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1 Introduction and functional overview

This specification describes the functionality, API and the configuration for the AUTOSAR Basic Software module FlexRay State Manager (FrSM).

The AUTOSAR BSW stack specifies for each communication bus a bus specific state manager. This module shall implement the control flow for the respective bus. The FrSM is a member of the Communication Service Layer. It interacts with the Communication Hardware Abstraction Layer and the System Service Layer.

2 Acronyms and Abbreviations

The glossary below includes acronyms and abbreviations relevant to the FlexRay Manager module that are not included in the [1, AUTOSAR glossary].

Acronym/ Abbrevation	Description:
BswM	Basic Software Mode Manager
CHI	Controller Host Interface
ComM	AUTOSAR Communication Manager
DCM	Diagnostic Communication Manager
e.g.	[lat.] exempli gratia = [eng.] for example
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
POC	Protocol Operation Control
POCState	Actual CC (defined in [1, AUTOSAR glossary]) 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).
RX	Reception
SchM	Schedule Manager
TX	Transmission
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

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

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.

Table 2.2: Definitions used in the scope of this Document

3 Related documentation

3.1 Input documents & related standards and norms

[1] Glossary
AUTOSAR_FO_TR_Glossary

[2] General Specification of Basic Software Modules
AUTOSAR_CP_SWS_BSWGeneral

[3] FlexRay Communications System Protocol Specification V2.1
http://www.flexray.com/

[4] General Requirements on Basic Software Modules
AUTOSAR_CP_RS_BSWGeneral

[5] System Template
AUTOSAR_CP_TPS_SystemTemplate

3.2 Related specification

AUTOSAR provides a General Specification on Basic Software modules [2, SWS BSW General], which is also valid for FrSM.

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

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 [3, FlexRay protocol specification]) is required. Furthermore, it enables the synchronized operation of several ECUs within a car.

The FrSM 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 AUTOSAR 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 FrIf 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 FrSM 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 FrSM 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 FrSM 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 FrSM has to have access to the Flex Ray Network Management.

5.8 File structure

5.8.1 Code file structure

For details refer to [2] Chapter 5.1.6 *"Code file structure"*.

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]

Upstream requirements: SRS_BSW_00004

⌈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.⌋

6 Requirements Tracing

The following tables reference the requirements specified in [4, SRS BSW General] and links to the fulfillment of these. Please note that if column “Satisfied by” is empty for a specific requirement this means that this requirement is not fulfilled by this document.

Requirement	Description	Satisfied by
[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_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_00167]	All AUTOSAR Basic Software Modules shall provide configuration rules and constraints to enable plausibility checks	[SWS_FrSM_00065]
[SRS_BSW_00310]	API naming convention	[SWS_FrSM_00013] [SWS_FrSM_00020] [SWS_FrSM_00024] [SWS_FrSM_00172] [SWS_FrSM_00174]
[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_00350]	All AUTOSAR Basic Software Modules shall allow the enabling/ disabling of detection and reporting of development errors.	[SWS_FrSM_00018] [SWS_FrSM_00019] [SWS_FrSM_00027] [SWS_FrSM_00028] [SWS_FrSM_00060] [SWS_FrSM_00061] [SWS_FrSM_00141] [SWS_FrSM_00168] [SWS_FrSM_00169] [SWS_FrSM_00179]
[SRS_BSW_00358]	The return type of init() functions implemented by AUTOSAR Basic Software Modules shall be void	[SWS_FrSM_00013]
[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_00385]	List possible error notifications	[SWS_FrSM_00300] [SWS_FrSM_00301] [SWS_FrSM_91001]
[SRS_BSW_00386]	The BSW shall specify the configuration and conditions for detecting an error	[SWS_FrSM_00300] [SWS_FrSM_00301]
[SRS_BSW_00405]	BSW Modules shall support multiple configuration sets	[SWS_FrSM_00013]
[SRS_BSW_00406]	API handling in uninitialized state	[SWS_FrSM_00060] [SWS_FrSM_00061] [SWS_FrSM_00169] [SWS_FrSM_00179]
[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_00450]	A Main function of a un-initialized module shall return immediately	[SWS_FrSM_00181]
[SRS_BSW_00458]	Classification of production errors	[SWS_FrSM_00300] [SWS_FrSM_00301]



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Requirement	Description	Satisfied by
[SRS_BSW_00460]	Reentrancy Levels	[SWS_FrSM_00013] [SWS_FrSM_00020] [SWS_FrSM_00024] [SWS_FrSM_00172] [SWS_FrSM_00174]
[SRS_BSW_00461]	Modules called by generic modules shall satisfy all interfaces requested by the generic module	[SWS_FrSM_00020] [SWS_FrSM_00024]
[SRS_BSW_00480]	Null pointer errors shall follow a naming rule	[SWS_FrSM_91001]
[SRS_BSW_00481]	Invalid configuration set selection errors shall follow a naming rule	[SWS_FrSM_91001]
[SRS_BSW_00483]	BSW Modules shall handle buffer alignments internally	[SWS_FrSM_00026] [SWS_FrSM_00127]
[SRS_BSW_00484]	Input parameters of scalar and enum types shall be passed as a value.	[SWS_FrSM_00020] [SWS_FrSM_00024] [SWS_FrSM_00172] [SWS_FrSM_00174]
[SRS_BSW_00485]	Input parameters of structure type shall be passed as a reference to a constant structure	[SWS_FrSM_00013]
[SRS_BSW_00487]	Errors for module initialization shall follow a naming rule	[SWS_FrSM_91001]

Table 6.1: Requirements Tracing

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 ComM has a completely abstracted bus view, it is the task of the FrSM 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 FrSM module can be summarized as follows:

The FrSM module shall provide an abstract interface to the AUTOSAR ComM module to startup or shutdown the communication on a FlexRay cluster. The FrSM module shall not directly access the FlexRay hardware (FlexRay Communication Controller and FlexRay Transceiver), but by means of the FrIf module. FrIf 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] ⌈FrSM 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 Chapter 4.1).

The state machine of each cluster is processed by the main function FrSM_MainFunction() assigned to that cluster. However, 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:

- FRSM_READY

- FRSM_WAKEUP
- FRSM_STARTUP
- FRSM_HALT_REQ
- FRSM_ONLINE
- FRSM_ONLINE_PASSIVE
- FRSM_KEYSLOT_ONLY
- FRSM_LOW_NUMBER_OF_COLDSTARTERS

⌋

Table 7.1 provides additional information about the state machine states.

FrSM Cluster State	Mapped FlexRay CC state	Description
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 and vPOCSlotMode $\neq$ 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.

Table 7.1: FrSM states and their mapping

[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:

- FRSM_ECU_ACTIVE
- FRSM_ECU_PASSIVE

⌋

Table 7.2 provides more information about the additional states.

FrSM additional State	Description
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

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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.

Table 7.2: FrSM Additional States

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

- FrSM additional state is FRSM_ECU_ACTIVE then the according FrSM state is reported, e.g. FRSM_ONLINE
- FrSM additional state is FRSM_ECU_PASSIVE then the according FrSM state is reported with the postfix '_ECU_PASSIVE', e.g. FRSM_ONLINE_ECU_PASSIVE

⌋

Table 7.3 provides all possible reportings to BswM

FrSM Cluster State	FrSM additional State	FrSM_BswM_StateType value
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_REQ	FRSM_ECU_ACTIVE	FRSM_HALT_REQ
FRSM_HALT_REQ	FRSM_ECU_PASSIVE	FRSM_HALT_REQ_ECU_PASSIVE
FRSM_LOW_NUMBER_OF_COLDSTARTERS	FRSM_ECU_ACTIVE	FRSM_LOW_NUMBER_OF_COLDSTARTERS
FRSM_LOW_NUMBER_OF_COLDSTARTERS	FRSM_ECU_PASSIVE	FRSM_LOW_NUMBER_OF_COLDSTARTERS_ECU_PASSIVE

Table 7.3: FrSM state reporting to BswM

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.

FrSM Variable	Type	Description
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: • SingleChannelWakeup • DualChannelWakeup • DualChannelWakeupForward • 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.

Table 7.4: FrSM variables

Note that the silent communication mode (SilentCom) 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 10.2.4 for each FlexRay cluster:

FrSM Configuration Parameter	Type	Description
FrSMIsWakeupEcu	Boolean	Configuration parameter, see Chapter 10.2.4.
FrSMCheckWakeupReason	Boolean	Configuration parameter, see Chapter 10.2.4.
FrSMIsColdstartEcu	Boolean	Configuration parameter, see Chapter 10.2.4.
FrSMIsDualChannelNode	Boolean	This 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	Configuration parameter, see Chapter 10.2.4. 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	Configuration parameter, see Chapter 10.2.4. 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	Configuration parameter, see Chapter 10.2.4.
FrSMDelayStartupWithoutWakeup	Boolean	Configuration parameter, see Chapter 10.2.4.
FrSMMinNumberOfColdstarter	Integer	Configuration parameter, see Chapter 10.2.4.

Table 7.5: FrSM state machine configuration parameters

7.3.5 Conditions

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

FrSM Condition	Type	Description
WUReason	Enum	If FrSMCheckWakeupReason is false, WUReason evaluates to NO_WU_BY_BUS. Otherwise if FrSMCheckWakeupReason is true, determine the wakeup reason by calling FrIf_GetTransceiverWUReason for each transceiver of the FlexRay cluster and check for FRTRCV_WU_BY_BUS and evaluate WUReason to • 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_TrcvStdbyDelay_IsActive	boolean	Evaluates to true if t_TrcvStdbyDelay has been started and has not expired yet, otherwise to false.
wakeupFinished	boolean	Evaluates to false if the wakeup pattern transmission as defined in Chapter 7.3.8 is still in progress, otherwise to true.
lowNumberOfColdstarters	boolean	Evaluates to true if FrIf_GetNumOfStartup Frames() is smaller than FrSMMinNumberOfColdstarter, otherwise to false.

Table 7.6: FrSM conditions

7.3.6 Timers

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

Timer	Description
t1	The timer t1 models the delay of clearing the coldstart inhibit mode (i.e. calling FrIf_AllowColdstart). The duration of this timer can be statically configured with the configuration parameter FrSMDurationT1.
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 FrSMDurationT2.
t3	The timer t3 supervises the transition to FullCom. The duration of this timer can be statically configured with the configuration parameter FrSMDurationT3.
t4	The timer t4 ensures that a dual channel node will eventually clear its coldstart inhibit bit and become a leading coldstarter.
t_TrcvStdbyDelay	The timer t_TrcvStdbyDelay models the time difference after which the FrSM will reinitialize the FlexRay communication controllers and set the transceivers into STANDBY mode when FlexRay communication is stopped.

