Document Title	Requirements on Synchronized Time-Base Manager
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	420
Document Classification	Auxiliary
Document Status	Final
Part of AUTOSAR Release	4.2.1

Document Change History		
Release	**Changed by**	**Change Description**

4.2.1	AUTOSAR Release Management	• Concept "Global Time Synchronization" incorporated to replace (and by that improve) original functionality and to support new functionality, e.g.:
		  ○ support of CAN and Ethernet
		  ○ support for gateways to enable time domains spanning several busses
		• Due to deficiencies R4.0/1 content has been removed (e.g. customer API + polling of time-base providers). Exception: API to synchronize OS schedule tables.

4.1.2	AUTOSAR Release Management	• Editorial changes
4.1.1	AUTOSAR Administration	• Link Requirement with BSW Feature Document • Updating format of requirements according to TPS_StandardizationTemplate
3.1.5	AUTOSAR Administration	• Initial Release

Disclaimer

Advice for users

AUTOSAR specifications may contain exemplary items (exemplary reference models, "use cases", and/or references to exemplary technical solutions, devices, processes or software).

Any such exemplary items are contained in the specifications for illustration purposes only, and they themselves are not part of the AUTOSAR Standard. Neither their presence in such specifications, nor any later documentation of AUTOSAR conformance of products actually implementing such exemplary items, imply that intellectual property rights covering such exemplary items are licensed under the same rules as applicable to the AUTOSAR Standard.

Table of Contents

1 Scope of Document

The purpose of this document is to define the functional and non-functional requirements of the Synchronized Time-Base Manager (StbM) module. The StbM module provides synchronized time bases to its customers.

The StbM module is located in the service layer of the AUTOSAR ECU SW Architecture as defined in [4].

2 Conventions to be used

- In requirements, the following specific semantics shall be used (based on the Internet Engineering Task Force IETF).

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

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

- The representation of requirements in AUTOSAR documents follows the table specified in [3]

3 Acronyms, Abbreviations, and Definitions

For a complete set of Abbreviations and Definitions refer to the corresponding chapter in [5].

4 Functional Overview

Figure 1 illustrates how the Synchronized Time-Base Manager interacts with other modules.

