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## Document Change History

| Date | Release | Changed by | Change Description |
|---|---|---|---|
| 2021-11-25 | R21-11 | AUTOSAR Release Management | • Support for CAN HW timestamping added<br>• API for cloning of timebases added<br>• Rate correction of the sync reception delay added<br>• Several minor clarifications and corrections |
| 2020-11-30 | R21-11 | AUTOSAR Release Management | • Update for Time Validation feature - support for time gateways - ring buffer added to pDelay data<br>• New interface Set/GetBusProtocolParam added to access bus specific protocol parameters<br>• Attribute “Variation” of the R-Port MeasurementNotification and DET Error from StbM_BusGetCurrentTime() and StbM_BusSetGlobalTime() APIs corrected<br>• Timesync definitions moved to RS_TimeSync |
| 2019-11-28 | R19-11 | AUTOSAR Release Management | • Time Validation (draft)<br>• Multicore Distribution support (draft)<br>• Clarification regarding behavior when Time Stamp or User Data is invalid<br>• Clarification on StbM ‘Time Notifications’ Feature<br>• Changed Document Status from Final to published |

# Document Change History

| Date | Release | Changed by | Change Description |
|---|---|---|---|
| 2018-10-31 | 4.4.0 | AUTOSAR Release Management | • Modifications to enhance the precision of Global Time Synchronization<br>• Additional minor corrections / clarifications / editorial changes; For details please refer to the ChangeDocumentation |
| 2017-12-08 | 4.3.1 | AUTOSAR Release Management | • Corrections and clarification on how to apply rate correction<br>• Clarifications on Time Base Status and Time Leap behavior<br>• Additional minor corrections / clarifications / editorial changes; For details please refer to the ChangeDocumentation |
| 2016-11-30 | 4.3.0 | AUTOSAR Release Management | • Rate Correction added<br>• Time precision measurement support added<br>• Time/status notification mechanism added<br>• Various enhancements and corrections |
| 2015-07-31 | 4.2.2 | AUTOSAR Release Management | • Config parameter argument added to StbM_Init<br>• StbM_TimeStampRawType changed uint32<br>• StbM_BusSetGlobalTime allow NULL as userDataPtr<br>• 'const' added to input arguments passed by pointer<br>• Debugging support marked as obsolete |

# Document Change History

| Date | Release | Changed by | Change Description |
|---|---|---|---|
| 2014-10-31 | 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.:<br>• support of CAN and Ethernet<br>• support for gateways to enable time domains spanning several busses<br>• 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. |
| 2014-03-31 | 4.1.3 | AUTOSAR Release Management | • Clarification on Autonomous Time Maintenance |
| 2013-10-31 | 4.1.2 | AUTOSAR Release Management | • Parameter StbMMainFunctionPeriod added<br>• Requirements StbM_0030 and 00035 removed<br>• Restructuring of and clarification w.r.t. Service Interface related chapters<br>• Parameters StbMFlexRayClusterRef / StbMTtcanClusterRef set to obsolete<br>• Editorial changes<br>• Removed chapter(s) on change documentation |
| 2013-03-15 | 4.1.1 | AUTOSAR Administration | • Added “Known Limitations”<br>• Contradictions in error handling removed<br>• Added chapter service interfaces<br>• Added Subchapter 3.x due to SWS General Rollout<br>• Reworked according to the new SWS_BSWGeneral |
| 2011-12-22 | 4.0.3 | AUTOSAR Administration | • Added functionality for absolute time provision |

| Document Change History | | | |
|---|---|---|---|
| **Date** | **Release** | **Changed by** | **Change Description** |
| 2010-09-30 | 3.1.5 | AUTOSAR Administration | • SRS_General: SRS_BSW_00004<br>• Binding character of the Standardized AUTOSAR Interfaces mentioned in the SWS Documents.<br>• Missing Port Driver DET Error Codes |
| 2010-02-02 | 3.1.4 | AUTOSAR Administration | • Initial Release |

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# Table of Contents

# 1 Introduction and Functional Overview

This document specifies the functionality, API and the configuration of the Synchronized Time-Base Manager (StbM) module.

The purpose of the Synchronized Time-Base Manager is to provide Synchronized Time Bases to its customers, i.e., time bases, which are synchronized with time bases on other nodes of a distributed system.

## 1.1 Use Cases

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

- **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 [10] 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.

- **Provision of absolute or relative time value**

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

  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.

## 1.2 Functional Overview

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

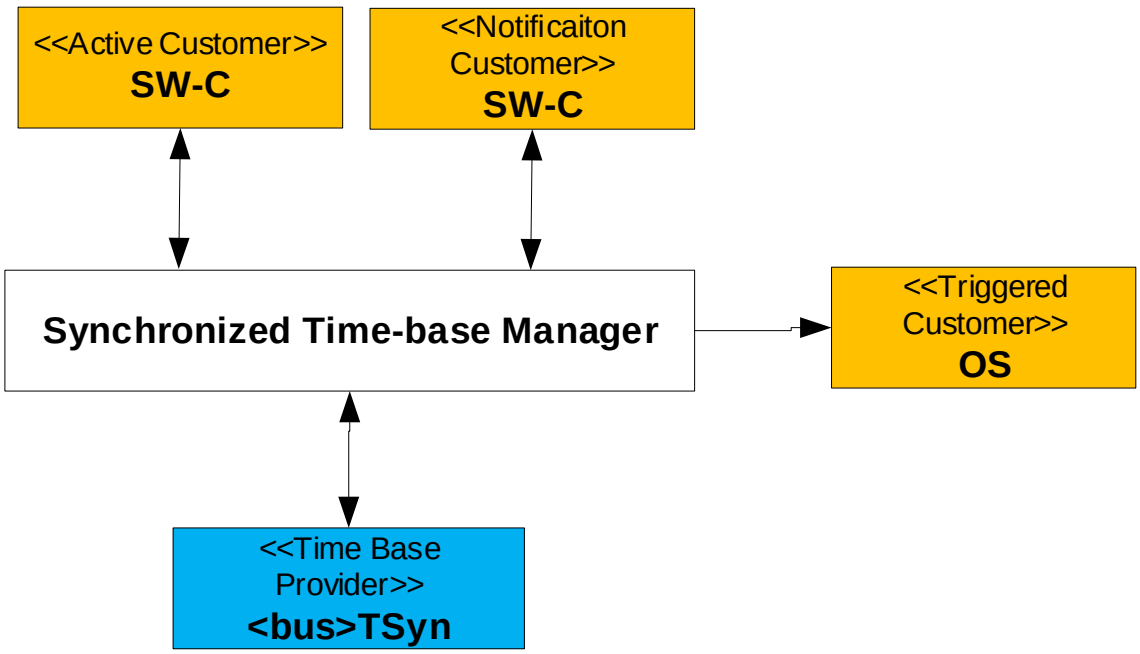


**Figure 1: Synchronized Time-Base Manager as broker**

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. Three types of customers may be distingushed:

a) Triggered customer
b) Active customer
c) Notification customer

For a detailed description of those three types refer to chapter 2.2.1.

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.

Providing access to Synchronized Time Bases between the updates of the Time Base Providers is usually realized by using a Hardware Reference Clock; often in combination with a Software Counter which keeps track of the Hardware Reference Clock’s overflows. Together Software Counter and Hardware Reference clock form

the Virtual Local Time (despite the name the Virtual Local Time is an actually realized implementation).

This time is subsequently used to drive the time of the Time Bases, taking account their Rate Deviations and Offsets to the underlying Virtual Local Time.

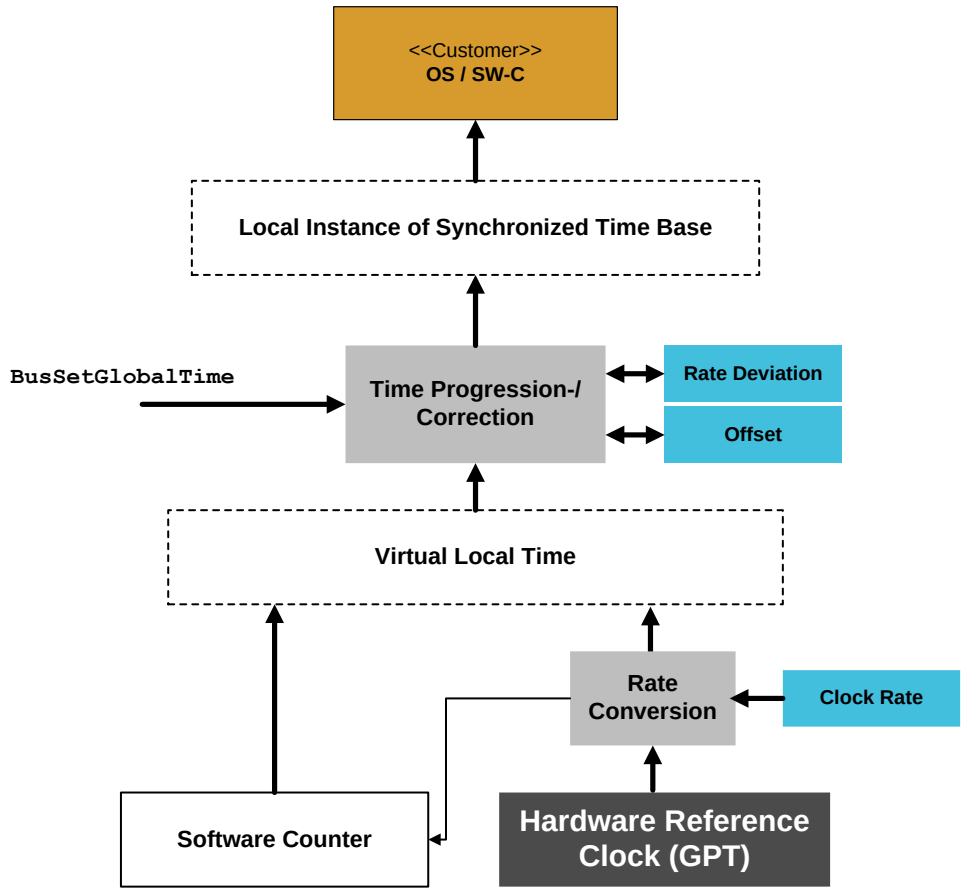


**Figure 2: Abstract Working Principle of the Synchronized Time-Base Manager**

The API for accessing the Synchronized Time Bases is provided to application software components as well as to other BSW modules:

- For the interaction with application software components, standardized AUTOSAR interfaces are specified in chapter 8.2.
- For the interaction with other BSW modules, respective interfaces are specified in chapter 8.1.3.

# 2 Acronyms, Abbreviations, and Definitions

Acronyms, abbreviations, and definitions, which have a StbM local scope and therefore are not contained in the AUTOSAR glossary or in [1], appear in this local glossary.

## 2.1 Acronyms and Abbreviations

| Abbreviation / Acronym: | Description |
|---|---|
| (G)TD | (Global) Time Domain |
| (G)TM | (Global)Time Master |
| <Bus>TSyn | A bus specific Time Synchronization Provider module |
| AVB | Audio Video Bridging |
| BMCA | Best Master Clock Algorithm |
| CAN | Controller Area Network |
| CanTSyn | Time Synchronization Provider module for CAN |
| DET | Default Error Tracer |
| ECU | Electronic Control Unit |
| ETH | Ethernet |
| EthTSyn | Time Synchronization Provider module for Ethernet |
| FR | FlexRay |
| FRC | Free running counter |
| FrTSyn | Time Synchronization Provider module for FlexRay |
| FUP message | Follow-Up message for a Synchronized Time Base |
| GM(C) | Grand Master (Clock) |
| GTS | Global Time Synchronization |
| OFNS message | Time Synchronization message for an Offset Time Base (containing the nanosecond part of the time) |
| OFS message | Time Synchronization message for an Offset Time Base |
| PTP | Precision Time Protocol |
| StbM | Synchronized Time-Base Manager |
| SYNC message | Time Synchronization message for a Synchronized Time Base |
| TG | Time Gateway |
| Timesync | Time Synchronization |
| TS | Time Slave |
| TSD | Time Sub-domain |
| TSP | Time Synchronization Provider |

## 2.2 Definitions

### 2.2.1 Time Base Customer

**a) Active Customer**
This kind of customer autonomously calls the Synchronized Time-Base Manager either

- to read time information from the Synchronized Time-Base Manager or
- to update the Time Base maintained by the Synchronized Time-Base Manager according to application information.

**b) Triggered Customer**

This kind of customer is triggered by the Synchronized Time-Base Manager. 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.

**c) Notification Customer**

This kind of customer is notified by the Synchronized Time-Base Manager, if the following Time Base related events occur:

- Time Base status has changed (e.g. a timeout has occurred for a Time Base)
- Time Base value has reached a given value, which has been previously set by the customer.

# 3 Related documentation

## 3.1 Input documents

[1] Requirements on Time Synchronization
AUTOSAR_RS_TimeSync.pdf

[2] Layered Software Architecture
AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf

[3] Specification of ECU Configuration
AUTOSAR_TPS_ECUConfiguration.pdf

[4] Specification of Operating System
AUTOSAR_SWS_OS.pdf

[5] Specification of FlexRay Interface
AUTOSAR_SWS_FlexRayInterface.pdf

[6] Specification of CAN Interface
AUTOSAR_SWS_CANInterface.pdf

[7] Virtual Functional Bus
AUTOSAR_EXP_VFB.pdf

[8] Software Component Template
AUTOSAR_TPS_SoftwareComponentTemplate.pdf

[9] Basic Software Module Description Template
AUTOSAR_TPS_BSWModuleDescriptionTemplate.pdf

[10] Specification of TimingExtensions
AUTOSAR_TPS_TimingExtensions.pdf

[13] General Requirements on Basic Software Modules
AUTOSAR_SRS_BSWGeneral.pdf

[14] General Specification of Basic Software Modules
AUTOSAR_SWS_BSWGeneral.pdf

[15] Specification of RTE
AUTOSAR_SWS_RTE.pdf

[16] Complex Driver design and integration guideline
AUTOSAR_EXP_CDDDesignAndIntegrationGuideline.pdf

[17] System Template
AUTOSAR_TPS_SystemTemplate

[19] Guide to BSW Distribution
AUTOSAR_EXP_BSWDistributionGuide.pdf

## 3.2 Related standards and norms

[18] IEEE Standard 802.1AS™- 30 of March 2011
http://standards.ieee.org/getieee802/download/802.1AS-2011.pdf

## 3.3 Related specification

AUTOSAR provides a General Specification on Basic Software modules [14] (SWS BSW General), which is also valid for the Synchronized Time-Base Manager.

Thus, the specification SWS BSW General shall be considered as additional and required specification for the Synchronized Time-Base Manager.

# 4 Constraints and assumptions

## 4.1 Limitations

The current module proposal has a number of limitations for the application of the Synchronized Time-Base Manager within an AUTOSAR system.

### 4.1.1 OS ScheduleTable

The Synchronized Time-Base Manager shall perform the functionality of synchronizing OS ScheduleTables with a respective Synchronized Time Base. However, the StbM considers only the case when the targeted OS ScheduleTable is **explicitly** synchronized. The **implicit** synchronization does not affect the StbM, because the synchronization mechanism bypasses the module (for more information about the difference between explicit and implicit synchronization, please refer to [4]). Thus, when talking in the following about synchronization of OS ScheduleTables, always the explicit one is meant.

### 4.1.2 Synchronized Time Base Identifier

The `StbMSynchronizedTimeBaseIdentifier` range (128 .. 65535) is currently reserved and might still be used by legacy applications (implementing Triggered Customers). The ID range will however be reassigned to new features in the next release. Legacy applications will then no longer be supported.

### 4.1.3 Mode switches

The Synchronized Time-Base Manager does not deal with mode switches during runtime.

### 4.1.4 Configuration

- Postbuild configuration of the StbM is limited to enabling or disabling the functionality of a system wide Global Time Master for a Time Base (refer to **ECUC_StbM_00036 :** ).

### 4.1.5 Out of scope

- Errors, which occurred during Global Time establishment and which are not caused by the module itself (e.g. loss of FlexRay global time is a FlexRay issue and is not an issue of the Synchronized Time-Base Manager).
- Errors, which occurred during interaction with *customers*.
  Example: Calling the explicit OS ScheduleTable synchronization may cause an exception, because the delta between the submitted parameter “counterValue” and the OS internal counter is higher than the tolerance range

of affected expiry points. Dealing with this exception is an OS issue, not an issue of the Synchronized Time-Base Manager.

## 4.2 Applicability to car domains

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.

## 4.3 Conflicts

None.

# 5 Dependencies to other modules

## 5.1 Code file structure

For details refer to the chapter 5.1.6 “Code file structure” in SWS BSW General [14]

## 5.2 Header file structure

For details, refer to the section 5.1.7 " Header file structure" of the SWS BSW General [14].

In addition to the files defined in section 5.1.7 “Header file structure” of the SWS BSW General, the StbM needs to include the file Os.h, CanIf.h, EthIf.h and Gpt.h.

**[SWS_StbM_00065]⌈**
If a triggered customer is configured (refer to **ECUC_StbM_00004 :** `StbMTriggeredCustomer`), StbM.c shall include Os.h to have access to the schedule table interface of the OS.
⌋ (SRS_BSW_00384)

**[SWS_StbM_00246]⌈**
If time stamping via Ethernet shall be supported (refer to `EthIfGlobalTimeSupport`, which is referenced via `StbMLocalTimeHardware` **ECUC_StbM_00053 : ,** if set to `EthTSynGlobalTimeDomain`), StbM.c shall include EthIf.h to have access to the interface of the EthIf module.
⌋(SRS_BSW_00384)

**[SWS_StbM_00538]** {DRAFT} **⌈**
If CAN hardware timestamping is supported (refer to configuration parameter `CanIfGlobalTimeSupport` in CanIf, which is referenced via **ECUC_StbM_00053 :** `StbMLocalTimeHardware`**,** if set to `CanTSynGlobalTimeDomain`), StbM.c shall include CanIf.h to have access to the interface of the CanIf module.
⌋(SRS_BSW_00384, RS_TS_20070)

[**SWS_StbM_00426]⌈**
If time stamping via GPT shall be supported (which is referenced via `StbMLocalTimeHardware` (**ECUC_StbM_00053 :** ), if set to `GptChannelConfiguration`), StbM.c shall include Gpt.h to have access to the interface of the GPT module.
⌋ (RS_TS_00017, RS_TS_00002)

# 6 Requirements traceability

| Requirement | Description | Satisfied by |
|---|---|---|
| RS_TS_00002 | The Implementation of Time Synchronization shall maintain its own Time Base independently of the acting role. | SWS_StbM_00178, SWS_StbM_00180, SWS_StbM_00342, SWS_StbM_00413, SWS_StbM_00426, SWS_StbM_00433, SWS_StbM_00512 |
| RS_TS_00003 | The TS shall initialize the Local Time Base with a configurable startup value | SWS_StbM_00170 |
| RS_TS_00004 | The Implementation of Time Synchronization shall initialize the Global Time Base with a configurable startup value. | SWS_StbM_00171 |
| RS_TS_00005 | The Implementation of Time Synchronization shall allow customers to have access to the Synchronized Time Base | SWS_StbM_00142, SWS_StbM_00173, SWS_StbM_00195, SWS_StbM_00200, SWS_StbM_00240, SWS_StbM_00244, SWS_StbM_00247, SWS_StbM_00248, SWS_StbM_00261, SWS_StbM_00262, SWS_StbM_00263, SWS_StbM_00267, SWS_StbM_00434, SWS_StbM_00435, SWS_StbM_00436, SWS_StbM_91005 |
| RS_TS_00006 | The Implementation of Time Synchronization shall provide time information to TSP modules | SWS_StbM_00173, SWS_StbM_00195, SWS_StbM_00434, SWS_StbM_00435, SWS_StbM_00436, SWS_StbM_00437, SWS_StbM_91005, SWS_StbM_91006 |
| RS_TS_00007 | The Implementation of Time Synchronization shall synchronize the Time Base of a Time Slave, on reception of a Time Master value | SWS_StbM_00179, SWS_StbM_00233, SWS_StbM_00393, SWS_StbM_00438, SWS_StbM_00439, SWS_StbM_00528, SWS_StbM_00529 |
| RS_TS_00008 | The Implementation of Time Synchronization shall continuously maintain its Time Bases based on a Time Base reference clock | SWS_StbM_00178, SWS_StbM_00180, SWS_StbM_00413, SWS_StbM_00433, SWS_StbM_00437, SWS_StbM_00512, SWS_StbM_00515, SWS_StbM_00539, SWS_StbM_91006 |
| RS_TS_00009 | The Implementation of Time Synchronization shall maintain the synchronization status of a Time Base | SWS_StbM_00179, SWS_StbM_00181, SWS_StbM_00182, SWS_StbM_00183, SWS_StbM_00184, SWS_StbM_00185, SWS_StbM_00187, SWS_StbM_00239, SWS_StbM_00305, SWS_StbM_00393, SWS_StbM_00399, SWS_StbM_00425, SWS_StbM_00438, SWS_StbM_00439, SWS_StbM_00528, SWS_StbM_00529, SWS_StbM_91003 |
| RS_TS_00010 | The Implementation of Time Synchronization shall allow customer on master side to set the Global Time | SWS_StbM_00213, SWS_StbM_00240, SWS_StbM_00244, SWS_StbM_00300, SWS_StbM_00342, SWS_StbM_00385 |
| RS_TS_00011 | The Implementation of Time Synchronization shall allow customers on master side to | SWS_StbM_00240, SWS_StbM_00344, SWS_StbM_00346, SWS_StbM_00347, SWS_StbM_00350, SWS_StbM_00351, |

| | | |
|---|---|---|
| | trigger time transmission by the TSP module | SWS_StbM_00414 |
| RS_TS_00012 | The Implementation of Time Synchronization shall allow customers and TSP modules to read the offset value of an Offset Time Base | SWS_StbM_00191, SWS_StbM_00193, SWS_StbM_00228 |
| RS_TS_00013 | The Implementation of Time Synchronization shall allow the customers and TSP modules to set the offset value of an Offset Master Time Base | SWS_StbM_00177, SWS_StbM_00190, SWS_StbM_00191, SWS_StbM_00192, SWS_StbM_00193, SWS_StbM_00223, SWS_StbM_00240, SWS_StbM_00244, SWS_StbM_00304 |
| RS_TS_00014 | The Implementation of Time Synchronization shall allow customers to read User Data propagated via the TSP modules. | SWS_StbM_00173, SWS_StbM_00192, SWS_StbM_00195, SWS_StbM_00200, SWS_StbM_00243, SWS_StbM_00247, SWS_StbM_00248, SWS_StbM_00434, SWS_StbM_00435, SWS_StbM_00436, SWS_StbM_91005 |
| RS_TS_00015 | The Implementation of Time Synchronization shall allow customers to set User Data propagated via the TSP modules. | SWS_StbM_00190, SWS_StbM_00218, SWS_StbM_00240, SWS_StbM_00243, SWS_StbM_00244, SWS_StbM_00381, SWS_StbM_00398, SWS_StbM_00427 |
| RS_TS_00016 | The Implementation of Time Synchronization shall notify customers about status events | SWS_StbM_00277, SWS_StbM_00279, SWS_StbM_00280, SWS_StbM_00284, SWS_StbM_00285, SWS_StbM_00286, SWS_StbM_00287, SWS_StbM_00288, SWS_StbM_00290, SWS_StbM_00299, SWS_StbM_00345, SWS_StbM_00526 |
| RS_TS_00017 | The Implementation of Time Synchronization shall notify customers about elapsed pre-defined time span. | SWS_StbM_00247, SWS_StbM_00270, SWS_StbM_00271, SWS_StbM_00272, SWS_StbM_00273, SWS_StbM_00274, SWS_StbM_00275, SWS_StbM_00276, SWS_StbM_00288, SWS_StbM_00301, SWS_StbM_00335, SWS_StbM_00336, SWS_StbM_00337, SWS_StbM_00409, SWS_StbM_00421, SWS_StbM_00426, SWS_StbM_00432, SWS_StbM_91004 |
| RS_TS_00018 | The Implementation of Time Synchronization shall support rate correction | SWS_StbM_00352, SWS_StbM_00353, SWS_StbM_00355, SWS_StbM_00356, SWS_StbM_00359, SWS_StbM_00360, SWS_StbM_00361, SWS_StbM_00362, SWS_StbM_00364, SWS_StbM_00366, SWS_StbM_00367, SWS_StbM_00368, SWS_StbM_00370, SWS_StbM_00371, SWS_StbM_00372, SWS_StbM_00373, SWS_StbM_00374, SWS_StbM_00375, SWS_StbM_00376, SWS_StbM_00377, SWS_StbM_00378, SWS_StbM_00390, SWS_StbM_00395, SWS_StbM_00396, SWS_StbM_00397, SWS_StbM_00400, SWS_StbM_00411, SWS_StbM_00412, SWS_StbM_00422, SWS_StbM_00424, SWS_StbM_00431, SWS_StbM_00440, SWS_StbM_00441, SWS_StbM_00442, |

| | | |
|---|---|---|
| | | SWS_StbM_00443, SWS_StbM_00527 |
| RS_TS_00019 | The Implementation of Time Synchronization shall support damping offset correction | SWS_StbM_00356 |
| RS_TS_00021 | The Implementation of Time Synchronization shall provide interfaces to query the synchronization status | SWS_StbM_00262 |
| RS_TS_00024 | The Implementation of Time Synchronization shall support storage of the Time Base value at shutdown if configured as Time Master | SWS_StbM_00172 |
| RS_TS_00025 | The Implementation of Time Synchronization shall provide fault detection mechanisms | SWS_StbM_00031, SWS_StbM_00183, SWS_StbM_00187, SWS_StbM_00199 |
| RS_TS_00029 | The configuration of the Time Synchronization implementation shall allow the implementation to behave as a (vehicle wide) Time Master | SWS_StbM_00195, SWS_StbM_00213, SWS_StbM_00223, SWS_StbM_00228, SWS_StbM_00244, SWS_StbM_00408, SWS_StbM_00490, SWS_StbM_00491, SWS_StbM_00492, SWS_StbM_91001, SWS_StbM_91002, SWS_StbM_91005 |
| RS_TS_00030 | The configuration of the Time Synchronization implementation shall allow the implementation to behave as a Time Slave | SWS_StbM_00195, SWS_StbM_00233, SWS_StbM_00248, SWS_StbM_00484, SWS_StbM_00485, SWS_StbM_00486 |
| RS_TS_00031 | The configuration of the Time Synchronization implementation shall allow the implementation to behave as a Time Gateway | SWS_StbM_00195, SWS_StbM_00228, SWS_StbM_00233, SWS_StbM_00248, SWS_StbM_00484, SWS_StbM_00485, SWS_StbM_00486, SWS_StbM_00490, SWS_StbM_00491, SWS_StbM_00492, SWS_StbM_91005 |
| RS_TS_00032 | The Implementation of Time Synchronization shall trigger registered customers | SWS_StbM_00020, SWS_StbM_00022, SWS_StbM_00077, SWS_StbM_00084, SWS_StbM_00092, SWS_StbM_00093, SWS_StbM_00107, SWS_StbM_00142, SWS_StbM_00302, SWS_StbM_00303 |
| RS_TS_00033 | The Implementation of Time Synchronization shall use a time format with a resolution of 1 ns | SWS_StbM_00437 |
| RS_TS_00034 | The Implementation of Time Synchronization shall provide measurement data to the application | SWS_StbM_00233, SWS_StbM_00247, SWS_StbM_00306, SWS_StbM_00307, SWS_StbM_00308, SWS_StbM_00309, SWS_StbM_00310, SWS_StbM_00311, SWS_StbM_00312, SWS_StbM_00313, SWS_StbM_00314, SWS_StbM_00315, SWS_StbM_00316, SWS_StbM_00317, SWS_StbM_00318, SWS_StbM_00319, SWS_StbM_00320, SWS_StbM_00322, SWS_StbM_00323, SWS_StbM_00325, SWS_StbM_00326, SWS_StbM_00328, SWS_StbM_00329, SWS_StbM_00331, SWS_StbM_00332, SWS_StbM_00333, |

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| | | SWS_StbM_00334, SWS_StbM_00339, SWS_StbM_00382, SWS_StbM_00383, SWS_StbM_00384, SWS_StbM_00387, SWS_StbM_00388, SWS_StbM_00428, SWS_StbM_00458, SWS_StbM_00459, SWS_StbM_00460, SWS_StbM_00461, SWS_StbM_00462, SWS_StbM_00463, SWS_StbM_00465, SWS_StbM_00466, SWS_StbM_00467, SWS_StbM_00468, SWS_StbM_00469, SWS_StbM_00470, SWS_StbM_00471, SWS_StbM_00472, SWS_StbM_00473, SWS_StbM_00474, SWS_StbM_00475, SWS_StbM_00476, SWS_StbM_00477, SWS_StbM_00478, SWS_StbM_00479, SWS_StbM_00480, SWS_StbM_00481, SWS_StbM_00482, SWS_StbM_00483, SWS_StbM_00484, SWS_StbM_00485, SWS_StbM_00486, SWS_StbM_00487, SWS_StbM_00490, SWS_StbM_00491, SWS_StbM_00492, SWS_StbM_00493, SWS_StbM_00496, SWS_StbM_00497, SWS_StbM_00500, SWS_StbM_00501, SWS_StbM_00503, SWS_StbM_00504, SWS_StbM_00505, SWS_StbM_00506, SWS_StbM_00507, SWS_StbM_00508, SWS_StbM_00509, SWS_StbM_00510, SWS_StbM_00511, SWS_StbM_00522, SWS_StbM_00523, SWS_StbM_00524, SWS_StbM_00525 |
| RS_TS_00035 | The Implementation of Time Synchronization shall provide a system service interface to applications | SWS_StbM_00142, SWS_StbM_00240, SWS_StbM_00244, SWS_StbM_00247, SWS_StbM_00248, SWS_StbM_00275, SWS_StbM_00276, SWS_StbM_00286, SWS_StbM_00287, SWS_StbM_00288, SWS_StbM_00290 |
| RS_TS_00036 | The Implementation of Time Synchronization shall provide a bus independent customer interface | SWS_StbM_00241, SWS_StbM_00242 |
| RS_TS_00037 | The configuration of the Time Synchronization implementation shall allow the interaction with different types of customers | SWS_StbM_00020, SWS_StbM_00022, SWS_StbM_00093, SWS_StbM_00277, SWS_StbM_00278, SWS_StbM_00279, SWS_StbM_00282, SWS_StbM_00285, SWS_StbM_00303, SWS_StbM_00526 |
| RS_TS_00038 | The Implementation of Time Synchronization shall copy Time Base information upon user request | SWS_StbM_00530, SWS_StbM_00531, SWS_StbM_00532, SWS_StbM_00533, SWS_StbM_00534, SWS_StbM_00535, SWS_StbM_00536, SWS_StbM_91011 |
| RS_TS_20031 | The Timesync over CAN module shall trigger Time Base Synchronization transmission | SWS_StbM_00140 |
| RS_TS_20032 | The Timesync over CAN module shall provide the Time Base after reception of a valid Timesync/TS messages | SWS_StbM_00140 |

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| RS_TS_20033 | The Timesync over CAN module shall support means to protect the Time synchronization protocol | SWS_StbM_00140 |
| RS_TS_20034 | The Timesync over CAN module shall detect and handle timeout and integrity errors in the Time Synchronization protocol | SWS_StbM_00140 |
| RS_TS_20035 | The Timesync over CAN module shall support a protocol for precise time measurement and synchronization over CAN | SWS_StbM_00140 |
| RS_TS_20036 | The Timesync over CAN module shall use the time measurement and synchronization protocol to transmit and receive an offset value | SWS_StbM_00140 |
| RS_TS_20037 | The Timesync over CAN module shall support user specific data within the time measurement and synchronization protocol | SWS_StbM_00140 |
| RS_TS_20038 | The Timesync over CAN module configuration shall allow the Implementation of Time Synchronization for CAN to support different roles for a Time Base | SWS_StbM_00140 |
| RS_TS_20039 | The Timesync over FlexRay module shall trigger Time Base Synchronization transmission | SWS_StbM_00140 |
| RS_TS_20040 | The Timesync over FlexRay module shall provide a Time Base after reception of a valid protocol information | SWS_StbM_00140 |
| RS_TS_20041 | The Timesync over FlexRay module shall support means to protect the Time Synchronization protocol | SWS_StbM_00140 |
| RS_TS_20042 | The Timesync over FlexRay module shall detect and handle timeout and integrity errors in the Time Synchronization protocol | SWS_StbM_00140 |
| RS_TS_20043 | The Timesync over FlexRay module shall support a protocol for precise time measurement and synchronization over FlexRay | SWS_StbM_00140 |
| RS_TS_20044 | The Timesync over FlexRay | SWS_StbM_00140 |

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| | module shall use the time measurement and synchronization protocol to transmit and receive an offset value | |
| RS_TS_20045 | The Timesync over FlexRay module shall support user specific data within the time measurement and synchronization protocol | SWS_StbM_00140 |
| RS_TS_20046 | The configuration for Time synchronization over FlexRay shall allow the FlexRay Time Synchronization module to support different roles for a Time Base | SWS_StbM_00140 |
| RS_TS_20047 | The Timesync over Ethernet module shall trigger Time Base Synchronization transmission | SWS_StbM_00140 |
| RS_TS_20048 | The Timesync over Ethernet module shall support IEEE 802.1AS as well as AUTOSAR extensions | SWS_StbM_00140 |
| RS_TS_20051 | The Timesync over Ethernet module shall detect and handle errors in synchronization protocol / communication | SWS_StbM_00140 |
| RS_TS_20052 | The configuration of the Time Synchronization over Ethernet module shall allow the module to work as a Time Master | SWS_StbM_00140 |
| RS_TS_20053 | The configuration of the Time Synchronization over Ethernet module shall allow the module to work as a Time Slave | SWS_StbM_00140 |
| RS_TS_20054 | The Implementation of the Time Synchronization shall evaluate and propagate Time Gateway relevant information | SWS_StbM_00140 |
| RS_TS_20058 | The Timesync over Ethernet module shall provide the precision of Synchronized Time Bases | SWS_StbM_00140 |
| RS_TS_20059 | The Timesync over Ethernet module shall access all communication ports belonging to Time Synchronization | SWS_StbM_00140 |
| RS_TS_20060 | The Timesync over Ethernet module shall provide a Time | SWS_StbM_00140 |

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| | Base after reception of a valid protocol information | |
| RS_TS_20061 | The Timesync over Ethernet module shall support means to protect the Time Synchronization protocol | SWS_StbM_00140 |
| RS_TS_20062 | The Timesync over Ethernet module shall support user specific data within the time measurement and synchronization protocol | SWS_StbM_00140 |
| RS_TS_20063 | The Timesync over Ethernet module shall use the Time Synchronization protocol for Synchronized Time Bases to transmit and receive Offset Time Bases | SWS_StbM_00140 |
| RS_TS_20066 | The Timesync over Ethernet module shall support a static (pre)configuration of IEEE 802.1AS Pdelay | SWS_StbM_00140 |
| RS_TS_20068 | The Timesync over CAN module shall support classic CAN and CAN FD | SWS_StbM_00140 |
| RS_TS_20069 | The TimeSync over Ethernet module shall provide read / write access to bus protocol specific parameters | SWS_StbM_00240, SWS_StbM_00247, SWS_StbM_00516, SWS_StbM_00517, SWS_StbM_91007, SWS_StbM_91008, SWS_StbM_91009, SWS_StbM_91010 |
| RS_TS_20070 | The Timesync over CAN module shall support hardware and software timestamping | SWS_StbM_00538, SWS_StbM_00539 |
| SRS_BSW_00005 | Modules of the ÂµC Abstraction Layer (MCAL) may not have hard coded horizontal interfaces | SWS_StbM_00140 |
| SRS_BSW_00006 | The source code of software modules above the ÂµC Abstraction Layer (MCAL) shall not be processor and compiler dependent. | SWS_StbM_00140 |
| SRS_BSW_00007 | All Basic SW Modules written in C language shall conform to the MISRA C 2012 Standard. | SWS_StbM_00140 |
| SRS_BSW_00009 | All Basic SW Modules shall be documented according to a common standard. | SWS_StbM_00140 |
| SRS_BSW_00010 | The memory consumption of all Basic SW Modules shall be documented for a defined configuration for all supported platforms. | SWS_StbM_00140 |

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| SRS_BSW_00101 | The Basic Software Module shall be able to initialize variables and hardware in a separate initialization function | SWS_StbM_00052 |
| SRS_BSW_00160 | Configuration files of AUTOSAR Basic SW module shall be readable for human beings | SWS_StbM_00140 |
| SRS_BSW_00161 | The AUTOSAR Basic Software shall provide a microcontroller abstraction layer which provides a standardized interface to higher software layers | SWS_StbM_00140 |
| SRS_BSW_00162 | The AUTOSAR Basic Software shall provide a hardware abstraction layer | SWS_StbM_00140 |
| SRS_BSW_00164 | The Implementation of interrupt service routines shall be done by the Operating System, complex drivers or modules | SWS_StbM_00140 |
| SRS_BSW_00168 | SW components shall be tested by a function defined in a common API in the Basis-SW | SWS_StbM_00140 |
| SRS_BSW_00170 | The AUTOSAR SW Components shall provide information about their dependency from faults, signal qualities, driver demands | SWS_StbM_00140 |
| SRS_BSW_00172 | The scheduling strategy that is built inside the Basic Software Modules shall be compatible with the strategy used in the system | SWS_StbM_00057, SWS_StbM_00407 |
| SRS_BSW_00301 | All AUTOSAR Basic Software Modules shall only import the necessary information | SWS_StbM_00051, SWS_StbM_00058, SWS_StbM_00059 |
| SRS_BSW_00304 | All AUTOSAR Basic Software Modules shall use only AUTOSAR data types instead of native C data types | SWS_StbM_00140 |
| SRS_BSW_00305 | Data types naming convention | SWS_StbM_00142 |
| SRS_BSW_00307 | Global variables naming convention | SWS_StbM_00140 |
| SRS_BSW_00308 | AUTOSAR Basic Software Modules shall not define global data in their header files, but in the C file | SWS_StbM_00140 |
| SRS_BSW_00309 | All AUTOSAR Basic Software | SWS_StbM_00140 |

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| | Modules shall indicate all global data with read-only purposes by explicitly assigning the const keyword | |
| SRS_BSW_00312 | Shared code shall be reentrant | SWS_StbM_00140 |
| SRS_BSW_00314 | All internal driver modules shall separate the interrupt frame definition from the service routine | SWS_StbM_00140 |
| SRS_BSW_00323 | All AUTOSAR Basic Software Modules shall check passed API parameters for validity | SWS_StbM_00041, SWS_StbM_00196, SWS_StbM_00197, SWS_StbM_00201, SWS_StbM_00202, SWS_StbM_00214, SWS_StbM_00215, SWS_StbM_00219, SWS_StbM_00220, SWS_StbM_00224, SWS_StbM_00225, SWS_StbM_00229, SWS_StbM_00230, SWS_StbM_00234, SWS_StbM_00235, SWS_StbM_00264, SWS_StbM_00268, SWS_StbM_00269, SWS_StbM_00296, SWS_StbM_00298, SWS_StbM_00327, SWS_StbM_00340, SWS_StbM_00341, SWS_StbM_00348, SWS_StbM_00349, SWS_StbM_00379, SWS_StbM_00380, SWS_StbM_00386, SWS_StbM_00391, SWS_StbM_00392, SWS_StbM_00394, SWS_StbM_00404, SWS_StbM_00405, SWS_StbM_00406, SWS_StbM_00415, SWS_StbM_00416, SWS_StbM_00444, SWS_StbM_00445, SWS_StbM_00446, SWS_StbM_00447, SWS_StbM_00448, SWS_StbM_00449, SWS_StbM_00451, SWS_StbM_00452, SWS_StbM_00453, SWS_StbM_00454, SWS_StbM_00455, SWS_StbM_00456, SWS_StbM_00457, SWS_StbM_00488, SWS_StbM_00489, SWS_StbM_00494, SWS_StbM_00495, SWS_StbM_00498, SWS_StbM_00499, SWS_StbM_00502, SWS_StbM_00503, SWS_StbM_00518, SWS_StbM_00519, SWS_StbM_00520, SWS_StbM_00521, SWS_StbM_00537 |
| SRS_BSW_00325 | The runtime of interrupt service routines and functions that are running in interrupt context shall be kept short | SWS_StbM_00140 |
| SRS_BSW_00327 | Error values naming convention | SWS_StbM_00041 |
| SRS_BSW_00328 | All AUTOSAR Basic Software Modules shall avoid the duplication of code | SWS_StbM_00140 |
| SRS_BSW_00333 | For each callback function it shall be specified if it is called from interrupt context or not | SWS_StbM_00107, SWS_StbM_00273, SWS_StbM_00285 |
| SRS_BSW_00334 | All Basic Software Modules shall provide an XML file that contains the meta data | SWS_StbM_00140 |

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| SRS_BSW_00336 | Basic SW module shall be able to shutdown | SWS_StbM_00140 |
| SRS_BSW_00337 | Classification of development errors | SWS_StbM_00041, SWS_StbM_00094 |
| SRS_BSW_00339 | Reporting of production relevant error status | SWS_StbM_00058, SWS_StbM_00059 |
| SRS_BSW_00341 | Module documentation shall contains all needed informations | SWS_StbM_00140 |
| SRS_BSW_00342 | It shall be possible to create an AUTOSAR ECU out of modules provided as source code and modules provided as object code, even mixed | SWS_StbM_00140 |
| SRS_BSW_00344 | BSW Modules shall support link-time configuration | SWS_StbM_00140 |
| SRS_BSW_00347 | A Naming seperation of different instances of BSW drivers shall be in place | SWS_StbM_00140 |
| SRS_BSW_00353 | All integer type definitions of target and compiler specific scope shall be placed and organized in a single type header | SWS_StbM_00140 |
| SRS_BSW_00358 | The return type of init() functions implemented by AUTOSAR Basic Software Modules shall be void | SWS_StbM_00052 |
| SRS_BSW_00360 | AUTOSAR Basic Software Modules callback functions are allowed to have parameters | SWS_StbM_00273, SWS_StbM_00285 |
| SRS_BSW_00361 | All mappings of not standardized keywords of compiler specific scope shall be placed and organized in a compiler specific type and keyword header | SWS_StbM_00140 |
| SRS_BSW_00373 | The main processing function of each AUTOSAR Basic Software Module shall be named according the defined convention | SWS_StbM_00057 |
| SRS_BSW_00375 | Basic Software Modules shall report wake-up reasons | SWS_StbM_00140 |
| SRS_BSW_00378 | AUTOSAR shall provide a boolean type | SWS_StbM_00140 |
| SRS_BSW_00384 | The Basic Software Module specifications shall specify at least in the description which other modules they require | SWS_StbM_00065, SWS_StbM_00246, SWS_StbM_00538 |
| SRS_BSW_00385 | List possible error | SWS_StbM_00041 |

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| | notifications | |
| SRS_BSW_00386 | The BSW shall specify the configuration for detecting an error | SWS_StbM_00041, SWS_StbM_00094, SWS_StbM_00196, SWS_StbM_00197, SWS_StbM_00201, SWS_StbM_00202, SWS_StbM_00214, SWS_StbM_00215, SWS_StbM_00219, SWS_StbM_00220, SWS_StbM_00224, SWS_StbM_00225, SWS_StbM_00229, SWS_StbM_00230, SWS_StbM_00234, SWS_StbM_00235, SWS_StbM_00264, SWS_StbM_00268, SWS_StbM_00269, SWS_StbM_00296, SWS_StbM_00298, SWS_StbM_00327, SWS_StbM_00340, SWS_StbM_00341, SWS_StbM_00348, SWS_StbM_00349, SWS_StbM_00379, SWS_StbM_00380, SWS_StbM_00386, SWS_StbM_00391, SWS_StbM_00392, SWS_StbM_00394, SWS_StbM_00404, SWS_StbM_00405, SWS_StbM_00406, SWS_StbM_00415, SWS_StbM_00416, SWS_StbM_00444, SWS_StbM_00445, SWS_StbM_00446, SWS_StbM_00447, SWS_StbM_00448, SWS_StbM_00449, SWS_StbM_00451, SWS_StbM_00452, SWS_StbM_00453, SWS_StbM_00454, SWS_StbM_00455, SWS_StbM_00456, SWS_StbM_00457, SWS_StbM_00488, SWS_StbM_00489, SWS_StbM_00494, SWS_StbM_00495, SWS_StbM_00498, SWS_StbM_00499, SWS_StbM_00502, SWS_StbM_00503, SWS_StbM_00518, SWS_StbM_00519, SWS_StbM_00520, SWS_StbM_00521, SWS_StbM_00537 |
| SRS_BSW_00398 | The link-time configuration is achieved on object code basis in the stage after compiling and before linking | SWS_StbM_00140 |
| SRS_BSW_00399 | Parameter-sets shall be located in a separate segment and shall be loaded after the code | SWS_StbM_00140 |
| SRS_BSW_00400 | Parameter shall be selected from multiple sets of parameters after code has been loaded and started | SWS_StbM_00140 |
| SRS_BSW_00404 | BSW Modules shall support post-build configuration | SWS_StbM_00140 |
| SRS_BSW_00405 | BSW Modules shall support multiple configuration sets | SWS_StbM_00140 |
| SRS_BSW_00406 | A static status variable denoting if a BSW module is initialized shall be initialized with value 0 before any APIs of the BSW module is called | SWS_StbM_00100, SWS_StbM_00121 |
| SRS_BSW_00407 | Each BSW module shall provide a function to read out | SWS_StbM_00066 |

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| | the version information of a dedicated module implementation | |
| SRS_BSW_00413 | An index-based accessing of the instances of BSW modules shall be done | SWS_StbM_00140 |
| SRS_BSW_00414 | Init functions shall have a pointer to a configuration structure as single parameter | SWS_StbM_00052, SWS_StbM_00249 |
| SRS_BSW_00415 | Interfaces which are provided exclusively for one module shall be separated into a dedicated header file | SWS_StbM_00140 |
| SRS_BSW_00416 | The sequence of modules to be initialized shall be configurable | SWS_StbM_00140 |
| SRS_BSW_00417 | Software which is not part of the SW-C shall report error events only after the DEM is fully operational. | SWS_StbM_00140 |
| SRS_BSW_00422 | Pre-de-bouncing of error status information is done within the DEM | SWS_StbM_00140 |
| SRS_BSW_00426 | BSW Modules shall ensure data consistency of data which is shared between BSW modules | SWS_StbM_00140 |
| SRS_BSW_00427 | ISR functions shall be defined and documented in the BSW module description template | SWS_StbM_00140 |
| SRS_BSW_00428 | A BSW module shall state if its main processing function(s) has to be executed in a specific order or sequence | SWS_StbM_00140 |
| SRS_BSW_00429 | Access to OS is restricted | SWS_StbM_00020, SWS_StbM_00092 |
| SRS_BSW_00432 | Modules should have separate main processing functions for read/receive and write/transmit data path | SWS_StbM_00140 |
| SRS_BSW_00433 | Main processing functions are only allowed to be called from task bodies provided by the BSW Scheduler | SWS_StbM_00140 |
| SRS_BSW_00437 | Memory mapping shall provide the possibility to define RAM segments which are not to be initialized during startup | SWS_StbM_00140 |
| SRS_BSW_00438 | Configuration data shall be defined in a structure | SWS_StbM_00140 |
| SRS_BSW_00439 | Enable BSW modules to | SWS_StbM_00140 |

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| | handle interrupts | |
| SRS_BSW_00440 | The callback function invocation by the BSW module shall follow the signature provided by RTE to invoke servers via Rte_Call API | SWS_StbM_00140 |
| SRS_BSW_00453 | BSW Modules shall be harmonized | SWS_StbM_00140 |
| SRS_BSW_00457 | Callback functions of Application software components shall be invoked by the Basis SW | SWS_StbM_00273, SWS_StbM_00285 |
| SRS_BSW_00459 | It shall be possible to concurrently execute a service offered by a BSW module in different partitions | SWS_StbM_00513, SWS_StbM_00514 |

# 7 Functional specification

## 7.1 Startup behavior

This chapter describes the actions, which shall be performed during `StbM_Init()`. `StbM_Init()` shall establish the initial state of the module to prepare the module for the actual functionality of providing Global Time Bases to the *customers*.

