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△

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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.





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 switching 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_SRS_BSWGeneral
- [7] Requirements on Mode Management
AUTOSAR_CP_SRS_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 Flexibility 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]





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]	A static status variable denoting if a BSW module is initialized shall be initialized with value 0 before any APIs of the BSW module is called	[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]





Requirement	Description	Satisfied by
[SRS_ModeMgm_-09109]	It shall be possible to prohibit the disabling of watchdog	[SWS_WdgM_00030] [SWS_WdgM_00031]
[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]
[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_-09232]	The Watchdog Manager shall provide a service to cause a watchdog reset	[SWS_WdgM_00264]

Table 6.1: RequirementsTracing

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 [subsection 7.2.1](#))
- Deadline Supervision (see [subsection 7.2.2](#))
- Logical Supervision (see [subsection 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 [subsection 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 [subsection 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.

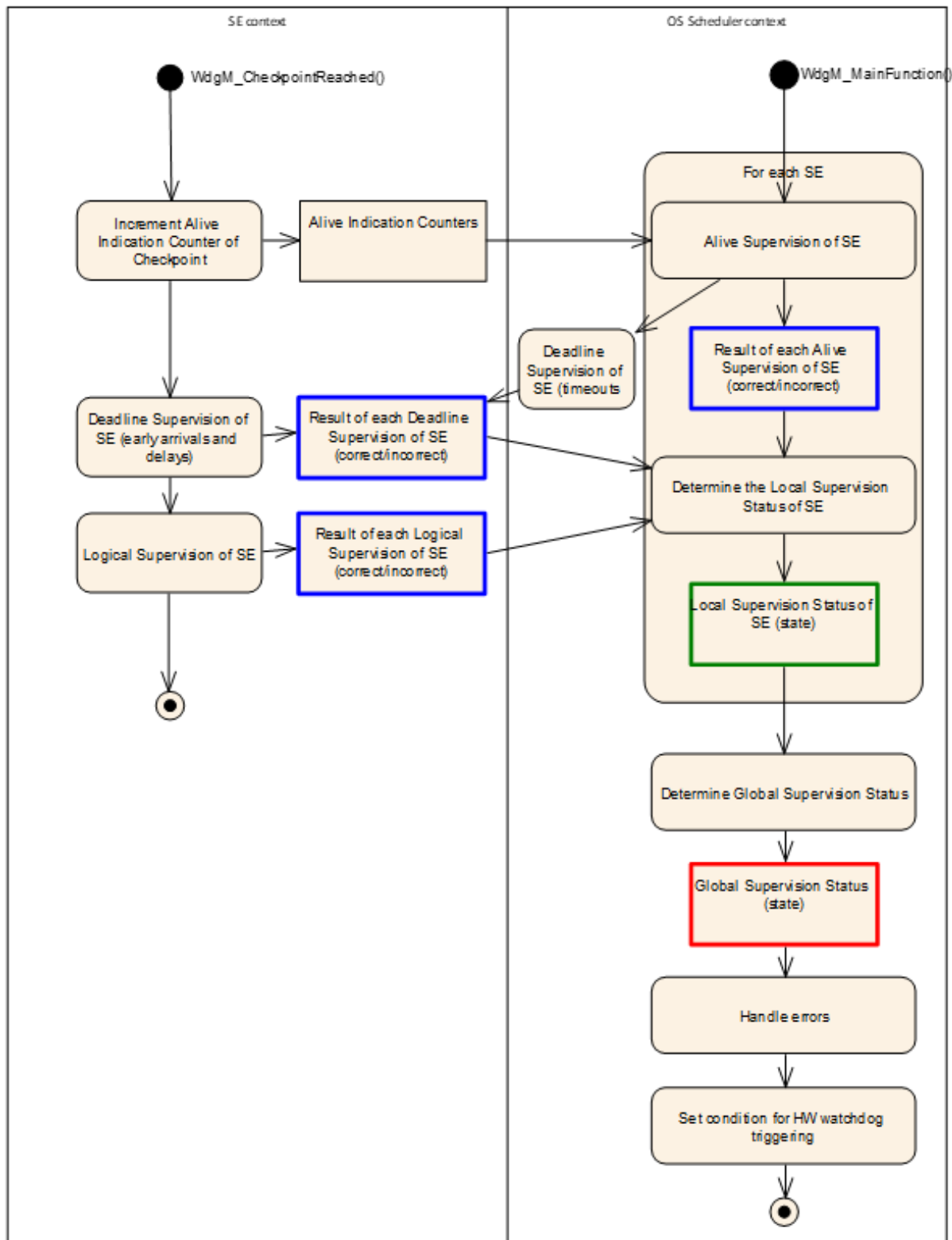


Figure 7.1: Overview of Watchdog Manager Supervision

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] [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.] ([SRS_BSW_00450](#))

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 WdgM module), to have consistent behavior as a Safety-related Monitoring Mechanism.

[SWS_WdgM_00407] [The WdgM module shall stop the Supervision Functions (for all Supervision Algorithms) and Watchdog Handling in the [WdgM_DeInit](#).] ([SRS_BSW_00450](#))

[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]{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]{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.]()

Figure 7.2 shows the state machine for Local Supervision Status of a Supervised Entity with all possible states.

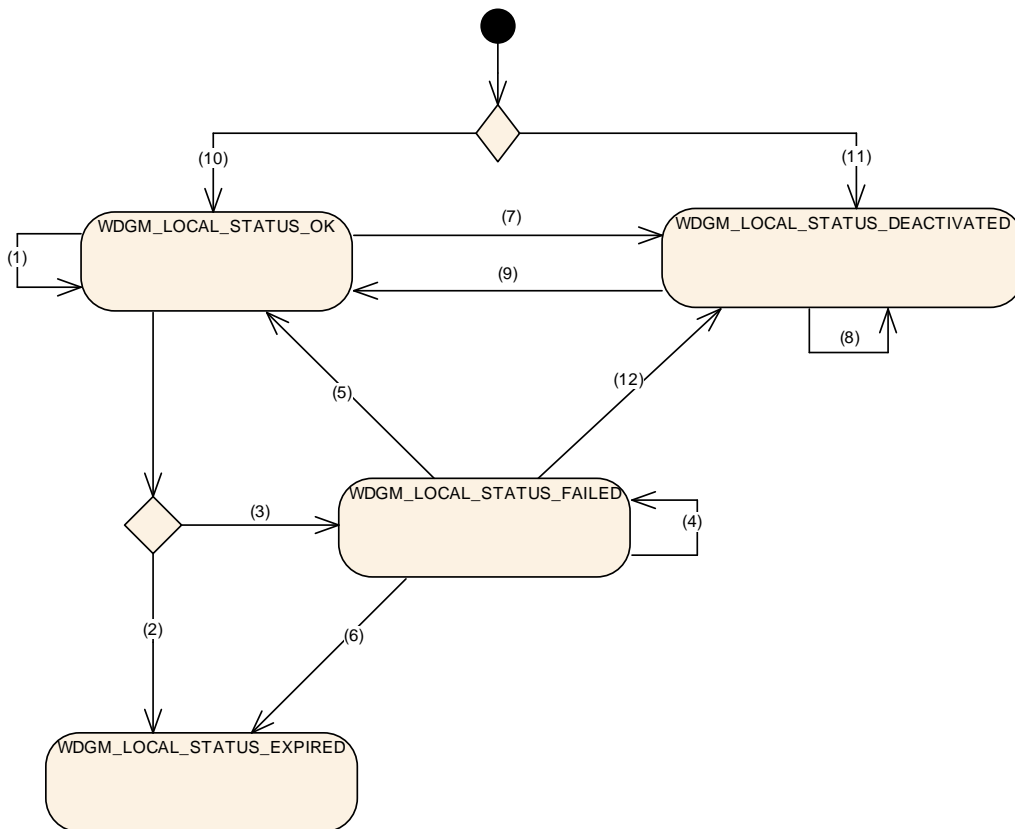


Figure 7.2: Local Supervision Status

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

[SWS_WdgM_00268] [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 [Figure 7.2](#)).] ([SRS_BSW_00101](#))

[SWS_WdgM_00269] [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 [Figure 7.2](#)).

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 [Figure 7.2](#)).] ([SRS_BSW_00101](#))

[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 [Figure 7.2](#)).]()

[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 [Figure 7.2](#)).]()

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 [Figure 7.2](#)).]()

[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 [Figure 7.2](#)).]()

[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 [Figure 7.2](#)).]()

[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 [Figure 7.2](#)).]()

[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 [Figure 7.2](#)).]()

[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 [Figure 7.2](#)).]()

[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 [Figure 7.2](#)).]()

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 [Figure 7.2](#))]()

[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_LOCAL_STATUS_OK`. And the counter for `Failed Supervision Reference Cycles` shall be set to zero (0). (see Transition (9) in [Figure 7.2](#))]()

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. [Figure 7.3](#) shows the values and transitions between them.

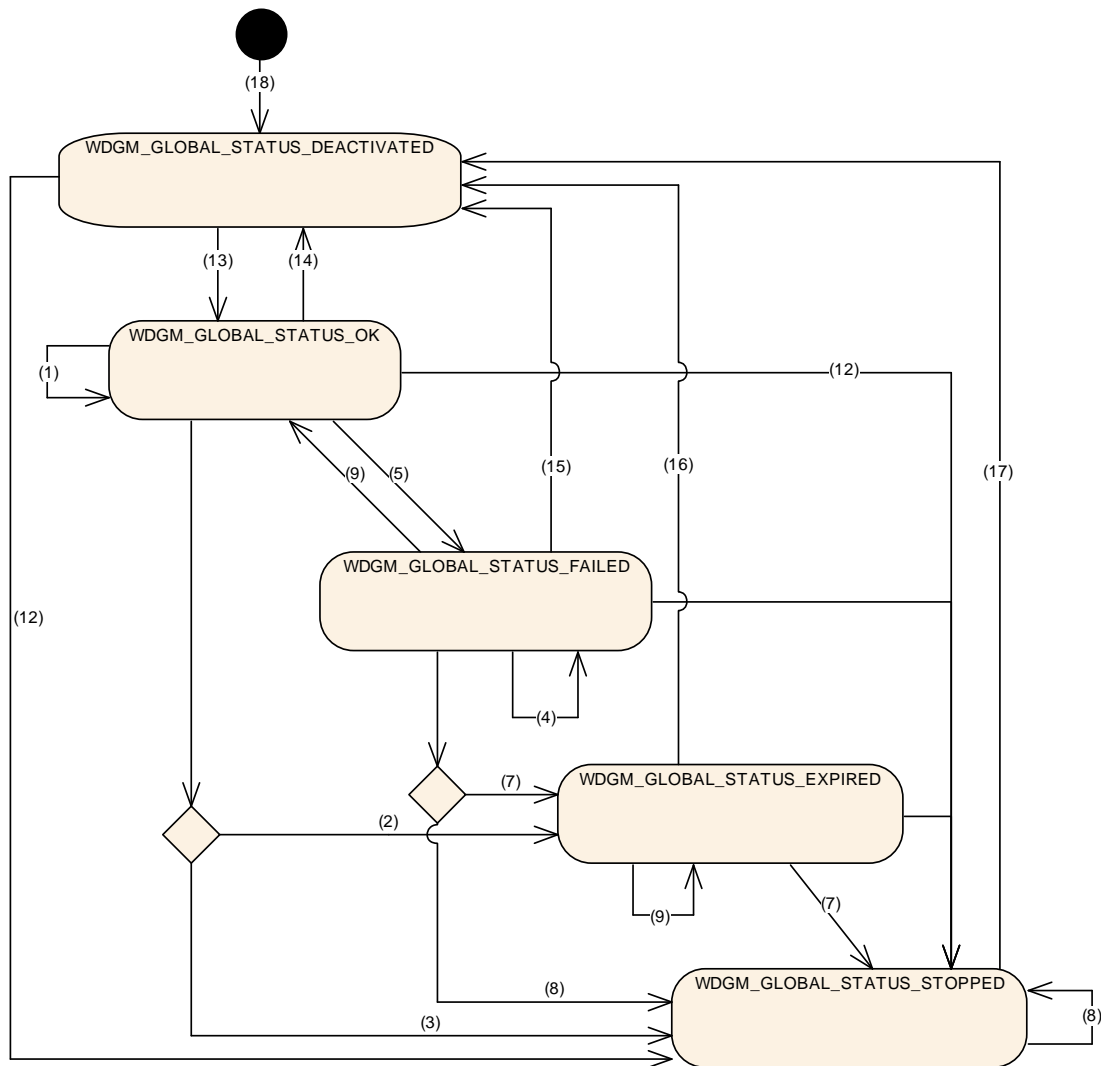


Figure 7.3: Global Supervision Status

[SWS_WdgM_00213] [The Watchdog Manager module shall have one Global Supervision Status for the whole monitored software.] ([SRS_ModeMgm_09112](#))

[SWS_WdgM_00387] [Global Supervision Status shall be statically initialized with `WDGM_GLOBAL_STATUS_DEACTIVATED` (see Transition (18) in [Figure 7.3](#)).] ()

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] [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.] (*SRS_ModeMgm_09112*)

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] [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 *Figure 7.3*).] (*SRS_BSW_00101*)

[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 *Figure 7.3*).] (/)

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] [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 *Figure 7.3*).] (*SRS_ModeMgm_09112*)

[SWS_WdgM_00076] [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 *Figure 7.3*).] (*SRS_ModeMgm_09112*)

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] [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 *Figure 7.3*).] (*SRS_ModeMgm_09163*)

[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 Figure 7.3).]()

[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 Figure 7.3)]()

[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 Figure 3).]()

[SWS_WdgM_00077] [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 Figure 7.3).] (*SRS_ModeMgm_09112, SRS_ModeMgm_09163*)

[SWS_WdgM_00117] [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 Figure 7.3).] (*SRS_ModeMgm_09112*)

[SWS_WdgM_00219] [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 Figure 7.3).] (*SRS_ModeMgm_09163*)

[SWS_WdgM_00220] [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 [Figure 7.3](#)).] ([SRS_ModeMgm_09163](#))

[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 [Figure 7.3](#)).] ()

[SWS_WdgM_00139] [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 [Figure 7.3](#))] ([SRS_ModeMgm_09110](#)) Note: see also [subsection 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]{DRAFT} [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`.] ([SRS_ModeMgm_09112](#), [SRS_ModeMgm_09125](#))

[SWS_WdgM_00063]{DRAFT} [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.] ([SRS_ModeMgm_09112](#))

[SWS_WdgM_00414]{DRAFT} [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.] ([SRS_ModeMgm_09125](#))

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 7.4](#).

