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Document Change History

Date	**Release**	**Changed by**	**Description**
2024-11-27	R24-11	AUTOSAR Release Management	• Fixed uptraces to SRS ModeManagement • Editorial changes
2023-11-23	R23-11	AUTOSAR Release Management	• Editorial changes
2022-11-24	R22-11	AUTOSAR Release Management	• Editorial changes
2021-11-25	R21-11	AUTOSAR Release Management	• Resolved inconsistency regarding determination of Supervised Entity ID values, between SWS WdgM and TPS • Set “Partition Restart / Shutdown” feature to obsolete • Removed the redundant parameter WdgMDemStoppedSupervisionReport • Extended to support supervision for Clustered Software Architecture (Classic Platform Flexibility), incl. support of multiple main functions

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2020-11-30	R20-11	AUTOSAR Release Management	• Clarified the meaning of thresholds WdgMDeadlineMin and WdgMDeadlineMax • Updated the structure and tables of the error sections • Editorial/Minor Corrections
2019-11-28	R19-11	AUTOSAR Release Management	• Enhancement of Deadline Supervision to support timeout detection • Correction/Clarification of supervision Algorithms and their configurations • Clarification of startup behavior (incl. failed WdgIf_SetMode during init) • Corrected/Changed/added Error Codes and other editorial issues • Changed Document Status from Final to published
2018-10-31	4.4.0	AUTOSAR Release Management	• Header File cleanup • EcuPartition vs. OSApplication • Editorial changes
2017-12-08	4.3.1	AUTOSAR Release Management	• Correction in development errors. • Renaming of default error to development errors.
2016-11-30	4.3.0	AUTOSAR Release Management	• Deprecated features removed • Service interfaces modified/corrected • Removed duplicate type definitions • Several minor fixes.
2015-07-31	4.2.2	AUTOSAR Release Management	• Debugging support marked as obsolete • Several minor fixes • Fixed handling of development errors.
2014-10-31	4.2.1	AUTOSAR Release Management	• Introduced modeling of system services • Reformulated some requirements to constraints • Minor corrections

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2014-03-31	4.1.3	AUTOSAR Release Management	• Addition of the OS counters for deadline monitoring • Fixed data types for Supervised Entity and Checkpoints (uint16) • Several minor corrections throughout the document
2013-10-31	4.1.2	AUTOSAR Release Management	• Minor fixes (mode switching, dependencies to other modules) • Quality corrections in the document (e.g.formatting of requirements) • Editorial changes • Removed chapter(s) on change documentation
2013-03-15	4.1.1	AUTOSAR Administration	• Reworked according to the new SWS_BSWGeneral • New indexing scheme for requirements • Clarification in Deadline Supervision • Minor corrections in Specification of the Ports and Port Interfaces • Include file structure changed. • Added a method to read after restart which SE caused the reset: WdgM_GetFirstExpiredSEID. • New template with requirements traceability
2011-12-22	4.0.3	AUTOSAR Administration	• Streamlined the used terms • Reorganized the structure of some chapters • Clarified ambigous statements and resolved contradicting ones • Corrected several bugs • Provided more details what WdgM functions do and in which sequence

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2010-09-30	3.1.5	AUTOSAR Administration	• New concept of windowed watchdogs • New supervision functions, Logical Supervision and Deadline Supervision • Split of the supervision status into local and global supervision status • New concept for activation and deactivation of supervision • New concept of Defensive Behavior • New failure recovery concept for partition (application) restart • Legal disclaimer revised
2008-08-13	3.1.1	AUTOSAR Administration	• Legal disclaimer revised
2007-12-21	3.0.1	AUTOSAR Administration	• Extended mode concept • Added GPT as activation source for operating during Startup, Shutdown and Sleep • Restructure module configuration • Generated APIs from BSW UML module • Generated configuration from Meta Model • Document meta information extended • Small layout adaptations made
2007-01-24	2.1.15	AUTOSAR Administration	• New chapter “Specification of the ports and port interfaces” added from “AUTOSAR Services” document • New featured added added : active reset as optional behavior • New behavior of Deinit function : triggering of the Watchdog Driver added • Default mode for the Watchdog Manager when SetMode service fails • Legal disclaimer revise • Release notes added ▽

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			△ • “Advice for users” revised • “Revision Information” added
2006-05-16	2.0	AUTOSAR Administration	• Initial Release

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Contents

1 Introduction and functional overview

The Watchdog Manager is a basic software module at the service layer of the standardized basic software architecture of AUTOSAR.

The Watchdog Manager is able to supervise the program execution abstracting from the triggering of hardware watchdog entities.

The Watchdog Manager supervises the execution of a configurable number of so-called Supervised Entities. When it detects a violation of the configured temporal and/or logical constraints on program execution, it takes a number of configurable actions to recover from this failure.

The Watchdog Manager provides three mechanisms:

1. Alive Supervision – for supervision of timing of periodic software
2. Deadline Supervision – for supervision of timing of aperiodic software
3. Logical Supervision – for supervision of the correctness of the execution sequence.

1.1 Supervised Entities and Checkpoints

The Watchdog Manager supervises the execution of software. The logical units of supervision are Supervised Entities. There is no fixed relationship between Supervised Entities and the architectural building blocks in AUTOSAR, i.e., SW-Cs, CDDs, RTE, BSW modules, but typically a Supervised Entity may represent one SW-C Prototype or one or more Runnable Entities within a SW-C Prototype, a BSW module instance or CDD instance depending on the choice of the developer.

Important places in a Supervised Entity are defined as Checkpoints. The code of Supervised Entities is interlaced with the calls of Watchdog Manager that report to the Watchdog Manager when they have reached a Checkpoint.

Each Supervised Entity has one or more Checkpoints. The Checkpoints and Transitions between the Checkpoints of a Supervised Entity form a Graph. This Graph is called Internal Graph. Moreover, Checkpoints from different Supervised Entities may also be connected by External Transition, forming an External Graph. There can be several External Graphs in each Watchdog Manager Mode.

A Graph may have one or more Initial Checkpoints and one or more Final Checkpoints. Any sequence of starting with any Initial Checkpoint and finishing with any Final Checkpoint is correct (assuming that the Checkpoints belong to the same Graph). After the Final Checkpoint, any Initial Checkpoint can be reported.

Within the Watchdog Manager configurations, it is possible to configure the required timing of Checkpoints as well as the allowed External and Internal Graphs.

At runtime, Watchdog Manager verifies if the configured Graphs are executed. This is called Logical Supervision. Watchdog Manager also verifies the timing of Checkpoints and Transitions. The mechanism for periodic Checkpoints is called Alive Supervision and for aperiodic Checkpoints it is called Deadline Supervision.

The granularity of Checkpoints is not fixed by the Watchdog Manager. Few coarse-grained Checkpoints limit the detection abilities of the Watchdog Manager. For example, if an application SW-C only has one Checkpoint that indicates that a cyclic Runnable has been started, then the Watchdog Manager is only capable of detecting that this Runnable is re-started and check the timing constraints. In contrast, if that SW-C has Checkpoints at each block and branch in the Runnable the Watchdog Manager may also detect failures in the control flow of that SW-C. High granularity of Checkpoints causes a complex and large configuration of the Watchdog Manager.

1.2 Interaction of Supervision Mechanisms

The three supervision mechanisms supervise each Supervised Entity. A Supervised Entity may have one, two or three mechanisms enabled. Based on the results from each of enabled mechanisms, the status of the Supervised Entity (called Local Supervision Status) is computed.

When the status of each Supervised Entity is determined, then based on each Local Supervision Status, the status of the whole MCU is determined (called Global Supervision Status).

1.3 Supervision Functions

1.3.1 Alive Supervision

Periodic Supervised Entities have constraints on the number of times they are executed within a given time span. By means of Alive Supervision, Watchdog Manager checks periodically if the Checkpoints of a Supervised Entity have been reached within the given limits. This means that Watchdog Manger checks if a Supervised Entity is run not too frequently or not too rarely.

1.3.2 Deadline Supervision

Aperiodic or episodical Supervised Entities have individual constraints on the timing between two Checkpoints. By means of Deadline Supervision, Watchdog Manager checks the timing of transitions between two Checkpoints of a Supervised Entity. This means that Watchdog Manager checks if some steps in a Supervised Entity take a time that is within the configured minimum and maximum values. Watchdog Manager also detects no arrival to the second Checkpoint.

1.3.3 Logical Supervision

Logical Supervision is a fundamental technique for checking the correct execution of embedded system software. Please refer to the safety standards (IEC 61508 [1] or ISO 26262 [2]) when Logical Supervision is required.

Logical Supervision focuses on control flow errors, which cause a divergence from the valid (i.e. coded/compiled) program sequence during the error-free execution of the application. An incorrect control flow occurs if one or more program instructions are processed either in the incorrect sequence or are not even processed at all. Control flow errors can lead to data corruption, microcontroller resets, or fail-silence violations.

For the Control Flow Graph this implies that every time the Supervised Entity reports a new Checkpoint, it must be verified that there is a Transition configured between the previous Checkpoint and the reported one.

1.4 Watchdog Handling

Watchdog Manager communicates with Watchdog Interface to control the hardware watchdog.

In contrast to versions before R4.0.1, the Watchdog Manager is no longer responsible for triggering the hardware watchdog via the Watchdog Interface and the Watchdog Driver. Instead, the Watchdog Manager reports via the Watchdog Interface a triggering condition to the Watchdog Driver. The Watchdog Driver is then responsible for triggering the hardware watchdog with the right timing for as long as the condition is true. The triggering condition is a counter value that the Watchdog Manager sets cyclically. The Watchdog Driver decrements this counter every time it triggers the hardware watchdog. When the counter reaches 0, the Watchdog Driver stops triggering the hardware watchdog. Therefore, when the Watchdog Manager fails to execute, this automatically causes a watchdog reset (after the time needed to decrement the counter plus the timeout value of HW watchdog).

When the Supervised Entities are not correctly evaluated due to a programming error or memory failure in the Watchdog Manager itself, it may still happen that the Watchdog Manager erroneously sets the triggering condition and no watchdog reset will be caused. Therefore, it may be needed to use Supervised Entities and Checkpoints (or some other internal supervision mechanism) within Watchdog Manager itself, while avoiding recursion in Watchdog Manager.

1.5 Error Handling

Depending on the Local Supervision Status of each Supervised Entity and on the Global Supervision Status, the Watchdog Manager initiates a number of mechanisms to recover from supervision failures. These range from local error recovery within the Supervised Entity to a global reset of the ECU.

1.5.1 Error Handling in the Supervised Entity

In case the Supervised Entity is an SW-C or a CDD, then the Watchdog Manager may inform the Supervised Entity about supervision failures via the RTE Mode mechanism. The Supervised Entity may then take its actions to recover from that failure.

The Watchdog Manager may register an entry with the Diagnostic Event Manager (DEM) when it detects a supervision failure. A Supervised Entity may take recovery actions based on that error entry.

1.5.2 Reset by Hardware Watchdog

The Watchdog Manager indicates to the Watchdog Interface when Watchdog Interface shall no longer trigger the hardware watchdog. After the timeout of the hardware watchdog, the hardware watchdog resets the ECU or the MCU. This leads to a re-initialization of the ECU and/or MCU hardware and the complete reinitialization of software.

1.5.3 Immediate MCU Reset

In case an immediate, global reaction to the supervision failure is necessary, the Watchdog Manager may directly cause an MCU reset. This will lead to a re-initialization of the MCU hardware and the complete software. Usually, a MCU reset will not re-initialize the rest of the ECU hardware.

Note that a MCU reset is not available on some types of micro controllers.

MCU reset and watchdog reset are two mostly equivalent mechanisms for system-level error reaction. In safety-related systems, it is recommended to use both of them in parallel. By this means, the two mechanisms make a “redundant shutdown path”.

2 Acronyms and Abbreviations

Abbreviation / Acronym:	Description:
AI	Alive Indication
BSW	Basic Software
BswM	Basic Software Mode Manager
DEM	Diagnostic Event Manager
DET	Default Error Tracer
EAI	Expected Alive Indications
EcuM	ECU State Manager
FiM	Function Inhibition Manager
HW	Hardware
ID	Identifier
MCU	Micro Controller Unit
OS	Operating System
SC	Supervision Cycle
SE	Supervised Entity
SRC	Supervision Reference Cycle
SW-C	Software Component
RTE	Runtime Environment
WdgM	Watchdog Manager

Table 2.1: Acronyms and abbreviations used in the scope of this Document

Term:	Description:
Alive Counter	An independent data resource in the Watchdog Manager in context of a `Checkpoint` to track and handle its amount of Alive Indications.
Alive Indication	An indication provided by a `Checkpoint` of a Supervised Entity to signal its aliveness to the Watchdog Manager.
Alive Supervision	Kind of supervision that checks if a Supervised Entity executed sufficiently often and not too often (including tolerances).
Checkpoint	A point in the control flow of a Supervised Entity where the activity is reported to the Watchdog Manager.
Deadline Supervision	Kind of supervision that checks if the execution time between two `Checkpoints` are lower than a given upper execution time limit.
Deadline Start Checkpoint	A `Checkpoint` for which Deadline Supervision is configured and which is a starting point for a particular Deadline Supervision.
Deadline End Checkpoint (Deadline Stop Checkpoint)	A `Checkpoint` for which Deadline Supervision is configured and which is an ending point for a particular Deadline Supervision. It is possible that a `Checkpoint` is both a Deadline Start `Checkpoint` and Deadline End `Checkpoint` – if Deadline Supervision is chained.
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.

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Graph	Control Flow Graph. A set of Checkpoints connected through Transitions, where at least one of Checkpoints is an Initial Checkpoint. There is a path (through Transitions) between any two Checkpoints of the Graph.
External Graph	Graph that may involve more than one Supervised Entity. Its configuration is mode-dependent.
Cross-Cluster External Graph	A special kind of External Graph that spans over multiple Software Clusters for Clustered Software Architecture. Its configuration is mode-dependent (controlled by Host Software Cluster) and has dedicated configuration structure additionally. Note: External Graph within one Software Cluster can be modelled without the configuration structure dedicated for clustered software architecture.
External Transition	An External Transition is a transition between two Checkpoints, where the Checkpoints belong to different Supervised Entities.
Local Supervision Status	Status that represents the current result of alive-supervision of a single Supervised Entity.
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).
Internal Graph	Graph that may not span over several Supervised Entity. Its configuration is mode-independent and can be disabled by disabling the corresponding Supervised Entity.
Internal Transition	An Internal Transition is a transition between two Checkpoints of a Supervised Entity.
Mode	A mode is a certain set of states of the various state machines that are running in the vehicle that are relevant to a particular entity, e.g. a SW-C, a BSW module, an application, a whole vehicle In its lifetime, an entity changes between a set of mutually exclusive modes. These changes are triggered by environmental data, e.g. signal reception, operation invocation. In the context of the Watchdog Manager a mode is defined by a set of configuration options. The set of Supervised Entities to be supervised may vary from mode to mode.
Supervised Entity	A software entity which is included in the supervision of the Watchdog Manager. Each Supervised Entity has exactly one identifier. A Supervised Entity denotes a collection of Checkpoints within an instance of Software Component Types or Basic Software Modules. There may be zero, one or more Supervised Entities in an instance of Software Component Types or Basic Software Modules.
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 by the Watchdog Manager 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 base of Supervision Reference Cycle of Watchdog Manager, where the cyclic Alive Supervision is performed. And it's also the interval for updating Global Supervision Status and execution of resulting Recovery Actions. This is done in every call of the Main Function of belonging Watchdog Manager and mode-dependent (may vary when swiching mode).
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) and mode-dependent.

Table 2.2: Terms used in the scope of this Document

3 Related documentation

3.1 Input documents & related standards and norms

[1] IEC 61508 (all parts) – Functional safety of electrical/electronic/programmable electronic safety-related systems
https://iec.ch/

[2] ISO 26262 (all parts) – Road vehicles – Functional Safety
https://www.iso.org

[3] General Specification of Basic Software Modules
AUTOSAR_CP_SWS_BSWGeneral

[4] Specification of ECU State Manager
AUTOSAR_CP_SWS_ECUStateManager

[5] Requirements on Health Monitoring
AUTOSAR_FO_RS_HealthMonitoring

[6] General Requirements on Basic Software Modules
AUTOSAR_CP_RS_BSWGeneral

[7] Requirements on Mode Management
AUTOSAR_CP_RS_ModeManagement

[8] Specification of MCU Driver
AUTOSAR_CP_SWS_MCUDriver

[9] Specification of RTE Software
AUTOSAR_CP_SWS_RTE

3.2 Related specification

AUTOSAR provides a General Specification on Basic Software modules [3] (SWS BSW General), which is also valid for Watchdog Manager.

Thus, the specification SWS BSW General shall be considered as additional and required specification for Watchdog Manager.

4 Constraints and assumptions

4.1 Limitations and conditions of use

The main limitations of Watchdog Manager design are as follows. They may be removed in upcoming versions of this document:

- {DRAFT} A Supervised Entity cannot span over multiple EcucPartitions.
- {DRAFT} Handling of unconnected transition proxies for Logical Supervision based on `Cross-Cluster External Graph` by Watchdog Manager is unspecified in this release.
- As libraries cannot call BSWs, libraries cannot be supervised by Watchdog Manager.
- The nesting of Deadline Supervision (i.e. start 1, start 2, end 2, end 1) is not supported.
- The Alive Supervision function with more than one `Checkpoint` per Supervised Entity is not consistently specified within the document. For now, it is recommended to support only one Alive Supervision `Checkpoint` per Supervised Entity.

Further limitations:

- The Watchdog Manager does not encapsulate the Watchdog Driver initialization. The Watchdog Driver must be initialized by [4, Specification of ECU State Manager] in the startup process before the initialization of the Watchdog Manager.
- The Watchdog Manager is initialized after the OS has been started. Hence, it cannot be responsible for controlling the Watchdog Driver earlier in the startup process. Usually, it is sufficient to configure a large enough initial timeout in the Watchdog Driver to bridge the gap between Watchdog Driver and Watchdog Manager initialization. Alternatively, the Integrator may use ECU State Manager facilities (callouts).
- The Watchdog Manager is de-initialized before the OS shutdown. Hence, it cannot be responsible for controlling the Watchdog Driver later in the shutdown process. Usually, it is sufficient to configure a large enough final timeout that is set when the Watchdog Manager is de-initialized. This allows bridging the gap between Watchdog Manager de-initialization and system power-off or resetting. Alternatively, the Integrator may use ECU State Manager facilities (callouts).
- For ECUs which implement sleep modes, if the hardware watchdog remains active in these sleep modes, its triggering shall also be handled by the ECU State Manager.
- The error recovery mechanism “Immediate MCU Reset” is available only on microcontrollers that are able to perform a reset by using the hardware feature of the microcontroller.

- All of following conditions must be met for the expected operation of WdgM supervision:
  - Initialized Wdg Interface,
  - Initialized OS (because of possible usage of OsCounter)
  - Initialized WdgM (done by calling WdgM_Init)
  - Periodic invocation of WdgM_MainFunction preferably by AUTOSAR BSW scheduler; during startup the invocation may be done by another module.
    - Note: The deviations/jitters on the periodic call of WdgM_MainFunction will lead to a potential risk of delayed detection in both Alive Supervision and Deadline Supervision (timeout detection part) and false/missed detection in Alive Supervision.
    - Note: Any blocking of this periodic invocation will cause loss of Deadline Supervision (timeout detection part), Alive Supervision, all state transition of both Local/Global Supervision Status and resulting Error Handling mechanisms to recover from supervision failures, except the last resort “Reset by Hardware Watchdog” due to the loss of the Watchdog Handling (no trigger to the hardware instance via WdgIf).
- A Supervised Entity with all its Checkpoints may belong to only one OS-Application (at most). Because OS-application can run on one core only, therefore one specific Supervised Entity may run at one core.
- The Deadline Supervision (timeout detection part) and Alive Supervision is highly depending on the periodic invocation of WdgM_MainFunction: the periodicity shall be chosen carefully according to the requested value of the timeout detection.
- {DRAFT} The result of WdgM_GetFirstExpiredSEID in software architecture with multi-partition configuration may be not fully reliable, depending on implementation (at least, it cannot be achieved without reliable and common time stamping over partitions, but it will not to be standardized).
- Watchdog Manager cannot detect timeout of Deadline Supervision for the Supervised Entities which are running in Category 2 ISRs.
  - Rationale: A deadlock of Runnable Entities which are running in Category 2 ISR blocks the execution of WdgM_MainFunction on Task level.

4.2 Applicability to car domains

No restriction.

5 Dependencies to other modules

Watchdog Interface (WdgIf) The Watchdog Manager module is responsible for changing the mode of the Watchdog Driver and for reporting to the Watchdog Driver the condition to trigger the hardware watchdog. The services of the Watchdog Driver are accessed via the Watchdog Interface which allows addressing multiple watchdog instances.

ECU State Manager (EcuM) The ECU State Manager is responsible for initializing, de-initializing of the Watchdog Manager module and for triggering the hardware watchdog in sleep modes.

Micro Controller Unit Driver (Mcu) The Watchdog Manager module may perform an immediate reset of the ECU in case of a supervision failure. This reset service is provided by the MCU driver.

Default Error Tracer (Det) If development error detection is enabled, the Watchdog Manager module informs the Default Error Tracer about detected development errors.

Diagnostic Event Manager (Dem) The Watchdog Manager may notify the Diagnostic Event Manager about detected functional / production-code relevant errors.

BSW Scheduler (SchM) The BSW Scheduler is responsible for calling the scheduled functions of the Watchdog Manager module. The Watchdog Manager module uses the services of the BSW Scheduler to implement critical sections.

Runtime Environment (Rte) The Runtime Environment is responsible for propagating `Checkpoint` information from Supervised Entities in SW-Cs or in CDDs to the Watchdog Manager module. The Watchdog Manager module uses the services of the Runtime Environment to inform SW-Cs about changes in the supervision status. BSW Modules can call the Watchdog Manager module without using RTE.

Operating system (Os) The Operating System is used by Watchdog Manager to provide the timestamp.

{DRAFT} Software Cluster Connector (SwCluC) SwCluC (introduced by Classic Platform Flexility Concept) can establish internal connection of WdgM over Software Clusters, by means of Binary Manifests. Note that, inter-EcucPartition connection within a WdgM will be established without SwCluC, as it’s a part of BSW Multicore Distribution Concept and its way for implementation is not standardized (one of typical implementation method is master-satellite pattern).

5.1 File Structure

5.1.1 Code File Structure

For details refer to the chapter 5.1.6 “Code file structure” in [3, General Specification of Basic Software Modules].

5.2 Version Check

For details refer to the chapter 5.1.8 “Version Check” in [3, General Specification of Basic Software Modules].

6 Requirements Tracing

The following tables reference the requirements specified in [5, Requirements on Health Monitoring], [6, General Requirements on Basic Software Modules], [7, Requirements on Mode Management] and links to the fulfillment of these. Please note that if column "Satisfied by" is empty for a specific requirement this means that this requirement is not fulfilled by this document.

Requirement	Description	Satisfied by
[RS_HM_09235]	Health Monitoring shall provide a Deadline Supervision	[SWS_WdgM_00322] [SWS_WdgM_00373] [SWS_WdgM_00374] [SWS_WdgM_00403] [SWS_WdgM_00404]
[SRS_BSW_00101]	The Basic Software Module shall be able to initialize variables and hardware in a separate initialization function	[SWS_WdgM_00018] [SWS_WdgM_00135] [SWS_WdgM_00268] [SWS_WdgM_00269] [SWS_WdgM_00285] [SWS_WdgM_00296] [SWS_WdgM_00298] [SWS_WdgM_00370]
[SRS_BSW_00171]	Optional functionality of a Basic-SW component that is not required in the ECU shall be configurable at pre-compile-time	[SWS_WdgM_00104]
[SRS_BSW_00310]	API naming convention	[SWS_WdgM_00151] [SWS_WdgM_00153] [SWS_WdgM_00154] [SWS_WdgM_00159] [SWS_WdgM_00168] [SWS_WdgM_00169] [SWS_WdgM_00175] [SWS_WdgM_00261] [SWS_WdgM_00263] [SWS_WdgM_00264]
[SRS_BSW_00323]	All AUTOSAR Basic Software Modules shall check passed API parameters for validity	[SWS_WdgM_00010] [SWS_WdgM_00020] [SWS_WdgM_00021] [SWS_WdgM_00030] [SWS_WdgM_00031] [SWS_WdgM_00039] [SWS_WdgM_00172] [SWS_WdgM_00173] [SWS_WdgM_00176] [SWS_WdgM_00253] [SWS_WdgM_00254] [SWS_WdgM_00256] [SWS_WdgM_00257] [SWS_WdgM_00258] [SWS_WdgM_00270] [SWS_WdgM_00278] [SWS_WdgM_00279] [SWS_WdgM_00284] [SWS_WdgM_00288] [SWS_WdgM_00388] [SWS_WdgM_00389] [SWS_WdgM_00390] [SWS_WdgM_00392] [SWS_WdgM_00394] [SWS_WdgM_00395] [SWS_WdgM_00396] [SWS_WdgM_00397] [SWS_WdgM_00401]
[SRS_BSW_00327]	Error values naming convention	[SWS_WdgM_00004] [SWS_WdgM_00375] [SWS_WdgM_00402]
[SRS_BSW_00336]	Basic SW module shall be able to shutdown	[SWS_WdgM_00261]
[SRS_BSW_00337]	Classification of development errors	[SWS_WdgM_00004] [SWS_WdgM_00375] [SWS_WdgM_00402]
[SRS_BSW_00339]	Reporting of production relevant error status	[SWS_WdgM_00129] [SWS_WdgM_00142] [SWS_WdgM_00408]
[SRS_BSW_00345]	BSW Modules shall support pre-compile configuration	[SWS_WdgM_00025] [SWS_WdgM_00104]

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Requirement	Description	Satisfied by
[SRS_BSW_00350]	All AUTOSAR Basic Software Modules shall allow the enabling/ disabling of detection and reporting of development errors.	[SWS_WdgM_00010] [SWS_WdgM_00020] [SWS_WdgM_00021] [SWS_WdgM_00039] [SWS_WdgM_00172] [SWS_WdgM_00173] [SWS_WdgM_00176] [SWS_WdgM_00253] [SWS_WdgM_00254] [SWS_WdgM_00256] [SWS_WdgM_00257] [SWS_WdgM_00258] [SWS_WdgM_00270] [SWS_WdgM_00278] [SWS_WdgM_00279] [SWS_WdgM_00284] [SWS_WdgM_00288] [SWS_WdgM_00388] [SWS_WdgM_00389] [SWS_WdgM_00390] [SWS_WdgM_00392] [SWS_WdgM_00394] [SWS_WdgM_00395] [SWS_WdgM_00396] [SWS_WdgM_00397] [SWS_WdgM_00401]
[SRS_BSW_00357]	For success/failure of an API call a standard return type shall be defined	[SWS_WdgM_00011]
[SRS_BSW_00358]	The return type of init() functions implemented by AUTOSAR Basic Software Modules shall be void	[SWS_WdgM_00151]
[SRS_BSW_00373]	The main processing function of each AUTOSAR Basic Software Module shall be named according the defined convention	[SWS_WdgM_00159]
[SRS_BSW_00385]	List possible error notifications	[SWS_WdgM_00004] [SWS_WdgM_00375] [SWS_WdgM_00402]
[SRS_BSW_00406]	API handling in uninitialized state	[SWS_WdgM_00021] [SWS_WdgM_00039]
[SRS_BSW_00450]	A Main function of a un-initialized module shall return immediately	[SWS_WdgM_00406] [SWS_WdgM_00407]
[SRS_BSW_00452]	Classification of runtime errors	[SWS_WdgM_00030] [SWS_WdgM_00031] [SWS_WdgM_00142] [SWS_WdgM_00319]
[SRS_BSW_00458]	Classification of production errors	[SWS_WdgM_00129] [SWS_WdgM_00375] [SWS_WdgM_00408]
[SRS_BSW_00469]	Fault detection and healing of production errors and extended production errors	[SWS_WdgM_00129] [SWS_WdgM_00408]
[SRS_BSW_00470]	Execution frequency of production error detection	[SWS_WdgM_00129] [SWS_WdgM_00408]
[SRS_BSW_00471]	Do not cause dead-locks on detection of production errors - the ability to heal from previously detected production errors	[SWS_WdgM_00408]
[SRS_BSW_00480]	Null pointer errors shall follow a naming rule	[SWS_WdgM_00004]
[SRS_BSW_00481]	Invalid configuration set selection errors shall follow a naming rule	[SWS_WdgM_00004]
[SRS_BSW_00487]	Errors for module initialization shall follow a naming rule	[SWS_WdgM_00004]
[SRS_ModeMgm_-09028]	The Watchdog Manager shall support multiple watchdog instances	[SWS_WdgM_00002]
[SRS_ModeMgm_-09106]	The list of entities supervised by the Watchdog Manager shall be configurable at pre-compile time	[SWS_WdgM_00085]
[SRS_ModeMgm_-09107]	The Watchdog Manager shall provide an initialization service	[SWS_WdgM_00018] [SWS_WdgM_00135] [SWS_WdgM_00151]
[SRS_ModeMgm_-09109]	It shall be possible to prohibit the disabling of watchdog	[SWS_WdgM_00030] [SWS_WdgM_00031]

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Requirement	Description	Satisfied by
[SRS_ModeMgm_-09110]	The watchdog Manager shall provide a service interface, to select a mode of the Watchdog Manager	[SWS_WdgM_00139] [SWS_WdgM_00154]
[SRS_ModeMgm_-09112]	The Watchdog Manager shall cyclically check the periodicity of the supervised entities	[SWS_WdgM_00063] [SWS_WdgM_00074] [SWS_WdgM_00076] [SWS_WdgM_00077] [SWS_WdgM_00078] [SWS_WdgM_00083] [SWS_WdgM_00098] [SWS_WdgM_00115] [SWS_WdgM_00117] [SWS_WdgM_00213] [SWS_WdgM_00214] [SWS_WdgM_00413]
[SRS_ModeMgm_-09125]	The Watchdog Manager shall provide a service allowing the Update temporal program flow monitoring	[SWS_WdgM_00413] [SWS_WdgM_00414]
[SRS_ModeMgm_-09143]	The Watchdog Manager shall set the triggering condition during inactive monitoring	[SWS_WdgM_00083] [SWS_WdgM_00119] [SWS_WdgM_00186] [SWS_WdgM_00223]
[SRS_ModeMgm_-09158]	The Watchdog Manager shall support Post build time and mode dependent selectable configuration sets for the Watchdog Manager	[SWS_WdgM_00145]
[SRS_ModeMgm_-09159]	The Watchdog Manager shall report failure of temporal or program flow monitoring to DEM	[SWS_WdgM_00129] [SWS_WdgM_00408]
[SRS_ModeMgm_-09160]	The Watchdog Manager shall provide the indication of failed temporal monitoring	[SWS_WdgM_00148] [SWS_WdgM_00150]
[SRS_ModeMgm_-09161]	The Watchdog Manager shall reset the triggering condition in the Watchdog Driver in Case of temporal failure	[SWS_WdgM_00223]
[SRS_ModeMgm_-09162]	The Watchdog Manager shall be able to notify the software of an upcoming watchdog reset	[SWS_WdgM_00150]
[SRS_ModeMgm_-09163]	It shall be possible to configure a delay before provoking a watchdog reset	[SWS_WdgM_00077] [SWS_WdgM_00215] [SWS_WdgM_00219] [SWS_WdgM_00220]
[SRS_ModeMgm_-09169]	The Watchdog Manager shall be able to immediately reset the MCU	[SWS_WdgM_00133] [SWS_WdgM_00134] [SWS_WdgM_CONSTR_06500]
[SRS_ModeMgm_-09221]	The Watchdog Manager shall check the correct sequence of code execution in supervised entities	[SWS_WdgM_00246] [SWS_WdgM_00252] [SWS_WdgM_00271] [SWS_WdgM_00273] [SWS_WdgM_00274] [SWS_WdgM_00295] [SWS_WdgM_00297] [SWS_WdgM_00331]
[SRS_ModeMgm_-09222]	The Watchdog Manager shall provide a service allowing the Update logical program flow monitoring	[SWS_WdgM_00246] [SWS_WdgM_00252] [SWS_WdgM_00271] [SWS_WdgM_00273] [SWS_WdgM_00274] [SWS_WdgM_00295] [SWS_WdgM_00297] [SWS_WdgM_00331]
[SRS_ModeMgm_-09225]	The Watchdog Manager shall provide the indication of failed logical monitoring	[SWS_WdgM_00148] [SWS_WdgM_00150]
[SRS_ModeMgm_-09226]	The Watchdog Manager shall reset reset the triggering condition in the Watchdog Driver in Case of logical program flow violation	[SWS_WdgM_00223]
[SRS_ModeMgm_-09231]	The Watchdog Manager shall periodically set the triggering condition in the Watchdog Driver as long as the monitoring has not failed	[SWS_WdgM_00119] [SWS_WdgM_00120] [SWS_WdgM_00121] [SWS_WdgM_00122] [SWS_WdgM_00223]

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Requirement	Description	Satisfied by
[SRS_ModeMgm_09232]	The Watchdog Manager shall provide a service to cause a watchdog reset	[SWS_WdgM_00232] [SWS_WdgM_00233] [SWS_WdgM_00264]
[SRS_ModeMgm_09233]	The Watchdog Manager shall support independent triggering condition values for each watchdog instance	[SWS_WdgM_00002]

Table 6.1: Requirements Tracing

7 Functional specification

This chapter presents the specification details of the internal functional behavior of the Watchdog Manager module.

7.1 Interaction of Supervision Functions

7.1.1 Overview

Supervised Entities are the units of supervision for the Watchdog Manager module. Each Supervised Entity can be supervised by a different Supervision Function or a combination of them.

The available Supervision Functions are:

- Alive Supervision (see Section 7.2.1)
- Deadline Supervision (see Section 7.2.2)
- Logical Supervision (see Section 7.2.3)

Each of three Supervision Functions results with a list of Results of Supervision Function for each Supervised Entity (highlighted in Blue on Figure 7.1), where each Result is either `correct` or `incorrect`. At Watchdog Manager initialization, all the Results are set to correct. This means that for every Supervised Entity there are three partial results (one from Alive Supervision, one from Deadline Supervision and one from Logical Supervision).

In a given Mode, each Supervised Entity may have zero, one or more Alive Supervisions (`WdgMAliveSupervision`), each having one `correct`/`incorrect` result.

In a given Mode, each Supervised Entity may have zero, one or more Deadline Supervisions (`WdgMDeadlineSupervision`), each having one `correct`/`incorrect` result.

Note: Deadline Supervision is the combination of the mechanisms for detection of:

- **early arrivals**: End `Checkpoint` reported before `WdgMDeadlineMin` since reporting of Start `Checkpoint`.
- **delays**: End `Checkpoint` reported after `WdgMDeadlineMax` since reporting of Start `Checkpoint`.
- **timeouts**: End `Checkpoint` not reported even after `WdgMDeadlineMax` since reporting of Start `Checkpoint`

In a given Mode, each Supervised Entity may have zero, one or more Logical Supervisions (i.e. `Graphs`) configured (`WdgMExternalLogicalSupervision` for one `Ex-`

ternal Graph, a set of WdgMInternalTransitions for one Internal Graph), each having one correct/incorrect result. Each Logical Supervision is for one External Graph or Internal Graph.

In case there are zero active supervisions in a given Mode, then Main Function sees no EXPIRED local status, so WdgIf_SetTriggerCondition can be invoked.