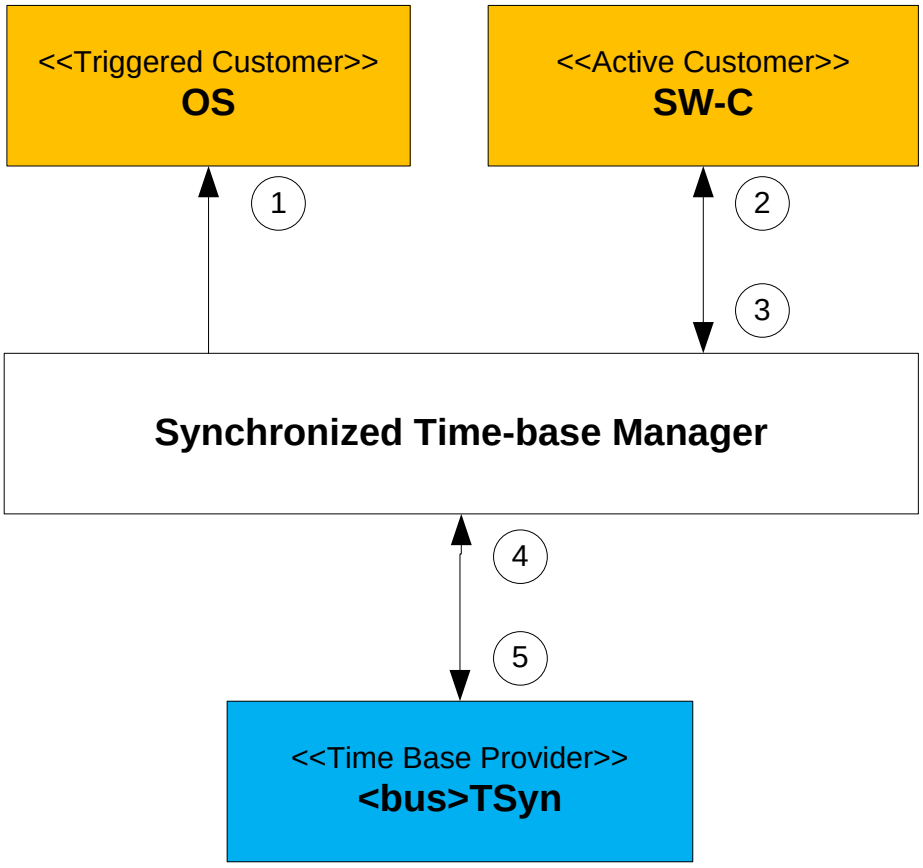

Figure 1: Synchronized Time-Base Manager as broker

The Synchronized Time-base Manager itself does not provide means like network time protocols or time agreement protocols to synchronize its (local) time bases to time bases on other nodes. It interacts with the <bus>TSyn modules of the BSW to achieve such synchronization. Those modules take as shown in Figure 1 the role of a *Time Base Provider* and support above mentioned time protocols.

With the information retrieved from the provider modules, the Synchronized Time-Base Manager is able to synchronize its time bases to time bases on other nodes.

BSW modules and SW-C, which take the role of a customer, consume the time information provided and managed by the Synchronized Time-Base Manager. 2 types of customers may be distingushed:

a) Triggered customer
This kind of customer is triggered by the Synchronized Time-Base Manager (arrow “1” in Figure 1). Thus, the Synchronized Time-Base Manager itself is aware of the required functionality of the customer, and uses the defined interface of the customer to access it. This functionality is currently limited to synchronization of OS ScheduleTables.

b) Active customer
This kind of customer autonomously calls the Synchronized Time-Base Manager either
- To read time information (arrow “2” in Figure 1) from the Synchronized Time-Base Manager or
- To update (arrow “3” in Figure 1) the timebase maintained by the Synchronized Time-Base Manager according to application information.

Thus, the Synchronized Time-Base Manager acts as time base broker by offering the customers access to synchronized time bases. Doing so, the Synchronized Time-Base Manager abstracts from the “real” time base provider.

4.1 Use Cases

2 main use cases are supported by the Synchronized Time-Base Manager:

1. **Synchronization of RunnableEntities**

   An arbitrary number of RunnableEntities must be executed synchronously. Synchronous means that they shall start with a well-defined and guaranteed relative offset (e.g. relative offset “0”, means the execution shall occur at the same point in time).

   Such a requirement can be specified by the AUTOSAR Timing Extensions [2] and must be fulfilled independently of the actual deployment of the software components.

   Typcial examples of this use case are the sensor data read out or synchronous actuator triggering by different RunnableEntities.

2. **Provision of absolute time value**

   The application (and other BSW modules) shall provide a central module that is responsible for the provision of information about the absolute time and passage of time.

   Typical examples of this use case are:
   - Sensor data fusion: Data from various sensor systems like radar or stereo multi-purpose cameras can be temporally correlated.
   - Event data recording: In some cases, e.g. crash, it is desirable to store data about the events and the internal state of different ECUs. For a temporal correlation of these events and states a common time base is required.
   - Access to synchronized calendar time for diagnostic events storage.

5 Requirements

This chapter describes all requirements driving the specification of the Synchronized Time-Base Manager.

5.1 Timebase Management

5.1.1 Limitations

The concept is targeted at supporting time-critical and safety-related automotive applications such as airbag systems and braking systems. This doesn't mean that the concept has all that is required by such systems though, but crucial timing-related features that cannot be deferred to implementation are considered.

In statically defined vehicle networks no dynamic, time consuming protocols are needed. Therefore, for time synchronization over Ethernet, the BMCA protocol like specified in [6] shall not be supported.