### 7.1.1 Preconditions

Required basic software modules for the Synchronized Time-Base Manager must be available (running) before the Synchronized Time-Base Manager accesses them.

Details of StbM initialization are considered implementation specific.

If StbM relies on the GPT driver, assumption is, that GPT is initialized by GPT driver before `StbM_Init()`. `StbM_Init` starts the GPT timer, which is selected by `StbMLocalTimeHardware` (**ECUC_StbM_00053 :** ) and configured in `GPT_CH_MODE_CONTINUOUS` mode with `GptChannelTickValueMax` as target time. Timer overflows are counted by the notification function `Gpt_Notification` for updating the Virtual Local Time. This timer is not stopped/reconfigured before ECU shutdown.

### 7.1.2 Initialization

**[SWS_StbM_00170]⌈**
On invocation of `StbM_Init()` each configured Time Base (refer to `StbMSynchronizedTimeBase`, **ECUC_StbM_00003 :** ) shall be initialized with zero and its synchronization status `timeBaseStatus` shall be set to `0x00`.
⌋(RS_TS_00003)

**[SWS_StbM_00345]⌈**
For each Time Base the StbM shall initialize the corresponding event status `NotificationEvents` with 0.
⌋(RS_TS_00016)

**[SWS_StbM_00344]⌈**
For each Time Base the StbM shall initialize the corresponding update counter `timeBaseUpdateCounter` with 0.
⌋(RS_TS_00011)

**[SWS_StbM_00171]⌈**
For each Time Base configured to be stored non-volatile (`StbMStoreTimebaseNonVolatile == STORAGE_AT_SHUTDOWN`), the Time Base value shall be loaded from NvM. In case the restore is not successful, the Time Base shall start with zero.

](RS_TS_00004)

**Note:** The further details on the NvM handling is intentionally left open. The implementer could choose e.g. between the ReadAll/WriteAll functionality from NvM; or explicit NvM-Block configuration and synchronization; also block restore via callback or via constant.

**[SWS_StbM_00306][**
If `StbMTimeRecordingSupport` (**ECUC_StbM_00038 :** ) is set to `TRUE`, the StbM shall initialize all Block Elements of the measurement recording table with zero (refer to 7.3.12.3.1 Record Tables ).
](RS_TS_00034)

[**SWS_StbM_00427**][
For each Time Base the StbM shall initialize all of the corresponding User Data bytes with 0.
](RS_TS_00015)

## 7.2 Shutdown behavior

**[SWS_StbM_00172][**
For each Time Base configured to be stored non-volatile (`StbMStoreTimebaseNonVolatile == STORAGE_AT_SHUTDOWN`), the value shall be stored to NvM latest at shutdown.
](RS_TS_00024)

## 7.3 Normal operation

### 7.3.1 Introduction

A Global Time network contains of a Time Master and at least one Time Slave. The Time Master is distributing via Time Synchronization messages the Global Time Base to the connected Time Slaves for each Time Domain. For CAN and Ethernet, the Time Slave corrects the received Global Time Base by considering the Time Stamp at the transmitter side and the own generated receiver Time Stamp. For FlexRay, the Time Synchronization mechanism is based on the local time of the FlexRay bus.

The local instance of the Time Base (derived from a HW reference clock) will be updated with the latest received valid value of the Global Time Base and runs autonomously until the next value of the Global Time Base is received.

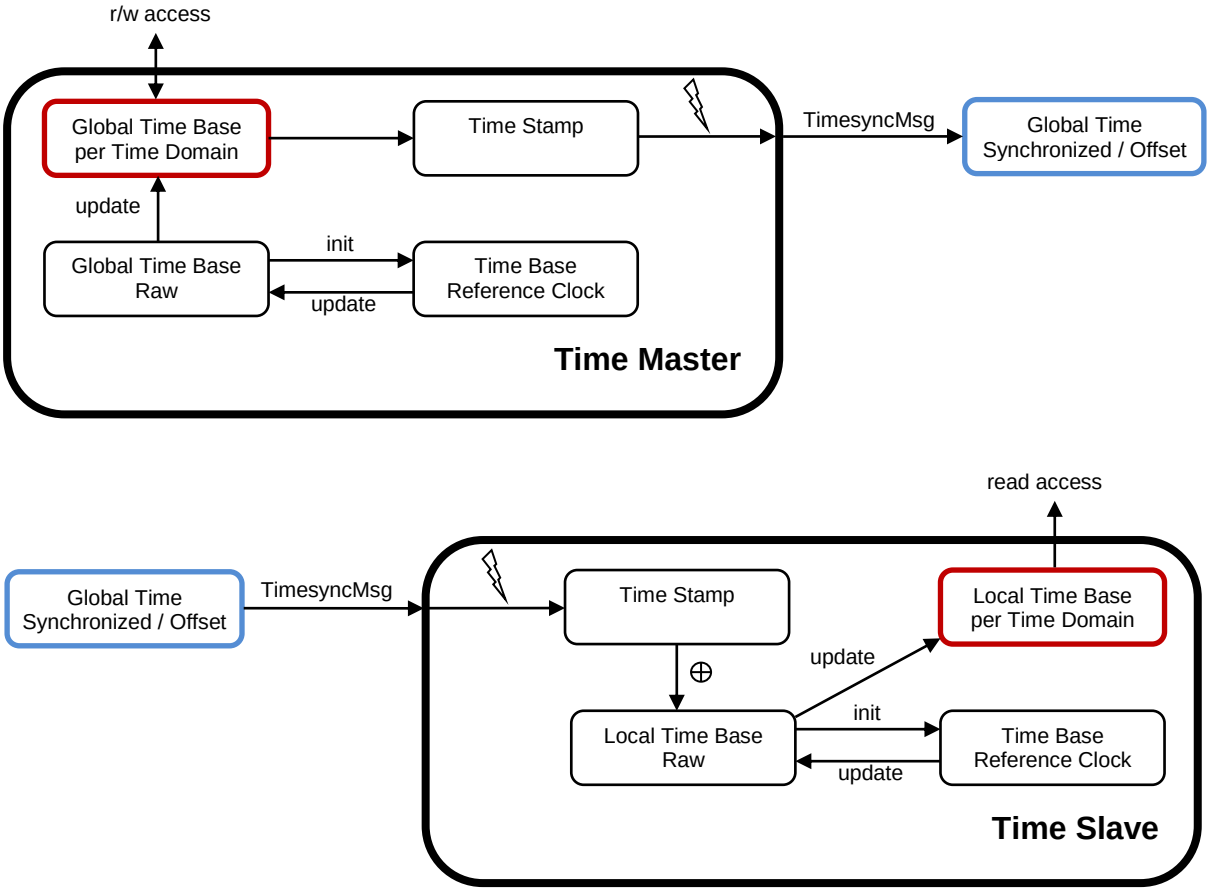


**Figure 3: Global Time Base Distribution**

### 7.3.1.1 Virtual Local Time

Virtual Local Time Bases is derived from a hardware reference clock (see Figure 2). The following hardware reference clocks are supported:
• OS counter
• GPT counter
• Ethernet freerunning counter (used for ingress and egress timestamping)

It is possible to use different Virtual Local Time Bases in parallel.

**[SWS_StbM_00512][**
If `StbMLocalTimeHardware` **ECUC_StbM_00053 :** references a Gpt Channel as local time source for a Synchronized Time Base, the StbM shall derive the Virtual Local Time from the value of the corresponding GPT timer.

The elapsed timer value shall be read via `Gpt_GetTimeElapsed()`.
](RS_TS_00008, RS_TS_00002)

**[SWS_StbM_00352][**

The StbM shall use the factor (StbMClockPrescaler/StbMClockFrequency) to convert the time of its local hardware reference clock to the actual time of the Virtual Local Time (refer to StbM_VirtualLocalTimeType), if the Virtual Local Time is derived from a GPT or OsCounter (refer to **ECUC_StbM_00053 :** StbMLocalTimeHardware).
](RS_TS_00018)

**Note:** Rationale is that a tick duration of the hardware reference clock does not necessarily have to match the resolution of the Virtual Local Time.

**[SWS_StbM_00515]**[
If the range of the corresponding HW reference counter is less than that of the Virtual Local Time (refer to StbM_VirtualLocalTimeType), the StbM shall extend the range accordingly.
](RS_TS_00008)

**Note:** Depending on the HW reference clock one way of extending the range is to count overflows of the HW reference clock.

**[SWS_StbM_00178]**[
If EthIfGlobalTimeSupport (referenced via StbMLocalTimeHardware **ECUC_StbM_00053 : ,** if set to EthTSynGlobalTimeDomain) is set to TRUE for a Synchronized Time Base, the StbM shall derive the current value of the Virtual Local Time (see StbM_VirtualLocalTimeType) from the freerunning HW counter from the corresponding Ethernet Controller via EthIf_GetCurrentTime().

If EthIf_GetCurrentTime() returns either ETH_UNCERTAIN or ETH_INVALID for parameter timeQualPtr, the time value returned by EthIf_GetCurrentTime() shall be ignored.
](RS_TS_00008, RS_TS_00002)

**[SWS_StbM_00539]** {DRAFT} [
If CanIfGlobalTimeSupport (referenced via StbMLocalTimeHardware **ECUC_StbM_00053 : ,** if set to CanTSynGlobalTimeDomain) is set to TRUE for a Synchronized Time Base, the StbM shall derive the current value of the Virtual Local Time (see StbM_VirtualLocalTimeType) from the freerunning HW counter from the corresponding CAN Controller via CanIf_GetCurrentTime().

If CanIf_GetCurrentTime() returns E_NOT_OK the time value returned by CanIf_GetCurrentTime() shall be ignored.
](RS_TS_20070, RS_TS_00008)

**Note:** If CanIf_GetCurrentTime() or EthIf_GetCurrentTime() fail, this means the corresponding Virtual Local Time is not available. Hence, related Time Bases cannot be interpolated anymore. APIs for Time Bases, which depend on that Virtual Local Time, would return E_NOT_OK.

**[SWS_StbM_00437]**[

`StbM_GetCurrentVirtualLocalTime()` shall return the value of the Virtual Local Time of the associated Time Base.

For Offset Time Bases the Virtual Local Time of the referenced Synchronized Time Base shall be returned.

If the Virtual Local Time could not be determined (e.g., the underlying hardware counter has not been activated yet), `StbM_GetCurrentVirtualLocalTime()` shall return `E_NOT_OK`.
](RS_TS_00006, RS_TS_00008, RS_TS_00033)

**Note:** `StbM_GetCurrentVirtualLocalTime()` is called by the Timesync modules with an established protection against interruptions.

### 7.3.1.2 Types of Time Bases

#### 7.3.1.2.1 Synchronized and Offset Time Bases

The Time Domains 0 to 15 are Synchronized Time Bases.

The Time Domains 16 to 31 are Offset Time Bases. An Offset Time Base is linked to a Synchronized Time Base only by system wide configuration.

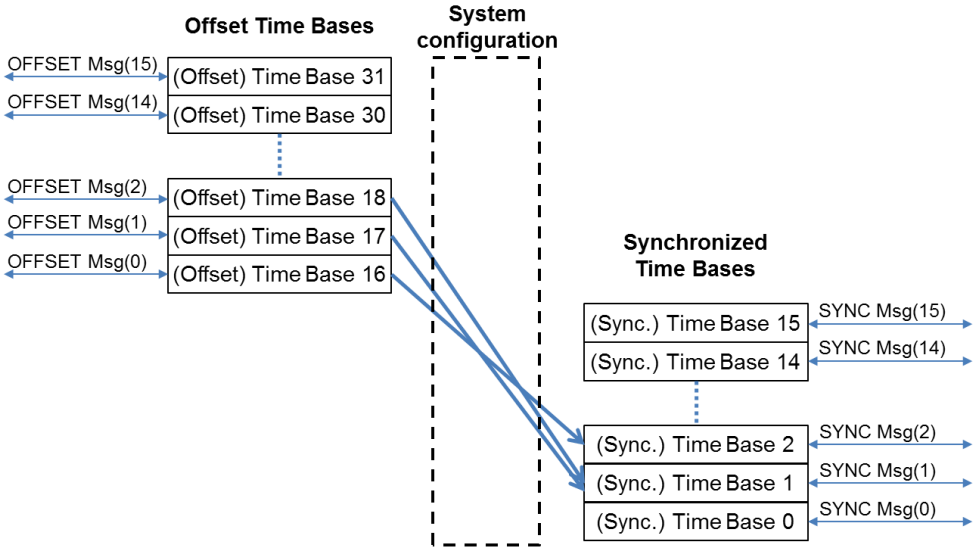


**Figure 4: Offset Time Base to Synchronized Time Base relationship**

**Example**:
For an Offset Time Base with Time Domain number 17 the OFFSET Timesync messages on CAN and FR always contain 17-16 = 1 in the Time Domain field. However, the underlying Synchronized Time Base could have Time Domain number 0, i.e., SYNC and FUP Timesync messages contain 0 in the Time Domain field. Another Offset Time Base with Time Domain number 18 (2 in the Time Domain field), may also based on the underlying Synchronized Time Base 0. An Offset Time Base might have leaps in time, e.g. after GPS time becomes available.

#### 7.3.1.2.2 Pure Local Time Bases

For details of Pure Local Time Bases refer to 7.3.4.

### 7.3.1.3 Roles of the StbM

Depending on its configuration the StbM may take one of the following three roles for a Time Base:

- Global Time Master
- Time Slave
- Time Gateway

In each role specific functionality is supported or not supported.

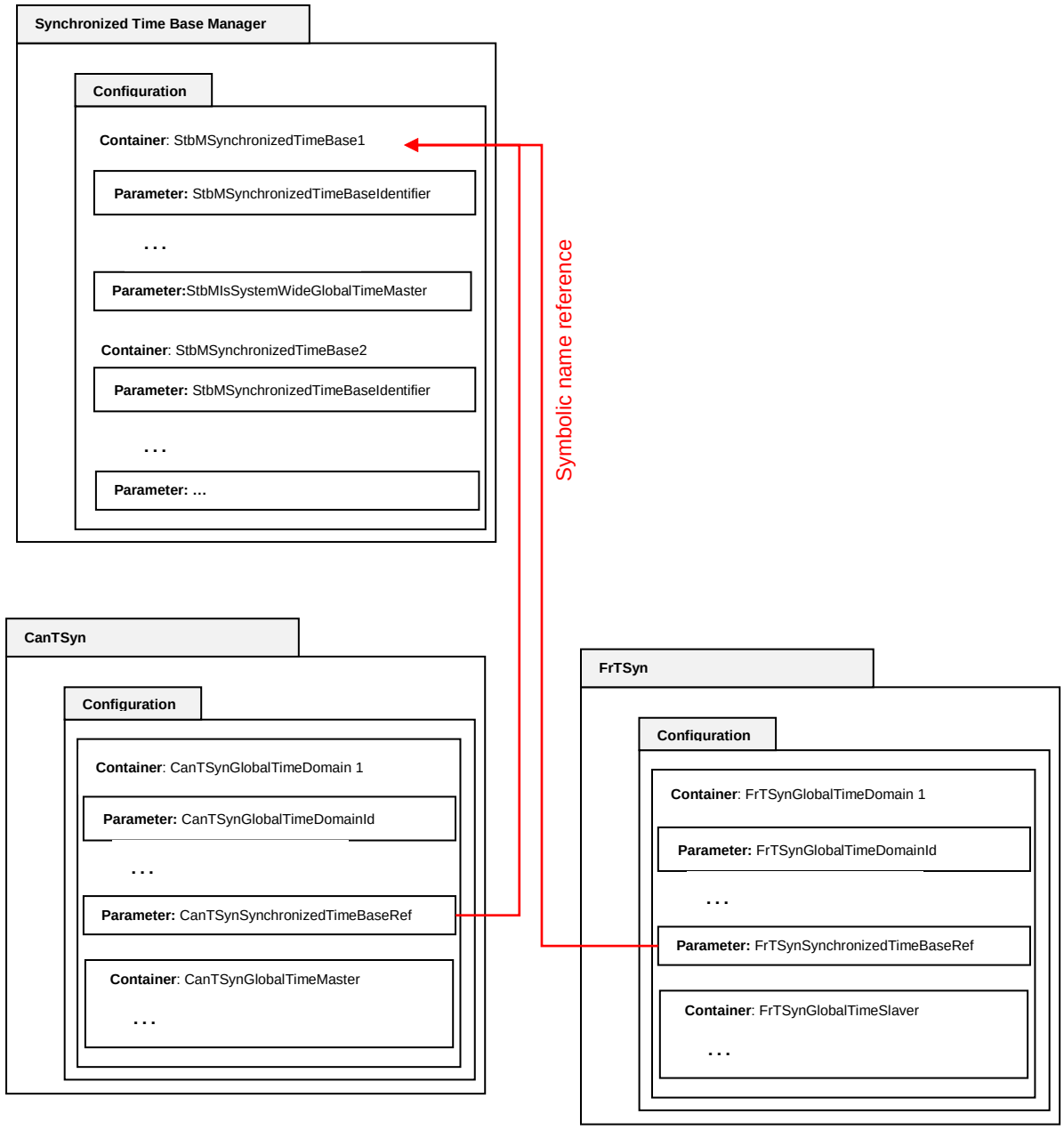


**Figure 5: Configuration of the StbM Role per Time Base**

**Example:** In Figure 5 the Time Base “StbMSynchronizedTimeBase1” is referenced by two Time Domains “CanTSynGlobalTimeDomain 1” and “FrTSynGlobalTimeDomain 1” from within a CanTSyn and a FrTSyn Timesync module, respectively. “CanTSynGlobalTimeDomain 1” is configured as a Time Master and “FrTSynGlobalTimeDomain 1” as a Time Slave. This makes the StbM a Time Gateway for Time Base “StbMSynchronizedTimeBase1”.

If Time Base “StbMSynchronizedTimeBase1” would have been referenced by only one of the Time Domains - “CanTSynGlobalTimeDomain 1” or

“FrTSynGlobalTimeDomain 1”- the StbM would have become a Time Master or a Time Slave for Time Base “StbMSynchronizedTimeBase1”, respectively.

**Note:** For system level representation of roles refer to figure 9.1 (“Big Picture of AUTOSAR global time synchronization”) in [17]

#### 7.3.1.3.1 Global Time Master

A Global Time Master is the system wide origin for a given Time Base. Its Time Base values are distributed via the network to the Time Slaves.

**[SWS_StbM_00408][**
`StbM_GetMasterConfig()` shall return the value of the configuration parameter `StbMIsSystemWideGlobalTimeMaster` (**ECUC_StbM_00036 :** ) for the Time Base `timeBaseId`. This is to check, if the StbM is configured as system wide Global Time Master for a specific Time Base.
](RS_TS_00029)

#### 7.3.1.3.2 Time Slave

In the role of a Time Slave the StbM updates its internally maintained local Time Base based on Global Time Base values, which are provided by the corresponding Timesync module.

#### 7.3.1.3.3 Time Gateway

A Time Gateway in the StbM is a Time Base which is referenced by one Time Slave and one or more Time Masters. The Time Slave, which references a StbM Time Gateway receives Timesync messages on the corresponding bus and passes the received Time Base values to the StbM (refer to 7.3.1 “Introduction” for the basic mechanisms). Every Time Master referencing the Time Gateway retrieves the Gateway Time Base values from the StbM and transmits those on the bus. Depending on configuration the reception on slave side can or cannot automatically trigger the transmission on the master side.

So, Timesync messages are not routed directly through an AUTOSAR Time Gateway. This is because routing delays need to be compensated.

### 7.3.1.4 Interpolating the Global Time

The Synchronized Time-Base Manager has to interpolate the local instance of the Global Time Base between the updates

- from the Timesync Modules (for a Time Slave) and
- from the application (for a Time Master)

Interpolation is done based on the Virtual Local Time, which is a local time reference derived from some kind of HW counter (refer to **ECUC_StbM_00047**).

Interpolation is done in principle according to the formula

$TL = TG_{Sync} + (TV – TV_{Sync}) * r$

With

- TL: Current value of the local instance of the Global Time
- $TG_{Sync}$: Global Time value (part of the Main Time Tuple)
- TV: Current value of the Virtual Local Time
- $TV_{Sync}$: Virtual Local Time value (part of the Main Time Tuple)
- r: optional Rate and Offset-By-Rate correction – if not used set to 1 for Synchronized Time Bases and 0 for Offset Time Bases

$TG_{Sync}$ and $TV_{Sync}$ form the Main Time Tuple.
For every Time Base there is more than one Time Tuple but there is only one Time Tuple which is used to interpolate the local instance of the Time Base. This Time Tuple is denoted as the **Main Time Tuple**.

The precision of a Time Base depends on the handling of the Main Time Tuple:

- when and how is it interpolated by the StbM
- for a Time Master or Time Gateway: how is it processed and transmitted by the Timesync Modules
- for a Time Slave or Time Gateway: how is it received and processed by the Timesync Modules

Regarding the interpolation by the StbM it is obvious that the precision depends on rounding effects and the granularity of the HW counters, e.g., if the Main Time Tuple would be updated in every `StbM_MainFunction()` while the applied rate correction value is small.

If requesting a Global Time by the application would always lead to an update of the Main Tuple, the frequency of those requests would influence the precision as well.

It is therefore necessary to ensure that updates of the Main Time Tuple don't happen too often.

The Main Time Tuple shall be updated however

- after setting a new Global Time or a new Rate Correction value by the application
- after obtaining a new Time Tuple from a Timesync Module

The Main Time Tuple shall not be updated:

- on every invocation of `StbM_MainFunction()`
- every time a Global Time value is requested by either `StbM_GetCurrentTime()`, `StbM_GetCurrentTimeExtended()` or `StbM_BusGetCurrentTime()`

Once a new Time Tuple (denoted as **Rx Time Tuple** [$TG_{Rx}$;$TV_{Rx}$]) is obtained from a Timesync Module (i.e., after reception of Timesync message(s)), and which is then updated to become the Updated Rx Time Tuple, the StbM determines a Time Tuple (denoted as **Synclocal Time Tuple** [$TL_{Sync}$;$TV_{Sync}$]) of the local instance of the

Global Time by using the Virtual Local Time of the Updated Rx Time Tuple as reference (i.e., TV = $TV_{URx}$). Refer to Figure 6 for an example.

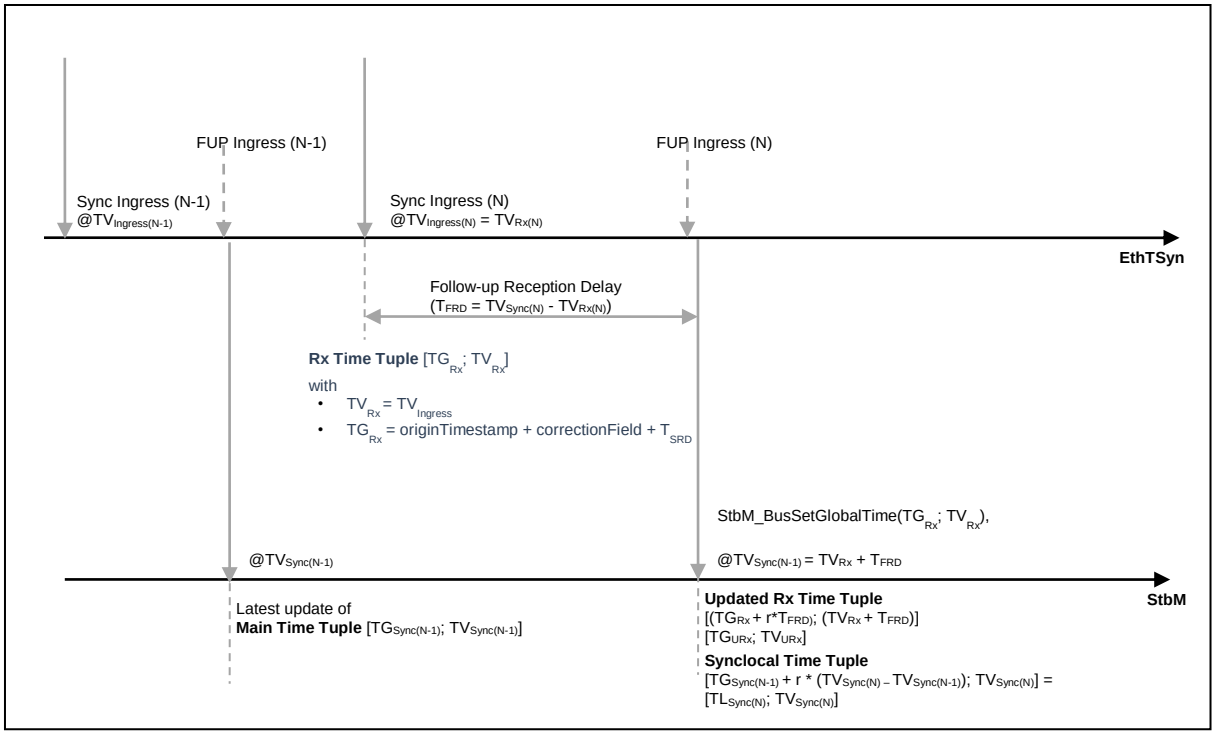


**Figure 6: Example for Rx Time Tuple (sent by EthTSyn) processing**

In case of actually performing Offset Correction By Rate Adaption (i.e., the mechanism is enabled and the prerequisites are fulfilled), the Main Time Tuple is not overwritten by the Updated Rx Time Tuple, instead the Main Time Tuple is overwritten by the Synclocal Time Tuple of the local instance of the Global Time.

Otherwise, the Main Time Tuple is overwritten by the Updated Rx Time Tuple.

The Main Time Tuple can be updated if a certain time has elapsed since the last update (refer to **[SWS_StbM_00433]**).

The Main Time Tuple [$TG_{Sync}$;$TV_{Sync}$] is managed by the StbM. Each time $TG_{Sync}$ is updated, $TV_{Sync}$ has to be updated as well and vice versa.

Below the application, in the BSW, the Time of a Time Base is always managed via the Time Tuple structure:

- Timesync Modules provide the received Global Time in form of a Time Tuple to the StbM
- Timesync Modules obtain the Global Time to transmit as a Time Tuple
- A Global Time value set by the application is immediately extended to a Time Tuple by adding the current value of the Virtual Local Time

It is essential to always adhere to the integrity of the Time Tuple.

**[SWS_StbM_00433]**⌈

The Main Time Tuple shall only be updated

- after setting a new Global Time or a new Rate Correction value by the application
- after obtaining a Rx Time Tuple (i.e., a new Time Tuple) from a Timesync Module
- after the Offset Correction By Rate Adaption interval (see **[SWS_StbM_00353]**)

However, the Main Time Tuple may be updated if there has been no update for more than 3s.
⌋(RS_TS_00008, RS_TS_00002)

**Note:** The 3s interval is derived from the value range of 32 bit results (e.g., when calculating the Virtual Local Time difference, i.e., 4.29 sec) with some safety margin. This is to prevent too frequent updates of the Main Time Tuple, which would lead to accumulation of rounding errors.

### 7.3.2 Synchronized Time Bases

**[SWS_StbM_00180]⌈**
After initialization the StbM shall maintain the Local Time of each Time Base autonomously via a hardware reference clock (referenced by `StbMLocalTimeClock`).
⌋(RS_TS_00008, RS_TS_00002)

**Note:** While no Global Time Base value has yet been set/received (`GLOBAL_TIME_BASE` bit is not yet set), the StbM shall maintain the Local Time of each Time Base (i.e., progress the time) starting at the value restored from NvM or at value 0 (depending on setting of `StbMStoreTimebaseNonVolatile`).

**Note:** Progressing the time means that the Virtual Local Time as part of the Main Time Tuple needs to be retrieved once the Global Time part of the Main Time Tuple was either set to 0 or to the value restored from NvM.

**[SWS_StbM_00173]⌈**
For Time Domains 0 to 15 `StbM_GetCurrentTime()` and `StbM_GetCurrentTimeExtended()` shall return for the requested Time Domain the time of the Time Base, the related Status and the User Data. The current time of the Time Base shall be derived from the associated Virtual Local Time, which is derived from either the referenced OS counter, a GPT or a referenced Ethernet controller (refer to `StbMLocalTimeHardware`).
⌋(RS_TS_00005, RS_TS_00006, RS_TS_00014)

**[SWS_StbM_00434]⌈**
For Time Domains 0 to 15 `StbM_GetCurrentTime()`, `StbM_GetCurrentTimeExtended()`, and `StbM_BusGetCurrentTime()` shall return `E_NOT_OK` if the value of the associated Virtual Local Time could not be retrieved.

](RS_TS_00005, RS_TS_00006, RS_TS_00014)

**Note:** Retrieving a Virtual Local Time value may fail for several reasons, e.g., if the related hardware counter was not yet activated.

**[SWS_StbM_00435]**[
For Time Base 0 to 15 `StbM_BusGetCurrentTime()` shall return for the requested Time Domain the Time Tuple [TL;TV] of the Time Base, the related Status and the User Data. The current time of the Time Base shall be derived from the associated Virtual Local Time, which is derived from either the referenced OS counter, a GPT or a referenced Ethernet controller (refer to `StbMLocalTimeHardware`).
](RS_TS_00005, RS_TS_00006, RS_TS_00014)

**[SWS_StbM_00436]**[
Although the retrieved value of the Virtual Local Time and the time which is returned by `StbM_GetCurrentTime()`, `StbM_GetCurrentTimeExtended()`, and `StbM_BusGetCurrentTime()` form a new Time Tuple [TL;TV], this tuple shall only replace the Main Time Tuple if the requirements as specified in **[SWS_StbM_00433]** are met.
](RS_TS_00005, RS_TS_00006, RS_TS_00014)

**Note:** Prohibiting the update of the Main Time Tuple after e.g. every invocation of `StbM_BusGetCurrentTime()` and `StbM_GetCurrentTime()` prevents worsening the precision of the requested Time Base due to rounding errors.

#### 7.3.2.1 Global Time Master

**[SWS_StbM_00342]**[
On a valid invocation of `StbM_SetGlobalTime()` or `StbM_UpdateGlobalTime()` the StbM shall update the Main Time Tuple of the corresponding Synchronized Time Base.

Within the functions `StbM_SetGlobalTime()` and `StbM_UpdateGlobalTime()` the StbM shall retrieve the value of the Virtual Local Time (as part of the Local Time tuple) **as soon as possible** in order to improve precision of the Time Base.
](RS_TS_00010, RS_TS_00002)

**Note:** In order to improve precision further it may be beneficial for applications to call `StbM_SetGlobalTime()` or `StbM_UpdateGlobalTime()` with locked interrupts.

**[SWS_StbM_00516]**[
On invocation of `StbM_SetBusProtocolParam()` for a Time Master of Time Bases 0 to 15, the StbM shall forward the values provided in argument `protocolParam` by calling `EthTSyn_SetProtocolParam()`.

If

- the corresponding Time Base is not mapped to Ethernet or

- member `protocolType` of argument `protocolParam` is not set to `STBM_TIMESYNC_ETHERNET`

`StbM_SetBusProtocolParam()` shall return `E_NOT_OK`.
](RS_TS_20069)

#### 7.3.2.2 Time Slave

**[SWS_StbM_00529]**[
For Time Bases 0 to 15 each invocation of `StbM_BusSetGlobalTime()` shall update the *Rx Time Tuple* [$TG_{Rx}$; $TV_{Rx}$] as follows (refer to Figure 6):

1. Retrieve the current Virtual Local Time value as $TV_{sync}$
2. Calculate the time interval $T_{FRD} = TV_{Rx} - TV_{sync}$ based on the Local Virtual Time value of the *Rx Time Tuple* ($TV_{Rx}$) as provided by input parameter `localTimePtr`.
3. Apply the current rate value of the Synchronized Time Base $r = r_{rc}$ to the time interval $T_{FRD}$
4. Add the rate corrected interval $r*T_{FRD}$ to the Global Time of the Rx Time Tuple ($TG_{Rx}$) as provided by input parameter `globalTimePtr`

The resulting Time Tuple [$TG_{Rx} + r*T_{FRD}$; $TV_{sync}$] is denoted as *Updated Rx Time Tuple* [$TG_{URx}$; $TV_{URx}$] of the Synchronized Time Base.
](RS_TS_00007, RS_TS_00009)

**[SWS_StbM_00179]**[
For Time Bases 0 to 15 each invocation of `StbM_BusSetGlobalTime()` shall update the corresponding Main Time Tuple and set the User Data and the Time Base Status accordingly.
](RS_TS_00007, RS_TS_00009)

**Note:** To update the Main Time Tuple does not mean to automatically overwrite the Main Time Tuple with the Updated Rx Time Tuple.

**[SWS_StbM_00438]**[
The StbM shall determine for Time Bases 0 to 15 on each invocation of `StbM_BusSetGlobalTime()` the Synclocal Time Tuple [$TL_{Sync}$;$TV_{Sync}$] by using the value of the Virtual Local Time of the Updated Rx Time Tuple as reference (i.e., $TV_{Rx}$ is used for TV when calculating TL in **[SWS_StbM_00355])**. The Synclocal Time Tuple shall be determined using the Main Time Tuple before the Main Time Tuple itself is updated.
](RS_TS_00007, RS_TS_00009)

**[SWS_StbM_00517]**[
On invocation of `StbM_GetBusProtocolParam()` for Time Bases 0 to 15, the StbM shall read the structure values referenced by argument `protocolParam` by calling `EthTSyn_GetProtocolParam()`, if member `protocolType` of argument `protocolParam` is set to `STBM_TIMESYNC_ETHERNET`.

If

- the corresponding Time Base is not mapped to Ethernet or
- member `protocolType` of argument `protocolParam` is not set to `STBM_TIMESYNC_ETHERNET`

`StbM_GetBusProtocolParam()` shall return `E_NOT_OK`.
](RS_TS_20069)

### 7.3.3 Offset Time Bases

An Offset Time Base only exists in combination with its underlying Synchronized Time Base.

The **Absolute Time** value of an Offset Time Base is given by adding the **Offset Time** value of an Offset Time Base to the time value of the underlying Synchronized Time Base.

**[SWS_StbM_00191]**[
`StbM_SetOffset()` and `StbM_GetOffset()` shall only accept Offset Time Bases with a timeBaseId 16 to 31.
](RS_TS_00012, RS_TS_00013)

**[SWS_StbM_00177]**[
For Time Bases 16 to 31 the `StbM_GetCurrentTime()` and `StbM_GetCurrentTimeExtended()` shall return for the requested Time Base an absolute time value calculated by adding the given offset to the current Time Base of the referenced Time Base via `StbMOffsetTimeBase` (**ECUC_StbM_00030 :** ).
](RS_TS_00013)

**[SWS_StbM_00193]**[
Configuration Constraint: The parameter `StbMOffsetTimeBase` shall only be valid for `StbMSynchronizedTimeBaseIdentifier` 16 to 31.
](RS_TS_00012, RS_TS_00013)

#### 7.3.3.1 Global Time Master

**[SWS_StbM_00190]**[
Each valid invocation of `StbM_SetOffset()` shall update the Main Time Tuple of the corresponding Offset Time Base. The Offset Time value and the User Data shall be set accordingly.
](RS_TS_00013, RS_TS_00015)

**[SWS_StbM_00192]**[
Each invocation of `StbM_GetOffset()` shall return the Offset Time value and the User Data of the corresponding Offset Time Base.
](RS_TS_00013, RS_TS_00014)

**[SWS_StbM_00304]⌈**
On invocation of `StbM_SetGlobalTime()` or `StbM_UpdateGlobalTime()` for Time Bases 16 to 31 the StbM shall check the `GLOBAL_TIME_BASE` bit within `timeBaseStatus` of the underlying Synchronized Time Base and shall return `E_NOT_OK` if is not set.

If the `GLOBAL_TIME_BASE` bit is set:

1. the StbM shall calculate the Offset Time by obtaining the actual Time Base value of the underlying Synchronized Time Base and subtract that from the Absolute Time value which is passed by `StbM_SetGlobalTime()` or `StbM_UpdateGlobalTime()`
2. 
   a) if the calculated Offset Time value is equal or greater than zero, the StbM shall update the corresponding Offset Time Base with the calculated Offset Time value and the User Data that was passed by `StbM_SetGlobalTime()` or `StbM_UpdateGlobalTime()`,
   b) otherwise (calculated Offset Time value is less than zero) the StbM shall return `E_NOT_OK` via `StbM_SetGlobalTime()` or `StbM_UpdateGlobalTime()`, respectively.

⌋(RS_TS_00013)

#### 7.3.3.2 Time Slave

**[SWS_StbM_00528]⌈**
For Time Bases 16 to 31 each invocation of `StbM_BusSetGlobalTime()` shall update the *Rx Time Tuple* [$TG_{Rx}$; $TV_{Rx}$] as follows (refer to Figure 6):

1. Retrieve the current Virtual Local Time value as $TV_{sync}$
2. Calculate the time interval $T_{FRD} = TV_{Rx} - TV_{sync}$ based on the Local Virtual Time value of the *Rx Time Tuple* ($TV_{Rx}$) as provided by input parameter localTimePtr
3. Apply the current rate value of the Offset Time Base $r = (r_{roc} – 1)$ to the time interval $T_{FRD}$
4. Add the rate corrected interval $r*T_{FRD}$ to the Global Time of the Rx Time Tuple ($TG_{Rx}$) as provided by input parameter globalTimePtr

The resulting Time Tuple [$TG_{Rx} + r*T_{FRD}$; $TV_{sync}$] is denoted as *Updated Rx Time Tuple* [$TG_{URx}$; $TV_{URx}$] of the Offset Time Base.
⌋(RS_TS_00007, RS_TS_00009)

**Note:** The calculation of the *Updated Rx Time Tuple* [$TG_{URx}$; $TV_{URx}$] ensures, that the delay between the ingress of the SYNC/OFS Message and the actual processing in the StbM is rate corrected. Otherwise, precision could be significantly impaired.

**[SWS_StbM_00393]⌈**
For Time Bases 16 to 31 each invocation of `StbM_BusSetGlobalTime()` shall update the corresponding Main Time Tuple and set the User Data and the Time Base Status accordingly.
⌋(RS_TS_00007, RS_TS_00009)

**Note:** To update the Main Time Tuple does not mean to automatically overwrite the Main Time Tuple with the Updated Rx Time Tuple.

**[SWS_StbM_00439]⌈**
The StbM shall determine for Time Bases 16 to 31 on each invocation of `StbM_BusSetGlobalTime()` the Synclocal Time Tuple [$TL_{Sync}$;$TV_{Sync}$] by using the value of the Virtual Local Time of the Updated Rx Time Tuple as reference (i.e., $TV_{Rx}$ is used for TV when calculating TL in **[SWS_StbM_00355]**). The Synclocal Time Tuple shall be determined using the Main Time Tuple before the Main Time Tuple is updated.
⌋(RS_TS_00007, RS_TS_00009)

### 7.3.4 Pure Local Time Bases

A Pure Local Time Base will only locally be set and read. A Pure Local Time Base behaves like a Synchronized Time Base since it progresses in time, however it is not synchronized via Timesync modules. So, only a subset of APIs is supported by Pure Local Time Base. Pure Local Time Bases behaving like an Offset Time Bases are not supported.

**[SWS_StbM_00413]⌈**
After initialization the StbM shall maintain the Time of each Pure Local Time Base autonomously via a hardware reference clock (referenced by `StbMLocalTimeClock`).
⌋(RS_TS_00008, RS_TS_00002)

**Note:** While no Time Base value has yet been set (`GLOBAL_TIME_BASE` bit is not yet set), the StbM shall maintain the time value of each Pure Local Time Base (i.e., progress the time) starting at the value 0.

