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Contents

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 Standardization Template, chapter Support for Traceability ([1]).

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

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

Status: DRAFT

Upstream requirements: RS_Main_00002

⌈

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

Status: DRAFT

⌈

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

Status: DRAFT

⌈

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

Status: DRAFT

⌈

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] Timer-based Blocking Operations Cancellation Mechanism

Status: DRAFT

⌈

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

Status: DRAFT

⌈

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

Status: DRAFT

⌈

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 can occur immediately after function call, getting specific error code. 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

Status: DRAFT

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] Safe State Recovery Mechanism

Status: DRAFT

Description:	If the operation sent to the Hardware Accelerator fails, then SHWA shall be able to restore the application data to its state prior to the execution attempt.
Rationale:	Adaptive Application needs to be confident that its state will not be altered in case of operation fail on Hardware accelerator.
Dependencies:	–
Use Case:	–
Supporting Material:	–

[RS_SHWA_00010] Allocated Resources Explicit Clean Up

Status: DRAFT

Description:	SHWA shall provide 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.
Dependencies:	–
Use Case:	–
Supporting Material:	–

4.3 Non-Functional Requirements

The SHWA currently does not have any non-functional requirements.

5 Requirements Tracing

The following table references the features specified in [4] and links to the fulfillments of these.

Requirement	Description	Satisfied by
[RS_Main_00002]	AUTOSAR shall provide a software platform for high performance computing platforms	[RS_SHWA_00001]

Table 5.1: Requirements Tracing

6 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

[4] Main Requirements
AUTOSAR_FO_RS_Main

A Appendix

There is no content.

B Change history of AUTOSAR traceable items

B.1 Change History of this document according to AUTOSAR Release R24-11

B.1.1 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.1: Added Requirements in R24-11

B.1.2 Changed Requirements in R24-11

B.1.3 Deleted Requirements in R24-11