

Document Title	Specification of FlexRay State Manager
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	254
Document Status	published
Part of AUTOSAR Standard	Classic Platform
Part of Standard Release	R21-11

Document Change History			
Date	Release	Changed by	Change Description
2021-11-25	R21-11	AUTOSAR Release Management	<ul style="list-style-type: none"> No content changes
2020-11-30	R20-11	AUTOSAR Release Management	<ul style="list-style-type: none"> Improved Error Handling Sections
2019-11-28	R19-11	AUTOSAR Release Management	<ul style="list-style-type: none"> Updated Transitions T03 and T06 Changed Document Status from Draft to published
2018-10-31	4.4.0	AUTOSAR Release Management	<ul style="list-style-type: none"> Minor corrections / clarifications / editorial changes; for details please refer to the ChangeDocumentation
2017-12-08	4.3.1	AUTOSAR Release Management	<ul style="list-style-type: none"> Minor corrections / clarifications / editorial changes; for details please refer to the ChangeDocumentation
2016-11-30	4.3.0	AUTOSAR Release Management	<ul style="list-style-type: none"> Added wakeup forwarding for dual channel FlexRay networks Minor corrections / clarifications / editorial changes; for details please refer to the ChangeDocumentation
2015-07-31	4.2.2	AUTOSAR Release Management	<ul style="list-style-type: none"> Revised development error handling. Debugging support marked as obsolete Minor corrections / clarifications / editorial changes; for details please refer to the ChangeDocumentation

Document Change History			
Date	Release	Changed by	Change Description
2014-10-31	4.2.1	AUTOSAR Release Management	<ul style="list-style-type: none"> • Changed development error checking of FrSM_Init pointer parameter. • Editorial changes
2014-03-31	4.1.3	AUTOSAR Release Management	<ul style="list-style-type: none"> • Removed Dual Channel Wakeup Echo
2013-10-31	4.1.2	AUTOSAR Release Management	<ul style="list-style-type: none"> • Added immediate handling of NoCom requests in normal passive mode or key slot only mode • Editorial changes • Removed chapter(s) on change documentation
2013-03-15	4.1.1	AUTOSAR Administration	<ul style="list-style-type: none"> • FlexRay Transceiver Mode Switch can be delayed • Formal updates
2011-12-22	4.0.3	AUTOSAR Administration	<ul style="list-style-type: none"> • Short term loss of synchronization is reported to DEM or DET. • Number of startup frames can be monitored during normal operation. • Revised production error handling.
2010-09-30	3.1.5	AUTOSAR Administration	<ul style="list-style-type: none"> • The amount of wakeup patterns can be configured • Clearing the Coldstart Inhibit Mode can be delayed also for passive wakeup. • Removed enabling and disabling of transceiver wakeups
2010-02-02	3.1.4	AUTOSAR Administration	<ul style="list-style-type: none"> • Added support of FlexRay Dual Channel Wakeup • Added support of FlexRay Single Slot Mode • Added support of Passive Mode (Receive only) • Improved timeout supervision of FlexRay startup • Legal disclaimer revised
2008-08-13	3.1.1	AUTOSAR Administration	<ul style="list-style-type: none"> • Legal disclaimer revised

Document Change History			
Date	Release	Changed by	Change Description
2008-02-01	3.0.2	AUTOSAR Administration	<ul style="list-style-type: none">• Chapter 8 API Spelling harmonized
2007-12-21	3.0.1	AUTOSAR Administration	<ul style="list-style-type: none">• Initial Release

Disclaimer

This work (specification and/or software implementation) and the material contained in it, as released by AUTOSAR, is for the purpose of information only. AUTOSAR and the companies that have contributed to it shall not be liable for any use of the work.

The material contained in this work is protected by copyright and other types of intellectual property rights. The commercial exploitation of the material contained in this work requires a license to such intellectual property rights.

This work may be utilized or reproduced without any modification, in any form or by any means, for informational purposes only. For any other purpose, no part of the work may be utilized or reproduced, in any form or by any means, without permission in writing from the publisher.

The work has been developed for automotive applications only. It has neither been developed, nor tested for non-automotive applications.

The word AUTOSAR and the AUTOSAR logo are registered trademarks.

Table of Contents

1	Introduction and functional overview	7
2	Acronyms and abbreviations.....	8
3	Related documentation	9
3.1	Input documents	9
3.2	Related standards and norms	9
3.3	Related specification.....	10
4	Constraints and assumptions.....	11
4.1	Limitations	11
4.2	Applicability to car domains	11
5	Dependencies to other modules	12
5.1	AUTOSAR BSW Scheduler.....	12
5.2	Communication Manager.....	12
5.3	AUTOSAR FlexRay Interface	12
5.4	AUTOSAR Default Error Tracer	12
5.5	AUTOSAR Diagnostic Event Manager.....	12
5.6	AUTOSAR BSW Mode Manager.....	12
5.7	AUTOSAR FlexRay Network Management.....	12
5.8	File structure	12
5.8.1	Code file structure	12
5.8.2	Header file structure	13
6	Requirements traceability	14
7	Functional specification.....	17
7.1	Background & Rationale.....	17
7.2	Main Task of the FlexRay State Manager.....	17
7.3	State Machine of the FlexRay State Manager	17
7.3.1	General.....	17
7.3.2	States	18
7.3.3	Variables.....	19
7.3.4	State Machine Configuration.....	20
7.3.5	Conditions.....	21
7.3.6	Timers.....	21
7.3.7	Functional Elements.....	22
7.3.8	Wakeup Pattern Transmission.....	25
7.3.9	Transitions	25
7.4	Configuration description	31
7.5	Error classification	31
7.5.1	Development Errors	32
7.5.2	Runtime Errors	32
7.5.3	Transient Faults.....	32
7.5.4	Production Errors	32
7.5.5	Extended Production Errors.....	33
8	API specification.....	34

8.1	Imported types	34
8.2	Type definitions.....	34
8.2.1	FrSM_ConfigType	34
8.2.2	FrSM_BswM_StateType	35
8.3	Function definitions.....	36
8.3.1	FrSM_Init.....	36
8.3.2	FrSM_RequestComMode	36
8.3.3	FrSM_GetCurrentComMode	38
8.3.4	FrSM_GetVersionInfo	39
8.3.5	FrSM_AllSlots.....	40
8.3.6	FrSM_SetEcuPassive	41
8.4	Call-back notifications.....	42
8.5	Scheduled functions	42
8.5.1	FrSM_MainFunction_<FrSMCluster.ShortName>.....	42
8.6	Expected Interfaces.....	43
8.6.1	Mandatory Interfaces.....	43
8.6.2	Optional Interfaces	44
8.6.3	Configurable Interfaces.....	45
9	Sequence diagrams	46
9.1	Initialization	46
9.2	Single Channel Wakeup	47
9.3	Single Channel Passive Startup	50
9.4	Dual Channel Wakeup.....	52
9.5	Dual Channel Wakeup Forward	55
9.6	Key Slot Only Mode.....	57
9.7	Transition from full communication to no communication.....	58
10	Configuration specification	59
10.1	How to read this chapter.....	59
10.2	Containers and configuration parameters	59
10.2.1	FrSM.....	60
10.2.2	FrSMConfig.....	60
10.2.3	FrSMGeneral.....	61
10.2.4	FrSMCluster	64
10.2.5	FrSMClusterDemEventParameterRefs	71
10.3	Published Information	72
11	Not applicable requirements	73

1 Introduction and functional overview

This specification specifies the functionality, API and the configuration of the AUTOSAR Basic Software module "FlexRay State Manager".

In the AUTOSAR Layered Software Architecture, the FlexRay State Manager belongs to the Services Layer, or more precisely, to the Communication Services.

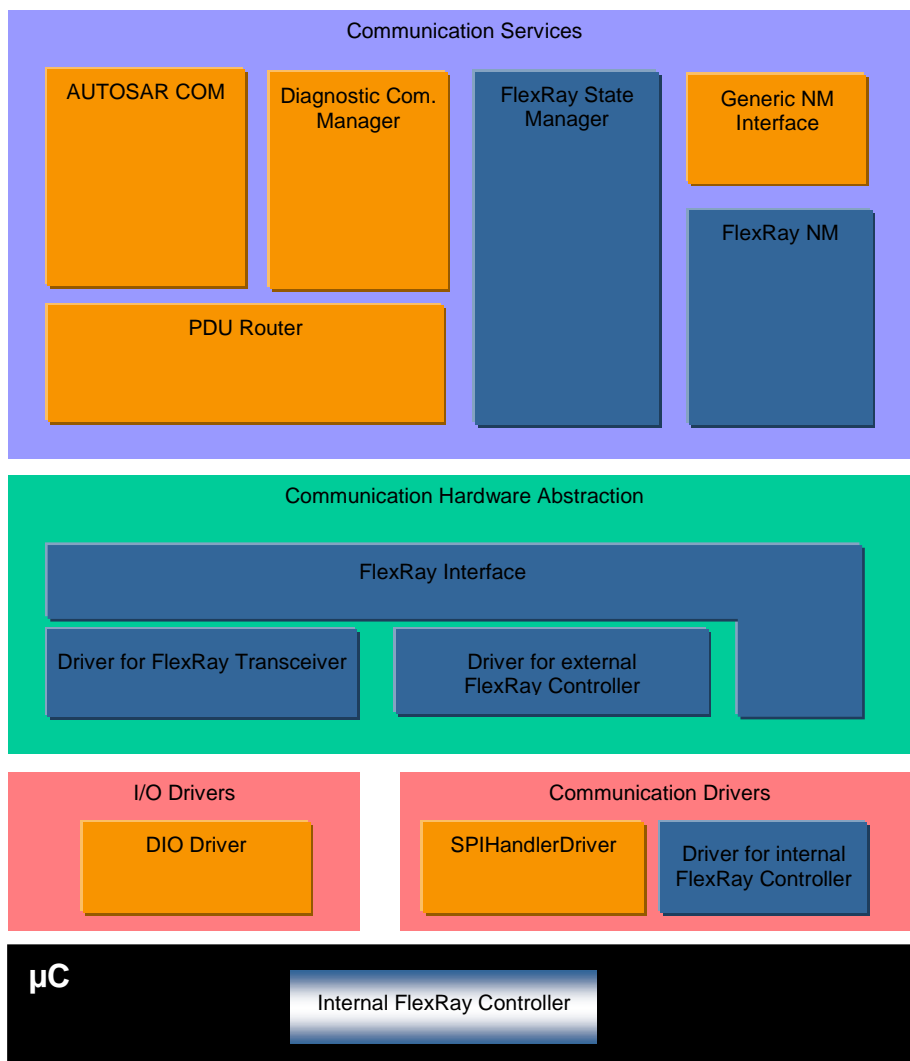


Figure 1 Software Architecture Overview

2 Acronyms and abbreviations

Acronym/ Abbreviation	Description:
API	Application Program Interface
AUTOSAR	Automotive Open System Architecture
BSW	Basic Software
CC	Communication Controller
CHI	Controller Host Interface
ComM	AUTOSAR Communication Manager
DCM	Diagnostic Communication Manager
Dem/DEM	Diagnostic Event Manager
Det/DET	Default Error Tracer
e.g.	[lat.] exempli gratia = [eng.] for example
ECU	Electronic Control Unit
EcuM	ECU State Manager
Fr	FlexRay Driver
FrIf	FlexRay Interface (AUTOSAR BSW module)
FrSM	FlexRay State Manager
FrTrcv	FlexRay Transceiver Driver
i.e.	[lat.] id est = [eng.] that is
Id/ID	Identifier
N/A	Not applicable
NM	Network Management
PDU	Protocol Data Unit
POC	Protocol Operation Control
POCState	Actual CC internal state of the POC. This state might differ from vPOC!State in certain cases, e.g. after FREEZE command invocation (see [11] for details).
RTE	Runtime Environment
RX	Reception
SchM	Schedule Manager
SW	Software
TX	Transmission
UML	Unified Modeling Language
vPOC	Data structure provided from the CC to the host at the CHI , which contains the actual POC status of the CC .
vPOC!Freeze	vPOC!Freeze denotes the Freeze bit that is part of the vPOC data structure. The Freeze bit is used by the CC to indicate that the HALT state has been entered due to an error condition.
vPOC!SlotMode	vPOC!SlotMode denotes the SlotMode field that is part of the vPOC data structure.
WUP	Wake-Up Pattern
XML	Extensible markup language

Term:	Description:
Active wake-up	Wake-up caused by the ECU e.g. by a sensor.
Passive wake-up	Wakeup caused by another ECU and propagated (e.g. by bus or wakeup-line) to the ECU currently in focus.
Remote wake-up	A passive wake-up received by the FlexRay bus or wakeup-line.

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] Specification of ECU Configuration
AUTOSAR_TPS_ECUConfiguration.pdf
- [5] Specification of Communication Stack Types
AUTOSAR_SWS_CommunicationStackTypes.pdf
- [6] Requirements on FlexRay
AUTOSAR_SRS_FlexRay.pdf
- [7] Specification of FlexRay Interface
AUTOSAR_SWS_FlexRayInterface.pdf
- [8] Specification of FlexRay Driver
AUTOSAR_SWS_FlexRayDriver.pdf
- [9] Specification of Communication Manager
AUTOSAR_SWS_ComManager.pdf
- [10] Requirements on Mode Management
AUTOSAR_SRS_ModeManagement.pdf
- [11] Basic Software Module Description Template,
AUTOSAR_TPS_BSWModuleDescriptionTemplate.pdf
- [12] General Specification of Basic Software Modules
AUTOSAR_SWS_BSWGeneral.pdf

3.2 Related standards and norms

- [13] FlexRay Communications System Protocol Specification Version 2.1 Rev A

3.3 Related specification

AUTOSAR provides a General Specification on Basic Software modules [12] (SWS BSW General), which is also valid for FlexRay State Manager.

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

4 Constraints and assumptions

4.1 Limitations

This specification only defines the straightforward case for starting and stopping the communication on a FlexRay cluster.

For the case of multiple [CC](#) of one ECU assigned to one FlexRay cluster some items are left open for the implementation:

- Which CC is used to transmit the wakeup pattern
- Handling of inconsistent POC states in the CCs

4.2 Applicability to car domains

The FlexRay Communication stack can be used wherever high data rates and fault tolerant communication (in conjunction with [11]) is required. Furthermore, it enables the synchronized operation of several ECUs within a car.

The FlexRay State Manager can be used for all domain applications which use the FlexRay Protocol.

5 Dependencies to other modules

5.1 AUTOSAR BSW Scheduler

The BSW Scheduler calls the main functions of the FrSM, which are necessary for the cyclic processes of the FrSM.

5.2 Communication Manager

The [ComM](#) requests network communication modes and is notified by the FrSM when a communication mode is reached.

5.3 AUTOSAR FlexRay Interface

The FrSM uses the API of the [Frlf](#) to initialize the FlexRay Communication Hardware and to control the operating modes of the FlexRay Controllers and FlexRay Transceivers assigned to the FlexRay Networks.

5.4 AUTOSAR Default Error Tracer

In order to be able to report development errors, the FlexRay State Manager has to have access to the error hook of the Default Error Tracer.

5.5 AUTOSAR Diagnostic Event Manager

In order to be able to report production errors the FlexRay State Manager has to have access to the Diagnostic Event Manager.

5.6 AUTOSAR BSW Mode Manager

In order to be able to report state changed the FlexRay State Manager has to have access to the BSW Mode Manager.

5.7 AUTOSAR FlexRay Network Management

In order to be able to report startup failures the FlexRay State Manager has to have access to the FlexRay Network Management.

5.8 File structure

5.8.1 Code file structure

For details refer to the chapter 5.1.6 “Code file structure” in *SWS_BSWGeneral*.