**[SWS_StbM_00398]⌈**
For Pure Local Time Bases `StbM_GetCurrentTime()` and `StbM_GetCurrentTimeExtended()` shall return the User Data as set by `StbM_SetGlobalTime()`, `StbM_UpdateGlobalTime()` or `StbM_SetUserData()` by the local Pure Local Time Master.
⌋(RS_TS_00015)

**[SWS_StbM_00399]⌈**
For Pure Local Time Bases all bits of the Time Base status `timeBaseStatus` shall be set to 0, except for bit `GLOBAL_TIME_BASE`.

`GLOBAL_TIME_BASE` shall be set to 1, by a valid invocation of `StbM_SetGlobalTime()` or `StbM_UpdateGlobalTime()` and only set to 0 by `StbM_Init()`.
⌋(RS_TS_00009)

### 7.3.5 Synchronization State

**[SWS_StbM_00261]⌈**
For Offset Time Bases `StbM_GetCurrentTime()` and `StbM_GetCurrentTimeExtended()` shall derive the status `timeBaseStatus` to be returned with the actual time value as follows from the status of the actual Offset Time Base and the Synchronized Time Base (referenced via parameter `StbMOffsetTimeBase` (**ECUC_StbM_00030 :** ):

| Bit Name | Bit Position | Description |
|---|---|---|
| `TIMEOUT` | Bit 0 (LSB) | 0: No Timeout occurred - neither for Offset nor for referenced Synchronized Time Base |
| | | 1: Timeout occurred for Offset or for referenced Synchronized Time Base |
| Reserved | Bit 1 | Bit 1: Always 0 (reserved for future usage) |
| `SYNC_TO_GATEWAY` | Bit 2 | 0: Local Offset and referenced Synchronized Time Base is synchronous to Global Offset Time Master |
| | | 1: Local Offset or referenced Synchronized Time Base updates are based on a Time Gateway below the Global Time Master |
| `GLOBAL_TIME_BASE` | Bit 3 | 0: Local Offset or referenced Synchronized Time Base are based on Local Time Base reference clock only (never synchronized with Global Time Base) |
| | | 1: Local Offset and referenced Synchronized Time Base have been synchronized with Global Time Base at least once |
| `TIMELEAP_FUTURE` | Bit 4 | 0: No leap into the future within the received time for the Offset and referenced Synchronized Time Base |
| | | 1: Leap into the future within the received time for the Offset or referenced Synchronized Time Base exceeds a configured threshold |
| `TIMELEAP_PAST` | Bit 5 | 0: No leap into the past within the received time for the Offset and referenced Synchronized Time Base |
| | | 1: Leap into the past within the received time for the Offset or referenced Synchronized Time Base exceeds a configured threshold |

⌋(RS_TS_00005)

**[SWS_StbM_00262]⌈**
For Synchronized Time Bases `StbM_GetTimeBaseStatus()` shall return

- the status of the corresponding Synchronized Time Base via `syncTimeBaseStatus` and
- 0 via `offsetTimeBaseStatus`

For Offset Time Bases `StbM_GetTimeBaseStatus()` shall return

- the status of the corresponding Offset Time Base via `offsetTimeBaseStatus` and
- the status of the related Synchronized Time Base (referenced by ECUC_StbM_00030 : ) via `syncTimeBaseStatus`.

For Pure Local Time Bases `StbM_GetTimeBaseStatus()` shall return

- the status of the corresponding Time Base (refer to **[SWS_StbM_00399]**) via `syncTimeBaseStatus` and
- 0 via `offsetTimeBaseStatus`

⌋(RS_TS_00005, RS_TS_00021)

#### 7.3.5.1 Global Time Master

**[SWS_StbM_00181]⌈**
On a valid invocation of `StbM_SetGlobalTime()`, `StbM_UpdateGlobalTime()`, or `StbM_SetOffset()` the StbM shall set the `GLOBAL_TIME_BASE` bit within `timeBaseStatus` of the corresponding Time Base and shall clear all other bits.
⌋(RS_TS_00009)

#### 7.3.5.2 Time Slaves

Usually, a Time Slave starts its local Time Base from 0. So, after initialization the 1st check against `StbMTimeLeapFutureThreshold` / `StbMTimeLeapPastThreshold` would most likely always fail and the `TIMELEAP_FUTURE` / `TIMELEAP_PAST` bit would be always set. To avoid this, threshold monitoring will start only after a first valid Time Base value has been received.

**[SWS_StbM_00182]⌈**
For Synchronized and Offset Time Bases for which the StbM is configured as Time Slave or Time Gateway, an invocation of `StbM_BusSetGlobalTime()` shall check, if the Global Time difference between the Updated Received Time (i.e., the updated Time Base value) and the Synclocal Time (i.e., the current Time Base value) exceeds the configured threshold of `StbMTimeLeapFutureThreshold` (**ECUC_StbM_00041 :** ), i.e., $TG_{Rx}$ - $TL_{Sync}$ > `StbMTimeLeapFutureThreshold`, if at least one Time Base value has been successfully received before.

With:

- $TL_{Sync}$ = Global Time part of the Synclocal Time Tuple
- $TG_{Rx}$ = Global Time part of the Updated Rx Time Tuple

In case the threshold is exceeded the StbM shall set the `TIMELEAP_FUTURE` bit within `timeBaseStatus` of the Time Base.

If the next StbMClearTimeleapCount updates are within the threshold of StbMTimeLeapFutureThreshold the StbM shall clear the TIMELEAP_FUTURE bit within timeBaseStatus of the Time Base.

A threshold of 0 shall deactivate this check.
](RS_TS_00009)

**[SWS_StbM_00305][**
For Synchronized and Offset Time Bases for which the StbM is configured as Time Slave or Time Gateway, an invocation of StbM_BusSetGlobalTime() shall check, if the Global Time difference between the Synclocal Time (i.e., the current Time Base value) and the Received Time (i.e., the updated Time Base value) exceeds the configured threshold of StbMTimeLeapPastThreshold (**ECUC_StbM_00042 :** ), i.e., $TL_{Sync}$ - $TG_{Rx}$ > StbMTimeLeapPastThreshold, if at least one Time Base value has been successfully received before.

With:
- $TL_{Sync}$ = Global Time part of the Synclocal Time Tuple
- $TG_{Rx}$ = Global Time part of the Updated Rx Time Tuple

In case the threshold is exceeded the StbM shall set the TIMELEAP_PAST bit within timeBaseStatus of the Time Base.

If the next StbMClearTimeleapCount updates are within the threshold of StbMTimeLeapPastThreshold the StbM shall clear the TIMELEAP_PAST bit within timeBaseStatus of the Time Base.

A threshold of 0 shall deactivate this check.
](RS_TS_00009)

**Note**: After a longer timeout a time leap is likely to be detected (either StbMTimeLeapFutureThreshold or StbMTimeLeapPastThreshold is exceeded), although the time drift was within the acceptable range. A time leap could also occur if a Time Slaves continues operating while a Time Master performs a restart.

Additional measures could be taken on application level to cope with those situations.

**Note**: If set, a TIMELEAP_FUTURE/TIMELEAP_PAST bit remains set while a timeout is active (i.e., while the TIMEOUT bit is set) and also beyond, if StbMClearTimeleapCount updates within the threshold of StbMTimeLeapFutureThreshold/StbMTimeLeapPastThreshold have not yet happened.

**[SWS_StbM_00425][**
For Synchronized and Offset Time Bases for which the StbM is configured as Time Slave or Time Gateway StbM_GetTimeLeap() shall return the Global Time

difference between the Updated Received Time and the Synclocal Time, i.e., $TG_{Rx}$ - $TL_{Sync}$, which is calculated upon each, except the very first, valid invocation of `StbM_BusSetGlobalTime()` for the corresponding Time Base.

With

- $TL_{Sync}$ = Global Time part of the Synclocal Time Tuple
- $TG_{Rx}$ = Global Time part of the Updated Rx Time Tuple

If the calculated time difference exceeds the value range of the `timeJump` parameter of `StbM_GetTimeLeap()` the returned time difference shall be limited to either the maximum negative or the maximum positive value of the type of `timeJump` (refer to StbM_TimeDiffType).

`StbM_GetTimeLeap()` shall return `E_NOT_OK` until the second valid invocation of `StbM_BusSetGlobalTime()` for the corresponding Time Base.
⌋(RS_TS_00009)

**[SWS_StbM_00183]⌈**
For Synchronized and Offset Time Bases for which the StbM is configured as Time Slave or Time Gateway, the StbM shall observe the timeout `StbMSyncLossTimeout` (**ECUC_StbM_00028 :** ). The timeout shall be measured from last invocation of `StbM_BusSetGlobalTime()`.

If the timeout occurs, the StbM shall set the `TIMEOUT` bit within `timeBaseStatus` of the Time Base.

An invocation of `StbM_BusSetGlobalTime()` shall clear the `TIMEOUT` bit.
⌋(RS_TS_00025, RS_TS_00009)

**Note:** Refer to notes beneath **[SWS_StbM_00187]** for suitable time references for determining the `StbMSyncLossTimeout` (**ECUC_StbM_00028 :** ) timeout.

**[SWS_StbM_00187]⌈**
For Synchronized and Offset Time Bases for which the StbM is configured as Time Gateway, the StbM shall set the `SYNC_TO_GATEWAY` bit within `timeBaseStatus` of the Time Base when a timeout occurs (refer to **[SWS_StbM_00183]**).
⌋(RS_TS_00025, RS_TS_00009)

**Note:** The Global Time is only suitable as a time reference for determining the `StbMSyncLossTimeout` (**ECUC_StbM_00028 :** ) timeout, if time leap detection is configured appropriately - otherwise time leaps may shorten or lengthen the time interval unacceptably.

Instead the timeout `StbMSyncLossTimeout` (**ECUC_StbM_00028 :** ) should be measured either

- based on the Virtual Local Time or
- by counting invocations of the main function `StbM_MainFunction()`

In case of time span measurement based on the Virtual Local Time, the StbM shall check for a timeout condition of a Time Base within `StbM_MainFunction()` and all API functions, which return the Time Base Status (e.g. `StbM_GetTimeBaseStatus()` or `StbM_GetCurrentTime()`.

In case of time span measurement based on counting invocations of the `StbM_MainFunction` the StbM shall check for a timeout condition of a Time Base within `StbM_MainFunction()`. When determining the number of invocations based on `StbMMainFunctionPeriod` (**ECUC_StbM_00027 :** ) and `StbMSyncLossTimeout` (**ECUC_StbM_00028 :** ), it has to be ensured, that the resulting timespan is not shorter than `StbMSyncLossTimeout`.

**[SWS_StbM_00184]⌈**
Every invocation of `StbM_BusSetGlobalTime()` shall set the `SYNC_TO_GATEWAY` bit within `timeBaseStatus` of the Time Base to the value of the `SYNC_TO_GATEWAY` bit within `timeBaseStatus` of the `timeStampPtr` argument passed to `StbM_BusSetGlobalTime()`.
⌋(RS_TS_00009)

**[SWS_StbM_00185]⌈**
For Synchronized and Offset Time Bases for which the StbM is configured as Time Slave or Time Gateway, an invocation of `StbM_BusSetGlobalTime()` shall set the `GLOBAL_TIME_BASE` bit within `timeBaseStatus` of the Time Base. Once set, the bit is never cleared.
⌋(RS_TS_00009)

### 7.3.6 Immediate Time Synchronization

All Timesync Modules are working independently of the StbM regarding the handling of the bus-specific Time Synchronization protocol (i.e. autonomous transmission of Timesync messages on the bus).

Nevertheless it is necessary, that the StbM provides an interface, based on a `timeBaseUpdateCounter`, to allow the Timesync Modules to detect, if a Time Base has been updated or not and thus may perform an immediate transmission of Timesync messages, e.g. to speed up re-synchronization.

`StbM_GetTimeBaseUpdateCounter()` allows the Timesync Modules to detect, whether a Time Base should be transmitted immediately in the subsequent `<Bus>TSyn_MainFunction()` cycle.

**[SWS_StbM_00414]⌈**
`StbM_GetTimeBaseUpdateCounter()` shall return the value of the `timeBaseUpdateCounter` of the corresponding Time Base.
⌋(RS_TS_00011)

**[SWS_StbM_00351]⌈**

For Synchronized and Offset Time Bases, the `timeBaseUpdateCounter` of a Time Base shall have the value range 0 to 255.
](RS_TS_00011)

**[SWS_StbM_00350][**
- For Synchronized and Offset Time Bases on a valid invocation of `StbM_SetGlobalTime()`, `StbM_BusSetGlobalTime()`, or `StbM_TriggerTimeTransmission()` and
- for Offset Time Bases on a valid invocation of `StbM_SetOffset()`,

the StbM shall increment the `timeBaseUpdateCounter` of the corresponding Time Base by 1 (one).

At 255 the `timeBaseUpdateCounter` shall wrap around to 0.
](RS_TS_00011)

**Note:** For Offset Time Bases the term “corresponding Time Base” refers to the Offset Time Base only and not to the underlying Synchronized Time Base.

**Note:** `StbM_UpdateGlobalTime()` can be used instead of `StbM_SetGlobalTime()`, if the StbM shall not increment the `timeBaseUpdateCounter` of the corresponding Time Base.

### 7.3.7 User Data

User Data is part of each Global Time Base. User Data is set by the Global Time Master of each Time Base and distributed as part of the Timesync messages.
User Data can be used to characterize the Time Base, e.g., regarding the quality of the underlying clock source or regarding the progress of time.

User Data consists of up to three bytes. Due to the frame format of various Timesync messages it is not possible to transmit all three bytes on every bus system. It is the responsibility of the system designer to only use those User Data bytes that can be distributed inside the vehicle network.

**[SWS_StbM_00381][**
All functions that are setting User Data shall only set as many User Data bytes as defined within the `userDataLength` element of the `StbM_UserDataType` structure.
If `userDataLength` is equal to 0, no User Data bytes shall be set. User Data bytes that are not set shall remain at their previous value.
](RS_TS_00015)

### 7.3.8 Time Correction

The Synchronized Time-Base Manager provides the ability for Time Slaves to perform Rate and Offset Correction.

For Global Time Masters the StbM provides the ability to perform Rate Correction of their Time Base(s).

Time Correction can be configured individually for each Time Base.

#### 7.3.8.1 Rate Correction Measurement (for Time Slaves)

Rate Correction detects and eliminates rate deviations of local instances of Time Bases. Rate Correction determines the rate deviation in the scope of a measurement. This rate deviation is used as correction factor which the StbM uses to correct the Time Base's time whenever it is determined (e.g., in the scope of `StbM_GetCurrentTime()` or `StbM_BusGetCurrentTime()`).

**Note:** Applying rate correction is inaccurate for short intervals (and for small rate deviation values).

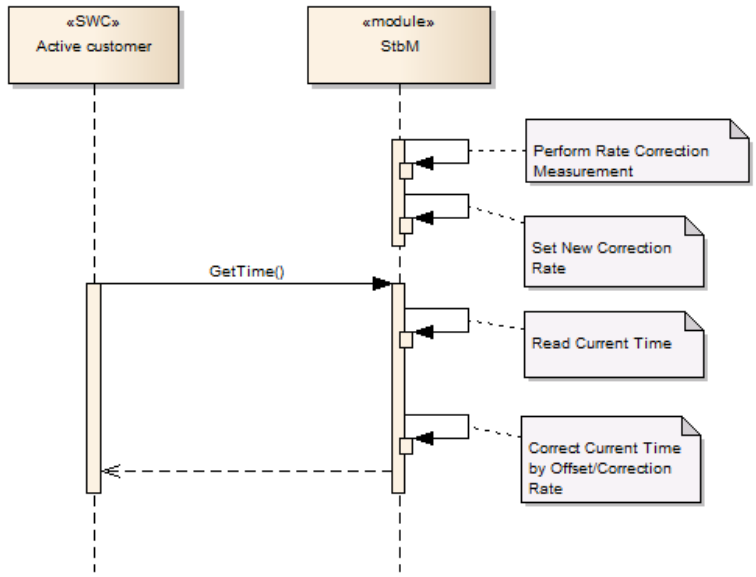


**Figure 7: Rate Correction**

**[SWS_StbM_00377][**
The StbM shall not perform Rate Correction when the measurement duration `StbMRateCorrectionMeasurementDuration` (**ECUC_StbM_00054 :** ) is set to zero.
](RS_TS_00018)

**[SWS_StbM_00376][**
For Rate Correction measurements, the StbM shall evaluate the `TIMELEAP_FUTURE` and `TIMELEAP_PAST` flags during measurements. The StbM shall discard the measurement, if any of the flags equals „Set".
](RS_TS_00018)

**[SWS_StbM_00375]⌈**
For Rate Correction measurements, the StbM shall evaluate state changes of the `SYNC_TO_GATEWAY` flag during measurements. The StbM shall discard the measurement if the flag state changes.
⌋(RS_TS_00018)

**[SWS_StbM_00374]⌈**
For Rate Correction measurements, the StbM shall evaluate the `TIMEOUT` flag. The StbM shall discard the measurement, if the flag equals „Set“.
⌋(RS_TS_00018)

**[SWS_StbM_00373]⌈**
For Rate Correction, the StbM shall evaluate the `TIMELEAP_FUTURE`/ `TIMELEAP_PAST` flags at the start of a measurement. The StbM shall not start a Rate Correction measurement when the state of any of the flags equals „Set“.
⌋(RS_TS_00018)

**[SWS_StbM_00372]⌈**
The StbM shall perform Rate Correction measurements to determine the rate deviation of each configured Time Base.
⌋(RS_TS_00018)

**[SWS_StbM_00371]⌈**
The StbM shall perform Rate Correction measurements continuously. The end of a measurement marks the start of the next measurement.
The start and end of measurements are always triggered by and aligned to the reception of time values for Synchronized or Offset Time Bases.
⌋(RS_TS_00018)

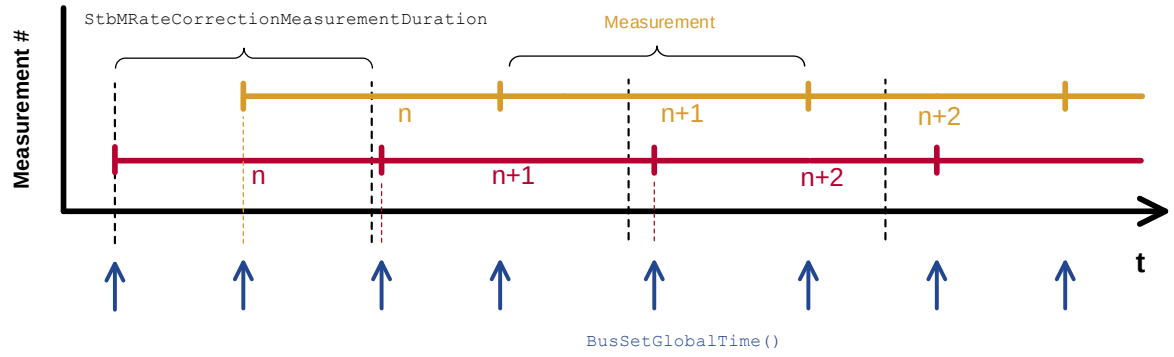


**Figure 8: Visualization of two parallel measurements**

**[SWS_StbM_00370]⌈**
During runtime the StbM shall determine the timespan of a Rate Correction measurement on the basis of the Virtual Local Time.
⌋(RS_TS_00018)

**Note:** Simply counting `StbM_BusSetGlobalTime()` calls (caused by incoming Timesync messages) and deriving the timespan, which has passed from the cycle

time, may lead to incorrect results, because the Timesync cycle time is allowed to vary.

The Global Time is only suitable as a time reference for determining the timespan of a Rate Correction measurement, if time leap detection is configured appropriately - otherwise time leaps may shorten or lengthen the time interval unacceptably.

Instead the timespan should be determined either

- based on the Virtual Local Time or
- by counting invocations of the main function `StbM_MainFunction()`

In the latter case, when determining the number of invocations based on `StbMMainFunctionPeriod` (**ECUC_StbM_00027 :** ) and `StbMRateCorrectionMeasurementDuration` (**ECUC_StbM_00054 :** ), it has to be ensured, that the resulting timespan is not shorter than `StbMRateCorrectionMeasurementDuration`.

**Note:** For implementation details of the timespan measurement refer to Note after **[SWS_StbM_00370]**.

**[SWS_StbM_00368]⌈**
The StbM shall perform as many simultaneous Rate Correction measurements as configured by parameter: `StbMRateCorrectionsPerMeasurementDuration` (**ECUC_StbM_00055 :** ).
⌋(RS_TS_00018)

**[SWS_StbM_00367]⌈**
Simultaneous Rate Correction measurements shall be started with a defined offset ($to_n$) to yield Rate Corrections evenly distributed over the measurement duration.
$to_n$ = n * (`StbMRateCorrectionMeasurementDuration` / `StbMRateCorrectionsPerMeasurementDuration`) (where ‘n’ is the zero-based index of the current measurement).
⌋(RS_TS_00018)

**Note:** If a Rate Correction measurement start is delayed e.g. due to a late reception of time values for Synchronized or Offset Time Bases (refer also to **[SWS_StbM_00371]**) such, that it would coincide with the start of a later simultaneous Rate Correction measurement, then the delayed measurement should be discarded and only the most recent one should be started. That is, only one of the simultaneous measurements is started at any reception of time values for Synchronized or Offset Time Bases.

**Note:** The implementation can, e.g., be realized by storing the relevant time snapshots in chained lists. Alternatively, measurements can be seen as objects, which store their relevant data and can be used independently.

**[SWS_StbM_00366]⌈**
At the start of a Rate Correction measurement, the StbM shall store the Updated Rx Time Tuple. The elements of the stored Time Tuple have the following denotation:

- $TG_{Start}$ – Global Time part of the Updated Rx Time Tuple
- $TV_{Start}$ – Virtual Local Time part of the Updated Rx Time Tuple

⌋(RS_TS_00018)

**Note:** This is equivalent to an atomic Time Tuple assigment: $[TG_{Start};TV_{Start}] = [TG_{Rx};TV_{Rx}]$

**[SWS_StbM_00364]⌈**
At the end of the Rate Correction measurement, the StbM shall store the Updated Rx Time Tuple. The elements of the stored Time Tuple have the following denotation:

- $TG_{Stop}$ – Global Time part of the Updated Rx Time Tuple
- $TV_{Stop}$ – Virtual Local Time part of the Updated Rx Time Tuple

⌋(RS_TS_00018)

**Note:** This is equivalent to an atomic Time Tuple assigment: $[TG_{Stop};TV_{Stop}] = [TG_{Rx};TV_{Rx}]$

**[SWS_StbM_00361]⌈**
At the end of a Rate Correction measurement, the StbM shall calculate the resulting correction rate ($r_{rc}$) for Synchronized Time Bases as shown:

$r_{rc} = (TG_{Stop} - TG_{Start}) / (TV_{Stop} - TV_{Start})$

⌋(RS_TS_00018)

**Note:** To determine the resulting rate deviation the value 1 has to be subtracted from $r_{rc}$.

**[SWS_StbM_00362]⌈**
The StbM shall use the same value for $r_{rc}$ and $r_{orc}$ until a new value has been calculated.
⌋(RS_TS_00018)

**Note:** A newly calculated Rate Correction $r_{rc}$ or $r_{orc}$ is only applied to following time calculations.

**[SWS_StbM_00360]⌈**
At the end of a Rate Correction measurement, the StbM shall calculate the resulting correction rate ($r_{orc}$) for Offset Time Bases as shown:

$r_{orc} = (TG_{Stop} - TG_{Start}) / (TV_{Stop} - TV_{Start}) + 1$

⌋(RS_TS_00018)

**Note:** $TG_{Stop}$ and $TG_{Start}$ refer to the Offset value of the Offset Time Base at the end and start of the measurement respectively, not to the corresponding absolute values

of the Offset Time Base (i.e., Offset value + value of underlying Synchronized Time Base). Since the Offset value is almost constant over time, $TG_{Stop}$ - $TG_{Start}$ is close to 0 for Offset Time Bases.

The rate for Offset Time Bases ($r_{orc}$) would therefore be close to 0, while $r_{rc}$ for Synchronized Time Bases is close to 1 (refer to **[SWS_StbM_00361]**), if +1 was not added. By adding +1 in the formula for $r_{orc}$ value ranges for rate correction $r_{orc}$ and $r_{rc}$ and the corresponding rate deviation values can be aligned which allows for more generic expressions, e.g. in **[SWS_StbM_00355]**.

However, when doing the actual rate correction for Offset Time Bases the extra +1 needs to be ignored (refer to **[SWS_StbM_00441]** and **[SWS_StbM_00424]**)

**[SWS_StbM_00527]⌈**
The StbM shall calculate the rate deviation $r_{Dev}$ as
- $r_{rc}$ -1 for Synchronized Time Bases and
- $r_{orc}$ - 1 for Offset Time Bases.

⌋(RS_TS_00018)

**[SWS_StbM_00397]⌈**
For Time Bases with `StbMSynchronizedTimeBaseIdentifier` 0 to 31 (**ECUC_StbM_00021 :** ) and `StbMIsSystemWideGlobalTimeMaster` = `False` (**ECUC_StbM_00036 :** ), the StbM shall return on invocation of `StbM_GetRateDeviation()` the rate deviation $r_{Dev}$, which has been calculated for that Time Base.

If no rate deviation has been calculated, `StbM_GetRateDeviation()` shall return `E_NOT_OK`.
⌋(RS_TS_00018)

**[SWS_StbM_00412]⌈**
For a Synchronized Time Base the StbM shall use $r_{rc}$ = 1, if a valid correction rate ($r_{rc}$) has not yet been calculated or is not being calculated (refer **[SWS_StbM_00377]**) but shall be applied (refer to 7.3.8.2).

For an Offset Time Base the StbM shall use $r_{orc}$ = 1, if a valid correction rate ($r_{orc}$) has not yet been calculated or is not being calculated (refer **[SWS_StbM_00377]**) but shall be applied (refer to 7.3.8.2).
⌋(RS_TS_00018)

### 7.3.8.2 Time Interpolation, Rate and Offset Correction (for Time Slaves)

Time interpolation happens whenever the current value of the local instance of a Time Base shall be determined. The calculation is based on the Main Time Tuple.

If Rate Correction is enabled for a given Time Base the calculation includes the Calculated Rate Correction value ($r_{rc}$ for Synchronized Time Bases, $r_{orc}$ for Offset Time Bases).

Whenever a new Global Time Tuple is received, there is a difference between the received Global Time and the Global Time of the Synclocal Time Tuple (see **[SWS_StbM_00438]**, **[SWS_StbM_00439]**). This difference is denoted as offset.

Offset Correction can be done in two ways:

- Offset Correction By Jump: the Main Time Tuple is overwritten by the Updated Rx Time Tuple, i.e., the time of the local instance of the Time Base jumps to the value of the received Global Time (refer ot Figure 9).

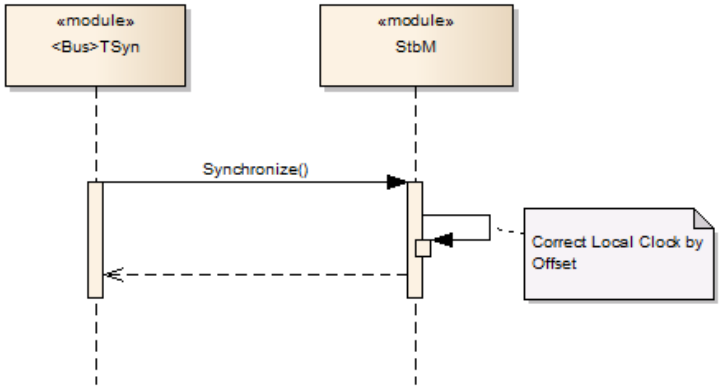


**Figure 9: Offset Jump Correction**

- Offset Correction By Rate Adaption: the Main Time Tuple is not overwritten by the Updated Rx Time Tuple, instead the applied Rate Correction is adapted such that the existing offset is steadily reduced to zero within a configured time span. Offset Correction By Rate Adaption can only be applied if Rate Correction is enabled, of course (refer ot Figure 10).

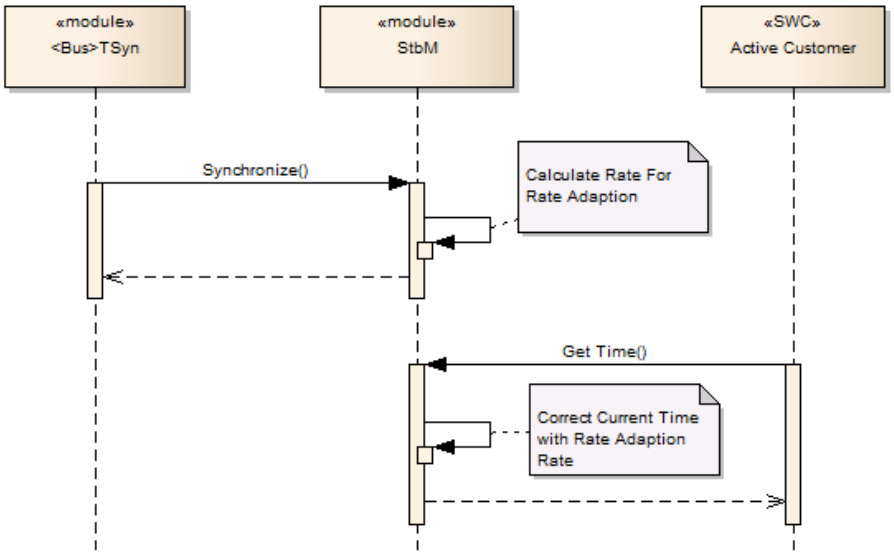


**Figure 10: Offset Rate Adaption**

**[SWS_StbM_00359]⌈**
The StbM shall calculate the Global Time offset (i.e., difference) between the Received Time and the Synclocal Time upon each, except the very first, valid invocation of `StbM_BusSetGlobalTime()`. The elements of the Time Tuples used for calculating the Global Time offset have the following denotation:

- $TL_{Sync}$ = Global Time part of the Synclocal Time Tuple
- $TG_{Rx}$ = Global Time part of the Updated Rx Time Tuple

⌋(RS_TS_00018)

**[SWS_StbM_00355]⌈**
The StbM shall calculate the current value of a Time Base based on the Main Tuple and the current rate correction term according to:

$TL = TG_{Sync} + (TV - TV_{Sync}) * r$

With:

- TL = Current value of the Time Base
- TV = Current value of the Virtual Local Time
- $TV_{Sync}$ = Virtual Local Time part of the Main Time Tuple
- $TG_{Sync}$ = Global Time part of the Main Time Tuple
- r = Current rate for correcting the local instance of the Time Base

⌋(RS_TS_00018)

**Note:** For Offset Time Bases $TG_{Sync}$ and TL refer to the Offset values of the Offset Time Base respectively, not to the corresponding absolute values of the Offset Time Base (i.e., Offset value + value of underlying Synchronized Time Base)

**[SWS_StbM_00440]⌈**
For Synchronized Time Bases and if rate correction is enabled (see **[SWS_StbM_00377])** and if the absolute value of the time offset between the Received Time and the Synclocal Time ($abs(TG_{Rx} - TL_{Sync})$) is equal or greater than `StbMOffsetCorrectionJumpThreshold` (**ECUC_StbM_00056 :** ), the StbM shall use the factor $r_{rc}$ for the rate correction term r:

$r = r_{rc}$

Otherwise r shall be set to 1, unless r shall be set accordingly to **[SWS_StbM_00356]** or **[SWS_StbM_00353]**.
⌋(RS_TS_00018)

**[SWS_StbM_00441]⌈**
For Offset Time Bases and if rate correction is enabled (see **[SWS_StbM_00377])** and if the absolute value of the time offset between the Received Time and the Synclocal Time ($abs(TG_{Rx} - TL_{Sync})$) is equal or greater than `StbMOffsetCorrectionJumpThreshold` (**ECUC_StbM_00056 :** ), the StbM shall use the factor $r_{orc}$ for the rate correction term r:

$r = r_{orc} - 1$

Otherwise r shall be set to 0, unless r shall be set accordlingly to **[SWS_StbM_00356]** or **[SWS_StbM_00353]**.
](RS_TS_00018)

**[SWS_StbM_00356][**
If rate correction is enabled (see **[SWS_StbM_00377])** and if the absolute value of the time offset between the Received Time and the Synclocal Time (abs($TG_{Rx}$ - $TL_{Sync}$)) is smaller than `StbMOffsetCorrectionJumpThreshold` (**ECUC_StbM_00056 :** ), the StbM shall correct the time offset by temporarily applying an additional rate ($r_{oc}$) to r:

$r = r_{rc} + r_{oc}$ (for Synchronized Time Bases)
$r = (r_{orc} – 1) + r_{oc}$ (for Offset Time Bases)

This rate correction term shall be applied for the duration defined by parameter `StbMOffsetCorrectionAdaptionInterval` (**ECUC_StbM_00057 :** ), starting when obtaining the Updated Rx Time Tuple (i.e., it shall be applied as long as (TV - $TV_{Sync}$) (see **[SWS_StbM_00355]**) is smaller than `StbMOffsetCorrectionAdaptionInterval`).

$r_{oc}$ shall be calculated as shown:

$r_{oc} = (TG_{Rx} – TL_{Sync}) / (T_{CorrInt})$

With:

- $T_{CorrInt}$ = `StbMOffsetCorrectionAdaptionInterval`
- $TL_{Sync}$ = Global Time part of the Synclocal Time Tuple
- $TG_{Rx}$ = Global Time part of the Updated Time Tuple

](RS_TS_00018, RS_TS_00019)

**[SWS_StbM_00353][**
If an additional rate has been applied (Offset Correction By Rate Adaption according to **[SWS_StbM_00356]**), the StbM shall **after** the period of `StbMOffsetCorrectionAdaptionInterval` (i.e., (TV - $TV_{Sync}$) (see **[SWS_StbM_00355]**) is larger or equal than `StbMOffsetCorrectionAdaptionInterval)` insert the following two steps if it needs to calculate the current value of a Time Base as defined by **[SWS_StbM_00355]:**

1. It shall first calculate a temporary Time Tuple [$TL_{Temp}$;$TV_{Temp}$] using the formula in **[SWS_StbM_00355]** with
   $TV = TV_{Temp} = TV_{Sync}$ + `StbMOffsetCorrectionAdaptionInterval`
   $r = r_{rc} + r_{oc}$ (for Synchronized Time Bases)
   $r = (r_{orc} – 1) + r_{oc}$ (for Offset Time Bases)
   $TL_{Temp}$ shall be set to the resulting value TL
2. Afterwards the Main Time Tuple [$TG_{Sync}$;$TV_{Sync}$] shall be set by an atomic operation to the values of the temporary Time Tuple [$TL_{Temp}$;$TV_{Temp}$].

Then, the calculation in **[SWS_StbM_00355]** shall be done by using the updated Main Time Tuple, the current value of the Virtual Local Time and r = $r_{rc}$ or, respectively, r = ($r_{orc}$ – 1).
](RS_TS_00018)

**Note:** It is possible for the StbM to perform the first two steps (i.e., to update the Main Time Tuple) in its Main Function after expiration of `StbMOffsetCorrectionAdaptionInterval` without being requested to calculate the current time. However, since a request to calculate the current time might occur after expiration of `StbMOffsetCorrectionAdaptionInterval` but before the next Main Function invocation, it is not possible to always decouple the first two steps from the last one.

**[SWS_StbM_00400]**[
If `StbMOffsetCorrectionJumpThreshold` (**ECUC_StbM_00056 :** ) is set to 0, Offset Correction shall be performed by Jump Correction only.
](RS_TS_00018)

#### 7.3.8.3 Time Interpolation and Rate Correction for Global Time Masters

Rate correction in Global Time Masters can be applied to Synchronized and Offset Time Bases (including Pure Local Time Bases).

Use cases are setting the rate of a Pure Local Time Base to the rate of a received Synchronized Time Base or adjusting the rate of Synchronized Time Bases to external time sources (e.g., GPS).

Rate correction is applied by setting a correction factor which the StbM uses to correct the Time Base's time whenever it is read (e.g., in the scope of `StbM_GetCurrentTime()` or `StbM_BusGetCurrentTime()`).

The interpolation of the Time Base is based on the Main Time Tuple, the current value of the Virtual Local Time and the current Rate Correction value.

**[SWS_StbM_00395]**[
If `StbMAllowMasterRateCorrection` equals `TRUE`, an invocation of `StbM_SetRateCorrection()` shall set the rate correction value. Otherwise `StbM_SetRateCorrection()` shall do nothing and return `E_NOT_OK`.
](RS_TS_00018)

**[SWS_StbM_00411]**[
The StbM shall apply rate correction to a Time Base, if `StbMAllowMasterRateCorrection` (**ECUC_StbM_00043 :** ) equals `TRUE` and a valid rate correction value has been set by `StbM_SetRateCorrection()`.
] (RS_TS_00018)

**[SWS_StbM_00396]**[

If the absolute value of the rate correction parameter `rateDeviation`, which is passed to `StbM_SetRateCorrection()`, is greater than `StbMMasterRateDeviationMax`, `StbM_SetRateCorrection` shall set the actually applied rate correction value to either (`StbMMasterRateDeviationMax`) or (`-StbMMasterRateDeviationMax`) (depending on sign of `rateDeviation`).
] (RS_TS_00018)

**Note:** The actual applied resulting rate will be

- for Synchronized Time Bases: `rateDeviation` + 1 (= $r_{rc}$ as given in **[SWS_StbM_00424]**)
- for Offset Time Bases: `rateDeviation` (= $r_{orc}$ – 1 as given in **[SWS_StbM_00424]**)

with `rateDeviation`: deviation value passed to `StbM_SetRateCorrection()`

If aligning the rate of one Time Base to the rate of another one, it is possible to use `StbM_GetRateDeviation()` and pass the value as argument to `StbM_SetRateCorrection()`.

**[SWS_StbM_00424][**
The StbM shall calculate the (rate corrected) time (TL) of its local instance of the Time Base as:

$TL = TG_{Sync} + (TV - TV_{Sync}) * r$

With:

- TV = Current value of the Virtual Local Time
- $TV_{Sync}$ = Virtual Local Time part of the Main Time Tuple
- $TG_{Sync}$ = Global Time part of the Main Time Tuple
- r = Rate for correcting the Time Base with
  r = $r_{rc}$ for Synchronized Time Bases
  r = $r_{orc}$ -1 for Offset Time Bases

If `StbMAllowMasterRateCorrection` (**ECUC_StbM_00043 :** ) equals `FALSE` r shall be set to

- 1 for Synchronized Time Bases
- 0 for Offset Time Bases

(i.e., no rate correction is applied).

] (RS_TS_00018)

**Note:** TL and TV form a new temporary Time Tuple.

**Note:** For Offset Time Bases $TG_{Sync}$ and TL refer to the Offset values of the Offset Time Base respectively, not to the corresponding absolute values of the Offset Time Base (i.e., Offset value + value of underlying Synchronized Time Base)

**[SWS_StbM_00442][**

For Synchronized Time Bases the Main Time Tuple shall be updated according to **[SWS_StbM_00440]** and **[SWS_StbM_00342]**.

Upon invocation of `StbM_SetRateCorrection()` the StbM shall calculate a temporary Time Tuple according to **[SWS_StbM_00424]** and replace the Main Time Tuple by this temporary Time Tuple. For calculation of the temporary Time Tuple StbM shall use the r value, which is valid before it is updated by current call of `StbM_SetRateCorrection()`.
⌋ (RS_TS_00018)

**[SWS_StbM_00443]⌈**
For Offset Time Bases the Main Time Tuple shall be updated according to **[SWS_StbM_00441]**, **[SWS_StbM_00190]** and **[SWS_StbM_00304]**.

Upon invocation of `StbM_SetRateCorrection()` the StbM shall calculate a temporary Time Tuple according to **[SWS_StbM_00424]** and replace the Main Time Tuple by this temporary Time Tuple. For calculation of the temporary Time Tuple StbM shall use the r value, which is valid before it is updated by current call of `StbM_SetRateCorrection()`.
⌋ (RS_TS_00018)

**[SWS_StbM_00422]⌈**
- For Time Bases with `StbMSynchronizedTimeBaseIdentifier` 32 to 127 (**ECUC_StbM_00021 :** ) and
- for Time Bases with `StbMSynchronizedTimeBaseIdentifier` 0 to 31 and `StbMIsSystemWideGlobalTimeMaster` equals `True` (**ECUC_StbM_00036 :** )

the StbM shall return on invocation of `StbM_GetRateDeviation()` the rate deviation that has been set by `StbM_SetRateCorrection()` for that Time Base.

If no rate deviation has been set, `StbM_GetRateDeviation()` shall return `E_NOT_OK`.
⌋(RS_TS_00018)

**[SWS_StbM_00431]⌈**
For the Time Master of a Synchronized Time Base the StbM shall use $r_{rc}$ = 1, if a valid correction rate ($r_{rc}$) has not yet been set.

For the Time Master of an Offset Time Base the StbM shall use $r_{orc}$ = 1, if a valid correction rate ($r_{orc}$) has not yet been set.
⌋(RS_TS_00018)

### 7.3.9 Time Base Cloning

The StbM provides an API to clone a Time Base (denoted as Source Time Base) by copying its current value, User Data and rate correction to another Time Base (denoted as Destination Time Base). The cloning API avoids loss of precision when

copying the Time Bases. Possible use cases for cloning are fallback scenarios as well as redundancy.

The StbM will clone the Time Base only if the Source Time Base's current status matches certain criteria (e.g., if no timeleap or timeout is present).

The StbM supports cloning for Synchronized and Pure Local Time Bases. Offset Time Bases are not supported.

**[SWS_StbM_00530]**⌈
For Synchronized Time Bases and Pure Local Time Bases upon invocation of `StbM_CloneTimeBase()`, the StbM shall

- first determine
  - the Destination Time Base (given by input parameter `timeBaseId`) and
  - the Source Time Base (given by configuration parameter `StbMSourceTimeBase` of the given Destination Time Base (refer to **ECUC_StbM_00074 :** ))
- and then derive a [Source;Destination] time tuple from the Time Bases
- and then check the `DEFERRED_COPY` flag in `cloneCfg`.

If the `DEFERRED_COPY` flag is set, the StbM shall

- store the clone request together with the parameters passed by `StbM_CloneTimeBase()` as 'deferred'
- replace any pending deferred clone request of the same [Source;Destination] tuple by the actual deferred clone request
- return E_OK.

If the `DEFERRED_COPY` flag is not set, the StbM shall

- remove any pending deferred clone request of the same [Source;Destination] tuple
- immediately process the clone request.

⌋(RS_TS_00038)

**[SWS_StbM_00531]**⌈
For Synchronized Time Bases and Pure Local Time Bases, the StbM shall check on every change of the `TIMEOUT` bit in the `timeBaseStatus` if a pending deferred clone request exists for which the Source part of the [Source;Destination] tuple is the same as the respective Time Base.

If such a pending deferred clone request exists it shall be removed.
⌋(RS_TS_00038)

**Note:** As a result any pending deferred clone request is removed when the related Source Time Base enters `TIMEOUT` state.
If the Source Time Base is already in `TIMEOUT` state when `StbM_CloneTimeBase()` is invoked with the `DEFERRED_COPY` flag being set, then

the effect of removing the request when leaving the `TIMEOUT` state later on is equivalent to not storing the pending deferred clone request at all.

**[SWS_StbM_00532]**⌈
For Synchronized Time Bases and Pure Local Time Bases, the StbM shall check on every invocation of `StbM_BusSetGlobalTime()` if a pending deferred clone request exists for which the Source part of the [Source;Destination] tuple is the same as the respective Time Base.