5.1.2 Functional Requirements

5.1.2.1 Configuration

5.1.2.1.1 [SRS_StbM_20001] The StbM configuration shall allow the interaction with different types of customers

⌜

Type:	Valid
Description:	The configuration of the Synchronized Time-Base Manager shall allow the interaction with different types of customers. The Synchronized Time-Base Manager is a service that should provide a time base (if requested) in such a way : a) it triggers interfaced SW-C and BSW (this functionality is currently limited to OS Schedule Tables) b) it provides the time base on demand when the customer asks for it The customer shall have the possibility to choose the desired interaction with the Synchronized Time-Base Manager.
Rationale:	It is necessary to have a configurable interface which allows the application of the Synchronized Time-Base Manager in different architectures (e.g. safety-related or not).
Use Case:	There exist applications (e.g. with safety-related background) that need to be triggered by the Synchronized Time-Base Manager in order to fulfil the functional requirement (e.g. the OS ScheduleTable must be synchronized by the Synchronized Time-Base Manager actively). However, in many other applications (e.g. DEM functionality), the Synchronized Time-Base Manager reacts on demand.
Dependencies:	--
Supporting Material:	--

⌟(RS_BRF_01432)

5.1.2.1.2 [SRS_StbM_20023] The StbM configuration shall allow the StbM to support different roles for a time base

⌜

Type:	Valid

Description:	The StbM configuration shall allow the StbM to fulfill 3 different roles: - Time Master - Time Slave - Time Gateway with respect to Global (vehicle wide) Time synchronization. In each role specific functionality is enabled / disabled.
Rationale:	Support of specific communication port role in a given Time Domain.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.1.3 [SRS_StbM_20024] The StbM configuration shall allow the StbM to support different types of time base providers

⌈

Type:	Valid
Description:	The StbM shall support 2 types of time base providers: - those, which maintain the time base themselves, supported by hardware, (e.g. Ethernet) - those, who leave maintenance of the time base to the StbM. The configuration depends on the capabilities of the HW and whether specific functionality of the StbM is enabled / disabled.
Rationale:	Time Base maintenance in hardware / software depends on the physical layers capability.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.2 Initialization

5.1.2.2.1 [SRS_StbM_20017] The StbM shall initialize the local time base if configured as Time Slave

⌈

Type:	Valid
Description:	If configured as Time Slave the StbM shall use the Local Time Base while no valid Global Time Base is available (e.g. at startup)
Rationale:	Startup with a defined Time Base.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.2.2 [SRS_StbM_20018] The StbM shall initialize the local time base with 0 at startup if configured as Time Slave

⌈

Type:	Valid
Description:	If configured as Time Slave, the StbM shall initialize the Local Time Base with 0 at startup.
Rationale:	Startup with a network wide common Time Base value.

Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.2.3 [SRS_StbM_20019] The StbM shall initialize the global time base with a configurable startup value if configured as Time Master

⌈

Type:	Valid
Description:	If configured as Time Master, the StbM shall allow configuration of the initialization value of the Global Time Base. The initialization value can be either - a value from static configuration or - a value from non-volatile memory
Rationale:	Startup with a dedicated Time Base value. Resume of time freeze.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.3 Normal Operation

5.1.2.3.1 [SRS_StbM_20002] The StbM shall trigger registered customers

⌈

Type:	Valid
Description:	If OS is configured as triggered customer, the Synchronized Time-Base Manager shall periodically synchronize the corresponding schedule table(s) to the configured time bases.
Rationale:	The Synchronized Time-Base Manager offers the option of synchronizing the customer with the definition of time. In this case, the customer does not require any additional algorithm for synchronization, and reacts on time base synchronization by the StbM.
Use Case:	An arbitrary number of RunnableEntities must be executed synchronously. Synchronous means, that they shall start with a well defined and guaranteed relative offset (e.g. relative offset “0”, means the execution shall occur at the same point in time).
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.3.2 [SRS_StbM_20003] The StbM shall allow customers to have access to the synchronized time base

⌈

Type:	Valid
Description:	The Synchronized Time-Base Manager shall allow active customers to have access to the synchronized time base. The Synchronized Time-Base Manager shall provide an interface for customers to access the synchronized time base, i.e., to read the current time and status. The customers shall always access a synchronize time base via the Synchronized Time-Base Manager.
Rationale:	The Synchronized Time-Base Manager offers the possibility to the customers to access the definition of time if required.