5.8.2 Header file structure

[SWS_FrSM_00139] [The header file FrSM.h shall include a software and specification version number.] ()

[SWS_FrSM_00140] [The FrSM module shall perform a consistency check between code files and header files based on pre-process-checking the version numbers of related code files and header files.] (SRS_BSW_00004)

6 Requirements traceability

Requirement	Description	Satisfied by
SRS_BSW_00004	All Basic SW Modules shall perform a pre-processor check of the versions of all imported include files	SWS_FrSM_00140
SRS_BSW_00005	Modules of the μ C Abstraction Layer (MCAL) may not have hard coded horizontal interfaces	SWS_FrSM_00186
SRS_BSW_00101	The Basic Software Module shall be able to initialize variables and hardware in a separate initialization function	SWS_FrSM_00126
SRS_BSW_00159	All modules of the AUTOSAR Basic Software shall support a tool based configuration	SWS_FrSM_00064
SRS_BSW_00161	The AUTOSAR Basic Software shall provide a microcontroller abstraction layer which provides a standardized interface to higher software layers	SWS_FrSM_00186
SRS_BSW_00162	The AUTOSAR Basic Software shall provide a hardware abstraction layer	SWS_FrSM_00186
SRS_BSW_00164	The Implementation of interrupt service routines shall be done by the Operating System, complex drivers or modules	SWS_FrSM_00186
SRS_BSW_00167	All AUTOSAR Basic Software Modules shall provide configuration rules and constraints to enable plausibility checks	SWS_FrSM_00065
SRS_BSW_00168	SW components shall be tested by a function defined in a common API in the Basis-SW	SWS_FrSM_00186
SRS_BSW_00170	The AUTOSAR SW Components shall provide information about their dependency from faults, signal qualities, driver demands	SWS_FrSM_00186
SRS_BSW_00314	All internal driver modules shall separate the interrupt frame definition from the service routine	SWS_FrSM_00186
SRS_BSW_00323	All AUTOSAR Basic Software Modules shall check passed API parameters for validity	SWS_FrSM_00018, SWS_FrSM_00028, SWS_FrSM_00168
SRS_BSW_00325	The runtime of interrupt service routines and functions that are running in interrupt context shall be kept short	SWS_FrSM_00186
SRS_BSW_00336	Basic SW module shall be able to shutdown	SWS_FrSM_00186
SRS_BSW_00347	A Naming separation of different instances of BSW drivers shall be in place	SWS_FrSM_00186
SRS_BSW_00359	All AUTOSAR Basic Software Modules callback functions shall avoid return types	SWS_FrSM_00186

	other than void if possible	
SRS_BSW_00360	AUTOSAR Basic Software Modules callback functions are allowed to have parameters	SWS_FrSM_00186
SRS_BSW_00369	All AUTOSAR Basic Software Modules shall not return specific development error codes via the API	SWS_FrSM_00018, SWS_FrSM_00028, SWS_FrSM_00168
SRS_BSW_00373	The main processing function of each AUTOSAR Basic Software Module shall be named according the defined convention	SWS_FrSM_00118
SRS_BSW_00375	Basic Software Modules shall report wake-up reasons	SWS_FrSM_00186
SRS_BSW_00377	A Basic Software Module can return a module specific types	SWS_FrSM_00186
SRS_BSW_00381	-	SWS_FrSM_00013
SRS_BSW_00405	BSW Modules shall support multiple configuration sets	SWS_FrSM_00013
SRS_BSW_00406	A static status variable denoting if a BSW module is initialized shall be initialized with value 0 before any APIs of the BSW module is called	SWS_FrSM_00060, SWS_FrSM_00061, SWS_FrSM_00169, SWS_FrSM_00179
SRS_BSW_00407	Each BSW module shall provide a function to read out the version information of a dedicated module implementation	SWS_FrSM_00029
SRS_BSW_00413	An index-based accessing of the instances of BSW modules shall be done	SWS_FrSM_00186
SRS_BSW_00415	Interfaces which are provided exclusively for one module shall be separated into a dedicated header file	SWS_FrSM_00186
SRS_BSW_00416	The sequence of modules to be initialized shall be configurable	SWS_FrSM_00186
SRS_BSW_00417	Software which is not part of the SW-C shall report error events only after the DEM is fully operational.	SWS_FrSM_00186
SRS_BSW_00419	If a pre-compile time configuration parameter is implemented as "const" it should be placed into a separate c-file	SWS_FrSM_00186
SRS_BSW_00422	Pre-de-bouncing of error status information is done within the DEM	SWS_FrSM_00186
SRS_BSW_00423	BSW modules with AUTOSAR interfaces shall be describable with the means of the SW-C Template	SWS_FrSM_00186
SRS_BSW_00425	The BSW module description template shall provide means to model the defined trigger conditions of schedulable objects	SWS_FrSM_00186
SRS_BSW_00427	ISR functions shall be defined and documented in the BSW module description template	SWS_FrSM_00186
SRS_BSW_00428	A BSW module shall state if its main	SWS_FrSM_00186

	processing function(s) has to be executed in a specific order or sequence	
SRS_BSW_00429	Access to OS is restricted	SWS_FrSM_00186
SRS_BSW_00432	Modules should have separate main processing functions for read/receive and write/transmit data path	SWS_FrSM_00186
SRS_BSW_00437	Memory mapping shall provide the possibility to define RAM segments which are not to be initialized during startup	SWS_FrSM_00186
SRS_BSW_00438	Configuration data shall be defined in a structure	SWS_FrSM_00013, SWS_FrSM_00126, SWS_FrSM_00127, SWS_FrSM_00128
SRS_BSW_00439	Enable BSW modules to handle interrupts	SWS_FrSM_00186
SRS_BSW_00440	The callback function invocation by the BSW module shall follow the signature provided by RTE to invoke servers via Rte_Call API	SWS_FrSM_00186
SRS_BSW_00449	BSW Service APIs used by Autosar Application Software shall return a Std_ReturnType	SWS_FrSM_00186
SRS_BSW_00450	A Main function of a un-initialized module shall return immediately	SWS_FrSM_00181
SRS_ModeMgm_09081	The Communication Manager shall provide an API allowing collecting communication requests	SWS_FrSM_00020
SRS_ModeMgm_09084	The Communication Manager shall provide an API which allows application to query the current communication mode	SWS_FrSM_00024

7 Functional specification

7.1 Background & Rationale

FlexRay start-up is a complex process that is completely different from CAN. E.g. on CAN every message can wakeup the bus, on FlexRay a special wakeup pattern is needed. In order to make the FlexRay start-up process as reliable as possible, it has to be controlled by a BSW module with in-depth FlexRay knowledge. As the AUTOSAR Communication Manager has a completely abstracted bus view, it is the task of the FlexRay State Manager to map this abstracted view to the states of the FlexRay [POC](#) and to the [CHI](#) commands to change these states.

7.2 Main Task of the FlexRay State Manager

The main task of the FlexRay State Manager module can be summarized as follows:

The FlexRay State Manager module shall provide an abstract interface to the AUTOSAR Communication Manager module to startup or shutdown the communication on a FlexRay cluster.

The FlexRay State Manager module shall not directly access the FlexRay hardware (FlexRay Communication Controller and FlexRay Transceiver), but by means of the FlexRay Interface module.

The FlexRay Interface module redirects the request to the appropriate driver module.

7.3 State Machine of the FlexRay State Manager

7.3.1 General

[SWS_FrSM_00030] [The FlexRay State Manager shall implement one state machine for each FlexRay cluster.

The states of this state machine are to some extent derived from the [POC](#) states of the FlexRay [CC](#). This document is based on the assumption that there is always a unique [POC](#) state for every FlexRay cluster (see Limitations in section 4.1).

The state machine of each cluster is processed by the main function `FrSM_MainFunction_<FrSMCluster.ShortName>` assigned to that cluster (see section 8.5.1). However, as defined in section 8.3.2, some transitions of the state machine are processed in the context of the [FrSM_RequestComMode](#) function in order to achieve a deterministic behavior for shutdown.] ()

7.3.2 States

[SWS_FrSM_00032] [The state machine shall comprise the following states:

<i>FrSM Cluster State</i>	<i>Mapped FlexRay CC state</i>	<i>Description</i>
FRSM_READY	POC:ready	
FRSM_WAKEUP	POC:wake-up	FrSM performs wake-up
FRSM_STARTUP	POC:start-up	FrSM performs startup
FRSM_HALT_REQ	POC:normal active or POC:normal passive	FrSM performs a shutdown
FRSM_ONLINE	POC:normal active	Full Communication
FRSM_ONLINE_PASSIVE	POC:normal passive	Due to clock synchronization errors no data is transmitted or received.
FRSM_KEYSLOT_ONLY	POC:normal active ^ vPOC!SlotMode ≠ AllSlots	Data can only be transmitted in the key slots.
FRSM_LOW_NUMBER_OF_COLDSTARTERS	POC:normal active	Full communication; FlexRay is synchronized based on sync frames only.

] ()

[SWS_FrSM_00176] [For controlling the passive mode (receive-only), the state machine shall additionally comprise the following states which concurrent to the states above:

<i>Passive State</i>	<i>Description</i>
FRSM_ECU_ACTIVE	When the FrSM is concurrently in state FRSM_READY , the transceivers are in set into mode FRTRCV_TRCVMODE_STANDBY, otherwise into mode FRTRCV_TRCVMODE_NORMAL
FRSM_ECU_PASSIVE	When the FrSM is concurrently in state FRSM_READY , the transceivers are in set into mode FRTRCV_TRCVMODE_STANDBY, otherwise into mode FRTRCV_TRCVMODE_RECEIVEONLY.

] ()

[SWS_FrSM_00180] [For reporting these two concurrent states to the BswM, a corresponding value of FrSM_BswM_StateType shall be determined as follows:

<i>FrSM Cluster State</i>	<i>Passive State</i>	<i>FrSM_BswM_StateType value</i>
FRSM_READY	FRSM ECU ACTIVE	FRSM_READY
FRSM_READY	FRSM ECU PASSIVE	FRSM_READY_ECU_PASSIVE
FRSM_WAKEUP	FRSM ECU ACTIVE	FRSM_WAKEUP
FRSM_WAKEUP	FRSM ECU PASSIVE	FRSM_WAKEUP_ECU_PASSIVE
FRSM_STARTUP	FRSM ECU ACTIVE	FRSM_STARTUP
FRSM_STARTUP	FRSM ECU PASSIVE	FRSM_STARTUP_ECU_PASSIVE
FRSM_ONLINE	FRSM ECU ACTIVE	FRSM_ONLINE
FRSM_ONLINE	FRSM ECU PASSIVE	FRSM_ONLINE_ECU_PASSIVE
FRSM_ONLINE_PASSIVE	FRSM ECU ACTIVE	FRSM_ONLINE_PASSIVE
FRSM_ONLINE_PASSIVE	FRSM ECU PASSIVE	FRSM_ONLINE_PASSIVE_ECU_PASSIVE
FRSM_KEYSLOT_ONLY	FRSM ECU ACTIVE	FRSM_KEYSLOT_ONLY
FRSM_KEYSLOT_ONLY	FRSM ECU PASSIVE	FRSM_KEYSLOT_ONLY_ECU_PASSIVE

FRSM HALT REQUEST	FRSM ECU ACTIVE	FRSM_HALT_REQUEST
FRSM HALT REQUEST	FRSM ECU PASSIVE	FRSM_HALT_REQUEST_ECU_PASSIVE
FRSM LOW NUMBER OF COLD-STARTERS	FRSM ECU ACTIVE	FRSM_LOW_NUMBER_OF_COLDSTARTERS
FRSM LOW NUMBER OF COLD-STARTERS	FRSM ECU PASSIVE	FRSM_LOW_NUMBER_OF_COLD-STARTERS_ECU_PASSIVE

l ()

7.3.3 Variables

In addition to its state, the state machine description uses the following variables. Note that these variables are only auxiliary means for improving the clearness and the readability of the specification.

<i>FrSM Variable</i>	<i>Type</i>	<i>Description</i>
reqComMode	ComM_ModeType	The communication mode that has been requested by the ComM . The communication modes are abbreviated in this document as follows: NoCom: COMM_NO_COMMUNICATION SilentCom: COMM_SILENT_COMMUNICATION FullCom: COMM_FULL_COMMUNICATION According to the definition of ComM_ModeType these modes are ordered as follows: NoCom < SilentCom < FullCom
startupCounter	Integer	The number of startup attempts that have been performed
wakeupType	Enum	The following values are supported: <ul style="list-style-type: none"> <input type="checkbox"/> SingleChannelWakeup <input type="checkbox"/> DualChannelWakeup <input type="checkbox"/> DualChannelWakeupForward <input type="checkbox"/> NoWakeup
wakeupTransmitted	Boolean	True if vPOC!WakeupStatus = FR_WAKEUP_TRANSMITTED for at least attempt to transmit a wakeup pattern, false otherwise
busTrafficDetected	Boolean	True if vPOC!WakeupStatus = FR_WAKEUP_RECEIVED_HEADER or FR_WAKEUP_RECEIVED_WUP for at least attempt to transmit a wakeup pattern, false otherwise
wakeupCounter	Integer	The number of attempts that have been performed for transmitting a wakeup pattern.

Note that the silent communication mode is not supported on FlexRay; it may not be requested by the [ComM](#) module.

7.3.4 State Machine Configuration

The state machine description uses the following configuration parameters that are defined in chapter 10.2 for each FlexRay cluster:

<i>FrSM Configuration Parameter</i>	<i>Type</i>	<i>Description</i>
FrSMIsWakeupEcu	Boolean	See chapter 10.2
FrSMCheckWakeupReason	Boolean	See chapter 10.2
FrSMIsColdstartEcu	Boolean	See chapter 10.2
FrSMIsDualChannelNode	Boolean	This configuration parameter is derived from the FrIf configuration. If the corresponding FrIf cluster is connected to both channels of the FlexRay cluster, this parameter is TRUE. Otherwise, it is FALSE.
FrSMStartupRepetitionsWithWakeup	Integer	The number of times an ECU may repeat the startup procedure including a wakeup for a FlexRay cluster. If this optional configuration parameter is missing, there shall be no limitation, i.e. the configuration parameter shall be treated as having the value ∞
FrSMStartupRepetitions	Integer	Determines how often the ECU can repeat the startup procedure by reinitializing the FlexRay CC , see chapter 10.2. This value must not be smaller than FrSMStartupRepetitionsWithWakeup . If this optional configuration parameter is missing, there shall be no limitation, i.e. the configuration parameter shall be treated as having the value ∞
FrSMNumWakeupPatterns	Integer	Maximum number of Wakeup Patterns the node may send before going to FRSM_STARTUP .
FrSMDelayStartupWithoutWakeup	Boolean	If true, timer t1 shall be started instead of immediately calling FrIf_AllowColdstart in case of a startup without wakeup.
FrSMMinNumberOfColdstarter	Integer	Minimum number of startup

		frames that have to be present, see chapter 10.2
--	--	--

7.3.5 Conditions

The state machine description uses the following conditions that are evaluated during runtime for each FlexRay cluster:

<i>FrSM Condition</i>	<i>Type</i>	<i>Description</i>
WUReason	Enum	If FrSMCheckWakeupReason is false, WUReason evaluates to NO_WU_BY_BUS. Otherwise if FrSMCheckWakeupReason is true, determine the wakeup reason by calling <code>FrIf_GetTransceiverWUReason</code> for each transceiver of the FlexRay cluster and check for FRTRCV_WU_BY_BUS and evaluate WUReason to <ul style="list-style-type: none"> □ NO_WU_BY_BUS in case no wakeup has been detected. □ PARTIAL_WU_BY_BUS in case the ECU is connected to both FlexRay channels of the cluster and wakeup has been detected for exactly one channel □ ALL_WU_BY_BUS in case wakeup has been detected for all of the FlexRay channels of the cluster to which the ECU is connected.
t1_IsActive	boolean	Evaluates to true if t1 has been started and has not expired yet, otherwise to false
t3_IsNotActive	boolean	Evaluates to false if t3 is running and has not expired, otherwise to true.
t_TrvcStdbbyDelay_IsActive	boolean	Evaluates to true if t_TrvcStdbbyDelay has been started and has not expired yet, otherwise to false.
wakeupFinished	boolean	Evaluates to false if the wakeup pattern transmission as defined in section 7.3.8 is still in progress, otherwise to true.
lowNumberOfColdstarters	boolean	= <code>FrIf_GetNumOfStartupFrames()</code> < FrSMMinNumberOfColdstarter

7.3.6 Timers

The state machine description uses the following timers for each FlexRay cluster:

<i>Timer</i>	<i>Description</i>
t1	The timer t1 models the delay of clearing the coldstart

	inhibit mode (i.e. calling <code>FrIf_AllowColdstart</code>). The duration of this timer can be statically configured with the configuration parameter <code>FrSMDurationT1</code> .
t2	The timer t2 models the time difference after which the FrSM will repeat the startup of the FlexRay cluster. The duration of this timer can be statically configured with the configuration parameter <code>FrSMDurationT2</code> .
t3	The timer t3 supervises the transition to FullCom . The duration of this timer can be statically configured with the configuration parameter <code>FrSMDurationT3</code> .
t4	The timer t4 ensures that a dual channel node will eventually clear its coldstart inhibit bit and become a leading coldstarter.
t_TrvcStdbbyDelay	The timer <code>t_TrvcStdbbyDelay</code> models the time difference after which the FlexRay State Manager will reinitialize the FlexRay communication controllers and set the transceivers into STANDBY mode when FlexRay communication is stopped.

[SWS_FrSM_00142] [If the configuration parameter `FrSMDurationT1` is set to 0, timer t1 shall not be started. Instead, the call of `FrIf_AllowColdstart` shall immediately follow the call of `FrIf_StartCommunication`.] ()

[SWS_FrSM_00143] [If the duration `FrSMDurationT2` of timer [t2](#) is set to 0, the startup of the FlexRay cluster shall not be supervised.

Note, that no assumption is made whether any of the timers is implemented in software or hardware.] ()

[SWS_FrSM_00209] [If the configuration parameter `FrSMTrcvStdbbyDelay` is not configured or set to 0, timer `t_TrvcStdbbyDelay` shall not be started. Instead, the transition from state `FRSM_HALT_REQ` to `FRSM_READY` shall be executed immediately.] ()

7.3.7 Functional Elements

The functionality being performed in the transitions of the state machine is partitioned into the following functional elements. I.e. the following table contains abbreviations used as actions in the FrSM state machine description, which reference one or more function calls visible at the interfaces of the FrSM module.

Functional Element	Description
FE_WAKEUP	Call <code>FrIf_SendWUP</code> for each controller of the FlexRay cluster.
FE_SET_WU_CHANNEL_INITIAL	In case of a single channel node, do nothing. In case of a dual channel node, call <code>FrIf_SetWakeupChannel</code> for each controller of the FlexRay cluster in order to set the wakeup channel to the channel A.