Table 7.7: FrsM timers

[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 FrSMTrcvStdbyDelay is not configured or set to 0, timer t_TrcvStdbyDelay 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 FrIf_SendWUP 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 FrIf_SetWakeupChannel 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 FrIf_SetWakeupChannel 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 FrIf_ControllerInit for each controller of the FlexRay cluster.
FE_START	Call FrIf_StartCommunication for each controller of the FlexRay cluster.
FE_ALLOW_COLDSTART	Call FrIf_AllowColdstart for each controller of the FlexRay cluster if the configuration parameter FrSMIsColdstartEcu is true.
FE_HALT	Call FrIf_HaltCommunication for each controller of the FlexRay cluster.
FE_TRCV_STANDBY	Call FrIf_SetTransceiverMode with FrIf_TrcvMode as FRTRCV_TRCVMODE_STANDBY for each transceiver of the FlexRay cluster.
FE_TRCV_NORMAL	In case the FrSM state machine is in state FRSM_ECU_ACTIVE, call FrIf_SetTransceiverMode with FrIf_TrcvMode as FRTRCV_TRCVMODE_NORMAL and FrIf_ClearTransceiverWakeup for each transceiver of the FlexRay cluster. In case the FrSM state machine is in state FRSM_ECU_PASSIVE, call FrIf_SetTransceiverMode with FrIf_TrcvMode as FRTRCV_TRCVMODE_RECEIVEONLY and FrIf_ClearTransceiverWakeup for each transceiver of the FlexRay cluster.
FE_START_FRIF	Set the FrIf state to ONLINE by calling FrIf_SetState with FrIf_State Transition as FRIF_GOTO_ONLINE for the cluster.
FE_STOP_FRIF	Set the FrIf state to OFFLINE by calling FrIf_SetState with FrIf_State Transition as FRIF_GOTO_OFFLINE 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 Chapter 8.5.3) is configured, call the indication function with the parameter SyncLossErrorStatus = true.
FE_DEM_SYNC_LOSS_PASSED	If the name of an indication function (see Chapter 8.5.3) is configured, call the indication function with the parameter SyncLossErrorStatus = false. 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 ComM_BusSM_ModeIndication (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.

Table 7.8: FrSM functional elements

7.3.8 Wakeup Pattern Transmission

[SWS_FrSM_00208] ⌈The FrSM 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!Wakeup Status of the FlexRay controllers and act as follows:
    - if vPOC!WakeupStatus = FR_WAKEUP_RECEIVED_HEADER ∨ FR_WAKEUP_RECEIVED_WUP: busTrafficDetected := true
    - else if vPOC!WakeupStatus = FR_WAKEUP_TRANSMITTED: wakeupTransmitted := true
    - else: 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

The following diagram shows the FrSM state machine.

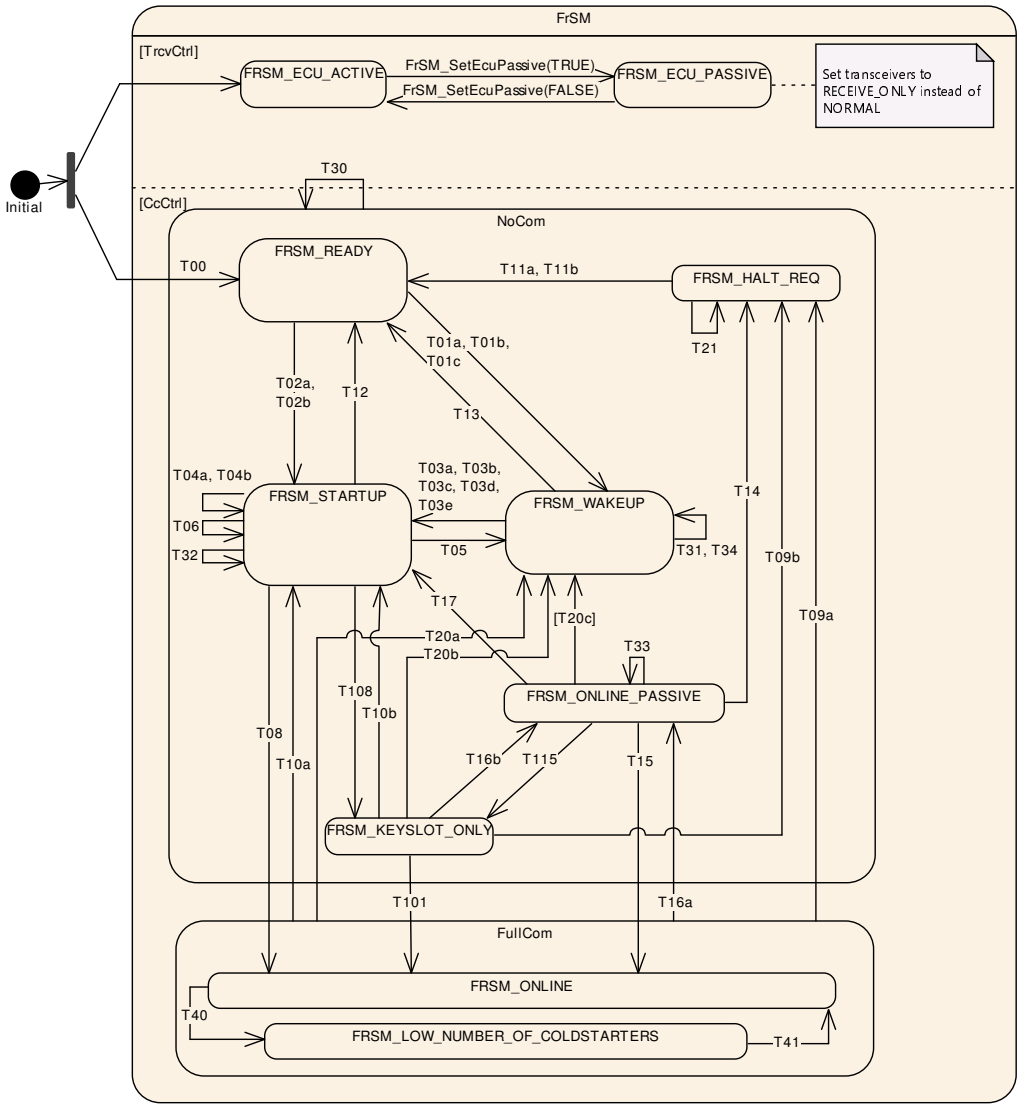

Figure 7.1: `FrSM` state machine

Note that the states are described in Chapter 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_00093] ⌈The `FrSM` shall execute the actions of the transition in the order that is defined in the table within [SWS_FrSM_00105].⌋

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

[SWS_FrSM_00105] ⌈

Transition	Event [Condition]	Actions
T00	FrSM_Init()	FE_CONFIG
T01 (a)	[reqComMode = FullCom ∧ FrSMIsWakeupEcu ∧ WUReason = NO_WU_BY_BUS ∧ ¬ 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 ∧ (¬ FrSMIsWakeupEcu ∨ WUReason = ALL_WU_BY_BUS) ∧ ¬ FrSMDelayStartupWithoutWakeup]	FE_TRCV_NORMAL startupCounter := 1 wakeupType := NoWakeup FE_START FE_ALLOW_COLDSTART start t2 start t3
T02 (b)	[reqComMode = FullCom ∧ (¬ FrSMIsWakeupEcu ∨ 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

▽

△

Transition	Event [Condition]	Actions
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 ∧ FrSMNumWakeupPatterns > 1 ∧ ¬ wakeupTransmitted ∧ wakeupType = SingleChannelWakeup]	FE_START start t2
T03 (d)	[wakeupFinished ∧ reqComMode = FullCom ∧ wakeupType = DualChannelWakeup ∧ wakeupTransmitted ∧ ¬ busTrafficDetected]	FE_START start t2
T03 (e)	[wakeupFinished ∧ reqComMode = FullCom ∧ wakeupType = DualChannelWakeupForward]	FE_START FE_ALLOW_COLDSTART start t2 cancel t4
T04 (a)	t1 [reqComMode = FullCom ∧ vPOC!State ≠ Normal Active]	FE_ALLOW_COLDSTART
T04 (b)	t4 [reqComMode = FullCom ∧ wakeupType = DualChannelWakeup ∧ vPOC!State ≠ Normal Active]	FE_ALLOW_COLDSTART
T05	t2 [startupCounter ≤ FrSMStartupRepetitionsWithWakeup ∧ reqComMode = FullCom ∧ wakeupType ≠ NoWakeup ∧ vPOC!State ≠ Normal Active]	FE_CONFIG FE_WAKEUP startupCounter := startupCounter + 1 start t4 (dual channel node only)
T06	t2 [(FrSMStartupRepetitionsWith- Wakeup < startupCounter ∧ wakeupType = NoWakeup) ∧ startupCounter ≤ FrSMStartup Repetitions ∧ reqComMode = FullCom ∧ vPOC!State ≠ Normal Active]	FE_CONFIG FE_START FE_ALLOW_COLDSTART startupCounter := startupCounter + 1 start t2

▽

△

Transi-tion	Event [Condition]	Actions
T08	[vPOC!State = Normal Active ∧ ¬ vPOCFreeze ∧ vPOCSlotMode = AllSlots ∧ 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 ∧ ¬ vPOCFreeze ∧ vPOCSlotMode ≠ AllSlots ∧ 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 ∨ vPOCFreeze) ∧ reqComMode = FullCom ∧ (FrSMCheckWakeupReason ∨ ¬ FrSMIsWakeupEcu)]	FE_DEM_SYNC_LOSS FE_STOP_FRIF FE_NO_COM_IND FE_CONFIG FE_START startupCounter := 1 start t2 start t3
T10b	[(vPOC!State = Halt ∨ vPOCFreeze) ∧ reqComMode = FullCom ∧ (FrSMCheckWakeupReason ∨ ¬ FrSMIsWakeupEcu)]	FE_DEM_SYNC_LOSS FE_STOP_FRIF FE_CONFIG FE_START startupCounter := 1 start t2 start t3
T101	[vPOC!State = Normal Active ∧ ¬ vPOCFreeze ∧ vPOCSlotMode = AllSlots]	FE_FULL_COM_IND
T11a	t_TrcvStdbyDelay[]	FE_TRCV_STANDBY FE_CONFIG
T11b	[(vPOC!State = Halt ∨ vPOCFreeze) ∧ reqComMode = FullCom]	cancel t_TrcvStdbyDelay FE_TRCV_STANDBY FE_CONFIG
T12	[reqComMode = NoCom]	cancel t1 cancel t2 cancel t3 FE_DEM_SYNC_LOSS_PASSED FE_TRCV_STANDBY FE_CONFIG

