| **Document Title** | # Specification of ECU State Manager with fixed state machine |
|---|---|
| **Document Owner** | AUTOSAR |
| **Document Responsibility** | AUTOSAR |
| **Document Identification No** | 444 |
| **Document Classification** | Standard |

| **Document Version** | 1.2.0 |
|---|---|
| **Document Status** | Final |
| **Part of Release** | 4.0 |
| **Revision** | 3 |

## Document Change History

| **Date** | **Version** | **Changed by** | Change Description |
|---|---|---|---|
| 06.12.2011 | 1.2.0 | AUTOSAR Administration | • Re-integrated EcuM_GetState<br>• EcuM_KillAllRUNRequests does no longer clear requests POST RUN<br>• EcuM_RequestPOST_RUN now accepts new requests during shutdown<br>• Fixed include structure (Don’t include Rte.h but Rte_EcuM.h)<br>• EcuMEnableDefBehaviour is deprecated for EcuM fixed |

## Document Change History

| Date | Version | Changed by | Change Description |
|---|---|---|---|
| 28.10.2010 | 1.1.0 | AUTOSAR Administration | Bugfixing:<br>• Removed obsolete interfaces (e.g. CanSM_EcuM)<br>• Deleted interface to WdgM (EcuM2861)<br>• Added DET errors (EcuM_GetVersionInfo, EcuM_GetBootTarget, EcuM_GetShutdownTarget)<br>• Changed polling mechanism in SLEEP SEQUENCE II state<br>• Fixed transition from GOSLEEP state to WAKEUP II state<br>• Defined binding character of the Standardized AUTOSAR Interfaces (EcuM_StateRequest, EcuM_CurrentMode, EcuM_ShutdownTarget, EcuM_BootTarget)<br>Clarification:<br>• Clarification under which circumstances the error hook will be called<br>• Added note for EcuM_SelectBootTarget / EcuM_GetBootTarget because of the default boot target<br>• Added Appendix A (help the application software programmer to understand when to request which mode)<br>Added note for exit from GO SLEEP state |
| 07.12.2009 | 1.0.0 | AUTOSAR Administration | Initial Release |

# Table of Contents

# List of Tables

## List of Figures

# 1 Introduction

There are actually two variants of AUTOSAR ECU management: flexible and fixed. Fixed ECU management continues ECU management in the form of previous AUTOSAR releases. Flexible ECU management extends the previous versions of the ECU Manager.

The ECU State Manager module for flexible ECU State Management is specified in [23]. This document specifies the ECU State Manager module for fixed ECU State Management.

## 1.1 Functional Overview

The ECU State Manager is a basic software module (see [1]). It manages all aspects of the ECU related to the OFF, RUN, and SLEEP states of that ECU and the transitions (transient states) between these states like STARTUP and SHUTDOWN.
In detail, the ECU State Manager Fixed module

- is responsible for the initialization and de-initialization of all basic software modules including OS and RTE,
- cooperates with the Communication Manager, and hence indirectly with network management, to shut down the ECU when needed,
- manages all wake up events and configures the ECU for SLEEP when requested.

In order to fulfill all these tasks, the ECU State Manager Fixed module provides some important protocols:

- the RUN request protocol, which is needed to coordinate whether the ECU must be kept alive or is ready to shut down,
- the wake up validation protocol to distinguish ‘real’ wake up events from ‘erratic’ ones,
- the time triggered increased inoperation protocol (TTII), which allows to put the ECU into an increasingly energy saving sleep state over time.

These protocols were specified with the following underlying constraints:

- standardization at the API side, to allow applicability to all kinds of ECUs and portability of AUTOSAR applications
- high degree of flexibility to the low side interface, mainly reached by a set of callouts
- quick startup times
- consistent programming paradigm across all mode managing modules (rubber band model[1])

[1] As long as some entity requests run, the rubber band is stretched to the RUN state, and it snaps back when it is released. Since there is only one state (namely the RUN state) to which the rubber band applies, this term is not used any further in this specification. However, it is important to understand that, if applied to resource managers, the result is a powerful and consistent concept for enhancing state machines. The Communication Manager is a module which picks up the idea of the resource manager and of the rubber band model and henceforce fits well into landscape spawn by the ECU State Manager.

Summarizing all this, the ECU State Manager Fixed module will be one of the principal state machines of an AUTOSAR compliant ECU, namely that one around states with the highest priority: RUN, SLEEP, and OFF. However, it does not and shall not in future contain functionality which might be related to terms like ‘vehicle modes’, ‘error modes’, or any other kind of application related kind of states or modes. These topics shall be addressed by other state machines (application mode managers).

## 1.2 Conventions Used in this Specification

### 1.2.1 Font Faces

**EcuM123** Requirements are tagged with an ID in bold font.

*References* to other documents or to other chapters within this document are printed in italic.

`Source code` is printed in a Courier font.

*`Configuration Parameters`* are printed in Courier Italic.

STATE names are written in capital letters.

### 1.2.2 Figures

**Figure X - Title (diagram type)**

Figures are typically drawn in UML. To capture the hierarchical organization of the UML diagrams, some diagrams are classified in the title (diagram type). The following types are used:

- *Top level*
  An entry diagram to the structural or behavioral domain
- *High level*
  First degree of break down below the top level
- *SUB-STATE*
  The diagram describes the behavior of the given sub-state, the diagram type is the name of the sub-state
- no class
  All other diagrams, typically detail information

In the present version of this documentation, there is only one top level diagram: The main state machine, see Figure 2 – ECU Main States (top level diagram).
The next level is covered by high level diagrams. There are five high level sequence diagrams:

*Figure 4 – Startup Sequence (high level diagram)*
*Figure 8 – RUN State Sequence (high level diagram)*
*Figure 12 – Shutdown Sequence (high level diagram)*
*Figure 17 – Sleep Sequence (high level diagram)*
*Figure 20 – Wake-up Sequence (high level diagram)*

These high level diagrams give an overview of the major activities in the main state and explain how the state transitions occur. High level sequence diagrams always start with a diagram reference to the preceding sequence and end with a diagram reference to the following sequence.
High level diagrams are typically broken down into SUB-STATE diagrams. They show details which are irrelevant at the high level.

# 2 Definitions and Acronyms

| ***Term*** | ***Description*** |
|---|---|
| Inoperation | An artificial word to describe the ECU when it is not operational, i.e. not running. Comprises all meanings of *off, sleeping, frozen*, etc. Using this definition is beneficial since it has no predefined meaning. |
| Shutdown Target | The shutdown of an ECU may end up in different states, depending on what application requires or desires for the next shutdown. By selecting a shutdown target, the application can communicate its wishes to the ECU State Manager. SLEEP, OFF, and RESET are shutdown targets. |
| Callout | Within this document, the term 'callout' is used for function stubs which can be filled by the system designer, usually at configuration time, with the purpose to add functionality to the ECU State Manager. Callouts are separated into two classes, where one class is optional to be filled. The other class is mandatory and serves as a hardware abstraction layer. |
| Passive Wake up | A wake up caused from an attached bus rather than an internal event like a timer or sensor activity. |
| Post run | Post run is the period from when the application detects a reason to start the shutdown until the shutdown actually occurs. Typically this period starts when all network communication is put to sleep and lasts until the ECU is put to sleep. |
| Vital Data | Any kind of data (RAM or NVRAM) that must stay consistent to ensure correct operation of the ECU. E.g. stacks, important state variables, etc. |
| Wake up Event | A physical event which causes a wake up. A CAN message or a toggling IO line can be wake up events.<br>Similarly, the internal SW representation, e.g. an interrupt, may also be called a wake up event. |
| Wake up Reason | The wake up reason is the wakeup event being the actual cause of the last wake up. |
| Wake up Source | The peripheral or ECU component which deals with wake up events is called a wake up source. |
| 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, an application or the whole vehicle.<br><br>The EcuM Mode is visible to the application.<br>The EcuM Mode offers exactly the following options<br>• STARTUP<br>• RUN<br>• SLEEP<br>• WAKE_SLEEP<br>• POST_RUN<br>• SHUTDOWN |
| State | States are not visible to the application but are used by the EcuM-internal state machine that handels the Modes.<br><br>The EcuM defines also sub-states, which are also not visible to the application (e.g. GO SLEEP, PREP SHUTDOWN, ...). |

| ***Acronym*** | ***Description*** |
|---|---|
| TTII | Time-Triggered Increased Inoperation |
| BswM | Basic Software Mode Manager |
| DEM | Diagnostic Event Manager |
| DET | Development Error Tracer |
| EcuM | ECU Manager |
| GPT | General Purpose Timer |
| ICU | Input Capture Unit |
| MCU | Microcontroller Unit |

# 3 Related documentation

## 3.1 Input documents

[1] List of Basic Software Modules
AUTOSAR_TR_BSWModuleList.pdf

[2] Layered Software Architecture
AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf

[3] General Requirements on Basic Software Modules
AUTOSAR_SRS_BSWGeneral.pdf

[4] Requirements on Mode Management
AUTOSAR_SRS_ModeManagement.pdf

## 3.2 Related standards and norms

None

## 3.3 Related AUTOSAR Software Specifications

[5] Glossary
AUTOSAR_TR_Glossary.pdf

[6] Specification of Communication Manager
AUTOSAR_SWS_ComManager.pdf

[7] Specification of Watchdog Manager
AUTOSAR_SWS_WatchdogManager.pdf

[8] Specification of CAN Interface
AUTOSAR_SWS_CANInterface.pdf

[9] Specification of LIN Interface
AUTOSAR_SWS_LINInterface.pdf

[10] Specification of FlexRay Interface
AUTOSAR_SWS_FlexRayInterface.pdf

[11] Specification of NVRAM Manager
AUTOSAR_SWS_NVRAMManager.pdf

[12] Specification of MCU Driver
AUTOSAR_SWS_MCUDriver.pdf

[13] Specification of SPI Handler/Driver
AUTOSAR_SWS_SPIHandlerDriver.pdf

[14] Specification of EEPROM Abstraction
AUTOSAR_SWS_EEPROMAbstraction.pdf

[15] Specification of Flash Driver
AUTOSAR_SWS_FlashDriver.pdf

[16] Specification of Operating System
AUTOSAR_SWS_OS.pdf

[17] Specification of RTE
AUTOSAR_SWS_RTE.pdf

[18] Specification of Diagnostic Event Manager
AUTOSAR_SWS_DiagnosticEventManager.pdf

[19] Specification of Development Error Tracer
AUTOSAR_SWS_DevelopmentErrorTracer.pdf

[20] Specification of CAN Transceiver Driver
AUTOSAR_SWS_CANTransceiverDriver.pdf

[21] Specification of C Implementation Rules
AUTOSAR_TR_CImplementationRules.pdf

[22] Basic Software Module Description Template,
AUTOSAR_TPS_BSWModuleDescriptionTemplate.pdf

[23] Specification of ECU Manager
AUTOSAR_SWS_ECUStateManager.pdf

[24] Specification of LIN Driver
AUTOSAR_SWS_LINDriver.pdf

# 4 Constraints and Assumptions

## 4.1 Limitations

*Requirement*: Applications (SW-C's) shall not assume that it is actually possible to switch off ECUs (i.e. power consumption is zero).
*Rationale*: The shutdown target OFF requires special hardware on the ECU so that it can actually be reached (e.g. a power hold circuit). If this hardware is not available, this specification proposes to issue a reset instead but other default behaviors can be defined.

*Requirement:* This specification of the ECU State Manager Fixed module does not support Multicore.

## 4.2 Hardware Requirements

*Requirement*: ECU RAM shall keep contents of vital data while ECU clock is switched off.
*Rationale*: This requirement is needed to implement sleep states as required in *7.6 SLEEP State*.

*Requirement*: ECU RAM shall provide a no-init area which keeps contents over a reset cycle.

*Requirement*: The no-init area in ECU RAM shall only be initialized on a power on event (clamp 30).

*Requirement*: The system designer is responsible for establishing an initialization strategy for the no-init area in ECU RAM.

## 4.3 Applicability to car domains

The ECU State Manager Fixed module is applicable to all car domains.

# 5 Dependencies to other Modules

The following sections outline the important relationships to other modules. They also contain some requirements that these modules have to fulfill to collaborate correctly with ECU State Manager.

## 5.1 Mode Management Modules

### 5.1.1 Communication Manager

The Communication Manager is a so-called 'Resource Manager'[2] and thus requests RUN state. Resource Managers are described in chapter *7.2.3 Resource Managers*.

The Communication Manager requests RUN state when it is leaving the 'no communication' state and it releases RUN when it is returning to this state.

### 5.1.2 Watchdog Manager

The Watchdog Manager is initialized by the ECU State Manager.

The ECU State Manager Fixed module does not set any Watchdog Manager Mode; this is considered to be handled via the BSW Mode Manager.

The ECU State Manager Fixed module is one of the Supervised Entities of the Watchdog Manager.

### 5.1.3 Basic Software Mode Manager

**EcuMf0013**: The ECU State Manager Fixed module shall run in parallel to the Basic Software Mode Manager.

**EcuMf0014**: The ECU State Manager Fixed module shall indicate the current ECU Operation Mode to the BswM (`BswM_EcuM_CurrentState`).

**EcuMf0015**: The ECU State Manager Fixed module shall indicate the current state of a wake up source to the BswM (`BswM_EcuM_CurrentWakeup`).

**EcuMf0016**: The ECU State Manager Fixed module shall initialize the BswM (`BswM_Init`)

**EcuMf0017**: The ECU State Manager Fixed module shall de-initialize the BswM (`BswM_Deinit`).

[2] 'Resource Manager' is invented in this specification to classify BSW modules which interact with Ecu State Manager.

## 5.2 SPAL Modules

### 5.2.1 MCU Driver

The MCU Driver is the first basic software module initialized by the ECU State Manager. However, returning `MCU_Init`, the MCU and the MCU driver are not necessarily fully initialized. Additional, MCU specific steps may be needed. The ECU State Manager Fixed module provides callouts where this additional code can be placed, see chapter 8.6.2. For details on how this code should look like refer to [12].

### 5.2.2 Driver Dependencies and Initialization Order

BSW drivers may depend on each other. A typical example is the watchdog driver which needs the SPI driver to access an external watchdog. This means on the one hand, that drivers may be stacked (not relevant to the ECU State Manager Fixed module) but on the other hand that the underlying driver needs to be initialized first.

The system designer is responsible for defining the initialization order of the BSW drivers at configuration time.

## 5.3 Peripherals with Wake-up Capability

Wake up sources have to be handled and encapsulated by drivers. The implementation must follow the protocols and requirements presented in this document to ensure a seamless integration into AUTOSAR BSW.
To support the wake up and validation protocol, the driver has to fulfill the following requirements:

The driver has to notify ECU State Manager Fixed module by invoking the `EcuM_SetWakeupEvent` service once when a wake up event is detected. The same service should also be invoked during initialization of the driver if a pending wake up event is detected during the initialization.

The driver shall provide an explicit service to put the wake up source to sleep. This service shall put the wake up source into an energy saving and inert operation mode and re-arm the wake up notification mechanism.

If the wake up source is capable of generating faulty events[3] then the driver or the software stack consuming the driver or another appropriate BSW module shall either provide a validation callout for the wake up event under validation or directly call the wake up validation service of the ECU State Manager. If validation is not necessary, then this requirement is not applicable for the according wake up source.

[3] Faulty wakeup events may result from EMV spikes, bouncing effects on wakeup lines etc.

## 5.4 Operating System

ECU State Manager Fixed module starts and shuts down the AUTOSAR OS. It also defines the protocol how control is handed over to the OS after its startup and how control is handed back to the ECU State Manager Fixed module when the OS is shut down.

## 5.5 Runtime Environment (RTE)

*Requirement*: The initialization and de-initialization functions of the RTE are assumed to return.

The ECU State Manager Fixed module shall use the mode port feature of the RTE to notify about mode changes. See chapter *7.10 AUTOSAR Ports* for more information.

## 5.6 BSW Scheduler

The ECU State Manager Fixed module has a twofold relation with the BSW Scheduler. It initializes the BSW Scheduler and it also contains scheduled functions. `EcuM_MainFunction` is scheduled to periodically evaluate run requests.

## 5.7 NVRAM Manager

The following operations of the NVRAM Manager [11] are executed by the ECU State Manager Fixed module .

- Initialization of NVRAM Manager after a power up or reset of the ECU
- Read-back of non-volatile data from NVRAM to ECU RAM during the initialization of the ECU
- Storing of non-volatile data to NVRAM in all shutdown paths. The storing process is prematurely terminated upon wake up events to ensure a quick restart of the ECU.

The ECU State Manager Fixed module does not read NVRAM during the wake up sequence since RAM contents is assumed to be still valid from the previous cycle. To verify this, the ECU State Manager Fixed module offers services to check RAM integrity[4]. The ECU State Manager Fixed module does only read NVRAM during the STARTUP phase.

The NVRAM Manager shall call the callbacks defined in chapter *8.5.1 Callbacks from NVRAM Manager* to notify the ECU State Manager Fixed module about job status.

[4] See *8.6.4.6 EcuM_GenerateRamHash* and *8.6.5.1 EcuM_CheckRamHash* for details.

## 5.8 Diagnostic Event Manager

The DEM module requires the NVRAM Manager module to be operational. The DEM module is aware if the NVRAM Manager module is operational or provides limited functionality. These differences are handled within the DEM module.

## 5.9 Network Management

**EcuMf0022**: The initialization process has to guarantee that NM is initialized, so the ECU is not set into sleep mode if AUTOSAR CAN Generic NM is not initialized.

**EcuMf0023** Initialization of NM is only allowed after the initialization of the respective bus interface.

Implementation hint: The integrator may call `Nm_Init` inside the callout `EcuM_AL_DriverInitThree`.

## 5.10 Other Basic Software Modules

**EcuMf0028**: The integrator shall place initialization code for Basic Software Modules not already mentioned in this specification in the callouts `EcuM_AL_DriverInitZero`, `EcuM_AL_DriverInitOne`, `EcuM_AL_DriverInitTwo`, or `EcuM_AL_DriverInitThree`

## 5.11 Software Components

The ECU State Manager Fixed module handles two ECU-wide settings/variables:

- OS application modes[5]
- Setting of shutdown targets

It is assumed in this specification that these properties are set by the application (through AUTOSAR ports), typically by some ECU specific part of the application. The ECU State Manager Fixed module does not prohibit an application overriding settings of other applications. The policy must be defined at a higher level.

The following two requirements formulate an attempt to resolve this issue.

The SW-C Template may specify a field whether the SW-C sets the shutdown target.

The generation tool may only allow configuration that have only one SW-C accessing shutdown target.

[5] In this context, 'application mode' is a technical term which is defined by the AUTOSAR OS specification.

## 5.12 File Structure

### 5.12.1 Code file structure

**EcuM2988**: The code file structure shall not be defined within this specification completely. At this point it shall be pointed out that the code-file structure shall include the following files named:

- `EcuM_Lcfg.c` – for link time configurable parameters and
- `EcuM_PBcfg.c` – for post build time configurable parameters.

These files shall contain all link time and post-build time configurable parameters.

**EcuM2989**: The implementation of the ECU State Manager Fixed module shall provide one or more C file `EcuM_xxx.c` containing the entire or parts of the ECU State Manager Fixed module code.

**EcuM2990**: The implementation of the ECU State Manager Fixed module shall provide one file `EcuM_Callout_Stubs.c` containing the stubs of the defined callouts.

Whether this file `EcuM_Callout_Stubs.c` has to be modified directly or includes other generated files is specific to the implementation.

### 5.12.2 Header file structure

**EcuM2991**: The implementation of the ECU State Manager Fixed module shall provide one file `EcuM.h` containing fix type declarations, forward declaration to generated types, and function prototypes.

**EcuM2992**: The implementation of the ECU State Manager Fixed module shall provide one file `EcuM_Generated_Types.h` containing generated types and fulfilling the forward declarations from `EcuM.h`.

**EcuM2993**: The implementation of the ECU State Manager Fixed module shall provide one file `EcuM_Cfg.h` containing the configuration parameters.

**EcuM2994**: The implementation of the ECU State Manager Fixed module shall provide one file `EcuM_Cbk.h` containing the callback/callout function prototypes.

**EcuM2677**: It shall only be necessary to include `EcuM_Cbk.h` to interact with the callbacks and callouts of the ECU State Manager.

**EcuM2676**: It shall only be necessary to include `EcuM.h` to use all services of the ECU State Manager.

**EcuM2862**: The ECU State Manager Fixed module implementation shall include `SchM_EcuM.h` and `MemMap.h`.

**EcuMf0001**: The implementation of the ECU State Manager Fixed module shall include `RTE_EcuM.h`.

**EcuMf037**: The module header file EcuM.h shall include
Rte_EcuM_Type.h to include the types which are common used by the ECU State Manager Fixed module and Software Components. This file shall only contain types, that are not already defined in Rte_Type.h.

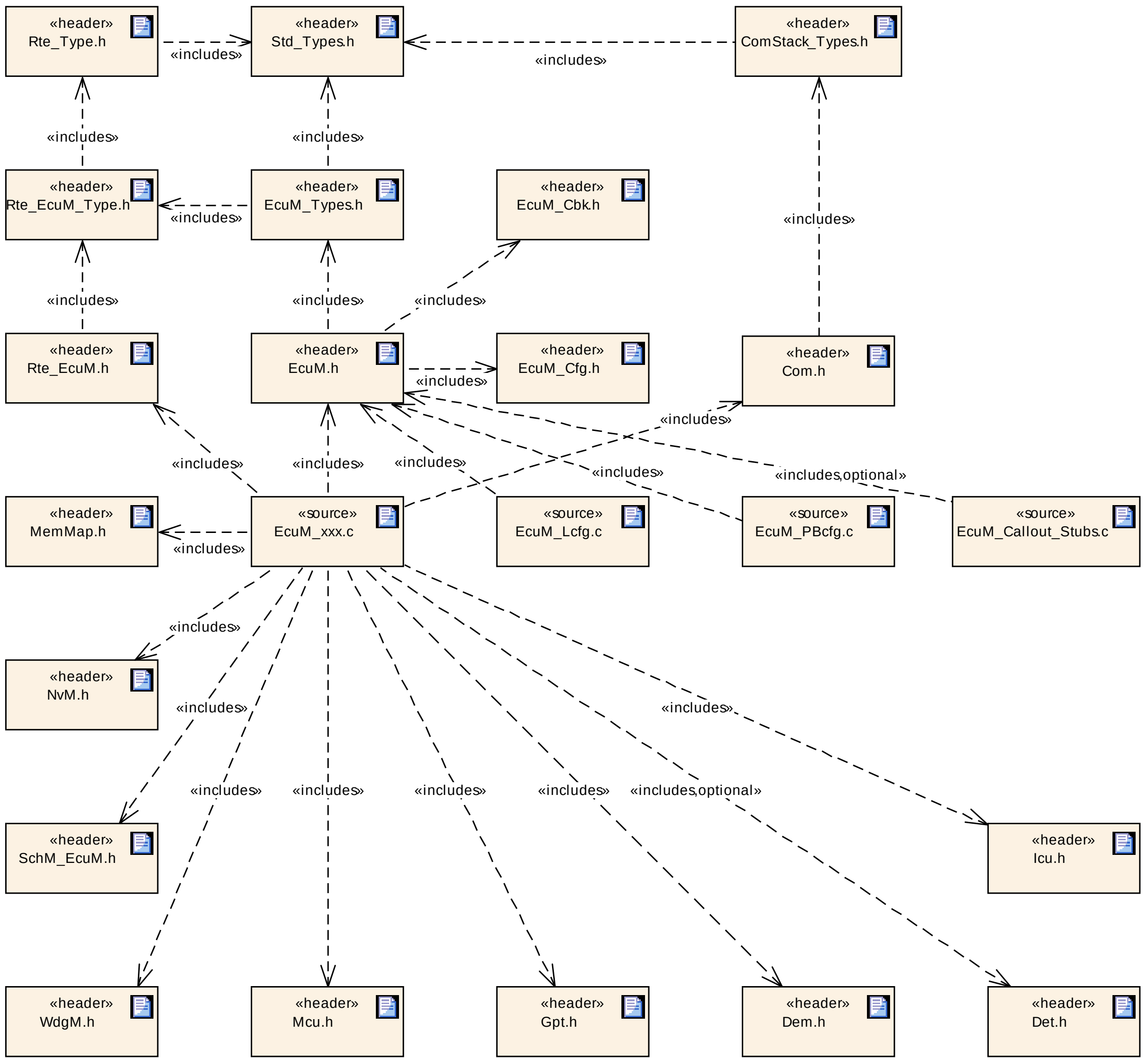


**Figure 1 – Header file structure**

**EcuM2875**: The ECU State Manager Fixed module shall include the `Dem.h` file. By this inclusion the APIs to report errors as well as the required Event Id symbols are included. This specification defines the name of the Event Id symbols which are provided by XML to the DEM configuration tool. The DEM configuration tool assigns ECU dependent values to the Event Id symbols and publishes the symbols in `Dem_IntErrId.h`.

Also refer to chapter *8.7 Expected Interfaces* for dependencies to other modules.

## 5.13 Version check

**EcuMf0024**: The ECU State Manager Fixed module's implementer shall avoid the integration of incompatible files. Minimum implementation is the version check of the header file.
For included header files the following version numbers shall be verified:

- `<MODULENAME>_AR_RELEASE_MAJOR_VERSION`
- `<MODULENAME>_AR_RELEASE MINOR_VERSION`

Where `<MODULENAME>` is the module short name of the other (external) modules which provide header files included by the EcuM fixed module[6].
The imported include files shall be checked by pre-processor directives.

[6] For example when det.h is included by the EcuM fixed module, the EcuM fixed module shall check that `DET_AR_RELEASE_MAJOR_VERSION` and `DET_AR_RELEASE_MINOR_VERSION` are the expected version number (i.e. `4` and `0` in the AUTOSAR Release R4.0)

# 6 Requirements traceability

Document: General Requirements on Basic Software Modules [3]

| ***Requirement*** | | ***Satisfied by*** |
|---|---|---|
| [BSW00344] | Reference to link-time configuration | 10.2 Variants<br>EcuM does not define configuration sets but references the init configuration, e.g. for driver initialization |
| [BSW00404] | Reference to post build time configuration | |
| [BSW00405] | Reference to multiple configuration sets | |
| [BSW00345] | Pre-compile-time configuration | *10.4 Configurable Parameters*<br>*5.12 File Structure* |
| [BSW159] | Tool-based configuration | not applicable<br>(EcuM does not specify the configuration tool) |
| [BSW167] | Static configuration checking | *10.4 Configurable Parameters* |
| [BSW171] | Configurability of optional functionality | *10.4 Configurable Parameters* |
| [BSW00380] | Separate C-files for configuration parameters | *5.12 File Structure* |
| [BSW00419] | Separate C-files for pre-compile-time configuration parameters | |
| [BSW00381] | Separate configuration header files for pre-compile-time parameters | |
| [BSW00412] | Separate H-file for configuration parameters | |
| [BSW00383] | List dependencies to other configuration files | *10.4 Configurable Parameters* |
| [BSW00384] | List dependencies to other modules | *5 Dependencies to other Modules*<br>*8.7Expected Interfaces* |
| [BSW00387] | Specify the configuration class of a callback function | *8.5 Callback Definitions* |
| [BSW00388] - [BSW00400] | | *10.4 Configurable Parameters* |
| [BSW00402] | Published information | *10.4 Configurable Parameters* |
| [BSW00375] | Notification of wake up reason | *8.3.4 Wake up* |
| [BSW101] | Initialization interface | *8.3.2.1 EcuM_Init* |
| [BSW00416] | Sequence of initialization | EcuM2559 |
| [BSW00406] | Check module initialization | not applicable<br>(EcuM initializes the BSW, hence EcuM is always initialized from the point of view of any other BSW module.) |
| [BSW00435] | Header File Structure for the Basic Software Scheduler | EcuM2862 |
| [BSW00436] | Module Header File Structure for the Basic Software Memory Mapping | EcuM2862 |
| | | |
| [BSW168] | Diagnostic Interface of SW components | not applicable<br>(EcuM has no testing requirements) |
| [BSW00407] | Function to read out published parameters | *8.3.1.1 EcuM_GetVersionInfo* |
| [BSW00423] | Usage of SW-C template to describe BSW modules with AUTOSAR interfaces | *7.10 AUTOSAR Ports* |

| | | |
|---|---|---|
| [BSW00424] | BSW main processing function task allocation | Implementation of `EcuM_MainFunction` according to this specification does not require extended task mechanisms. |
| [BSW00425] | Trigger conditions for schedulable objects | *8.4.1 EcuM_MainFunction* |
| [BSW00426] | Exclusive areas in BSW modules | not applicable<br>(EcuM does not specify directly accessible global data.) |
| [BSW00427] | ISR description for BSW modules | not applicable<br>(EcuM does not specify ISRs.) |
| [BSW00428] | Execution order dependencies of main processing functions | There are no requirements of this sort. |
| [BSW00429] | Restricted BSW OS functionality access | EcuM does not use any other than the allowed OS services. |
| [BSW00431] | The BSW Scheduler module implements task bodies | EcuM does not define any task body. |
| [BSW00432] | Modules should have separated main processing functions for a read/receive and write/transmit data path | not applicable<br>(EcuM does not specify RxTx functionality.) |
| [BSW00433] | Calling of main processing functions | EcuM does not call any main processing function. |
| [BSW00434] | The Schedule Module shall provide an API for exclusive areas | not applicable<br>(This is not an EcuM requirement) |
| [BSW00336] | Shutdown interface | *8.3.2.3 EcuM_Shutdown* |
| *Fault Operation and Error Detection* | | |
| [BSW00337] | Classification of errors | *Table 5 - Error Classification* |
| [BSW00338] | Detection and reporting of development errors | *Table 5 - Error Classification* |
| [BSW00369] | Do not return development error codes via API | *8 API specification* |
| [BSW00339] | Reporting of production relevant error statuses | EcuM2759 |
| [BSW00417] | Reporting of Error Events by Non-Basic Software | not applicable |
| [BSW00323] | API parameter checking | *18.8 API Parameter Checking* |
| [BSW004] | Version check | *5.13 Version check* |
| [BSW00409] | Header files for production code error IDs | *5.12 File Structure* |
| [BSW00385] | List possible error notifications | *Table 5 - Error Classification* |
| [BSW00386] | Configuration for detecting errors | *7.12 Error Classification* |
| [BSW161] | Microcontroller abstraction | not applicable<br>(Requirements related to layered software architecture are reflected by the EcuM SRS) |
| [BSW162] | ECU layout abstraction | |
| [BSW005] | No hard coded horizontal interfaces within MCAL | |
| [BSW00415] | User dependent include files | not applicable<br>(EcuM does not define user specific functionality) |
| [BSW164] | Implementation of ISRs | not applicable<br>(EcuM does not specify ISRs.) |
| [BSW00325] | Runtime of ISRs | |
| [BSW00326] | Transition from ISRs to OS task | |
| [BSW00342] | Usage of source code and object code. | *5.12 File Structure* |
| [BSW00343] | Specification and configuration of time | *10.4 Configurable Parameters* |
| [BSW160] | Human-readable configuration | not applicable |

| | | |
|---|---|---|
| | data | (This specification does not define the configuration file) |
| [BSW007] | HIS MISRA C | The API definition complies with MISRA C. *8 API specification* |
| [BSW00300] | Module naming conventions. | *5.12 File Structure* |
| [BSW00413] | Accessing instances of BSW modules | not applicable (EcuM defines only one instance.) |
| [BSW00347] | Naming separation of different instances of BSW drivers | |
| [BSW00305] | Self-defined data types naming conventions | *8.2 Type definitions* |
| [BSW00307] | Global variables naming convention | not applicable (EcuM does not specify global variables.) |
| [BSW00310] | API naming conventions | *8 API specification* |
| [BSW00373] | Main processing function naming convention | *8.4.1 EcuM_MainFunction* |
| [BSW00327] | Error values naming convention | *Table 5 - Error Classification* |
| [BSW00335] | Status values naming convention | *8.2 Type definitions* |
| [BSW00350] | Development error detection keyword | *10.4 Configurable Parameters* |
| [BSW00408] | Configuration parameter naming convention | *10.4 Configurable Parameters* |
| [BSW00410] | Compiler switches shall have defined values | not applicable (This specification does not define compiler switchers) |
| [BSW00411] | Get version info keyword | *10.4 Configurable Parameters* |
| [BSW00346] | Basic set of module files | *5.12 File Structure* |
| [BSW158] | Separation of configuration from implementation | *5.12 File Structure* |
| [BSW00314] | Separation of interrupt frames from service routines | not applicable (EcuM does not specify ISRs.) |
| [BSW00370] | Separation of callback interface from API | *8 API specification* |
| [BSW00450] | Main function processing for uninitialized module | *8.4.1 EcuM_MainFunction* |
| *Standard Header Files* | | |
| [BSW00348] | Standard header type | not applicable (EcuM does not define standard types) |
| [BSW00353] | Platform specific type header | not applicable (EcuM is specified platform independent) |
| [BSW00361] | Compiler specific language extension header | not applicable (EcuM does not define language extensions) |
| [BSW00301] | Limited import information | *8.1 Imported Types* |
| [BSW00302] | Limited export information | *8 API specification* |
| [BSW00328] | Avoid duplication of code | Not applicable (Requirement to implementation) |
| [BSW00312] | Shared code shall be re-entrant | *8 API specification* |
| [BSW006] | Platform independency | *8 API specification* |
| [BSW00357] | Standard API return type | *8 API specification* |
| [BSW00377] | Module specific API return types | *8 API specification* |
| [BSW00304] | AUTOSAR integer data types | *8 API specification* |
| [BSW00355] | Do not redefine AUTOSAR integer data types | *8 API specification* |
| [BSW00378] | AUTOSAR boolean type | *8 API specification* |

| | | |
|---|---|---|
| [BSW00306] | Avoid direct use of compiler and platform specific keywords | *8 API specification* |
| [BSW00308] | Defintion of global data | Not applicable (EcuM does not specify global data.) |
| [BSW00309] | Global data with read-only constraints | |
| [BSW00371] | Do not pass function pointers via API | *8 API specification* |
| [BSW00358] | Return type of init() functions | EcuM2811 |
| [BSW00414] | Parameter of init function | |
| [BSW00376] | Return type and parameters of main processing functions | *8.4.1 EcuM_MainFunction* |
| [BSW00359] | Return type of callback functions | *8.5 Callback Definitions* |
| [BSW00360] | Parameters of callback functions | *8.5 Callback Definitions* |
| [BSW00329] | Avoidance of generic interfaces | *8 API specification* |
| [BSW00330] | Usage of macros/inline functions instead of functions | not applicable (Requirement to implementation) |
| [BSW00331] | Separation of error and status values | *8.2 Type definitions* |
| [BSW009] | Module user documentation | Fulfilled by usage of template/formal review |
| [BSW00401] | Documentation of multiple instances of configuration parameters | *10.4 Configurable Parameters* |
| [BSW172] | Compatibility and documentation of scheduling strategy | EcuM2836 |
| [BSW010] | Memory resource documentation | not applicable (requirement to implementation) |
| [BSW00333] | Documentation of callback function context | *8.5 Callback Definitions* |
| [BSW00374] | Module vendor identification | *10.4 Configurable Parameters* |
| [BSW00379] | Module identification | *10.4 Configurable Parameters* |
| [BSW003] | Version identification | *10.4 Configurable Parameters* |
| [BSW00318] | Format of module version numbers | *10.4 Configurable Parameters* |
| [BSW00321] | Enumeration of module version numbers | *10.4 Configurable Parameters* |
| [BSW00341] | Microcontroller compatibility documentation | not applicable (requirement to implementation) |
| [BSW00334] | Provision of XML file | not applicable (provided by system team) |
| [BSW00447] | Standardizing Include file structure of BSW Modules Implementing Autosar Service | *5.12.2 Header file structure* |

Document: Requirements on Mode Management [4]

| ***Requirement*** | | ***Satisfied by*** |
|---|---|---|
| [BSW09120] | Configuration of initialization process of basic software | EcuM2559, EcuM2520, *8.6.2 Callouts from STARTUP* |
| [BSW09147] | Configuration of de-initialization process of basic software | |
| [BSW09122] | Configuration of users of the | EcuM487 |

| | | |
|---|---|---|
| | ECU State Manager | *10.4 Configurable Parameters* |
| [BSW09100] | Selection of wake up sources shall be configurable | EcuM2389<br>*10.4 Configurable Parameters* |
| [BSW09146] | Configuration of time triggered increased inoperation | EcuM2654, EcuM2223,<br>*10.4 Configurable Parameters* |
| [BSW09001] | Standardization of state relations | EcuM2664 |
| [BSW09116] | Requesting and releasing the RUN state | EcuM2814, EcuM2815 |
| [BSW09114] | Starting/invoking the shutdown process | EcuM2311 |
| [BSW09104] | ECU State Manager Fixed module shall take over control after OS shutdown | EcuM2328 |
| [BSW09113] | Initialization of Basic Software modules | *Table 1 - Initialization Activities* |
| [BSW09127] | De-initialization of BSW | *Table 3 - Shutdown Activities* |
| [BSW09128] | Support of several shutdown targets | *7.6.2.1 Shutdown Targets* |
| [BSW09119] | Support of several sleep modes | *7.4.3.4RUN III*<br>*7.5SHUTDOWN State* |
| [BSW09102] | API for selecting the sleep mode | EcuM2822 |
| [BSW09072] | Force ECU shutdown | EcuM2821 |
| [BSW09009] | Activation of software when entering/leaving ECU states | *8.6 Callout Definitions* |
| [BSW09017] | Provide ECU state information | *8.6 Callout Definitions* |
| [BSW09138] | Selection of application modes of OS | *7.11.1 OS Application Modes* |
| [BSW09136] | Centralized Wake-up Management | *7.8 Wake-up Validation Protocol* |
| [BSW09098] | Registration of wake up reasons | *8.3.4 Wake up* |
| [BSW09097] | Validation of physical channel wake up | *7.8 Wake-up Validation Protocol* |
| [BSW09118] | Time Triggered Increased Inoperation | *7.9 Time Triggered Increased Inoperation* |
| [BSW09145] | Support of wake-sleep operation | *7.11.5 Configuration Alternative for Providing Wake-Sleep Operation* |
| [BSW09126] | Provide an API for querying of wake up reason | *8.3.4 Wake up* |
| [BSW09145] | Evaluate condition to stay in the RUN state | EcuM2311 |
| [BSW09164] | Shutdown synchronization support for SW-Components | *7.4.3.4 RUN* |
| [BSW09165] | Requesting and releasing the POST RUN state | EcuM2819, EcuM2820 |
| [BSW09166] | Evaludate condition to stay in POST RUN state | EcuM2761 |
| [BSW09170] | Triggering Watchdog Manager during Startup / Shutdown and Sleep | Integration code |
| [BSW09173] | Minimum duration of Run State | EcuM2310 |

# 7 Functional Specification

## 7.1 Main States of the ECU State Manager

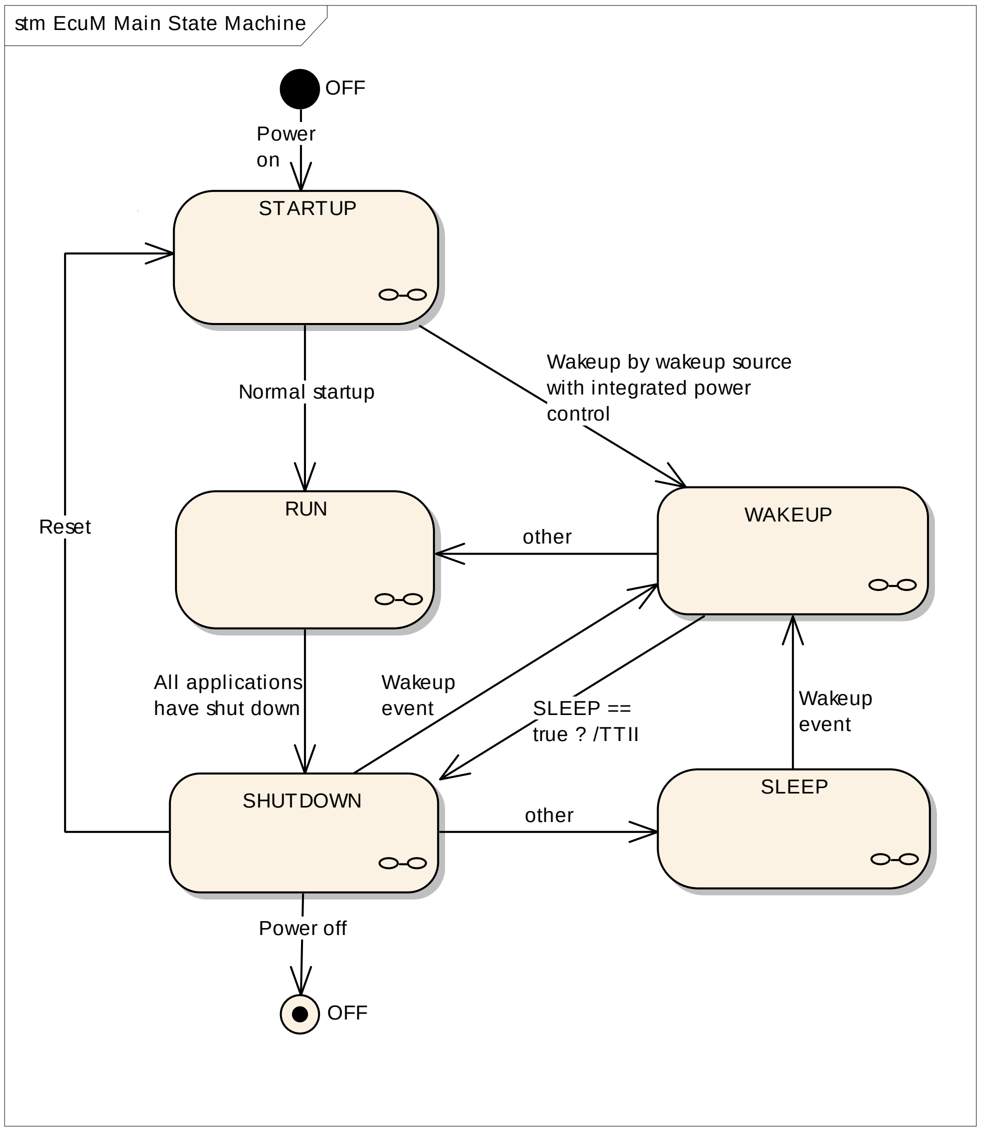


**Figure 2 – ECU Main States (top level diagram)**

*Figure 2 – ECU Main States (top level diagram)* shows the main state machine provided by the ECU State Manager Fixed module . This state machine manages the 'life cycle' of an ECU from OFF through STARTUP and RUN to SLEEP or OFF.

Please refer to the following chapters and to 8.2.2 EcuM_StateType for the relevant substates.

### 7.1.1 STARTUP State

The purpose of the STARTUP state is to initialize the basic software modules. The STARTUP state is divided into two parts, the first being the part before OS startup, the second part after OS startup (and therefore with a running OS). More details about the initialization are given in chapter *7.3 STARTUP State*.

### 7.1.2 RUN State

The RUN State is entered by the ECU State Manager Fixed module after all modules of basic software including OS and RTE have been initialized by the ECU State Manager Fixed module .
The RUN State indicates to the SW-C's above RTE that BSW has initialized and applications start operating. Further, the RUN state provides a mechanism for synchronized shutdown of application software.
RUN state must be requested by the application explicitly or implicitly[7] whenever it is needed to keep the ECU awake. Otherwise, the ECU State Manager Fixed module will commence shutdown. In other words: a SW-C has to request the RUN state from the ECU State Manager Fixed module when the ECU needs to stay awake.
The RUN State falls into two sub-states: The regular RUN state and a POST RUN state. The POST RUN state can be requested by SW-C's to indicate that the need to execute cleanup or saving activities before the ECU goes to sleep. The POST RUN state can be requested independently from the RUN state with a separate API or from AUTOSAR ports accordingly[8].
SW-C's shall react on state changes by interfacing with the mode port of the ECU State Manager Fixed module .
If the SW-C's primary intent is to communicate with other SW-C's, the SW-C has to request a communication state from the Communication Manager module instead.

### 7.1.3 SHUTDOWN State

The SHUTDOWN state handles the controlled shutdown of basic software modules and finally results in the selected shutdown target for the ECU: SLEEP, OFF, or Reset. An important activity in this state is to write non-volatile data back to NVRAM.

[7] RUN state is requested implicitly if a non-idle state is requested from a Resource Manager. E.g. requesting any state but 'no communication' from the Communication Manager will have the Communication Manager requesting RUN state from the ECU State Manager in turn. This is a request for communication which implicitly results in a request for RUN state. See also [5].
[8] In this specification RUN and POST RUN sub-states are called RUN II and RUN III.

### 7.1.4 SLEEP State

The SLEEP state is an energy saving state. Typically, no code is executed but power is still supplied, and if configured accordingly, the ECU is wakeable in this state[9]. The SLEEP state provides a configurable set of sleep modes which typically are a trade off between power consumption and time to restart the ECU. In terms of the API, the sleep modes are referred to as *shutdown targets*.

### 7.1.5 WAKEUP State

The WAKEUP State is entered when the ECU comes out of the SLEEP state, due to intended or unintended wake up.
The WAKEUP State provides a protocol to support validation of wake up events. This is necessary to differentiate between intended und unintended wake-ups. The validation itself is a cooperative process between the driver which handles the wake up source and the ECU State Manager Fixed module (see *7.8 Wake-up Validation Protocol*).

### 7.1.6 OFF State

The OFF state describes the unpowered ECU. Wakeability may be required in this state but only for wake up sources with integrated power control. In any case the ECU must be startable (e.g. by reset events).

[9] Some ECU designs actually do require code execution to implement a SLEEP state (and the wakeup capability). For these ECUs, the clock speed is typically dramatically reduced. These could be implemented with a small loop inside the SLEEP state.

## 7.2 Structural Description of the ECU State Manager

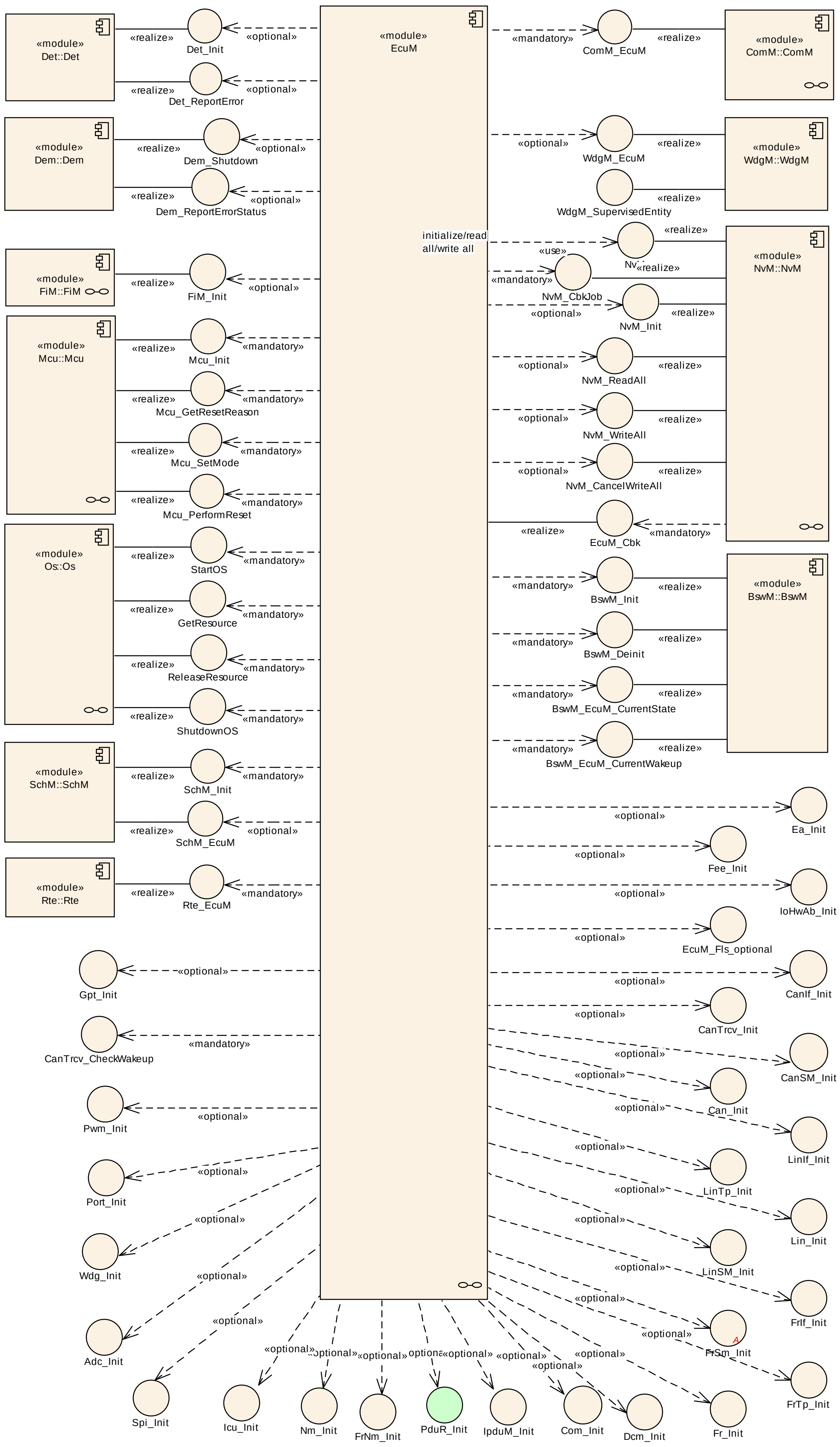

«module»
EcuM
«module»
Det::Det
«realize»
Det_Init
«optional»
Det_ReportError
«module»
Dem::Dem
Dem_Shutdown
Dem_ReportErrorStatus
«module»
FiM::FiM
FiM_Init
«module»
Mcu::Mcu
Mcu_Init
«mandatory»
Mcu_GetResetReason
Mcu_SetMode
Mcu_PerformReset
«module»
Os::Os
StartOS
GetResource
ReleaseResource
ShutdownOS
«module»
SchM::SchM
SchM_Init
SchM_EcuM
«module»
Rte::Rte
Rte_EcuM
Gpt_Init
CanTrcv_CheckWakeup
Pwm_Init
Port_Init
Wdg_Init
Adc_Init
Spi_Init
Icu_Init
Nm_Init
FrNm_Init
PduR_Init
IpduM_Init
Com_Init
Dcm_Init
Fr_Init
«module»
ComM::ComM
ComM_EcuM
«module»
WdgM::WdgM
WdgM_EcuM
WdgM_SupervisedEntity
initialize/read
all/write all
«use»
«module»
NvM::NvM
NvM_CbkJob
NvM_Init
NvM_ReadAll
NvM_WriteAll
NvM_CancelWriteAll
EcuM_Cbk
«module»
BswM::BswM
BswM_Init
BswM_Deinit
BswM_EcuM_CurrentState
BswM_EcuM_CurrentWakeup
Ea_Init
Fee_Init
IoHwAb_Init
EcuM_Fls_optional
CanIf_Init
CanTrcv_Init
CanSM_Init
Can_Init
LinIf_Init
LinTp_Init
Lin_Init
LinSM_Init
FrIf_Init
FrSm_Init
FrTp_Init

**Figure 3 – Module Relationship (top level diagram)**

Figure 3 shows how the ECU State Manager Fixed module is related to other modules. In most cases, the ECU State Manager Fixed module is simply responsible for initialization[10]. There are however some modules that have a functional relationship with the ECU State Manager Fixed module which are explained in the following paragraphs.