Based on the results of Supervision Functions (correct/incorrect), the Local Supervision Status of each Supervised Entity (highlighted in Green on Figure 7.1) is determined by means of the Local Supervision Status state machine (see Section 7.1.2).

Based on Local Supervision Status of each Supervised Entity, the Global Supervision Status highlighted in Red on Figure 7.1) is determined by means of Global Supervision Status state machine (see Section 7.1.3).

Based on the Global Supervision Status, the error handling (see Section 7.3) and watchdog handling (see Section 7.3) take place.

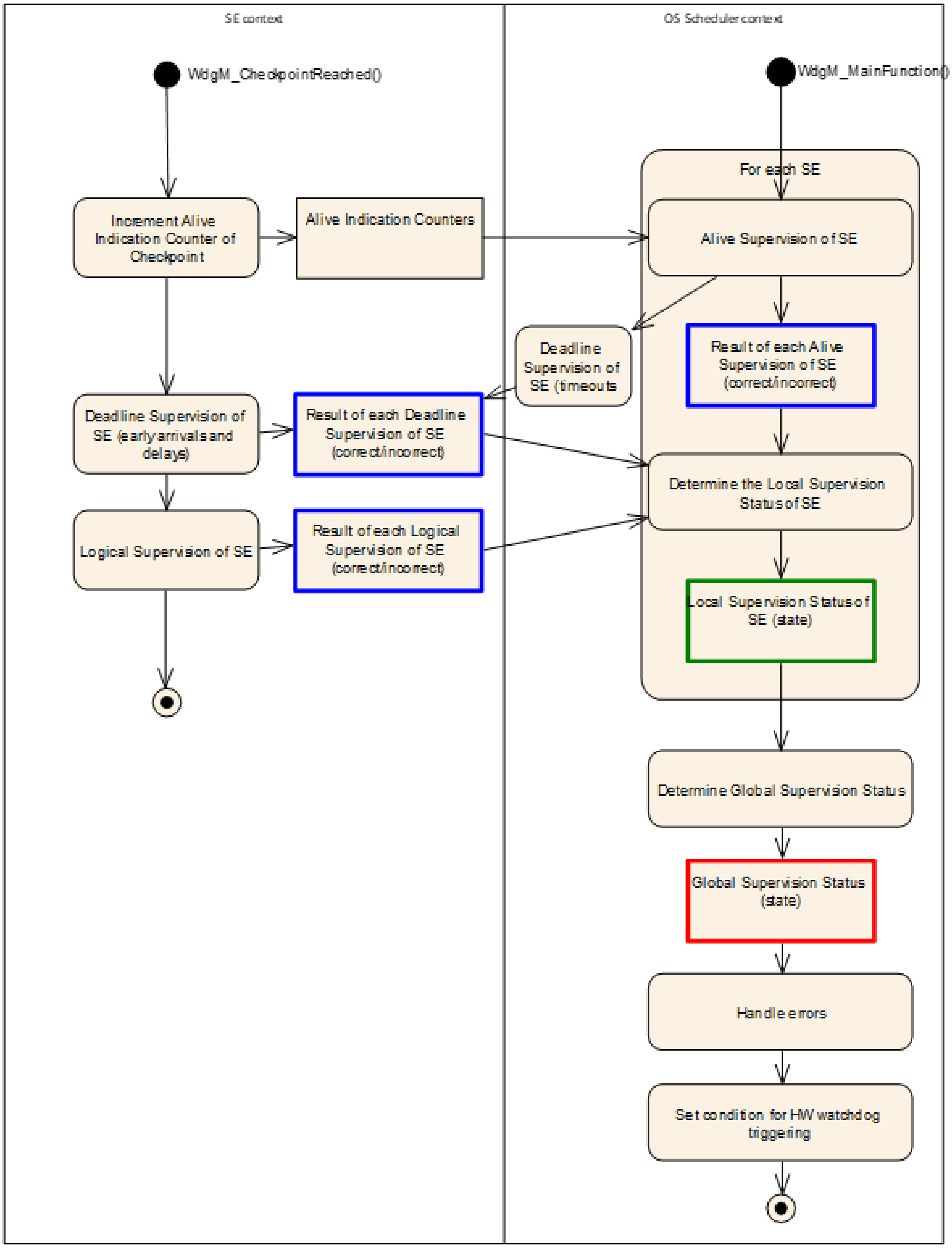

SE context
OS Scheduler context
WdgM_CheckpointReached()
WdgM_MainFunction()
Increment Alive Indication Counter of Checkpoint
Alive Indication Counters
For each SE
Alive Supervision of SE
Deadline Supervision of SE (timeouts
Result of each Alive Supervision of SE (correct/incorrect)
Deadline Supervision of SE (early arrivals and delays)
Result of each Deadline Supervision of SE (correct/incorrect)
Determine the Local Supervision Status of SE
Logical Supervision of SE
Result of each Logical Supervision of SE (correct/incorrect)
Local Supervision Status of SE (state)
Determine Global Supervision Status
Global Supervision Status (state)
Handle errors
Set condition for HW watchdog triggering

Figure 7.1: Overview of Watchdog Manager Supervision

The determination of supervision result for Deadline Supervision (detection of early arrivals and delays) and Logical Supervision is executed within the function WdgM_-

CheckpointReached. During one execution of this function, it updates the result for one particular Supervised Entity only.

The determination of supervision result for Deadline Supervision (timeout detection part) and Alive Supervision is executed within the function WdgM_MainFunction. During one execution of this function, it updates the Results of Deadline Supervision (timeout detection part) and/or Alive Supervision for all Supervised Entities.

[SWS_WdgM_00406]

Upstream requirements: SRS_BSW_00450

⌈The WdgM module shall start both the Supervision Functions (for all Supervision Algorithms, including Supervision Reference Cycles) and the Watchdog Handling during the first invocation of the WdgM_MainFunction after the initialization of the module.⌋

Note: If the WdgM module is not initialized, its Main Function will return immediately without performing any functionality and without raising any errors (see [SWS_BSW_-00037]). Also, the module cannot use RTE APIs before first invocation of the Main Function (see [SWS_BSW_00218]). Therefore, the first call of the Main Function after initialization should be considered as the starting point of the Supervision Functions and the resulting handling of the hardware watchdog instances (using the WdgIf module), to have consistent behavior as a Safety-related Monitoring Mechanism.

[SWS_WdgM_00407]

Upstream requirements: SRS_BSW_00450

⌈The WdgM module shall stop the Supervision Functions (for all Supervision Algorithms) and Watchdog Handling in the WdgM_DeInit.⌋

[SWS_WdgM_CONSTR_06510] ⌈The following shall be available for the operation Supervision Functions of Watchdog Manager:

1. availability of initialized Wdg Interface,
2. availability of initialized OS,
3. initialized WdgM – by invocation of WdgM_Init() function, and
4. periodic invocation of WdgM_MainFunction() function.

⌋

[SWS_WdgM_CONSTR_06511] ⌈It shall be ensured by the callers of WdgM module, that the functions WdgM_DeInit, WdgM_Init and WdgM_SetMode are not invoked concurrently to the WdgM_MainFunction.⌋

This can be achieved by the integrator by means of appropriate coordination of initialization and task scheduling.

{DRAFT} Note that, in the case of clustered software architecture (WdgMSwClusterSupport = ENABLE_SW_CLUSTER_SUPPORT), the WdgM_MainFunction instances in Application Software Clusters can be called at any time, regardless of the concurrent invocation of the functions WdgM_DeInit, WdgM_Init and WdgM_SetMode in the Host Software Cluster.

To be able to continue Alive Supervision and Deadline Supervision (timeout detection part) even if a Supervised Entity had a deadlock, each WdgM_MainFunction must be mapped to the tasks which don't contain Supervised Entities to be supervised by the WdgM_MainFunction instance.

[SWS_WdgM_CONSTR_00275] ⌈The OS task which is executing the main function WdgM_MainFunction shall be separated from the OS task(s) calling any function from a Supervised Entity under supervision.⌋

7.1.2 Local Supervision Status

The Local Supervision Status state machine determines the status of the Supervised Entity. This is done based on the following:

1. Previous value of the Local Supervision Status,
2. Current values of result of Alive Supervision, result of Deadline Supervision, result of Logical Supervision.

[SWS_WdgM_00409]

Status: DRAFT

⌈The Local Supervision Status state machine shall be calculated in every call of the function WdgM_MainFunction which the Supervised Entity is belonging to.⌋

[SWS_WdgM_00410]

Status: DRAFT

⌈The state machine shall be initialized by the function WdgM_Init.⌋

The Watchdog Manager module provides a feature to provide fault tolerance (corresponding to the local supervision status WDGM_LOCAL_STATUS_FAILED) for Alive Supervision for a configurable amount of (cumulative) time measured in multiples of the Supervision Cycle (Supervision Cycle is the period at which WdgM_MainFunction is called), named Failed Supervision Reference Cycles (see configuration parameter WdgMFailedAliveSupervisionRefCycleTol). If this parameter is set to

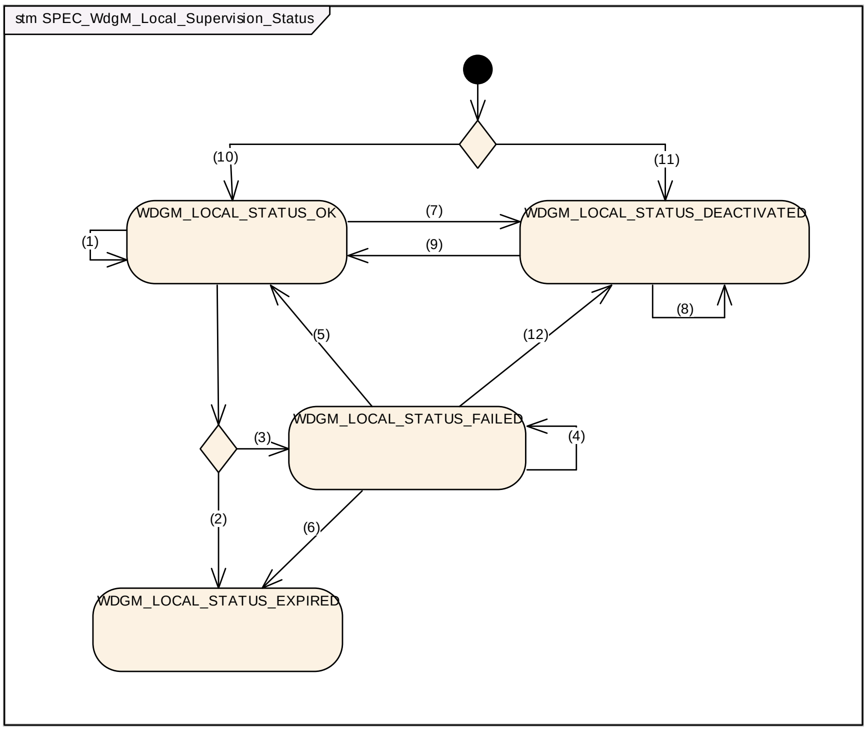
0, then there is no tolerance for Alive Supervision and then Alive Supervision behaves in the same way as Deadline Supervision and Logical Supervision, where the first incorrect result causes the transition to WDGM_LOCAL_STATUS_EXPIRED.

Note that, Deadline and Logical Supervisions will not be affected by WdgMFailedAliveSupervisionRefCycleTol.

[SWS_WdgM_00200] ⌈The Watchdog Manager module shall track the Local Supervision Status of each Supervised Entity.⌋

[SWS_WdgM_91006] shows the state machine for Local Supervision Status of a Supervised Entity with all possible states.

[SWS_WdgM_91006] Local Supervision Status ⌈


stm SPEC_WdgM_Local_Supervision_Status
(10)
(11)
WDGM_LOCAL_STATUS_OK
(7)
WDGM_LOCAL_STATUS_DEACTIVATED
(1)
(9)
(8)
(5)
(12)
WDGM_LOCAL_STATUS_FAILED
(3)
(4)
(2)
(6)
WDGM_LOCAL_STATUS_EXPIRED

⌋

For the transitions between the states of the Local Supervision Status the following rules apply:

[SWS_WdgM_00268]

Upstream requirements: SRS_BSW_00101

⌈If the function WdgM_Init is successfully called, then for each Supervised Entity that is referenced from the Initial Mode (WdgMInitialMode) (i.e. each Supervised Entity that is activated in the Initial Mode), the function WdgM_Init shall set the Local Supervision Status for this Supervised Entity to WDGM_LOCAL_STATUS_OK. And the counter for Failed Supervision Reference Cycles shall be set to zero (0). (see Transition (10) in [SWS_WdgM_91006]).⌋

[SWS_WdgM_00269]

Upstream requirements: SRS_BSW_00101

⌈If the function WdgM_Init is successfully called, then for each Supervised Entity that is not referenced from the Initial Mode (WdgMInitialMode), the function WdgM_Init shall set the Local Supervision Status for this Supervised Entity to WDGM_LOCAL_STATUS_DEACTIVATED (see Transition (11) in [SWS_WdgM_91006]).

If the function WdgM_Init is successfully called and the parameter WdgMInitialMode [ECUC_WdgM_00336] of this Supervised Entity in WdgMInitialMode is not configured to WDGM_LOCAL_STATUS_OK then the Watchdog Manager module shall set the Local Supervision Status for this Supervised Entity to WDGM_LOCAL_STATUS_DEACTIVATED. (see Transition (11) in [SWS_WdgM_91006])⌋

[SWS_WdgM_00201] ⌈If all values in three sets of results of Supervision (results of Alive Supervision, results of Deadline Supervision, results of Logical Supervision) for the Supervised Entity are correct and the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_OK, then the function WdgM_MainFunction shall keep the Supervised Entity in the Local Supervision Status WDGM_LOCAL_STATUS_OK (see Transition (1) in [SWS_WdgM_91006]).⌋

[SWS_WdgM_00202] ⌈If the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_OK AND:

1. (At least one result of Alive Supervision of the Supervised Entity is incorrect and a Failure Tolerance of zero is configured (see configuration parameter WdgMFailedAliveSupervisionRefCycleTol [ECUC_WdgM_00327]) OR
2. If the result of at least one Deadline Supervision of the Supervised Entity or the result of at least one Logical supervision of the Supervised Entity is incorrect),

THEN the function WdgM_MainFunction shall change the Local Supervision Status to WDGM_LOCAL_STATUS_EXPIRED (see Transition (2) in [SWS_WdgM_91006]).⌋

The below requirements show the important difference of Alive Supervision versus Deadline and Logical Supervision: The Alive Supervision has an error tolerance for failed reference cycles.

[SWS_WdgM_00203] ⌈If the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_OK AND:

1. (If the result of at least one Alive Supervision of the Supervised Entity is incorrect and a Failure Tolerance greater than zero is configured (see configuration parameter WdgMFailedAliveSupervisionRefCycleTol [ECUC_WdgM_00327]) AND
2. If all the results of Deadline Supervision of the Supervised Entity and all results of Logical Supervision of the Supervised Entity are correct),

THEN the function WdgM_MainFunction shall change the Local Supervision Status to WDGM_LOCAL_STATUS_FAILED and increment the counter for Failed Supervision Reference Cycles (see Transition (3) in [SWS_WdgM_91006]).⌋

[SWS_WdgM_00204] ⌈If the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_FAILED AND:

1. (If the result of at least one Alive Supervision is incorrect and the counter for Failed Supervision Reference Cycles is less than the configured Failure Tolerance (see parameter WdgMFailedAliveSupervisionRefCycleTol [ECUC_WdgM_00327]) AND
2. If all the results of Deadline Supervisions of the Supervised Entity and all the result of Logical Supervision of the Supervised Entity are correct),

THEN the function WdgM_MainFunction shall keep the Local Supervision Status in WDGM_LOCAL_STATUS_FAILED and increment the counter for Failed Supervision Reference Cycles (see Transition (4)in [SWS_WdgM_91006]).⌋

[SWS_WdgM_00300] ⌈If the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_FAILED AND:

1. (If all the results of Alive Supervision of the Supervised Entity are correct and the counter for Failed Supervision Reference Cycles is > 1) AND
2. If all the result of Deadline Supervision of the Supervised Entity and all the result of Logical Supervision of the Supervised Entity are correct),

THEN the function WdgM_MainFunction shall keep the Local Supervision Status in WDGM_LOCAL_STATUS_FAILED and decrement the counter for Failed Supervision Reference Cycles (see Transition (4) in [SWS_WdgM_91006]).⌋

[SWS_WdgM_00205] ⌈If the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_FAILED AND:

1. (If all the results of Alive Supervision of the Supervised Entity are correct and the counter for Failed Supervision Reference Cycles equals 1) AND

2. If all the results of Deadline Supervisions of the Supervised Entity and all the results of Logical Supervision of the Supervised Entity are correct),

THEN the function WdgM_MainFunction shall change the Local Supervision Status to WDGM_LOCAL_STATUS_OK and decrement the counter for Failed Supervision Reference Cycles (see Transition (5) in [SWS_WdgM_91006]).⌋

[SWS_WdgM_00206] ⌈If the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_FAILED AND:

1. (If at least one result of Alive Supervision is incorrect and the counter for Failed Supervision Reference Cycles is equal to the configured Failure Tolerance (see configuration parameter WdgMFailedAliveSupervisionRefCycleTol [ECUC_WdgM_00327]) OR
2. If at least one result of Deadline Supervision of the Supervised Entity or at least one the result of Logical Supervision of the Supervised Entity is incorrect),

THEN the function WdgM_MainFunction shall change the Local Supervision Status to WDGM_LOCAL_STATUS_EXPIRED (see Transition (6) in [SWS_WdgM_91006]).⌋

[SWS_WdgM_00207] ⌈If the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_OK and if a call of WdgM_SetMode switches to a mode which deactivates the Supervised Entity (see [SWS_WdgM_00283]), then the Watchdog Manager module shall change the Local Supervision Status to WDGM_LOCAL_STATUS_DEACTIVATED (see Transition (7) in [SWS_WdgM_91006]).⌋

[SWS_WdgM_00291] ⌈If the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_FAILED and if a call of WdgM_SetMode switches to a mode in which the Supervised Entity is Deactivated (see [SWS_WdgM_00283]), then the Watchdog Manager module shall change the Local Supervision Status to WDGM_LOCAL_STATUS_DEACTIVATED (see Transition (12) in [SWS_WdgM_91006]).⌋

Note that the above requirement is only applicable for the WDGM_LOCAL_STATUS_FAILED status, but not for WDGM_LOCAL_STATUS_EXPIRED.

[SWS_WdgM_00208] ⌈If the Supervised Entity was in the Local Supervision Status WDGM_LOCAL_STATUS_DEACTIVATED, the functions WdgM_CheckpointReached and WdgM_MainFunction shall not perform any Supervision Functions for this Supervised Entity and keep the Local Supervision Status in the state WDGM_LOCAL_STATUS_DEACTIVATED. (see Transition (8) in [SWS_WdgM_91006])⌋

[SWS_WdgM_00209] ⌈If the Supervised Entity was in Local Supervision Status WDGM_LOCAL_STATUS_DEACTIVATED and if a call of WdgM_SetMode switches to a mode in which the Supervised Entity is active (see [SWS_WdgM_00282]), then the Watchdog Manager module shall change the Local Supervision Status to WDGM_LO-

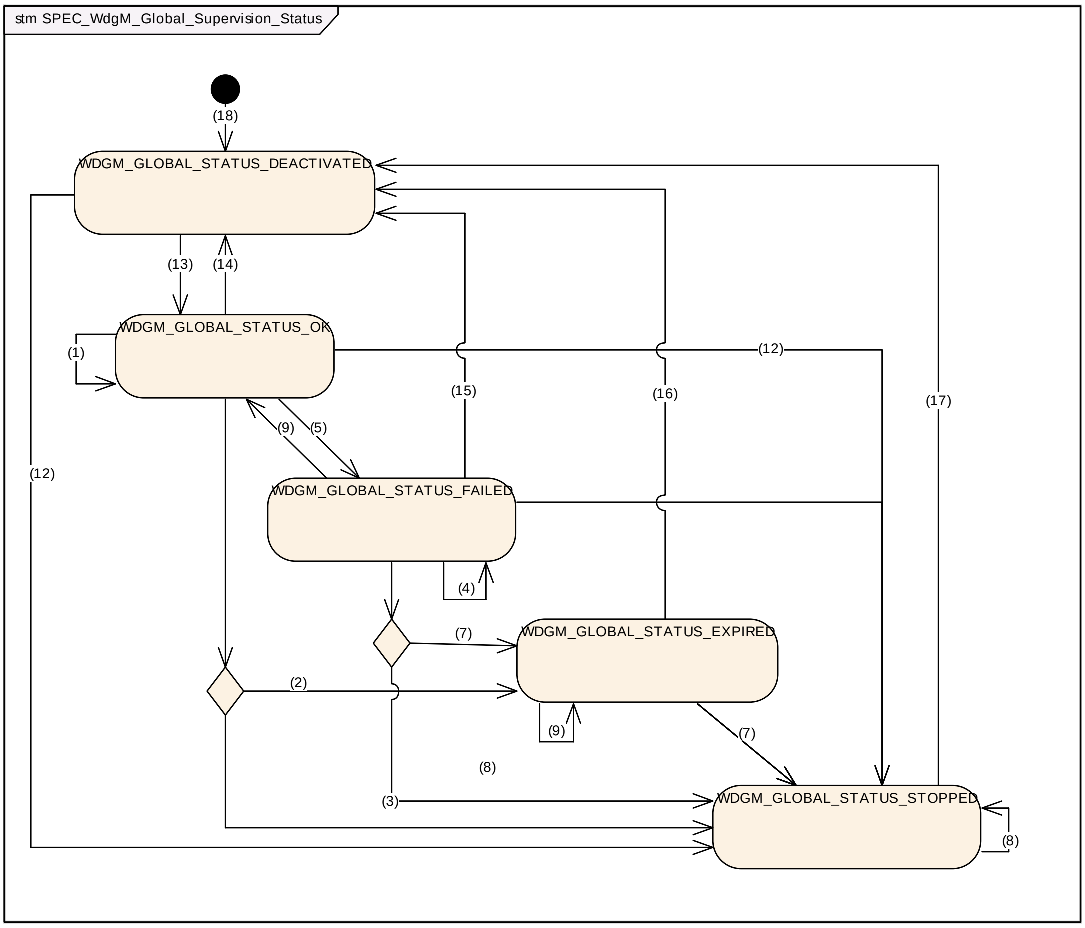
CAL_STATUS_OK. And the counter for Failed Supervision Reference Cycles shall be set to zero (0). (see Transition (9) in [SWS_WdgM_91006])⌋

7.1.3 Global Supervision Status

Based on the Local Supervision Status of all Supervised Entities, the Global Supervision Status is computed.

The Global Supervision Status has similar values as the Local Supervision Status. The main differences are the addition of the WDGM_GLOBAL_STATUS_STOPPED value. [SWS_WdgM_91005] shows the values and transitions between them.

[SWS_WdgM_91005] Global Supervision Status ⌈


stm SPEC_WdgM_Global_Supervision_Status
(18)
WDGM_GLOBAL_STATUS_DEACTIVATED
(13)
(14)
WDGM_GLOBAL_STATUS_OK
(1)
(12)
(15)
(16)
(17)
(12)
(9)
(5)
WDGM_GLOBAL_STATUS_FAILED
(4)
(7)
WDGM_GLOBAL_STATUS_EXPIRED
(2)
(9)
(7)
(8)
(3)
WDGM_GLOBAL_STATUS_STOPPED
(8)

⌋

[SWS_WdgM_00213]

Upstream requirements: SRS_ModeMgm_09112

⌈The Watchdog Manager module shall have one Global Supervision Status for the whole monitored software.⌋

[SWS_WdgM_00387] ⌈Global Supervision Status shall be statically initialized with WDGM_GLOBAL_STATUS_DEACTIVATED (see Transition (18) in [SWS_WdgM_91005]).⌋

The Watchdog Manager module provides a feature to postpone the error reaction (the error reaction being not setting a correct trigger condition) for a configurable amount of time measured in multiples of the Supervision Cycle, named Expired Supervision Tolerance (see configuration parameter WdgMExpiredSupervisionCycleTol [ECUC_WdgM_00329]).

The Expired Supervision Tolerance is implemented within the state machine of the Global Supervision Status. The defined state machine is in the state WDGM_GLOBAL_STATUS_EXPIRED while the blocking is postponed.

[SWS_WdgM_00214]

Upstream requirements: SRS_ModeMgm_09112

⌈The function WdgM_MainFunction shall calculate the Global Supervision Status in every Main Function Period. The function shall compute the Global Supervision Status after computation of every Local Supervision Status.⌋

The cyclic update of Global Supervision Status is necessary to trigger the timely transition from WDGM_GLOBAL_STATUS_EXPIRED to WDGM_GLOBAL_STATUS_STOPPED.

{DRAFT} Note that, in case of clustered software architecture, multiple WdgM_MainFunction instances may exist. In this case, Global Supervision Status can be updated every call of any WdgM_MainFunction instance.

Following rules shall be used to calculate the Global Supervision Status:

[SWS_WdgM_00285]

Upstream requirements: SRS_BSW_00101

⌈If the function WdgM_Init [SWS_WdgM_00151] was successfully called then the function shall change the Global Supervision Status to WDGM_GLOBAL_STATUS_OK. And the Expired Cycle Counter shall be set to zero (0). (see Transition (13) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00286] ⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_OK and the function WdgM_DeInit [SWS_WdgM_00261] is successfully called, then the function shall change the Global Supervision Status to WDGM_-

GLOBAL_STATUS_DEACTIVATED (see Transitions (14), (15), (16) and (17) in [SWS_WdgM_91005]).⌋

It has to be considered carefully that a deactivation of WdgM when it is in states WDGM_GLOBAL_STATUS_EXPIRED or WDGM_GLOBAL_STATUS_STOPPED can hinder error reporting or error reaction.

[SWS_WdgM_00078]

Upstream requirements: SRS_ModeMgm_09112

⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_OK and the Local Supervision Status of all Supervised Entities are either WDGM_LOCAL_STATUS_OK or WDGM_LOCAL_STATUS_DEACTIVATED then the function WdgM_MainFunction shall keep the Global Supervision Status WDGM_GLOBAL_STATUS_OK (see Transition (1) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00076]

Upstream requirements: SRS_ModeMgm_09112

⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_OK, the Local Supervision Status of at least one Supervised Entity is WDGM_LOCAL_STATUS_FAILED, and no Supervised Entity is in Local Supervision Status WDGM_LOCAL_STATUS_EXPIRED, then the function WdgM_MainFunction shall change the Global Supervision Status to WDGM_GLOBAL_STATUS_FAILED (see Transition (2) in [SWS_WdgM_91005]).⌋

The Watchdog Manager module supports a feature to delay the error reaction (switching to WDGM_LOCAL_STATUS_EXPIRED) for a configurable amount of time. This could be used to allow clean-up activities before a watchdog reset, e.g. writing the error cause, writing NVRAM data.

[SWS_WdgM_00215]

Upstream requirements: SRS_ModeMgm_09163

⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_OK, the Local Supervision Status of at least one Supervised Entity is WDGM_LOCAL_STATUS_EXPIRED, and the Expired Supervision Tolerance is configured to a value larger than zero (see configuration parameter WdgMExpiredSupervisionCycleTol [ECUC_WdgM_00329]), then function WdgM_MainFunction shall change the Global Supervision Status to WDGM_GLOBAL_STATUS_EXPIRED. And increment the Expired Cycle Counter. (see Transition (3) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00216] ⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_OK, the Local Supervision Status of at least one Supervised Entity is WDGM_LOCAL_STATUS_EXPIRED, and the Expired Supervision Tolerance is configured to zero (see configuration parameter WdgMExpiredSupervisionCycleTol [ECUC_WdgM_00329]), then the function WdgM_MainFunction shall change the Global Supervision Status to WDGM_GLOBAL_STATUS_STOPPED (see Transition (4) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00217] ⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_FAILED, the Local Supervision Status of at least one Supervised Entity is WDGM_LOCAL_STATUS_FAILED, and no Supervised Entity is in Local Supervision Status WDGM_LOCAL_STATUS_EXPIRED, then function WdgM_MainFunction shall remain in Global Supervision Status WDGM_GLOBAL_STATUS_FAILED. (see Transition (5) in [SWS_WdgM_91005])⌋

[SWS_WdgM_00218] ⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_FAILED and the Local Supervision Status of all Supervised Entities is either WDGM_LOCAL_STATUS_OK or WDGM_LOCAL_STATUS_DEACTIVATED then function WdgM_MainFunction shall change the Global Supervision Status to WDGM_GLOBAL_STATUS_OK (see Transition (6) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00077]

Upstream requirements: SRS_ModeMgm_09112, SRS_ModeMgm_09163

⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_FAILED, the Local Supervision Status of at least one Supervised Entity is WDGM_LOCAL_STATUS_EXPIRED, and the Expired Supervision Tolerance is configured to a value larger than zero (see configuration parameter WdgMExpiredSupervisionCycleTol [ECUC_WdgM_00329]), then function WdgM_MainFunction shall change the Global Supervision Status to WDGM_GLOBAL_STATUS_EXPIRED. And increment the Expired Cycle Counter. (see Transition (7) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00117]

Upstream requirements: SRS_ModeMgm_09112

⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_FAILED, the Local Supervision Status of at least one Supervised Entity is WDGM_LOCAL_STATUS_EXPIRED, and the Expired Supervision Tolerance is configured to zero (see configuration parameter WdgMExpiredSupervisionCycleTol [ECUC_WdgM_00329]), then function WdgM_MainFunction shall change the Global Supervision Status to WDGM_GLOBAL_STATUS_STOPPED (see Transition (8) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00219]

Upstream requirements: SRS_ModeMgm_09163

⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_EXPIRED, the Local Supervision Status of at least one Supervised Entity is WDGM_LOCAL_STATUS_EXPIRED, and the Expired Cycle Counter is less than the configured Expired Supervision Tolerance (see configuration parameter WdgMExpiredSupervisionCycleTol

[ECUC_WdgM_00329]), then function WdgM_MainFunction shall keep Global Supervision Status WDGM_GLOBAL_STATUS_EXPIRED and increment the Expired Cycle Counter (see Transition (9) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00220]

Upstream requirements: SRS_ModeMgm_09163

⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_EXPIRED, the Local Supervision Status of at least one Supervised Entity is WDGM_LOCAL_STATUS_EXPIRED, and the Expired Cycle Counter is equal to the configured Expired Supervision Tolerance (see configuration parameter WdgMExpiredSupervisionCycleTol [ECUC_WdgM_00329]), then function WdgM_MainFunction shall change the Global Supervision Status to WDGM_GLOBAL_STATUS_STOPPED (see Transition (10) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00221] ⌈If the Global Supervision Status was WDGM_GLOBAL_STATUS_STOPPED, then function WdgM_MainFunction shall remain in Global Supervision Status WDGM_GLOBAL_STATUS_STOPPED (see Transition (11) in [SWS_WdgM_91005]).⌋

[SWS_WdgM_00139]

Upstream requirements: SRS_ModeMgm_09110

⌈If a call to WdgIf_SetMode fails, function shall assume a global supervision failure and set the Global Supervision Status to WDGM_GLOBAL_STATUS_STOPPED. (see Transition (12) in [SWS_WdgM_91005])⌋

Note: see also Section 7.5.2 for the information about possible failed call to WdgIf_SetMode.

This is the final state and the failure recovery mechanisms will be started. Usually a watchdog reset will occur after the hardware watchdog has expired.

7.2 Supervision Functions

[SWS_WdgM_00413]

Status: DRAFT
Upstream requirements: SRS_ModeMgm_09112, SRS_ModeMgm_09125

⌈Alive Supervision and Deadline Supervision (timeout detection part) for each Supervised Entity shall be executed within the corresponding Main Function instance, which is identified by WdgMMainFunctionPartitionRef.⌋

[SWS_WdgM_00063]

Status: DRAFT
Upstream requirements: SRS_ModeMgm_09112

⌈If the Global Supervision Status is not in the state WDGM_GLOBAL_STATUS_DEACTIVATED, then the WdgM_MainFunction() shall execute Alive Supervision according to the configured Supervision Cycle.⌋

[SWS_WdgM_00414]

Status: DRAFT
Upstream requirements: SRS_ModeMgm_09125

⌈If the Global Supervision Status is not in the state WDGM_GLOBAL_STATUS_DEACTIVATED, then the WdgM_MainFunction() shall execute Deadline Supervision (timeout detection part) according to the configured Main Function Period.⌋

7.2.1 Alive Supervision

Alive Supervision is one of the Supervision Functions of the Watchdog Manager module. The Alive Supervision offers a mechanism to periodically check the execution reliability of one or several Supervised Entities. This mechanism supports a check of cyclic timing constraints of independent Supervised Entities.

7.2.1.1 Alive Supervision Configuration

To provide Alive Supervision, the Checkpoints and their timing constraints need to be configured. The simplest configuration for Alive Supervision is one Checkpoint without any Transitions, as shown in Figure 7.2.

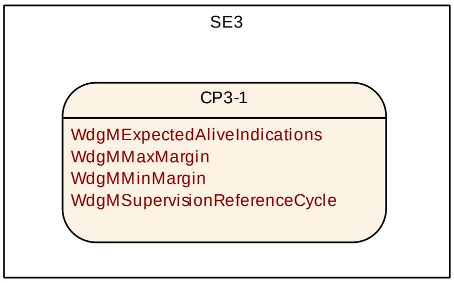


Figure 7.2: Simplest Alive Supervision Checkpoint Configuration

The above configuration provides backward compatibility to Alive Supervision as defined in versions before AUTOSAR Classic Platform R4.0.1, where each Supervised Entity could be supervised with one set of parameters only.

Moreover, it is also possible to have more than one Checkpoint as shown in Figure 7.3.

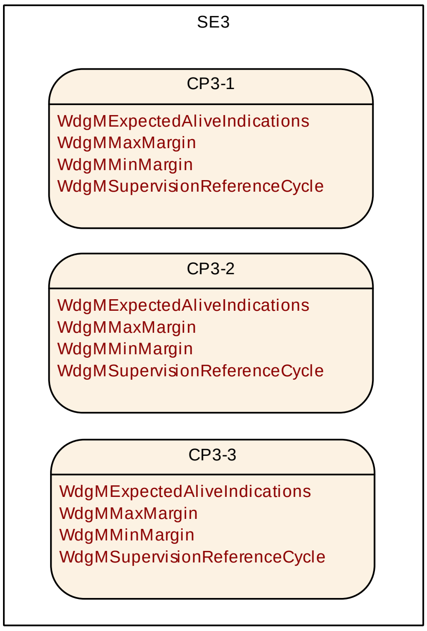

SE3
CP3-1
WdgMExpectedAliveIndications
WdgMMaxMargin
WdgMMinMargin
WdgMSupervisionReferenceCycle
CP3-2
WdgMExpectedAliveIndications
WdgMMaxMargin
WdgMMinMargin
WdgMSupervisionReferenceCycle
CP3-3
WdgMExpectedAliveIndications
WdgMMaxMargin
WdgMMinMargin
WdgMSupervisionReferenceCycle

Figure 7.3: Multiple Checkpoints for Alive Supervision in one Supervised Entity

Each Checkpoint has its own set of Alive Supervision Parameters. Transitions are not used by Alive Supervision. Although each Checkpoint has its own parameters, it is the Supervised Entity for which status is determined based on the frequency of Checkpoints.

The parameters of the Alive Supervision (see WdgMAliveSupervision) depend on the Watchdog Manager Mode and are defined for per Checkpoint (and not globally for the whole Supervised Entity).

