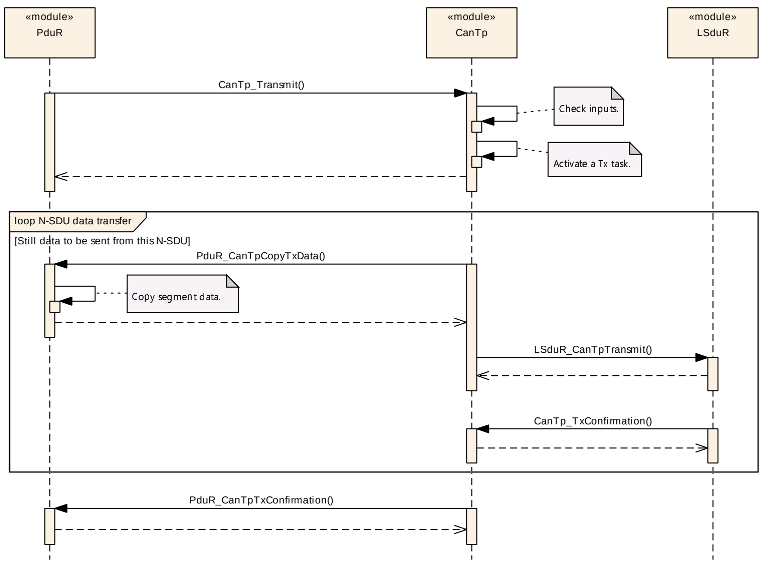

Figure 9.4: Transmit request of larger N-SDU

9.4.3 Transition description

Transition	Name	Description
1	CanTp_Transmit (TxPduId, PduInfoPtr)	The PDU Router needs to transmit an I-PDU that requires transport protocol functionality and whose data refers to with the data structure information Pdu InfoPtr (see definition of type: PduInfo Type). So the PduR translates the I-PDU identifier to find which transport layer to use (CanTp, LinTp or FrTp), and what the associate N-SDU identifier is (identifier translation). Then PduR calls the CanTp's primitive CanTp_Transmit. This function shall perform these following steps: - Validates input parameters and resource availability - Searches out the useful information to process the transmit request in the configuration set of this CanTp entity (e.g. SF/FF/CF N-PDU identifier, FC N-PDU identifier, N_TA value, and so on) - Launches an internal transmit task with parameters: TxPduId and PduInfo Ptr. Note: only the length information within the PduInfoPtr structure shall be analyzed. The pointer to the payload data shall be discarded. Upon successful return of the call, the upper layer locks the required Tx buffer.
2	E_OK	The upper layer allocates and locks the required Tx buffer. Then returns E_OK.
3	PduR_CanTpCopyTxData (id, info, retry, availableDataPtr)	The PduR_CanTpCopyTxData is called. The upper layer copies segment data into the destination buffer.
4	LSduR_CanTpTransmit (TxPduId, PduInfoPtr)	Within the task, CanTp calls the L-SDU Router module by using LSduR_Can TpTransmit, where TxPduId identifies the L-SDU (a translation has to be preformed between the N-SDU Id used by CanTp and the L-SDU Id used by L-SDU Router module), and PduInfoPtr indicator data and their length.

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Transition	Name	Description
5	CanTp_TxConfirmation(TxPduId, result)	CanTp awaits a confirmation from the L-SDU Router module (CanTp_Tx Confirmation)
6	PduR_CanTpCopyTxData (id, info, retry, availableDataPtr)	For each consecutive frame CanTp asks the PDU Router to provide new data to be sent.
7	PduR_CanTpTxConfirmation (id, result)	When all data have been sent, or when an error occurs, CanTp notifies PDU Router with PduR_CanTpTx Confirmation. Id identify the N-SDU which transmission is confirmed, and result indicates if transmission has been completed or not.

9.5 Large N-SDU Reception

9.5.1 Assumptions

- All input parameters are OK;
- The N-SDU data length does not fit into the associated N-PDU;
- Reception is successfully processed.

9.5.2 Sequence diagram

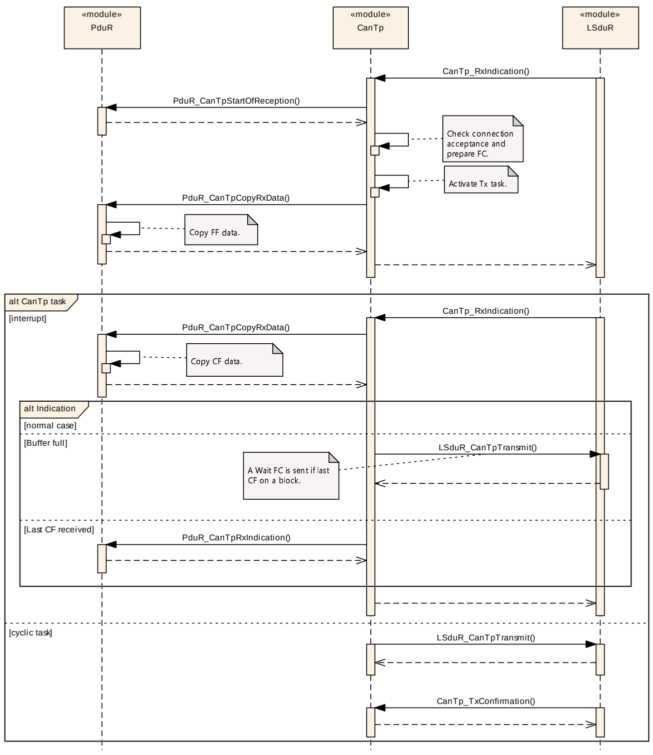

Figure 9.5: Large N-SDU Reception

Note : This sequence diagram demonstrates the working of the CAN_Tp module only. However, if the whole system is considered in such reception, more modules are involved. Since this reception can be triggered in the context of a CAN ISR, the CAN Tp operation should be as short as possible.

9.5.3 Transition description

Transition	Name	Description
1	CanTp_RxIndication (RxPduId, PduInfoPtr)	When the L-SDU Router module receives a frame (here a first frame), it notifies CanTp by means of a CanTp_RxIndication callback. RxPduId represents the ID of L-PDU that has been received and PduInfoPtr indicates payload and L-SDU datalength to the L-SDU.

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Transition	Name	Description
2	PduR_CanTpStartOfReception(id, info, TpSduLength, bufferSizePtr)	CanTp ask PDU Router to make a buffer available for incoming data with PduR_CanTpStartOfReception callback.
3		Check connection acceptance and prepare FC parameters.
4		CanTp activates a task for sending an FC with a Flow Status set to Continue ToSend. (see step 8.)
5	CanTp_RxIndication (RxPduId, PduInfoPtr)	When the L-SDU Router receives a frame (here a consecutive frame), L-SDU Router notifies CanTp by means of a CanTp_RxIndication callback. RxPduId represents the ID of the CAN frame that has been received and PduInfoPtr indicates payload to the L-SDU.
6		CanTp shall verify the sequence number and if correct, it asks the PduR to copy the data.
7	PduR_CanTpCopyRxData(id, info, bufferSizePtr) Or PduR_CanTpRxIndication (id, result)	Three cases can apply : - Normal Case: the received consecutive frame is not the last one. CanTp forwards received data to the upper layer. - Last CF Received: this consecutive frame is the last (Total length information was, as parameter, in the first frame). CanTp shall notify PDU Router with PduR_CanTpRxIndication callback.
8		When flow control needs to be sent, the CanTp cyclical task should call the L-SDU Router by using LSduR_CanTp Transmit and wait confirmation from the L-SDU Router. Flow control can be either ContinueTo Send or Wait, depending on the available buffer in the upper layer.

10 Configuration specification

In general, this chapter defines configuration parameters and their clustering into containers. In order to support the specification Chapter 10.1 describes fundamentals. It also specifies a template (table) you shall use for the parameter specification. We intend to leave Chapter 10.1 in the specification to guarantee comprehension.

Chapter 10.2 specifies the structure (containers) and the parameters of the module CAN Transport Layer.

Chapter 10.3 specifies published information of the module CAN Transport Layer.

[SWS_CanTp_00146]

Upstream requirements: SRS_BSW_00159

⌈The listed configuration items can be derived from a network description database, which is based on the EcuConfigurationTemplate. The configuration tool should extract all information to configure the CAN Transport Protocol.⌋

[SWS_CanTp_00147]

Upstream requirements: SRS_BSW_00167

⌈The consistency of the configuration must be checked by the configuration tool at configuration time.⌋

10.1 How to read this chapter

For details refer to the chapter 10.1 "Introduction to configuration specification" in SWS_BSWGeneral.

10.2 Containers and configuration parameters

The following chapters summarize all configuration parameters. The detailed meanings of the parameters are described in Chapters 7 and 8.

[SWS_CanTp_00328] ⌈The same NPdu may be referenced by more than one NSdu (RxNSdu or TxNSdu, via CanTpRxNPdu, CanTpTxFcNPdu, CanTpTxNPdu or CanTp RxFcNPdu) independent of the used addressing format.⌋

10.2.1 CanTp

[ECUC_CanTp_00306] Definition of EcucModuleDef CanTp ⌈

Module Name	CanTp
Description	Configuration of the CanTp (CAN Transport Protocol) module.
Post-Build Variant Support	true
Supported Config Variants	VARIANT-POST-BUILD, VARIANT-PRE-COMPILE

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
CanTpConfig	1	This container contains the configuration parameters and sub containers of the AUTOSAR CanTp module.
CanTpDemEventParameterRefs	0..1	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_SetEventStatus in case the corresponding error occurs. The Event Id is taken from the referenced DemEventParameter's DemEventId symbolic value. The standardized errors are provided in this container and can be extended by vendor-specific error references.
CanTpGeneral	1	This container contains the general configuration parameters of the CanTp module.

