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Disclaimer

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1 Scope of Document

This document specifies requirements on Platform Health Management. Platform Health Management implements the Platform Health Monitoring on the AUTOSAR Adaptive Platform.

2 Conventions to be used

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

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

3 Acronyms and abbreviations

The glossary below includes acronyms and abbreviations relevant to the specification or implementation of Health Monitoring that are not included in the [2, AUTOSAR glossary].

Abbreviation:	Description:
CM	AUTOSAR Adaptive Communication Management
DM	AUTOSAR Adaptive Diagnostic Management
PHM	Platform Health Management
SE	Supervised Entity

Acronym:	Description:
Alive Counter	An independent data resource in context of a Checkpoint to track and handle its amount of Alive Indications.
Alive Indication	An indication of a Supervised Entity to signal its aliveness by calling a checkpoint used for Alive Supervision.
Alive Supervision	Mechanism to check the timing constraints of cyclic Supervised Entities to be within the configured min and max limits.
Checkpoint	A point in the control flow of a Supervised Entity where the activity is reported.

Deadline End Checkpoint	A Checkpoint for which `Deadline Supervision` is configured and which is a ending point for a particular Transition. It is possible that a Checkpoint is both a Deadline Start Checkpoint and Deadline End Checkpoint - if `Deadline Supervision` is chained.
Deadline Start Checkpoint	A Checkpoint for which `Deadline Supervision` is configured and which is a starting point for a particular Transition.
Deadline Supervision	Mechanism to check that the timing constraints for execution of the transition from a to a corresponding are within the configured min and max limits.
Expired Supervision Cycle	A Supervision Cycle where the `Alive Supervision` has failed its two escalation steps (Alive Counter fails the expected amount of Alive Indications (including tolerances) more often than the allowed amount of failed reference cycles).
Failed Supervision Reference Cycle	A Supervision Reference Cycle that ends with a detected deviation (including tolerances) between the Alive Counter and the expected amount of Alive Indications.
Global Supervision Status	Status that summarizes the Local Supervision Status of all Supervised Entities of a software subsystem.
Graph	A set of Checkpoints connected through Transitions, where at least one of Checkpoints is an Initial Checkpoint and there is a path (through Transitions) between any two Checkpoints of the Graph.
Health Channel	Channel providing information about the health status of a (sub)system. This might be the Global Supervision Status of an application, the result any test routine or the status reported by a (sub)system (e.g. voltage monitoring, OS kernel, ECU status, ...).
Health Channel Supervision	Kind of supervision that checks if the health indicators registered by the supervised software are within the tolerances/limits.
Health Monitoring	Supervision of the software behaviour for correct timing and sequence.
Health Status	A set of states that are relevant to the supervised software (e.g. the Global Supervision Status of an application, a Voltage State, an application state, the result of a RAM monitoring algorithm).
Logical Supervision	Kind of online supervision of software that checks if the software (Supervised Entity or set of Supervised Entities) is executed in the sequence defined by the programmer (by the developed code).

Local Supervision Status	Status that represents the current result of Alive Supervision, Deadline Supervision and Logical Supervision of a single Supervised Entity.
Platform Health Management	Health Monitoring for the Adaptive Platform
Supervised Entity	A software entity which is included in the supervision. A Supervised Entity denotes a collection of Checkpoints within an application. There may be zero, one or more Supervised Entities in an application. A Supervised Entity may be instantiated multiple times, in which case each instance is independently supervised.
Supervised Entity Identifier	An Identifier that identifies uniquely a Supervised Entity within an Application.
Supervision Counter	An independent data resource in context of a Supervised Entity which is updated during each supervision cycle and which is used by the Alive Supervision algorithm to perform the check against counted Alive Indications.
Supervision Cycle	The time period in which the cyclic Alive Supervision is performed.
Supervised Entity	A software entity which is included in the supervision. A Supervised Entity denotes a collection of Checkpoints within a software component. There may be zero, one or more Supervised Entities in a Software Component. A Supervised Entity may be instantiated multiple times, in which case each instance is independently supervised.
Supervision Mode	An overall state of a microcontroller or virtual machine. Modes are mutually exclusive and all Supervised Entities are in the same Supervision Mode. A mode can be e.g. Startup, Shutdown, Low power.
Supervision Reference Cycle	The amount of Supervision Cycles to be used as reference by the Alive Supervision to perform the check of counted Alive Indications (individually for each Supervised Entity).

Table 3.1: Acronyms

4 Requirements Specification

This chapter describes all requirements driving the work to define the Platform Health Management.

4.1 Functional Overview

See SWS Health Monitoring [3] for the overview of the functionality.

This document specifies the requirements regarding the realization of the Health Monitoring on Adaptive Platform. This includes:

- Standardized interfaces
- Mapping of abstract functionalities/concepts defined in Foundation to entities in Adaptive Platform.