None, some, or all of the Checkpoints of a Supervised Entity can be configured for Alive Supervision in a given Mode. Moreover, in each Mode the Alive Supervision options of Checkpoints can be different.

The WdgMExpectedAliveIndications [ECUC_WdgM_00311] (EAI) specifies the amount of Expected Alive Indications from a given Checkpoint, within a fixed period of Supervision Cycles.

An acceptable negative variation (WdgMMinMargin [ECUC_WdgM_00312]) and acceptable positive variation (WdgMMaxMargin [ECUC_WdgM_00313]) can be configured.

The Watchdog Manager module has to support a configurable amount of independent Supervised Entities. As a consequence, the following general issue has to be considered.

[SWS_WdgM_00085]

Upstream requirements: SRS_ModeMgm_09106

⌈The Watchdog Manager module shall derive the required number of independent data resources to perform the Alive Supervision within the Watchdog Manager module from the number of Supervised Entities, number of WdgMModes and their WdgMAliveSupervisions.⌋

Examples of independent data resources in context of the Watchdog Manager module are: Alive Counters, Supervision Cycles counters, Failed Supervision Reference Cycles counters, Expired Supervision Cycles counters, Local Supervision Status.

7.2.1.2 Alive Supervision Algorithm

To send an Alive Indication, a Supervised Entity invokes the function WdgM_CheckpointReached, which results with incrementation of an Alive Counter for the Checkpoint.

Alive Supervision is performed by counting the number of reports from Supervised Entities (by WdgM_CheckpointReached) during a configurable period.

This Supervision is executed by WdgM_MainFunctions with configurable cycle times. The cyclic examination of the Counter of each Checkpoint of a Supervised Entity by the Main Function happens at every Supervision Reference Cycle (which is a multiple of Supervision Cycle).

The Supervision Cycle and Supervision Reference Cycle (see WdgMSupervisionReferenceCycle) are the properties of an Alive Supervision of a Checkpoint in a given Watchdog Manager Mode.

[SWS_WdgM_00098]

Upstream requirements: SRS_ModeMgm_09112

⌈The function WdgM_MainFunction shall perform for each Alive Supervision (WdgMAliveSupervision) configured in the active Mode, the examination of the Alive Counter of each Checkpoint of the Supervised Entity. The examination shall be done at the period WdgMSupervisionReferenceCycle of the corresponding Alive Supervision (WdgMAliveSupervision).⌋

Note: During the intermediate Supervision Cycles of the Alive Supervision, the function WdgM_MainFunction does not perform the examination of Alive Counters.

[SWS_WdgM_00074]

Upstream requirements: SRS_ModeMgm_09112

⌈The function WdgM_MainFunction shall examine an Alive Counter by checking if it is within the allowed tolerance (Expected - Min Margin; Expected + Max Margin) (see WdgMExpectedAliveIndications [ECUC_WdgM_00311], WdgMMinMargin, WdgMMaxMargin).⌋

If any Checkpoint of a Supervised Entity fails the examination, then the result of Alive Supervision for the Supervised Entity is set to incorrect.

[SWS_WdgM_00115]

Upstream requirements: SRS_ModeMgm_09112

⌈If the function WdgM_MainFunction detects a deviation between the counted Alive Indications and the expected amount of alive indications [ECUC_WdgM_00311] (including tolerance margins [ECUC_WdgM_00312], [ECUC_WdgM_00313]) for any Checkpoint of a Supervised Entity, then Alive Supervision at this Supervision Reference Cycle for this Supervised Entity shall be defined as incorrect. Otherwise, it shall be defined as correct.⌋

If a Checkpoint is not Alive-Supervised in a mode, then it is ignored by Watchdog Manager.

[SWS_WdgM_00083]

Upstream requirements: SRS_ModeMgm_09112, SRS_ModeMgm_09143

⌈The function WdgM_MainFunction shall not perform the examination of the Alive Counter of a Checkpoint if no corresponding Alive Supervision (WdgMAliveSupervision) is defined in the active Watchdog Manager Mode.⌋

7.2.2 Deadline Supervision

Deadline Supervision checks the timing constraints of non-cyclic Supervised Entities. In these Supervised Entities, a certain event happens and a following event happens within a given time span. This time span can have a maximum and minimum deadline (time window).

7.2.2.1 Deadline Supervision Configuration

For every Deadline Supervision, two Checkpoints connected by a Transition are configured. The Deadline is attached to the Transition from the Start Checkpoint to the End Checkpoint. The simplest Deadline Supervision configuration contains two Checkpoints and one Transition, as shown in Figure 7.4.

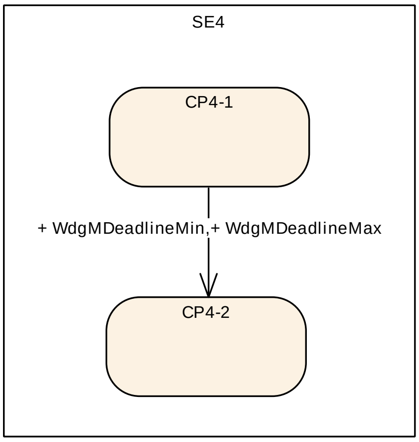


Figure 7.4: Simplest Deadline Supervision Configuration

More than one Transition can be defined in a Supervised Entity. The Transitions and Checkpoints do not have to form a closed Graph. Since only the Start and End (Stop) Checkpoints are considered by this Supervision Function, there can be independent Graphs, as shown in Figure 7.5. Moreover, the Checkpoints can be chained.

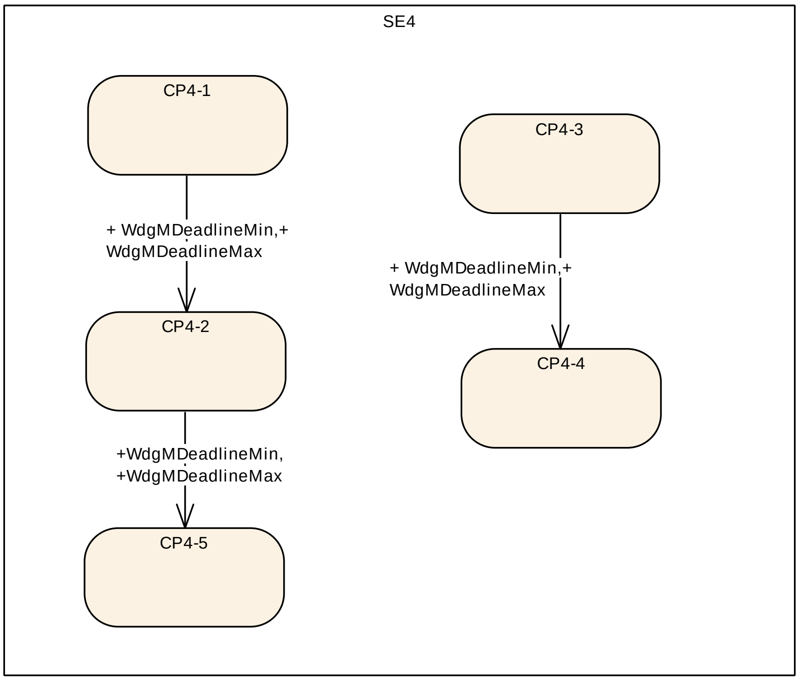


Figure 7.5: Multiple Transitions for Deadline Supervision in one Supervised Entity

The configuration of Deadline Supervision is similar to the one of Alive Supervision.

The parameters of the Deadline Supervision (see WdgMDeadlineSupervision) depend on the Watchdog Manager Mode (WdgMMode) and are defined for per a set of two Checkpoints. None, some, or all of the Checkpoints of a Supervised Entity can be configured for Deadline Supervision in a given Mode.

A Deadline Supervision is defined as a set of Transitions with time constraints. A Transition is defined as two references to two Checkpoints, called

Deadline Start Checkpoint and Deadline End Checkpoint (WdgMDeadlineStartRef and WdgMDeadlineStopRef). A Transition has minimum and maximum time (WdgMDeadlineMin [ECUC_WdgM_00317], WdgMDeadlineMax [ECUC_WdgM_00318]).

[SWS_WdgM_00293] ⌈The Watchdog Manager module shall derive the required number of independent data resources to perform the Deadline Supervision within the Watchdog Manager module from the number of Supervised Entities, number of WdgMModes and their WdgMDeadlineSupervisions.⌋

7.2.2.2 Deadline Supervision Algorithm

For each Deadline Start Checkpoints (i.e. Checkpoint referenced by WdgMDeadlineStartRef), Watchdog Manager has a timestamp variable storing the time when that Checkpoint has been reached.

A timestamp variable for Deadline Supervision is obtained by reading OS tick. For each Supervised Entity, an OS counter is configured.

An OS counter can be shared between Supervised Entities, or a separate OS counter can be used for each Supervised Entity (implementation-specific). In case OS-Applications/partitioning is used and a counter is shared across Supervised Entities belonging to different OS-applications, then the list of allowed OS-Applications to access the counter needs to be configured (OsCounterAccessingApplication).

[SWS_WdgM_CONSTR_06513] ⌈For each Supervised Entity, an OS counter shall be configured (see WdgMOSCounter, [ECUC_WdgM_00361]) if at least one Deadline Supervision is configured for the Supervised Entity in any of the Watchdog Manager Modes.⌋

[SWS_WdgM_CONSTR_06514] ⌈The OS counters for each Supervised Entity shall be configured to be accessible from the OsApplication which contains the Supervised Entity.⌋

[SWS_WdgM_CONSTR_06515] ⌈The OS counters for each Supervised Entity shall be configured to be also accessible from the OsApplication which calls WdgM_MainFunction, if WdgMEnableTimeoutDetection is set to true.⌋

[SWS_WdgM_00373]

Upstream requirements: RS_HM_09235

⌈To determine the timestamp and to compute the timestamp differences, the function WdgM_CheckpointReached shall use OS function GetElapsedValue, using as 1st parameter the CounterID that is configured for the Supervised Entity. To determine the timestamp and to compute the timestamp differences, the function WdgM_CheckpointReached (for detection of both early arrivals and delays) and the function WdgM_MainFunction (for detection of timeouts) shall use OS function GetElapsedValue, using as 1st parameter the CounterID that is configured for the Supervised Entity (see WdgMOSCounter, [ECUC_WdgM_00361])⌋

The timestamps are in ticks. However, the Watchdog deadline configuration is in seconds. The scaling between ticks and seconds is configured in OS.

[SWS_WdgM_00374]

Upstream requirements: RS_HM_09235

⌈For scaling of timestamp difference to the limit values (WdgMDeadlineMin and WdgMDeadlineMax) (see [SWS_WdgM_00294], the function WdgM_CheckpointReached (for detection of early arrivals and delays) and the function WdgM_MainFunction (for detection of timeouts) shall use OsSecondsPerTick configuration parameter.⌋

During the initialization, all the timestamps of Deadline Start Checkpoints (i.e. Checkpoint referenced by WdgMDeadlineStartRef) are cleared – set to 0.

[SWS_WdgM_00298]

Upstream requirements: SRS_BSW_00101

⌈The function WdgM_Init shall for all Deadline Start Checkpoints set their timestamps to 0.⌋

When a Deadline Start Checkpoint (i.e. Checkpoint referenced by WdgMDeadlineStartRef) is reached, a Supervised Entity invokes the function WdgM_CheckpointReached, which results with the execution of Deadline Supervision.

[SWS_WdgM_00228] ⌈When the Deadline Start Checkpoint is reached and this Checkpoint is referenced in the active Mode, then the function WdgM_CheckpointReached shall record the current timestamp under the timestamp of the reached Deadline Start Checkpoint. The current timestamp shall be used as the reference for examining the time of the corresponding Deadline End Checkpoint.⌋

The function WdgM_CheckpointReached shall determine the current timestamp by invoking the OS functions ()

[SWS_WdgM_00228] means that the timestamp of the reached Deadline Start Checkpoint is overwritten by the current timestamp, regardless of the value (just before the overwriting) of the reached Deadline Start Checkpoint. Moreover, [SWS_WdgM_00228] means that it is not considered as an error by Deadline Supervision if a given Deadline Start Checkpoint is reached several times without reaching the corresponding Deadline End Checkpoint (each time the timestamp is just updated).

[SWS_WdgM_00229] ⌈When the Deadline End Checkpoint is reached and this Checkpoint is referenced in the active Mode, and timestamp of the corresponding Deadline Start Checkpoint is <>0, then the function WdgM_CheckpointReached shall measure the time difference between current timestamp and the corresponding Deadline Start Checkpoint timestamp. Then, the function shall clear (i.e. set to 0) the timestamp of the corresponding Deadline Start Checkpoint.⌋

[SWS_WdgM_00354] ⌈When the Deadline End Checkpoint is reached and this Checkpoint is referenced in the active Mode, and timestamp of the corresponding Deadline Start Checkpoint is =0, then the function WdgM_CheckpointReached shall exit with success (without measuring the time difference).⌋

[SWS_WdgM_00354] means that it is not considered as an error by Deadline Supervision if a given Deadline End Checkpoint is reached several times in a sequence.

[SWS_WdgM_00294] ⌈If the measured time difference (see [SWS_WdgM_00229]) is not within the minimum and the maximum limits (that is, the time difference is either less than WdgMDeadlineMin or greater than WdgMDeadlineMax), then the function WdgM_CheckpointReached shall define the result of Deadline Supervision for this Supervised Entity as incorrect. Otherwise, it shall be defined as correct.⌋

Note: If the maximum limit (WdgMDeadlineMax) is configured with value 'INF', it is not necessary to check whether time difference is greater than the limit.

[SWS_WdgM_00299] ⌈For any reported Checkpoint that is neither a Deadline Start Checkpoint nor a Deadline End Checkpoint, the function WdgM_CheckpointReached [SWS_WdgM_00263] shall ignore this Checkpoint and not update the result of the Deadline Supervision for the Supervised Entity.⌋

[SWS_WdgM_00403]

Upstream requirements: RS_HM_09235

⌈If Deadline Timeout detection is enabled [i.e. WdgMEnableTimeoutDetection [ECUC_WdgM_00363] is set to 'true'] then, for all Deadline Supervisions configured in the active mode, if timestamp of the corresponding Deadline Start Checkpoint is <>0 (i.e. if the Start Checkpoint is reported but corresponding End Checkpoint is not yet reported), then the function WdgM_MainFunction shall measure the time difference between current timestamp and the corresponding Deadline Start Checkpoint timestamp. If the measured time difference exceeds (is greater than) maximum limit (WdgMDeadlineMax), then the function WdgM_MainFunction shall define the result of Deadline Supervision for the Supervised Entity as incorrect.⌋

Note: With this, it is possible to detect error in case Deadline End Checkpoint is never reached (timeout detection part of Deadline Supervision).

7.2.3 Logical Supervision

Logical Supervision checks if the code of Supervised Entities is executed in the correct sequence.

7.2.3.1 Logical Supervision Configuration

For every Logical Supervision, there is a Graph of Checkpoints connected by Transitions. The Graph abstracts the behavior of the Supervised Entity for the Watchdog Manager module.

As an example for a Supervised Entity, let us consider the following code fragment, which contains the Checkpoints CP0-0 to CP0-6.

```
CP0-0  i = 0;
CP0-1  while(i < n) {
CP0-2    if (a[i] < b[i])
CP0-3      a[i] = b[i];
CP0-4    else
           a[i] = 0;
CP0-5    i++;
CP0-6  }
```

This Supervised Entity can be represented by the Graph shown by Figure 7.6.

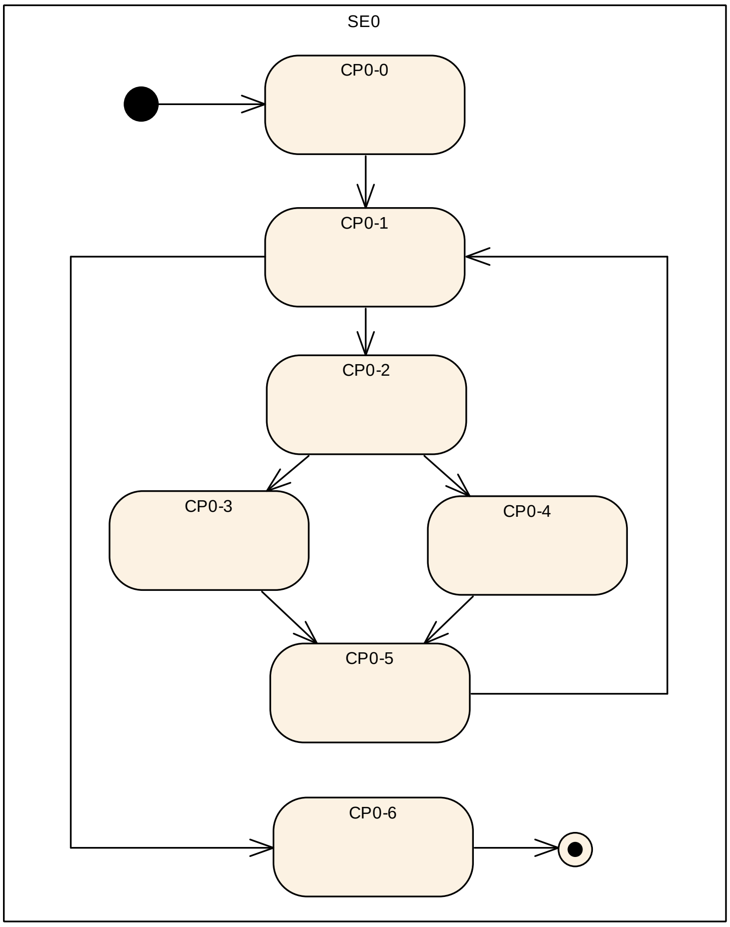


Figure 7.6: Example Control Flow Graph

A more abstract view of the Supervised Entity is given by the Graph shown in Figure 7.7, where the Checkpoint CP0-1 represents the complete while loop.

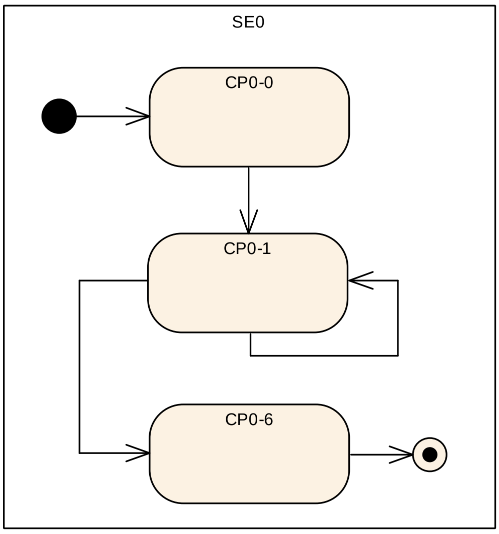


Figure 7.7: Abstracted Example Control Flow Graph

There are two types of Graphs for Logical Supervision. Firstly, there is an Internal Graph, in which all the Checkpoints belong to the same Supervised Entity and the Checkpoints are connected by Internal Transitions.

Second, there is an External Graph, in which at least two Checkpoints belong to different Supervised Entities. The Checkpoints are connected with External Transitions.

There are two types of Graphs for Logical Supervision. The main difference of the Internal Graphs and External Graphs is that an Internal Graph is a property of a Supervised Entity and is Mode independent (i.e. its structure does not change by switching Watchdog Manager Modes, even though its supervision behavior can be disabled if the Supervised Entity is disabled in a Mode), whereas an External Graph is Mode dependent.

The parameters of the Logical Supervision for Internal Graphs are Internal Transitions (see WdgMInternalTransition), which are contained in a Supervised Entity (WdgMSupervisedEntity). Each Internal Transition connects two Checkpoints. This means that all the modes share the same Internal Transitions. It is only possible to deactivate a Supervised Entity in a Mode, which makes its Logical Supervision of Internal Transitions inactive.

The parameters of the External Graphs (see WdgMExternalLogicalSupervision) are contained in a Mode (WdgMMode). Each External Transition connects two Checkpoints.

The Checkpoints exist irrespective if they are connected by any Transitions.

[SWS_WdgM_00366] ⌈The Watchdog Manager module shall derive the required number of independent data resources to perform the Logical Supervision within the Watchdog Manager module from the number of Supervised Entities, number of WdgMModes and their WdgMExternalLogicalSupervisions and WdgMInternalTransitions.⌋

7.2.3.2 Logical Supervision Algorithm

Immediately after initialization of the Watchdog Manager there has not yet been a Checkpoint reported, i.e. Logical Supervision for the Supervised Entity is inactive. This information is held in the Activity Flag (one flag per Graph).

Each Internal Graph represents one Logical Supervision. Assuming N Internal Graphs, this means that a Supervised Entity has N results from Logical Supervision for the Supervised Entity (Note: currently N is limited up to one per Supervised Entity).

Each External Graph represents one Logical Supervision, but it spans across possibly several Supervised Entities. Assuming M External Graphs that cross a Supervised Entity, this results with M results from the Logical Supervision for the Supervised Entity.

[SWS_WdgM_00271]

Upstream requirements: SRS_ModeMgm_09221, SRS_ModeMgm_09222

⌈The Watchdog Manager module shall maintain an Activity Flag for each Graph.⌋

[SWS_WdgM_00296]

Upstream requirements: SRS_BSW_00101

⌈The function WdgM_Init shall set the Activity Flag for each Graph to false.⌋

Each Graph may have one or more Initial Checkpoints. Initial Checkpoints are Checkpoints with which a Graph can start.

To notify reaching a Checkpoint, a Supervised Entity invokes the function WdgM_CheckpointReached, which results with execution of Logical Supervision algorithm.

To verify if transitions are valid, the algorithm needs to store the most recently reached Checkpoint. For every External Graph and Internal Graph, the Watchdog Manger stores the most recently reached Checkpoint.

Because a Checkpoint can belong to multiple Graphs, the function WdgM_CheckpointReached has to be able to identify to which Graph(s) a Checkpoint belongs.

[SWS_WdgM_00295]

Status: DRAFT
Upstream requirements: SRS_ModeMgm_09221, SRS_ModeMgm_09222

⌈The Watchdog Manager module shall identify to which Graph(s) each Checkpoint belongs.⌋

[SWS_WdgM_00246]

Status: DRAFT
Upstream requirements: SRS_ModeMgm_09221, SRS_ModeMgm_09222

⌈The function WdgM_CheckpointReached shall store the Checkpoint that has been most recently reported by a Supervised Entity, for each Graph (see WdgM_CheckpointReached [SWS_WdgM_00263]).

If the Activity Flag for a Graph is true, the function WdgM_CheckpointReached checks for each new Checkpoint if the Transition between the stored Checkpoint and the newly reported Checkpoint is allowed.⌋

[SWS_WdgM_00274]

Upstream requirements: SRS_ModeMgm_09221, SRS_ModeMgm_09222

⌈The function WdgM_CheckpointReached [SWS_WdgM_00263] shall verify if the reported Checkpoint belonging to an Internal Graph is a correct one by the following checks:

1. If the Activity Flag for the Graph of the reported Checkpoint is false, then:
   - If the Checkpoint is an Initial Checkpoint (WdgMInternalCheckpointInitialRef) the result of Logical Supervision for the Supervised Entity is correct, otherwise incorrect.
2. Else if Activity Flag is true and all previously called Checkpoints of this Graph were called in the right sequence, then:
   - If the reported Checkpoint is a successor of the stored Checkpoint within the Graph of the reported Checkpoint (this means there is an WdgMInternalTransition with WdgMInternalTransitionSourceRef and WdgMInternalTransitionDestRef), then the result of this Logical Supervision of the Supervised Entity is correct, otherwise incorrect.
3. Else (i.e. Activity Flag is true, but at least one Checkpoint in this Graph was previously called in a wrong sequence):
   - The result of this Logical Supervision of the Supervised Entity keeps incorrect.

⌋

A similar check takes place for Checkpoints belonging to External Graphs.

[SWS_WdgM_00252]

Upstream requirements: SRS_ModeMgm_09221, SRS_ModeMgm_09222

⌈The function WdgM_CheckpointReached [SWS_WdgM_00263] shall verify if the reported Checkpoint belonging to an External Graph is a correct one by the following checks:

1. If the Activity Flag for the Graph of the reported Checkpoint is false, then:
   - If the Checkpoint is an Initial Checkpoint (WdgMExternalCheckpointInitialRef), then the result of this Logical Supervision within the Supervised Entity of the reported Checkpoint is correct, otherwise incorrect.
2. Else if Activity Flag is true and all previously called Checkpoints of this Graph were called in the right sequence, then:

- If the reported Checkpoint is a successor of the stored Checkpoint within the Graph of the reported Checkpoint (this means there is an WdgMExternalTransition with WdgMExternalTransitionSourceRef and WdgMExternalTransitionDestRef), then the result of this Logical Supervision for Supervised Entity of the reported Checkpoint is correct, otherwise incorrect.

3. Else (i.e. Activity Flag is true, but at least one Checkpoint in this Graph was previously called in a wrong sequence):
   - The result of this Logical Supervision of the Supervised Entity keeps incorrect.

The above requirement means that in case of an incorrect External Transition, the Supervised Entity that is considered as erroneous is the one that reported the incorrect Checkpoint.⌋

If a Checkpoint is one of the initial Checkpoints of a Graph, then the Graph is set as active.

[SWS_WdgM_00273]

Upstream requirements: SRS_ModeMgm_09221, SRS_ModeMgm_09222

⌈If the function WdgM_CheckpointReached determines that the result of the Logical Supervision for the given Checkpoint is correct, and the Checkpoint is defined as an initial one, then the function WdgM_CheckpointReached shall set the Activity Flag of the corresponding Graph to true.⌋

The reverse applies for the Final Checkpoint.

[SWS_WdgM_00331]

Upstream requirements: SRS_ModeMgm_09221, SRS_ModeMgm_09222

⌈If the function WdgM_CheckpointReached determines that the result of the Logical Supervision for the given Checkpoint is correct, and the Checkpoint is defined as a final one, then the function WdgM_CheckpointReached shall set the Activity Flag of the corresponding Graph to false.⌋

As a result, after the report from a Final Checkpoint, the correct reports within the same Graph are only from Initial Checkpoints (Note: for an evaluation of the Graph, any reports from the Checkpoints not belonging to the Graph are ignored, see [SWS_WdgM_00297]).

A Checkpoint can belong to multiple Graphs (can be a combination of Internal Graphs and External Graphs). This means that both the check defined in [SWS_WdgM_00274] and the one in [SWS_WdgM_00252] can be executed simultaneously, and also means that, in any execution of WdgM_CheckpointReached and if the reported Checkpoint belongs to any Internal Graphs or External Graphs, the function can set the result of Logical Supervision for each corresponding Supervised Entity to correct (for all belonging Graphs) or incorrect (for all or a part of belonging Graphs).

If the reported Checkpoint does not belong to any Graph, then the result of Logical Supervision is not be updated. This is because the Checkpoint may be used by other Supervision Functions (Alive or Deadline).

[SWS_WdgM_00297]

Upstream requirements: SRS_ModeMgm_09221, SRS_ModeMgm_09222

⌈For any reported Checkpoint that does not belong to any Graph, the function WdgM_CheckpointReached [SWS_WdgM_00263] shall ignore it and not update the result of the Logical Supervision for the Supervised Entity.⌋

7.3 Error Handling / Failure Recovery

The Watchdog Manager module initiates a number of mechanisms to recover from supervision failures. These range from local error recovery within the Supervised Entity to a global reset of the ECU.

7.3.1 RTE Mode Mechanism Notifications

The Watchdog Manager module informs SW-Cs and CDDs about supervision failures via the RTE Mode mechanism. The SW-C and CDDs can then take its actions to recover from that failure. (see [SWS_WdgM_00197], [SWS_WdgM_00198]).

7.3.2 Report to DEM in WDGM_GLOBAL_STATUS_STOPPED

The Watchdog Manager module registers an entry with the Diagnostic Event Manager (DEM) when Watchdog Manages reaches the state WDGM_GLOBAL_STATUS_STOPPED. An SW-C or a CDD can take recovery actions based on that error entry.

[SWS_WdgM_00129]

Upstream requirements: SRS_BSW_00339, SRS_BSW_00458, SRS_BSW_00469, SRS_BSW_00470, SRS_ModeMgm_09159

⌈Within the first call of WdgM_MainFunction after WdgM_Init and when the reset-cause was that in the previous operation cycle the Global Supervision Status had reached WDGM_GLOBAL_STATUS_STOPPED and if the parameter WDGM_E_SUPERVI-

SION is configured, the Watchdog Manager module shall report an error status FAILED for WDGM_E_SUPERVISION to the DEM.⌋

7.3.3 Not Setting the Watchdog Trigger Condition

In the state WDGM_GLOBAL_STATUS_STOPPED, the Watchdog Manager module stops setting the trigger condition to Watchdog Interface. As a result, after the timeout of the hardware watchdog, it will cause a reset of the ECU.

See Section 7.4.2 for the corresponding requirements.

7.3.4 MCU Reset

For applications which need a microcontroller reset as soon as an unrecoverable supervision failure is detected, or to have the independent shutdown path from the Hardware Watchdog, the Watchdog Manager module can perform an immediate reset of the MCU.

[SWS_WdgM_00133]

Upstream requirements: SRS_ModeMgm_09169

⌈If the configuration parameter WdgMImmediateReset [ECUC_WdgM_00339] is set to TRUE and the Global Supervision Status has reached the state WDGM_GLOBAL_STATUS_STOPPED, the Watchdog Manager module shall call the MCU service Mcu_PerformReset on the MCU Driver module.⌋

[SWS_WdgM_CONSTR_06500] Interface provision in MCU driver

Upstream requirements: SRS_ModeMgm_09169

⌈The parameter WdgMImmediateReset [ECUC_WdgM_00339] may only be set to TRUE if the McuPerformResetApi (defined in SWS MCU Driver [8]) is set to TRUE.⌋

[SWS_WdgM_00134]

Upstream requirements: SRS_ModeMgm_09169

⌈In case of an immediate MCU reset, the Watchdog Manager module shall not provide a notification to the application via the RTE mode mechanism.⌋

7.4 Watchdog Handling

The handling of watchdogs is an important feature of the Watchdog Manager module. It prevents the ECU from resets by expired hardware watchdog instances while program execution is running properly.

Usually hardware watchdogs have their own timing constraints and the trigger for each watchdog instance must be performed cyclically within a maximum time span or within a defined time window according to the timing constraints of the corresponding watchdog instance. If the trigger does not occur, the corresponding hardware watchdog instance will cause a reset.

The actual timing of watchdog triggering is encapsulated in the Watchdog Driver. The Watchdog Manager only sets via the Watchdog Interface a triggering condition that instructs the Watchdog Driver to continue triggering.

7.4.1 Support for Multiple Watchdog Instances

Some hardware platforms can be designed to have multiple watchdog instances (i.e. an internal and an external watchdog in parallel).

[SWS_WdgM_00002]

Upstream requirements: SRS_ModeMgm_09028, SRS_ModeMgm_09233

⌈The Watchdog Manager module shall support the parallel usage of multiple watchdogs.⌋

7.4.2 Setting the Trigger Conditions

The Watchdog Manager module uses the service `WdgIf_SetTriggerCondition` of the Watchdog Interface modules to set (update) the trigger condition of the watchdogs. This service requires the watchdog device index and the timeout/counter as a parameter (see configuration parameter `WdgMTrigger` [ECUC_WdgM_00331]).

[SWS_WdgM_00223]

Upstream requirements: SRS_ModeMgm_09143, SRS_ModeMgm_09161, SRS_ModeMgm_09226, SRS_ModeMgm_09231

⌈The Watchdog Manager module shall update the trigger condition every time the Global Supervision Status has been recomputed. The following rules shall be used to derive the decision, how to set the triggering condition:

1. For the states `WDGM_GLOBAL_STATUS_OK`, `WDGM_GLOBAL_STATUS_FAILED` and `WDGM_GLOBAL_STATUS_EXPIRED`, the function `WdgM_MainFunction` shall correctly set the trigger conditions.

2. For the state WDGM_GLOBAL_STATUS_STOPPED, the function WdgM_MainFunction shall set the trigger condition to 0, which results in a reset through HW watchdog(s).
3. For the state WDGM_GLOBAL_STATUS_DEACTIVATED, the function WdgM_MainFunction shall not perform setting of the trigger condition (because this state means that the Watchdog Manager module is not properly initialized).

⌋

[SWS_WdgM_00119]

Upstream requirements: SRS_ModeMgm_09143, SRS_ModeMgm_09231

⌈If the Global Supervision Status has recomputed as WDGM_GLOBAL_STATUS_OK, then the Watchdog Manager module shall call WdgIf_SetTriggerCondition for all watchdogs not configured as WDGIF_OFF_MODE [ECUC_WdgM_00332] with <parameter for id> set to WdgMWatchdogDeviceRef [ECUC_WdgM_00348] and <parameter for trigger condition> set to WdgMTriggerConditionValue [ECUC_WdgM_00333].⌋

[SWS_WdgM_00120]

Upstream requirements: SRS_ModeMgm_09231

⌈If the Global Supervision Status has recomputed as WDGM_GLOBAL_STATUS_FAILED, then the Watchdog Manager module shall call WdgIf_SetTriggerCondition for all watchdogs not configured as WDGIF_OFF_MODE [ECUC_WdgM_00332] with <parameter for id> set to WdgMWatchdogDeviceRef [ECUC_WdgM_00348] and <parameter for trigger condition> set to WdgMTriggerConditionValue [ECUC_WdgM_00333].⌋

[SWS_WdgM_00121]

Upstream requirements: SRS_ModeMgm_09231

⌈If the Global Supervision Status has recomputed as WDGM_GLOBAL_STATUS_EXPIRED, then the Watchdog Manager module shall call WdgIf_SetTriggerCondition for all watchdogs not configured as WDGIF_OFF_MODE [ECUC_WdgM_00332] with <parameter for id> set to WdgMWatchdogDeviceRef [ECUC_WdgM_00348] and <parameter for trigger condition> set to WdgMTriggerConditionValue [ECUC_WdgM_00333].⌋

[SWS_WdgM_00122]

Upstream requirements: SRS_ModeMgm_09231

⌈If the Global Supervision Status has recomputed as WDGM_GLOBAL_STATUS_STOPPED, then the Watchdog Manager module shall call WdgIf_SetTriggerCondition for all watchdogs not configured as WDGIF_OFF_MODE [ECUC_WdgM_00332] with <parameter for id> set to WdgMWatchdogDeviceRef [ECUC_WdgM_00348] and <parameter for trigger condition> set to zero.⌋

Setting the trigger condition to zero will immediately prevent the Watchdog Driver module from triggering the hardware watchdog.

7.5 Switching Modes

7.5.1 Effect on Supervision Status

The function WdgM_SetMode (see [SWS_WdgM_00154]) is used to switch between different modes. The modes are statically configured and contained in the Watchdog Manager module configuration set.

A Mode switch changes the supervision parameters of the Supervised Entities.

[SWS_WdgM_00182] ⌈If the current global status is WDGM_GLOBAL_STATUS_OK or WDGM_GLOBAL_STATUS_FAILED then for each Supervised Entity that is activated in the new mode (passed to function WdgM_SetMode as parameter), the function WdgM_SetMode shall retain the current state of the Supervised Entity.