▽

△

Transi-tion	Event [Condition]	Actions
T13	[reqComMode = NoCom]	FE_DEM_SYNC_LOSS_PASSED FE_TRCV_STANDBY FE_CONFIG cancel t3 cancel t1
T14	FrSM_RequestComMode() [reqComMode = NoCom]	FE_DEM_SYNC_LOSS_PASSED FE_HALT cancel t3
T15	[vPOC!State = Normal Active ∧ ¬ vPOCFreeze ∧ vPOCSlotMode = AllSlots]	FE_DEM_SYNC_LOSS_PASSED FE_START_FRIF FE_FULL_COM_IND cancel t3
T115	[vPOC!State = Normal Active ∧ ¬ vPOCFreeze ∧ vPOCSlotMode ≠ AllSlots]	FE_DEM_SYNC_LOSS_PASSED FE_START_FRIF cancel t3
T16a	[vPOC!State = Normal Passive ∧ ¬ vPOCFreeze]	FE_DEM_SYNC_LOSS FE_STOP_FRIF FE_NO_COM_IND start t3
T16b	[vPOC!State = Normal Passive ∧ ¬ vPOCFreeze]	FE_DEM_SYNC_LOSS FE_STOP_FRIF start t3
T17	[(vPOC!State = Halt ∨ vPOCFreeze) ∧ reqComMode = FullCom ∧ (FrSMCheckWakeupReason ∨ ¬ FrSMIsWakeupEcu)]	FE_CONFIG wakeupType := NoWakeup FE_START startupCounter := 1 start t2
T20a	[(vPOC!State = Halt ∨ vPOCFreeze) ∧ reqComMode = FullCom ∧ ¬ FrSMCheckWakeupReason ∧ FrSMIsWakeupEcu]	wakeupType := SingleChannelWakeup FE_DEM_SYNC_LOSS FE_STOP_FRIF FE_NO_COM_IND FE_CONFIG FE_WAKEUP startupCounter := 1 start t1 start t3
T20b	[(vPOC!State = Halt ∨ vPOCFreeze) ∧ reqComMode = FullCom ∧ ¬ FrSMCheckWakeupReason ∧ FrSMIsWakeupEcu]	wakeupType := SingleChannelWakeup FE_DEM_SYNC_LOSS FE_STOP_FRIF FE_CONFIG FE_WAKEUP startupCounter := 1 start t1 start t3

▽

△

Transition	Event [Condition]	Actions
T20c	[(vPOC!State = Halt ∨ vPOCFreeze) ∧ reqComMode = FullCom ∧ ¬ FrSMCheckWakeupReason ∧ FrSMIsWakeupEcu]	wakeupType := SingleChannelWakeup FE_CONFIG FE_WAKEUP startupCounter := 1 start t1 start t3
T21	[(vPOC!State = Halt ∨ vPOCFreeze) ∧ ¬ t_TrcvStdbyDelay_IsActive]	start t_TrcvStdbyDelay
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 ∧ reqComMode = FullCom ∧ FrSMNumWakeupPatterns > 1 ∧ (¬ wakeupTransmitted ∨ busTrafficDetected) ∧ wakeupType = DualChannelWakeup]	startupCounter := 1 wakeupType := DualChannelWakeupForward FE_SET_WU_CHANNEL_FORWARD wakeupTransmitted := false busTrafficDetected := false FE_WAKEUP start t1 start t3
T40	[lowNumberOfColdstarters]	
T41	[lowNumberOfColdstarters]	

Legend:		
	∧ AND	start t: start timer t
	∨ OR	cancel t: stop timer t
	¬ NOT	[. . .] guard condition for transition
	:= assignment	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 ([SWS_FrSM_00105] T08 and T108), 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 FrSMStartup-RepetitionsWithWakeup, the startup procedure will be repeated including the wakeup.
- If startupCounter exceeds the threshold FrSMStartupRepetitionsWith-Wakeup 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 ([SWS_FrSM_00105] all transitions where t3 is cancelled).

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 FrIf API returns a failure (e.g. E_NOT_OK), the FrSM shall ignore this return value and continue with the transition.⌋

Rationale: When the FrIf 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 FrSM configuration tool reads the ECU configuration description of the FrIf as the mapping of controllers to clusters is contained in the FrIf configuration description.

7.5 Error Classification

Chapter [2, General Specification of Basic Software Modules] 7.2 *"Error Handling"* 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] Definition of development errors in module FrSM

Upstream requirements: SRS_BSW_00385, SRS_BSW_00480, SRS_BSW_00481, SRS_BSW_00487

⌈

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 Production Errors

7.5.3.1 FRSM_E_CLUSTER_STARTUP

[SWS_FrSM_00300] FlexRay cluster startup failure.

Upstream requirements: SRS_BSW_00385, SRS_BSW_00386, SRS_BSW_00458

⌈

Diagnostic Event (Error Name)	FRSM_E_CLUSTER_STARTUP
Description	FlexRay controller has not reached the state normal active within the configured time after FlexRay startup.
Failed condition	FlexRay controller has not reached the state normal active within the time t3.
Passed condition	FlexRay controller has reached the state normal active.

⌋

7.5.3.2 FRSM_E_CLUSTER_SYNC_LOSS

[SWS_FrSM_00301] FlexRay synchronization loss.

Upstream requirements: SRS_BSW_00385, SRS_BSW_00386, SRS_BSW_00458

⌈

Diagnostic Event (Error Name)	FRSM_E_CLUSTER_SYNC_LOSS
Description	FlexRay controller has lost synchronization after successful startup.
Failed condition	FlexRay controller has lost synchronization after it has reached state normal active.
Passed condition	FlexRay controller has reached the state normal active or the request for FlexRay communication has been released.

⌋

8 API specification

8.1 Imported types

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

[SWS_FrSM_00095] Definition of imported datatypes of module FrSM ⌈

Module	*Header File*	*Imported Type*
ComM	Rte_ComM_Type.h	ComM_ModeType
Comtype	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_POCStateType
	Fr_GeneralTypes.h	Fr_POCStatusType
	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_TrcvModeType
	Fr_GeneralTypes.h	FrTrcv_TrcvWUReasonType
Std	Std_Types.h	Std_ReturnType

⌋

8.2 Type definitions

8.2.1 FrSM_ConfigType

[SWS_FrSM_00198] Definition of datatype FrSM_ConfigType ⌈

Name	FrSM_ConfigType
Kind	Structure
Description	This type contains the implementation-specific post build time configuration structure that is for Fr SM_Init.
Available via	FrSM.h

⌋

8.2.2 FrSM_BswM_StateType

[SWS_FrSM_00199] Definition of datatype FrSM_BswM_StateType ⌈

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 chapter contains all APIs provided by the module.

8.3.1 FrSM_Init

[SWS_FrSM_00013] Definition of API function FrSM_Init

Upstream requirements: SRS_BSW_00405, SRS_BSW_00438, SRS_BSW_00310, SRS_BSW_00358, SRS_BSW_00460, SRS_BSW_00485

⌈

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	

⌋

[SWS_FrSM_00126]

Upstream requirements: SRS_BSW_00438, SRS_BSW_00101

⌈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.⌋

[SWS_FrSM_00127]

Upstream requirements: SRS_BSW_00438, SRS_BSW_00483

⌈The `FrSM_Init` function shall internally store the configuration data address to enable subsequent API calls to access the configuration data.⌋

[SWS_FrSM_00128]

Upstream requirements: SRS_BSW_00438

⌈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.⌋

8.3.2 FrSM_RequestComMode

[SWS_FrSM_00020] Definition of API function FrSM_RequestComMode

Upstream requirements: SRS_BSW_00310, SRS_BSW_00460, SRS_BSW_00461, SRS_BSW_00484

⌈

Service Name	FrSM_RequestComMode	
Syntax	`Std_ReturnType FrSM_RequestComMode ( NetworkHandleType network, ComM_ModeType mode )`	
Service ID [hex]	0x40	
Sync/Async	Asynchronous	
Reentrancy	Reentrant for different networks. Non reentrant for the same network.	
Parameters (in)	network	Handle of the communication network
	mode	Requested communication mode
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	E_OK: Request accepted E_NOT_OK: Request not accepted
Description	Request of a new communication mode.	
Available via	FrSM.h	

⌋

[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 Chapter 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_COLDSTARTERS or FRSM_ONLINE_PASSIVE), the FrSM_RequestComMode function shall immediately process the corresponding transition of the state machine (see [SWS_FrSM_00093]).⌋

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]

Upstream requirements: SRS_BSW_00350

⌈If the parameter mode has the value COMM_SILENT_COMMUNICATION, the FrSM shall not store the requested communication mode and return E_NOT_OK. In case de-

velopment error detection is enabled, the FrSM shall additionally raise the development error code FRSM_E_INV_MODE.⌋

[SWS_FrSM_00018]

Upstream requirements: SRS_BSW_00369, SRS_BSW_00323, SRS_BSW_00350

⌈If development error detection is enabled and the parameter network 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.⌋

[SWS_FrSM_00019]

Upstream requirements: SRS_BSW_00350

⌈If development error detection is enabled and the parameter 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]

Upstream requirements: SRS_BSW_00406, SRS_BSW_00350

⌈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.⌋

8.3.3 FrSM_GetCurrentComMode

[SWS_FrSM_00024] Definition of API function FrSM_GetCurrentComMode

Upstream requirements: SRS_BSW_00310, SRS_BSW_00460, SRS_BSW_00461, SRS_BSW_00484

⌈

Service Name	FrSM_GetCurrentComMode	
Syntax	`Std_ReturnType FrSM_GetCurrentComMode ( NetworkHandleType network, ComM_ModeType* mode )`	
Service ID [hex]	0x41	
Sync/Async	Synchronous	
Reentrancy	Reentrant for different networks. Non reentrant for the same network.	
Parameters (in)	network	Handle of the communication channel
Parameters (inout)	None	
Parameters (out)	mode	Pointer to the memory location where the current communication mode shall be stored

▽

△

Return value	Std_ReturnType	E_OK: Request accepted E_NOT_OK: Request not accepted
Description	Query the current communication mode.	
Available via	FrSM.h	

⌋

[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]

Upstream requirements: SRS_BSW_00483

⌈The FrSM_GetCurrentComMode function shall determine the communication mode as follows:

- If the FrSM state machine for the FlexRay cluster determined by the parameter network 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]

Upstream requirements: SRS_BSW_00350

⌈If development error detection is enabled and the parameter network 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]

Upstream requirements: SRS_BSW_00369, SRS_BSW_00323, SRS_BSW_00350

⌈If development error detection is enabled and the parameter mode 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.⌋

[SWS_FrSM_00060]

Upstream requirements: SRS_BSW_00406, SRS_BSW_00350

⌈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.⌋

8.3.4 FrSM_AllSlots

[SWS_FrSM_00172] Definition of API function FrSM_AllSlots

Upstream requirements: SRS_BSW_00310, SRS_BSW_00460, SRS_BSW_00484

⌈

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)	NetworkHandle	This parameter identifies the FlexRay cluster for which a communication mode is requested.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	`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]

Upstream requirements: SRS_BSW_00369, SRS_BSW_00323, SRS_BSW_00350

⌈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.⌋

[SWS_FrSM_00169]

Upstream requirements: SRS_BSW_00406, SRS_BSW_00350

⌈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.⌋

8.3.5 FrSM_SetEcuPassive

[SWS_FrSM_00174] Definition of API function FrSM_SetEcuPassive

Upstream requirements: SRS_BSW_00310, SRS_BSW_00460, SRS_BSW_00484

⌈

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_ReturnType	`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]

Upstream requirements: SRS_BSW_00406, SRS_BSW_00350

⌈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.⌋

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 FrSM_MainFunction_<FrSMCluster.ShortName>

[SWS_FrSM_00118] Definition of scheduled function FrSM_MainFunction_<FrSMCluster.ShortName>

Upstream requirements: SRS_BSW_00373

⌈

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

⌋

[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 Chapter 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 Flex Ray 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]

Upstream requirements: SRS_BSW_00450

⌈If the FrSM module has not been initialized using FrSM_Init, the `FrSM_MainFunction` function shall shall return immediately without performing any functionality and without raising any errors.⌋

8.5 Expected interfaces

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

8.5.1 Mandatory interfaces

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

[SWS_FrSM_00096] Definition of mandatory interfaces required by module FrSM
⌈

API Function	*Header File*	*Description*
BswM_FrSM_CurrentState	BswM_FrSM.h	Function called by FrSM to indicate its current state.
ComM_<Bus>SM_ModeIndication	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_HaltCommunication	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_SetTransceiverMode	FrIf.h	Wraps the FlexRay Transceiver Driver API function FrTrcv_SetTransceiverMode(). The enum value "FR_CHANNEL_AB" shall not be used.
FrIf_StartCommunication	FrIf.h	Wraps the FlexRay Driver API function Fr_StartCommunication().