If such a pending deferred clone request exists it shall be processed once `StbM_BusSetGlobalTime()` has been processed completely, i.e., the Time Base Status has been updated, the Updated Rx Time Tuple has been subject to rate correction calculations and the Main Time Tuple has been overwritten by the Updated Rx Time Tuple (refer to chapter 7.3.8.2).

After processing the pending deferred clone request it shall be removed.
⌋(RS_TS_00038)

**[SWS_StbM_00533]**⌈
To process an immediate or deferred clone request the StbM shall first mask (logical AND) the current Time Base Status with the `statusMask` parameter of the clone request.

If the masked value is equal to the `statusValue` parameter of the clone request, the StbM shall perform the clone operation.

When processing an immediate clone request in the course of `StbM_CloneTimeBase()`, the StbM shall return E_OK if the clone request was successfully performed, otherwise the StbM shall return E_NOT_OK.
⌋(RS_TS_00038)

**[SWS_StbM_00534]**⌈
When performing the clone operation the StbM shall copy the Time Base value and the Time Base User Bytes.

If both, Source and Destination Time Base, are using the same Virtual Local Time Source, then the Main Time Tuple shall be copied, otherwise the StbM shall

- establish a protection against interruptions and run the next two steps directly afterwards:
- retrieve the current Virtual Local Time $TV_{Source}$ for the Source Time Base
- retrieve the current Virtual Local Time $TV_{Destination}$ for the Destination Time Base
- the protection against interruptions can be removed now
- determine a temporary Time Tuple [$TL_{Source}$;$TV_{Source}$]
- create a Time Tuple [$TL_{Source}$;$TV_{Destination}$] which then replaces the Main Time Tuple of the Destination Time Base.

⌋(RS_TS_00038)

**[SWS_StbM_00535]**⌈

When performing the clone operation the StbM shall check the flag `APPLY_RATE` of the `cloneCfg` parameter of the clone request.

If the flag is set, the StbM shall copy the Rate Correction value of the Source Time Base to the Destination Time Base.
⌋(RS_TS_00038)

**Note:** The Destination Time Base will apply the Rate Correction value only if `StbMAllowMasterRateCorrection` (**ECUC_StbM_00043 :** ) is set to `True`.

**[SWS_StbM_00536]**⌈
When performing the clone operation the StbM shall check the flag `IMMEDIATE_TX` of the `cloneCfg` parameter of the clone request.

If the flag is set, StbM shall increment the `timeBaseUpdateCounter` of the Destination Time Base after having copied the Time Base value and User Data to the Destination Time Base (refer to **[SWS_StbM_00534]**) to force an immediate transmission of the Time Base on the bus.
⌋(RS_TS_00038)

**Note:** If `IMMEDIATE_TX` flag is not set, the Destination Time Base will be transmitted on the bus with the next cyclic transmission of the corresponding Timesync module(s).
For a Pure Local Time Base the `IMMEDIATE_TX` flag has no effect since Pure Local Time Bases don't have a `timeBaseUpdateCounter`.

### 7.3.10 Notification of Customers

The StbM allows Notification Customers (i.e., SW-Cs or other BSW modules) either to register to be notified of status change events for a Time Base or to be notified if an alarm expires.

#### 7.3.10.1 Time Notifications

The StbM allows Notification Customers to register to be notified if a Customer specific alarm expires.

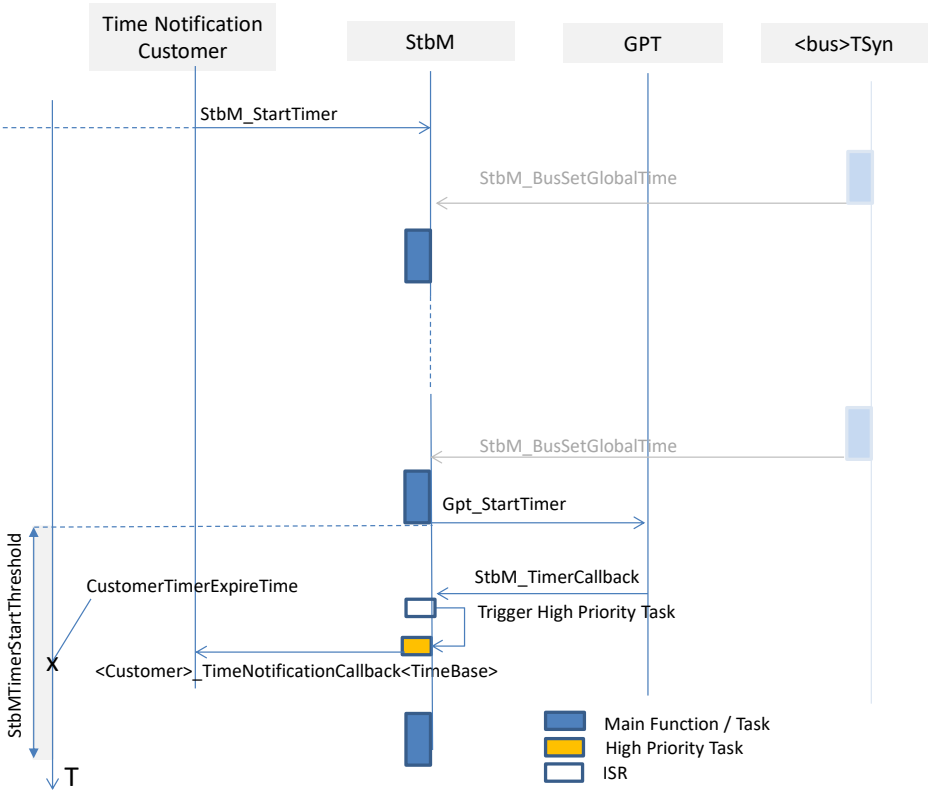


**Figure 11: Basic mechanism of Time Notification**

**[SWS_StbM_00421]⌈**
If any `StbMNotificationCustomer` (**ECUC_StbM_00050 :** ) is configured, the StbM shall use one additional GPT source (referenced by `StbMGptTimerRef` **ECUC_StbM_00039 :** ), which is not used for other purposes.
⌋(RS_TS_00017)

**[SWS_StbM_00270]⌈**
On invocation of `StbM_StartTimer` for a Time Notification Customer of a Time Base the StbM shall calculate the time `CustomerTimerExpireTime` when that Customer Timer will expire based on the corresponding Time Base. If a Customer Timer for the same Customer is already running, `StbM_StartTimer` shall return `E_NOT_OK`.
⌋(RS_TS_00017)

**[SWS_StbM_00335]⌈**
For currently active Time Notification Customers the StbM shall cyclically calculate and monitor in its `StbM_MainFunction` the difference between the current value of the corresponding Time Base and the expiration time `'CustomerTimerExpireTime'`.
⌋ (RS_TS_00017)

**Note:** Cyclic recalculation accounts for asynchronous updates of the Time Base e.g. by `StbM_BusSetGlobalTime()`.

**[SWS_StbM_00336][**
A time interval `StbMTimerStartThreshold` (**ECUC_StbM_00063 :** ) before a Customer Timer expires, the StbM shall calculate the time difference between `CustomerTimerExpireTime` and the current value of the corresponding Time Base.

The StbM shall then start a GPT timer (**ECUC_StbM_00039 :** ) via `Gpt_StartTimer()` to be notified, when the time difference has elapsed.
](RS_TS_00017)

**Note:** `StbMTimerStartThreshold` should be set to a value greater than `StbMMainFunctionPeriod` to account for the jitter of the `StbM_MainFunction`.

If the GPT timer expires for a Time Notification Customer, `StbM_TimerCallback` is called by the GPT.

**[SWS_StbM_00271][**
Upon invocation of `StbM_TimerCallback`, the StbM shall calculate the time difference between `CustomerTimerExpireTime` and the current value of the corresponding Time Base.

If the calculated time difference exceeds the value range of the `deviationTime` parameter of `<Customer>_TimeNotificationCallback()` the returned time difference shall be limited to either the maximum negative or the maximum positive value of the type of `deviationTime` (refer to StbM_TimeDiffType).

If `StbMTimeNotificationCallback` (**ECUC_StbM_00064 :** ) is not NULL,

- the StbM shall call the function `<Customer>_TimeNotificationCallback<TimeBase>()`

else

- the StbM shall call the service operation `NotifyTime` of the required port `GlobalTime_TimeEvent_{TBName}_{CName}`

to inform the corresponding Time Notification Customer and return the value of the calculated time difference in the parameter `deviationTime`.
](RS_TS_00017)

**Note:** `StbM_TimerCallback()` is called in interrupt context. The operation `NotifyTime` may however only be called from task context. Therefore, the StbM has to decouple the interrupt context from the task context (e.g. by triggering an `ExternalTriggerOccurredEvent`). The details are considered to be implementation specific.

**Note:** The `StbM_TimerCallback` notification function, which is implemented by the StbM and called by the Gpt, conforms to the `<Gpt_Notification_<channel>>` prototype. The configured notification function (`StbM_TimerCallback`) is declared via Gpt header.

**[SWS_StbM_00432]**⌈
When the StbM detects for an active customer, while monitoring the difference to `CustomerTimerExpireTime` (see **[SWS_StbM_00335]**), that

- the `CustomerTimerExpireTime` has already been passed and
- the GPT timer has not yet been started,

the StbM shall call `StbM_TimeNotificationCallback()` immediately.
⌋ (RS_TS_00017)

**Note:** This can happen, if the Time Base jumps over the expiration time (i.e., `CustomerTimerExpireTime`) due to an invocation of `StbM_BusSetGlobalTime` but the GPT timer was not yet started.

**Note:** If GPT timer is already running, StbM will call `StbM_TimeNotificationCallback()` only when GPT timer expires.

**[SWS_StbM_00337]**⌈
If multiple Customer Timers run and expire within the same interval `StbMTimerStartThreshold`, the StbM shall calculate all expiry points within the `StbMTimerStartThreshold` interval and re-start the same GPT timer for next expiry point after the previous expiry point has been reached.
⌋(RS_TS_00017)

**Caveat:** If a `StbM_BusSetGlobalTime` function call occurs and updates the Time Base, for which a GPT timer is running, the newly received Global Time value could be in the future relative to the Local Time of the Time Base. Depending on how far, that value is in the future, it could mean, that the timer expires too late (based on the new Global Time).

#### 7.3.10.2 Status Notifications

The StbM allows Notification Customers to register to be notified of status change events for a Time Base. The StbM tracks for each registered Notification Customer the occurence of various Time Base related events. Notification Customers can configure the StbM such, that they will be informed by a notification callback, if one or more events occur.

**[SWS_StbM_00277]**⌈
For Synchronized, Offset and Pure Local Time Bases:

- If parameter `StbMNotificationInterface` (**ECUC_StbM_00068 :** ) is set to either `SR_INTERFACE` or `CALLBACK_AND_SR_INTERFACE`, the StbM shall notify the application via the `StatusNotification` service interface.
- If parameter `StbMNotificationInterface` is set to either `CALLBACK` or `CALLBACK_AND_SR_INTERFACE`, the StbM shall use the callback `StatusNotificationCallback<TimeBase>` to notify a CDD about status related events.
- If parameter `StbMNotificationInterface` is set to `NO_NOTIFICATION` the notification mechanism shall be disabled for the given Time Base.

The callback StatusNotificationCallback<TimeBase> shall be set via configuration parameter StbMStatusNotificationCallback (**ECUC_StbM_00046 :** ).
] (RS_TS_00037, RS_TS_00016)

**[SWS_StbM_00526]⌈**
The StbM shall call the Status Notification callback from StbM_MainFunction().
⌋(RS_TS_00037, RS_TS_00016)

**Note:** Since a Status Notification is triggered inside StbM_MainFunction(), the other functions like e.g StbM_GetTimeBaseStatus() might detect a timeout condition sooner than the corresponding Status Notification is actually triggered. Such a delayed Status Notification is considered acceptable.

**[SWS_StbM_00279]⌈**
For each Time Base the StbM has a configurable mask StbMStatusNotificationMask (**ECUC_StbM_00045 :** ), which allows to mask individually status event notifications.
] (RS_TS_00037, RS_TS_00016)

**[SWS_StbM_00284]⌈**
The StbM shall detect the following status events:

| Status Event Name | Status Event Set Condition |
|---|---|
| EV_GLOBAL_TIME_BASE | 1: GLOBAL_TIME_BASE in timeBaseStatus has changed from 0 to 1<br>0: otherwise |
| EV_TIMEOUT_OCCURED | 1: TIMEOUT bit in timeBaseStatus has changed from 0 to 1<br>0: otherwise |
| EV_TIMEOUT_REMOVED | 1: TIMEOUT bit in timeBaseStatus has changed from 1 to 0<br>0: otherwise |
| EV_TIMELEAP_FUTURE | 1: TIMELEAP_FUTURE bit in timeBaseStatus has changed from 0 to 1<br>0: otherwise |
| EV_TIMELEAP_FUTURE_REMOVED | 1: TIMELEAP_FUTURE bit in timeBaseStatus has changed from 1 to 0<br>0: otherwise |
| EV_TIMELEAP_PAST | 1: TIMELEAP_PAST bit in timeBaseStatus has changed from 0 to 1<br>0: otherwise |
| EV_TIMELEAP_PAST_REMOVED | 1: TIMELEAP_PAST bit in timeBaseStatus has changed from 1 to 0<br>0: otherwise |
| EV_SYNC_TO_SUBDOMAIN | 1: SYNC_TO_GATEWAY bit in timeBaseStatus has changed from 0 to 1 |

| | |
|---|---|
| | 0: otherwise |
| EV_SYNC_TO_GLOBAL_MASTER | 1: SYNC_TO_GATEWAY bit in timeBaseStatus has changed from 1 to 0<br>0: otherwise |
| EV_RESYNC | 1: resynchronization has occurred and a new time value has been applied<br>0: otherwise |
| EV_RATECORRECTION | 1: a valid rate correction has been calculated (not beyond limits)<br>0: otherwise |

](RS_TS_00016)

**[SWS_StbM_00278][**
For Synchronized and Offset Time Bases the StbM shall use a variable NotificationEvents of type StbM_TimeBaseNotificationType to keep track, if any status event (refer to **[SWS_StbM_00284]**) for the referenced Time Base occurs.

If any status event occurs and the corresponding bit in the NotificationMask mask is set, the corresponding bit in the NotificationEvents variable is set , i.e., NotificationEvents can only contain bits for the events, which are enabled within the NotificationMask mask (refer to **[SWS_StbM_00284]**).
](RS_TS_00037)

**[SWS_StbM_00282][**
If any status event (refer to **[SWS_StbM_00284]**) occurs and the corresponding bit in the NotificationMask mask is set, the StbM shall report the value of the NotificationEvents variable

- via the callback function StatusNotificationCallback<TimeBase> (refer to parameter eventNotifications) and/or
- via StatusNotification service interface (refer to data element eventNotification)

depending on the setting of parameter StbMNotificationInterface (**ECUC_StbM_00068 :** ).

If multiple status events occur simultaneously for the same Time Base, the StbM shall trigger the callback function StatusNotificationCallback<TimeBase> and the StatusNotification service interface only once.
] (RS_TS_00037)

**Note:** If e.g. a (re)synchronization takes place several of the following events may occur simultaneously: EV_RESYNC, EV_TIMEOUT_REMOVED, EV_GLOBAL_TIME_BASE, EV_TIMELEAP_FUTURE, EV_TIMELEAP_PAST, EV_TIMELEAP_FUTURE_REMOVED / EV_TIMELEAP_PAST_REMOVED, EV_RATECORRECTION, EV_SYNC_TO_SUBDOMAIN and EV_SYNC_TO_GLOBAL_MASTER.

**[SWS_StbM_00280]⌈**
After reporting a status event via the `StatusNotificationCallback<TimeBase>` API and the `StatusNotification` service interface the StbM shall reset `NotificationEvents` to 0.
⌋ (RS_TS_00016)

### 7.3.11 Triggering Customers

The OS provides the API `SyncScheduleTable()` to synchronize a schedule table to a counter value.

**[SWS_StbM_00020]⌈**
The Synchronized Time-Base Manager must be able to interact with the OS as Triggered Customer. The module calls the OS API for synchronizing OS ScheduleTables.
⌋(SRS_BSW_00429, RS_TS_00037, RS_TS_00032)

**[SWS_StbM_00022]⌈**
The Synchronized Time-Base Manager shall provide means to configure the Time Base to which the OS ScheduleTable should be synchronized (see container **ECUC_StbM_00004 :** `StbMTriggeredCustomer`).
⌋(RS_TS_00037, RS_TS_00032)

The schedule table to be synchronized is given by `StbMOSScheduleTableRef` (refer to **ECUC_StbM_00007 :** ) and the Time Base, which synchronizes the schedule table, is given by `StbMSynchronizedTimeBaseRef`.

It is configurable at pre-compile time if an OS ScheduleTable shall be synchronized with a Synchronized Time Base.

**[SWS_StbM_00084]⌈**
Customers of type Triggered Customer shall be invoked periodically by the Synchronized Time-Base Manager.
⌋(RS_TS_00032)

**[SWS_StbM_00031]⌈**
If a Triggered Customer is configured (refer to **ECUC_StbM_00004 :** `StbMTriggeredCustomer`), the Synchronized Time-Base Manager shall monitor the cyclic execution of the `StbM_MainFunction()` (see section 8.1.3.23).

This is to guarantee cyclic synchronization of OS schedule tables.
⌋(RS_TS_00025)

**[SWS_StbM_00093]⌈**
The triggering period `StbMTriggeredCustomerPeriod` (refer to **ECUC_StbM_00020 :** ) shall be configurable for each Triggered Customer.

](RS_TS_00037, RS_TS_00032)

Based on the configuration, the Synchronized Time-Base Manager synchronizes the OS counter value of the associated OS ScheduleTable.

**[SWS_StbM_00302][**
The StbM shall set the synchronization count of the OS ScheduleTable via `SyncScheduleTable()`.
](RS_TS_00032)

The Synchronized Time-Base Manager is not responsible for starting and stopping the execution of OS ScheduleTables.

**[SWS_StbM_00303][**
The StbM shall derive the synchronization count of the OS ScheduleTable in microseconds by calculating the modulus of the current Time Base value (converted to microseconds) and `OsScheduleTableDuration` (see `OsScheduleTable` container referenced by **ECUC_StbM_00007 :** ).
](RS_TS_00037, RS_TS_00032)

**Note:** This requires, that the ticks of an OS counter, which drives a schedule table, have a duration of 1 us.

**[SWS_StbM_00077][**
The Synchronized Time-Base Manager shall synchronize OS ScheduleTables only when the associated Synchronized Time Base is synchronized, i.e., if

- GLOBAL_TIME_BASE = 1 and
- TIMEOUT = 0 and
- SYNC_TO_GATEWAY = 0 and
- TIMELEAP_FUTURE = 0 and
- TIMELEAP_PAST = 0

](RS_TS_00032)

**[SWS_StbM_00092][**
The Synchronized Time-Base Manager shall check the OS for the status of the OS ScheduleTable by calling `GetScheduleTableStatus()` before performing the synchronization.

The Synchronized Time-Base Manager shall synchronize only OS ScheduleTables that are in one of the states `SCHEDULETABLE_WAITING`, `SCHEDULETABLE_RUNNING` or `SCHEDULETABLE_RUNNING_SYNCHRONOUS`.
](SRS_BSW_00429, RS_TS_00032)

**Note:** The Synchronized Time-Base Manager should ignore possible errors caused by the sequential execution of a) getting OS ScheduleTable status and b) performing the synchronization (e.g., someone else might have called a service to stop the OS ScheduleTable in the meantime).

### 7.3.12 Time Recording

#### 7.3.12.1 General

**[SWS_StbM_00307][**
The StbM shall support the Global Time precision measurement for a Time Base, if `StbMTimeRecordingSupport` (**ECUC_StbM_00038 :** ) is set to `TRUE`.
](RS_TS_00034)

#### 7.3.12.2 Global Time Precision Measurement Support

To verify the precision of each Local Time Base compared to the Global Time Base a recording mechanism shall be optionally supported for Time Slaves and Time Gateways.
In principle, the StbM takes a snapshot of all required data at the point in time, where a synchronization event takes place. The StbM provides access to those values by an actively pushed API function on each successful assembled data block. An Off-Board Tester collects each block and calculates the precision afterwards and maintains a history of recorded blocks and their elements accordingly.
How and by which protocol the data will be transferred to the Off-Board Tester will be specified by the Application.

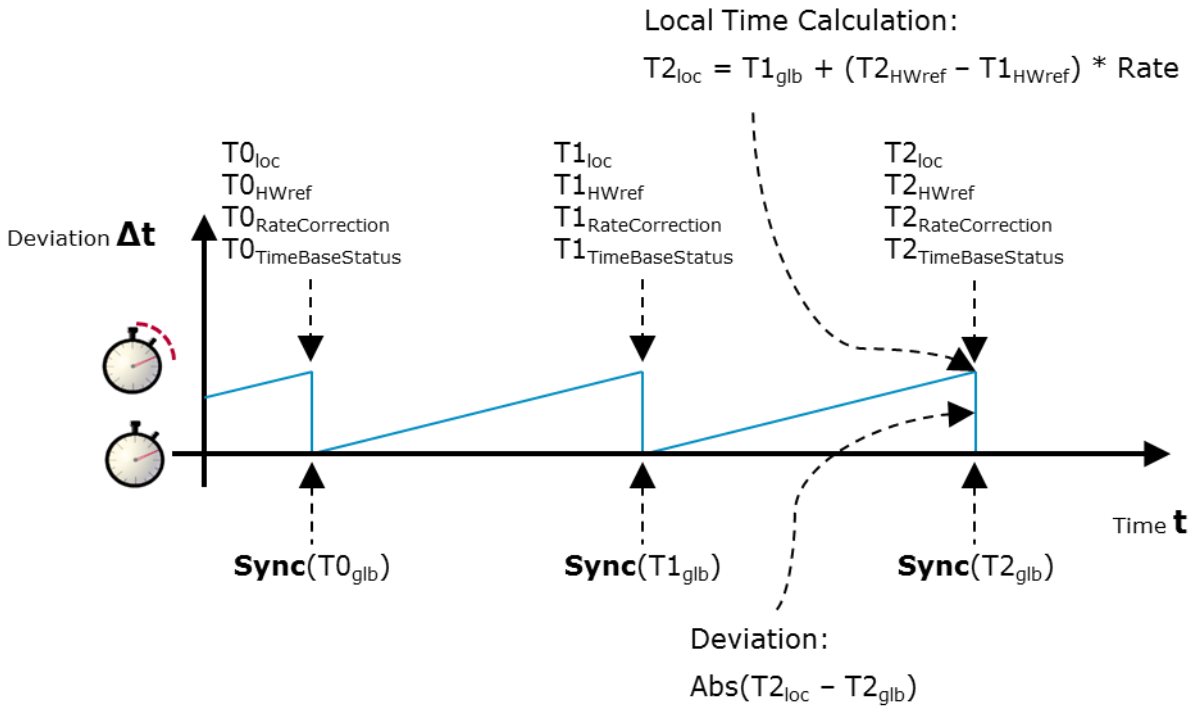


**Figure 12: Simplified view how the recorded Time Base related snapshot data are taken**

**[SWS_StbM_00428][**

The StbM shall do Global Time precision measurement only for Synchronized Time Bases and Offset Time Bases, for which `StbMIsSystemWideGlobalTimeMaster` (**ECUC_StbM_00036 : :** ) is set to `FALSE`.
] (RS_TS_00034)

#### 7.3.12.2.1 Synchronized Time Base Record Table

**[SWS_StbM_00308]**[
If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, the StbM shall establish a table to record values depending on the Synchronized Time Base with the following structure:

| | Record Table Element | Multi-plicity | Range | Bytes | Type / Unit |
|---|---|---|---|---|---|
| **Header** | | 1 | | 9 | |
| | SynchronizedTimeDomain | 1 | 0..15 | 1 | uint8 |
| | HWfrequency | 1 | 0..4294967295 | 4 | uint32 / Hz |
| | HWprescaler | 1 | 0..4294967295 | 4 | uint32 |
| **Block 0** | | 1 | | 27 | |
| | GlbSeconds | 1 | 0..4294967295 | 4 | StbM_TimeStampType. seconds |
| | GlbNanoSeconds | 1 | 0..999999999 | 4 | StbM_TimeStampType. nanoseconds |
| | TimeBaseStatus | 1 | 0..255 | 1 | StbM_TimeStampType. StbM_TimeBaseStatusType |
| | VirtualLocalTimeLow | 1 | 0..4294967295 | 4 | uint32 / nanoseconds |
| | RateDeviation | 1 | 0..+-32000 | 2 | StbM_RateDeviationType / ppm |
| | LocSeconds | 1 | 0..4294967295 | 4 | StbM_TimeStampType. seconds |
| | LocNanoSeconds | 1 | 0..999999999 | 4 | StbM_TimeStampType. nanoseconds |
| | PathDelay | 1 | 0..4294967295 | 4 | uint32 / nanoseconds |
| **Block 1** | … | | | | |
| **…** | | | | | |
| **Block** (Block-Count-1) | … | | | | |

](RS_TS_00034)

**[SWS_StbM_00309]**[
If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, `StbMClockfrequency` (**ECUC_StbM_00051 :** ) shall be mapped to the Header Element `HWfrequency` of the table belonging to the Synchronized Time Base unless the Virtual Local Time for

the Time Base is provided by a Timesync module. In this case, `HWfrequency` shall be set to 1000000000.
](RS_TS_00034)

**[SWS_StbM_00310][**
If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, `StbMClockprescaler` (**ECUC_StbM_00052 :** ) shall be mapped to the Header Element `HWprescaler` of the table belonging to the Synchronized Time Base unless the Virtual Local Time for the Time Base is provided by a Timesync module. In this case, `HWprescaler` shall be set to 1.
](RS_TS_00034)

**[SWS_StbM_00382][**
If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, the Synchronized Time Base Record Table shall contain a history of as many blocks as configured by `StbMSyncTimeRecordTableBlockCount` (**ECUC_StbM_00058 :** ).
](RS_TS_00034)

#### 7.3.12.2.2 Offset Time Base Record Table

**[SWS_StbM_00311][**
If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, the StbM shall establish a table to record values depending on the Offset Time Base with the following structure:

| | **Record Table Element** | **Multi-plicity** | **Range** | **Bytes** | **Type / Unit** |
|---|---|---|---|---|---|
| **Header** | | 1 | | 1 | |
| | OffsetTimeDomain | 1 | 16..31 | 1 | uint8 |
| **Block 0** | | 1 | | 9 | |
| | GlbSeconds | 1 | 0..4294967295 | 4 | StbM_TimeStampType. seconds |
| | GlbNanoSeconds | 1 | 0..999999999 | 4 | StbM_TimeStampType. nanoseconds |
| | TimeBaseStatus | 1 | 0..255 | 1 | StbM_TimeStampType. StbM_TimeBaseStatusType |
| **Block 1** | … | | | | |
| **…** | | | | | |
| **Block** (Block-Count-1) | … | | | | |

**Table 1: Offset Time Base Record Table**

](RS_TS_00034)

**[SWS_StbM_00383][**

If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]**) for the Time Base, the Offset Time Base Record Table shall contain a history of as many blocks as configured by `StbMOffsetTimeRecordTableBlockCount` (**ECUC_StbM_00059 :** ).
](RS_TS_00034)

#### 7.3.12.2.3 Snapshot Conditions

**[SWS_StbM_00312]**[
If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** for the Time Base, on an invocation of `StbM_BusSetGlobalTime()` the StbM shall update all elements of the block of the recording table.

If all blocks have been written and no notification via

- `SyncTimeRecordBlockCallback<TimeBase>` or
- `OffsetTimeRecordBlockCallback<TimeBase>`

has yet occurred to pass all blocks with their elements to the application, the StbM shall again overwrite the block containing the oldest measurement data with the incoming measurement data.
](RS_TS_00034)

**Note:** From the implementation point of view, this mechanism belongs to a ring buffer concept in case data cannot be forwarded to the Application fast enough.

**[SWS_StbM_00313]**[
For Synchronized Time Bases, if Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, on an invocation of `StbM_BusSetGlobalTime()` the StbM shall write the block elements

- `LocSeconds` and
- `LocNanoSeconds`

to the related measurement recording table before updating the Main Time Tuple (i.e., updating the Local Time Base by the Global Time Base). `LocSeconds` and `LocNanoSeconds` are the elements of the Global Time part of the Synclocal Time Tuple (i.e., $TL_{Sync}$ , see **[SWS_StbM_00438]**).
](RS_TS_00034)

**[SWS_StbM_00314]**[
For Synchronized Time Bases, if Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, on an invocation of `StbM_BusSetGlobalTime()` the StbM shall write the block elements

- `GlbSeconds`,
- `GlbNanoSeconds`,
- `VirtualLocalTimeLow`,
- `RateDeviation`,
- `TimeBaseStatus`
- `PathDelay`

to the related measurement recording table after updating the Main Time Tuple (i.e., after updating the Local Time Base by the Global Time Base).

`GlbSeconds`, `GlbNanoSeconds` are the elements of the Global Time part of the Updated Rx Time Tuple (i.e., $TG_{Rx}$); `VirtualLocalTimeLow` is the `nanosecondsLo` element of the Virtual Local Time part of the Updated Rx Time Tuple (i.e., $TV_{Rx}$).
⌋(RS_TS_00034)

**Note:** `PathDelay` will be retrieved from the <Bus>TSyn module as `PathDelay` member of parameter `measureDataPtr` of `StbM_BusSetGlobalTime()`.

**[SWS_StbM_00388]⌈**
For Offset Time Bases, if Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, on an invocation of `StbM_BusSetGlobalTime()` the StbM shall write the block elements `GlbSeconds`, `GlbNanoSeconds` and `TimeBaseStatus` to the related measurement recording table.
⌋(RS_TS_00034)

**[SWS_StbM_00315]⌈**
If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, the application collects the contents of the header of the Synchronized Time Base Record Table by calling `StbM_GetSyncTimeRecordHead()`.
⌋(RS_TS_00034)

**[SWS_StbM_00316]⌈**
If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, the application collects the contents of the header of the Offset Time Base Record Table by calling `StbM_GetOffsetTimeRecordHead()`.
⌋(RS_TS_00034)

**[SWS_StbM_00317]⌈**
If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, the StbM shall notify the Application by calling `SyncTimeRecordBlockCallback<TimeBase>` in the next `StbM_MainFunction()` call cycle block by block (i.e., repeatedly) for all unread blocks (i.e., containing data that has yet not been passed to the Application), starting with the block containing the oldest data, and followed by the blocks in ascending order regarding their age (i.e., FIFO order), the block containing the newest data shall be passed last.

The StbM shall ensure data integrity: a block shall not be passed if it currently being overwritten and a block that is passed shall be prevented from being overwritten until processed by the Application.
⌋(RS_TS_00034)

**[SWS_StbM_00318]⌈**

If Global Time Precision Measurement is enabled (refer to **[SWS_StbM_00428]** and **[SWS_StbM_00307]**) for the Time Base, the StbM shall notify the Application by calling `OffsetTimeRecordBlockCallback<TimeBase>` in the next `StbM_MainFunction()` call cycle block by block (i.e., repeatedly) for all unread blocks (i.e., containing data that has yet not been passed to the Application), starting with the block containing the oldest data, and followed by the blocks in ascending order regarding their age (i.e., FIFO order), the block containing the newest data shall be passed last.

The StbM shall ensure data integrity: a block shall not be passed if it currently being overwritten and a block that is passed shall be prevented from being overwritten until processed by the Application.
⌋(RS_TS_00034)

#### 7.3.12.3 Time Validation Support

Figure 13 outlines the basic concept of the “Time Validation” feature. Time Slaves, Time Masters and Time Gateways collect information on the time synchronization process from the corresponding Timesync modules, to allow for, e.g. predicting the Global Time of Sync ingress events based on their local instance of the Global Time (by using the Synclocal Time Tuple) and make this information available to the application (i.e. to an SWC). In doing so one application can check peer-wise whether a Master and a neighboring Slave agree upon the current Global Time.

The predictions, etc. may be locally analyzed by the application to detect any impairments quickly with the desired safety integrity. Furthermore, information on the time synchronization process between all Time Masters and Slaves that participate in the “Time Validation” is also shared with a Validator SWC which may run anywhere in the network, e.g. on the Global Time Master. The Validator SWC has therefore global system view which allows the Validator to check whether a coherent time base is established among all peers or not. The Validator constitutes simultaneously a single authorization instance that can assess the safety integrity of the overall system with the desired ASIL. The Validator receives the necessary information from all entities via a user defined feedback channel.

The Time Validation feature only provides service interfaces to the application. The feedback channel and the actual validation performed by the respective SWCs is not standardized in AUTOSAR. It is done in a user defined way on application level.

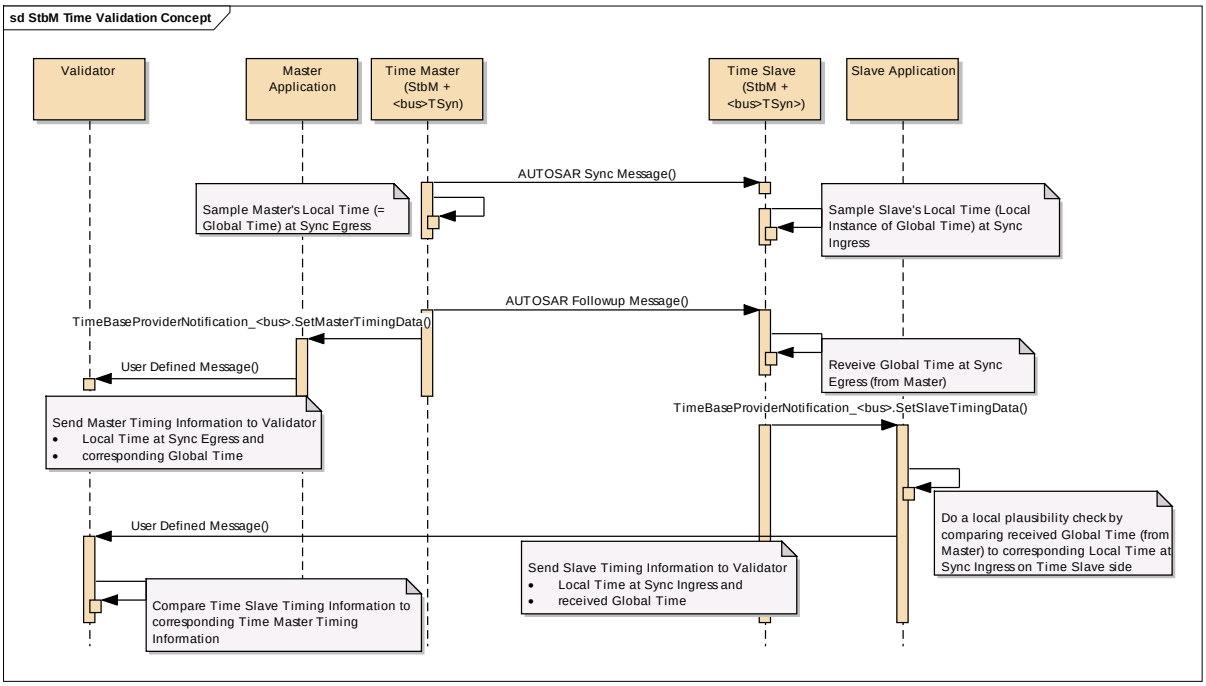


**Figure 13 : Concept of Time Validation**

**[SWS_StbM_00465]⌈**
The StbM shall record timing data for Time Validation for Synchronized Time Bases (refer to **ECUC_StbM_00021 :** `StbMSynchronizedTimeBase`), which have Time Validation enabled (i.e., **ECUC_StbM_00072 :** `SbMTimeValidation` is configured).
⌋(RS_TS_00034)

### 7.3.12.3.1 Record Tables

#### 7.3.12.3.1.1 Time-Slave/Master

**[SWS_StbM_00466]⌈**
For each Time Base,

- which has Time Validation enabled (refer to **[SWS_StbM_00465]**) and
- which is mapped to a Slave Communication Port in a Timesync module

the StbM shall manage a Time Slave Validation Record table with the following structure:

| | **Block Structure Element** | **Type** | **Description** |
|---|---|---|---|
| **Block 0** | <bus>SlaveTimingData | StbM_<bus>TimeSlaveMeasurementType | Bus specific structure to capture Time Slave Validation recording data |
| **Block 1** | <bus>SlaveTimingData | StbM_<bus>TimeSlaveMeasurementType | |
| **…** | | | |
| **Block** | | | |

| | | | |
|---|---|---|---|
| (StbMTime-Validation-RecordTable-BlockCount -1) | | | |

**Table 2: Time Slave Validation Record Table**

**](RS_TS_00034)**

**[SWS_StbM_00467][**
The type of the blocks in the Time Slave Validation Record Table (Table 2) shall depend on the Timesync Module, which provides the data for the Time Slave Validation Record Table of the corresponding Time Base.

| **Timesync Module**<br>(which provides timing record data) | **Type**<br>(of block in the Time Slave Validation Record Table) |
|---|---|
| CanTSyn<br>(by StbM_CanSetSlaveTimingData()) | StbM_CanTimeSlaveMeasurementType |
| FrTSyn<br>(by StbM_FrSetSlaveTimingData()) | StbM_FrTimeSlaveMeasurementType |
| EthTSyn<br>(by StbM_EthSetSlaveTimingData()) | StbM_EthTimeSlaveMeasurementType |

**Table 3:Type Mapping for Time Slave Validation Record Table**

](RS_TS_00034)
**[SWS_StbM_00468][**
For each Time Base,

- which has Time Validation enabled (refer to **[SWS_StbM_00465]**) and
- which is mapped to a Master Communication Port in a Timesync module

the StbM shall manage a Time Master Validation Record Table with the following structure:

| | **Block Structure Element** | **Type** | **Description** |
|---|---|---|---|
| **Block 0** | <bus>MasterTimingData | StbM_<bus>TimeMasterMeasurementType | Bus specific structure to capture Time Master Validation recording data of a Time Master |
| **Block 1** | <bus>MasterTimingData | StbM_<bus>TimeMasterMeasurementType | |
| **…** | | | |
| **Block** (StbMTime-Validation-RecordTable-BlockCount -1) | | | |

**Table 4:Time Master Validatioin Record Table**

](RS_TS_00034)

**[SWS_StbM_00469]**[
The type of the blocks in the Time Master Validation Record Table (Table 4) shall depend on the Timesync Module, which provides the data for the Time Master Validation Record Table of the corresponding Time Base.

| **Timesync Module**<br>(which provides timing record data) | **Type**<br>(of block in the Time Master Validation Record Table) |
|---|---|
| CanTSyn<br>(by `StbM_CanSetMasterTimingData()`) | `StbM_CanTimeMasterMeasurementType` |
| FrTSyn<br>(by `StbM_FrSetMasterTimingData()`) | `StbM_FrTimeMasterMeasurementType` |
| EthTSyn<br>(by `StbM_EthSetMasterTimingData()`) | `StbM_EthTimeMasterMeasurementType` |

**Table 5:Type Mapping for Time Master Validation Record Table**

](RS_TS_00034)

**Note:** The `<bus>TSynSynchronizedTimeBaseRef` parameter in the configuration of the Timesync Modules defines, which Timesync module is linked to which Time Base in the StbM, and hence determines which Timesync Module provides the data for Time Master/Slave Validation Record Table of the Time Base.

**Note:** If the StbM is configured to be a Time Gateway for a Time Base with Time Validation enabled, one Time Slave Validation Record Table and one Time Master Validation Record Tables are maintained for that Time Base by the StbM.

#### 7.3.12.3.1.2 Pdelay Initiator/Responder

**[SWS_StbM_00522]**[
For each Time Base, which

- has Time Validation enabled (refer to **[SWS_StbM_00465]**) and
- is mapped to a Slave Communication Port on an Ethernet Time Domain

the StbM shall manage a Pdelay Initiator Time Validation Record Table with the following structure:

| | **Block Structure Element** | **Type** | **Description** |
|---|---|---|---|
| **Block 0** | pdelayInitiatorData | StbM_PdelayInitiatorMeasurementType | Structure to capture Time Validation recording data of a PdelayInitiator |
| **Block 1** | pdelayInitiatorData | StbM_PdelayInitiatorMeasurementType | |
| **…** | | | |
| **Block** (`StbMTime-Validation-RecordTable-` | | | |

| | | | |
|---|---|---|---|
| BlockCount -1) | | | |

**Table 6: Pdelay Initiator Validation Record Table**

](RS_TS_00034)

**[SWS_StbM_00523]**[
For each Time Base, which

- has Time Validation enabled (refer to **[SWS_StbM_00465]**) and
- is mapped to a Master Communication Port on an Ethernet Time Domain

the StbM shall manage a Pdelay Responder Validation Record Table with the following structure:

| | Block Structure Element | Type | Description |
|---|---|---|---|
| **Block 0** | pdelayResponderData | StbM_PdelayResponderMeasurementType | Structure to capture Time Validation recording data of a PdelayResponder |
| **Block 1** | pdelayResponderData | StbM_PdelayResponderMeasurementType | |
| **…** | | | |
| **Block** (StbMTime-Validation-RecordTable-BlockCount -1) | | | |

**Table 7: Pdelay Responder Validation Record Table**

](RS_TS_00034)

#### 7.3.12.3.1.3 Common

**[SWS_StbM_00470]**[
Each

- Time Slave Validation Record Table (Table 2) and
- Time Master Validation Record Table (Table 4)
- Pdelay Initiator Validation Record Table (Table 6)
- Pdelay Responder Validation Record Table (Table 7)

shall contain as many blocks as configured by StbMTimeVadidationRecordTableBlockCount (**ECUC_StbM_00073 :** ).
](RS_TS_00034)

### 7.3.12.3.2 Time Validation Snapshot Conditions

#### 7.3.12.3.2.1 Time-Slave/Master

**[SWS_StbM_00471]**[
If Time Validation is enabled for a Time Base (refer to **[SWS_StbM_00464]** and **[SWS_StbM_00465]**), upon invocation of StbM_<bus>SetSlaveTimingData()

the StbM shall copy the content of the structure, which is passed by parameter `measureDataPtr`, to the next free `<bus>SlaveTimingData` block of the Time Slave Validation Record Table (Table 2) of that Time Base.

The StbM shall then shall set the value of the block element

- `<bus>SlaveTimingData.referenceGlobalTimestamp` as $TL_{Sync}$ (refer to **[SWS_StbM_00438]**) and
- `<bus>SlaveTimingData.referenceLocalTimestamp` as $TV_{Syn}$ (refer to **[SWS_StbM_00438]**).

(i.e., to the value of the Synclocal Time Tuple as set by the preceding call of `StbM_BusSetGlobalTime()`).
⌋(RS_TS_00034)

**[SWS_StbM_00472]⌈**
If no free block is available in the Time Slave Validation Record Table of a Time Base (i.e., all blocks have been written and no notification via operation `SetSlaveTimingData` of port `TimeBaseProviderNotification_{bus}_{TimeBase}` has yet occurred to pass all blocks to the application), the StbM shall overwrite the block containing the oldest measurement data upon invocation of `StbM_<bus>SetSlaveTimingData()`.
⌋(RS_TS_00034)

**[SWS_StbM_00473]⌈**
If Time Validation is enabled for a Time Base (refer to **SWS_StbM_00464**,**SWS_StbM_00465**), upon invocation of `StbM_<bus>SetMasterTimingData()` the StbM shall copy the content of the structure, which is passed by parameter `measureDataPtr`, to the next free block `<bus>MasterTimingData` of the Time Master Validation Record Table (Table 4) of that Time Base.
⌋(RS_TS_00034)

**[SWS_StbM_00474]⌈**
If no free block is available in a Time Master Validation Record Table of a Time Base (i.e., all blocks have been written and no notification via `SetMasterTimingData` of port `TimeBaseProviderNotification_{bus}_{TB_Name}` has yet occurred to pass all blocks to the application), the StbM shall overwrite the block containing the oldest measurement data upon invocation of `StbM_<bus>SetMasterTimingData()`.
⌋(RS_TS_00034)

**Note:** From the implementation point of view, this mechanism belongs to a ring buffer concept in case data cannot be forwarded to the application fast enough.