Switching to the mode where a Supervised Entity is deactivated clears also errors that had resulted with the WDGM_GLOBAL_STATUS_FAILED status.⌋

[SWS_WdgM_00315] ⌈If the current global status is WDGM_GLOBAL_STATUS_OK or WDGM_GLOBAL_STATUS_FAILED then for each Supervised Entity that is deactivated in the new mode (passed to function WdgM_SetMode as parameter), the function WdgM_SetMode shall change the state of the Supervised Entity to WDGM_LOCAL_STATUS_DEACTIVATED; It shall set its Results of Active, Deadline and Logical Supervision to correct; It shall also clear its failed reference cycle counter to 0.⌋

Executing a mode switch is possible when the Watchdog Manager module is in the state WDGM_GLOBAL_STATUS_OK or WDGM_GLOBAL_STATUS_FAILED. In other modes the function WdgM_SetMode has no effect (see [SWS_WdgM_00145]).

[SWS_WdgM_00316] ⌈If the current global status is not WDGM_GLOBAL_STATUS_OK nor WDGM_GLOBAL_STATUS_FAILED then the function WdgM_SetMode shall return without doing any actions.⌋

7.5.2 Effect on Watchdogs

A mode switch also changes the parameters for watchdog triggering.

[SWS_WdgM_00186]

Upstream requirements: SRS_ModeMgm_09143

⌈If function WdgM_SetMode (see [SWS_WdgM_00154]) is called, the Watchdog Manager module shall apply the configured watchdog mode parameters (see WdgMWatchdogMode [ECUC_WdgM_00332]) to each watchdog by calling the WdgM_SetMode service.⌋

Note: If a call to WdgM_SetMode service fails, the Watchdog Manager module assumes a global supervision failure and set the Global Supervision Status to WDGM_GLOBAL_STATUS_STOPPED (see [SWS_WdgM_00139]). This will cause a reset, either when the first watchdog expires or immediately, if an immediate reset of the Watchdog Manager module is configured.

There is also the possibility to forbid switching off the watchdogs (see [SWS_WdgM_00031]).

7.5.3 Watchdog Handling during Sleep

When the ECU State Manager enters SLEEP state it activates the sleep mode and calls the service WdgM_DeInit.

The WdgM_DeInit (see [SWS_WdgM_00261]) updates the trigger conditions via a Watchdog Manager Mode switch to a sleep mode defined by the integrator and deinitializes the Watchdog Manager module. The mode switch is needed to update the watchdogs trigger conditions of all running watchdogs to a timeout that allows the rest of the shutdown to be executed without a watchdog reset. This is needed as a consequence of the concept “Windowed Watchdogs”.

While the ECU is in SLEEP state, the normal execution of code and therefore also of the Watchdog Manager module is suspended. If the hardware watchdogs cannot or shall not be deactivated during SLEEP, this would inevitably lead to a watchdog reset.

Thus, the watchdogs have to be triggered at some time during SLEEP. BSW components which are still in-service (like the BswM or the EcuM) have to care about the triggering of the hardware watchdogs while the Watchdog Manager module is deactivated. The Integrator has to configure the needed modes accordingly.

7.6 Watchdog Manager Configuration

7.6.1 Mode-independent Supervision Settings

7.6.1.1 Supervised Entity

To support portability of SW-Cs across platforms, the Watchdog Manager module needs to be adapted to the amount of Supervised Entities located on the respective ECU.

[SWS_WdgM_CONSTR_06502]

Status: DRAFT

⌈A unique Supervised Entity identifier for each Supervised Entity is provided in configuration parameter WdgMSupervisedEntityId (see [ECUC_WdgM_00304]). The Identifier shall be unique in the scope of a Watchdog Manager configuration.⌋

The Supervised Entities and Checkpoints exist irrespective of Modes. On the other side, the Supervision Functions exist partially irrespective of Modes, and partially dependent on Modes.

[SWS_WdgM_00282] ⌈In order to have a Supervised Entity with supervision activated in a given mode (in short: Activated Supervised Entity), the following shall be fulfilled:

1. The Supervised Entity shall be referenced from the Mode (see WdgMMode -> WdgMLocalStatusParams -> WdgMLocalStatusSupervisedEntityRef -> WdgMSupervisedEntity AND
2. At least one of mode-dependent settings of Supervision Functions shall be set for the given Mode (Alive, Deadline, Logical for External Graphs)

⌋

[SWS_WdgM_00283] ⌈In order to have a Supervised Entity with supervision deactivated in a given mode (in short: Deactivated Supervised Entity), the following shall be fulfilled:

1. The Supervised Entity shall not be referenced from the Mode (see WdgMMode -> WdgMLocalStatusParams -> WdgMLocalStatusSupervisedEntityRef -> WdgMSupervisedEntity AND
2. No mode-dependent settings of Supervision Functions shall be set for the given Mode (Alive, Deadline, Logical for External Graphs)

As the Logical supervision for Internal Graphs is a property of a Supervised Entity, the configurations of Logical Supervision for Internal Graphs do not impact the deactivation/activation status of Supervised Entity.⌋

7.6.1.2 Logical Supervision of Internal Graphs

Each Supervised Entity can have a configured control flow that is supervised by Watchdog Manager. This control flow is abstracted by its Checkpoints and Transitions (see [ECUC_WdgM_00303]). At least one of the Checkpoints per Graph is marked as the initial one (see [ECUC_WdgM_00343]).

[SWS_WdgM_CONSTR_06506] ⌈Internal Transitions (see WdgMInternalTransition) in a Supervised Entity shall not connect Checkpoints that do not both belong to the same Supervised Entity.⌋

To switch on and off the Logical Supervision of an Internal Graph depending on the mode, it is needed to reference (or respectively do not reference) the Supervised Entity from each mode (see WdgMLocalStatusParams).

It is possible to have zero or one Internal Graphs per Supervised Entity. Not all Checkpoints of a Supervised Entity need to be a part of its Internal Graph.

The Internal Transitions and Internal Graphs are a property of Supervised Entity. These Internal Transitions depend only on the control flow within the Supervised Entity. Thus, the developer of an SW-C or BSW module that contains the Supervised Entity can deliver this configuration of Checkpoints and Internal Transitions independently of other Supervised Entities. Figure 7.8 shows a configuration of two independently Supervised Entities, with independently configured Internal Graphs.

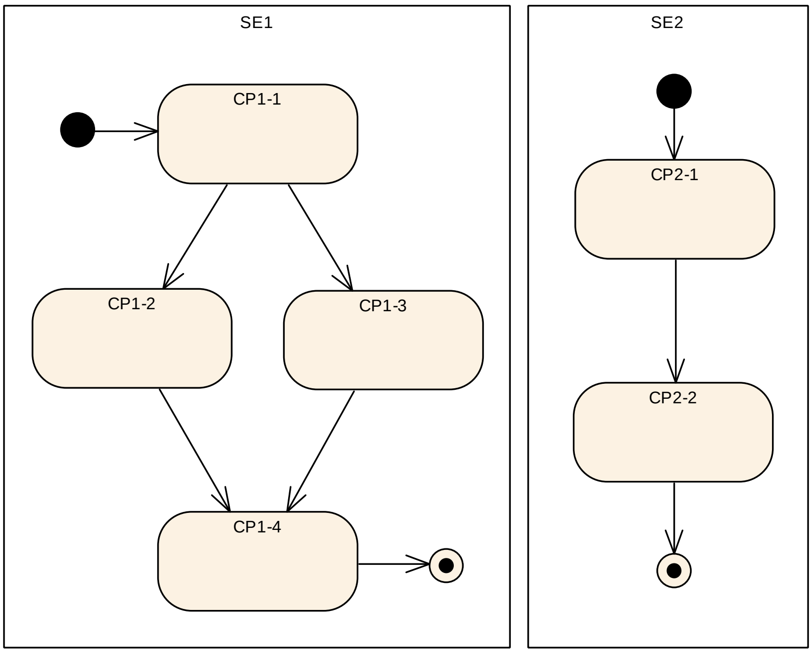


Figure 7.8: Two Supervised Entities with their Checkpoints and Internal Transitions

7.6.2 Mode-Dependent Parameters

7.6.2.1 Mode

Changing the mode of the Watchdog Manager module (Watchdog Manager Mode) also leads to changed conditions for handling the watchdogs, such as different watchdog modes. Therefore the Watchdog Manager module provides for each configured mode and for each watchdog a number of statically configured watchdog parameters (see WdgMTrigger [ECUC_WdgM_00331]).

[SWS_WdgM_00181] ⌈For each watchdog instance, the watchdog mode shall be statically configured and represented by the parameter WdgMWatchdogMode.⌋

The corresponding watchdog can be disabled by configuring the watchdog mode to WDGIF_OFF_MODE.

The Watchdog Manager module has a set of statically configured supervision parameters for each configured mode (WdgMMode [ECUC_WdgM_00335]) and for each Supervised Entity that is expected to be supervised in the given mode.

7.6.2.2 Logical Supervision of External Graphs

There are also Transitions that cross the boundaries of Supervised Entities. These External Transitions appear when the Watchdog Manager module should also supervise the execution sequence of multiple Supervised Entities. The External Transitions form External Graphs.

Thus, External Transitions have to be configured independently from the Internal Transitions and only in the context of Logical Supervision. (see WdgMExternalLogicalSupervision [ECUC_WdgM_00319])

When we integrate the two Supervised Entities from Figure 7.8, we can for example decide that Supervised Entity SE1 must always be executed to Checkpoint CP1-4 and then Supervised Entity SE2 has to start execution at Checkpoint CP2-1. Then it is necessary to configure a Transition from CP1-4 to CP2-1. This Transition does neither belong to SE1 nor to SE2. Figure 7.9 shows the External Transition.

There is a significant difference in configuring Internal and External Transitions. An Internal Transition belongs to one Supervised Entity and it does not depend on the Watchdog Manager Modes. One can configure to activate/deactivate an SE in a given mode by referencing it from the mode. However, it is not possible to have different Transitions or Checkpoints within the same SE depending on the mode. In contrary, External Transitions are contained in a particular Watchdog Manager Mode. There can be several External Transition Graphs per mode. In case two different Modes have same global Graphs of global Transitions, then they need to be duplicated.

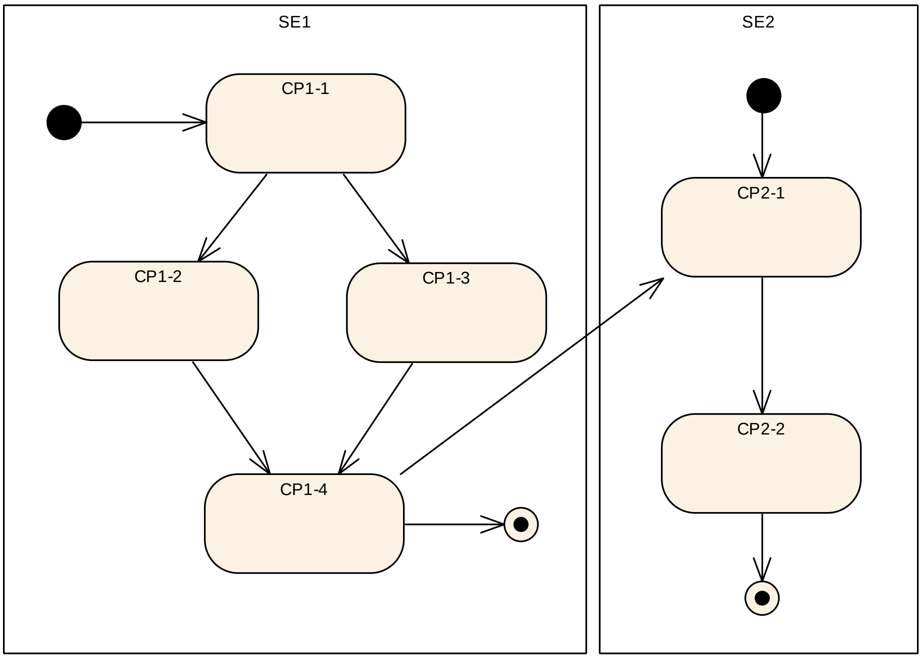


Figure 7.9: Two Supervised Entities with an External Transition

The start points (see [ECUC_WdgM_00324]), endpoints (see [ECUC_WdgM_00323]) and the External Transitions are configured for each Watchdog Manager Mode (see [ECUC_WdgM_00319]).

The Watchdog Manager module supports a number of different modes (see WdgM-ConfigSet [ECUC_WdgM_00337]) of operation. Each mode (see WdgMMode [ECUC_WdgM_00335]) is defined by:

- the set of Activated Supervised Entities (see [SWS_WdgM_00282]) and their parameters (see WdgMLocalStatusParams [ECUC_WdgM_00325]),
- the Supervision Functions (see WdgMAliveSupervision [ECUC_WdgM_00308], WdgMDeadlineSupervision [ECUC_WdgM_00314], WdgMExternalLogicalSupervision [ECUC_WdgM_00319]),
- the set of watchdogs to have their trigger condition updated (see WdgMTrigger [ECUC_WdgM_00331])

Different modes are needed for different phases in the ECU life cycle. E.g. one mode is active during startup and shutdown, another during normal operation and yet another during sleep. Even during normal operation, multiple modes could be needed: when multiple applications run on the same ECU, one application could be shutdown already and require no supervision, while another application still runs and needs to be supervised.

[SWS_WdgM_00178] ⌈Each mode of the Watchdog Manager module has an identifier (see WdgMModeId [ECUC_WdgM_00308]) which shall be unique.⌋

[SWS_WdgM_00179] ⌈The Watchdog Manager module has one initial mode WdgMInitialMode [ECUC_WdgM_00336] which shall be activated when it is initialized.⌋

7.6.2.3 Alive Supervision

The timing constraints of each Checkpoint are represented by configurable parameters of the Watchdog Manager module (see WdgMAliveSupervision [ECUC_WdgM_00308]). Although the timing constraints are defined for a Checkpoint, the Watchdog Manager determines the result of the Alive Supervision for the whole Supervised Entity.

The acceptable amount of Failed Supervision Reference Cycles is based on application context of each Supervised Entity. Therefore the individual thresholds to check if Alive Supervision of the corresponding Supervised Entity has failed finally, needs to be a configurable parameter (see WdgMFailedAliveSupervisionRefCycleTol [ECUC_WdgM_00327]).

When the Alive Supervision has reached expired conditions by any Local Supervision Status, this will make recovery obsolete. As a consequence the watchdog triggering will be stopped, but to ensure a certain time-period for any further reactions on this condition, the blocking of watchdog triggering could be postponed for an amount of consecutive Supervision Cycles (see WdgMExpiredSupervisionCycleTol [ECUC_WdgM_00329]).

[SWS_WdgM_CONSTR_00320] ⌈No two WdgMAliveSupervisions aggregated by the same WdgMMode shall refer to the identical WdgMCheckpoint.⌋

7.6.2.4 Deadline Supervision

[SWS_WdgM_CONSTR_06505] ⌈Deadline Supervision (WdgMDeadlineSupervision) of a Supervised Entity shall refer to Checkpoints (WdgMDeadlineStartRef, WdgMDeadlineStopRef) that both belong to that Supervised Entity. In other words, any of the referred Checkpoints shall not belong to other Supervised Entities.⌋

[SWS_WdgM_CONSTR_06512] ⌈Any ordered set of two Checkpoints shall not have more than one Deadline Supervision (WdgMDeadlineSupervision) defined.⌋

7.7 Support for Clustered Software Architecture using Software Cluster Connector (SwCluC)

This section is applicable to clustered software architecture (WdgMSwClusterSupport = ENABLE_SW_CLUSTER_SUPPORT) only, i.e. not applicable to non-clustered software architecture.

7.7.1 Software Architectural Assumptions and Constraints

For an ECU Software which supports clustered software architecture (with or without a multi-partition configuration), it is assumed that the Watchdog Manager will be allocated to each Software Cluster with the fashion below (also illustrated in Figure 7.10):

- Within the Host Software Cluster, the WdgM shall provide complete sets of APIs (WdgM_MainFunction, WdgM_CheckpointReached etc.). At least one WdgM_MainFunction will be available per EcucPartition. These API sets perform:
  - Alive, Deadline and Logical Supervision within the Host Software Cluster, per EcucPartition (i.e. in the master and in every satellites)
  - Logical Supervision over Software Clusters, based on Cross-Cluster External Graph (only in the EcucPartition which contains master side of WdgM)
  - Determination of Local Supervision Status per Supervised Entity
  - Determination of Global Supervision Status (only in the master)
  - Recovery Actions based on Local Supervision Status
  - Recovery Actions based on Global Supervision Status (only in the master)
  - Watchdog Handling (incl. Watchdog Trigger via WdgIf and Wdg modules) (only in the master)
- Within the Host Software Cluster, WdgM shall provide satellites (WdgM_MainFunctions) on all EcucPartitions, that can be connected to WdgM masters within every Application Software Cluster. This ensures that each WdgM (master) in an Application Software Cluster can get access to the WdgM in the Host Software Cluster on the same partition.
- Within each Application Software Cluster, WdgM shall provide subsets of APIs. At least one WdgM_MainFunction will be available per EcucPartition.
  - Alive, Deadline and Logical Supervision within the Host Software Cluster, per EcucPartition (i.e. in the master and in every satellites)
  - Determination of Local Supervision Status per Supervised Entity
  - Recovery Actions based on Local Supervision Status

Note that, if there're multiple Main Functions in the master side within Host Software Cluster, following design decision will be required, but not standardized in this specification (because realization of master-satellite pattern is implementation specific).

- Mapping of Recovery Action etc. to Main Functions
- Availability of Init / DeInit APIs etc.

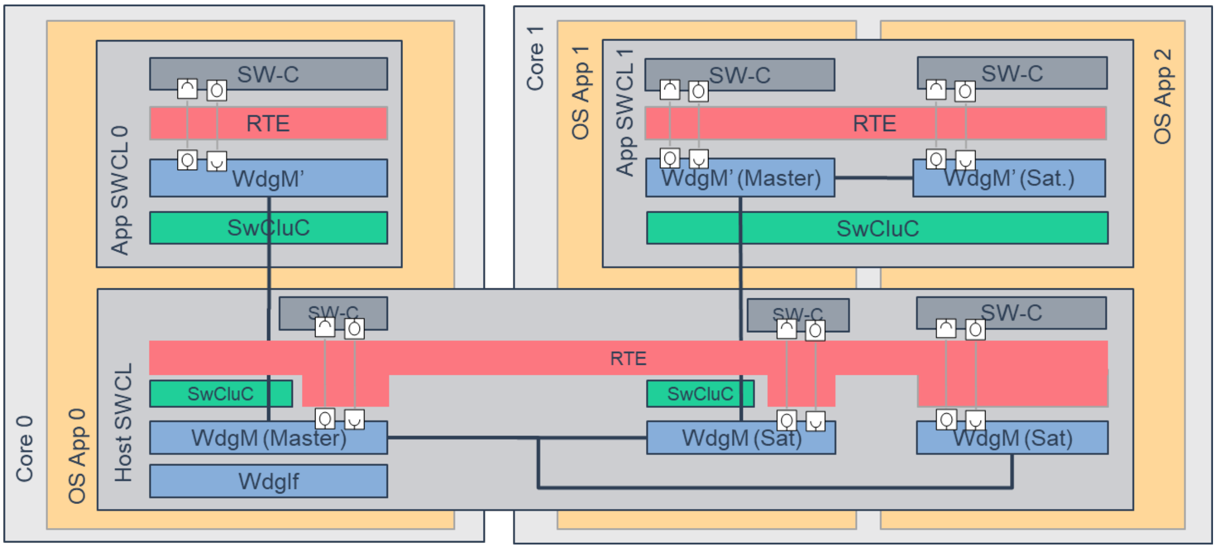


Figure 7.10: Overview of Watchdog Manager with Software Clustering

7.7.2 Configuration Aspects

[SWS_WdgM_CONSTR_06516] Software Cluster related configurations cannot be used with disabled Software Cluster Support

Status: DRAFT

⌈In case of non-clustered software architecture (WdgMSwClusterSupport is not set or set to DISABLE_SW_CLUSTER_SUPPORT), the parameters and containers WdgMCrossClusterTransition, WdgMTransitionProxy and WdgMBaseSocket shall not exist.⌋

[SWS_WdgM_CONSTR_06517] Valid cross cluster transition

Status: DRAFT

⌈A WdgMCrossClusterTransition is only valid in following configurations:

- from a WdgMCheckpoint to a WdgMTransitionProxy
- from a WdgMTransitionProxy to a WdgMCheckpoint
- from a WdgMTransitionProxy to another WdgMTransitionProxy (in Host Software Cluster only)

- from a WdgMTransitionProxy to the identical WdgMTransitionProxy (in Application Software Cluster only for the case that no WdgMCheckpoint has to be reached in the Application Software Cluster), or
- from a WdgMCheckpoint to a WdgMCheckpoint (in case the cross cluster transition Graph is entirely described with WdgMCrossClusterTransition containers).

Hereby the “from” is configured with the WdgMCrossClusterTransitionSourceRef, and the “to” is given by the WdgMCrossClusterTransitionDestRef.⌋

[SWS_WdgM_CONSTR_06518] WdgMBaseSocket relates only to a CpSoftwareClusterServiceResource of category SWCLUSTER_RES_WDGM_BASES_SOCKET

Status: DRAFT

⌈The WdgMBaseSocket.WdgMResourceRef shall only reference a CpSoftwareClusterServiceResource of category SWCLUSTER_RES_WDGM_BASES_SOCKET.⌋

[SWS_WdgM_CONSTR_06519] WdgMTransitionProxy relates only to a CpSoftwareClusterServiceResource of category SWCLUSTER_RES_WDGM_TRANSITION

Status: DRAFT

⌈The WdgMTransitionProxy.WdgMResourceRef shall only reference a CpSoftwareClusterServiceResource of category SWCLUSTER_RES_WDGM_TRANSITION.⌋

ECU Configuration will be made per Software Cluster. Therefore,

- A Supervised Entity ID can be reused in different Software Clusters (see also [SWS_WdgM_CONSTR_06502])
- WdgMMode and WdgMInitialMode configuration must be consistent over Software Clusters (Host Software Clusters and Application Software Clusters)

Note that, type of Software Cluster can be identified by SwCluCGeneral. SwCluCDefinitionSelection.

7.7.2.1 Configuration for Cross-Cluster External Graphs

Cross-Cluster External Graph is an extension of External Graph to model Graphs that spans over multiple Software Clusters for clustered software architecture.

To model Graphs with inter-Cluster Transitions, following configuration elements can be used:

- WdgMCrossClusterTransition (instead of WdgMExternalTransition) which represents a Transition to other Software Cluster (contains reference to destination Checkpoint in other Software Cluster) or a Transition from other Software Cluster (contains reference to source Checkpoint in other Software Cluster)
- WdgMTransitionProxy (instead of WdgMCheckpoint) which represents a Checkpoint in other Software Cluster

7.8 Error Classification

Section "Error Handling" of the document [3, General Specification of Basic Software Modules] 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.

7.8.1 Development Errors

[SWS_WdgM_00004] Definiton of development errors in module WdgM

Upstream requirements: SRS_BSW_00327, SRS_BSW_00337, SRS_BSW_00385, SRS_BSW_00480, SRS_BSW_00481, SRS_BSW_00487

⌈

Type of error	*Related error code*	*Error value*
API service used in wrong context (without module initialization)	WDGM_E_UNINIT	0x10
API service Wdg_Init was called with an erroneous configuration set	WDGM_E_PARAM_CONFIG	0x11
API service called with wrong "mode" parameter	WDGM_E_PARAM_MODE	0x12
API service called with wrong "supervised entity identifier" parameter	WDGM_E_PARAM_SEID	0x13
API service called with invalid pointer	WDGM_E_INV_POINTER	0x14
API service used with an invalid CheckpointId.	WDGM_E_CPID	0x16
API service used in wrong context - WdgM_Init called when module is not deinitialized (global status is not WDGM_GLOBAL_STATUS_DEACTIVATED)	WDGM_E_NO_DEINIT	0x1A

▽

△

Type of error	*Related error code*	*Error value*
Initialization failed, e.g. selected configuration set doesn't exist	WDGM_E_INIT_FAILED	0x1B
API service called with a null pointer parameter	WDGM_E_PARAM_POINTER	0x1C

⌋

7.8.2 Runtime Errors

[SWS_WdgM_00402] Definiton of runtime errors in module WdgM

Upstream requirements: SRS_BSW_00327, SRS_BSW_00337, SRS_BSW_00385

⌈

Type of error	*Related error code*	*Error value*
Disabling of watchdog not allowed (e.g. in safety-related systems)	WDGM_E_DISABLE_NOT_ALLOWED	0x15
API service used with a checkpoint of a Supervised Entity that is deactivated in the current Watchdog Manager mode.	WDGM_E_SEDEACTIVATED	0x19
Watchdog drivers' mode switch has failed	WDGM_E_SET_MODE	0x1D

⌋

7.8.3 Production Errors

The Watchdog Manager module detects the following production errors:

[SWS_WdgM_00375]

Upstream requirements: SRS_BSW_00327, SRS_BSW_00337, SRS_BSW_00385, SRS_BSW_00458

⌈

Error Name:	WDGM_E_SUPERVISION
Short Description:	Supervision has failed and a watchdog reset will occur
Long Description:	Supervision has failed (Global Supervision Status has reached WDGM_GLOBAL_STATUS_STOPPED) and a watchdog reset will occur.

▽

△

Detection Criteria:	Fail	WDGM_GLOBAL_STATUS_STOPPED has been reached, the reset will occur.
	Pass	After a start up.
Secondary Parameters:	-	
Time Required:	depending on configuration of WdgM	
Monitor Frequency:	periodic supervision within WdgM	

⌋

Note: The stored DTC will never show up as “confirmed”, because it will be reset at each start up (see [SWS_Dem_00391]).

Note: The stored DTC may not show up “test failed (event active)” even if DemStatusBitStorageTestFailed were set to true, because storage of the DTC cannot be always ensured after reaching Global Supervision Status = WDGM_GLOBAL_STATUS_-STOPPED (see [SWS_Dem_00388] and [SWS_Dem_00525]).

[SWS_WdgM_00408]

Upstream requirements: SRS_BSW_00339, SRS_BSW_00458, SRS_BSW_00469, SRS_BSW_-00470, SRS_BSW_00471, SRS_ModeMgm_09159

⌈Within the first call of WdgM_MainFunction after WdgM_Init, but after [SWS_WdgM_00129] is executed and if the parameter WDGM_E_SUPERVISION is configured, the Watchdog Manager module shall report an error status PASSED for WDGM_E_SUPERVISION to the DEM.⌋

7.8.4 Extended Production Errors

There are no extended production errors.

7.9 Security Events

The module does not report security events.

8 API specification

8.1 Imported types

The following data types are used by Watchdog Manager module.

[SWS_WdgM_00011] Definition of imported datatypes of module WdgM

Upstream requirements: SRS_BSW_00357

⌈

Module	***Header File***	***Imported Type***
Dem	Rte_Dem_Type.h	Dem_EventIdType
	Rte_Dem_Type.h	Dem_EventStatusType
Os	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
SwCluC	SwCluC_BManif.h	SwCluC_BManif_HandleIndexType
	SwCluC_BManif.h	SwCluC_BManif_SwClusterIdType
	SwCluC_BManif.h	SwCluC_BManif_TableIndexType
WdgIf	WdgIf.h	WdgIf_ModeType

⌋

8.2 Type definitions

The following Data Types are used for the functions defined in this specification.

8.2.1 WdgM_ConfigType

[SWS_WdgM_00355] Definition of datatype WdgM_ConfigType ⌈

Name	WdgM_ConfigType	
Kind	Structure	
Elements	implementation specific	
	Type	–
	Comment	The contents of this structure depends on the configuration variant.
Description	This structure contains all post-build configurable parameters of the Watchdog Manager. A pointer to this structure is passed to the Watchdog Manager initialization function for configuration.	
Available via	WdgM.h	

⌋

8.3 Function definitions

[SWS_WdgM_00411]

Status: DRAFT

⌈For clustered software architecture (one Host Software Cluster and zero or more Application Software Cluster), Host Software Cluster shall provide all APIs which are permanently available or enabled by configuration.⌋

[SWS_WdgM_00412]

Status: DRAFT

⌈For clustered software architecture, Application Software Cluster shall provide following APIs which are permanently available or enabled by configuration.

- WdgM_GetVersionInfo
- WdgM_CheckpointReached
- WdgM_GetMode
- WdgM_GetLocalStatus

⌋

8.3.1 WdgM_Init

[SWS_WdgM_00151] Definition of API function WdgM_Init

Upstream requirements: SRS_BSW_00310, SRS_BSW_00358, SRS_ModeMgm_09107

⌈

Service Name	WdgM_Init	

Syntax	`void WdgM_Init (`
	`  const WdgM_ConfigType* ConfigPtr`
	`)`	

Service ID [hex]	0x00	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	ConfigPtr	Pointer to post-build configuration data
Parameters (inout)	None	
Parameters (out)	None	
Return value	None	
Description	Initializes the Watchdog Manager.	
Available via	WdgM.h	

⌋

This function initializes the Watchdog Manager. After execution of this function, supervision is activated according to the list of Supervised Entities defined in the initial Mode.

To perform a module reinitialization (e.g. after error), the caller can invoke WdgM_DeInit() and then WdgM_Init().

[SWS_WdgM_00018]

Upstream requirements: SRS_BSW_00101, SRS_ModeMgm_09107

⌈The function WdgM_Init shall initialize all module variables (global and static) of the Watchdog Manager module.⌋

[SWS_WdgM_00135]

Upstream requirements: SRS_BSW_00101, SRS_ModeMgm_09107

⌈The function WdgM_Init shall establish the initial mode of the Watchdog Manager module.⌋

Note: If a call to WdgIf_SetMode service fails during WdgM_Init, then the MCU Reset API is called directly (only if configured, see [SWS_WdgM_00133]) and the Watchdog Manager module will be in state initialized afterwards with Global Supervision Status = WDGM_GLOBAL_STATUS_STOPPED (see [SWS_WdgM_00139]). This will cause a reset, either when the first watchdog expires (if an immediate reset of the

Watchdog Manager module is not configured) or immediately (if an immediate reset is configured).

[SWS_WdgM_00030]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00452, SRS_ModeMgm_09109

⌈If the WdgMOffModeEnabled [ECUC_WdgM_00340] switch is not enabled, and the initial mode provided by the configuration (ConfigPtr) will disable the watchdog (WDGIF_OFF_MODE) then the function WdgM_Init shall return with E_NOT_OK without any action, and the function WdgM_Init shall report runtime error code WDGM_E_DISABLE_NOT_ALLOWED to the Default Error Tracer.⌋

There are optional checks that are executed if and only if WdgMDevErrorDetect is enabled.

[SWS_WdgM_00389]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled: The function WdgM_Init shall report the error to default error tracer with error code WDGM_E_UNINIT, without any further effect, if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00390]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is disabled: The function WdgM_Init shall return without any effect if the Watchdog Manager is not in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00010]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the WdgMDevErrorDetect [ECUC_WdgM_00301] switch is enabled and the configuration variant is VARIANT-POST-BUILD, the function WdgM_Init shall check the contents of the given configuration set for being within the allowed boundaries. If the function WdgM_Init detects an error, then it shall not execute the initialization of the Watchdog Manager module and it shall report the error code WDGM_E_PARAM_CONFIG to the Det_ReportError service of the Default Error Tracer.⌋

[SWS_WdgM_00370]

Upstream requirements: SRS_BSW_00101

⌈The function WdgM_Init shall clear from the non-initialized RAM the double-inverse value storing the SEID that first reached the EXIRED state.⌋

See Section 8.3.10 for more information.

8.3.2 WdgM_DeInit

[SWS_WdgM_00261] Definition of API function WdgM_DeInit

Upstream requirements: SRS_BSW_00310, SRS_BSW_00336

⌈

Service Name	WdgM_DeInit

Syntax	`void WdgM_DeInit (`
	`  void`
	`)`

Service ID [hex]	0x01
Sync/Async	Synchronous
Reentrancy	Non Reentrant
Parameters (in)	None
Parameters (inout)	None
Parameters (out)	None
Return value	None
Description	De-initializes the Watchdog Manager.
Available via	WdgM.h

⌋

This function deinitializes the Watchdog Manager module and updates the trigger conditions of all Watchdog Drivers via a mode switch (see [SWS_WdgM_00154]).

Note this service is needed as a consequence of the concept “Windowed Watchdogs”. Before the Watchdog Manager module stops working, it has to set the trigger conditions of all running watchdogs to a timeout that allows the rest of the shutdown to be executed without a watchdog reset.

There are optional checks that are executed if and only if WdgMDevErrorDetect is enabled.

[SWS_WdgM_00288]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled: The function WdgM_DeInit shall report the error to default error tracer with error code WDGM_E_UNINIT, without any further effect, if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00388]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is disabled: The function WdgM_DeInit shall return without any effect if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

8.3.3 WdgM_GetVersionInfo

[SWS_WdgM_00153] Definition of API function WdgM_GetVersionInfo

Upstream requirements: SRS_BSW_00310

⌈

Service Name	WdgM_GetVersionInfo	

Syntax	`void WdgM_GetVersionInfo (`
	`  Std_VersionInfoType* VersionInfo`
	`)`	

Service ID [hex]	0x02	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	None	
Parameters (inout)	None	
Parameters (out)	VersionInfo	Pointer to where to store the version information of the module WdgM.
Return value	None	
Description	Returns the version information of this module.	
Available via	WdgM.h	

⌋

[SWS_WdgM_00256]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the WdgMDevErrorDetect [ECUC_WdgM_00301] switch is enabled, the function WdgM_GetVersionInfo shall check if a NULL pointer is passed for the VersionInfo parameter. In case of an error the remaining function WdgM_GetVersionInfo shall not be executed and the function WdgM_GetVersionInfo shall report development error code WDGM_E_INV_POINTER to the Det_ReportError service of the Default Error Tracer.⌋

8.3.4 WdgM_SetMode

[SWS_WdgM_00154] Definition of API function WdgM_SetMode

Upstream requirements: SRS_BSW_00310, SRS_ModeMgm_09110

⌈

Service Name	WdgM_SetMode	

Syntax	`Std_ReturnType WdgM_SetMode (`
	`  WdgM_ModeType Mode`
	`)`	

Service ID [hex]	0x03	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	Mode	One of the configured Watchdog Manager modes.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	E_OK: Successfully changed to the new mode E_NOT_OK: Changing to the new mode failed
Description	Sets the current mode of Watchdog Manager.	
Available via	WdgM.h	

⌋

The behavior of this service and the corresponding functional requirements are described in Section 7.5.

[SWS_WdgM_00145]

Upstream requirements: SRS_ModeMgm_09158

⌈The Watchdog Manager module shall only execute the service WdgM_SetMode if the Global Supervision Status is equal to [WDGM_GLOBAL_STATUS_OK or WDGM_GLOBAL_STATUS_FAILED.⌋

[SWS_WdgM_00142]

Upstream requirements: SRS_BSW_00339, SRS_BSW_00452

⌈If the function WdgM_SetMode [SWS_WdgM_00154] fails because a call to WdgIf_SetMode service fails [SWS_WdgM_00139], the Watchdog Manager shall report to the Default Error Tracer a runtime error with the value WDGM_E_SET_MODE.⌋

[SWS_WdgM_00031]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00452, SRS_ModeMgm_09109

⌈If disabling the watchdog is not allowed by setting the parameter WdgMOffModeEnabled [ECUC_WdgM_00340] to FALSE, the routine shall check if the requested mode would disable the watchdog (WDGIF_OFF_MODE). In this case (i.e. it would disable while it is not allowed),

1. The mode switch shall not be executed.
2. The error shall be reported to the Default Error Tracer with the runtime error code WDGM_E_DISABLE_NOT_ALLOWED.
3. The routine shall return the value E_NOT_OK.