FE_SET_WU_CHANNEL_FORWARD	In case of a single channel node, do nothing. In case of a dual channel node, call <code>FrIf_SetWakeupChannel</code> for each controller of the FlexRay cluster in order to set the wakeup channel to the channel on which no wakeup has been detected while evaluating WUReason .
FE_CONFIG	Call <code>FrIf_ControllerInit</code> for each controller of the FlexRay cluster.
FE_START	Call <code>FrIf_StartCommunication</code> for each controller of the FlexRay cluster.
FE_ALLOW_COLDSTART	Call <code>FrIf_AllowColdstart</code> for each controller of the FlexRay cluster if the configuration parameter FrSMIsColdstartEcu is true.
FE_HALT	Call <code>FrIf_HaltCommunication</code> for each controller of the FlexRay cluster.
FE_TRCV_STANDBY	Call <code>FrIf_SetTransceiverMode</code> with <code>FrIf_TrcvMode</code> as <code>FRTRCV_TRCVMODE_STANDBY</code> for each transceiver of the FlexRay cluster.
FE_TRCV_NORMAL	In case the FrSM state machine is in state FRSM ECU ACTIVE , call <code>FrIf_SetTransceiverMode</code> with <code>FrIf_TrcvMode</code> as <code>FRTRCV_TRCVMODE_NORMAL</code> and <code>FrIf_ClearTransceiverWakeup</code> for each transceiver of the FlexRay cluster. In case the FrSM state machine is in state FRSM ECU PASSIVE , call <code>FrIf_SetTransceiverMode</code> with <code>FrIf_TrcvMode</code> as <code>FRTRCV_TRCVMODE_RECEIVEONLY</code> and <code>FrIf_ClearTransceiverWakeup</code> for each transceiver of the FlexRay cluster.
FE_START_FRIF	Set the FrIf state to ONLINE by calling <code>FrIf_SetState</code> with <code>FrIf_StateTransition</code> as <code>FRIF_GOTO_ONLINE</code> for the cluster.
FE_STOP_FRIF	Set the FrIf state to OFFLINE by calling <code>FrIf_SetState</code> with <code>FrIf_StateTransition</code> as <code>FRIF_GOTO_OFFLINE</code> for the cluster.
FE_DEM_STATUS_FAILED	Report status of production error FRSM E CLUSTER STARTUP as failed.
FE_DEM_STATUS_PASSED	Report status of production error FRSM E CLUSTER STARTUP as passed.
FE_DEM_SYNC_LOSS	Report the status of the production error FRSM E CLUSTER SYNC LOSS as failed. If the name of an indication function (see section 8.6.3) is configured, call the indication function with the parameter <code>SyncLossErrorStatus = true</code> .
FE_DEM_SYNC_LOSS_PASSED	If the name of an indication function (see section 8.6.3) is configured, call the indication function with the parameter <code>SyncLossErrorStatus = false</code> . Additionally report the status of the production error FRSM E CLUSTER SYNC LOSS as passed.
FE_FULL_COM_IND	Indicate to the ComM that FullCom has been reached by calling <code>ComM_BusSM_ModelIndication</code> (FullCom)

FE_NO_COM_IND	Indicate to the ComM that FullCom has been left by calling ComM_BusSM_ModeIndication (NoCom).
FE_STARTUP_ERROR_IND	Call FrNm_StartupError.

7.3.8 Wakeup Pattern Transmission

[SWS_FrSM_00208] The FlexRay State Manager shall repeat the transmission of wakeup patterns according to the configuration parameter [FrSMNumWakeupPatterns](#). I.e. the FlexRay State Manager shall perform the following actions while being in state FRSM_WAKEUP:

- Set counter wakeupCounter to 1 when the state FRSM_WAKEUP is entered
- While wakeupCounter □ [FrSMNumWakeupPatterns](#) and [busTrafficDetected](#) = false:
 - Wait until the FlexRay controllers of the FlexRay cluster are in state FR_READY
 - When the FlexRay controllers are in state FR_READY, check vPOC!WakeupStatus of the FlexRay controllers and act as follows:

vPOC!WakeupStatus	Actions
FR_WAKEUP_RECEIVED_HEADER, FR_WAKEUP_RECEIVED_WUP	busTrafficDetected := true
FR_WAKEUP_TRANSMITTED	wakeupTransmitted := true
FR_WAKEUP_UNDEFINED FR_WAKEUP_COLLISION_HEADER FR_WAKEUP_COLLISION_WUP FR_WAKEUP_COLLISION_UNKNOWN	wakeupTransmitted := false

- If [busTrafficDetected](#) = false and wakeupCounter < [FrSMNumWakeupPatterns](#), execute [FE_WAKEUP](#)
- Increment the wakeupCounter

If any of the FlexRay controllers enters the HALT state due to an error condition, the wakeup pattern transmission shall be aborted and the [wakeupFinished](#) condition shall evaluate to true. **]()**

7.3.9 Transitions

[SWS_FrSM_00093] [The following FrSM state machine diagram defines source state and the target state of the transitions, which are defined in detail in the table following this diagram.

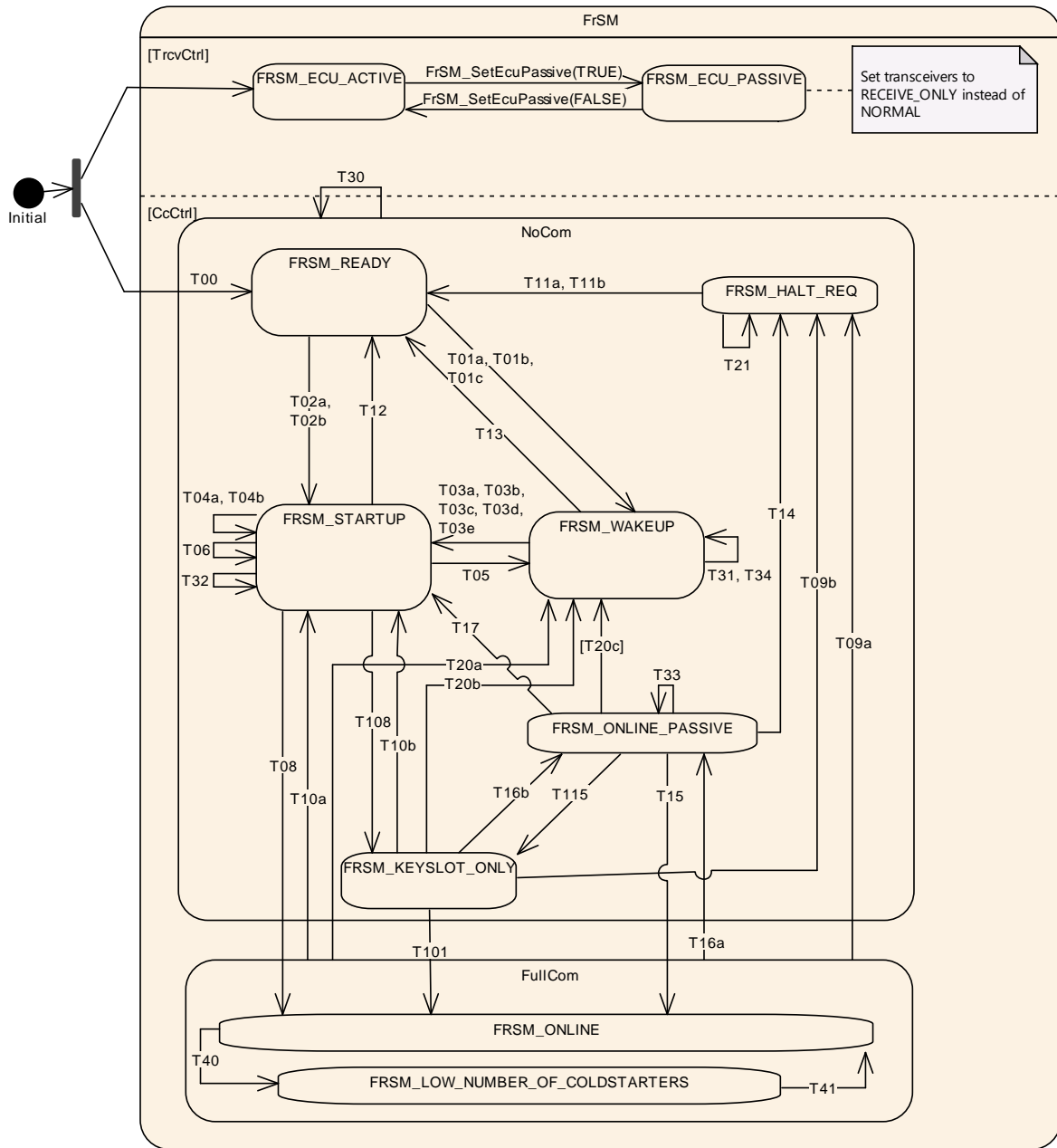


Figure 2 FrSM state machine of the FlexRay State Manager

Note that the states are described in section 7.3.2.

The following table defines the events and conditions that trigger the transitions of FrSM state machine and the actions that are executed within the transitions. Each row of the table contains a requirement which should be interpreted as follows. If the FrSM module is in the source state of the transition in column “Transition” as defined in [SWS FrSM_00093](#) and when the condition in column “Event [Condition]” holds and if the event in column “Event [Condition]” occurs, then the actions in column “Actions” shall be executed and afterwards the FrSM module shall change its state to the target state of the transition in column “Transition” as defined in [SWS FrSM_00093](#).

In case different actions have to be performed in a transition T, there can be multiple rows in the table. The rows are denoted as T (a), T (b) etc. in this case. Note that the conditions ensure that only one of the possibilities matches.] ()

[SWS_FrSM_00145] [After every transition to a different state, the FrSM shall inform the BswM by calling BswM_FrSM_CurrentState.] ()

[SWS_FrSM_00105] [The FrSM shall execute the actions of the transition in the order that is defined in the following table.

Transition	Event [Condition]	Actions
T00	FrSM_Init()	FE_CONFIG
T01 (a)	[reqComMode = FullCom ^ FrSMIsWakeupEcu ^ WUReason = NO_WU_BY_BUS ^ \neg FrSMIsDualChannelNode]	FE_TRCV_NORMAL startupCounter := 1 wakeupType := SingleChannelWakeup wakeupTransmitted := false FE_WAKEUP start t1 start t3
T01 (b)	[reqComMode = FullCom ^ FrSMIsWakeupEcu ^ WUReason = NO_WU_BY_BUS ^ FrSMIsDualChannelNode]	FE_TRCV_NORMAL startupCounter := 1 wakeupType := DualChannelWakeup FE_SET_WU_CHANNEL_INITIAL wakeupTransmitted := false FE_WAKEUP start t3 start t4
T01 (c)	[reqComMode = FullCom ^ FrSMIsWakeupEcu ^ WUReason = PARTIAL_WU_BY_BUS]	FE_TRCV_NORMAL startupCounter := 1 wakeupType := DualChannelWakeupForward FE_SET_WU_CHANNEL_FORWARD FE_WAKEUPwakeupTransmitted := false FE_WAKEUP start t3
T02 (a)	[reqComMode = FullCom ^ (\neg FrSMIsWakeupEcu v WUReason = ALL_WU_BY_BUS) ^ \neg FrSMDelayStartupWithoutWakeup]	FE_TRCV_NORMAL startupCounter := 1 wakeupType := NoWakeup FE_START FE_ALLOW_COLDSTART start t2 start t3
T02 (b)	[reqComMode = FullCom ^ (\neg FrSMIsWakeupEcu v WUReason = ALL_WU_BY_BUS) ^ FrSMDelayStartupWithoutWakeup]	FE_TRCV_NORMAL startupCounter := 1 wakeupType := NoWakeup FE_START start t1 start t2 start t3
T03 (a)	[wakeupFinished ^ reqComMode = FullCom ^ FrSMNumWakeupPatterns = 1 ^ wakeupType = SingleChannelWakeup]	FE_START cancel t1 start t1 start t2
T03 (b)	[wakeupFinished ^ reqComMode = FullCom ^ FrSMNumWakeupPatterns > 1 ^ wakeupTransmitted ^ wakeupType = SingleChannelWakeup]	FE_START start t2 IF t1_IsActive : cancel t1 ELSE: FE_ALLOW_COLDSTART
T03 (c)	[wakeupFinished ^ reqComMode = FullCom]	FE_START start t2

Transition	Event [Condition]	Actions
	\wedge FrSMNumWakeupPatterns > 1 \wedge \neg wakeupTransmitted \wedge wakeupType = SingleChannelWakeup]	
T03 (d)	[wakeupFinished \wedge reqComMode = FullCom \wedge wakeupType = DualChannelWakeup \wedge wakeupTransmitted \wedge \neg busTrafficDetected]	FE_START start t2
T03 (e)	[wakeupFinished \wedge reqComMode = FullCom \wedge wakeupType = DualChannelWakeup-Forward]	FE_START FE_ALLOW_COLDSTART start t2 cancel t4
T04 (a)	t1 [reqComMode = FullCom \wedge vPOC!State \neq Normal Active]	FE_ALLOW_COLDSTART
T04 (b)	t4 [reqComMode = FullCom \wedge wakeupType = DualChannelWakeup \wedge vPOC!State \neq Normal Active]	FE_ALLOW_COLDSTART
T05	t2 [startupCounter \leq FrSMStartupRepetitionsWithWakeup \wedge reqComMode = FullCom \wedge wakeupType \neq NoWakeup \wedge vPOC!State \neq Normal Active]	FE_CONFIG FE_WAKEUP startupCounter := startupCounter + 1 start t4 (dual channel node only)
T06	t2 [(FrSMStartupRepetitionsWithWakeup $<$ startupCounter \vee wakeupType = NoWakeup) \wedge startupCounter \leq FrSMStartupRepetitions \wedge reqComMode = FullCom \wedge vPOC!State \neq Normal Active]	FE_CONFIG FE_START FE_ALLOW_COLDSTART startupCounter := startupCounter + 1 start t2
T08	[vPOC!State = Normal Active \wedge \neg vPOC!Freeze \wedge vPOC!SlotMode = AllSlots \wedge reqComMode = FullCom]	cancel t1 cancel t2 FE_START_FRIF FE_DEM_STATUS_PASSED FE_DEM_SYNC_LOSS_PASSED FE_FULL_COM_IND cancel t3
T108	[vPOC!State = Normal Active \wedge \neg vPOC!Freeze \wedge vPOC!SlotMode \neq AllSlots \wedge reqComMode = FullCom]	cancel t1 cancel t2 FE_START_FRIF FE_DEM_STATUS_PASSED FE_DEM_SYNC_LOSS_PASSED cancel t3
T09a	FrSM_RequestComMode() [reqComMode = NoCom]	FE_STOP_FRIF FE_HALT FE_NO_COM_IND
T09b	FrSM_RequestComMode() [reqComMode = NoCom]	FE_STOP_FRIF FE_HALT
T10a	[(vPOC!State = Halt \vee vPOC!Freeze) \wedge reqComMode = FullCom \wedge (FrSmCheckWakeupReason \vee \neg FrSMIsWakeupEcu)]	FE_DEM_SYNC_LOSS FE_STOP_FRIF FE_NO_COM_IND FE_CONFIG FE_START startupCounter := 1 start t2 start t3

Transition	Event [Condition]	Actions
T10b	[(<u>vPOC!State = Halt</u> ∨ <u>vPOC!Freeze</u>) ∧ <u>reqComMode = FullCom</u> ∧ (<u>FrSmCheckWakeupReason</u> ∨ ¬ <u>FrSMIsWakeupEcu</u>)]	<u>FE DEM SYNC LOSS</u> <u>FE_STOP_FRIF</u> <u>FE_CONFIG</u> <u>FE_START</u> <u>startupCounter := 1</u> start <u>t2</u> start <u>t3</u>
T101	[<u>vPOC!State = Normal Active</u> ∧ ¬ <u>vPOC!Freeze</u> ∧ <u>vPOC!SlotMode = AllSlots</u>]	<u>FE_FULL_COM_IND</u>
T11a	<u>t_TrcvStdbbyDelay</u>]	<u>FE_TRCV_STANDBY</u> <u>FE_CONFIG</u>
T11b	[(<u>vPOC!State = Halt</u> ∨ <u>vPOC!Freeze</u>) ∧ <u>reqComMode = FullCom</u>]	cancel <u>t_TrcvStdbbyDelay</u> <u>FE_TRCV_STANDBY</u> <u>FE_CONFIG</u>
T12	[<u>reqComMode = NoCom</u>]	cancel <u>t1</u> cancel <u>t2</u> cancel <u>t3</u> <u>FE_DEM_SYNC_LOSS_PASSED</u> <u>FE_TRCV_STANDBY</u> <u>FE_CONFIG</u>
T13	[<u>reqComMode = NoCom</u>]	<u>FE_DEM_SYNC_LOSS_PASSED</u> <u>FE_TRCV_STANDBY</u> <u>FE_CONFIG</u> cancel <u>t3</u> cancel <u>t1</u>
T14	<u>FrSM_RequestComMode()</u> [<u>reqComMode = NoCom</u>]	<u>FE_DEM_SYNC_LOSS_PASSED</u> <u>FE_HALT</u> cancel <u>t3</u>
T15	[<u>vPOC!State = Normal Active</u> ∧ ¬ <u>vPOC!Freeze</u> ∧ <u>vPOC!SlotMode = AllSlots</u>]	<u>FE_DEM_SYNC_LOSS_PASSED</u> <u>FE_START_FRIF</u> <u>FE_FULL_COM_IND</u> cancel <u>t3</u>
T115	[<u>vPOC!State = Normal Active</u> ∧ ¬ <u>vPOC!Freeze</u> ∧ <u>vPOC!SlotMode ≠ AllSlots</u>]	<u>FE_DEM_SYNC_LOSS_PASSED</u> <u>FE_START_FRIF</u> cancel <u>t3</u>
T16a	[<u>vPOC!State = Normal Passive</u> ∧ ¬ <u>vPOC!Freeze</u>]	<u>FE_DEM_SYNC_LOSS</u> <u>FE_STOP_FRIF</u> <u>FE_NO_COM_IND</u> start <u>t3</u>
T16b	[<u>vPOC!State = Normal Passive</u> ∧ ¬ <u>vPOC!Freeze</u>]	<u>FE_DEM_SYNC_LOSS</u> <u>FE_STOP_FRIF</u> start <u>t3</u>
T17	[(<u>vPOC!State = Halt</u> ∨ <u>vPOC!Freeze</u>) ∧ <u>reqComMode = FullCom</u> ∧ (<u>FrSmCheckWakeupReason</u> ∨ ¬ <u>FrSMIsWakeupEcu</u>)]	<u>FE_CONFIG</u> <u>wakeupType := NoWakeup</u> <u>FE_START</u> <u>startupCounter := 1</u> start <u>t2</u>
T20a	[(<u>vPOC!State = Halt</u> ∨ <u>vPOC!Freeze</u>) ∧ <u>reqComMode = FullCom</u> ∧ ¬ <u>FrSmCheckWakeupReason</u> ∧ <u>FrSMIsWakeupEcu</u>]	<u>wakeupType := SingleChannelWakeup</u> <u>FE_DEM_SYNC_LOSSFE_STOP_FRIF</u> <u>FE_NO_COM_IND</u> <u>FE_CONFIG</u> <u>FE_WAKEUP</u> <u>startupCounter := 1</u> start <u>t1</u> start <u>t3</u>