**[SWS_StbM_00475]⌈**
For each Time Base,

- which has Time Validation enabled (refer to **SWS_StbM_00465**) and
- for which the StbM is configured as a Time Slave or Time Gateway

the StbM shall check within each `StbM_MainFunction()` call, if new blocks (i.e., containing data that has not yet been passed to the application) have been written in the Time Slave Validation Record Table (Table 2).

If so, the StbM shall pass all new blocks to the application by (repeatedly, block by block) calling operation `SetSlaveTimingData` of port `TimeBaseProviderNotification_{bus}_{TimeBase}`.

The StbM shall pass the blocks starting with the block containing the oldest data, and followed by the blocks in ascending order regarding their age (i.e., FIFO order). The block containing the newest data shall be passed last.
](RS_TS_00034)

**[SWS_StbM_00476]**[
For each Time Base,

- which has Time Validation enabled (refer to **SWS_StbM_00465**) and
- for which the StbM is configured as a Time Master or Time Gateway

the StbM shall check within each `StbM_MainFunction()`, if new blocks (i.e., containing data that has not yet been passed to the application) have been written to the Time Master Validation Record Table (Table 4).

If so, the StbM shall pass all new blocks to the application by (repeatedly, block by block) calling operation `SetMasterTimingData` of port `TimeBaseProviderNotification_{bus}_{TimeBase}`.

The StbM shall pass the blocks starting with the block containing the oldest data, and followed by the blocks in ascending order regarding their age (i.e., FIFO order). The block containing the newest data shall be passed last.
](RS_TS_00034)

#### 7.3.12.3.2.2 Pdelay Initiator/Responder

**[SWS_StbM_00478]**[
If Time Validation is enabled for a Time Base (refer to **SWS_StbM_00465**), upon invocation of `StbM_EthSetPdelayInitiatorData()` the StbM shall write the content of the structure, which is passed by parameter `measureDataPtr`, to the next free block `pdelayInitiatorData` of the corresponding Pdelay Initiator Validation Record Table (Table 6) of that Time Base.
](RS_TS_00034)

**[SWS_StbM_00524]**[
If no free block is available in the Pdelay Initiator Validation Record Table of a Time Base (i.e., all blocks have been written and no notification via operation `SetPdelayInitiatorData` of port `TimeBaseProviderNotification_Eth_{TimeBase}` has yet occurred to pass all blocks to the application), the StbM shall overwrite the block containing the oldest measurement data upon invocation of `StbM_EthSetPdelayInitiatorData()`.
](RS_TS_00034)

**[SWS_StbM_00479]⌈**
For each Time Base, which

- has Time Validation enabled (refer to **SWS_StbM_00465**) and
- is mapped to a Slave Communication Port on an Ethernet Time Domain,

the StbM shall check within each `StbM_MainFunction()`, if new blocks (i.e., containing data that has not yet been passed to the application) have been written to the Pdelay Initiator Validation Record Table (Table 6).

If so, the StbM shall pass all new blocks to the application by (repeatedly, block by block) calling operation `SetPdelayInitiatorData` of port `TimeBaseProviderNotification_Eth_{TimeBase}`.

The StbM shall pass the blocks starting with the block containing the oldest data and followed by the blocks in ascending order regarding their age (i.e., FIFO order). The block containing the newest data shall be passed last. ⌋(RS_TS_00034)

**[SWS_StbM_00480]⌈**
If Time Validation is enabled for a Time Base (refer to **SWS_StbM_00464**,**SWS_StbM_00465**), upon invocation of `StbM_EthSetPdelayResponderData()` the StbM shall write the content of the structure, which is passed by parameter `measureDataPtr`, to the next free block `PdelayResponderData` of the corresponding Pdelay Responder Validation Record Table (Table 7) of that Time Base.

⌋(RS_TS_00034)

**[SWS_StbM_00525]⌈**
If no free block is available in the Pdelay Responder Validation Record Table of a Time Base (i.e., all blocks have been written and no notification via operation `SetPdelayResponderData` of port `TimeBaseProviderNotification_Eth_{TimeBase}` has yet occurred to pass all blocks to the application), the StbM shall overwrite the block containing the oldest measurement data upon invocation of `StbM_EthSetPdelayResponderData()`.
⌋(RS_TS_00034)

**[SWS_StbM_00481]⌈**
For each Time Base, which

- has Time Validation enabled (refer to **SWS_StbM_00465**) and
- is mapped to a Master Communication Port on an Ethernet Time Domain,

the StbM shall check within each `StbM_MainFunction()`, if new blocks (i.e., containing data that has not yet been passed to the application) have been written to the Pdelay Responder Validation Record Table (Table 7).

If so, the StbM shall pass all new blocks to the application by (repeatedly, block by block) calling operation `SetPdelayResponderData` of port `TimeBaseProviderNotification_Eth_{TimeBase}`.

The StbM shall pass the blocks starting with the block containing the oldest data and followed by the blocks in ascending order regarding their age (i.e., FIFO order). The block containing the newest data shall be passed last.
](RS_TS_00034)

#### 7.3.12.3.2.3 Common

**[SWS_StbM_00477][**
The StbM shall ensure data integrity of the blocks in the

- Time Slave Validation Record Table (Table 2) and
- Time Master Validation Record Table (Table 4) and
- Pdelay Initiator Validation Record Table (Table 6) and
- Pdelay Responder Validation Record Table (Table 7).

If a block is currently being overwritten, it shall not be passed to the application.
If a block is currently passed to the application, it shall not be overwritten until processed by the application.
](RS_TS_00034)

### 7.3.13 Interaction with User Defined Timesync Module (CDD)

User defined Time Base Providers are implemented by a CDD module. Details of the interaction between the StbM and such a CDD module are described in section “Interfacing with StbM module” of [16].

## 7.4 Multicore Distribution

The StbM needs to ensure the precision of Synchronized Time Bases (i.e. the Global Time). Therefore, it needs to ensure processing APIs reporting current timestamps without any delay, even so APIs need to support Master/Satellite-approach according to [19]. This is only possible in a synchronous processing directly in the caller context. Means all these APIs are executed in different context and StbM needs to protect the access to according data with multi-core capable means.

**[SWS_StbM_00513][**
The StbM module shall apply appropriate mechanisms to allow calls of its APIs from other partitions than its main function, e.g. by providing a StbM satellite.
](SRS_BSW_00459)

**Note:**
Parameter **ECUC_StbM_00069 :** `StbMEcucPartitionRef` references the partition, which the StbM/main function is allocated to.

**[SWS_StbM_00514][**
The StbM module shall ensure to keep the synchronous contract of its APIs, even so they are called in other partitions than StbM module is assigned to.

⌋(SRS_BSW_00459)

## 7.5 Error Handling

**[SWS_StbM_00199]⌈**
For any StbM API service other than `StbM_Init()` and `StbM_GetVersion()` all out parameters shall remain untouched, if an error occurs during execution of that API service.
⌋(RS_TS_00025)

**Note:** For further details refer to the chapter 7.2 “Error Handling” in *SWS_BSWGeneral* and chapter 8 for API specific error handling.

## 7.6 Error Classification

Section 7.2 "Error Handling" of the document "General Specification of Basic Software Modules" [14] describes the error handling of the Basic Software in detail. Above all, it constitutes a classification scheme consisting of five error types which may occur in BSW modules.

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

### 7.6.1 Development Errors

**[SWS_StbM_00041]⌈**

| *Type of error* | *Related error code* | *Error value* |
|---|---|---|
| API called with invalid time base ID | STBM_E_PARAM | 0x0A |
| API called while StbM is not initialized | STBM_E_UNINIT | 0x0B |
| API called with invalid pointer in parameter list | STBM_E_PARAM_POINTER | 0x10 |
| StbM_Init called with an invalid configuration pointer | STBM_E_INIT_FAILED | 0x11 |
| API disabled by configuration | STBM_E_SERVICE_DISABLED | 0x12 |
| API called with invalid timestamp | STBM_E_PARAM_TIMESTAMP | 0x25 |
| API called with invalid user data | STBM_E_PARAM_USERDATA | 0x26 |

⌋(SRS_BSW_00337, SRS_BSW_00385, SRS_BSW_00386, SRS_BSW_00327, SRS_BSW_00323)

### 7.6.2 Runtime Errors

There are no runtime errors.

### 7.6.3 Transient Faults

There are no transient faults.

### 7.6.4 Production Errors

There are no production errors.

### 7.6.5 Extended Production Errors

There are no extended production errors.

## 7.7 Version Check

For details refer to the chapter 5.1.8 “Version Check” in *SWS_BSWGeneral.*

# 8 API specification

## 8.1 API

### 8.1.1 Imported types

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

**[SWS_StbM_00051]**⌈

| *Module* | *Header File* | *Imported Type* |
|---|---|---|
| Can | Can_GeneralTypes.h | Can_TimeStampType (draft) |
| Eth | Eth_GeneralTypes.h | Eth_TimeStampQualType |
| | Eth_GeneralTypes.h | Eth_TimeStampType |
| Gpt | Gpt.h | Gpt_ChannelType |
| | Gpt.h | Gpt_ValueType |
| Os | Os.h | ScheduleTableStatusRefType |
| | Os.h | ScheduleTableStatusType |
| | Os.h | ScheduleTableType |
| | Os.h | StatusType |
| | Os.h | TickRefType |
| | Os.h | TickType |
| | Rte_Os_Type.h | CounterType |
| Std | Std_Types.h | Std_ReturnType |
| | Std_Types.h | Std_VersionInfoType |

⌋(SRS_BSW_00301)

### 8.1.2 Type definitions

#### 8.1.2.1 StbM_ConfigType

**[SWS_StbM_00249]**⌈

| | | |
|---|---|---|
| ***Name*** | StbM_ConfigType | |
| ***Kind*** | Structure | |
| ***Elements*** | implementation specific | |
| | ***Type*** | -- |
| | ***Comment*** | -- |
| ***Description*** | Configuration data structure of the StbM module. | |
| ***Available via*** | StbM.h | |

⌋(SRS_BSW_00414)

#### 8.1.2.2 StbM_VirtualLocalTimeType

**[SWS_StbM_91003]**⌈

| | | |
|---|---|---|
| ***Name*** | StbM_VirtualLocalTimeType | |
| ***Kind*** | Structure | |
| ***Elements*** | nanosecondsLo | |
| | ***Type*** | uint32 |
| | ***Comment*** | Least significant 32 bits of the 64 bit Virtual Local Time |
| | nanosecondsHi | |
| | ***Type*** | uint32 |
| | ***Comment*** | Most significant 32 bits of the 64 bit Virtual Local Time |
| ***Description*** | Variables of this type store time stamps of the Virtual Local Time. The unit is nanoseconds. | |
| ***Variation*** | -- | |
| ***Available via*** | StbM.h | |

⌋(RS_TS_00009)

#### 8.1.2.3 StbM_MeasurementType

**[SWS_StbM_00384]**⌈

| | | |
|---|---|---|
| ***Name*** | StbM_MeasurementType | |
| ***Kind*** | Structure | |
| ***Elements*** | pathDelay | |
| | ***Type*** | uint32 |
| | ***Comment*** | Propagation delay in nanoseconds |
| ***Description*** | Structure which contains additional measurement data | |
| ***Available via*** | StbM.h | |

⌋(RS_TS_00034)

### 8.1.3 Function definitions

This is a list of functions provided for upper layer modules.

#### 8.1.3.1 StbM_GetVersionInfo

**[SWS_StbM_00066]⌈**

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetVersionInfo | |
| ***Syntax*** | `void StbM_GetVersionInfo (`<br>`  Std_VersionInfoType* versioninfo`<br>`)` | |
| ***Service ID [hex]*** | 0x05 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Reentrant | |
| ***Parameters (in)*** | None | |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | versioninfo | Pointer to the memory location holding the version information of the module. |
| ***Return value*** | None | |
| ***Description*** | Returns the version information of this module. | |
| ***Available via*** | StbM.h | |

⌋(SRS_BSW_00407)

**[SWS_StbM_00094]⌈**
If development error detection for the StbM module is enabled the function `StbM_GetVersionInfo` shall raise the development error `STBM_E_PARAM_POINTER` and return if versioninfo is a NULL pointer (`NULL_PTR`).
⌋(SRS_BSW_00386, SRS_BSW_00337)

#### 8.1.3.2 StbM_Init

**[SWS_StbM_00052]⌈**

| | |
|---|---|
| ***Service Name*** | StbM_Init |
| ***Syntax*** | `void StbM_Init (`<br>`  const StbM_ConfigType* ConfigPtr`<br>`)` |

| | | |
|---|---|---|
| ***Service ID [hex]*** | 0x00 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | ConfigPtr | Pointer to the selected configuration set. |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | None | |
| ***Description*** | Initializes the Synchronized Time-base Manager | |
| ***Available via*** | StbM.h | |

⌋(SRS_BSW_00101, SRS_BSW_00358, SRS_BSW_00414)

The ECU State Manager calls the function `StbM_Init()` during the startup phase of the ECU in order to initialize the module. The StbM is not functional until this function has been called.

**[SWS_StbM_00100]⌈**
A static status variable denoting if the StbM is initialized shall be initialized with value 0 before any APIs of the StbM are called.
⌋(SRS_BSW_00406)

**[SWS_StbM_00121]⌈**
StbM_Init shall set the static status variable to a value not equal to 0.
⌋(SRS_BSW_00406)

### 8.1.3.3 StbM_GetCurrentTime

**[SWS_StbM_00195]⌈**

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetCurrentTime | |
| ***Syntax*** | `Std_ReturnType StbM_GetCurrentTime (`<br>`  StbM_SynchronizedTimeBaseType timeBaseId,`<br>`  StbM_TimeStampType* timeStamp,`<br>`  StbM_UserDataType* userData`<br>`)` | |
| ***Service ID [hex]*** | 0x07 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | time base reference |

| | | |
|---|---|---|
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | timeStamp | Current time stamp that is valid at this time |
| | userData | User data of the Time Base |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Returns a time value (Local Time Base derived from Global Time Base) in standard format.<br>Note: This API shall be called with locked interrupts / within an Exclusive Area to prevent interruption (i.e., the risk that the time stamp is outdated on return of the function call). | |
| ***Available via*** | StbM.h | |

](RS_TS_00005, RS_TS_00006, RS_TS_00029, RS_TS_00030, RS_TS_00031, RS_TS_00014)

**[SWS_StbM_00196]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetCurrentTime()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which is

- not configured or
- within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00197]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetCurrentTime()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `timeStamp` or `userData`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.4 StbM_GetCurrentTimeExtended

**[SWS_StbM_00200]**[

| | |
|---|---|
| ***Service Name*** | StbM_GetCurrentTimeExtended |
| ***Syntax*** | `Std_ReturnType StbM_GetCurrentTimeExtended (`<br>`  StbM_SynchronizedTimeBaseType timeBaseId,`<br>`  StbM_TimeStampExtendedType* timeStamp,`<br>`  StbM_UserDataType* userData`<br>`)` |
| ***Service ID [hex]*** | 0x08 |
| ***Sync/Async*** | Synchronous |

| | | |
|---|---|---|
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | time base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | timeStamp | Current time stamp that is valid at this time |
| | userData | User data of the Time Base |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Returns a time value (Local Time Base derived from Global Time Base) in extended format.<br>Note: This API shall be called with locked interrupts / within an Exclusive Area to prevent interruption (i.e., the risk that the time stamp is outdated on return of the function call). | |
| ***Available via*** | StbM.h | |

⌋(RS_TS_00005, RS_TS_00014)

**[SWS_StbM_00201]⌈**
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetCurrentTimeExtended()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which is

- not configured or
- within the reserved value range.

⌋(SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00202]⌈**
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetCurrentTimeExtended()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `timeStamp` or `userData`.
⌋(SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.5 StbM_GetCurrentVirtualLocalTime

**[SWS_StbM_91006]⌈**

| | |
|---|---|
| ***Service Name*** | StbM_GetCurrentVirtualLocalTime |
| ***Syntax*** | `Std_ReturnType StbM_GetCurrentVirtualLocalTime ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_VirtualLocalTimeType* localTimePtr )` |
| ***Service ID [hex]*** | 0x1e |
| ***Sync/Async*** | Synchronous |

| | | |
|---|---|---|
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | localTimePtr | Current Virtual Local Time value |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Returns the Virtual Local Time of the referenced Time Base. | |
| ***Available via*** | StbM.h | |

](RS_TS_00006, RS_TS_00008)

**[SWS_StbM_00444]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetCurrentVirtualLocalTime ()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `localTimePtr`.
](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00445]**[ If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetCurrentVirtualLocalTime ()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- is within the reserved value range.

] ( SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.6 StbM_SetGlobalTime

**[SWS_StbM_00213]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_SetGlobalTime | |
| ***Syntax*** | `Std_ReturnType StbM_SetGlobalTime (`<br>`  StbM_SynchronizedTimeBaseType timeBaseId,`<br>`  const StbM_TimeStampType* timeStamp,`<br>`  const StbM_UserDataType* userData`<br>`)` | |
| ***Service ID [hex]*** | 0x0b | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | time base reference |
| | timeStamp | New time stamp |

| | | |
|---|---|---|
| | userData | New user data (if not NULL) |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Allows the Customers to set the new global time that has to be valid for the system, which will be sent to the busses. This function will be used if a Time Master is present in this ECU. | |
| ***Available via*** | StbM.h | |

](RS_TS_00029, RS_TS_00010)

**[SWS_StbM_00214]⌈**
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_SetGlobalTime()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which is

- not configured or
- within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00215]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_SetGlobalTime()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `timeStamp`.
](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00448]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_SetGlobalTime()` shall report to DET the development error `STBM_E_PARAM_TIMESTAMP`, if called with a parameter `timeStamp` that contains invalid elements (e.g., nanoseconds part > 999999999 ns).
](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00449]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_SetGlobalTime()` shall report to DET the development error `STBM_E_PARAM_USERDATA`, if called with an invalid value of parameter `userData`, i.e., `userDataLength` > 3.
](SRS_BSW_00386, SRS_BSW_00323)

#### 8.1.3.7 StbM_UpdateGlobalTime

**[SWS_StbM_00385]⌈**

| | | |
|---|---|---|
| ***Service Name*** | StbM_UpdateGlobalTime | |
| ***Syntax*** | `Std_ReturnType StbM_UpdateGlobalTime (`<br>`  StbM_SynchronizedTimeBaseType timeBaseId,`<br>`  const StbM_TimeStampType* timeStamp,`<br>`  const StbM_UserDataType* userData`<br>`)` | |
| ***Service ID [hex]*** | 0x10 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | time base reference |
| | timeStamp | New time stamp |
| | userData | New user data (if not NULL) |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Allows the Customers to set the Global Time that will be sent to the buses. This function will be used if a Time Master is present in this ECU. Using UpdateGlobal Time will not lead to an immediate transmission of the Global Time. | |
| ***Available via*** | StbM.h | |

⌋(RS_TS_00010)

**[SWS_StbM_00340]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_UpdateGlobalTime()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which is

- not configured or
- within the reserved value range.

⌋(SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00341]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_UpdateGlobalTime()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `timeStamp`.
⌋(SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00451]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_UpdateGlobalTime()` shall report to DET the development error `STBM_E_PARAM_TIMESTAMP`, if called with a parameter `timeStamp` that contains invalid elements (e.g., nanoseconds part > 999999999 ns).
⌋(SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00452]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_UpdateGlobalTime()` shall report to DET the development error `STBM_E_PARAM_USERDATA`, if called with an invalid value of parameter `userData`, i.e., `userDataLength` > 3.
⌋(SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.8 StbM_SetUserData

**[SWS_StbM_00218]⌈**

| | | |
|---|---|---|
| ***Service Name*** | StbM_SetUserData | |
| ***Syntax*** | `Std_ReturnType StbM_SetUserData ( StbM_SynchronizedTimeBaseType timeBaseId, const StbM_UserDataType* userData )` | |
| ***Service ID [hex]*** | 0x0c | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | userData | New User Data |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Allows the Customers to set the new User Data that has to be valid for the system, which will be sent to the busses. | |
| ***Available via*** | StbM.h | |

⌋(RS_TS_00015)

**[SWS_StbM_00219]⌈**

If the switch StbMDevErrorDetect (**ECUC_StbM_00012 :** ) is set to TRUE, StbM_SetUserData() shall report to DET the development error STBM_E_PARAM, if called with a parameter timeBaseId, which

- is not configured or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00220]**[
If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_SetUserData() shall report to DET the development error STBM_E_PARAM_POINTER, if called with a NULL pointer for parameter userData.
](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00457]**[
If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_SetUserData() shall report to DET the development error STBM_E_PARAM_USERDATA, if called with an invalid value of parameter userData, i.e., userDataLength > 3.

](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.9 StbM_SetOffset

**[SWS_StbM_00223]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_SetOffset | |
| ***Syntax*** | `Std_ReturnType StbM_SetOffset ( StbM_SynchronizedTimeBaseType timeBaseId, const StbM_TimeStampType* timeStamp, const StbM_UserDataType* userData )` | |
| ***Service ID [hex]*** | 0x0d | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | time base reference |
| | timeStamp | New offset time stamp |
| | userData | New User Data (Or NULL if no new user data is provided) |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Allows the Customers and the Timesync Modules to set the Offset Time and the | |

| | |
|---|---|
| | User Data. |
| ***Available via*** | StbM.h |

](RS_TS_00029, RS_TS_00013)

**[SWS_StbM_00224]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_SetOffset()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- refers to a Synchronized or Pure Local Time Base or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00225]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_SetOffset()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `timeStamp`.
](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00453]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_SetOffset()` shall report to DET the development error `STBM_E_PARAM_TIMESTAMP`, if called with a parameter `timeStamp` that contains invalid elements (e.g., nanoseconds part > 999999999 ns).
](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00454]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_SetOffset()` shall report to DET the development error `STBM_E_PARAM_USERDATA`, if called with an invalid value of parameter `userData`, i.e., `userDataLength` > 3.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.10 StbM_GetOffset

**[SWS_StbM_00228]**[

| | |
|---|---|
| ***Service Name*** | StbM_GetOffset |
| ***Syntax*** | `Std_ReturnType StbM_GetOffset (`<br>`  StbM_SynchronizedTimeBaseType timeBaseId,`<br>`  StbM_TimeStampType* timeStamp,`<br>`  StbM_UserDataType* userData`<br>`)` |
| ***Service ID [hex]*** | 0x0e |

| | | |
|---|---|---|
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | timeStamp | Current Offset Time value |
| | userData | Current User Data |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Allows the Timesync Modules to get the current Offset Time and User Data. | |
| ***Available via*** | StbM.h | |

](RS_TS_00012, RS_TS_00029, RS_TS_00031)

**[SWS_StbM_00229]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_GetOffset()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- refers to a Synchronized or Pure Local Time Base or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00230]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_GetOffset()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `timeStamp` or `userData`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.11 StbM_BusGetCurrentTime

**[SWS_StbM_91005]**[

| | |
|---|---|
| ***Service Name*** | StbM_BusGetCurrentTime |
| ***Syntax*** | `Std_ReturnType StbM_BusGetCurrentTime (`<br>`  StbM_SynchronizedTimeBaseType timeBaseId,`<br>`  StbM_TimeStampType* globalTimePtr,`<br>`  StbM_VirtualLocalTimeType* localTimePtr,`<br>`  StbM_UserDataType* userData`<br>`)` |
| ***Service ID [hex]*** | 0x1f |

| | | |
|---|---|---|
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | globalTime Ptr | Value of the local instance of the Global Time, which is sampled when the function is called |
| | localTimePtr | Value of the Virtual Local Time, which is sampled when the function is called |
| | userData | User data of the Time Base |
| ***Return value*** | Std_Return-Type | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Returns the current Time Tuple, status and User Data of the Time Base. | |
| ***Available via*** | StbM.h | |

](RS_TS_00005, RS_TS_00006, RS_TS_00029, RS_TS_00031, RS_TS_00014)

**[SWS_StbM_00446]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_BusGetCurrentTime()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- refers to an Offset Time Base or
- refers to a Pure Local Time Base or
- is not configured or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00447]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_BusGetCurrentTime()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `globalTimePtr`, `localTimePtr` or `userData`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.12 StbM_BusSetGlobalTime

**[SWS_StbM_00233]**[

| | |
|---|---|
| ***Service Name*** | StbM_BusSetGlobalTime |
| ***Syntax*** | `Std_ReturnType StbM_BusSetGlobalTime (`<br>`  StbM_SynchronizedTimeBaseType timeBaseId,`<br>`  const StbM_TimeStampType* globalTimePtr,` |

| | | |
|---|---|---|
| | `const StbM_UserDataType* userDataPtr,`<br>`const StbM_MeasurementType* measureDataPtr,`<br>`const StbM_VirtualLocalTimeType* localTimePtr`<br>`)` | |
| ***Service ID [hex]*** | 0x0f | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | globalTimePtr | New Global Time value |
| | userDataPtr | New User Data (if not NULL) |
| | measureDataPtr | New measurement data |
| | localTimePtr | Value of the Virtual Local Time associated to the new Global Time |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Allows the Time Base Provider Modules to forward a new Global Time tuple (i.e., Rx Time Tuple) to the StbM. | |
| ***Available via*** | StbM.h | |

](RS_TS_00007, RS_TS_00030, RS_TS_00031, RS_TS_00034)

**[SWS_StbM_00234][**
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_BusSetGlobalTime()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- refers to a Pure Local Time Base or
- is not configured or
- is within the reserved value range

](SRS_BSW_00386, SRS_BSW_00323)

**Note:**
A parameter `timeBaseId` within the reserved value range indicates legacy use.

**[SWS_StbM_00235][**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_BusSetGlobalTime()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter

- `globalTimePtr`

- measureDataPtr
- localTimePtr

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00455]**[
If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_BusSetGlobalTime() shall report to DET the development error STBM_E_PARAM_TIMESTAMP, if called with a parameter timeStamp that contains invalid elements (e.g., nanoseconds part > 999999999 ns).

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00456]**[
If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_BusSetGlobalTime() shall report to DET the development error STBM_E_PARAM_USERDATA, if called with an invalid value of parameter userData, i.e., userDataLength > 3.

](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.13 StbM_GetRateDeviation

**[SWS_StbM_00378]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetRateDeviation | |
| ***Syntax*** | `Std_ReturnType StbM_GetRateDeviation ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_RateDeviationType* rateDeviation )` | |
| ***Service ID [hex]*** | 0x11 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | rateDeviation | Value of the current rate deviation of a Time Base |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Returns value of the current rate deviation of a Time Base | |
| ***Available via*** | StbM.h | |

](RS_TS_00018)

**[SWS_StbM_00379]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_GetRateDeviation()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- is within the reserved value range.

⌋(SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00380]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_GetRateDeviation()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `rateDeviation`.
⌋(SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.14 StbM_SetRateCorrection

**[SWS_StbM_00390]⌈**

| | | |
|---|---|---|
| ***Service Name*** | StbM_SetRateCorrection | |
| ***Syntax*** | `Std_ReturnType StbM_SetRateCorrection ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_RateDeviationType rateDeviation )` | |
| ***Service ID [hex]*** | 0x12 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | rateDeviation | Value of the applied rate deviation |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Allows to set the rate of a Synchronized Time Base (being either a Pure Local Time Base or not). | |
| ***Available via*** | StbM.h | |

⌋(RS_TS_00018)

**[SWS_StbM_00391]⌈**

If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_SetRateCorrection() shall report to DET the development error STBM_E_PARAM, if called with a parameter timeBaseId, which

- is not configured or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00392]**[
If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_SetRateCorrection() shall report to DET the development error STBM_E_SERVICE_DISABLED, if StbMAllowMasterRateCorrection is set to FALSE for the corresponding Time Base, i.e., it is not allowed to call StbM_SetRateCorrection().
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.15 StbM_GetTimeLeap

**[SWS_StbM_00267]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetTimeLeap | |
| ***Syntax*** | `Std_ReturnType StbM_GetTimeLeap ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_TimeDiffType* timeJump )` | |
| ***Service ID [hex]*** | 0x13 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | timeJump | Time leap value |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Returns value of Time Leap. | |
| ***Available via*** | StbM.h | |

](RS_TS_00005)

**[SWS_StbM_00268]**[
If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_GetTimeLeap() shall report to DET the development error STBM_E_PARAM, if called with a parameter timeBaseId, which

- is not configured or

- refers to a Pure Local Time Base or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00269]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_GetTimeLeap()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `timeJump`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.16 StbM_GetTimeBaseStatus

**[SWS_StbM_00263]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetTimeBaseStatus | |
| ***Syntax*** | `Std_ReturnType StbM_GetTimeBaseStatus ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_TimeBaseStatusType* syncTimeBaseStatus, StbM_TimeBaseStatusType* offsetTimeBaseStatus )` | |
| ***Service ID [hex]*** | 0x14 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | syncTimeBaseStatus | Status of the Synchronized (or Pure Local) Time Base |
| | offsetTimeBaseStatus | Status of the Offset Time Base |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Returns detailed status information for a Synchronized (or Pure Local) Time Base and, if called for an Offset Time Base, for the Offset Time Base and the underlying Synchronized Time Base. | |
| ***Available via*** | StbM.h | |

](RS_TS_00005)

**[SWS_StbM_00264]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetTimeBaseStatus()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00386]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_GetTimeBaseStatus()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `syncTimeBaseStatus` or `offsetTimeBaseStatus`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.17 StbM_CloneTimeBase

**[SWS_StbM_91012]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_CloneTimeBase | |
| ***Syntax*** | `Std_ReturnType StbM_CloneTimeBase ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_CloneConfigType cloneCfg, StbM_TimeBaseStatusType statusMask, StbM_TimeBaseStatusType statusValue )` | |
| ***Service ID [hex]*** | 0x2b | |
| ***Sync/Async*** | Depends on Configuration | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Destination Time Base for cloning |
| | cloneCfg | Refines how source Time Base is cloned to destination |
| | statusMask | Status flags mask for definition of relevant status flags |
| | statusValue | Status flags value define whether cloning shall take place |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Copies Time Base data (current time, user data, rate corrction) from Source Time Base to Destination Time Base. The Source Time Base is identified by the parameter StbMSourceTimeBase (ECUC_StbM_00074).<br>Stb?M_?CloneTimeBase behaves synchronuously (immediate copy of Time Base) if DEFERRED_COPY flag of parameter cloneCfg is set to true, otherwise it behaves asynchronuously (deferred copy of Time Base).<br>Note: Even, if configured to behave synchronuously (immediate copy of Time Base), actual transmission of cloned Time Base value on the bus occurs asynchronuously. | |

| | |
|---|---|
| ***Available via*** | StbM.h |

](

**[SWS_StbM_00537]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012) is set to `TRUE`, `StbM_CloneTimeBase()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `TimeBaseId`, which

- is not configured or
- refers to an Offset Time Base or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.18 StbM_StartTimer

**[SWS_StbM_00272]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_StartTimer | |
| ***Syntax*** | `Std_ReturnType StbM_StartTimer (`<br>`  StbM_SynchronizedTimeBaseType timeBaseId,`<br>`  StbM_CustomerIdType customerId,`<br>`  const StbM_TimeStampType* expireTime`<br>`)` | |
| ***Service ID [hex]*** | 0x15 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | customerId | Status of the Synchronized Time Base |
| | expireTime | Time value relative to current Time Base value of the Notification Customer, when the Timer shall expire |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_Return-Type | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Sets a time value, which the Time Base value is compared against | |
| ***Available via*** | StbM.h | |

](RS_TS_00017)

**[SWS_StbM_00296]**[

If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_StartTimer()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00406]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_StartTimer()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `customerId`, which is not configured.
](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00298]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_StartTimer()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with an invalid pointer of parameter `expireTime`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.19 StbM_GetSyncTimeRecordHead

**[SWS_StbM_00319]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetSyncTimeRecordHead | |
| ***Syntax*** | `Std_ReturnType StbM_GetSyncTimeRecordHead ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_SyncRecordTableHeadType* syncRecordTableHead )` | |
| ***Service ID [hex]*** | 0x16 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | syncRecordTableHead | Header of the table |
| ***Return value*** | Std_ReturnType | E_OK: Table access done<br>E_NOT_OK: Table contains no data or access invalid |
| ***Description*** | Accesses to the recorded snapshot data Header of the table belonging to the Synchronized Time Base. | |
| ***Available via*** | StbM.h | |

](RS_TS_00034)

**[SWS_StbM_00320]**[
The function `StbM_GetSyncTimeRecordHead()` shall be pre compile time configurable `ON`/`OFF` by the configuration parameter: `StbMTimeRecordingSupport` (**ECUC_StbM_00038 :** ).
](RS_TS_00034)

**[SWS_StbM_00394]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetSyncTimeRecordHead`() shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- refers to a Pure Local or a Offset Time Base or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00405]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `GetSyncTimeRecordHead` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with an invalid pointer of parameter `syncRecordTableHead`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.20 StbM_GetOffsetTimeRecordHead

**[SWS_StbM_00325]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetOffsetTimeRecordHead | |
| ***Syntax*** | `Std_ReturnType StbM_GetOffsetTimeRecordHead ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_OffsetRecordTableHeadType* offsetRecordTableHead )` | |
| ***Service ID [hex]*** | 0x17 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | offsetRecordTableHead | Header of the table |
| ***Return value*** | Std_ReturnType | E_OK: Table access done<br>E_NOT_OK: Table contains no data or access invalid |
| ***Description*** | Accesses to the recorded snapshot data Header of the table belonging to the | |

| | |
|---|---|
| | Offset Time Base. |
| ***Available via*** | StbM.h |

](RS_TS_00034)

**[SWS_StbM_00326]**[
The function `StbM_GetOffsetTimeRecordHead()` shall be pre compile time configurable `ON`/`OFF` by the configuration parameter: `StbMTimeRecordingSupport` (**ECUC_StbM_00038 :** ) .
](RS_TS_00034)

**[SWS_StbM_00327]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_GetOffsetTimeRecordHead`() shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- refers to a Pure Local or a Synchronized Time Base or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00404]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `GetOffsetTimeRecordHead` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with an invalid pointer of parameter `offsetRecordTableHead`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.21 StbM_TriggerTimeTransmission

**[SWS_StbM_00346]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_TriggerTimeTransmission | |
| ***Syntax*** | `Std_ReturnType StbM_TriggerTimeTransmission ( StbM_SynchronizedTimeBaseType timeBaseId )` | |
| ***Service ID [hex]*** | 0x1c | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters*** | None | |

| | | |
|---|---|---|
| ***(out)*** | | |
| ***Return value*** | Std_ReturnType | E_OK: Operation successful<br>E_NOT_OK: Operation not successful |
| ***Description*** | Called by the <Upper Layer> to force the Timesync Modules to transmit the current Time Base again due to an incremented timeBaseUpdateCounter[timeBaseId] | |
| ***Available via*** | StbM.h | |

](RS_TS_00011)

**[SWS_StbM_00349]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_TriggerTimeTransmission()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- refers to a Pure Local Time Base or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.22 StbM_GetTimeBaseUpdateCounter

**[SWS_StbM_00347]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetTimeBaseUpdateCounter | |
| ***Syntax*** | `uint8 StbM_GetTimeBaseUpdateCounter ( StbM_SynchronizedTimeBaseType timeBaseId )` | |
| ***Service ID [hex]*** | 0x1b | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | uint8 | Counter value belonging to the Time Base, that indicates a Time Base update to the Timesync Modules |
| ***Description*** | Allows the Timesync Modules to detect, whether a Time Base should be transmitted immediately in the subsequent <Bus>TSyn_MainFunction() cycle. | |
| ***Available via*** | StbM.h | |

](RS_TS_00011)

**[SWS_StbM_00348]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetTimeBaseUpdateCounter`() shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which

- is not configured or
- refers to a Pure Local Time Base or
- is within the reserved value range.

](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.23 StbM_GetMasterConfig

**[SWS_StbM_91002]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetMasterConfig | |
| ***Syntax*** | `Std_ReturnType StbM_GetMasterConfig ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_MasterConfigType* masterConfig )` | |
| ***Service ID [hex]*** | 0x1d | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | masterConfig | Indicates, if system wide master functionality is supported |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Indicates if the functionality for a system wide master (e.g. StbM_SetGlobalTime) for a given Time Base is available or not. | |
| ***Available via*** | StbM.h | |

](RS_TS_00029)

**[SWS_StbM_00415]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetMasterConfig()` shall report to DET the development error `STBM_E_PARAM`, `if` called with a parameter `timeBaseId`, which

- is not configured or
- is within the reserved value range.

] ( SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00416][**
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_GetMasterConfig()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `masterConfig`.
] ( SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.24 StbM_CanSetSlaveTimingData

**[SWS_StbM_00484]**{DRAFT} [

| | | |
|---|---|---|
| ***Service Name*** | StbM_CanSetSlaveTimingData (draft) | |
| ***Syntax*** | `Std_ReturnType StbM_CanSetSlaveTimingData ( StbM_SynchronizedTimeBaseType timeBaseId, const StbM_CanTimeSlaveMeasurementType* measureDataPtr )` | |
| ***Service ID [hex]*** | 0x26 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | measureDataPtr | New measurement data |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Allows the CanTSyn Module to forward CAN specific details to the StbM.<br>**Tags:** atp.Status=draft | |
| ***Available via*** | StbM_CanTSyn.h | |

](RS_TS_00030, RS_TS_00031, RS_TS_00034)

### 8.1.3.25 StbM_ FrSetSlaveTimingData

**[SWS_StbM_00485]**{DRAFT} [

| | |
|---|---|
| ***Service Name*** | StbM_FrSetSlaveTimingData (draft) |
| ***Syntax*** | `Std_ReturnType StbM_FrSetSlaveTimingData (` |

| | | |
|---|---|---|
| | `StbM_SynchronizedTimeBaseType timeBaseId,`<br>`const StbM_FrTimeSlaveMeasurementType* measureDataPtr`<br>`)` | |
| ***Service ID [hex]*** | 0x27 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | measureDataPtr | New measurement data |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Allows the FrTSyn Module to forward Flexray specific details to the StbM.<br>**Tags:** atp.Status=draft | |
| ***Available via*** | StbM_FrTSyn.h | |

](RS_TS_00030, RS_TS_00031, RS_TS_00034)

### 8.1.3.26 StbM_EthSetSlaveTimingData

**[SWS_StbM_00486]**{DRAFT} [

| | | |
|---|---|---|
| ***Service Name*** | StbM_EthSetSlaveTimingData (draft) | |
| ***Syntax*** | `Std_ReturnType StbM_EthSetSlaveTimingData (`<br>`StbM_SynchronizedTimeBaseType timeBaseId,`<br>`const StbM_EthTimeSlaveMeasurementType* measureDataPtr`<br>`)` | |
| ***Service ID [hex]*** | 0x28 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | measureDataPtr | New measurement data |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |

| | |
|---|---|
| ***Description*** | Allows the EthTSyn Module to forward Ethernet specific details to the StbM.<br>**Tags:** atp.Status=draft |
| ***Available via*** | StbM_EthTSyn.h |

](RS_TS_00030, RS_TS_00031, RS_TS_00034)

**[SWS_StbM_00487]**[
The function `StbM_<bus>SetSlaveTimingData()` shall be pre compile time configurable `ON`/`OFF`. If the corresponding <bus>TSyn module is configured with Time Validation Support enabled (refer to parameter `<bus>TSynTimeValidationSupport` in <bus>TSyn module) `StbM_<bus>SetSlaveTimingData()` shall be `ON`, otherwise `OFF`.
](RS_TS_00034)

**[SWS_StbM_00488]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_<bus>SetSlaveTimingData()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which does not refer to a Synchronized Time Base.
](SRS_BSW_00386, SRS_BSW_00323)

**Note:**
A parameter `timeBaseId` within the reserved value range indicates legacy use.

**[SWS_StbM_00489]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_<bus>SetSlaveTimingData()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `measureDataPtr`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.27 StbM_CanSetMasterTimingData

**[SWS_StbM_00490]**{DRAFT} [

| | |
|---|---|
| ***Service Name*** | StbM_CanSetMasterTimingData (draft) |
| ***Syntax*** | `Std_ReturnType StbM_CanSetMasterTimingData ( StbM_SynchronizedTimeBaseType timeBaseId, const StbM_CanTimeMasterMeasurementType* measureDataPtr )` |
| ***Service ID [hex]*** | 0x20 |
| ***Sync/Async*** | Synchronous |
| ***Reentrancy*** | Non Reentrant |

| | | |
|---|---|---|
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | measureDataPtr | Measurement data |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Provides CAN Timesyn module specific data for a Time Master to the StbM.<br>**Tags:** atp.Status=draft | |
| ***Available via*** | StbM_CanTSyn.h | |

](RS_TS_00029, RS_TS_00031, RS_TS_00034)

### 8.1.3.28 StbM_FrSetMasterTimingData

**[SWS_StbM_00491]**{DRAFT} [

| | | |
|---|---|---|
| ***Service Name*** | StbM_FrSetMasterTimingData (draft) | |
| ***Syntax*** | `Std_ReturnType StbM_FrSetMasterTimingData ( StbM_SynchronizedTimeBaseType timeBaseId, const StbM_FrTimeMasterMeasurementType* measureDataPtr )` | |
| ***Service ID [hex]*** | 0x21 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | measureDataPtr | Measurement data |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Provides Flexray Timesyn module specific data for a Time Master to the StbM.<br>**Tags:** atp.Status=draft | |
| ***Available via*** | StbM_FrTSyn.h | |

](RS_TS_00029, RS_TS_00031, RS_TS_00034)

### 8.1.3.29 StbM_EthSetMasterTimingData

**[SWS_StbM_00492]**{DRAFT} ⌈

| | | |
|---|---|---|
| ***Service Name*** | StbM_EthSetMasterTimingData (draft) | |
| ***Syntax*** | `Std_ReturnType StbM_EthSetMasterTimingData ( StbM_SynchronizedTimeBaseType timeBaseId, const StbM_EthTimeMasterMeasurementType* measureDataPtr )` | |
| ***Service ID [hex]*** | 0x22 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | measureDataPtr | Measurement data |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | Provides Ethernet Timesyn module specific data for a Time Master to the Stb M.<br>**Tags:** atp.Status=draft | |
| ***Available via*** | StbM_EthTSyn.h | |

⌋(RS_TS_00029, RS_TS_00031, RS_TS_00034)

**[SWS_StbM_00493]⌈**
The function `StbM_<bus>SetMasterTimingData()` shall be pre compile time configurable `ON`/`OFF`. If the corresponding <bus>TSyn module is configured with Time Validation Support enabled (refer to parameter `<bus>TSynTimeValidationSupport` in <bus>TSyn module), `StbM_<bus>SetMasterTimingData()` shall be `ON`, otherwise `OFF`.
⌋(RS_TS_00034)

**[SWS_StbM_00494]⌈**
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_<bus>SetMasterTimingData ()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which does not refer to a Synchronized Time Base ⌋(SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00495]⌈**
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_<bus>SetMasterTimingData()` shall report to DET the development error

STBM_E_PARAM_POINTER, if called with a NULL pointer for parameter measureDataPtr.](SRS_BSW_00386, SRS_BSW_00323)

#### 8.1.3.30 StbM_EthSetPdelayInitiatorData

**[SWS_StbM_00496]**{DRAFT} [

| | | |
|---|---|---|
| ***Service Name*** | StbM_EthSetPdelayInitiatorData (draft) | |
| ***Syntax*** | `Std_ReturnType StbM_EthSetPdelayInitiatorData ( StbM_SynchronizedTimeBaseType timeBaseId, const StbM_PdelayInitiatorMeasurementType* measureDataPtr )` | |
| ***Service ID [hex]*** | 0x23 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | measureDataPtr | Measurement data |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | --<br>**Tags:** atp.Status=draft | |
| ***Available via*** | StbM_EthTSyn.h | |

](RS_TS_00034)

**[SWS_StbM_00497][**
The function StbM_EthSetPdelayInitiatorData() shall be pre compile time configurable ON/OFF. If the EthTSyn module is configured with Time Validation Support enabled (refer to parameter EthTSynTimeValidationSupport in EthTSyn module), StbM_EthSetPdelayInitiatorData() shall be ON, otherwise OFF.
](RS_TS_00034)

**[SWS_StbM_00498][**
If the switch StbMDevErrorDetect (**ECUC_StbM_00012 :** ) is set to TRUE, StbM_EthSetPdelayInitiatorData() shall report to DET the development

error STBM_E_PARAM, if called with a parameter timeBaseId, which does not refer to a Synchronized Time Base ](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00499]**[
If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_EthSetPdelayInitiatorData() shall report to DET the development error STBM_E_PARAM_POINTER, if called with a NULL pointer for parameter measureDataPtr.
](SRS_BSW_00386, SRS_BSW_00323)

#### 8.1.3.31 StbM_EthSetPdelayResponderData

**[SWS_StbM_00500]**{DRAFT} [

| | | |
|---|---|---|
| ***Service Name*** | StbM_EthSetPdelayResponderData (draft) | |
| ***Syntax*** | `Std_ReturnType StbM_EthSetPdelayResponderData ( StbM_SynchronizedTimeBaseType timeBaseId, const StbM_PdelayResponderMeasurementType* measureDataPtr )` | |
| ***Service ID [hex]*** | 0x24 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Time Base reference |
| | measureDataPtr | Measurement data |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | --<br>**Tags:** atp.Status=draft | |
| ***Available via*** | StbM_EthTSyn.h | |

](RS_TS_00034)

**[SWS_StbM_00501]**[
The function StbM_EthSetPdelayResponderData() shall be pre compile time configurable ON/OFF. If the EthTSyn module is configured with Time Validation Support enabled (refer to parameter EthTSynTimeValidationSupport in EthTSyn module), StbM_EthSetPdelayResponderData() shall be ON, otherwise OFF.