⌋

8.5.2 Optional interfaces

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

[SWS_FrSM_00097] Definition of optional interfaces requested by module FrSM ⌈

API Function	*Header File*	*Description*
Dem_SetEventStatus	Dem.h	Called by SW-Cs or BSW modules to report monitor status information to the Dem. BSW modules calling Dem_SetEventStatus can safely ignore the return value. This API will be available only if ({Dem/Dem ConfigSet/DemEventParameter/DemEvent ReportingType} == STANDARD_REPORTING)
Det_ReportError	Det.h	Service to report development errors.
FrIf_AllSlots	FrIf.h	Wraps the FlexRay Driver API function Fr_AllSlots
FrIf_GetNumOfStartupFrames	FrIf.h	Wraps the FlexRay Driver API function Fr_GetNum OfStartupFrames and gets a list of the current number of startup frames seen on the cluster. See variable vStartupPairs of [12] for details.
FrIf_GetWakeupRxStatus	FrIf.h	Wraps the FlexRay Driver API function Fr_Get WakeupRxStatus and gets the wakeup received information from the FlexRay controller.
FrIf_SetWakeupChannel	FrIf.h	Wraps the FlexRay Driver API function Fr_Set WakeupChannel(). 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.

⌋

8.5.3 Configurable interfaces

In this section, all interfaces are listed where the target function could be configured. The target function is usually a callback function. The names of this kind of interfaces are not fixed because they are configurable.

8.5.3.1 <Cdd>_SyncLossErrorIndication

[SWS_FrSM_00190] Definition of configurable interface <Cdd>_SyncLossError Indication ⌈

Service Name	<Cdd>_SyncLossErrorIndication
Syntax	`void <Cdd>_SyncLossErrorIndication ( NetworkHandleType NetworkHandle, boolean SyncLossErrorStatus )`
Sync/Async	Synchronous

▽

△

Reentrancy	Reentrant for different FlexRay clusters	
Parameters (in)	NetworkHandle	Handle of FlexRay cluster
	SyncLossErrorStatus	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 FlexRay 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 SyncLossError Status = 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 FrSM SyncLossErrorIndicationName (see Chapter 10.2.3). The FrSM will call this function when the ECU looses 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.

8.6 Service Interfaces

FrSM does not provide any service interfaces.

9 Sequence diagrams

9.1 Initialization

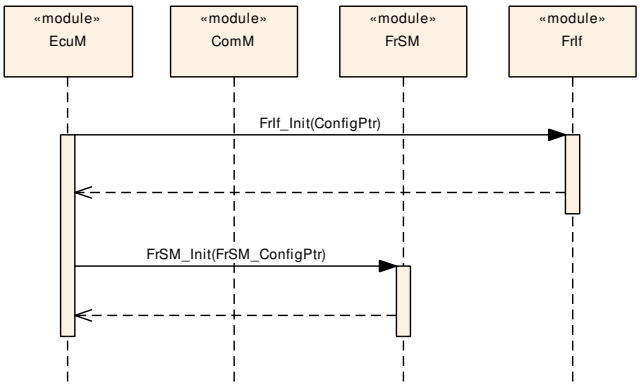

Figure 9.1: Initialization

9.2 Single Channel Wakeup

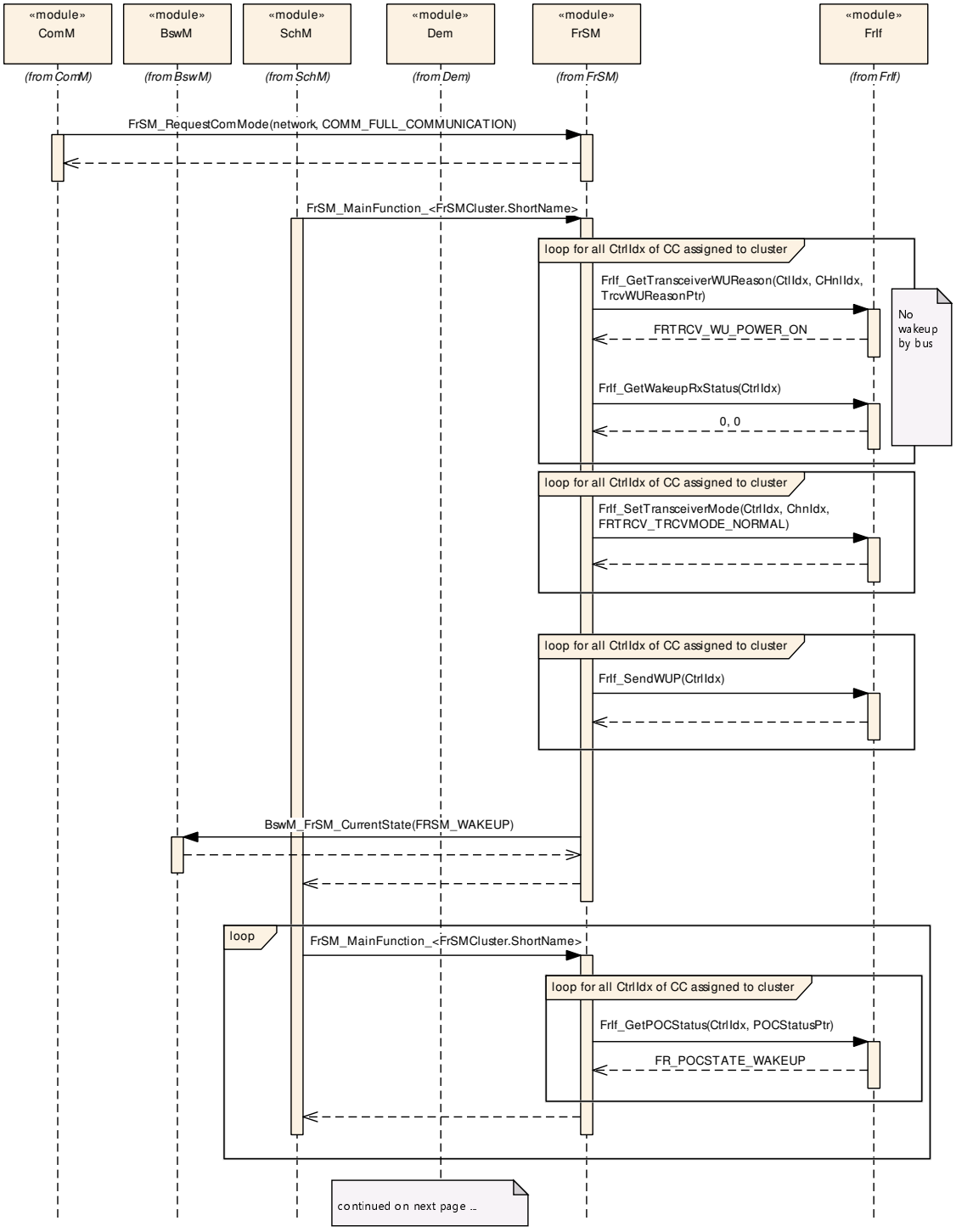

Figure 9.2: continued on next page

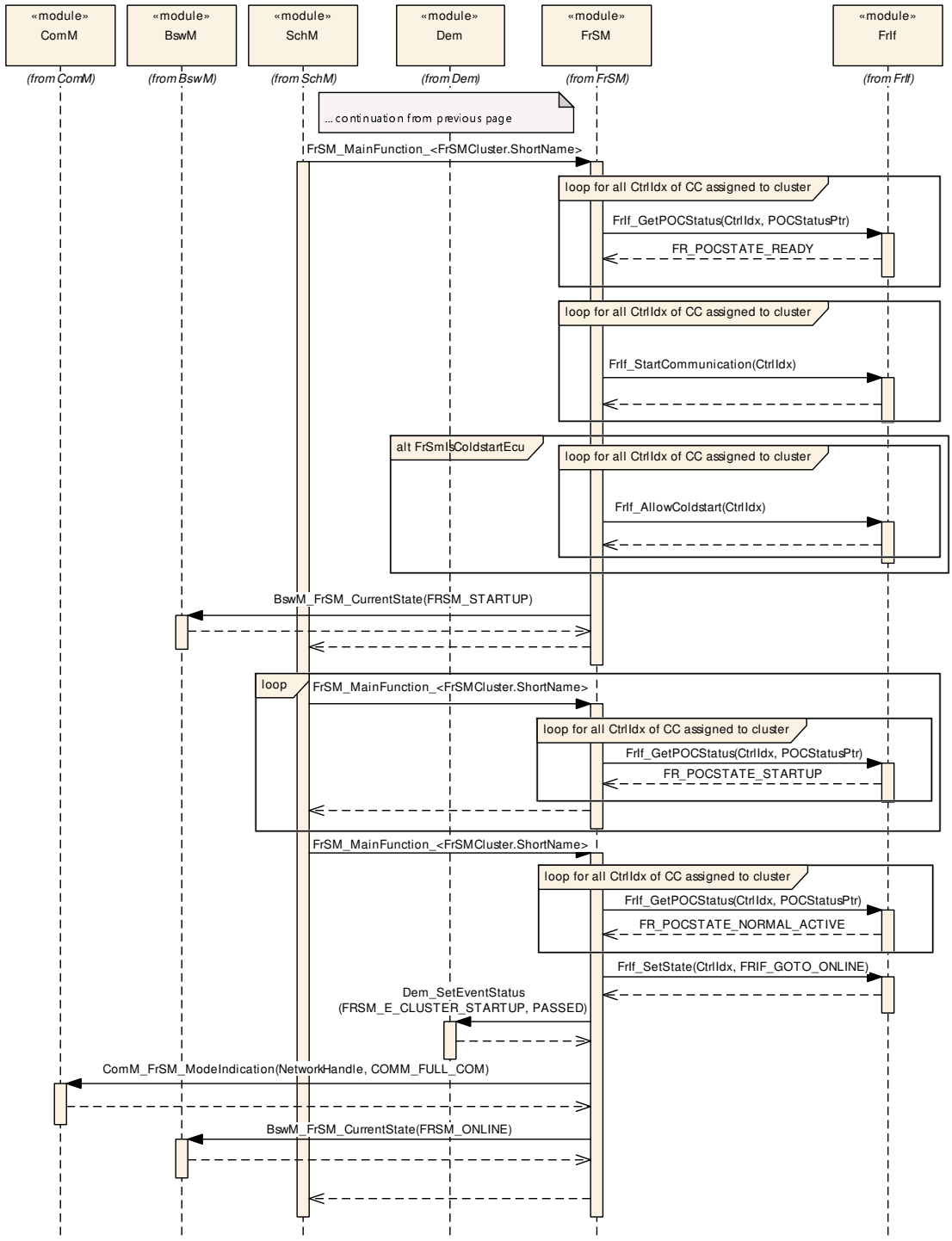

Figure 9.3: Transition from no communication to full communication for the case of an ECU that has a local wakeup reason.