4.2 Functional Requirements

4.2.1 Supervision functions

[RS_PHM_00101] Platform Health Management shall provide a standardized C++ interface for the reporting of Checkpoints. ⌈

Type:	draft
Description:	Platform Health Management shall provide a standardized C++ interface for the reporting of Checkpoints.
Rationale:	Checkpoints are locations inside the code of Supervised Entitys. Platform Health Management checks that these locations are reached in correct time and order. Therefore Platform Health Management needs to be informed when a Checkpoint is reached.
Dependencies:	
Use Case:	Reporting of reached code locations for Alive Supervision, Deadline Supervision and Logical Supervision.
Supporting Material:	

⌋*(RS_Main_00330, RS_Main_00011)*

[RS_PHM_00102] Platform Health Management shall provide a standardized C++ interface for the reporting of Health Channel. ⌈

Type:	draft
Description:	Platform Health Management shall provide a standardized C++ interface for the reporting of Health Channel.
Rationale:	A Health Channel is a channel for passing external supervision results (e.g. from RAM test, voltage monitoring, ...) to Platform Health Management. Therefore Platform Health Management needs to be informed the status of Health Channels.
Dependencies:	
Use Case:	Reporting of Global Supervision Status, results of test routines or status of (sub)systems (e.g. voltage monitoring, OS kernel, ECU status).
Supporting Material:	

⌋*(RS_Main_00330, RS_Main_00011)*

[RS_PHM_00103] `Platform Health Management` functionality shall be able to be available within the same process and as a separate one. ⌈

Type:	draft
Description:	PHM functionality shall be able to be available, with respect to the monitored process, as: • library component executed in the context of the monitored process • a separate process in the same OS or in the same machine
Rationale:	
Dependencies:	
Use Case:	Local monitoring is necessary within the same process for efficiency reasons. Monitoring is also needed in another process for achieving independence. This means the reporting of checkpoints or reporting of health channel status do not cross the boundaries of the OS/VM.
Supporting Material:	

⌋(*RS_Main_00410*)

4.2.2 Mapping of `Supervised Entitys` to threads and processes

[RS_PHM_00104] `Platform Health Management` shall realize the Supervision Mode as a tuple of `Execution Management states`. ⌈

Type:	draft
Description:	`Platform Health Management` shall realize the `Supervision Mode` as a tuple <`machine state`, `function group state`, `application state`>.
Rationale:	There is no need to specify the abstract `Supervision Mode` in the configuration or in the standardized interface. `Supervision Mode` is an abstract concept and it is realized by those three states, so they need to be used.
Dependencies:	
Use Case:	Depending on those three states, the behavior of processes is different, so the supervision functions need to perform differently.
Supporting Material:	

⌋(*RS_Main_00049*)

[RS_PHM_00105] `Platform Health Management` shall support different allocations/distributions of a `Supervised Entity` through threads and processes. ⌈

Type:	draft

Description:	Platform Health Management shall support the following Supervised Entities: • A Supervised Entity belonging to one thread • A Supervised Entity spread across several threads of the same process • A Supervised Entity spread accross different processes
Rationale:	Algorithms can be executed in one thread, multiple threads or processes. It must be possible to supervise a whole algorithm.
Dependencies:	
Use Case:	Supervision of the global flow of algorithms distributed to multiple threads or processes.
Supporting Material:	

⌋(*RS_Main_00410*, *RS_Main_00460*)

[RS_PHM_00106] Platform Health Management shall support allocating of multiple Supervised Entitys to the same process or thread. ⌈

Type:	draft
Description:	Platform Health Management shall support allocating of multiple Supervised Entitys to the same process or thread
Rationale:	It shall be possible to define separate Supervised Entitys for different supervision functionalities or for subfunctions within the same process or thread
Dependencies:	
Use Case:	Separate Supervised Entitys for Alive Supervision and Logical Supervision of the same thread.
Supporting Material:	

⌋(*RS_Main_00501*, *RS_Main_00460*)

[RS_PHM_00107] Platform Health Management shall support multiple instantiation. ⌈

Type:	draft
Description:	Platform Health Management shall support: • multiple instantiation of the same executable (resulting with several processes) • multiple instantiation of threads (performing the same action) in an executable • static and dynamic libraries executed in different context • services/servers that can be concurrently invoked by different clients.
Rationale:	The Health Status shall be collected and passed between multiple instances by daisy chaining.
Dependencies:	

Use Case:	Collect and validate the `Health Status` reported by the instance(s) on one or multiple microcontroller(s)/cores by another instance running on a separate controller for safety supervisions.
Supporting Material:	

⌋(*RS_Main_00460*)

4.2.3 Daisy chaining

[RS_PHM_00108] `Platform Health Management` shall provide a standardized interface between `Platform Health Management` components used in a daisy chain. ⌈

Type:	draft
Description:	`Platform Health Management` shall provide a standardized interface between `Platform Health Management` components used in a daisy chain.
Rationale:	
Dependencies:	
Use Case:	The components are possibly provided by different vendors, working on different microcontrollers or virtual machines. On each controller or (virtual) machine a separate instance of `Platform Health Management` might be used and it should be possible to operate these instances in a daisy chain.
Supporting Material:	