⌋

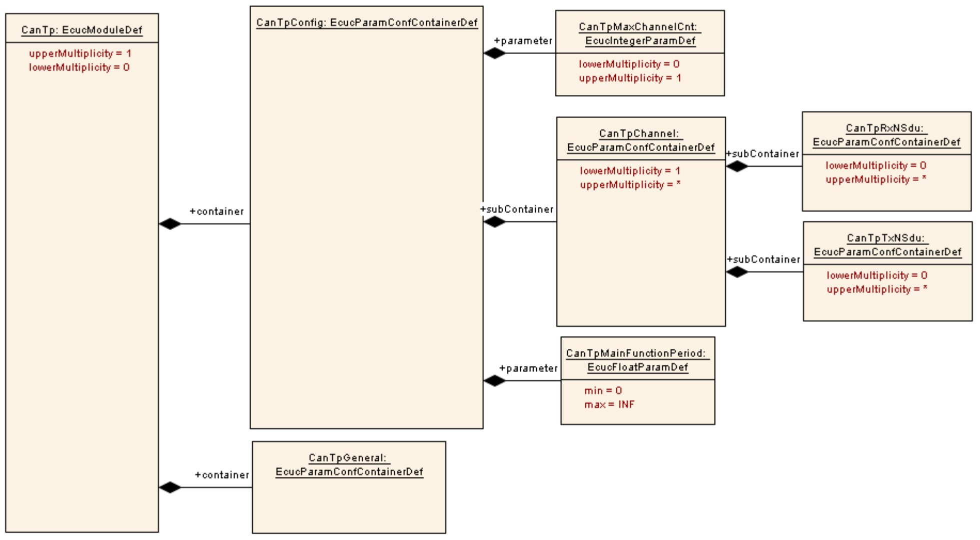

Figure 10.1: Configuration overview

10.2.2 CanTpConfig

[ECUC_CanTp_00290] Definition of EcucParamConfContainerDef CanTpConfig ⌈

Container Name	CanTpConfig
Parent Container	CanTp
Description	This container contains the configuration parameters and sub containers of the AUTOSAR CanTp module.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpMainFunctionPeriod	1	[ECUC_CanTp_00240]
CanTpMaxChannelCnt	0..1	[ECUC_CanTp_00304]

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
CanTpChannel	1..*	This container contains the configuration parameters of the Can Tp channel.

⌋

[ECUC_CanTp_00240] Definition of EcucFloatParamDef CanTpMainFunctionPeriod ⌈

Parameter Name	CanTpMainFunctionPeriod		
Parent Container	CanTpConfig		
Description	Allow to configure the time for the MainFunction (as float in seconds). The CanTpMain FunctionPeriod should be assigned a value which is optimal regarding all of the timers configured for CanTp in TX and RX data transfer i.e. the differences from the configured timing should be as small as possible. Please note: This period shall be the same as call cycle time of the periodic task were CanTp Main function is called.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	]0 .. INF[		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00304] Definition of EcucIntegerParamDef CanTpMaxChannelCnt ⌈

Parameter Name	CanTpMaxChannelCnt
Parent Container	CanTpConfig
Description	Maximum number of channels. This parameter is needed only in case of post-build loadable implementation using static memory allocation.

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Multiplicity	0..1		
Type	EcucIntegerParamDef		
Range	0 .. 18446744073709551615		
Default value	–		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

10.2.3 CanTpGeneral

[ECUC_CanTp_00278] Definition of EcucParamConfContainerDef CanTpGeneral
⌈

Container Name	CanTpGeneral
Parent Container	CanTp
Description	This container contains the general configuration parameters of the CanTp module.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpChangeParameterApi	1	[ECUC_CanTp_00299]
CanTpDevErrorDetect	1	[ECUC_CanTp_00239]
CanTpDynIdSupport	0..1	[ECUC_CanTp_00302]
CanTpEnableSecurityEventReporting	1	[ECUC_CanTp_00318]
CanTpFlexibleDataRateSupport	0..1	[ECUC_CanTp_00305]
CanTpGenericConnectionSupport	0..1	[ECUC_CanTp_00303]
CanTpPaddingByte	1	[ECUC_CanTp_00298]
CanTpReadParameterApi	1	[ECUC_CanTp_00300]
CanTpVersionInfoApi	1	[ECUC_CanTp_00283]

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
CanTpEnableSecurityEventRefs	0..1	Container for the references to IdsMEvent elements representing the security events that the CanTp module shall report to the Ids M in case the coresponding security related event occurs (and if CanTpEnableSecurityEventReporting is set to "true"). The standardized security events in this container can be extended by vendor-specific security events.

⌋

[ECUC_CanTp_00299] Definition of EcucBooleanParamDef CanTpChangeParameterApi ⌈

Parameter Name	CanTpChangeParameterApi		
Parent Container	CanTpGeneral		
Description	This parameter, if set to true, enables the CanTp_ChangeParameterRequest Api for this Module.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00239] Definition of EcucBooleanParamDef CanTpDevErrorDetect ⌈

Parameter Name	CanTpDevErrorDetect		
Parent Container	CanTpGeneral		
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		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00302] Definition of EcucBooleanParamDef CanTpDynIdSupport ⌈

Parameter Name	CanTpDynIdSupport
Parent Container	CanTpGeneral
Description	Enable support for dynamic ID handling via N-PDU MetaData.
Multiplicity	0..1

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Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00318] Definition of EcucBooleanParamDef CanTpEnableSecurityEventReporting ⌈

Parameter Name	CanTpEnableSecurityEventReporting		
Parent Container	CanTpGeneral		
Description	Switches the reporting of security events to the IdsM: * true: reporting is enabled. * false: reporting is disabled.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00305] Definition of EcucBooleanParamDef CanTpFlexibleDataRateSupport ⌈

Parameter Name	CanTpFlexibleDataRateSupport		
Parent Container	CanTpGeneral		
Description	Enable support for CAN FD frames.		
Multiplicity	0..1		
Type	EcucBooleanParamDef		
Default value	true		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00303] Definition of EcucBooleanParamDef CanTpGenericConnectionSupport ⌈

Parameter Name	CanTpGenericConnectionSupport		
Parent Container	CanTpGeneral		
Description	Enable support for the handling of generic connections using N-SDUs with MetaData. Requires CanTpDynIdSupport.		
Multiplicity	0..1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local dependency: Requires CanTpDynIdSupport.		

⌋

[ECUC_CanTp_00298] Definition of EcucIntegerParamDef CanTpPaddingByte ⌈

Parameter Name	CanTpPaddingByte		
Parent Container	CanTpGeneral		
Description	Used for the initialization of unused bytes with a certain value		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00300] Definition of EcucBooleanParamDef CanTpReadParameterApi ⌈

Parameter Name	CanTpReadParameterApi
Parent Container	CanTpGeneral
Description	This parameter, if set to true, enables the CanTp_ReadParameterApi for this module.

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△

Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00283] Definition of EcucBooleanParamDef CanTpVersionInfo Api ⌈

Parameter Name	CanTpVersionInfoApi		
Parent Container	CanTpGeneral		
Description	The function CanTp_GetVersionInfo is configurable (On/Off) by this configuration parameter.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency			

⌋

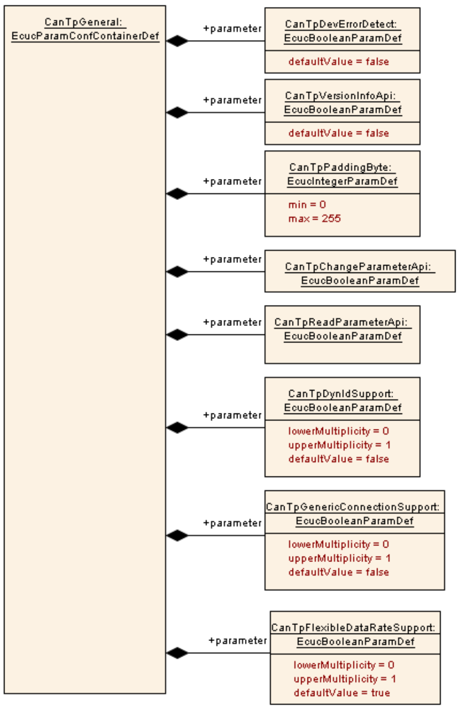
CanTpGeneral: EcucParamConfContainerDef
+parameter
CanTpDevErrorDetect: EcucBooleanParamDef
defaultValue = false
+parameter
CanTpVersionInfoApi: EcucBooleanParamDef
defaultValue = false
+parameter
CanTpPaddingByte: EcucIntegerParamDef
min = 0
max = 255
+parameter
CanTpChangeParameterApi: EcucBooleanParamDef
+parameter
CanTpReadParameterApi: EcucBooleanParamDef
+parameter
CanTpDynIdSupport: EcucBooleanParamDef
lowerMultiplicity = 0
upperMultiplicity = 1
defaultValue = false
+parameter
CanTpGenericConnectionSupport: EcucBooleanParamDef
lowerMultiplicity = 0
upperMultiplicity = 1
defaultValue = false
+parameter
CanTpFlexibleDataRateSupport: EcucBooleanParamDef
lowerMultiplicity = 0
upperMultiplicity = 1
defaultValue = true

Figure 10.2: CanTpGeneral configuration overview

10.2.4 CanTpDemEventParameterRefs

[ECUC_CanTp_00307] Definition of EcucParamConfContainerDef CanTpDem EventParameterRefs ⌈

Container Name	CanTpDemEventParameterRefs		
Parent Container	CanTp		
Description	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_SetEventStatus in case the corresponding error occurs. The Event Id is taken from the referenced DemEventParameter's DemEventId symbolic value. The standardized errors are provided in this container and can be extended by vendor-specific error references.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CANTP_E_CANTPNAR_TIMEOUT_OCCURRED	0..1	[ECUC_CanTp_00309]
CANTP_E_CANTPNAS_TIMEOUT_OCCURRED	0..1	[ECUC_CanTp_00308]
CANTP_E_CANTPNBR_TIMEOUT_OCCURRED	0..1	[ECUC_CanTp_00311]