](RS_TS_00034)

**[SWS_StbM_00502]**[
If the switch `StbMDevErrorDetect` (**ECUC_StbM_00012 :** ) is set to `TRUE`, `StbM_EthSetPdelayResponderData ()` shall report to DET the development error `STBM_E_PARAM`, if called with a parameter `timeBaseId`, which does not refer to a Synchronized Time Base
](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00503]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_EthSetPdelayResponderData ()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `measureDataPtr`
](SRS_BSW_00386, SRS_BSW_00323, RS_TS_00034)

### 8.1.3.32 StbM_GetBusProtocolParam

**[SWS_StbM_91007]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_GetBusProtocolParam | |
| ***Syntax*** | `Std_ReturnType StbM_GetBusProtocolParam ( StbM_SynchronizedTimeBaseType timeBaseId, StbM_ProtocolParamType* protocolParam )` | |
| ***Service ID [hex]*** | 0x29 | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Reentrant | |
| ***Parameters (in)*** | timeBaseId | Id of referenced Time Base |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | protocolParam | structure to store received Follow_Up information TLV parameters |
| ***Return value*** | Std_Return-Type | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | This API is used to get bus specific parameters from received Follow_Up message | |
| ***Available via*** | StbM.h | |

](RS_TS_20069)

**[SWS_StbM_00518]**[

If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_GetBusProtocolParam() shall report to DET the development error STBM_E_PARAM, if called with a parameter timeBaseId, which is not referring to a Synchronized Time Base.
](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00519]**[
If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_GetBusProtocolParam() shall report to DET the development error STBM_E_PARAM_POINTER, if called with a NULL pointer for parameter protocolParam.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.3.33 StbM_SetBusProtocolParam

**[SWS_StbM_91008]**[

| | | |
|---|---|---|
| ***Service Name*** | StbM_SetBusProtocolParam | |
| ***Syntax*** | `Std_ReturnType StbM_SetBusProtocolParam ( StbM_SynchronizedTimeBaseType timeBaseId, const StbM_ProtocolParamType* protocolParam )` | |
| ***Service ID [hex]*** | 0x2a | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | timeBaseId | Id of referenced Time Base |
| | protocolParam | structure with Follow_Up information TLV parameters |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | This API is used to set bus specific parameters of a Time Master | |
| ***Available via*** | StbM.h | |

](RS_TS_20069)

**[SWS_StbM_00520]**[
If the switch StbMDevErrorDetect (ECUC_StbM_00012 : ) is set to TRUE, StbM_SetBusProtocolParam() shall report to DET the development error STBM_E_PARAM, if called with a parameter timeBaseId, which is not referring to a Synchronized Time Base.

](SRS_BSW_00386, SRS_BSW_00323)

**[SWS_StbM_00521]**[
If the switch `StbMDevErrorDetect` (ECUC_StbM_00012 : ) is set to `TRUE`, `StbM_SetBusProtocolParam()` shall report to DET the development error `STBM_E_PARAM_POINTER`, if called with a NULL pointer for parameter `protocolParam`.
](SRS_BSW_00386, SRS_BSW_00323)

### 8.1.4 Scheduled functions

#### 8.1.4.1 StbM_MainFunction

**[SWS_StbM_00057]**[

| | |
|---|---|
| ***Service Name*** | StbM_MainFunction |
| ***Syntax*** | `void StbM_MainFunction (`<br>`  void`<br>`)` |
| ***Service ID [hex]*** | 0x04 |
| ***Description*** | This function will be called cyclically by a task body provided by the BSW Schedule. It will invoke the triggered customers and synchronize the referenced OS Schedule Tables. |
| ***Available via*** | SchM_StbM.h |

](SRS_BSW_00172, SRS_BSW_00373)

**[SWS_StbM_00407]**[
The frequency of invocations of `StbM_MainFunction` is determined by the configuration parameter `StbMMainFunctionPeriod`.
](SRS_BSW_00172)

**[SWS_StbM_00107]**[
If OS is configured as triggered customer, the function `StbM_MainFunction` shall synchronize the referenced OS ScheduleTable.
](RS_TS_00032, SRS_BSW_00333)

### 8.1.5 Expected Interfaces

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

#### 8.1.5.1 Mandatory Interfaces

This chapter defines all interfaces which are required to fulfill the core functionality of the Synchronized Time-Base Manager.

**[SWS_StbM_00058]**⌈

| *API Function* | *Header File* | *Description* |
|---|---|---|
| Det_Report-Error | Det.h | Service to report development errors. |
| EthTSyn_Get-ProtocolParam | Eth TSyn.h | This API is used to read FollowUp information TLV parameters from received Follow_Up message. |
| EthTSyn_Set-ProtocolParam | Eth TSyn.h | This API is used to set FollowUp information TLV parameters of a Follow_Up message prior transmission. The API is called within StbM_ SetBusProtocolParam which provides the content of the structure protocolParam. |

⌋(SRS_BSW_00301, SRS_BSW_00339)

#### 8.1.5.2 Optional Interfaces

This chapter defines all interfaces which are required to fulfill an optional functionality of the Synchronized Time-Base Manager.

**[SWS_StbM_00059]**⌈

| *API Function* | *Header File* | *Description* |
|---|---|---|
| CanIf_Get-CurrentTime (draft) | CanIf.h | This service calls the corresponding CAN Driver service to retrieve the current time value out of the HW registers.<br>**Tags:** atp.Status=draft |
| EthIf_Get-CurrentTime | EthIf.h | Returns a time value out of the HW registers according to the capability of the HW. Is the HW resolution is lower than the Eth_TimeStampType resolution resp. range, the remaining bits will be filled with 0.<br>Important Note: EthIf_GetCurrentTime may be called within an exclusive area. |
| GetCounter-Value | Os.h | This service reads the current count value of a counter (returning either the hardware timer ticks if counter is driven by hardware or the software ticks when user drives counter). |
| GetElapsed-Value | Os.h | This service gets the number of ticks between the current tick value and a previously read tick value. |
| GetSchedule-TableStatus | Os.h | This service queries the state of a schedule table (also with respect to synchronization). |
| Gpt_GetTime-Elapsed | Gpt.h | Returns the time already elapsed. |
| Gpt_StartTimer | Gpt.h | Starts a timer channel. |

| | | |
|---|---|---|
| SyncSchedule-Table | Os.h | This service provides the schedule table with a synchronization count and start synchronization. |

](SRS_BSW_00301, SRS_BSW_00339)

#### 8.1.5.3 Configurable Interfaces

**Note:** The return value of the callback C-APIs is defined as `Std_ReturnType` to follow the signature of the corresponding service APIs. According to the SWS BSW General [14] (chapter 8.4) the caller, i.e. the StbM, can assume, that the callback will always return E_OK.

##### 8.1.5.3.1 SyncTimeRecordBlockCallback

**[SWS_StbM_00322]**[

| | | |
|---|---|---|
| ***Service Name*** | SyncTimeRecordBlockCallback<TimeBase> | |
| ***Syntax*** | `Std_ReturnType SyncTimeRecordBlockCallback<TimeBase> ( const StbM_SyncRecordTableBlockType* syncRecordTableBlock )` | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | syncRecordTableBlock | Block of the table |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: Table access done<br>E_NOT_OK: Table contains no data or access invalid |
| ***Description*** | Provides a recorded snapshot data block of the measurement data table belonging to the Synchronized Time Base. | |
| ***Available via*** | StbM_Externals.h | |

](RS_TS_00034)

**[SWS_StbM_00323]**[
The function `SyncTimeRecordBlockCallback<timeBaseId>()` shall be set by the parameter `StbMSyncTimeRecordBlockCallback` (**ECUC_StbM_00060 :** ).
](RS_TS_00034)

##### 8.1.5.3.2 OffsetTimeRecordBlockCallback

**[SWS_StbM_00328]**[

| | |
|---|---|
| ***Service Name*** | OffsetTimeRecordBlockCallback<TimeBase> |

| | | |
|---|---|---|
| ***Syntax*** | `Std_ReturnType OffsetTimeRecordBlockCallback<TimeBase> ( const StbM_OffsetRecordTableBlockType* offsetRecordTableBlock ) ` | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | offsetRecordTableBlock | Block of the table |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: Table access done<br>E_NOT_OK: Table contains no data or access invalid |
| ***Description*** | Provides a recorded snapshot data block of the measurement data table belonging to the Offset Time Base. | |
| ***Available via*** | StbM_Externals.h | |

](RS_TS_00034)

**[SWS_StbM_00329][**
The function `OffsetTimeRecordBlockCallback<timeBaseId>` shall set by the parameter `StbMOffsetTimeRecordBlockCallback` (**ECUC_StbM_00061 :** ).
](RS_TS_00034)

### 8.1.5.3.3 StatusNotificationCallback

**[SWS_StbM_00285][**

| | | |
|---|---|---|
| ***Service Name*** | StatusNotificationCallback<TimeBase> | |
| ***Syntax*** | `Std_ReturnType StatusNotificationCallback<TimeBase> ( StbM_TimeBaseNotificationType eventNotification ) ` | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | eventNotification | Holds the notification bits for the different Time Base related events |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |

| | |
|---|---|
| ***Description*** | The callback notifies the customers, when a <TimeBase> related event occurs, which is enabled by the notification mask |
| ***Available via*** | StbM_Externals.h |

](RS_TS_00037, RS_TS_00016, SRS_BSW_00457, SRS_BSW_00360, SRS_BSW_00333)

**[SWS_StbM_00299]**[
The status notification callback function shall be set by the parameter `StbMStatusNotificationCallback` (**ECUC_StbM_00046 :** ).
](RS_TS_00016)

**Note:** The event notification callback might be called in interrupt context only, if there is no callback configured in StbM which belongs to a SW-C.

#### 8.1.5.3.4 <Customer>_TimeNotificationCallback

**[SWS_StbM_00273]**[

| | | |
|---|---|---|
| ***Service Name*** | <Customer>_TimeNotificationCallback<TimeBase> | |
| ***Syntax*** | `Std_ReturnType <Customer>_TimeNotificationCallback<Time Base> ( StbM_TimeDiffType deviationTime )` | |
| ***Sync/Async*** | Synchronous | |
| ***Reentrancy*** | Non Reentrant | |
| ***Parameters (in)*** | deviationTime | Difference time value when callback is called by StbM. |
| ***Parameters (inout)*** | None | |
| ***Parameters (out)*** | None | |
| ***Return value*** | Std_ReturnType | E_OK: successful<br>E_NOT_OK: failed |
| ***Description*** | This callback notifies the <Customer>, when a Time Base reaches the time value set by StbM_StartTimer for the <TimeBase> | |
| ***Available via*** | StbM_Externals.h | |

](RS_TS_00017, SRS_BSW_00457, SRS_BSW_00360, SRS_BSW_00333)

**[SWS_StbM_00274]**[
The event notification callback function shall be set by the parameter `StbMTimeNotificationCallback` (**ECUC_StbM_00064 :** .)
](RS_TS_00017)

## 8.2 Service Interfaces

This chapter defines the AUTOSAR Interfaces and Ports of the AUTOSAR Service "Synchronized Time-base Manager" (StbM).

The interfaces and ports described here will be visible on the VFB and are used to generate the RTE between application software components and the Synchronized Time-Base Manager.

### 8.2.1 Provided Ports

#### 8.2.1.1 GlobalTime_Master

**[SWS_StbM_00244]⌈**

| | | | |
|---|---|---|---|
| ***Name*** | GlobalTime_Master_{Name} | | |
| ***Kind*** | ProvidedPort | ***Interface*** | GlobalTime_Master_{Name} |
| ***Description*** | -- | | |
| ***Port Defined Argument Value(s)*** | ***Type*** | StbM_SynchronizedTimeBaseType | |
| | ***Value*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronized TimeBaseIdentifier.value)} | |
| ***Variation*** | (({ecuc(StbM/StbMSynchronizedTimeBase/StbMIsSystemWideGlobalTime Master)} == TRUE ) \|\|({ecuc(StbM/StbMSynchronizedTimeBase/StbMAllow SystemWideGlobalTimeMaster)} == TRUE ))&& ({ecuc(StbM/StbMSynchronized TimeBase/StbMSynchronizedTimeBaseIdentifier)} < 128)<br>Name = {ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |

⌋(RS_TS_00005, RS_TS_00035, RS_TS_00029, RS_TS_00010, RS_TS_00013, RS_TS_00015)

#### 8.2.1.2 GlobalTime_Slave

**[SWS_StbM_00248]⌈**

| | | | |
|---|---|---|---|
| ***Name*** | GlobalTime_Slave_{Name} | | |
| ***Kind*** | Provided Port | ***Interface*** | GlobalTime_Slave_{Name} |
| ***Description*** | -- | | |
| ***Port Defined Argument Value(s)*** | ***Type*** | StbM_SynchronizedTimeBaseType | |
| | ***Value*** | {ecuc(StbM/StbMSynchronizedTimeBase/Stb MSynchronizedTimeBaseIdentifier.value)} | |
| ***Variation*** | Name = {ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |

⌋(RS_TS_00005, RS_TS_00030, RS_TS_00031, RS_TS_00035, RS_TS_00014)

#### 8.2.1.3 GlobalTime_StatusEvent

**[SWS_StbM_00290]⌈**

| | | | |
|---|---|---|---|
| ***Name*** | GlobalTime_StatusEvent_{TBName} | | |
| ***Kind*** | ProvidedPort | ***Interface*** | StatusNotification |
| ***Description*** | -- | | |
| ***Variation*** | (({ecuc(StbM/StbMSynchronizedTimeBase/StbMNotificationInterface)} == SR_INTERFACE \|\| {ecuc(StbM/StbMSynchronizedTimeBase/StbMNotificationInterface)} == CALLBACK_AND_SR_INTERFACE)) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 128)<br>TBName = {ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |

⌋(RS_TS_00035, RS_TS_00016)

#### 8.2.1.4 StartTimer

**[SWS_StbM_91004]⌈**

| | | | |
|---|---|---|---|
| ***Name*** | StartTimer_{TimeBase}_{Customer} | | |
| ***Kind*** | Provided Port | ***Interface*** | StartTimer |
| ***Description*** | -- | | |
| ***Port Defined Argument Value(s)*** | ***Type*** | StbM_SynchronizedTimeBaseType | |
| | ***Value*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier.value)} | |
| | ***Type*** | StbM_CustomerIdType | |
| | ***Value*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMNotificationCustomer/StbMNotificationCustomerId.value)} | |
| ***Variation*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 128<br>TimeBase = {ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)}<br>Customer = {ecuc(StbM/StbMSynchronizedTimeBase/StbMNotificationCustomer.SHORT-NAME)} | | |

⌋(RS_TS_00017)

### 8.2.2 Required Ports

#### 8.2.2.1 GlobalTime_TimeEvent

**[SWS_StbM_00276]⌈**

| | |
|---|---|
| ***Name*** | GlobalTime_TimeEvent_{TBName}_{CName} |

| | | | |
|---|---|---|---|
| ***Kind*** | RequiredPort | ***Interface*** | TimeNotification |
| ***Description*** | -- | | |
| ***Variation*** | ({ecuc(StbM/StbMSynchronizedTimeBase/StbMNotificationCustomer/StbMTimeNotificationCallback)}==NULL) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 128)<br>TBName={ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)}<br>CName={ecuc(StbM/StbMSynchronizedTimeBase/StbMNotificationCustomer.SHORT-NAME)} | | |

](RS_TS_00035, RS_TS_00017)

### 8.2.2.2 GlobalTime_Measurement

**[SWS_StbM_00387]**[

| | | | |
|---|---|---|---|
| ***Name*** | MeasurementNotification_{TBName} | | |
| ***Kind*** | RequiredPort | ***Interface*** | MeasurementNotification_{TB_Name} |
| ***Description*** | -- | | |
| ***Variation*** | (({ecuc(StbM/StbMSynchronizedTimeBase/StbMIsSystemWideGlobalTimeMaster)} == FALSE) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMAllowSystemWideGlobalTimeMaster)} == FALSE)) && ({ecuc(StbM/StbMGeneral/StbMTimeRecordingSupport)} == True) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 32) && (({ecuc(StbM/StbMSynchronizedTimeBase/StbMTimeRecording/StbMSyncTimeRecordBlockCallback)}==NULL) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMTimeRecording/StbMOffsetTimeRecordBlockCallback)}==NULL))<br>TBName={ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |

](RS_TS_00034)

### 8.2.2.3 TimeBaseProviderNotification_Eth

**[SWS_StbM_00458]**{DRAFT} [

| | | | |
|---|---|---|---|
| ***Name*** | TimeBaseProviderNotification_Eth_{TB_Name} (draft) | | |
| ***Kind*** | RequiredPort | ***Interface*** | TimeBaseProviderNotification_Eth_{TB_-Name} |
| ***Description*** | --<br>**Tags:** atp.Status=draft | | |
| ***Variation*** | ({ecuc(StbM/StbMSynchronizedTimeBase/StbMTimeValidation)} != NULL) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16) && ({ecuc(StbM/StbMSynchronizedTimeBase)} == {ecuc(EthTSyn/EthTSynGlobalTimeDomain/EthTSynSynchronizedTimeBaseRef->StbMSynchronizedTimeBase)}))<br>TBName={ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |

](RS_TS_00034)

#### 8.2.2.4 TimeBaseProviderNotification_Fr

**[SWS_StbM_00459]**{DRAFT} ⌈

| | | | |
|---|---|---|---|
| ***Name*** | TimeBaseProviderNotification_Fr_{TB_Name} (draft) | | |
| ***Kind*** | RequiredPort | ***Interface*** | TimeBaseProviderNotification_Fr_{TB_Name} |
| ***Description*** | --<br>**Tags:** atp.Status=draft | | |
| ***Variation*** | ({ecuc(StbM/StbMSynchronizedTimeBase/StbMTimeValidation)} != NULL) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16) && ({ecuc(StbM/StbMSynchronizedTimeBase)} == {ecuc(FrTSyn/FrTSynGlobal TimeDomain/FrTSynSynchronizedTimeBaseRef->StbMSynchronizedTimeBase)}) TBName={ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |

⌋(RS_TS_00034)

#### 8.2.2.5 TimeBaseProviderNotification_Can

**[SWS_StbM_00460]**{DRAFT} ⌈

| | | | |
|---|---|---|---|
| ***Name*** | TimeBaseProviderNotification_Can_{TB_Name} (draft) | | |
| ***Kind*** | RequiredPort | ***Interface*** | TimeBaseProviderNotification_Can_{TB_-Name} |
| ***Description*** | --<br>**Tags:** atp.Status=draft | | |
| ***Variation*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMTimeValidation)} != NULL) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16) && ({ecuc(StbM/StbMSynchronizedTimeBase)} == {ecuc(CanTSyn/CanTSyn GlobalTimeDomain/CanTSynSynchronizedTimeBaseRef->StbMSynchronizedTime Base)}) TBName={ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |

⌋(RS_TS_00034)

### 8.2.3 Sender-Receiver Interfaces

#### 8.2.3.1 StatusNotification

**[SWS_StbM_00286]**⌈

| | |
|---|---|
| ***Name*** | StatusNotification |
| ***Comment*** | Notification about a Time Base related status change |
| ***IsService*** | false |
| ***Variation*** | -- |

| | | |
|---|---|---|
| ***Data Elements*** | eventNotification | |
| | ***Type*** | StbM_TimeBaseNotificationType |
| | ***Variation*** | -- |

](RS_TS_00035, RS_TS_00016)

### 8.2.4 Client-Server-Interfaces

#### 8.2.4.1 GlobalTime_Master

**[SWS_StbM_00240]**⌈

| | | | |
|---|---|---|---|
| ***Name*** | GlobalTime_Master_{Name} | | |
| ***Comment*** | -- | | |
| ***IsService*** | true | | |
| ***Variation*** | (({ecuc(StbM/StbMSynchronizedTimeBase/StbMIsSystemWideGlobalTimeMaster)} == TRUE ) \|\| ({ecuc(StbM/StbMSynchronizedTimeBase/StbMAllowSystemWideGlobal TimeMaster)} == TRUE )) && ({ecuc(StbM/StbMSynchronizedTimeBase/Stb MSynchronizedTimeBaseIdentifier)} < 128)<br>Name = {ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |
| ***Possible Errors*** | 0 | E_OK | Operation successful |
| | 1 | E_NOT_OK | Operation failed |

| | | |
|---|---|---|
| ***Operation*** | Clone | |
| ***Comment*** | Copies Time Base data (current time, user data, rate correction) from Source Time Base to Destination Time Base. The Source Time Base is identified by the parameter StbMSourceTimeBase (ECUC_StbM_00074) | |
| ***Variation*** | ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16) \|\| ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBase Identifier)} > 31) | |
| ***Parameters*** | cloneCfg | |
| | ***Type*** | StbM_CloneConfigType |
| | ***Direction*** | IN |
| | ***Comment*** | Refines how source Time Base is cloned to destination |
| | ***Variation*** | -- |
| | statusMask | |
| | ***Type*** | StbM_TimeBaseStatusType |
| | ***Direction*** | IN |

| | | |
|---|---|---|
| | ***Comment*** | Status flags mask for definition of relevant status flags |
| | ***Variation*** | -- |
| | statusValue | |
| | ***Type*** | StbM_TimeBaseStatusType |
| | ***Direction*** | IN |
| | ***Comment*** | Status flags value define whether cloning shall take place |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | GetMasterConfig | |
| ***Comment*** | Indicates in postbuild use case, if the StbM is actually configured as system wide master | |
| ***Variation*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMAllowSystemWideGlobalTimeMaster)} != NULL | |
| ***Parameters*** | masterConfig | |
| | ***Type*** | StbM_MasterConfigType |
| | ***Direction*** | OUT |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | SetBusProtocolParam | |
| ***Comment*** | Operation is used to set bus specific parameters for a Time Master | |
| ***Variation*** | ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16) &&({ecuc(StbM/StbMSynchronizedTimeBase)} == {ecuc(EthTSyn/EthTSynGlobalTimeDomain/EthTSynSynchronizedTimeBaseRef->StbMSynchronizedTimeBase)})) | |
| ***Parameters*** | protocolParams | |
| | ***Type*** | StbM_ProtocolParamType |
| | ***Direction*** | IN |
| | ***Comment*** | Structure with Follow_Up information TLV parameters |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | SetGlobalTime | |
| ***Comment*** | Allows the Customers to set the Global Time that will be sent to the buses and modify HW registers behind the providers, if supported. This function will be used if a Time Master is present in this ECU.<br>Using SetGlobalTimecan lead to an immediate transmission of the Global Time. | |
| ***Variation*** | -- | |
| ***Parameters*** | timeStamp | |
| | ***Type*** | StbM_TimeStampType |
| | ***Direction*** | IN |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| | userData | |
| | ***Type*** | StbM_UserDataType |
| | ***Direction*** | IN |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | SetOffset | |
| ***Comment*** | Allows the Customers and the Timesync Modules to set the Offset Time. | |
| ***Variation*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} > 15 && {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBase Identifier)} < 32 | |
| ***Parameters*** | timeStamp | |
| | ***Type*** | StbM_TimeStampType |
| | ***Direction*** | IN |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| | userData | |
| | ***Type*** | StbM_UserDataType |
| | ***Direction*** | IN |
| | ***Comment*** | -- |
| | ***Variation*** | -- |

| | |
|---|---|
| ***Possible Errors*** | E_OK<br>E_NOT_OK |

| | | |
|---|---|---|
| ***Operation*** | SetRateCorrection | |
| ***Comment*** | Allows to set the rate of a Synchronized Time Base (being either a Pure Local Time Base or not). | |
| ***Variation*** | -- | |
| ***Parameters*** | rateDeviation | |
| | ***Type*** | StbM_RateDeviationType |
| | ***Direction*** | IN |
| | ***Comment*** | Value of the applied rate deviation |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | SetUserData | |
| ***Comment*** | Allows the Customers to set the User Data that will be sent to the buses. | |
| ***Variation*** | -- | |
| ***Parameters*** | userData | |
| | ***Type*** | StbM_UserDataType |
| | ***Direction*** | IN |
| | ***Comment*** | New user data |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | |
|---|---|
| ***Operation*** | TriggerTimeTransmission |
| ***Comment*** | Allows the Customers to force the Timesync Modules to transmit the current Time Base due to an incremented timeBaseUpdateCounter |
| ***Variation*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 32 |
| ***Possible Errors*** | E_OK<br>E_NOT_OK |

| | |
|---|---|
| ***Operation*** | UpdateGlobalTime |
| ***Comment*** | Allows the Customers to set the Global Time that will be sent to the buses and |

| | | |
|---|---|---|
| | modify HW registers behind the providers, if supported. This function will be used if a Time Master is present in this ECU.<br>Using UpdateGlobalTime will not lead to an immediate transmission of the Global Time. | |
| ***Variation*** | -- | |
| ***Parameters*** | timeStamp | |
| | ***Type*** | StbM_TimeStampType |
| | ***Direction*** | IN |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| | userData | |
| | ***Type*** | StbM_UserDataType |
| | ***Direction*** | IN |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

](RS_TS_00005, RS_TS_00035, RS_TS_00010, RS_TS_00013, RS_TS_00015, RS_TS_00011, RS_TS_20069)

### 8.2.4.2 GlobalTime_Slave

**[SWS_StbM_00247]**[

| | | | |
|---|---|---|---|
| ***Name*** | GlobalTime_Slave_{Name} | | |
| ***Comment*** | -- | | |
| ***IsService*** | true | | |
| ***Variation*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 128<br>Name = {ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |
| ***Possible Errors*** | 0 | E_OK | Operation successful |
| | 1 | E_NOT_OK | Operation failed |

| | |
|---|---|
| ***Operation*** | GetBusProtocolParam |
| ***Comment*** | Operation is used to get bus specific parameters for a Time Master or Time Slave |
| ***Variation*** | ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16) &&({ecuc(StbM/StbMSynchronizedTimeBase)} == {ecuc(EthTSyn/EthTSynGlobal |

| | | |
|---|---|---|
| | TimeDomain/EthTSynSynchronizedTimeBaseRef->StbMSynchronizedTimeBase)})) | |
| ***Parameters*** | protocolParams | |
| | ***Type*** | StbM_ProtocolParamType |
| | ***Direction*** | OUT |
| | ***Comment*** | Structure with Follow_Up information TLV parameters |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | GetCurrentTime | |
| ***Comment*** | Returns a time value (Local Time Base derived from Global Time Base) in standard format. | |
| ***Variation*** | -- | |
| ***Parameters*** | timeStamp | |
| | ***Type*** | StbM_TimeStampType |
| | ***Direction*** | OUT |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| | userData | |
| | ***Type*** | StbM_UserDataType |
| | ***Direction*** | OUT |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | GetCurrentTimeExtended | |
| ***Comment*** | Returns a time value (Local Time Base derived from Global Time Base) in extended format. | |
| ***Variation*** | {ecuc(StbM/StbMGeneral/StbMGetCurrentTimeExtendedAvailable)} | |
| ***Parameters*** | timeStamp | |
| | ***Type*** | StbM_TimeStampExtendedType |
| | ***Direction*** | OUT |
| | ***Comment*** | -- |

| | | |
|---|---|---|
| | ***Variation*** | -- |
| | userData | |
| | ***Type*** | StbM_UserDataType |
| | ***Direction*** | OUT |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | GetOffsetTimeRecordHead | |
| ***Comment*** | Reads the header of the table with recorded measurement data belonging to the Offset Time Base | |
| ***Variation*** | (({ecuc(StbM/StbMSynchronizedTimeBase/StbMIsSystemWideGlobalTimeMaster)} == FALSE) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMAllowSystemWide GlobalTimeMaster)} == FALSE)) && ({ecuc(StbM/StbMGeneral/StbMTimeRecording Support)} == True) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronized TimeBaseIdentifier)} > 15) && {ecuc(StbM/StbMSynchronizedTimeBase/Stb MSynchronizedTimeBaseIdentifier)} < 32 | |
| ***Parameters*** | offsetRecordTableHead | |
| | ***Type*** | StbM_OffsetRecordTableHeadType |
| | ***Direction*** | OUT |
| | ***Comment*** | Header of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | GetRateDeviation | |
| ***Comment*** | Returns value of the current rate deviation of a Time Base | |
| ***Variation*** | -- | |
| ***Parameters*** | rateDeviation | |
| | ***Type*** | StbM_RateDeviationType |
| | ***Direction*** | OUT |
| | ***Comment*** | Value of the current rate deviation of a Time Base |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | GetSyncTimeRecordHead | |
| ***Comment*** | Reads the header of the table with recorded measurement data belonging to the Synchronized Time Base | |
| ***Variation*** | (({ecuc(StbM/StbMSynchronizedTimeBase/StbMIsSystemWideGlobalTimeMaster)} == FALSE) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMAllowSystemWide GlobalTimeMaster)} == FALSE)) && ({ecuc(StbM/StbMGeneral/StbMTimeRecording Support)} == True) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronized TimeBaseIdentifier)} < 16) | |
| ***Parameters*** | syncRecordTableHead | |
| | ***Type*** | StbM_SyncRecordTableHeadType |
| | ***Direction*** | OUT |
| | ***Comment*** | Header of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | GetTimeBaseStatus | |
| ***Comment*** | Returns detailed status information for a Synchronized (or Pure Local) Time Base and, if called for an Offset Time Base, for the Offset Time Base and the underlying Synchronized Time Base. | |
| ***Variation*** | -- | |
| ***Parameters*** | syncTimeBaseStatus | |
| | ***Type*** | StbM_TimeBaseStatusType |
| | ***Direction*** | OUT |
| | ***Comment*** | Status of the Synchronized (or Pure Local) Time Base |
| | ***Variation*** | -- |
| | offsetTimeBaseStatus | |
| | ***Type*** | StbM_TimeBaseStatusType |
| | ***Direction*** | OUT |
| | ***Comment*** | Status of the Offset Time Base. |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | |
|---|---|
| ***Operation*** | GetTimeLeap |

| | | |
|---|---|---|
| ***Comment*** | Returns value of time leap. | |
| ***Variation*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 32 | |
| ***Parameters*** | timeJump | |
| | ***Type*** | StbM_TimeDiffType |
| | ***Direction*** | OUT |
| | ***Comment*** | Time leap value |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

](RS_TS_00005, RS_TS_00035, RS_TS_00014, RS_TS_00017, RS_TS_00034, RS_TS_20069)

### 8.2.4.3 StartTimer

**[SWS_StbM_00409]**[

| | | | |
|---|---|---|---|
| ***Name*** | StartTimer | | |
| ***Comment*** | Interface, which starts a timer for a Time Base | | |
| ***IsService*** | true | | |
| ***Variation*** | -- | | |
| ***Possible Errors*** | 0 | E_OK | Operation successful |
| | 1 | E_NOT_OK | Operation failed |

| | | |
|---|---|---|
| ***Operation*** | StartTimer | |
| ***Comment*** | Starts a StbM internal timer, which expires at the given expireTime and which triggers a time notification callback. | |
| ***Variation*** | -- | |
| ***Parameters*** | expireTime | |
| | ***Type*** | StbM_TimeStampType |
| | ***Direction*** | IN |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

](RS_TS_00017)

#### 8.2.4.4 TimeNotification

**[SWS_StbM_00275]**[

| | | | |
|---|---|---|---|
| ***Name*** | TimeNotification | | |
| ***Comment*** | Notification, which indicates, that the timer has expired, which has been set by StartTimer | | |
| ***IsService*** | true | | |
| ***Variation*** | -- | | |
| ***Possible Errors*** | 0 | E_OK | Operation successful |
| | 1 | E_NOT_OK | Operation failed |

| | | |
|---|---|---|
| ***Operation*** | NotifyTime | |
| ***Comment*** | Notification, which indicates, that the timer has expired, which has been set by Stb M_StartTimer | |
| ***Variation*** | -- | |
| ***Parameters*** | deviationTime | |
| | ***Type*** | StbM_TimeDiffType |
| | ***Direction*** | IN |
| | ***Comment*** | -- |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

](RS_TS_00035, RS_TS_00017)

#### 8.2.4.5 MeasurementNotification

**[SWS_StbM_00339]**[

| | |
|---|---|
| ***Name*** | MeasurementNotification_{TB_Name} |
| ***Comment*** | Notifies about the availability of a new recorded measurement data block belonging to the Time Base. |
| ***IsService*** | true |
| ***Variation*** | (ecuc(StbM/StbMGeneral/StbMTimeRecordingSupport)} == True) && ({ecuc(StbM/ StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 32) |

| | | | |
|---|---|---|---|
| | TBName={ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |
| ***Possible Errors*** | 0 | E_OK | Operation successful |
| | 1 | E_NOT_OK | Operation failed |

| | | |
|---|---|---|
| ***Operation*** | SetOffsetTimeRecordTable | |
| ***Comment*** | Provides to the recorded snapshot data Block of the table belonging to the Offset Time Base. | |
| ***Variation*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} > 15 && {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBase Identifier)} < 32 | |
| ***Parameters*** | offsetRecordTableBlock | |
| | ***Type*** | StbM_OffsetRecordTableBlockType |
| | ***Direction*** | IN |
| | ***Comment*** | Header of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | SetSyncTimeRecordTable | |
| ***Comment*** | Provides the recorded snapshot data Block of the table belonging to the Synchronized Time Base. | |
| ***Variation*** | {ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16 | |
| ***Parameters*** | syncRecordTableBlock | |
| | ***Type*** | StbM_SyncRecordTableBlockType |
| | ***Direction*** | IN |
| | ***Comment*** | Block of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

](RS_TS_00034)

### 8.2.4.6 TimeBaseProviderNotification_Eth

**[SWS_StbM_00461]**{DRAFT} [

| | |
|---|---|
| ***Name*** | TimeBaseProviderNotification_Eth_{TB_Name} (draft) |

| | | | |
|---|---|---|---|
| ***Comment*** | Notifies about the availability of a new Ethernet specific data block recorded for the Time Base.<br>**Tags:** atp.Status=draft | | |
| ***IsService*** | true | | |
| ***Variation*** | ({ecuc(StbM/StbMSynchronizedTimeBase/StbMTimeValidation)} != NULL) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16) && ({ecuc(StbM/StbMSynchronizedTimeBase)} == {ecuc(EthTSyn/EthTSynGlobalTimeDomain/EthTSynSynchronizedTimeBaseRef->StbMSynchronizedTimeBase)})<br>TB_Name ={ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |
| ***Possible Errors*** | 0 | E_OK | Operation successful |
| | 1 | E_NOT_OK | Operation failed |

| | | |
|---|---|---|
| ***Operation*** | SetMasterTimingData | |
| ***Comment*** | Provides the recorded data block for the Time Master of the Time Base. | |
| ***Variation*** | ({ecuc(EthTSyn/EthTSynGlobalTimeDomain/EthTSynPortRole/EthTSynGlobalTimeMaster)}!=NULL) | |
| ***Parameters*** | measurementData | |
| | ***Type*** | StbM_EthTimeMasterMeasurementType |
| | ***Direction*** | IN |
| | ***Comment*** | Block of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | SetPdelayInitiatorData | |
| ***Comment*** | Provides the recorded data block for the pDelay Initiator of the Time Base. | |
| ***Variation*** | (({ecuc(EthTSyn/EthTSynGlobalTimeDomain/EthTSynPortRole/EthTSynGlobalTimeSlave)}!=NULL) | |
| ***Parameters*** | measurementData | |
| | ***Type*** | StbM_PdelayInitiatorMeasurementType |
| | ***Direction*** | IN |
| | ***Comment*** | Block of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | |
|---|---|
| ***Operation*** | SetPdelayResponderData |

| | | |
|---|---|---|
| ***Comment*** | Provides the recorded data block for the pDelay Responder of the Time Base. | |
| ***Variation*** | (({ecuc(EthTSyn/EthTSynGlobalTimeDomain/EthTSynPortRole/EthTSynGlobalTimeMaster)}!=NULL) | |
| ***Parameters*** | measurementData | |
| | ***Type*** | StbM_PdelayResponderMeasurementType |
| | ***Direction*** | IN |
| | ***Comment*** | Block of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | SetSlaveTimingData | |
| ***Comment*** | Provides the recorded data block for the Time Slave of the Time Base. | |
| ***Variation*** | ({ecuc(EthTSyn/EthTSynGlobalTimeDomain/EthTSynPortRole/EthTSynGlobalTimeSlave)}!=NULL) | |
| ***Parameters*** | measurementData | |
| | ***Type*** | StbM_EthTimeSlaveMeasurementType |
| | ***Direction*** | IN |
| | ***Comment*** | Block of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

](RS_TS_00034)

### 8.2.4.7 TimeBaseProviderNotification_Fr

**[SWS_StbM_00462]**{DRAFT} [

| | |
|---|---|
| ***Name*** | TimeBaseProviderNotification_Fr_{TB_Name} (draft) |
| ***Comment*** | Notifies about the availability of a new Flexray specific data block recorded for the Time Base.<br>**Tags:** atp.Status=draft |
| ***IsService*** | true |
| ***Variation*** | ({ecuc(StbM/StbMSynchronizedTimeBase/StbMTimeValidation)} != NULL) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16) && ({ecuc(StbM/StbMSynchronizedTimeBase)} == {ecuc(FrTSyn/FrTSynGlobalTimeDomain/FrTSynSynchronizedTimeBaseRef->StbMSynchronizedTimeBase)}) |

| | | | |
|---|---|---|---|
| | TB_Name ={ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |
| ***Possible Errors*** | 0 | E_OK | Operation successful |
| | 1 | E_NOT_OK | Operation failed |

| | | |
|---|---|---|
| ***Operation*** | SetMasterTimingData | |
| ***Comment*** | Provides the recorded data block for the Time Master of the Time Base. | |
| ***Variation*** | ({ecuc(FrTSyn/FrTSynGlobalTimeDomain/FrTSynGlobalTimeMaster)}!=NULL) | |
| ***Parameters*** | measurementData | |
| | ***Type*** | StbM_FrTimeMasterMeasurementType |
| | ***Direction*** | IN |
| | ***Comment*** | Block of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | SetSlaveTimingData | |
| ***Comment*** | Provides the recorded data block for the Time Slave of the Time Base. | |
| ***Variation*** | ({ecuc(FrTSyn/FrTSynGlobalTimeDomain/FrTSynGlobalTimeSlave)}!=NULL) | |
| ***Parameters*** | measurementData | |
| | ***Type*** | StbM_FrTimeSlaveMeasurementType |
| | ***Direction*** | IN |
| | ***Comment*** | Block of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

⌋(RS_TS_00034)

### 8.2.4.8 TimeBaseProviderNotification_Can

**[SWS_StbM_00463]**{DRAFT} ⌈

| | |
|---|---|
| ***Name*** | TimeBaseProviderNotification_Can_{TB_Name} (draft) |
| ***Comment*** | Notifies about the availability of a new CAN specific data block recorded for the Time Base. |

| | | | |
|---|---|---|---|
| | **Tags:** atp.Status=draft | | |
| ***IsService*** | true | | |
| ***Variation*** | ({ecuc(StbM/StbMSynchronizedTimeBase/StbMTimeValidation)} != NULL) && ({ecuc(StbM/StbMSynchronizedTimeBase/StbMSynchronizedTimeBaseIdentifier)} < 16) && ({ecuc(StbM/StbMSynchronizedTimeBase)} == {ecuc(CanTSyn/CanTSynGlobalTimeDomain/CanTSynSynchronizedTimeBaseRef->StbMSynchronizedTimeBase)}) TB_Name ={ecuc(StbM/StbMSynchronizedTimeBase.SHORT-NAME)} | | |
| ***Possible Errors*** | 0 | E_OK | Operation successful |
| | 1 | E_NOT_OK | Operation failed |

| | | |
|---|---|---|
| ***Operation*** | SetMasterTimingData | |
| ***Comment*** | Provides the recorded data block for the Time Master of the Time Base. | |
| ***Variation*** | ({ecuc(CanTSyn/CanTSynGlobalTimeDomain/CanTSynGlobalTimeMaster)}!=NULL) | |
| ***Parameters*** | measurementData | |
| | ***Type*** | StbM_CanTimeMasterMeasurementType |
| | ***Direction*** | IN |
| | ***Comment*** | Block of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

| | | |
|---|---|---|
| ***Operation*** | SetSlaveTimingData | |
| ***Comment*** | Provides the recorded data block for the Time Slave of the Time Base. | |
| ***Variation*** | ({ecuc(CanTSyn/CanTSynGlobalTimeDomain/CanTSynGlobalTimeSlave)}!=NULL) | |
| ***Parameters*** | measurementData | |
| | ***Type*** | StbM_CanTimeSlaveMeasurementType |
| | ***Direction*** | IN |
| | ***Comment*** | Block of the table |
| | ***Variation*** | -- |
| ***Possible Errors*** | E_OK<br>E_NOT_OK | |

](RS_TS_00034)

### 8.2.5 Implementation Data Types

This chapter specifies the data types which will be used for the service port interfaces for accessing the Synchronized Time-Base Manager service.

The implementation header defines additionally those data types, which are listed in chapter 8.1.2, if not included by the application types header.

