Document Title	Requirements on Time Service
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	623
Document Classification	Auxiliary

Document Status	Final
Part of AUTOSAR Release	4.2.2

Document Change History		
Release	**Changed by**	**Change Description**
4.2.2	AUTOSAR Release Management	• Editorial changes
4.2.1	AUTOSAR Release Management	• New RS_BRF_ feature linked to all requirements
4.1.2	AUTOSAR Release Management	• Editorial changes
4.1.1	AUTOSAR Administration	• Initial release

Disclaimer

This specification and the material contained in it, as released by AUTOSAR, is for the purpose of information only. AUTOSAR and the companies that have contributed to it shall not be liable for any use of the specification.

The material contained in this specification is protected by copyright and other types of Intellectual Property Rights. The commercial exploitation of the material contained in this specification requires a license to such Intellectual Property Rights.

This specification may be utilized or reproduced without any modification, in any form or by any means, for informational purposes only. For any other purpose, no part of the specification may be utilized or reproduced, in any form or by any means, without permission in writing from the publisher.

The AUTOSAR specifications have been developed for automotive applications only. They have neither been developed, nor tested for non-automotive applications.

The word AUTOSAR and the AUTOSAR logo are registered trademarks.

Advice for users

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

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

Table of Contents

1 Scope of Document

This specification defines requirements of the BSW module Time Service.

Constraints

First scope for specification of requirements on basic software modules is systems which are not safety relevant. For implementation of the basic software modules in safety relevant systems, it shall be checked if additional requirements are necessary.

2 Conventions to be used

- The representation of requirements in AUTOSAR documents follows the table specified in [1].

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

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

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

3 Functional Overview

The Time Service module is part of the Services Layer. The module provides services for time based functionality. Use cases are:

- Time measurement

- Time based state machine

- Timeout supervision

- Busy waiting

Several "timer types" - so called "Time Service Predef Timers" - are available, if supported by hardware and enabled by configuration.

Each Predef Timer has a predefined tick duration (physical time unit) and a predefined number of bits (physical range). By this, compatibility of time based functionality is ensured for all platforms which support the required Time Service Predef Timers.

The Time Service Predef Timers are based on so-called "GPT Predef Timers", which are free running hardware timers, provided by the GPT driver.

All services are called by user ("polling mode"). Notifications are not supported.

The Time Service module does <u>not</u> use and distribute all features of the GPT driver. The Time Service module is <u>not</u> the top of a "Timer Stack".

4 Acronyms, abbreviations and terms

The acronyms and abbreviations defined in the table below have a local scope within this document.

Acronym / Abbreviation	Description

Table 1: Acronyms and abbreviations

The terms defined in the table below have a local scope within this document.

Term	Description
GPT Predef Timer	A GPT Predef Timer is a free running up counter provided by the GPT driver. Which GPT Predef Timer(s) are available depends on hardware (clock, hardware timers, prescaler, width of timer register, …) and configuration. A GPT Predef Timer has predefined physical time unit and range.
Time Service Predef Timer	A Time Service Predef Timer is a free running up counter with predefined physical time unit and range. The hardware timer functionality is based on the corresponding GPT Predef Timer. For each Predef Timer a set of API services is provided by the Time Service module. The user can instantiate any timers (only limited by available memory) and can use the instances completely independently of each other.
Timer instance	A timer instance is a data object of an API data type.
Reference time	The reference time is a time value stored for each timer instance.

Table 2: Terms

5 Requirements Specification

5.1 Functional Requirements

5.1.1 General

5.1.1.1 [SRS_Tm_00001] Different types of Predef Timers shall be supported by the Time Service module

[

Type:	Valid
Description:	The following types of Predef Timers shall be supported by the Time Service module: • Timer 1µs16bit • Timer 1µs24bit • Timer 1µs32bit • Timer 100µs32bit
Rationale:	1µs: high resolution timer. 16bit timer: To support 16bit hardware timers. 24bit timer: To support 24bit hardware timers. 32bit timer: To support 32bit hardware timers. 100µs32bit timer: covers automotive use cases (time span 4.9 days)
Use Case:	Time measurement, time based state machine, timeout supervision, busy waiting
Dependencies:	[SRS_BSW_00343] Specification and configuration of time
Supporting Material:	--

](RS_BRF_01408, RS_BRF_01468)

5.1.1.2 [SRS_Tm_00002] The GPT Predef Timers shall be used as time base for the Predef Timers of the Time Service module

[

Type:	Valid
Description:	The GPT Predef Timers shall be used as time base for the Predef Timers of the Time Service module.
Rationale:	The Time Service module has to use a driver module for hardware access
Use Case:	Read current timer value
Dependencies:	--
Supporting Material:	--

](RS_BRF_01408, RS_BRF_01468)

5.1.2 Configuration

5.1.2.1 [SRS_Tm_00003] The Time Service module shall make it possible to configure which Predef Timers are enabled