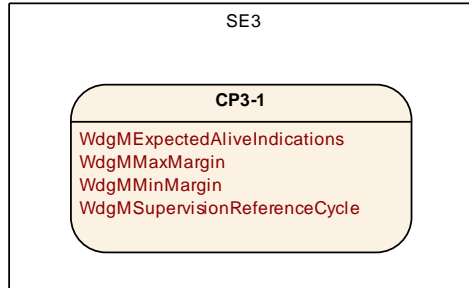


Figure 7.4: Simplest Alive Supervision [Checkpoint](#) Configuration

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 7.5](#).

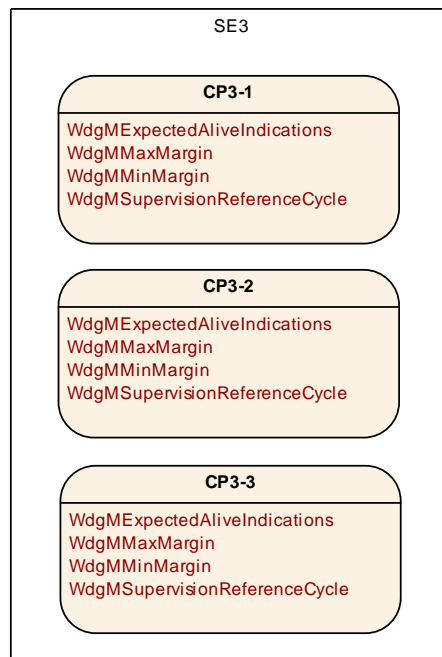


Figure 7.5: Multiple [Checkpoints](#) for Alive Supervision in one Supervised Entity

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] [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](#).] ([SRS_ModeMgm_09106](#))

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] [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`).] (*SRS_ModeMgm_09112*)

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] [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`).] (*SRS_ModeMgm_09112*)

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] [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`.] (*SRS_ModeMgm_09112*)

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

[SWS_WdgM_00083] [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.] (*SRS_ModeMgm_09112*, *SRS_ModeMgm_09143*)

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 7.6](#).

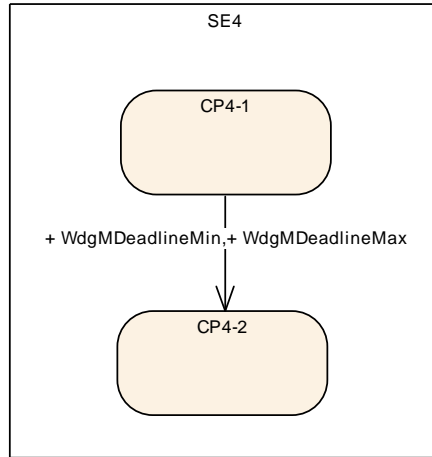


Figure 7.6: Simplest Deadline Supervision Configuration

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 7.7](#). Moreover, the [Checkpoints](#) can be chained.

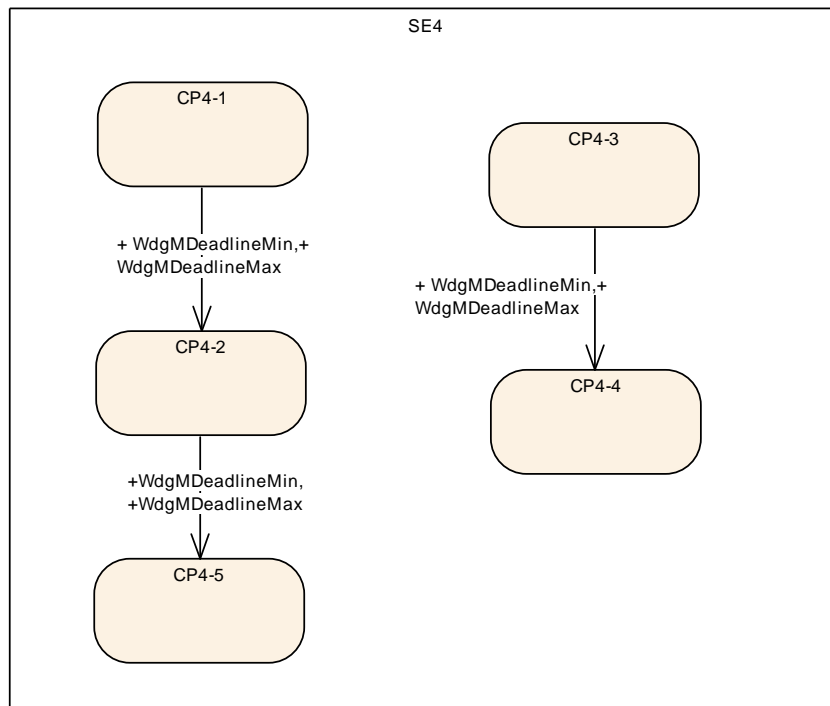


Figure 7.7: Multiple Transitions for Deadline Supervision in one Supervised Entity

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] [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]) (RS_HM_09235)

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] [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.] (RS_HM_09235)

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

[SWS_WdgM_00298] [The function `WdgM_Init` shall for all `Deadline Start Checkpoints` set their timestamps to 0.] (SRS_BSW_00101)

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] [If Deadline Timeout detection is enabled [i.e. `WdgMEnable-TimeoutDetection` **[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 $\neq 0$ (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`.] (**RS_HM_09235**)

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
CP0-5      a[i] = 0;
CP0-5    i++;
CP0-6  }
    