Transition	Event [Condition]	Actions
T20b	[(vPOC!State = Halt \vee vPOC!Freeze) \wedge reqComMode = FullCom \wedge \neg FrSmCheckWakeupReason \wedge FrSMIsWakeupEcu	wakeupType := SingleChannelWakeup FE_DEM_SYNC_LOSSFE_STOP_FRIF FE_CONFIG FE_WAKEUP startupCounter := 1 start t1 start t3
T20c	[(vPOC!State = Halt \vee vPOC!Freeze) \wedge reqComMode = FullCom \wedge \neg FrSmCheckWakeupReason \wedge FrSMIsWakeupEcu	wakeupType := SingleChannelWakeup FE_CONFIG FE_WAKEUP startupCounter := 1 start t1 start t3
T21	[(vPOC!State = Halt \vee vPOC!Freeze) \wedge \neg t_TrcvStdbbyDelay_IsActive	start t_TrcvStdbbyDelay
T30	t3[]	FE_DEM_STATUS_FAILED FE_STARTUP_ERROR_IND
T31	t3_IsNotActive	FE_STARTUP_ERROR_IND
T32	t3_IsNotActive	FE_STARTUP_ERROR_IND
T33	t3_IsNotActive	FE_STARTUP_ERROR_IND
T34	[wakeupFinished \wedge reqComMode = FullCom \wedge FrSMNumWakeupPatterns > 1 \wedge (\neg wakeupTransmitted \vee busTrafficDetected) \wedge wakeupType = DualChannelWakeup]	startupCounter := 1 wakeupType := DualChannelWakeupForward FE_SET_WU_CHANNEL_FORWARD wakeupTransmitted := false busTrafficDetected := false FE_WAKEUP start t1 start t3
T40	[lowNumberOfColdstarters]	
T41	[\neg lowNumberOfColdstarters]	

Legend: \wedge AND

\vee OR

\neg NOT

$:=$ assignment

start t: start timer t

cancel t: stop timer t

[...] guard condition for transition

t1 [...] t1 has expired

] ()

Note: If synchronization is lost after FullCom has been reached, the FrSM module will first try to bring the FlexRay CC to the startup state without allowing cold start.

Rationale: The loss of synchronization may be a local problem of the ECU. Thus the ECU should first try to re-integrate without disturbing the cluster.

Note: If resynchronization cannot be achieved before [t2](#) expires (see [FrSm076](#) and [FrSm077](#)), the same wakeup and startup procedure as for the initial synchronization will be used.

Note: If the startup of a FlexRay cluster is not successful (i.e. timer [t2](#) expires), the FrSM module will repeat the startup procedure depending on the value of the counter [startupCounter](#):

- If [startupCounter](#) does not exceed the threshold [FrSMStartupRepetitionsWithWakeup](#), the startup procedure will be repeated including the wakeup.
- If [startupCounter](#) exceeds the threshold [FrSMStartupRepetitionsWithWakeup](#) but does not exceed the threshold [FrSMStartupRepetitions](#), the startup procedure will be repeated without wakeup.

Note: When the timer [t3](#) expires, the FrSM will report the production error [FRSM_E_CLUSTER_STARTUP](#).

Note: After timer [t3](#) has expired, the FrSM will call `FrNm_StartupError` until either synchronisation has been achieved or [NoCom](#) is requested (see [FrSm160](#) and [FrSm161](#)).

Note: When the counter [startupCounter](#) exceeds the threshold [FrSMStartupRepetitions](#), an ECU that has been configured as a coldstart node will stop performing coldstart attempts. However, if another ECU performs a coldstart, the ECU will join the coldstart.

Note: If no threshold [FrSMStartupRepetitions](#) has been configured, an ECU that has been configured as a coldstart node will not stop performing coldstart attempts until either synchronisation has been achieved or [NoCom](#) is requested.

Rationale: If the RX path of a FlexRay CC is faulty, an ECU performing a wakeup or coldstart could disturb the FlexRay communication as it will not be able to detect any collision. Thus, an unlimited number of coldstart attempts could lead to a continuous disturbance of the FlexRay communication.

[SWS_FrSM_00149] [When a call of a function of the FlexRay Interface API returns a failure (e.g. `E_NOT_OK`), the FrSM shall ignore this return value and continue with the transition.] ()

Rationale: When the FlexRay Interface returns `E_NOT_OK` in a production environment, a production error has been reported to DEM. This will usually trigger the reinitialization of the FlexRay stack.

7.4 Configuration description

The FlexRay State Manager configuration tool reads the ECU configuration description of the FlexRay Interface as the mapping of controllers to clusters is contained in the FlexRay Interface configuration description.

7.5 Error classification

Section 7.x "Error Handling" of the document "General Specification of Basic Software Modules" [12] describes the error handling of the Basic Software in detail. Above all, it constitutes a classification scheme consisting of five error types which may occur in BSW modules.

Based on this foundation, the following section specifies particular errors arranged in the respective subsections below.

7.5.1 Development Errors

[SWS_FrSM_91001]

Type of error	Related error code	Error value
Invalid pointer in parameter list. In case of this error, the API service shall return immediately without any further action, beside reporting this development error.	FRSM_E_PARAM_POINTER	0x01
Invalid network handle parameter	FRSM_E_INV_HANDLE	0x02
FrSM module was not initialized	FRSM_E_UNINIT	0x03
Invalid communication mode requested	FRSM_E_INV_MODE	0x04
Initialization failed	FRSM_INIT_FAILED	0x05

()

7.5.2 Runtime Errors

There are no runtime errors.

7.5.3 Transient Faults

There are no transient faults.

7.5.4 Production Errors

7.5.4.1 FRSM_E_CLUSTER_STARTUP

Error Name:	FRSM_E_CLUSTER_STARTUP	
Short Description:	FlexRay cluster startup failure.	
Long Description:	FlexRay controller has not reached the state <i>normal active</i> within the configured time after FlexRay startup.	
Recommended DTC:	Assigned by DEM	
Detection Criteria:	Fail	FlexRay controller has not reached the state <i>normal active</i> within the time t3
	Pass	FlexRay controller has reached the state <i>normal active</i>

Secondary Parameters:	None
Time Required:	FrSMDurationT3
Monitor Frequency	Continuous
MIL illumination:	Assigned by DEM

7.5.4.2 FRSM_E_CLUSTER_SYNC_LOSS

Error Name:	FRSM_E_CLUSTER_SYNC_LOSS	
Short Description:	FlexRay synchronization loss.	
Long Description:	FlexRay controller has lost synchronization after successful startup.	
Recommended DTC:	Assigned by DEM	
Detection Criteria:	Fail	FlexRay controller has lost synchronization after it has reached state normal active.
	Pass	FlexRay controller has reached the state normal active or the request for FlexRay communication has been released.
Secondary Parameters:	None	
Time Required:	Depends on FlexRay configuration.	
Monitor Frequency	Continuous	
MIL illumination:	Assigned by DEM	

7.5.5 Extended Production Errors

There are no extended production errors.

8 API specification

8.1 Imported types

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

[SWS_FrSM_00095]

<i>Module</i>	<i>Header File</i>	<i>Imported Type</i>
ComM	Rte_ComM_Type.h	ComM_ModeType
ComStack_Types	ComStack_Types.h	NetworkHandleType
Dem	Rte_Dem_Type.h	Dem_EventIdType
	Rte_Dem_Type.h	Dem_EventStatusType
Fr	Fr_GeneralTypes.h	Fr_ChannelType
	Fr_GeneralTypes.h	Fr_ErrorModeType
	Fr_GeneralTypes.h	Fr_POCSStateType
	Fr_GeneralTypes.h	Fr_POCSStatusType
	Fr_GeneralTypes.h	Fr_SlotModeType
	Fr_GeneralTypes.h	Fr_StartupStateType
	Fr_GeneralTypes.h	Fr_WakeupStatusType
FrIf	FrIf.h	FrIf_StateTransitionType
FrTrcv	Fr_GeneralTypes.h	FrTrcv_TrvcModeType
	Fr_GeneralTypes.h	FrTrcv_TrvcWUReasonType
Std	Std_Types.h	Std_ReturnType
	Std_Types.h	Std_VersionInfoType

()

8.2 Type definitions

8.2.1 FrSM_ConfigType

[SWS_FrSM_00198]

Name	FrSM_ConfigType
Kind	Structure
Description	This type contains the implementation-specific post build time configuration structure

	that is for FrSM_Init.
Available via	FrSm.h

]()

8.2.2 FrSM_BswM_StateType

[SWS_FrSM_00199]

Name	FrSM_BswM_StateType		
Kind	Enumeration		
Range	FRSM_BSWM_READY	0x00	--
	FRSM_BSWM_READY_ECU_PASSIVE	0x01	--
	FRSM_BSWM_STARTUP	0x02	--
	FRSM_BSWM_STARTUP_ECU_PASSIVE	0x03	--
	FRSM_BSWM_WAKEUP	0x04	--
	FRSM_BSWM_WAKEUP_ECU_PASSIVE	0x05	--
	FRSM_BSWM_HALT_REQ	0x06	--
	FRSM_BSWM_HALT_REQ_ECU_PASSIVE	0x07	--
	FRSM_BSWM_KEYSLOT_ONLY	0x08	--
	FRSM_BSWM_KEYSLOT_ONLY_ECU_PASSIVE	0x09	--
	FRSM_BSWM_ONLINE	0x0A	--
	FRSM_BSWM_ONLINE_ECU_PASSIVE	0x0B	--
	FRSM_BSWM_ONLINE_PASSIVE	0x0C	--
	FRSM_BSWM_ONLINE_PASSIVE_ECU_PASSIVE	0x0D	--
	FRSM_LOW_NUMBER_OF_COLDSTARTERS	0x0E	--
FRSM_LOW_NUMBER_OF_COLDSTARTERS_ECU_PASSIVE	0x0F	--	
Description	This type defines the states that are reported to the BswM using BswM_FrSM_CurrentState.		
Available via	FrSm.h		

]()

8.3 Function definitions

This is a list of functions provided for upper layer modules.

8.3.1 FrSM_Init

[SWS_FrSM_00013]

Service Name	FrSm_Init	
Syntax	void FrSm_Init (const FrSM_ConfigType* FrSM_ConfigPtr)	
Service ID [hex]	0x01	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	FrSM_ConfigPtr	Pointer to a selected configuration structure
Parameters (inout)	None	
Parameters (out)	None	
Return value	None	
Description	Initializes the FlexRay State Manager.	
Available via	FrSm.h	

|(SRS_BSW_00405, SRS_BSW_00381, SRS_BSW_00438)

[SWS_FrSM_00126] |The [FrSM_Init](#) function shall initialize the state machines for all FlexRay clusters and set them into the state [FRSM_READY](#), i.e. perform transition [T00](#). |(SRS_BSW_00438, SRS_BSW_00101)

[SWS_FrSM_00127] |The [FrSM_Init](#) function shall internally store the configuration data address to enable subsequent API calls to access the configuration data. |(SRS_BSW_00438)

[SWS_FrSM_00128] |If development error detection is enabled (FrSMDevErrorDetect is ON), the [FrSM_Init](#) function shall remember internally the successful initialization for other API functions to check for proper module initialization. |(SRS_BSW_00438)

8.3.2 FrSM_RequestComMode

[SWS_FrSM_00020]

Service Name	FrSM_RequestComMode
---------------------	---------------------

Syntax	Std_ReturnType FrSM_RequestComMode (NetworkHandleType NetworkHandle, ComM_ModeType ComM_Mode)	
Service ID [hex]	0x02	
Sync/Async	Asynchronous	
Reentrancy	Reentrant for different FlexRay clusters	
Parameters (in)	Network Handle	This parameter identifies the FlexRay cluster for which a communication mode is requested.
	ComM_Mode	This parameter holds the requested communication mode.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_Return-Type	E_OK: Request accepted E_NOT_OK: Request not accepted
Description	This API function is used by the ComM to startup or shutdown the communication on a FlexRay cluster.	
Available via	FrSm.h	

](SRS_ModeMgm_09081)

[SWS_FrSM_00021] [The [FrSM_RequestComMode](#) function shall store the requested communication mode.

The next activation of the [FrSM_MainFunction](#) will then process this request when processing the state machine of the corresponding cluster.

Note, that the state machine definition in section 7.2 refers to this stored request as [reqComMode](#).] ()

[SWS_FrSM_00022] [If [NoCom](#) is requested after [FullCom](#) has been reached (i.e. when the FrSM state machine of the corresponding cluster is in state [FRSM_ONLINE](#), [FRSM_KEYSLOT_ONLY](#), [FRSM_LOW_NUMBER_OF_COLD-STARTERS](#) or [FRSM_ONLINE_PASSIVE](#)), the [FrSM_RequestComMode](#) function shall immediately process the corresponding transition of the state machine (see section 7.2).] ()

Rationale of [SWS_FrSM_00022](#): This shall ensure that the [NoCom](#) request will stop the participation of the ECU in the FlexRay communication at the end of the current FlexRay cycle.

[SWS_FrSM_00141] [If [ComM_Mode](#) has the value [COMM_SILENT_COMMUNICATION](#), the FrSM shall not store the requested communication mode and return E_NOT_OK. In case development error detection is

enabled, the FrSM shall additionally raise the development error code [FRSM_E_INV_MODE](#).] ()

[SWS_FrSM_00018] [If development error detection is enabled and the parameter NetworkHandle has an invalid value, the FrSM_RequestComMode function shall raise the development error code FRSM_E_INV_HANDLE and the FrSM_RequestComMode function shall return E_NOT_OK.] (SRS_BSW_00369, SRS_BSW_00323)

[SWS_FrSM_00019] [If development error detection is enabled and the parameter ComM_Mode has an invalid value, the FrSM_RequestComMode function shall raise the development error code FRSM_E_INV_MODE and the FrSM_RequestComMode function shall return E_NOT_OK.] ()

[SWS_FrSM_00061] [If development error detection is enabled and the FrSM module has not been initialized using FrSM_Init, the FrSM_RequestComMode function shall raise the development error code FRSM_E_UNINIT and the function FrSM_RequestComMode shall return E_NOT_OK.] (SRS_BSW_00406)

8.3.3 FrSM_GetCurrentComMode

[SWS_FrSM_00024]

Service Name	FrSM_GetCurrentComMode	
Syntax	Std_ReturnType FrSM_GetCurrentComMode (NetworkHandleType NetworkHandle, ComM_ModeType* ComM_ModePtr)	
Service ID [hex]	0x03	
Sync/Async	Synchronous	
Reentrancy	Reentrant for different FlexRay clusters	
Parameters (in)	Network Handle	Handle of communication network
Parameters (inout)	None	
Parameters (out)	ComM_Mode Ptr	Pointer to the memory location where the current communication mode shall be stored
Return value	Std_Return-Type	E_OK: Request accepted E_NOT_OK: Request was not accepted as the FrSM has not been initialized using FrSM_Init.
Description	This API function can be used to determine the current communication mode of a FlexRay cluster.	
Available via	FrSm.h	

](SRS_ModeMgm_09084)

[SWS_FrSM_00025] [The [FrSM_GetCurrentComMode](#) function shall write the current communication mode of the corresponding FlexRay cluster into the given memory location.] ()

[SWS_FrSM_00026] [The [FrSM_GetCurrentComMode](#) function shall determine the communication mode as follows:

- If the FrSM state machine for the FlexRay cluster determined by NetworkHandle is in state [FRSM ONLINE](#) or [FRSM LOW NUMBER-OF COLDSTARTERS](#), the communication mode is COMM_FULL_COMMUNICATION.
- In any other case, the communication mode is COMM_NO_COMMUNICATION.

] ()

[SWS_FrSM_00027] [If development error detection is enabled and the parameter NetworkHandle has an invalid value, the [FrSM_GetCurrentComMode](#) function shall raise the development error code [FRSM_E_INV_HANDLE](#) and the [FrSM_GetCurrentComMode](#) function shall return E_NOT_OK.] ()

[SWS_FrSM_00028] [If development error detection is enabled and the parameter ComM_ModePtr equals NULL_PTR, the [FrSM_GetCurrentComMode](#) function shall raise the development error code [FRSM_E_PARAM_POINTER](#) and the [FrSM_GetCurrentComMode](#) function shall return E_NOT_OK.] (SRS_BSW_00369, SRS_BSW_00323)

[SWS_FrSM_00060] [If development error detection is enabled and the FrSM module has not been initialized using [FrSM_Init](#), the [FrSM_GetCurrentComMode](#) function shall raise the development error code [FRSM_E_UNINIT](#) and the [FrSM_GetCurrentComMode](#) function shall return E_NOT_OK.] (SRS_BSW_00406)

8.3.4 FrSM_GetVersionInfo

[SWS_FrSM_00029][

Service Name	FrSM_GetVersionInfo	
Syntax	void FrSM_GetVersionInfo (Std_VersionInfoType* versioninfo)	
Service ID [hex]	0x04	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	None	
Parameters (inout)	None	
Parameters	versioninfo	Pointer to where to store the version information of this module.