[

Type:	Valid
Description:	The Time Service module shall make it possible to configure which Predef Timers are enabled. For each enabled Predef Timer a set of API services shall be available: • Reset timer • Get time span • Shift timer • Synchronize timer • Busy waiting, only for 1µs timers
Rationale:	To disable Predef Timers if not needed or related GPT Predef Timers not available.
Use Case:	--
Dependencies:	--
Supporting Material:	--

](RS_BRF_01408, RS_BRF_01468)

5.1.3 Initialization

5.1.4 Normal Operation

5.1.4.1 [SRS_Tm_00004] The Time Service module shall provide a synchronous service to reset a timer instance

[

Type:	Valid
Description:	The Time Service module shall provide a synchronous service for each enabled Predef Timer, to reset a timer instance. By this service a reference time is set, which is needed for further services. The service shall have the following parameter: • Pointer to a timer instance defined by the user
Rationale:	Basic functionality. Due to performance reasons, this service is required for each Predef Timer. A pointer is used (instead of an identifier) for referencing a timer instance to avoid user dependent configuration of module Time Service. So, the service can be used flexibly just like a library service.
Use Case:	Time measurement, time based state machine, timeout supervision, busy waiting
Dependencies:	--
Supporting Material:	--

](RS_BRF_01408, RS_BRF_01056, RS_BRF_01468)

5.1.4.2 [SRS_Tm_00005] The Time Service module shall provide a synchronous service to get the time span

[

Type:	Valid
Description:	The Time Service module shall provide a synchronous service for each enabled Predefined Timer, to get the time span. The time span is the time difference between the reference time and the current point in time. The service shall have the following parameter: • Pointer to a timer instance defined by the user
Rationale:	Basic functionality. Due to performance reasons, this service is required for each Predef Timer. A pointer is used (instead of an identifier) for referencing a timer instance to avoid user dependent configuration of module Time Service. So, the service can be used flexibly just like a library service.
Use Case:	Time measurement, time based state machine, timeout supervision, busy waiting
Dependencies:	--
Supporting Material:	--

](RS_BRF_01408, RS_BRF_01056, RS_BRF_01468)

5.1.4.3 [SRS_Tm_00006] The Time Service module shall provide a synchronous service to shift the reference time of a timer instance

[

Type:	Valid
Description:	The Time Service module shall provide a synchronous service for each enabled Predef Timer, to shift the reference time of a timer instance. Shifting means to add a time value to the reference time to get a new reference time. The service shall have the following parameters: • Pointer to a timer instance defined by the user • Time value which has to be added to the reference time
Rationale:	Extended functionality. Due to performance reasons, this service is required for each Predef Timer. A pointer is used (instead of an identifier) for referencing a timer instance to avoid user dependent configuration of module Time Service. So, the service can be used flexibly just like a library service.
Use Case:	Measurement of the cycle time of a runnable piece of software without loss of accuracy
Dependencies:	--
Supporting Material:	--

](RS_BRF_01408, RS_BRF_01056, RS_BRF_01468)

5.1.4.4 [SRS_Tm_00007] The Time Service module shall provide a synchronous service to synchronize two timer instances

[

Type:	Valid
Description:	The Time Service module shall provide a synchronous service for each enabled Predef Timer, to synchronize two timer instances. Synchronization means to set the reference time of a timer instance "Destination" to the

	reference time of a timer instance "Source". The service shall have the following parameters: • Pointer to a destination timer instance defined by the user • Pointer to a source timer instance defined by the user
Rationale:	Extended functionality. Due to performance reasons, this service is required for each Predef Timer. A pointer is used (instead of an identifier) for referencing a timer instance to avoid user dependent configuration of module Time Service. So, the service can be used flexibly just like a library service.
Use Case:	Measurement of different time stamps (e.g. first call of some tasks) related to the same reference time.
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01408, RS_BRF_01056, RS_BRF_01468)

5.1.4.5 [SRS_Tm_00008] The Time Service module shall provide a synchronous service with tick duration 1µs to perform busy waiting by polling

⌈

Type:	Valid
Description:	The Time Service module shall provide a synchronous service for each enabled Predef Timer with tick duration 1µs to perform busy waiting (active waiting) by polling. The waiting time shall be restricted to 8 bits (255µs) to prevent long time blocking of code execution. The interrupts shall not be disabled, this means the real waiting time may be greater than the desired waiting time. The service shall have the following parameter: • Minimum waiting time
Rationale:	Extended functionality. Due to performance reasons, this service is required for each 1µs Predef Timer. The service can be used flexibly just like a library service. To reduce risk of bad implementation of busy waiting on user software level. To ensure correct waiting time independent of: • CPU speed • Pipeline effects • Cache effects • Access time to memory (bus width, wait states, ...) • Compiler version, compiler options, compiler optimizations
Use Case:	Implementation of drivers (hardware dependant waiting times)
Dependencies:	--
Supporting Material:	--

⌋(RS_BRF_01408, RS_BRF_01056, RS_BRF_01468)

6 References

6.1 Deliverables of AUTOSAR

[1] Software Standardization Template
AUTOSAR_TPS_StandardizationTemplate.pdf

Document ID 623: AUTOSAR_SRS_TimeService