### 7.2.1 Standardized AUTOSAR Software Modules

Basic Software modules are initialized and shut down by the ECU State Manager.
The RTE is initialized and shut down by the ECU State Manager.

The OS is initialized and shut down by the ECU State Manager.

After the OS initialization, additional initialization steps are undertaken by the ECU State Manager Fixed module before the RUN state is reached. Execution control is handed over to the ECU State Manager Fixed module after OS shutdown. Details are provided in the chapters *7.3 STARTUP State* and *7.5 SHUTDOWN State*.

### 7.2.2 Software Components

SW Components contain the application code of an AUTOSAR ECU. Software Components shall request the RUN state from the ECU State Manager Fixed module when they have the need to keep the ECU alive.
If the intent of the SW-C is primarily to communicate then it should request a communication state from the Communication Manager (see [5]). This will implicitly keep the ECU alive. A SW-C should clearly separate between the need to communicate and the need to keep an ECU alive. Mixing up these two ideas may result in an instable shutdown algorithm.
A SW-C interacts with the ECU State Manager Fixed module using AUTOSAR ports.

### 7.2.3 Resource Managers

The concept of resource managers allows adding new state machines to the BSW (as a part of new BSW modules) which behave like sub-state machines of the RUN state.

In order to collaborate correctly with the ECU State Manager Fixed module only very few requirements must be met:

A Resource Manager has to define exactly one idle state that signifies the state where the Resource Manager isn't doing anything but waiting.

[10] To be precise, "initialization" could also mean de-initialization.

A Resource Manager has to transit into its idle state after initialization. It shall request the RUN state from the ECU State Manager Fixed module whenever it leaves its idle state and it shall release the RUN state when it returns back to its idle state.

The Communication Manager module is one such resource manager.

## 7.3 STARTUP State

See *7.1.1 STARTUP State* for an overview description.

### 7.3.1 High Level Sequence Diagram

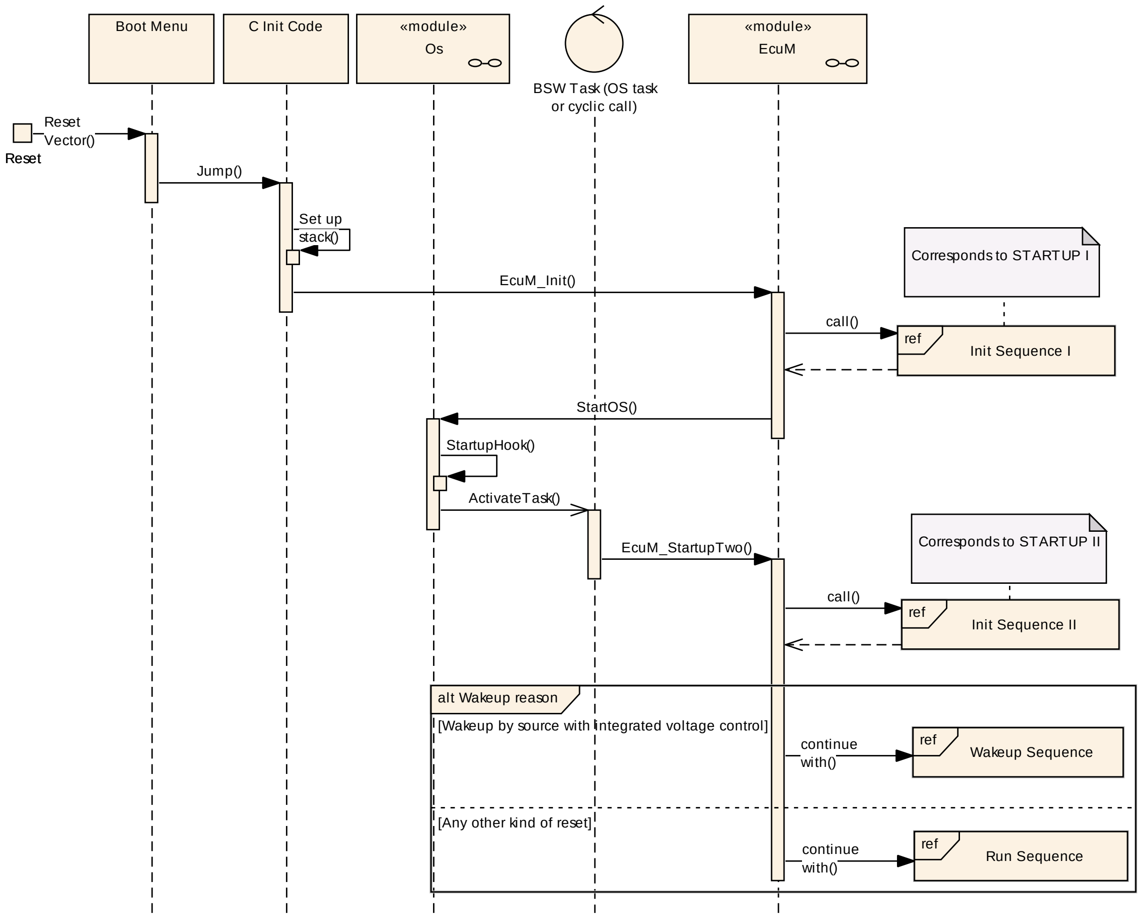


**Figure 4 – Startup Sequence (high level diagram)**

To see adjacent diagrams refer to

*Figure 8 – RUN State Sequence*
*Figure 2 – ECU Main States (top level diagram)*

The startup sequence in Figure 4 shows the startup behavior of the ECU. With the invocation of `EcuM_Init` the ECU State Manager Fixed module takes control of the startup procedure. The startup of the ECU falls into two parts.

The first part, init sequence I or STARTUP I is finished when the AUTOSAR OS is started.

The second part, init sequence II or STARTUP II is finished when RTE is started.

To distinguish services that are called before the OS is started from those that are called afterwards and to have a cleaner visualization, the ECU State Manager Fixed module is split into two parts: The EcuM_Initializer, which runs without OS, and EcuM.

### 7.3.2 Activities before EcuM_Init

The ECU State Manager Fixed module assumes that before `EcuM_Init` is called a minimal initialization of the MCU has taken place, so that a stack is set up and code can be executed.

### 7.3.3 STARTUP Activity Overview

**EcuMf0007**: Initialization dependencies (as defined in the BSWMDs) have to be respected.

Example (to show when ComM_CommunicationAllowed shall be called):

- ComM_Init()
- CanXX_Init()
- ComM_CommunicationAllowed(<CAN channel>, true)
- And reverse for DeInit

**EcuM2411**: The following table shows the Startup activities and the order in which they shall be executed.

| ***Sub-state*** <br> ***Initialization Activity***[11] | ***Comment*** | ***Opt.***[12] |
|---|---|---|
| **STARTUP I** | | |
| Callout `EcuM_AL_DriverInitZero` | Init block 0<br>This callout may only initialize BSW modules that do not use post-build configuration parameters. The callout may not only contain driver initialization but any kind of pre-OS, low level initialization code.<br>See *7.3.5 Driver Initialization* | yes |
| Callout `EcuM_DeterminePbConfiguration` | This callout is expected to return a pointer to a fully initialized `EcuM_ConfigType` structure containing the post-build configuration data for EcuM and all other BSW modules. | no |
| Check consistency of configuration data | If check fails the `EcuM_ErrorHook` is called. See *10.5 Checking Configuration Consistency* for details on the consistency check. | No |
| Callout `EcuM_AL_DriverInitOne` | Init block I<br>The callout may not only contain driver initialization but any kind of pre-OS, low level initialization code.<br>See *7.3.5 Driver Initialization* | Yes |
| Get reset reason | The reset reason is derived from a call to `Mcu_GetResetReason` and the mapping defined via the `EcuMWakeupSource` configuration containers. | No |

[11] Activities marked with × are conditional.
[12] Optional activities can be switched on or off by configuration. See chapter *10.3* Published for details.

| ***Sub-state*** <br> ***Initialization Activity***[11] | ***Comment*** | ***Opt.***[12] |
|---|---|---|
| | See *8.5.2.2 EcuM_SetWakeupEvent* and *8.3.4.3 EcuM_GetValidatedWakeupEvents*. | |
| Select default shutdown target | See EcuM2181 | No |
| Start OS | Start the AUTOSAR OS, see EcuM2603 | No |
| | | |
| **STARTUP II** | | |
| Init BSW Scheduler | Initialize the semaphores for critical sections used by BSW modules | No |
| Callout `EcuM_AL_DriverInitTwo` | Init block II<br>The callout may only initialize BSW modules that need OS support but don't need access to private NvRam data (other that post-build configuration data in their <Module>_ConfigType) or manage that data on their own.<br>See *7.3.5 Driver Initialization* | Yes |
| Callout `EcuM_OnRTEStartup` | | No |
| Start RTE | From now on SW-Cs are running. RTE will signal the (initial) mode STARTUP during start. | No |
| Callout `EcuM_AL_DriverInitThree` | Init block III<br>The callout may initialize BSW modules that need OS support and rely on their private NvRam data (other that post-build configuration data in their <Module>_`ConfigType`) to be restored.<br>See *7.3.5 Driver Initialization* | Yes |
| Indicate mode change to RTE | Indicated mode is `SLEEP` if next state is WAKEUP VALIDATION, indicated mode is `RUN` if next state is RUN. | No |

**Table 1 - Initialization Activities**

**EcuM2623**: The ECU State Manager shall remember the wake up source resulting from the reset reason translation (see Table 1 - Initialization Activities).

### 7.3.4 Sub-State Descriptions

#### 7.3.4.1 STARTUP I

The STARTUP I state is entered with a call of the API function `EcuM_Init`.

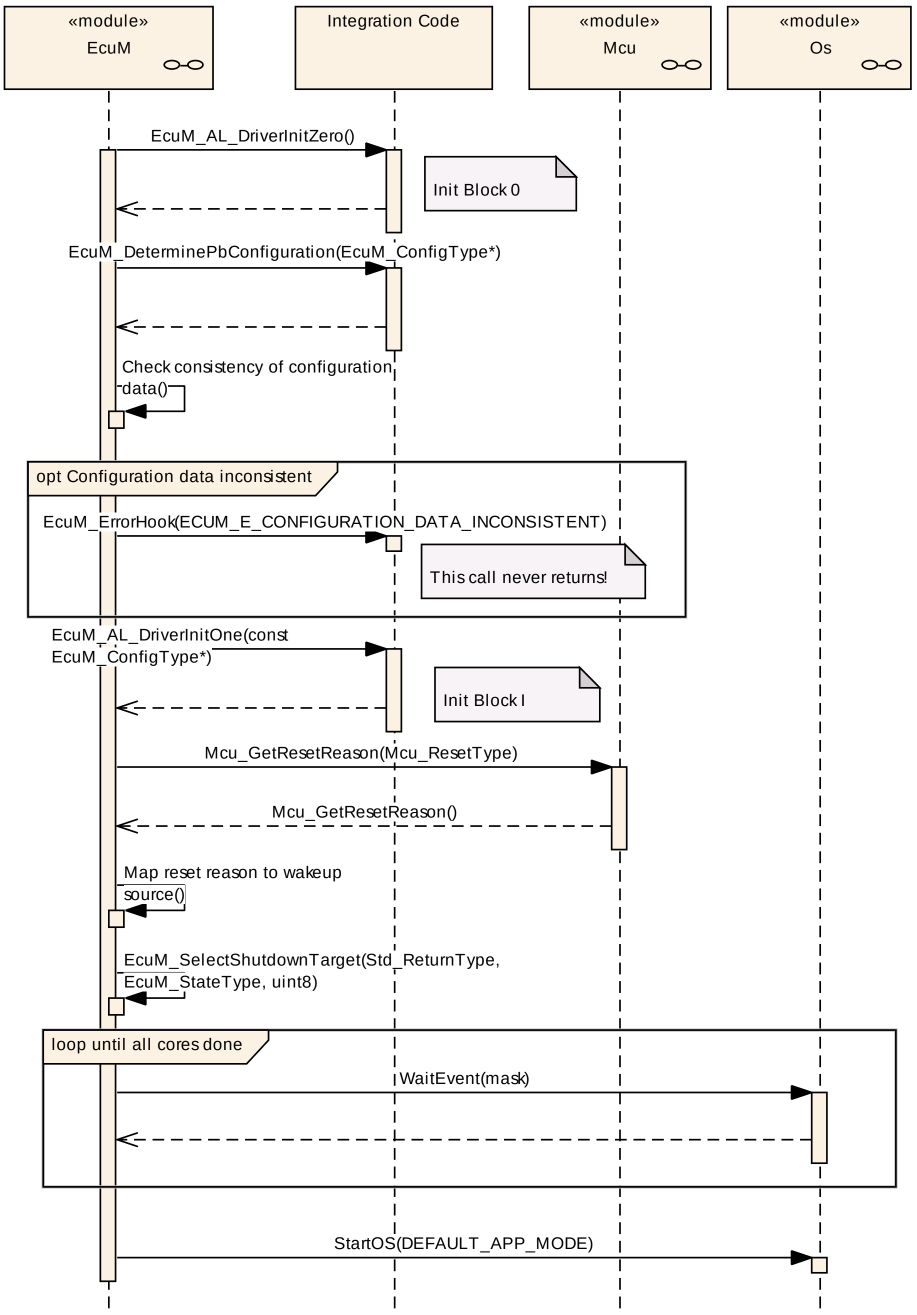

«module»
EcuM
Integration Code
«module»
Mcu
«module»
Os
EcuM_AL_DriverInitZero()
Init Block 0
EcuM_DeterminePbConfiguration(EcuM_ConfigType*)
Check consistency of configuration data()
opt Configuration data inconsistent
EcuM_ErrorHook(ECUM_E_CONFIGURATION_DATA_INCONSISTENT)
This call never returns!
EcuM_AL_DriverInitOne(const EcuM_ConfigType*)
Init Block I
Mcu_GetResetReason(Mcu_ResetType)
Mcu_GetResetReason()
Map reset reason to wakeup source()
EcuM_SelectShutdownTarget(Std_ReturnType, EcuM_StateType, uint8)
loop until all cores done
WaitEvent(mask)
StartOS(DEFAULT_APP_MODE)

**Figure 5 – Init Sequence I (STARTUP I)**

STARTUP I is intended for preparing the ECU to initialize the OS. The phase should be kept as short as possible. This also applies to the callouts. Initialization of drivers should be done in STARTUP II whenever possible. Interrupts should not be used in

this phase. If interrupts have to be used, only category I interrupts are allowed in STARTUP phase 1[13].
Initialization of drivers and hardware abstraction modules is not strictly defined by the ECU State Manager. Two callouts `EcuM_AL_DriverInitZero` and `EcuM_AL_DriverInitOne` are provided to define the init blocks 0 and I. These blocks are initialization activities during STARTUP I, where initialization can take place. Modules needing OS support can be placed into init blocks II or III (see *7.3.4.2 STARTUP II*).

`MCU_Init` does not provide complete MCU initialization. Additionally, hardware dependent steps have to be executed and must be defined at system design time. These steps are supposed to be taken within the `EcuM_AL_DriverInitZero` or `EcuM_AL_DriverInitOne` callouts. Details can be found in [12].

**EcuM2181**: ECU State Manager Fixed module must call `EcuM_SelectShutdownTarget` with the configured default shutdown target (see *7.6.2.1 Shutdown Targets*, *7.9 Time* Triggered Increased Inoperation and 10.4 Configurable Parameters.

**EcuM2603**: At the end of the STARTUP I state, the ECU State Manager starts the OS. All basic software modules which are needed by the OS shall be initialized by this time. Modules left out so far may be initialized later in STARTUP II.

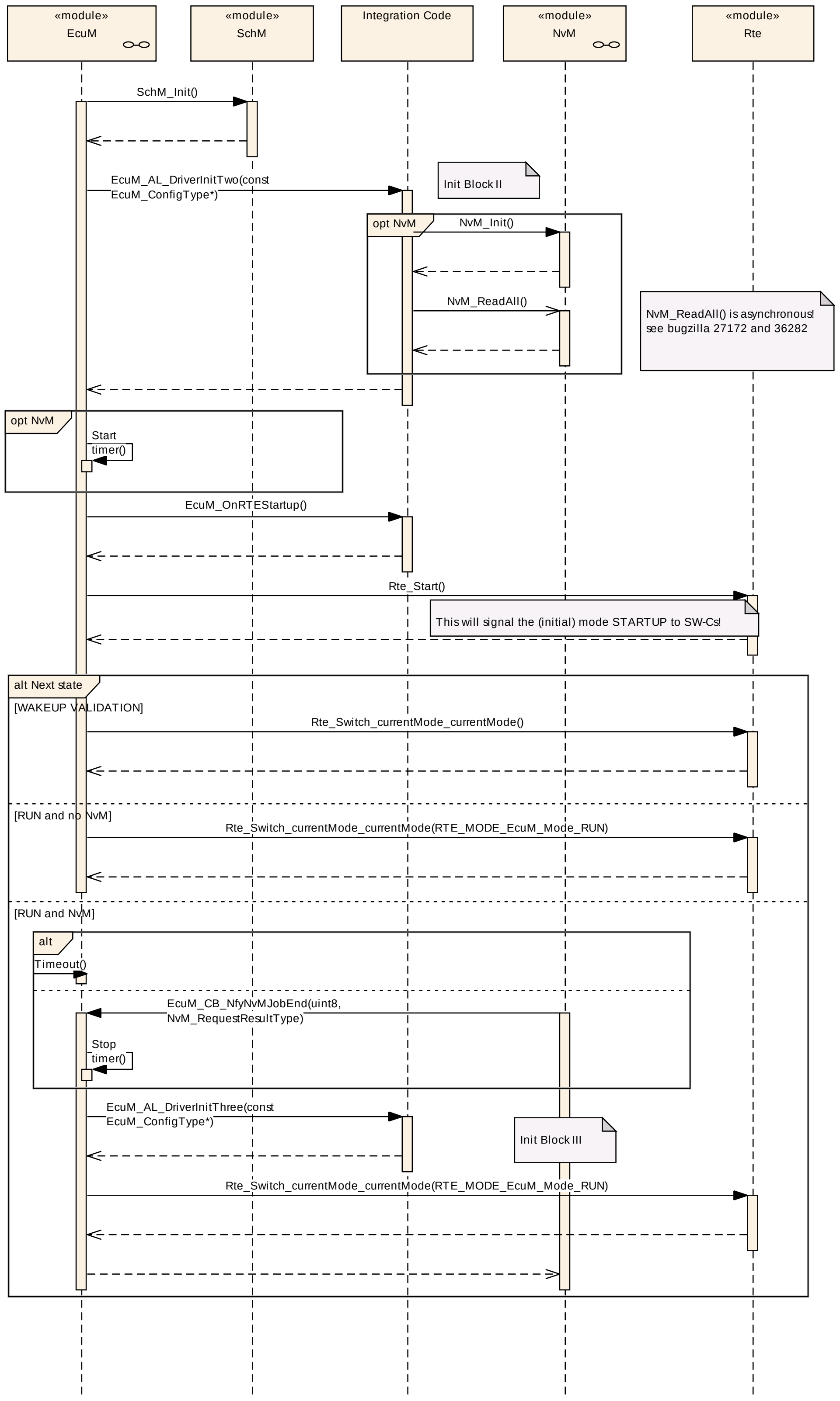
Note: If a Watchdog Manager is configured and initialized in any of the Init Blocks, the integration code shall call the Watchdog Manager often enough to ensure correct operation of the ECU during the transient states.

For the handling of the functionalities during `SLEEP` see [7] Chapter 7.4.

[13] Category II interrupts require a running OS while category I interrupts do not. AUTOSAR OS requires each interrupt vector to be exclusively put into one category.

### 7.3.4.2 STARTUP II

STARTUP II is carried out by the `EcuM_StartupTwo` API


«module» EcuM
«module» SchM
Integration Code
«module» NvM
«module» Rte
SchM_Init()
EcuM_AL_DriverInitTwo(const EcuM_ConfigType*)
Init Block II
opt NvM
NvM_Init()
NvM_ReadAll()
NvM_ReadAll() is asynchronous! see bugzilla 27172 and 36282
opt NvM
Start timer()
EcuM_OnRTEStartup()
Rte_Start()
This will signal the (initial) mode STARTUP to SW-Cs!
alt Next state
[WAKEUP VALIDATION]
Rte_Switch_currentMode_currentMode()
[RUN and no NvM]
Rte_Switch_currentMode_currentMode(RTE_MODE_EcuM_Mode_RUN)
[RUN and NvM]
alt
Timeout()
EcuM_CB_NfyNvMJobEnd(uint8, NvM_RequestResultType)
Stop timer()
EcuM_AL_DriverInitThree(const EcuM_ConfigType*)
Init Block III
Rte_Switch_currentMode_currentMode(RTE_MODE_EcuM_Mode_RUN)

function.

**Figure 6 – Init Sequence II (STARTUP II)**

The callout `EcuM_AL_DriverInitTwo` is provided, where initialization of those basic software modules should take place, which need OS support and need no access to NvRam data or manage the NvRam data on their own.

The callout `EcuM_AL_DriverInitThree` is provided, where initialization of those basic software modules should take place, which need OS support and need NvRam data to be completely restored.

**EcuM2632**: If one of the wake up sources listed in *7.8.7 Wake up Sources and Reset Reason* is set, then exection shall continue with RUN state. In all other cases, execution shall continue with WAKEUP VALIDATION state.

### 7.3.5 Driver Initialization

This chapter applies to drivers of the AUTOSAR Basic Software that are not handled directly by the ECU State Manager Fixed module.
A driver's location in the initialization process depends strongly on its implementation and the target hardware design. Drivers can be initialized from the driver init blocks I and II during STARTUP I and II respectively.

**EcuM2559**: The order inside of the blocks shall be generated from configuration information (see 10.4 Configurable Parameters `EcuMDriverInitListZero`, `EcuMDriverInitListOne`, `EcuMDriverInitListTwo`, `EcuMDriverInitListThree`, and `EcuMDriverRestartList`).

**EcuM2730**: For each driver, its init function with the configured init configuration shall be called. The init parameter for the init function shall be derived from driver's configuration (see 10.4 Configurable Parameters `EcuMFixedModuleConfigurationRef`).

Some drivers may need re-initialization when the ECU is woken up. This is especially true for drivers with wake up sources. For re-initialization, a restart block is defined. The restart block is part of the `WAKEUP` state.

**EcuM2561**: The restart list will typically only contain a subset of drivers. But drivers shall appear in the same order as in the combined list of init block I and init block II (see 10.4 Configurable Parameters, `EcuMDriverRestartList`).

**EcuM2562**: Drivers which serve as wake up sources may need to be re-initialized in the restart block. The driver restart shall re-arm the trigger mechanism of the 'wake up detected' callback (see *7.7.4.1 WAKEUP I*).

**EcuM2563**: If hardware is put into a sleep mode during `SHUTDOWN` then this hardware must be restarted by its driver.
The restart list will be invoked in state WAKEUP I (see *7.1.5 WAKEUP State*).

The following table shows one possible (and recommended) sequence of activities for the Init Blocks 0, I, II, and III. Depending on hardware and software configuration, BSW modules may be added or left out and other sequences may also be possible.

Recommended Init Block

| Init Activity | Comment |
|---|---|
| Init Block 0[14] | |
| Development Error Tracer | This always needs to be the first module to be initialized, so that other modules can report development errors. |
| Any drivers needed to access post-build configuration data | These drivers may themselves not need post-build configuration or OS features. |
| Init Block I[15] | |
| MCU Driver | |
| PORT | |
| DIO | |
| Diagnostic Event Manager | Pre-Initialization |
| General Purpose Timer | |
| Watchdog Driver | Internal watchdogs only, external ones may need SPI |
| Watchdog Manager | |
| SchM | |
| BswM | |
| ADC Driver | |
| ICU Driver | |
| PWM Driver | |
| Init Block II[16] | |
| SPI Driver | |
| EEPROM Driver | |
| Flash Driver | |
| NVRAM Manager | Initialization and start NvM_ReadAll job |
| CAN Transceiver | |
| CAN Driver | |
| CAN Interface | |
| CAN State Manager | |
| CAN TP | |
| LIN Driver | |
| LIN Interface | |
| LIN State Manager | |
| LIN TP | |
| FlexRay Transceiver | |
| FlexRay Driver | |
| FlexRay Interface | |
| FlexRay State Manager | |
| FlexRay TP | |
| PDU Router | |
| CAN NM | |
| FlexRay NM | |
| NM Interface | |
| I-PDU Multiplexer | |
| COM | |
| Diagnostic Communication Manager | |

[14] Drivers in Init Block 0 are listed in the *EcuMDriverInitListZero* configuration container.
[15] Drivers in Init Block I are listed in the *EcuMDriverInitListOne* configuration container.
[16] Drivers in Init Block II are listed in the *EcuMDriverInitListTwo* configuration container.

| Recommended Init Block<br>Init Activity | Comment |
|---|---|
| Init Block III[17] | |
| Communication Manager<br>Diagnostic Event Manager<br>Function Inhibition Manager | Full initialization |

**Table 2 - Driver Initialization Details, Sample Configuration**

### 7.3.6 DET Initialization

The Development Error Tracer is a software module for debugging purposes.

**EcuM2783**: DET shall be initialized early during STARTUP I by the ECU State Manager.

**EcuM2634**: DET is not *started* by default but the system designer has to configure the point where DET is started, preferably into one of the callouts `EcuM_AL_DriverInitOne` or `EcuM_AL_DriverInitTwo`. The best point for starting DET depends on its implementation and behavior. DET is started by invoking `Det_Start`.

[17] Drivers in Init Block III are listed in the *`EcuMDriverInitListThree`* configuration container.

## 7.4 RUN State

See *7.1.2 RUN State* for an overview description.
All activities in the RUN state described in this chapter are carried out in the `EcuM_MainFunction` service.

### 7.4.1 State Breakdown Structure

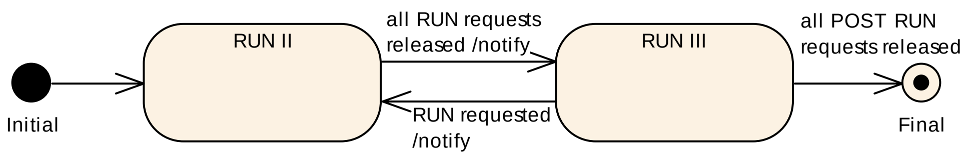

RUN II
all RUN requests released /notify
RUN III
all POST RUN requests released
Initial
RUN requested /notify
Final

**Figure 7 – RUN State Breakdown**

### 7.4.2 High Level Sequence Diagram

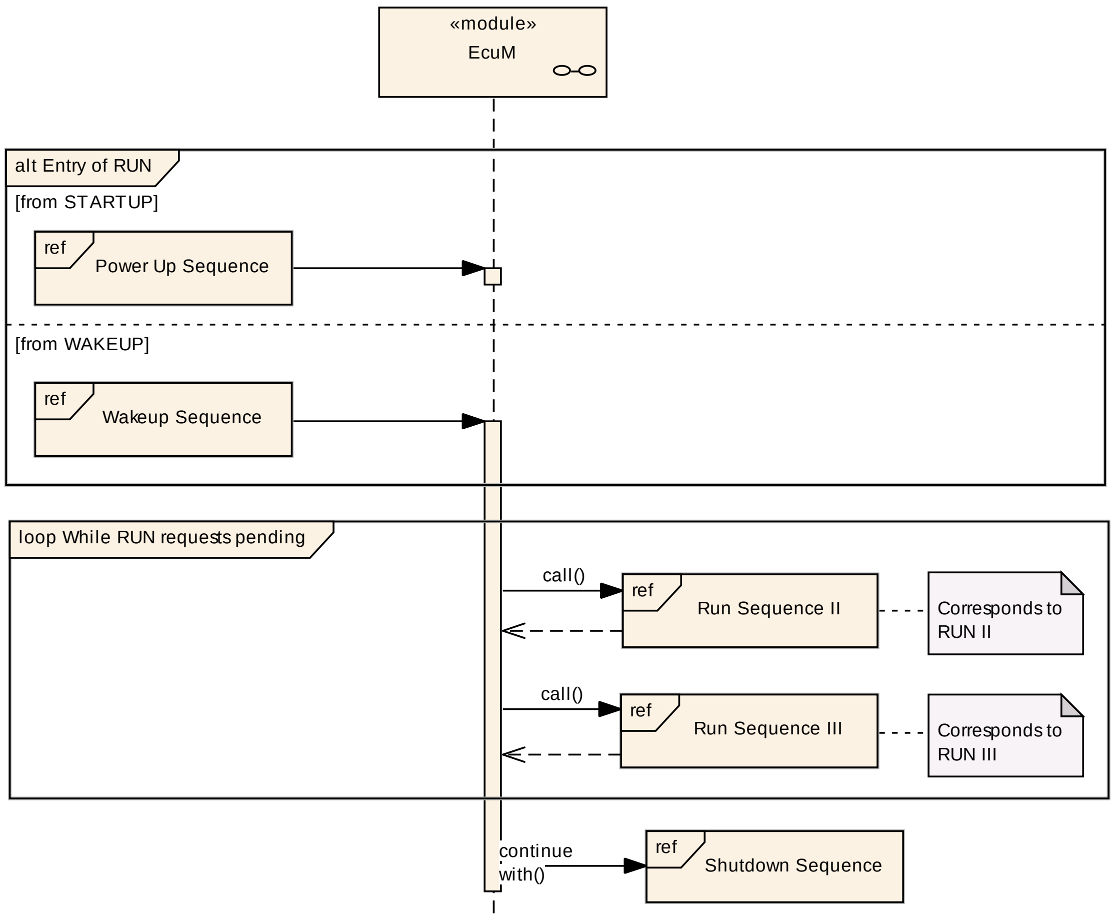


**Figure 8 – RUN State Sequence (high level diagram)**

To see adjacent diagrams refer to

*Figure 4 – Startup Sequence (high level diagram)*
*Figure 20 – Wake-up Sequence (high level diagram)*
*Figure 12 – Shutdown Sequence (high level diagram)*
*Figure 2 – ECU Main States (top level diagram)*

## 7.4.3 Sub-State Description

### 7.4.3.1 RUN II

RUN II is the state in which SW-C's should execute their regular tasks.

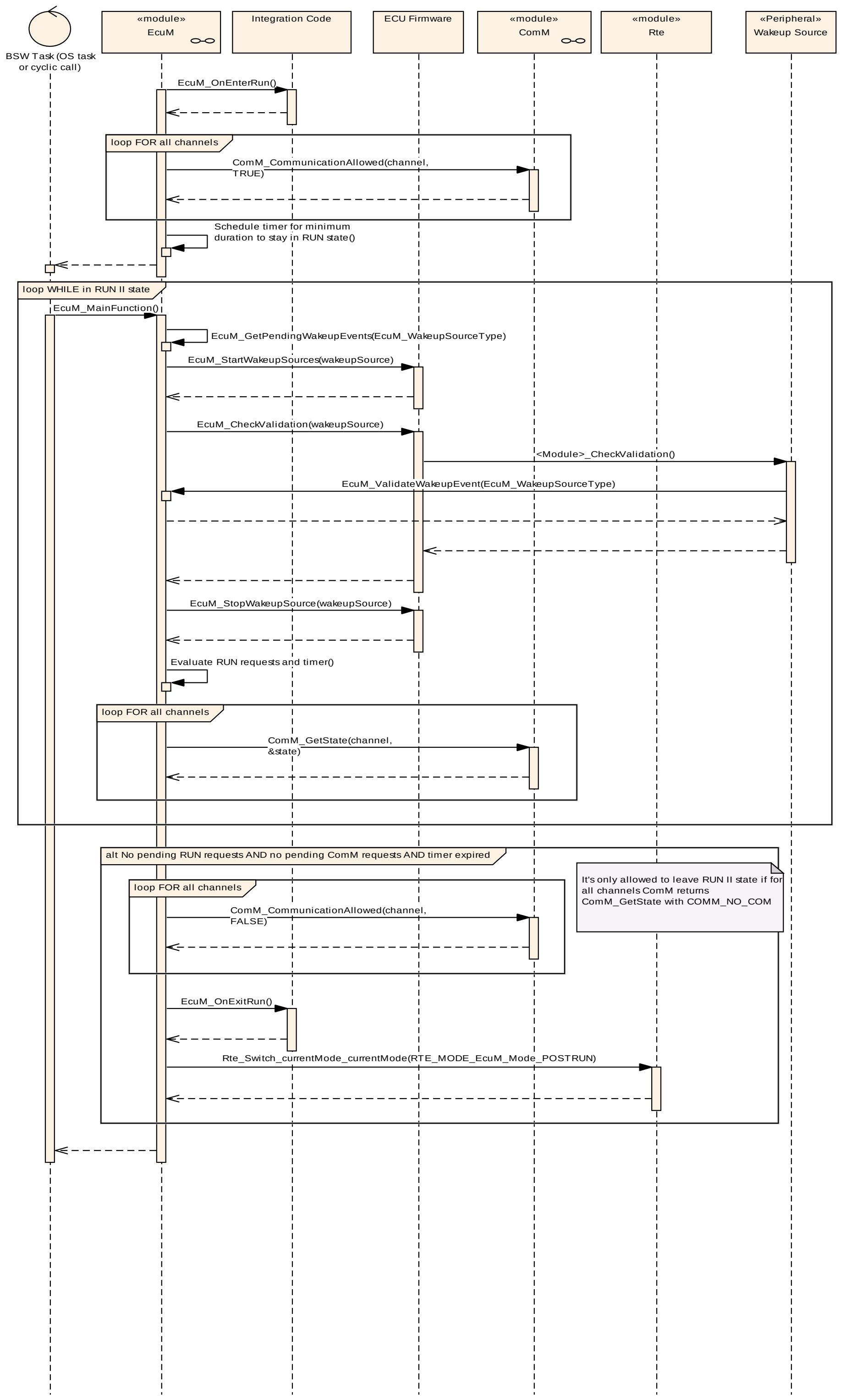

BSW Task (OS task or cyclic call)
«module» EcuM
Integration Code
ECU Firmware
«module» ComM
«module» Rte
«Peripheral» Wakeup Source
EcuM_OnEnterRun()
loop FOR all channels
ComM_CommunicationAllowed(channel, TRUE)
Schedule timer for minimum duration to stay in RUN state()
loop WHILE in RUN II state
EcuM_MainFunction()
EcuM_GetPendingWakeupEvents(EcuM_WakeupSourceType)
EcuM_StartWakeupSources(wakeupSource)
EcuM_CheckValidation(wakeupSource)
<Module>_CheckValidation()
EcuM_ValidateWakeupEvent(EcuM_WakeupSourceType)
EcuM_StopWakeupSource(wakeupSource)
Evaluate RUN requests and timer()
loop FOR all channels
ComM_GetState(channel, &state)
alt No pending RUN requests AND no pending ComM requests AND timer expired
loop FOR all channels
ComM_CommunicationAllowed(channel, FALSE)
It's only allowed to leave RUN II state if for all channels ComM returns ComM_GetState with COMM_NO_COM
EcuM_OnExitRun()
Rte_Switch_currentMode_currentMode(RTE_MODE_EcuM_Mode_POSTRUN)

**Figure 9 – RUN II State Sequence**

#### 7.4.3.2 Entering RUN II State

On entering RUN II state, the steps as shown in Figure 9 must be performed.

**EcuM2308**: When entering RUN II state, the callout `EcuM_OnEnterRun` shall be invoked and RUN mode shall be indicated.

**EcuMf0008**: The ECU State Manager Fixed module shall call `ComM_CommunicationAllowed` when it becomes possible to communicate on that channel (parameter `TRUE`) and when it becomes impossible to communciate (parameter `FALSE`).
Exception is LIN communication in "sleep mode"

**EcuMf0018**: The call to `ComM_CommunicationAllowed` shall be configurable (It must be possible to define within the configuration for which ComM channels the ECU State Manager Fixed module should call `ComM_CommunicationAllowed`.)

**EcuMf0019**: For all channels for which this is defined, the ECU State Manager Fixed module must call `ComM_CommunicationAllowed(channel, TRUE)` immediately after entering RUN mode.

**EcuMf0020**: For all channels for which this is defined, the ECU State Manager Fixed module must call `ComM_CommunicationAllowed(channel, FALSE)` immediately before leaving RUN mode.

**EcuM2310**: The ECU State Manager Fixed module shall remain in `RUN` state for a configurable minimum duration (see 10.4 Configurable Parameters parameter EcuMRunMinimumDuration).

The minimum duration of RUN state is needed to give the SW-Cs a chance to request `RUN`. Otherwise the ECU State Manager Fixed module will immediately leave `RUN` again.

**EcuMf0027**: ECU in `RUN` state shall also perform wake up validation of sleeping busses

#### 7.4.3.3 Leaving RUN II State

**EcuM2311**: When the last RUN request has been released, ECU State Manager Fixed module shall advance to the RUN III state. The evaluation is done with the next cyclic invocation of `EcuM_MainFunction`.

**EcuM2865**: When leaving RUN II state, the callout `EcuM_OnExitRun` shall be invoked and POSTRUN mode shall be indicated.

If a SW-C needs post run activity during RUN III (e.g. shutdown preparation), then it must request POST RUN before releasing the RUN request. Otherwise it is not guaranteed that this SW-C will get a chance to run its POST RUN code.

The Communication Manager will not release `RUN` unless the no communication state is reached.

### 7.4.3.4 RUN III

RUN III state provides a post run phase for SW-C's and allows them to save important data or switch off peripherals before the ECU State Manager Fixed module continues with the shutdown process.

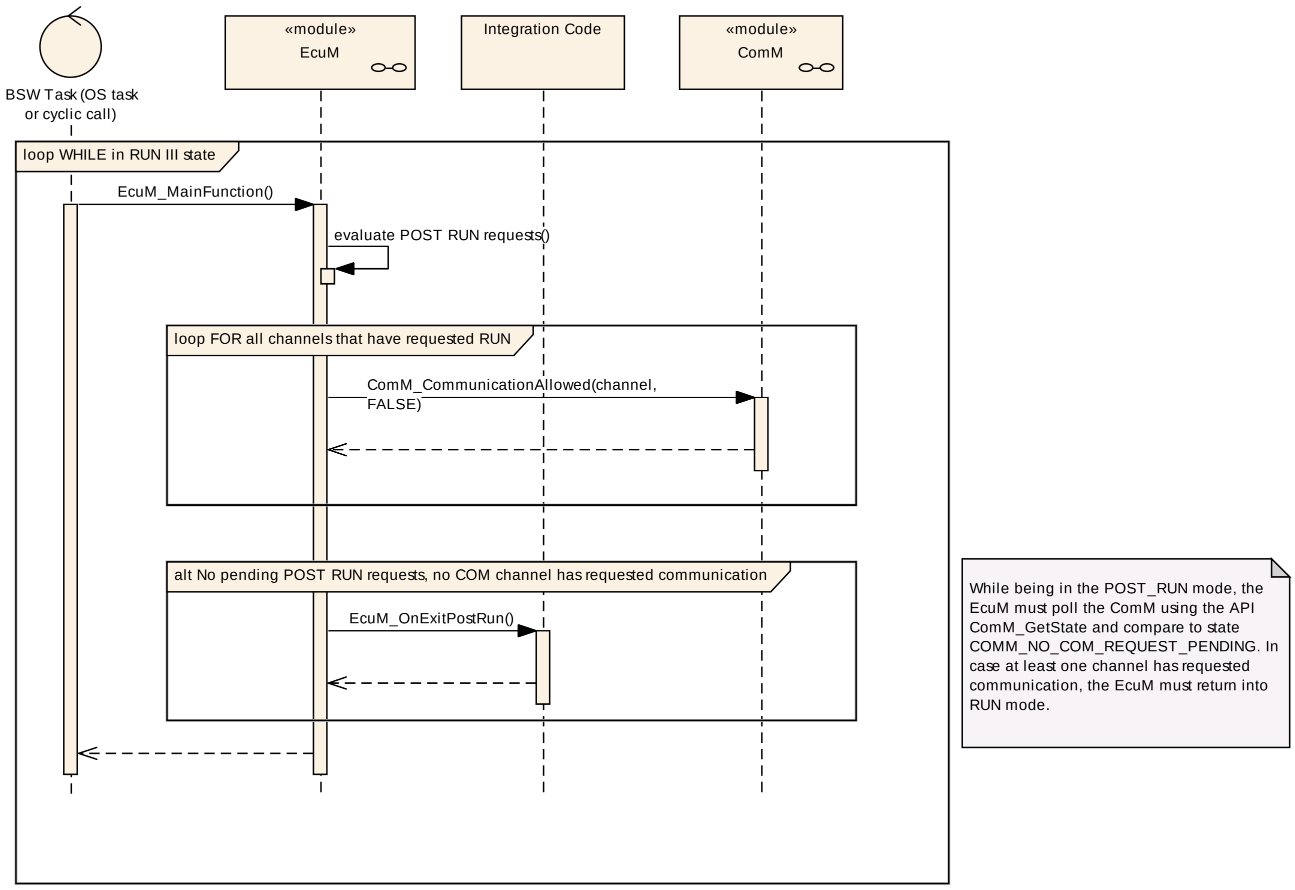

BSW Task (OS task or cyclic call)
«module» EcuM
Integration Code
«module» ComM
loop WHILE in RUN III state
EcuM_MainFunction()
evaluate POST RUN requests()
loop FOR all channels that have requested RUN
ComM_CommunicationAllowed(channel, FALSE)
alt No pending POST RUN requests, no COM channel has requested communication
EcuM_OnExitPostRun()
While being in the POST_RUN mode, the EcuM must poll the ComM using the API ComM_GetState and compare to state COMM_NO_COM_REQUEST_PENDING. In case at least one channel has requested communication, the EcuM must return into RUN mode.

**Figure 10 – RUN III State Sequence**

#### 7.4.3.5 Leaving RUN III State

**EcuM2761**: When the last POST RUN request has been released and no RUN request has been issued, the ECU State Manager Fixed module shall advance to the SHUTDOWN state and shall invoke the callout `EcuM_OnExitPostRun`. The evaluation is done with the next cyclic invocation of `EcuM_MainFunction`.

**EcuM2866**: While in RUN III state, if a RUN request is received, the ECU State Manager Fixed module shall immediately enter RUN II state again.

## 7.5 SHUTDOWN State

Refer to *7.1.3 SHUTDOWN State* for an overview description.

**EcuM2188**: When SHUTDOWN state is entered and shutdown target is SLEEP, no wake up event shall be missed. If a valid wake up event occurs while the ECU is in transition to SLEEP the ECU shall as quickly as possible proceed to the WAKEUP state and shall not enter the SLEEP state.

**EcuM2756**: When a wake up event occurs during the shutdown phase and the shutdown target is OFF or RESET, then the shutdown shall complete but the ECU shall restart immediately thereafter.

### 7.5.1 State Breakdown Structure

When the SHUTDOWN state is entered, applications have de-initialized and the communication stack has been put into the no communication state[18]. Please refer to *7.4.3.3 Leaving RUN II State* for details.

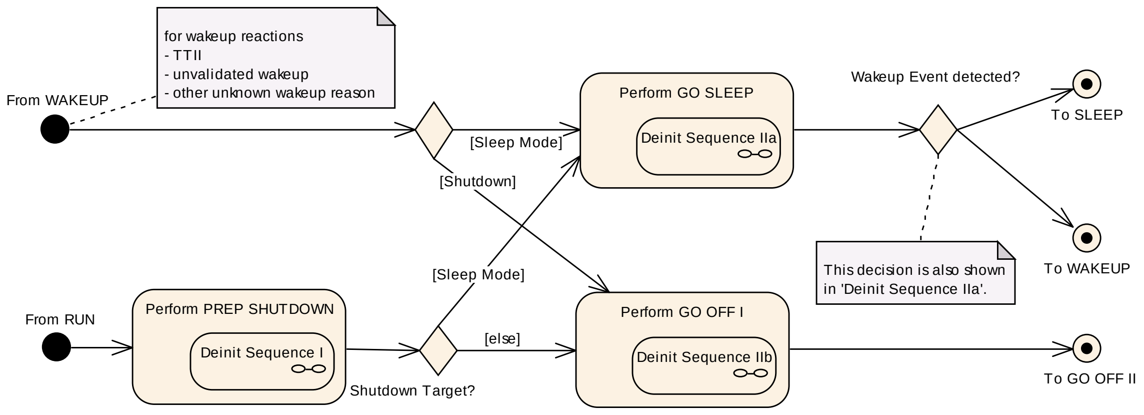


**Figure 11 – Fine Structure of SHUTDOWN**

[18] This statement is only true for SW-Cs which are registered users of the ECU State or Communication Manager. All other SW-C may be terminated by the system without warning.

### 7.5.2 High Level Sequence Diagram

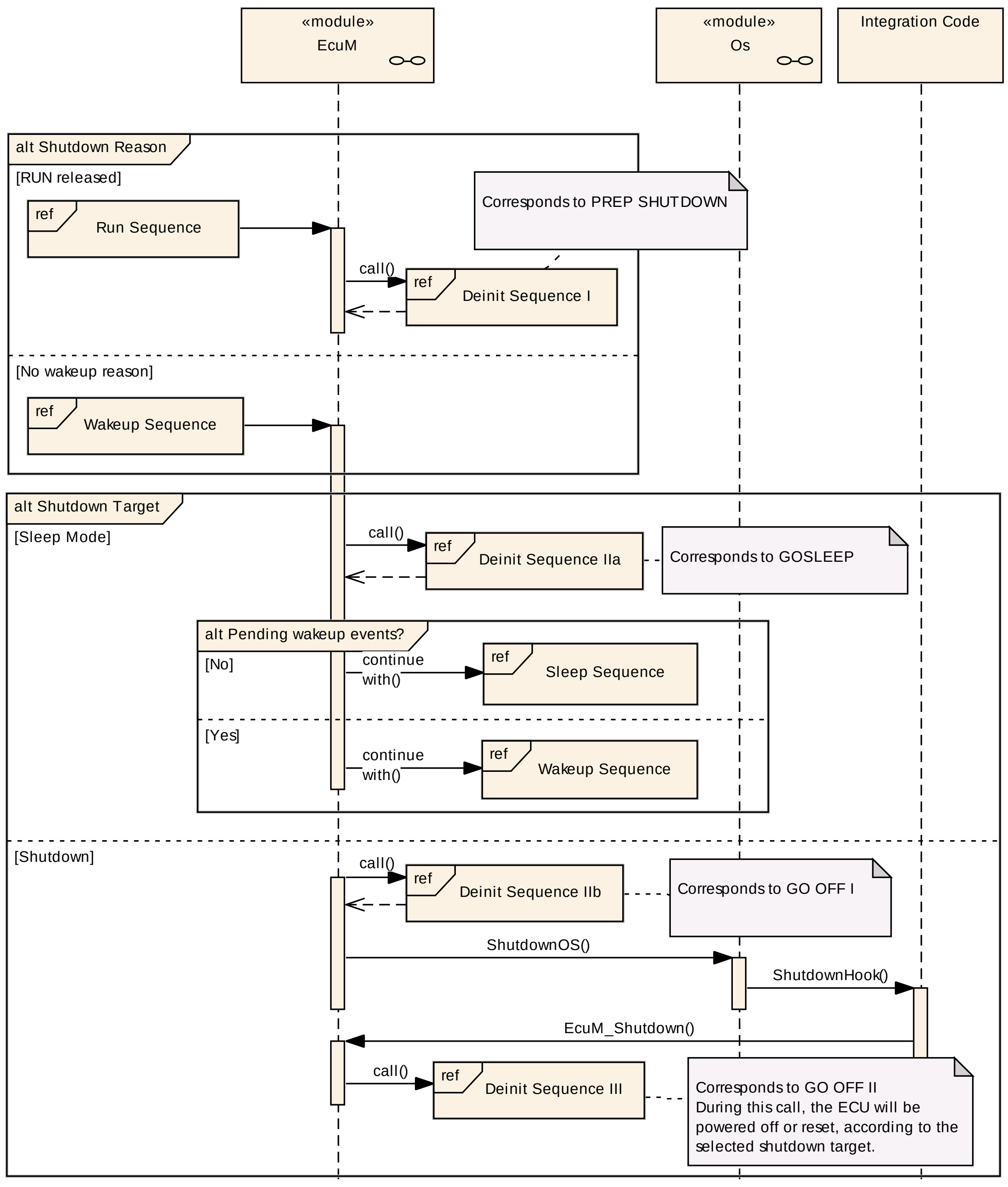


**Figure 12 – Shutdown Sequence (high level diagram)**

To see adjacent diagrams refer to

*Figure 8 – RUN State Sequence (high level diagram)*
*Figure 20 – Wake-up Sequence (high level diagram)*
*Figure 17 – Sleep Sequence (high level diagram)*
*Figure 2 – ECU Main States (top level diagram)*

EcuM_Initializer is an interface of the ECU State Manager. It is only introduced here to improve readability of the diagram. See also *Figure 4 – Startup Sequence (high level diagram)* and its comments.

### 7.5.3 SHUTDOWN Activity Overview

| *Sub-state*[19] *Shutdown Activity* | *Comment* | *Optional*[20] |
|---|---|---|
| **PREP SHUTDOWN** | | |
| *Callout* `EcuM_OnPrepShutdown` | | |
| Shutdown Diagnostic Event Manager | | yes |
| Indicate mode change to RTE | Indicated mode is `SLEEP` if next state is GO SLEEP, indicated mode is `SHUTDOWN` if next state is GO OFF I. | |
| **GO SLEEP** | | |
| *Callout* `EcuM_OnGoSleep` | | |
| Save persistent data to NVRAM | An incoming wake up event will cancel an ongoing write job | yes |
| Check for pending wake up events | Purpose is to detect wake up events that occurred while interrupts were disabled | |
| *Callout* `EcuM_EnableWakeupSources` | See *EcuM_EnableWakeupSources* | |
| Lock Scheduler | Prevent other tasks from running in SLEEP state. | |
| **GO OFF I** | | |
| *Callout* `EcuM_OnGoOffOne` | | |
| Stop RTE | | |
| Deinit Communication Manager | | yes |
| Save persistent data to NVRAM | | yes |
| Check for pending wake up events | Purpose is to detect wake up events that occurred during shutdownd | |
| Set RESET as shutdown target | This action shall only be carried out when pending wake up events were detected | yes |
| ShutdownOS | Last operation in this OS task | |
| **GO OFF II** | | |
| *Callout* `EcuM_OnGoOffTwo` | | |
| Call Mcu_PerformReset or *Callout* `EcuM_AL_SwitchOff` | Depends on the selected shutdown target (RESET or OFF) | |
| The following modules need not to be shut down: | | |
| NVRAM Manager | | |
| All other modules are not shutdown automatically. The following basic software modules must not be shut down at all. | | |
| None | | |

**Table 3 - Shutdown Activities**

[19] Rows marked with × are conditional.
[20] Optional activities can be switched on or off by configuration. It shall be the system designer's choice if a module is compiled in or not for an ECU design. See chapter *10.3* Published for details.