```

This Supervised Entity can be represented by the **Graph** shown by **Figure 7.8**.

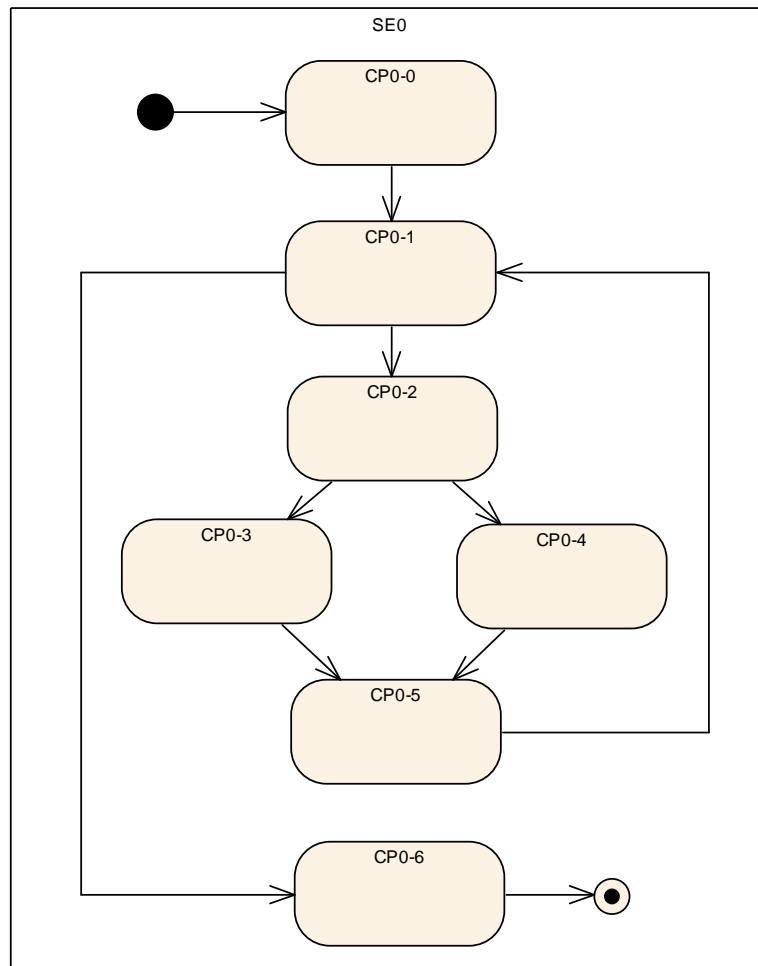


Figure 7.8: Example Control Flow Graph

A more abstract view of the Supervised Entity is given by the **Graph** shown in **Figure 7.9**, where the **Checkpoint** CP0-1 represents the complete while loop.

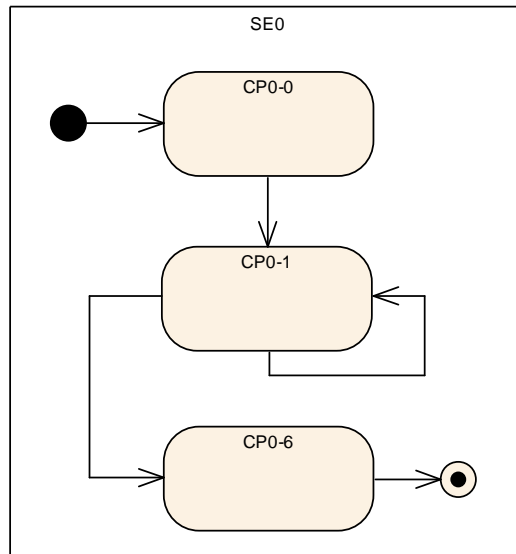


Figure 7.9: Abstracted Example Control Flow Graph

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] [The Watchdog Manager module shall maintain an Activity Flag for each `Graph`.](*SRS_ModeMgm_09221*, *SRS_ModeMgm_09222*)

[SWS_WdgM_00296] [The function `WdgM_Init` shall set the Activity Flag for each `Graph` to false.](*SRS_BSW_00101*)

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]{DRAFT} [The Watchdog Manager module shall identify to which `Graph(s)` each `Checkpoint` belongs.](*SRS_ModeMgm_09221*, *SRS_ModeMgm_09222*)

[SWS_WdgM_00246]{DRAFT} [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.](*SRS_ModeMgm_09221*, *SRS_ModeMgm_09222*)

[SWS_WdgM_00274] [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`.

](*SRS_ModeMgm_09221*, *SRS_ModeMgm_09222*)

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

[SWS_WdgM_00252] [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`.] (*SRS_ModeMgm_09221*, *SRS_ModeMgm_09222*)

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

[SWS_WdgM_00273] [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.] (*SRS_ModeMgm_09221*, *SRS_ModeMgm_09222*)

The reverse applies for the Final `Checkpoint`.

[SWS_WdgM_00331] [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.] (*SRS_ModeMgm_09221*, *SRS_ModeMgm_09222*)

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] [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.] (*SRS_ModeMgm_09221*, *SRS_ModeMgm_09222*)

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] [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_SUPERVISION` is configured, the Watchdog Manager module shall report an error status FAILED for `WDGM_E_SUPERVISION` to the DEM.] (*SRS_BSW_00339*, *SRS_BSW_00458*, *SRS_BSW_00469*, *SRS_BSW_00470*, *SRS_ModeMgm_09159*)

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 [subsection 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] [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.]([SRS_ModeMgm_09169](#))

[SWS_WdgM_CONSTR_06500] Interface provision in MCU driver [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.]([SRS_ModeMgm_09169](#))

[SWS_WdgM_00134] [In case of an immediate MCU reset, the Watchdog Manager module shall not provide a notification to the application via the RTE mode mechanism.]([SRS_ModeMgm_09169](#))

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] [The Watchdog Manager module shall support the parallel usage of multiple watchdogs.]([SRS_ModeMgm_09028](#))

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] [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).

]([SRS_ModeMgm_09161](#), [SRS_ModeMgm_09226](#))

[SWS_WdgM_00119] [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] [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] [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] [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] [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]{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 7.10](#) shows a configuration of two independently Supervised Entities, with independently configured [Internal Graphs](#).

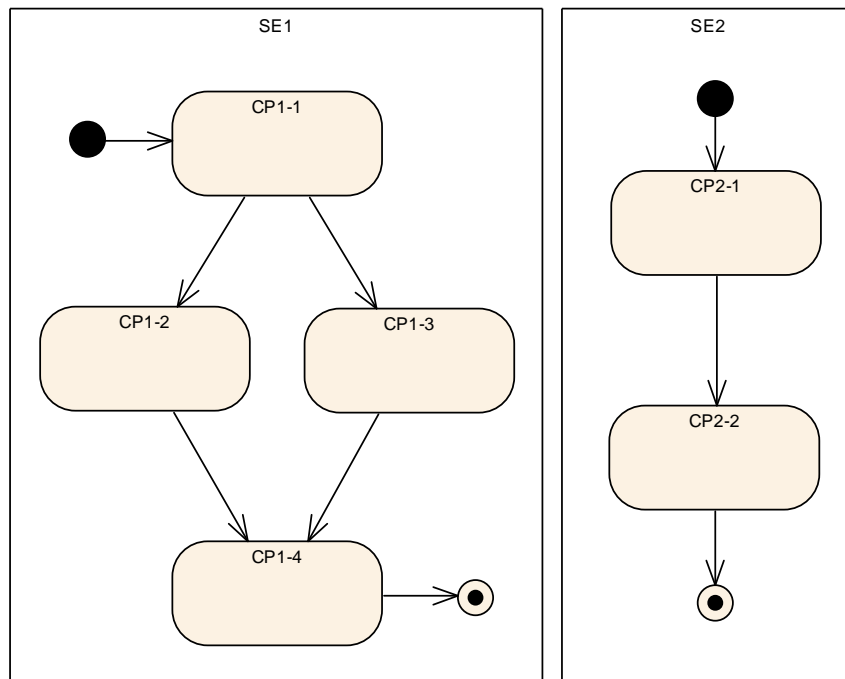


Figure 7.10: Two Supervised Entities with their Checkpoints and Internal Transitions

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 7.10](#), 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 7.11](#) 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.

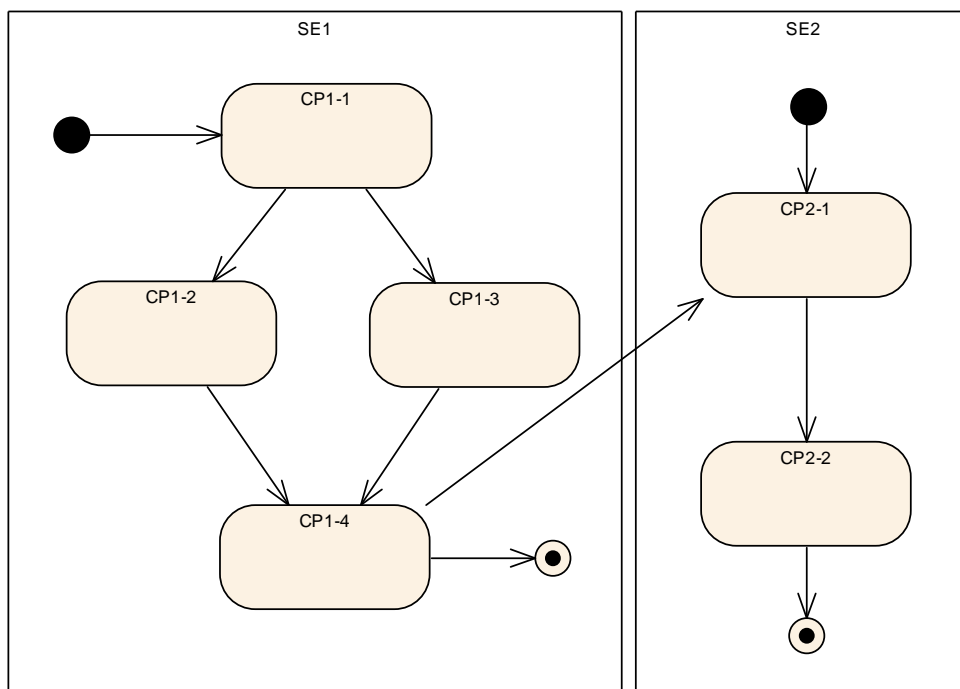


Figure 7.11: Two Supervised Entities with an External Transition

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 [WdgMConfigSet](#) [[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 `WdgMFailedAliveSupervisionReferenceCycleTol` [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 7.12](#)):

- 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 / Delnit APIs etc.

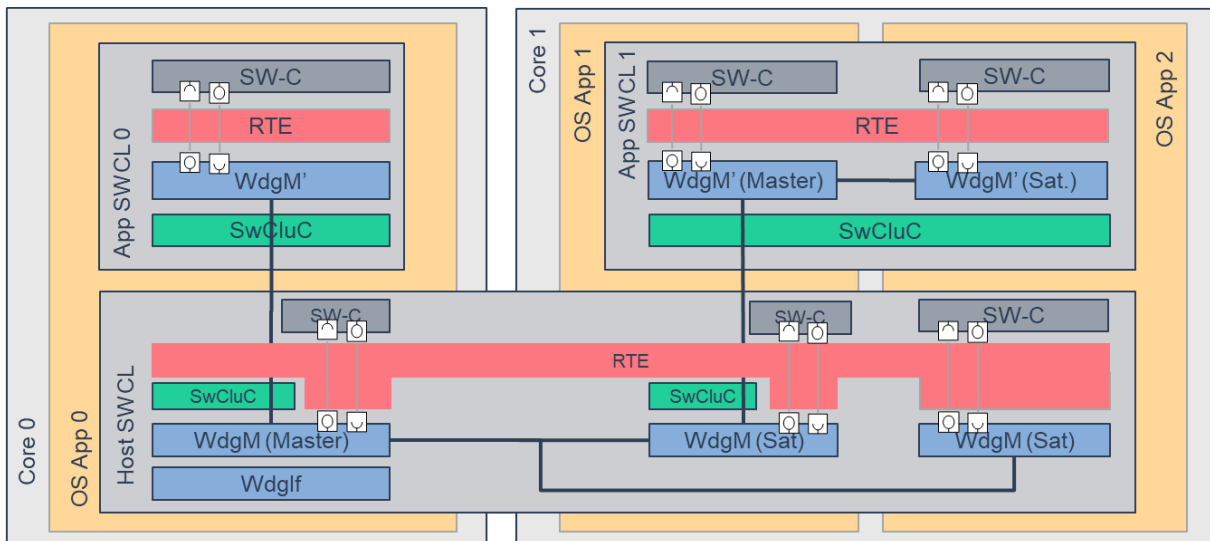


Figure 7.12: Overview of Watchdog Manager with Software Clustering

7.7.2 Configuration Aspects

[SWS_WdgM_CONSTR_06516]{DRAFT} Software Cluster related configurations cannot be used with disabled Software Cluster Support [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]{DRAFT} Valid cross cluster transition [A [WdgM-CrossClusterTransition](#) 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 [WdgMCrossClusterTransition-SourceRef](#), and the “to” is given by the [WdgMCrossClusterTransitionDestRef](#).]()

[SWS_WdgM_CONSTR_06518]{DRAFT} WdgMBaseSocket relates only to a [CpSoftwareClusterServiceResource](#) of category [SWCLUSTER_RES_WDGM_BASES_SOCKET](#) [The [WdgMBaseSocket.WdgMResourceRef](#) shall only reference a [CpSoftwareClusterServiceResource](#) of category [SWCLUSTER_RES_WDGM_BASES_SOCKET](#).]()

[SWS_WdgM_CONSTR_06519]{DRAFT} WdgMTransitionProxy relates only to a [CpSoftwareClusterServiceResource](#) of category [SWCLUSTER_RES_WDGM_TRANSITION](#) [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 [

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
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

]([SRS_BSW_00327](#), [SRS_BSW_00337](#), [SRS_BSW_00385](#), [SRS_BSW_00480](#), [SRS_BSW_00481](#), [SRS_BSW_00487](#))

7.8.2 Runtime Errors

[SWS_WdgM_00402] Definiton of runtime errors in module WdgM [

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

]([SRS_BSW_00327](#), [SRS_BSW_00337](#), [SRS_BSW_00385](#))

7.8.3 Transient Faults

There are no transient faults.

7.8.4 Production Errors

The Watchdog Manager module detects the following production errors:

[SWS_WdgM_00375] [

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	

]([SRS_BSW_00327](#), [SRS_BSW_00337](#), [SRS_BSW_00385](#), [SRS_BSW_00458](#))

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] [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.](*SRS_BSW_00339, SRS_BSW_00458, SRS_BSW_00469, SRS_BSW_00470, SRS_BSW_00471, SRS_ModeMgm_09159*)

7.8.5 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 [

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
WdgM	WdgM.h	WdgM_ModeType

]([SRS_BSW_00357](#))

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]{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]{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](#) [

Service Name	WdgM_Init	
Syntax	<pre>void WdgM_Init (const WdgM_ConfigType* ConfigPtr)</pre>	
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	

] ([SRS_BSW_00310](#), [SRS_BSW_00358](#), [SRS_ModeMgm_09107](#)) 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] [The function `WdgM_Init` shall initialize all module variables (global and static) of the Watchdog Manager module.]([SRS_BSW_00101](#), [SRS_ModeMgm_09107](#))

[SWS_WdgM_00135] [The function `WdgM_Init` shall establish the initial mode of the Watchdog Manager module.]([SRS_BSW_00101](#), [SRS_ModeMgm_09107](#))

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] [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.]([SRS_BSW_00323](#), [SRS_BSW_00452](#), [SRS_ModeMgm_09109](#))

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

[SWS_WdgM_00389] [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`.]([SRS_BSW_00323](#), [SRS_BSW_00350](#))

[SWS_WdgM_00390] [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`.]([SRS_BSW_00323](#), [SRS_BSW_00350](#))

[SWS_WdgM_00010] [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.]([SRS_BSW_00323](#), [SRS_BSW_00350](#))

[SWS_WdgM_00370] [The function `WdgM_Init` shall clear from the non-initialized RAM the double-inverse value storing the `SEID` that first reached the EXIRED state.]([SRS_BSW_00101](#)) See [subsection 8.3.10](#) for more information.

8.3.2 WdgM_DeInit

[SWS_WdgM_00261] Definition of API function WdgM_DeInit [

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

]([SRS_BSW_00310](#), [SRS_BSW_00336](#)) 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] [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](#).]([SRS_BSW_00323](#), [SRS_BSW_00350](#))

[SWS_WdgM_00388] [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](#).]([SRS_BSW_00323](#), [SRS_BSW_00350](#))

8.3.3 WdgM_GetVersionInfo

[SWS_WdgM_00153] Definition of API function WdgM_GetVersionInfo [

Service Name	WdgM_GetVersionInfo	
Syntax	<pre>void WdgM_GetVersionInfo (Std_VersionInfoType* VersionInfo)</pre>	
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	

](SRS_BSW_00310)

[SWS_WdgM_00256] [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.](SRS_BSW_00323, SRS_BSW_00350)

8.3.4 WdgM_SetMode

[SWS_WdgM_00154] Definition of API function WdgM_SetMode [

Service Name	WdgM_SetMode	
Syntax	<pre>Std_ReturnType WdgM_SetMode (WdgM_ModeType Mode)</pre>	
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	

]([SRS_BSW_00310](#), [SRS_ModeMgm_09110](#)) The behavior of this service and the corresponding functional requirements are described in [section 7.5](#).