⌋

There are optional checks that are executed if and only if WdgMDevErrorDetect is enabled.

[SWS_WdgM_00020]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled, the parameter Mode shall be checked for being in the allowed range. In case of an error, the mode switch shall not be executed and the error shall be reported to the Default Error Tracer with the value WDGM_E_PARAM_MODE.⌋

[SWS_WdgM_00021]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350, SRS_BSW_00406

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled: The function WdgM_SetMode shall report the error to default error tracer with error code WDGM_E_UNINIT, without any further effect, if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00392]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is disabled: The function WdgM_SetMode shall return without any effect if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

8.3.5 WdgM_GetMode

[SWS_WdgM_00168] Definition of API function WdgM_GetMode

Upstream requirements: SRS_BSW_00310

⌈

Service Name	WdgM_GetMode	

Syntax	`Std_ReturnType WdgM_GetMode (`
	`  WdgM_ModeType* Mode`
	`)`	

Service ID [hex]	0x0b	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	None	
Parameters (inout)	None	
Parameters (out)	Mode	Current mode of the Watchdog Manager.
Return value	Std_ReturnType	E_OK: Current mode successfully returned E_NOT_OK: Returning current mode failed
Description	Returns the current mode of the Watchdog Manager.	
Available via	WdgM.h	

⌋

[SWS_WdgM_00170] ⌈The WdgM_GetMode service shall return the currently active mode of the Watchdog Manager. If the WdgM_SetMode service is active while this service is called, WdgM_GetMode shall return the previously active mode as long as the new mode has not been completely activated.⌋

There are optional checks that are executed if and only if WdgMDevErrorDetect is enabled.

[SWS_WdgM_00253]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled: The function WdgM_GetMode shall report the error to default error tracer with error code WDGM_E_UNINIT, without any further effect, if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00395]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is disabled: The function WdgM_GetMode shall return without any effect if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00254]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter `WdgMDevErrorDetect` [ECUC_WdgM_00301] is enabled, the routine shall check if NULL pointers are passed for OUT parameters. In case of an error, the service shall not be executed and the error shall be reported to the Default Error Tracer with the error code `WDGM_E_INV_POINTER`.⌋

8.3.6 `WdgM_CheckpointReached`

[SWS_WdgM_00263] Definition of API function WdgM_CheckpointReached

Upstream requirements: SRS_BSW_00310

⌈

Service Name	WdgM_CheckpointReached	

Syntax	`Std_ReturnType WdgM_CheckpointReached (`
	`  WdgM_SupervisedEntityIdType SEID,`
	`  WdgM_CheckpointIdType CheckpointID`
	`)`	

Service ID [hex]	0x0e	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	SEID	Identifier of the Supervised Entity that reports a Checkpoint.
	CheckpointID	Identifier of the Checkpoint within a Supervised Entity that has been reached.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	`E_OK`: Successfully updated alive counter `E_NOT_OK`: Update failed
Description	Indicates to the Watchdog Manager that a Checkpoint within a Supervised Entity has been reached.	
Available via	WdgM.h	

⌋

[SWS_WdgM_00321] ⌈The function `WdgM_CheckpointReached()` shall increment the Alive Counter of reported `Checkpoint`.⌋

[SWS_WdgM_00322]

Upstream requirements: RS_HM_09235

⌈The function `WdgM_CheckpointReached()` shall perform the Deadline Supervision (detection of early arrivals and delays) for the reported Supervised Entity using the reported `Checkpoint`. The output shall be an updated result of Deadline Supervision for the Supervised Entity.⌋

[SWS_WdgM_00323] ⌈The function WdgM_CheckpointReached() shall perform the Logical Supervision for the reported Supervised Entity using the reported Checkpoint. The output shall be an updated result of Logical Supervision for the Supervised Entity.⌋

[SWS_WdgM_00319]

Upstream requirements: SRS_BSW_00452

⌈The routine shall check if Supervised Entity to which the parameter CheckpointID belongs, is activated in the current mode. In case of an error (i.e. the Supervised Entity is deactivated in the current mode), the service shall return with E_NOT_OK without any action, and the error shall be reported to the Default Error Tracer with the runtime error code WDGM_E_SEDEACTIVATED.⌋

There are optional checks that are executed if and only if WdgMDevErrorDetect is enabled.

[SWS_WdgM_00394]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is disabled: The function WdgM_CheckpointReached shall return without any effect if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00278]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled, the parameter SEID shall be checked for being in the list of the entities under control of the Watchdog Manager. In case of an error, the service shall not be executed and the error shall be reported to the Default Error Tracer with the error code WDGM_E_PARAM_SEID.⌋

[SWS_WdgM_00279]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled: The function WdgM_CheckpointReached shall report the error to default error tracer with error code WDGM_E_UNINIT, without any further effect, if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00396]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is disabled: The function WdgM_CheckpointReached shall return without any effect if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00284]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled, the routine shall check if the parameter CheckpointID is within the set of Checkpoints (see [ECUC_WdgM_00303]) associated with the Supervised Entity given by the parameter SEID. In case of an error, the service shall not be executed and the error shall be reported to the Default Error Tracer with the error code WDGM_E_CPID.⌋

8.3.7 WdgM_GetLocalStatus

[SWS_WdgM_00169] Definition of API function WdgM_GetLocalStatus

Upstream requirements: SRS_BSW_00310

⌈

Service Name	WdgM_GetLocalStatus	

Syntax	`Std_ReturnType WdgM_GetLocalStatus (`
	`  WdgM_SupervisedEntityIdType SEID,`
	`  WdgM_LocalStatusType* Status`
	`)`	

Service ID [hex]	0x0c	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	SEID	Identifier of the supervised entity whose supervision status shall be returned.
Parameters (inout)	None	
Parameters (out)	Status	Supervision status of the given supervised entity.
Return value	Std_ReturnType	E_OK: Current supervision status successfully returned E_NOT_OK: Returning current supervision status failed
Description	Returns the supervision status of an individual Supervised Entity.	
Available via	WdgM.h	

⌋

[SWS_WdgM_00171] ⌈The WdgM_GetLocalStatus service shall return the individual supervision status of the given Supervised Entity.⌋

There are optional checks that are executed if and only if WdgMDevErrorDetect is enabled.

[SWS_WdgM_00172]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled, the parameter SEID shall be checked for being in the list of entities under control of the Watchdog Manager. In case of an error, the service shall not be executed and the error shall be reported to the Default Error Tracer with the error code WDGM_E_PARAM_SEID.⌋

[SWS_WdgM_00257]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled, the routine shall check if NULL pointers are passed for OUT parameters. In case of an error, the service shall not be executed and the error shall be reported to the Default Error Tracer with the error code WDGM_E_INV_POINTER.⌋

[SWS_WdgM_00173]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled: The function WdgM_GetLocalStatus shall report the error to default error tracer with error code WDGM_E_UNINIT, without any further effect, if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00397]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is disabled: The function WdgM_GetLocalStatus shall return without any effect if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

8.3.8 WdgM_GetGlobalStatus

[SWS_WdgM_00175] Definition of API function WdgM_GetGlobalStatus

Upstream requirements: SRS_BSW_00310

⌈

Service Name	WdgM_GetGlobalStatus	

Syntax	`Std_ReturnType WdgM_GetGlobalStatus (`
	`  WdgM_GlobalStatusType* Status`
	`)`	

Service ID [hex]	0x0d	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	None	
Parameters (inout)	None	
Parameters (out)	Status	Global supervision status of the Watchdog Manager.
Return value	Std_ReturnType	`E_OK`: Current supervision status successfully returned `E_NOT_OK`: Returning current supervision status failed
Description	Returns the global supervision status of the Watchdog Manager.	
Available via	WdgM.h	

⌋

[SWS_WdgM_00344] ⌈If development error detection for the Watchdog Manager module is enabled, then the function `WdgM_GetGlobalStatus` shall check whether the parameter Status is a NULL pointer (`NULL_PTR`, see [SWS_Std_00031]). If Status is a NULL pointer, then the function shall raise the development error `WDGM_E_INV_POINTER` (i.e. invalid pointer), without any further effect.⌋

There are optional checks that are executed if and only if `WdgMDevErrorDetect` is enabled.

[SWS_WdgM_00258]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter `WdgMDevErrorDetect` [ECUC_WdgM_00301] is enabled, the routine shall check if NULL pointers are passed for OUT parameters. In case of an error, the service shall not be executed and the error shall be reported to the Default Error Tracer with the error code `WDGM_E_INV_POINTER`.⌋

[SWS_WdgM_00176]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter `WdgMDevErrorDetect` [ECUC_WdgM_00301] is enabled, the routine shall check if the Watchdog Manager is initialized. In case of an error, the service shall not be executed and the error shall be reported to the Default Error Tracer with the error code WDGM_E_UNINIT.⌋

8.3.9 WdgM_PerformReset

[SWS_WdgM_00264] Definition of API function WdgM_PerformReset

Upstream requirements: SRS_BSW_00310, SRS_ModeMgm_09232

⌈

Service Name	WdgM_PerformReset

Syntax	`void WdgM_PerformReset (`
	`  void`
	`)`

Service ID [hex]	0x0f
Sync/Async	Synchronous
Reentrancy	Non Reentrant
Parameters (in)	None
Parameters (inout)	None
Parameters (out)	None
Return value	None
Description	Instructs the Watchdog Manager to cause a watchdog reset.
Available via	WdgM.h

⌋

[SWS_WdgM_00232]

Upstream requirements: SRS_ModeMgm_09232

⌈When this service is called, the Watchdog Manager shall set the trigger condition for all configured Watchdog Drivers to 0 (zero).⌋

Thereby, the hardware watchdogs will cause an external hardware reset.

[SWS_WdgM_00233]

Upstream requirements: SRS_ModeMgm_09232

⌈After this service has been called, the Watchdog Manager shall not update the trigger condition anymore.⌋

When this API has been called, Global Supervision Status is not considered anymore.

There are optional checks that are executed if and only if WdgMDevErrorDetect is enabled.

[SWS_WdgM_00270]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled: The function WdgM_PerformReset shall report the error to default error tracer with error code WDGM_E_UNINIT, without any further effect, if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

[SWS_WdgM_00401]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is disabled: The function WdgM_PerformReset shall return without any effect if the Watchdog Manager is in WDGM_GLOBAL_STATUS_DEACTIVATED.⌋

8.3.10 WdgM_GetFirstExpiredSEID

[SWS_WdgM_00346] Definition of API function WdgM_GetFirstExpiredSEID ⌈

Service Name	WdgM_GetFirstExpiredSEID	

Syntax	`Std_ReturnType WdgM_GetFirstExpiredSEID (`
	`  WdgM_SupervisedEntityIdType* SEID`
	`)`	

Service ID [hex]	0x10	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	None	
Parameters (inout)	None	
Parameters (out)	SEID	Identifier of the supervised entity that first reached the state WDGM_LOCAL_STATUS_EXPIRED.
Return value	Std_ReturnType	E_OK: SEID successfully returned E_NOT_OK: Error when returning the SEID
Description	Returns SEID that first reached the state WDGM_LOCAL_STATUS_EXPIRED.	
Available via	WdgM.h	

⌋

[SWS_WdgM_00347] ⌈If development error detection for the Watchdog Manager module is enabled, then the function WdgM_GetFirstExpiredSEID() shall check whether the parameter SEID is a NULL pointer (NULL_PTR, see [SWS_Std_00031]). If Status is a NULL pointer, then the function shall raise the development error WDGM_E_INV_POINTER (i.e. invalid pointer), without any further effect.⌋

[SWS_WdgM_00348] ⌈The function WdgM_GetFirstExpiredSEID() shall be available before WdgM_Init.⌋

[SWS_WdgM_00349] ⌈The function WdgM_GetFirstExpiredSEID() shall read the SEID from non-initialized RAM location, stored as a double-inverse value. In case the value and the inverse value do not correspond to each other, then the function shall return E_NOT_OK and shall write 0 to *SEID. In case the value and the inverse value correspond, the function shall return E_OK and set write the read value to *SEID.⌋

8.4 Callback notifications

Not Applicable.

8.5 Scheduled functions

These functions are directly called by Basic Software Scheduler.

8.5.1 WdgM_MainFunction

[SWS_WdgM_00159] Definition of scheduled function WdgM_MainFunction

Upstream requirements: SRS_BSW_00310, SRS_BSW_00373

⌈

Service Name	WdgM_MainFunction

Syntax	`void WdgM_MainFunction (`
	`  void`
	`)`

Service ID [hex]	0x08
Description	Performs the processing of the cyclic Watchdog Manager jobs.
Available via	SchM_WdgM.h

⌋

[SWS_WdgM_00324] ⌈The function WdgM_MainFunction() shall perform the Alive Supervision for the reported Supervised Entity using the reported Checkpoint. The input of this function shall be the Alive Counters of the Checkpoint. The output of this function shall be the Results of Alive Supervision for the Supervised Entity.⌋

[SWS_WdgM_00404]

Upstream requirements: RS_HM_09235

⌈The function WdgM_MainFunction() shall perform the Deadline Supervision (detection of timeouts) for the all Supervised Entities with active Deadline Supervisions (e.g. reached a Deadline Start Checkpoints and before reaching the corresponding

Deadline End Checkpoint). The output shall be an updated result of Deadline Supervision for the Supervised Entity.⌋

[SWS_WdgM_00325] ⌈Based on the results from Alive, Deadline and Logical Supervision, for each activated Supervised Entity the function WdgM_MainFunction() shall determine the Local Supervision Status.⌋

[SWS_WdgM_00351] ⌈For the first Supervised Entity that switched to the state WDGM_LOCAL_STATUS_EXPIRED since the last time WdgM_Init() was called, the function WdgM_MainFunction() shall store the SEID of that Supervised Entity in a non-initialized RAM, as a double-inverted value (i.e. SEID and ~SEID).⌋

[SWS_WdgM_00326] ⌈Based on the Local Supervision Status of each activated Supervised Entity, the function WdgM_MainFunction() shall determine the Global Supervision Status.⌋

[SWS_WdgM_00415]

Status: DRAFT

⌈If multiple Main Functions were configured (see WdgMMainFunction), each Main Function shall have function name WdgM_MainFunction_<shortName>. The suffix <shortName> shall be derived from the short name of the WdgMMainFunction configuration container in the ECU configuration.⌋

[SWS_WdgM_00039]

Upstream requirements: SRS_BSW_00323, SRS_BSW_00350, SRS_BSW_00406

⌈If the configuration parameter WdgMDevErrorDetect [ECUC_WdgM_00301] is enabled, the routine shall check if the Watchdog Manager is initialized. In case of an error, the main function shall not be executed and the development error shall be reported to the Default Error Tracer with the error code WDGM_E_UNINIT.⌋

8.6 Expected interfaces

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

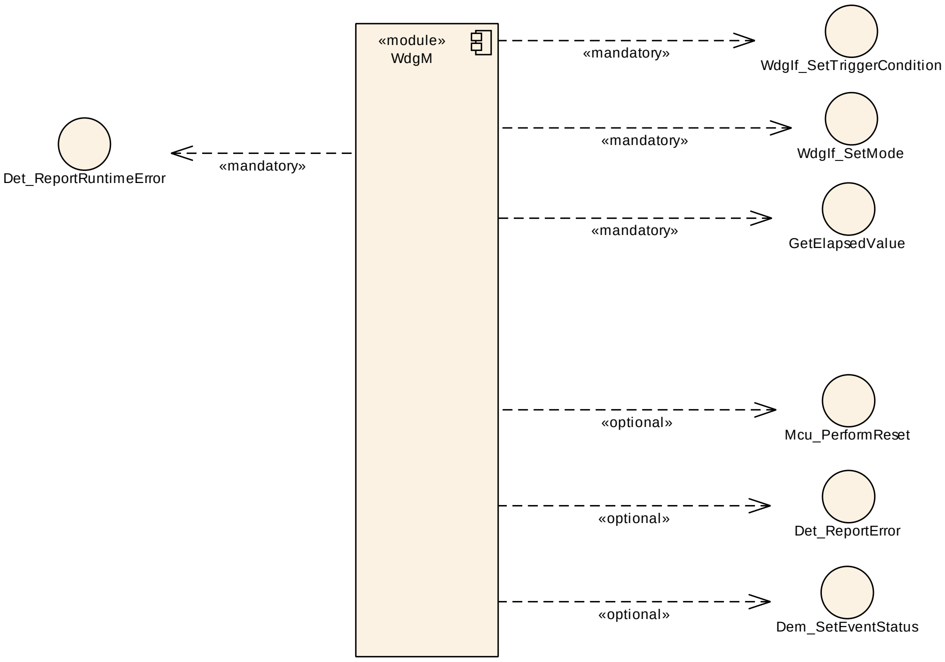


Figure 8.1: Expected Interfaces

8.6.1 Mandatory interfaces

This section defines all interfaces, which are required to fulfill the core functionality of the module.

[SWS_WdgM_00161] Definition of mandatory interfaces required by module WdgM ⌈

API Function	***Header File***	***Description***
Det_ReportRuntimeError	Det.h	Service to report runtime errors. If a callout has been configured then this callout shall be called.
GetElapsedValue	Os.h	This service gets the number of ticks between the current tick value and a previously read tick value.
WdgIf_SetMode	WdgIf.h	Map the service WdgIf_SetMode to the service Wdg_SetMode of the corresponding Watchdog Driver.
WdgIf_SetTriggerCondition	WdgIf.h	Map the service WdgIf_SetTriggerCondition to the service Wdg_SetTriggerCondition of the corresponding Watchdog Driver.

⌋

8.6.2 Optional interfaces

This section defines all interfaces, which are required to fulfill an optional functionality of the module.

[SWS_WdgM_00162] Definition of optional interfaces requested by module WdgM ⌈

API Function	*Header File*	*Description*
Dem_SetEventStatus	Dem.h	Called by SW-Cs or BSW modules to report monitor status information to the Dem. BSW modules calling Dem_SetEventStatus can safely ignore the return value. This API will be available only if ({Dem/DemConfigSet/DemEventParameter/DemEventReportingType} == STANDARD_REPORTING)
Det_ReportError	Det.h	Service to report development errors.
Mcu_PerformReset	Mcu.h	The service performs a microcontroller reset.
SwCluC_BManif_GetConSwClusterId_<ResourceEntryGroup>_<Handle>	SwCluC_BManif.h	Returns the Id of the connected Software Cluster for a Notifier Handle of a Provide Resource Entry or a Provide Handle of a Require Resource Entry
SwCluC_BManif_GetConSwClusterId_<ResourceEntryGroup>_<ResourceEntry>_<Handle>	SwCluC_BManif.h	Returns the Id of the connected Software Cluster for a Notifier Handle of a Provide Resource Entry or a Provide Handle of a Require Resource Entry
SwCluC_BManif_GetHandle_<ResourceEntryGroup>_<Handle>	SwCluC_BManif.h	Returns a handle of a Resource Entry in a Resource Entry Group
SwCluC_BManif_GetHandle_<ResourceEntryGroup>_<ResourceEntry>_<Handle>	SwCluC_BManif.h	Returns a handle of a Resource Entry in a Resource Entry Group
SwCluC_BManif_GetNoOfHandleSets_<Resource Entry Group>	SwCluC_BManif.h	Returns the number of actually used - and thereby connected - handle sets.
SwCluC_BManif_GetNoOfHandleSets_<Resource Entry Group>_<Resource Entry>	SwCluC_BManif.h	Returns the number of actually used - and thereby connected - handle sets

⌋

8.6.3 Configurable interfaces

Not Applicable.

8.7 Service Interfaces

This chapter specifies the AUTOSAR Interfaces which are provided by the Watchdog Manager module. The SW-C description of the Watchdog Manager Service will define the Watchdog Manager ports available to SW-Cs and CDDs. Each AUTOSAR SW-C or CDD that uses the service must contain service ports in its own description. These ports are typed with the same interfaces and have to be connected to the ports of the

Watchdog Manager module, so that the RTE can generate the appropriate IDs and the required symbols.

The Local Supervision Status and the Global Supervision Status of the Watchdog Manager module are reported to SW-Cs and CDDs through mode ports. An SW-C and CDD can define its own mode port with the same interface as the mode ports of the Watchdog Manager module. Afterwards the SW-C or CDD can query the status and will be informed of status changes via the mode port. In addition, the SW-C can define Runnables that are started or stopped by the RTE because of status changes.

BSW modules can call the WdgM API functions directly and taking into account the mapping by RTE, or call them via Service Ports using RTE.

[SWS_WdgM_00416]

Status: DRAFT

⌈For clustered software architecture (one Host Software Cluster and zero or more Application Software Cluster), Host Software Cluster shall provide all Ports and corresponding Port Interfaces with all Operations and ModeGroups which are permanently available or enabled by configuration.⌋

[SWS_WdgM_00417]

Status: DRAFT

⌈For clustered software architecture, Application Software Cluster shall provide following Ports and corresponding Port Interfaces with listed Operations and ModeGroups which are permanently available or enabled by configuration.

- Port: `localSupervision_{SupervisedEntityCheckpointName}` [SWS_WdgM_00147] (Port Interface: `WdgM_LocalSupervision` [SWS_WdgM_00333] with the Operation: `CheckpointReached`)
- Port: `globalSupervision` [SWS_WdgM_91002] (Port Interface: `WdgM_GlobalSupervision` [SWS_WdgM_91001] with the Operation: `GetMode`)
- Port: `mode_{SupervisedEntityName}` [SWS_WdgM_00149] (Port Interface: `WdgM_LocalMode` [SWS_WdgM_00335] with the ModeGroup: `currentMode`

⌋

8.7.1 Ports and Port Interface for Supervision

8.7.1.1 General Approach

To reduce the number of ports provided by the Watchdog Manager module all interfaces between SW-Cs / CDD and the service are modeled as Client/Server communication. To report `Checkpoints` the sender-receiver paradigm may seem more appropriate, but this kind of modeling would double the number of ports. Therefore, also for this functionality, the Client/Server paradigm has been chosen.

The unique Supervised Entity IDs are used to identify the Supervised Entities within an ECU. In order to keep the application code independent of the configuration of ECU-dependent Supervised Entity IDs, the IDs used by SW-Cs and CDDs are not modeled explicitly as data elements to be passed between SW-C and service. These IDs are modeled as “port defined argument values” of the Provide Ports of the Watchdog Manager module. As a consequence, the Supervised Entity IDs will not show up as arguments in the operations of the client-server interface. As a further consequence for this approach, there will be separate ports for each Supervised Entity.

8.7.1.2 Data Types

The information passed between the application and the service are:

1. ID to identify a Supervised Entity (as port defined argument value) and
2. ID to identify a `Checkpoint`.

The type for this Supervised Entity Identifier shall be based on the type `WdgM_SupervisedEntityIdType`. This type is defined as `uint16`. Therefore, the following type description is required:

[SWS_WdgM_00356] Definition of ImplementationDataType WdgM_Supervised EntityIdType ⌈

Name	WdgM_SupervisedEntityIdType		
Kind	Type		
Derived from	uint16		
Range	0-<Number of Supervised Entities>	–	The range of valid IDs depends on the number of configured Supervised Entities.
Description	This type identifies an individual Supervised Entity for the Watchdog Manager.		
Variation	–		
Available via	Rte_WdgM_Type.h		

⌋

The type for this Checkpoint Identifier shall be based on the type WdgM_CheckpointIdType. This type is defined as uint16. Therefore, the following type description is required:

[SWS_WdgM_00357] Definition of ImplementationDataType WdgM_Checkpoint IdType ⌈

Name	WdgM_CheckpointIdType		
Kind	Type		
Derived from	uint16		
Range	0-<Maximum number of Checkpoints>	–	The range of valid IDs depends on the maximum number of configured Checkpoints within all configured Supervised Entities.
Description	This type identifies a Checkpoint in the context of a Supervised Entity for the Watchdog Manager. Note that an individual Checkpoint can only be identified by the pair of Supervised Entity ID and Checkpoint ID.		
Variation	–		
Available via	Rte_WdgM_Type.h		

⌋

Beware, that the Checkpoint ID by itself is not unique. Only the pair of Supervised Entity ID and Checkpoint ID uniquely identifies a Checkpoint.

8.7.1.3 Port Interfaces

All operations are put into two interfaces (one with operations specific for an individual Supervised Entity, and one for global WdgM operations).

[SWS_WdgM_00333] Definition of ClientServerInterface WdgM_LocalSupervision ⌈

Name	WdgM_LocalSupervision		
Comment	–		
IsService	true		
Variation	–		
Possible Errors	0	E_OK	Operation successful
	1	E_NOT_OK	Operation failed

Operation	CheckpointReached
Comment	Indicates to the Watchdog Manager that a Checkpoint within a Supervised Entity has been reached.
Mapped to API	WdgM_CheckpointReached
Variation	–
Possible Errors	E_OK E_NOT_OK

⌋

[SWS_WdgM_91004] Definition of ClientServerInterface WdgM_LocalSupervisionStatus ⌈

Name	WdgM_LocalSupervisionStatus		
Comment	–		
IsService	true		
Variation	–		
Possible Errors	0	E_OK	Operation successful
	1	E_NOT_OK	Operation failed

Operation	GetLocalStatus	
Comment	Returns the supervision status of an individual Supervised Entity.	
Mapped to API	WdgM_GetLocalStatus	
Variation	–	
Parameters	Status	
	Type	WdgM_LocalStatusType
	Direction	OUT
	Comment	Supervision status of the given supervised entity.
	Variation	–
Possible Errors	E_OK E_NOT_OK	

⌋

[SWS_WdgM_91001] Definition of ClientServerInterface WdgM_GlobalSupervision ⌈

Name	WdgM_GlobalSupervision		
Comment	–		
IsService	true		
Variation	–		
Possible Errors	0	E_OK	Operation successful
	1	E_NOT_OK	Operation failed

Operation	GetFirstExpiredSEID	
Comment	Returns SEID that first reached the state WDGM_LOCAL_STATUS_EXPIRED.	
Mapped to API	WdgM_GetFirstExpiredSEID	
Variation	–	
Parameters	SEID	
	Type	WdgM_SupervisedEntityIdType
	Direction	OUT
	Comment	Identifier of the supervised entity that first reached the state WDGM_LOCAL_STATUS_EXPIRED.
	Variation	–

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Possible Errors	E_OK E_NOT_OK

Operation	GetGlobalStatus	
Comment	Returns the global supervision status of the Watchdog Manager.	
Mapped to API	WdgM_GetGlobalStatus	
Variation	–	
Parameters	Status	
	Type	WdgM_GlobalStatusType
	Direction	OUT
	Comment	Global supervision status of the Watchdog Manager.
	Variation	–
Possible Errors	E_OK E_NOT_OK	

Operation	GetMode	
Comment	Returns the current mode of the Watchdog Manager.	
Mapped to API	WdgM_GetMode	
Variation	–	
Parameters	Mode	
	Type	WdgM_ModeType
	Direction	OUT
	Comment	Current mode of the Watchdog Manager.
	Variation	–
Possible Errors	E_OK E_NOT_OK	

Operation	PerformReset
Comment	Instructs the Watchdog Manager to cause a watchdog reset.
Mapped to API	WdgM_PerformReset
Variation	–
Possible Errors	–

Operation	SetMode	
Comment	Sets the current mode of Watchdog Manager.	
Mapped to API	WdgM_SetMode	
Variation	–	
Parameters	Mode	
	Type	WdgM_ModeType
	Direction	IN
	Comment	One of the configured Watchdog Manager modes.
	Variation	–
Possible Errors	E_OK E_NOT_OK	

⌋

Compared to the API, the “WdgM_” prefix in the names is not required, because the names given here will show up in the XML not globally but as part of an interface description.

8.7.1.4 Service Ports

Figure 8.2 shows how AUTOSAR Software components (single or multiple instances) are connected via service ports to the Watchdog Manager module. On the left side, there are two instances (swc1 and swc2) of component SWC Type A and one instance (swc3) of component SWC Type B.

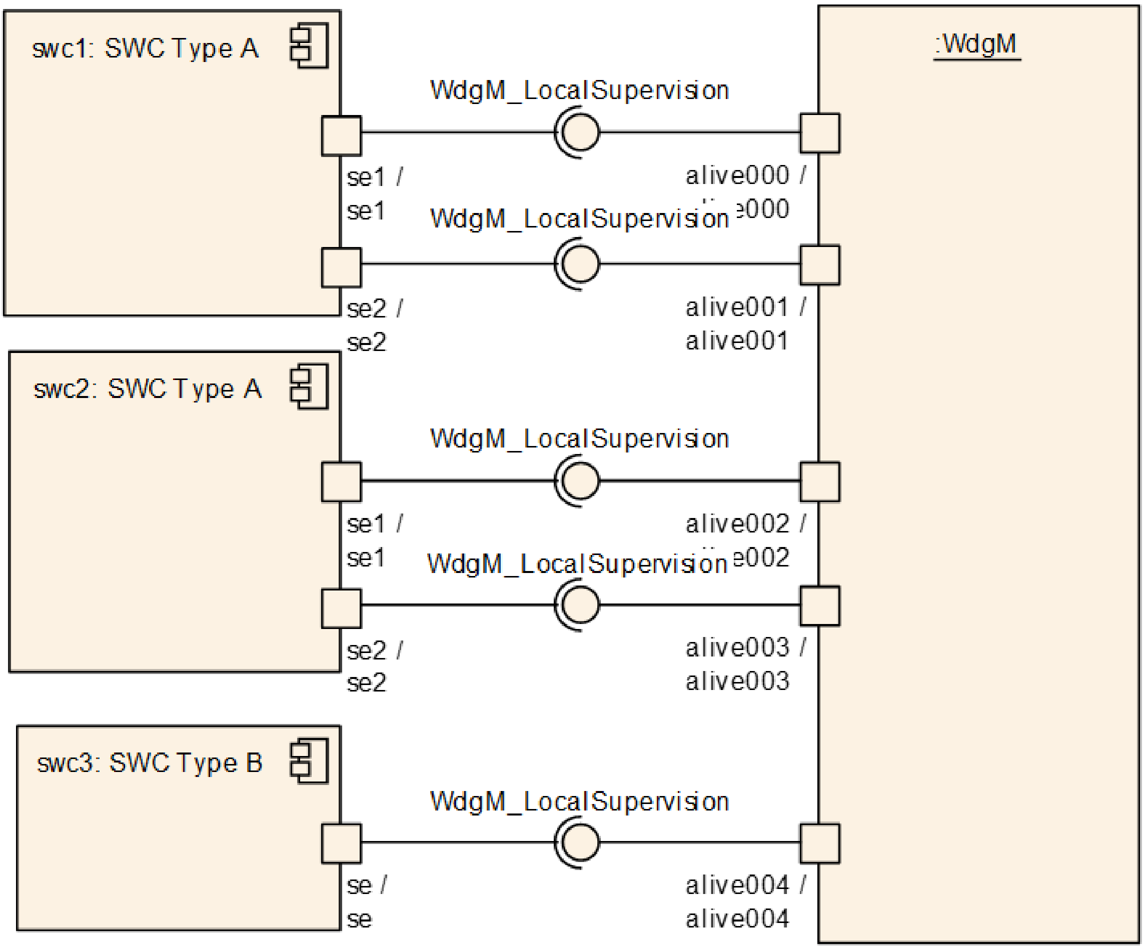

Figure 8.2: Example of SW-Cs connected to the Watchdog Manager via service ports

On the Watchdog Manager side, there is one port per Supervised Entity providing all the services of the interface WdgM_LocalSupervision described above. Each Supervised Entity has one port for requiring those services for each Supervised Entity associated with that application.

[SWS_WdgM_00146] ⌈The Watchdog Manager module shall provide a single service port for Supervision for each Supervised Entity that is configured.

To be able to match a Supervision port with its corresponding mode port for Status Reporting, a naming convention is necessary.⌋

The Local Supervision ports of the Watchdog Manager module is named as follows:

[SWS_WdgM_00147] Definition of Port localSupervision_{SupervisedEntityCheckpointName} provided by module WdgM ⌈

Name	localSupervision_{SupervisedEntityCheckpointName}		
Kind	ProvidedPort	***Interface***	WdgM_LocalSupervision
Description	This port provides the Supervision interface of one Supervised Entity Checkpoint to a SWC.		
Port Defined Argument Value(s)	***Type***	WdgM_SupervisedEntityIdType	
	Value	{ecuc(WdgM/WdgMGeneral/WdgMSupervisedEntity/WdgMSupervisedEntityId.value)}	
	Type	WdgM_CheckpointIdType	
	Value	ecuc{WdgM/WdgMGeneral/WdgMSupervisedEntity/WdgMCheckpoint/WdgMCheckpointId}	
Variation	SupervisedEntityCheckpointName = {ecuc(WdgM/WdgMGeneral/WdgMSupervisedEntity.SHORT-NAME)}_{ecuc(WdgM/WdgMGeneral/WdgMSupervisedEntity/WdgMCheckpoint.SHORT-NAME)}		

⌋

[SWS_WdgM_91003] Definition of Port localSupervisonStatus_{SupervisedEntityName} provided by module WdgM ⌈

Name	localSupervisonStatus_{SupervisedEntityName}		
Kind	ProvidedPort	***Interface***	WdgM_LocalSupervisionStatus
Description	This port provides the Supervision status interface of one Supervised Entity to a SWC.		
Port Defined Argument Value(s)	***Type***	WdgM_SupervisedEntityIdType	
	Value	{ecuc(WdgM/WdgMGeneral/WdgMSupervisedEntity/WdgMSupervisedEntityId.value)}	
Variation	SupervisedEntityName = {ecuc(WdgM/WdgMGeneral/WdgMSupervisedEntity.SHORT-NAME)}		

⌋

The Global Supervision ports of the Watchdog Manager module is named as follows:

[SWS_WdgM_91002] Definition of Port globalSupervision provided by module WdgM ⌈

Name	globalSupervision		
Kind	ProvidedPort	***Interface***	WdgM_GlobalSupervision
Description	This port provides the Global Supervision interface of the WdgM.		
Variation	–		

⌋

8.7.1.5 Error Codes

The Supervision service does not return any service specific error codes.

8.7.2 Ports and Port Interface for Status Reporting

8.7.2.1 General Approach

To control the state-dependent behavior of SW-Cs and CDDs, the RTE provides the mechanism of mode ports. A mode manager can switch between different modes that are defined in the mode port. The SW-C / CDD that connects to the mode port can use the mode information in two ways:

- The SW-C / CDD can query the current mode via the mode port.
- The SW-C / CDD can declare Runnables that are started or stopped by the RTE because of mode changes.

According to RTE Specification [9, Specification of RTE Software] a mode port has a ModeSwitchInterface. The mode manager, here the Watchdog Manager module, is the sender and the SW-Cs are the receivers.

The Watchdog Manager module uses mode ports to provide two kinds of information:

- First, it provides the Local Supervision Status of each Supervised Entity. Therefore, the Watchdog Manager module has a mode port for each Supervised Entity.
- Second, the Watchdog Manager module provides the Global Supervision Status which reflects the combined Supervision Status of all Supervised Entities. Therefore, it has one additional mode port.

8.7.2.2 Data Types

The mode declaration group WdgM_Mode represents the modes of the Watchdog Manager module that will be notified to the SW-Cs / CDDs and the RTE.