Use Case:	The DEM wants to know the current definition of time in order to clock the error logging.
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.3.3 [SRS_StbM_20013] The StbM shall provide time information for time base providers

⌈

Type:	Valid
Description:	The Synchronized Time-Base Manager shall allow the time base providers to have access to time information managed by the StbM.
Rationale:	Separation of Concerns: The Synchronized Time-Base Manager does not provide its own time agreement protocol / network time protocol. The StbM leaves this to the time base providers (<bus>TSyn). However, for the time agreement protocol / network time protocol the time base providers depend on time information managed by the StbM. Thus, they need access to it.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.3.4 [SRS_StbM_20014] The StbM shall synchronize on Time Slave side its time base on reception of a Time Master value

⌈

Type:	Valid
Description:	If configured as Time Slave for a time base, the StbM shall synchronize its Local Time Base to the Global Time provided by the bus specific time base provider each time a valid time base indication from the <Bus>TSyn is received. A valid Global Time Base overwrites the Local Time Base immediately.
Rationale:	Rapid time synchronization
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.3.5 [SRS_StbM_20016] The StbM shall continuously maintain its time bases based on a time base reference clock

⌈

Type:	Valid
Description:	The StbM shall maintain its time bases based on a local reference clock. As a reference clock the StbM accesses • either an OS counter, • or, if the time base provider provides HW support for this (e.g. Ethernet), a counter in the time base provider.
Rationale:	• Allow time base providers, which are not capable to maintain their time base internally (CAN and FlexRay).

	• Availability of time information. Even if synchronization fails on the bus (for a Time Slave), the module is still be able to provide a time value.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.3.6 [SRS_StbM_20021] The StbM shall use a time format with a resolution of 1 ns

⌈

Type:	Valid
Description:	The StbM shall use independently of the time base providers the same time format, which is compatible to IEEE 802.1AS and allows for a resolution of 1ns. **Note:** The actual resolution of the time value for a time base depends on the time base provider capabilities. The StbM adjusts the time value as needed.
Rationale:	Time base harmonization between all busses regarding design of Global / Local Time Base
Use Case:	--
Dependencies:	"[6], Annex C/C1"
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.3.7 [SRS_StbM_20025] The StbM shall maintain the synchronization status of a synchronized time base

⌈

Type:	Valid
Description:	The StbM shall maintain the synchronization status of a synchronized time base and provide the customer access to this synchronization status
Rationale:	Allows time base qualification, if required by customer.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.3.8 [SRS_StbM_20026] The StbM shall allow customer on master side to set the local time

⌈

Type:	Valid
Description:	If configured as Time Master the StbM shall allow the customer to set the Global Time Base.
Rationale:	Allows Global Time Base adjustment
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.3.9 [SRS_StbM_20027] The StbM shall allow time base providers to read the offset value of a time base

⌜

Type:	Valid
Description:	The StbM shall allow time base provider modules to read the offset value of a time base.
Rationale:	Allows usage of relative time base.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌟(RS_BRF_01432)

5.1.2.3.10 [SRS_StbM_20028] The StbM shall allow customers and time base providers to set the offset value of a time base

⌜

Type:	Valid
Description:	If configured as Time Master the StbM shall allow customers and time base provider modules to set the offset value of a time base.
Rationale:	Allows usage of relative time base as Time Master.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌟(RS_BRF_01432)

5.1.2.3.11 [SRS_StbM_20029] The StbM shall allow customers to read User Data propagated via the time synchronization protocol

⌜

Type:	Valid
Description:	If configured as Time Slave the StbM shall allow customers to read User Data propagated via the time synchronization protocol.
Rationale:	Allows usage of User Data as Time Slave.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌟(RS_BRF_01432)

5.1.2.3.12 [SRS_StbM_20030] The StbM shall allow customers to set User Data propagated via the time synchronization protocol

⌜

Type:	Valid
Description:	If configured as Time Master the StbM shall allow customers to set User Data propagated via the time synchronization protocol.
Rationale:	Allows usage of User Data as Time Master.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌟(RS_BRF_01432)