#### 8.2.5.1 StbM_PortIdType

**[SWS_StbM_00483]**⌈

| | | |
|---|---|---|
| ***Name*** | StbM_PortIdType | |
| ***Kind*** | Structure | |
| ***Elements*** | clockIdentity | |
| | ***Type*** | uint64 |
| | ***Comment*** | ClockIdentity of the clock |
| | portNumber | |
| | ***Type*** | uint16 |
| | ***Comment*** | Number of Ethernet port |
| ***Description*** | Structure which contains port identity data | |
| ***Variation*** | ({ecuc(EthTSyn/EthTSynGeneral/EthTSynTimeValidationSupport)} == True) | |
| ***Available via*** | Rte_StbM_Type.h | |

⌋(RS_TS_00034)

#### 8.2.5.2 StbM_SynchronizedTimeBaseType

**[SWS_StbM_00142]**⌈

| | | | |
|---|---|---|---|
| ***Name*** | StbM_SynchronizedTimeBaseType | | |
| ***Kind*** | Type | | |
| ***Derived from*** | uint16 | | |
| ***Range*** | 0..2^16-1 | -- | -- |
| ***Description*** | Variables of this type are used to represent the kind of synchronized time-base. | | |
| ***Variation*** | -- | | |
| ***Available via*** | Rte_StbM_Type.h | | |

⌋(SRS_BSW_00305, RS_TS_00005, RS_TS_00032, RS_TS_00035)

### 8.2.5.3 StbM_TimeBaseStatusType

**[SWS_StbM_00239]**⌈

| | | | | |
|---|---|---|---|---|
| ***Name*** | StbM_TimeBaseStatusType | | | |
| ***Kind*** | Bitfield | | | |
| ***Derived from*** | uint8 | | | |
| ***Elements*** | ***Kind*** | ***Name*** | ***Mask*** | ***Description*** |
| | bit | TIMEOUT | 0x01 | Bit 0 (LSB): 0x00: No Timeout on receiving Synchronisation Messages 0x01: Timeout on receiving Synchronisation Messages |
| | bit | SYNC_TO_ GATEWAY | 0x04 | Bit 2 0x00: Local Time Base is synchronous to Global Time Master 0x04: Local Time Base updates are based on a Time Gateway below the Global Time Master |
| | bit | GLOBAL_ TIME_BASE | 0x08 | Bit 3 0x00: Local Time Base is based on Local Time Base reference clock only (never synchronized with Global Time Base) 0x08: Local Time Base was at least synchronized with Global Time Base one time |
| | bit | TIMELEAP_ FUTURE | 0x10 | Bit 4 0x00: No leap into the future within the received time for Time Base 0x10: Leap into the future within the received time for Time Base exceeds a configured threshold |
| | bit | TIMELEAP_ PAST | 0x20 | Bit 5 0x00: No leap into the past within the received time for Time Base 0x20: Leap into the past within the received time for Time Base exceeds a configured threshold |
| ***Description*** | Bit 1, 6, and 7 are always 0 (reserved for future usage)<br>Variables of this type are used to express if and how a Local Time Base is synchronized to the Global Time Master. The type is a bitfield of individual status bits, although not every combination is possible, i.e. any of the bits TIMEOUT, TIMELEAP_ FUTURE, TIMELEAP_PAST and SYNC_TO_GATEWAY can only be set if the GLOBAL_TIME_BASE bit is set. | | | |
| ***Variation*** | -- | | | |
| ***Available via*** | Rte_StbM_Type.h | | | |

⌋(RS_TS_00009)

### 8.2.5.4 StbM_TimeStampShortType

**[SWS_StbM_00482]**⌈

| | | |
|---|---|---|
| ***Name*** | StbM_TimeStampShortType | |
| ***Kind*** | Structure | |
| ***Elements*** | nanoseconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | Nanoseconds part of the time |
| | seconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | 32 bit LSB of the 48 bits Seconds part of the time |
| ***Description*** | Variables of this type are used for expressing time stamps with a limited range including relative time and absolute calendar time. The absolute time starts from 1970-01-01. 0 to 4.294.967.295 s ~ 136 years<br>0 to 999999999ns [0x3B9A C9FF] invalid value in nanoseconds: [0x3B9A CA00] to [0x3FFF FFFF] Bit 30 and 31 reserved, default: 0 | |
| ***Variation*** | -- | |
| ***Available via*** | Rte_StbM_Type.h | |

⌋(RS_TS_00034)

### 8.2.5.5 StbM_TimeStampType

**[SWS_StbM_00241]**⌈

| | | |
|---|---|---|
| ***Name*** | StbM_TimeStampType | |
| ***Kind*** | Structure | |
| ***Elements*** | timeBaseStatus | |
| | ***Type*** | StbM_TimeBaseStatusType |
| | ***Comment*** | Status of the Time Base |
| | nanoseconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | Nanoseconds part of the time |
| | seconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | 32 bit LSB of the 48 bits Seconds part of the time |
| | secondsHi | |

| | | |
|---|---|---|
| | ***Type*** | uint16 |
| | ***Comment*** | 16 bit MSB of the 48 bits Seconds part of the time |
| ***Description*** | Variables of this type are used for expressing time stamps including relative time and absolute calendar time. The absolute time starts from 1970-01-01. 0 to 281474976710655s == 3257812230d [0xFFFF FFFF FFFF] 0 to 999999999ns [0x3B9A C9FF] invalid value in nanoseconds: [0x3B9A CA00] to [0x3FFF FFFF] Bit 30 and 31 reserved, default: 0 | |
| ***Variation*** | -- | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00036)

**Note:** Start of absolute time (1970-01-01) is according to [18], Annex C/C1 (refer to parameter "approximate epoch" for PTP)

### 8.2.5.6 StbM_TimeStampExtendedType

**[SWS_StbM_00242]**[

| | | |
|---|---|---|
| ***Name*** | StbM_TimeStampExtendedType | |
| ***Kind*** | Structure | |
| ***Elements*** | timeBaseStatus | |
| | ***Type*** | StbM_TimeBaseStatusType |
| | ***Comment*** | Status of the Time Base |
| | nanoseconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | Nanoseconds part of the time |
| | seconds | |
| | ***Type*** | uint64 |
| | ***Comment*** | 48 bit Seconds part of the time |
| ***Description*** | Variables of this type are used for expressing time stamps including relative time and absolute calendar time. The absolute time starts from 1970-01-01. | |
| ***Variation*** | -- | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00036)

**Note**: Start of absolute time (1970-01-01) is according to [18], Annex C/C1 (refer to parameter "approximate epoch" for PTP)

### 8.2.5.7 StbM_TimeDiffType

**[SWS_StbM_00300]**⌈

| | | | |
|---|---|---|---|
| ***Name*** | StbM_TimeDiffType | | |
| ***Kind*** | Type | | |
| ***Derived from*** | sint32 | | |
| ***Range*** | -2147483647..2147483647 | -- | nanoseconds (-2147483647 .. 2147483647) |
| ***Description*** | Variables of this type are used to express time differences / offsets as signed values in in nanoseconds | | |
| ***Variation*** | -- | | |
| ***Available via*** | Rte_StbM_Type.h | | |

⌋(RS_TS_00010)

### 8.2.5.8 StbM_RateDeviationType

**[SWS_StbM_00301]**⌈

| | | | |
|---|---|---|---|
| ***Name*** | StbM_RateDeviationType | | |
| ***Kind*** | Type | | |
| ***Derived from*** | sint16 | | |
| ***Range*** | -32000..32000 | -- | parts per million (-32000..32000) |
| ***Description*** | Variables of this type are used to express a rate deviation in ppm. | | |
| ***Variation*** | -- | | |
| ***Available via*** | Rte_StbM_Type.h | | |

⌋(RS_TS_00017)

### 8.2.5.9 StbM_CloneConfigType

**[SWS_StbM_91011]**⌈

| | |
|---|---|
| ***Name*** | StbM_CloneConfigType |
| ***Kind*** | Bitfield |

| | | | | |
|---|---|---|---|---|
| ***Derived from*** | uint8 | | | |
| ***Elements*** | ***Kind*** | ***Name*** | ***Mask*** | ***Description*** |
| | bit | DEFERRED_ COPY | 0x01 | True: copy of time information to destination is deferred until Source Time base is updated next time by <bus>TSyn module False: time information copied immediately to Destination Time Base |
| | bit | IMMEDIATE_ TX | 0x02 | True: time information is transmitted on destination bus immediately after cloning False: time information is transmitted on destination bus only on next cyclic transmission after cloning |
| | bit | APPLY_RATE | 0x04 | True: Rate correction value of SOurce Time Base shall be applied to Destination Time Base |
| ***Description*** | Bitfield to configure the cloning process.<br>Bit 3 .. 7 are always 0 (reserved for future usage). | | | |
| ***Variation*** | -- | | | |
| ***Available via*** | Rte_StbM_Type.h | | | |

](RS_TS_00038)

### 8.2.5.10 StbM_UserDataType

**[SWS_StbM_00243]**[

| | | |
|---|---|---|
| ***Name*** | StbM_UserDataType | |
| ***Kind*** | Structure | |
| ***Elements*** | userDataLength | |
| | ***Type*** | uint8 |
| | ***Comment*** | User Data Length in bytes, value range: 0..3 |
| | userByte0 | |
| | ***Type*** | uint8 |
| | ***Comment*** | User Byte 0 |
| | userByte1 | |
| | ***Type*** | uint8 |
| | ***Comment*** | User Byte 1 |
| | userByte2 | |
| | ***Type*** | uint8 |
| | ***Comment*** | User Byte 2 |

| | |
|---|---|
| ***Description*** | Current user data of the Time Base |
| ***Variation*** | -- |
| ***Available via*** | Rte_StbM_Type.h |

](RS_TS_00014, RS_TS_00015)

### 8.2.5.11 StbM_CustomerIdType

**[SWS_StbM_00288]**[

| | | | |
|---|---|---|---|
| ***Name*** | StbM_CustomerIdType | | |
| ***Kind*** | Type | | |
| ***Derived from*** | uint16 | | |
| ***Range*** | 0..65535 | -- | (0x00..0xFFFF) |
| ***Description*** | unique identifier of a notification customer | | |
| ***Variation*** | -- | | |
| ***Available via*** | Rte_StbM_Type.h | | |

](RS_TS_00035, RS_TS_00016, RS_TS_00017)

### 8.2.5.12 StbM_TimeBaseNotificationType

**[SWS_StbM_00287]**[

| | | | | |
|---|---|---|---|---|
| ***Name*** | StbM_TimeBaseNotificationType | | | |
| ***Kind*** | Bitfield | | | |
| ***Derived from*** | uint32 | | | |
| ***Elements*** | ***Kind*** | ***Name*** | ***Mask*** | ***Description*** |
| | bit | EV_GLOBAL_TIME | 0x01 | Bit 0 (LSB): 0: synchronization to global time master not changed 1: GLOBAL_ TIME_BASE in StbM_TimeBaseStatus Type has changed from 0 to 1 |
| | bit | EV_TIMEOUT_ OCCURRED | 0x02 | Bit 1: 1: TIMEOUT bit in timeBaseStatus has changed from 0 to 1 0: otherwise |
| | bit | EV_TIMEOUT_ REMOVED | 0x04 | Bit 2 1: TIMEOUT bit in timeBaseStatus has changed from 1 to 0 0: otherwise |
| | bit | EV_TIMELEAP_ FUTURE | 0x08 | Bit 3 1: TIMELEAP_FUTURE bit in time BaseStatus has changed from 0 to 1 0: otherwise |

| | | | | |
|---|---|---|---|---|
| | bit | EV_TIMELEAP_ FUTURE_REMOVED | 0x10 | Bit 4 1: TIMELEAP_FUTURE bit in time BaseStatus has changed from 1 to 0 0: otherwise |
| | bit | EV_TIMELEAP_PAST | 0x20 | Bit 5 1: TIMELEAP_PAST bit in time BaseStatus has changed from 0 to 1 0: otherwise |
| | bit | EV_TIMELEAP_PAST_ REMOVED | 0x40 | Bit 6 1: TIMELEAP_PAST bit in time BaseStatus has changed from 1 to 0 0: otherwise |
| | bit | EV_SYNC_TO_ SUBDOMAIN | 0x80 | Bit 7 1: SYNC_TO_GATEWAY bit in timeBaseStatus has changed from 0 to 1 0: otherwise |
| | bit | EV_SYNC_TO_ GLOBAL_MASTER | 0x100 | Bit 8 1: SYNC_TO_GATEWAY bit of Time Domain changes from 1 to 0 0: otherwise |
| | bit | EV_RESYNC | 0x0200 | Bit 9: 1: A synchronization of the local time to the valid Global Time value has occured 0: No resynchronization event occured |
| | bit | EV_RATECORRECTION | 0x0400 | Bit 10 1: a valid rate correction has been calculated (not beyond limits) 0: No rate correction calculated |
| ***Description*** | The StbM_TimeBaseNotificationType type defines a number of global time related events. The type definition is used for storing the events in the status variable NotificationEvents and for setting the mask variable NotificationMask which defines a subset of events for which an interrupt request shall be raised. | | | |
| ***Variation*** | -- | | | |
| ***Available via*** | Rte_StbM_Type.h | | | |

](RS_TS_00035, RS_TS_00016)

### 8.2.5.13 StbM_SyncRecordTableHeadType

**[SWS_StbM_00331]**[

| | | |
|---|---|---|
| ***Name*** | StbM_SyncRecordTableHeadType | |
| ***Kind*** | Structure | |
| ***Elements*** | SynchronizedTimeDomain | |
| | ***Type*** | uint8 |
| | ***Comment*** | Time Domain 0..15 |
| | HWfrequency | |

| | | |
|---|---|---|
| | ***Type*** | uint32 |
| | ***Comment*** | HW Frequency in Hz |
| | HWprescaler | |
| | ***Type*** | uint32 |
| | ***Comment*** | Prescaler value |
| ***Description*** | Synchronized Time Base Record Table Header | |
| ***Variation*** | -- | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00034)

### 8.2.5.14 StbM_SyncRecordTableBlockType

**[SWS_StbM_00332]**[

| | | |
|---|---|---|
| ***Name*** | StbM_SyncRecordTableBlockType | |
| ***Kind*** | Structure | |
| ***Elements*** | GlbSeconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | Seconds of the Local Time Base directly after synchronization with the Global Time Base |
| | GlbNanoSeconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | Nanoseconds of the Local Time Base directly after synchronization with the Global Time Base |
| | TimeBaseStatus | |
| | ***Type*** | StbM_TimeBaseStatusType |
| | ***Comment*** | Time Base Status of the Local Time Base directly after synchronization with the Global Time Base |
| | VirtualLocalTimeLow | |
| | ***Type*** | uint32 |
| | ***Comment*** | Least significant 32 bit of the Virtual Local Time directly after synchronization with the Global Time Base |
| | RateDeviation | |
| | ***Type*** | StbM_RateDeviationType |

| | | |
|---|---|---|
| | ***Comment*** | Calculated Rate Deviation directly after rate deviation measurement |
| | LocSeconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | Seconds of the Local Time Base directly before synchronization with the Global Time Base |
| | LocNanoSeconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | Nanoseconds of the Local Time Base directly before synchronization with the Global Time Base |
| | PathDelay | |
| | ***Type*** | uint32 |
| | ***Comment*** | Current propagation delay in nanoseconds |
| ***Description*** | Synchronized Time Base Record Table Block | |
| ***Variation*** | -- | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00034)

### 8.2.5.15 StbM_OffsetRecordTableHeadType

**[SWS_StbM_00333]**[

| | | |
|---|---|---|
| ***Name*** | StbM_OffsetRecordTableHeadType | |
| ***Kind*** | Structure | |
| ***Elements*** | OffsetTimeDomain | |
| | ***Type*** | uint8 |
| | ***Comment*** | Time Domain 16..31 |
| ***Description*** | Offset Time Base Record Table Header | |
| ***Variation*** | -- | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00034)

### 8.2.5.16 StbM_OffsetRecordTableBlockType

**[SWS_StbM_00334]⌈**

| | | |
|---|---|---|
| ***Name*** | StbM_OffsetRecordTableBlockType | |
| ***Kind*** | Structure | |
| ***Elements*** | GlbSeconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | Seconds of the Offset Time Base |
| | GlbNanoSeconds | |
| | ***Type*** | uint32 |
| | ***Comment*** | Nanoseconds of the Offset Time Base |
| | TimeBaseStatus | |
| | ***Type*** | StbM_TimeBaseStatusType |
| | ***Comment*** | Time Base Status of the Local Time Base directly after synchronization with the Global Time Base |
| ***Description*** | Offset Time Base Record Table Block | |
| ***Variation*** | -- | |
| ***Available via*** | Rte_StbM_Type.h | |

⌋(RS_TS_00034)

### 8.2.5.17 StbM_MasterConfigType

**[SWS_StbM_91001]⌈**

| | | | |
|---|---|---|---|
| ***Name*** | StbM_MasterConfigType | | |
| ***Kind*** | Type | | |
| ***Derived from*** | uint8 | | |
| ***Range*** | STBM_SYSTEM_WIDE_MASTER_ DISABLED | 0x00 | not configured as System Wide Master |
| | STBM_SYSTEM_WIDE_MASTER_ ENABLED | 0x01 | configured as System Wide Master |
| ***Description*** | This type indicates if an ECU is configured for a system wide master for a given Time Base is available or not. | | |
| ***Variation*** | -- | | |

| | |
|---|---|
| ***Available via*** | Rte_StbM_Type.h |

](RS_TS_00029)

### 8.2.5.18 StbM_EthTimeMasterMeasurementType

**[SWS_StbM_00504]**⌈

| | | |
|---|---|---|
| ***Name*** | StbM_EthTimeMasterMeasurementType | |
| ***Kind*** | Structure | |
| ***Elements*** | sequenceId | |
| | ***Type*** | uint16 |
| | ***Comment*** | sequenceId of sent Ethernet frame |
| | sourcePortId | |
| | ***Type*** | StbM_PortIdType |
| | ***Comment*** | sourcePortId of sending Ethernet port |
| | syncEgressTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Egress timestamp of Sync frame |
| | preciseOriginTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | the preciseOriginTime as copied to the Follow_Up frame |
| | correctionField | |
| | ***Type*** | sint64 |
| | ***Comment*** | the correctionField as copied to the Follow_Up frame |
| ***Description*** | Structure with detailed data for Time Validation of the Time Master on Ethernet | |
| ***Variation*** | ({ecuc(EthTSyn/EthTSynGeneral/EthTSynTimeValidationSupport)} == True) | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00034)

### 8.2.5.19 StbM_FrTimeMasterMeasurementType

**[SWS_StbM_00505]**⌈

| | | |
|---|---|---|
| ***Name*** | StbM_FrTimeMasterMeasurementType | |
| ***Kind*** | Structure | |
| ***Elements*** | sequenceCounter | |
| | ***Type*** | uint16 |
| | ***Comment*** | sequence counter of sent Sync frame |
| | referenceTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Retrieved reference Virtual Local Time used to calculate (future) time value of the Time Base |
| | preciseOriginTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | (future) time value of the Time Base in Global Time |
| | segmentId | |
| | ***Type*** | uint8 |
| | ***Comment*** | network segment id of the physical channel on which the Sync message has been sent |
| | currentCycle | |
| | ***Type*** | uint8 |
| | ***Comment*** | Value of current?Cycle upon transmission of the Sync message |
| | currentMacroticks | |
| | ***Type*** | uint16 |
| | ***Comment*** | Value of Current?Macroticks upon transmission of the Sync message |
| | macrotickDuration | |
| | ***Type*** | uint16 |
| | ***Comment*** | Duration of one Macrotick in ns |
| | cycleLength | |
| | ***Type*** | uint32 |
| | ***Comment*** | Flexray cycle length in nanoseconds |
| ***Description*** | Structure with detailed data for Time Validation of the Time Master on Flexray | |
| ***Variation*** | ({ecuc(FrTSyn/FrTSynGeneral/FrTSynTimeValidationSupport)} == True) | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00034)

### 8.2.5.20 StbM_CanTimeMasterMeasurementType

**[SWS_StbM_00511]**[

| | | |
|---|---|---|
| ***Name*** | StbM_CanTimeMasterMeasurementType | |
| ***Kind*** | Structure | |
| ***Elements*** | sequenceCounter | |
| | ***Type*** | uint16 |
| | ***Comment*** | Sequence counter of sent CAN frame |
| | syncEgressTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Egress timestamp of Sync frame |
| | preciseOriginTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | preciseOriginTimestamp as sent in the Follow up frame |
| | segmentId | |
| | ***Type*** | uint8 |
| | ***Comment*** | network segment id of the physical channel on which the Sync message has been sent |
| ***Description*** | Structure with detailed data for Time Validation of the Time Master on CAN | |
| ***Variation*** | ({ecuc(CanTSyn/CanTSynGeneral/CanTSynTimeValidationSupport)} == True) | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00034)

### 8.2.5.21 StbM_EthTimeSlaveMeasurementType

**[SWS_StbM_00506]**[

| | |
|---|---|
| ***Name*** | StbM_EthTimeSlaveMeasurementType |
| ***Kind*** | Structure |
| ***Elements*** | sequenceId |

| | | |
|---|---|---|
| | ***Type*** | uint16 |
| | ***Comment*** | Sequence Id of received Sync frame |
| | sourcePortId | |
| | ***Type*** | StbM_PortIdType |
| | ***Comment*** | sourcePortId from received Sync frame |
| | syncIngressTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Ingress timestamp of Sync frame converted to Virtual Local Time |
| | preciseOriginTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | preciseOriginTimestamp taken from the received Follow_Up frame |
| | correctionField | |
| | ***Type*** | sint64 |
| | ***Comment*** | correctionField taken from the received Follow_Up frame |
| | pDelay | |
| | ***Type*** | uint32 |
| | ***Comment*** | Currently valid pDelay value |
| | referenceLocalTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | SyncLocal Time Tuple (Virtual Local Time part) |
| | referenceGlobalTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | SyncLocal Time Tuple (Global Time part) |
| ***Description*** | Structure with detailed data for Time Validation of the Time Slave on Ethernet | |
| ***Variation*** | ({ecuc(EthTSyn/EthTSynGeneral/EthTSynTimeValidationSupport)} == True) | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00034)

### 8.2.5.22 StbM_FrTimeSlaveMeasurementType

**[SWS_StbM_00507]**[

| | | |
|---|---|---|
| ***Name*** | StbM_FrTimeSlaveMeasurementType | |
| ***Kind*** | Structure | |
| ***Elements*** | sequenceCounter | |
| | ***Type*** | uint16 |
| | ***Comment*** | Sequence counter of received Sync frame |
| | syncIngressTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Retrieved reference Virtual Local Time used to calculate (future) time value of the Time Base |
| | preciseOriginTimestampSec | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | Timestamp contained in received Sync frame |
| | currentCycle | |
| | ***Type*** | uint8 |
| | ***Comment*** | Value of currentCycle used to update the Time Slave's local instance of the Time Base |
| | CurrentMacroticks | |
| | ***Type*** | uint16 |
| | ***Comment*** | Value of CurrentMacroticks used to update the Time Slave's local instance of the Time Base |
| | FCNT | |
| | ***Type*** | uint8 |
| | ***Comment*** | FCNT of received Sync frame |
| | macrotickDuration | |
| | ***Type*** | uint16 |
| | ***Comment*** | Duration of one Macrotick in ns |
| | cycleLength | |
| | ***Type*** | uint32 |
| | ***Comment*** | Flexray cycle length in nanoseconds |
| | referenceLocalTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | SyncLocal Time Tuple (Virtual Local Time part) |

| | | |
|---|---|---|
| | referenceGlobalTimestampSec | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | SyncLocal Time Tuple (Global Time part) |
| | segmentId | |
| | ***Type*** | uint8 |
| | ***Comment*** | network segment id of the physical channel on which the Sync message has been received |
| ***Description*** | Structure with detailed data for Time Validation of the Time Slave on Flexray | |
| ***Variation*** | ({ecuc(FrTSyn/FrTSynGeneral/FrTSynTimeValidationSupport)} == True) | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00034)

### 8.2.5.23 StbM_CanTimeSlaveMeasurementType

**[SWS_StbM_00510]**[

| | | |
|---|---|---|
| ***Name*** | StbM_CanTimeSlaveMeasurementType | |
| ***Kind*** | Structure | |
| ***Elements*** | sequenceCounter | |
| | ***Type*** | uint16 |
| | ***Comment*** | sequence counter of received Sync frame |
| | syncIngressTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Ingress timestamp of Sync frame |
| | preciseOriginTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | preciseOriginTimestamp taken from the received Follow_Up frame |
| | referenceLocalTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | SyncLocal Time Tuple (Virtual Local Time part) |
| | referenceGlobalTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |

| | | |
|---|---|---|
| | ***Comment*** | SyncLocal Time Tuple (Global Time part) |
| | segmentId | |
| | ***Type*** | uint8 |
| | ***Comment*** | network segment id of the physical channel on which the Sync message has been received |
| ***Description*** | Structure with detailed timing data for the Time Slave on CAN | |
| ***Variation*** | ({ecuc(CanTSyn/CanTSynGeneral/CanTSynTimeValidationSupport)} == True) | |
| ***Available via*** | Rte_StbM_Type.h | |

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### 8.2.5.24 StbM_PdelayInitiatorMeasurementType

**[SWS_StbM_00508]**⌈

| | | |
|---|---|---|
| ***Name*** | StbM_PdelayInitiatorMeasurementType | |
| ***Kind*** | Structure | |
| ***Elements*** | sequenceId | |
| | ***Type*** | uint16 |
| | ***Comment*** | Sequence Id of sent Pdelay_Req frame |
| | requestPortId | |
| | ***Type*** | StbM_PortIdType |
| | ***Comment*** | sourcePortId of sent Pdelay_Req frame |
| | responsePortId | |
| | ***Type*** | StbM_PortIdType |
| | ***Comment*** | sourcePortId of received Pdelay_Resp frame |
| | requestOriginTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Egress timestamp of Pdelay_Req in Virtual Local Time |
| | responseReceiptTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Ingress timestamp of Pdelay_Resp in Virtual Local Time |
| | requestReceiptTimestamp | |

| | | |
|---|---|---|
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | Ingress timestamp of Pdelay_Req in Global Time taken from the received Pdelay_Resp |
| | responseOriginTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | Egress timestamp of Pdelay_Resp in Global Time taken from the received Pdelay_Resp_Follow_Up |
| | referenceLocalTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Value of the Virtual Local Time of the reference Global Time Tuple |
| | referenceGlobalTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | Value of the local instance of the Global Time of the reference Global Time Tuple |
| | pdelay | |
| | ***Type*** | uint32 |
| | ***Comment*** | Currently valid Pdelay value |
| ***Description*** | Structure with detailed timing data for the pDelay Initiator | |
| ***Variation*** | ({ecuc(EthTSyn/EthTSynGeneral/EthTSynTimeValidationSupport)} == True) | |
| ***Available via*** | Rte_StbM_Type.h | |

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### 8.2.5.25 StbM_PdelayResponderMeasurementType

**[SWS_StbM_00509]**[

| | | |
|---|---|---|
| ***Name*** | StbM_PdelayResponderMeasurementType | |
| ***Kind*** | Structure | |
| ***Elements*** | sequenceId | |
| | ***Type*** | uint16 |
| | ***Comment*** | sequenceId of received Pdelay_Req frame |
| | requestPortId | |
| | ***Type*** | StbM_PortIdType |
| | ***Comment*** | sourcePortId of received Pdelay_Req frame |

| | | |
|---|---|---|
| | responsePortId | |
| | ***Type*** | StbM_PortIdType |
| | ***Comment*** | sourcePortId of sent Pdelay_Resp frame |
| | requestReceiptTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Ingress timestamp of Pdelay_Req converted to Virtual Local Time |
| | responseOriginTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Egress timestamp of Pdelay_Resp converted to Virtual Local Time |
| | referenceLocalTimestamp | |
| | ***Type*** | StbM_VirtualLocalTimeType |
| | ***Comment*** | Value of the Virtual Local Time of the reference Global Time Tuple used to convert requestReceiptTimestamp and responseOriginTimestamp into Global Time |
| | referenceGlobalTimestamp | |
| | ***Type*** | StbM_TimeStampShortType |
| | ***Comment*** | Value of the local instance of the Global Time of the reference Global Time Tuple used to convert requestReceiptTimestamp and response OriginTimestamp into Global Time |
| ***Description*** | Structure with detailed timing data for the pDelay Responder | |
| ***Variation*** | ({ecuc(EthTSyn/EthTSynGeneral/EthTSynTimeValidationSupport)} == True) | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_00034)

### 8.2.5.26 StbM_TimeSyncType

**[SWS_StbM_91009]**[

| | | | |
|---|---|---|---|
| ***Name*** | StbM_TimeSyncType | | |
| ***Kind*** | Enumeration | | |
| ***Range*** | STBM_TIMESYNC_ ETHERNET | 0x01 | Indicates Time Synchronization on Ethernet |
| | STBM_TIMESYNC_CAN | 0x02 | Indicates Time Synchronization on CAN |
| | STBM_TIMESYNC_FLEXRAY | 0x03 | Indicates Time Synchronization on Flexray |

| | |
|---|---|
| ***Description*** | Indicates the underlying Time Sync module |
| ***Variation*** | -- |
| ***Available via*** | Rte_StbM_Type.h |

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### 8.2.5.27 StbM_ProtocolParamType

**[SWS_StbM_91010]**[

| | | |
|---|---|---|
| ***Name*** | StbM_ProtocolParamType | |
| ***Kind*** | Structure | |
| ***Elements*** | protocolType | |
| | ***Type*** | StbM_TimeSyncType |
| | ***Comment*** | Indicates the underlying Time Sync module. |
| | cumulativeScaledRateOffset | |
| | ***Type*** | sint32 |
| | ***Comment*** | The cumulative rate offset of the Time Master acc. to IEEE 802.1AS |
| | gmTimeBaseIndicator | |
| | ***Type*** | uint16 |
| | ***Comment*** | The time base indicator of the current Global Time Master acc. to IEEE 802.1AS |
| | lastGmPhaseChange | |
| | ***Type*** | sint32 |
| | ***Comment*** | The phase change of the current Global Time Master acc. to IEEE 802.1AS |
| | scaledLastGmFreqChange | |
| | ***Type*** | uint32 |
| | ***Comment*** | The scaled last frequency change of the Global Time Master acc. to IEEE 802.1AS |
| ***Description*** | This structure defines TimeSync protocol specific parameters relevant for the individual TimeSync modules (only EthTSyn specific parameters are known so far) | |
| ***Variation*** | -- | |
| ***Available via*** | Rte_StbM_Type.h | |

](RS_TS_20069)

# 9 Sequence diagrams

The sequence diagrams in this chapter show the basic operations of the Synchronized Time-Base Manager.

Please note that the sequence diagrams are an extension for illustrational purposes to ease understanding of the specification.

## 9.1 StbM Initialization

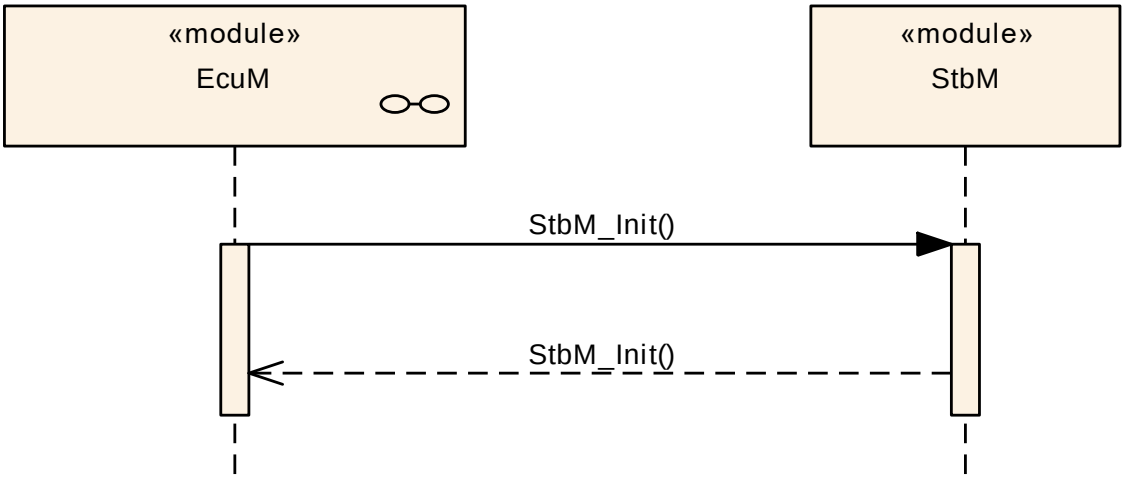



**Figure 14: StbM Initialization**

## 9.2 Immediate Time Synchronisation

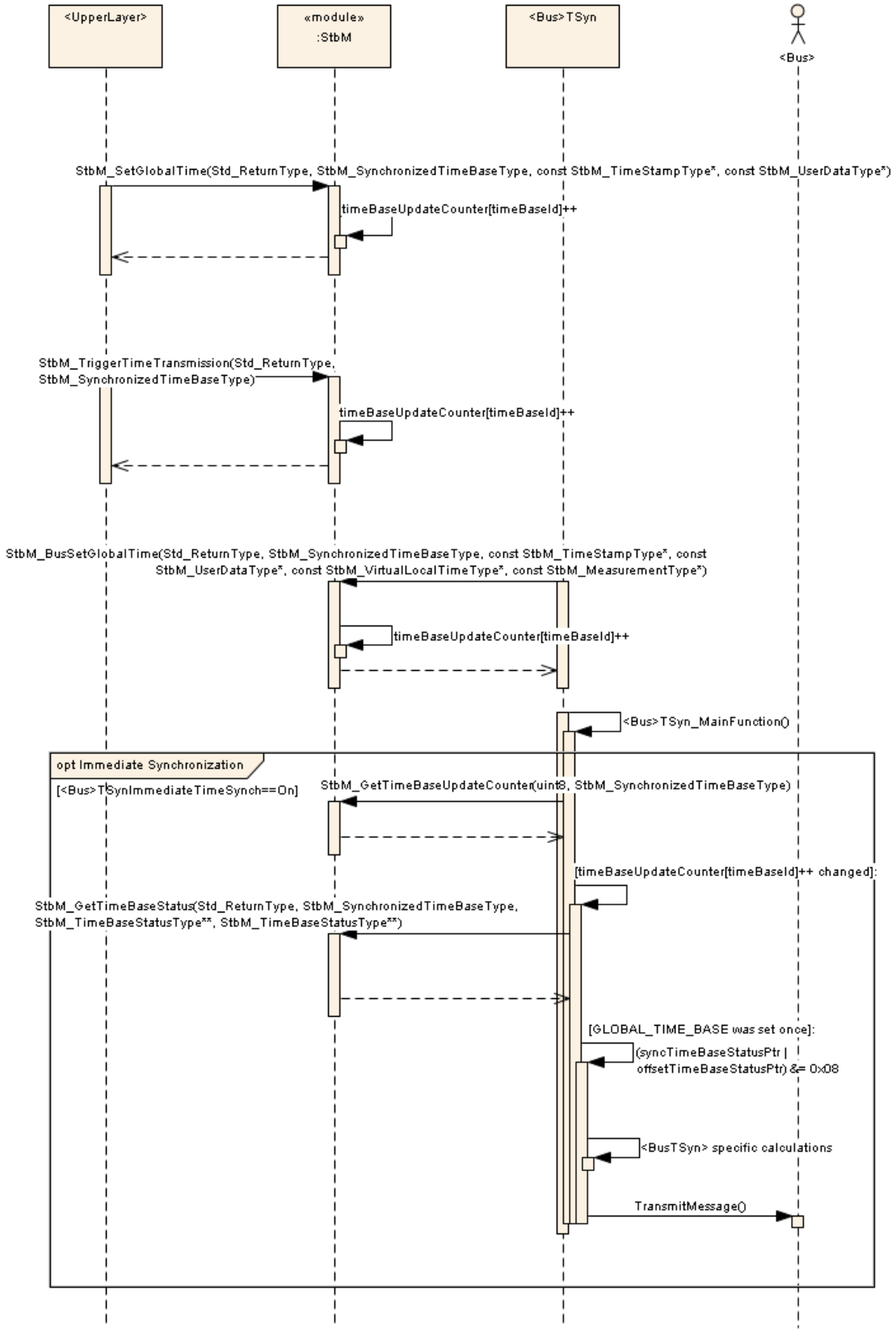



**Figure 15: Immediate time synchronization sequence (StbM API)**

## 9.3 Explicit synchronization of OS ScheduleTable

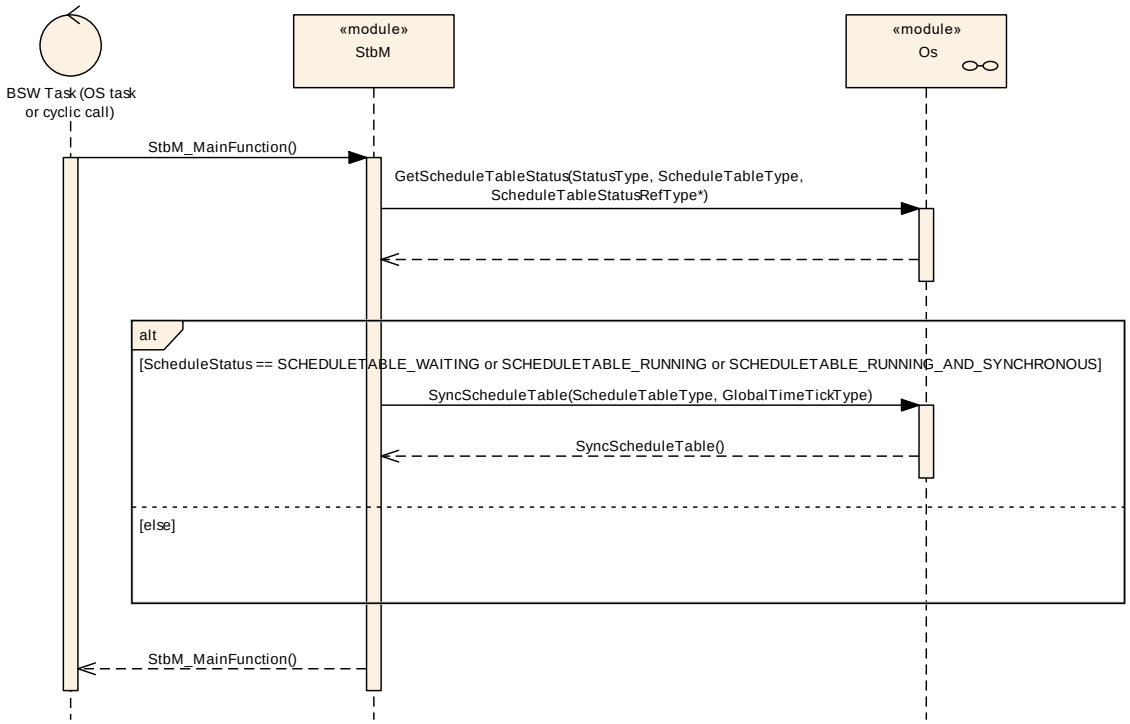



**Figure 16: Explicit synchronization of OS Schedule Table**

# 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 Synchronized Time-Base Manager. Chapter 10.3 specifies published information of the module Synchronized Time-Base Manager.

## 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 describe Chapters 7 and Chapter 8.

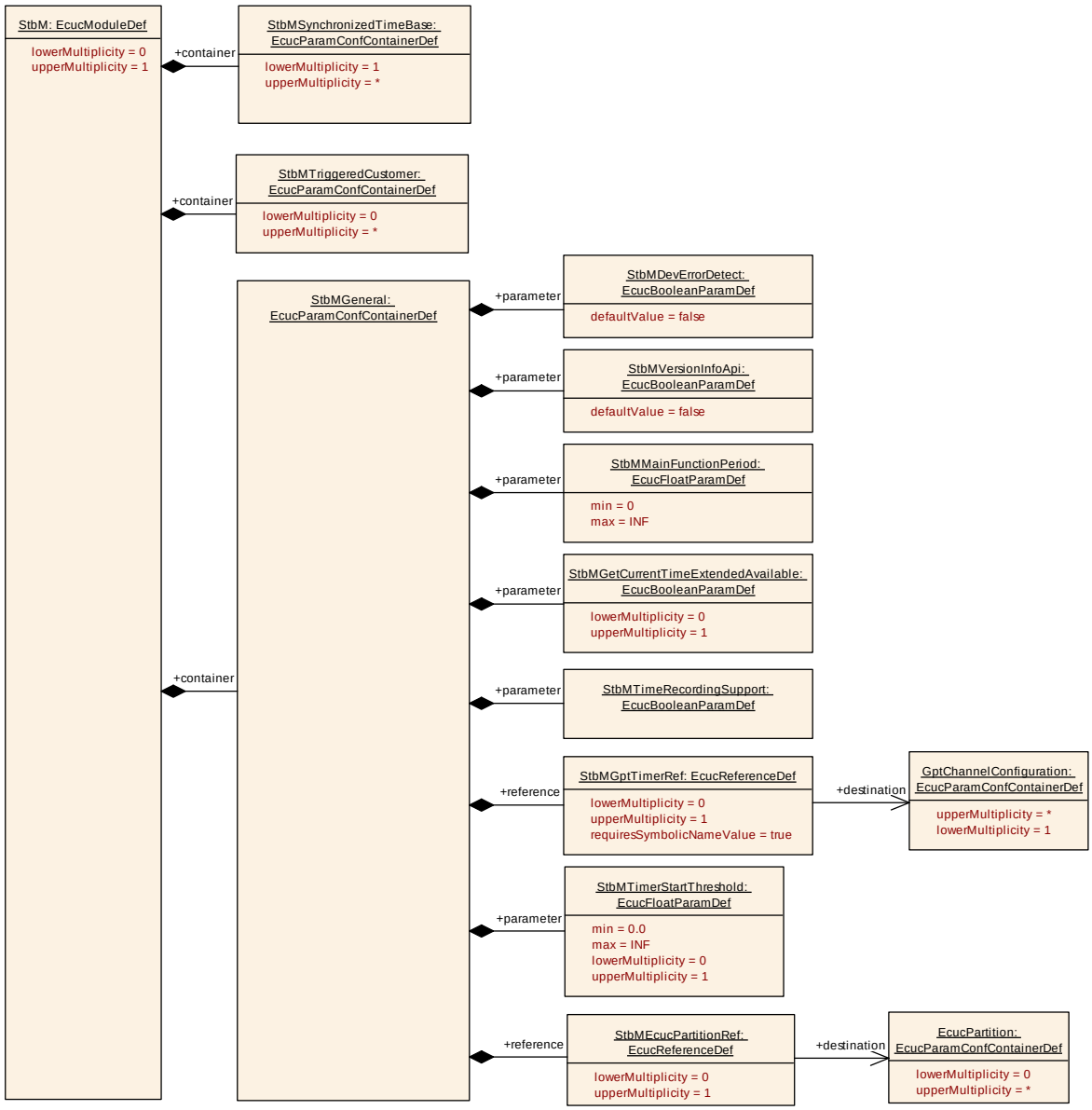
The module supports different post-build variants (previously known as post-build selectable configuration sets), but not post-build loadable configuration.

The configuration tool must check the consistency of the configuration at configuration time.