⌋

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Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CANTP_E_CANTPNBS_TIMEOUT_OCCURRED	0..1	[ECUC_CanTp_00310]
CANTP_E_CANTPNCR_TIMEOUT_OCCURRED	0..1	[ECUC_CanTp_00313]
CANTP_E_CANTPNCS_TIMEOUT_OCCURRED	0..1	[ECUC_CanTp_00312]
CANTP_E_DROPPED_CONSECUTIVE_FRAMES_DETECTED	0..1	[ECUC_CanTp_00315]
CANTP_E_FC_OVERFLOW_RECEIVED	0..1	[ECUC_CanTp_00316]
CANTP_E_FC_OVERFLOW_TRANSMITTED	0..1	[ECUC_CanTp_00317]
CANTP_E_SWAPPED_CONSECUTIVE_FRAMES_RECEIVED	0..1	[ECUC_CanTp_00314]

No Included Containers

⌋

[ECUC_CanTp_00309] Definition of EcucReferenceDef CANTP_E_CANTPNAR_TIMEOUT_OCCURRED ⌈

Parameter Name	CANTP_E_CANTPNAR_TIMEOUT_OCCURRED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_CANTPNAR_TIMEOUT_OCCURRED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00308] Definition of EcucReferenceDef CANTP_E_CANTPNAS_TIMEOUT_OCCURRED ⌈

Parameter Name	CANTP_E_CANTPNAS_TIMEOUT_OCCURRED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_CANTPNAS_TIMEOUT_OCCURRED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00311] Definition of EcucReferenceDef CANTP_E_CANTPNBR_TIMEOUT_OCCURRED ⌈

Parameter Name	CANTP_E_CANTPNBR_TIMEOUT_OCCURRED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_CANTPNBR_TIMEOUT_OCCURRED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00310] Definition of EcucReferenceDef CANTP_E_CANTPNBS_TIMEOUT_OCCURRED ⌈

Parameter Name	CANTP_E_CANTPNBS_TIMEOUT_OCCURRED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_CANTPNBS_TIMEOUT_OCCURRED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00313] Definition of EcucReferenceDef CANTP_E_CANTPNCR_TIMEOUT_OCCURRED ⌈

Parameter Name	CANTP_E_CANTPNCR_TIMEOUT_OCCURRED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_CANTPNCR_TIMEOUT_OCCURRED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00312] Definition of EcucReferenceDef CANTP_E_CANTPNCS_TIMEOUT_OCCURRED ⌈

Parameter Name	CANTP_E_CANTPNCS_TIMEOUT_OCCURRED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_CANTPNCS_TIMEOUT_OCCURRED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00315] Definition of EcucReferenceDef CANTP_E_DROPPED_CONSECUTIVE_FRAMES_DETECTED ⌈

Parameter Name	CANTP_E_DROPPED_CONSECUTIVE_FRAMES_DETECTED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_DROPPED_CONSECUTIVE_FRAMES_DETECTED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00316] Definition of EcucReferenceDef CANTP_E_FC_OVERFLOW_RECEIVED ⌈

Parameter Name	CANTP_E_FC_OVERFLOW_RECEIVED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_FC_OVERFLOW_RECEIVED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00317] Definition of EcucReferenceDef CANTP_E_FC_OVERFLOW_TRANSMITTED ⌈

Parameter Name	CANTP_E_FC_OVERFLOW_TRANSMITTED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_FC_OVERFLOW_TRANSMITTED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00314] Definition of EcucReferenceDef CANTP_E_SWAPPED_CONSECUTIVE_FRAMES_RECEIVED ⌈

Parameter Name	CANTP_E_SWAPPED_CONSECUTIVE_FRAMES_RECEIVED		
Parent Container	CanTpDemEventParameterRefs		
Description	A Reference to DemEventParameter element which shall be invoked using the API Dem_SetEventStatus in case CANTP_E_SWAPPED_CONSECUTIVE_FRAMES_RECEIVED error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

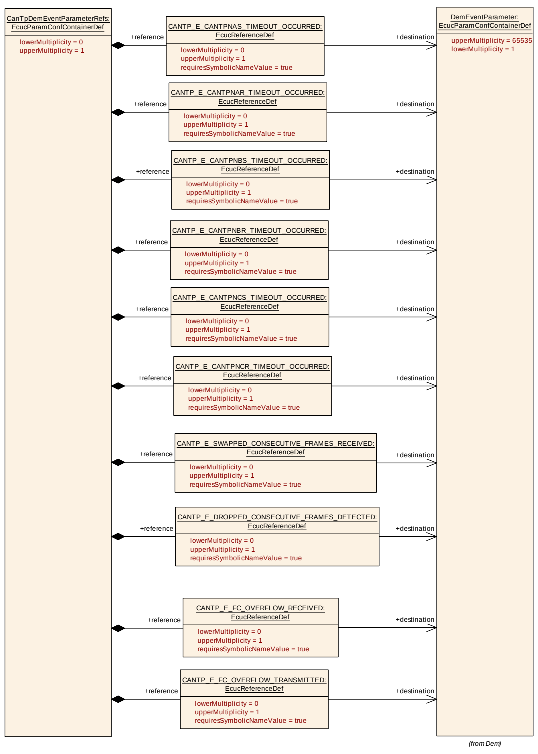
CanTpDemEventParameterRefs: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 1
DemEventParameter: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 1
(from Dem)
CANTP_E_CANTPNAS_TIMEOUT_OCCURRED: EcucReferenceDef
CANTP_E_CANTPNAR_TIMEOUT_OCCURRED: EcucReferenceDef
CANTP_E_CANTPNBS_TIMEOUT_OCCURRED: EcucReferenceDef
CANTP_E_CANTPNBR_TIMEOUT_OCCURRED: EcucReferenceDef
CANTP_E_CANTPNCS_TIMEOUT_OCCURRED: EcucReferenceDef
CANTP_E_CANTPNCR_TIMEOUT_OCCURRED: EcucReferenceDef
CANTP_E_SWAPPED_CONSECUTIVE_FRAMES_RECEIVED: EcucReferenceDef
CANTP_E_DROPPED_CONSECUTIVE_FRAMES_DETECTED: EcucReferenceDef
CANTP_E_FC_OVERFLOW_RECEIVED: EcucReferenceDef
CANTP_E_FC_OVERFLOW_TRANSMITTED: EcucReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 1
requiresSymbolicNameValue = true
+reference
+destination

Figure 10.3: CanTpDemEventParameterRefs configuration overview

10.2.5 CanTpEnableSecurityEventRefs

[ECUC_CanTp_00319] Definition of EcucParamConfContainerDef CanTpEnableSecurityEventRefs ⌈

Container Name	CanTpEnableSecurityEventRefs		
Parent Container	CanTpGeneral		
Description	Container for the references to IdsMEvent elements representing the security events that the CanTp module shall report to the IdsM in case the coresponding security related event occurs (and if CanTpEnableSecurityEventReporting is set to "true"). The standardized security events in this container can be extended by vendor-specific security events.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
SEV_CAN_ERROR_INVALID_FS	0..1	[ECUC_CanTp_00325]
SEV_CAN_ERROR_NO_BUFFER	0..1	[ECUC_CanTp_00324]
SEV_CAN_ERROR_PADDING	0..1	[ECUC_CanTp_00328]
SEV_CAN_ERROR_TIMEOUT_A	0..1	[ECUC_CanTp_00321]
SEV_CAN_ERROR_TIMEOUT_BS	0..1	[ECUC_CanTp_00326]
SEV_CAN_ERROR_TIMEOUT_CR	0..1	[ECUC_CanTp_00322]
SEV_CAN_ERROR_UNEXP_PDU	0..1	[ECUC_CanTp_00327]
SEV_CAN_ERROR_WFT_OVRN	0..1	[ECUC_CanTp_00320]
SEV_CAN_ERROR_WRONG_SN	0..1	[ECUC_CanTp_00323]
SEV_CAN_INVALID_TATYPE	0..1	[ECUC_CanTp_00329]

No Included Containers

⌋

[ECUC_CanTp_00325] Definition of EcucReferenceDef SEV_CAN_ERROR_INVALID_FS ⌈

Parameter Name	SEV_CAN_ERROR_INVALID_FS		
Parent Container	CanTpEnableSecurityEventRefs		
Description	Flow Control with invalid Flow Status received.		
Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	

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	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00324] Definition of EcucReferenceDef SEV_CAN_ERROR_NO_BUFFER ⌈

Parameter Name	SEV_CAN_ERROR_NO_BUFFER		
Parent Container	CanTpEnableSecurityEventRefs		
Description	Flow Control with OVFLW Flow Status received.		
Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00328] Definition of EcucReferenceDef SEV_CAN_ERROR_PADDING ⌈

Parameter Name	SEV_CAN_ERROR_PADDING		
Parent Container	CanTpEnableSecurityEventRefs		
Description	PDU received with a length smaller than 8 bytes (i.e. PduInfoPtr.SduLength < 8).		
Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00321] Definition of EcucReferenceDef SEV_CAN_ERROR_TIMEOUT_A ⌈

Parameter Name	SEV_CAN_ERROR_TIMEOUT_A		
Parent Container	CanTpEnableSecurityEventRefs		
Description	N_Ar timeout.		
Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00326] Definition of EcucReferenceDef SEV_CAN_ERROR_TIMEOUT_BS ⌈

Parameter Name	SEV_CAN_ERROR_TIMEOUT_BS		
Parent Container	CanTpEnableSecurityEventRefs		
Description	N_Bs timeout.		
Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00322] Definition of EcucReferenceDef SEV_CAN_ERROR_TIMEOUT_CR ⌈

Parameter Name	SEV_CAN_ERROR_TIMEOUT_CR
Parent Container	CanTpEnableSecurityEventRefs
Description	N_Cr timeout.