[SWS_WdgM_00145] [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`.]([SRS_ModeMgm_09158](#))

[SWS_WdgM_00142] [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`.]([SRS_BSW_00339](#), [SRS_BSW_00452](#))

[SWS_WdgM_00031] [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`.

]([SRS_BSW_00323](#), [SRS_BSW_00452](#), [SRS_ModeMgm_09109](#))

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

[SWS_WdgM_00020] [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`.]([SRS_BSW_00323](#), [SRS_BSW_00350](#))

[SWS_WdgM_00021] [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`.]([SRS_BSW_00323](#), [SRS_BSW_00350](#), [SRS_BSW_00406](#))

[SWS_WdgM_00392] [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`.]([SRS_BSW_00323](#), [SRS_BSW_00350](#))

8.3.5 WdgM_GetMode

[SWS_WdgM_00168] Definition of API function WdgM_GetMode [

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	

](SRS_BSW_00310)

[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] [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 WDGME_UNINIT, without any further effect, if the Watchdog Manager is in WDGMGLOBAL_STATUS_DEACTIVATED.](SRS_BSW_00323, SRS_BSW_00350)

[SWS_WdgM_00395] [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 WDGMGLOBAL_STATUS_DEACTIVATED.](SRS_BSW_00323, SRS_BSW_00350)

[SWS_WdgM_00254] [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 WDGME_INV_POINTER.](SRS_BSW_00323, SRS_BSW_00350)

8.3.6 WdgM_CheckpointReached

[SWS_WdgM_00263] Definition of API function WdgM_CheckpointReached [

Service Name	WdgM_CheckpointReached	
Syntax	<pre>Std_ReturnType WdgM_CheckpointReached (WdgM_SupervisedEntityIdType SEID, WdgM_CheckpointIdType CheckpointID)</pre>	
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	

](SRS_BSW_00310)

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

[SWS_WdgM_00322] [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.](RS_HM_09235)

[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] [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`.](SRS_BSW_00452)

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

[SWS_WdgM_00394] [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`.](SRS_BSW_00323, SRS_BSW_00350)

[SWS_WdgM_00278] [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`.] ([SRS_BSW_00323](#), [SRS_BSW_00350](#))

[SWS_WdgM_00279] [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`.] ([SRS_BSW_00323](#), [SRS_BSW_00350](#))

[SWS_WdgM_00396] [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`.] ([SRS_BSW_00323](#), [SRS_BSW_00350](#))

[SWS_WdgM_00284] [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`.] ([SRS_BSW_00323](#), [SRS_BSW_00350](#))

8.3.7 `WdgM_GetLocalStatus`

[SWS_WdgM_00169] Definition of API function `WdgM_GetLocalStatus` [

Service Name	WdgM_GetLocalStatus	
Syntax	<pre>Std_ReturnType WdgM_GetLocalStatus (WdgM_SupervisedEntityType SEID, WdgM_LocalStatusType* Status)</pre>	
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	<code>Std_ReturnType</code>	<code>E_OK</code> : Current supervision status successfully returned <code>E_NOT_OK</code> : Returning current supervision status failed
Description	Returns the supervision status of an individual Supervised Entity.	
Available via	WdgM.h	

] ([SRS_BSW_00310](#))

[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] [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`.] (*SRS_BSW_00323*, *SRS_BSW_00350*)

[SWS_WdgM_00257] [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`.] (*SRS_BSW_00323*, *SRS_BSW_00350*)

[SWS_WdgM_00173] [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`.] (*SRS_BSW_00323*, *SRS_BSW_00350*)

[SWS_WdgM_00397] [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`.] (*SRS_BSW_00323*, *SRS_BSW_00350*)

8.3.8 `WdgM_GetGlobalStatus`

[SWS_WdgM_00175] Definition of API function `WdgM_GetGlobalStatus` [

Service Name	<code>WdgM_GetGlobalStatus</code>	
Syntax	<code>Std_ReturnType WdgM_GetGlobalStatus (</code> <code> <code>WdgM_GlobalStatusType*</code> Status</code> <code>)</code>	
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	<code>Std_ReturnType</code>	<code>E_OK</code> : Current supervision status successfully returned <code>E_NOT_OK</code> : Returning current supervision status failed
Description	Returns the global supervision status of the Watchdog Manager.	
Available via	<code>WdgM.h</code>	

](*SRS_BSW_00310*)

[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). 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] [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](#).] ([SRS_BSW_00323](#), [SRS_BSW_00350](#))

[SWS_WdgM_00176] [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](#).] ([SRS_BSW_00323](#), [SRS_BSW_00350](#))

8.3.9 [WdgM_PerformReset](#)

[SWS_WdgM_00264] Definition of API function [WdgM_PerformReset](#) [

Service Name	WdgM_PerformReset
Syntax	<pre>void WdgM_PerformReset (void)</pre>
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

] ([SRS_BSW_00310](#), [SRS_ModeMgm_09232](#))

[SWS_WdgM_00232] [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] [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] [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`.] (*SRS_BSW_00323*, *SRS_BSW_00350*)

[SWS_WdgM_00401] [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`.] (*SRS_BSW_00323*, *SRS_BSW_00350*)

8.3.10 `WdgM_GetFirstExpiredSEID`

[SWS_WdgM_00346] Definition of API function `WdgM_GetFirstExpiredSEID` [

Service Name	WdgM_GetFirstExpiredSEID	
Syntax	<pre>Std_ReturnType WdgM_GetFirstExpiredSEID (WdgM_SupervisedEntityIdType* SEID)</pre>	
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 <code>WDGM_LOCAL_STATUS_EXPIRED</code> .
Return value	<code>Std_ReturnType</code>	<code>E_OK</code> : SEID successfully returned <code>E_NOT_OK</code> : Error when returning the SEID
Description	Returns SEID that first reached the state <code>WDGM_LOCAL_STATUS_EXPIRED</code> .	
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`). 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` [

Service Name	<code>WdgM_MainFunction</code>
Syntax	<code>void WdgM_MainFunction (</code> <code> void</code> <code>)</code>
Service ID [hex]	0x08
Description	Performs the processing of the cyclic Watchdog Manager jobs.
Available via	<code>SchM_WdgM.h</code>

]([SRS_BSW_00310](#), [SRS_BSW_00373](#))

[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] [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.]([RS_HM_09235](#))

[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]{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] [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`.] ([SRS_BSW_00323](#), [SRS_BSW_00350](#), [SRS_BSW_00406](#))

8.6 Expected interfaces

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

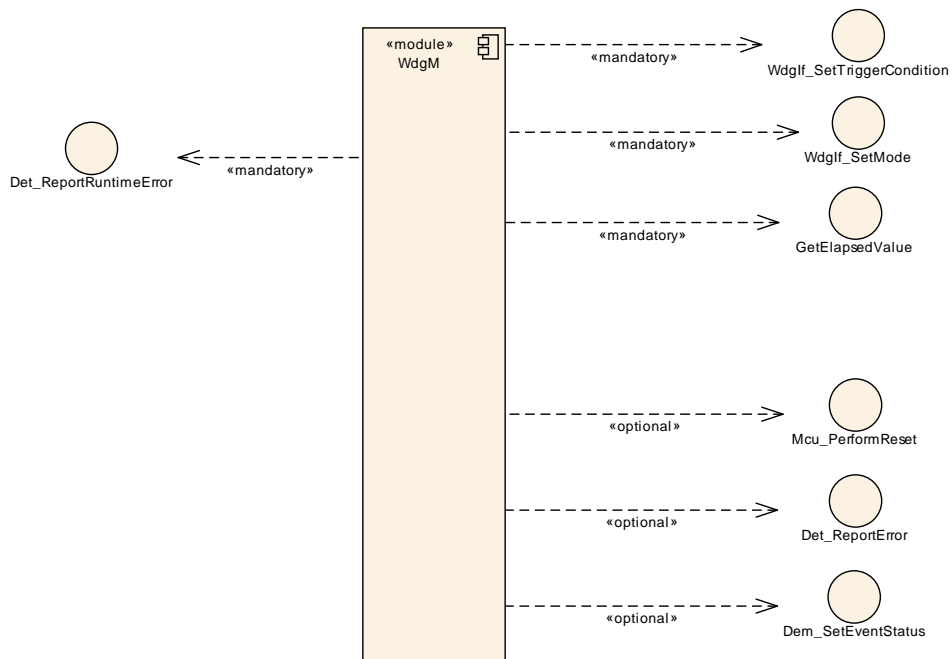


Figure 8.1: Expected Interfaces

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 in 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 in 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/Dem ConfigSet/DemEventParameter/DemEvent ReportingType) == 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_<ResourceEntryGroup>	SwCluC_BManif.h	Returns the number of actually used - and thereby connected - handle sets.
SwCluC_BManif_GetNoOfHandleSets_<ResourceEntryGroup>_<ResourceEntry>	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]{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]{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_SupervisedEntityType](#). This type is defined as `uint16`. Therefore, the following type description is required:

[SWS_WdgM_00356] Definition of ImplementationDataType WdgM_SupervisedEntityType

Name	WdgM_SupervisedEntityType		
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 WDG_M_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 WDG_M_LOCAL_STATUS_EXPIRED.	
Variation	–		
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.

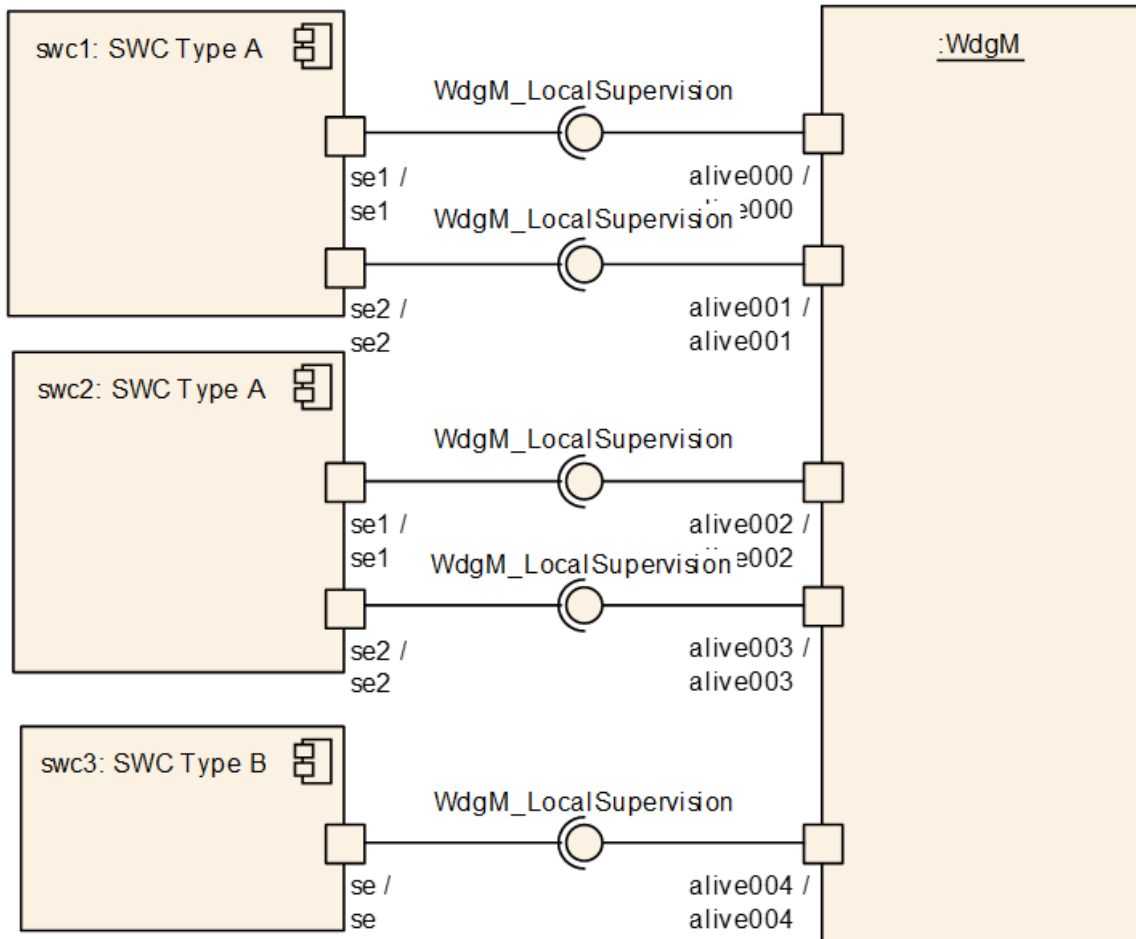


Figure 8.2: Example of SW-Cs connected to the Watchdog Manager via service ports

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_SupervisedEntityType	
	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 localSupervisionStatus_{SupervisedEntityName} provided by module WdgM [

Name	localSupervisionStatus_{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_SupervisedEntityType	
	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	<p>The category of ModeDeclarationGroup WdgM_Mode is EXPLICIT_ORDER, The attribute value for the ModeDeclaration are set as following:</p> <p>"SUPERVISION_OK" = 0 "SUPERVISION_FAILED" = 1 "SUPERVISION_EXPIRED" = 2 "SUPERVISION_STOPPED" = 3 "SUPERVISION_DEACTIVATED" = 4</p> <p>The onTransitionValue is defined as 255</p>
--------------------	--

]()

[SWS_WdgM_00359] Definition of ImplementationDataType WdgM_LocalStatus Type

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.
Range	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.
Range	WDGM_LOCAL_STATUS_EXPIRED	2	The supervision of this Supervised Entity has failed permanently. This state cannot be left.
Range	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_GlobalStatus Type

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.:

```

1  /**
2  * Called within WdgM. Reports the status/mode of the SE
3  * to SW-Cs / CDDs through Rte
4  */
5  void WdgM_NotifyOKToSE(WdgM_SupervisedEntityIdType se)
6  {
7      Rte_PortHandle_WdgM_LocalMode_P ph = Rte_Ports_WdgM_LocalMode_P();
8      ph[se].Switch_currentMode(RTE_MODE_WdgM_Mode_SUPERVISION_OK);
9  }
```

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.

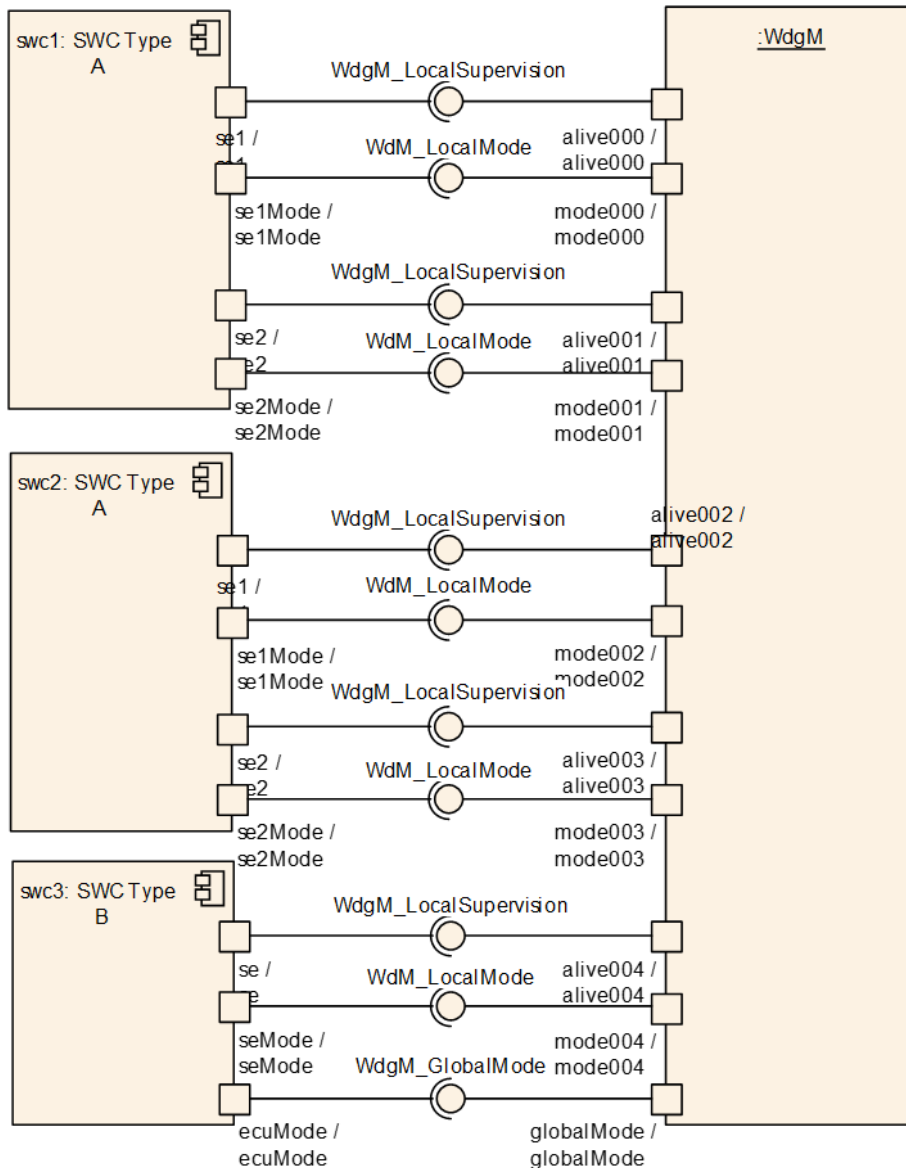


Figure 8.3: Example of SW-Cs connected to the Watchdog Manager via service ports and mode ports

This results in one mode port per Supervised Entity.

[SWS_WdgM_00148] [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.]([SRS_ModeMgm_09160](#), [SRS_ModeMgm_09225](#))

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 [

Name	globalmode		
Kind	ProvidedPort	Interface	WdgM_GlobalMode
Description	–		
Variation	–		

] ([SRS_ModeMgm_09160](#), [SRS_ModeMgm_09225](#), [SRS_ModeMgm_09162](#))

[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.

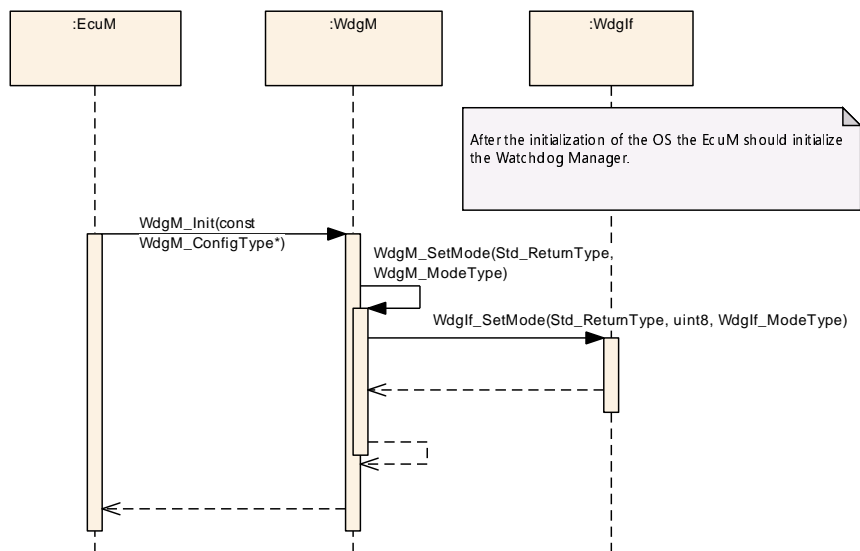


Figure 9.1: Initialization of the Watchdog Manager module

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] [The parameters of the Watchdog Manager module that shall minimally be configurable at system generation and / or system compile time (pre-compile).] ([SRS_BSW_00345](#))

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] [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.] ([SRS_BSW_00345](#), [SRS_BSW_00171](#))

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

SWS Item	[ECUC_WdgM_00001]
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.

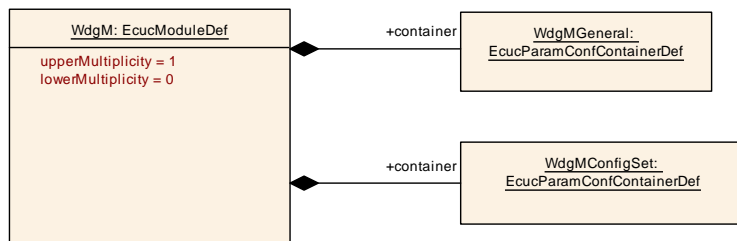


Figure 10.1: Configuration Module Watchdog Manager (WdgM)

10.2.3 WdgMGeneral

SWS Item	[ECUC_WdgM_00300]
Container Name	WdgMGeneral
Parent Container	WdgM
Description	Container defines all general configuration parameters of the Watchdog Manager.
Configuration Parameters	

SWS Item	[ECUC_WdgM_00301]
Parameter Name	WdgMDevErrorDetect
Parent Container	WdgMGeneral
Description	Switches the development error detection and notification on or off. <ul style="list-style-type: none"> • 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		

SWS Item	[ECUC_WdgM_00363]		
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		

SWS Item	[ECUC_WdgM_00339]		
Parameter Name	WdgMImmediateReset		
Parent Container	WdgMGeneral		
Description	This parameter enables/disables 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		

SWS Item	[ECUC_WdgM_00340]		
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		

SWS Item	[ECUC_WdgM_00365]		
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		

SWS Item	[ECUC_WdgM_00302]		
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		

Included Containers		
Container Name	Multiplicity	Scope / Dependency
WdgMBaseSocket	0..*	<p>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</p> <p>If the infrastructure connection is specific to one or several Ecuc Partition(s) the WdgMSocketEcucPartitionRef(s) denotes the applicable EcucPartition.</p> <p>Tags: atp.Status=draft</p>
WdgMMainFunction	0..*	<p>Reference to the WdgMInstanceMainFunction which this Supervised Entity belongs to. Relevant to Alive Supervision and Deadline Supervision</p> <p>Tags: atp.Status=draft</p>
WdgMSupervisedEntity	0..65535	<p>This container collects all common (mode-independent) parameters of a Supervised Entity to be supervised by the Watchdog Manager.</p>
WdgMWatchdog	0..255	<p>This container collects all common (mode-independent) parameters of a Watchdog to be triggered by the Watchdog Manager.</p>

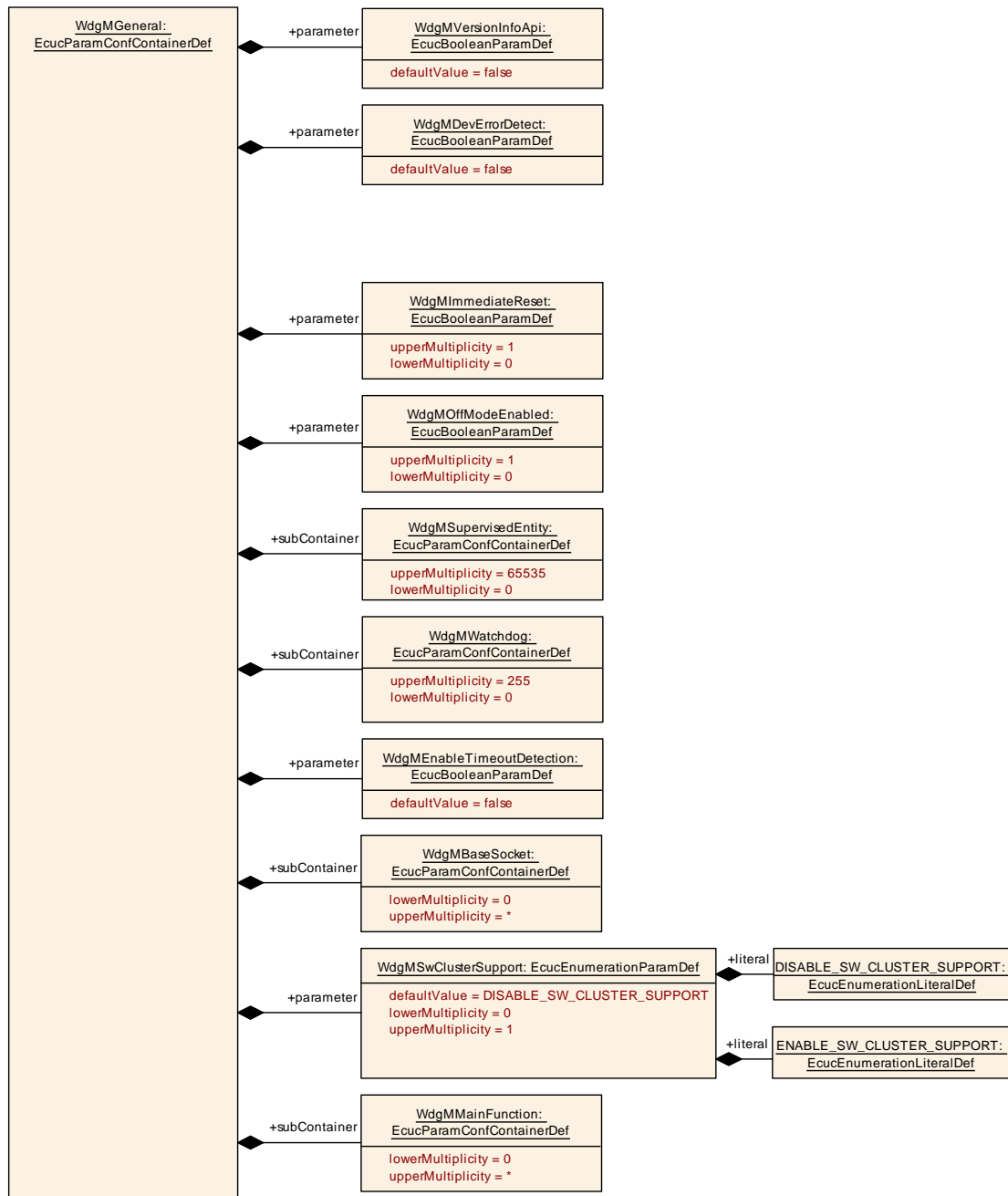


Figure 10.2: Configuration Container **WdgMGeneral**

10.2.4 WdgMSupervisedEntity

SWS Item	[ECUC_WdgM_00303]
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			

SWS Item	[ECUC_WdgM_00304]		
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		

SWS Item	[ECUC_WdgM_00343]		
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		

SWS Item	[ECUC_WdgM_00344]		
Parameter Name	WdgMInternalCheckpointFinalRef		
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		

SWS Item	[ECUC_WdgM_00368]		
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		

SWS Item	[ECUC_WdgM_00361]		
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			

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.

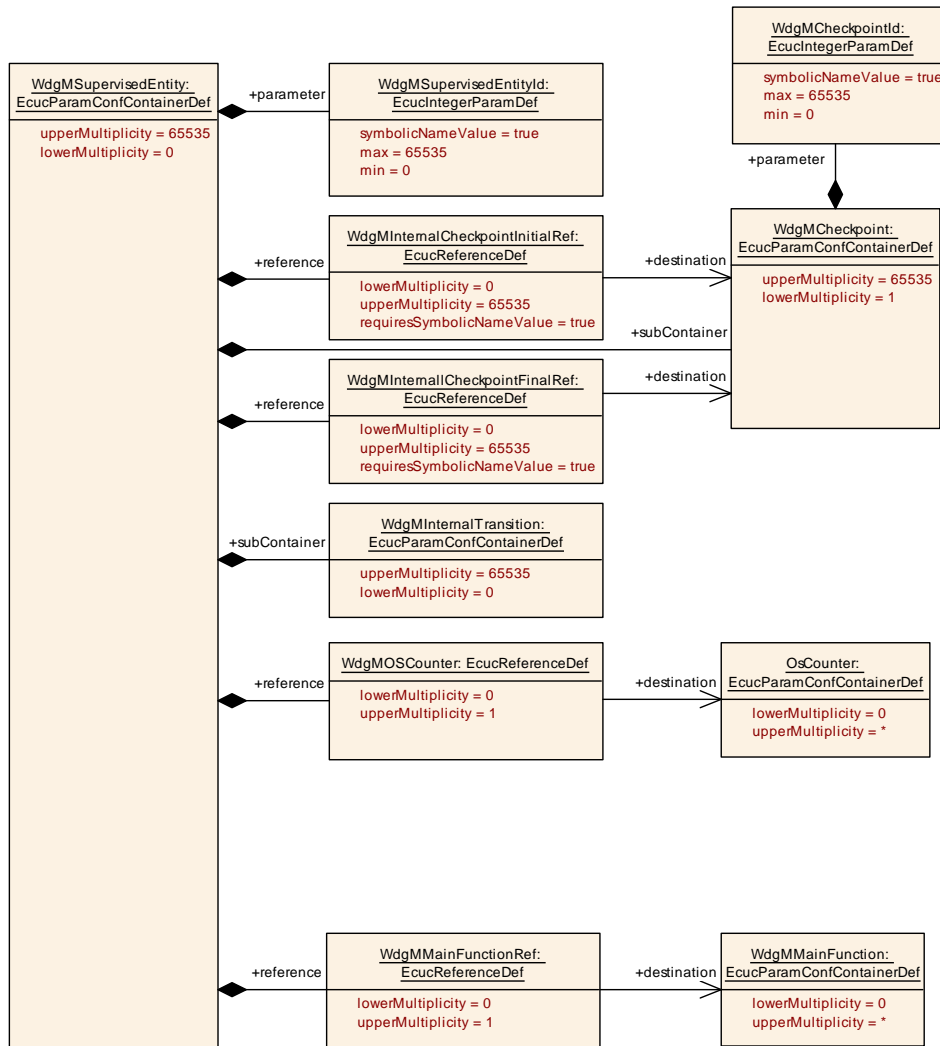


Figure 10.3: Configuration Container **WdgMSupervisedEntity**

10.2.5 WdgMCheckpoint

SWS Item	[ECUC_WdgM_00305]
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	