9.3 Single Channel Passive Startup

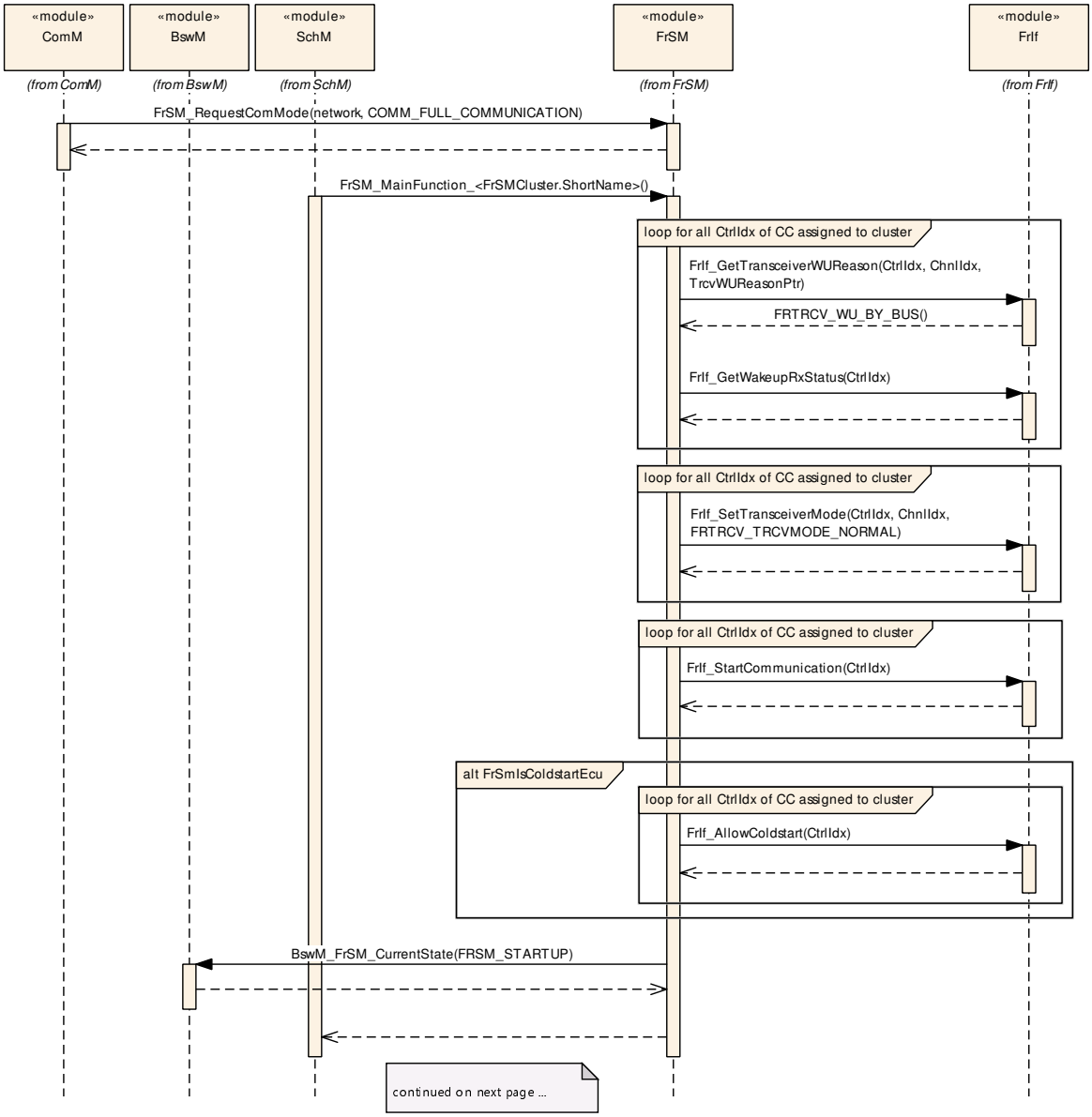

Figure 9.4: continued on next page

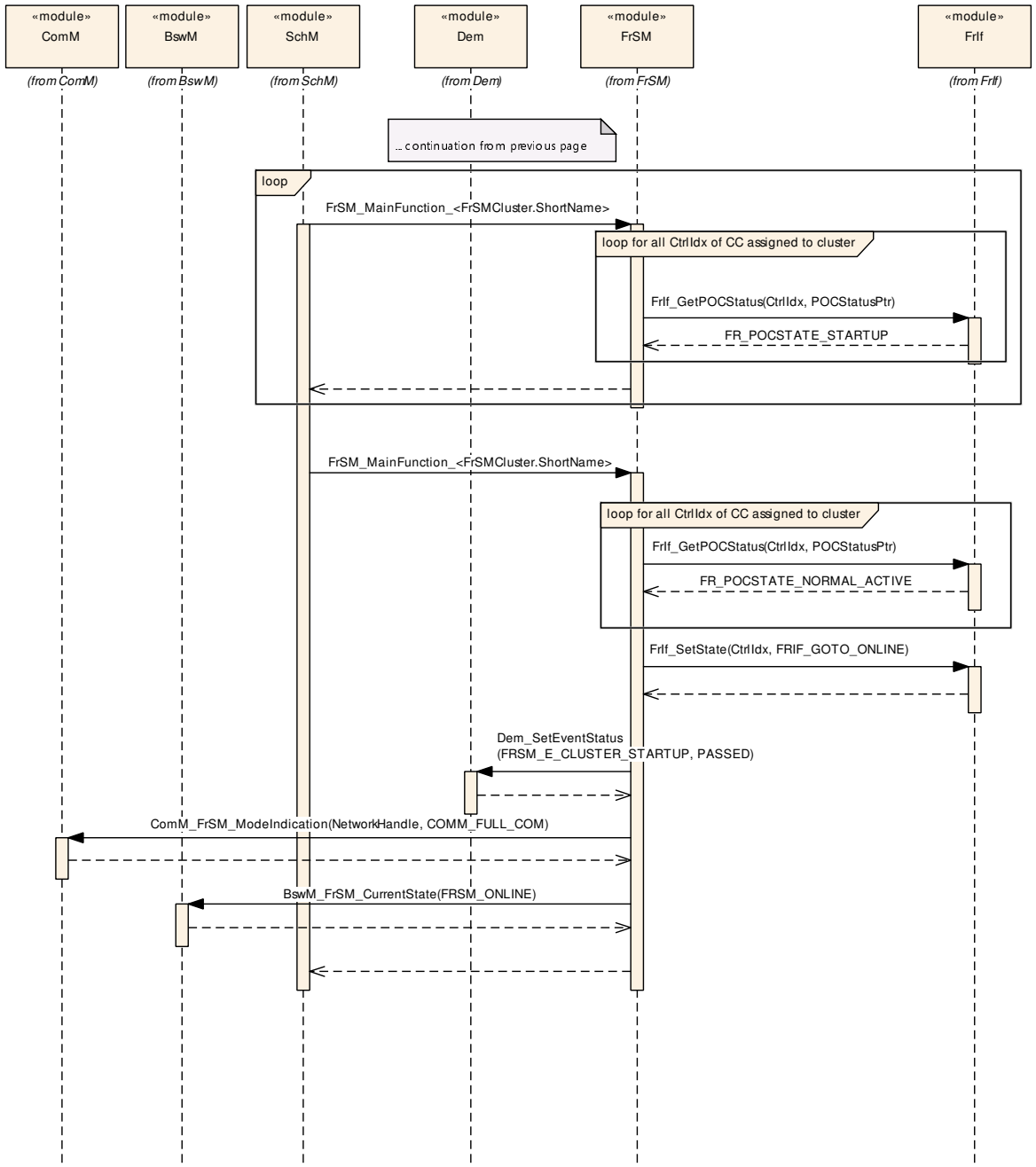

Figure 9.5: Transition from no communication to full communication for the case of an ECU that has been woken up by bus.