[SWS_WdgM_00334] Definition of ModeDeclarationGroup WdgM_Mode ⌈

Name	WdgM_Mode	
Kind	ModeDeclarationGroup	
Category	EXPLICIT_ORDER	
Initial mode	SUPERVISION_OK	
On transition value	255	
Modes	SUPERVISION_OK	0
	SUPERVISION_FAILED	1
	SUPERVISION_EXPIRED	2
	SUPERVISION_STOPPED	3
	SUPERVISION_DEACTIVATED	4
Description	The category of ModeDeclarationGroup WdgM_Mode is EXPLICIT_ORDER, The attribute value for the ModeDeclaration are set as following: "SUPERVISION_OK" = 0 "SUPERVISION_FAILED" = 1 "SUPERVISION_EXPIRED" = 2 "SUPERVISION_STOPPED" = 3 "SUPERVISION_DEACTIVATED" = 4 The onTransitionValue is defined as 255	

⌋

[SWS_WdgM_00359] Definition of ImplementationDataType WdgM_LocalStatusType ⌈

Name	WdgM_LocalStatusType		
Kind	Type		
Derived from	uint8		
Range	WDGM_LOCAL_STATUS_OK	0	The supervision of this Supervised Entity has not shown any failures.
	WDGM_LOCAL_STATUS_FAILED	1	The supervision of this Supervised Entity has failed but can still be "healed". I.e., if the Supervised Entity returns to a normal behavior, its supervision state will also return to WDGM_LOCAL_STATUS_OK. Furthermore, the number of times that the supervision has failed has not yet exceeded a configurable limit. When this limit has been exceeded the state will change to WDGM_LOCAL_STATUS_EXPIRED.
	WDGM_LOCAL_STATUS_EXPIRED	2	The supervision of this Supervised Entity has failed permanently. This state cannot be left.
	WDGM_LOCAL_STATUS_DEACTIVATED	4	The supervision of this Supervised Entity is temporarily disabled.
Description	This type shall be used for variables that represent the current status of supervision for individual Supervised Entities.		
Variation	–		

▽

△

Available via	Rte_WdgM_Type.h

⌋

[SWS_WdgM_00360] Definition of ImplementationDataType WdgM_GlobalStatusType ⌈

Name	WdgM_GlobalStatusType		
Kind	Type		
Derived from	uint8		
Range	WDGM_GLOBAL_STATUS_OK	0	Supervision did not show any failures.
	WDGM_GLOBAL_STATUS_FAILED	1	Supervision has failed but is still within the limit of allowed failures.
	WDGM_GLOBAL_STATUS_EXPIRED	2	Supervision has failed, the allowed limit of failures has been exceeded, but the Watchdog Driver has not yet been instructed to stop triggering.
	WDGM_GLOBAL_STATUS_STOPPED	3	Supervision has failed, the allowed limit of failures has been exceeded, and the Watchdog Driver has been instructed to stop triggering. A watchdog reset is about to happen.
	WDGM_GLOBAL_STATUS_DEACTIVATED	4	WdgM is not initialized and therefore will not manage the watchdogs.
Description	This type shall be used for variables that represent the global supervision status of the Watchdog Manager module.		
Variation	–		
Available via	Rte_WdgM_Type.h		

⌋

[SWS_WdgM_00358] Definition of ImplementationDataType WdgM_ModeType ⌈

Name	WdgM_ModeType		
Kind	Type		
Derived from	uint8		
Range	0-<Number of Modes>	–	The actual upper limit depends on the number of configured modes for Watchdog Manager.
Description	This type distinguishes the different modes that were configured for the Watchdog Manager.		
Variation	–		
Available via	Rte_WdgM_Type.h		

⌋

8.7.2.3 Port Interfaces

There are two different interfaces to indicate changes in the Supervision Status to interested SW-Cs / CDDs and the RTE.

The interface `WdgM_LocalMode` is used to signal the Local Supervision Status of a single Supervised Entity.

[SWS_WdgM_00335] Definition of ModeSwitchInterface WdgM_LocalMode ⌈

Name	WdgM_LocalMode	
Comment	–	
IsService	true	
Variation	–	
ModeGroup	currentMode	WdgM_Mode

⌋

The interface `WdgM_GlobalMode` is used to signal the Global Supervision Status that is combined from all individual Supervised Entities.

[SWS_WdgM_00336] Definition of ModeSwitchInterface WdgM_GlobalMode ⌈

Name	WdgM_GlobalMode	
Comment	–	
IsService	true	
Variation	–	
ModeGroup	currentMode	WdgM_Mode

⌋

The reason for defining two different interfaces is the way these interfaces are used. For the `WdgM_GlobalMode` interfaces the Watchdog Manager module provides only one single port with that interface. By contrast, for the `WdgM_LocalMode` interface the Watchdog Manager module provides as many ports as there are Supervised Entities. In order to access these ports efficiently, the Indirect Port API of the RTE can be used. This API provides a list of all ports that have the same interface, e.g.:

```c
/**
* Called within WdgM. Reports the status/mode of the SE
* to SW-Cs / CDDs through Rte
*/
void WdgM_NotifyOKToSE(WdgM_SupervisedEntityIdType se)
{
  Rte_PortHandle_WdgM_LocalMode_P ph = Rte_Ports_WdgM_LocalMode_P();
  ph[se].Switch_currentMode(RTE_MODE_WdgM_Mode_SUPERVISION_OK);
}
```

To avoid that the mode port for the Global Supervision Status shows up in this list, this port uses a different interface, i.e. `WdgM_GlobalMode` instead of `WdgM_LocalMode`.

8.7.2.4 Mode Ports

Figure 8.3 shows how AUTOSAR Software components (single or multiple instances) are connected via mode and service ports to the Watchdog Manager module. On the left side, there are two instances (swc1 and swc2) of component SWC Type A and one instance (swc3) of component SWC Type B. Each component is connected to the mode ports that correspond to its own Supervised Entities. In addition, swc3 is connected to the global mode port and can therefore react to changes in the combined Supervision Status of all Supervised Entities.

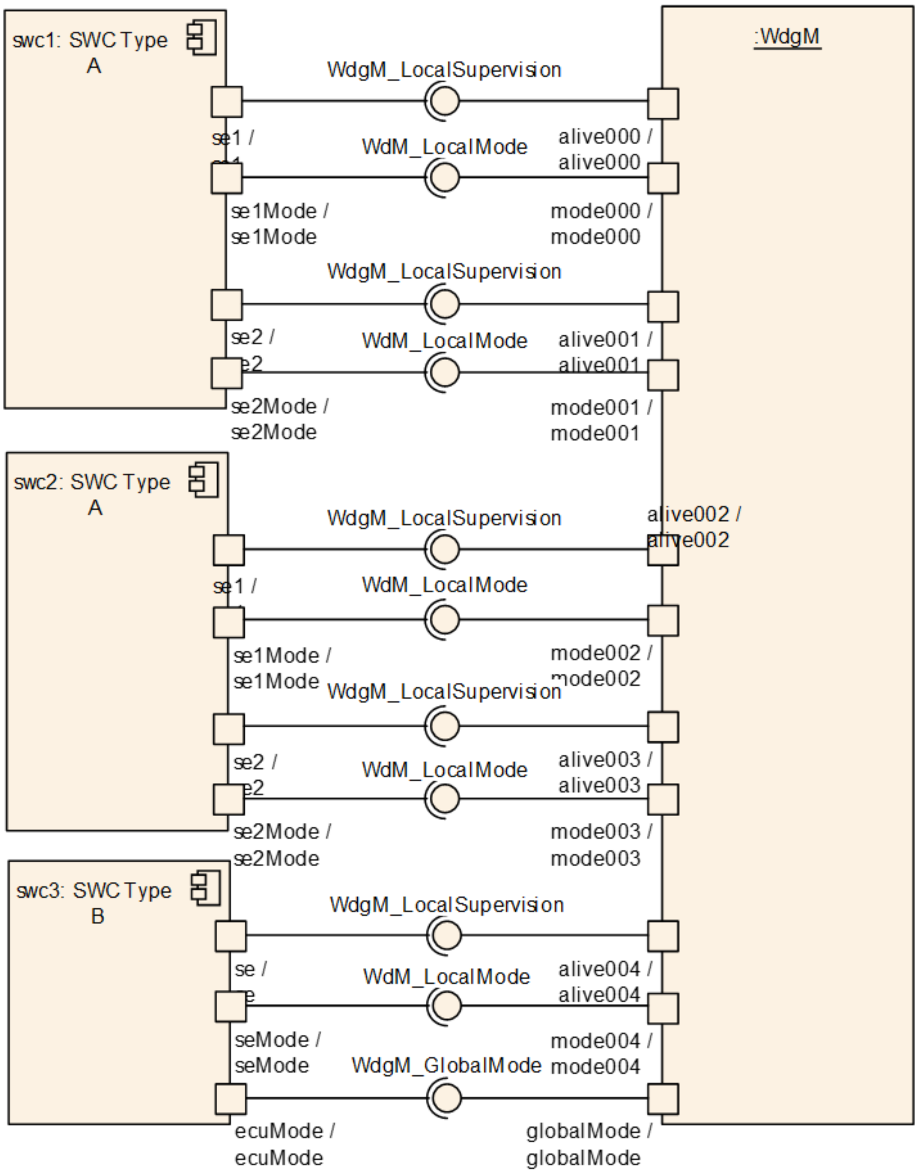

Figure 8.3: Example of SW-Cs connected to the Watchdog Manager via service ports and mode ports

This results in one mode port per Supervised Entity.

[SWS_WdgM_00148]

Upstream requirements: SRS_ModeMgm_09160, SRS_ModeMgm_09225

⌈The Watchdog Manager module shall provide a single mode port for reporting the Local Supervision Status of each Supervised Entity that is configured.

To be able to match a Supervision port with its corresponding mode port for Status Reporting, a naming convention is necessary.⌋

The Watchdog Manager provides mode ports for reporting the Supervision Status of each Supervised Entity:

[SWS_WdgM_00149] Definition of Port mode_{SupervisedEntityName} provided by module WdgM ⌈

Name	mode_{SupervisedEntityName}		
Kind	ProvidedPort	***Interface***	WdgM_LocalMode
Description	–		
Variation	SupervisedEntityName = {ecuc(WdgM/WdgMGeneral/WdgMSupervisedEntity/WdgMSupervisedEntityId.SHORT-NAME)}		

⌋

[SWS_WdgM_00197] ⌈When the Local Supervision Status of a single Supervised Entity changes, the Watchdog Manager module shall report that change via the mode port for that Supervised Entity immediately after it has been recognized.⌋

The Watchdog Manager module provides one mode port for reporting the Global Supervision Status:

[SWS_WdgM_00150] Definition of Port globalmode provided by module WdgM

Upstream requirements: SRS_ModeMgm_09160, SRS_ModeMgm_09225, SRS_ModeMgm_09162

⌈

Name	globalmode		
Kind	ProvidedPort	***Interface***	WdgM_GlobalMode
Description	–		
Variation	–		

⌋

[SWS_WdgM_00198] ⌈When the Global Supervision Status changes, the Watchdog Manager module shall report that change via the global mode port.⌋

[SWS_WdgM_00199] ⌈After computing the Global Supervision Status from all Local Supervision Status, the Watchdog Manager module shall report any change in the resulting Global Supervision Status only once.⌋

The resulting behavior is that first all changes in Local Supervision Status are reported. Afterwards the Global Supervision Status is reported only once and only if it changed due to the individual changes.

For instance, if in one Supervision Cycle SE1 goes from WDGM_LOCAL_STATUS_OK to WDGM_LOCAL_STATUS_FAILED, WDGM_LOCAL_STATUS_FAILED is reported on the local mode port for SE1. In the same Supervision Cycle SE2 goes from WDGM_LOCAL_STATUS_OK to WDGM_LOCAL_STATUS_EXPIRED directly, WDGM_LOCAL_STATUS_EXPIRED is reported on the local mode port for SE2. The resulting Global Supervision Status in this Supervision Cycle changes from WDGM_GLOBAL_STATUS_OK to WDGM_GLOBAL_STATUS_EXPIRED and only WDGM_GLOBAL_STATUS_EXPIRED is reported on the global mode port. In that example WDGM_GLOBAL_STATUS_FAILED is not reported on the global mode port, because it was only an intermediate state while evaluating a subset of Supervised Entities.

9 Sequence diagrams

This chapter shows the interactions between the Watchdog Manager and other BSW modules as well as Supervised Entities.

9.1 Initialization

The diagram shows the initialization of the Watchdog Manager module. The initialization should be done at a late phase of ECU initialization after the initialization of the OS.

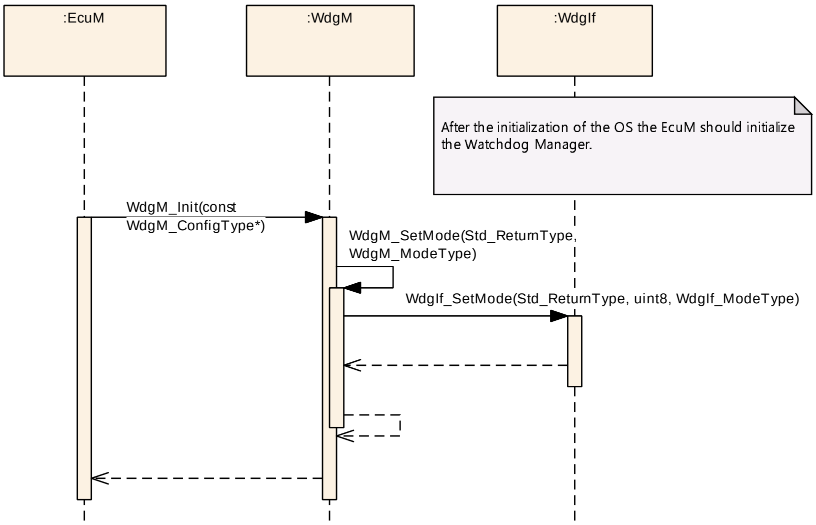
:EcuM
:WdgM
:WdgIf
After the initialization of the OS the EcuM should initialize the Watchdog Manager.
WdgM_Init(const WdgM_ConfigType*)
WdgM_SetMode(Std_ReturnType, WdgM_ModeType)
WdgIf_SetMode(Std_ReturnType, uint8, WdgIf_ModeType)

Figure 9.1: Initialization of the Watchdog Manager module

10 Configuration specification

10.1 Parameter Differentiation

Within this chapter, you find a brief introduction of terms, which are used to differentiate type of configuration parameters. In the subchapter you find concrete specification issue for parameters in Watchdog Manager context.

For details refer to the chapter 10.1 “Introduction to configuration specification” in [3, General Specification of Basic Software Modules].

10.1.1 Static Configuration Parameters

[SWS_WdgM_00025]

Upstream requirements: SRS_BSW_00345

⌈The parameters of the Watchdog Manager module that shall minimally be configurable at system generation and / or system compile time (pre-compile).⌋

10.1.2 Runtime Configuration Parameters

[SWS_WdgM_00029] ⌈The parameters of the Watchdog Manager module that shall be configurable at post-build time.⌋

10.1.3 Precompile Options

[SWS_WdgM_00104]

Upstream requirements: SRS_BSW_00345, SRS_BSW_00171

⌈The precompile options shall be used for code implementations that are not directly generated out of code generators. Therefore, the precompile options support the optimization of re-used source code-file of the Watchdog Manager module according to settings of static configuration.⌋

10.2 Containers and configuration parameters

The following variants are supported by Watchdog Manager module:

10.2.1 Configuration Variants

For details refer to chapter “Variants” in [3, General Specification of Basic Software Modules].

10.2.2 WdgM

[ECUC_WdgM_00001] Definition of EcucModuleDef WdgM ⌈

Module Name	WdgM
Description	Configuration of the WdgM (Watchdog Manager) module.
Post-Build Variant Support	true
Supported Config Variants	VARIANT-POST-BUILD, VARIANT-PRE-COMPILE

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
WdgMConfigSet	1	This container describes one of multiple configuration sets of WdgM.
WdgMGeneral	1	Container defines all general configuration parameters of the Watchdog Manager.

⌋

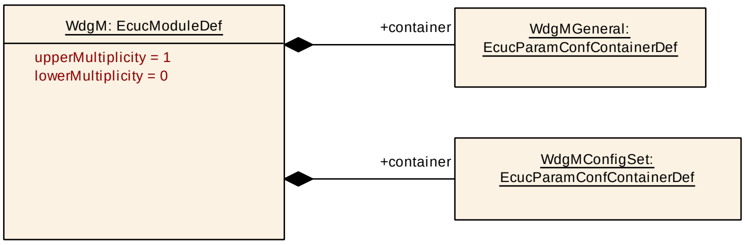

Figure 10.1: Configuration Module Watchdog Manager (WdgM)

10.2.3 WdgMGeneral

[ECUC_WdgM_00300] Definition of EcucParamConfContainerDef WdgMGeneral ⌈

Container Name	WdgMGeneral
Parent Container	WdgM
Description	Container defines all general configuration parameters of the Watchdog Manager.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMDevErrorDetect	1	[ECUC_WdgM_00301]
WdgMEnableTimeoutDetection	1	[ECUC_WdgM_00363]
WdgMImmediateReset	0..1	[ECUC_WdgM_00339]
WdgMOffModeEnabled	0..1	[ECUC_WdgM_00340]
WdgMSwClusterSupport	0..1	[ECUC_WdgM_00365]
WdgMVersionInfoApi	1	[ECUC_WdgM_00302]

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
WdgMBaseSocket	0..*	This container configures how many EcucPartitions specific infrastructure links are required for the WdgM instances in Application Software Clusters provided by the Host Software Cluster. Such infrastructure links serve for: the initialization of Application Software Cluster WdgM instances by Host WdgM instance the transmission of supervision results from Application Software Cluster WdgM instances to Host WdgM instance any other implementation specific purpose which is need for the interaction of Application Software Cluster WdgM instances and Host WdgM instance If the infrastructure connection is specific to one or several Ecuc Partition(s) the WdgMSocketEcucPartitionRef(s) denotes the applicable EcucPartition. **Tags:** atp.Status=draft
WdgMMainFunction	0..*	Reference to the WdgMInstanceMainFunction which this Supervised Entity belongs to. Relevant to Alive Supervision and Deadline Supervision **Tags:** atp.Status=draft
WdgMSupervisedEntity	0..65535	This container collects all common (mode-independent) parameters of a Supervised Entity to be supervised by the Watchdog Manager.
WdgMWatchdog	0..255	This container collects all common (mode-independent) parameters of a Watchdog to be triggered by the Watchdog Manager.

⌋

[ECUC_WdgM_00301] Definition of EcucBooleanParamDef WdgMDevErrorDetect ⌈

Parameter Name	WdgMDevErrorDetect		
Parent Container	WdgMGeneral		
Description	Switches the development error detection and notification on or off. • 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		

⌋

[ECUC_WdgM_00363] Definition of EcucBooleanParamDef WdgMEnableTimeoutDetection ⌈

Parameter Name	WdgMEnableTimeoutDetection		
Parent Container	WdgMGeneral		
Description	This parameter enables the timeout detection part of the Deadline Supervision (needed to detect deadline supervision violation when end checkpoint is never reached). true : Timeout detection is enabled. false : Timeout detection is disabled. Note: By default this option is disabled for backward compatibility reasons.		
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		

⌋

[ECUC_WdgM_00339] Definition of EcucBooleanParamDef WdgMImmediateReset ⌈

Parameter Name	WdgMImmediateReset		
Parent Container	WdgMGeneral		
Description	This parameter enables/disablse the immediate reset feature in case of alive-supervision failure. true: Immediate reset is enabled false: Immediate reset is disabled		
Multiplicity	0..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		

⌋

[ECUC_WdgM_00340] Definition of EcucBooleanParamDef WdgMOffModeEnabled ⌈

Parameter Name	WdgMOffModeEnabled		
Parent Container	WdgMGeneral		
Description	This parameter enables/disables the selection of the "OffMode" of the watchdog driver. true: "OffMode" selection is allowed false: "OffMode" selection is disallowed		
Multiplicity	0..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		

⌋

[ECUC_WdgM_00365] Definition of EcucEnumerationParamDef WdgMSwCluster Support

Status: DRAFT

⌈

Parameter Name	WdgMSwClusterSupport	
Parent Container	WdgMGeneral	
Description	This parameter selects the support for SW Architecture with Software Clusters. If the parameter is not set the default behavior DISABLE_SW_CLUSTER_SUPPORT applies. **Tags:** atp.Status=draft	
Multiplicity	0..1	
Type	EcucEnumerationParamDef	
Range	DISABLE_SW_CLUSTER_SUPPORT	Additional functionality to support the Watchdog Manager integration into a SW Architecture with Software Clusters is disabled. **Tags:** atp.Status=draft
	ENABLE_SW_CLUSTER_SUPPORT	Additional functionality to support the Watchdog Manger integration into a SW Architecture with Software Clusters is enabled. **Tags:** atp.Status=draft
Default value	DISABLE_SW_CLUSTER_SUPPORT	
Post-Build Variant Value	false	

Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00302] Definition of EcucBooleanParamDef WdgMVersionInfoApi

⌈

Parameter Name	WdgMVersionInfoApi		
Parent Container	WdgMGeneral		
Description	Preprocessor switch to enable/disable the existence of the API WdgM_GetVersionInfo. Shall be used to remove unneeded code segments. true: API is enabled false: API 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		

⌋

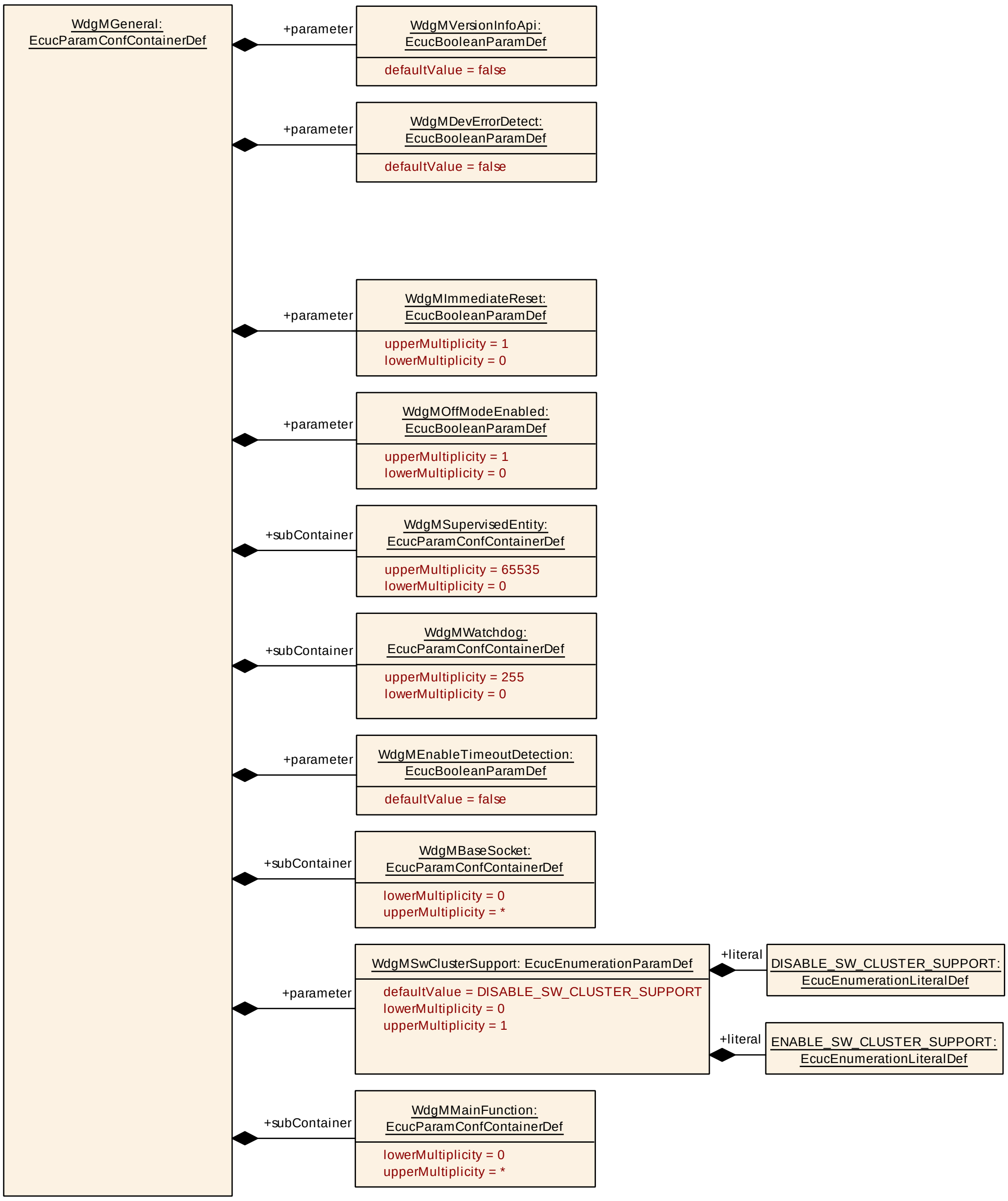

Figure 10.2: Configuration Container WdgMGeneral

10.2.4 WdgMSupervisedEntity

[ECUC_WdgM_00303] Definition of EcucParamConfContainerDef WdgMSupervisedEntity ⌈

Container Name	WdgMSupervisedEntity
Parent Container	WdgMGeneral
Description	This container collects all common (mode-independent) parameters of a Supervised Entity to be supervised by the Watchdog Manager.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMSupervisedEntityId	1	[ECUC_WdgM_00304]
WdgMInternalCheckpointInitialRef	0..65535	[ECUC_WdgM_00343]
WdgMInternallCheckpointFinalRef	0..65535	[ECUC_WdgM_00344]
WdgMMainFunctionRef	0..1	[ECUC_WdgM_00368]
WdgMOSCounter	0..1	[ECUC_WdgM_00361]

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
WdgMCheckpoint	1..65535	This container collects all Checkpoints of this Supervised Entity. Each Supervised Entity has at least one Checkpoint.
WdgMInternalTransition	0..65535	This container defines the graph of Internal Transitions within this Supervised Entity.

⌋

[ECUC_WdgM_00304] Definition of EcucIntegerParamDef WdgMSupervisedEntityId ⌈

Parameter Name	WdgMSupervisedEntityId		
Parent Container	WdgMSupervisedEntity		
Description	This parameter shall contain the unique identifier of the supervised entity.		
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		

⌋

[ECUC_WdgM_00343] Definition of EcucReferenceDef WdgMInternalCheckpointInitialRef ⌈

Parameter Name	WdgMInternalCheckpointInitialRef		
Parent Container	WdgMSupervisedEntity		
Description	This is the reference to the initial Checkpoint for this Supervised Entity.		
Multiplicity	0..65535		
Type	Symbolic name reference to WdgMCheckpoint		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00344] Definition of EcucReferenceDef WdgMInternallCheckpointFinalRef ⌈

Parameter Name	WdgMInternallCheckpointFinalRef		
Parent Container	WdgMSupervisedEntity		
Description	This is the reference to the final Checkpoint(s) for this Supervised Entity.		
Multiplicity	0..65535		
Type	Symbolic name reference to WdgMCheckpoint		
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		

⌋

[ECUC_WdgM_00368] Definition of EcucReferenceDef WdgMMainFunctionRef

Status: DRAFT

⌈

Parameter Name	WdgMMainFunctionRef
Parent Container	WdgMSupervisedEntity
Description	Reference to the WdgMInstanceMainFunction which this Supervised Entity belongs to. Relevant to Alive Supervision and Deadline Supervision **Tags:** atp.Status=draft
Multiplicity	0..1

▽

△

Type	Reference to WdgMMainFunction		
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		

⌋

[ECUC_WdgM_00361] Definition of EcucReferenceDef WdgMOSCounter ⌈

Parameter Name	WdgMOSCounter		
Parent Container	WdgMSupervisedEntity		
Description	OS counter used by Watchdog Manager to perform the deadline supervision of the Supervised Entity.		
Multiplicity	0..1		
Type	Reference to 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			

⌋

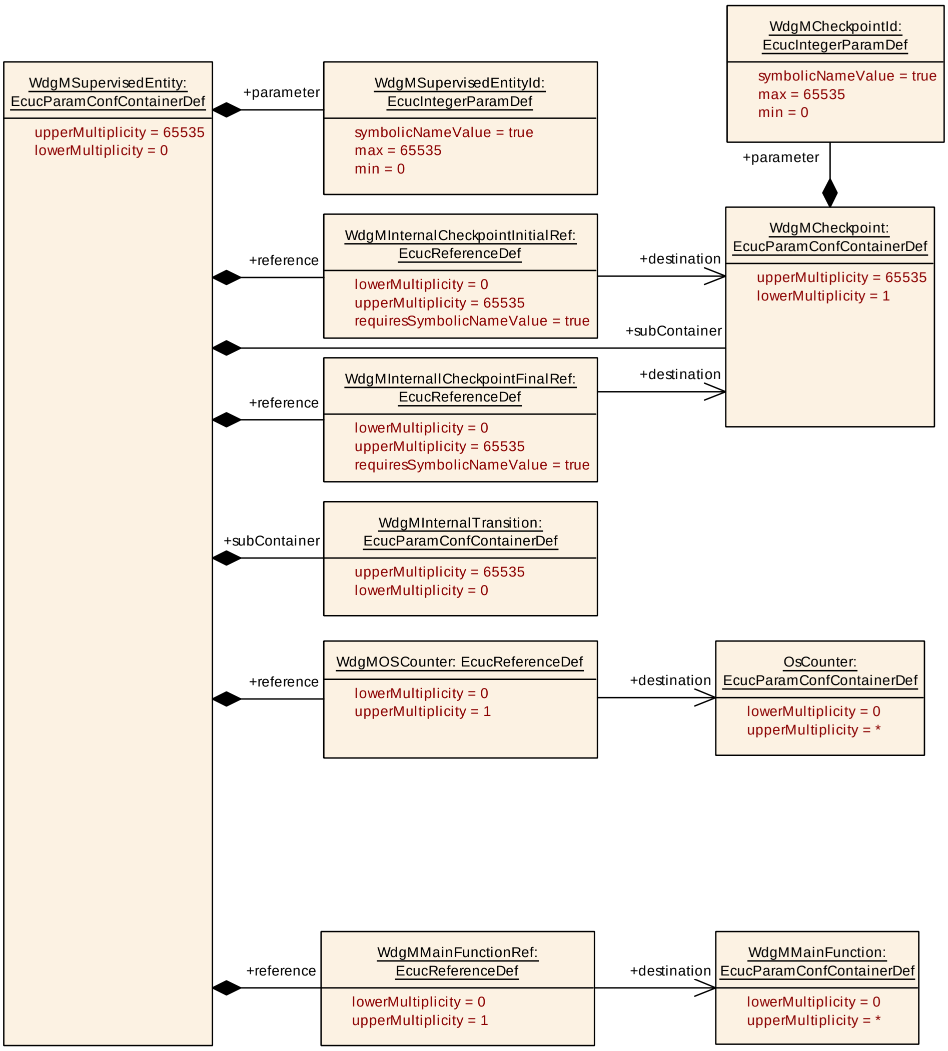
WdgMSupervisedEntity: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+parameter
WdgMSupervisedEntityId: EcucIntegerParamDef
symbolicNameValue = true
max = 65535
min = 0
WdgMCheckpointId: EcucIntegerParamDef
symbolicNameValue = true
max = 65535
min = 0
+parameter
+reference
WdgMInternalCheckpointInitialRef: EcucReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 65535
requiresSymbolicNameValue = true
+destination
WdgMCheckpoint: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 1
+subContainer
+destination
+reference
WdgMInternallCheckpointFinalRef: EcucReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 65535
requiresSymbolicNameValue = true
+subContainer
WdgMInternalTransition: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+reference
WdgMOSCounter: EcucReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 1
+destination
OsCounter: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+reference
WdgMMainFunctionRef: EcucReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 1
+destination
WdgMMainFunction: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *

Figure 10.3: Configuration Container WdgMSupervisedEntity

10.2.5 WdgMCheckpoint

[ECUC_WdgM_00305] Definition of EcucParamConfContainerDef WdgMCheckpoint ⌈

Container Name	WdgMCheckpoint
Parent Container	WdgMSupervisedEntity
Description	This container collects all Checkpoints of this Supervised Entity. Each Supervised Entity has at least one Checkpoint.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMCheckpointId	1	[ECUC_WdgM_00306]

No Included Containers

⌋

[ECUC_WdgM_00306] Definition of EcucIntegerParamDef WdgMCheckpointId ⌈

Parameter Name	WdgMCheckpointId		
Parent Container	WdgMCheckpoint		
Description	This parameter shall contain the unique identifier of Checkpoint.		
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		

⌋

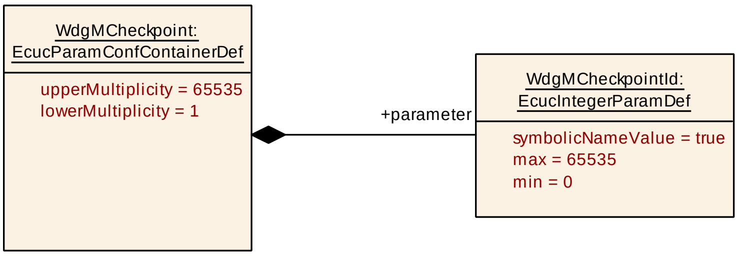

Figure 10.4: Configuration Container WdgMCheckpoint

10.2.6 WdgMInternalTransition

[ECUC_WdgM_00345] Definition of EcucParamConfContainerDef WdgMInternalTransition ⌈

Container Name	WdgMInternalTransition
Parent Container	WdgMSupervisedEntity
Description	This container defines the graph of Internal Transitions within this Supervised Entity.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMInternalTransitionDestRef	1	[ECUC_WdgM_00351]
WdgMInternalTransitionSourceRef	1	[ECUC_WdgM_00350]

No Included Containers

⌋

[ECUC_WdgM_00351] Definition of EcucReferenceDef WdgMInternalTransitionDestRef ⌈

Parameter Name	WdgMInternalTransitionDestRef		
Parent Container	WdgMInternalTransition		
Description	This is the reference to the destination Checkpoint of a Internal Transition within this Supervised Entity.		
Multiplicity	1		
Type	Symbolic name reference to WdgMCheckpoint		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00350] Definition of EcucReferenceDef WdgMInternalTransitionSourceRef ⌈

Parameter Name	WdgMInternalTransitionSourceRef		
Parent Container	WdgMInternalTransition		
Description	This is the reference to the source Checkpoint of a Internal Transition within this Supervised Entity.		
Multiplicity	1		
Type	Symbolic name reference to WdgMCheckpoint		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

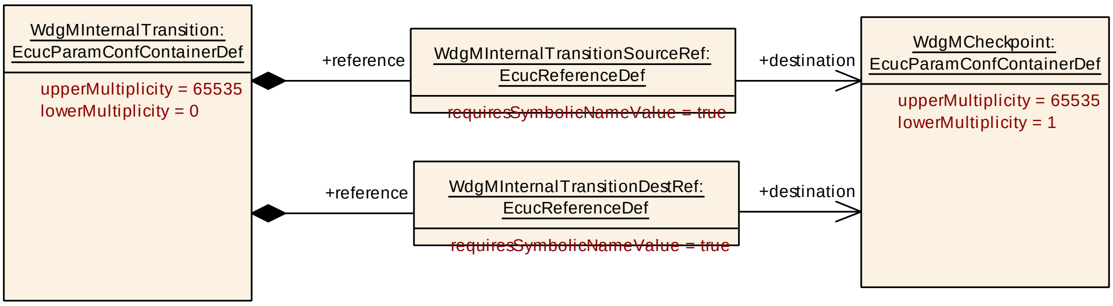
WdgMInternalTransition:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+reference
WdgMInternalTransitionSourceRef:
EcucReferenceDef
requiresSymbolicNameValue = true
+destination
WdgMCheckpoint:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 1
+reference
WdgMInternalTransitionDestRef:
EcucReferenceDef
requiresSymbolicNameValue = true
+destination

Figure 10.5: Configuration Container WdgMInternalTransition

10.2.7 WdgMWatchdog

[ECUC_WdgM_00347] Definition of EcucParamConfContainerDef WdgMWatchdog ⌈

Container Name	WdgMWatchdog
Parent Container	WdgMGeneral
Description	This container collects all common (mode-independent) parameters of a Watchdog to be triggered by the Watchdog Manager.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMWatchdogName	1	[ECUC_WdgM_00348]
WdgMWatchdogDeviceRef	1	[ECUC_WdgM_00349]

No Included Containers

⌋

[ECUC_WdgM_00348] Definition of EcucStringParamDef WdgMWatchdogName ⌈

Parameter Name	WdgMWatchdogName		
Parent Container	WdgMWatchdog		
Description	This parameter shall contain the name of the watchdog instance.		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	

▽

△

	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00349] Definition of EcucReferenceDef WdgMWatchdogDeviceRef ⌈

Parameter Name	WdgMWatchdogDeviceRef		
Parent Container	WdgMWatchdog		
Description	Reference to one device container of Watchdog Interface. In the referenced container WdgIfDevice, the parameter WdgIfDeviceIndex contains the Index parameter that WdgM has to use for WdgIf_SetTriggerCondition calls for that watchdog instance.		
Multiplicity	1		
Type	Symbolic name reference to WdgIfDevice		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

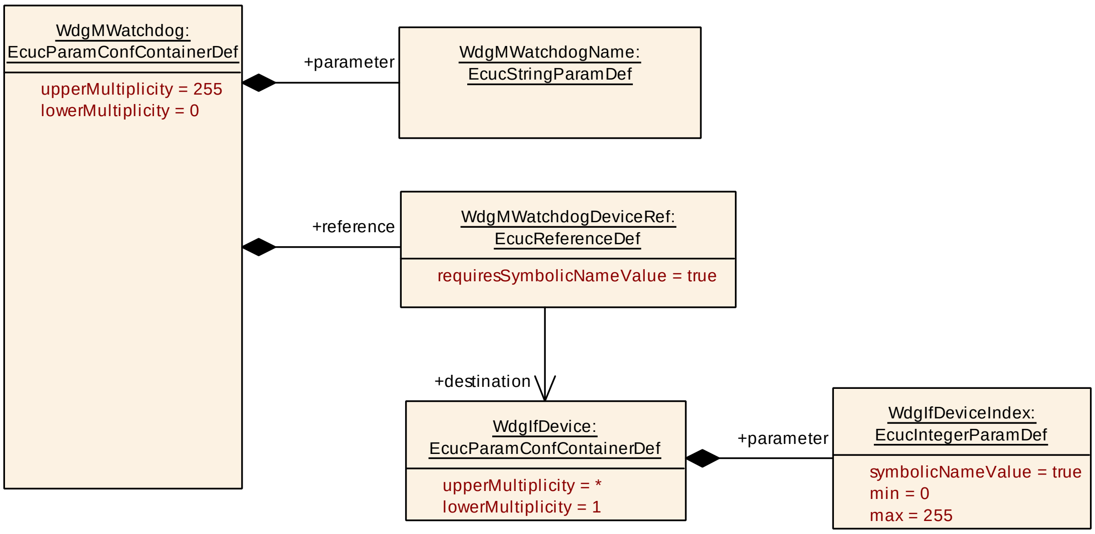

Figure 10.6: Configuration Container WdgMWatchdog

10.2.8 WdgMConfigSet

[ECUC_WdgM_00337] Definition of EcucParamConfContainerDef WdgMConfigSet ⌈

Container Name	WdgMConfigSet
Parent Container	WdgM
Description	This container describes one of multiple configuration sets of WdgM.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMInitialMode	1	[ECUC_WdgM_00336]

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
WdgMDemEventParameterRefs	0..1	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_SetEventStatus in case the corresponding error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value. The standardized errors are provided in this container and can be extended by vendor-specific error references.
WdgMMode	1..255	The container describes one of several modes of the Watchdog Manager.