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Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00327] Definition of EcucReferenceDef SEV_CAN_ERROR_UNEXP_PDU ⌈

Parameter Name	SEV_CAN_ERROR_UNEXP_PDU		
Parent Container	CanTpEnableSecurityEventRefs		
Description	Unexpected protocol data unit received (segmented reception in progress).		
Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00320] Definition of EcucReferenceDef SEV_CAN_ERROR_WFT_OVRN ⌈

Parameter Name	SEV_CAN_ERROR_WFT_OVRN		
Parent Container	CanTpEnableSecurityEventRefs		
Description	The Flow Control WAIT frame exceeded the maximum counter N_WFTmax received.		
Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants

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	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00323] Definition of EcucReferenceDef SEV_CAN_ERROR_WRONG_SN ⌈

Parameter Name	SEV_CAN_ERROR_WRONG_SN		
Parent Container	CanTpEnableSecurityEventRefs		
Description	Invalid sequence number value received.		
Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_CanTp_00329] Definition of EcucReferenceDef SEV_CAN_INVALID_TATYPE ⌈

Parameter Name	SEV_CAN_INVALID_TATYPE		
Parent Container	CanTpEnableSecurityEventRefs		
Description	Multi-frame reception occurs with a handle whose communication type is functional.		
Multiplicity	0..1		
Type	Symbolic name reference to IdsMEvent		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	

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Scope / Dependency	scope: ECU

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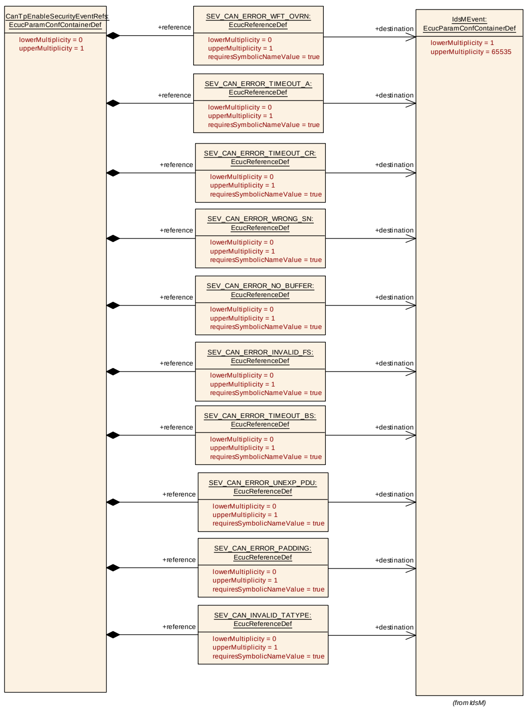
CanTpEnableSecurityEventRefs: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 1
+reference
SEV_CAN_ERROR_WFT_OVRN: EcucReferenceDef
SEV_CAN_ERROR_TIMEOUT_A: EcucReferenceDef
SEV_CAN_ERROR_TIMEOUT_CR: EcucReferenceDef
SEV_CAN_ERROR_WRONG_SN: EcucReferenceDef
SEV_CAN_ERROR_NO_BUFFER: EcucReferenceDef
SEV_CAN_ERROR_INVALID_FS: EcucReferenceDef
SEV_CAN_ERROR_TIMEOUT_BS: EcucReferenceDef
SEV_CAN_ERROR_UNEXP_PDU: EcucReferenceDef
SEV_CAN_ERROR_PADDING: EcucReferenceDef
SEV_CAN_INVALID_TATYPE: EcucReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 1
requiresSymbolicNameValue = true
+destination
IdsMEvent: EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = 65535
(from IdsM)

Figure 10.4: CanTpEnableSecurityEventRefs configuration overview

10.2.6 CanTpChannel

[ECUC_CanTp_00288] Definition of EcucParamConfContainerDef CanTpChannel ⌈

Container Name	CanTpChannel		
Parent Container	CanTpConfig		
Description	This container contains the configuration parameters of the CanTp channel.		
Post-Build Variant Multiplicity	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Configuration Parameters			

No Included Parameters

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
CanTpRxNSdu	0..*	The following parameters needs to be configured for each CAN N-SDU that the CanTp module receives via the CanTpChannel. This N-SDU produces meta data items of type SOURCE_ADDRESS_16, TARGET_ADDRESS_16 and ADDRESS_EXTENSION_8.
CanTpTxNSdu	0..*	The following parameters needs to be configured for each CAN N-SDU that the CanTp module transmits via the CanTpChannel. This N-SDU consumes meta data items of type SOURCE_ADDRESS_16, TARGET_ADDRESS_16 and ADDRESS_EXTENSION_8.

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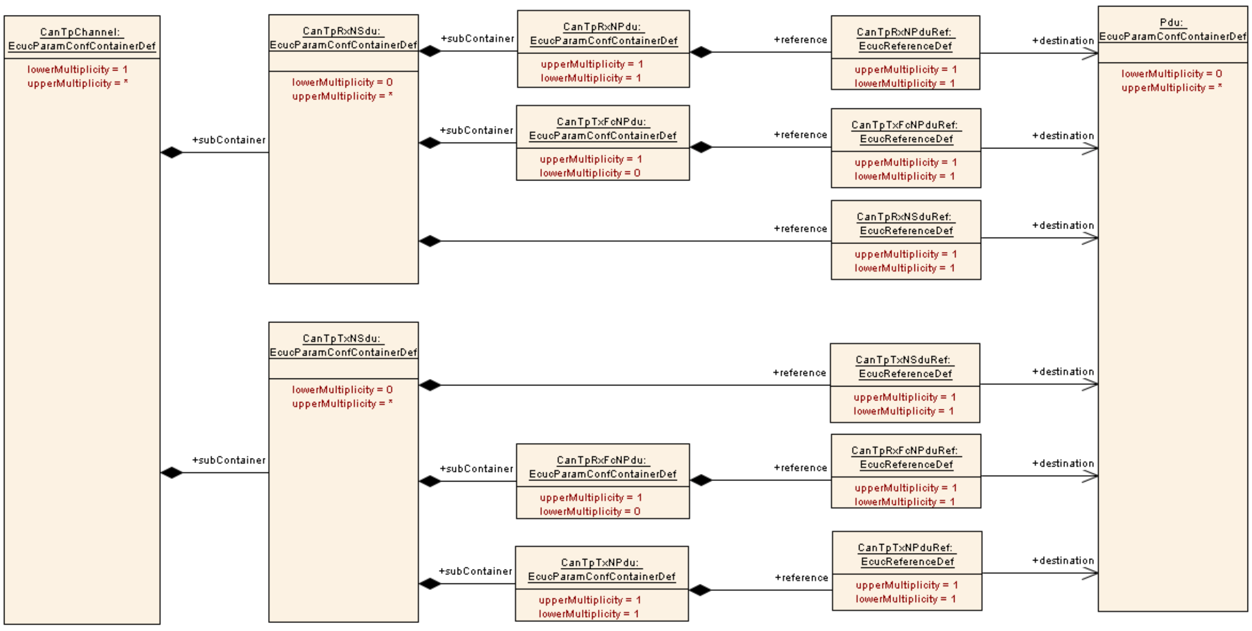

Figure 10.5: CanTpChannel configuration overview

10.2.7 CanTpRxNSdu

[ECUC_CanTp_00137] Definition of EcucParamConfContainerDef CanTpRxNSdu ⌈

Container Name	CanTpRxNSdu
Parent Container	CanTpChannel
Description	The following parameters needs to be configured for each CAN N-SDU that the CanTp module receives via the CanTpChannel. This N-SDU produces meta data items of type SOURCE_ADDRESS_16, TARGET_ADDRESS_16 and ADDRESS_EXTENSION_8.
Post-Build Variant Multiplicity	true

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Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Configuration Parameters			

Included Parameters		
Parameter Name	Multiplicity	ECUC ID
CanTpBs	0..1	[ECUC_CanTp_00276]
CanTpNar	0..1	[ECUC_CanTp_00277]
CanTpNbr	0..1	[ECUC_CanTp_00245]
CanTpNcr	0..1	[ECUC_CanTp_00279]
CanTpRxAddressingFormat	1	[ECUC_CanTp_00281]
CanTpRxNSduId	1	[ECUC_CanTp_00301]
CanTpRxPaddingActivation	1	[ECUC_CanTp_00249]
CanTpRxTaType	1	[ECUC_CanTp_00250]
CanTpRxWftMax	0..1	[ECUC_CanTp_00251]
CanTpSTmin	0..1	[ECUC_CanTp_00252]
CanTpRxNSduRef	1	[ECUC_CanTp_00241]

Included Containers		
Container Name	Multiplicity	Scope / Dependency
CanTpNAe	0..1	This container is required for each RxNSdu and TxNSdu with AddressingFormat CANTP_MIXED or CANTP_MIXED29BIT.
CanTpNSa	0..1	This container is required for each RxNSdu and TxNSdu with RxTaType CANTP_PHYSICAL and CanTpAddressingFormat CANTP_EXTENDED. When DynIdSupport is enabled, this container is also required for each TxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT. When DynIdSupport is enabled and GenericConnectionSupport is not enabled, this container is also required for each RxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT.
CanTpNTa	0..1	This container is required for each RxNSdu and TxNSdu with AddressingFormat CANTP_EXTENDED. When DynIdSupport is enabled, this container is also required for each RxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT. When DynIdSupport is enabled and GenericConnectionSupport is not enabled, this container is also required for each TxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT.
CanTpRxNPdu	1	Used for grouping of the ID of a PDU and the Reference to a PDU. This N-PDU consumes a meta data item of type CAN_ID_32.
CanTpTxFcNPdu	0..1	Used for grouping of the ID of a PDU and the Reference to a PDU. This N-PDU produces a meta data item of type CAN_ID_32.