### 7.5.4 Sub-State Descriptions

#### 7.5.4.1 PREP SHUTDOWN

PREP SHUTDOWN is a state common for all shutdown targets, i.e. SLEEP, OFF, reset, etc. During this state, handlers and managers of the basic software are shut down.

**EcuM2288**: If the shutdown target is not any of the sleep modes, then control has to be handed over to GO OFF I (see *7.5.4.3 GO OFF I*) after activities of this state have finished.

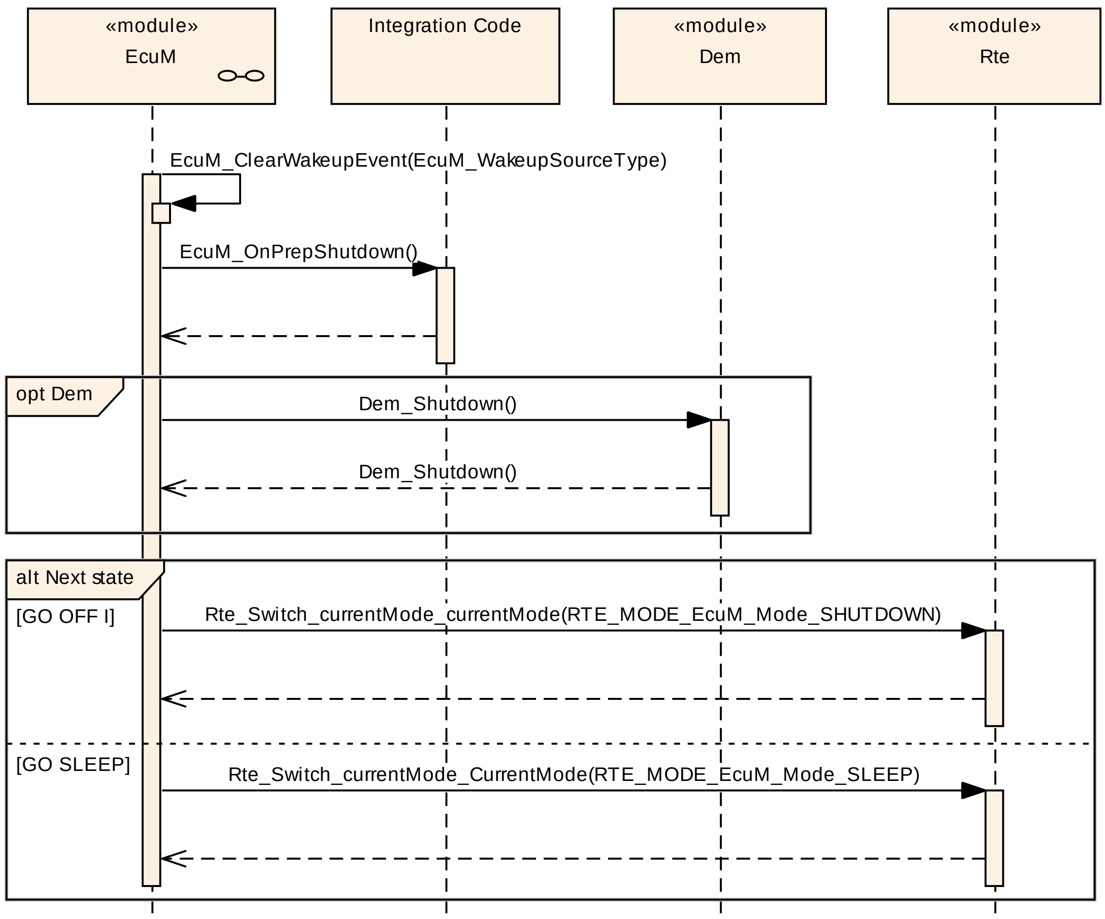

«module»
EcuM
Integration Code
«module»
Dem
«module»
Rte
EcuM_ClearWakeupEvent(EcuM_WakeupSourceType)
EcuM_OnPrepShutdown()
opt Dem
Dem_Shutdown()
Dem_Shutdown()
alt Next state
[GO OFF I]
Rte_Switch_currentMode_currentMode(RTE_MODE_EcuM_Mode_SHUTDOWN)
[GO SLEEP]
Rte_Switch_currentMode_CurrentMode(RTE_MODE_EcuM_Mode_SLEEP)

**Figure 13 – Deinitialization Sequence I (PREP SHUTDOWN)**

#### 7.5.4.2 GO SLEEP

Purpose of GO SLEEP is to configure hardware for the following sleep phase and to setup the ECU for the next wake up event.

**EcuM2389**: To set up the wake up sources for the next sleep mode, the ECU State Manager Fixed module shall execute the callout `EcuM_EnableWakeupSources` for each wake up source that is configured in the target sleep mode.

In contrast to shutdown, the OS is not shut down when entering the sleep state. The sleep mode shall be transparent to the OS.

**Note:**
In case of pending wake up events, after calling `NvM_CancelWriteAll()` the transition shall go to WAKEUP VALIDATION as for the "Power On Sequence" (see also Figure 29).

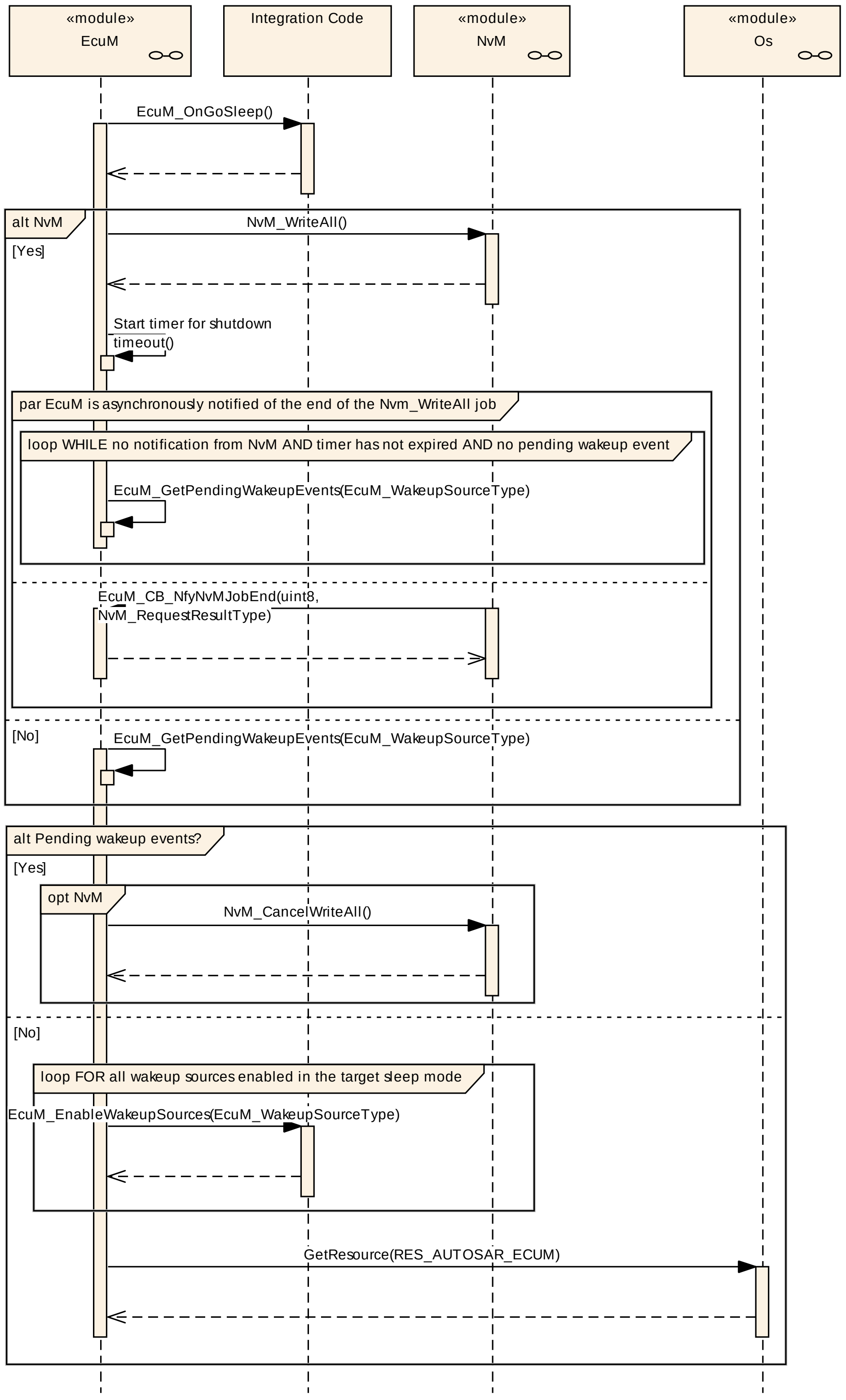

«module»
EcuM
Integration Code
«module»
NvM
«module»
Os
EcuM_OnGoSleep()
alt NvM
NvM_WriteAll()
[Yes]
Start timer for shutdown timeout()
par EcuM is asynchronously notified of the end of the Nvm_WriteAll job
loop WHILE no notification from NvM AND timer has not expired AND no pending wakeup event
EcuM_GetPendingWakeupEvents(EcuM_WakeupSourceType)
EcuM_CB_NfyNvMJobEnd(uint8, NvM_RequestResultType)
[No]
EcuM_GetPendingWakeupEvents(EcuM_WakeupSourceType)
alt Pending wakeup events?
[Yes]
opt NvM
NvM_CancelWriteAll()
[No]
loop FOR all wakeup sources enabled in the target sleep mode
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
GetResource(RES_AUTOSAR_ECUM)

**Figure 14 – Deinitialization Sequence IIa (GOSLEEP)**

#### 7.5.4.3 GO OFF I

GO OFF I is carried out under OS control and is implemented by the `EcuM_MainFunction` service.

**EcuM2328**: As its last activity, the `ShutdownOS` service shall be called. This service will end up in the shutdown hook. The shutdown hook in turn shall call `EcuM_Shutdown` to terminate the shutdown process. `EcuM_Shutdown` will not return but switch off the ECU or issue a reset.

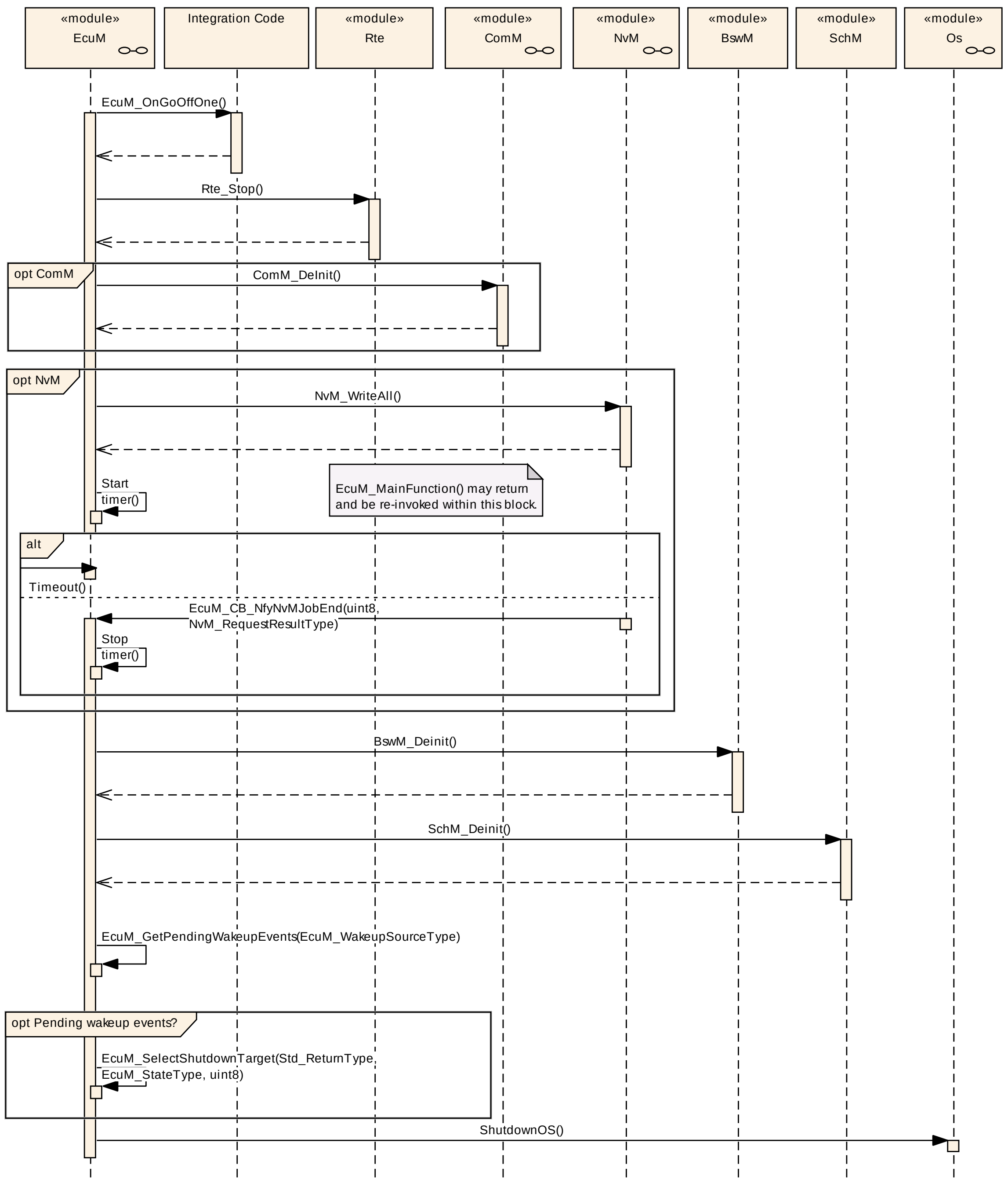

«module» EcuM
Integration Code
«module» Rte
«module» ComM
«module» NvM
«module» BswM
«module» SchM
«module» Os
EcuM_OnGoOffOne()
Rte_Stop()
opt ComM
ComM_DeInit()
opt NvM
NvM_WriteAll()
Start timer()
EcuM_MainFunction() may return and be re-invoked within this block.
alt
Timeout()
EcuM_CB_NfyNvMJobEnd(uint8, NvM_RequestResultType)
Stop timer()
BswM_Deinit()
SchM_Deinit()
EcuM_GetPendingWakeupEvents(EcuM_WakeupSourceType)
opt Pending wakeup events?
EcuM_SelectShutdownTarget(Std_ReturnType, EcuM_StateType, uint8)
ShutdownOS()

**Figure 15 – Deinitialization Sequence IIb (GO OFF I)**

#### 7.5.4.4 GO OFF II

This state implements the final steps to reach the shutdown target after the OS has been shut down.

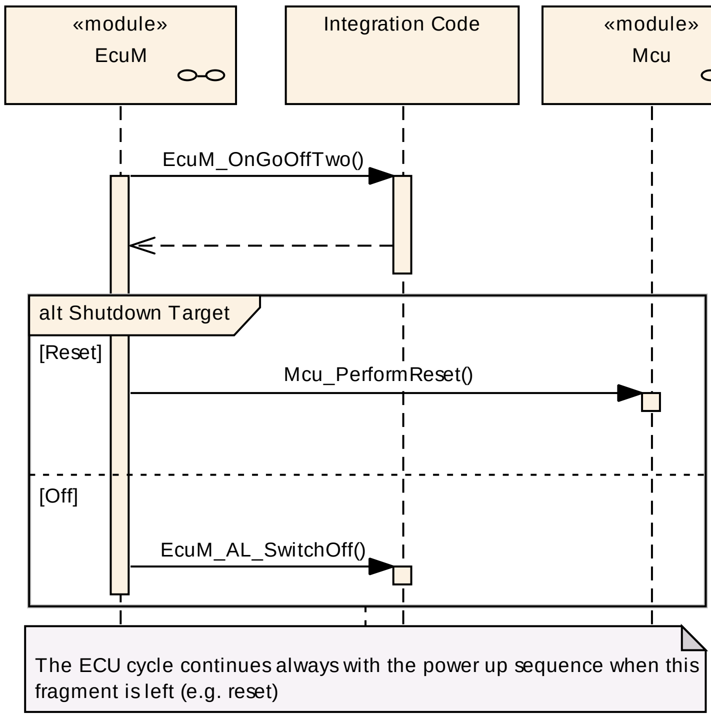


**Figure 16 – Deinitialization Sequence III (GO OFF II)**

The shutdown target RESET is reached by invoking the `Mcu_PerformReset` service of the MCU driver (see [12]).
The shutdown target OFF is implemented by the `EcuM_AL_SwitchOff` callout which must be filled at configuration time. See *8.6.4.7 EcuM_AL_SwitchOff* for details.
EcuM_Initializer is only introduced to improve readability of the diagram. See also *Figure 4 – Startup Sequence (high level diagram)* and its comments.

## 7.6 SLEEP State

Refer To chapter *7.1.4 SLEEP State* for an overview description.

**EcuMf0025**: The ECU State Manager Fixed module shall not put the ECU into SLEEP state before all run requests are released.

**EcuMf0026**: The ECU State Manager Fixed module shall put all communication interfaces to standby state and shall arm the wake up source before the ECU State Manager Fixed module may put the ECU into SLEEP state.

### 7.6.1 High Level Sequence Diagram

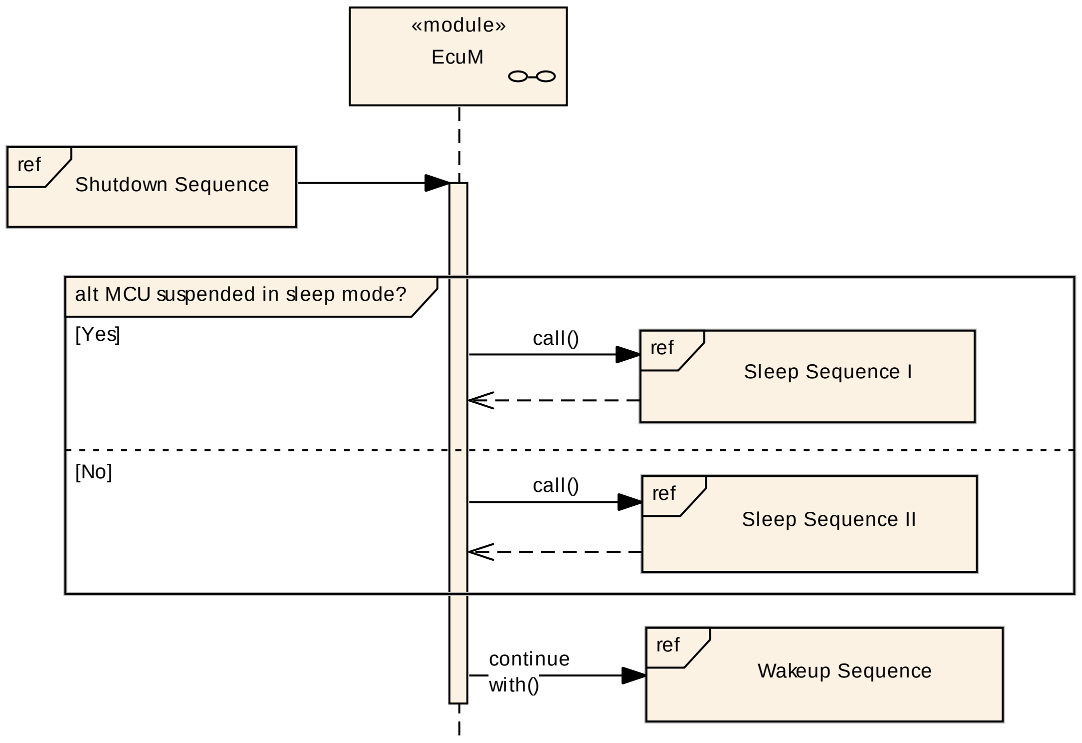


**Figure 17 – Sleep Sequence (high level diagram)**

To see adjacent diagrams refer to
*Figure 12 – Shutdown Sequence (high level diagram)*
*Figure 20 – Wake-up Sequence (high level diagram)*
*Figure 2 – ECU Main States (top level diagram)*

### 7.6.2 Sub-State Descriptions

#### 7.6.2.1 Shutdown Targets

Shutdown Targets is a descriptive term for all states and their modes or sub-states where no code is executed. They are called shutdown targets because it is the final state where the state machine will drive to when RUN state is left. The following states are shutdown targets:

- `OFF`[21]
- `SLEEP`
- Reset
  is only a transient a state, but also can be selected as shutdown target.

**EcuM2232**: The default shutdown target shall be defined by configuration. This shutdown target shall be overridden by calling `EcuM_SelectShutdownTarget`.

The SLEEP state can define a configurable set of sleep modes, where each mode itself is a shutdown target (the bullet list above is a simplification). These sleep modes are hardware dependent and differ typically in clock settings or other low power features provided by the hardware. These different features are accessible through the MCU driver as so called MCU modes (see [12]). The ECU State Manager Fixed module allows to map these MCU modes to ECU sleep modes and hence they are addressable as shutdown targets. Further the configuration allows defining aliases for shutdown targets to simplify portability of code across different ECUs. See 10.4 Configurable Parameters container EcuMSleepMode for details.

[21] The OFF state requires the capability of the ECU to switch off itself. This is not granted for all hardware designs.

### 7.6.2.2 Sleep Sequence I

Sleep Sequence I is executed in sleep modes that halt the microcontroller. In these sleep modes no code is executed.

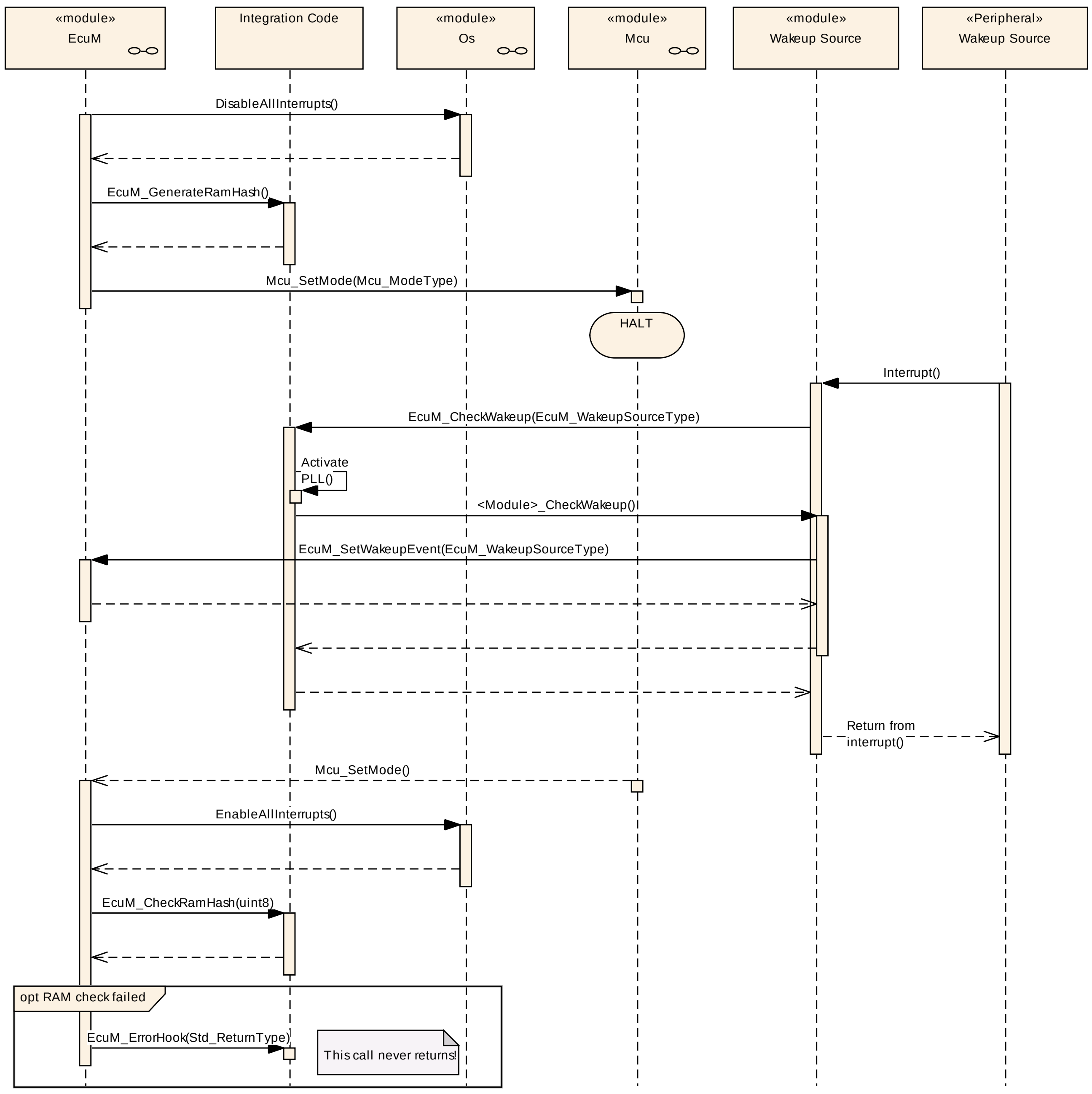


**Figure 18 – Sleep Sequence I**

A callout is invoked where the system designer can place a RAM integrity check. See also `EcuM_GenerateRamHash` and `EcuM_CheckRamHash`.

**EcuM2863**: The ECU Manager module shall invoke the callout EcuM_GenerateRamHash (see EcuM2919) before halting the microcontroller and the callout EcuM_CheckRamHash (see EcuM2921) after the processor returns from halt.

Rationale for EcuM2863: RAM memory may become corrupted when an ECU is held in SLEEP mode for a long time. The RAM memory's integrity should therefore be checked to prevent unforeseen behavior. The system designer may choose an adequate checksum algorithm to perform the check.

#### 7.6.2.3 Sleep Sequence II

**EcuM2962:** The ECU State Manager Fixed module shall execute the Poll Sequence in sleep modes that reduce the power consumption of the microcontroller but still execute code.

**EcuM3020**: In the Poll sequence the ECU State Manager Fixed module shall call the callouts `EcuM_SleepActivity()` and `EcuM_CheckWakeup()` in a blocking loop until a pending wake up event is reported.

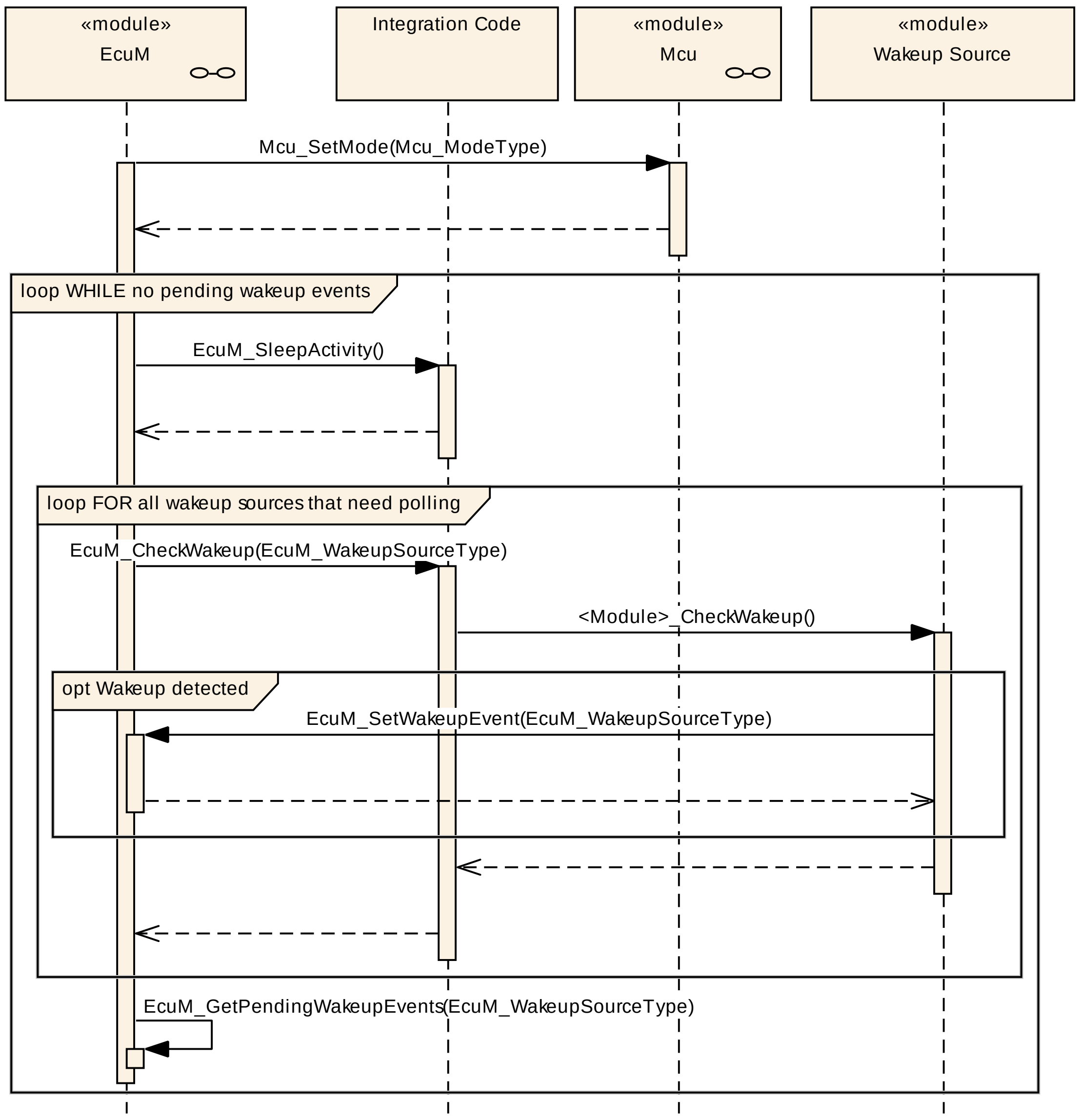

«module»
EcuM
Integration Code
«module»
Mcu
«module»
Wakeup Source
Mcu_SetMode(Mcu_ModeType)
loop WHILE no pending wakeup events
EcuM_SleepActivity()
loop FOR all wakeup sources that need polling
EcuM_CheckWakeup(EcuM_WakeupSourceType)
<Module>_CheckWakeup()
opt Wakeup detected
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
EcuM_GetPendingWakeupEvents(EcuM_WakeupSourceType)

**Figure 19 – Sleep Sequence II**

### 7.6.3 Leaving SLEEP State

Regular exits of the `SLEEP` state are a result of a wake up event (toggling a wake up line, communication on a CAN bus etc.). An ISR may be invoked to handle the event, but this is specific to hardware and driver implementation. Finally, the `MCU_SetMode` service of the MCU driver will return and the ECU State Manager Fixed module will regain control. Execution then continues with the `WAKEUP` state.

Irregular events are a hardware reset or a power cycle. In this case, the ECU will restart from the `STARTUP` state.

## 7.7 WAKEUP State

### 7.7.1 High Level Sequence Diagram

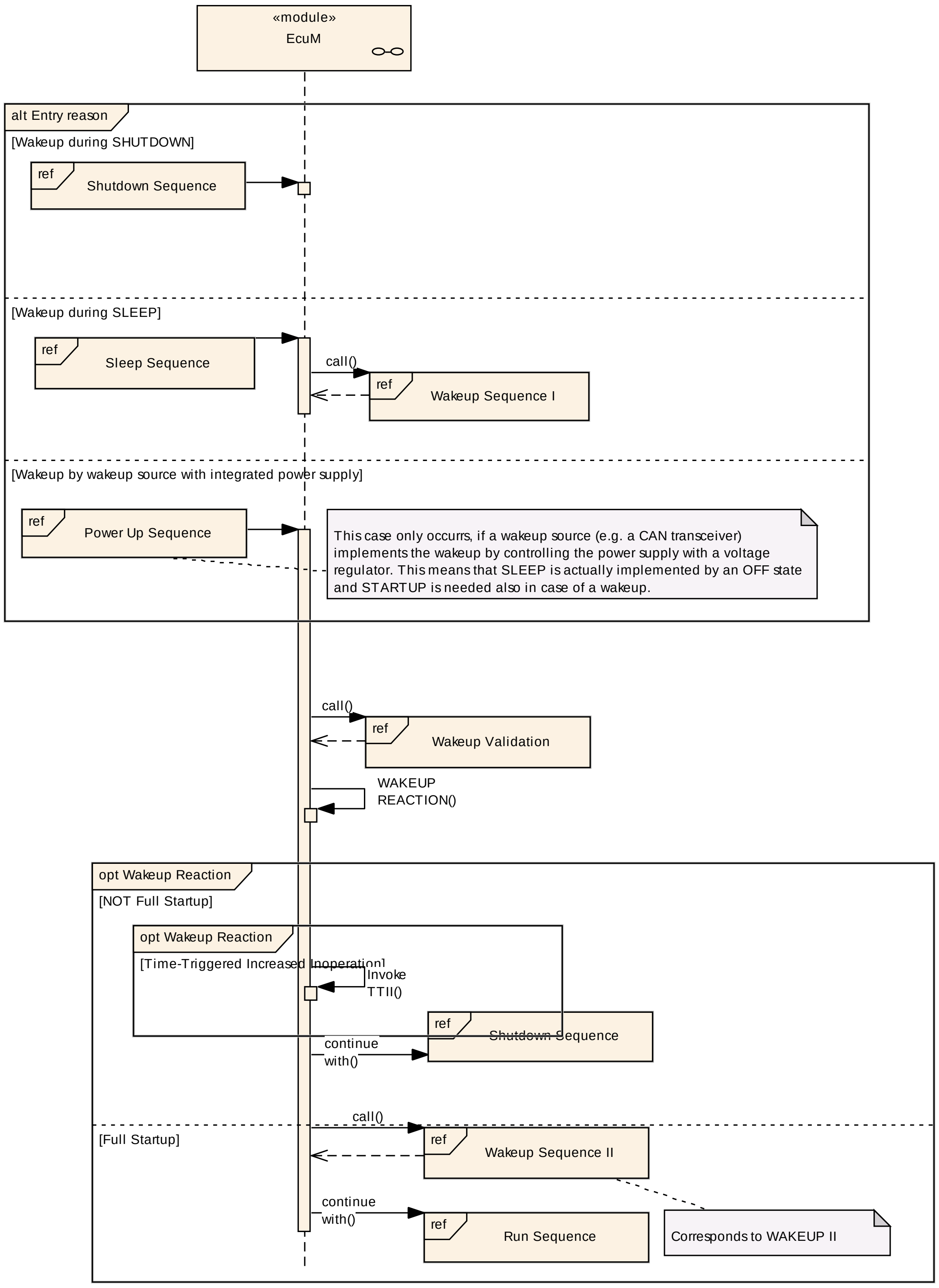


**Figure 20 – Wake-up Sequence (high level diagram)**

To see adjacent diagrams, refer to

*Figure 12 – Shutdown Sequence (high level diagram)*
*Figure 8 – RUN State Sequence (high level diagram)*
*Figure 2 – ECU Main States (top level diagram)*

### 7.7.2 State Breakdown Structure

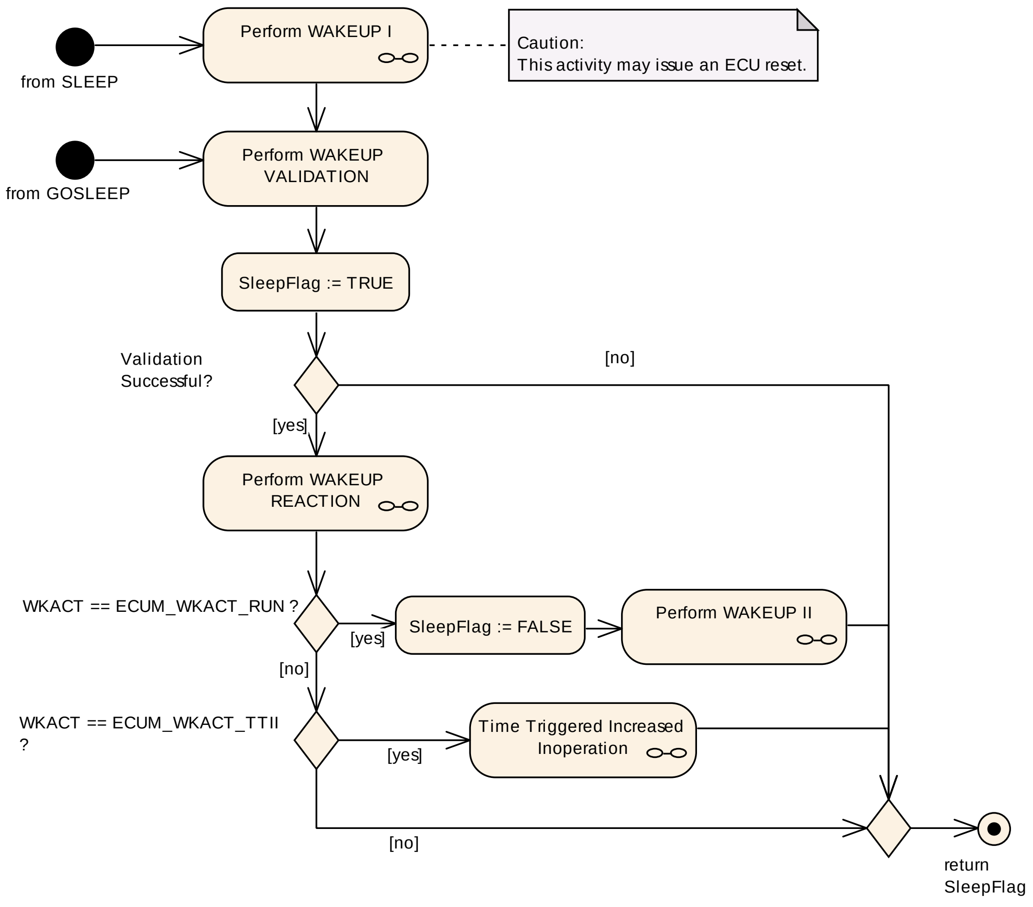


**Figure 21 – WAKEUP State Breakdown**

### 7.7.3 WAKEUP Activity Overview

| *Sub-state*[22] | *Wake-up Activity* | *Comment* | *Opt.* |
|---|---|---|---|
| **WAKEUP I** | | | |
| | Restore MCU normal mode | Selected MCU mode is configured in parameter EcuMNormalMcuModeRef | |
| | Get the pending wake up sources | | |
| | *Callout EcuM_DisableWakeupSources* | Disable currently pending wake up source but leave the others armed so that later wake-ups are possible. | |
| | *Callout EcuM_AL_DriverRestart* | Initialize drivers that need restarting | |
| | Unlock Scheduler | From this point on, all other tasks may run again | |
| **WAKEUP VALIDATION** | | see chapter *7.7.4.2 WAKEUP VALIDATION* | |
| **WAKEUP REACTION** | | | |
| | Compute wake up reaction | see chapter 7.7.4.3 below | |
| | *Callout EcuM_OnWakeupReaction* | | |
| × | Invoke TTII protocol | see chapter 7.9 below | |
| **WAKEUP II** | | | |
| | Initialize Diagnostic Event Manager | Conditional:<br>a) If the System comes out of SLEEP, the Dem shall be initialized<br>b) If this is not the case the EcuM shall wait for EcuM_CB_NfyNvMJobEnd() and then execute `EcuMDriverInitListThree` | yes |
| × | Indicate mode change to RTE | | |

**Table 4 – Wake-up Activities**

[22] Rows marked with × are conditional.

### 7.7.4 Sub-State Descriptions

#### 7.7.4.1 WAKEUP I

The `EcuM_AL_DriverRestart` callout is invoked. This callout is intended for re-initializing drivers. Re-initialization is typically required for drivers with wake up sources, at least. For more details on driver initialization refer to *7.3.5 Driver Initialization*.

**EcuM2539**: During re-initialization, a driver must check if one of its assigned wake up sources was the reason for the previous wake up. If this test is true, it must invoke its ‘wake up detected’ callback (see [20] for an example), which in turn has to call the `EcuM_SetWakeupEvent` service. As a result, when WAKEUP I has finished, the ECU State Manager Fixed module has a list of wake up source candidates. These wake up source candidates still may need validation. See also *7.8 Wake-up Validation Protocol* for more information.

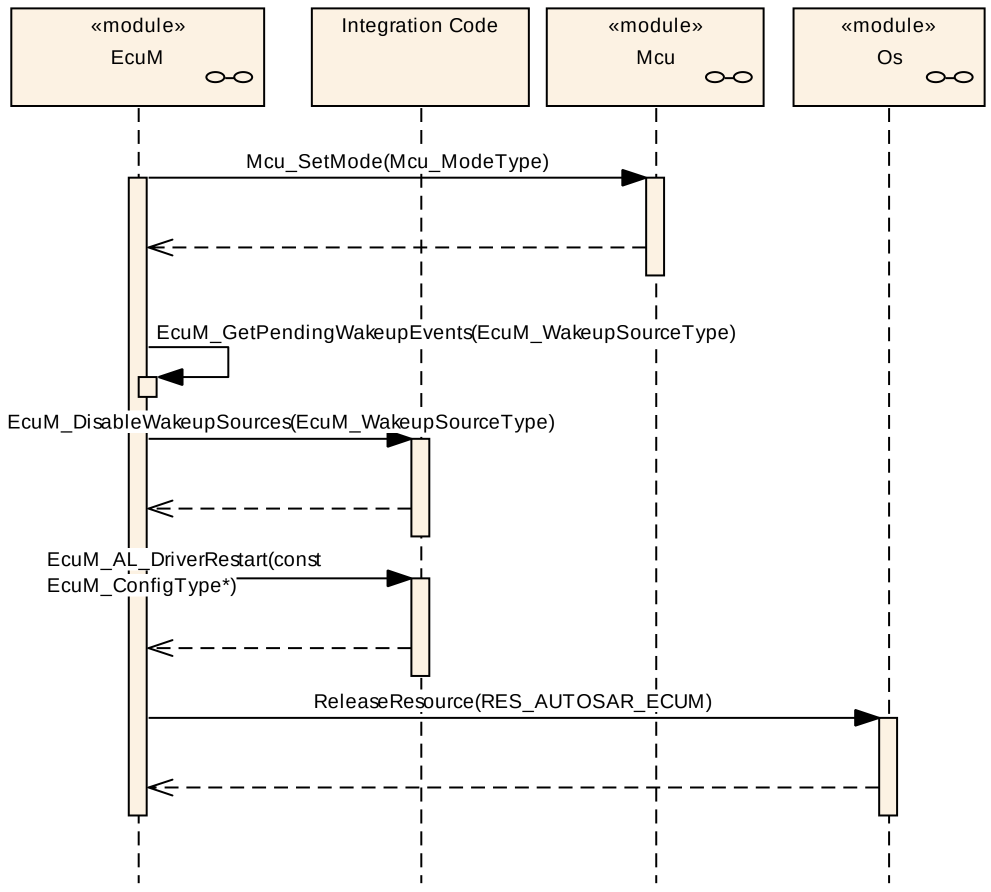

«module»
EcuM
Integration Code
«module»
Mcu
«module»
Os
Mcu_SetMode(Mcu_ModeType)
EcuM_GetPendingWakeupEvents(EcuM_WakeupSourceType)
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
EcuM_AL_DriverRestart(const EcuM_ConfigType*)
ReleaseResource(RES_AUTOSAR_ECUM)

**Figure 22 – Wake-up Sequence I**

**EcuM2545**: The driver should be implemented in a way that it only invokes the wake up callback once and then requires a dedicated service call to re-arm this mechanism. The driver then needs to be re-armed to fire the callback again.

#### 7.7.4.2 WAKEUP VALIDATION

Because wake up events can be generated unintended (e.g. EVM spike on CAN line), it is necessary to validate wake-ups before the ECU takes up its full operation. The validation mechanism is the same for all wake up sources. When a wake up event occurs, the ECU is woken up from its SLEEP state and execution resumes within the `MCU_SetMode` service of the MCU driver[23]. When WAKEUP I is left, the ECU State Manager Fixed module will have a list of pending wake up events which need to be validated.

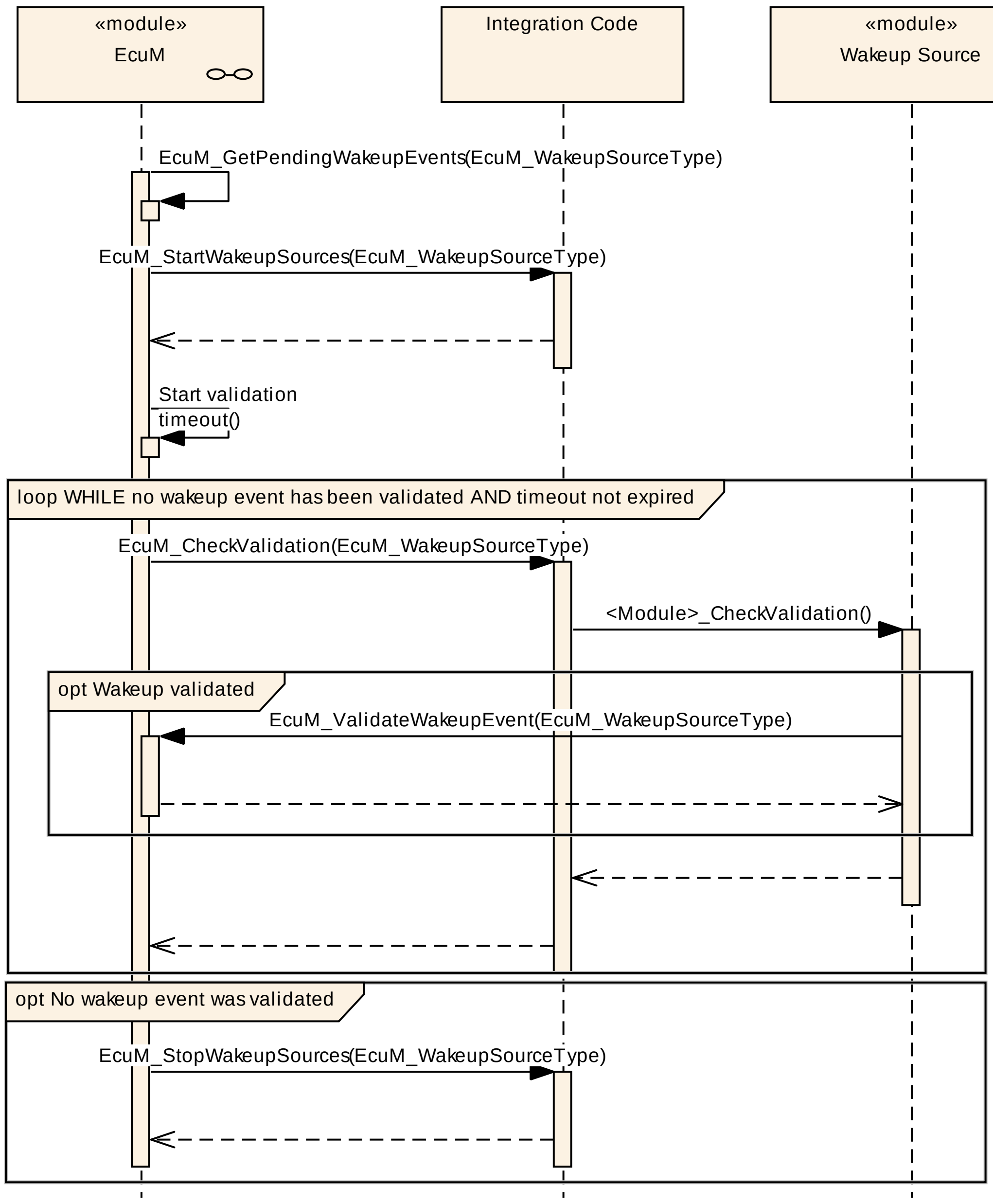

«module»
EcuM
Integration Code
«module»
Wakeup Source
EcuM_GetPendingWakeupEvents(EcuM_WakeupSourceType)
EcuM_StartWakeupSources(EcuM_WakeupSourceType)
Start validation timeout()
loop WHILE no wakeup event has been validated AND timeout not expired
EcuM_CheckValidation(EcuM_WakeupSourceType)
<Module>_CheckValidation()
opt Wakeup validated
EcuM_ValidateWakeupEvent(EcuM_WakeupSourceType)
opt No wakeup event was validated
EcuM_StopWakeupSources(EcuM_WakeupSourceType)

**Figure 23 – Wake-up Validation Sequence**

[23] Actually, the first code to be executed may be an ISR, e.g. a wakeup ISR. However, this is specific to hardware and/or driver implementation.

**EcuM2566**: Wake up validation shall apply only to those wake up sources where it is required by configuration. If the validation protocol is not configured, then a call to `EcuM_SetWakeupEvent` shall also imply a call to `EcuM_ValidateWakeupEvent`.

**EcuM2565**: For each pending wake up event, for which validation is required, a validation timeout shall be started. The timeout is event specific and can be defined by configuration. Strictly spoken, it is sufficient for an implementation to provide only one timer, which is prolonged to the largest timeout when new wake up events are reported.

**EcuM2567**: If the last timeout expires without validation then the wake up validation is considered to have failed.

**EcuM2568**: If at least one of the pending events is validated then the entire validation has passed.
Pending events are validated with a call to `EcuM_ValidateWakeupEvent`. This call must be placed in the driver or the consuming stack on top of the driver (e.g. the handler). The best place to put this depends on hardware and software design. See also *7.8.5 Requirements for drivers with wake up sources*.

### 7.7.4.3 WAKEUP REACTION

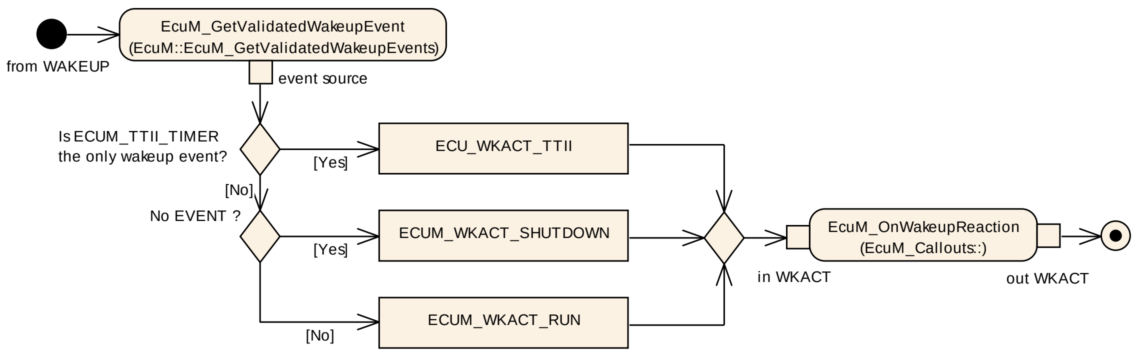


**Figure 24 – Activity Diagram of WAKEUP REACTION**

The WAKEUP REACTION state determines the appropriate wake up reaction (see 8.2.6 EcuM_WakeupReactionType) according to the wake up source (see 8.2.4 EcuM_WakeupSourceType).
As can be seen from*, Figure 24 – Activity Diagram of WAKEUP REACTION* there are the following wake up reactions:

- Execution of the TTII protocol (see *7.9 Time Triggered Increased Inoperation*)
- Proceed to RUN state (full startup)
- Shutdown
  If none of the above cases is chosen, the ECU will be shut down again by default. The exact behavior depends on the selected shutdown target.