⌋

[ECUC_WdgM_00336] Definition of EcucReferenceDef WdgMInitialMode ⌈

Parameter Name	WdgMInitialMode		
Parent Container	WdgMConfigSet		
Description	The mode that the Watchdog Manager is in after it has been initialized.		
Multiplicity	1		
Type	Symbolic name reference to WdgMMode		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

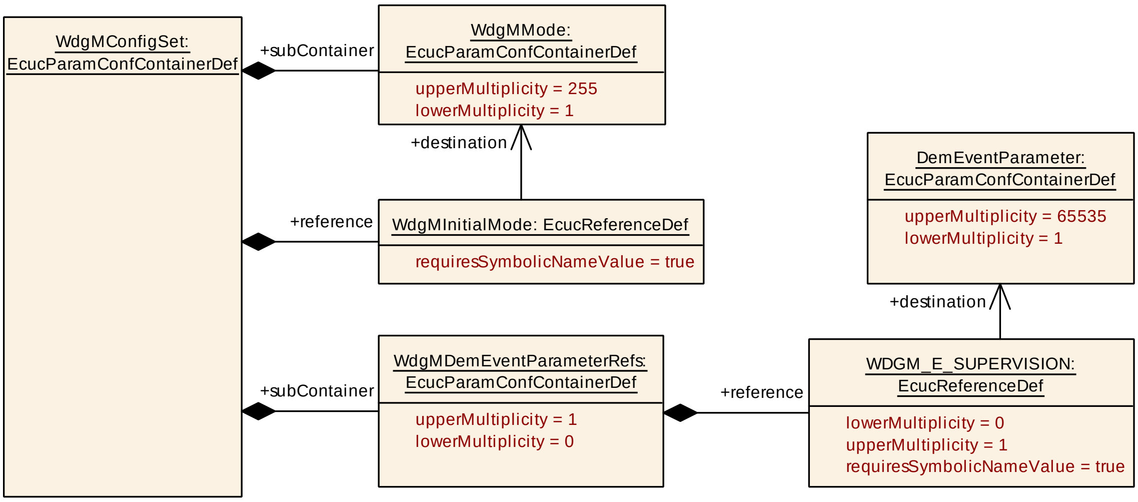

Figure 10.7: Configuration Container WdgMConfigSet

10.2.9 WdgMDemEventParameterRefs

[ECUC_WdgM_00353] Definition of EcucParamConfContainerDef WdgMDemEventParameterRefs ⌈

Container Name	WdgMDemEventParameterRefs
Parent Container	WdgMConfigSet
Description	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_SetEventStatus in case the corresponding error occurs. The Event Id is taken from the referenced DemEventParameter's DemEventId symbolic value. The standardized errors are provided in this container and can be extended by vendor-specific error references.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WDGM_E_SUPERVISION	0..1	[ECUC_WdgM_00362]

No Included Containers

⌋

[ECUC_WdgM_00362] Definition of EcucReferenceDef WDGM_E_SUPERVISION ⌈

Parameter Name	WDGM_E_SUPERVISION		
Parent Container	WdgMDemEventParameterRefs		
Description	Reference to the DemEventParameter which shall be issued when the error "Supervision has failed (Global Supervision Status has reached WDGM_GLOBAL_STATUS_STOPPED) and a watchdog reset will occur" has occurred.		
Multiplicity	0..1		
Type	Symbolic name reference to DemEventParameter		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

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10.2.10 WdgMMode

[ECUC_WdgM_00335] Definition of EcucParamConfContainerDef WdgMMode ⌈

Container Name	WdgMMode
Parent Container	WdgMConfigSet
Description	The container describes one of several modes of the Watchdog Manager.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMExpiredSupervisionCycleTol	1	[ECUC_WdgM_00329]
WdgMModeId	1	[ECUC_WdgM_00307]

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
WdgMAliveSupervision	0..65535	This container collects all configuration parameters of Alive-Supervision of one Checkpoint. Note that each Checkpoint may have different parameters. For example, it may have different min and max margin.
WdgMDeadlineSupervision	0..65535	This container collects all configuration parameters for Deadline Supervision for a Supervised Entity.
WdgMExternalLogicalSupervision	0..65535	This container collects all configuration parameters for Logical Supervision for one external graph.

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Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
WdgMLocalStatusParams	0..65535	This container collects all configuration parameters for the Local Status of a Supervised Entity.
WdgMMainFunctionModeProps	0..*	This container provides configuration values for a WdgMMain Function which apply in a specific WdgMMode. **Tags:** atp.Status=draft
WdgMTrigger	0..255	This container collects all configuration parameters for the triggering of hardware watchdogs.

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[ECUC_WdgM_00329] Definition of EcucIntegerParamDef WdgMExpiredSupervisionCycleTol ⌈

Parameter Name	WdgMExpiredSupervisionCycleTol		
Parent Container	WdgMMode		
Description	This parameter shall be used to define a value that fixes the amount of expired supervision cycles for how long the blocking of watchdog triggering shall be postponed, AFTER THE GLOBAL SUPERVISION STATUS HAS REACHED THE STATE EXPIRED.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 65535		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: ECU		

⌋

[ECUC_WdgM_00307] Definition of EcucIntegerParamDef WdgMModeId ⌈

Parameter Name	WdgMModeId		
Parent Container	WdgMMode		
Description	This parameter fixes the identifier for the mode. This identifier is for instance passed as a parameter to the WdgM_SetMode service.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	

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Scope / Dependency	scope: local

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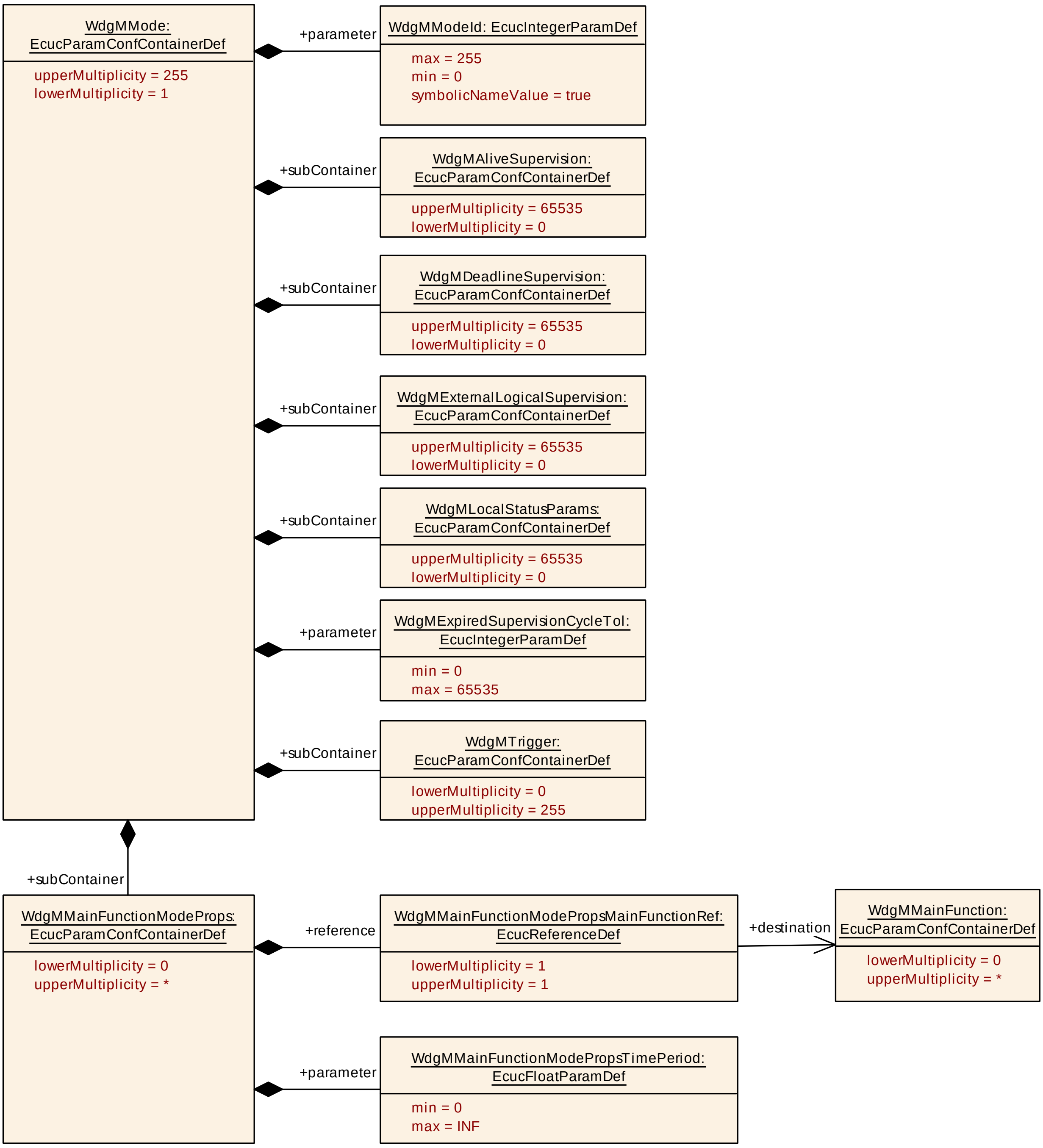
WdgMMode: EcucParamConfContainerDef
upperMultiplicity = 255
lowerMultiplicity = 1
+parameter
WdgMModeId: EcucIntegerParamDef
max = 255
min = 0
symbolicNameValue = true
+subContainer
WdgMAliveSupervision: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+subContainer
WdgMDeadlineSupervision: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+subContainer
WdgMExternalLogicalSupervision: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+subContainer
WdgMLocalStatusParams: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+parameter
WdgMExpiredSupervisionCycleTol: EcucIntegerParamDef
min = 0
max = 65535
+subContainer
WdgMTrigger: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 255
+subContainer
WdgMMainFunctionModeProps: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+reference
WdgMMainFunctionModePropsMainFunctionRef: EcucReferenceDef
lowerMultiplicity = 1
upperMultiplicity = 1
+destination
WdgMMainFunction: EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+parameter
WdgMMainFunctionModePropsTimePeriod: EcucFloatParamDef
min = 0
max = INF

Figure 10.8: Configuration Container WdgMMode

10.2.11 WdgMAliveSupervision

[ECUC_WdgM_00308] Definition of EcucParamConfContainerDef WdgMAliveSupervision ⌈

Container Name	WdgMAliveSupervision
Parent Container	WdgMMode
Description	This container collects all configuration parameters of Alive-Supervision of one Checkpoint. Note that each Checkpoint may have different parameters. For example, it may have different min and max margin.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMExpectedAliveIndications	1	[ECUC_WdgM_00311]
WdgMMaxMargin	1	[ECUC_WdgM_00313]
WdgMMinMargin	1	[ECUC_WdgM_00312]
WdgMSupervisionReferenceCycle	1	[ECUC_WdgM_00310]
WdgMAliveSupervisionCheckpointRef	1	[ECUC_WdgM_00309]

No Included Containers

⌋

[ECUC_WdgM_00311] Definition of EcucIntegerParamDef WdgMExpectedAlive Indications ⌈

Parameter Name	WdgMExpectedAliveIndications		
Parent Container	WdgMAliveSupervision		
Description	This parameter contains the amount of expected alive indications of the Checkpoint within the referenced amount of defined supervision cycles according to corresponding SE.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 65535		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

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[ECUC_WdgM_00313] Definition of EcucIntegerParamDef WdgMMaxMargin ⌈

Parameter Name	WdgMMaxMargin		
Parent Container	WdgMAliveSupervision		
Description	This parameter contains the amount of alive indications of the Checkpoint that are acceptable to be additional to the expected alive indications within the corresponding supervision reference cycle.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

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[ECUC_WdgM_00312] Definition of EcucIntegerParamDef WdgMMinMargin ⌈

Parameter Name	WdgMMinMargin		
Parent Container	WdgMAliveSupervision		
Description	This parameter contains the amount of alive indications of the Checkpoint that are acceptable to be missed from the expected alive indications within the corresponding supervision reference cycle.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00310] Definition of EcucIntegerParamDef WdgMSupervisionReferenceCycle ⌈

Parameter Name	WdgMSupervisionReferenceCycle
Parent Container	WdgMAliveSupervision
Description	This parameter shall contain the amount of supervision cycles to be used as reference by the alive-supervision mechanism to perform the checkup with counted alive indications according to corresponding SE.
Multiplicity	1
Type	EcucIntegerParamDef

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Range	1 .. 65535		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

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[ECUC_WdgM_00309] Definition of EcucReferenceDef WdgMAliveSupervisionCheckpointRef ⌈

Parameter Name	WdgMAliveSupervisionCheckpointRef		
Parent Container	WdgMAliveSupervision		
Description	Reference to Checkpoint within a Supervised Entity that shall be supervised.		
Multiplicity	1		
Type	Symbolic name reference to WdgMCheckpoint		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

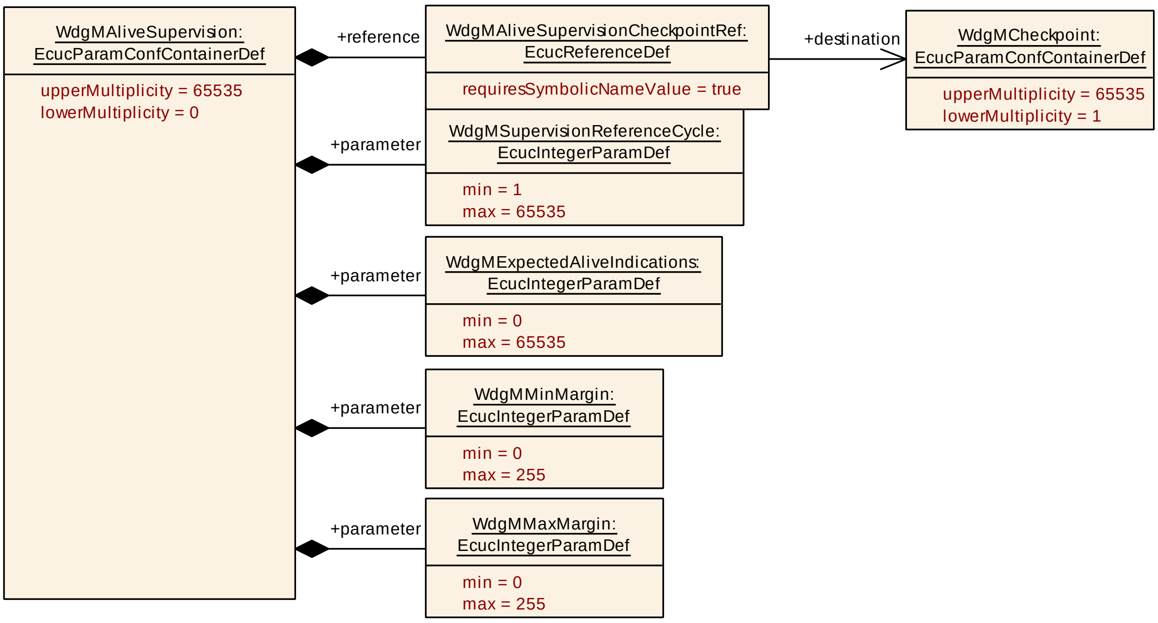

Figure 10.9: Configuration Container WdgMAliveSupervision

10.2.12 WdgMDeadlineSupervision

[ECUC_WdgM_00314] Definition of EcucParamConfContainerDef WdgMDeadlineSupervision ⌈

Container Name	WdgMDeadlineSupervision
Parent Container	WdgMMode
Description	This container collects all configuration parameters for Deadline Supervision for a Supervised Entity.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMDeadlineMax	1	[ECUC_WdgM_00318]
WdgMDeadlineMin	1	[ECUC_WdgM_00317]
WdgMDeadlineStartRef	1	[ECUC_WdgM_00315]
WdgMDeadlineStopRef	1	[ECUC_WdgM_00316]

No Included Containers

⌋

[ECUC_WdgM_00318] Definition of EcucFloatParamDef WdgMDeadlineMax ⌈

Parameter Name	WdgMDeadlineMax		
Parent Container	WdgMDeadlineSupervision		
Description	This parameter contains the longest time span after which the deadline is considered to be met. Unit: [s]		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	[0 .. INF]		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00317] Definition of EcucFloatParamDef WdgMDeadlineMin ⌈

Parameter Name	WdgMDeadlineMin		
Parent Container	WdgMDeadlineSupervision		
Description	This parameter contains the shortest time span after which the deadline is considered to be met. Unit: [s]		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	[0 .. INF]		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00315] Definition of EcucReferenceDef WdgMDeadlineStartRef ⌈

Parameter Name	WdgMDeadlineStartRef		
Parent Container	WdgMDeadlineSupervision		
Description	This is the reference to the start Checkpoint for Deadline Supervision.		
Multiplicity	1		
Type	Symbolic name reference to WdgMCheckpoint		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

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[ECUC_WdgM_00316] Definition of EcucReferenceDef WdgMDeadlineStopRef ⌈

Parameter Name	WdgMDeadlineStopRef		
Parent Container	WdgMDeadlineSupervision		
Description	This is the reference to the stop Checkpoint for Deadline Supervision.		
Multiplicity	1		
Type	Symbolic name reference to WdgMCheckpoint		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

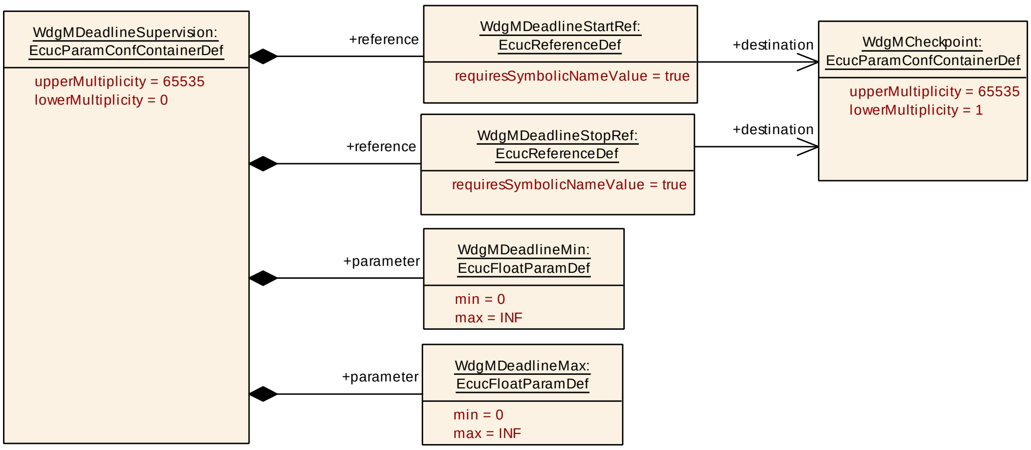
WdgMDeadlineSupervision: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+reference
WdgMDeadlineStartRef: EcucReferenceDef
requiresSymbolicNameValue = true
+destination
WdgMCheckpoint: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 1
+reference
WdgMDeadlineStopRef: EcucReferenceDef
requiresSymbolicNameValue = true
+destination
+parameter
WdgMDeadlineMin: EcucFloatParamDef
min = 0
max = INF
+parameter
WdgMDeadlineMax: EcucFloatParamDef
min = 0
max = INF

Figure 10.10: Configuration Container WdgMDeadlineSupervision

10.2.13 WdgMExternalLogicalSupervision

[ECUC_WdgM_00319] Definition of EcucParamConfContainerDef WdgMExternalLogicalSupervision ⌈

Container Name	WdgMExternalLogicalSupervision
Parent Container	WdgMMode
Description	This container collects all configuration parameters for Logical Supervision for one external graph.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMExternalCheckpointFinalRef	1..65535	[ECUC_WdgM_00324]
WdgMExternalCheckpointInitialRef	1..65535	[ECUC_WdgM_00323]

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
WdgMCrossClusterTransition	0..65535	This container configures a cross cluster transition. A WdgMCrossClusterTransition can be configured • from a WdgMCheckpoint to a WdgMTransitionProxy • from a WdgMTransitionProxy to a WdgMCheckpoint • from a WdgMTransitionProxy to another WdgMTransitionProxy (in Host Software Cluster only) • from a WdgMTransitionProxy to the identical WdgMTransition Proxy (in Application Software Cluster only for the case that no WdgMCheckpoint has to be reached in the Application Software Cluster) • from a WdgMCheckpoint to a WdgMCheckpoint (in case the cross cluster transition graph is entirely described with Wdg MCrossClusterTransition containers) **Tags:** atp.Status=draft
WdgMExternalTransition	0..65535	This container collects the Checkpoints for an External Transition across Supervised Entities.
WdgMTransitionProxy	0..65535	The WdgMTransitionProxy defines a proxy for a transition between the Host Software Cluster and an Application Software Cluster and vice versa. From the Host Software Cluster perspective a Cross Cluster Transition graph leaves the host after the transition which has the WdgMTransitionProxy as a destination or initial reference and returns in this Wdg MTransitionProxy after the configured transitions are occurred in the related Application Software Cluster. Afterwards the transition in the host are expected which are referencing the WdgMTransitionProxy by a source or final reference. **Tags:** atp.Status=draft

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[ECUC_WdgM_00324] Definition of EcucChoiceReferenceDef WdgMExternal CheckpointFinalRef ⌈

Parameter Name	WdgMExternalCheckpointFinalRef		
Parent Container	WdgMExternalLogicalSupervision		
Description	This is the reference to the final Checkpoint(s) for this External Graph which can end with a WdgMCheckpoint or in case of cross cluster transitions with a WdgMTransition Proxy. Both WdgMCheckpoint(s) and WdgMTransitionProxy(s) could be mixed inside the same WdgMExternalLogicalSupervision.		
Multiplicity	1..65535		
Type	Choice symbolic name reference to [WdgMCheckpoint, WdgMTransitionProxy]		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD

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Scope / Dependency	scope: local		

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[ECUC_WdgM_00323] Definition of EcucChoiceReferenceDef WdgMExternalCheckpointInitialRef ⌈

Parameter Name	WdgMExternalCheckpointInitialRef		
Parent Container	WdgMExternalLogicalSupervision		
Description	This is the reference to the initial Checkpoint(s) for this External Graph which can start with a WdgMCheckpoint or in case of cross cluster transitions with a WdgMTransitionProxy. Both WdgMCheckpoint(s) and WdgMTransitionProxy(s) could be mixed inside the same WdgMExternalLogicalSupervision.		
Multiplicity	1..65535		
Type	Choice symbolic name reference to [WdgMCheckpoint, WdgMTransitionProxy]		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

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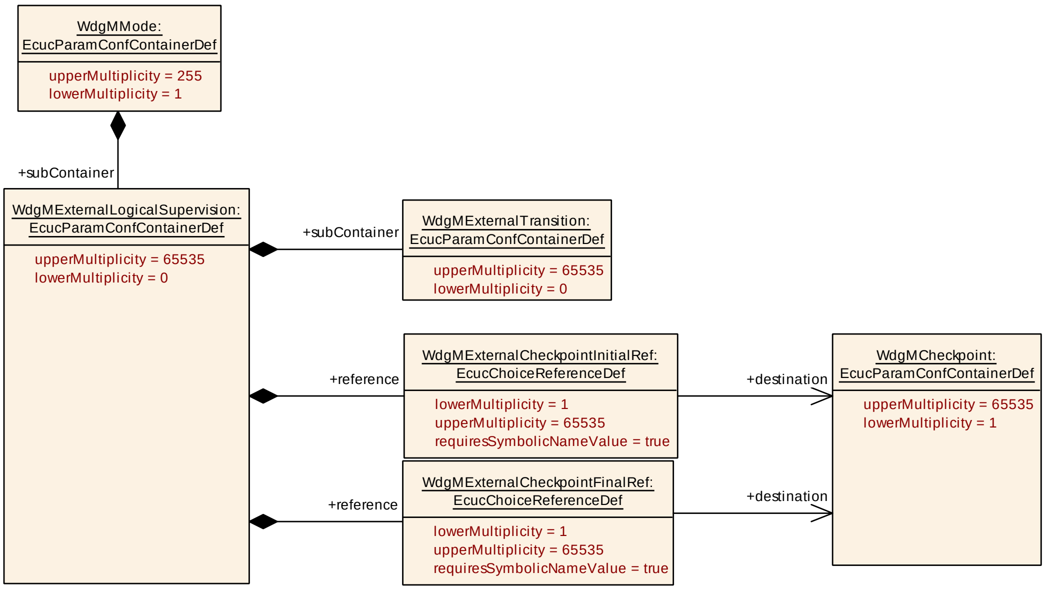
WdgMMode:
EcucParamConfContainerDef
upperMultiplicity = 255
lowerMultiplicity = 1
+subContainer
WdgMExternalLogicalSupervision:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+subContainer
WdgMExternalTransition:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+reference
WdgMExternalCheckpointInitialRef:
EcucChoiceReferenceDef
lowerMultiplicity = 1
upperMultiplicity = 65535
requiresSymbolicNameValue = true
+destination
WdgMCheckpoint:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 1
+reference
WdgMExternalCheckpointFinalRef:
EcucChoiceReferenceDef
lowerMultiplicity = 1
upperMultiplicity = 65535
requiresSymbolicNameValue = true
+destination

Figure 10.11: Configuration Container WdgMExternalLogicalSupervision

10.2.14 WdgMExternalTransition

[ECUC_WdgM_00320] Definition of EcucParamConfContainerDef WdgMExternalTransition ⌈

Container Name	WdgMExternalTransition
Parent Container	WdgMExternalLogicalSupervision
Description	This container collects the Checkpoints for an External Transition across Supervised Entities.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMExternalTransitionDestRef	1	[ECUC_WdgM_00322]
WdgMExternalTransitionSourceRef	1	[ECUC_WdgM_00321]

No Included Containers

⌋

[ECUC_WdgM_00322] Definition of EcucReferenceDef WdgMExternalTransitionDestRef ⌈

Parameter Name	WdgMExternalTransitionDestRef		
Parent Container	WdgMExternalTransition		
Description	This is the reference to the destination Checkpoint of an External Transition.		
Multiplicity	1		
Type	Symbolic name reference to WdgMCheckpoint		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00321] Definition of EcucReferenceDef WdgMExternalTransitionSourceRef ⌈

Parameter Name	WdgMExternalTransitionSourceRef
Parent Container	WdgMExternalTransition
Description	This is the reference to the source Checkpoint of an External Transition.
Multiplicity	1
Type	Symbolic name reference to WdgMCheckpoint
Post-Build Variant Value	true

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Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

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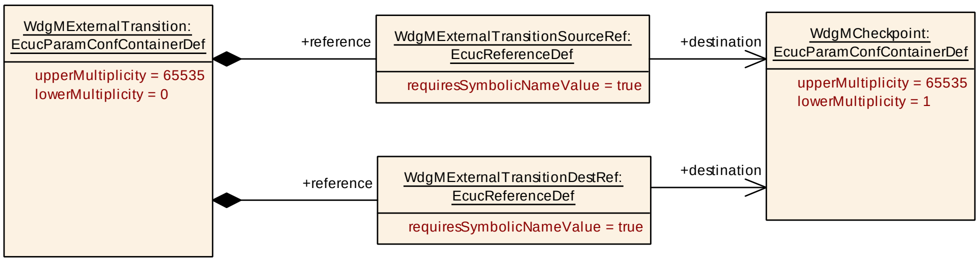
WdgMExternalTransition:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+reference
WdgMExternalTransitionSourceRef:
EcucReferenceDef
requiresSymbolicNameValue = true
+destination
WdgMCheckpoint:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 1
+reference
WdgMExternalTransitionDestRef:
EcucReferenceDef
requiresSymbolicNameValue = true
+destination

Figure 10.12: Configuration Container `WdgMExternalTransition`

10.2.15 `WdgMTrigger`

[ECUC_WdgM_00331] Definition of EcucParamConfContainerDef WdgMTrigger ⌈

Container Name	WdgMTrigger
Parent Container	WdgMMode
Description	This container collects all configuration parameters for the triggering of hardware watchdogs.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMTriggerConditionValue	1	[ECUC_WdgM_00333]
WdgMWatchdogMode	1	[ECUC_WdgM_00332]
WdgMTriggerWatchdogRef	1	[ECUC_WdgM_00334]

No Included Containers

⌋

[ECUC_WdgM_00333] Definition of EcucIntegerParamDef WdgMTriggerConditionValue ⌈

Parameter Name	WdgMTriggerConditionValue		
Parent Container	WdgMTrigger		
Description	This parameter shall contain the value that is passed to WdgIf_SetTriggerCondition for this watchdog.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 65535		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00332] Definition of EcucEnumerationParamDef WdgMWatchdogMode ⌈

Parameter Name	WdgMWatchdogMode		
Parent Container	WdgMTrigger		
Description	This parameter contains the watchdog mode that shall be used for the referenced watchdog in this Watchdog Manager mode. Implementation Type: WdgIf_ModeType		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	WDGIF_FAST_MODE	–	
	WDGIF_OFF_MODE	–	
	WDGIF_SLOW_MODE	–	
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00334] Definition of EcucReferenceDef WdgMTriggerWatchdogRef ⌈

Parameter Name	WdgMTriggerWatchdogRef
Parent Container	WdgMTrigger
Description	This parameter is a reference to the configured watchdog.
Multiplicity	1

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Type	Reference to WdgMWatchdog		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

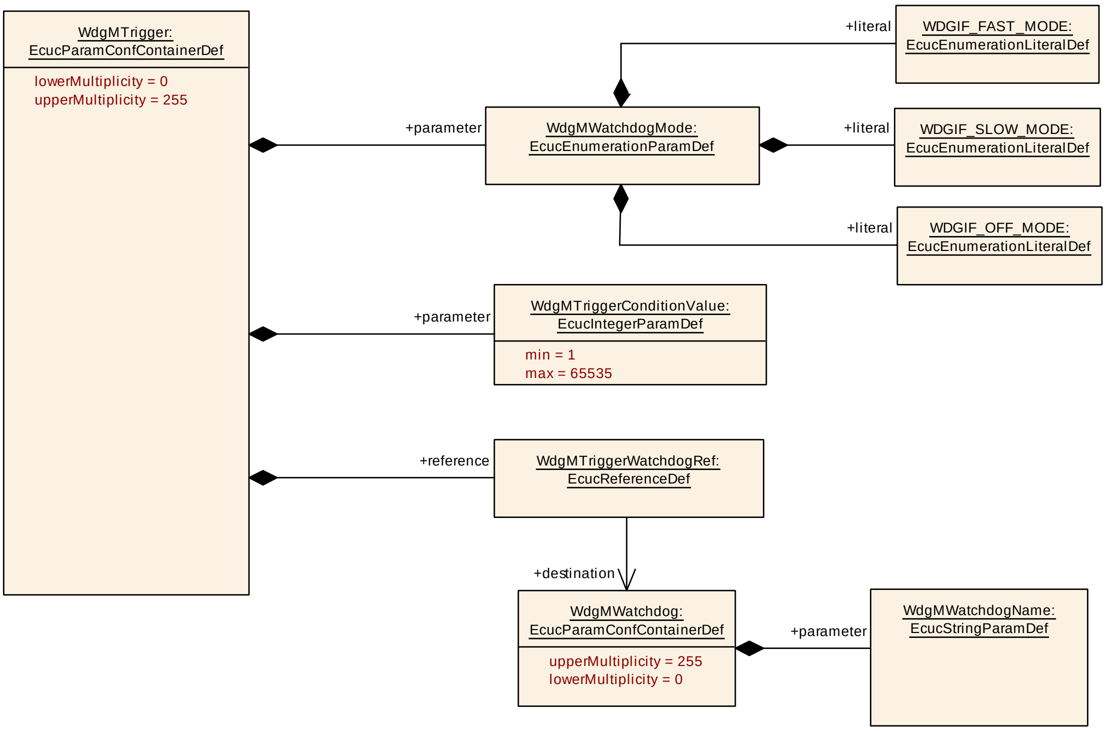

Figure 10.13: Configuration Container WdgMTrigger

10.2.16 WdgMLocalStatusParams

[ECUC_WdgM_00325] Definition of EcucParamConfContainerDef WdgMLocalStatusParams ⌈