(out)	
Return value	None
Description	<p>This service returns the version information of this module. The version information includes:</p> <ul style="list-style-type: none"> • Module Id • Vendor Id • Vendor specific version numbers (BSW00407). <p>This function shall be pre compile time configurable On/Off by the configuration parameter: FRSM_VERSION_INFO_API 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.</p>
Available via	FrSm.h

](SRS_BSW_00407)

8.3.5 FrSM_AllSlots

[SWS_FrSM_00172]

Service Name	FrSm_AllSlots	
Syntax	Std_ReturnType FrSm_AllSlots (NetworkHandleType NetworkHandle)	
Service ID [hex]	0x05	
Sync/Async	Asynchronous	
Reentrancy	Reentrant for different FlexRay clusters	
Parameters (in)	Network Handle	This parameter identifies the FlexRay cluster for which a communication mode is requested.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_Return-Type	E_OK: Request accepted E_NOT_OK: Request not accepted
Description	This API function can be used to leave the KeySlotOnlyMode.	
Available via	FrSm.h	

]()

[SWS_FrSM_00197] The [FrSM AllSlots](#) function shall be pre compile time configurable ON/OFF by the configuration parameter FrSMAllSlotsSupport]()

[SWS_FrSM_00171] [The [FrSM AllSlots](#) function shall call FrIf_AllSlots for each controller of the FlexRay cluster. It shall return E_OK if each of these calls returned E_OK, otherwise [FrSM AllSlots](#) shall return E_NOT_OK.] ()

[SWS_FrSM_00168] [If development error detection is enabled and the parameter NetworkHandle has an invalid value, the [FrSM AllSlots](#) function shall raise the development error code FRSM_E_INV_HANDLE and the [FrSM AllSlots](#) function shall return E_NOT_OK.] (SRS_BSW_00369, SRS_BSW_00323)

[SWS_FrSM_00169] [If development error detection is enabled and the FrSM module has not been initialized using FrSM_Init, the [FrSM AllSlots](#) function shall raise the development error code FRSM_E_UNINIT and the [FrSM AllSlots](#) function shall return E_NOT_OK.] (SRS_BSW_00406)

8.3.6 FrSM_SetEcuPassive

[SWS_FrSM_00174]

Service Name	FrSm_SetEcuPassive	
Syntax	Std_ReturnType FrSm_SetEcuPassive (boolean FrSM_Passive)	
Service ID [hex]	0x06	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	FrSM_Passive	This parameter determines whether all FlexRay clusters are set to passive, i.e. receive only.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_Return-Type	E_OK: Request accepted E_NOT_OK: Request not accepted
Description	This API function can be used to set all FlexRay clusters of the ECU to a receive only mode.	
Available via	FrSm.h	

]()

[SWS_FrSM_00177] [The [FrSM_SetEcuPassive](#) function shall set the state of all FrSM state machines to [FRSM_ECU_PASSIVE](#) if the parameter FrSM_Passive evaluates to true, otherwise it shall set the state of all FrSM state machines to [FRSM_ECU_ACTIVE](#).] ()

[SWS_FrSM_00178] [If the state machine of a FlexRay cluster is not in state [FRSM_READY](#) (i.e. the transceivers of the FlexRay cluster are not in standby mode), the function shall execute [FE_TRCV_NORMAL](#) for this cluster.] ()

[SWS_FrSM_00179] [If development error detection is enabled and the FrSM module has not been initialized using FrSM_Init, the [FrSM_SetEcuPassive](#) function shall raise the development error code FRSM_E_UNINIT and the [FrSM_SetEcuPassive](#) function shall return E_NOT_OK.] (SRS_BSW_00406)

8.4 Call-back notifications

The FlexRay State Manager does not provide any call-back API services to other BSW modules.

8.5 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.

8.5.1 FrSM_MainFunction_<FrSMCluster.ShortName>

[SWS_FrSM_00118]

Service Name	FrSM_MainFunction_<FrSMCluster.ShortName>
Syntax	void FrSM_MainFunction_<FrSMCluster.ShortName> (void)
Service ID [hex]	0x80
Description	--
Available via	SchM_FrSm.h

](SRS_BSW_00373)

[SWS_FrSM_00047] [The [FrSM_MainFunction](#) shall determine the [POC](#) status of all FlexRay [CC](#) that are connected to the corresponding FlexRay cluster.

This document is based on the assumption that there is always a unique [POC](#) state for every FlexRay cluster (see Limitations in section 4.1).] ()

[SWS_FrSM_00192] [If the optional configuration parameter FrSMMinNumberOfColdstarter is configured, the [FrSM_MainFunction](#) shall determine the number startup frames by calling FrIf_GetNumOfStartupFrames.] ()

[SWS_FrSM_00048] [After determining the [POC](#) status and optionally the number of startup frames, the [FrSM_MainFunction](#) shall process the state machine of the corresponding cluster.] ()

Note: The [FrSM_MainFunction](#) shall be called cyclically with a cycle time that is shorter than or equal to the FlexRay cycle duration.

Rationale: The [FrSM_MainFunction](#) should be called at least once per FlexRay cycle. As the [POC](#) status only changes once per cycle, multiple invocations per FlexRay cycle have no benefit.

Note: After [FullCom](#) has been reached, the invocation of the [FrSM_MainFunction](#) can optionally be synchronized to the FlexRay global time to ensure that the [FrSM_MainFunction](#) is activated once per FlexRay cycle. However, this is outside of the scope of this specification.

Note: In case of very short FlexRay cycle times the [FrSM_MainFunction](#) can optionally be called with a cycle time that is larger than the FlexRay cycle time. However, this is outside of the scope of this specification as it can lead to increased startup time and to undetected [POC](#) status changes.

[SWS_FrSM_00181] [If the FrSM module has not been initialized using [FrSM_Init](#), the [FrSM_MainFunction](#) function shall return immediately without performing any functionality and without raising any errors.] (SRS_BSW_00450)

8.6 Expected Interfaces

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

8.6.1 Mandatory Interfaces

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

[SWS_FrSM_00096]

<i>API Function</i>	<i>Header File</i>	<i>Description</i>
BswM_FrSM_CurrentState	BswM_FrSM.h	Function called by FrSM to indicate its current state.
ComM_BusSM_ModelIndication	ComM.h	Indication of the actual bus mode by the corresponding Bus State Manager. ComM shall propagate the indicated state to the users with means of the RTE and BswM.
FrIf_AllowColdstart	FrIf.h	Wraps the FlexRay Driver API function Fr_AllowColdstart().
FrIf_ClearTransceiverWakeup	FrIf.h	Wraps the FlexRay Transceiver Driver API function FrTrcv_ClearTransceiverWakeup(). The enum value "FR_CHANNEL_AB" shall not be used.
FrIf_ControllerInit	FrIf.h	Initialized a FlexRay CC.
FrIf_GetPOCStatus	FrIf.h	Wraps the FlexRay Driver API function Fr_GetPOCStatus().
FrIf_GetTransceiverWUReason	FrIf.h	Wraps the FlexRay Transceiver Driver API function FrTrcv_GetTransceiverWUReason(). The enum value "FR_CHANNEL_AB"

		shall not be used.
FrIf_Halt-Communication	FrIf.h	Wraps the FlexRay Driver API function Fr_HaltCommunication().
FrIf_SendWUP	FrIf.h	Wraps the FlexRay Driver API function Fr_SendWUP().
FrIf_SetState	FrIf.h	Requests FrIf state machine transition.
FrIf_SetTransceiver-Mode	FrIf.h	Wraps the FlexRay Transceiver Driver API function FrTrcv_SetTransceiverMode(). The enum value "FR_CHANNEL_AB" shall not be used.
FrIf_Start-Communication	FrIf.h	Wraps the FlexRay Driver API function Fr_StartCommunication().

I()

8.6.2 Optional Interfaces

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

[SWS_FrSM_00097]

API Function	Header File	Description
Dem_Set-EventStatus	Dem.h	Called by SW-Cs or BSW modules to report monitor status information to the Dem. BSW modules calling Dem_SetEventStatus can safely ignore the return value. This API will be available only if $\{\{Dem/DemConfigSet/DemEventParameter/DemEventReportingType\} == STANDARD_REPORTING\}$
Det_Report-Error	Det.h	Service to report development errors.
FrIf_AllSlots	FrIf.h	Wraps the FlexRay Driver API function Fr_AllSlots
FrIf_GetNum-OfStartup-Frames	FrIf.h	Wraps the FlexRay Driver API function Fr_GetNumOfStartupFrames and gets a list of the current number of startup frames seen on the cluster. See variable vStartupPairs of [12] for details.
FrIf_Get-WakeupRx-Status	FrIf.h	Wraps the FlexRay Driver API function Fr_GetWakeupRxStatus and gets the wakeup received information from the FlexRay controller.
FrIf_Set-Wakeup-Channel	FrIf.h	Wraps the FlexRay Driver API function Fr_SetWakeupChannel(). The enum value "FR_CHANNEL_AB" shall not be used.
FrNm_-StartupError	FrNm.h	This function is called by the FrSM when synchronization of the FlexRay cluster could not be achieved.

I()

8.6.3 Configurable Interfaces

8.6.3.1 <Cdd>_SyncLossErrorIndication

[SWS_FrSM_00190]

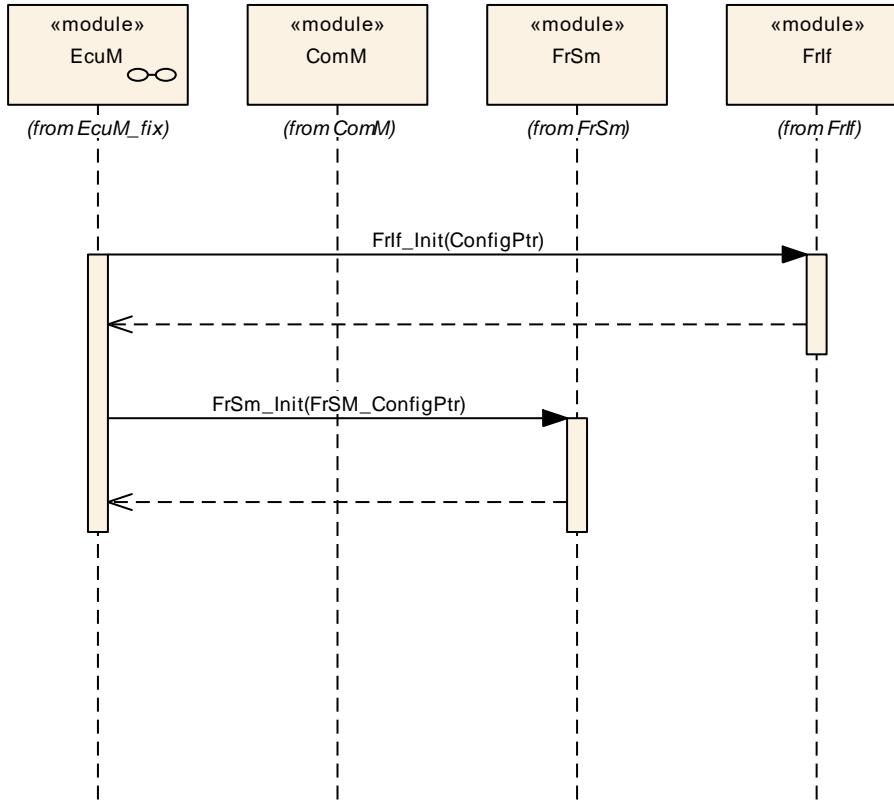
Service Name	<Cdd>_SyncLossErrorIndication	
Syntax	void <Cdd>_SyncLossErrorIndication (NetworkHandleType NetworkHandle, boolean SyncLossErrorStatus)	
Sync/Async	Synchronous	
Reentrancy	Reentrant for different FlexRay clusters	
Parameters (in)	Network Handle	Handle of FlexRay cluster
	SyncLoss ErrorStatus	true: ECU lost synchronization to the FlexRay cluster. false: ECU can synchronize to the FlexRay cluster or request for full communication has been released after the ECU lost its synchronization to the Flex Ray cluster.
Parameters (inout)	None	
Parameters (out)	None	
Return value	None	
Description	This function is called with parameter SyncLossErrorStatus = true when the ECU loses its synchronization to the FlexRay cluster. The function is called with parameter SyncLossErrorStatus = false either when the ECU can synchronize to the FlexRay cluster or when the request for full communication has been released after the ECU lost its synchronization to the FlexRay cluster.	
Available via	FrSm_Externals.h	

()

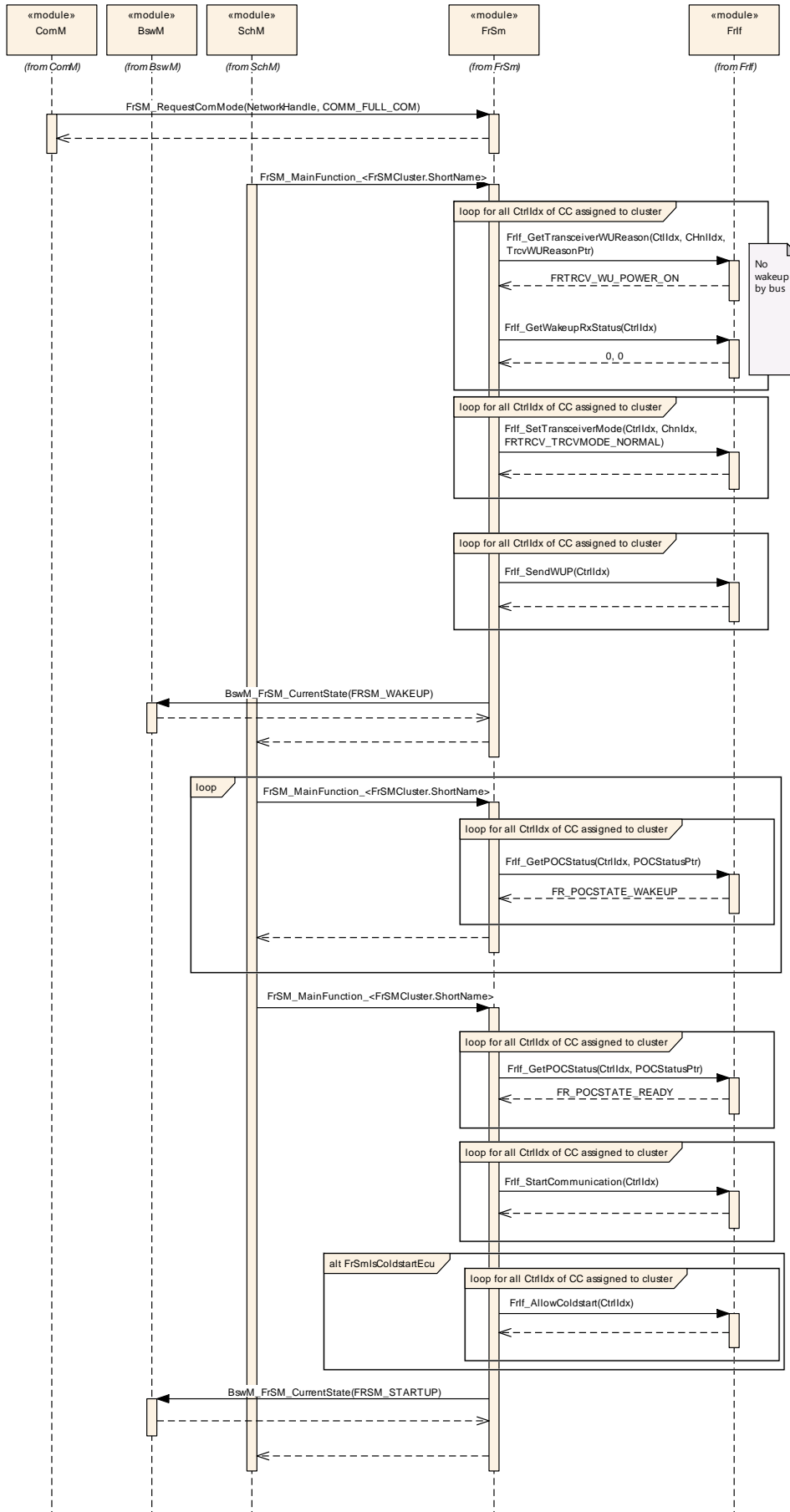
The name of this function can be configured using the configuration parameter FrMmSyncLossErrorIndicationName (see chapter 10). The FlexRay State Manager will call this function when the ECU loses its synchronization to the FlexRay cluster, after it could synchronize to the FlexRay cluster or when the FullCom request is released after the ECU lost its synchronization to the FlexRay cluster.