The callout of this state may be used to override the wake up reaction and provide an ECU specific algorithm.
In case of an ECU Reset, the ECU State Manager Fixed module will perform a full initialization.

After a failed wake up validation the EcuM shall put the ECU into the same state as before the wake up event which failed, i.e. into "SLEEP" or "OFF". The state before the wake up event can be determined by calling `"EcuM_GetLastShutdownTarget()".`

#### 7.7.4.4 WAKEUP II

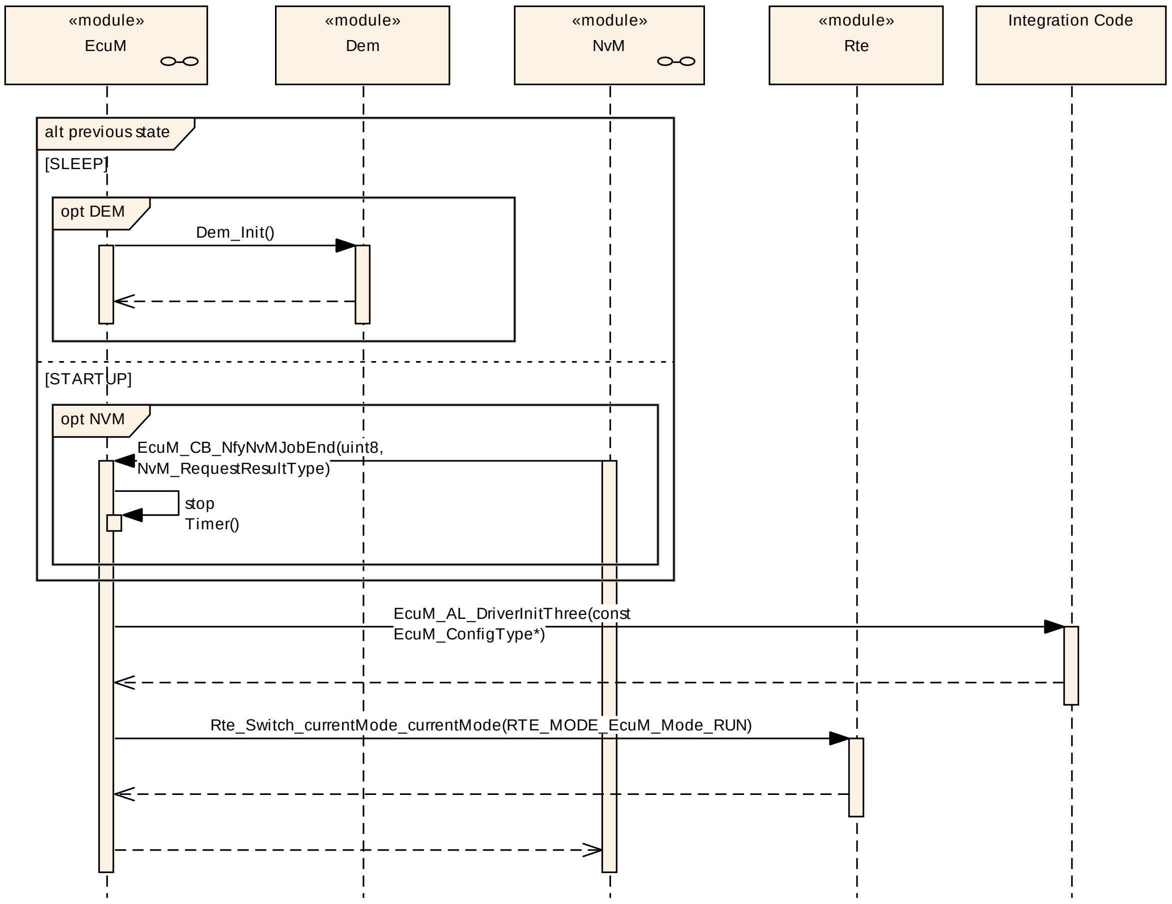

«module»
EcuM
«module»
Dem
«module»
NvM
«module»
Rte
Integration Code
alt previous state
[SLEEP]
opt DEM
Dem_Init()
[STARTUP]
opt NVM
EcuM_CB_NfyNvMJobEnd(uint8, NvM_RequestResultType)
stop Timer()
EcuM_AL_DriverInitThree(const EcuM_ConfigType*)
Rte_Switch_currentMode_currentMode(RTE_MODE_EcuM_Mode_RUN)

**Figure 25 – Wake-up Sequence II**

## 7.8 Wake-up Validation Protocol

### 7.8.1 Wake-up of Communication Channels

Communication channels have their own state machines including run and also sleep states. This is necessary since an ECU may have interfaces to several communication busses and busses can go to sleep independently from the ECU.
Consider the following example:

> An ECU may have two bus interfaces A and B. The ECU may be awake, bus A is in full communication state, but bus B is sleeping.

The state machines of the communication channels are completely provided by the Communication Manager, see [5] for details.
According to the specification, the Communication Manager autonomously can fulfill the following tasks:

- Drive a channel from full communication in no communication mode in collaboration with Network Management.
- Put the bus transceiver into standby mode by using the Bus State Manager according to the bus interface type. This will configure the bus transceiver to generate wake up events when bus traffic occurs.

The Communication Manager however will not drive the wake up process since wake up events will be directed to the ECU State Manager Fixed module which in turn will notify the Communication Manager if and only if appropriate.

**EcuM2478**: If a wake up occurs on a communication channel, the according bus transceiver driver shall notify the ECU State Manager Fixed module by invoking the `EcuM_SetWakeupEvent` service. Requirements for this notification are described in *5.3 Peripherals with Wake-up Capability*.

**EcuM2479**: The ECU State Manager Fixed module shall execute the wake up validation protocol according to *7.8.3 Interaction of wake up Sources and the* later in this chapter.

**EcuM2480**: If validation is successful, the ECU State Manager Fixed module shall inform the Communication Manager about the wake up event by invoking the Communication Manager’s `ComM_EcuM_WakeUpIndication` service with the according channel as parameter. In turn, the Communication Manager will use this event to bring the channel into full communication mode.

### 7.8.2 Wake-up of the Entire ECU

Before the ECU State Manager Fixed module can put the ECU into `SLEEP` state, the Communication Manager must have released all run requests[24], see **EcuMf0025**. This will only happen, if all communication state machines are in ‘no communication’ mode.

[24] This statement can be extended to any resource manager which may be added in future versions of the AUTOSAR Basic Software.

But this, taking into account the previous paragraphs, implies that all communication interfaces (i.e. all bus transceivers) must have been put to standby state and the wake up source must have been armed. Thus, when a wake up occurs, all communication channels are in no communication state and there are no RUN requests.
The wake up procedure is identical to the previous chapter.

### 7.8.3 Interaction of wake up Sources and the ECU State Manager Fixed module

All wake up sources must be treated in the same way. The procedure shall be as follows:

Upon occurrence of a wake up event, the responsible driver shall invoke an indication to notify the ECU State Manager Fixed module about the wake up.

This step can happen in several scenarios. The most likely are:

- After exiting the `SLEEP` state. In this scenario, the ECU State Manager Fixed module would issue a re-initialization of the relevant drivers which in turn get a chance to scan their hardware e.g. for pending wake up interrupts.
- If the wake up source is actually in sleep mode, then the driver shall scan autonomously for wake up events. The driver may do this interrupt driven or in polling mode, whichever is the preferred way for implementing it.

**EcuM2494**: If wake up validation is required for this event, then the validation protocol applies. Otherwise the event is valid immediately.

**EcuM2495**: If the valid event is a wake up event from a communication interface then it is propagated to the Communication Manager.

**EcuM2975**: If a wake up event requires validation then the ECU Manager module shall invoke the validation protocol.

**EcuM2976**: If a wake up event does not require validation, the ECU Manager module shall issue a mode switch request to set the event’s mode to `ECUM_WKSTATUS_VALIDATED`.

**EcuM2496**: If the wake up event is validated (either immediately or by the wake up validation protocol), it is labelled as a wake up source and this information is made available by the `EcuM_GetValidatedWakeupEvents` service.

### 7.8.4 Wake up validation timeout

It is the implementer’s choice whether he wants to provide a single wake up validation timeout timer or one timer per wake up source. The following requirements apply:

**EcuM2709**: The timer shall be started when the service `EcuM_SetWakeupEvent` is called.

**EcuM2710**: The timer shall be stopped and the validation is set to “passed” when the service `EcuM_ValidateWakeupEvent` is called.

**EcuM2711**: When the timer expires, validation is set to “failed”.

**EcuM2712**: Subsequent calls to `EcuM_SetWakeupEvent` for the same wake up source shall not prolong the timeout.
If only one timer is used, the following approach is proposed:

**EcuM2714**: If `EcuM_SetWakeupEvent` is called for a wake up source which did not fire yet during the same wake up cycle then the timeout should be prolonged for the validation timeout of that wake up source.
Wake up timeouts are defined by configuration in chapter 10.4 Configurable Parameters.

### 7.8.5 Requirements for drivers with wake up sources

The driver shall invoke the `EcuM_SetWakeupEvent` service with a configurable parameter identifying the source of the wake up once when the wake up event is detected.

**EcuM2572**: Wake-ups which occurred prior to driver initialization shall be detectable. This applies to initialization from `SLEEP` or from `OFF` state.

The driver shall provide an API to configure the wake up source for the `SLEEP` state, to enable or disable the wake up source, and to put the related peripherals to sleep. This requirement only applies if hardware provides these capabilities.

The callback invocation shall be enabled by calling the driver initialization service.

### 7.8.6 Requirements for Wake-up Validation

If the wake up source requires validation, this may be done by any but only by one appropriate module of the basic software. This may be a driver, an interface, a handler, or a manager.

Validation is done by calling the `EcuM_ValidateWakeupEvent` service.

### 7.8.7 Wake up Sources and Reset Reason

The API of the ECU State Manager Fixed module API only provides one type (`EcuM_WakeupSourceType`) which can describe all reasons why the ECU starts or wakes up.

**EcuM2625**: The following wake up sources shall not require validation under no circumstances:

- `ECUM_WKSOURCE_POWER`
- `ECUM_WKSOURCE_RESET`
- `ECUM_WKSOURCE_INTERNAL_RESET`
- `ECUM_WKSOURCE_INTERNAL_WDG`
- `ECUM_WKSOURCE_EXTERNAL_WDG`

### 7.8.8 Wake up Sources with Integrated Power Control

This section applies if the sleep state is realized by a system chip which controls the MCU's power supply. Typical examples are CAN transceivers with integrated power supplies. These transceivers switch off power upon application request and switch on power upon CAN activity.
As a consequence, the sleep state looks like the `OFF` state for the ECU State Manager. This distinction is rather philosophical and not of practical importance. The practical impact is that a passive wake up on CAN will look like a power on reset to the ECU. Hence, the ECU will continue with the startup sequence after a wake up event. Nevertheless, wake up validation is required. In order to make this work, the system designer has to consider the following topics:

- The CAN transceiver is initialized during one of the driver initialization blocks (Init Block II by default). This is configured or generated code, i.e. code which is under control of the system designer.
- The CAN transceiver driver API provides services to find out if it was the CAN transceiver, due to a passive wake up, which started the ECU. It is the system designer's responsibility to check the CAN transceiver for wake up reasons and give this information to the ECU State Manager Fixed module by using the `EcuM_SetWakeupEvent` and `EcuM_ClearWakeupEvent` services.
- If the system designer sets the CAN transceiver as the wake up source, then the ECU State Manager Fixed module will not continue with the RUN state when STARTUP II is finished. Instead it will continue with the WAKEUP VALIDATION state.

This behavior can be applied to all kinds of wake up sources. The CAN transceiver only serves as an example here.

Waking up from a sleep state which is implemented by unpowering the MCU is not fully transparent to the SW-Cs. First of all the BSW modules are brought back into their default states after initialization. Second, when starting RTE the SW-Cs will be initialized and `STARTUP` state is signaled for a very short time. When the MCU is unpowered, it is inevitable that the ECU State Manager Fixed module carries out the `STARTUP` state. The ECU State Manager Fixed module offers support by detecting this case and then branching into wake up validation and from there (if validation is successful) into `RUN` state. If wake up validation is not successful, the ECU State Manager Fixed module supports branching into `SHUTDOWN` state. During wake up validation the ECU State Manager Fixed module will signal `SLEEP` state to the SW-Cs so that afterwards it appears as if they were woken up from a normal `SLEEP` state.

## 7.8.9 Activity Diagram

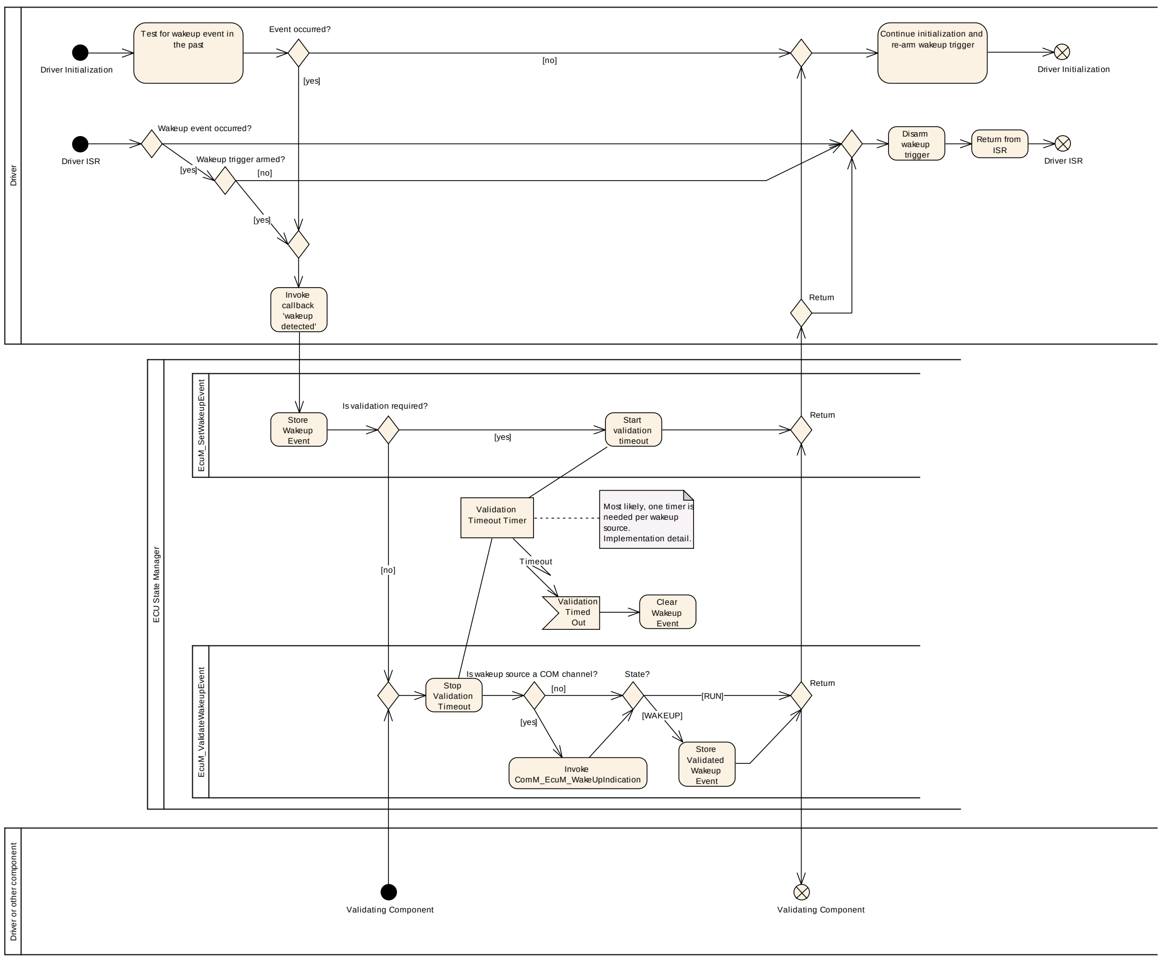


**Figure 26 – Wake up Validation Protocol**

## 7.9 Time Triggered Increased Inoperation

**EcuM2653**: TTII shall manage a list of all sleep modes (shutdown targets). These sleep modes can be defined at configuration time. Typically the sleep modes are ordered to deepen the sleep phase of the ECU (decreased power consumption).

**EcuM2654**: An entry of the sleep mode list shall contain the following properties:

- A description of the ECU sleep mode
- A reference to the successor sleep mode
- A divisor counter which tells how often the ECU must be woken up before the successor sleep mode is selected.

These properties shall be defined at configuration time (see 10.4 Configurable Parameters container EcuMFixedTTII).

The TTII protocol is executed during the WAKEUP REACTION sub-state. Refer to chapter *7.7.4.3 WAKEUP REACTION* and *Figure 24 – Activity Diagram of WAKEUP REACTION*.

**EcuM2223**: The entire TTII feature can be completely disabled by setting the *ECUM_TTII_ENABLED* configuration parameter to false. All further described activities are only applicable if TTII is enabled.

**EcuM2222**: A wake up source must be selected by configuration (*ECUM_TTII_WKSOURCE* configurable parameter) for use by the TTII protocol. Typically, the wake up source will be a timer, which serves as a timebase for TTII. Whenever the ECU is woken up by this configured wake up source, then the TTII protocol shall be executed.

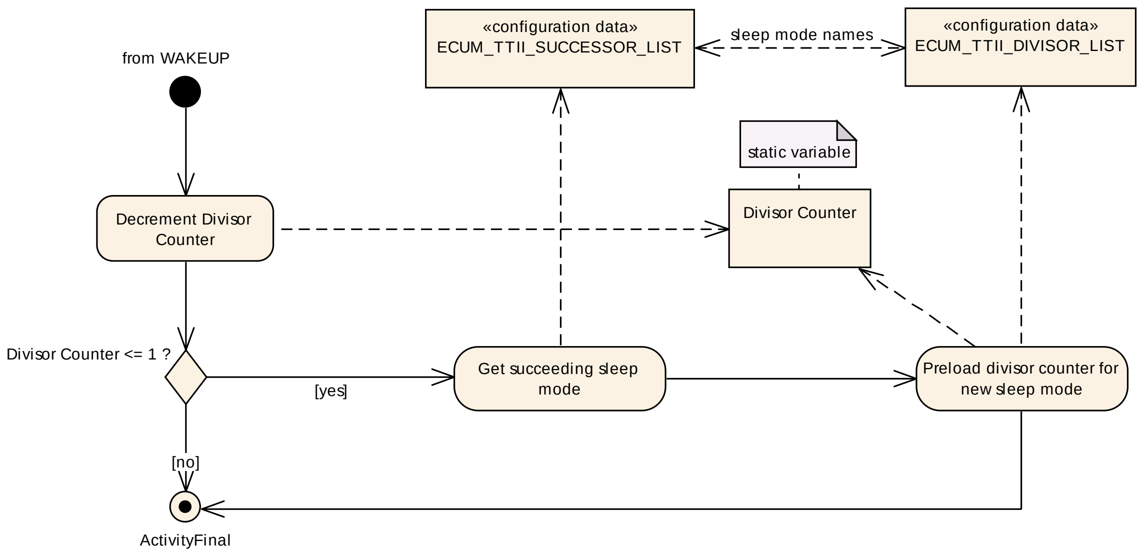


**Figure 27 – Activity Diagram of TTII**

## 7.10 AUTOSAR Ports

### 7.10.1 Scope of this Chapter

The following definitions are interpreted to be in `ARPackage` `AUTOSAR/Services/EcuM`.

### 7.10.2 Use Cases

**EcuM2762**: The ECU State Manager Fixed module shall provide AUTOSAR ports for the following functionalities:

- requesting RUN
- releasing RUN
- requesting POST RUN
- releasing POST RUN

**EcuM2763**: The ECU State Manager Fixed module shall provide also AUTOSAR ports for the following functionality:

- selecting and getting shutdown target
- selecting and getting boot targets

The interfaces used in this chapter will be described in the following.

### 7.10.3 Specification of the Port Interfaces

This chapter specifies the Port Interfaces that are needed in order to operate the ECU State Manager Fixed module functionality over the VFB. The ports implementing the Port Interfaces described in this chapter will be defined in chapter 7.10.4.

#### 7.10.3.1 Port Interface for Interface EcuM_StateRequest

##### 7.10.3.1.1 General Approach

A SW-C which needs to keep the ECU alive or needs to execute any operations before the ECU is shut down shall require the client-server interface `EcuM_StateRequest`.
This interface uses port-defined argument values to identify the user that requests modes. See [rte_sws_1360] in [17] for a description of port-defined argument values.

##### 7.10.3.1.2 Data Types

No data types are need for this interface

#### 7.10.3.1.3 Port Interface

```
EcuMf030: ClientServerInterface EcuM_StateRequest
{
      PossibleErrors {
      E_NOT_OK = 1 /* The request was not accepted by EcuM, a detailed
      error condition was sent to DET */
      };

      // The SW-C can request or release an ECU RUN or POSTRUN state when
      // requiring this interface
      RequestRUN(ERR{E_NOT_OK});
      ReleaseRUN(ERR{E_NOT_OK});
      RequestPOSTRUN(ERR{E_NOT_OK});
      ReleasePOSTRUN(ERR{E_NOT_OK});
};
```

The ECU State Manager Fixed module provides additional calls which would typically be made by one management instance on the ECU as they have a global impact. The function “`EcuM_KillAllRUNRequests()`” unconditionally undoes all requests to RUN. Because of this, calling `EcuM_RequestRUN` does not necessarily guarantee that the ECU will stay awake until calling `EcuM_ReleaseRUN` (e.g. a `KillAllRUNRequests`-call can override the wish of individual users for the ECU to stay awake). The function “`EcuM_KillAllRUNRequests()`” is not accessible over the RTE and thus can not be used by SW-Cs.

The following activity chart is not normative and shall help the application software programmer to understand when to request which state via EcuM_StateRequest.

- RequestRUN is actually prohibiting shutdown.
- RequestPOSTRUN is actually requesting the opportunity to de-initialize.
- The application software components shall only listen to the EcuM state over the mode switch port.
- RUN state can be requested (RequestRUN) and released (ReleaseRUN) arbitrarily often during operation.

The EcuM is the mode manager, but does not have a requestmode (RTE ModeGroup) interface.

When all RUN requests are released, the ECU shuts down, so the active Software Components have to request RUN (RequestRUN) right after their initialization, otherwise the ECU may shut down immediately.

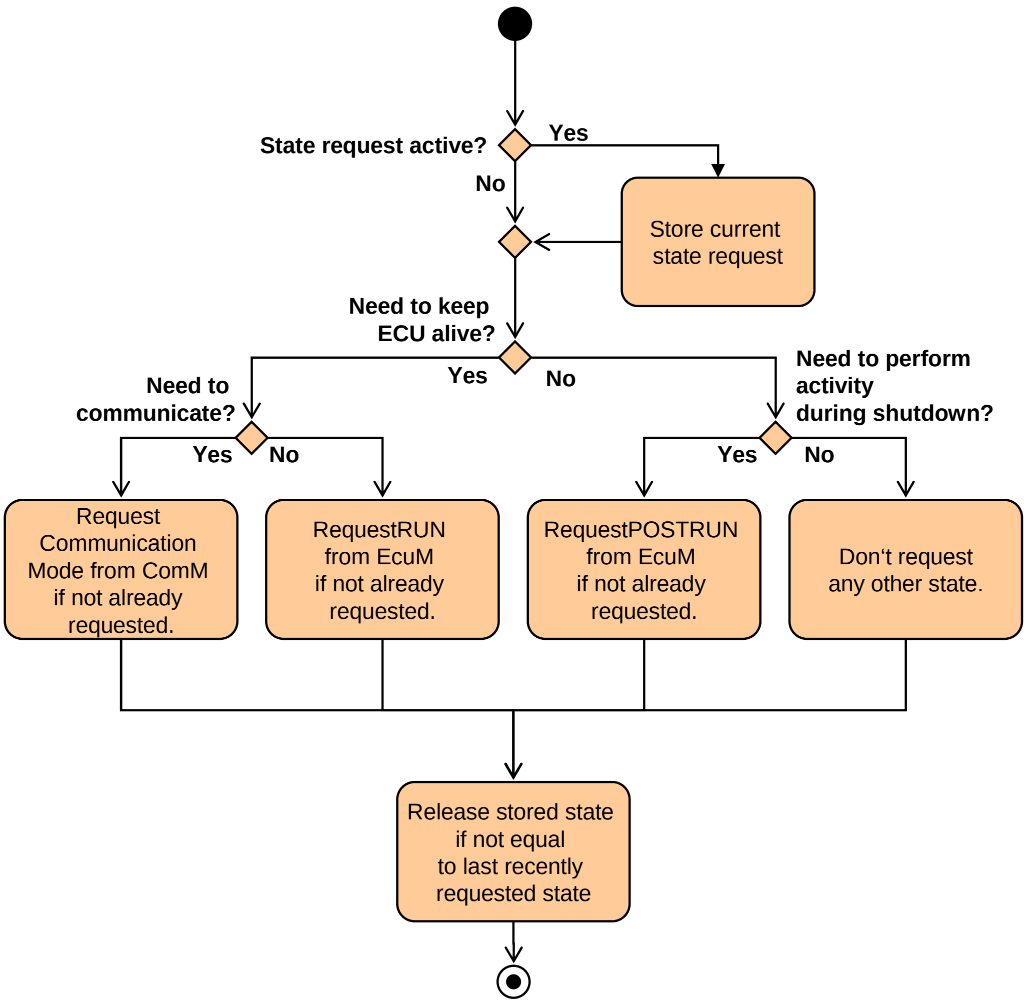

State request active?
Yes
No
Store current state request
Need to keep ECU alive?
Yes
No
Need to communicate?
Yes
No
Need to perform activity during shutdown?
Yes
No
Request Communication Mode from ComM if not already requested.
RequestRUN from EcuM if not already requested.
RequestPOSTRUN from EcuM if not already requested.
Don't request any other state.
Release stored state if not equal to last recently requested state

**Figure 28 – Activity chart for SW-C**

#### 7.10.3.2 Port Interface for Interface EcuM_CurrentMode

##### 7.10.3.2.1 General Approach

**EcuM2749**: The mode port of the ECU State Manager Fixed module shall declare the following modes:

- STARTUP
- RUN
- POST_RUN
- SLEEP
- WAKE_SLEEP
- SHUTDOWN

This definition is a simplified view of ECU Modes that applications do need to know. It does not restrict or limit in any way how application modes could be defined. Applications modes are completely handled by the application itself.

**EcuM2750**: Mode changes shall be notified to SW-Cs through the RTE mode ports when the mode change occurs. The ECU State Manager Fixed module shall not wait until the RTE has performed the mode switch completely.

This specification assumes that the port name is currentMode and that the direct API of RTE will be used. Under these conditions mode changes signaled by invoking

```
Rte_StatusType Rte_Switch_currentMode_currentMode(
        Rte_ModeType_EcuM_Mode mode)
```

where `mode` is the new mode to be notified. The value range is specified by the previous requirement. The return value shall be ignored.

A SW-C which wants to be notified of mode changes should require the mode switch interface `EcuM_CurrentMode`.

The following figure shows how the defined modes are mapped to the states of the ECU State Manager Fixed module and when the notifications shall occur.

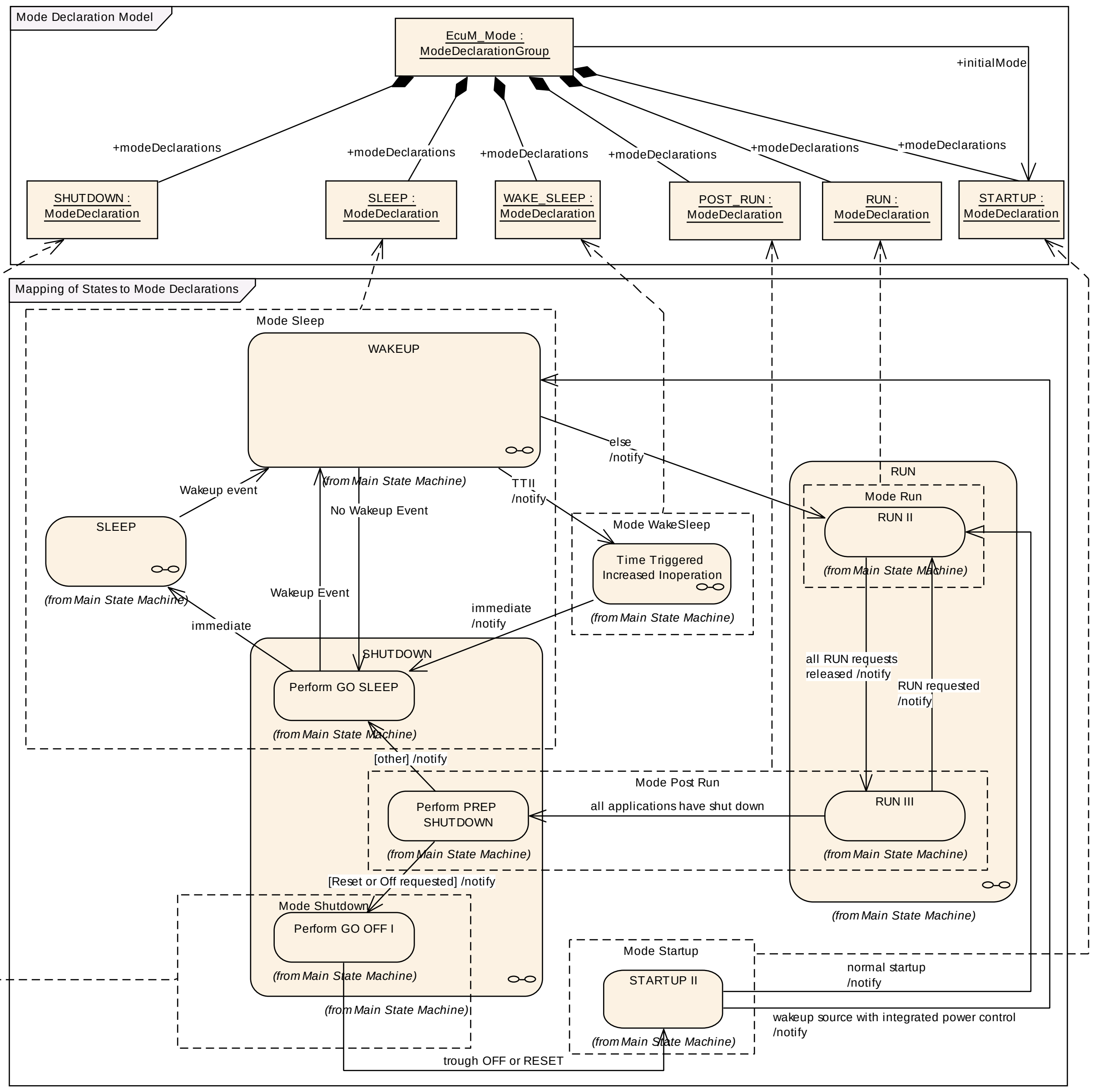


**Figure 29 – Mapping of Declared Modes to states of ECU State Manager Fixed module**

**EcuM2752**: The ECU State Manager Fixed module shall notify WakeSleep mode and Sleep mode when transiting from `WAKEUP` to `SHUTDOWN`, but only if the selected shutdown target is `SLEEP`.
This allows the system designer to trigger runnables for TTII.

#### 7.10.3.2.2 Data Types

The mode declaration group `EcuM_Mode` represents the modes of the ECU State Manager Fixed module that will be notified to the SW-Cs.

```
ModeDeclarationGroup EcuM_Mode {
      { STARTUP,
      RUN,
      POST_RUN,
      SLEEP,
      WAKE_SLEEP,
      SHUTDOWN
      }
      initialMode = STARTUP
};
```

###### 7.10.3.2.3 Port Interface

```
EcuMf031: SenderReceiverInterface EcuM_CurrentMode {
      EcuM_Mode currentMode;
};
```

#### 7.10.3.3 Ports and Port Interface for Interface EcuM_ShutdownTarget

###### 7.10.3.3.1 General Approach

A SW-C which wants to select a shutdown target should require the client-server interface `EcuM_ShutdownTarget`.

###### 7.10.3.3.2 Data Types

This data type represents the states of the ECU State Manager Fixed module and thus includes the shutdown targets.

```
PrimitiveTypeWithSemantics EcuM_StateType {
      IntegerType {
            LOWER-LIMIT=0x10, UPPER-LIMIT=0x90
      };
      0x10 -> ECUM_STATE_STARTUP
      0x11 -> ECUM_STATE_STARTUP_ONE
      0x12 –> ECUM_STATE_STARTUP_TWO
      0x20 –> ECUM_STATE_WAKEUP
      0x21 –> ECUM_STATE_WAKEUP_ONE
      0x22 –> ECUM_STATE_WAKEUP_VALIDATION
      0x23 –> ECUM_STATE_WAKEUP_REACTION
      0x24 –> ECUM_STATE_WAKEUP_TWO
      0x25 –> ECUM_STATE_WAKEUP_WAKESLEEP
      0x26 –> ECUM_STATE_WAKEUP_TTII
      0x30 –> ECUM_STATE_RUN
      0x32 –> ECUM_STATE_APP_RUN
      0x33 –> ECUM_STATE_APP_POST_RUN
      0x40 –> ECUM_STATE_SHUTDOWN
      0x44 –> ECUM_STATE_PREP_SHUTDOWN
      0x49 –> ECUM_STATE_GO_SLEEP
      0x4d –> ECUM_STATE_GO_OFF_ONE
      0x4e –> ECUM_STATE_GO_OFF_TWO
      0x50 –> ECUM_STATE_SLEEP
      0x80 –> ECUM_STATE_OFF
      0x90 –> ECUM_STATE_RESET
};
```

#### 7.10.3.3.3 Port Interface

```
EcuMf032: ClientServerInterface EcuM_ShutdownTarget
{
      // The SW-C can select a shutdown target when requiring
      // this interface
      PossibleErrors {
      E_NOT_OK = 1 /* The new shutdown target was not set */
      };

      // The SW-C selects a shutdown target
      SelectShutdownTarget(IN EcuM_StateType target, IN uint8 mode,
      ERR{E_NOT_OK});

      // The SW-C gets the currently selected shutdown target
      GetShutdownTarget(OUT EcuM_StateType target, OUT uint8 mode);

      // The SW-C gets the shutdown target of the previous shutdown process
      GetLastShutdownTarget(OUT EcuM_StateType target, OUT uint8 mode);
};
```

The parameter mode determines the concrete sleep mode. This parameter shall only be used if the target parameter equals to ECUM_STATE_SLEEP, otherwise it will be ignored.

### 7.10.3.4 Port Interface for Interface EcuM_BootTarget

#### 7.10.3.4.1 General Approach

A SW-C which wants to select a boot target shall require the client-server interface `EcuM_BootTarget`.

#### 7.10.3.4.2 Data Types

This data type represents the boot targets the ECU State Manager Fixed module can be configured with.

```
PrimitiveTypeWithSemantics EcuM_BootTargetType {
      IntegerType {LOWER-LIMIT=0, UPPER-LIMIT=1};
      0 -> ECUM_BOOT_TARGET_APP
      1 -> ECUM_BOOT_TARGET_OEM_BOOTLOADER
        2 -> ECUM_BOOT_TARGET_SYS_BOOTLOADER

        // ECUM_BOOT_TARGET_APP
        //      The ECU will boot into the application
        // ECUM_BOOT_TARGET_OEM_BOOTLOADER
        //      The ECU will boot into the OEM specific bootloader
        // ECUM_BOOT_TARGET_SYS_BOOTLOADER
        //      The ECU will boot into the system supplier bootloader


};
```

#### 7.10.3.4.3 Port Interface

```
EcuMf033: ClientServerInterface EcuM_BootTarget
{
      PossibleErrors {
      E_NOT_OK = 1 /* The new boot target was not accepted by EcuM */
      };

      // The SW-C selects a boot target
      SelectBootTarget (IN EcuM_BootTargetType target, ERR{E_NOT_OK});

      // The SW-C gets informed of the current boot target
      GetBootTarget(OUT EcuM_BootTargetType target);
};
```

## 7.10.4 Summary of ports

### 7.10.4.1 Definitions of interfaces

```
PrimitiveTypeWithSemantics EcuM_StateType {
      IntegerType {
            LOWER-LIMIT=0x10, UPPER-LIMIT=0x90
      };
      0x10 -> ECUM_STATE_STARTUP
      0x11 -> ECUM_STATE_STARTUP_ONE
      0x12 –> ECUM_STATE_STARTUP_TWO
      0x20 –> ECUM_STATE_WAKEUP
      0x21 –> ECUM_STATE_WAKEUP_ONE
      0x22 –> ECUM_STATE_WAKEUP_VALIDATION
      0x23 –> ECUM_STATE_WAKEUP_REACTION
      0x24 –> ECUM_STATE_WAKEUP_TWO
      0x25 –> ECUM_STATE_WAKEUP_WAKESLEEP
      0x26 –> ECUM_STATE_WAKEUP_TTII
      0x30 –> ECUM_STATE_RUN
      0x32 –> ECUM_STATE_APP_RUN
      0x33 –> ECUM_STATE_APP_POST_RUN
      0x40 –> ECUM_STATE_SHUTDOWN
      0x44 –> ECUM_STATE_PREP_SHUTDOWN
      0x49 –> ECUM_STATE_GO_SLEEP
      0x4d –> ECUM_STATE_GO_OFF_ONE
      0x4e –> ECUM_STATE_GO_OFF_TWO
      0x50 –> ECUM_STATE_SLEEP
      0x80 –> ECUM_STATE_OFF
      0x90 –> ECUM_STATE_RESET
};


ClientServerInterface EcuM_StateRequest
{
      PossibleErrors {
      E_NOT_OK = 1 /* The request was not accepted by EcuM, a detailed
      error condition was sent to DET */
      };

      // The SW-C can request or release an ECU RUN or POSTRUN state when
      // requiring this interface
      RequestRUN(ERR{E_NOT_OK});
      ReleaseRUN(ERR{E_NOT_OK});
      RequestPOSTRUN(ERR{E_NOT_OK});
      ReleasePOSTRUN(ERR{E_NOT_OK});
};

ModeDeclarationGroup EcuM_Mode {
      { STARTUP,
      RUN,
      POST_RUN,
      SLEEP,
      WAKE_SLEEP,
      SHUTDOWN
      }
      initialMode = STARTUP
};

SenderReceiverInterface EcuM_CurrentMode {
      EcuM_Mode currentMode;
};

ClientServerInterface EcuM_ShutdownTarget
{
      // The SW-C can select a shutdown target when requiring
      // this interface
      PossibleErrors {
      E_NOT_OK = 1 /* The new shutdown target was not set */
      };

      // The SW-C selects a shutdown target
      SelectShutdownTarget(IN EcuM_StateType target, IN uint8 mode,
      ERR{E_NOT_OK});

      // The SW-C gets the currently selected shutdown target
      GetShutdownTarget(OUT EcuM_StateType target, OUT uint8 mode);

      // The SW-C gets the shutdown target of the previous shutdown process
      GetLastShutdownTarget(OUT EcuM_StateType target, OUT uint8 mode);
};

PrimitiveTypeWithSemantics EcuM_BootTargetType {
      IntegerType {LOWER-LIMIT=0, UPPER-LIMIT=1};
      0 -> ECUM_BOOT_TARGET_APP
      1 -> ECUM_BOOT_TARGET_OEM_BOOTLOADER
      2 -> ECUM_BOOT_TARGET_SYS_BOOTLOADER

      // Bootloaders and application are three separated programs which in
      // many cases even can be flashed separately. The only way to get
      // from one image to another is through reset. The boot menu will
      // branch into the one or other image depending on the selected boot
      // target
};

ClientServerInterface EcuM_BootTarget
{
      PossibleErrors {
      E_NOT_OK = 1 /* The new boot target was not accepted by EcuM */
      };

      // The SW-C selects a boot target
      SelectBootTarget (IN EcuM_BootTargetType target, ERR{E_NOT_OK});
      // The SW-C gets informed of the current boot target
      GetBootTarget(OUT EcuM_BootTargetType target);
};
```

#### 7.10.4.2 Definition of the Service ECU State Manager

This section provides guidance on the definition of the ECU State Manager service. Note that these definitions can only be completed during ECU configuration (because it depends on certain configuration parameters of the ECU State Manager Fixed module which determine the number of ports provided by the ECU State Manager service). Also note that the implementation of a SW-C does *not* depend on these definitions.
There are ports on both sides of the RTE: This description of the ECU State Manager service defines the ports below the RTE. Each SW-Component, which uses the service, must contain “service ports” in its own SW-C description which will be connected to the ports of the ECU State Manager, so that the RTE can be generated.

```
/* This is the definition of the ECU State Manager Fixed module as a
service. This is the “outside-view” of the ECU State Manager, which must be
visible to the SW-C’s / ECU-integrator */
Service EcuStateManager {
      // For each user the ECU State Manager Fixed module provides a port
      // to request/release RUN and POSTRUN states.
      // there are NU users;
      ProvidePort EcuM_StateRequest SR000;
      …
      ProvidePort EcuM_StateRequest SR<NU-1>;

      ProvidePort EcuM_CurrentMode currentMode;

      ProvidePort EcuM_ShutdownTarget shutdownTarget;

      ProvidePort EcuM_BootTarget bootTarget;
};
```

### 7.10.5 Runnables and Entry points

#### 7.10.5.1 Internal behavior

This is the inside description of the ECU State Manager. This detailed description is only needed for the configuration of the local RTE.

```
InternalBehavior EcuStateManager {

      // Runnable entities of the EcuStateManager
      RunnableEntity RequestRUN
            symbol “EcuM_RequestRUN”
            canbeInvokedConcurrently = TRUE
      RunnableEntity ReleaseRUN
            symbol “EcuM_ReleaseRUN”
            canbeInvokedConcurrently = TRUE
      RunnableEntity RequestPOSTRUN
            symbol “EcuM_RequestPOST_RUN”
            canbeInvokedConcurrently = TRUE
      RunnableEntity ReleasePOSTRUN
            symbol “EcuM_ReleasePOST_RUN”
            canbeInvokedConcurrently = TRUE
      RunnableEntity SelectShutdownTarget
            symbol “EcuM_SelectShutdownTarget”
            canbeInvokedConcurrently = TRUE
      RunnableEntity GetShutdownTarget
            symbol “EcuM_GetShutdownTarget”
            canbeInvokedConcurrently = TRUE
      RunnableEntity GetLastShutdownTarget
            symbol “EcuM_GetLastShutdownTarget”
            canbeInvokedConcurrently = TRUE
      RunnableEntity SelectBootTarget
            symbol “EcuM_SelectBootTarget”
            canbeInvokedConcurrently = TRUE
      RunnableEntity GetBootTarget
            symbol “EcuM_GetBootTarget”
            canbeInvokedConcurrently = TRUE

      // Port present for each user. There are NU users
      SR000.RequestRUN -> RequestRUN
      SR000.ReleaseRUN -> ReleaseRUN
      SR000.RequestPOSTRUN -> RequestPOSTRUN
      SR000.ReleasePOSTRUN -> RequestPOSTRUN
      PortArgument {port=SR000, value.type=EcuM_UserType,
      value.value=EcuM_User[0].User}
      (...)
      SRnnn.RequestRUN -> RequestRUN
      SRnnn.ReleaseRUN -> ReleaseRUN
      SRnnn.RequestPOSTRUN -> RequestPOSTRUN
      SRnnn.ReleasePOSTRUN -> RequestPOSTRUN
      PortArgument {port=SRnnn, value.type=EcuM_UserType,
      value.value=EcuM_User[nnn].User}

      shutDownTarget.SelectShutdownTarget -> SelectShutdownTarget
      shutDownTarget.GetShutdownTarget -> GetShutdownTarget
      shutDownTarget.GetLastShutdownTarget -> GetLastShutdownTarget
      bootTarget.SelectBootTarget -> SelectBootTarget
      bootTarget.GetBootTarget -> GetBootTarget
};
```

## 7.11 Advanced Topics

### 7.11.1 OS Application Modes

OS Application Modes is a feature of the OS which allows defining different configurations, e.g. sets of tasks which will be started initially. The application mode is an in parameter of the `StartOS` service [5]. Since the ECU State Manager Fixed module is responsible for starting the OS, it has also responsibility for managing the application mode.

**EcuMf0010**: Since AUTOSAR RTE does not use application modes, the ECU State Manager Fixed module always has to start the OS with the value `DEFAULT_APP_MODE` (defined by the operating system).

**EcuM2243**: The default application mode is set in the STARTUP I state in case of unintended restarts[25], see chapter *7.3.4.1 STARTUP I*.

### 7.11.2 Relation to Bootloader

The Bootloader is not part of AUTOSAR. Still, the application needs an interface to activate the bootloader. For this purpose, two functions are provided: `EcuM_SelectBootTarget` and `EcuM_GetBootTarget`.

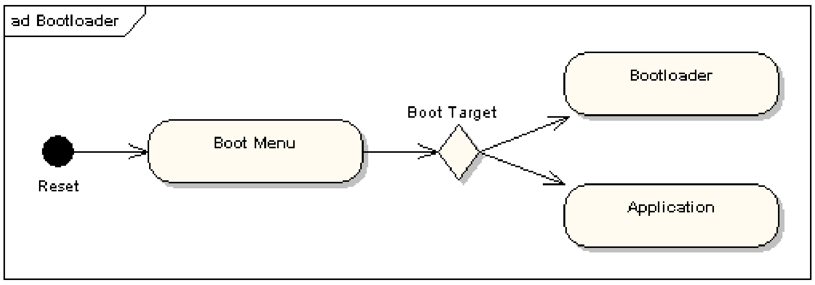


**Figure 30 – Selection of Boot Targets**

Bootloader and application are two separated programs which in many cases even can be flashed separately. The only way to get from one image to another is through reset. The boot menu will branch into the one or other image depending on the selected boot target.

### 7.11.3 Relation to Complex Drivers

If the complex driver handles a wake up source, it must obey all rules of this specification which are related to handling wake up events.

A complex driver may issue RUN requests.

### 7.11.4 Handling Errors during Startup and Shutdown

The ECU State Manager Fixed module will ignore all types of errors that occur during initialization, e.g. as return values of init functions. Initialization is a configuration issue and henceforth cannot be standardized.
If errors occur during the initialization of a BSW module and this error is worthwhile being reported, then it is in the responsibility of that BSW module to report this error directly to DEM or DET and not the responsibility of the ECU State Manager.
If special error reactions are necessary, then also this is in the responsibility of the BSW module.

[25] e.g. like watchdog reset

### 7.11.5 Configuration Alternative for Providing Wake-Sleep Operation

In rare use cases, an ECU has to wake up cyclically (e.g. each second), execute a very simple task (like blinking an LED) and go back to sleep. For most operations, the normal WAKEUP/SHUTDOWN behavior as defined by the ECU State Manager Fixed module will be sufficient. Sometimes, however, the software has to be written very specific to maximize energy savings. Because the use case is so rare, there is no built-in feature in the ECU State Manager. However, the system designer can achieve this by using the ECU State Manager Fixed module in the following way:

- Define a wake up source to be used for the wake-sleep-operation (typically a timer)
- Check the wake up source in the `EcuM_AL_DriverInitOne` callout and, if it was the reason, execute the necessary task
- Finally, put the ECU back to sleep or perform a startup

The code needed for this behavior is custom code which is located below the RTE.

### 7.11.6 Selecting Scheduling Schemes for Startup and Shutdown

On some ECU designs, it will be necessary to change the scheduling tables for startup and shutdown of the ECU, e.g. to improve speed for reading or writing non-volatile data. Unless other mechanisms are provided by basic software, the notification to switch the schedule table shall preferably be done from the `EcuM_OnEnterRun` and `EcuM_OnExitRun` callouts.

## 7.12 Error Classification

| *Type or error* | *Relevance* | *Related error code* | *Value* |
|---|---|---|---|
| A service was called prior to initialization | Development | `ECUM_E_UNINIT` | `0x10` |
| A service was called which was disabled by configuration | Development | `ECUM_E_SERVICE_DISABLED` | `0x11` |
| A null pointer was passed as an argument | Development | `ECUM_E_NULL_POINTER` | `0x12` |
| A parameter was invalid (unspecific) | Development | `ECUM_E_INVALID_PAR` | `0x13` |
| RUN / POST RUN was requested multiple times by the same user ID | Development | `ECUM_E_MULTIPLE_RUN_REQUESTS` | `0x14` |
| RUN / POST RUN was released though it was not requested | Development | `ECUM_E_MISMATCHED_RUN_RELEASE` | `0x15` |
| A state, passed as an argument to a service, was out of range (specific parameter test) | Development | `ECUM_E_STATE_PAR_OUT_OF_RANGE` | `0x16` |
| An unknown wake up source was passed as a parameter to an API | Development | `ECUM_E_UNKNOWN_WAKEUP_SOURCE` | `0x17` |
| The RAM check during wake up failed | Production | `ECUM_E_RAM_CHECK_FAILED` | |
| The service EcuM_KillAllRUNRequests was issued | Production | `ECUM_E_ALL_RUN_REQUESTS_KILLED` | |
| Configuration data is inconsistent | Production | `ECUM_E_CONFIGURATION_DATA_INCONSISTENT` | |

**Table 5 - Error Classification**

**EcuM2759**: All errors shall be reported as events.

**EcuM2757**: All errors shall be treated as errors immediately.

**EcuM2758**: Not all errors shall be healable.

**EcuMf0012**: The definition of values for error codes not defined in this specification are up to the implementation and implementation specific. In this case, values shall be defined by including the file EcuM.h.

## 7.13 Debug Support

In order to support debugging AUTOSAR implementations must publish information which can be used for debugging purpose. As start-up and shut-down are crucial system phases, sufficient information to track the current state of the ECU State Manager Fixed module needs to be provided by implementations.

**EcuMf0004**: Each variable that shall be accessible by AUTOSAR Debugging shall be defined as global variable.

**EcuMf0005**: All type definitions of variables which shall be debugged shall be accessible by the header file EcuM.h.

**EcuMf0006**: The declaration of variables in the header file shall be such, that it is possible to calculate the size of the variables by C-"sizeof".