Container Name	WdgMLocalStatusParams
Parent Container	WdgMMode
Description	This container collects all configuration parameters for the Local Status of a Supervised Entity.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMFailedAliveSupervisionRefCycleTol	1	[ECUC_WdgM_00327]
WdgMLocalStatusSupervisedEntityRef	1	[ECUC_WdgM_00326]

No Included Containers

⌋

[ECUC_WdgM_00327] Definition of EcucIntegerParamDef WdgMFailedAliveSupervisionRefCycleTol ⌈

Parameter Name	WdgMFailedAliveSupervisionRefCycleTol		
Parent Container	WdgMLocalStatusParams		
Description	This parameter shall contain the acceptable amount of reference cycles with incorrect/ failed alive supervisions for this Supervised Entity.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00326] Definition of EcucReferenceDef WdgMLocalStatusSupervisedEntityRef ⌈

Parameter Name	WdgMLocalStatusSupervisedEntityRef		
Parent Container	WdgMLocalStatusParams		
Description	This is the reference to the Supervised Entity for which the Local Status parameters are specified.		
Multiplicity	1		
Type	Symbolic name reference to WdgMSupervisedEntity		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

⌋

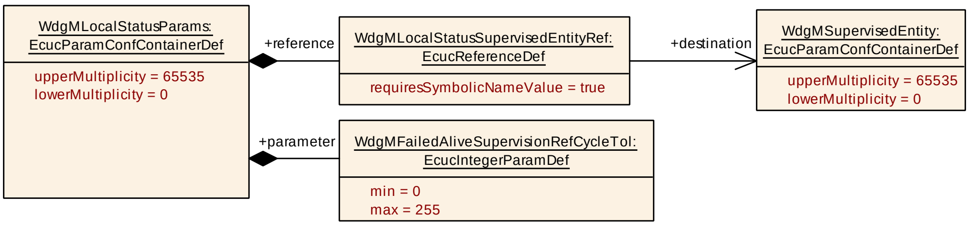
WdgMLocalStatusParams: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+reference
WdgMLocalStatusSupervisedEntityRef: EcucReferenceDef
requiresSymbolicNameValue = true
+destination
WdgMSupervisedEntity: EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+parameter
WdgMFailedAliveSupervisionRefCycleTol: EcucIntegerParamDef
min = 0
max = 255

Figure 10.14: Configuration Container WdgMLocalStatusParams

10.2.17 WdgMMainFunction

[ECUC_WdgM_00373] Definition of EcucParamConfContainerDef WdgMMainFunction

Status: DRAFT

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Container Name	WdgMMainFunction		
Parent Container	WdgMGeneral		
Description	Reference to the WdgMInstanceMainFunction which this Supervised Entity belongs to. Relevant to Alive Supervision and Deadline Supervision **Tags:** atp.Status=draft		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMMainFunctionPartitionRef	0..1	[ECUC_WdgM_00369]

No Included Containers

⌋

[ECUC_WdgM_00369] Definition of EcucReferenceDef WdgMMainFunctionPartitionRef

Status: DRAFT

⌈

Parameter Name	WdgMMainFunctionPartitionRef		
Parent Container	WdgMMainFunction		
Description	Reference to EcucPartition, where the according WdgM_MainFunction instance is assigned to. For the software architecture with single partition, this reference is unnecessary. **Tags:** atp.Status=draft		
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		

⌋

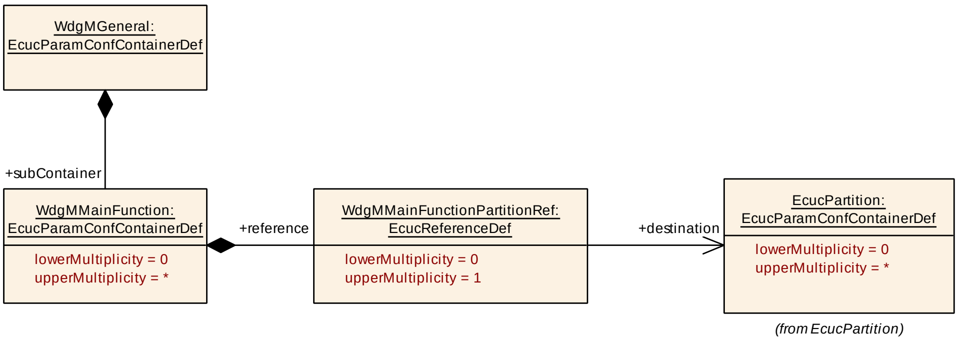

Figure 10.15: Configuration Container WdgMMainFunction

10.2.18 WdgMMainFunctionModeProps

[ECUC_WdgM_00372] Definition of EcucParamConfContainerDef WdgMMainFunctionModeProps

Status: DRAFT

⌈

Container Name	WdgMMainFunctionModeProps		
Parent Container	WdgMMode		
Description	This container provides configuration values for a WdgMMainFunction which apply in a specific WdgMMode. **Tags:** atp.Status=draft		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMMainFunctionModePropsTimePeriod	1	[ECUC_WdgM_00370]
WdgMMainFunctionModePropsMainFunctionRef	1	[ECUC_WdgM_00371]

No Included Containers

⌋

[ECUC_WdgM_00370] Definition of EcucFloatParamDef WdgMMainFunctionModePropsTimePeriod

Status: DRAFT

⌈

Parameter Name	WdgMMainFunctionModePropsTimePeriod		
Parent Container	WdgMMainFunctionModeProps		
Description	The period between successive calls to according instance of WdgM_MainFunction in seconds. This parameter may be used by the WdgM generator to transform the values of the WdgMModes and/or WdhMSupervisedEntities timing configuration parameters of the WdgM module to internal implementation specific counter or tick values. The WdgM module's internal timing handling is implementation specific. The WdgM module (generator) may rely on the fact that Wdg_MainFunction is scheduled according to the value configured here. Unit: [s] **Tags:** atp.Status=draft		
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		

⌋

[ECUC_WdgM_00371] Definition of EcucReferenceDef WdgMMainFunctionModePropsMainFunctionRef

Status: DRAFT

⌈

Parameter Name	WdgMMainFunctionModePropsMainFunctionRef		
Parent Container	WdgMMainFunctionModeProps		
Description	Reference to the WdgMMainFunction for which the WdgMMainFunctionModeProps apply. **Tags:** atp.Status=draft		
Multiplicity	1		
Type	Reference to WdgMMainFunction		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

10.2.19 WdgMCrossClusterTransition

[ECUC_WdgM_00376] Definition of EcucParamConfContainerDef WdgMCrossClusterTransition

Status: DRAFT

⌈

Container Name	WdgMCrossClusterTransition
Parent Container	WdgMExternalLogicalSupervision
Description	This container configures a cross cluster transition. A WdgMCrossClusterTransition can be configured • from a WdgMCheckpoint to a WdgMTransitionProxy • from a WdgMTransitionProxy to a WdgMCheckpoint • from a WdgMTransitionProxy to another WdgMTransitionProxy (in Host Software Cluster only) • from a WdgMTransitionProxy to the identical WdgMTransitionProxy (in Application Software Cluster only for the case that no WdgMCheckpoint has to be reached in the Application Software Cluster) • from a WdgMCheckpoint to a WdgMCheckpoint (in case the cross cluster transition graph is entirely described with WdgMCrossClusterTransition containers) **Tags:** atp.Status=draft
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMCrossClusterTransitionDestRef	1	[ECUC_WdgM_00375]
WdgMCrossClusterTransitionSourceRef	1	[ECUC_WdgM_00374]

No Included Containers

⌋

[ECUC_WdgM_00375] Definition of EcucChoiceReferenceDef WdgMCrossClusterTransitionDestRef

Status: DRAFT

⌈

Parameter Name	WdgMCrossClusterTransitionDestRef		
Parent Container	WdgMCrossClusterTransition		
Description	This is the reference to the destination of a cross cluster transition. **Tags:** atp.Status=draft		
Multiplicity	1		
Type	Choice symbolic name reference to [WdgMCheckpoint, WdgMTransitionProxy]		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_WdgM_00374] Definition of EcucChoiceReferenceDef WdgMCrossClusterTransitionSourceRef

Status: DRAFT

⌈

Parameter Name	WdgMCrossClusterTransitionSourceRef		
Parent Container	WdgMCrossClusterTransition		
Description	This is the reference to the source of a cross cluster transition. **Tags:** atp.Status=draft		
Multiplicity	1		
Type	Choice symbolic name reference to [WdgMCheckpoint, WdgMTransitionProxy]		
Post-Build Variant Value	true		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

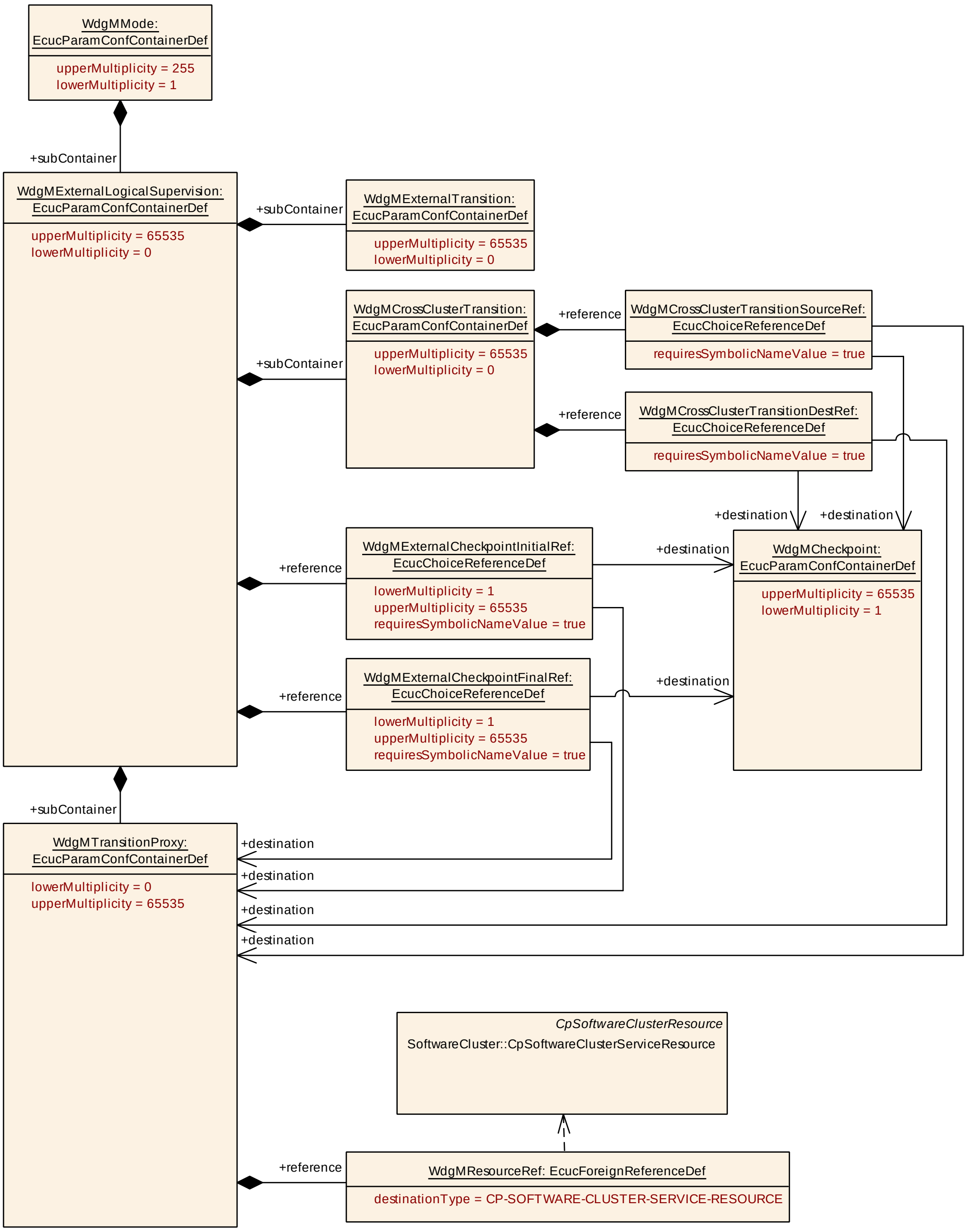
WdgMMode:
EcucParamConfContainerDef
upperMultiplicity = 255
lowerMultiplicity = 1
+subContainer
WdgMExternalLogicalSupervision:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+subContainer
WdgMExternalTransition:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+subContainer
WdgMCrossClusterTransition:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
+reference
WdgMCrossClusterTransitionSourceRef:
EcucChoiceReferenceDef
requiresSymbolicNameValue = true
+reference
WdgMCrossClusterTransitionDestRef:
EcucChoiceReferenceDef
requiresSymbolicNameValue = true
+destination
+destination
+reference
WdgMExternalCheckpointInitialRef:
EcucChoiceReferenceDef
lowerMultiplicity = 1
upperMultiplicity = 65535
requiresSymbolicNameValue = true
+destination
WdgMCheckpoint:
EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 1
+reference
WdgMExternalCheckpointFinalRef:
EcucChoiceReferenceDef
lowerMultiplicity = 1
upperMultiplicity = 65535
requiresSymbolicNameValue = true
+destination
+subContainer
WdgMTransitionProxy:
EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 65535
+destination
+destination
+destination
+destination
CpSoftwareClusterResource
SoftwareCluster::CpSoftwareClusterServiceResource
+reference
WdgMResourceRef: EcucForeignReferenceDef
destinationType = CP-SOFTWARE-CLUSTER-SERVICE-RESOURCE

Figure 10.16: Configuration Container WdgMCrossClusterTransition (for Clustered Software Architecture)

10.2.20 WdgMTransitionProxy

[ECUC_WdgM_00364] Definition of EcucParamConfContainerDef WdgMTransitionProxy

Status: DRAFT

⌈

Container Name	WdgMTransitionProxy
Parent Container	WdgMExternalLogicalSupervision
Description	The WdgMTransitionProxy defines a proxy for a transition between the Host Software Cluster and an Application Software Cluster and vice versa. From the Host Software Cluster perspective a Cross Cluster Transition graph leaves the host after the transition which has the WdgMTransitionProxy as a destination or initial reference and returns in this WdgMTransitionProxy after the configured transitions are occurred in the related Application Software Cluster. Afterwards the transition in the host are expected which are referencing the WdgMTransitionProxy by a source or final reference. **Tags:** atp.Status=draft
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMResourceRef	1	[ECUC_WdgM_00367]

No Included Containers

⌋

For parameter table [ECUC_WdgM_00367] WdgMResourceRef, see definition below container WdgMBaseSocket.

10.2.21 WdgMBaseSocket

[ECUC_WdgM_00377] Definition of EcucParamConfContainerDef WdgMBase Socket

Status: DRAFT

⌈

Container Name	WdgMBaseSocket		
Parent Container	WdgMGeneral		
Description	This container configures how many EcucPartitions specific infrastructure links are required for the WdgM instances in Application Software Clusters provided by the Host Software Cluster. Such infrastructure links serve for: the initialization of Application Software Cluster WdgM instances by Host WdgM instance the transmission of supervision results from Application Software Cluster WdgM instances to Host WdgM instance any other implementation specific purpose which is need for the interaction of Application Software Cluster WdgM instances and Host WdgM instance If the infrastructure connection is specific to one or several EcucPartition(s) the WdgMSocketEcucPartitionRef(s) denotes the applicable EcucPartition. **Tags:** atp.Status=draft		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
WdgMResourceRef	1	[ECUC_WdgM_00367]
WdgMSocketEcucPartitionRef	0..*	[ECUC_WdgM_00366]

No Included Containers

⌋

[ECUC_WdgM_00367] Definition of EcucForeignReferenceDef WdgMResourceRef

Status: DRAFT

⌈

Parameter Name	WdgMResourceRef
Parent Container	WdgMBaseSocket, WdgMTransitionProxy
Description	Reference to the CpSoftwareClusterServiceResource. **Tags:** atp.Status=draft
Multiplicity	1
Type	Foreign reference to CP-SOFTWARE-CLUSTER-SERVICE-RESOURCE
Scope / Dependency	scope: ECU

⌋

[ECUC_WdgM_00366] Definition of EcucReferenceDef WdgMSocketEcucPartitionRef

Status: DRAFT

⌈

Parameter Name	WdgMSocketEcucPartitionRef		
Parent Container	WdgMBaseSocket		
Description	Reference to the EcucPartition. **Tags:** atp.Status=draft		
Multiplicity	0..*		
Type	Reference to EcucPartition		
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: ECU		

⌋

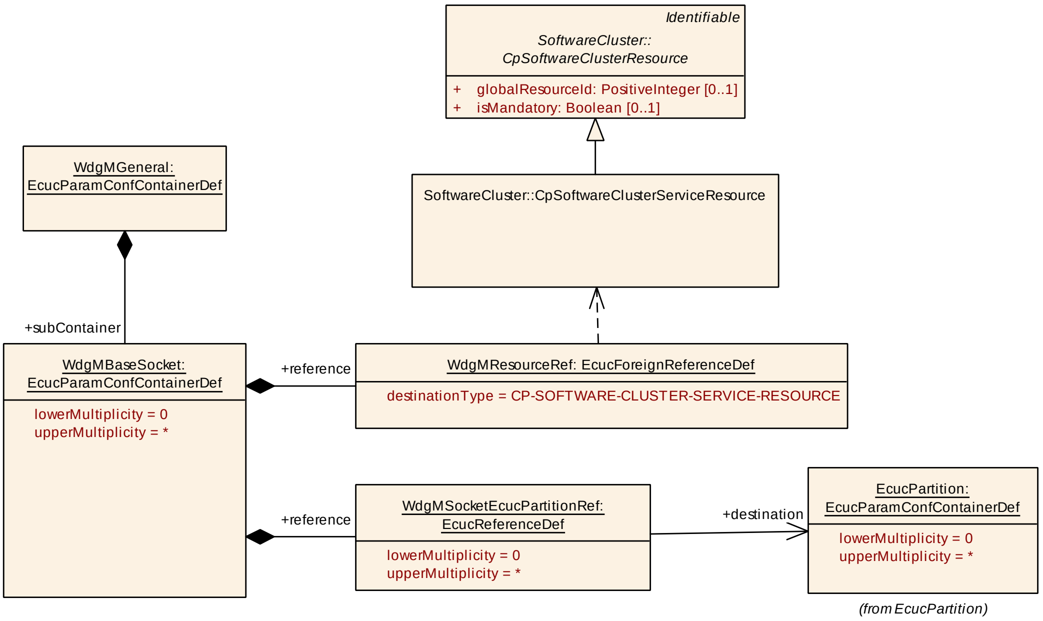
Identifiable
SoftwareCluster::
CpSoftwareClusterResource
+ globalResourceId: PositiveInteger [0..1]
+ isMandatory: Boolean [0..1]
WdgMGeneral:
EcucParamConfContainerDef
SoftwareCluster::CpSoftwareClusterServiceResource
+subContainer
WdgMBaseSocket:
EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+reference
WdgMResourceRef: EcucForeignReferenceDef
destinationType = CP-SOFTWARE-CLUSTER-SERVICE-RESOURCE
+reference
WdgMSocketEcucPartitionRef:
EcucReferenceDef
lowerMultiplicity = 0
upperMultiplicity = *
+destination
EcucPartition:
EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
(from EcucPartition)

Figure 10.17: Configuration Container WdgMBaseSocket (for Clustered Software Architecture)

10.3 Published Information

For details refer to the chapter 10.3 “Published Information” in [3, General Specification of Basic Software Modules].

A Example Implementation of Alive Supervision Algorithm

For the Alive Supervision, an algorithm to detect mismatching timing constraints of the Checkpoints is provided in order to clearly define the parameters needed for the Alive Supervision.

Doing this with incremental Alive Counters for the Checkpoints brings up a representation of aliveness by a counted number of alive indications in relationship with the Alive Supervision period.

With this approach, it must be possible to deal with two different scenarios:

A) The alive indications of a Checkpoint are expected to occur at least one time within one supervision cycle. The number of alive indications (AI) within one supervision cycle (SC) shall be counted.

B) The alive indication of a Checkpoint is expected to occur less often than the supervision cycle. The number of supervision cycles (SC) between two alive indications (AI) has to be counted.

To cope with these two scenarios, it is necessary to count both AI and SC.

We also need the parameter WdgMExpectedAliveIndications [ECUC_WdgM_00311] (EAI) which represents the expected amount of alive indications of the Checkpoint within the referenced amount of supervision cycles also called Supervision Reference Cycle [ECUC_WdgM_00310] (SRC). The value of this parameter should have been determined during the design phase and defined by configuration.

To avoid the detection of too many supervision errors for the Checkpoints, there are parameters WdgMMinMargin [ECUC_WdgM_00312] and WdgMMinMargin [ECUC_WdgM_00313] to define tolerances on the timing constraints.

WdgMMinMargin represents the allowed number of missing executions of the Checkpoint.

WdgMMaxMargin represents the allowed number of additional executions of the Checkpoint.

Therefore, the algorithm becomes:

(n (AI) - n (SC) + f(EAI, SRC) <= WdgMMinMargin) and

(n (AI) - n (SC) + f(EAI, SRC) >= - WdgMMinMargin),

where the function f is defined as

f(EAI, SRC) = SRC - EAI .

Note that f(EAI, SRC) has a constant value and can be preliminary computed if EAI and SRC are constant.

A.1 Scenario A

The alive indications (AI) of a Checkpoint are expected to occur at least one time within one supervision cycle.

Example: 2 alive indications are expected in one supervision cycle which represents the Supervision Reference Cycle then the value of f(EAI, SRC) is:

f(EAI, SRC) = 1 - 2 = -1

When SC occurs, the number of supervision cycles is incremented (n (SC) = 1) and the regularly checkup is performed during each supervision cycle (Supervision Reference Cycle = 1 supervision cycle) with the algorithm.

After performing the check, the current numbers of alive indications and supervision cycles are reset.

For our examples, Max and Min margins are set to 0 for more simplicity, so the algorithm used is

n (AI) - n (SC) + f(EAI, SRC) = 0.

This brings the compare algorithm to a negative result if not enough alive indications occurred before the supervision cycle. If the number of alive indications fits exactly to the expected number, the result is 0. If more alive indications have occurred, the number is bigger than 0.

The result of the algorithm represents exactly the number of “extra” alive indications within the last supervision cycle.

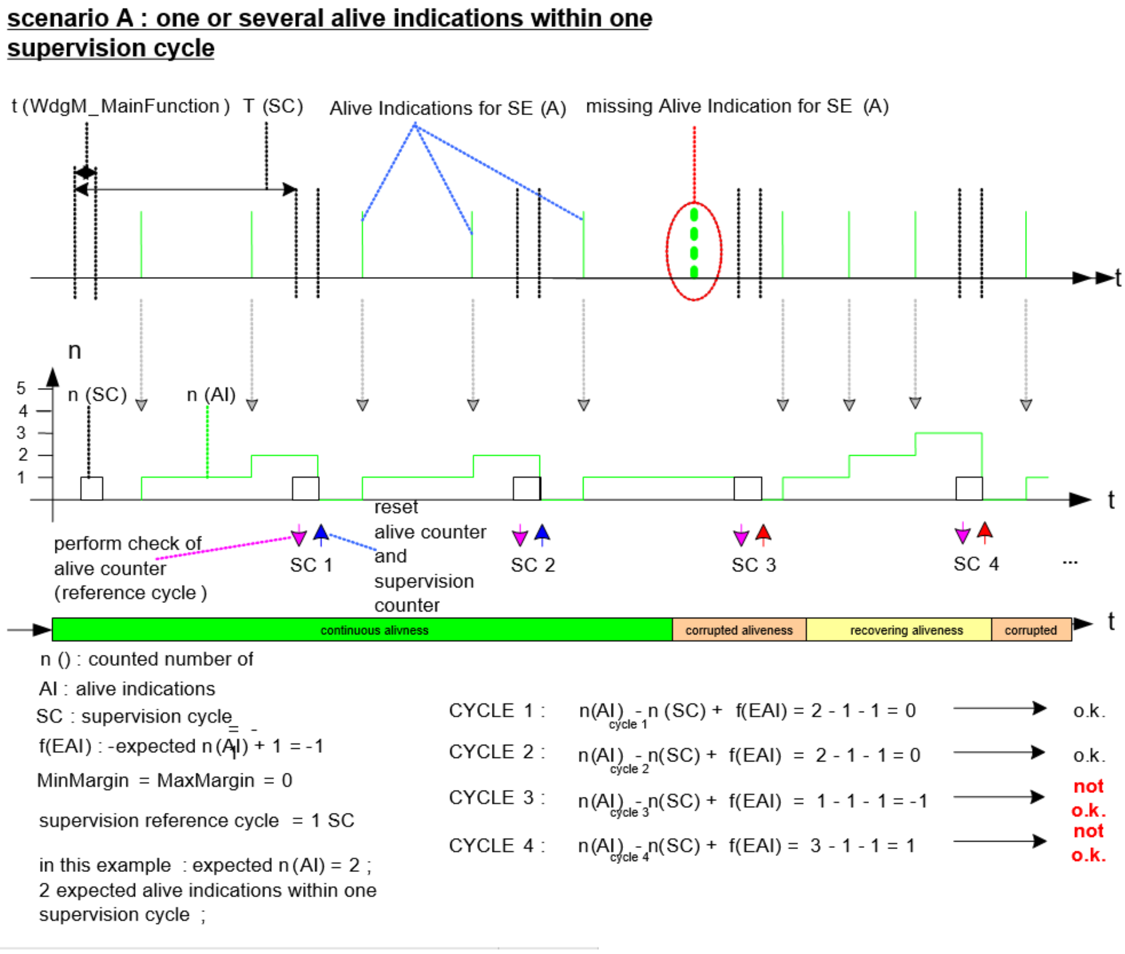
scenario A : one or several alive indications within one supervision cycle
t (WdgM_MainFunction)
T (SC)
Alive Indications for SE (A)
missing Alive Indication for SE (A)
t
n
5
4
3
2
1
n (SC)
n (AI)
t
perform check of alive counter (reference cycle)
SC 1
reset alive counter and supervision counter
SC 2
SC 3
SC 4
...
continuous alivness
corrupted aliveness
recovering aliveness
corrupted
t
n () : counted number of
AI : alive indications
SC : supervision cycle
f(EAI) : -expected n (AI) + 1 = -1
MinMargin = MaxMargin = 0
supervision reference cycle = 1 SC
in this example : expected n (AI) = 2 ; 2 expected alive indications within one supervision cycle ;
CYCLE 1 : n(AI)cycle 1 - n (SC) + f(EAI) = 2 - 1 - 1 = 0 → o.k.
CYCLE 2 : n(AI)cycle 2 - n(SC) + f(EAI) = 2 - 1 - 1 = 0 → o.k.
CYCLE 3 : n(AI)cycle 3 - n(SC) + f(EAI) = 1 - 1 - 1 = -1 → not o.k.
CYCLE 4 : n(AI)cycle 4 - n(SC) + f(EAI) = 3 - 1 - 1 = 1 → not o.k.

Figure A.1: Alive-supervision algorithm – Scenario A

A.2 Scenario B

The supervision cycle is expected more often than the alive indication. In this case, we have to count the supervision cycles, which have occurred, until the Alive Counter is incremented again. The check of aliveness should be performed during each Supervision Reference Cycle and the same algorithm should be used:

n (AI) - n (SC) + f(EAI, SRC) = 0

The alive indication must occur at least within a predefined number of supervision cycles which represent the Supervision Reference Cycle.

Example: one alive indication is expected within 2 supervision cycles (Supervision Reference Cycle = 2 supervision cycles):

f(EAI, SRC) = 2 - 1 = +1

The Alive Counter has to be incremented by 1 with every alive indication. Aliveness should be evaluated in the supervision cycle corresponding to the Supervision Reference Cycle. The compare-conditions of the algorithm remain in the same manner, but the detected incrementation of the Alive Counter should also invoke a reset of the Alive Counter and Supervision Counter after this compare-operation.

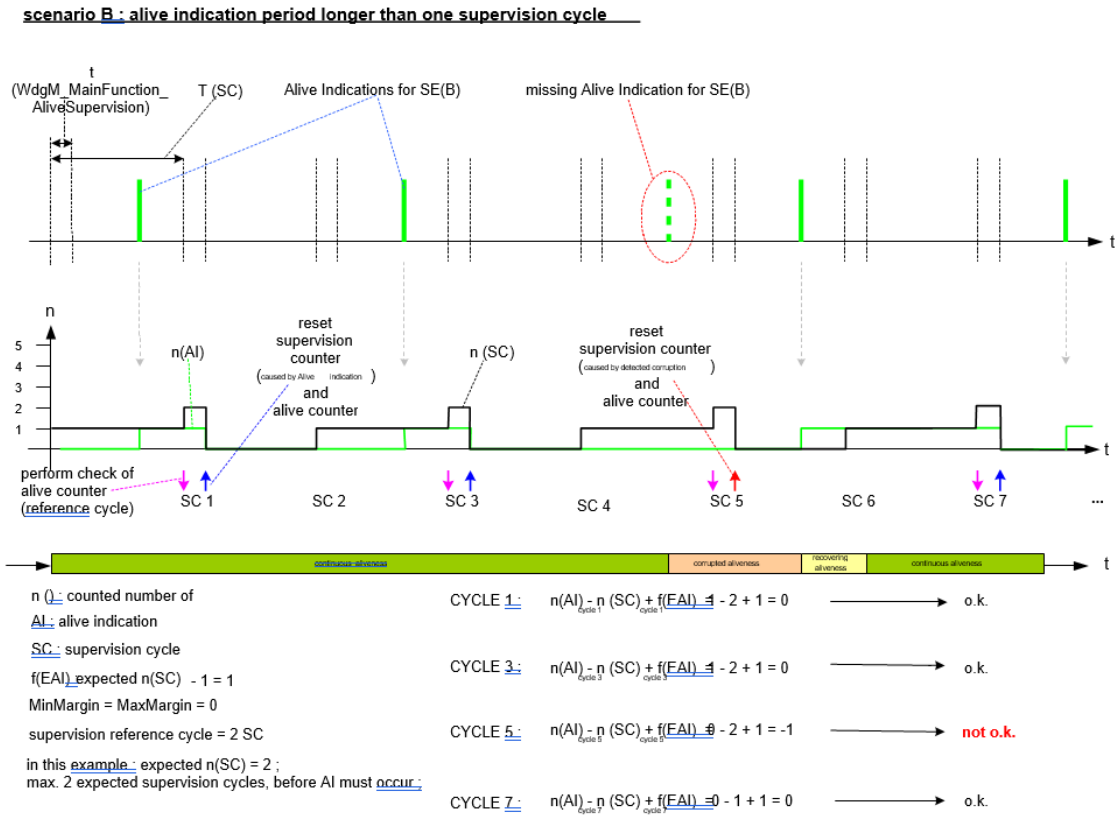
scenario B : alive indication period longer than one supervision cycle
t
(WdgM_MainFunction_
AliveSupervision)
T (SC)
Alive Indications for SE(B)
missing Alive Indication for SE(B)
t
n
5
4
3
2
1
n(AI)
reset
supervision
counter
(caused by Alive Indication)
and
alive counter
n (SC)
reset
supervision counter
(caused by detected corruption)
and
alive counter
t
perform check of
alive counter
(reference cycle)
SC 1
SC 2
SC 3
SC 4
SC 5
SC 6
SC 7
...
continuous alveness
corrupted aliveness
recovering aliveness
continuous aliveness
t
n () : counted number of
AI : alive indication
SC : supervision cycle
f(EAI) expected n(SC) - 1 = 1
MinMargin = MaxMargin = 0
supervision reference cycle = 2 SC
in this example : expected n(SC) = 2 ;
max. 2 expected supervision cycles, before AI must occur ;
CYCLE 1 : $n(AI)_{cycle 1} - n(SC)_{cycle 1} + f(EAI) = 1 - 2 + 1 = 0$ o.k.
CYCLE 3 : $n(AI)_{cycle 3} - n(SC)_{cycle 3} + f(EAI) = 1 - 2 + 1 = 0$ o.k.
CYCLE 5 : $n(AI)_{cycle 5} - n(SC)_{cycle 5} + f(EAI) = 0 - 2 + 1 = -1$ not o.k.
CYCLE 7 : $n(AI)_{cycle 7} - n(SC)_{cycle 7} + f(EAI) = 0 - 1 + 1 = 0$ o.k.

Figure A.2: Alive-supervision algorithm – Scenario B

B Not applicable requirements

[SWS_WdgM_NA_00345]

Upstream requirements: SRS_BSW_00004, SRS_BSW_00159, SRS_BSW_00167, SRS_BSW_00168, SRS_BSW_00170, SRS_BSW_00344, SRS_BSW_00369, SRS_BSW_00375, SRS_BSW_00380, SRS_BSW_00383, SRS_BSW_00384, SRS_BSW_00386, SRS_BSW_00388, SRS_BSW_00389, SRS_BSW_00390, SRS_BSW_00392, SRS_BSW_00393, SRS_BSW_00394, SRS_BSW_00395, SRS_BSW_00396, SRS_BSW_00397, SRS_BSW_00398, SRS_BSW_00399, SRS_BSW_00400, SRS_BSW_00402, SRS_BSW_00403, SRS_BSW_00404, SRS_BSW_00405, SRS_BSW_00407, SRS_BSW_00409, SRS_BSW_00416, SRS_BSW_00417, SRS_BSW_00419, SRS_BSW_00422, SRS_BSW_00423, SRS_BSW_00424, SRS_BSW_00425, SRS_BSW_00426, SRS_BSW_00427, SRS_BSW_00428, SRS_BSW_00429, SRS_BSW_00432, SRS_BSW_00433, SRS_BSW_00437, SRS_BSW_00438, SRS_BSW_00451, SRS_BSW_00461, SRS_BSW_00466, SRS_BSW_00467, SRS_BSW_00472, SRS_BSW_00478, SRS_BSW_00488, SRS_BSW_00489, SRS_BSW_00490, SRS_BSW_00491, SRS_BSW_00492, SRS_BSW_00493

⌈These requirements are not applicable to this specification.⌋

C Change history of AUTOSAR traceable items

Please note that the lists in this chapter also include traceable items that have been removed from the specification in a later version. These items do not appear as hyperlinks in the document.

C.1 Traceable item history of this document according to AUTOSAR Release R24-11

C.1.1 Added Specification Items in R24-11

Number	Heading
[SWS_WdgM_91005]	Global Supervision Status
[SWS_WdgM_91006]	Local Supervision Status

Table C.1: Added Specification Items in R24-11

C.1.2 Changed Specification Items in R24-11

none

C.1.3 Deleted Specification Items in R24-11

none

C.1.4 Added Constraints in R24-11

none

C.1.5 Changed Constraints in R24-11

none

C.1.6 Deleted Constraints in R24-11

none