SWS Item	[ECUC_WdgM_00306]
Parameter Name	WdgMCheckpointId
Parent Container	WdgMCheckpoint
Description	This parameter shall contain the unique identifier of Checkpoint.





Multiplicity	1		
Type	EcuIntegerParamDef (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		

No Included Containers

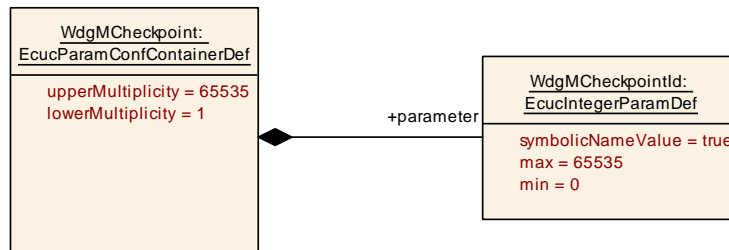


Figure 10.4: Configuration Container [WdgMCheckpoint](#)

10.2.6 [WdgMInternalTransition](#)

SWS Item	[ECUC_WdgM_00345]
Container Name	WdgMInternalTransition
Parent Container	WdgMSupervisedEntity
Description	This container defines the graph of Internal Transitions within this Supervised Entity.
Configuration Parameters	

SWS Item	[ECUC_WdgM_00351]		
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		

SWS Item	[ECUC_WdgM_00350]		
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		

No Included Containers

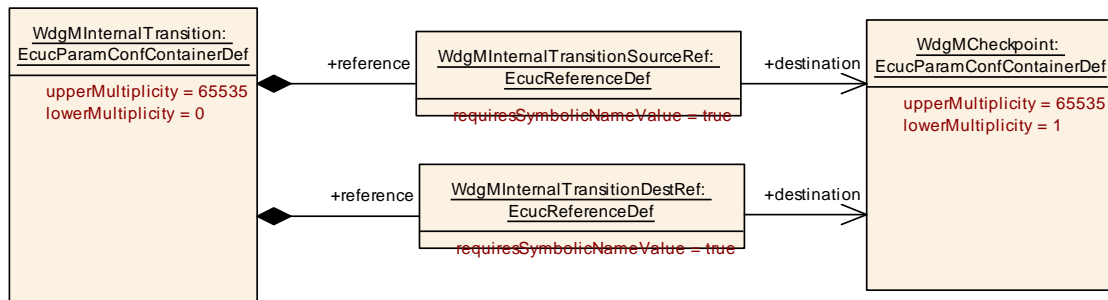


Figure 10.5: Configuration Container [WdgMInternalTransition](#)

10.2.7 [WdgMWatchdog](#)

SWS Item	[ECUC_WdgM_00347]
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	

SWS Item	[ECUC_WdgM_00348]
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		

SWS Item	[ECUC_WdgM_00349]		
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 Wdg M 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		

No Included Containers

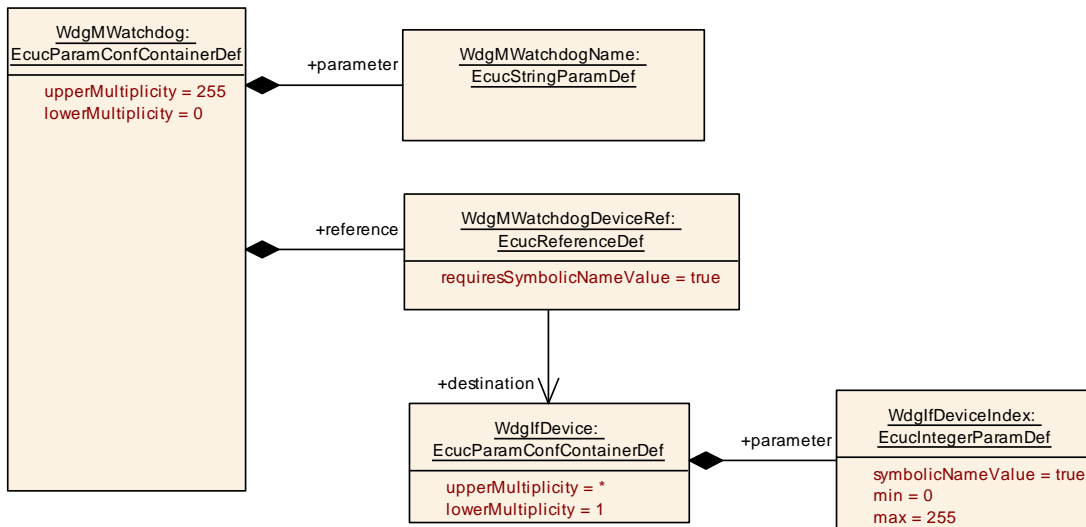


Figure 10.6: Configuration Container WdgMWatchdog

10.2.8 WdgMConfigSet

SWS Item	[ECUC_WdgM_00337]
Container Name	WdgMConfigSet
Parent Container	WdgM
Description	This container describes one of multiple configuration sets of WdgM.
Configuration Parameters	

SWS Item	[ECUC_WdgM_00336]		
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		

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.

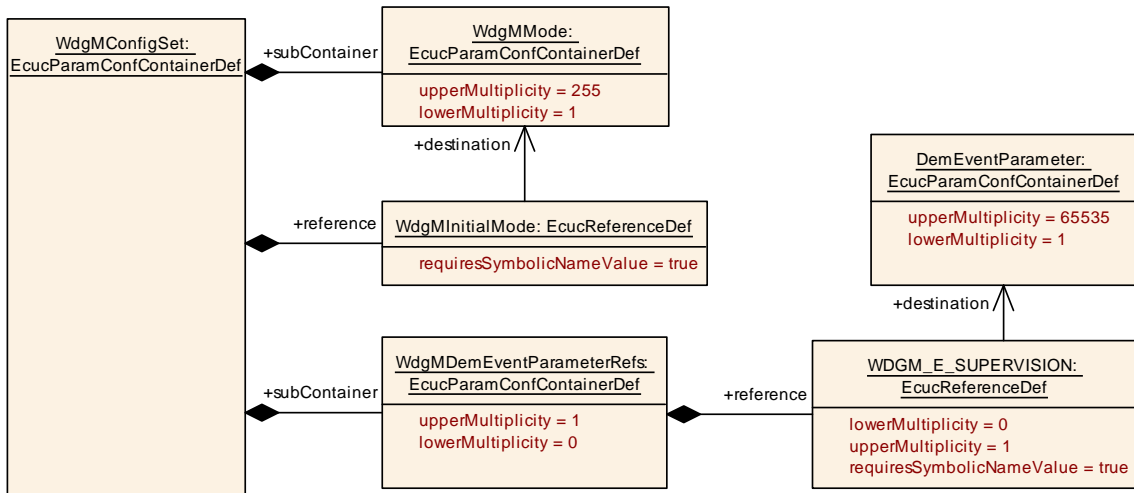


Figure 10.7: Configuration Container [WdgMConfigSet](#)

10.2.9 [WdgMDemEventParameterRefs](#)

SWS Item	[ECUC_WdgM_00353]
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	

SWS Item	[ECUC_WdgM_00362]		
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		

No Included Containers

10.2.10 [WdgMMode](#)

SWS Item	[ECUC_WdgM_00335]
Container Name	WdgMMode
Parent Container	WdgMConfigSet
Description	The container describes one of several modes of the Watchdog Manager.
Configuration Parameters	

SWS Item	[ECUC_WdgM_00329]
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		

SWS Item	[ECUC_WdgM_00307]		
Parameter Name	WdgMModelId		
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	–	
Scope / Dependency	scope: local		

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.
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.

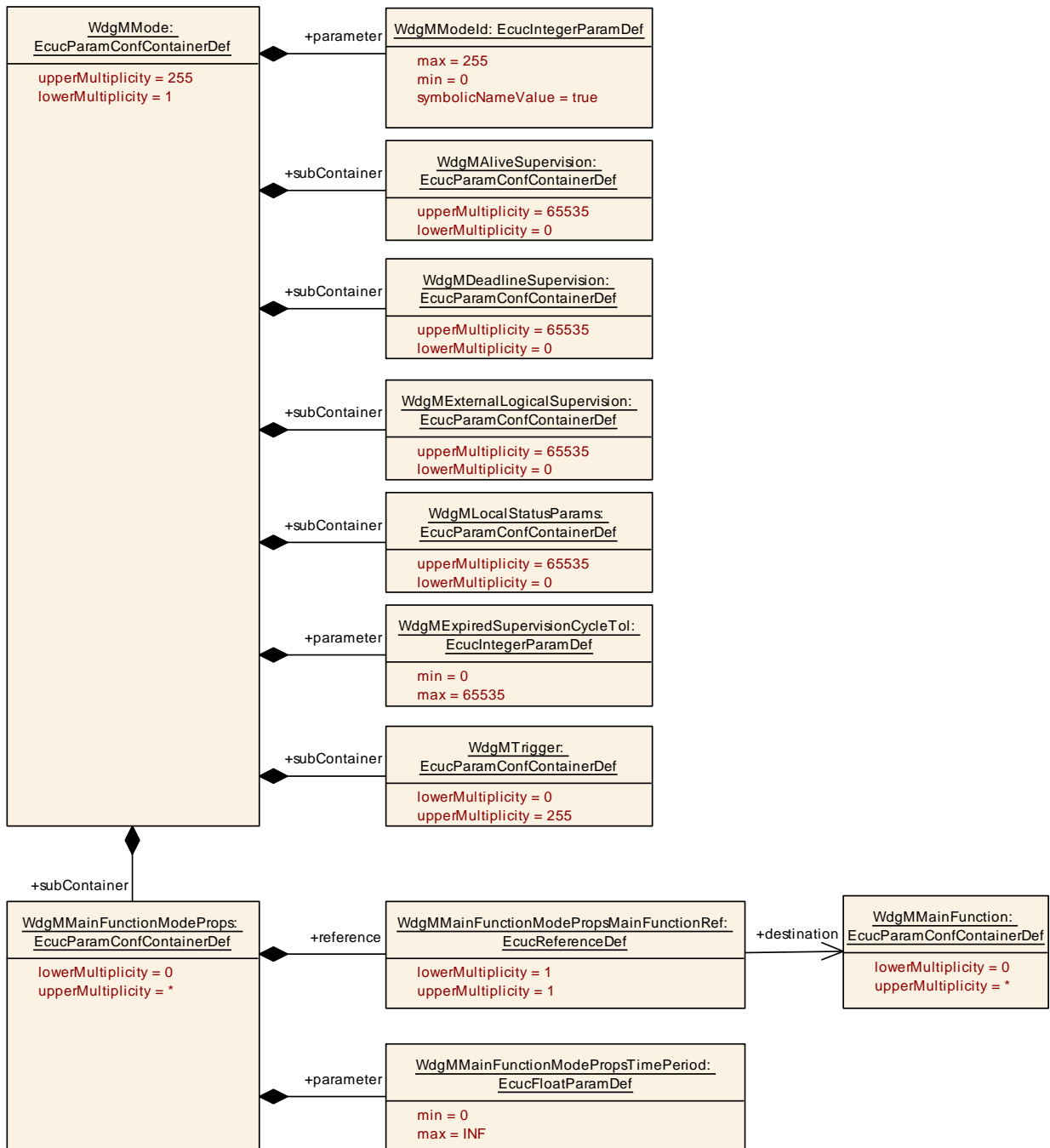


Figure 10.8: Configuration Container *WdgMMode*

10.2.11 WdgMAliveSupervision

SWS Item	[ECUC_WdgM_00308]
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	

SWS Item	[ECUC_WdgM_00311]		
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		

SWS Item	[ECUC_WdgM_00313]		
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		

SWS Item	[ECUC_WdgM_00312]		
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		

SWS Item	[ECUC_WdgM_00310]		
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		
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		

SWS Item	[ECUC_WdgM_00309]		
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		

No Included Containers

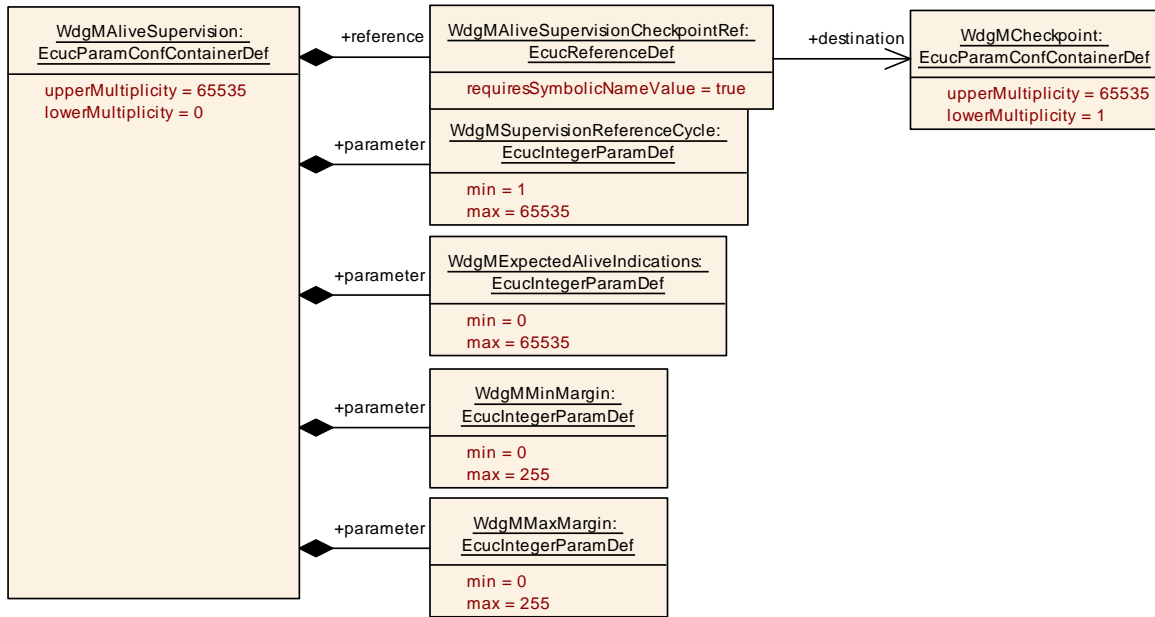


Figure 10.9: Configuration Container **WdgMAliveSupervision**

10.2.12 WdgMDeadlineSupervision

SWS Item	[ECUC_WdgM_00314]
Container Name	WdgMDeadlineSupervision
Parent Container	WdgMMode
Description	This container collects all configuration parameters for Deadline Supervision for a Supervised Entity.
Configuration Parameters	

SWS Item	[ECUC_WdgM_00318]		
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		

SWS Item	[ECUC_WdgM_00317]		
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		

SWS Item	[ECUC_WdgM_00315]		
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		

SWS Item	[ECUC_WdgM_00316]		
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		

No Included Containers

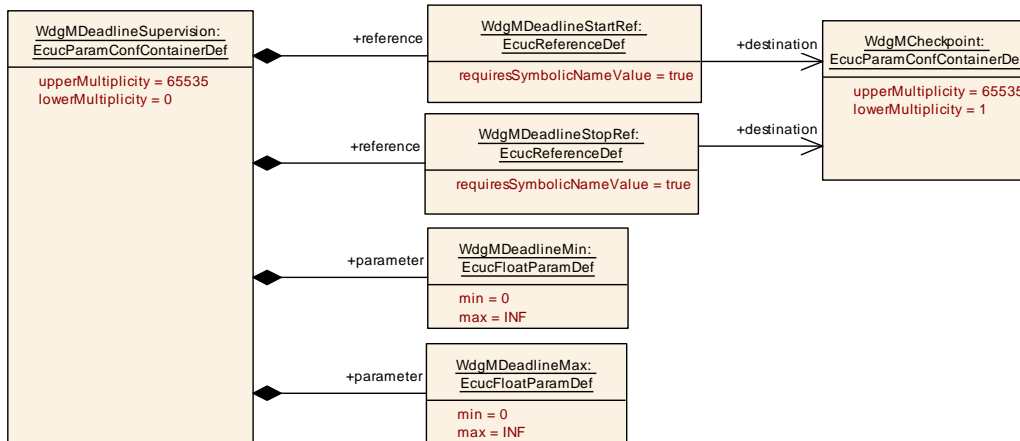


Figure 10.10: Configuration Container **WdgMDeadlineSupervision**

10.2.13 WdgMExternalLogicalSupervision

SWS Item	[ECUC_WdgM_00319]
Container Name	WdgMExternalLogicalSupervision
Parent Container	WdgMMode
Description	This container collects all configuration parameters for Logical Supervision for one external graph.
Configuration Parameters	