### 10.2.1 StbM

| ***SWS Item*** | **ECUC_StbM_00065 :** |
|---|---|
| ***Module Name*** | *StbM* |
| ***Module Description*** | Configuration of the Synchronized Time-base Manager (StbM) module. |
| ***Post-Build Variant Support*** | true |
| ***Supported Config Variants*** | VARIANT-PRE-COMPILE |

| ***Included Containers*** | | |
|---|---|---|
| ***Container Name*** | ***Multiplicity*** | ***Scope / Dependency*** |
| StbMGeneral | 1 | This container holds the general parameters of the Synchronized Time-base Manager |
| StbMSynchronizedTimeBase | 1..* | Synchronized time.base collects the information about a specific time-base provider within the system. |
| StbMTriggeredCustomer | 0..* | The triggered customer is directly triggered by the Synchronized Time-base Manager by getting synchronized with the current (global) definition of time and passage of time. |




## 10.2.2 StbMGeneral

| *SWS Item* | **ECUC_StbM_00002 :** |
|---|---|
| ***Container Name*** | StbMGeneral |
| ***Parent Container*** | StbM |
| ***Description*** | This container holds the general parameters of the Synchronized Time-base Manager |
| ***Configuration Parameters*** | |

| *SWS Item* | **ECUC_StbM_00012 :** |
|---|---|
| ***Name*** | StbMDevErrorDetect |
| ***Parent Container*** | StbMGeneral |
| ***Description*** | Switches the development error detection and notification on or off.<br>• 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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00032 :** | | |
| ***Name*** | StbMGetCurrentTimeExtendedAvailable | | |
| ***Parent Container*** | StbMGeneral | | |
| ***Description*** | This allows to define whether an additional variant of the API GetCurrentTime with a 64 bit argument is provided. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00027 :** | | |
| ***Name*** | StbMMainFunctionPeriod | | |
| ***Parent Container*** | StbMGeneral | | |
| ***Description*** | Schedule period of the main function StbM_MainFunction. Unit: [s]. | | |
| ***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: local | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00038 :** | | |
| ***Name*** | StbMTimeRecordingSupport | | |
| ***Parent Container*** | StbMGeneral | | |
| ***Description*** | Enables/Disables the usage of the recording functionality for Synchronized and Offset timebases for Global Time precision measurement purpose. | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00063 :** | | |
| ***Name*** | StbMTimerStartThreshold | | |
| ***Parent Container*** | StbMGeneral | | |
| ***Description*** | This interval defines, when a GPT Timer shall be started for Time Notification Customers for which the corresponding Customer Timer is running [unit: seconds]. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | ]0 .. INF[ | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00013 :** | | |
| ***Name*** | StbMVersionInfoApi | | |
| ***Parent Container*** | StbMGeneral | | |
| ***Description*** | Activate/Deactivate the version information API (StbM_GetVersionInfo). True: version information API activated False: version information API deactivated. | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00069 :** | | |
| ***Name*** | StbMEcucPartitionRef | | |
| ***Parent Container*** | StbMGeneral | | |
| ***Description*** | Reference to EcucPartition, where StbM module is assigned to. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Reference to [ EcucPartition ] | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00039 :** | | |
| ***Name*** | StbMGptTimerRef | | |
| ***Parent Container*** | StbMGeneral | | |
| ***Description*** | This represents an optional sub-container in case any Time Notification Customer is configured.<br>The designated GPT timer has to be configured to have a tick duration of one micro second. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Symbolic name reference to [ GptChannelConfiguration ] | | |
| ***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 | | |

| |
|---|
| ***No Included Containers*** |

### 10.2.3 StbMSynchronizedTimeBase

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00003 :** | | |
| ***Container Name*** | StbMSynchronizedTimeBase | | |
| ***Parent Container*** | StbM | | |
| ***Description*** | Synchronized time.base collects the information about a specific time-base provider within the system. | | |
| ***Post-Build Variant Multiplicity*** | false | | |
| ***Multiplicity Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Configuration Parameters*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00066 :** | | |
| ***Name*** | StbMAllowSystemWideGlobalTimeMaster | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | For postbuild variant of the StbM this parameter has to be set to true for a Global Time Master that may act as a system-wide source of time.<br>Otherwise no corresponding service ports/interfaces is provided.<br>The Global Time Master functionality behind the service ports/interfaces has to be enabled/disabled separately via parameter StbMIsSystemWideGlobalTimeMaster. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00037 :** | | |
| ***Name*** | StbMClearTimeleapCount | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | This attribute describes the required number of updates to the Time Base where the time difference to the previous value has to remain below StbMTimeLeapPastThreshold/StbMTimeLeapFutureThreshold until the TIMELEAP_PAST/TIMELEAP_FUTURE bit within timeBaseStatus of the Time Base is cleared. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***Range*** | 1 .. 65535 | | |
| ***Default value*** | 1 | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00036 :** | | |
| ***Name*** | StbMIsSystemWideGlobalTimeMaster | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | This parameter shall be set to true for a Global Time Master that acts as a system-wide source of time information with respect to Global Time.<br>It is possible that several Global Time Masters exist that have set this parameter set to true because the Global Time Masters exist once per Global Time Domain and one ECU may own several Global Time Domains on different buses it is connected to. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***Post-Build Variant Value*** | true | | |
| ***Value Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | scope: local | | |

| | | |
|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00068 :** | |
| ***Name*** | StbMNotificationInterface | |
| ***Parent Container*** | StbMSynchronizedTimeBase | |
| ***Description*** | The parameter defines what type of interface shall be used to notify a customer of a status event. | |
| ***Multiplicity*** | 1 | |
| ***Type*** | EcucEnumerationParamDef | |
| ***Range*** | CALLBACK | -- |
| | CALLBACK_AND_SR_INTERFACE | -- |

| | | | |
|---|---|---|---|
| | NO_NOTIFICATION | -- | |
| | SR_INTERFACE | -- | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00046 :** | | |
| ***Name*** | StbMStatusNotificationCallback | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | Name of the customer specific status notification callback function, which shall be called, if a non-masked status event occurs. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFunctionNameDef | | |
| ***Default value*** | -- | | |
| ***maxLength*** | -- | | |
| ***minLength*** | -- | | |
| ***regularExpression*** | -- | | |
| ***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<br>dependency: StbMStatusNotificationCallback shall be available, if and only if StbMNotificationInterface is set to either CALLBACK or CALLBACK_AND_SR_INTERFACE. | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00045 :** | | |
| ***Name*** | StbMStatusNotificationMask | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | The parameter defines the initial value for NotificationMask mask, which defines the events for which the event notification callback function shall be called. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***Range*** | 0 .. 4294967295 | | |
| ***Default value*** | 0 | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00031 :** | | |
| ***Name*** | StbMStoreTimebaseNonVolatile | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | This allows for specifying that the Time Base shall be stored in the NvRam. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucEnumerationParamDef | | |
| ***Range*** | NO_STORAGE | -- | |
| | STORAGE_AT_SHUTDOWN | -- | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00021 :** | | |
| ***Name*** | StbMSynchronizedTimeBaseIdentifier | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | Identification of a Synchronized TimeBase via a unique identifier.<br>Range:<br>• 0 .. 15: Synchronized Time Bases<br>• 16 .. 31: Offset Time Bases<br>• 32 .. 127: Pure Local Time Bases<br>• 128 .. 65535: Reserved | | |
| ***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 | | |

| | | |
|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00028 :** | |
| ***Name*** | StbMSyncLossTimeout | |
| ***Parent Container*** | StbMSynchronizedTimeBase | |
| ***Description*** | This attribute describes the timeout for the situation that the time synchronization gets lost in the scope of the time domain. Unit: seconds | |
| ***Multiplicity*** | 0..1 | |
| ***Type*** | EcucFloatParamDef | |
| ***Range*** | ]0 .. INF[ | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00041 :** | | |
| ***Name*** | StbMTimeLeapFutureThreshold | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | This represents the maximum allowed positive difference between a newly received Global Time Base value and the current Local Time Base value [unit: seconds]. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | [0 .. INF[ | | |
| ***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 | | |

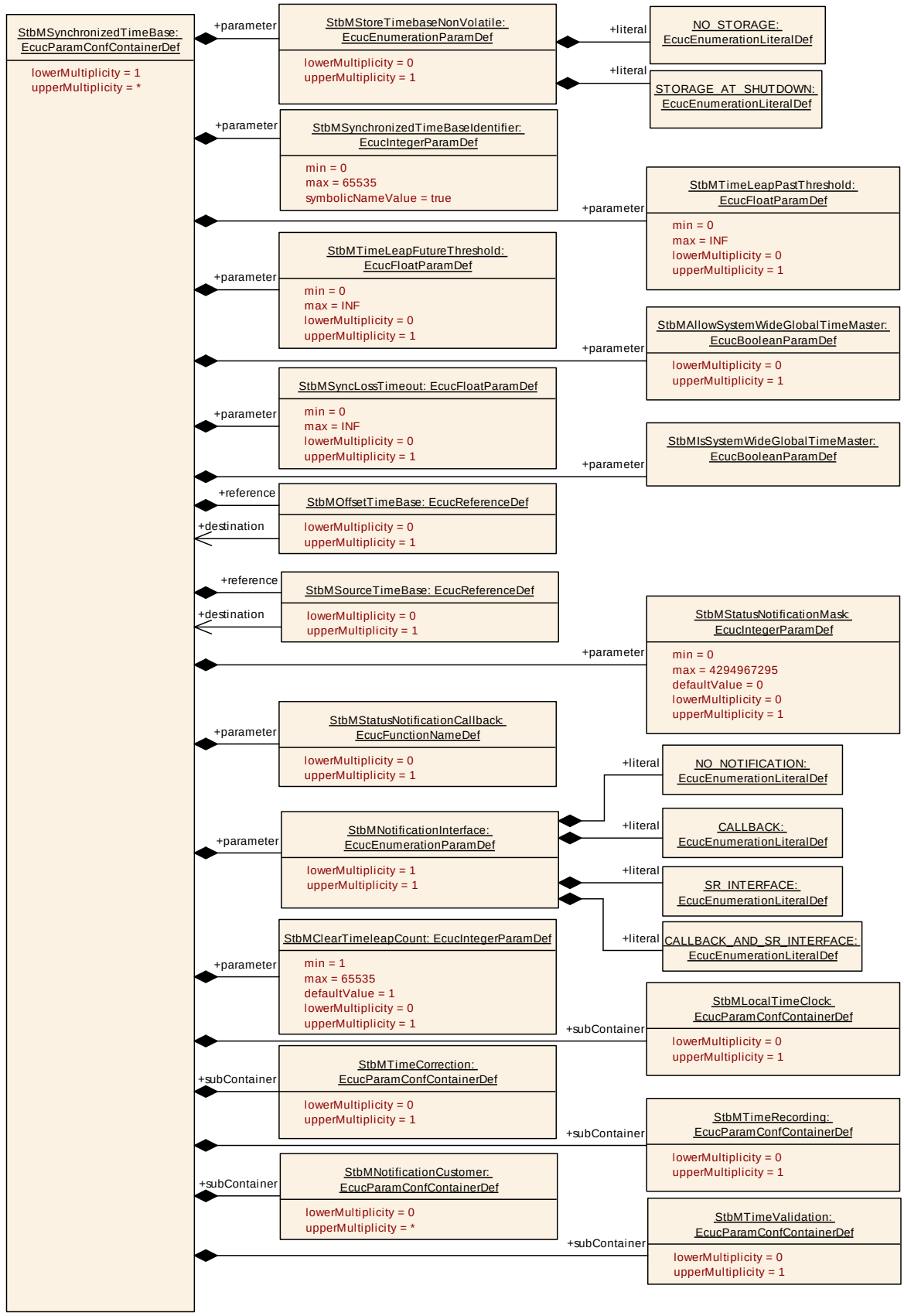
| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00042 :** | | |
| ***Name*** | StbMTimeLeapPastThreshold | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | This represents the maximum allowed negative difference between the current Local Time Base value and a newly received Global Time Base value [unit: seconds]. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | [0 .. INF[ | | |
| ***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 | | |

| | |
|---|---|
| ***SWS Item*** | **ECUC_StbM_00030 :** |
| ***Name*** | StbMOffsetTimeBase |
| ***Parent Container*** | StbMSynchronizedTimeBase |

| | | | |
|---|---|---|---|
| ***Description*** | This is the reference to the Synchronized Time-Base this Offset Time-Base is based on. This reference makes the containing StbMSynchronizedTimeBase an Offset Time-Base. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Reference to [ StbMSynchronizedTimeBase ] | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00074 :** | | |
| ***Name*** | StbMSourceTimeBase | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | This is a reference to a Time Base, which the current Time Base is cloned from. This makes the referenced Time Base the source Time Base for cloning and the current Time the destination Time Base for cloning. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Reference to [ StbMSynchronizedTimeBase ] | | |
| ***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 | | |

| ***Included Containers*** | | |
|---|---|---|
| ***Container Name*** | ***Multiplicity*** | ***Scope / Dependency*** |
| StbMLocalTimeClock | 0..1 | References the hardware reference clock of this Synchronized Time Base. |
| StbMNotificationCustomer | 0..* | This container holds the configuration of a notification customer, which is notified is informed about the occurance of a Time-base related event. |
| StbMTimeCorrection | 0..1 | Collects the information relevant for the rate- and offset correction of a Time Base. |
| StbMTimeRecording | 0..1 | Collects the information relevant for configuration of the precision measurement of a Time Base. |
| StbMTimeValidation | 0..1 | Container with Time Validation configuration for Time Base. |


StbMSynchronizedTimeBase: EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = *
+parameter
StbMStoreTimebaseNonVolatile: EcucEnumerationParamDef
lowerMultiplicity = 0
upperMultiplicity = 1
+literal
NO_STORAGE: EcucEnumerationLiteralDef
+literal
STORAGE_AT_SHUTDOWN: EcucEnumerationLiteralDef
+parameter
StbMSynchronizedTimeBaseIdentifier: EcucIntegerParamDef
min = 0
max = 65535
symbolicNameValue = true
+parameter
StbMTimeLeapPastThreshold: EcucFloatParamDef
min = 0
max = INF
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMTimeLeapFutureThreshold: EcucFloatParamDef
min = 0
max = INF
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMAllowSystemWideGlobalTimeMaster: EcucBooleanParamDef
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMSyncLossTimeout: EcucFloatParamDef
min = 0
max = INF
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMIsSystemWideGlobalTimeMaster: EcucBooleanParamDef
+reference
+destination
StbMOffsetTimeBase: EcucReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 1
+reference
+destination
StbMSourceTimeBase: EcucReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMStatusNotificationMask: EcucIntegerParamDef
min = 0
max = 4294967295
defaultValue = 0
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMStatusNotificationCallback: EcucFunctionNameDef
lowerMultiplicity = 0
upperMultiplicity = 1
+literal
NO_NOTIFICATION: EcucEnumerationLiteralDef
+literal
CALLBACK: EcucEnumerationLiteralDef
+literal
SR_INTERFACE: EcucEnumerationLiteralDef
+literal
CALLBACK_AND_SR_INTERFACE: EcucEnumerationLiteralDef
+parameter
StbMNotificationInterface: EcucEnumerationParamDef
lowerMultiplicity = 1
upperMultiplicity = 1
+parameter
StbMClearTimeleapCount: EcucIntegerParamDef
min = 1
max = 65535
defaultValue = 1
lowerMultiplicity = 0
upperMultiplicity = 1
+subContainer
StbMLocalTimeClock: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 1
+subContainer
StbMTimeCorrection: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 1
+subContainer
StbMTimeRecording: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 1
+subContainer
StbMNotificationCustomer: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+subContainer
StbMTimeValidation: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 1

### 10.2.4 StbMTimeCorrection

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00048 :** | | |
| ***Container Name*** | StbMTimeCorrection | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | Collects the information relevant for the rate- and offset correction of a Time Base. | | |
| ***Post-Build Variant Multiplicity*** | false | | |
| ***Multiplicity Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Configuration Parameters*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00043 :** | | |
| ***Name*** | StbMAllowMasterRateCorrection | | |
| ***Parent Container*** | StbMTimeCorrection | | |
| ***Description*** | This attribute describes whether the rate correction value of a Time Base can be set by StbM_SetRateCorrection():<br>• false: the rate correction value can not be set by StbM_SetRateCorrection()<br>• true: the rate correction value can be set by StbM_SetRateCorrection() | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00044 :** | | |
| ***Name*** | StbMMasterRateDeviationMax | | |
| ***Parent Container*** | StbMTimeCorrection | | |
| ***Description*** | This attribute describes the maximum allowed absolute value of the rate deviation value to be set by StbM_SetRateCorrection() [unit: ppm]. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***Range*** | 0 .. 32000 | | |
| ***Default value*** | 0 | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00057 :** | | |
| ***Name*** | StbMOffsetCorrectionAdaptionInterval | | |
| ***Parent Container*** | StbMTimeCorrection | | |
| ***Description*** | Defines the interval during which the adaptive rate correction cancels out the rate- and time deviation [unit: seconds]. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | ]0 .. INF[ | | |
| ***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 | | |

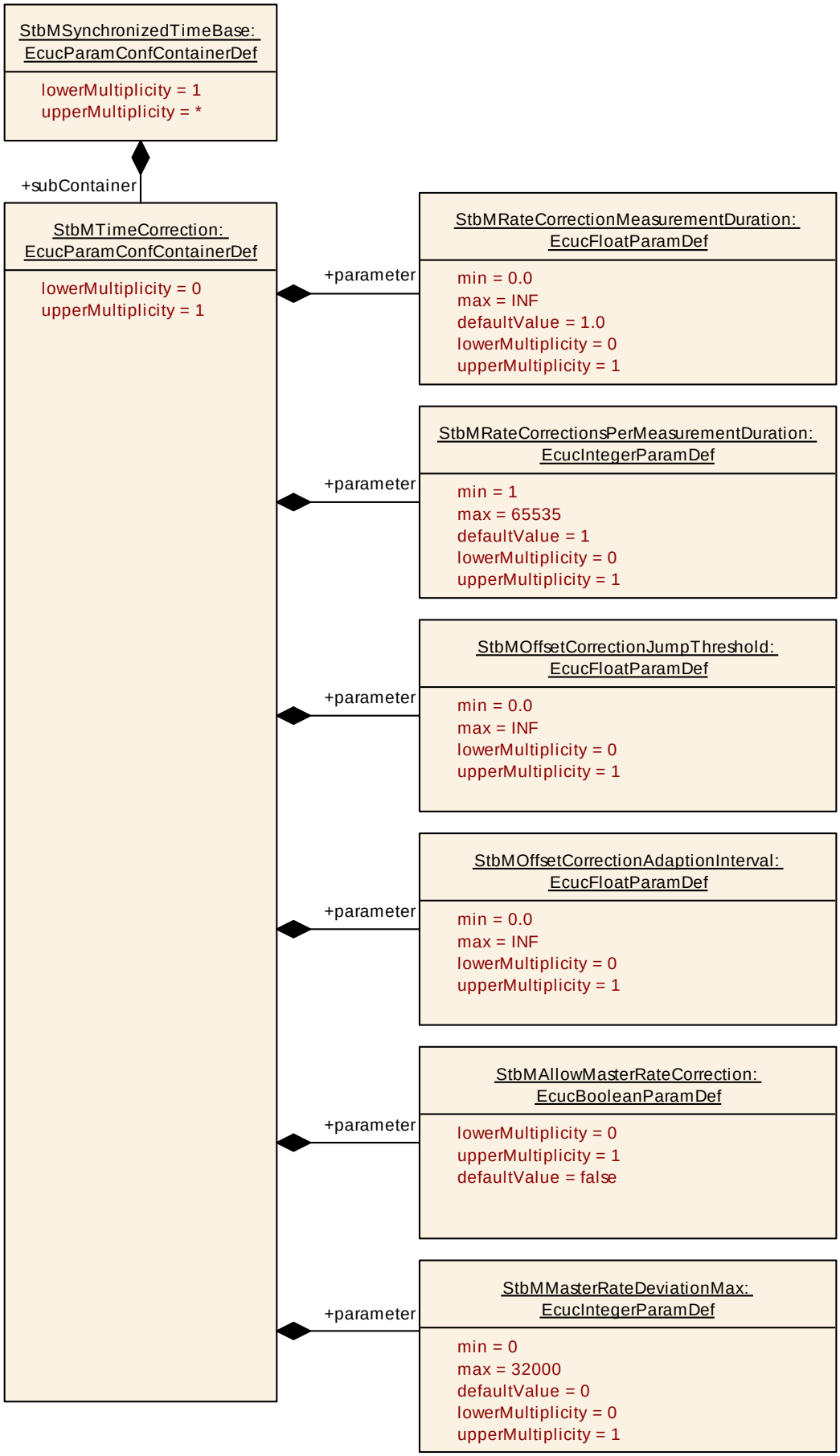
| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00056 :** | | |
| ***Name*** | StbMOffsetCorrectionJumpThreshold | | |
| ***Parent Container*** | StbMTimeCorrection | | |
| ***Description*** | Threshold for the correction method. Deviations below this value will be corrected by a linear reduction over a defined timespan. Values equal- and greater than this value will be corrected by immediately setting the correct time- and rate in form of a jump [unit: seconds]. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | [0 .. INF[ | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00054 :** | | |
| ***Name*** | StbMRateCorrectionMeasurementDuration | | |
| ***Parent Container*** | StbMTimeCorrection | | |
| ***Description*** | Definition of the time span [s] which is used to calculate the rate deviation. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | [0 .. INF[ | | |
| ***Default value*** | 1 | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00055 :** | | |
| ***Name*** | StbMRateCorrectionsPerMeasurementDuration | | |
| ***Parent Container*** | StbMTimeCorrection | | |
| ***Description*** | Number of simultaneous rate measurements to determine the current rate deviation. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***Range*** | 1 .. 65535 | | |
| ***Default value*** | 1 | | |
| ***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 | | |

| |
|---|
| ***No Included Containers*** |


StbMSynchronizedTimeBase:
EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = *
+subContainer
StbMTimeCorrection:
EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMRateCorrectionMeasurementDuration:
EcucFloatParamDef
min = 0.0
max = INF
defaultValue = 1.0
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMRateCorrectionsPerMeasurementDuration:
EcucIntegerParamDef
min = 1
max = 65535
defaultValue = 1
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMOffsetCorrectionJumpThreshold:
EcucFloatParamDef
min = 0.0
max = INF
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMOffsetCorrectionAdaptionInterval:
EcucFloatParamDef
min = 0.0
max = INF
lowerMultiplicity = 0
upperMultiplicity = 1
+parameter
StbMAllowMasterRateCorrection:
EcucBooleanParamDef
lowerMultiplicity = 0
upperMultiplicity = 1
defaultValue = false
+parameter
StbMMasterRateDeviationMax:
EcucIntegerParamDef
min = 0
max = 32000
defaultValue = 0
lowerMultiplicity = 0
upperMultiplicity = 1

### 10.2.5 StbMLocalTimeClock

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00047 :** | | |
| ***Container Name*** | StbMLocalTimeClock | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | References the hardware reference clock of this Synchronized Time Base. | | |
| ***Post-Build Variant Multiplicity*** | false | | |
| ***Multiplicity Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Configuration Parameters*** | | | |

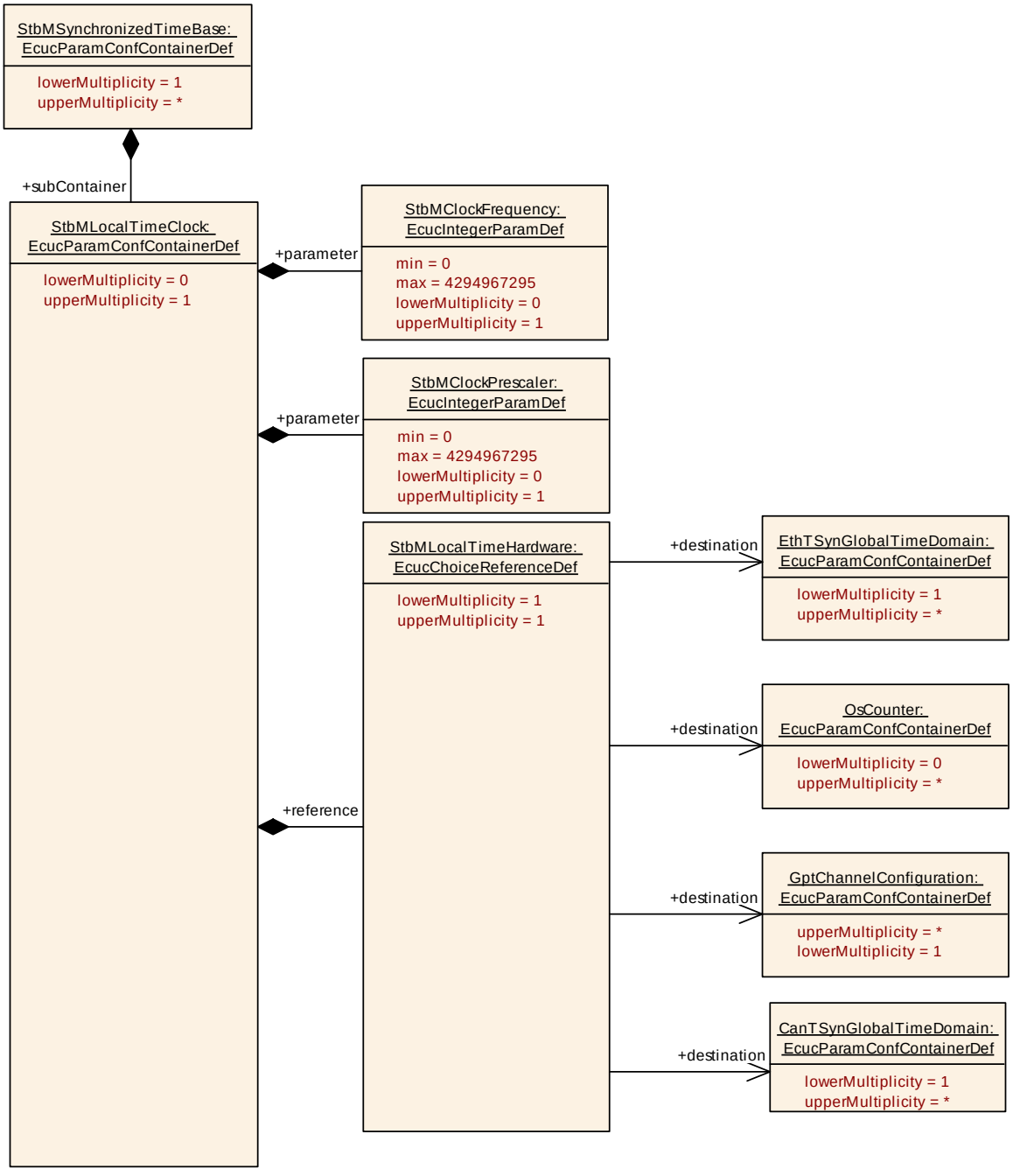
| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00051 :** | | |
| ***Name*** | StbMClockFrequency | | |
| ***Parent Container*** | StbMLocalTimeClock | | |
| ***Description*** | Represents the frequency [Hz] of the HW reference clock used by the StbM. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***Range*** | 0 .. 4294967295 | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00052 :** | | |
| ***Name*** | StbMClockPrescaler | | |
| ***Parent Container*** | StbMLocalTimeClock | | |
| ***Description*** | Represents the prescaler to calculate the resulting frequency of the HW reference clock used by the StbM. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***Range*** | 0 .. 4294967295 | | |
| ***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 | | |

| | |
|---|---|
| ***SWS Item*** | **ECUC_StbM_00053 :** |
| ***Name*** | StbMLocalTimeHardware |
| ***Parent Container*** | StbMLocalTimeClock |
| ***Description*** | Reference to the local time hardware. |
| ***Multiplicity*** | 1 |
| ***Type*** | Choice reference to [ CanTSynGlobalTimeDomain , EthTSynGlobalTimeDomain , GptChannelConfiguration , OsCounter ] |
| ***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 | | |

| ***No Included Containers*** |
|---|



### 10.2.6 StbMTimeRecording

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00049 :** | | |
| ***Container Name*** | StbMTimeRecording | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | Collects the information relevant for configuration of the precision measurement of a Time Base. | | |
| ***Post-Build Variant Multiplicity*** | false | | |
| ***Multiplicity Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Configuration Parameters*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00061 :** | | |
| ***Name*** | StbMOffsetTimeRecordBlockCallback | | |
| ***Parent Container*** | StbMTimeRecording | | |
| ***Description*** | Name of the customer specific callback function, which shall be called, if a measurement data for a Offset Time Base are available. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFunctionNameDef | | |
| ***Default value*** | -- | | |
| ***maxLength*** | -- | | |
| ***minLength*** | -- | | |
| ***regularExpression*** | -- | | |
| ***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 | | |

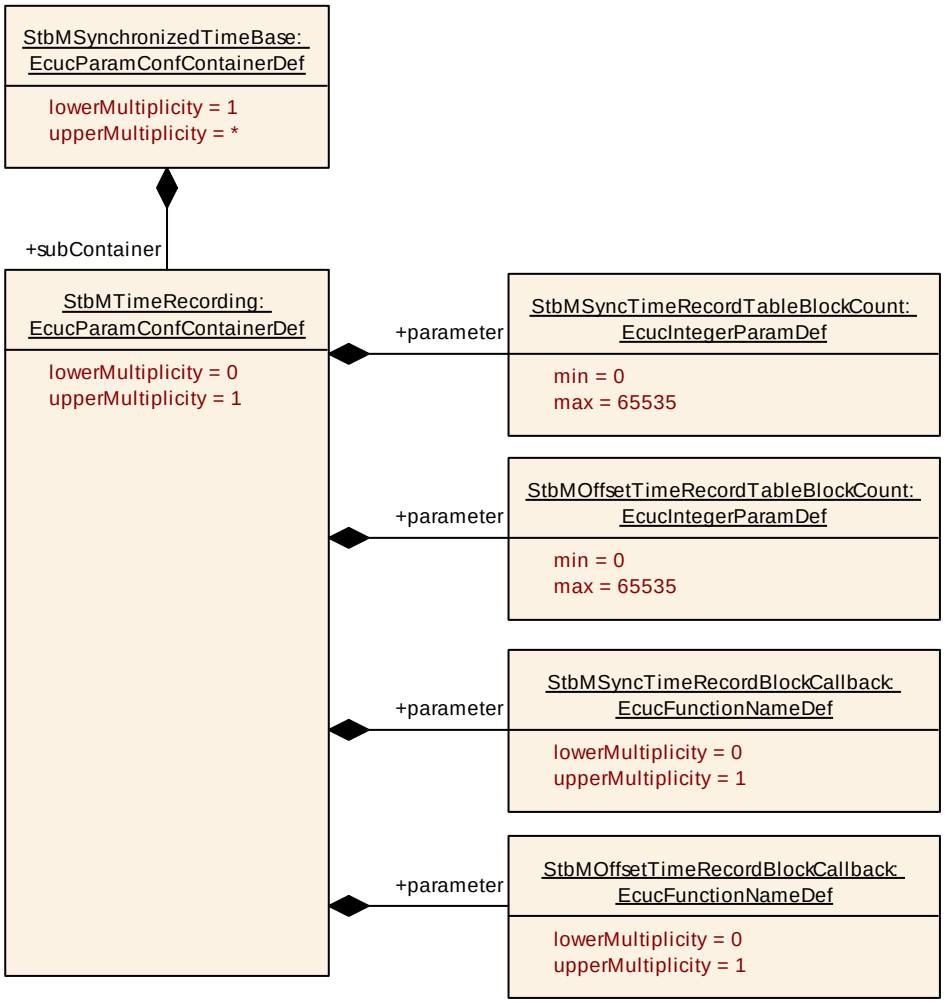
| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00059 :** | | |
| ***Name*** | StbMOffsetTimeRecordTableBlockCount | | |
| ***Parent Container*** | StbMTimeRecording | | |
| ***Description*** | Represents the number of Blocks used for queing time measurement events for the Offset Time Base Record Table. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***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 | | |

| | |
|---|---|
| ***SWS Item*** | **ECUC_StbM_00060 :** |
| ***Name*** | StbMSyncTimeRecordBlockCallback |
| ***Parent Container*** | StbMTimeRecording |
| ***Description*** | Name of the customer specific callback function, which shall be called, if a measurement data for a Synchronized Time Base are available. |

| | | | |
|---|---|---|---|
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFunctionNameDef | | |
| ***Default value*** | -- | | |
| ***maxLength*** | -- | | |
| ***minLength*** | -- | | |
| ***regularExpression*** | -- | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00058 :** | | |
| ***Name*** | StbMSyncTimeRecordTableBlockCount | | |
| ***Parent Container*** | StbMTimeRecording | | |
| ***Description*** | Represents the number of Blocks used for queing time measurement events for the Synchronized Time Base Record Table. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***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 | | |

| |
|---|
| ***No Included Containers*** |



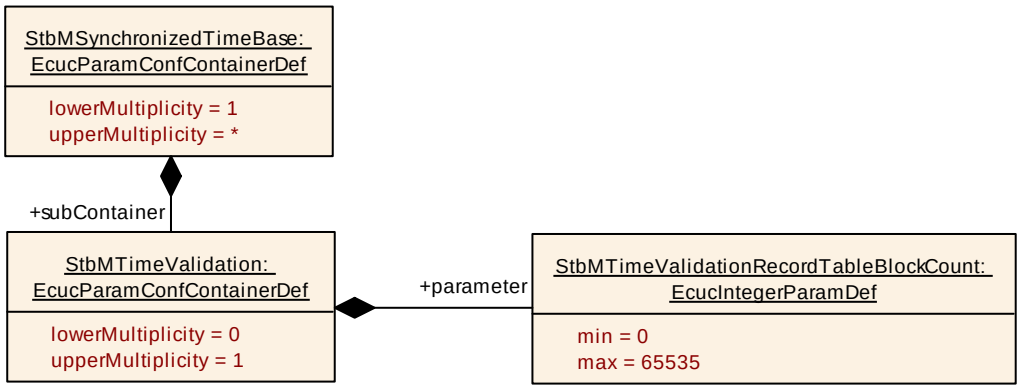

### 10.2.7 StbMTimeValidation

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00072 :** | | |
| ***Container Name*** | StbMTimeValidation | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | Container with Time Validation configuration for Time Base. | | |
| ***Post-Build Variant Multiplicity*** | false | | |
| ***Multiplicity Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Configuration Parameters*** | | | |

| | | |
|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00073 :** | |
| ***Name*** | StbMTimeValidationRecordTableBlockCount | |
| ***Parent Container*** | StbMTimeValidation | |
| ***Description*** | Size of record table for Time Validation (number of blocks). | |
| ***Multiplicity*** | 1 | |
| ***Type*** | EcucIntegerParamDef | |
| ***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 | | |

| |
|---|
| ***No Included Containers*** |




### 10.2.8 StbMNotificationCustomer

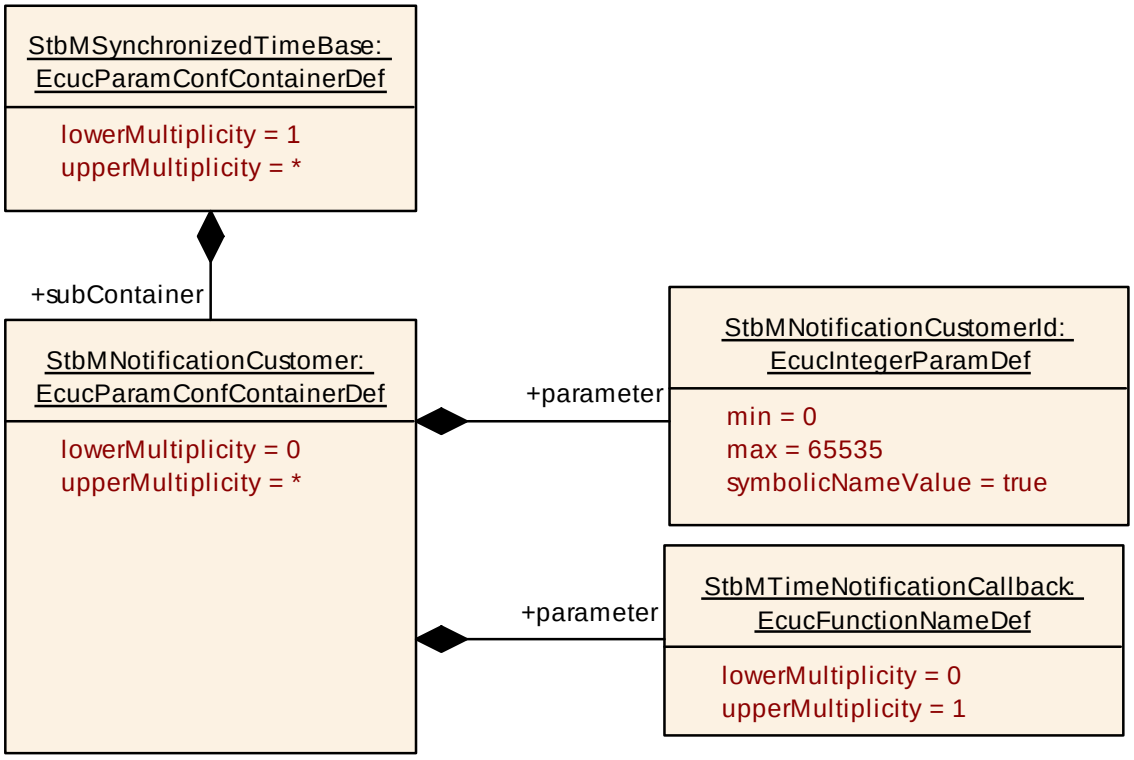
| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00050 :** | | |
| ***Container Name*** | StbMNotificationCustomer | | |
| ***Parent Container*** | StbMSynchronizedTimeBase | | |
| ***Description*** | This container holds the configuration of a notification customer, which is notified is informed about the occurance of a Time-base related event. | | |
| ***Post-Build Variant Multiplicity*** | false | | |
| ***Multiplicity Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Configuration Parameters*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00062 :** | | |
| ***Name*** | StbMNotificationCustomerId | | |
| ***Parent Container*** | StbMNotificationCustomer | | |
| ***Description*** | Identification of a event notification customer. | | |
| ***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 | | |

| | |
|---|---|
| ***SWS Item*** | **ECUC_StbM_00064 :** |
| ***Name*** | StbMTimeNotificationCallback |

| | | | |
|---|---|---|---|
| ***Parent Container*** | StbMNotificationCustomer | | |
| ***Description*** | Name of the customer specific notification callback function, which shall be called, if the time previously set by the customer is reached. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFunctionNameDef | | |
| ***Default value*** | -- | | |
| ***maxLength*** | -- | | |
| ***minLength*** | -- | | |
| ***regularExpression*** | -- | | |
| ***Post-Build Variant Value*** | false | | |
| ***Value Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | scope: local | | |

| |
|---|
| ***No Included Containers*** |




### 10.2.9 StbMTriggeredCustomer

| | |
|---|---|
| ***SWS Item*** | **ECUC_StbM_00004 :** |
| ***Container Name*** | StbMTriggeredCustomer |
| ***Parent Container*** | StbM |
| ***Description*** | The triggered customer is directly triggered by the Synchronized Time-base Manager by getting synchronized with the current (global) definition of time and passage of time. |
| ***Post-Build Variant*** | false |

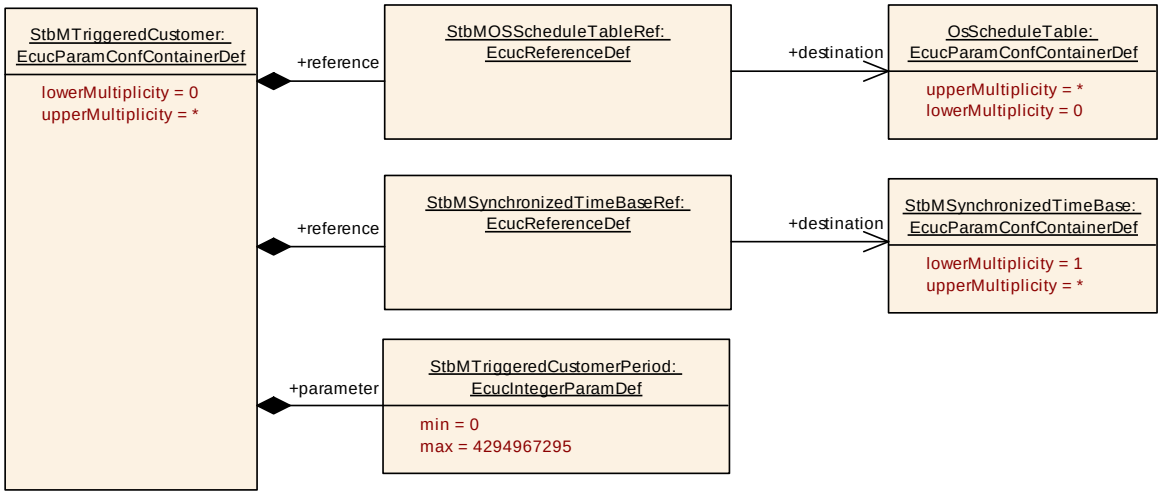
| | | | |
|---|---|---|---|
| ***Multiplicity*** | | | |
| ***Multiplicity Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Configuration Parameters*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00020 :** | | |
| ***Name*** | StbMTriggeredCustomerPeriod | | |
| ***Parent Container*** | StbMTriggeredCustomer | | |
| ***Description*** | The triggering period of the triggered customer, called by the StbM_MainFunction.<br>The period is documented in microseconds. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***Range*** | 0 .. 4294967295 | | |
| ***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 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00007 :** | | |
| ***Name*** | StbMOSScheduleTableRef | | |
| ***Parent Container*** | StbMTriggeredCustomer | | |
| ***Description*** | Mandatory reference to synchronized OS ScheduleTable, which will be explicitly synchronized by the StbM. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | Reference to [ OsScheduleTable ] | | |
| ***Post-Build Variant Value*** | false | | |
| ***Value Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | scope: local | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUC_StbM_00010 :** | | |
| ***Name*** | StbMSynchronizedTimeBaseRef | | |
| ***Parent Container*** | StbMTriggeredCustomer | | |
| ***Description*** | Mandatory reference to the required synchronized time-base. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | Reference to [ StbMSynchronizedTimeBase ] | | |
| ***Post-Build Variant Value*** | false | | |
| ***Value Configuration Class*** | ***Pre-compile time*** | X | All Variants |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | scope: local | | |

| |
|---|
| ***No Included Containers*** |




## 10.3 Constraints

**[SWS_StbM_CONSTR_00001]**
If variant is `VARIANT-POST-BUILD`, `StbMAllowSystemWideGlobalTimeMaster` shall be mandatory.

**[SWS_StbM_CONSTR_00002]**
If variant is `VARIANT-POST-BUILD`, `StbMIsSystemWideGlobalTimeMaster` can only be set to `TRUE`, if `StbMAllowSystemWideGlobalTimeMaster` is set to `TRUE`.

## 10.4 Published Information

For details refer to the chapter 10.3 “Published Information” in *SWS_BSWGeneral.*

# 11 Not applicable requirements

**[SWS_StbM_00140]** ⌈These requirements are not applicable to this specification.⌋

(RS_TS_20031, RS_TS_20032, RS_TS_20033, RS_TS_20034, RS_TS_20035, RS_TS_20036, RS_TS_20037, RS_TS_20038, RS_TS_20039, RS_TS_20040, RS_TS_20041, RS_TS_20042, RS_TS_20043, RS_TS_20044, RS_TS_20045, RS_TS_20046, RS_TS_20047, RS_TS_20048, RS_TS_20051, RS_TS_20052, RS_TS_20053, RS_TS_20054, RS_TS_20058, RS_TS_20059, RS_TS_20060, RS_TS_20061, RS_TS_20062, RS_TS_20063, RS_TS_20066, RS_TS_20068, SRS_BSW_00005, SRS_BSW_00006, SRS_BSW_00007, SRS_BSW_00009, SRS_BSW_00010, SRS_BSW_00160, SRS_BSW_00161, SRS_BSW_00162, SRS_BSW_00164, SRS_BSW_00168, SRS_BSW_00170, SRS_BSW_00304, SRS_BSW_00307, SRS_BSW_00308, SRS_BSW_00309, SRS_BSW_00312, SRS_BSW_00314, SRS_BSW_00325, SRS_BSW_00328, SRS_BSW_00334, SRS_BSW_00336, SRS_BSW_00341, SRS_BSW_00342, SRS_BSW_00344, SRS_BSW_00347, SRS_BSW_00353, SRS_BSW_00361, SRS_BSW_00375, SRS_BSW_00378, SRS_BSW_00398, SRS_BSW_00399, SRS_BSW_00400, SRS_BSW_00404, SRS_BSW_00405, SRS_BSW_00413, SRS_BSW_00415, SRS_BSW_00416,SRS_BSW_00417, SRS_BSW_00422, SRS_BSW_00426, SRS_BSW_00427, SRS_BSW_00428, SRS_BSW_00432, SRS_BSW_00433, SRS_BSW_00437, SRS_BSW_00438, SRS_BSW_00439, SRS_BSW_00440, SRS_BSW_00453)