⌋

[ECUC_CanTp_00276] Definition of EcucIntegerParamDef CanTpBs ⌈

Parameter Name	CanTpBs		
Parent Container	CanTpRxNSdu		
Description	Sets the number of N-PDUs the CanTp receiver allows the sender to send, before waiting for an authorization to continue transmission of the following N-PDUs.For further details on this parameter value see ISO 15765-2 specification.		
Multiplicity	0..1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	–		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00277] Definition of EcucFloatParamDef CanTpNar ⌈

Parameter Name	CanTpNar		
Parent Container	CanTpRxNSdu		
Description	Value in seconds of the N_Ar timeout. N_Ar is the time for transmission of a CAN frame (any N_PDU) on the receiver side.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	]0 .. INF]		
Default value	–		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00245] Definition of EcucFloatParamDef CanTpNbr ⌈

Parameter Name	CanTpNbr		
Parent Container	CanTpRxNSdu		
Description	Value in seconds of the performance requirement for (N_Br + N_Ar). N_Br is the elapsed time between the receiving indication of a FF or CF or the transmit confirmation of a FC, until the transmit request of the next FC.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	]0 .. INF]		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00279] Definition of EcucFloatParamDef CanTpNcr ⌈

Parameter Name	CanTpNcr		
Parent Container	CanTpRxNSdu		
Description	Value in seconds of the N_Cr timeout. N_Cr is the time until reception of the next Consecutive Frame N_PDU.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	]0 .. INF]		
Default value	–		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00281] Definition of EcucEnumerationParamDef CanTpRxAddressingFormat ⌈

Parameter Name	CanTpRxAddressingFormat		
Parent Container	CanTpRxNSdu		
Description	Declares which communication addressing mode is supported for this RxNSdu. Definition of Enumeration values: CanTpStandard to use normal addressing format. CanTpExtended to use extended addressing format. CanTpMixed to use mixed 11 bit addressing format. CanTpNormalFixed to use normal fixed addressing format. CanTp Mixed29Bit to use mixed 29 bit addressing format.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CANTP_EXTENDED	Extended addressing format	
	CANTP_MIXED	Mixed 11 bit addressing format	
	CANTP_MIXED29BIT	Mixed 29 bit addressing format	
	CANTP_NORMALFIXED	Normal fixed addressing format	
	CANTP_STANDARD	Normal addressing format	
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00301] Definition of EcucIntegerParamDef CanTpRxNSduId ⌈

Parameter Name	CanTpRxNSduId		
Parent Container	CanTpRxNSdu		
Description	Unique identifier user by the upper layer to call CanTp_CancelReceive, CanTp_ ChangeParameter and CanTp_ReadParameter.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 65535		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local withAuto = true		

⌋

[ECUC_CanTp_00249] Definition of EcucEnumerationParamDef CanTpRxPaddingActivation ⌈

Parameter Name	CanTpRxPaddingActivation		
Parent Container	CanTpRxNSdu		
Description	Defines if the received frame uses padding or not. This parameter is restricted to 8 bytes N-PDUs. Definition of enumeration values: CanTpOn: The N-PDU received uses padding for SF, FC and the last CF. (N-PDU length is always >= 8 bytes in case of CAN 2.0) CanTpOff: The N-PDU received does not use padding for SF, FC and the last CF. (N-PDU length is dynamic - any valid DLC value). Note: The mandatory mapping to the next higher valid DLC value for N-PDUs with a length > 8 bytes is not affected by this parameter.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CANTP_OFF	Padding is not used	
	CANTP_ON	Padding is used	
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00250] Definition of EcucEnumerationParamDef CanTpRxTaType ⌈

Parameter Name	CanTpRxTaType		
Parent Container	CanTpRxNSdu		
Description	Declares the communication type of this Rx N-SDU.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CANTP_FUNCTIONAL	Functional request type	
	CANTP_PHYSICAL	Physical request type	
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00251] Definition of EcucIntegerParamDef CanTpRxWftMax ⌈

Parameter Name	CanTpRxWftMax		
Parent Container	CanTpRxNSdu		
Description	This parameter indicates how many Flow Control wait N-PDUs can be consecutively transmitted by the receiver. It is local to the node and is not transmitted inside the FC protocol data unit. CanTpRxWftMax is used to avoid sender nodes being potentially hooked-up in case of a temporarily reception inability on the part of the receiver nodes, whereby the sender could be waiting continuously.		
Multiplicity	0..1		
Type	EcucIntegerParamDef		
Range	0 .. 65535		
Default value	–		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00252] Definition of EcucFloatParamDef CanTpSTmin ⌈

Parameter Name	CanTpSTmin		
Parent Container	CanTpRxNSdu		
Description	Sets the duration of the minimum time the CanTp sender shall wait between the transmissions of two CF N-PDUs. For further details on this parameter value see ISO 15765-2 specification.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	[0 .. INF]		
Default value	–		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00241] Definition of EcucReferenceDef CanTpRxNSduRef ⌈

Parameter Name	CanTpRxNSduRef		
Parent Container	CanTpRxNSdu		
Description	Reference to a Pdu in the COM-Stack.		
Multiplicity	1		
Type	Reference to Pdu		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency			

⌋

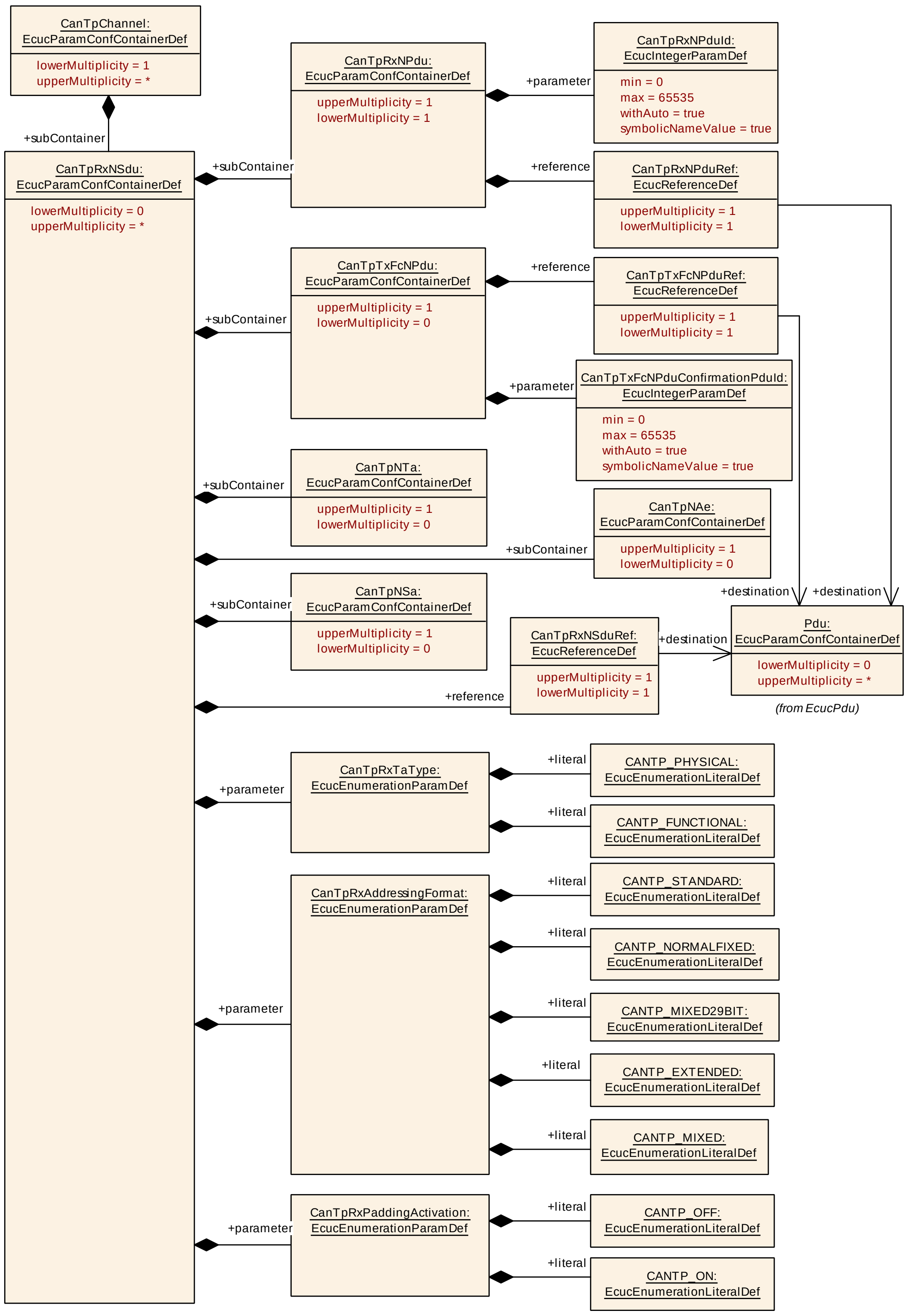
CanTpChannel: EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = *
+subContainer
CanTpRxNSdu: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+subContainer
CanTpRxNPdu: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 1
+parameter
CanTpRxNPduId: EcucIntegerParamDef
min = 0
max = 65535
withAuto = true
symbolicNameValue = true
+reference
CanTpRxNPduRef: EcucReferenceDef
upperMultiplicity = 1
lowerMultiplicity = 1
+subContainer
CanTpTxFcNPdu: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 0
+reference
CanTpTxFcNPduRef: EcucReferenceDef
upperMultiplicity = 1
lowerMultiplicity = 1
+parameter
CanTpTxFcNPduConfirmationPduId: EcucIntegerParamDef
min = 0
max = 65535
withAuto = true
symbolicNameValue = true
+subContainer
CanTpNTa: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 0
+subContainer
CanTpNAe: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 0
+subContainer
CanTpNSa: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 0
+reference
CanTpRxNSduRef: EcucReferenceDef
upperMultiplicity = 1
lowerMultiplicity = 1
+destination
+destination
+destination
Pdu: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
(from EcucPdu)
+parameter
CanTpRxTaType: EcucEnumerationParamDef
+literal
CANTP_PHYSICAL: EcucEnumerationLiteralDef
+literal
CANTP_FUNCTIONAL: EcucEnumerationLiteralDef
+parameter
CanTpRxAddressingFormat: EcucEnumerationParamDef
+literal
CANTP_STANDARD: EcucEnumerationLiteralDef
+literal
CANTP_NORMALFIXED: EcucEnumerationLiteralDef
+literal
CANTP_MIXED29BIT: EcucEnumerationLiteralDef
+literal
CANTP_EXTENDED: EcucEnumerationLiteralDef
+literal
CANTP_MIXED: EcucEnumerationLiteralDef
+parameter
CanTpRxPaddingActivation: EcucEnumerationParamDef
+literal
CANTP_OFF: EcucEnumerationLiteralDef
+literal
CANTP_ON: EcucEnumerationLiteralDef