5.1.2.4 Shutdown Operation

5.1.2.4.1 [SRS_StbM_20020] The StbM shall support storage of the time base at shutdown if configured as Time Master

⌈

Type:	Valid
Description:	If configured as Time Master, the StbM shall support storage of the last Global Time value to non-volatile memory at shutdown.
Rationale:	Startup with a dedicated Time Base value. Support of time freeze.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01432)

5.1.2.5 Fault Operation

5.1.2.5.1 [SRS_StbM_20007] The StbM shall provide fault detection mechanisms

⌈

Type:	Valid
Description:	The Synchronized Time-Base Manager shall provide fault detection mechanisms. It must detect the following state changes: • Loss/Re-Establishment of synchronized time bases • Errors during customer / provider call
Rationale:	Part of the vehicle dynamic subsystem must guarantee a concurrent execution of their distributed functionality. If a synchronization loss is detected, the subsystem must trigger appropriate counteractions.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_00113, RS_BRF_01432)

5.1.3 Non-Functional Requirements

5.1.3.1 Design Requirements

5.1.3.1.1 [SRS_StbM_20010] The StbM shall provide a system service interface to applications

⌈

Type:	Valid
Description:	The Synchronized Time-Base Manager shall be located in the AUTOSAR Service Layer and provide its services to customers in the application and in the BSW. It provides its services via a Standardized AUTOSAR Interface to customers in the application and via a standardized C-API to customers in the BSW.
Rationale:	A synchronized time is required by customers in application and in the BSW.
Use Case:	An application SW-C wants to get informed about the current value of a time base
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01408, RS_BRF_01432)

5.1.3.1.2 [SRS_StbM_20012] The StbM shall provide a bus independent customer interface

⌜

Type:	Valid
Description:	The StbM shall provide a bus independent customer interface and time format. The resolution of the received time base might be vary depending on the origin bus. In such cases, the StbM adjusts the time value properly. If the ECU is configured as Time Master, reading the time base value is furthermore possible.
Rationale:	Hide bus / physical layer specific details to decouple application/ customers from the lower layers
Use Case:	--
Dependencies:	The <Bus>TSyn will do the conversion to a bus independent time format.
Supporting Material:	--

⌟(RS_BRF_01000)

5.1.3.2 Resource Usage

None

5.1.3.3 Timing Requirements

None

5.2 Time Synchronisation over CAN

5.2.1.1.1 [SRS_StbM_20031] The CAN TimeSync module shall trigger time base synchronization transmission

⌈

Type:	Valid
Description:	If configured as Time Master for a time base the CAN TimeSync module shall cyclically trigger the transmission of the time synchronization protocol sequence.
Rationale:	Time synchronization protocol.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.2.1.1.2 [SRS_StbM_20032] The CAN TimeSync Module shall provide a time base after reception of a valid protocol information

⌈

Type:	Valid
Description:	If configured as Time Slave, the CAN TimeSync Module shall provide a time base after reception of a valid protocol information (SYNC + FUP message). This time base is forwarded to the StbM to update the Local Time Base.
Rationale:	Synchronization of local time base to global time base
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.2.1.1.3 [SRS_StbM_20033] The CAN TimeSync module shall support means to protect the time synchronization protocol

⌈

Type:	Valid
Description:	The CAN TimeSync module shall support means (e.g. sequence counter, CRC) to protect the time synchronization protocol against corruption of the time information.
Rationale:	Detection of wrong protocol sequences and data.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.2.1.1.4 [SRS_StbM_20034] The CAN TimeSync Module shall detect and handle timeout and integrity errors in the time synchronization protocol

⌈

Type:	Valid
Description:	The CAN TimeSync Module shall monitor the time synchronization protocol for timeout and integrity (e.g. sequence counter, CRC).
Rationale:	Error handling / detection for synchronization protocol
Use Case:	--
Dependencies:	--

Supporting Material:	--

⌋(RS_BRF_01660)

5.2.1.1.5 [SRS_StbM_20035] The CAN TimeSync module shall support a protocol for precise time measurement and synchronization over CAN