9.4 Dual Channel Wakeup

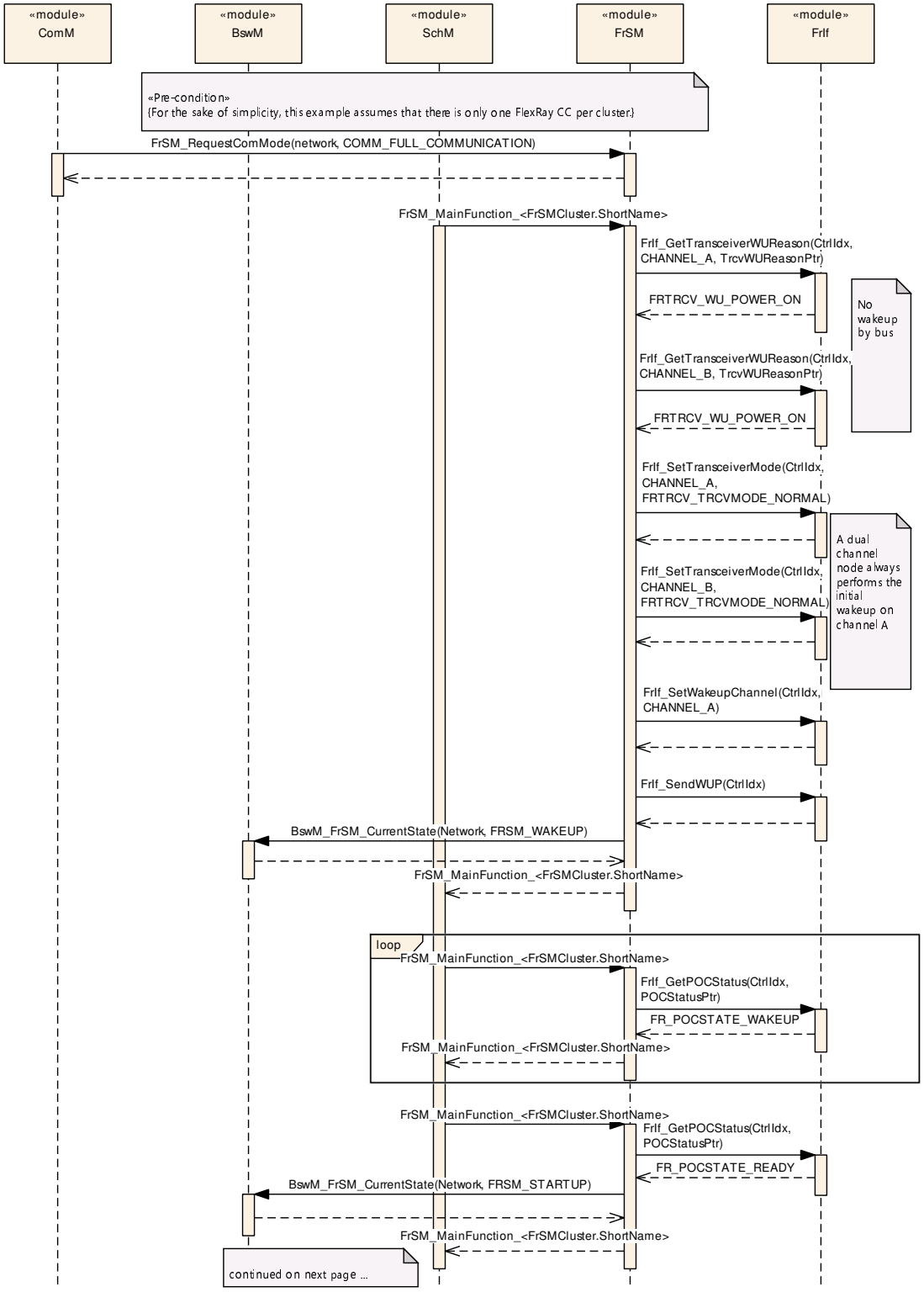

Figure 9.6: continued on next page

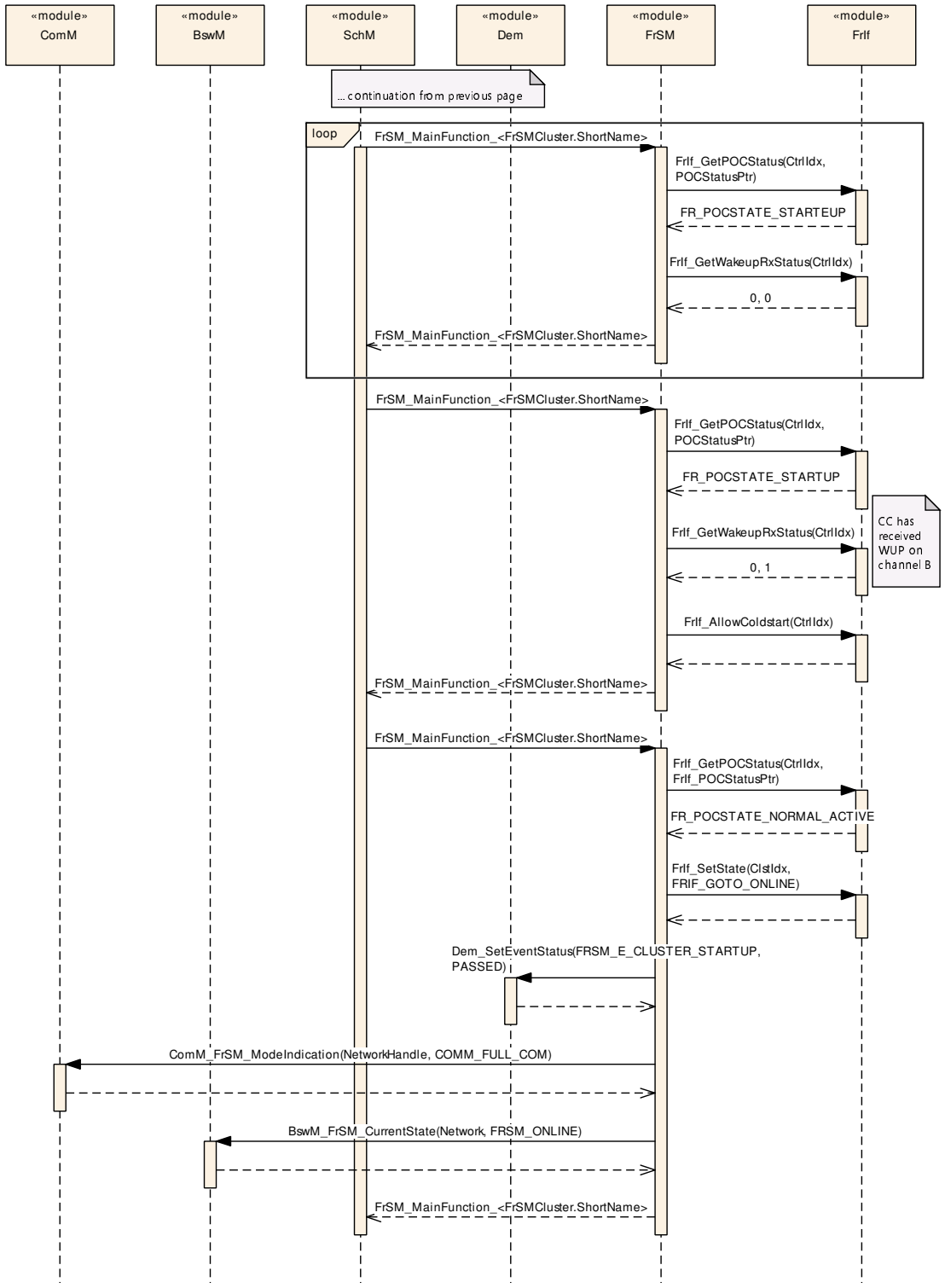

Figure 9.7: Transition from no communication to full communication for the case of a dual channel ECU with a local wakeup reason.