9 Sequence diagrams

9.1 Initialization



9.2 Single Channel Wakeup



(continued)

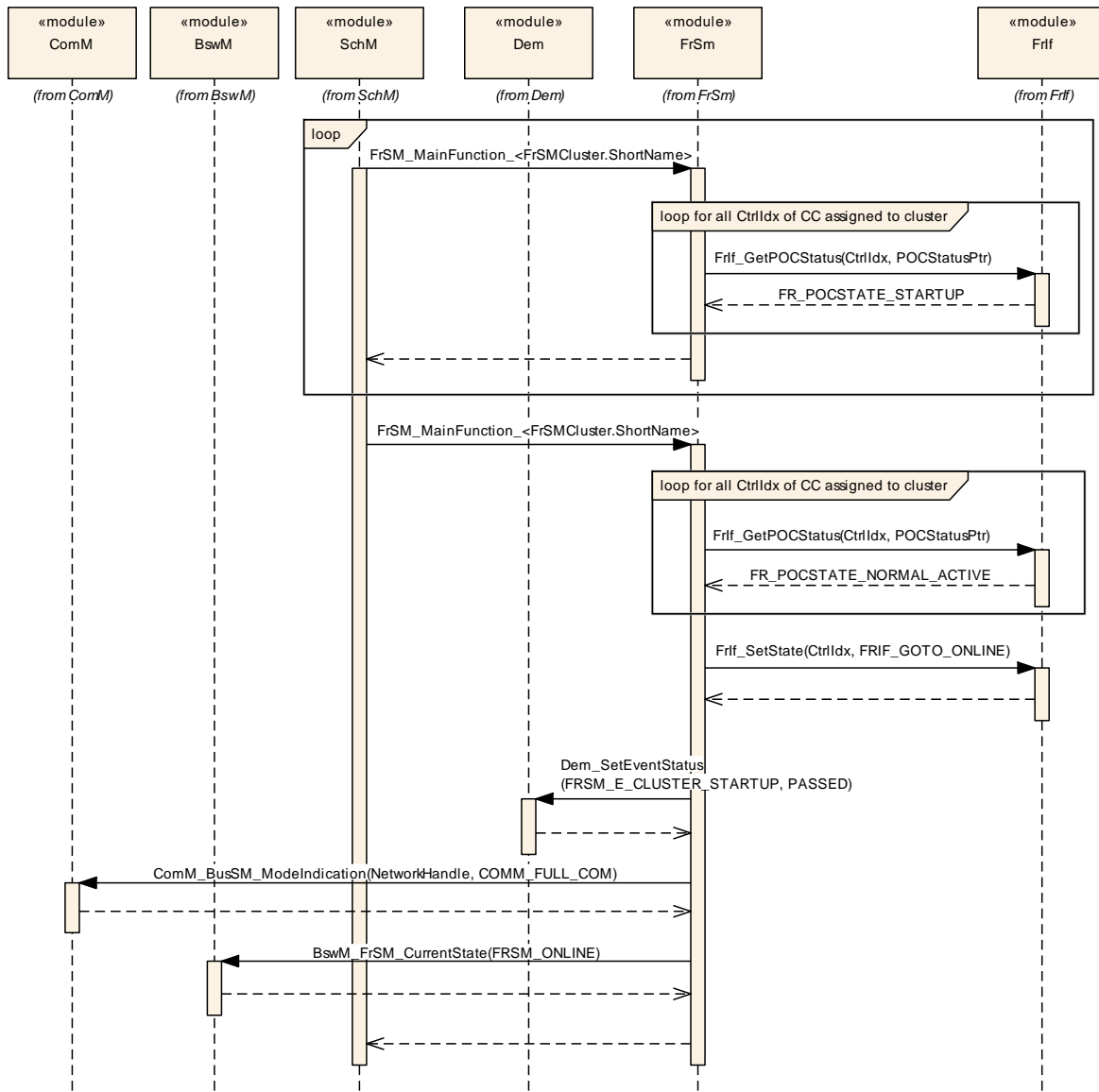
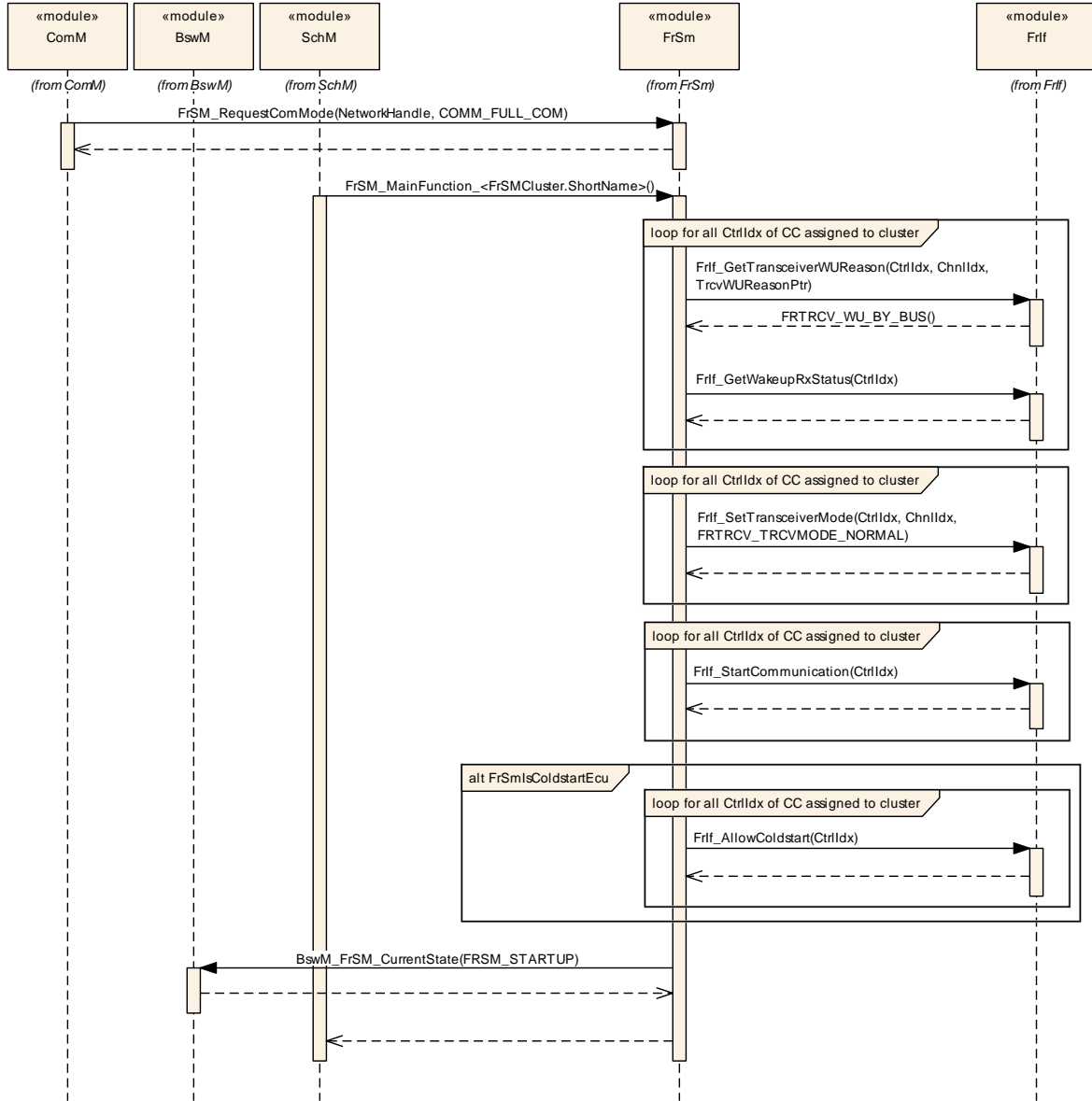


Figure 3 Transition from no communication to full communication for the case of an ECU that has a local wakeup reason.

9.3 Single Channel Passive Startup



(continued)

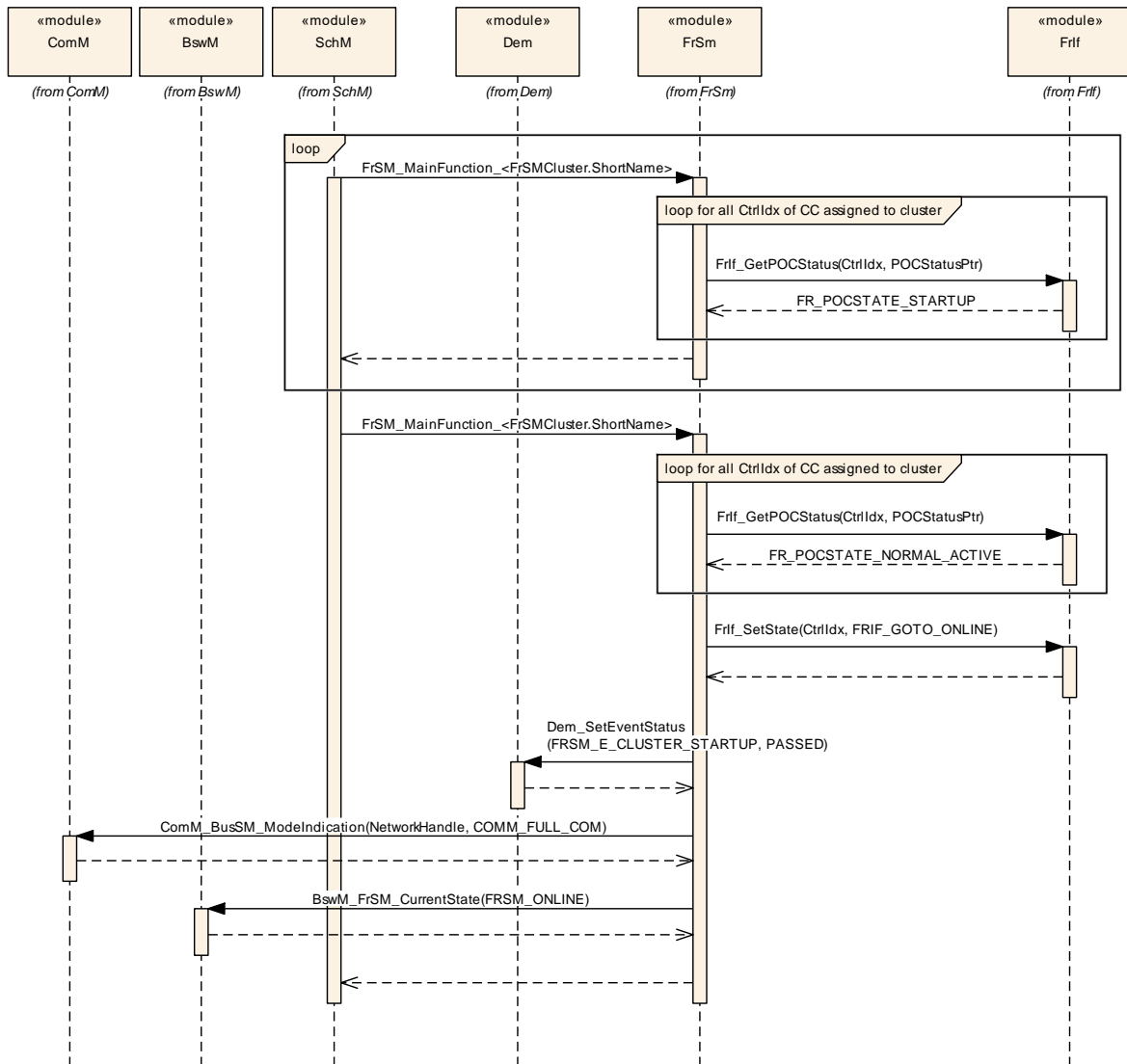
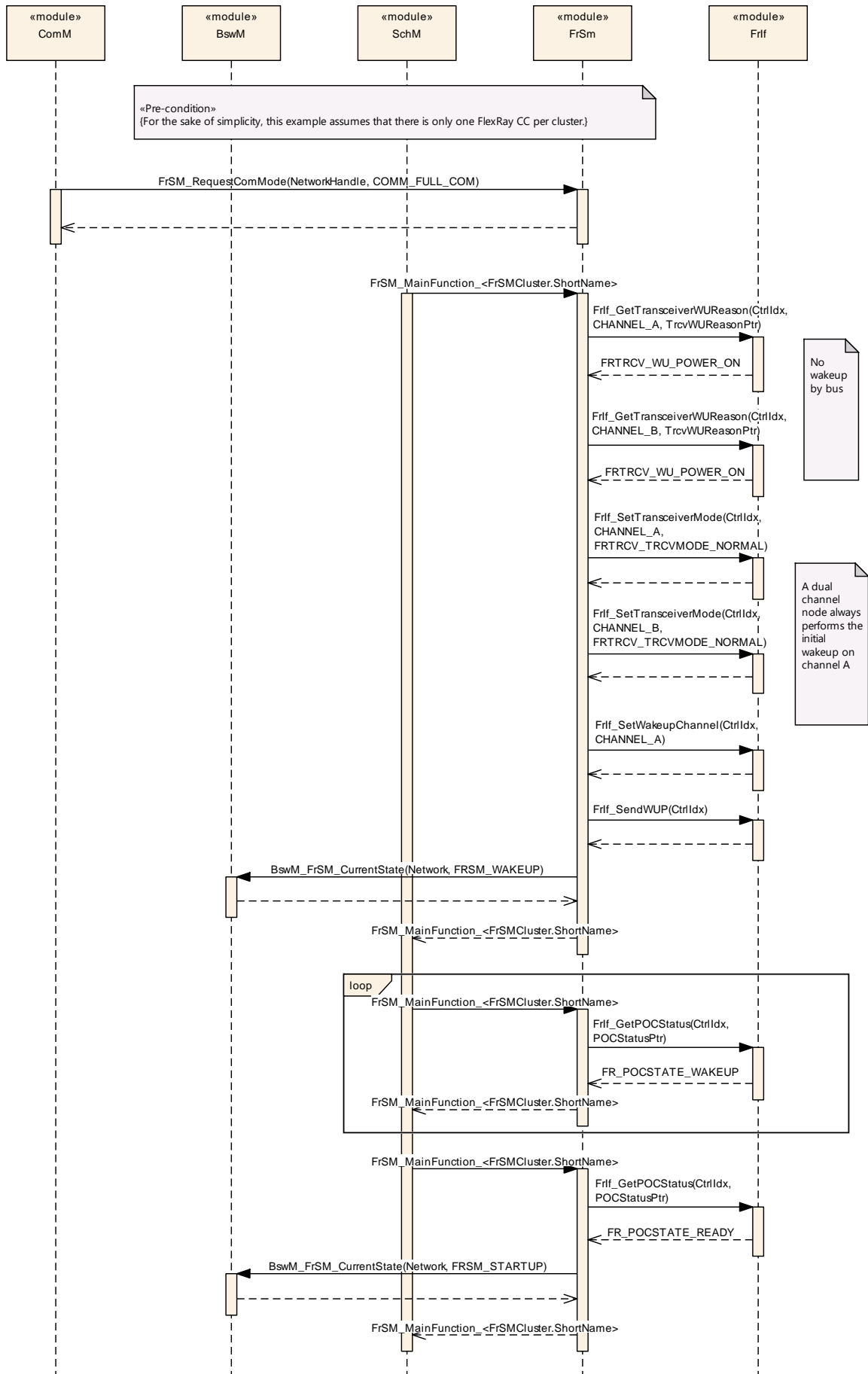


Figure 4 Transition from no communication to full communication for the case of an ECU that has been woken up by bus.