# 8 API specification

## 8.1 Imported Types

In this chapter all types included from the following files are listed:

**EcuM2810**:

| *Module* | *Imported Type* |
|---|---|
| Adc | Adc_ConfigType |
| BswM | BswM_ConfigType |
| Can | Can_ConfigType |
| CanIf | CanIf_ConfigType |
| CanNm | CanNm_ConfigType |
| CanSM | CanSM_ConfigType |
| CanTp | CanTp_ConfigType |
| CanTrcv | CanTrcv_ConfigType |
| Com | Com_ConfigType |
| ComM | ComM_StateType |
| ComStack_Types | NetworkHandleType |
| Dcm | Dcm_ConfigType |
| Dem | Dem_EventIdType |
| | Dem_EventStatusType |
| | Dem_ConfigType |
| Dio | Dio_ConfigType |
| Dlt | Dlt_ConfigType |
| Eep | Eep_ConfigType |
| Eth | Eth_ConfigType |
| EthIf | EthIf_ConfigType |
| EthTrcv | EthTrcv_ConfigType |
| FiM | FiM_ConfigType |
| Fls | Fls_ConfigType |
| Fr | Fr_ConfigType |
| FrIf | FrIf_ConfigType |
| FrNm | FrNm_ConfigType |
| FrSm | FrSM_ConfigType |
| FrTp | FrTp_ConfigType |
| Gpt | Gpt_ConfigType |
| Icu | Icu_ConfigType |
| IpduM | IpduM_ConfigType |
| J1939Tp | J1939Tp_ConfigType |
| Lin | Lin_ConfigType |
| LinIf | LinIf_ConfigType |
| | LinTp_ConfigType |
| LinSM | LinSM_ConfigType |
| Mcu | Mcu_ModeType |
| | Mcu_ResetType |
| | Mcu_ConfigType |
| NvM | NvM_RequestResultType |
| Os | AppModeType |
| PduR | PduR_PBConfigType |
| Port | Port_ConfigType |
| Pwm | Pwm_ConfigType |
| Rte | Rte_ModeType_EcuM_Mode |

| | |
|---|---|
| SoAd | SoAd_ConfigType |
| Spi | Spi_ConfigType |
| Std_Types | Std_ReturnType |
| | Std_VersionInfoType |
| UdpNm | UdpNm_ConfigType |
| Wdg | Wdg_ConfigType |
| WdgM | WdgM_ConfigType |
| Xcp | Xcp_ConfigType |

## 8.2 Type definitions

### 8.2.1 EcuM_ConfigType

| | | |
|---|---|---|
| ***Name:*** | `EcuM_ConfigType` | |
| ***Type:*** | `Structure` | |
| ***Range:*** | - | The content of this structure depends on the post-build configuration of EcuM. |
| ***Description:*** | A pointer to such a structure shall be provided to the ECU State Manager initialization routine for configuration. | |

**EcuM2801**: This structure shall hold the post-build configuration parameters for the ECU State Manager Fixed module as well as pointers to all `ConfigType` structures of modules that are initialized by the ECU State Manager.

**EcuM2793**: The ECU State Manager Configuration Tool shall specifically generate this structure for a given set of basic software modules that comprise the ECU configuration. The set of basic software modules is derived from the corresponding *EcuMFixedModuleConfiguration* parameters.

**EcuM2794**: This structure shall contain an additional post-build configuration variant identifier (uint8/uint16/uint32 depending on algorithm to compute the identifier). See also chapter *10.5 Checking Configuration Consistency.*

**EcuM2795**: This structure shall contain an additional hash code with is tested against the configuration parameter *EcuMConfigConsistencyHash* for checking consistency of the configuration data. See also chapter *10.5 Checking Configuration Consistency.*

**EcuM2800**: The ECU State Manager Configuration Tool shall also generate for each given ECU configuration an instance of this structure that is filled with the post-build configuration parameters of the ECU State Manager Fixed module as well as pointers to instances of configuration structures for the modules mentioned in ***EcuM2793***. The pointers are derived from the corresponding *EcuMFixedModuleConfiguration* parameters.

### 8.2.2 EcuM_StateType

| | | | |
|---|---|---|---|
| ***Name:*** | `EcuM_StateType` | | |
| ***Type:*** | `uint8` | | |
| ***Range:*** | `ECUM_SUBSTATE_MASK` | `0x0f` | -- |
| | `ECUM_STATE_STARTUP` | `0x10` | -- |
| | `ECUM_STATE_STARTUP_ONE` | `0x11` | -- |
| | `ECUM_STATE_STARTUP_TWO` | `0x12` | -- |
| | `ECUM_STATE_WAKEUP` | `0x20` | -- |
| | `ECUM_STATE_WAKEUP_ONE` | `0x21` | -- |
| | `ECUM_STATE_WAKEUP_VALIDATION` | `0x22` | -- |
| | `ECUM_STATE_WAKEUP_REACTION` | `0x23` | -- |
| | `ECUM_STATE_WAKEUP_TWO` | `0x24` | -- |
| | `ECUM_STATE_WAKEUP_WAKESLEEP` | `0x25` | -- |
| | `ECUM_STATE_WAKEUP_TTII` | `0x26` | -- |
| | `ECUM_STATE_RUN` | `0x30` | -- |

| | | | |
|---|---|---|---|
| | ECUM_STATE_APP_RUN | 0x32 | -- |
| | ECUM_STATE_APP_POST_RUN | 0x33 | -- |
| | ECUM_STATE_SHUTDOWN | 0x40 | -- |
| | ECUM_STATE_PREP_SHUTDOWN | 0x44 | -- |
| | ECUM_STATE_GO_SLEEP | 0x49 | -- |
| | ECUM_STATE_GO_OFF_ONE | 0x4d | -- |
| | ECUM_STATE_GO_OFF_TWO | 0x4e | -- |
| | ECUM_STATE_SLEEP | 0x50 | -- |
| | ECUM_STATE_OFF | 0x80 | -- |
| | ECUM_STATE_RESET | 0x90 | -- |
| ***Description:*** | ECU State Manager states. | | |

**EcuM507**: Encodes states and sub-states of the ECU State Manager. States are encoded in the high-nibble, sub-state in the low-nibble. The sub-state can be determined by ANDing the state value with `ECUM_SUBSTATE_MASK`.

**EcuM2664**: The ECU State Manager Fixed module shall define all states as listed in the `EcuM_StateType`.

### 8.2.3 EcuM_UserType

| | |
|---|---|
| ***Name:*** | `EcuM_UserType` |
| ***Type:*** | `uint8` |
| ***Description:*** | Unique value for each user. |

**EcuM487**: For each user, a unique value must be defined at system generation time, please refer to 10.4 Configurable Parameters.

### 8.2.4 EcuM_WakeupSourceType

| | | | |
|---|---|---|---|
| ***Name:*** | `EcuM_WakeupSourceType` | | |
| ***Type:*** | `uint32` | | |
| ***Range:*** | ECUM_WKSOURCE_POWER | -- | Power cycle (bit 0) |
| | ECUM_WKSOURCE_RESET (default) | -- | Hardware reset (bit 1). If hardware cannot distinguish between a power cycle and a reset reason, then this shall be the default wakeup source. |
| | ECUM_WKSOURCE_INTERNAL_RESET | -- | Internal reset of µC (bit 2) The internal reset typically only resets the µC core but not peripherals or memory controllers. The exact behavior is hardware specific. This source may also indicate an unhandled exception. |
| | ECUM_WKSOURCE_INTERNAL_WDG | -- | Reset by internal watchdog (bit 3) |
| | ECUM_WKSOURCE_EXTERNAL_WDG | -- | Reset by external watchdog (bit 4), if detection supported by hardware |
| ***Description:*** | EcuM_WakeupSourceType defines a bitfield with 5 pre-defined positions (see Range). The bitfield provides one bit for each wakeup source. In WAKEUP, all bits cleared indicates that no wakeup source is known. In STARTUP, all bits cleared indicates that no reason for restart or reset is known. In this case, ECUM_WKSOURCE_RESET shall be assumed. | | |

**EcuM2165**: The list can be extended by configuration

**EcuM2166**: Extension values (see chapter 10.4 Configurable Parameters) must define single additional bits. The bit assignment shall be done by the configuration tool.

**EcuMf0002**: The following rule applies for extension values of type `EcuM_WakeupSourceType:`
`EcuMWakeupSourceId` defines the bit position of the corresponding wake up source in `EcuM_WakeupSourceType`.
Values `0` to `4` are not allowed for `EcuMWakeupSourceId` (pre-defined values in `EcuM_WakeupSourceType`)
Values `5` up to `31` in `EcuMWakeupSourceId` implies `0x00000020` up to `0x8000000000` in `EcuM_WakeupSourceType` (i.e. bit 5 up to bit 31).

**EcuM2601**: If hardware cannot detect a specific wake up source, then the ECU State Manager Fixed module shall report `ECUM_WKSOURCE_RESET` instead.

### 8.2.5 EcuM_WakeupStatusType

| | | | |
|---|---|---|---|
| ***Name:*** | `EcuM_WakeupStatusType` | | |
| ***Type:*** | `uint8` | | |
| ***Range:*** | `ECUM_WKSTATUS_NONE` | `0` | No pending wakeup event was detected |
| | `ECUM_WKSTATUS_PENDING` | `1` | The wakeup event was detected but not yet validated |
| | `ECUM_WKSTATUS_VALIDATED` | `2` | The wakeup event is valid |
| | `ECUM_WKSTATUS_EXPIRED` | `3` | The wakeup event has not been validated and has expired therefore |
| | `ECUM_WKSTATUS_DISABLED` | `4` | The wakeup source is disabled and does not detect wakeup events. |
| ***Description:*** | The type describes the possible states of a wakeup source. | | |

See also *8.3.4.5 EcuM_GetStatusOfWakeupSource*.

### 8.2.6 EcuM_WakeupReactionType

| | | | |
|---|---|---|---|
| ***Name:*** | `EcuM_WakeupReactionType` | | |
| ***Type:*** | `uint8` | | |
| ***Range:*** | `ECUM_WKACT_RUN` | `0` | Initialization into RUN state |
| | `ECUM_WKACT_TTII` | `2` | Execute time triggered increased inoperation protocol and shutdown |
| | `ECUM_WKACT_SHUTDOWN` | `3` | Immediate shutdown |
| ***Description:*** | The type describes the possible outcomes of the WAKEUP REACTION state. | | |

### 8.2.7 EcuM_BootTargetType

| | | | |
|---|---|---|---|
| ***Name:*** | `EcuM_BootTargetType` | | |
| ***Type:*** | `uint8` | | |
| ***Range:*** | `ECUM_BOOT_TARGET_APP` | `0` | The ECU will boot into the |

| | | | |
|---|---|---|---|
| | | | application |
| | ECUM_BOOT_TARGET_OEM_BOOTLOADER | 1 | The ECU will boot into the OEM bootloader |
| | ECUM_BOOT_TARGET_SYS_BOOTLOADER | 2 | The ECU will boot into the system supplier bootloader |
| ***Description:*** | This type represents the boot targets the ECU Manager module can be configured with. The default boot target is ECUM_BOOT_TARGET_OEM_BOOTLOADER. | | |

## 8.3 Function Definitions

### 8.3.1 General

#### 8.3.1.1 EcuM_GetVersionInfo

**EcuM2813**: EcuM_GetVersionInfo

| | | |
|---|---|---|
| ***Service name:*** | EcuM_GetVersionInfo | |
| ***Syntax:*** | `void EcuM_GetVersionInfo(`<br>`    Std_VersionInfoType* versioninfo`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | None | |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | versioninfo | Pointer to where to store the version information of this module. |
| ***Return value:*** | None | |
| ***Description:*** | Returns the version information of this module. | |

**EcuM2728**: This service returns the version information of this module. The version information includes:

- Module Id
- Vendor Id
- Vendor specific version numbers (BSW00407).

**EcuM2729**: This function shall be pre compile time configurable On/Off by the configuration parameter: ECUM_VERSION_INFO_API

**EcuMf034**: Parameter `versioninfo` of the function `EcuM_GetVersionInfo`:
An implementation shall cope with NULL pointers by returning immediately without any further action. If using DET, the implementation shall assert the `ECUM_E_NULL_POINTER` development error.

Hint:
If source code for caller and callee of this function is available this function should be realized as a macro. The macro should be defined in the modules header file.

### 8.3.2 Initialization and Shutdown

#### 8.3.2.1 EcuM_Init

**EcuM2811**:

| | |
|---|---|
| ***Service name:*** | EcuM_Init |
| ***Syntax:*** | `void EcuM_Init(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x01 |

| | |
|---|---|
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | Initializes the ECU state manager and carries out the startup procedure. The function will never return (it calls StartOS) |

#### 8.3.2.2 EcuM_StartupTwo

**EcuM2838**:

| | |
|---|---|
| ***Service name:*** | EcuM_StartupTwo |
| ***Syntax:*** | `void EcuM_StartupTwo(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x1a |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | This function implements the STARTUP II state. |

**EcuM2806**: This function must be called from a task which is started directly as a consequence of StartOS. I.e. either it must be called from an autostart task or it must be called from a task which is explicitely started.

#### 8.3.2.3 EcuM_Shutdown

**EcuM2812**:

| | |
|---|---|
| ***Service name:*** | EcuM_Shutdown |
| ***Syntax:*** | `void EcuM_Shutdown(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x02 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | Typically called from the shutdown hook, this function takes over execution control and will carry out GO OFF II activities. |

### 8.3.3 State Management

#### 8.3.3.1 EcuM_RequestRUN

**EcuM2814**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_RequestRUN | |
| ***Syntax:*** | `Std_ReturnType EcuM_RequestRUN(`<br>`    EcuM_UserType user`<br>`)` | |
| ***Service ID[hex]:*** | 0x03 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | user | ID of the entity requesting the RUN state. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | Std_ReturnType | E_OK: The request was accepted by EcuM.<br>E_NOT_OK: The request was not accepted by EcuM, a detailed error condition was sent to DET (see Error Codes below). |
| ***Description:*** | Places a request for the RUN state. Requests can be placed by every user made known to the state manager at configuration time. | |

**EcuM2143**: Requests of `EcuM_RequestRUN` cannot be nested, i.e. one user can only place one request but not more. Additional or duplicate user requests by the same user shall be reported to DET. Of course the DET will only be notified under development conditions.

**EcuM2144**: An implementation must track requests for each user known on the ECU. Run requests are specific to the user.

**EcuM2668**: RUN requests shall be ignored after `EcuM_KillAllRUNRequests` has been executed until the shutdown has completed.

Configuration of `EcuM_RequestRUN`: Refer to 8.2.3 EcuM_UserType for more information about user IDs and their generation.

Error Codes of `EcuM_RequestRUN`: `ECUM_E_MULTIPLE_RUN_REQUESTS`: On multiple requests by the same user ID

#### 8.3.3.2 EcuM_ReleaseRUN

**EcuM2815**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_ReleaseRUN | |
| ***Syntax:*** | `Std_ReturnType EcuM_ReleaseRUN(`<br>`    EcuM_UserType user`<br>`)` | |
| ***Service ID[hex]:*** | 0x04 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | user | ID of the entity releasing the RUN state. |
| ***Parameters*** | None | |

| | | |
|---|---|---|
| ***(inout):*** | | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | Std_ReturnType | E_OK: The release request was accepted by EcuM<br>E_NOT_OK: The release request was not accepted by EcuM, a detailed error condition was sent to DET (see Error Codes below). |
| ***Description:*** | Releases a RUN request previously done with a call to EcuM_RequestRUN. The service is intended for implementing AUTOSAR ports. | |

Configuration of `EcuM_ReleaseRUN`: Refer to 8.2.3 EcuM_UserType for more information about user IDs and their generation.

Error Codes of `EcuM_ReleaseRUN`: `ECUM_E_MISMATCHED_RUN_RELEASE`: On releasing without a matching request.

**EcuM2789**: The ECU State Manager Fixed module shall track requests by communication channels in exactly the same way as it tracks other users.

#### 8.3.3.3 EcuM_RequestPOST_RUN

**EcuM2819**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_RequestPOST_RUN | |
| ***Syntax:*** | `Std_ReturnType EcuM_RequestPOST_RUN(`<br>`    EcuM_UserType user`<br>`)` | |
| ***Service ID[hex]:*** | 0x0a | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | user | ID of the entity requesting the POST RUN state. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | Std_ReturnType | E_OK: The request was accepted by EcuM<br>E_NOT_OK: The request was not accepted by EcuM, a detailed error condition was sent to DET (see Error Codes below). |
| ***Description:*** | Places a request for the POST RUN state. Requests can be placed by every user made known to the state manager at configuration time.<br>Requests for RUN and POST RUN must be tracked independently (in other words: two independent variables).<br>The service is intended for implementing AUTOSAR ports. | |

All requirements of *8.3.3.1 EcuM_RequestRUN* apply accordingly to the function EcuM_RequestPOST_RUN.

Configuration of `EcuM_RequestPOST_RUN`: Refer to 8.2.3 EcuM_UserType for more information about user IDs and their generation.

Error Codes of `EcuM_RequestPOST_RUN`: `ECUM_E_MULTIPLE_RUN_REQUESTS`: On multiple requests by the same user ID.

#### 8.3.3.4 EcuM_ReleasePOST_RUN

**EcuM2820**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_ReleasePOST_RUN | |
| ***Syntax:*** | `Std_ReturnType EcuM_ReleasePOST_RUN( EcuM_UserType user )` | |
| ***Service ID[hex]:*** | 0x0b | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | user | ID of the entity releasing the POST RUN state. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | Std_ReturnType | E_OK: The release request was accepted by EcuM<br>E_NOT_OK: The release request was not accepted by EcuM, a detailed error condition was sent to DET (see Error Codes below). |
| ***Description:*** | Releases a POST RUN request previously done with a call to EcuM_RequestPOST_RUN. The service is intended for implementing AUTOSAR ports. | |

Configuration of `EcuM_ReleasePOST_RUN`: Refer to 8.2.3 EcuM_UserType for more information about user IDs and their generation.

Error Codes of `EcuM_ReleasePOST_RUN`: `ECUM_E_MISMATCHED_RUN_RELEASE`: On releasing without a matching request.

#### 8.3.3.5 EcuM_KillAllRUNRequests

**EcuM2821**

| | |
|---|---|
| ***Service name:*** | EcuM_KillAllRUNRequests |
| ***Syntax:*** | `void EcuM_KillAllRUNRequests( void )` |
| ***Service ID[hex]:*** | 0x05 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | The benefit of this function over an ECU reset is that the shutdown sequence is executed, which e.g. takes care of writing back NV memory contents. |

**EcuM1872**: The function unconditionally clears all requests to RUN.
Note: As an effect the ECU State Manager switches to RUN III state (see also **EcuM2311**), which allows for a controlled shutdown.

**EcuM2600**: As a consequence `EcuM_RequestRUN` must not accept any new requests unless the resulting shutdown has been completed.

Caveat of `EcuM_KillAllRUNRequests`: Use this function with care. Side effects may occur in the application. If an implementation contains synchronization for more graceful shutdown a timeout must be provided to ensure that the shutdown process is initiated.

Error Codes of `EcuM_KillAllRUNRequests`:
`ECUM_E_ALL_RUN_REQUESTS_KILLED`: On each invocation.

#### 8.3.3.6 EcuM_SelectShutdownTarget

**EcuM2822**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_SelectShutdownTarget | |
| ***Syntax:*** | `Std_ReturnType EcuM_SelectShutdownTarget(`<br>`    EcuM_StateType target,`<br>`    uint8 mode`<br>`)` | |
| ***Service ID[hex]:*** | 0x06 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | target | The selected shutdown target. |
| | mode | The identfier of a sleep mode (if target is ECUM_STATE_SLEEP) or a reset mechanism (if target is ECUM_STATE_RESET) as defined by configuration. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | Std_ReturnType | E_OK: The new shutdown target was set<br>E_NOT_OK: The new shutdown target was not set |
| ***Description:*** | EcuM_SelectShutdownTarget selects the shutdown target.<br>EcuM_SelectShutdownTarget is part of the ECU Manager Module port interface. | |

**EcuM624**: Parameter mode of the function EcuM_SelectShutdownTarget: The selected shutdown target. Only the following subset of the EcuM_StateType value range is accepted:

- ECUM_STATE_SLEEP
- ECUM_STATE_RESET
- ECUM_STATE_OFF

All other values will be rejected and result in a development error message `ECUM_E_STATE_PAR_OUT_OF_RANGE` must be thrown.

**EcuM2185**: The parameter mode of the function `EcuM_SelectShutdownTarget` shall be the identifier of a sleep mode. The mode parameter shall only be used if the target parameter equals `ECUM_STATE_SLEEP`. In all other cases, it shall be ignored. Only sleep modes that are defined at configuration time and are stored in the EcuMSleepMode container are allowed as parameters.

**EcuM2585**: An implementation of this service should not initiate any setup activities but only store the value for later use in the `SHUTDOWN` state.

**EcuM2228**: An implementation must preload the TTII divisor counter variable with the preload value defined in the *ECUM_TTII_DIVISOR_LIST*.
The service is intended for implementing AUTOSAR ports.

Caveat of EcuM_SelectShutdownTarget: The ECU State Manager Fixed module does not define any mechanism to resolve issues arising from requests from different sources. Always the last set values will be used as shutdown target. It is assumed that there will be one piece of application which is specific to the ECU and handles these kinds of issues.

#### 8.3.3.7 EcuM_GetShutdownTarget

**EcuM2824**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_GetShutdownTarget | |
| ***Syntax:*** | `Std_ReturnType EcuM_GetShutdownTarget(`<br>`    EcuM_StateType* shutdownTarget,`<br>`    uint8* sleepMode`<br>`)` | |
| ***Service ID[hex]:*** | 0x09 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | None | |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | shutdownTarget | One of these values is returned:<br>• ECUM_STATE_SLEEP<br>• ECUM_STATE_RESET<br>• ECUM_STATE_OFF |
| | sleepMode | If the out parameter "shutdownTarget" is ECUM_STATE_SLEEP, sleepMode tells which of the configured sleep modes was actually chosen. If "shutdownTarget" is ECUM_STATE_RESET, sleepMode tells which of the configured reset modes was actually chosen. |
| ***Return value:*** | Std_ReturnType | E_OK: The service has succeeded<br>E_NOT_OK: The service has failed, e.g. due to NULL pointer being passed |
| ***Description:*** | EcuM_GetShutdownTarget returns the currently selected shutdown target as set by EcuM_SelectShutdownTarget.<br>EcuM_GetShutdownTarget is part of the ECU Manager Module port interface. | |

**EcuM2788**: Parameter sleepMode and shutdownTarget of the function EcuM_GetShutdownTarget: An implementation shall cope with NULL pointers by simply ignoring the out parameter in all cases. If using DET, the implementation shall assert the ECUM_E_NULL_POINTER development error.

#### 8.3.3.8 EcuM_GetLastShutdownTarget

**EcuM2825**:

| | |
|---|---|
| ***Service name:*** | EcuM_GetLastShutdownTarget |
| ***Syntax:*** | `Std_ReturnType EcuM_GetLastShutdownTarget(`<br>`    EcuM_StateType* shutdownTarget,`<br>`    uint8* sleepMode`<br>`)` |

| | | |
|---|---|---|
| ***Service ID[hex]:*** | 0x08 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | None | |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | shutdownTarget | One of these values is returned:<br>• ECUM_STATE_SLEEP<br>• ECUM_STATE_RESET<br>• ECUM_STATE_OFF |
| | sleepMode | If the out parameter "shutdownTarget" is ECUM_STATE_SLEEP, sleepMode tells which of the configured sleep modes was actually chosen. If "shutdownTarget" is ECUM_STATE_RESET, sleepMode tells which of the configured reset modes was actually chosen. |
| ***Return value:*** | Std_ReturnType | E_OK: The service has succeeded<br>E_NOT_OK: The service has failed, e.g. due to NULL pointer being passed |
| ***Description:*** | EcuM_GetLastShutdownTarget returns the shutdown target of the previous shutdown process.<br>EcuM_GetLastShutdownTarget is part of the ECU Manager Module port interface. | |

**EcuM2336**: Parameter `sleepMode` of the function `EcuM_GetLastShutdownTarget`: If the return parameter is `ECUM_STATE_SLEEP`, this out parameter tells which of the configured sleep modes was actually chosen.

**EcuM2337**: Parameters `sleepMode` and `shutdownTarget` of the function `EcuM_GetLastShutdownTarget`: An implementation shall cope with NULL pointers by simply ignoring the out parameter in all cases. If using DET, the implementation shall assert the `ECUM_E_NULL_POINTER` development error.

**EcuM2156**: The return value describes the ECU state from which the last wake up or power up occurred. This function shall return always the same value until the next shutdown.

**EcuM2157**: This function is intended for primary use in `STARTUP` or `RUN` state. Reasonable use cases exist there. To simplify implementation, it is acceptable if the value is set in late shutdown phase for use during the next startup. If so, implementation specific limitations must be clearly documented.

#### 8.3.3.9 EcuM_GetState

**EcuM2823**:

| | |
|---|---|
| ***Service name:*** | EcuM_GetState |
| ***Syntax:*** | `Std_ReturnType EcuM_GetState(`<br>`    EcuM_StateType* state`<br>`)` |
| ***Service ID[hex]:*** | 0x07 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |

| | | |
|---|---|---|
| ***Parameters (out):*** | state | The value of the internal state variable. |
| ***Return value:*** | Std_ReturnType | E_OK: The out parameter was set successfully.<br>E_NOT_OK: The out parameter was not set. |
| ***Description:*** | Gets a state. | |

**EcuM2423**: The service must be accessible from an OS and an OS-free context as well as from an interrupt context.

### 8.3.4 Wake up Handling

#### 8.3.4.1 EcuM_GetPendingWakeupEvents

**EcuM2827**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_GetPendingWakeupEvents | |
| ***Syntax:*** | `EcuM_WakeupSourceType EcuM_GetPendingWakeupEvents( void )` | |
| ***Service ID[hex]:*** | 0x0d | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non-Reentrant, Non-Interruptible | |
| ***Parameters (in):*** | None | |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | EcuM_WakeupSourceType | All wakeup events |
| ***Description:*** | Gets pending wakeup events. | |

**EcuM1156**: Return code of the function `EcuM_GetPendingWakeupEvents`: Returns wake up events which have been set but not yet validated.

**EcuM2172**: The service `EcuM_GetPendingWakeupEvents` must be callable from interrupt context, from OS context and an OS-free context.

Caveat of `EcuM_GetPendingWakeupEvents`: The wake up events returned by this service are only pending

#### 8.3.4.2 EcuM_ClearWakeupEvent

**EcuM2828**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_ClearWakeupEvent | |
| ***Syntax:*** | `void EcuM_ClearWakeupEvent( EcuM_WakeupSourceType sources )` | |
| ***Service ID[hex]:*** | 0x16 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non-Reentrant, Non-Interruptible | |
| ***Parameters (in):*** | sources | Events to be cleared |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | Clears wakeup events. | |

**EcuM2683**:`EcuM_ClearWakeupEvent` shall clear all wake up events like pending, validated and expired events.

**EcuM2807**: The function must be callable from interrupt context, from OS context and an OS-free context.

#### 8.3.4.3 EcuM_GetValidatedWakeupEvents

**EcuM2830**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_GetValidatedWakeupEvents | |
| ***Syntax:*** | `EcuM_WakeupSourceType EcuM_GetValidatedWakeupEvents(`<br>`    void`<br>`)` | |
| ***Service ID[hex]:*** | 0x15 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non-Reentrant, Non-Interruptible | |
| ***Parameters (in):*** | None | |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | EcuM_WakeupSourceType | All wakeup events |
| ***Description:*** | Gets validated wakeup events. | |

**EcuM2533**: Return code of `EcuM_GetValidatedWakeupEvents`: Returns the value from the internal variable.

**EcuM2532**: The service must be callable from interrupt context, from OS context and an OS-free context.

#### 8.3.4.4 EcuM_GetExpiredWakeupEvents

**EcuM2831**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_GetExpiredWakeupEvents | |
| ***Syntax:*** | `EcuM_WakeupSourceType EcuM_GetExpiredWakeupEvents(`<br>`    void`<br>`)` | |
| ***Service ID[hex]:*** | 0x19 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non-Reentrant, Non-Interruptible | |
| ***Parameters (in):*** | None | |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | EcuM_WakeupSourceType | All wakeup events: Returns all events that have been set and for which validation has failed. Events which do not need validation must never be reported by this function. |
| ***Description:*** | Gets expired wakeup events. | |

**EcuM2589**: The service `EcuM_GetExpiredWakeupEvents` must be callable from interrupt context, from OS context and an OS-free context.

#### 8.3.4.5 EcuM_GetStatusOfWakeupSource

**EcuM2832**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_GetStatusOfWakeupSource | |
| ***Syntax:*** | `EcuM_WakeupStatusType EcuM_GetStatusOfWakeupSource(`<br>`    EcuM_WakeupSourceType sources`<br>`)` | |
| ***Service ID[hex]:*** | 0x17 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | sources | The sources for which the status is returned |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | EcuM_WakeupStatusType | Sum status of all wakeup sources passed in the in parameter. |
| ***Description:*** | The sum status shall be computed according to the following algorithm:<br>If (EcuM_GetValidatedWakeupEvents() AND sources) is not 0 then return ECUM_WKSTATUS_VALIDATED.<br>If (EcuM_GetPendingWakeupEvents() AND sources) is not 0 then return ECUM_WKSTATUS_PENDING.<br>If (EcuM_GetExpiredWakeupEvents() AND sources) is not 0 then return ECUM_WKSTATUS_EXPIRED.<br>Otherwise, return ECUM_WKSTATUS_NONE. | |

**EcuM2754**: When the `EcuM_GetStatusOfWakeupSource` service is called and parameter “sources” equals 0, then this service shall return `ECUM_WKSTATUS_NONE`. If parameter “sources” equals `ECUM_WKSOURCE_ALL_SOURCES`, then this service shall return the sum status of all configured wake up sources.

**EcuM2864**: If parameter “sources” contains an unknown (unconfigured) wake up source and is not `ECUM_WKSOURCE_ALL_SOURCES`, then the sum status of all known sources listed in parameter “sources” shall be returned. If Development Error Reporting is turned on, the service shall send the `ECUM_E_UNKNOWN_WAKEUP_SOURCE` error message to DET.

### 8.3.5 Miscellaneous

#### 8.3.5.1 EcuM_SelectBootTarget

**EcuM2835**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_SelectBootTarget | |
| ***Syntax:*** | `Std_ReturnType EcuM_SelectBootTarget(`<br>`    EcuM_BootTargetType target`<br>`)` | |
| ***Service ID[hex]:*** | 0x12 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | target | The selected boot target. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | Std_ReturnType | E_OK: The new boot target was accepted by EcuM<br>E_NOT_OK: The new boot target was not accepted by EcuM |
| ***Description:*** | EcuM_SelectBootTarget selects a boot target.<br>EcuM_SelectBootTarget is part of the ECU Manager Module port interface. | |

**EcuM2247**: The service must store the selected target in a way which is compatible with the boot loader. This may mean format AND location. The service is intended for implementing AUTOSAR ports.

Caveat of the function `EcuM_SelectBootTarget`: This service may be dependent on the available hardware and the boot loader used.

The implementation of this service will not be prescribed by AUTOSAR. The implementer of the service `EcuM_SelectBootTarget` has to ensure to place the boot target information at a safe location, which then shall be evaluated by the boot manager after a reset.

This service is only intended for use by SW-C's related to diagnostics (boot management).

Note: In the definition of `EcuM_BootTargetType` a default boot target is defined. So even in case of E_NOT_OK, a valid boot targed is defined.

#### 8.3.5.2 EcuM_GetBootTarget

**EcuM2836**:

| | |
|---|---|
| ***Service name:*** | EcuM_GetBootTarget |
| ***Syntax:*** | `Std_ReturnType EcuM_GetBootTarget(`<br>`    EcuM_BootTargetType * target`<br>`)` |
| ***Service ID[hex]:*** | 0x13 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters*** | None |

| | | |
|---|---|---|
| ***(inout):*** | | |
| ***Parameters (out):*** | target | The currently selected boot target. |
| ***Return value:*** | Std_ReturnType | E_OK: The service always succeeds. |
| ***Description:*** | EcuM_GetBootTarget returns the current boot target - see EcuM_SelectBootTarget.<br>EcuM_GetBootTarget is part of the ECU Manager Module port interface. | |

Since the information of the boot target shall also be evaluated by the boot loader, the service EcuM_GetBootTarget must be available without the context of the RTE, the OS, or even the C language! If this is not implementable, the implementer has to offer and document another API which then is available for the boot loader.

**EcuMf035**: Parameter `target` of the function `EcuM_GetBootTarget`: An implementation shall cope with NULL pointers by simply ignoring the out parameter in all cases. If using DET, the implementation shall assert the `ECUM_E_NULL_POINTER` development error.

Note: In the definition of `EcuM_BootTargetType` a default boot target is defined. So even if `EcuM_SelectBootTarget` was not called beforehand, a valid boot targed is defined.

## 8.4 Scheduled Functions

These functions are directly called by Basic Software Scheduler. The following functions shall have no return value and no parameter. All functions shall be non reentrant.

### 8.4.1 EcuM_MainFunction

**EcuM2837**:

| | |
|---|---|
| ***Service name:*** | EcuM_MainFunction |
| ***Syntax:*** | `void EcuM_MainFunction(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x18 |
| ***Timing:*** | VARIABLE_CYCLIC |
| ***Description:*** | The purpose of this service is to implement all activities of the ECU State Manager while the OS is up and running. |

**EcuM2594**: This service must be called on a periodic basis from an adequate BSW task (i.e. a task under control of the BSW scheduler).
To determine the period, the system designer should consider the following timings:

- The period directly results in a possible latency for testing RUN requests. The largest acceptable reaction time will therefore limit the maximum period for invocation.
- The service will also carry out the wake up validation protocol (see *7.8 Wake-up Validation Protocol*). The smallest validation timeout typically should limit the period.
- As a rule of thumb, the period of this service should be in the order of half as long as the shortest time constant mentioned in the topics above.

**EcuM2656**: The service shall not be called from tasks which may invoke runnable entities.

**EcuMf0029**: If the `EcuM_MainFunction` is called without having called `EcuM_Init` in advance (so the EcuM is un-initialized) the `EcuM_MainFunction` shall return immediately without performing any functionality and without raising any errors.

## 8.5 Callback Definitions

### 8.5.1 Callbacks from NVRAM Manager

#### 8.5.1.1 EcuM_CB_NfyNvMJobEnd

**EcuM2839**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_CB_NfyNvMJobEnd | |
| ***Syntax:*** | `void EcuM_CB_NfyNvMJobEnd(`<br>`    uint8 ServiceId,`<br>`    NvM_RequestResultType JobResult`<br>`)` | |
| ***Service ID[hex]:*** | 0x65 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | ServiceId | Unique Service ID of NVRAM manager service. |
| | JobResult | Covers the job result of the previous processed multi block job. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | Used to notify about the end of NVRAM jobs initiated by EcuM<br>The callback must be callable from normal and interrupt execution contexts. | |

Configuration of `EcuM_CB_NfyNvMJobEnd`: NVRAM manager must be configured to call this callback as a multiple block job end notification. See [11] for details.

### 8.5.2 Callbacks from Wake up Sources

#### 8.5.2.1 EcuM_CheckWakeup

See *8.6.6.28.6.6.2* EcuM_CheckWakeup*EcuM_CheckWakeup* for a description of the service.

This service is a Callout of the ECU State Manager Fixed module as well as a Callback that wake up sources invoke when they process wake up interrupts.

#### 8.5.2.2 EcuM_SetWakeupEvent

**EcuM2826**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_SetWakeupEvent | |
| ***Syntax:*** | `void EcuM_SetWakeupEvent(`<br>`    EcuM_WakeupSourceType sources`<br>`)` | |
| ***Service ID[hex]:*** | 0x0c | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non-Reentrant, Non-Interruptible | |
| ***Parameters (in):*** | sources | Value to be set |
| ***Parameters (inout):*** | None | |

| | |
|---|---|
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | Sets the wakeup event. |

**EcuM1117**: Takes the value and stores it in an internal variable (OR-operation).

**EcuM2707**: The service must start the wake up validation timeout timer according to chapter *7.8.4 Wake up validation timeout.*

**EcuM2867**: If Development Error Reporting is turned on and parameter “sources” contains an unknown (unconfigured) wake up source, the service shall ignore the call and send the ECUM_E_UNKNOWN_WAKEUP_SOURCE error message to DET.

**EcuM2171**: The function must be callable from interrupt context, from OS context and an OS-free context.

#### 8.5.2.3 EcuM_ValidateWakeupEvent

**EcuM2829**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_ValidateWakeupEvent | |
| ***Syntax:*** | `void EcuM_ValidateWakeupEvent(`<br>`    EcuM_WakeupSourceType sources`<br>`)` | |
| ***Service ID[hex]:*** | 0x14 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Reentrant | |
| ***Parameters (in):*** | sources | Events that have been validated |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | After wakeup, the ECU State Manager will stop the process during the WAKEUP VALIDATION state/sequence to wait for validation of the wakeup event.This API service is used to indicate to the ECU Manager module that the wakeup events indicated in the sources parameter have been validated. | |

**EcuM2344**: The validation shall be valid when ANDing the parameter `events` with the internal variable of pending wake up events results in a value other than null.

**EcuM2645**: The service shall invoke `ComM_EcuM_WakeUpIndication` of the Communication Manager for each wake up event if the EcuMComMChannelRef parameter in the EcuMWakeupSource configuration container for the corresponding wake up source is configured.

**EcuM2868**: If Development Error Reporting is turned on and parameter “sources” contains an unknown (unconfigured) wake up source, the service shall ignore the call and send the `ECUM_E_UNKNOWN_WAKEUP_SOURCE` error message to DET.

**EcuM2345**: The function must be callable from interrupt context, from OS context, and an OS-free context.

**EcuM2790**: The service shall return without effect for all sources except communication channels when called while ECU State Manager Fixed module is NOT in one of the states: SHUTDOWN, SLEEP, WAKEUP I, WAKEUP VALIDATION, and STARTUP.

**EcuM2791**: The service shall have full effect in any state for those sources which correspond to a communication channel (see EcuM2645), if RUN has not yet been requested for this channel.

## 8.6 Callout Definitions

Callouts are pieces of code that have to be added to the ECU State Manager Fixed module during ECU integration. The content of most callouts is hand-written code, for some callouts the ECU State Manager Fixed module configuration tool shall generate a default implementation that is manually edited by the integrator. Conceptually, these callouts belong to the ECU State Manager Fixed module .

Since callouts are no services of the ECU State Manager Fixed module they do not have an assigned Service ID.

### 8.6.1 Generic Callouts

#### 8.6.1.1 EcuM_ErrorHook

**EcuM2904**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_ErrorHook | |
| ***Syntax:*** | `void EcuM_ErrorHook(`<br>`    Std_ReturnType reason`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | reason | Reason for calling the error hook |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | The ECU State Manager will call the error hook if the error codes "ECUM_E_RAM_CHECK_FAILED" or "ECUM_E_CONFIGURATION_DATA_INCONSISTENT" occur. In this situation it is not possible to continue processing and the ECU must be stopped. The integrator may choose the modality how the ECU is stopped, i.e. reset, halt, restart, safe state etc. | |

Invocation of `EcuM_ErrorHook`: in all states

Class of `EcuM_ErrorHook`: Mandatory

EcuM_ErrorHook is integration code and the integrator is free to define additional individual error codes to be passed as the `reason` parameter. These error codes shall not conflict with the development and production error codes as defined in Table 1 and Table 5 nor with the standard error codes i.e. E_OK, E_NOT_OK, etc.

### 8.6.2 Callouts from STARTUP

#### 8.6.2.1 EcuM_AL_DriverInitZero

**EcuM2905**:

| | |
|---|---|
| ***Service name:*** | EcuM_AL_DriverInitZero |

| | | |
|---|---|---|
| ***Syntax:*** | `void EcuM_AL_DriverInitZero(`<br>`    void`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | None | |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | This callout shall provide driver initialization and other hardware-related startup activities for loading the post-build configuration data. Beware: Here only pre-compile and link-time configurable modules may be used. | |

Invocation of `EcuM_AL_DriverInitZero`: Early in STARTUP I

The ECU State Manager Fixed module configuration tool shall generate a default implementation of the EcuM_AL_DriverInitZero callout from the sequence of modules defined in the EcuMDriverInitListZero configuration container. See EcuM2559 and EcuM2730.

### 8.6.2.2 EcuM_DeterminePbConfiguration

**EcuM2906**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_DeterminePbConfiguration | |
| ***Syntax:*** | `EcuM_ConfigType* EcuM_DeterminePbConfiguration(`<br>`    void`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | None | |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | EcuM_ConfigType* | Pointer to the EcuM post-build configuration which contains pointers to all other BSW module post-build configurations. |
| ***Description:*** | This callout should evaluate some condition, like port pin or NVRAM value, to determine which post-build configuration shall be used in the remainder of the startup process. It shall load this configuration data into a piece of memory that is accessible by all BSW modules and shall return a pointer to the EcuM post-build configuration as a base for all BSW module post-build configrations. | |

Invocation of `EcuM_DeterminePbConfiguration`: Early in STARTUP I

Content is manually written.

#### 8.6.2.3 EcuM_AL_DriverInitOne

**EcuM2907**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_AL_DriverInitOne | |
| ***Syntax:*** | `void EcuM_AL_DriverInitOne( const EcuM_ConfigType* ConfigPtr )` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | ConfigPtr | Pointer to the EcuM post-build configuration which contains pointers to all other BSW module post-build configurations. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | This callout shall provide driver initialization and other hardware-related startup activities in case of a power on reset. | |

Invocation of `EcuM_AL_DriverInitOne`: In STARTUP I

The ECU State Manager Fixed module configuration tool shall generate a default implementation of the `EcuM_AL_DriverInitOne` callout from the sequence of modules defined in the `EcuMDriverInitListOne` configuration container. See EcuM2559 and EcuM2730.

Besides driver initialization, the following initialization sequences should be considered in this block: MCU initialization according to AUTOSAR_SWS_Mcu_Driver chapter 9.1.

#### 8.6.2.4 EcuM_AL_DriverInitTwo

**EcuM2908**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_AL_DriverInitTwo | |
| ***Syntax:*** | `void EcuM_AL_DriverInitTwo( const EcuM_ConfigType* ConfigPtr )` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | ConfigPtr | Pointer to the EcuM post-build configuration which contains pointers to all other BSW module post-build configurations. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | This callout shall provide driver initialization of drivers which need OS and do not need to wait for the NvM_ReadAll job to finish. | |

Invocation of `EcuM_AL_DriverInitTwo`: In STARTUP II

The ECU State Manager Fixed module configuration tool shall generate a default implementation of the `EcuM_AL_DriverInitTwo` callout from the sequence of modules defined in the `EcuMDriverInitListTwo` configuration container. See EcuM2559 and EcuM2730.

#### 8.6.2.5 EcuM_AL_DriverInitThree

**EcuM2909**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_AL_DriverInitThree | |
| ***Syntax:*** | `void EcuM_AL_DriverInitThree(`<br>`    const EcuM_ConfigType* ConfigPtr`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | ConfigPtr | Pointer to the EcuM post-build configuration which contains pointers to all other BSW module post-build configurations. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | This callout shall provide driver initialization of drivers which need OS and need to wait for the NvM_ReadAll job to finish. | |

Invocation of `EcuM_AL_DriverInitThree`: In STARTUP II

The ECU State Manager Fixed module configuration tool shall generate a default implementation of the `EcuM_AL_DriverInitThree` callout from the sequence of modules defined in the `EcuMDriverInitListThree` configuration container. See EcuM2559 and EcuM2730.

#### 8.6.2.6 EcuM_OnRTEStartup

**EcuM2910**:

| | |
|---|---|
| ***Service name:*** | EcuM_OnRTEStartup |
| ***Syntax:*** | `void EcuM_OnRTEStartup(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | -- |

Invocation of `EcuM_OnRTEStartup`: Just before calling RTE_Start

### 8.6.3 Callouts from RUN State

#### 8.6.3.1 EcuM_OnEnterRun

**EcuM2911**:

| | |
|---|---|
| ***Service name:*** | EcuM_OnEnterRun |
| ***Syntax:*** | `void EcuM_OnEnterRun(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | On entry of RUN state is very similar to “just after startup”. This call allows the system designer to notify that RUN state has been reached. |

Invocation of `EcuM_OnEnterRun`: On entry of RUN state.

#### 8.6.3.2 EcuM_OnExitRun

**EcuM2912**:

| | |
|---|---|
| ***Service name:*** | EcuM_OnExitRun |
| ***Syntax:*** | `void EcuM_OnExitRun(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | This call allows the system designer to notify that the APP RUN state is about to be left. |

Invocation of `EcuM_OnExitRun`: By `EcuM_ReleaseRUN` upon detection that the last run request has been released.

#### 8.6.3.3 EcuM_OnExitPostRun

**EcuM2913**:

| | |
|---|---|
| ***Service name:*** | EcuM_OnExitPostRun |
| ***Syntax:*** | `void EcuM_OnExitPostRun(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |

| | |
|---|---|
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | This call allows the system designer to notify that the APP POST RUN state is about to be left. |

Invocation of `EcuM_OnExitPostRun`: By `EcuM_ReleasePOST_RUN` upon detection that the last post run request has been released.

### 8.6.4 Callouts from SHUTDOWN

#### 8.6.4.1 EcuM_OnPrepShutdown

**EcuM2914**:

| | |
|---|---|
| ***Service name:*** | EcuM_OnPrepShutdown |
| ***Syntax:*** | `void EcuM_OnPrepShutdown(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | This call allows the system designer to notify that the PREP SHUTDOWN state is about to be entered. |

Invocation of `EcuM_OnPrepShutdown`: On entry of PREP SHUTDOWN

#### 8.6.4.2 EcuM_OnGoSleep

**EcuM2915**:

| | |
|---|---|
| ***Service name:*** | EcuM_OnGoSleep |
| ***Syntax:*** | `void EcuM_OnGoSleep(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | This call allows the system designer to notify that the GO SLEEP state is about to |

| | |
|---|---|
| | be entered. |

Invocation of `EcuM_OnGoSleep`: On entry of GO SLEEP

#### 8.6.4.3 EcuM_OnGoOffOne

**EcuM2916**:

| | |
|---|---|
| ***Service name:*** | EcuM_OnGoOffOne |
| ***Syntax:*** | `void EcuM_OnGoOffOne(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | This call allows the system designer to notify that the GO OFF I state is about to be entered. |

Invocation of `EcuM_OnGoOffOne`: On entry of GO OFF I

#### 8.6.4.4 EcuM_OnGoOffTwo

**EcuM2917**:

| | |
|---|---|
| ***Service name:*** | EcuM_OnGoOffTwo |
| ***Syntax:*** | `void EcuM_OnGoOffTwo(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | This call allows the system designer to notify that the GO OFF II state is about to be entered. |

Invocation of `EcuM_OnGoOffTwo`: On entry of GO OFF II

#### 8.6.4.5 EcuM_EnableWakeupSources

**EcuM2918**:

| | |
|---|---|
| ***Service name:*** | EcuM_EnableWakeupSources |
| ***Syntax:*** | `void EcuM_EnableWakeupSources(`<br>`    EcuM_WakeupSourceType wakeupSource` |

| | | |
|---|---|---|
| | ) | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | wakeupSource | -- |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | The ECU Manager Module calls EcuM_EnableWakeupSource to allow the system designer to notify wakeup sources defined in the wakeupSource bitfield that SLEEP will be entered and to adjust their source accordingly. | |

**EcuM2546**: The ECU State Manager Fixed module needs to derive the wake up sources to be enabled for the from configuration information.

Invocation of `EcuM_EnableWakeupSources`: From GOSLEEP II

#### 8.6.4.6 EcuM_GenerateRamHash

**EcuM2919**:

| | |
|---|---|
| ***Service name:*** | EcuM_GenerateRamHash |
| ***Syntax:*** | `void EcuM_GenerateRamHash(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | see EcuM_CheckRamHash |

#### 8.6.4.7 EcuM_AL_SwitchOff

**EcuM2920**:

| | |
|---|---|
| ***Service name:*** | EcuM_AL_SwitchOff |
| ***Syntax:*** | `void EcuM_AL_SwitchOff(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | This callout shall take the code for shutting off the power supply of the ECU. If the ECU cannot unpower itself, a reset may be an adequate reaction. |

Invocation of `EcuM_AL_SwitchOff`: Last activity in SHUTDOWN II

**Note**: In some cases of HW/SW concurrency, it may happen that during the power down in `EcuM_AL_SwitchOff` (endless loop) some hardware (e.g. a CAN transceiver) switches on the ECU again. In this case the ECU may be in a deadlock until the hardware watchdog resets the ECU. To reduce the time until the hardware watchdog fixes this deadlock, the integrator code in `EcuM_AL_SwitchOff` as last action can limit the endless loop and after a sufficient long time reset the ECU using `Mcu_PerformReset()`.

### 8.6.5 Callouts from WAKEUP

#### 8.6.5.1 EcuM_CheckRamHash

**EcuM2921**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_CheckRamHash | |
| ***Syntax:*** | `uint8 EcuM_CheckRamHash(`<br>`    void`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | None | |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | uint8 | 0: RAM integrity test failed<br>else: RAM integrity test passed |
| ***Description:*** | This callout is intended to provide a RAM integrity test. The goal of this test is to ensure that after a long SLEEP duration, RAM contents is still consistent. The check does not need to be exhaustive since this would consume quite some processing time during wakeups. A well designed check will execute quickly and detect RAM integrity defects with a sufficient probability.<br>This specification does not make any assumption about the algorithm chosen for a particular ECU.<br>The areas of RAM which will be checked have to be chosen carefully. It depends on the check algorithm itself and the task structure. Stack contents of the task executing the RAM check e.g. very likely cannot be checked. It is good practice to have the hash generation and checking in the same task and that this task is not preemptible and that there is only little activity between hash generation and hash check.<br>The RAM check itself is provided by the system designer.<br>In case of applied multi core and existence of Satellite-EcuM(s): this API will be called by the Master-EcuM only. | |

#### 8.6.5.2 EcuM_DisableWakeupSources

**EcuM2922**:

| | |
|---|---|
| ***Service name:*** | EcuM_DisableWakeupSources |
| ***Syntax:*** | `void EcuM_DisableWakeupSources(`<br>`    EcuM_WakeupSourceType wakeupSource` |

| | | |
|---|---|---|
| | ) | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | wakeupSource | -- |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | The ECU Manager Module calls EcuM_DisableWakeupSources to set the wakeup source(s) defined in the wakeupSource bitfield so that they are not able to wake the ECU up. | |

Invocation of `EcuM_DisableWakeupSources`: In WAKEUP I

#### 8.6.5.3 EcuM_AL_DriverRestart

**EcuM2923**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_AL_DriverRestart | |
| ***Syntax:*** | `void EcuM_AL_DriverRestart(`<br>`    const EcuM_ConfigType* ConfigPtr`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | ConfigPtr | Pointer to the EcuM post-build configuration which contains pointers to all other BSW module post-build configurations. |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | This callout shall provide driver initialization and other hardware-related startup activities in the wakeup case. | |

Invocation of `EcuM_AL_DriverRestart`: In WAKEUP I

The ECU State Manager Fixed module configuration tool shall generate a default implementation of the `EcuM_AL_DriverRestart` callout from the sequence of modules defined in the `EcuMDriverRestartList` configuration container. See EcuM2561, EcuM2559 and EcuM2730.