SWS Item	[ECUC_WdgM_00324]		
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 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		

SWS Item	[ECUC_WdgM_00323]
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		

Included Containers		
Container Name	Multiplicity	Scope / Dependency
WdgMCrossClusterTransition	0..65535	<p>This container configures a cross cluster transition.</p> <p>A WdgMCrossClusterTransition can be configured</p> <ul style="list-style-type: none"> • 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) <p>Tags: atp.Status=draft</p>
WdgMExternalTransition	0..65535	<p>This container collects the Checkpoints for an External Transition across Supervised Entities.</p>
WdgMTransitionProxy	0..65535	<p>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.</p> <p>Tags: atp.Status=draft</p>

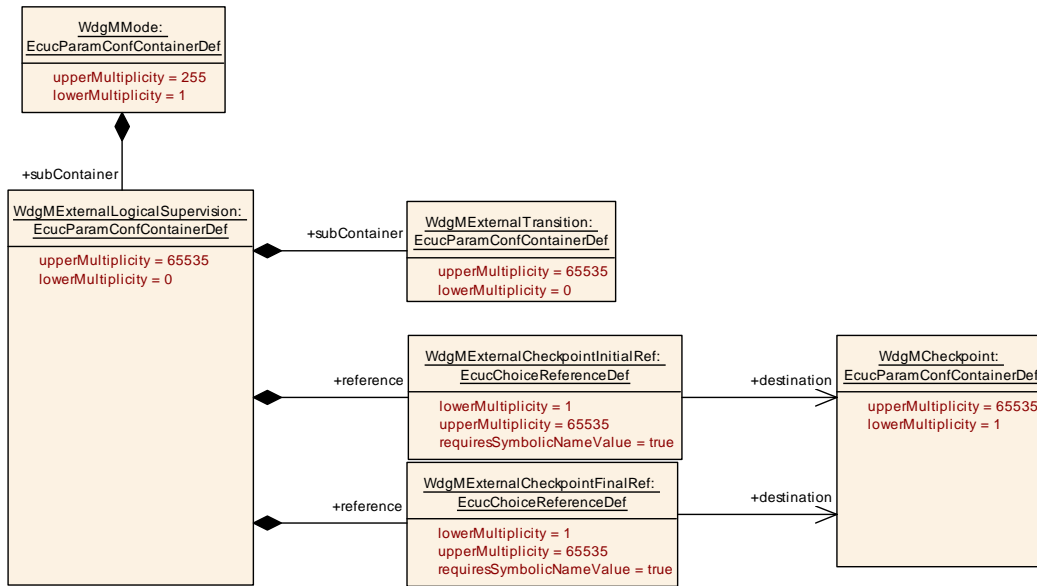


Figure 10.11: Configuration Container **WdgMExternalLogicalSupervision**

10.2.14 WdgMExternalTransition

SWS Item	[ECUC_WdgM_00320]
Container Name	WdgMExternalTransition
Parent Container	WdgMExternalLogicalSupervision
Description	This container collects the Checkpoints for an External Transition across Supervised Entities.
Configuration Parameters	

SWS Item	[ECUC_WdgM_00322]		
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		

SWS Item	[ECUC_WdgM_00321]
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		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	–	
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

No Included Containers

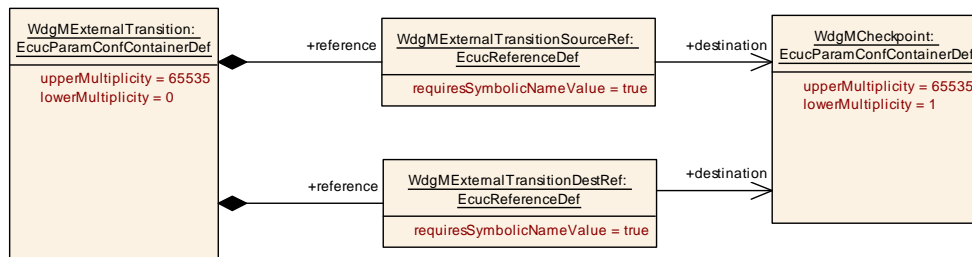


Figure 10.12: Configuration Container [WdgMExternalTransition](#)

10.2.15 [WdgMTrigger](#)

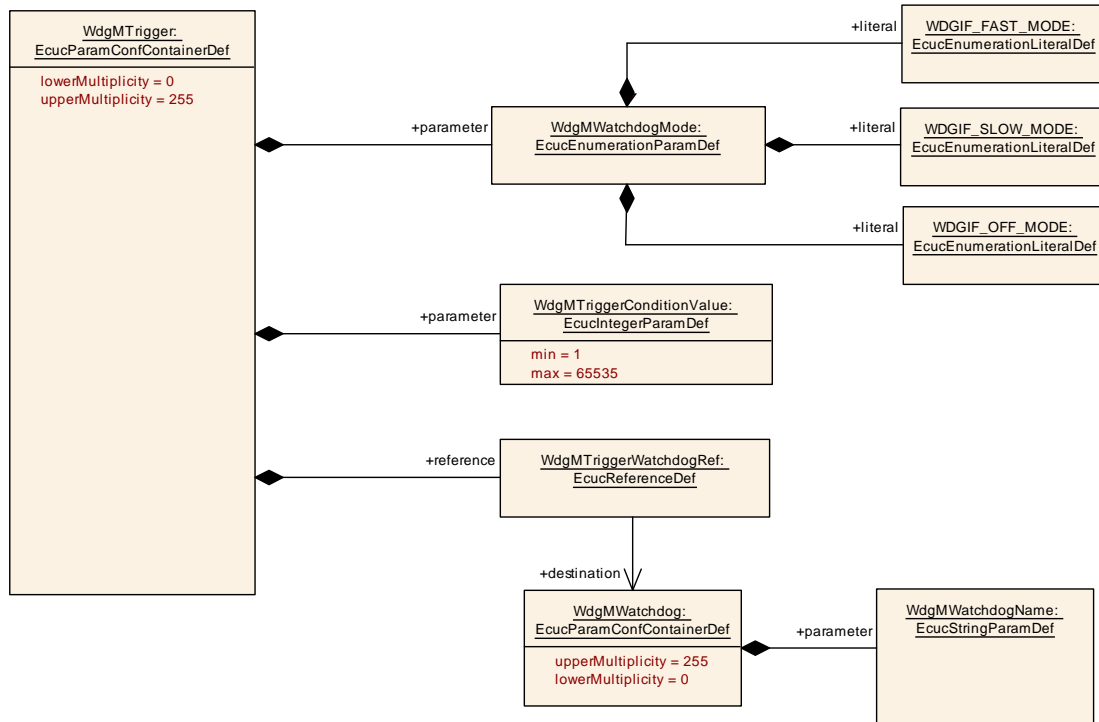
SWS Item	[ECUC_WdgM_00331]
Container Name	WdgMTrigger
Parent Container	WdgMMode
Description	This container collects all configuration parameters for the triggering of hardware watchdogs.
Configuration Parameters	

SWS Item	[ECUC_WdgM_00333]		
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		

SWS Item	[ECUC_WdgM_00332]		
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		

SWS Item	[ECUC_WdgM_00334]		
Parameter Name	WdgMTriggerWatchdogRef		
Parent Container	WdgMTrigger		
Description	This parameter is a reference to the configured watchdog.		
Multiplicity	1		
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		

No Included Containers


 Figure 10.13: Configuration Container **WdgMTrigger**

10.2.16 WdgMLocalStatusParams

SWS Item	[ECUC_WdgM_00325]
Container Name	WdgMLocalStatusParams
Parent Container	WdgMMode
Description	This container collects all configuration parameters for the Local Status of a Supervised Entity.
Configuration Parameters	

SWS Item	[ECUC_WdgM_00327]		
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		

SWS Item	[ECUC_WdgM_00326]		
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		

No Included Containers

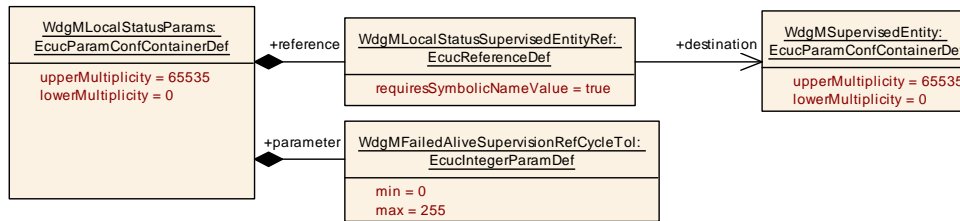


Figure 10.14: Configuration Container [WdgMLocalStatusParams](#)

10.2.17 [WdgMMainFunction](#)

SWS Item	[ECUC_WdgM_00373]		
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			

SWS Item	[ECUC_WdgM_00369]		
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		

No Included Containers

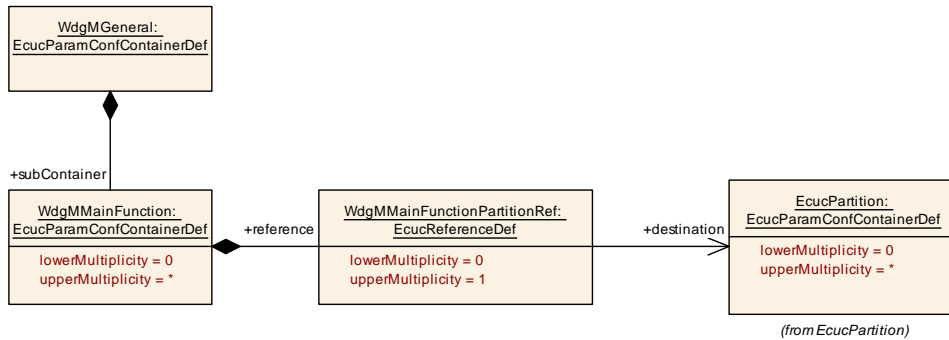


Figure 10.15: Configuration Container **WdgMMainFunction**

10.2.18 WdgMMainFunctionModeProps

SWS Item	[ECUC_WdgM_00372]		
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			

SWS Item	[ECUC_WdgM_00370]		
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		

SWS Item	[ECUC_WdgM_00371]		
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		

No Included Containers

10.2.19 [WdgMCrossClusterTransition](#)

SWS Item	[ECUC_WdgM_00376]
Container Name	WdgMCrossClusterTransition
Parent Container	WdgMExternalLogicalSupervision





Description	<p>This container configures a cross cluster transition.</p> <p>A WdgMCrossClusterTransition can be configured</p> <ul style="list-style-type: none"> • 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) <p>Tags: atp.Status=draft</p>
Configuration Parameters	

SWS Item	[ECUC_WdgM_00375]		
Parameter Name	WdgMCrossClusterTransitionDestRef		
Parent Container	WdgMCrossClusterTransition		
Description	<p>This is the reference to the destination of a cross cluster transition.</p> <p>Tags: atp.Status=draft</p>		
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		

SWS Item	[ECUC_WdgM_00374]		
Parameter Name	WdgMCrossClusterTransitionSourceRef		
Parent Container	WdgMCrossClusterTransition		