Figure 10.6: CanTpRxNSdu configuration overview (part 1)

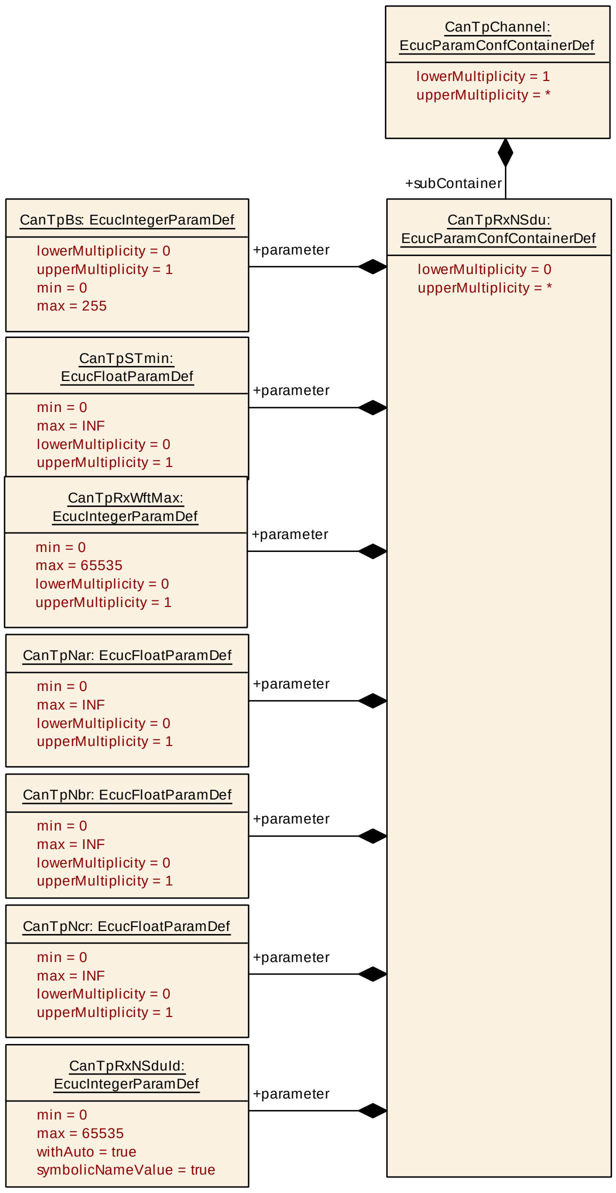

Figure 10.7: CanTpRxNSdu configuration overview (part 2)

10.2.8 CanTpTxFcNPdu

[ECUC_CanTp_00259] Definition of EcucParamConfContainerDef CanTpTxFcNPdu ⌈

Container Name	CanTpTxFcNPdu
Parent Container	CanTpRxNSdu
Description	Used for grouping of the ID of a PDU and the Reference to a PDU. This N-PDU produces a meta data item of type CAN_ID_32.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpTxFcNPduConfirmationPduId	1	[ECUC_CanTp_00287]
CanTpTxFcNPduRef	1	[ECUC_CanTp_00260]

No Included Containers

⌋

[ECUC_CanTp_00287] Definition of EcucIntegerParamDef CanTpTxFcNPduConfirmationPduId ⌈

Parameter Name	CanTpTxFcNPduConfirmationPduId		
Parent Container	CanTpTxFcNPdu		
Description	Handle Id to be used by the LSduR to confirm the transmission of the CanTpTxFcNPdu to the LSduR module.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 65535		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local withAuto = true		

⌋

[ECUC_CanTp_00260] Definition of EcucReferenceDef CanTpTxFcNPduRef ⌈

Parameter Name	CanTpTxFcNPduRef		
Parent Container	CanTpTxFcNPdu		
Description	Reference to a Pdu in the COM-Stack.		
Multiplicity	1		
Type	Reference to Pdu		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency			

⌋

10.2.9 CanTpRxNPdu

[ECUC_CanTp_00256] Definition of EcucParamConfContainerDef CanTpRxNPdu ⌈

Container Name	CanTpRxNPdu
Parent Container	CanTpRxNSdu
Description	Used for grouping of the ID of a PDU and the Reference to a PDU. This N-PDU consumes a meta data item of type CAN_ID_32.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpRxNPduId	1	[ECUC_CanTp_00258]
CanTpRxNPduRef	1	[ECUC_CanTp_00257]

No Included Containers

⌋

[ECUC_CanTp_00258] Definition of EcucIntegerParamDef CanTpRxNPduId ⌈

Parameter Name	CanTpRxNPduId		
Parent Container	CanTpRxNPdu		
Description	The N-PDU identifier attached to the RxNsdu is identified by CanTpRxNSduId. Each RxNsdu identifier is linked to only one SF/FF/CF N-PDU identifier. Nevertheless, in the case of extended or mixed addressing format, the same N-PDU identifier can be used for several N-SDU identifiers. The distinction is made by the N_TA or N_AE value (first data byte of SF or FF frames).		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 65535		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local withAuto = true		

⌋

[ECUC_CanTp_00257] Definition of EcucReferenceDef CanTpRxNPduRef ⌈

Parameter Name	CanTpRxNPduRef		
Parent Container	CanTpRxNPdu		
Description	Reference to a Pdu in the COM-Stack.		
Multiplicity	1		
Type	Reference to Pdu		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency			

⌋

10.2.10 CanTpTxNSdu

[ECUC_CanTp_00138] Definition of EcucParamConfContainerDef CanTpTxNSdu ⌈

Container Name	CanTpTxNSdu		
Parent Container	CanTpChannel		
Description	The following parameters needs to be configured for each CAN N-SDU that the CanTp module transmits via the CanTpChannel. This N-SDU consumes meta data items of type SOURCE_ADDRESS_16, TARGET_ADDRESS_16 and ADDRESS_ EXTENSION_8.		
Post-Build Variant Multiplicity	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Configuration Parameters			

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpNas	1	[ECUC_CanTp_00263]
CanTpNbs	0..1	[ECUC_CanTp_00264]
CanTpNcs	0..1	[ECUC_CanTp_00265]
CanTpTc	1	[ECUC_CanTp_00282]
CanTpTxAddressingFormat	1	[ECUC_CanTp_00262]
CanTpTxNSduId	1	[ECUC_CanTp_00268]
CanTpTxPaddingActivation	1	[ECUC_CanTp_00269]
CanTpTxTaType	1	[ECUC_CanTp_00270]
CanTpTxNSduRef	1	[ECUC_CanTp_00261]

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
CanTpNAe	0..1	This container is required for each RxNSdu and TxNSdu with AddressingFormat CANTP_MIXED or CANTP_MIXED29BIT.
CanTpNSa	0..1	This container is required for each RxNSdu and TxNSdu with RxTaType CANTP_PHYSICAL and CanTpAddressingFormat CANTP_EXTENDED. When DynIdSupport is enabled, this container is also required for each TxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT. When DynIdSupport is enabled and GenericConnectionSupport is not enabled, this container is also required for each RxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT.
CanTpNTa	0..1	This container is required for each RxNSdu and TxNSdu with AddressingFormat CANTP_EXTENDED. When DynIdSupport is enabled, this container is also required for each RxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT. When DynIdSupport is enabled and GenericConnectionSupport is not enabled, this container is also required for each TxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT.
CanTpRxFcNPdu	0..1	Used for grouping of the ID of a PDU and the Reference to a PDU. This N-PDU consumes a meta data item of type CAN_ID_32.
CanTpTxNPdu	1	Used for grouping of the ID of a PDU and the Reference to a PDU. This N-PDU produces a meta data item of type CAN_ID_32.