#### 8.6.5.4 EcuM_StartWakeupSources

**EcuM2924**:

| | |
|---|---|
| ***Service name:*** | EcuM_StartWakeupSources |
| ***Syntax:*** | `void EcuM_StartWakeupSources(`<br>`    EcuM_WakeupSourceType wakeupSource`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |

| | | |
|---|---|---|
| ***Parameters (in):*** | wakeupSource | -- |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | The callout shall start the given wakeup source(s) so that they are ready to perform wakeup validation. | |

Invocation of `EcuM_StartWakeupSources`: In WAKEUP VALIDATION

#### 8.6.5.5 EcuM_CheckValidation

**EcuM2925**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_CheckValidation | |
| ***Syntax:*** | `void EcuM_CheckValidation(`<br>`    EcuM_WakeupSourceType wakeupSource`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | wakeupSource | -- |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | This callout is called by the EcuM to validate a wakeup source. If a valid wakeup has been detected, it shall be reported to EcuM via EcuM_ValidateWakeupEvent(). | |

Invocation of `EcuM_CheckValidation`: In WAKEUP VALIDATION

#### 8.6.5.6 EcuM_StopWakeupSources

**EcuM2926**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_StopWakeupSources | |
| ***Syntax:*** | `void EcuM_StopWakeupSources(`<br>`    EcuM_WakeupSourceType wakeupSource`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | wakeupSource | -- |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | The callout shall stop the given wakeup source(s) after unsuccessful wakeup validation. | |

Invocation of `EcuM_StopWakeupSources`: In WAKEUP VALIDATION

#### 8.6.5.7 EcuM_OnWakeupReaction

**EcuM2927**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_OnWakeupReaction | |
| ***Syntax:*** | `EcuM_WakeupReactionType EcuM_OnWakeupReaction(`<br>`    EcuM_WakeupReactionType wact`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | wact | The wakeup reaction computed by ECU State Manager |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | EcuM_WakeupReactionType | All values: The desired wakeup reaction. |
| ***Description:*** | This callout gives the system designer the chance to intercept the automatic boot behavior and to override the wakeup reaction computed from wakeup source. | |

Invocation of `EcuM_OnWakeupReaction`: In WAKEUP REACTION after default computation of wake up reaction.

### 8.6.6 Callouts from SLEEP State

#### 8.6.6.1 EcuM_SleepActivity

**EcuM2928**:

| | |
|---|---|
| ***Service name:*** | EcuM_SleepActivity |
| ***Syntax:*** | `void EcuM_SleepActivity(`<br>`    void`<br>`)` |
| ***Service ID[hex]:*** | 0x00 |
| ***Sync/Async:*** | Synchronous |
| ***Reentrancy:*** | Non Reentrant |
| ***Parameters (in):*** | None |
| ***Parameters (inout):*** | None |
| ***Parameters (out):*** | None |
| ***Return value:*** | None |
| ***Description:*** | This callout is invoked periodically in all reduced clock sleep modes.<br>It is explicitely allowed to poll wakeup sources from this callout and to call wakeup notification functions to indicate the end of the sleep state to the ECU State Manager. |

Invocation of `EcuM_SleepActivity`: Periodically in SLEEP state if the MCU is not halted (i.e. clock is reduced)

Note: If called from the poll sequence the EcuM calls this callout functions in a blocking loop at maximum frequency. The callout implementation must ensure by other means if callout code shall be executed with a lower period. The integrator may choose any method to control this, e.g. with the help of OS counters, OS alarms, or Gpt timers.

#### 8.6.6.2 EcuM_CheckWakeup

**EcuM2929**:

| | | |
|---|---|---|
| ***Service name:*** | EcuM_CheckWakeup | |
| ***Syntax:*** | `void EcuM_CheckWakeup(`<br>`    EcuM_WakeupSourceType wakeupSource`<br>`)` | |
| ***Service ID[hex]:*** | 0x00 | |
| ***Sync/Async:*** | Synchronous | |
| ***Reentrancy:*** | Non Reentrant | |
| ***Parameters (in):*** | wakeupSource | -- |
| ***Parameters (inout):*** | None | |
| ***Parameters (out):*** | None | |
| ***Return value:*** | None | |
| ***Description:*** | This callout is called by the EcuM to poll a wakeup source. It shall also be called by the ISR of a wakeup source to set up the PLL and check other wakeup sources that may be connected to the same interrupt. | |

Invocation of `EcuM_CheckWakeup`: Periodically in SLEEP state if the MCU is not halted, or when handling a wake up interrupt

Note: If called from the poll sequence the EcuM calls this callout functions in a blocking loop at maximum frequency. The callout implementation must ensure by other means if callout code shall be executed with a lower period. The integrator may choose any method to control this, e.g. with the help of OS counters, OS alarms,
or Gpt timers.

## 8.7 Expected Interfaces

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

### 8.7.1 Mandatory Interfaces

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

**EcuM2858**:

| ***API function*** | ***Description*** |
|---|---|
| BswM_Deinit | Deinitializes the BSW Mode Manager. |
| BswM_EcuM_CurrentState | Function called by EcuM to indicate the current ECU Operation Mode. |
| BswM_EcuM_CurrentWakeup | Function called by EcuM to indicate the current state of a wakeup source. |
| BswM_Init | Initializes the BSW Mode Manager. |
| ComM_CommunicationAllowed | EcuM or BswM shall indicate to ComM when communication is allowed.<br>If EcuM/Fixed is used: EcuM/Fixed.<br>If EcuM/Flex is used: BswM |
| ComM_DeInit | This API de-initializes the AUTOSAR Communication Manager. |
| ComM_EcuM_WakeUpIndication | Notification of a wake up on the corresponding channel. |
| ComM_GetState | Return current state, including sub-state, of the ComM channel state machine.<br><br>Usage of function only valid if EcuM/Fixed is used:<br>To leave RUN: state/sub-state need to be COMM_NO_COM_NO_PENDING_REQUEST (No communication and no pending request to start communication)<br>In POST RUN to return to RUN: state/sub-state need to be in COMM_NO_COM_REQUEST_PENDING (No communication, but a pending request to start communication)<br><br>If EcuM/Flex and BswM is used, BswM instead use received mode indications from ComM (BswM_ComM_RequestedMode(..)). |
| ComM_Init | Initializes the AUTOSAR Communication Manager and restarts the internal state machines. |
| DisableAllInterrupts | -- |
| EnableAllInterrupts | -- |
| GetResource | -- |
| Mcu_GetResetReason | The service reads the reset type from the hardware, if supported. |
| Mcu_Init | This service initializes the MCU driver. |
| Mcu_PerformReset | The service performs a microcontroller reset. |
| Mcu_SetMode | This service activates the MCU power modes. |
| NvM_JobEndNotification | Function to be used by the underlying memory abstraction to signal end of job without error. |
| NvM_JobErrorNotification | Function to be used by the underlying memory abstraction to signal end of job with error. |
| ReleaseResource | -- |
| Rte_Start | -- |
| Rte_Stop | -- |

| | |
|---|---|
| Rte_Switch_currentMode_currentMode | -- |
| SchM_Init | Function for initialization of the SchM module. |
| ShutdownOS | -- |
| StartOS | -- |

**Table 6 - Mandatory interfaces**

Remark: The OS service `GetResource` needs a resource name. Therefore the ECU State Manager Fixed module has to define one OS resource name. The name of this OS resource is up to the implementation of the ECU State Manager, nevertheless this document assumes the name "`RES_AUTOSAR_ECUM`", which will be used in all figures in this document.

### 8.7.2 Optional Interfaces

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

**EcuM2859**:

| ***API function*** | ***Description*** |
|---|---|
| Adc_Init | Initializes the ADC hardware units and driver. |
| CanIf_Init | This service Initializes internal and external interfaces of the CAN Interface for the further processing. |
| CanNm_Init | Initialize the complete CanNm module, i.e. all channels which are activated (see also configuration parameter CANNM_CHANNEL_ACTIVE) at configuration time are initialized. |
| CanSM_Init | This service initializes the CanSM module |
| CanTp_Init | This function initializes the CanTp module. |
| CanTrcv_Init | Initializes the CanTrcv module. |
| Can_Init | This function initializes the module. |
| Com_Init | This service initializes internal and external interfaces and variables of the AUTOSAR COM module layer for the further processing.<br>After calling this function the inter-ECU communication is still disabled. |
| Dcm_Init | Service for basic initialization of DCM module. |
| Dem_Init | Initializes or reinitializes this module. |
| Dem_PreInit | Initializes the internal states necessary to process events reported by BSW-modules. |
| Dem_ReportErrorStatus | Queues the reported events from the BSW modules (API is only used by BSW modules). The interface has an asynchronous behavior, because the processing of the event is done within the Dem main function. |
| Dem_Shutdown | Shuts down this module. |
| Det_Init | Service to initialize the Development Error Tracer. |
| Det_ReportError | Service to report development errors. |
| Det_Start | Service to initialize the Development Error Tracer. |
| Dio_Init | Initializes the module. |
| Dlt_Init | Dlt is using the NVRamManager and is to be initialized very late in the ECU<br>startup phase. The Dlt_Init() function should be called after the NVRamManager<br>is initialed." |
| Ea_Init | Initializes the EEPROM abstraction module. |
| Eep_Init | Service for EEPROM initialization. |
| EthIf_Init | Initializes the Ethernet Interface |

| | |
|---|---|
| EthTrcv_Init | Initializes the Ethernet Transceiver Driver |
| Eth_Init | Initializes the Ethernet Driver |
| Fee_Init | Service to initialize the FEE module. |
| FiM_Init | This service initializes the FIM. |
| Fls_Init | Initializes the Flash Driver. |
| FrIf_Init | Initializes the FlexRay Interface. |
| FrNm_Init | Initializes the FlexRay NM and its internal state machine. |
| FrSM_Init | Initializes the FlexRay State Manager. |
| FrTp_Init | This service initializes all global variables of a FlexRay Transport Layer instance and set it in the idle state. It has no return value because software errors in initialisation data shall be detected during configuration time (e.g. by configuration tool). |
| Fr_Init | Initalizes the Fr. |
| Gpt_Init | Initializes the hardware timer module. |
| Icu_Init | This function initializes the driver. |
| IoHwAb_Init<Init_Id> | Initializes either all the IO Hardware Abstraction software or is a part of the IO Hardware Abstraction. |
| IpduM_Init | Initializes the I-PDU Multiplexer. |
| J1939Tp_Init | This function initializes the J1939Tp module. |
| LinIf_Init | Initializes the LIN Interface. |
| LinSM_Init | This function initializes the LinSM. |
| LinTp_Init | Initializes the LIN Transport Layer. |
| Lin_Init | Initializes the LIN module. |
| Nm_Init | Initializes the NM Interface. |
| NvM_CancelWriteAll | Service to cancel a running NvM_WriteAll request. |
| NvM_Init | Service for resetting all internal variables. |
| NvM_ReadAll | Initiates a multi block read request. |
| NvM_WriteAll | Initiates a multi block write request. |
| PduR_Init | Initializes the PDU Router |
| Port_Init | Initializes the Port Driver module. |
| Pwm_Init | Service for PWM initialization. |
| SchM_Enter_EcuM | -- |
| SchM_Exit_EcuM | -- |
| SoAd_Init | Description:<br>This service initializes all global variables of a Socket Adaptor instance and puts it into the idle state. It has no return value because software errors in initialization data shall be detected during configuration time (e.g. by configuration tool). Furthermore, if a hardware error occurs it shall be reported via the error manager modules.<br><br>Caveats:<br>The call of this service is mandatory before using the SoAd instance for further processing.<br>The API has to be called during initialization. |
| Spi_Init | Service for SPI initialization. |
| UdpNm_Init | Initialize the complete UdpNm module, i.e. all channels which are activated at configuration time are initialized.<br>A UDP socket shall be set up with the TCP/IP stack.<br><br>Caveats:<br>This function has to be called after initialization of the TCP/IP stack.<br><br>Configuration:<br>Mandatory |
| WdgM_DeInit | De-initializes the Watchdog Manager. |
| WdgM_Init | Initializes the Watchdog Manager. |

| | |
|---|---|
| Wdg_Init | Initializes the module. |
| Xcp_Init | This service initializes interfaces and variables of the AUTOSAR XCP layer. |

**Table 7 - Optional Interfaces**

### 8.7.3 Configurable interfaces

There are no configurable interfaces.

## 8.8 API Parameter Checking

If development error detection is enabled for this module, then all services shall test input parameters and running conditions and use the following error codes in an adequate way:

- `ECUM_E_UNINIT`
- `ECUM_E_SERVICE_DISABLED`
- `ECUM_E_NULL_POINTER`
- `ECUM_E_INVALID_PAR`

Specific development errors are listed in the functions, where they do apply.

# 9 Sequence Charts

## 9.1 State Sequences

Sequence charts showing the behavior of the ECU State Manager Fixed module in various states are contained in the flow of the specification text. The following list shows all sequence charts presented in this specification.

## 9.2 Wake-up Sequences

The Wake-up Sequences show how a number of modules cooperate to put the ECU into a sleep state to be able to wake up and startup the ECU when a wake up event has occurred.

### 9.2.1 GPT Wake-up Sequences

The General Purpose Timer (GPT) is one of the possible wake up sources. Usually the GPT is started before the ECU is put to sleep and the hardware timer causes an interrupt when it expires. The interrupt wakes the microcontroller, and executes the interrupt handler in the GPT module. It informs the ECU State Manager Fixed module that a GPT wake up has occurred. In order to distinguish different GPT channels that caused the wake up, the integrator can assign a different wake up source identifier to each GPT channel. Figure 31 shows the corresponding sequence of calls.

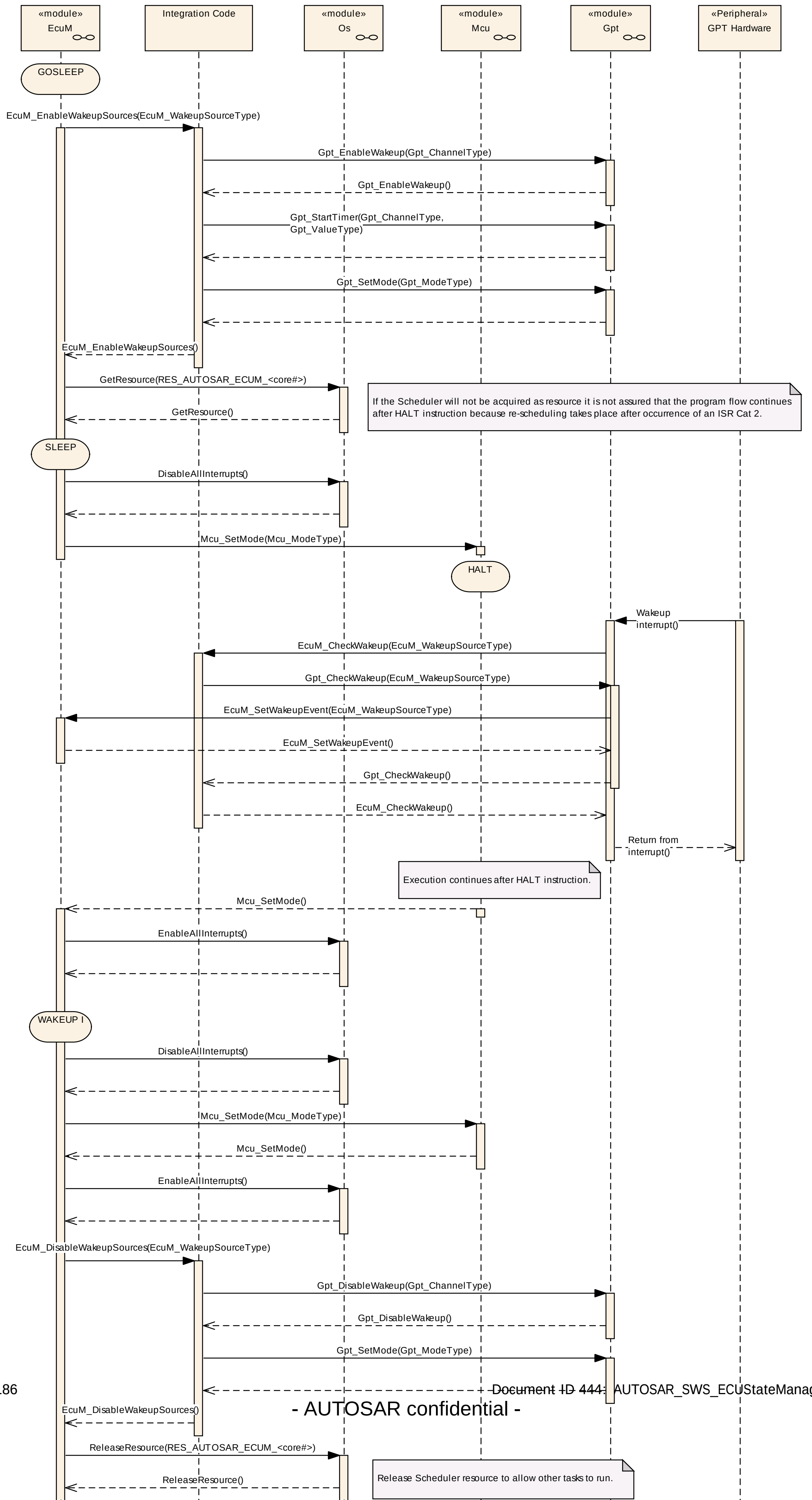

«module»
EcuM
Integration Code
«module»
Os
«module»
Mcu
«module»
Gpt
«Peripheral»
GPT Hardware
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
Gpt_EnableWakeup(Gpt_ChannelType)
Gpt_EnableWakeup()
Gpt_StartTimer(Gpt_ChannelType, Gpt_ValueType)
Gpt_SetMode(Gpt_ModeType)
EcuM_EnableWakeupSources()
GetResource(RES_AUTOSAR_ECUM_<core#>)
If the Scheduler will not be acquired as resource it is not assured that the program flow continues after HALT instruction because re-scheduling takes place after occurrence of an ISR Cat 2.
GetResource()
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
HALT
Wakeup interrupt()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
Gpt_CheckWakeup(EcuM_WakeupSourceType)
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
EcuM_SetWakeupEvent()
Gpt_CheckWakeup()
EcuM_CheckWakeup()
Return from interrupt()
Execution continues after HALT instruction.
Mcu_SetMode()
EnableAllInterrupts()
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode()
EnableAllInterrupts()
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
Gpt_DisableWakeup(Gpt_ChannelType)
Gpt_DisableWakeup()
Gpt_SetMode(Gpt_ModeType)
EcuM_DisableWakeupSources()
ReleaseResource(RES_AUTOSAR_ECUM_<core#>)
Release Scheduler resource to allow other tasks to run.
ReleaseResource()

**Figure 31 – GPT wake up by interrupt**

If the GPT hardware is capable of latching timer overruns, it is also possible to poll the GPT for wake-ups as shown in Figure 32.

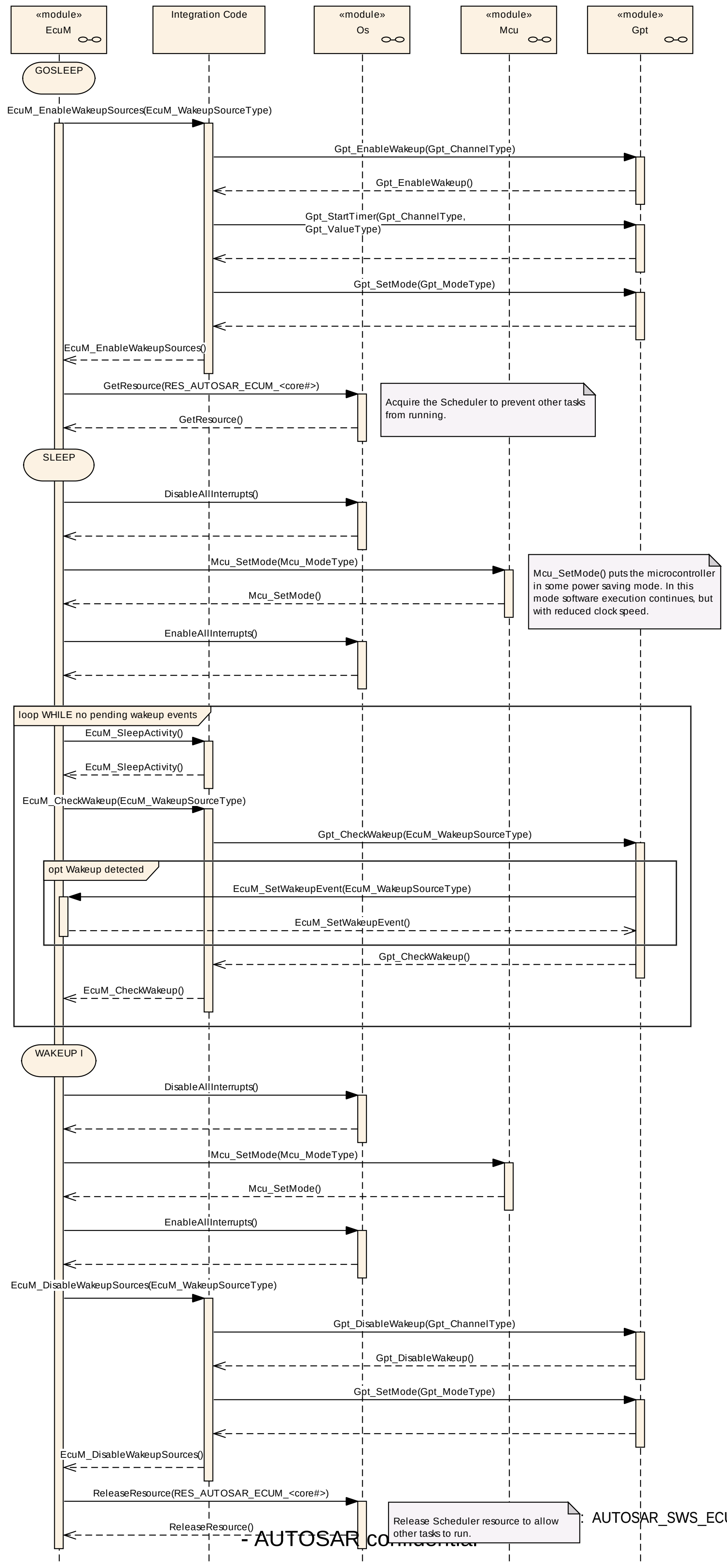

«module» EcuM
Integration Code
«module» Os
«module» Mcu
«module» Gpt
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
Gpt_EnableWakeup(Gpt_ChannelType)
Gpt_EnableWakeup()
Gpt_StartTimer(Gpt_ChannelType, Gpt_ValueType)
Gpt_SetMode(Gpt_ModeType)
EcuM_EnableWakeupSources()
GetResource(RES_AUTOSAR_ECUM_<core#>)
Acquire the Scheduler to prevent other tasks from running.
GetResource()
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode() puts the microcontroller in some power saving mode. In this mode software execution continues, but with reduced clock speed.
Mcu_SetMode()
EnableAllInterrupts()
loop WHILE no pending wakeup events
EcuM_SleepActivity()
EcuM_SleepActivity()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
Gpt_CheckWakeup(EcuM_WakeupSourceType)
opt Wakeup detected
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
EcuM_SetWakeupEvent()
Gpt_CheckWakeup()
EcuM_CheckWakeup()
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode()
EnableAllInterrupts()
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
Gpt_DisableWakeup(Gpt_ChannelType)
Gpt_DisableWakeup()
Gpt_SetMode(Gpt_ModeType)
EcuM_DisableWakeupSources()
ReleaseResource(RES_AUTOSAR_ECUM_<core#>)
Release Scheduler resource to allow other tasks to run.
ReleaseResource()

**Figure 32 – GPT wake up by polling**

### 9.2.2 ICU Wake-up Sequences

The Input Capture Unit (ICU) is another wake up source. In contrast to GPT, the ICU driver is not itself the wake up source. It is just the module that processes the wake up interrupt. Therefore, only the driver of the wake up source can tell if it was responsible for that wake up. This makes it necessary for `EcuM_CheckWakeup` to ask the module that is the actual wake up source. In order to know which module to ask, the ICU has to pass the identifier of the wake up source to `EcuM_CheckWakeup`.

For shared interrupts the Integration code may have to check multiple wake up sources within `EcuM_CheckWakeup`. To this end, the ICU has to pass the identifiers of all wake up sources that may have caused this interrupt to `EcuM_CheckWakeup`. Note that, `EcuM_WakeupSourceType` contains one bit for each wake up source, so that multiple wake up sources can be passed in one call.

Figure 33 shows the resulting sequence of calls.

Since the ICU is only responsible for processing the wake up interrupt, polling the ICU is not sensible. For polling the wake up sources have to be checked directly as shown in Figure 19 – Sleep Sequence II.

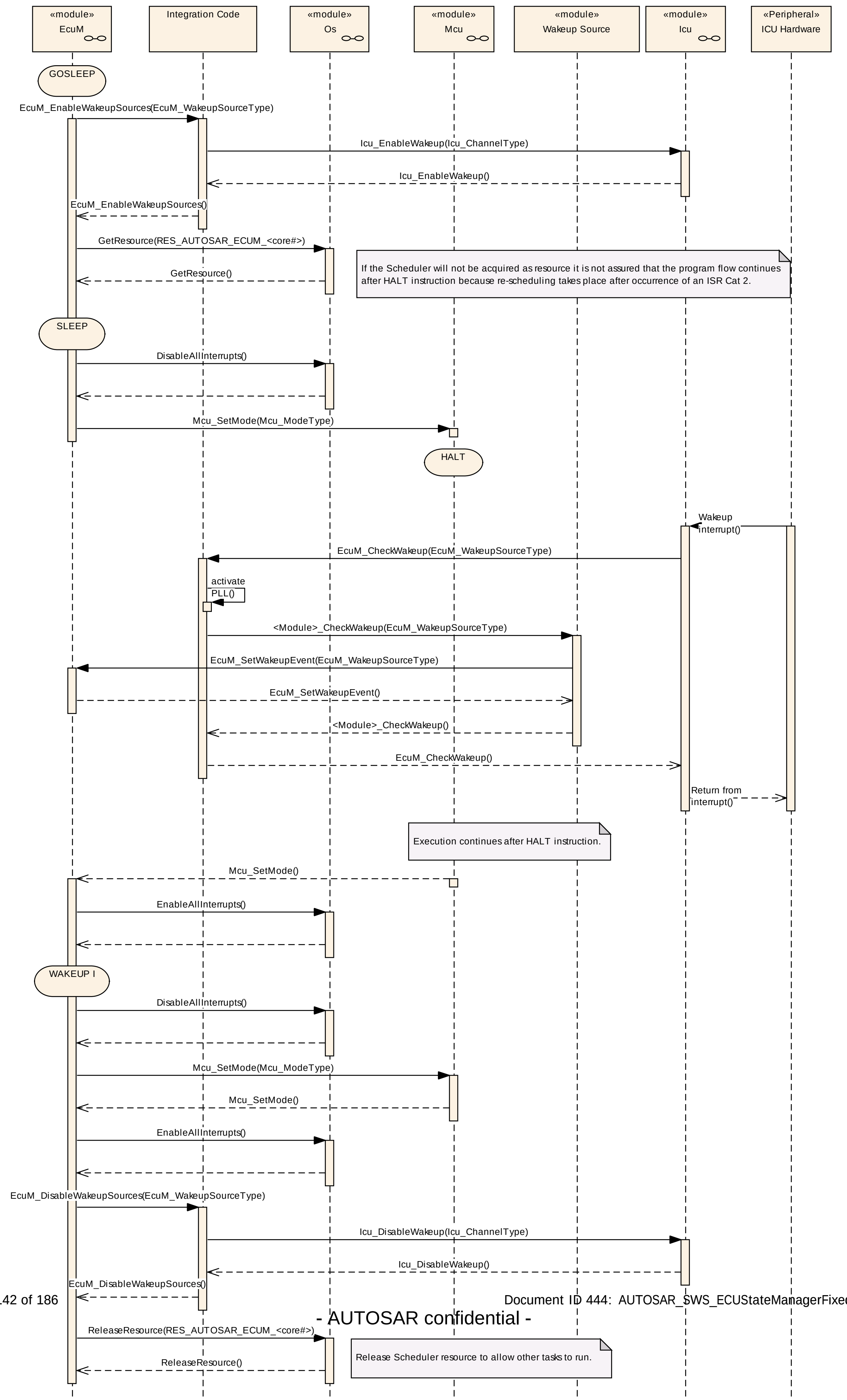

«module» EcuM
Integration Code
«module» Os
«module» Mcu
«module» Wakeup Source
«module» Icu
«Peripheral» ICU Hardware
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
Icu_EnableWakeup(Icu_ChannelType)
Icu_EnableWakeup()
EcuM_EnableWakeupSources()
GetResource(RES_AUTOSAR_ECUM_<core#>)
GetResource()
If the Scheduler will not be acquired as resource it is not assured that the program flow continues after HALT instruction because re-scheduling takes place after occurrence of an ISR Cat 2.
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
HALT
Wakeup interrupt()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
activate PLL()
<Module>_CheckWakeup(EcuM_WakeupSourceType)
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
EcuM_SetWakeupEvent()
<Module>_CheckWakeup()
EcuM_CheckWakeup()
Return from interrupt()
Execution continues after HALT instruction.
Mcu_SetMode()
EnableAllInterrupts()
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode()
EnableAllInterrupts()
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
Icu_DisableWakeup(Icu_ChannelType)
Icu_DisableWakeup()
EcuM_DisableWakeupSources()
ReleaseResource(RES_AUTOSAR_ECUM_<core#>)
ReleaseResource()
Release Scheduler resource to allow other tasks to run.

Figure 33 – ICU wake up by interrupt

### 9.2.3 CAN Wake-up Sequences

On CAN a wake up can be detected by the transceiver or the communication controller using either an interrupt or polling. Wake up source identifiers should be shared between transceiver and controller as the ECU State Manager Fixed module only needs to know the network that has woken up and passes that on to the Communication Manager module.

In interrupt case or in shared interrupt case it is not clear which specific wake up source (CAN controller, CAN transceiver, LIN controller etc.) detected the wake up. Therefore the integrator has to assign the derived wakeupSource of EcuM_CheckWakeup(wakeupSource), which could stand for a shared interrupt or just for a interrupt channel, to specific wake up sources which are passed to CanIf_CheckWakeup(WakeupSource). So here the parameters wakeupSource from EcuM_CheckWakeup() could be different to WakeupSource of CanIf_CheckWakeup or they could equal. It depends on the hardware topology and the implementation in the integrator code of EcuM_CheckWakeup().

During CanIf_CheckWakeup(WakeupSource) the CAN Interface module (CanIf) will check if any device (CAN communication controller or transceiver) is configured with the value of “WakeupSource”. If this is the case, the device is checked for wake up via the corresponding device driver module. If the device detected a wake up, the device driver informs EcuM via EcuM_SetWakeupEvent(sources). The parameter “sources” is set to the configured value at the device. Thus it is set to the value CanIf_CheckWakeup() was called with.

Multiple devices might be configured with the same wake up source value. But if devices are connected to different bus medium and they are wake-able, it makes sense to configure them with different wake up sources.

The following CAN Wake-up Sequences are partly optional, because there is no specification for the “Integration Code”. Thus it is implementation specific if e.g. during EcuM_CheckWakeup() the CanIf is called to check the wake up source.

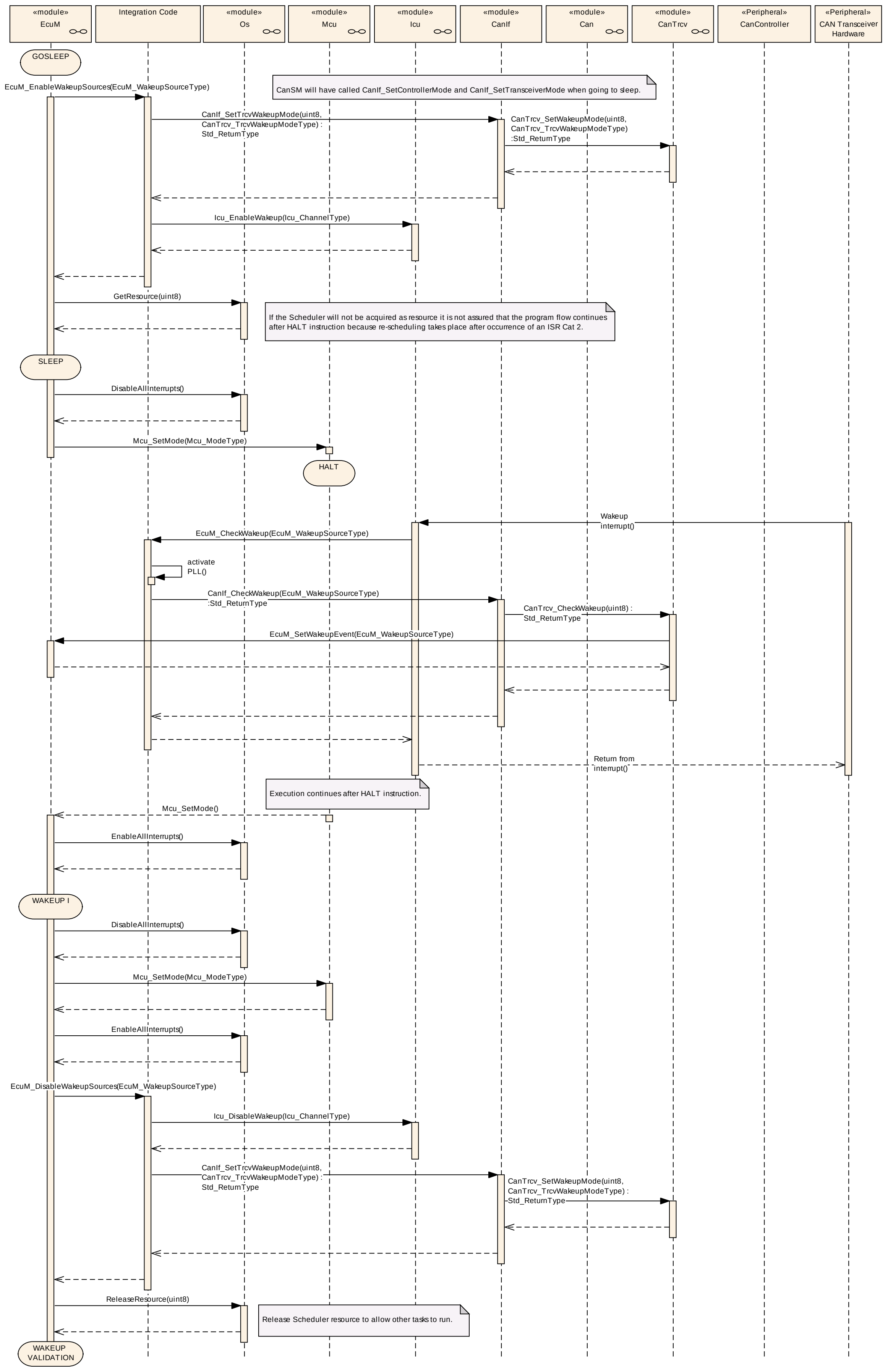

«module» EcuM
Integration Code
«module» Os
«module» Mcu
«module» Icu
«module» CanIf
«module» Can
«module» CanTrcv
«Peripheral» CanController
«Peripheral» CAN Transceiver Hardware
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
CanSM will have called CanIf_SetControllerMode and CanIf_SetTransceiverMode when going to sleep.
CanIf_SetTrcvWakeupMode(uint8, CanTrcv_TrcvWakeupModeType) : Std_ReturnType
CanTrcv_SetWakeupMode(uint8, CanTrcv_TrcvWakeupModeType) :Std_ReturnType
Icu_EnableWakeup(Icu_ChannelType)
GetResource(uint8)
If the Scheduler will not be acquired as resource it is not assured that the program flow continues after HALT instruction because re-scheduling takes place after occurrence of an ISR Cat 2.
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
HALT
Wakeup interrupt()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
activate PLL()
CanIf_CheckWakeup(EcuM_WakeupSourceType) :Std_ReturnType
CanTrcv_CheckWakeup(uint8) : Std_ReturnType
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
Return from interrupt()
Execution continues after HALT instruction.
Mcu_SetMode()
EnableAllInterrupts()
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
EnableAllInterrupts()
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
Icu_DisableWakeup(Icu_ChannelType)
CanIf_SetTrcvWakeupMode(uint8, CanTrcv_TrcvWakeupModeType) : Std_ReturnType
CanTrcv_SetWakeupMode(uint8, CanTrcv_TrcvWakeupModeType) : Std_ReturnType
ReleaseResource(uint8)
Release Scheduler resource to allow other tasks to run.
WAKEUP VALIDATION

**Figure 34 – CAN transceiver wake up by interrupt**

Figure 34 shows the CAN transceiver wake up via interrupt. The interrupt is usually handled by the ICU Driver as described in Chapter 9.2.2.

A CAN controller wake up by interrupt works similar to the GPT wake up. Here the interrupt handler and the CheckWakeup functionality are both encapsulated in the CAN Driver module, as shown in Figure 35.

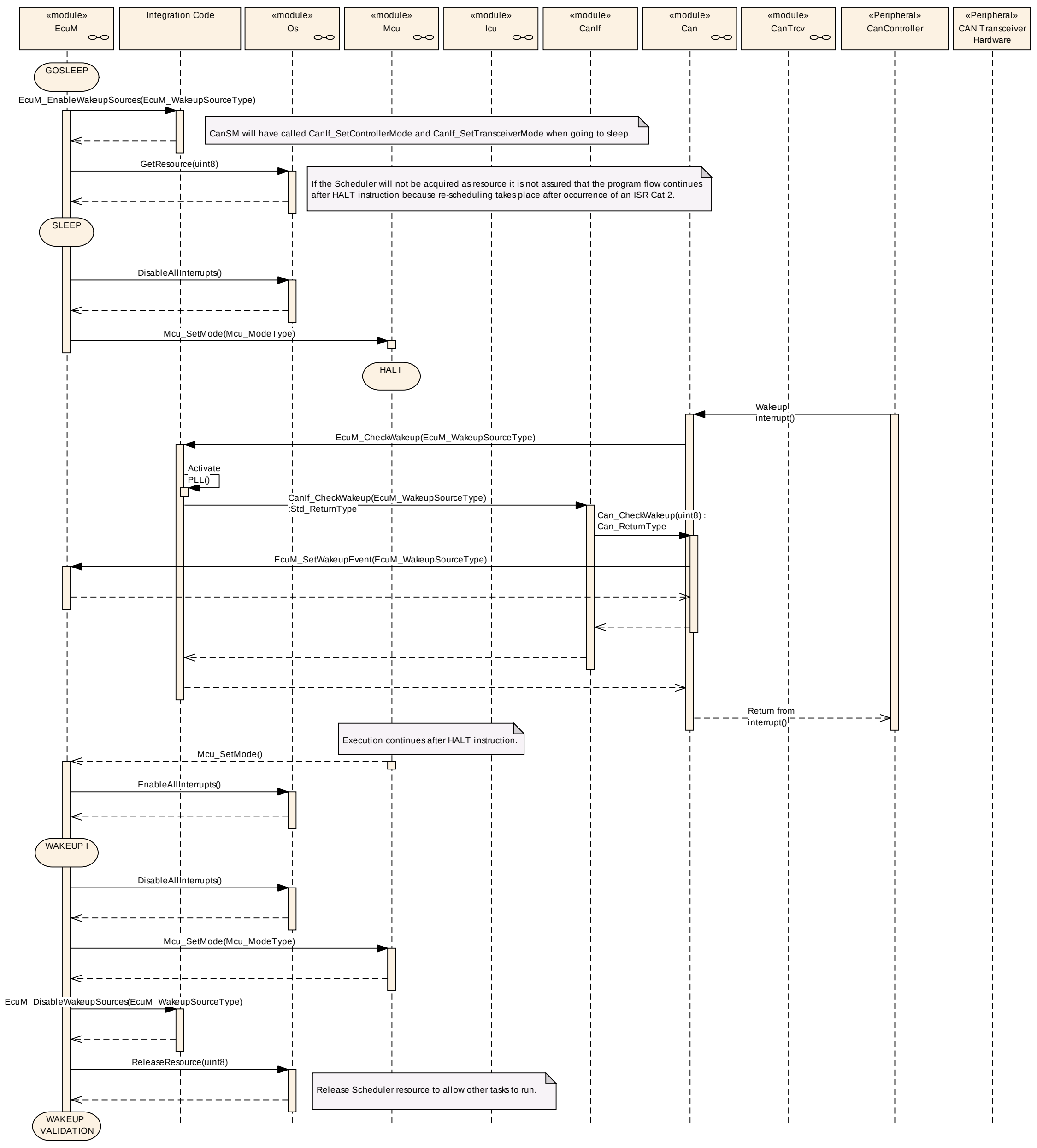

«module» EcuM
Integration Code
«module» Os
«module» Mcu
«module» Icu
«module» CanIf
«module» Can
«module» CanTrcv
«Peripheral» CanController
«Peripheral» CAN Transceiver Hardware
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
CanSM will have called CanIf_SetControllerMode and CanIf_SetTransceiverMode when going to sleep.
GetResource(uint8)
If the Scheduler will not be acquired as resource it is not assured that the program flow continues after HALT instruction because re-scheduling takes place after occurrence of an ISR Cat 2.
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
HALT
Wakeup interrupt()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
Activate PLL()
CanIf_CheckWakeup(EcuM_WakeupSourceType) :Std_ReturnType
Can_CheckWakeup(uint8) : Can_ReturnType
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
Return from interrupt()
Execution continues after HALT instruction.
Mcu_SetMode()
EnableAllInterrupts()
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
ReleaseResource(uint8)
Release Scheduler resource to allow other tasks to run.
WAKEUP VALIDATION

**Figure 35 – CAN controller wake up by interrupt**

Wake up by polling is possible both for CAN transceiver and CAN controller. The ECU State Manager Fixed module will regularly check the CAN Interface module, which in turn asks either the CAN Driver module or the CAN Transceiver Driver module depending on the wake up source parameter passed to the CAN Interface module, as shown in Figure 36.

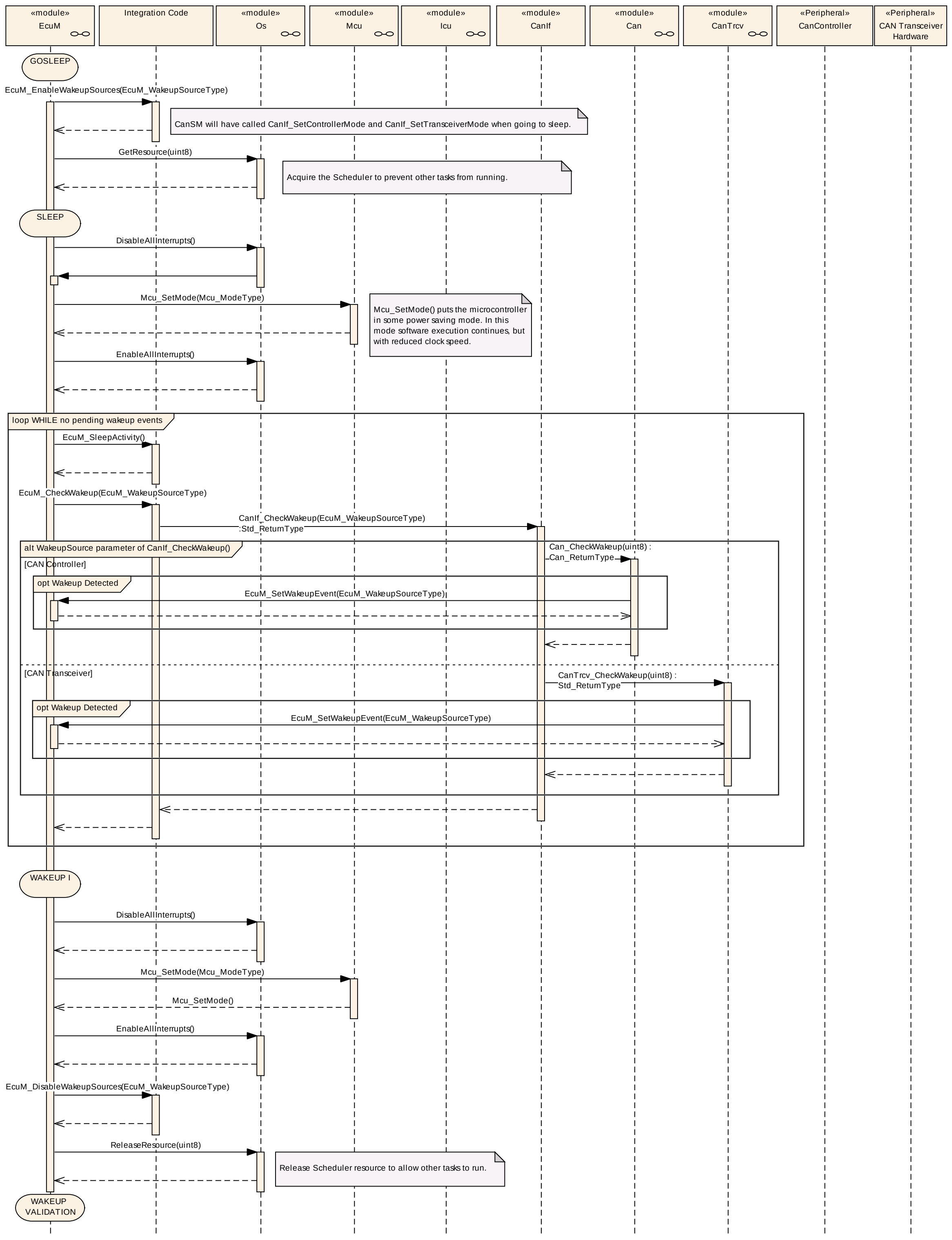

«module» EcuM
Integration Code
«module» Os
«module» Mcu
«module» Icu
«module» CanIf
«module» Can
«module» CanTrcv
«Peripheral» CanController
«Peripheral» CAN Transceiver Hardware
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
CanSM will have called CanIf_SetControllerMode and CanIf_SetTransceiverMode when going to sleep.
GetResource(uint8)
Acquire the Scheduler to prevent other tasks from running.
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode() puts the microcontroller in some power saving mode. In this mode software execution continues, but with reduced clock speed.
EnableAllInterrupts()
loop WHILE no pending wakeup events
EcuM_SleepActivity()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
CanIf_CheckWakeup(EcuM_WakeupSourceType) :Std_ReturnType
alt WakeupSource parameter of CanIf_CheckWakeup()
[CAN Controller]
Can_CheckWakeup(uint8) : Can_ReturnType
opt Wakeup Detected
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
[CAN Transceiver]
CanTrcv_CheckWakeup(uint8) : Std_ReturnType
opt Wakeup Detected
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode()
EnableAllInterrupts()
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
ReleaseResource(uint8)
Release Scheduler resource to allow other tasks to run.
WAKEUP VALIDATION

**Figure 36 – CAN controller or transceiver wake up by polling**

After the detection of a wake up event from the CAN transceiver or CAN controller by either interrupt or polling, the wake up event can be validated. This is done by switching on the corresponding CAN transceiver and CAN controller in

`EcuM_StartWakeupSources`. It depends on the used CAN transceivers and controllers, which function calls in Integrator Code EcuM_StartWakeupSource are necessary. In Figure 37 e.g. the needed function calls to start and stop the wake up sources from CAN state manager module are mentioned.

Note that, although controller and transceiver are switched on, no CAN message will be forwarded by the CAN Interface module to any upper layer module.

Only when the corresponding PDU channel modes of the CAN Interface module are set to “Online”, it will forward CAN messages.

The CAN Interface module recognizes the successful reception of at least one message and records it as a successful validation. During validation the ECU State Manager Fixed module regularly checks the CAN Interface module in Integrator Code `EcuM_CheckValidation`.

The ECU State Manager Fixed module will, after successful validation, continue the normal startup of the CAN network via the Communication Manager module.

Otherwise, it will shutdown the CAN controller and CAN transceiver in `EcuM_StopWakeupSources` and go back to sleep. The resulting sequence is shown in Figure 37.