9.5 Dual Channel Wakeup Forward

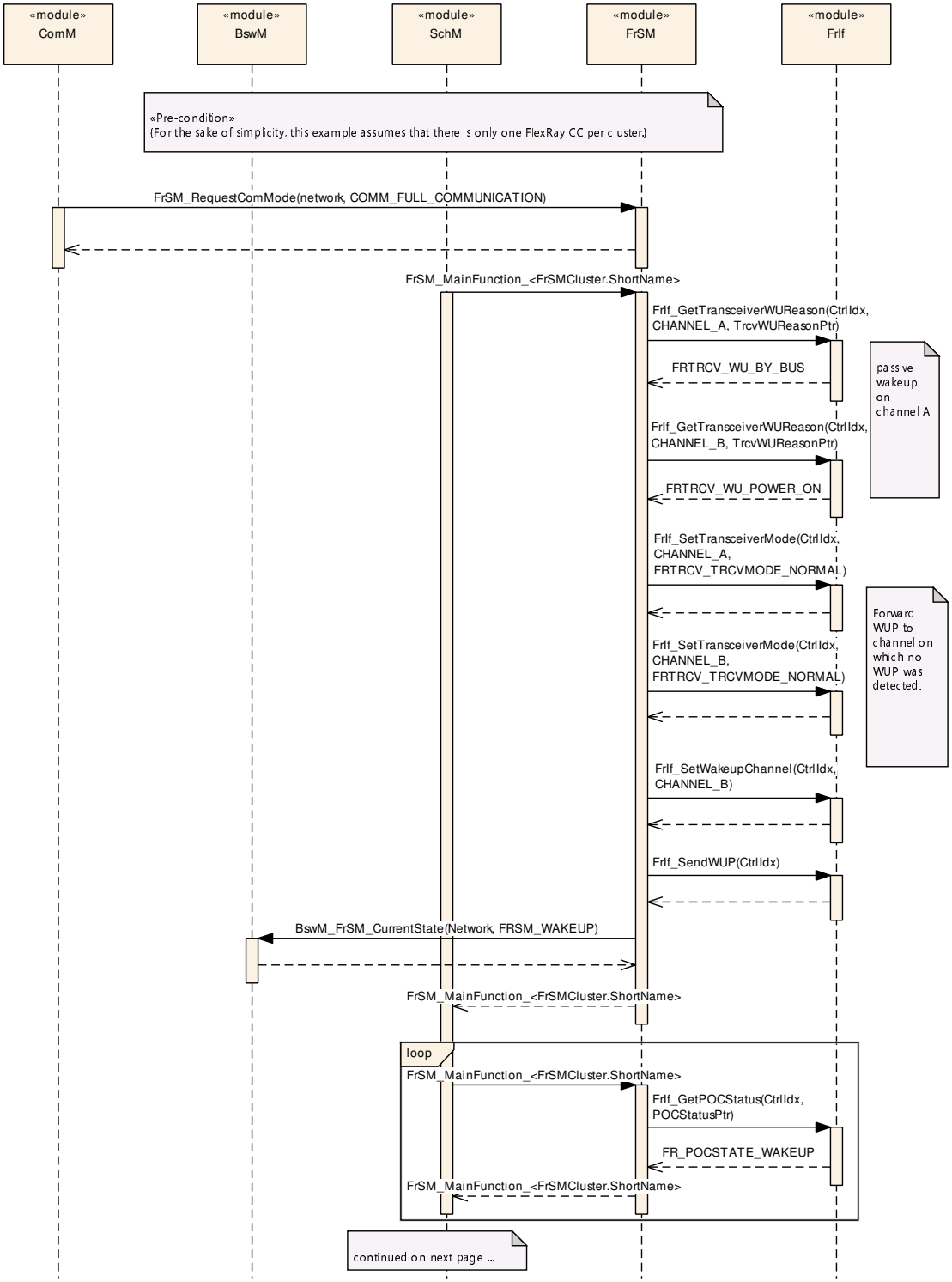

Figure 9.8: continued on next page

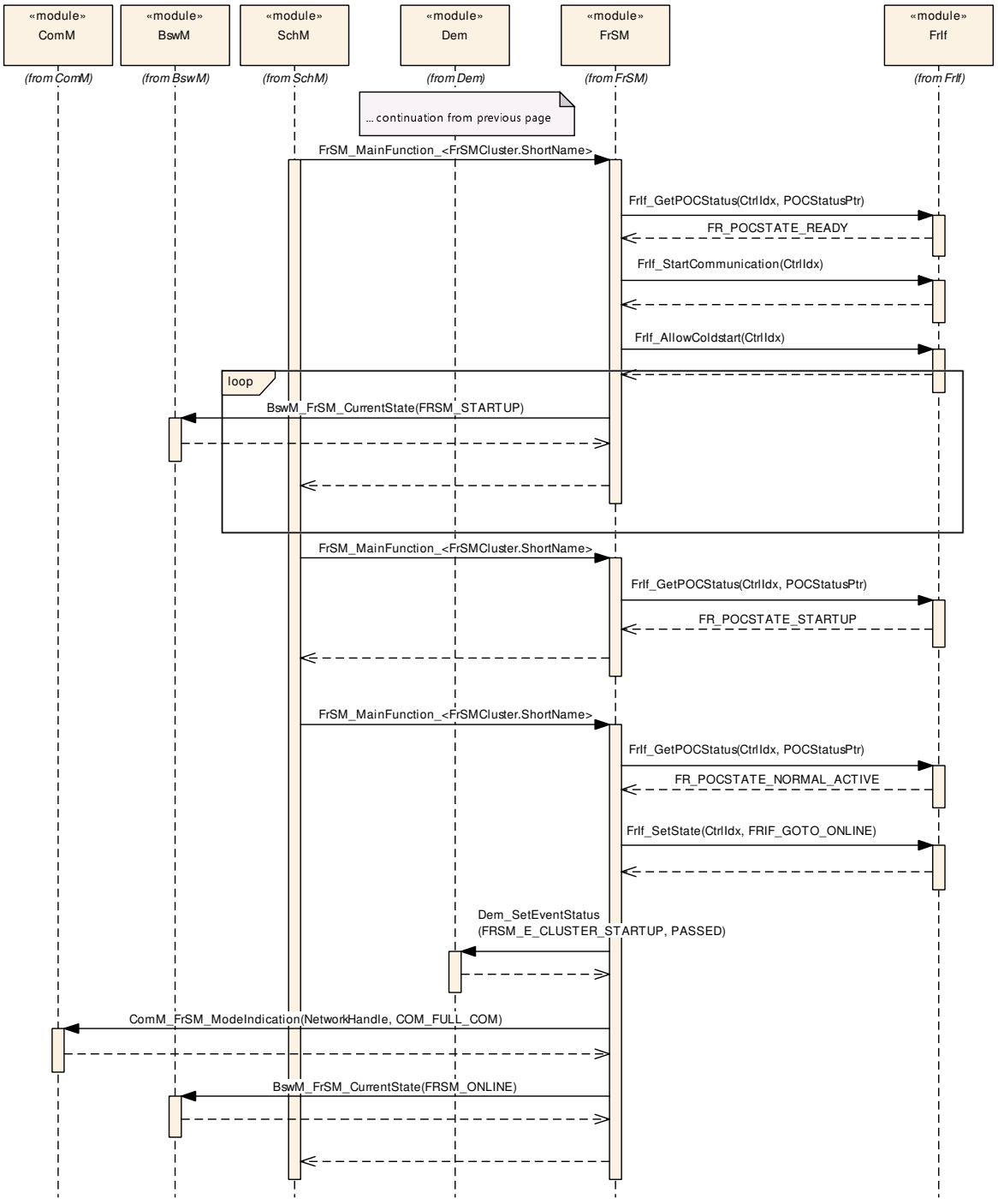

Figure 9.9: Transition from no communication to full communication for the case of a dual channel that has been woken up by bus.

9.6 Key Slot Only Mode

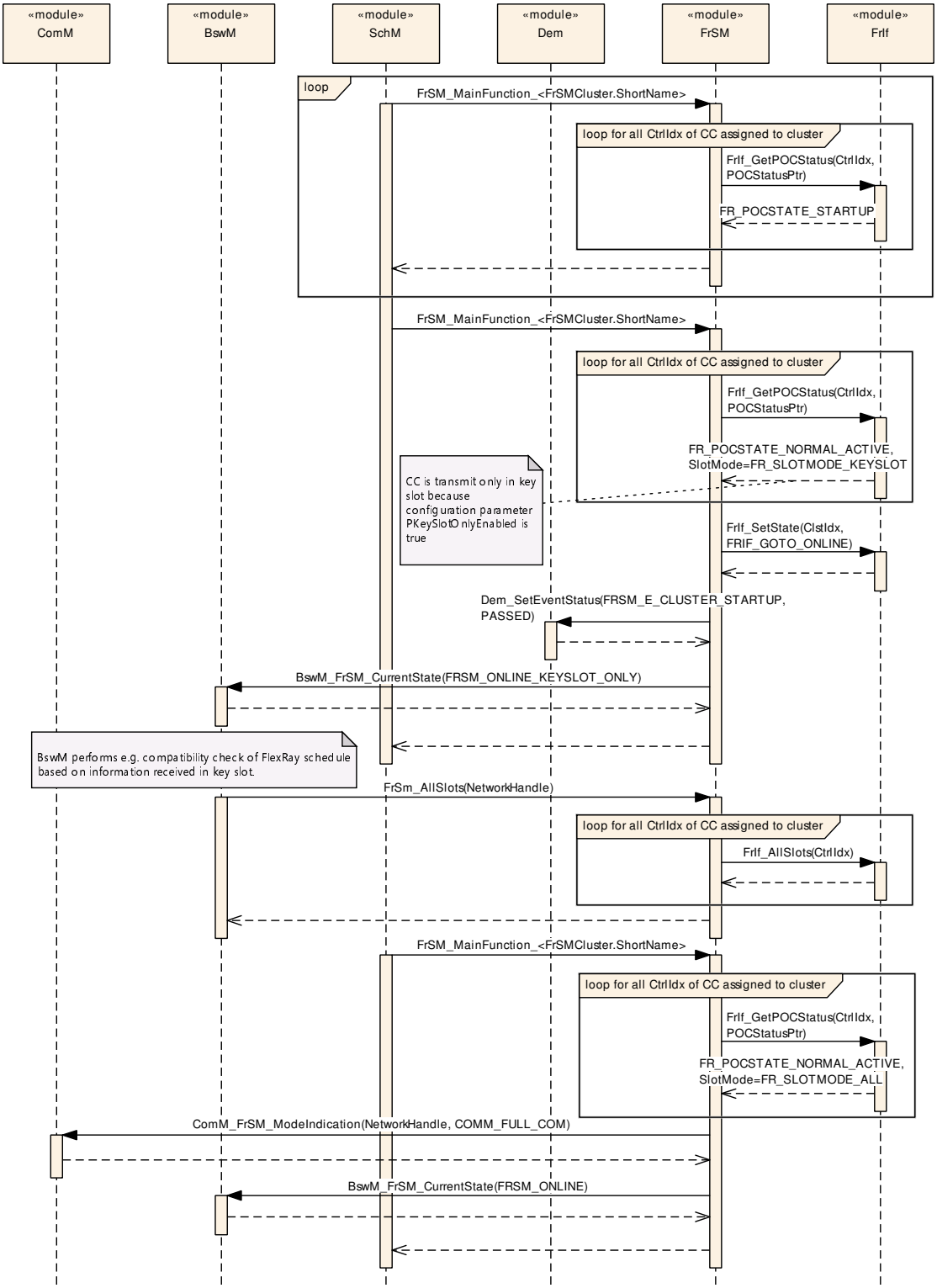

Figure 9.10: Startup in case of Key Slot Only Mode is Enabled

9.7 Transition from full communication to no communication

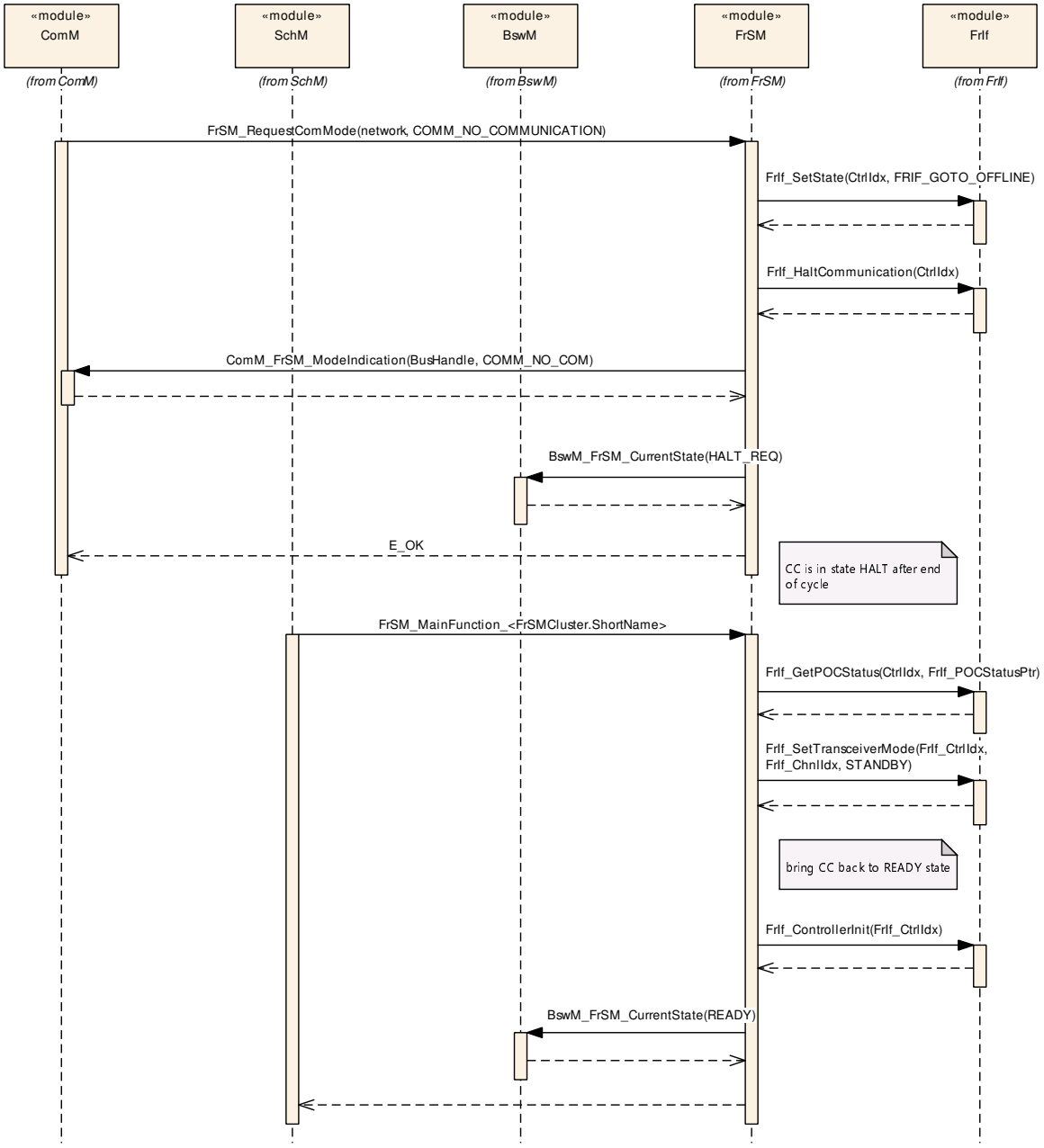

Figure 9.11: Transition from FullCom to NoCom

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 [2] Chapter 10.1 *"Introduction to configuration specification"*.