⌋

[ECUC_CanTp_00263] Definition of EcucFloatParamDef CanTpNas ⌈

Parameter Name	CanTpNas		
Parent Container	CanTpTxNSdu		
Description	Value in second of the N_As timeout. N_As is the time for transmission of a CAN frame (any N_PDU) on the part of the sender.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	]0 .. INF]		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00264] Definition of EcucFloatParamDef CanTpNbs ⌈

Parameter Name	CanTpNbs		
Parent Container	CanTpTxNSdu		
Description	Value in seconds of the N_Bs timeout. N_Bs is the time of transmission until reception of the next Flow Control N_PDU.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	]0 .. INF]		
Default value	–		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00265] Definition of EcucFloatParamDef CanTpNcs ⌈

Parameter Name	CanTpNcs		
Parent Container	CanTpTxNSdu		
Description	Value in seconds of the performance requirements relating to N_Cs. CanTpNcs is the time in which CanTp is allowed to request from PduR the Tx data of a Consecutive Frame N_PDU.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	]0 .. INF]		
Default value	–		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00282] Definition of EcucBooleanParamDef CanTpTc ⌈

Parameter Name	CanTpTc		
Parent Container	CanTpTxNSdu		
Description	Switch for enabling Transmit Cancellation.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00262] Definition of EcucEnumerationParamDef CanTpTxAddressingFormat ⌈

Parameter Name	CanTpTxAddressingFormat		
Parent Container	CanTpTxNSdu		
Description	Declares which communication addressing format is supported for this TxNSdu. Definition of Enumeration values: CanTpStandard to use normal addressing format. CanTpExtended to use extended addressing format. CanTpMixed to use mixed 11 bit addressing format. CanTpNormalFixed to use normal fixed addressing format. CanTp Mixed29Bit to use mixed 29 bit addressing format.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CANTP_EXTENDED	Extended addressing format	
	CANTP_MIXED	Mixed 11 bit addressing format	
	CANTP_MIXED29BIT	Mixed 29 bit addressing format	
	CANTP_NORMALFIXED	Normal fixed addressing format	
	CANTP_STANDARD	Normal addressing format	
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00268] Definition of EcucIntegerParamDef CanTpTxNSduId ⌈

Parameter Name	CanTpTxNSduId
Parent Container	CanTpTxNSdu
Description	Unique identifier to a structure that contains all useful information to process the transmission of a TxNsdu.

▽

△

Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 65535		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local withAuto = true		

⌋

[ECUC_CanTp_00269] Definition of EcucEnumerationParamDef CanTpTxPaddingActivation ⌈

Parameter Name	CanTpTxPaddingActivation		
Parent Container	CanTpTxNSdu		
Description	Defines if the transmit frame use padding or not. This parameter is restricted to 8 byte N-PDUs. Definition of Enumeration values: CanTpOn The transmit N-PDU uses padding for SF, FC and the last CF. (N-PDU length is always 8 bytes in case of CAN 2.0) CanTpOff The transmit N-PDU does not use padding for SF, CF and the last CF. (N-PDU length is dynamic - any valid DLC value). Note: The mandatory mapping to the next higher valid DLC value for N-PDUs with a length > 8 bytes is not affected by this parameter.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CANTP_OFF	Padding is not used	
	CANTP_ON	Padding is used	
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00270] Definition of EcucEnumerationParamDef CanTpTxTaType ⌈

Parameter Name	CanTpTxTaType		
Parent Container	CanTpTxNSdu		
Description	Declares the communication type of this TxNsdu. Enumeration values: CanTpPhysical. Used for 1:1 communication. CanTpFunctional. Used for 1:n communication.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CANTP_FUNCTIONAL	Functional request type	
	CANTP_PHYSICAL	Physical request type	
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_CanTp_00261] Definition of EcucReferenceDef CanTpTxNSduRef ⌈

Parameter Name	CanTpTxNSduRef		
Parent Container	CanTpTxNSdu		
Description	Reference to a Pdu in the COM-Stack.		
Multiplicity	1		
Type	Reference to Pdu		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency			

⌋

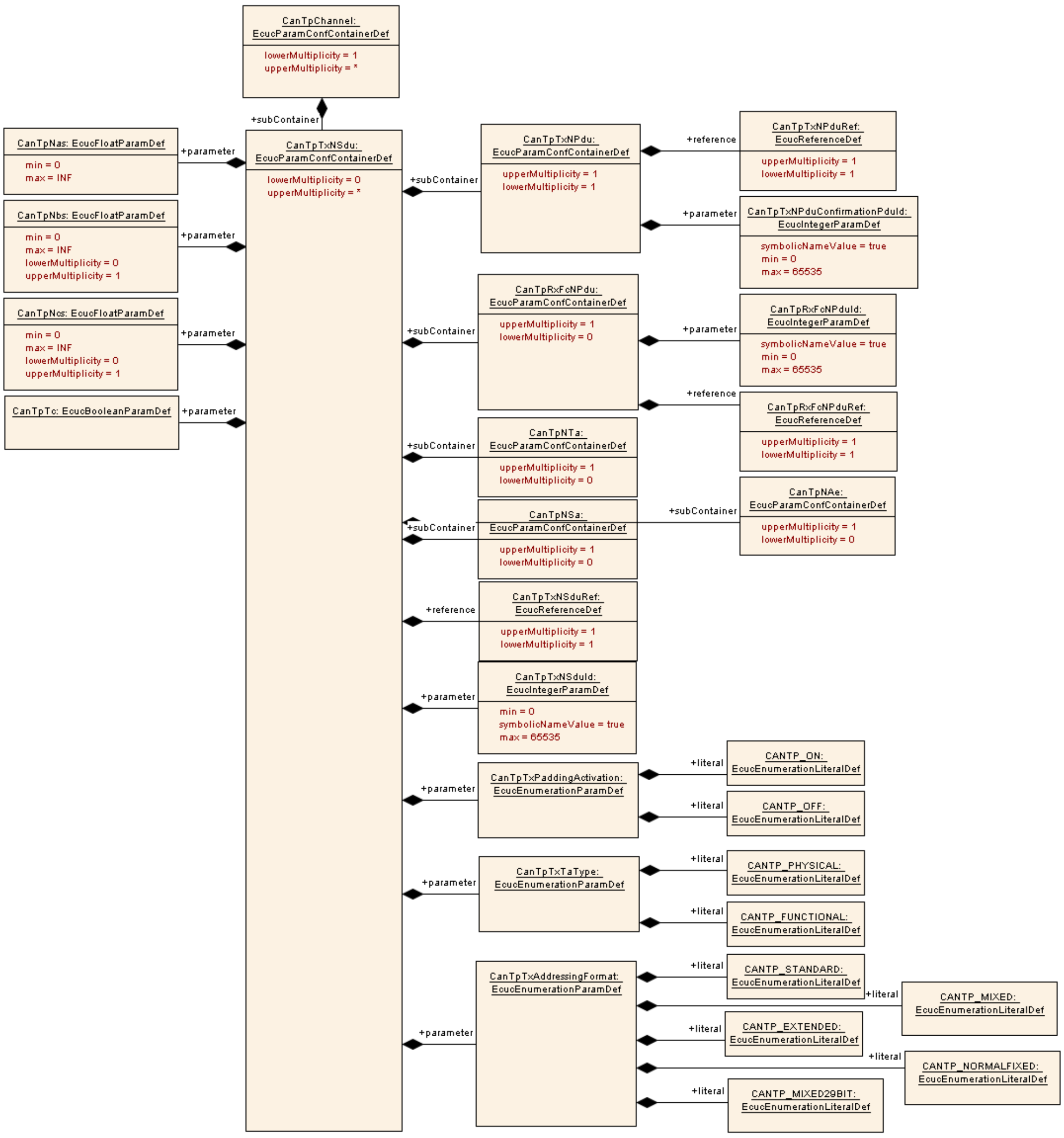
CanTpChannel: EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = *
+subContainer
CanTpTxNSdu: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
CanTpNas: EcucFloatParamDef
min = 0
max = INF
+parameter
CanTpNbs: EcucFloatParamDef
min = 0
max = INF
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
CanTpNcs: EcucFloatParamDef
min = 0
max = INF
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
CanTpTc: EcucBooleanParamDef
+parameter
+subContainer
CanTpTxNPdu: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 1
+reference
CanTpTxNPduRef: EcucReferenceDef
upperMultiplicity = 1
lowerMultiplicity = 1
+parameter
CanTpTxNPduConfirmationPduId: EcucIntegerParamDef
symbolicNameValue = true
min = 0
max = 65535
+subContainer
CanTpRxFcNPdu: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 0
+parameter
CanTpRxFcNPduId: EcucIntegerParamDef
symbolicNameValue = true
min = 0
max = 65535
+reference
CanTpRxFcNPduRef: EcucReferenceDef
upperMultiplicity = 1
lowerMultiplicity = 1
+subContainer
CanTpNTa: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 0
+subContainer
CanTpNAe: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 0
+subContainer
CanTpNSa: EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 0
+reference
CanTpTxNSduRef: EcucReferenceDef
upperMultiplicity = 1
lowerMultiplicity = 1
+parameter
CanTpTxNSduId: EcucIntegerParamDef
min = 0
symbolicNameValue = true
max = 65535
+parameter
CanTpTxPaddingActivation: EcucEnumerationParamDef
+literal
CANTP_ON: EcucEnumerationLiteralDef
+literal
CANTP_OFF: EcucEnumerationLiteralDef
+parameter
CanTpTxTaType: EcucEnumerationParamDef
+literal
CANTP_PHYSICAL: EcucEnumerationLiteralDef
+literal
CANTP_FUNCTIONAL: EcucEnumerationLiteralDef
+parameter
CanTpTxAddressingFormat: EcucEnumerationParamDef
+literal
CANTP_STANDARD: EcucEnumerationLiteralDef
+literal
CANTP_MIXED: EcucEnumerationLiteralDef
+literal
CANTP_EXTENDED: EcucEnumerationLiteralDef
+literal
CANTP_NORMALFIXED: EcucEnumerationLiteralDef
+literal
CANTP_MIXED29BIT: EcucEnumerationLiteralDef

Figure 10.8: CanTpTxNSdu configuration overview

10.2.11 CanTpTxNPdu

[ECUC_CanTp_00274] Definition of EcucParamConfContainerDef CanTpTxNPdu
⌈

Container Name	CanTpTxNPdu
Parent Container	CanTpTxNSdu
Description	Used for grouping of the ID of a PDU and the Reference to a PDU. This N-PDU produces a meta data item of type CAN_ID_32.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpTxNPduConfirmationPduId	1	[ECUC_CanTp_00286]
CanTpTxNPduRef	1	[ECUC_CanTp_00275]

No Included Containers

⌋

[ECUC_CanTp_00286] Definition of EcucIntegerParamDef CanTpTxNPduConfirmationPduId ⌈