9.4 Dual Channel Wakeup



(continued)

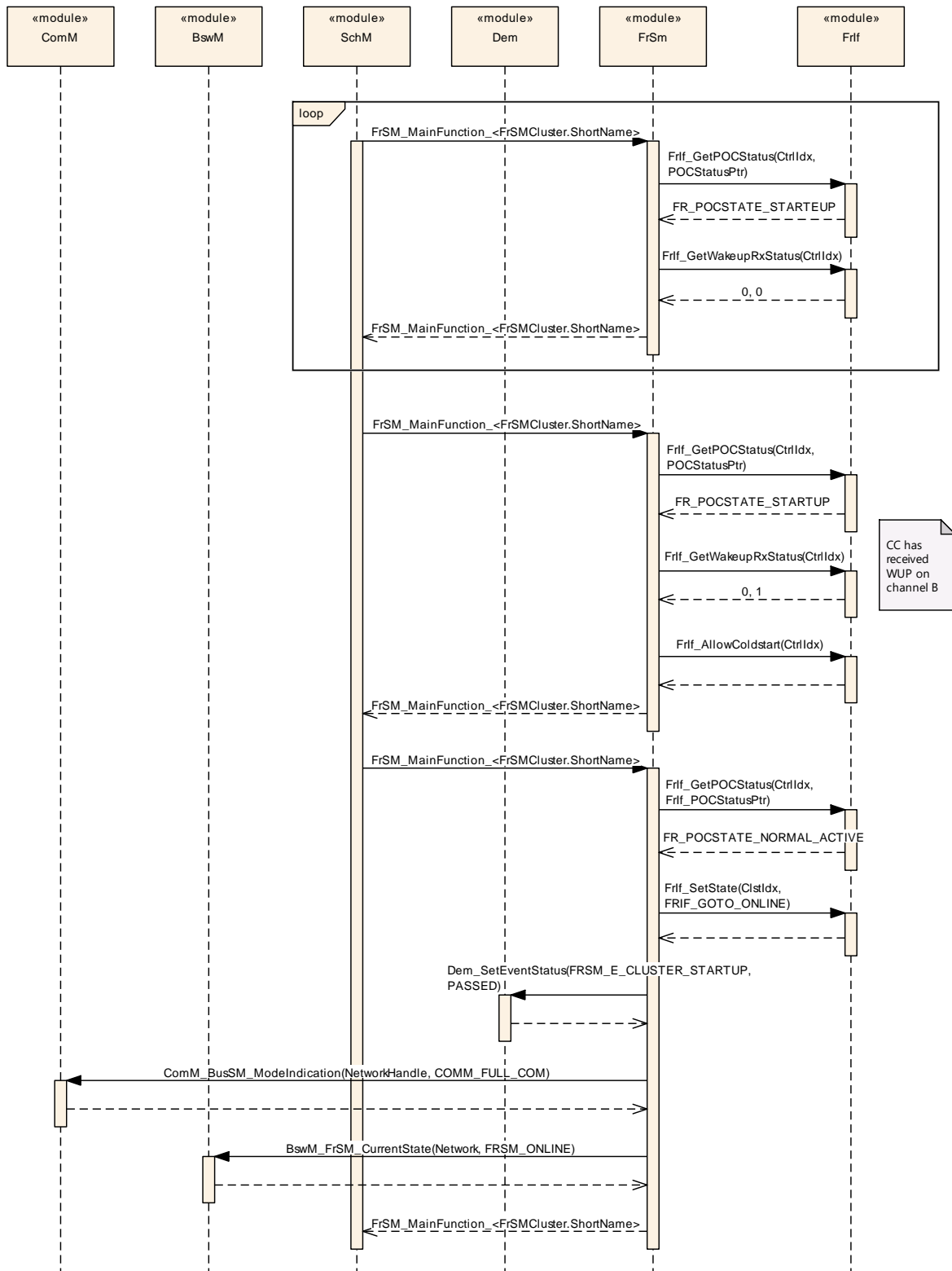
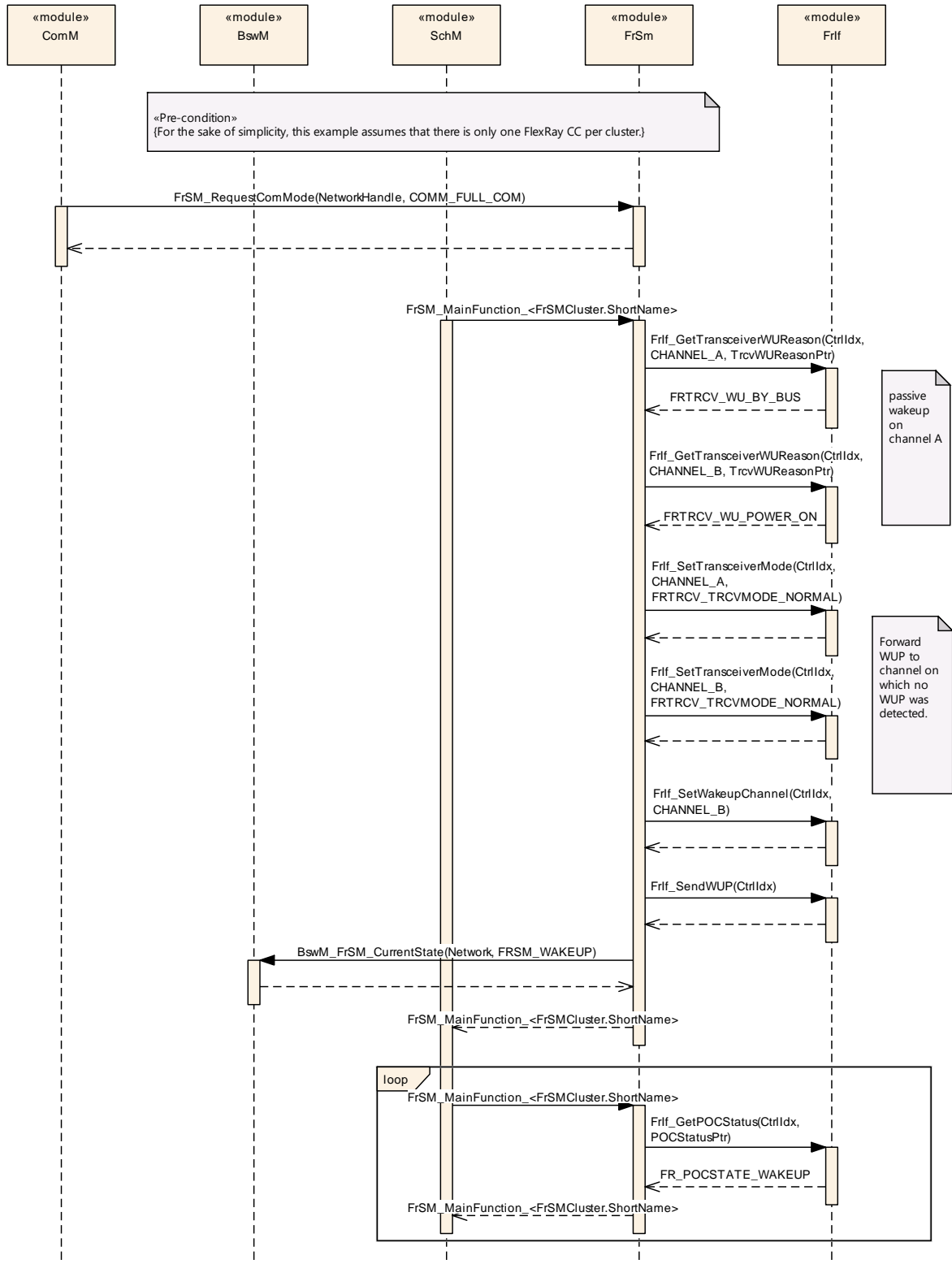


Figure 5 Transition from no communication to full communication for the case of a dual channel ECU with a local wakeup reason.

9.5 Dual Channel Wakeup Forward



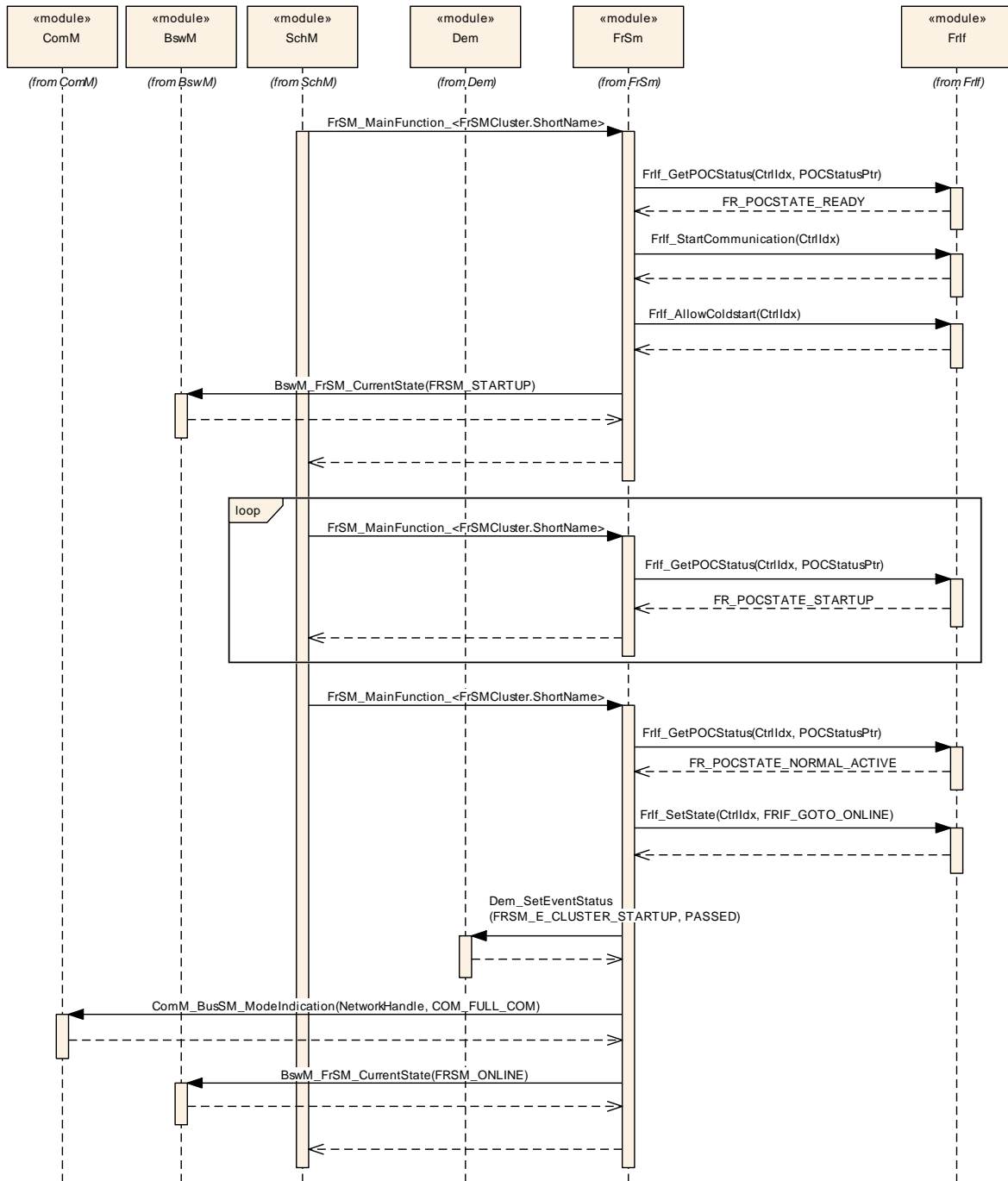
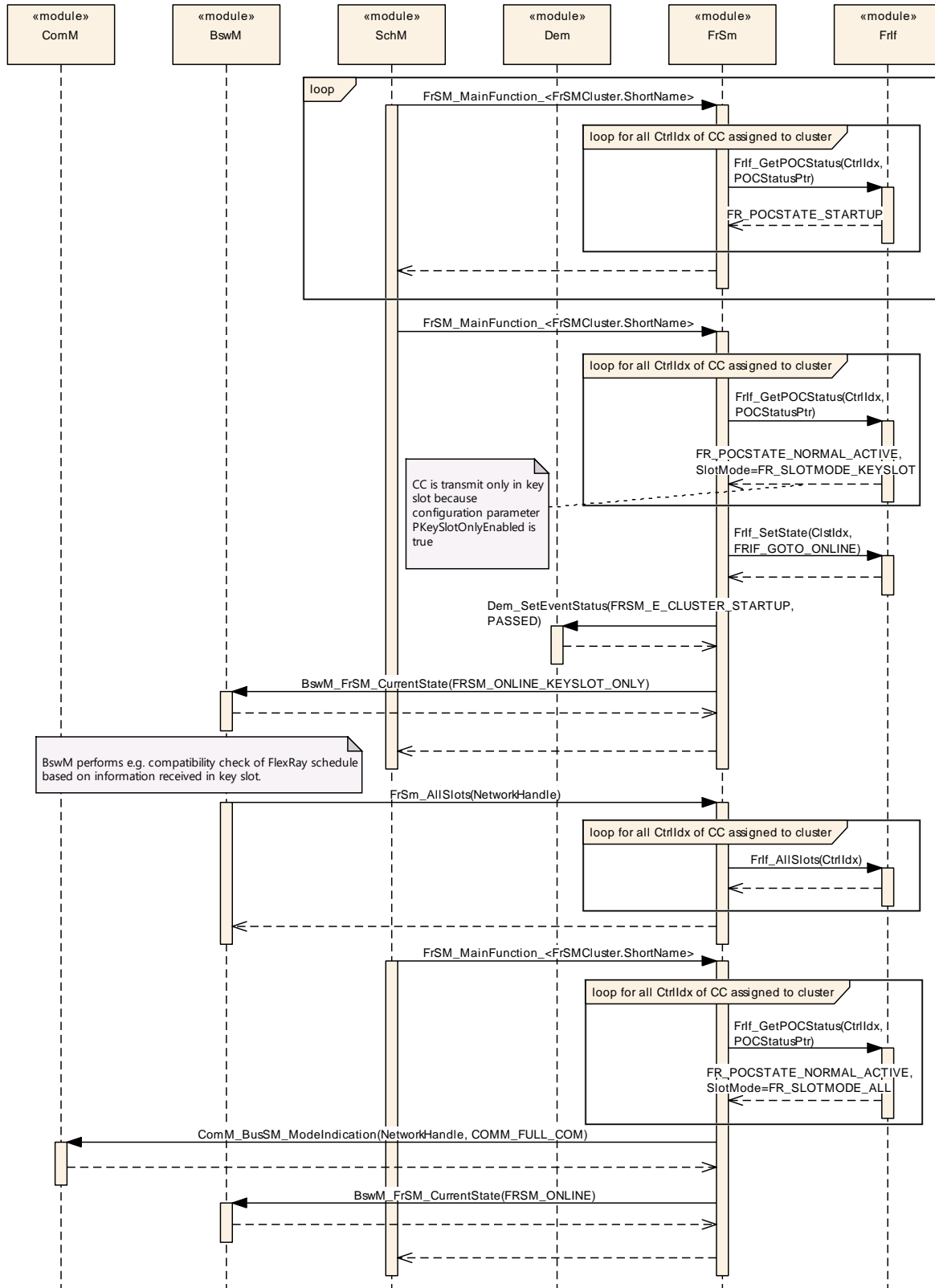
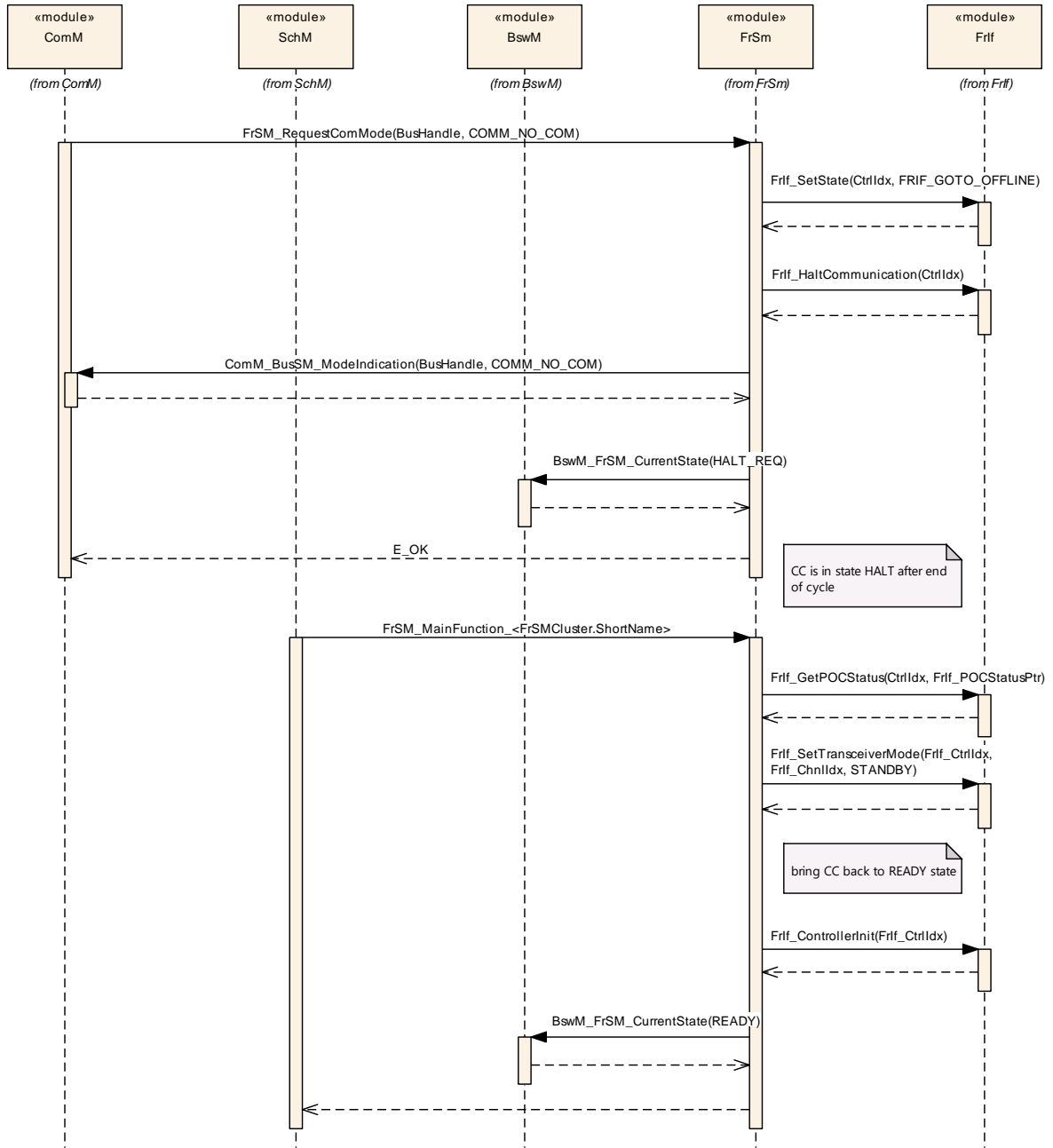


Figure 6 Transition from no communication to full communication for the case of a dual channel that has been woken up by bus.

9.6 Key Slot Only Mode



9.7 Transition from full communication to no communication



10 Configuration specification

In general, this chapter defines configuration parameters and their clustering into containers. In order to support the specification Chapter 10.1 describes fundamentals.

Chapter 10.2 specifies the structure (containers) and the parameters of the module FlexRay State Manager.

Chapter 10.3 specifies published information of the module FlexRay State Manager.

10.1 How to read this chapter

For details refer to the chapter 10.1 “Introduction to configuration specification” in *SWS_BSWGeneral*.

10.2 Containers and configuration parameters

The following chapters summarize all configuration parameters. The detailed meanings of the parameters are described Chapters 0 and Chapter 8.