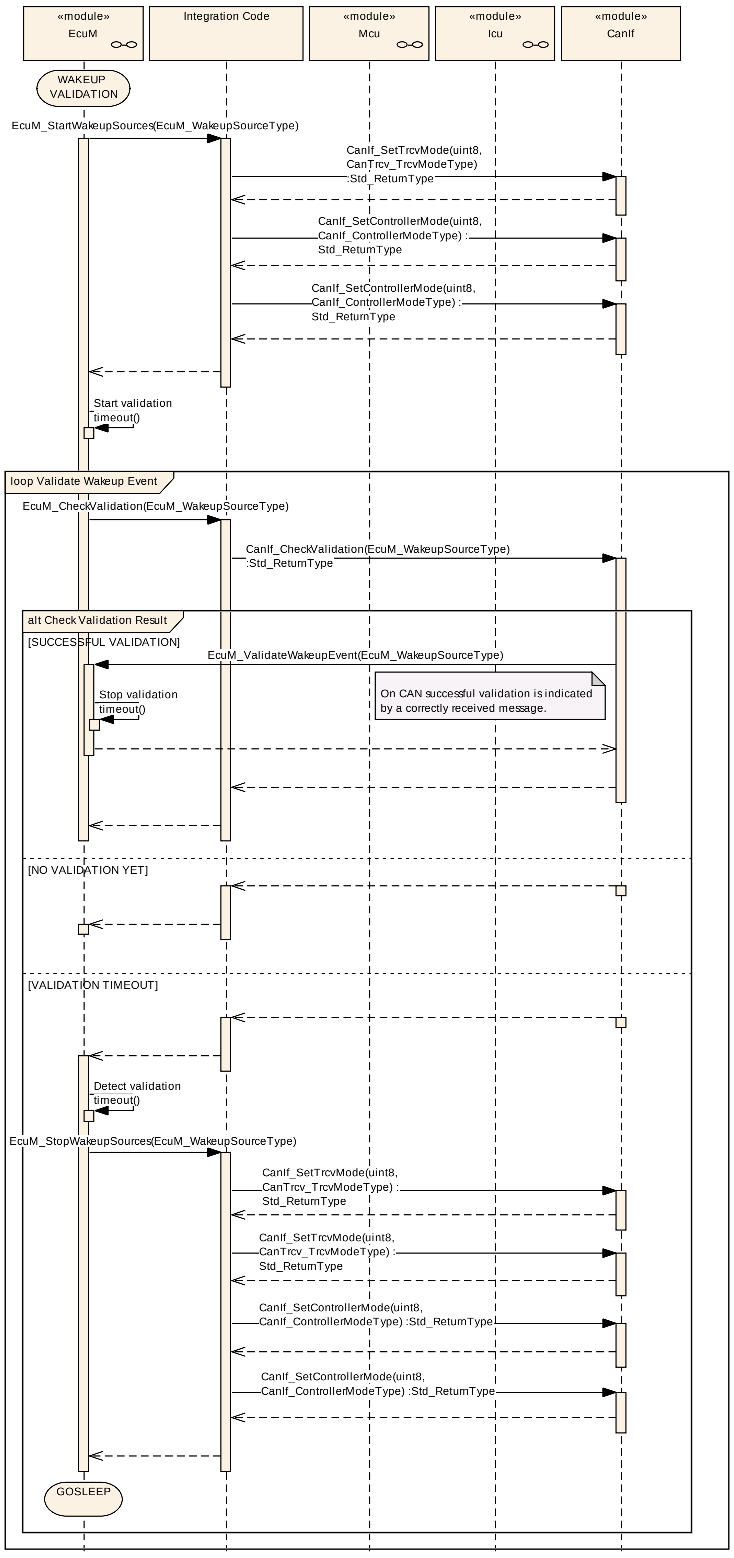

«module» EcuM
Integration Code
«module» Mcu
«module» Icu
«module» CanIf
WAKEUP VALIDATION
EcuM_StartWakeupSources(EcuM_WakeupSourceType)
CanIf_SetTrcvMode(uint8, CanTrcv_TrcvModeType) :Std_ReturnType
CanIf_SetControllerMode(uint8, CanIf_ControllerModeType) : Std_ReturnType
CanIf_SetControllerMode(uint8, CanIf_ControllerModeType) : Std_ReturnType
Start validation timeout()
loop Validate Wakeup Event
EcuM_CheckValidation(EcuM_WakeupSourceType)
CanIf_CheckValidation(EcuM_WakeupSourceType) :Std_ReturnType
alt Check Validation Result
[SUCCESSFUL VALIDATION]
EcuM_ValidateWakeupEvent(EcuM_WakeupSourceType)
Stop validation timeout()
On CAN successful validation is indicated by a correctly received message.
[NO VALIDATION YET]
[VALIDATION TIMEOUT]
Detect validation timeout()
EcuM_StopWakeupSources(EcuM_WakeupSourceType)
CanIf_SetTrcvMode(uint8, CanTrcv_TrcvModeType) : Std_ReturnType
CanIf_SetTrcvMode(uint8, CanTrcv_TrcvModeType) : Std_ReturnType
CanIf_SetControllerMode(uint8, CanIf_ControllerModeType) :Std_ReturnType
CanIf_SetControllerMode(uint8, CanIf_ControllerModeType) :Std_ReturnType
GOSLEEP

**Figure 37 – CAN wake up validation**

### 9.2.4 LIN Wake-up Sequences

Figure 38 shows the LIN transceiver wake up via interrupt. The interrupt is usually handled by the ICU Driver as described in Chapter 9.2.2.

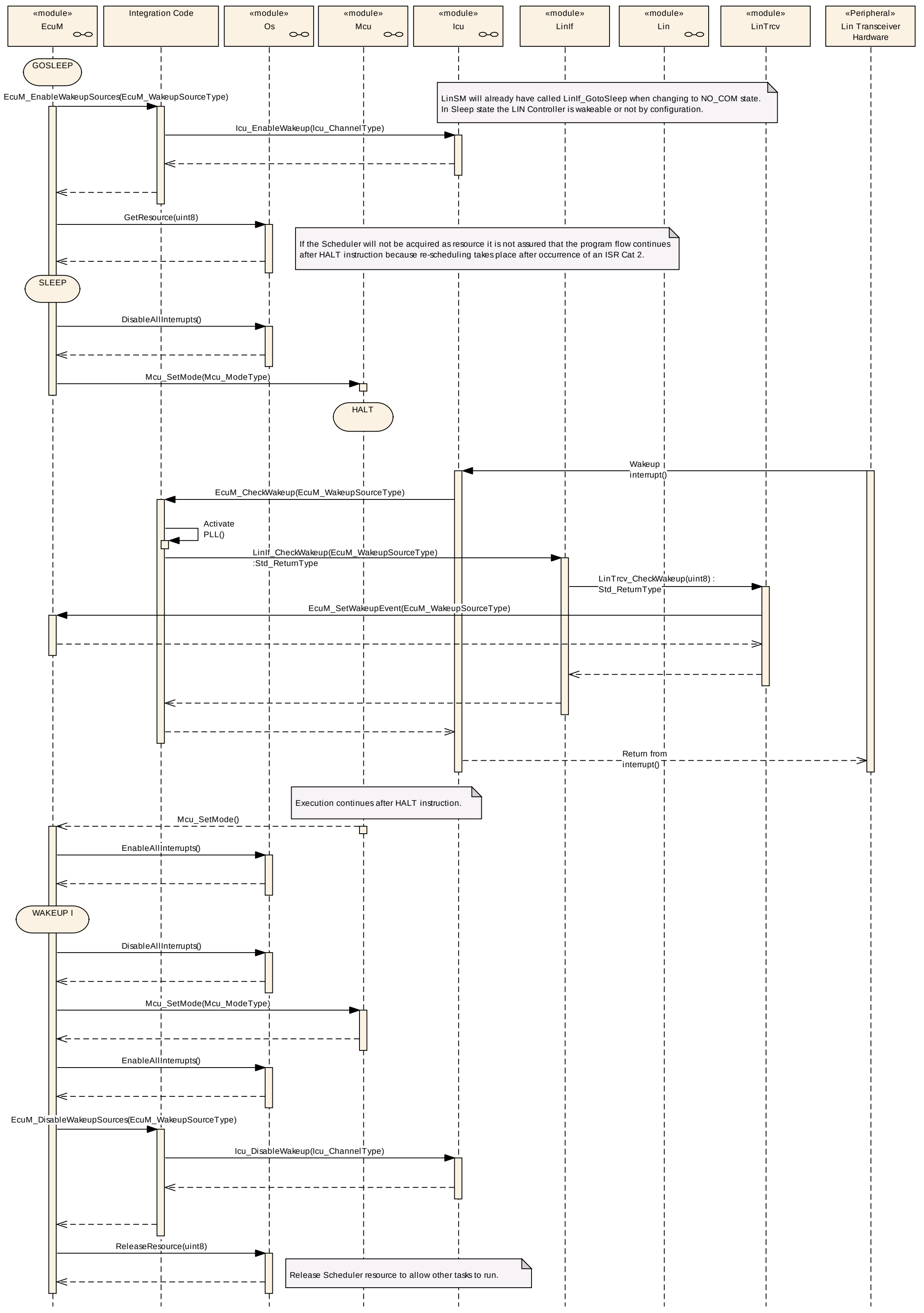

«module» EcuM
Integration Code
«module» Os
«module» Mcu
«module» Icu
«module» LinIf
«module» Lin
«module» LinTrcv
«Peripheral» Lin Transceiver Hardware
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
LinSM will already have called LinIf_GotoSleep when changing to NO_COM state. In Sleep state the LIN Controller is wakeable or not by configuration.
Icu_EnableWakeup(Icu_ChannelType)
GetResource(uint8)
If the Scheduler will not be acquired as resource it is not assured that the program flow continues after HALT instruction because re-scheduling takes place after occurrence of an ISR Cat 2.
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
HALT
Wakeup interrupt()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
Activate PLL()
LinIf_CheckWakeup(EcuM_WakeupSourceType) :Std_ReturnType
LinTrcv_CheckWakeup(uint8) : Std_ReturnType
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
Return from interrupt()
Execution continues after HALT instruction.
Mcu_SetMode()
EnableAllInterrupts()
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
EnableAllInterrupts()
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
Icu_DisableWakeup(Icu_ChannelType)
ReleaseResource(uint8)
Release Scheduler resource to allow other tasks to run.

**Figure 38 – LIN transceiver wake up by interrupt**

As shown in Figure 39, the LIN controller wake up by interrupt works similar to the CAN controller wake up by interrupt. In both cases the Driver module encapsulates the interrupt handler.

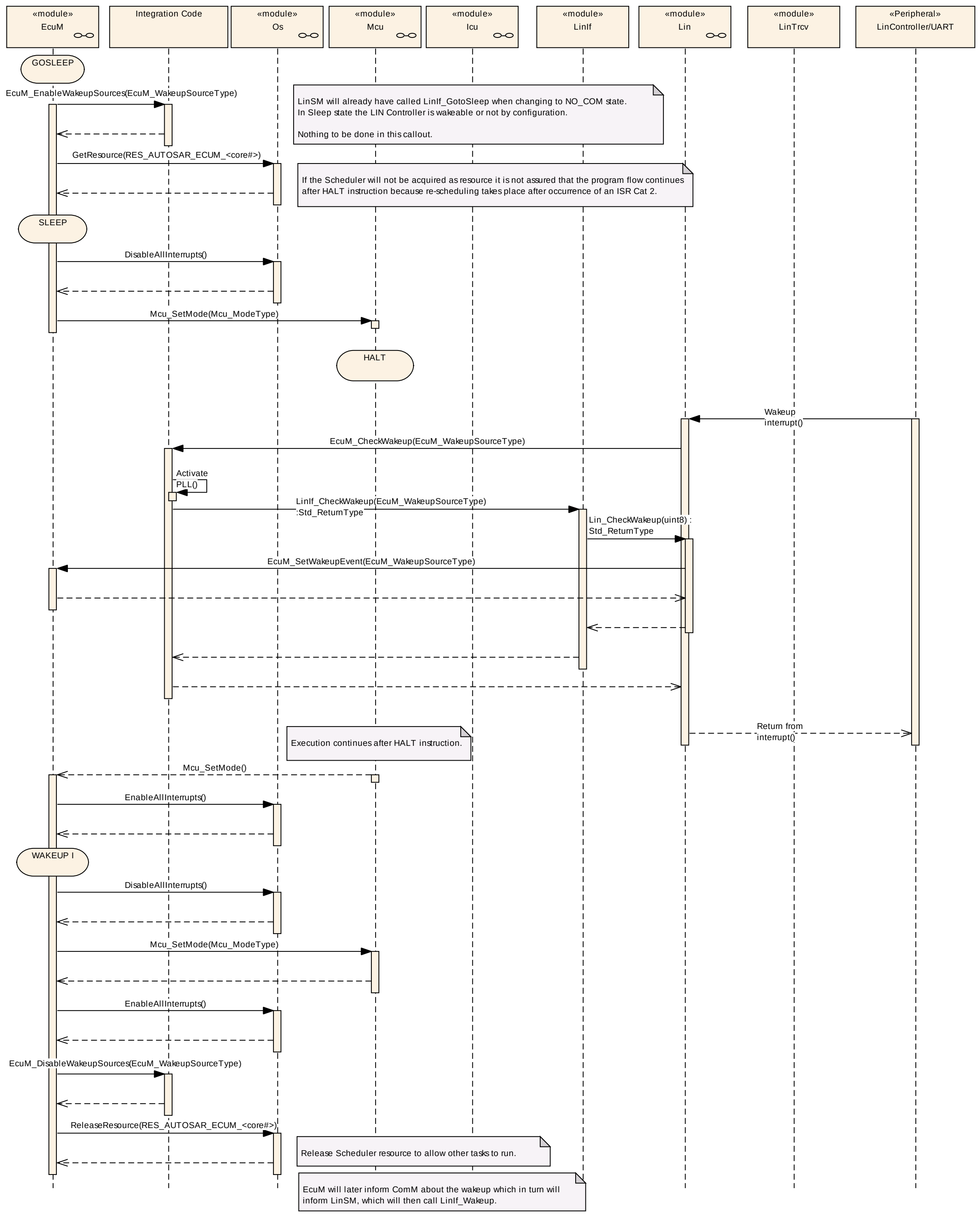

«module» EcuM
Integration Code
«module» Os
«module» Mcu
«module» Icu
«module» LinIf
«module» Lin
«module» LinTrcv
«Peripheral» LinController/UART
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
LinSM will already have called LinIf_GotoSleep when changing to NO_COM state. In Sleep state the LIN Controller is wakeable or not by configuration. Nothing to be done in this callout.
GetResource(RES_AUTOSAR_ECUM_<core#>)
If the Scheduler will not be acquired as resource it is not assured that the program flow continues after HALT instruction because re-scheduling takes place after occurrence of an ISR Cat 2.
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
HALT
Wakeup interrupt()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
Activate PLL()
LinIf_CheckWakeup(EcuM_WakeupSourceType) :Std_ReturnType
Lin_CheckWakeup(uint8) : Std_ReturnType
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
Return from interrupt()
Execution continues after HALT instruction.
Mcu_SetMode()
EnableAllInterrupts()
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
EnableAllInterrupts()
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
ReleaseResource(RES_AUTOSAR_ECUM_<core#>)
Release Scheduler resource to allow other tasks to run.
EcuM will later inform ComM about the wakeup which in turn will inform LinSM, which will then call LinIf_Wakeup.

**Figure 39 – LIN Controller wake up by Interrupt**

Wake up by polling is possible for LIN transceiver and LIN controller. The ECU State Manager Fixed module will regularly check the LIN Interface module, which in turn asks either the LIN Driver module or the LIN Transceiver Driver module, as shown in Figure 40.

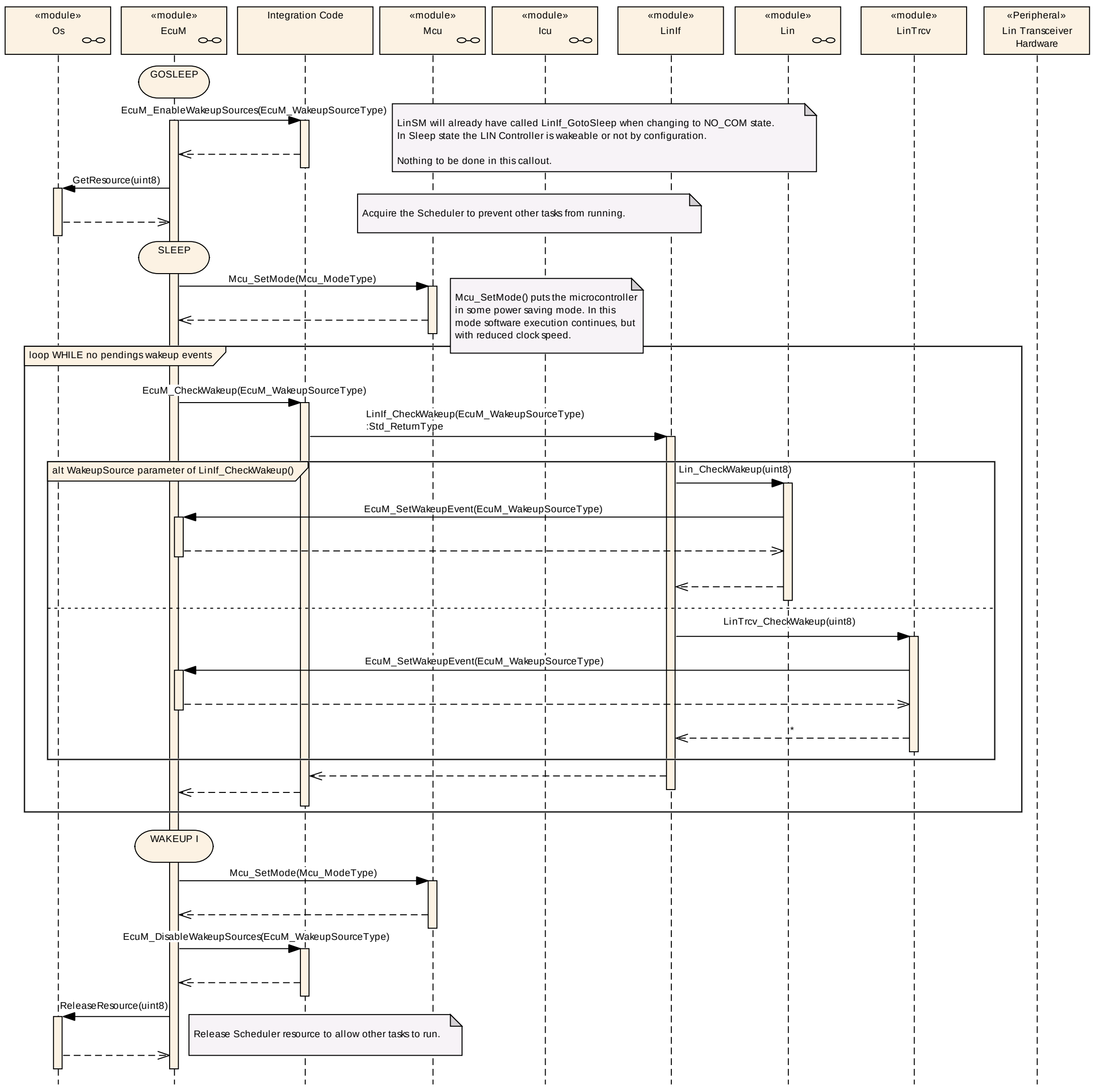

«module» Os
«module» EcuM
Integration Code
«module» Mcu
«module» Icu
«module» LinIf
«module» Lin
«module» LinTrcv
«Peripheral» Lin Transceiver Hardware
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
LinSM will already have called LinIf_GotoSleep when changing to NO_COM state.
In Sleep state the LIN Controller is wakeable or not by configuration.
Nothing to be done in this callout.
GetResource(uint8)
Acquire the Scheduler to prevent other tasks from running.
SLEEP
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode() puts the microcontroller in some power saving mode. In this mode software execution continues, but with reduced clock speed.
loop WHILE no pendings wakeup events
EcuM_CheckWakeup(EcuM_WakeupSourceType)
LinIf_CheckWakeup(EcuM_WakeupSourceType) :Std_ReturnType
alt WakeupSource parameter of LinIf_CheckWakeup()
Lin_CheckWakeup(uint8)
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
LinTrcv_CheckWakeup(uint8)
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
WAKEUP I
Mcu_SetMode(Mcu_ModeType)
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
ReleaseResource(uint8)
Release Scheduler resource to allow other tasks to run.

**Figure 40 – LIN controller or transceiver wake up by polling**

Note that LIN does not require wake up validation.

### 9.2.5 FlexRay Wake-up Sequences

For FlexRay a wake up is only possible via the FlexRay transceivers. There are two transceivers for the two different channels in a FlexRay cluster. They are treated as belonging to one network and thus, there should be only one wake up source identifier configured for both channels.

Figure 41 shows the FlexRay transceiver wake up via interrupt. The interrupt is usually handled by the ICU Driver module as described in Chapter 9.2.2.

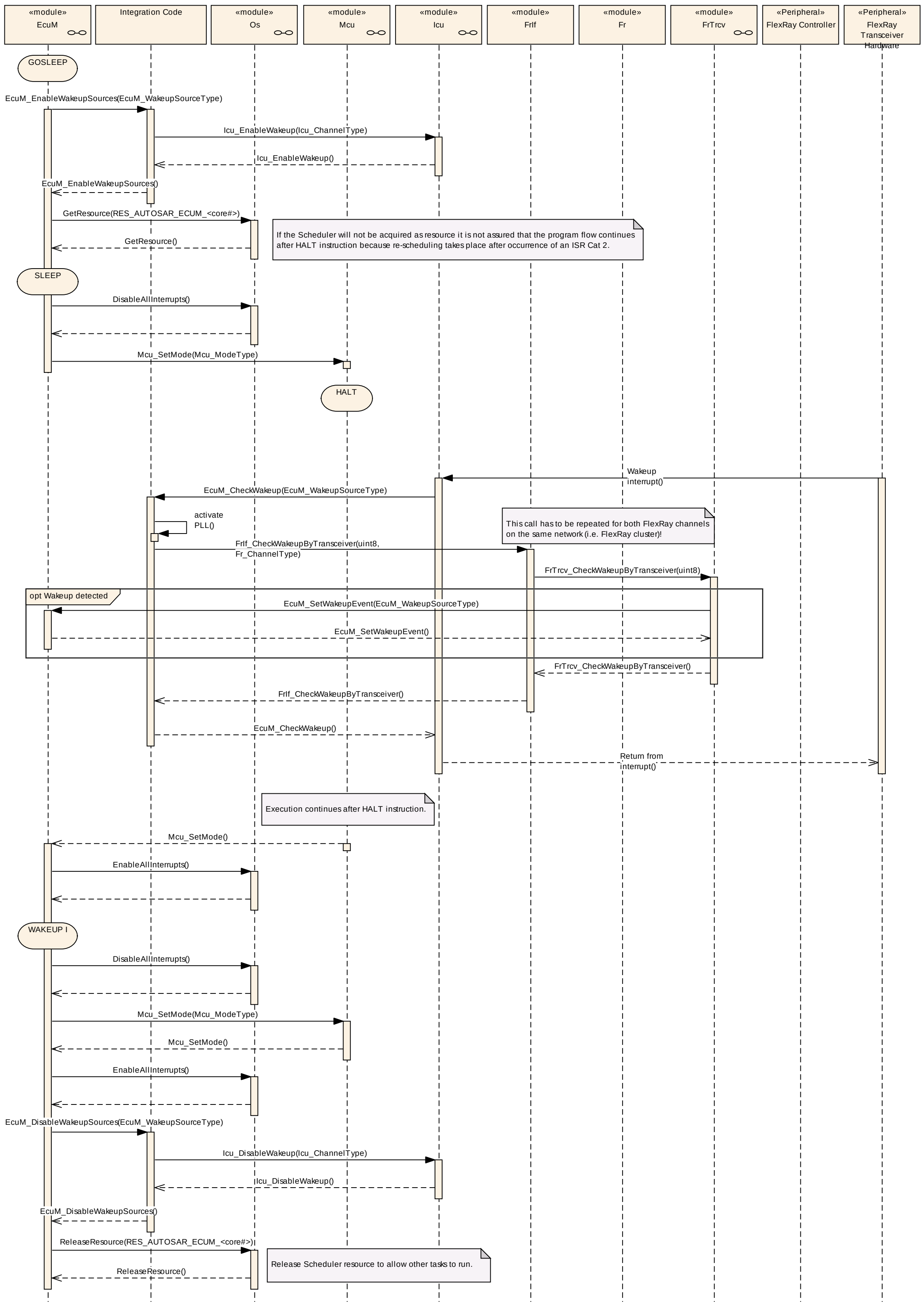

«module» EcuM
Integration Code
«module» Os
«module» Mcu
«module» Icu
«module» FrIf
«module» Fr
«module» FrTrcv
«Peripheral» FlexRay Controller
«Peripheral» FlexRay Transceiver Hardware
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
Icu_EnableWakeup(Icu_ChannelType)
Icu_EnableWakeup()
EcuM_EnableWakeupSources()
GetResource(RES_AUTOSAR_ECUM_<core#>)
GetResource()
If the Scheduler will not be acquired as resource it is not assured that the program flow continues after HALT instruction because re-scheduling takes place after occurrence of an ISR Cat 2.
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
HALT
Wakeup interrupt()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
activate PLL()
This call has to be repeated for both FlexRay channels on the same network (i.e. FlexRay cluster)!
FrIf_CheckWakeupByTransceiver(uint8, Fr_ChannelType)
FrTrcv_CheckWakeupByTransceiver(uint8)
opt Wakeup detected
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
EcuM_SetWakeupEvent()
FrTrcv_CheckWakeupByTransceiver()
FrIf_CheckWakeupByTransceiver()
EcuM_CheckWakeup()
Return from interrupt()
Execution continues after HALT instruction.
Mcu_SetMode()
EnableAllInterrupts()
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode()
EnableAllInterrupts()
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
Icu_DisableWakeup(Icu_ChannelType)
Icu_DisableWakeup()
EcuM_DisableWakeupSources()
ReleaseResource(RES_AUTOSAR_ECUM_<core#>)
ReleaseResource()
Release Scheduler resource to allow other tasks to run.

**Figure 41 – FlexRay transceiver wake up by interrupt**

Note that in EcuM_CheckWakeup there need to be two separate calls to `FrIf_CheckWakeupByTransceiver`, one for each FlexRay channel.

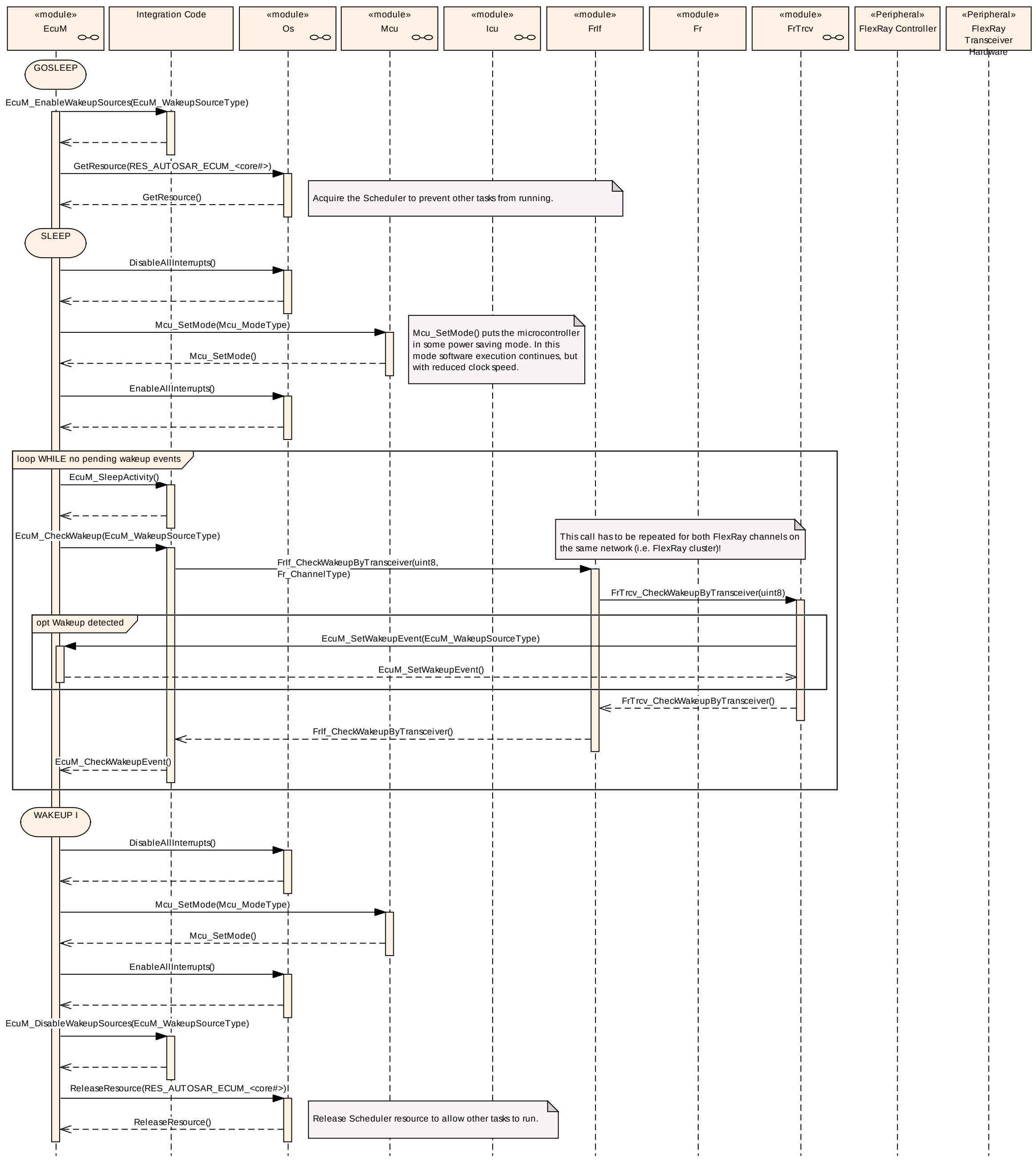

«module» EcuM
Integration Code
«module» Os
«module» Mcu
«module» Icu
«module» FrIf
«module» Fr
«module» FrTrcv
«Peripheral» FlexRay Controller
«Peripheral» FlexRay Transceiver Hardware
GOSLEEP
EcuM_EnableWakeupSources(EcuM_WakeupSourceType)
GetResource(RES_AUTOSAR_ECUM_<core#>)
GetResource()
Acquire the Scheduler to prevent other tasks from running.
SLEEP
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode()
Mcu_SetMode() puts the microcontroller in some power saving mode. In this mode software execution continues, but with reduced clock speed.
EnableAllInterrupts()
loop WHILE no pending wakeup events
EcuM_SleepActivity()
EcuM_CheckWakeup(EcuM_WakeupSourceType)
This call has to be repeated for both FlexRay channels on the same network (i.e. FlexRay cluster)!
FrIf_CheckWakeupByTransceiver(uint8, Fr_ChannelType)
FrTrcv_CheckWakeupByTransceiver(uint8)
opt Wakeup detected
EcuM_SetWakeupEvent(EcuM_WakeupSourceType)
EcuM_SetWakeupEvent()
FrTrcv_CheckWakeupByTransceiver()
FrIf_CheckWakeupByTransceiver()
EcuM_CheckWakeupEvent()
WAKEUP I
DisableAllInterrupts()
Mcu_SetMode(Mcu_ModeType)
Mcu_SetMode()
EnableAllInterrupts()
EcuM_DisableWakeupSources(EcuM_WakeupSourceType)
ReleaseResource(RES_AUTOSAR_ECUM_<core#>)
ReleaseResource()
Release Scheduler resource to allow other tasks to run.

**Figure 42 – FlexRay transceiver wake up by polling**

### 9.2.6 TCP/IP Wake-up Sequences

With TCP/IP there can be no wake up from the bus. There is a wake up line connected to the ICU. All TCP/IP wake ups are therefore handled as normal ICU wake ups. Refer to section 9.2.1 GPT Wake-up Sequences for details.

# 10 Configuration specification

## 10.1 Containers and configuration parameters

Configuration parameters define the variability of the generic part(s) of an implementation of a module. This means that only generic or configurable module implementation can be adapted to the environment (software/hardware) in use during system and/or ECU configuration.

## 10.2 Variants

Variants describe sets of configuration parameters. E.g., variant 1: only pre-compile time configuration parameters; variant 2: mix of pre-compile- and post build time-configuration parameters.

There following variants are available in AUTOSAR modules:

- VARIANT-PRE-COMPILE: Only parameters with "Pre-compile time" configuration are allowed in this variant,
- VARIANT-LINK-TIME: Only parameters with "Pre-compile time" and "Link time" are allowed in this variant, and
- VARIANT-POST-BUILD: Parameters with "Pre-compile time", "Link time" and "Post-build time" are allowed in this variant.

**EcuMf0003**: The ECU State Manager shall have only one configuration variant.

## 10.3 Published Information

**EcuMf001_PI**: The standardized common published parameters as required by BSW00402 in the General Requirements on Basic Software Modules [3] shall be published within the header file of this module and need to be provided in the BSW Module Description. The according module abbreviation can be found in the List of Basic Software Modules [1].

Additional module-specific published parameters are listed below if applicable.

## 10.4 Configurable Parameters

**EcuM2809**: The following containers contain various references to initialization structures of BSW modules. NULL shall be a valid reference meaning 'no configuration data available' but only if the implementation of the initialized BSW module supports this.

### 10.4.1 EcuM

| | |
|---|---|
| ***Module Name*** | *EcuM* |
| ***Module Description*** | Configuration of the EcuM (ECU State Manager) module. |

| ***Included Containers*** | | |
|---|---|---|
| ***Container Name*** | ***Multiplicity*** | ***Scope / Dependency*** |
| EcuMConfiguration | 1 | This container contains the configuration (parameters) of the ECU State Manager. |
| EcuMFixedGeneral | 0..1 | This container holds the general, pre-compile configuration parameters for the EcuMFixed. Only applicable if EcuMFixed is implemented. |
| EcuMFlexGeneral | 0..1 | This container holds the general, pre-compile configuration parameters for the EcuMFlex. Only applicable if EcuMFlex is implemented. |
| EcuMGeneral | 1 | This container holds the general, pre-compile configuration parameters. |

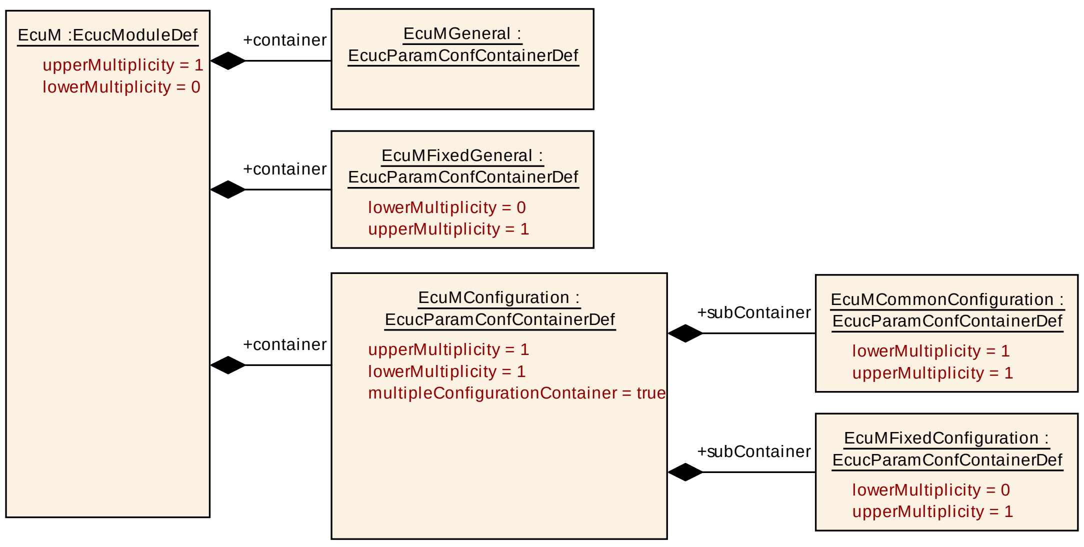


**Figure 43 – EcuM Fixed Containers**

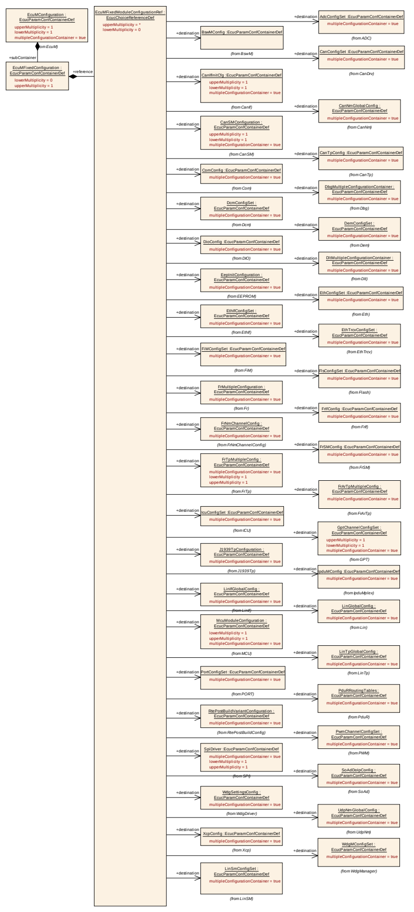


**Figure 44 – EcuM Fixed Module Configuration**

### 10.4.2 EcuMGeneral

| | |
|---|---|
| ***SWS Item*** | **ECUM116_Conf :** |
| ***Container Name*** | EcuMGeneral |
| ***Description*** | This container holds the general, pre-compile configuration parameters. |
| ***Configuration Parameters*** | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM108_Conf :** | | |
| ***Name*** | EcuMDevErrorDetect {ECUM_DEV_ERROR_DETECT} | | |
| ***Description*** | If false, no debug artifacts (e.g. calls to DET) shall remain in the executable object. Initialization of DET, however is controlled by configuration of optional BSW modules. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | |
|---|---|
| ***SWS Item*** | **ECUM117_Conf :** |
| ***Name*** | EcuMIncludeDem {ECUM_INCLUDE_DEM} |
| ***Description*** | If enabled, the according BSW module will be included to the ECU State Manager. |

| | | | |
|---|---|---|---|
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM118_Conf :** | | |
| ***Name*** | EcuMIncludeDet {ECUM_INCLUDE_DET} | | |
| ***Description*** | If defined, the according BSW module will be initialized by the ECU State Manager | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM121_Conf :** | | |
| ***Name*** | EcuMMainFunctionPeriod {ECUM_MAIN_FUNCTION_PERIOD} | | |
| ***Description*** | This parameter defines the schedule period of EcuM_MainFunction. Unit: [s] | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | `0 .. INF` | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | dependency: EcuM2594 | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM149_Conf :** | | |
| ***Name*** | EcuMVersionInfoApi | | |
| ***Description*** | Switches the version info API on or off | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| ***No Included Containers*** |
|---|

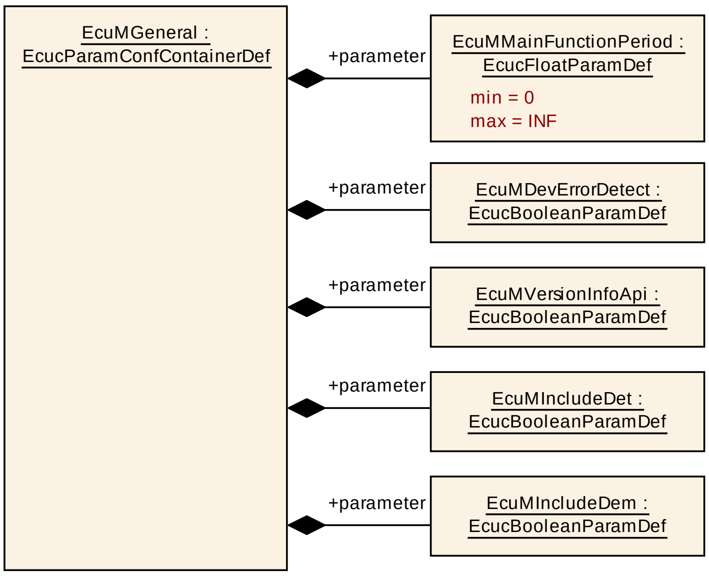


**Figure 45 – Container EcuMGeneral**

### 10.4.3 EcuMFixedGeneral

| | |
|---|---|
| ***SWS Item*** | **ECUM166_Conf :** |
| ***Container Name*** | EcuMFixedGeneral |
| ***Description*** | This container holds the general, pre-compile configuration parameters for the EcuMFixed.<br>Only applicable if EcuMFixed is implemented. |
| ***Configuration Parameters*** | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM189_Conf :** | | |
| ***Name*** | EcuMIncludeComM {ECUM_INCLUDE_COMM} | | |
| ***Description*** | This configuration parameter defines whether the communication manager is supported by EcuM. This feature is presented for development purpose to compile out the communication manager in the early debugging phase. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM190_Conf :** | | |
| ***Name*** | EcuMIncludeNvM {ECUM_INCLUDE_NVM} | | |
| ***Description*** | This configuration parameter defines whether the non volatile memory manager is supported by EcuM. This feature is presented for development purpose to compile out the volatile memory manager in the early debugging phase. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |

| | | | |
|---|---|---|---|
| | *Link time* | -- | |
| | *Post-build time* | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM119_Conf :** | | |
| ***Name*** | EcuMIncludeNvramMgr {ECUM_INCLUDE_NVRAM_MGR} | | |
| ***Description*** | If NVRAM manager is enabled but both flash and EEPROM driver are missing, then an error shall be flagged by the configuration tool | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM144_Conf :** | | |
| ***Name*** | EcuMTTIIEnabled {ECUM_TTII_ENABLED} | | |
| ***Description*** | Boolean switch to enable / disable TTII | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM145_Conf :** | | |
| ***Name*** | EcuMTTIIWakeupSourceRef {ECUM_TTII_WKSOURCE} | | |
| ***Description*** | This configuration parameter references the initial sleep mode to be used by TTII when TTII is activated after a RUN mode. EcuM2785: Whenever RUN mode is reached, the TTII protocol shall be reset to use the wakeup source referenced by this parameter. This configuration parameter is a human readable name for a TTII wakeup source which is only needed by the configuration tool. For imlementation on the ECU, this parameter may be dropped and replaced by a generated list index of EcuM_TTII. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | Reference to [ EcuMWakeupSource ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| |
|---|
| ***No Included Containers*** |

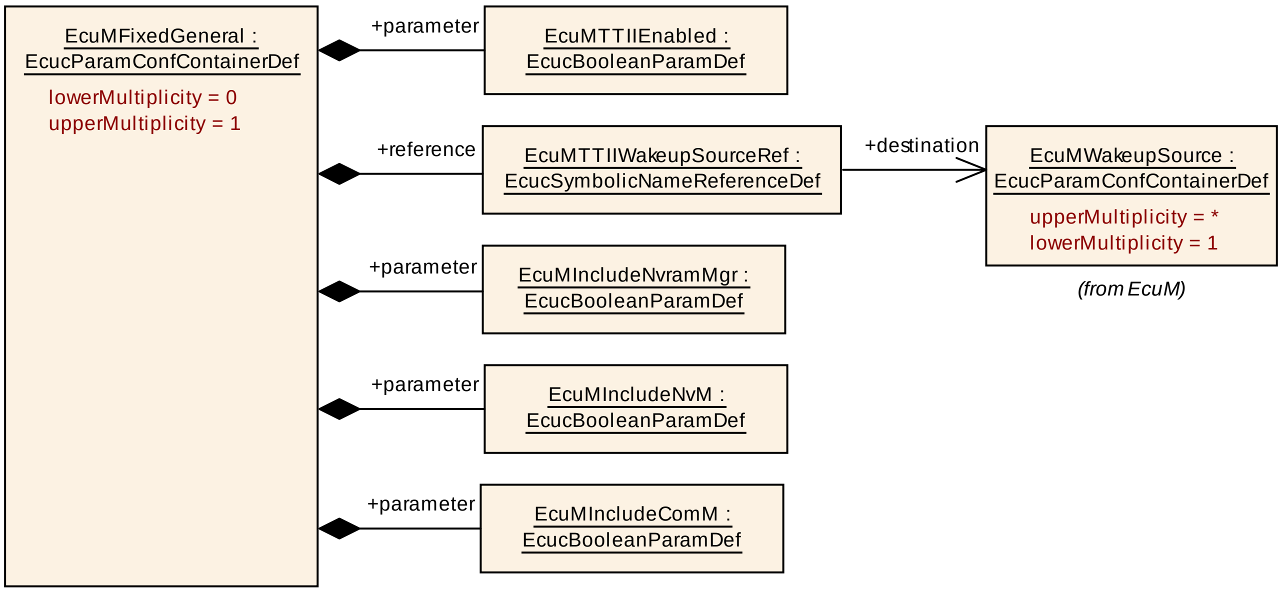


**Figure 46 – Container EcuMFixedGeneral**

### 10.4.4 EcuMFixedConfiguration

| | |
|---|---|
| ***SWS Item*** | **ECUM165_Conf :** |
| ***Container Name*** | EcuMFixedConfiguration |
| ***Description*** | This container contains the configuration (parameters) of the EcuMFixed. Only applicable if EcuMFixed is implemented. |
| ***Configuration Parameters*** | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM126_Conf :** | | |
| ***Name*** | EcuMNvramReadallTimeout | | |
| ***Description*** | Period given in seconds for which the ECU State Manager will wait until it considers a ReadAll job of the NVRAM Manager as failed. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | `0 .. INF` | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | -- | |
| | ***Link time*** | -- | |
| | ***Post-build time*** | X | VARIANT-POST-BUILD |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM127_Conf :** | | |
| ***Name*** | EcuMNvramWriteallTimeout {ECUM_NVRAM_WRITEALL_TIMEOUT} | | |
| ***Description*** | Period given in seconds for which the ECU State Manager will wait until it considers a WriteAll job of the NVRAM Manager as failed. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | `0 .. INF` | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | -- | |
| | ***Link time*** | -- | |
| | ***Post-build time*** | X | VARIANT-POST-BUILD |

| | | | |
|---|---|---|---|
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM129_Conf :** | | |
| ***Name*** | EcuMRunMinimumDuration {ECUM_RUN_SELF_REQUEST_PERIOD} | | |
| ***Description*** | Duration given in seconds for which the ECU State Manager will stay in RUN state even when no one requests RUN. This duration should be long at least as long as a SW-Cs needs to request RUN. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | `0 .. INF` | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | -- | |
| | ***Link time*** | -- | |
| | ***Post-build time*** | X | VARIANT-POST-BUILD |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM191_Conf :** | | |
| ***Name*** | EcuMComMCommunicationAllowedList | | |
| ***Description*** | These parameters contain references to the ComMChannels for which EcuM has to call ComM_CommunicationAllowed. | | |
| ***Multiplicity*** | 0..* | | |
| ***Type*** | Reference to [ ComMChannel ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM122_Conf :** | | |
| ***Name*** | EcuMFixedModuleConfigurationRef {InitConfiguration} | | |
| ***Description*** | These parameters contain references to the init structure of the corresponding BSW module. | | |
| ***Multiplicity*** | 0..* | | |
| ***Type*** | Choice reference to [ AdcConfigSet , CanConfigSet , CanIfInitCfg , CanNmGlobalConfig , CanSMConfiguration , CanTpConfig , CanTrcvConfigSet , ComConfig , ComMConfigSet , DbgMultipleConfigurationContainer , DcmConfigSet , DemConfigSet , DioConfig , DltMultipleConfigurationContainer , EepInitConfiguration , EthConfigSet , EthIfConfigSet , EthTrcvConfigSet , FiMConfigSet , FlsConfigSet , FlsTstConfigSet , FrArTpMultipleConfig , FrIfConfig , FrMultipleConfiguration , FrNmChannelConfig , FrSMConfig , FrTpMultipleConfig , GptChannelConfigSet , IcuConfigSet , IpduMConfig , J1939TpConfiguration , LinGlobalConfig , LinIfGlobalConfig , LinSMConfigSet , LinTpGlobalConfig , McuModuleConfiguration , PduRRoutingTables , PortConfigSet , PwmChannelConfigSet , RtePostBuildVariantConfiguration , SoAdDoIpConfig , SpiDriver , UdpNmGlobalConfig , WdgMConfigSet , WdgSettingsConfig , XcpConfig ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | -- | |
| | ***Link time*** | -- | |
| | ***Post-build time*** | X | VARIANT-POST-BUILD |
| ***Scope / Dependency*** | | | |

| | |
|---|---|
| ***SWS Item*** | **ECUM125_Conf :** |
| ***Name*** | EcuMNormalMcuModeRef |
| ***Description*** | This parameter is a reference to the normal MCU mode to be restored after a sleep. |

| | | | |
|---|---|---|---|
| ***Multiplicity*** | 1 | | |
| ***Type*** | Reference to [ McuModeSettingConf ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| ***Included Containers*** | | |
|---|---|---|
| ***Container Name*** | ***Multiplicity*** | ***Scope / Dependency*** |
| EcuMDriverInitListThree | 0..1 | Container for Init Block III. This container holds a list of module IDs that will be initialised. Each module in the list will be called for initialisation in the list order. All modules in this list are initilialised after the OS is started and so these modules may use OS support. These modules may also rely on the Nvram ReadAll job to have provided all data. |
| EcuMDriverInitListTwo | 0..1 | Container for Init Block II. This container holds a list of module IDs that will be initialised. Each module in the list will be called for initialisation in the list order. All modules in this list are initilialised after the OS is started and so these modules may use OS support. These modules may not rely on the Nvram ReadAll job to have provided all data. |
| EcuMFixedUserConfig | 1..* | These containers describe the identifiers that are needed to refer to a software component or another appropriate entity in the system which is designated to request the RUN state. Application requestors refer to entities above RTE, system requestors to entities below RTE (e.g. Communication Manager). |
| EcuMTTII | 0..* | These containers describe the structures and the following configuration items describe its elements. These structures are concatenated to build a list as indicated by Figure 27 - Configuration Container Diagram. The list must contain at least one element when ECUM_TTII_ENABLED is set to true. |

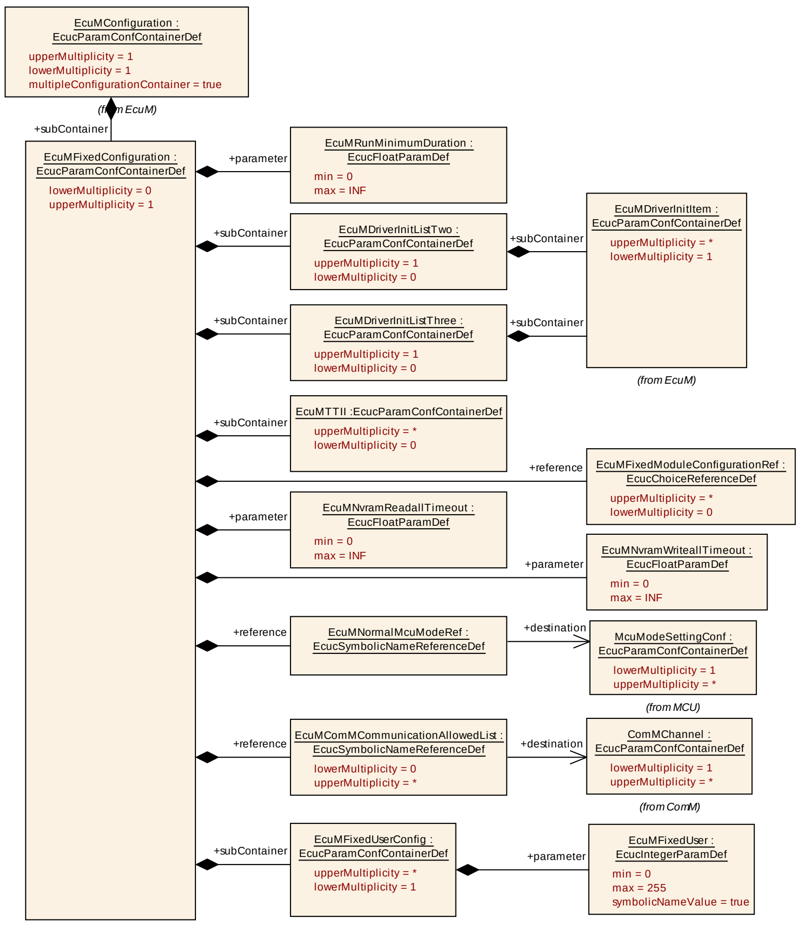


**Figure 47 – Container EcuMFixedConfiguration**

### 10.4.5 EcuMCommonConfiguration

| | |
|---|---|
| ***SWS Item*** | **ECUM181_Conf :** |
| ***Container Name*** | EcuMCommonConfiguration |
| ***Description*** | This container contains the common configuration (parameters) of the ECU State Manager. |
| ***Configuration Parameters*** | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM102_Conf :** | | |
| ***Name*** | EcuMConfigConsistencyHash {ECUM_CONFIGCONSISTENCY_HASH} | | |
| ***Description*** | A hash value generated across all pre-compile and link-time parameters of all BSW modules. This hash value is compared against a field in the EcuM_ConfigType and hence allows checking the consistency of the entire configuration. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***Range*** | 0 .. 18446744073709551615 | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | -- | |
| | ***Link time*** | X | VARIANT-POST-BUILD |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | |
|---|---|
| ***SWS Item*** | **ECUM104_Conf :** |

| | | | |
|---|---|---|---|
| ***Name*** | EcuMDefaultAppMode {ECUM_DEFAULT_APP_MODE} | | |
| ***Description*** | The default application mode loaded when the ECU comes out of reset. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | Reference to [ OsAppMode ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | -- | |
| | ***Link time*** | -- | |
| | ***Post-build time*** | X | VARIANT-POST-BUILD |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM183_Conf :** | | |
| ***Name*** | EcuMOSResource | | |
| ***Description*** | This parameter is a reference to a OS ressource which is used to bring the ECU into sleep mode. In case of multi core each core shall have an own OsResource. | | |
| ***Multiplicity*** | 1..* | | |
| ***Type*** | Reference to [ OsResource ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| ***Included Containers*** | | |
|---|---|---|
| ***Container Name*** | ***Multiplicity*** | ***Scope / Dependency*** |
| EcuMDefaultShutdownTarget | 1 | This container describes the default shutdown target to be selected by EcuM. The actual shutdown target may be overridden by the EcuM_SelectShutdownTarget service. |
| EcuMDemEventParameterRefs | 0..1 | Container for the references to DemEventParameter elements which shall be invoked using the API Dem_ReportErrorStatus in case the corresponding error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId value. The standardized errors are provided in this container and can be extended by vendor specific error references. |
| EcuMDriverInitListOne | 0..1 | Container for Init Block I. This container holds a list of module IDs that will be initialised. Each module in the list will be called for initialisation in the list order. All modules in this list are initilialised before the OS is started and so these modules require no OS support. |
| EcuMDriverInitListZero | 0..1 | Container for Init Block 0. This container holds a list of module IDs that will be initialised. Each module in the list will be called for initialisation in the list order. All modules in this list are initilialised before the post-build configuration has been loaded and the OS is initialized. Therefore, these modules may not use post-build configuration. |
| EcuMDriverRestartList | 0..1 | List of module IDs. EcuM2719: A configuration tool shall fill the callout EcuM_AL_DriverRestart with initialization calls to the listed drivers in the order in which they occur in the list. EcuM2720: Entries in this list must appear in the same order as in the combined list of EcuM_DriverInitListOne and EcuM_DriverInitListTwo. This list may be a real subset though. In all other cases, the generation tool shall report an error. The included container has the same structure as EcuM_DriverInitItem |
| EcuMSleepMode | 1..* | These containers describe the configured sleep modes. The names of these containers specify the symbolic names of the different sleep modes. |
| EcuMWakeupSource | 1..* | These containers describe the configured wakeup sources. |