⌋(*RS_Main_00511*, *RS_Main_00190*)

[RS_PHM_00109] `Platform Health Management` shall provide the `daisy chaining` interface over `ara::com`. ⌈

Type:	draft
Description:	`Platform Health Management` shall provide the `daisy chaining` interface over at least `ara::com`.
Rationale:	
Dependencies:	
Use Case:	The `Platform Health Management` is possibly provided by different vendors, working on different microcontrollers or virtual machines. On each controller or (virtual) machine a separate instance of `Platform Health Management` might be used and it should be possible to operate these instances in a daisy chain. Note: Providing the `ara::com` is mandatory for each implementation `Platform Health Management`, but it is also possible to add more efficient implementations locally.
Supporting Material:	

⌋(*RS_Main_00511*, *RS_Main_00190*)

4.2.4 Interaction with other `functional clusters`

[RS_PHM_00110] `Platform Health Management` shall invoke the interfaces of `Execution Management` and `State Management`. ⌈

Type:	draft
Description:	`Platform Health Management` shall invoke the interfaces of `Execution Management` and `State Management` in order to request error reactions: • notification about the need to restart of a process / request to restart it • request to go to another `machine state`, `function group state` or `application state` • request to reenter properly the current `machine state`, `function group state` or `application state`.
Rationale:	Error reactions on failures detected by `Platform Health Management` might change the state of an `application` or require the restart of a process.
Dependencies:	
Use Case:	Restart of a process after `Platform Health Management` detected an unrecoverable error.
Supporting Material:	

⌋(*RS_Main_00011*, *RS_Main_00049*)

4.3 Non-Functional Requirements (Qualities)

[RS_PHM_00001] The `Platform Health Management` shall provide a standardized header file structure for each service. ⌈

Type:	draft
Description:	The `Platform Health Management` shall provide a standardized header file structure for each service. The application uses the standardized header files which are independent of the underlying implementation.
Rationale:	The application code shall be reusable for different AUTOSAR Adaptive platform implementations.
Dependencies:	–
Use Case:	The application developers implement their code against the standardized header files.
Supporting Material:	–

⌋(*RS_Main_00060*)

[RS_PHM_00002] The service header files shall define the namespace for the respective service. ⌈

Type:	draft
Description:	The service header files shall define the namespace for the respective service to uniquely identify each service instance.

Rationale:	The application code shall be reusable for different AUTOSAR Adaptive platform implementations and for different vehicle lines.
Dependencies:	–
Use Case:	To avoid conflicts with other applications and other services, each service shall have its own namespace.
Supporting Material:	–

⌋(*RS_Main_00060*)

[RS_PHM_00003] The `Platform Health Management` shall define how language specific data types are derived from modeled data types. ⌈

Type:	draft
Description:	The `Platform Health Management` shall define how language specific data types, e.g. C++ data types, are derived from modeled data types.
Rationale:	The `Platform Health Management` shall support different language bindings.
Dependencies:	–
Use Case:	The Health Management supports C++ language binding and therefore has to define the modeled data types in C++.
Supporting Material:	–

⌋(*RS_Main_00060*)

5 Requirements Tracing

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

Feature	Description	Satisfied by
[RS_Main_00011]	AUTOSAR shall support the development of reliable systems	[RS_PHM_00101] [RS_PHM_00102] [RS_PHM_00110]
[RS_Main_00049]	AUTOSAR shall provide an Execution Management for running multiple applications	[RS_PHM_00104] [RS_PHM_00110]
[RS_Main_00060]	AUTOSAR shall provide a standardized software interface for communication between Applications	[RS_PHM_00001] [RS_PHM_00002] [RS_PHM_00003]
[RS_Main_00190]	AUTOSAR shall support standardized interoperability with non-AUTOSAR software	[RS_PHM_00108] [RS_PHM_00109]
[RS_Main_00330]	No description	[RS_PHM_00101] [RS_PHM_00102]
[RS_Main_00410]	AUTOSAR shall provide specifications for routines commonly used by Application Software to support sharing and optimization	[RS_PHM_00103] [RS_PHM_00105]
[RS_Main_00460]	AUTOSAR shall standardize methods to organize mode management on Application, ECU and System level	[RS_PHM_00105] [RS_PHM_00106] [RS_PHM_00107]
[RS_Main_00501]	AUTOSAR shall support redundancy concepts	[RS_PHM_00106]
[RS_Main_00511]	AUTOSAR shall support virtualization	[RS_PHM_00108] [RS_PHM_00109]

6 References

[1] System Template
AUTOSAR_TPS_SystemTemplate

[2] Glossary
AUTOSAR_TR_Glossary

[3] Specification of Health Monitoring
AUTOSAR_SWS_HealthMonitoring

[4] Main Requirements
AUTOSAR_RS_Main