[SWS_FrSM_00064] [The [FrSM](#) module shall support tool based configuration.]
(SRS_BSW_00159)

[SWS_FrSM_00065] [The configuration tool shall check the consistency of the configuration parameters at system configuration time.] (SRS_BSW_00167)

10.2.1 FrSM

SWS Item	ECUC_FrSM_00174 :
Module Name	FrSM
Module Description	Configuration of the FlexRay State Manager
Post-Build Variant Support	true
Supported Config Variants	VARIANT-LINK-TIME, VARIANT-POST-BUILD, VARIANT-PRE-COMPILE

Included Containers		
Container Name	Multiplicity	Scope / Dependency
FrSMConfig	1	This container comprises the cluster specific configuration of the FlexRay State Manager.
FrSMGeneral	1	This container contains the general configuration parameters of the FlexRay State Manager.

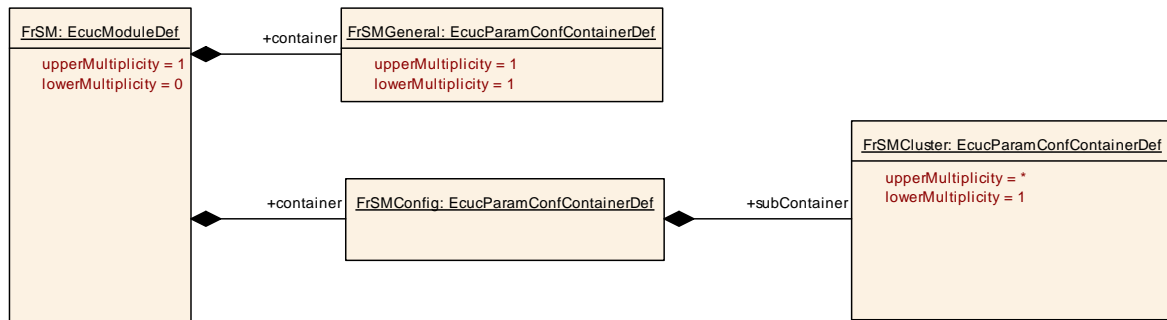


Figure 7 FlexRay State Manager Configuration

10.2.2 FrSMConfig

SWS Item	ECUC_FrSM_00146 :
Container Name	FrSMConfig
Parent Container	FrSM
Description	This container comprises the cluster specific configuration of the FlexRay State Manager.
Configuration Parameters	

Included Containers		
Container Name	Multiplicity	Scope / Dependency
FrSMCluster	1..*	This container specifies a FlexRay cluster and all related data. A FlexRay cluster may consist of more than one controller per ECU.

10.2.3 FrSMGeneral

SWS Item	ECUC_FrSM_00107 :
Container Name	FrSMGeneral
Parent Container	FrSM
Description	This container contains the general configuration parameters of the FlexRay State Manager.
Configuration Parameters	

SWS Item	ECUC_FrSM_00172 :		
Name	FrSMAllSlotsSupport		
Parent Container	FrSMGeneral		
Description	Configuration parameter to enable/disable FrSM support to enable/disable the switching from key-slot/single-slot mode to all-slot mode.		
Multiplicity	0..1		
Type	EcucBooleanParamDef		
Default value	--		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00066 :		
Name	FrSMDevErrorDetect		
Parent Container	FrSMGeneral		
Description	Switches the development error detection and notification on or off. <ul style="list-style-type: none"> • true: detection and notification is enabled. • false: detection and notification is disabled. 		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00167 :		
Name	FrSMSyncLossErrorIndicationName		
Parent Container	FrSMGeneral		
Description	Name of <Cdd>_SyncLossErrorIndication function that shall be called on loss of synchronization. If this parameter is omitted no indication shall take place.		
Multiplicity	0..1		

Type	EcucFunctionNameDef		
Default value	--		
maxLength	--		
minLength	--		
regularExpression	--		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	ECUC FrSM_00108 :		
Name	FrSMVersionInfoApi		
Parent Container	FrSMGeneral		
Description	Enables and disables the version info API		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

No Included Containers

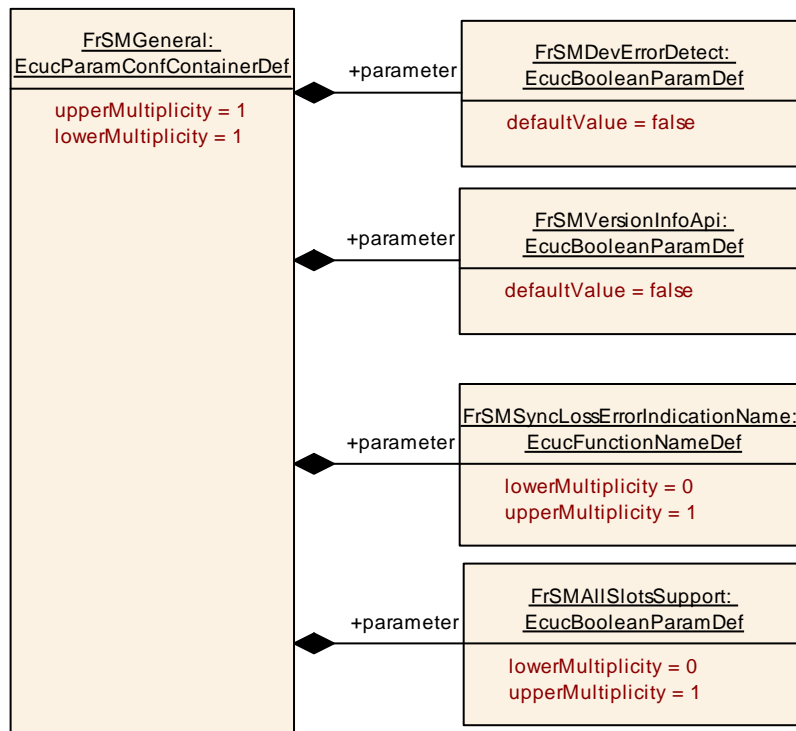


Figure 8 FrSMGeneral Container

10.2.4 FrSMCluster

SWS Item	ECUC_FrSM_00067 :
Container Name	FrSMCluster
Parent Container	FrSMConfig
Description	This container specifies a FlexRay cluster and all related data. A FlexRay cluster may consist of more than one controller per ECU.
Configuration Parameters	

SWS Item	ECUC_FrSM_00001 :		
Name	FrSMCheckWakeupReason		
Parent Container	FrSMCluster		
Description	If FrSMCheckWakeupReason is true, the FrSM will check the wakeup reason in order to skip the wakeup in case of wakeup by bus. If FrSMCheckWakeupReason is false, the FrSM will always try to perform a wakeup.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00166 :		
Name	FrSMDelayStartupWithoutWakeup		
Parent Container	FrSMCluster		
Description	If true, timer t1 shall be started instead of immediately calling Frlf_AllowColdstart in case of a startup without wakeup.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00102 :		
Name	FrSMDurationT1		
Parent Container	FrSMCluster		
Description	The duration of timer t1 in seconds. A value of 0 shall imply that the timer is not used.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	[0 .. INF]		
Default value	--		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

	dependency: FrSMMainFunctionCycleTime (As timers are checked during the call of FrSM_MainFunction, the effective timer duration will always be a multiple of FrSMMainFunctionCycleTime).
--	--

SWS Item	ECUC FrSM_00089 :		
Name	FrSMDurationT2		
Parent Container	FrSMCluster		
Description	The duration of timer t2 in seconds. A value of 0 shall imply that the timer is not used. The value of this parameter shall be larger than the value of FrSMDurationT1 parameter.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	[0 .. INF]		
Default value	--		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local dependency: FrSMMainFunctionCycleTime (As timers are checked during the call of FrSM_MainFunction, the effective timer duration will always be a multiple of FrSMMainFunctionCycleTime).		

SWS Item	ECUC FrSM_00162 :		
Name	FrSMDurationT3		
Parent Container	FrSMCluster		
Description	The duration of timer t3 in seconds. The value of this parameter shall be larger than the value of FrSMDurationT1 parameter. A value of 0 shall imply that the timer is not used. It shall only be possible to configure a value 0 if no FrNm is used.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	[0 .. INF]		
Default value	--		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local dependency: FrSMMainFunctionCycleTime (As timers are checked during the call of FrSM_MainFunction, the effective timer duration will always be a multiple of FrSMMainFunctionCycleTime).		

SWS Item	ECUC FrSM_00173 :		
Name	FrSMDurationT4		
Parent Container	FrSMCluster		
Description	The timer t4 ensures that a dual channel node will eventually clear its coldstart inhibit bit and become a leading coldstarter.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	[0 .. INF]		
Default value	--		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00068 :		
Name	FrSMIsColdstartEcu		
Parent Container	FrSMCluster		
Description	True: The ECU is a coldstart node for this FlexRay cluster. False: The ECU is no coldstart node for this FlexRay cluster.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00109 :		
Name	FrSMIsWakeupEcu		
Parent Container	FrSMCluster		
Description	True: FrSM shall perform a wakeup for this cluster. False: FrSM shall never perform a wakeup for this FlexRay cluster.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00115 :		
Name	FrSMMainFunctionCycleTime		
Parent Container	FrSMCluster		
Description	This parameter defines the cycle time in seconds of the periodic calling of FrSM main function.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range]0 .. INF[
Default value	--		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00168 :		
Name	FrSMMinNumberOfColdstarter		
Parent Container	FrSMCluster		
Description	This parameter defines the number of coldstarter that should not be underrun. If this parameter is not configured the mainfunction shall not check the number of startup frames.		
Multiplicity	0..1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	--		
Post-Build Variant	true		

Multiplicity			
Post-Build Variant Value	true		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00165 :		
Name	FrSMNumWakeupPatterns		
Parent Container	FrSMCluster		
Description	Maximum number of Wakeup Patterns the node may send before going to FRSM_STARTUP.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 65535		
Default value	--		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local dependency: A value greater than zero is required in case the parameter FrSMIsWakeupEcu is true.		

SWS Item	ECUC_FrSM_00069 :		
Name	FrSMStartupRepetitions		
Parent Container	FrSMCluster		
Description	The number of times an ECU may repeat the startup procedure for a FlexRay cluster.		
Multiplicity	0..1		
Type	EcucIntegerParamDef		
Range	0 .. 65535		
Default value	--		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local dependency: This value must be greater or equal to FrSMStartupRepetitionsWithWakeup		

SWS Item	ECUC_FrSM_00094 :		
Name	FrSMStartupRepetitionsWithWakeup		
Parent Container	FrSMCluster		
Description	The number of times an ECU may repeat the startup procedure including a wakeup for a FlexRay cluster.		
Multiplicity	0..1		
Type	EcucIntegerParamDef		

Range	0 .. 65535		
Default value	--		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00170 :		
Name	FrSMTrcvStdbbyDelay		
Parent Container	FrSMCluster		
Description	The duration of timer t_TrvcStdbbyDelay in seconds. The granularity of this parameter shall be restricted to full FlexRay cycles (FrIfGdCycle). A value of 0 shall imply that the timer is not used.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	[0 .. INF]		
Default value	--		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local dependency: FrSmMainFunctionCycleTime		

SWS Item	ECUC_FrSM_00070 :		
Name	FrSMComMNetworkHandleRef		
Parent Container	FrSMCluster		
Description	Reference to the unique handle to identify one certain FlexRay network correspond to one of the network handles of the ComM configuration.		
Multiplicity	1		
Type	Symbolic name reference to [ComMChannel]		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00116 :		
Name	FrSMFrIfClusterRef		
Parent Container	FrSMCluster		
Description	References the cluster configuration in the FlexRay Interface configuration. Note that the assigned controllers and transceivers are defined in the FrIf configuration and can be accessed via this reference.		
Multiplicity	1		

Type	Symbolic name reference to [FrIfCluster]		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: local		

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

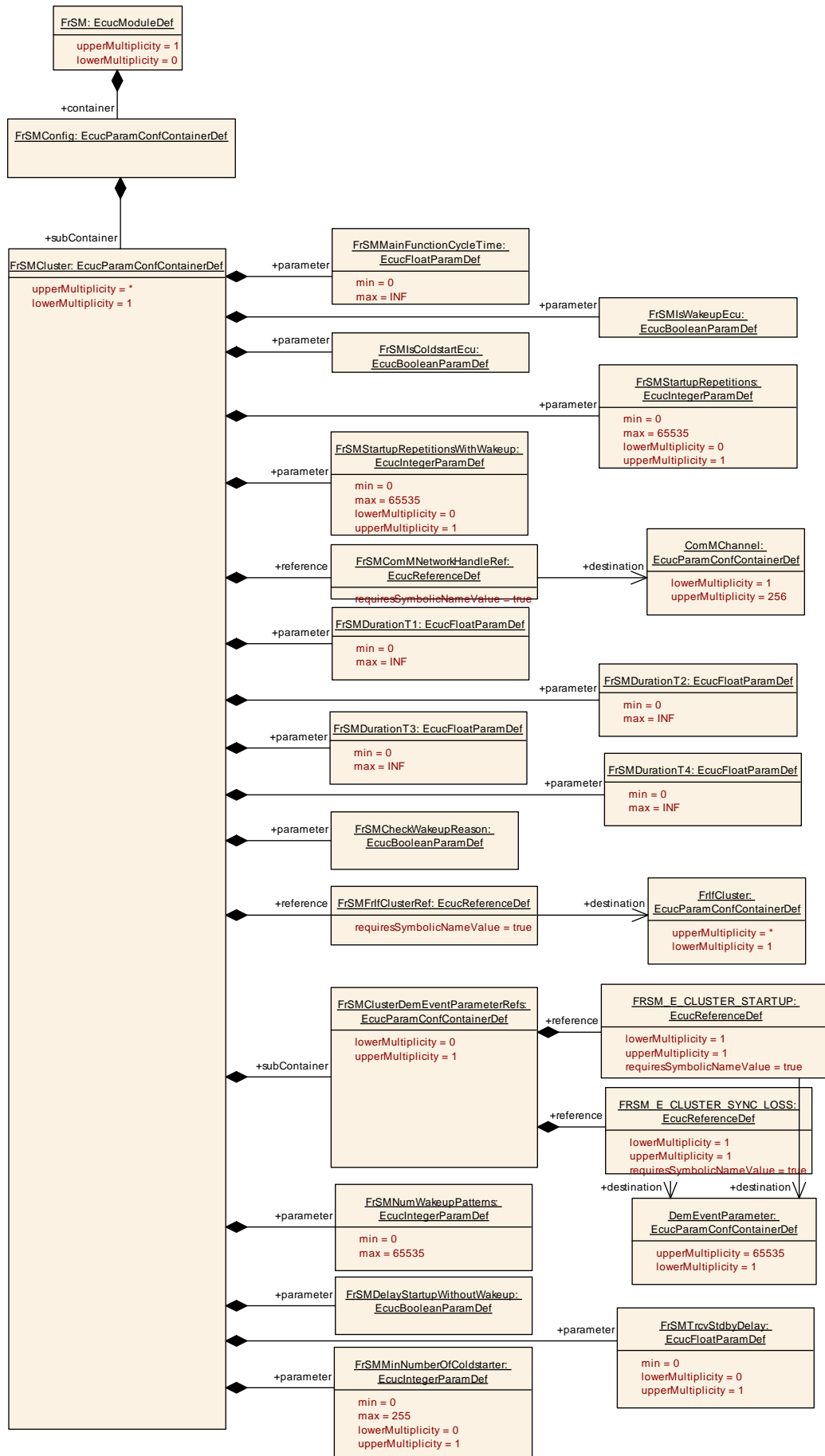


Figure 9 FrSMCluster Container

10.2.5 FrSMClusterDemEventParameterRefs

SWS Item	ECUC_FrSM_00163 :
Container Name	FrSMClusterDemEventParameterRefs
Parent Container	FrSMCluster
Description	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_SetEventStatus in case the corresponding error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId symbolic value. The standardized errors are provided in this container and can be extended by vendor-specific error references.
Configuration Parameters	

SWS Item	ECUC_FrSM_00164 :		
Name	FRSM_E_CLUSTER_STARTUP		
Parent Container	FrSMClusterDemEventParameterRefs		
Description	Reference to the DemEventParameter which shall be issued when the error "FRSM_E_CLUSTER_STARTUP" has occurred. If the reference is not configured the error shall be reported as DET error.		
Multiplicity	1		
Type	Symbolic name reference to [DemEventParameter]		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	ECUC_FrSM_00169 :		
Name	FRSM_E_CLUSTER_SYNC_LOSS		
Parent Container	FrSMClusterDemEventParameterRefs		
Description	Reference to the DemEventParameter which shall be issued when the error "FRSM_E_CLUSTER_SYNC_LOSS" has occurred. If the reference is not configured the error shall be reported as DET error.		
Multiplicity	1		
Type	Symbolic name reference to [DemEventParameter]		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: local		

No Included Containers

10.3 Published Information

For details refer to the chapter 10.3 “Published Information” in *SWS_BSWGeneral*.

11 Not applicable requirements

[SWS_FrSM_00186] [These requirements are not applicable to this specification.]
(SRS_BSW_00170, SRS_BSW_00419, SRS_BSW_00375, SRS_BSW_00416, SRS_BSW_00437,
SRS_BSW_00168, SRS_BSW_00423, SRS_BSW_00425, SRS_BSW_00427, SRS_BSW_00428,
SRS_BSW_00429, SRS_BSW_00432, SRS_BSW_00336, SRS_BSW_00422, SRS_BSW_00417,
SRS_BSW_00161, SRS_BSW_00162, SRS_BSW_00005, SRS_BSW_00415, SRS_BSW_00164,
SRS_BSW_00325, SRS_BSW_00413, SRS_BSW_00347, SRS_BSW_00314, SRS_BSW_00439,
SRS_BSW_00449, SRS_BSW_00377, SRS_BSW_00359, SRS_BSW_00360, SRS_BSW_00440)