⌈

Type:	Valid
Description:	The CAN TimeSync module shall support a protocol for precise time measurement and synchronization over CAN, which is made up of a sequence of a SYNC (synchronization) and a FUP (follow-up) message to achieve higher precision.
Rationale:	Basic time synchronization mechanism.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.2.1.1.6 [SRS_StbM_20036] The CAN TimeSync module shall use the time measurement and synchronization protocol to transmit and receive an offset value

⌈

Type:	Valid
Description:	Additionally to the actual timestamp the CAN TimeSync module shall support transmission / reception of an offset value via the time measurement and synchronization protocol, which is made up of a sequence of an OFS (offset synchronization) and an OFNS (offset adjustment) message.
Rationale:	Additional offset time synchronization mechanism.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.2.1.1.7 [SRS_StbM_20037] The CAN TimeSync module shall support user specific data within the time measurement and synchronization protocol

⌈

Type:	Valid
Description:	The CAN TimeSync module shall support transmission / reception of a user specific data via the time measurement and synchronization protocol.
Rationale:	Allows usage of specific user data.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.2.1.1.8 [SRS_StbM_20038] The CAN TimeSync configuration shall allow the CanTSyn to support different roles for a time base

⌈

Type:	Valid
Description:	The CAN TimeSync configuration shall allow the CanTSyn to fulfill 3 different roles:

	- Time Master - Time Slave - Time Gateway with respect to Global (vehicle wide) Time synchronization. In each role specific functionality is enabled / disabled.
Rationale:	Support of specific communication port role in a given Time Domain.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.3 Time Synchronisation over Flexray

5.3.1.1.1 [SRS_StbM_20039] The FlexRay TimeSync module shall trigger time base synchronization transmission

⌈

Type:	Valid
Description:	If configured as Time Master for a time base the FlexRay TimeSync module shall cyclically trigger the transmission of the time synchronization protocol sequence.
Rationale:	Time synchronization protocol.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.3.1.1.2 [SRS_StbM_20040] The FlexRay TimeSync module shall provide a time base after reception of a valid protocol information

⌈

Type:	Valid
Description:	If configured as Time Slave, the FlexRay TimeSync Module shall provide a time base after reception of a valid protocol information (SYNC message). This time base is forwarded to the StbM to update the Local Time Base.
Rationale:	Synchronization of local time base to global time base
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.3.1.1.3 [SRS_StbM_20041] The FlexRay TimeSync module shall support means to protect the time synchronization protocol

⌈

Type:	Valid
Description:	The FlexRay TimeSync module shall support means (e.g. sequence counter, CRC) to protect the time synchronization protocol against corruption of the time information.
Rationale:	Detection of wrong protocol sequences and data.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.3.1.1.4 [SRS_StbM_20042] The FlexRay TimeSync Module shall detect and handle timeout and integrity errors in the time synchronization protocol

⌈

Type:	Valid
Description:	The FlexRay TimeSync module shall monitor the time synchronization protocol for timeout and integrity (e.g. sequence counter, CRC).
Rationale:	Error handling / detection for synchronization protocol
Use Case:	--
Dependencies:	--

Supporting Material:	--

⌋(RS_BRF_01660)

5.3.1.1.5 [SRS_StbM_20043] The FlexRay TimeSync module shall support a protocol for precise time measurement and synchronization over FlexRay

⌈

Type:	Valid
Description:	The FlexRay TimeSync module shall support a protocol for precise time measurement and synchronization over FlexRay, which is made up of a sequence of SYNC (synchronization) messages.
Rationale:	Basic time synchronization mechanism.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.3.1.1.6 [SRS_StbM_20044] The FlexRay TimeSync module shall use the time measurement and synchronization protocol to transmit and receive an offset value

⌈

Type:	Valid
Description:	Additionally to the actual timestamp the FlexRay TimeSync module shall support transmission / reception of an offset value via the time measurement and synchronization protocol, which is made up of a sequence of OFS (offset synchronization) messages.
Rationale:	Additional offset time synchronization mechanism.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.3.1.1.7 [SRS_StbM_20045] The FlexRay TimeSync module shall support user specific data within the time measurement and synchronization protocol