Parameter Name	CanTpTxNPduConfirmationPduId		
Parent Container	CanTpTxNPdu		
Description	Handle Id to be used by the LSduR to confirm the transmission of the CanTpTxNPdu to the LSduR module.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 65535		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local withAuto = true		

⌋

[ECUC_CanTp_00275] Definition of EcucReferenceDef CanTpTxNPduRef ⌈

Parameter Name	CanTpTxNPduRef		
Parent Container	CanTpTxNPdu		
Description	Reference to a Pdu in the COM-Stack.		
Multiplicity	1		
Type	Reference to Pdu		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD

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△

Scope / Dependency	

⌋

10.2.12 CanTpRxFcNPdu

[ECUC_CanTp_00271] Definition of EcucParamConfContainerDef CanTpRxFcNPdu ⌈

Container Name	CanTpRxFcNPdu
Parent Container	CanTpTxNSdu
Description	Used for grouping of the ID of a PDU and the Reference to a PDU. This N-PDU consumes a meta data item of type CAN_ID_32.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpRxFcNPduId	1	[ECUC_CanTp_00273]
CanTpRxFcNPduRef	1	[ECUC_CanTp_00272]

No Included Containers

⌋

[ECUC_CanTp_00273] Definition of EcucIntegerParamDef CanTpRxFcNPduId ⌈

Parameter Name	CanTpRxFcNPduId		
Parent Container	CanTpRxFcNPdu		
Description	N-PDU identifier attached to the FC N-PDU of this TxNsdu identified by CanTpTxNSdu Id. Each TxNsdu identifier is linked to one Rx FC N-PDU identifier only. However, in the case of extended addressing format, the same FC N-PDU identifier can be used for several N-SDU identifiers. The distinction is made by means of the N_TA value (first data byte of FC frames).		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 65535		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	

▽

△

Scope / Dependency	scope: local withAuto = true

⌋

[ECUC_CanTp_00272] Definition of EcucReferenceDef CanTpRxFcNPduRef ⌈

Parameter Name	CanTpRxFcNPduRef		
Parent Container	CanTpRxFcNPdu		
Description	Reference to a Pdu in the COM-Stack.		
Multiplicity	1		
Type	Reference to Pdu		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency			

⌋

10.2.13 CanTpNTa

[ECUC_CanTp_00139] Definition of EcucParamConfContainerDef CanTpNTa ⌈

Container Name	CanTpNTa
Parent Container	CanTpRxNSdu, CanTpTxNSdu
Description	This container is required for each RxNSdu and TxNSdu with AddressingFormat CANTP_EXTENDED. When DynIdSupport is enabled, this container is also required for each RxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT. When DynIdSupport is enabled and GenericConnectionSupport is not enabled, this container is also required for each TxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpNTa	1	[ECUC_CanTp_00255]

No Included Containers

⌋

[ECUC_CanTp_00255] Definition of EcucIntegerParamDef CanTpNTa ⌈

Parameter Name	CanTpNTa		
Parent Container	CanTpNTa		
Description	This parameter contains the transport protocol target address value.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

10.2.14 CanTpNSa

[ECUC_CanTp_00253] Definition of EcucParamConfContainerDef CanTpNSa ⌈

Container Name	CanTpNSa
Parent Container	CanTpRxNSdu, CanTpTxNSdu
Description	This container is required for each RxNSdu and TxNSdu with RxTaType CANTP_PHYSICAL and CanTpAddressingFormat CANTP_EXTENDED. When DynIdSupport is enabled, this container is also required for each TxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT. When DynIdSupport is enabled and GenericConnectionSupport is not enabled, this container is also required for each RxNSdu with AddressingFormat CANTP_NORMALFIXED or CANTP_MIXED29BIT.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpNSa	1	[ECUC_CanTp_00254]

No Included Containers

⌋

[ECUC_CanTp_00254] Definition of EcucIntegerParamDef CanTpNSa ⌈

Parameter Name	CanTpNSa
Parent Container	CanTpNSa
Description	This parameter contains the transport protocol source address value.
Multiplicity	1

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Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

10.2.15 CanTpNAe

[ECUC_CanTp_00284] Definition of EcucParamConfContainerDef CanTpNAe ⌈

Container Name	CanTpNAe
Parent Container	CanTpRxNSdu, CanTpTxNSdu
Description	This container is required for each RxNSdu and TxNSdu with AddressingFormat CANTP_MIXED or CANTP_MIXED29BIT.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
CanTpNAe	1	[ECUC_CanTp_00285]

No Included Containers

⌋

[ECUC_CanTp_00285] Definition of EcucIntegerParamDef CanTpNAe ⌈

Parameter Name	CanTpNAe		
Parent Container	CanTpNAe		
Description	This parameter contains the transport protocol address extension value.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

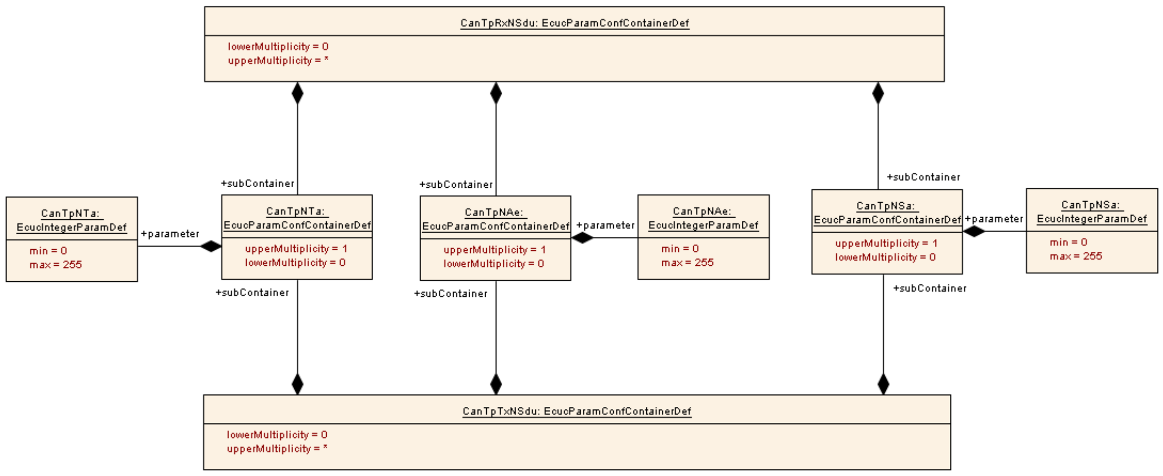

Figure 10.9: CanTpNTa, CanTpNSa and CanTpNAe configuration overview

10.3 Published Information

For details refer to the chapter 10.3 "Published Information" in SWS_BSWGeneral.

A Not applicable requirements

[SWS_CanTp_NA_00327]

Upstream requirements: SRS_BSW_00344, SRS_BSW_00404, SRS_BSW_00405, SRS_BSW_-00170, SRS_BSW_00419, SRS_BSW_00383, SRS_BSW_00397, SRS_BSW_00398, SRS_BSW_00399, SRS_BSW_00400, SRS_BSW_-00375, SRS_BSW_00416, SRS_BSW_00168, SRS_BSW_00423, SRS_BSW_00427, SRS_BSW_00428, SRS_BSW_00429, SRS_BSW_-00432, SRS_BSW_00433, SRS_BSW_00422, SRS_BSW_00417, SRS_BSW_00161, SRS_BSW_00162, SRS_BSW_00415, SRS_BSW_-00325, SRS_BSW_00342, SRS_BSW_00413, SRS_BSW_00347, SRS_BSW_00307, SRS_BSW_00314, SRS_BSW_00328, SRS_BSW_-00378, SRS_BSW_00172, SRS_BSW_00010, SRS_BSW_00321, SRS_BSW_00341

⌈These requirements are not applicable to this specification.⌋

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 R23-11

B.1.1 Added Specification Items in R23-11

[SWS_CanTp_00361] [SWS_CanTp_00362] [SWS_CanTp_00363] [SWS_CanTp_00364] [SWS_CanTp_00365] [SWS_CanTp_00366] [SWS_CanTp_00367] [SWS_CanTp_00368] [SWS_CanTp_00369] [SWS_CanTp_00370]

B.1.2 Changed Specification Items in R23-11

[SWS_CanTp_00328]

B.1.3 Deleted Specification Items in R23-11

none

B.2 Traceable item history of this document according to AUTOSAR Release R24-11

B.2.1 Added Specification Items in R24-11

[ECUC_CanTp_00318] [ECUC_CanTp_00319] [ECUC_CanTp_00320] [ECUC_CanTp_00321] [ECUC_CanTp_00322] [ECUC_CanTp_00323] [ECUC_CanTp_00324] [ECUC_CanTp_00325] [ECUC_CanTp_00326] [ECUC_CanTp_00327] [ECUC_CanTp_00328] [ECUC_CanTp_00329] [SWS_CanTp_00371] [SWS_CanTp_00372] [SWS_CanTp_00373] [SWS_CanTp_00374] [SWS_CanTp_00375] [SWS_CanTp_00376] [SWS_CanTp_00377] [SWS_CanTp_00378] [SWS_CanTp_00379] [SWS_CanTp_00380] [SWS_CanTp_00381] [SWS_CanTp_00382] [SWS_CanTp_00383]

B.2.2 Changed Specification Items in R24-11

[ECUC_CanTp_00278] [ECUC_CanTp_00286] [ECUC_CanTp_00287] [SWS_-CanTp_00031] [SWS_CanTp_00166] [SWS_CanTp_00209] [SWS_CanTp_00216] [SWS_CanTp_00217] [SWS_CanTp_00332] [SWS_CanTp_00335] [SWS_CanTp_-00342] [SWS_CanTp_00343] [SWS_CanTp_00348] [SWS_CanTp_00351]

B.2.3 Deleted Specification Items in R24-11

[SWS_CanTp_00176]