### 10.4.6 EcuMDefaultShutdownTarget

| | |
|---|---|
| ***SWS Item*** | **ECUM105_Conf :** |
| ***Container Name*** | EcuMDefaultShutdownTarget{ECUM_DEFAULT_SHUTDOWN_TARGET} |
| ***Description*** | This container describes the default shutdown target to be selected by EcuM. The actual shutdown target may be overridden by the EcuM_SelectShutdownTarget service. |
| ***Configuration Parameters*** | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM107_Conf :** | | |
| ***Name*** | EcuMDefaultState {ECUM_DEFAULT_SHUTDOWN_TARGET} | | |
| ***Description*** | This parameter describes the state part of the default shutdown target selected when the ECU comes out of reset. If EcuMStateSleep is selected, the parameter EcuMDefaultSleepModeRef selects the specific sleep mode. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucEnumerationParamDef | | |
| ***Range*** | EcuMStateOff | Corresponds to ECUM_STATE_OFF in EcuM_StateType. | |
| | EcuMStateReset | Corresponds to ECUM_STATE_RESET in EcuM_StateType. This literal is only be applicable for EcuMFlex. | |
| | EcuMStateSleep | Corresponds to ECUM_STATE_SLEEP in EcuM_StateType. | |
| ***ConfigurationClass*** | ***Pre-compile time*** | -- | |
| | ***Link time*** | -- | |
| | ***Post-build time*** | X | VARIANT-POST-BUILD |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM205_Conf :** | | |
| ***Name*** | EcuMDefaultResetModeRef | | |
| ***Description*** | If EcuMDefaultShutdownTarget is EcuMStateReset, this parameter selects the default reset mode. Otherwise this parameter may be ignored. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Reference to [ EcuMResetMode ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | -- | |
| | ***Link time*** | -- | |
| | ***Post-build time*** | X | VARIANT-POST-BUILD |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM106_Conf :** | | |
| ***Name*** | EcuMDefaultSleepModeRef | | |
| ***Description*** | If EcuMDefaultShutdownTarget is EcuMStateSleep, this parameter selects the default sleep mode. Otherwise this parameter may be ignored. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Reference to [ EcuMSleepMode ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | -- | |
| | ***Link time*** | -- | |
| | ***Post-build time*** | X | VARIANT-POST-BUILD |
| ***Scope / Dependency*** | | | |

| |
|---|
| ***No Included Containers*** |

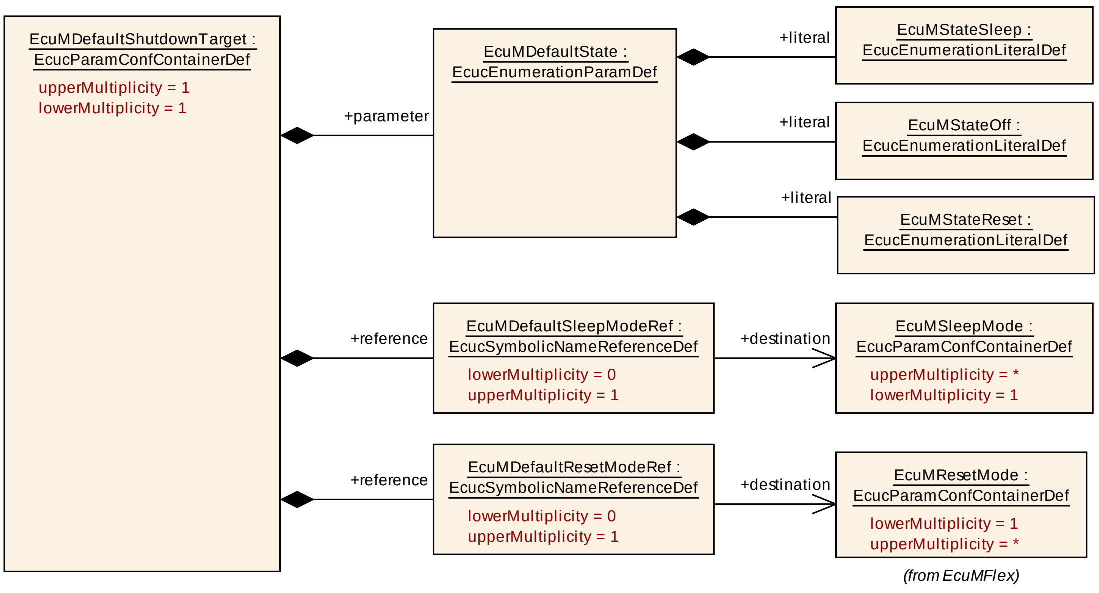

EcuMDefaultShutdownTarget : EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 1
+parameter
EcuMDefaultState : EcucEnumerationParamDef
+literal
EcuMStateSleep : EcucEnumerationLiteralDef
+literal
EcuMStateOff : EcucEnumerationLiteralDef
+literal
EcuMStateReset : EcucEnumerationLiteralDef
+reference
EcuMDefaultSleepModeRef : EcucSymbolicNameReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 1
+destination
EcuMSleepMode : EcucParamConfContainerDef
upperMultiplicity = *
lowerMultiplicity = 1
+reference
EcuMDefaultResetModeRef : EcucSymbolicNameReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 1
+destination
EcuMResetMode : EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = *
(from EcuMFlex)

**Figure 48 – EcuM Default Shutdown Target**

### 10.4.7 EcuMDemEventParameterRefs

| | |
|---|---|
| ***SWS Item*** | **ECUM160_Conf :** |
| ***Container Name*** | EcuMDemEventParameterRefs |
| ***Description*** | Container for the references to DemEventParameter elements which shall be invoked using the API Dem_ReportErrorStatus in case the corresponding error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId value.<br>The standardized errors are provided in this container and can be extended by vendor specific error references. |
| ***Configuration Parameters*** | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM162_Conf :** | | |
| ***Name*** | ECUM_E_ALL_RUN_REQUESTS_KILLED | | |
| ***Description*** | Reference to the DemEventParameter which shall be issued when the error "ECUM_E_ALL_RUN_REQUESTS_KILLED" has occured. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Reference to [ DemEventParameter ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM163_Conf :** | | |
| ***Name*** | ECUM_E_CONFIGURATION_DATA_INCONSISTENT | | |
| ***Description*** | Reference to the DemEventParameter which shall be issued when the error "ECUM_E_CONFIGURATION_DATA_INCONSISTENT" has occured. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Reference to [ DemEventParameter ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| SWS Item | ECUM161_Conf : | | |
|---|---|---|---|
| Name | ECUM_E_RAM_CHECK_FAILED | | |
| Description | Reference to the DemEventParameter which shall be issued when the error "ECUM_E_RAM_CHECK_FAILED" has occured. | | |
| Multiplicity | 0..1 | | |
| Type | Reference to [ DemEventParameter ] | | |
| ConfigurationClass | Pre-compile time | X | VARIANT-POST-BUILD |
| | Link time | -- | |
| | Post-build time | -- | |
| Scope / Dependency | | | |

| No Included Containers |
|---|

## 10.4.8 EcuMDriverInitItem

| SWS Item | ECUM110_Conf : |
|---|---|
| Container Name | EcuMDriverInitItem |
| Description | These containers describe the entries in a driver init list. |
| Configuration Parameters | |

| SWS Item | ECUM123_Conf : | | |
|---|---|---|---|
| Name | EcuMModuleID {ModuleID} | | |
| Description | Short name of the module to be initialized, e.g. Mcu, Gpt etc. | | |
| Multiplicity | 1 | | |
| Type | EcucStringParamDef | | |
| Default value | -- | | |
| maxLength | -- | | |
| minLength | -- | | |
| regularExpression | -- | | |
| ConfigurationClass | Pre-compile time | X | VARIANT-POST-BUILD |
| | Link time | -- | |
| | Post-build time | -- | |
| Scope / Dependency | | | |

| SWS Item | ECUM124_Conf : | | |
|---|---|---|---|
| Name | EcuMModuleService | | |
| Description | The service to be called to initialize that module, e.g. Init, PreInit, Start etc. If the service is Init and the parameter EcuMModuleConfigurationRef has been set for that module, the corresponding pointer to the init structure (<Module>_ConfigType) and in case of multiple instantiation an uint8 value to identify the instance of the module(<MSN>_CtrlIdx) shall be passed as arguments. | | |
| Multiplicity | 1 | | |
| Type | EcucStringParamDef | | |
| Default value | -- | | |
| maxLength | -- | | |
| minLength | -- | | |
| regularExpression | -- | | |
| ConfigurationClass | Pre-compile time | X | VARIANT-POST-BUILD |
| | Link time | -- | |
| | Post-build time | -- | |
| Scope / Dependency | | | |

| *No Included Containers* |
|---|

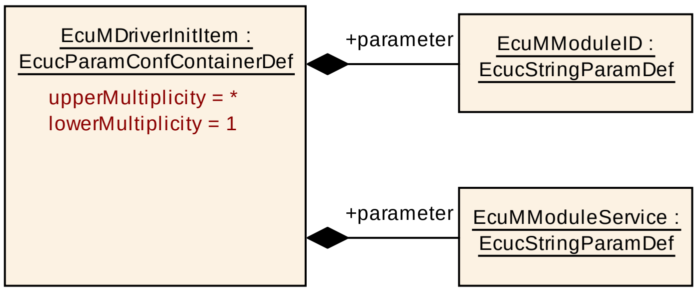

EcuMDriverInitItem : EcucParamConfContainerDef
upperMultiplicity = *
lowerMultiplicity = 1
+parameter
EcuMModuleID : EcucStringParamDef
+parameter
EcuMModuleService : EcucStringParamDef

**Figure 49 – EcuM Driver Init Item**

### 10.4.9 EcuMDriverInitListZero

| *SWS Item* | **ECUM114_Conf :** |
|---|---|
| *Container Name* | EcuMDriverInitListZero |
| *Description* | Container for Init Block 0.<br>This container holds a list of module IDs that will be initialised. Each module in the list will be called for initialisation in the list order.<br>All modules in this list are initilialised before the post-build configuration has been loaded and the OS is initialized. Therefore, these modules may not use post-build configuration. |
| *Configuration Parameters* | |

| *Included Containers* | | |
|---|---|---|
| *Container Name* | *Multiplicity* | *Scope / Dependency* |
| EcuMDriverInitItem | 1..* | These containers describe the entries in a driver init list. |

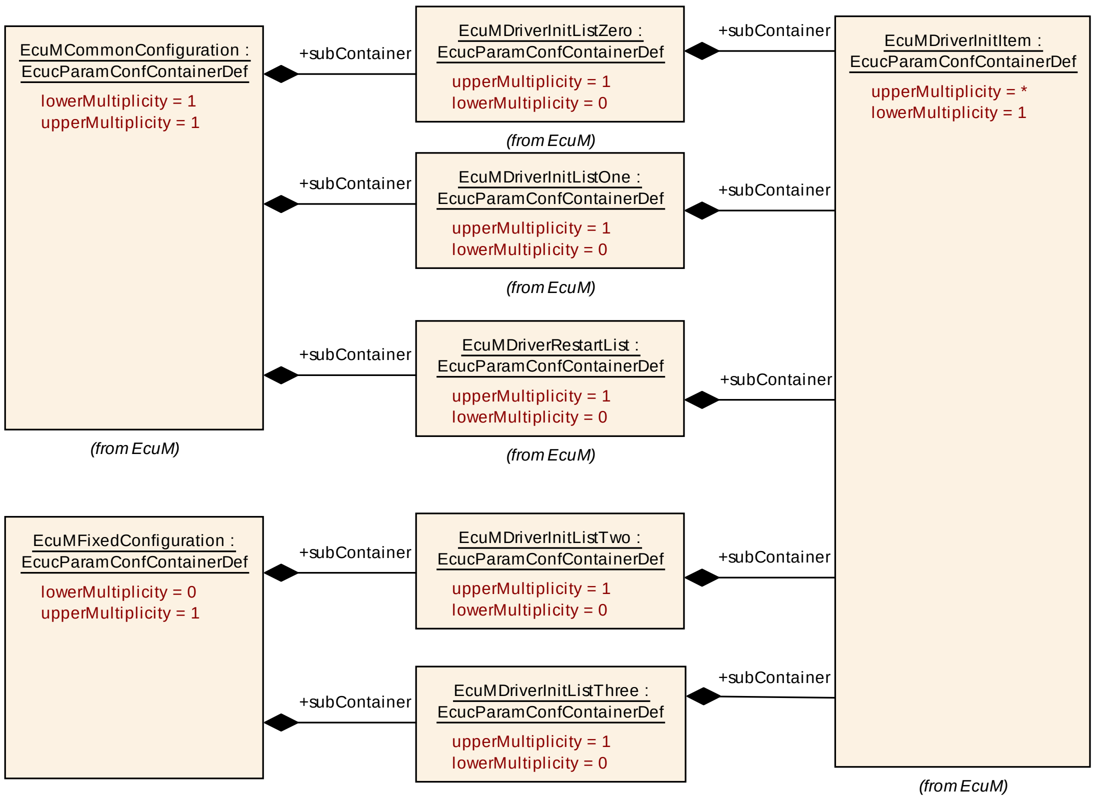


**Figure 50 – EcuM Fixed Init Lists**

### 10.4.10 EcuMDriverInitListOne

| | |
|---|---|
| ***SWS Item*** | **ECUM111_Conf :** |
| ***Container Name*** | EcuMDriverInitListOne |
| ***Description*** | Container for Init Block I.<br>This container holds a list of module IDs that will be initialised. Each module in the list will be called for initialisation in the list order.<br>All modules in this list are initilialised before the OS is started and so these modules require no OS support. |
| ***Configuration Parameters*** | |

| ***Included Containers*** | | |
|---|---|---|
| ***Container Name*** | ***Multiplicity*** | ***Scope / Dependency*** |
| EcuMDriverInitItem | 1..* | These containers describe the entries in a driver init list. |

### 10.4.11 EcuMDriverInitListTwo

| | |
|---|---|
| ***SWS Item*** | **ECUM113_Conf :** |
| ***Container Name*** | EcuMDriverInitListTwo |
| ***Description*** | Container for Init Block II.<br>This container holds a list of module IDs that will be initialised. Each module in the list will be called for initialisation in the list order.<br>All modules in this list are initilialised after the OS is started and so these modules may use OS support. These modules may not rely on the Nvram ReadAll job to have provided all data. |
| ***Configuration Parameters*** | |

| ***Included Containers*** | | |
|---|---|---|
| ***Container Name*** | ***Multiplicity*** | ***Scope / Dependency*** |
| EcuMDriverInitItem | 1..* | These containers describe the entries in a driver init list. |

### 10.4.12 EcuMDriverInitListThree

| | |
|---|---|
| ***SWS Item*** | **ECUM112_Conf :** |
| ***Container Name*** | EcuMDriverInitListThree |
| ***Description*** | Container for Init Block III.<br>This container holds a list of module IDs that will be initialised. Each module in the list will be called for initialisation in the list order.<br>All modules in this list are initilialised after the OS is started and so these modules may use OS support. These modules may also rely on the Nvram ReadAll job to have provided all data. |
| ***Configuration Parameters*** | |

| ***Included Containers*** | | |
|---|---|---|
| ***Container Name*** | ***Multiplicity*** | ***Scope / Dependency*** |
| EcuMDriverInitItem | 1..* | These containers describe the entries in a driver init list. |

### 10.4.13 EcuMSleepMode

| | |
|---|---|
| ***SWS Item*** | **ECUM131_Conf :** |
| ***Container Name*** | EcuMSleepMode |
| ***Description*** | These containers describe the configured sleep modes.<br>The names of these containers specify the symbolic names of the different sleep modes. |
| ***Configuration Parameters*** | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM132_Conf :** | | |
| ***Name*** | EcuMSleepModeId | | |
| ***Description*** | This ID identifies this sleep mode in services like EcuM_SelectShutdownTarget. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucIntegerParamDef (Symbolic Name generated for this parameter) | | |
| ***Range*** | 0 .. 255 | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM136_Conf :** | | |
| ***Name*** | EcuMSleepModeSuspend | | |
| ***Description*** | Flag, which is set true, if the CPU is suspended, halted, or powered off in the sleep mode. If the CPU keeps running in this sleep mode, then this flag must be set to false. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |

| | |
|---|---|
| ***Scope / Dependency*** | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM133_Conf :** | | |
| ***Name*** | EcuMSleepModeMcuModeRef {SleepModeConfiguration} | | |
| ***Description*** | This parameter is a reference to the corresponding MCU mode for this sleep mode. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | Reference to [ McuModeSettingConf ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM152_Conf :** | | |
| ***Name*** | EcuMWakeupSourceMask | | |
| ***Description*** | These parameters are references to the wakeup sources that shall be enabled for this sleep mode. | | |
| ***Multiplicity*** | 1..* | | |
| ***Type*** | Reference to [ EcuMWakeupSource ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| |
|---|
| ***No Included Containers*** |

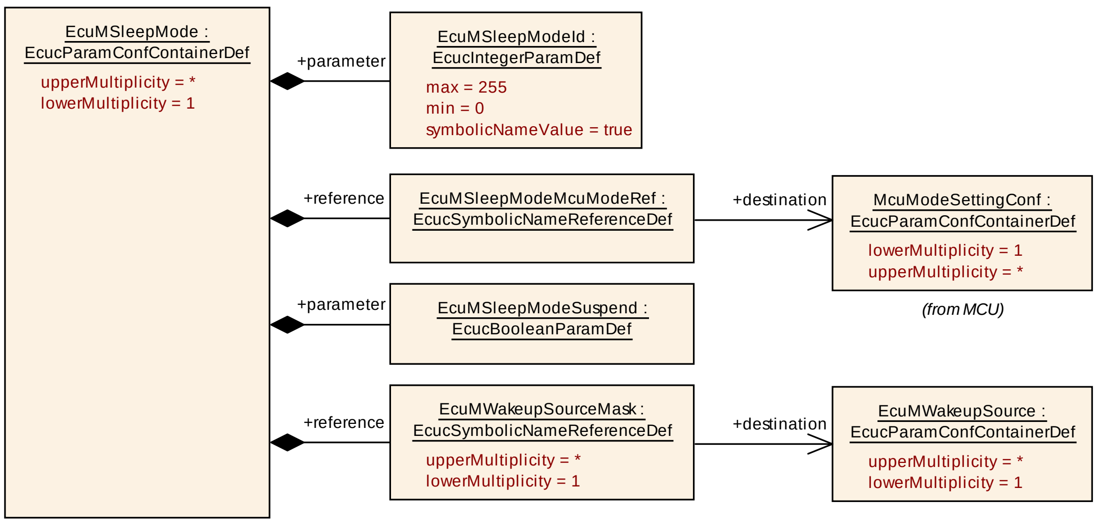

EcuMSleepMode : EcucParamConfContainerDef
upperMultiplicity = *
lowerMultiplicity = 1
+parameter
EcuMSleepModeId : EcucIntegerParamDef
max = 255
min = 0
symbolicNameValue = true
+reference
EcuMSleepModeMcuModeRef : EcucSymbolicNameReferenceDef
+destination
McuModeSettingConf : EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = *
(from MCU)
+parameter
EcuMSleepModeSuspend : EcucBooleanParamDef
+reference
EcuMWakeupSourceMask : EcucSymbolicNameReferenceDef
upperMultiplicity = *
lowerMultiplicity = 1
+destination
EcuMWakeupSource : EcucParamConfContainerDef
upperMultiplicity = *
lowerMultiplicity = 1

**Figure 51 – EcuM Sleep Mode**

## 10.4.14 EcuMWakeupSource

| | |
|---|---|
| ***SWS Item*** | **ECUM150_Conf :** |
| ***Container Name*** | EcuMWakeupSource{EcuM_WakupSource} |
| ***Description*** | These containers describe the configured wakeup sources. |
| ***Configuration Parameters*** | |

| | |
|---|---|
| ***SWS Item*** | **ECUM148_Conf :** |

| | | | |
|---|---|---|---|
| ***Name*** | EcuMValidationTimeout {ValidationTimeout} | | |
| ***Description*** | The validation timeout (period for which the ECU State Manager will wait for the validation of a wakeup event) can be defined for each wakeup source independently. The timeout is specified in seconds. When the timeout is not instantiated, there is no validation routine and the ECU Manager shall not validate the wakeup source. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | EcucFloatParamDef | | |
| ***Range*** | `0 .. INF` | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM151_Conf :** | | |
| ***Name*** | EcuMWakeupSourceId {WakeupSourceName} | | |
| ***Description*** | This parameter defines the identifier of this wakeup source. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucIntegerParamDef (Symbolic Name generated for this parameter) | | |
| ***Range*** | 0 .. 31 | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM153_Conf :** | | |
| ***Name*** | EcuMWakeupSourcePolling | | |
| ***Description*** | This parameter describes if the wakeup source needs polling. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucBooleanParamDef | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM101_Conf :** | | |
| ***Name*** | EcuMComMChannelRef {ComChannel} | | |
| ***Description*** | This parameter is a reference to a Network (channel) defined in the Communication Manager. No reference indicates that the wakeup source is not a communication channel. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Reference to [ ComMChannel ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| | |
|---|---|
| ***SWS Item*** | **ECUM128_Conf :** |
| ***Name*** | EcuMResetReasonRef {ResetReason} |
| ***Description*** | This parameter describes the mapping of reset reasons detected by the MCU driver into wakeup sources. |

| | | | |
|---|---|---|---|
| ***Multiplicity*** | 1 | | |
| ***Type*** | Reference to [ McuResetReasonConf ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| ***No Included Containers*** |
|---|

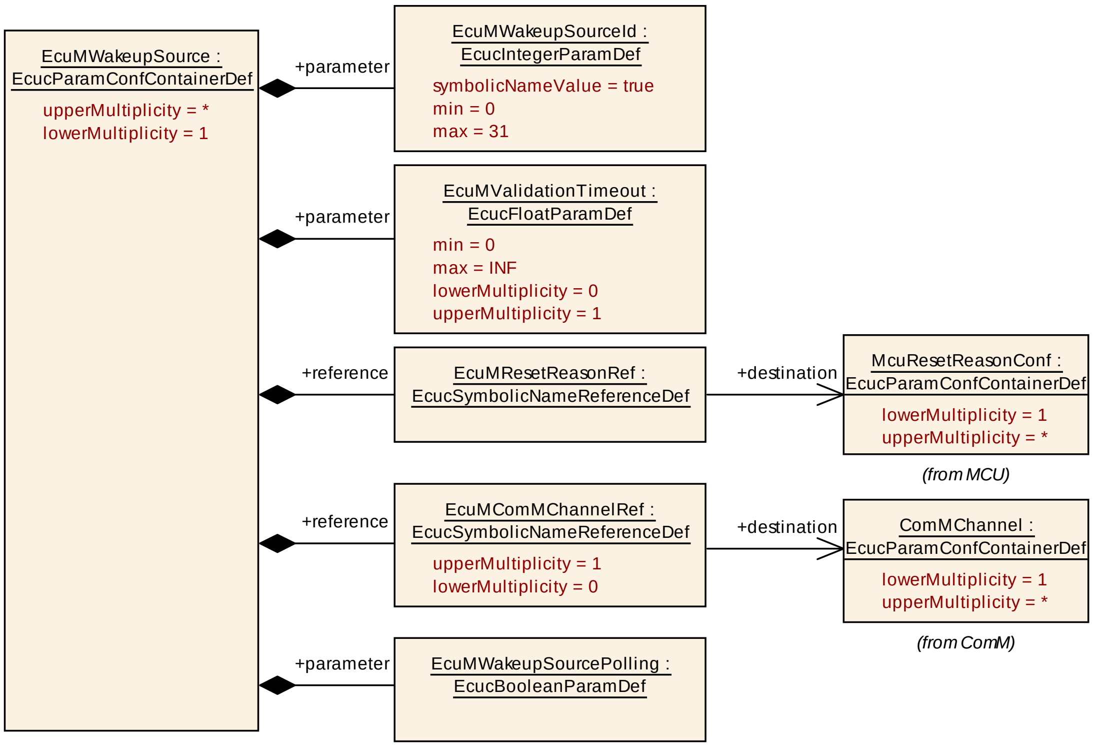


**Figure 52 – EcuM Wakeup Source**

## 10.4.15 EcuMFixedUserConfig

| | |
|---|---|
| ***SWS Item*** | **ECUM147_Conf :** |
| ***Container Name*** | EcuMFixedUserConfig{EcuM_Fixed_User} |
| ***Description*** | These containers describe the identifiers that are needed to refer to a software component or another appropriate entity in the system which is designated to request the RUN state. Application requestors refer to entities above RTE, system requestors to entities below RTE (e.g. Communication Manager). |
| ***Configuration Parameters*** | |

| | | | |
|---|---|---|---|
| ***SWS Item*** | **ECUM202_Conf :** | | |
| ***Name*** | EcuMFixedUser {User} | | |
| ***Description*** | Parameter used to identify one user. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucIntegerParamDef (Symbolic Name generated for this parameter) | | |
| ***Range*** | 0 .. 255 | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |

| | | | |
|---|---|---|---|
| | *Link time* | -- | |
| | *Post-build time* | -- | |
| *Scope / Dependency* | | | |

| *No Included Containers* |
|---|

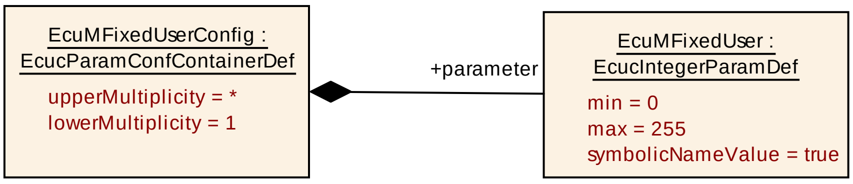


**Figure 53 – EcuM Fixed User Config**

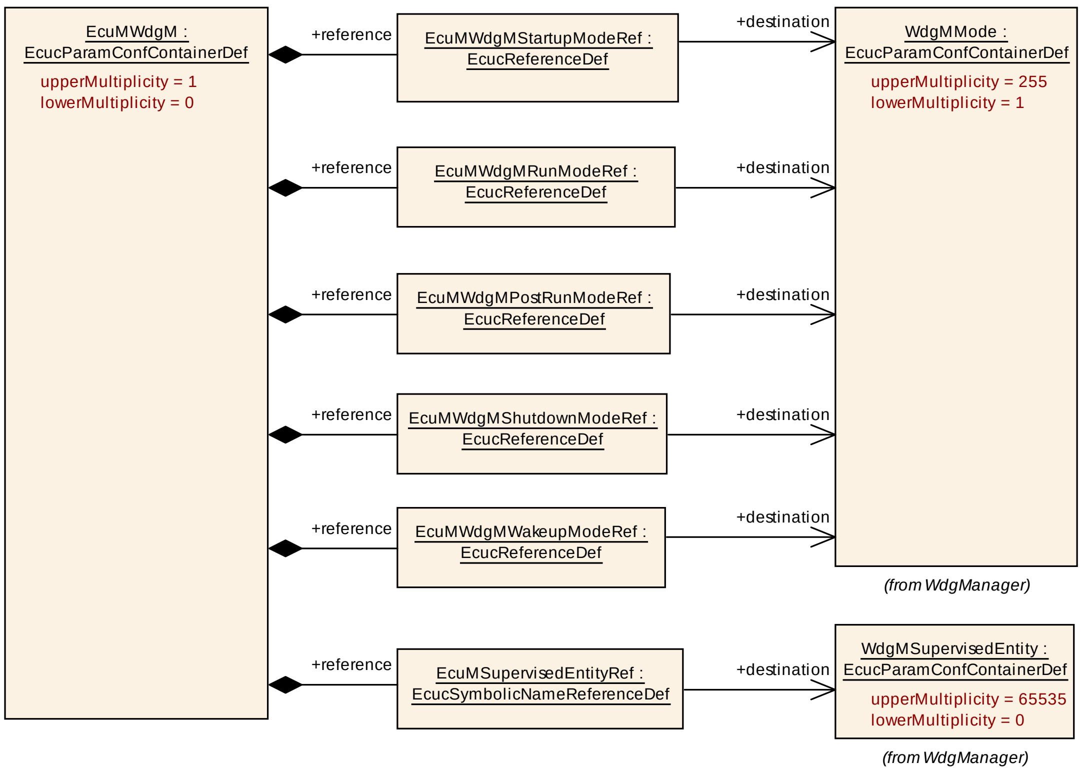

EcuMWdgM : EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 0
+reference
EcuMWdgMStartupModeRef : EcucReferenceDef
+destination
WdgMMode : EcucParamConfContainerDef
upperMultiplicity = 255
lowerMultiplicity = 1
+reference
EcuMWdgMRunModeRef : EcucReferenceDef
+destination
+reference
EcuMWdgMPostRunModeRef : EcucReferenceDef
+destination
+reference
EcuMWdgMShutdownModeRef : EcucReferenceDef
+destination
+reference
EcuMWdgMWakeupModeRef : EcucReferenceDef
+destination
(from WdgManager)
+reference
EcuMSupervisedEntityRef : EcucSymbolicNameReferenceDef
+destination
WdgMSupervisedEntity : EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 0
(from WdgManager)

**Figure 54 – EcuM Fixed WdgM**

### 10.4.16 EcuMDriverRestartList

| | |
|---|---|
| *SWS Item* | **ECUM115_Conf :** |
| *Container Name* | EcuMDriverRestartList |
| *Description* | List of module IDs. EcuM2719: A configuration tool shall fill the callout EcuM_AL_DriverRestart with initialization calls to the listed drivers in the order in which they occur in the list. EcuM2720: Entries in this list must appear in the same order as in the combined list of EcuM_DriverInitListOne and EcuM_DriverInitListTwo. This list may be a real subset though. In all other cases, the generation tool shall report an error. The included container has the same structure as EcuM_DriverInitItem |

| ***Configuration Parameters*** |
|---|

| ***Included Containers*** | | |
|---|---|---|
| ***Container Name*** | ***Multiplicity*** | ***Scope / Dependency*** |
| EcuMDriverInitItem | 1..* | These containers describe the entries in a driver init list. |

### 10.4.17 EcuMTTII

| ***SWS Item*** | **ECUM143_Conf :** |
|---|---|
| ***Container Name*** | EcuMTTII |
| ***Description*** | These containers describe the structures and the following configuration items describe its elements. These structures are concatenated to build a list as indicated by Figure 27 - Configuration Container Diagram. The list must contain at least one element when ECUM_TTII_ENABLED is set to true. |
| ***Configuration Parameters*** | |

| ***SWS Item*** | **ECUM109_Conf :** | | |
|---|---|---|---|
| ***Name*** | EcuMDivisor {Divisor} | | |
| ***Description*** | This parameter defines the divisor preload value. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | EcucIntegerParamDef | | |
| ***Range*** | 0 .. 18446744073709551615 | | |
| ***Default value*** | -- | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| ***SWS Item*** | **ECUM135_Conf :** | | |
|---|---|---|---|
| ***Name*** | EcuMSleepModeRef | | |
| ***Description*** | This configuration parameter is a reference to a configured sleep mode that is used for TTII. | | |
| ***Multiplicity*** | 1 | | |
| ***Type*** | Reference to [ EcuMSleepMode ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| ***SWS Item*** | **ECUM141_Conf :** | | |
|---|---|---|---|
| ***Name*** | EcuMSuccessorRef {Successor} | | |
| ***Description*** | This parameter is a reference to the next sleep mode in the TTII protocol. | | |
| ***Multiplicity*** | 0..1 | | |
| ***Type*** | Reference to [ EcuMSleepMode ] | | |
| ***ConfigurationClass*** | ***Pre-compile time*** | X | VARIANT-POST-BUILD |
| | ***Link time*** | -- | |
| | ***Post-build time*** | -- | |
| ***Scope / Dependency*** | | | |

| ***No Included Containers*** |
|---|

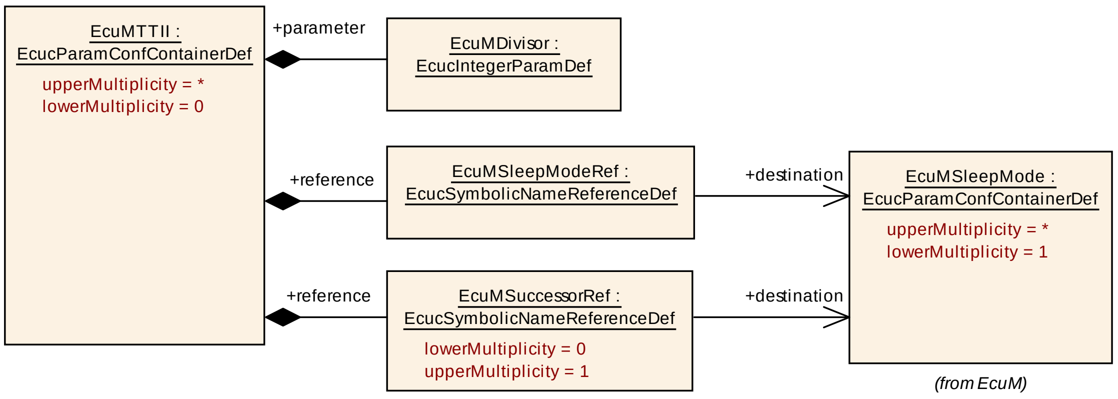

EcuMTTII : EcucParamConfContainerDef
upperMultiplicity = *
lowerMultiplicity = 0
+parameter
EcuMDivisor : EcucIntegerParamDef
+reference
EcuMSleepModeRef : EcucSymbolicNameReferenceDef
+destination
EcuMSleepMode : EcucParamConfContainerDef
upperMultiplicity = *
lowerMultiplicity = 1
+reference
EcuMSuccessorRef : EcucSymbolicNameReferenceDef
lowerMultiplicity = 0
upperMultiplicity = 1
+destination
(from EcuM)

**Figure 55 – EcuM TTII**

## 10.5 Checking Configuration Consistency

### 10.5.1 The Necessity for Checking Configuration Consistency

In an AUTOSAR ECU several configuration parameters are set and put into the ECU at different times. Pre-compile parameters are set, put into the generated source code and compiled into object code. When the source code has been compiled, link-time parameters are set, compiled, and linked with the previously configured object code into an image that is put into the ECU. Finally, post-build parameters are set, compiled, linked, and put into the ECU at a different time. All these parameters must match to obtain a stable ECU.

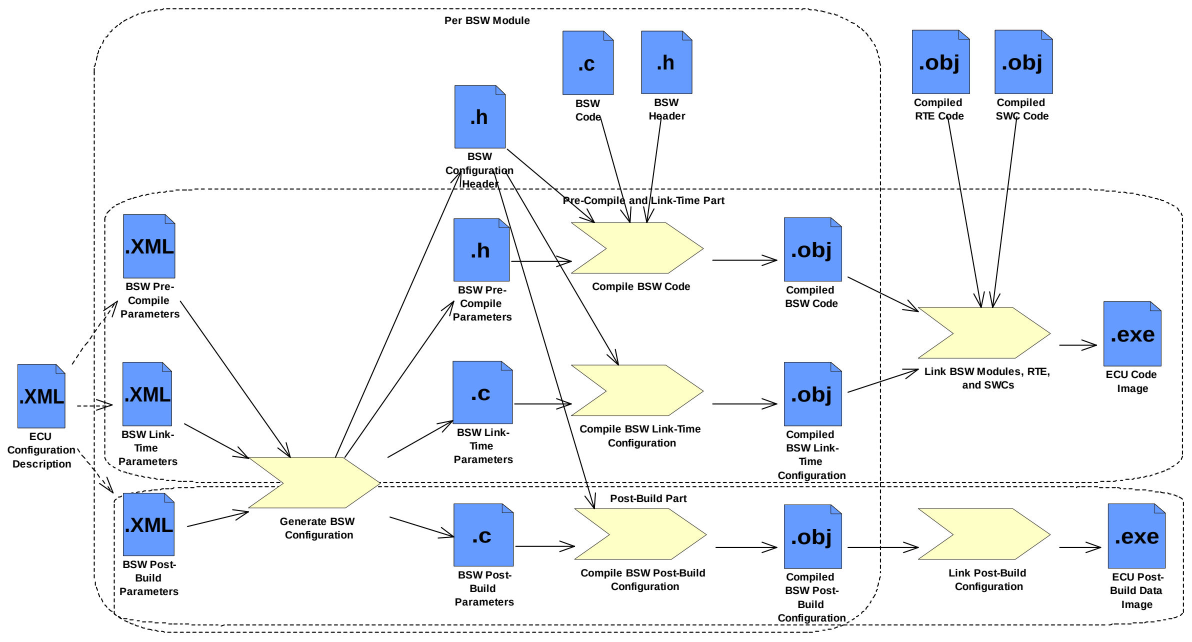

Per BSW Module
.c
BSW Code
.h
BSW Header
.obj
Compiled RTE Code
.obj
Compiled SWC Code
.h
BSW Configuration Header
Pre-Compile and Link-Time Part
.XML
BSW Pre-Compile Parameters
.h
BSW Pre-Compile Parameters
Compile BSW Code
.obj
Compiled BSW Code
Link BSW Modules, RTE, and SWCs
.exe
ECU Code Image
.XML
ECU Configuration Description
.XML
BSW Link-Time Parameters
.c
BSW Link-Time Parameters
Compile BSW Link-Time Configuration
.obj
Compiled BSW Link-Time Configuration
Generate BSW Configuration
Post-Build Part
.XML
BSW Post-Build Parameters
.c
BSW Post-Build Parameters
Compile BSW Post-Build Configuration
.obj
Compiled BSW Post-Build Configuration
Link Post-Build Configuration
.exe
ECU Post-Build Data Image

**Figure 56 – BSW Configuration Steps**

Checking consistency of parameters at configuration time can be done within the configuration tool itself. At compilation time, parameter errors may be detected by the compiler and at link time, the linker may find additional errors. Unfortunately, finding configuration errors in post-build parameters is very difficult. This can only be achieved at run-time by checking that

- the pre-compile and link-time parameter settings used when compiling the code

are exactly the same as

- the pre-compile and link-time parameter settings used when configuring and compiling the post-build parameters.

This can only be done at run-time.

**EcuM2796**: To avoid multiple checks scattered over the different BSW modules, the ECU State Manager Fixed module shall check the consistency once before initializing the first BSW module. This also implies that the ECU State Manager Fixed module must not only check the consistency of its own parameters but of all post-build configurable BSW modules.

The ECU configuration tool shall compute a hash value over all pre-compile and link-time configuration parameters of all BSW modules and put that into the link-time configuration parameter *ECUM_CONFIGCONSISTENCY_HASH.* The hash value is necessary for two reasons. First, the pre-compile and link-time parameters are not accessible anymore at run-time. Second, the check must be very efficient at run-time. Comparing hundreds of parameters would cause an unacceptable delay in the ECU startup process.

**EcuM2798**: The ECU State Manager Fixed module configuration tool shall put the current value of the configuration parameter *ECUM_CONFIGCONSISTENCY_HASH* into a field in the `EcuM_ConfigType` structure, which contains the root of all post-build configuration parameters. The ECU State Manager Fixed module shall check in `EcuM_Init` that the field in the structure is equal to the value of *ECUM_CONFIGCONSISTENCY_HASH.*

By computing both hash values at configuration time and comparing them at run-time the code of the ECU State Manager Fixed module becomes very efficient and independent of a certain hash computation algorithm. This allows for the use of complex hash computation algorithms, e.g. cryptographically strong hash functions.

Note that the same hash algorithm can be used to produce the value for the post-build configuration identifier in the `EcuM_ConfigType` structure. Then the hash algorithm is applied to the post-build parameters instead of the pre-compile and link-time parameters.

The used hash computation algorithm shall always produce the same hash value for the same set of configuration data, regardless of the order of configuration parameters in the XML files.

### 10.5.2 Example Hash Computation Algorithm

Note: This chapter is non-normative. It describes one possible way of computing hash values.

A simple CRC over the values of configuration parameters will not serve as a good hash algorithm. It only detects global changes, e.g. one parameter has changed from 1 to 2. But if another parameter changed from 2 to 1, the CRC might stay the same.

Additionally, not only the values of the configuration parameters but also their names must be taken into account in the hash algorithm. One possibility is to build a text file that contains the names of the configuration parameters and containers, separate them from the values using a delimiter, e.g. a colon, and putting each parameter as a line into a text file. For the above Watchdog Manager example only one parameter will be included because only this one is pre-compile configured. The text file would then contain the line:

```
/WdgMConfiguration/WdgM_Trigger/WDGM_NUMBER_OF_WATCHDOG_INSTANCES:2
```

If there are multiple containers of the same type, each container name can be appended with a number, e.g. “_0”, “_1” and so on.

To make the hash value independent of the order in which the parameters are written into the text file, the lines in the file must now be sorted lexicographically.

Finally, a cryptographically strong hash function, e.g. MD5, can be run on the text file to produce the hash value. These hash functions produce completely different hash values for slightly changed input files.

# 11 Changes to Release 3.1 of ECU State Manager

## 11.1 Deleted SWS Items

| ***SWS Item*** | ***Rationale*** |
|---|---|
| EcuM2522 | Not a requirement for EcuM, moved to Limitations |
| Ecum2502 | Not a requirement for EcuM |
| EcuM2261 | Not a requirement for EcuM |
| EcuM2262 | Not a requirement for EcuM |
| EcuM2799 | Not a requirement for EcuM |
| EcuM2797 | Not a requirement for EcuM |
| EcuM2384 | Replaced by EcuMf0008 |
| EcuM2700 | Replaced by EcumF0010 |
| EcuM2241 | obsolete (application mode handling) |
| EcuM2242 | obsolete (application mode handling) |
| EcuM2675 | Replaced by EcuM2988 .. EcuM2294 |
| EcuM2153 | Not a requirement for EcuM |
| EcuM2154 | Not a requirement for EcuM |
| EcuM2271 | Not a requirement for EcuM |
| EcuM2492 | Not a requirement for EcuM |
| EcuM2571 | Not a requirement for EcuM |
| EcuM2573 | Not a requirement for EcuM |
| EcuM2574 | Not a requirement for EcuM |
| EcuM2575 | Not a requirement for EcuM |
| EcuM2321 | Not a requirement for EcuM |
| EcuM2322 | Not a requirement for EcuM |
| EcuM2816 | obsolete (old API to ComM) |
| EcuM2792 | obsolete (old API to ComM) |
| EcuM2817 | obsolete (old API to ComM) |
| EcuM2818 | obsolete (old API to ComM) |
| EcuM2861 | There is no API for the EcuM to check whether the WdgM was configured and initialized, so the EcuM has no means to know when the WdgM is initialized.<br>Even if the EcuM knew that the WdgM was initialized, the EcuM would not know how often and how long the EcuM would have to trigger the WdgM. |

## 11.2 Changed SWS Items

| ***SWS Item*** | ***Rationale*** |
|---|---|
| EcuM2683 | rephrased for better readability |
| EcuM2496 | rephrased for better readability |
| EcuM2243 | removed option to change application mode during runtime |
| EcuM2833 | removed API EcuM_SelectApplicationMode |
| EcuM2081 | obsolete (application mode handling) |
| EcuM2834 | removed API EcuM_GetApplicationMode |
| EcuM2758 | rephrased for better readability |
| EcuM2763 | removed application mode handling |
| EcuM2143 | rephrased for better readability |
| EcuM2861 | corrected typo |
| EcuM2863 | synchronized formulation according to EcuM flexible, moved to SLEEP I substate |
| EcuM2919 | removed misleading comment |
| EcuM2921 | removed misleading comment |
| EcuM2788 | extended DET error information for all pointer parameters |

| | |
|---|---|
| EcuM2337 | extended DET error information for all pointer parameters |

## 11.3 Added SWS Items

| ***SWS Item*** | ***Rationale*** |
|---|---|
| EcuM2975 | Wake up validation as in EcuM flexible |
| EcuM2976 | Wake up validation as in EcuM flexible |
| EcuM2988 | Code file structure |
| EcuM2989 | Code file structure |
| EcuM2990 | Code file structure |
| EcuM2991 | Header file structure |
| EcuM2992 | Header file structure |
| EcuM2993 | Header file structure |
| EcuM2994 | Header file structure |
| EcuMf0001 | Include `RTE.h` |
| EcuMf0002 | Clarification of `EcuM_WakeupSourceType` |
| EcuMf0003 | Clarification of Variants |
| EcuMf0004 | Variables accessible for debugging |
| EcuMf0005 | Typedefs in `EcuM.h` for debugging |
| EcuMf0006 | C-"sizeof" must work for header file (e.g. for debugging) |
| EcuMf0007 | Initialization dependencies of BSWMDs |
| EcuMf0008 | Call to `ComM_CommunicationAllowed` |
| EcuMf0009 | Handling of application modes (deleted EcuM2700, changed EcuM2243) |
| EcuMf0012 | Handling of implementation specific return values. |
| EcuMf0013 | Reference to Basic Software Mode Manager |
| EcuMf0014 | Use of `BswM_EcuM_CurrentState` |
| EcuMf0015 | Use of `BswM_EcuM_CurrentWakeup` |
| EcuMf0016 | Use of `BswM_Init` |
| EcuMf0017 | Use of `BswM_Deinit` |
| EcuMf0018 | Configuration of `ComM_CommunicationAllowed` |
| EcuMf0019 | Use of `ComM_CommunicationAllowed (TRUE)` for RUN mode |
| EcuMf0020 | Use of `ComM_CommunicationAllowed (FALSE)` for RUN mode |
| EcuMf0022 | NM initialization |
| EcuMf0023 | NM initialization order |
| EcuMf0024 | Version check |
| EcuMf0025 | Requirement was in text but not formulated as requirement. |
| EcuMf0026 | Requirement was in text but not formulated as requirement. |
| EcuMf0027 | ECU in RUN state shall also perform wake up validation of sleeping busses |
| EcuMf0028 | Allow integrator code |
| EcuMf0029 | Main function processing for uninitialized modules |
| EcuMf001_PI | Rework of Published Information |
| EcuMf030 | Binding character of the Standardized AUTOSAR Interface `EcuM_StateRequest` |
| EcuMf031 | Binding character of the Standardized AUTOSAR Interface `EcuM_CurrentMode` |
| EcuMf032 | Binding character of the Standardized AUTOSAR Interface `EcuM_ShutdownTarget` |
| EcuMf033 | Binding character of the Standardized AUTOSAR Interface `EcuM_BootTarget` |
| EcuMf034 | Adding DET error for `EcuM_GetVersionInfo` |
| EcuMf035 | Adding DET error for `EcuM_GetBootTarget` |
| EcuMf036 | Adding DET error for `EcuM_GetShutdownTarget` |

# 12 Changes to Release 4.0 revision 1

## 12.1 Deleted SWS Items

| SWS Item | Rationale |
|---|---|
| EcuM2861 | There is no API for the EcuM to check whether the WdgM was configured and initialized, so the EcuM has no means to know when the WdgM is initialized.<br>Even if the EcuM knew that the WdgM was initialized, the EcuM would not know how often and how long the EcuM would have to trigger the WdgM. |

## 12.2 Changed SWS Items

| SWS Item | Rationale |
|---|---|
| EcuM2863 | synchronized formulation according to EcuM flexible, moved to SLEEP I substate |
| EcuM2788 | extended DET error information for all pointer parameters |
| EcuM2337 | extended DET error information for all pointer parameters |
| EcuMf0024 | Version check reformulated for inclusion of other BSW header files. |
| EcuM2904 | Updated description on EcuM_ErrorHook |

## 12.3 Added SWS Items

| SWS Item | Rationale |
|---|---|
| EcuMf034 | Adding DET error for `EcuM_GetVersionInfo` |
| EcuMf035 | Adding DET error for `EcuM_GetBootTarget` |
| EcuMf036 | Adding DET error for `EcuM_GetShutdownTarget` |
| EcuM3020 | Added requirement during Sleep Sequence II |

# 13 Changes to Release 4.0 revision 2

## 13.1 Deleted SWS Items

| SWS Item | Rationale |
|---|---|
| ECUM196_Conf | EcuMEnableDefBehaviour is deprecated for EcuM fixed<br>(defensive behavior is not applicable to EcuM fixed) |

## 13.2 Changed SWS Items

| SWS Item | Rationale |
|---|---|
| EcuM1872 | EcuM_KillAllRUNRequests does no longer clear requests POST RUN |
| EcuM2423 | Re-integrated accessiblity of EcuM_GetState |
| EcuM2600 | EcuM_RequestPOST_RUN now accepts new requests during shutdown |
| EcuM2823 | Re-integrated EcuM_GetState |
| EcuMf0001 | Don’t include Rte.h but Rte_EcuM.h |

## 13.3 Added SWS Items

| SWS Item | Rationale |
|---|---|

| | |
|---|---|
| EcuMf037 | Include Structure of Services has to respect BSW00447 |