Document Title	Requirements on Safe Hardware Acceleration
Document Category	Requirement specification (RS)
Document UID	1087
Document Status	published
Part of AUTOSAR Standard	Adaptive Platform
Part of Standard Release	R26-11

Document Change History			
Date	**Release**	**Changed by**	**Description**
2026-11-26	R26-11	AUTOSAR Release Management	• Set requirement statuses to valid
2025-11-27	R25-11	AUTOSAR Release Management	• Alignment with new AP SWS SafeHardwareAcceleration
2024-11-27	R24-11	AUTOSAR Release Management	• Initial release

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1 Scope of Document

This document specifies requirements on the functional cluster Safe Hardware Acceleration of the AUTOSAR Adaptive Platform. The motivation is to provide a standardized and portable way to utilize hardware acceleration for safe and efficient computations.

2 Conventions to be used

The representation of requirements in AUTOSAR documents follows the table specified in [TPS_STDT_00078], see [1, Standardization Template].

The verbal forms for the expression of obligation specified in [TPS_STDT_00053] shall be used to indicate requirements, see [1, Standardization Template].

2.1 Requirements Guidelines

The requirements for the functional cluster Safe Hadware Acceleration should consider AUTOSAR Safety Requirements [2].
Currently there are no other guidelines.

3 Acronyms and abbreviations

The glossary below includes acronyms, abbreviations and terms relevant to the current document that are not included in the AUTOSAR TR Glossary [3].

Abbreviation / Acronym:	Description:
DSP	Digital signal processor.
FPGA	Field programmable gate array.
GPU	Graphics processing unit.
HPC	High performance computing.
HWA	Hardware Accelerator.
SHWA	Safe Hardware Acceleration functional cluster in AUTOSAR Adaptive platform.

Table 3.1: Acronyms and abbreviations used in the scope of this Document

Term:	Description:
Asynchronous error	The error happens independently of user program like an error in hardware. This type of error should be caught and handled by specific error handler when they occurr.
Hardware Accelerator	A computer hardware designed to perform specific functions more efficiently when compared to software running on a general-purpose central processing unit (CPU). Examples of such devices are GPU, FPGA, DSP etc.
Host device	A device that is charged with controlling other devices. It is able to run code that can offload some of the processing to a dedicated hardware unit(hardware accelerator). Usually it is a general-purpose central processing unit (CPU) in heterogeneous systems.
Synchronous error	The error which happens when a problem is while processing the user program. Synchronous errors are categorized as programming errors and access errors. This type of error should be handled in place where they occurred.

Table 3.2: Terms used in the scope of this document

4 Requirements Specification

This chapter describes all requirements driving the work to define the functional cluster Safe Hardware Acceleration. The functional cluster Safe Hardware Acceleration will be referenced as SHWA in the remainder of this document.

4.1 Functional Overview

The AUTOSAR Adaptive Platform SHWA provides APIs for Adaptive Applications and other functional clusters of the AUTOSAR Adaptive Platform. The AUTOSAR Adaptive Platform SHWA is responsible for the aspects related to parallel computations considering safety rules and restrictions of the Adaptive Platform.

- Making heavy computations efficient by performing computations in parallel(simultaneous multi-core computation on the HWA).
- Error detection and correction of the tasks executed on the HWA.
- Monitoring hardware accelerators working states.

4.2 Functional Requirements

[RS_SHWA_00001] SHWA Operations Execution on Hardware Accelerator ⌈

Description:	SHWA shall support execution of operations needed for Adaptive Application on Hardware accelerator.
Rationale:	Adaptive Application needs to perform dedicated operations on hardware accelerator to improve efficiency.
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00002] SHWA Data Exchange with Hardware Accelerators ⌈

Description:	SHWA shall support mechanisms of data exchange between Adaptive application and Hardware accelerator within the same ECU.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00003] SHWA Hardware Resources Restrictions ⌈

Description:	SHWA shall support mechanisms of configuration of Hardware accelerator resources allowed for use.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00004] Hardware Accelerator Runtime State Monitoring ⌈

Description:	SHWA shall support mechanisms to monitor the state of the Hardware accelerator in runtime.
Rationale:	Adaptive Application needs to make a decision if it's safe to execute planned operations.
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00005] Timeout-based Blocking Operations Cancellation Mechanism ⌈

Description:	SHWA shall provide timing control of blocking mechanisms.
Rationale:	Disallow suspend of Adaptive Application process or its threads for undetermined period of time.
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00006] Hardware Accelerator Type Selection ⌈

Description:	SHWA shall support mechanisms for selecting Hardware accelerator type on the Host machine.
Rationale:	Application needs to use the most appropriate Hardware accelerator type for the intended task.
Dependencies:	–
Use Case:	Adaptive Application wants to execute its specific operations on FPGA.
Supporting Material:	–