Description	<p>This is the reference to the source of a cross cluster transition.</p> <p>Tags: atp.Status=draft</p>		
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		

No Included Containers

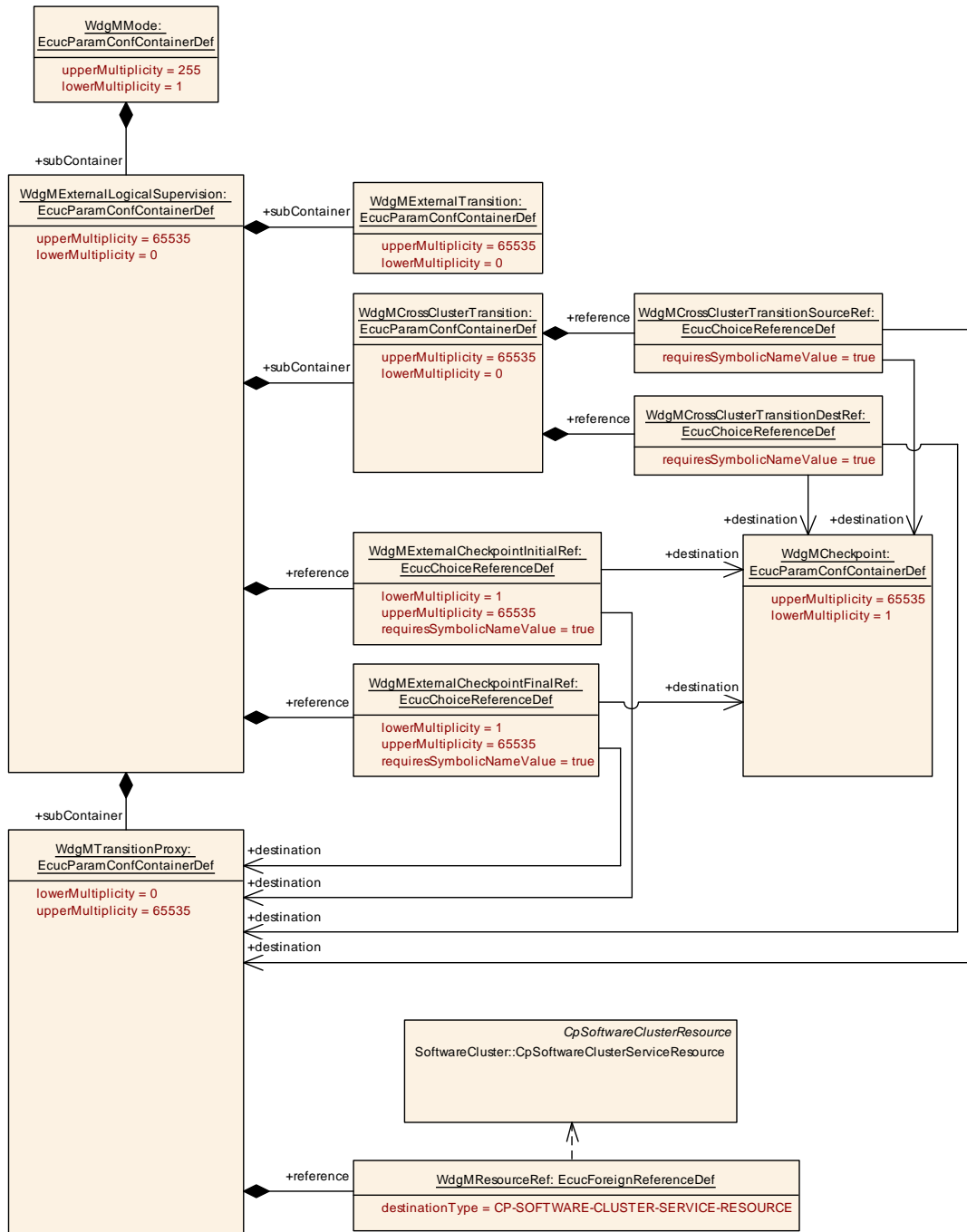


Figure 10.16: Configuration Container `WdgMCrossClusterTransition` (for Clustered Software Architecture)

10.2.20 [WdgMTransitionProxy](#)

SWS Item	[ECUC_WdgM_00364]
Container Name	WdgMTransitionProxy
Parent Container	WdgMExternalLogicalSupervision
Description	<p>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.</p> <p>Tags: atp.Status=draft</p>
Configuration Parameters	

SWS Item	[ECUC_WdgM_00367]
Parameter Name	WdgMResourceRef
Parent Container	WdgMTransitionProxy
Description	<p>Reference to the CpSoftwareClusterServiceResource.</p> <p>Tags: atp.Status=draft</p>
Multiplicity	1
Type	Foreign reference to CP-SOFTWARE-CLUSTER-SERVICE-RESOURCE
Scope / Dependency	scope: ECU

No Included Containers

10.2.21 [WdgMBaseSocket](#)

SWS Item	[ECUC_WdgM_00377]		
Container Name	WdgMBaseSocket		
Parent Container	WdgMGeneral		
Description	<p>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</p> <p>If the infrastructure connection is specific to one or several EcucPartition(s) the WdgMSocketEcucPartitionRef(s) denotes the applicable EcucPartition.</p> <p>Tags: atp.Status=draft</p>		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_WdgM_00367]
Parameter Name	WdgMResourceRef
Parent Container	WdgMBaseSocket
Description	Reference to the CpSoftwareClusterServiceResource. Tags: atp.Status=draft
Multiplicity	1
Type	Foreign reference to CP-SOFTWARE-CLUSTER-SERVICE-RESOURCE
Scope / Dependency	scope: ECU

SWS Item	[ECUC_WdgM_00366]		
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		

No Included Containers

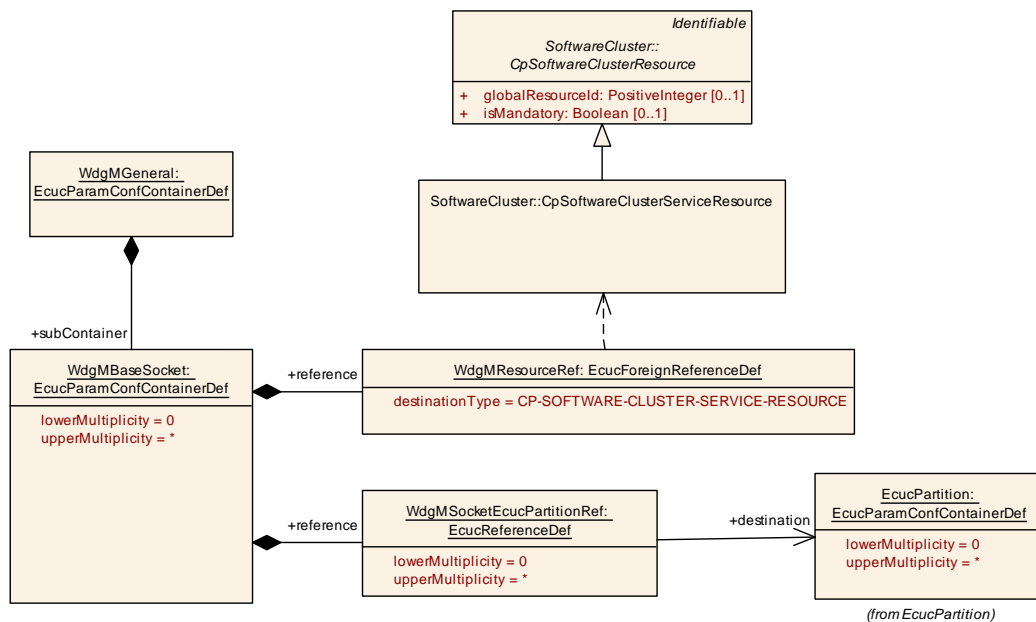


Figure 10.17: Configuration Container [WdgMBaseSocket](#) (for Clustered Software Architecture)

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 [WdgMMaxMargin \[ECUC_WdgM_00313\]](#) 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:

$$(n(AI) - n(SC) + f(EAI, SRC) \leq WdgMMinMargin) \text{ and}$$

$$(n(AI) - n(SC) + f(EAI, SRC) \geq -WdgMMinMargin),$$

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 $f(\text{EAI}, \text{SRC})$ is:

$$f(\text{EAI}, \text{SRC}) = 1 - 2 = -1$$

When SC occurs, the number of supervision cycles is incremented ($n(\text{SC}) = 1$) 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

$$n(\text{AI}) - n(\text{SC}) + f(\text{EAI}, \text{SRC}) = 0.$$

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

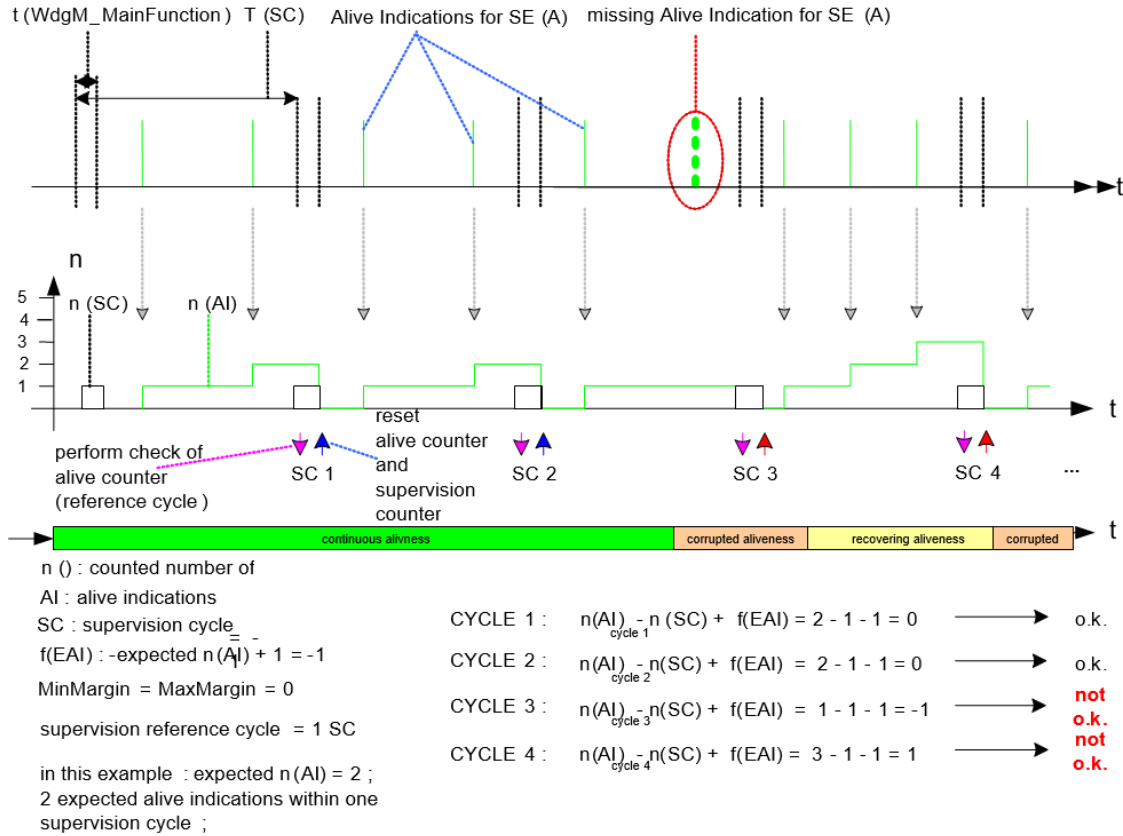


Figure A.1: Alive-supervision algorithm – Scenario A

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

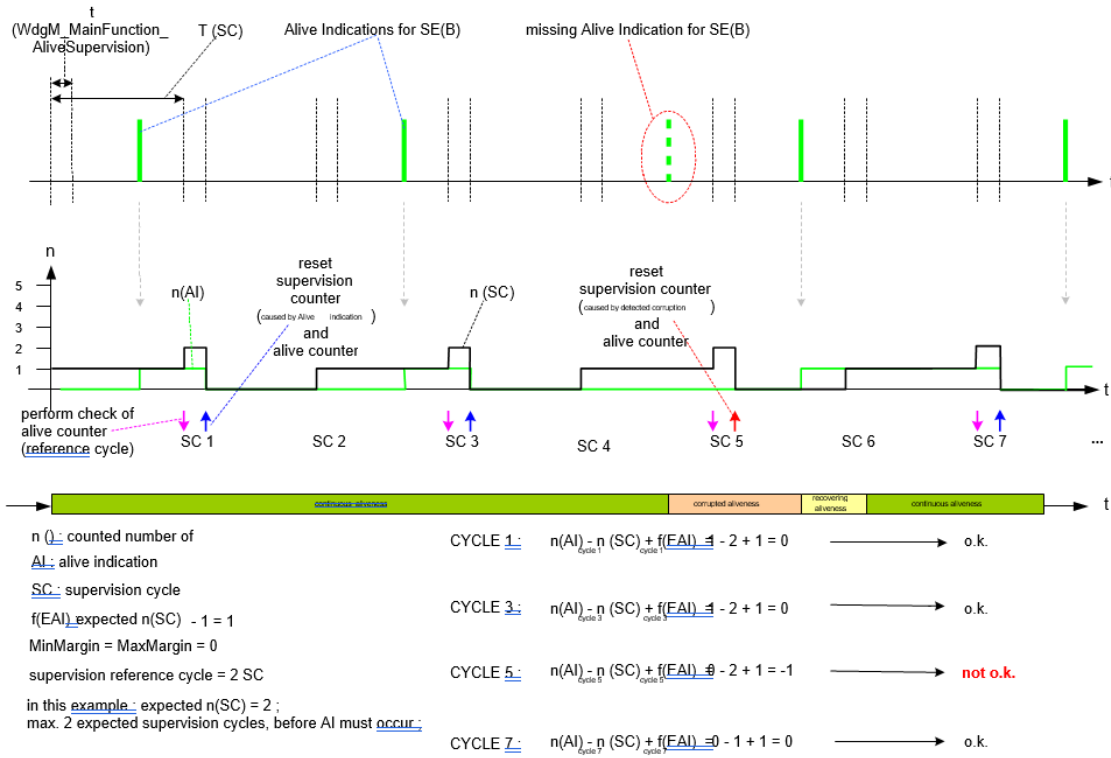


Figure A.2: Alive-supervision algorithm – Scenario B

B Not applicable requirements

[SWS_WdgM_NA_00345] [These requirements are not applicable to this specification.] (*SRS_BSW_00003, SRS_BSW_00004, SRS_BSW_00005, SRS_BSW_00006, SRS_BSW_00007, SRS_BSW_00009, SRS_BSW_00010, SRS_BSW_00159, SRS_BSW_00160, SRS_BSW_00161, SRS_BSW_00162, SRS_BSW_00164, SRS_BSW_00167, SRS_BSW_00168, SRS_BSW_00170, SRS_BSW_00172, SRS_BSW_00300, SRS_BSW_00301, SRS_BSW_00302, SRS_BSW_00304, SRS_BSW_00305, SRS_BSW_00306, SRS_BSW_00307, SRS_BSW_00308, SRS_BSW_00309, SRS_BSW_00312, SRS_BSW_00314, SRS_BSW_00318, SRS_BSW_00321, SRS_BSW_00325, SRS_BSW_00328, SRS_BSW_00330, SRS_BSW_00331, SRS_BSW_00333, SRS_BSW_00334, SRS_BSW_00335, SRS_BSW_00341, SRS_BSW_00342, SRS_BSW_00343, SRS_BSW_00344, SRS_BSW_00346, SRS_BSW_00347, SRS_BSW_00348, SRS_BSW_00351, SRS_BSW_00353, SRS_BSW_00359, SRS_BSW_00360, SRS_BSW_00369, SRS_BSW_00374, SRS_BSW_00375, SRS_BSW_00377, SRS_BSW_00378, SRS_BSW_00379, 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_00401, SRS_BSW_00402, SRS_BSW_00403, SRS_BSW_00404, SRS_BSW_00405, SRS_BSW_00407, SRS_BSW_00408, SRS_BSW_00409, SRS_BSW_00410, SRS_BSW_00411, SRS_BSW_00413, SRS_BSW_00414, SRS_BSW_00415, 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_00439, SRS_BSW_00440, SRS_BSW_00441, SRS_BSW_00447, SRS_BSW_00448, SRS_BSW_00449, SRS_BSW_00451, SRS_BSW_00453, SRS_BSW_00454, SRS_BSW_00456, SRS_BSW_00457, SRS_BSW_00459, SRS_BSW_00460, SRS_BSW_00461, SRS_BSW_00462, SRS_BSW_00463, SRS_BSW_00464, SRS_BSW_00465, SRS_BSW_00466, SRS_BSW_00467, SRS_BSW_00472, SRS_BSW_00473, SRS_BSW_00477, SRS_BSW_00478, SRS_BSW_00479, SRS_BSW_00482, SRS_BSW_00483, SRS_BSW_00484, SRS_BSW_00485, SRS_BSW_00486, SRS_BSW_00488, SRS_BSW_00489, SRS_BSW_00490, SRS_BSW_00491, SRS_BSW_00492, SRS_BSW_00493, SRS_BSW_00494*)