⌈

Type:	Valid
Description:	The FlexRay TimeSync module shall support transmission / reception of a user specific data via the time measurement and synchronization protocol.
Rationale:	Allows usage of specific user data.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋()

5.3.1.1.8 [SRS_StbM_20046] The FlexRay TimeSync configuration shall allow the FrTSyn to support different roles for a time base

⌈

Type:	Valid
Description:	The FlexRay TimeSync configuration shall allow the FrTSyn to fulfill 3 different roles: - Time Master

	- Time Slave - Time Gateway with respect to Global (vehicle wide) Time synchronization. In each role specific functionality is enabled / disabled.
Rationale:	Support of specific communication port role in a given Time Domain.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.4 Time Synchronisation over Ethernet

5.4.1.1.1 [SRS_StbM_20047] The Ethernet TimeSync module shall trigger time base synchronization transmission

⌈

Type:	Valid
Description:	If configured as Time Master for a time base the Ethernet TimeSync module shall cyclically trigger the transmission of the time synchronization protocol sequence.
Rationale:	Time synchronization protocol.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.4.1.1.2 [SRS_StbM_20048] The Ethernet TimeSync module shall support IEEE 802.1AS

⌈

Type:	Valid
Description:	The Ethernet TimeSync module shall support IEEE 802.1AS “[6], chapter 11” in terms of `Sync`, `Follow_Up` (time synchronization) and `Pdelay_Req`, `Pdelay_Resp`, `Pdelay_Resp_Follow_Up` (delay measurement).
Rationale:	Time synchronization protocol.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.4.1.1.3 [SRS_StbM_20049] The Ethernet TimeSync module shall provide access to the local time stamp unit in the Ethernet HW

⌈

Type:	Valid
Description:	The Ethernet TimeSync module shall provide access for users (i.e. the StbM) to the local time stamp unit in the Ethernet HW. The Ethernet TimeSync module shall access the Ethernet HW via the EthIf.
Rationale:	Allow customers (of the StbM) to access current time base maintained by Ethernet HW.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.4.1.1.4 [SRS_StbM_20050] The Ethernet TimeSync module shall support rate correction

⌈

Type:	Valid
Description:	The Ethernet TimeSync module shall correct the local time (maintained in Ethernet HW), if Global Time Base and local time drift apart.
Rationale:	Avoid that Global Time Base and local time drift apart.
Use Case:	--

Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.4.1.1.5 [SRS_StbM_20051] The Ethernet TimeSync module shall detect and handle errors in synchronization protocol / communication

⌈

Type:	Valid
Description:	The Ethernet TimeSync module shall detect and handle errors in synchronization protocol / communication (e.g. Transceiver Link State Lost).
Rationale:	Error handling / detection for synchronization protocol.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

5.4.1.1.6 [SRS_StbM_20052] The Ethernet TimeSync configuration shall allow the EthTSyn to support different roles for a time base

⌈

Type:	Valid
Description:	The Ethernet TimeSync configuration shall allow the EthTSyn to fulfill 3 different roles: - Time Master - Time Slave - Time Gateway with respect to Global (vehicle wide) Time synchronization. In each role specific functionality is enabled / disabled.
Rationale:	Support of specific communication port role in a given Time Domain.
Use Case:	--
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01660)

6 References

6.1 AUTOSAR Deliverables

[1] Glossary
AUTOSAR_TR_Glossary.pdf
[2] Specification of Timing Extensions
AUTOSAR_TPS_TimingExtensions.pdf
[3] Software Standardization Template
AUTOSAR_TPS_StandardizationTemplate.pdf
[4] Layered Software Architecture
AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf
[5] Requirements on Synchronized Time-Base Manager
AUTOSAR_SWS_SynchronizedTimeBaseManager.pdf

6.2 Related standards and norms

[6] IEEE Standard 802.1AS™- 30 of March 2011
http://standards.ieee.org/getieee802/download/802.1AS-2011.pdf
[7] IEC 7498-1 The Basic Model, IEC Norm, 1994