⌋

[RS_SHWA_00007] Synchronous Errors Handling Mechanism ⌈

Description:	SHWA shall provide error handling mechanisms for **synchronous errors**. (See chapter 3.Acronyms and abbreviations, Table 3.2: Terms used in the scope of this document).
Rationale:	The error which may occur immediately after function call, resulting in a specific error code being returned. The error occurs in the same thread where function was invoked and has to be handled in the same thread.
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00008] Asynchronous Error Handling Mechanism ⌈

Description:	SHWA shall provide error handling mechanisms for **asynchronous errors**. (See chapter 3.Acronyms and abbreviations, Table 3.2: Terms used in the scope of this document).
Rationale:	The error which can occur at any moment of time, independently of previous function calls time. This type of error occurs in the other threads. Therefore, should be caught and handled in any thread.
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00009] Data Integrity Support ⌈

Description:	If the operation sent to the Hardware Accelerator fails, SHWA shall guarantee that application data remains unchanged or appropriate error should be returned to the application to inform about data invalidation.
Rationale:	Adaptive Application needs to be confident that the data it operates using SHWA is valid.
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00010] Allocated Resources Clean Up ⌈

Description:	SHWA shall support mechanisms to release allocated resources on the Hardware Accelerator.
Rationale:	Adaptive Application offloads Hardware accelerator and other allocated resources like RAM when they are not needed anymore.

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△

Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00012] Initialization and Shutdown ⌈

Description:	SHWA shall support central initialization and shutdown.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00013] Memory Allocation ⌈

Description:	SHWA shall support memory allocation on the host and hardware accelerator.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00014] Device Properties ⌈

Description:	SHWA shall support mechanism to check used device properties and capabilities.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00015] Device Abstraction ⌈

Description:	SHWA shall support abstraction for used compute device.
Rationale:	–
Dependencies:	–
Use Case:	–

▽

△

Supporting Material:	–

⌋

[RS_SHWA_00016] Event-based Synchronization ⌈

Description:	SHWA shall support event-based task execution synchronization between HWA and Host application.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00017] Data Access ⌈

Description:	SHWA shall support data access mechanisms for reading and modification.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

[RS_SHWA_00018] Environment Information ⌈

Description:	SHWA shall support mechanisms for retrieving software and hardware environment information.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

4.3 Non-Functional Requirements

[RS_SHWA_00011] SHWA multi-processing ⌈

Description:	Objects created by SHWA shall be always local to one `Process`.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋

5 References

[1] Standardization Template
AUTOSAR_FO_TPS_StandardizationTemplate

[2] Safety Requirements for AUTOSAR Adaptive Platform and AUTOSAR Classic Platform
AUTOSAR_FO_RS_Safety

[3] Glossary
AUTOSAR_FO_TR_Glossary

A Appendix

There is no content.

B Change history of AUTOSAR traceable items

B.1 Change History of this document according to AUTOSAR Release R26-11

B.1.1 Added Requirements in R26-11

none

B.1.2 Changed Requirements in R26-11

none

B.1.3 Deleted Requirements in R26-11

none

B.2 Change History of this document according to AUTOSAR Release R25-11

B.2.1 Added Requirements in R25-11

Number	Heading
[RS_SHWA_00011]	SHWA multi-processing
[RS_SHWA_00012]	Initialization and Shutdown
[RS_SHWA_00013]	Memory Allocation
[RS_SHWA_00014]	Device Properties
[RS_SHWA_00015]	Device Abstraction
[RS_SHWA_00016]	Event-based Synchronization
[RS_SHWA_00017]	Data Access
[RS_SHWA_00018]	Environment Information

Table B.1: Added Requirements in R25-11

B.2.2 Changed Requirements in R25-11

Number	Heading
[RS_SHWA_00001]	SHWA Operations Execution on Hardware Accelerator
[RS_SHWA_00007]	Synchronous Errors Handling Mechanism
[RS_SHWA_00009]	Data Integrity Support
[RS_SHWA_00010]	Allocated Resources Clean Up

Table B.2: Changed Requirements in R25-11

B.2.3 Deleted Requirements in R25-11

none

B.3 Change History of this document according to AUTOSAR Release R24-11

B.3.1 Added Requirements in R24-11

Number	Heading
[RS_SHWA_00001]	SHWA Operations Execution on Hardware Accelerator
[RS_SHWA_00002]	SHWA Data Exchange with Hardware Accelerators
[RS_SHWA_00003]	SHWA Hardware Resources Restrictions
[RS_SHWA_00004]	Hardware Accelerator Runtime State Monitoring
[RS_SHWA_00005]	Timer-based Blocking Operations Cancellation Mechanism
[RS_SHWA_00006]	Hardware Accelerator Type Selection
[RS_SHWA_00007]	Synchronous Errors Handling Mechanism
[RS_SHWA_00008]	Asynchronous Error Handling Mechanism
[RS_SHWA_00009]	Safe State Recovery Mechanism
[RS_SHWA_00010]	Allocated Resources Explicit Clean Up

Table B.3: Added Requirements in R24-11

B.3.2 Changed Requirements in R24-11

none

B.3.3 Deleted Requirements in R24-11

none