Document Title	Requirements on TTCAN
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	441
Document Classification	Auxiliary

Document Version	1.0.0
Document Status	Final
Part of Release	4.0
Revision	1

Document Change History

Date	Version	Changed by	Change Description
07.12.2009	1.0.0	AUTOSAR Administration	Initial Release

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1 Scope of this document

This document specifies the additional TTCAN requirements for the CAN BSW stack.

2 How to read this document

Each requirement has its unique identifier starting with the prefix “BSW” (for “Basic Software”). For any review annotations, remarks or questions, please refer to this unique ID rather than chapter or page numbers!

2.1 Conventions used

In requirements, the following specific semantics are used (taken from Request for Comment RFC 2119 from the Internet Engineering Task Force IETF)

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119. Note that the requirement level of the document in which they are used modifies the force of these words.

- MUST: This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.
- MUST NOT: This phrase, or the phrase „SHALL NOT“, means that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
- MAY: This word, or the adjective „OPTIONAL“, means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation, which does not include a particular option, MUST be prepared to interoperate with another implementation, which does include the option, though perhaps with reduced functionality. In the same vein an implementation, which does include a particular option, MUST be prepared to interoperate with another implementation, which does not include the option (except, of course, for the feature the option provides.)

3 Acronyms and abbrevations

Acronym:	*Description:*
CAN	Controller Area Network
TTCAN	Time Triggered CAN

4 Requirements Specification

4.1 Functional requirements

This chapter describes functional requirements that shall be fulfilled to support TTCAN. Only requirements are listed that are additional with respect to the CAN requirements [3].

4.1.1 [BSW441001] TTCAN support

Initiator:	BOSCH
Date:	08.04.2009
Short Description:	The CAN stack shall support TTCAN according to ISO11898-4:2004 [6].
Type:	New
Importance:	High
Description:	The CAN stack shall additionally support part 4 of ISO11898 Time-triggered communication [6]. TTCAN level 1 and level 2 shall be supported.
Rationale:	--
Use Case:	Time triggered communication, Event synchronized time triggered communication
Dependencies:	--
Conflicts:	--
Supporting Material:	ISO11898-4:2004 [6], BSW & RTE Features: BRF00312 [5]

4.2 Non-functional requirements

4.2.1 [BSW441002] CAN dependence

Initiator:	BOSCH
Date:	18.04.2009
Short Description:	The additional TTCAN components shall be integrated into the CAN stack.
Type:	New
Importance:	High
Description:	TheCAN stack shall be extended by additional APIs, type definitions and functionality to support TTCAN.
Rationale:	TTCAN completely uses the CAN stack. The CAN stack shall not be available twice (code optimization).
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.3 CAN Driver with TTCAN functionality

4.3.1 Functional requirements

4.3.1.1 Configuration

4.3.1.1.1 [BSW441003] CAN Hardware Object Handle mapping to time windows

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	The Hardware Object Handles (see BSW01039 CAN SRS) shall be mappable to all types of time windows defined in ISO 11898-4:2004 [6] by configuration.
Type:	New
Importance:	Medium
Description:	The hardware objects (BSW01039 CAN SRS) shall be mappable to the specific time windows defined in ISO 11898-4:2004. The configuration parameters shall be allowed to be of types Pre-Compile-Time, Link-Time or Post-Build-Time.
Rationale:	A Hardware object shall be configurable to transmit or receive messages in a specific time window.
Use Case:	See Rationale.
Dependencies:	BSW01039
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.3.1.1.2 [BSW441014] Configuration Interfaces of ISO 11898-4:2004

Initiator:	BOSCH
Date:	28.07.2009
Short Description:	Configuration interfaces defined in ISO 11898-4:2004 [6] shall be configurable.
Type:	New
Importance:	Medium
Description:	The “configuration interfaces” of chapter 10 of ISO 11898-4:2004 shall be configurable. The configuration parameters shall be allowed to be of types Pre-Compile-Time.
Rationale:	Parameters like e.g. “operation mode” , “master/slave”, “trigger” etc. need to be configured.
Use Case:	See Rationale.
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.3.1.1.3 [BSW441004] Watchdog

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	The “Appl_Watchdog_Limit” (see chapter 10.1.2.7 of ISO 11898-4:2004) shall be configurable.
Type:	New
Importance:	Medium
Description:	Activation of “Application_Watchdog” needs to be configured. The configuration parameter shall be allowed to be of type Pre-Compile-Time, Link-Time or Post-Build-Time.
Rationale:	See description
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.3.1.2 Normal Operation

4.3.1.2.1 [BSW441005] Synchronization

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	The CAN Driver with TTCAN functionality shall provide means for influencing timing parameters and providing information from the TTCAN controller for synchronization purposes.
Type:	New
Importance:	Medium
Description:	Timing parameters, synchronization state and master state (see ISO 11898-4:2004 for details) shall be provided by the CAN Driver with TTCAN functionality. If a TTCAN controller is timing master, it shall be possible to adjust the timing parameters during runtime (see ISO 11898-4:2004 for details).
Rationale:	Synchronizing application with communication if required
Use Case:	See Rationale.
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.3.1.2.2 [BSW441006] Event synchronized communication

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	The CAN Driver with TTCAN functionality shall support the event synchronized time-triggered communication.
Type:	New
Importance:	Medium
Description:	Event-Synchronized communication (see chapter 5.2.3 of ISO 11898-4:2004) shall be supported.
Rationale:	Synchronizing communication with external events.
Use Case:	See Rationale.
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.3.1.2.3 [BSW441007] Indication of TTCAN Controller events

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	The CAN Driver with TTCAN functionality shall indicate occurred events according to chapter 10.2.2 “Interrupt_Status_Vector” of ISO 11898-4:2004.
Type:	New
Importance:	Medium
Description:	The events which will be supported by ISO 11898-4 shall be available to application if needed.
Rationale:	See description
Use Case:	Application can react on occurred events.
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.3.1.3 Fault Operation

4.3.1.3.1 [BSW441008] Severe Error

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	The CAN Driver with enabled TTCAN functionality shall provide a notification for severe error (S3).
Type:	New
Importance:	Medium
Description:	The CAN Driver with TTCAN functionality shall notify the CAN Interface with TTCAN functionality if the TTCAN Controller enters error level S3 (Severe Error, see ISO 11898-4:2004 [6]). The notification is done by call of static (non-configurable) callback function implemented inside the CAN Interface with TTCAN functionality.
Rationale:	see ISO 11898-4:2004 [6]
Use Case:	Any state transition is notified to the CAN Interface with TTCAN functionality which forwards this notification to the responsible upper layer.
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.3.1.3.2 [BSW441009] No automatic Severe Error recovery

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	The CAN Driver with TTCAN functionality shall not recover from severe error (S3) automatically.
Type:	New
Importance:	Medium
Description:	The severe error (S3, see ISO 11898-4:2004 [6]) recovery shall be software driven.
Rationale:	see ISO 11898-4:2004 chapter 9 Failure handling [6]
Use Case:	See Rationale
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.4 CAN Interface with TTCAN functionality

4.4.1 Functional requirements

4.4.1.1 [BSW441010] Job List

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	A Job List shall be configurable.
Type:	New
Importance:	High
Description:	It shall be configurable Pre-Compile-Time and per controller, whether a Job List shall be available.
Rationale:	Handling of BasicCAN hardware objects
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.4.1.2 [BSW441011] Job List Execution Function

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	If a Job List is available (see BSW441010) it shall be executed by a separate Job List Execution Function.
Type:	New
Importance:	High
Description:	The Job List Execution Function shall be called in task or interrupt context.
Rationale:	Handling of BasicCAN hardware objects
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.4.1.3 [BSW441012] Time Mark

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	“Time Marks” (see ISO 11898-4:2004 [6]) shall be configurable Pre-Compile-Time.
Type:	New
Importance:	High
Description:	The “Time Marks” of ISO 11898-4:2004 shall be configurable.
Rationale:	--
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

4.4.1.4 [BSW441013] Handling of Severe Errors as Bus Off

Initiator:	BOSCH
Date:	18.05.2009
Short Description:	An occurred severe error (S3) shall be processed as a BusOff (see BSW01029 of CAN SRS)
Type:	New
Importance:	High
Description:	Severe Error (see ISO 11898-4:2004 [6]), Handling and recovery is the same as for BusOff events.
Rationale:	The required behaviour for an occured severe error (see ISO 11898-4_2004 [6]) is the same as the AUTOSAR BSW behaviour of a detected BusOff.
Use Case:	--
Dependencies:	--
Conflicts:	--
Supporting Material:	BSW & RTE Features: BRF00312 [5]

5 References

5.1 Deliverables of AUTOSAR

[1] **[Ttcan]** Specification of TTCAN Driver
AUTOSAR_SWS_TTCANDriver.pdf

[2] **[TtcanIf]** Specification of TTCAN Interface
AUTOSAR_SWS_TTCANInterface.pdf

[3] **[SrsCan]** Requirements on CAN
AUTOSAR_SRS_CAN.pdf

[4] **[SrsGeneral]** General Requirements on Basic Software Modules
AUTOSAR_SRS_BSWGeneral.pdf

[5] **[BSW&RTE_Features]** BSW & RTE Features
[BRF00312] AUTOSAR_RS_BSWAndRTEFeatures.pdf

5.2 Related standard and norms

[6] ISO 11898-4 (2004-08-01), Road vehicles – Controller Area Network (CAN) Part4: Time triggered communication