10.2 Containers and configuration parameters

The following chapters summarize all configuration parameters. The detailed meanings of the parameters describe Chapter 7 and Chapter 8.

[SWS_FrSM_00064]

Upstream requirements: SRS_BSW_00159

⌈The `FrSM` module shall support tool based configuration.⌋

[SWS_FrSM_00065]

Upstream requirements: SRS_BSW_00167

⌈The configuration tool shall check the consistency of the configuration parameters at system configuration time.⌋

10.2.1 FrSM

[ECUC_FrSM_00174] Definition of EcucModuleDef FrSM ⌈

Module Name	FrSM
Description	Configuration of the FlexRay State Manager
Post-Build Selectable Support	true
Post-Build Loadable Support	true

Included Containers		
Container Name	**Multiplicity**	**Description**
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.

⌋

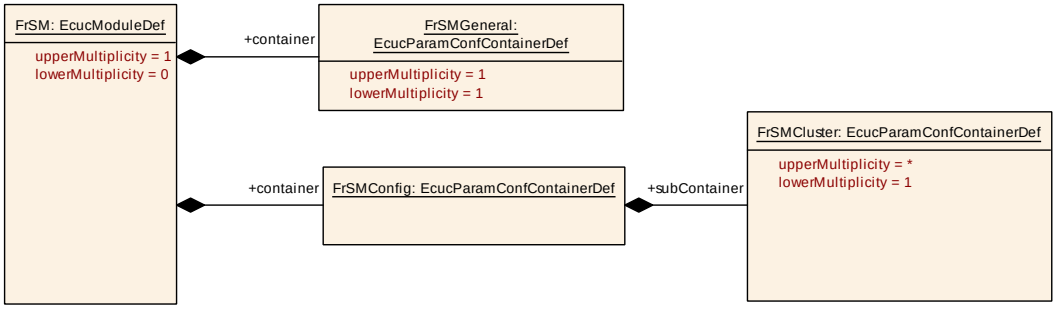

Figure 10.1: FlexRay State Manager Configuration

10.2.2 FrSMConfig

[ECUC_FrSM_00146] Definition of EcucParamConfContainerDef FrSMConfig ⌈

Container Name	FrSMConfig
Parent Container	FrSM
Upstream mapping defined	–
Description	This container comprises the cluster specific configuration of the FlexRay State Manager.
Multiplicity	1
Pre-Compile only	true
Configuration Parameters	

No Included Parameters

Included Containers		
Container Name	**Multiplicity**	**Description**
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

[ECUC_FrSM_00107] Definition of EcucParamConfContainerDef FrSMGeneral ⌈

Container Name	FrSMGeneral
Parent Container	FrSM
Upstream mapping defined	–
Description	This container contains the general configuration parameters of the FlexRay State Manager.

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Multiplicity	1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
FrSMAllSlotsSupport	0..1	[ECUC_FrSM_00172]
FrSMDevErrorDetect	1	[ECUC_FrSM_00066]
FrSMSyncLossErrorIndicationName	0..1	[ECUC_FrSM_00167]

No Included Containers

⌋

[ECUC_FrSM_00172] Definition of EcucBooleanParamDef FrSMAllSlotsSupport ⌈

Parameter Name	FrSMAllSlotsSupport
Parent Container	FrSMGeneral
Upstream mapping defined	–
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	–
Pre-Compile only	true

⌋

[ECUC_FrSM_00066] Definition of EcucBooleanParamDef FrSMDevErrorDetect ⌈

Parameter Name	FrSMDevErrorDetect
Parent Container	FrSMGeneral
Upstream mapping defined	–
Description	Switches the development error detection and notification on or off. • true: detection and notification is enabled. • false: detection and notification is disabled.
Multiplicity	1
Type	EcucBooleanParamDef
Default value	false
Pre-Compile only	true

⌋

[ECUC_FrSM_00167] Definition of EcucFunctionNameDef FrSMSyncLossErrorIndicationName ⌈

Parameter Name	FrSMSyncLossErrorIndicationName
Parent Container	FrSMGeneral
Upstream mapping defined	–
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	–
Regular Expression	–
Pre-Compile only	true

⌋

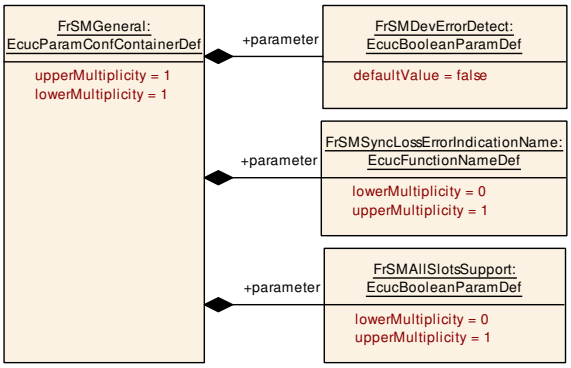

Figure 10.2: FrSMGeneral Container

10.2.4 FrSMCluster

[ECUC_FrSM_00067] Definition of EcucParamConfContainerDef FrSMCluster ⌈

Container Name	FrSMCluster
Parent Container	FrSMConfig
Upstream mapping defined	–
Description	This container specifies a FlexRay cluster and all related data. A FlexRay cluster may consist of more than one controller per ECU.
Multiplicity	1..*
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
FrSMCheckWakeupReason	1	[ECUC_FrSM_00001]
FrSMDelayStartupWithoutWakeup	1	[ECUC_FrSM_00166]
FrSMDurationT1	1	[ECUC_FrSM_00102]

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Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
FrSMDurationT2	1	[ECUC_FrSM_00089]
FrSMDurationT3	1	[ECUC_FrSM_00162]
FrSMDurationT4	1	[ECUC_FrSM_00173]
FrSMIsColdstartEcu	1	[ECUC_FrSM_00068]
FrSMIsWakeupEcu	1	[ECUC_FrSM_00109]
FrSMMainFunctionCycleTime	1	[ECUC_FrSM_00115]
FrSMMinNumberOfColdstarter	0..1	[ECUC_FrSM_00168]
FrSMNumWakeupPatterns	1	[ECUC_FrSM_00165]
FrSMStartupRepetitions	0..1	[ECUC_FrSM_00069]
FrSMStartupRepetitionsWithWakeup	0..1	[ECUC_FrSM_00094]
FrSMTrcvStdbyDelay	0..1	[ECUC_FrSM_00170]
FrSMComMNetworkHandleRef	1	[ECUC_FrSM_00070]
FrSMFrIfClusterRef	1	[ECUC_FrSM_00116]

Included Containers		
Container Name	**Multiplicity**	**Description**
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.

⌋

[ECUC_FrSM_00001] Definition of EcucBooleanParamDef FrSMCheckWakeupReason ⌈

Parameter Name	FrSMCheckWakeupReason	
Parent Container	FrSMCluster	
Upstream mapping defined	–	
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 Value	Loadable	Selectable

⌋

[ECUC_FrSM_00166] Definition of EcucBooleanParamDef FrSMDelayStartupWithoutWakeup ⌈

Parameter Name	FrSMDelayStartupWithoutWakeup
Parent Container	FrSMCluster
Upstream mapping defined	–

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△

Description	If true, timer t1 shall be started instead of immediately calling FrIf_AllowColdstart in case of a startup without wakeup.	
Multiplicity	1	
Type	EcucBooleanParamDef	
Default value	–	
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00102] Definition of EcucFloatParamDef FrSMDurationT1 ⌈

Parameter Name	FrSMDurationT1	
Parent Container	FrSMCluster	
Upstream mapping defined	–	
Description	The duration of timer t1 in seconds. A value of 0 shall imply that the timer is not used. Dependency: FrSMMainFunctionCycleTime (As timers are checked during the call of FrSM_MainFunction, the effective timer duration will always be a multiple of FrSMMain FunctionCycleTime).	
Multiplicity	1	
Type	EcucFloatParamDef	
Range	[0 .. INF]	
Default value	–	
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00089] Definition of EcucFloatParamDef FrSMDurationT2 ⌈

Parameter Name	FrSMDurationT2	
Parent Container	FrSMCluster	
Upstream mapping defined	–	
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. Dependency: FrSMMainFunctionCycleTime (As timers are checked during the call of FrSM_MainFunction, the effective timer duration will always be a multiple of FrSMMain FunctionCycleTime).	
Multiplicity	1	
Type	EcucFloatParamDef	
Range	[0 .. INF]	
Default value	–	
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00162] Definition of EcucFloatParamDef FrSMDurationT3 ⌈

Parameter Name	FrSMDurationT3
Parent Container	FrSMCluster
Upstream mapping defined	–

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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. Dependency: FrSMMainFunctionCycleTime (As timers are checked during the call of FrSM_MainFunction, the effective timer duration will always be a multiple of FrSMMain FunctionCycleTime).	
Multiplicity	1	
Type	EcucFloatParamDef	
Range	[0 .. INF]	
Default value	–	
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00173] Definition of EcucFloatParamDef FrSMDurationT4 ⌈

Parameter Name	FrSMDurationT4	
Parent Container	FrSMCluster	
Upstream mapping defined	–	
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 Value	Loadable	Selectable

⌋

[ECUC_FrSM_00068] Definition of EcucBooleanParamDef FrSMIsColdstartEcu ⌈

Parameter Name	FrSMIsColdstartEcu	
Parent Container	FrSMCluster	
Upstream mapping defined	[5, CP_TPS_SystemTemplate]	
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 Value	Loadable	Selectable

⌋

[ECUC_FrSM_00109] Definition of EcucBooleanParamDef FrSMIsWakeupEcu ⌈

Parameter Name	FrSMIsWakeupEcu
Parent Container	FrSMCluster
Upstream mapping defined	–
Description	True: FrSM shall perform a wakeup for this cluster. False: FrSM shall never perform a wakeup for this FlexRay cluster.
Multiplicity	1

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Type	EcucBooleanParamDef	
Default value	–	
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00115] Definition of EcucFloatParamDef FrSMMainFunctionCycleTime ⌈

Parameter Name	FrSMMainFunctionCycleTime	
Parent Container	FrSMCluster	
Upstream mapping defined	–	
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	–	
Pre-Compile only	true	

⌋

[ECUC_FrSM_00168] Definition of EcucIntegerParamDef FrSMMinNumberOfColdstarter ⌈

Parameter Name	FrSMMinNumberOfColdstarter	
Parent Container	FrSMCluster	
Upstream mapping defined	–	
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 Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00165] Definition of EcucIntegerParamDef FrSMNumWakeupPatterns ⌈

Parameter Name	FrSMNumWakeupPatterns
Parent Container	FrSMCluster
Upstream mapping defined	–
Description	Maximum number of Wakeup Patterns the node may send before going to FRSM_STARTUP. Dependency: A value greater than zero is required in case the parameter FrSMIs WakeupEcu is true.

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Multiplicity	1	
Type	EcucIntegerParamDef	
Range	0 .. 65535	
Default value	–	
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00069] Definition of EcucIntegerParamDef FrSMStartupRepetitions ⌈

Parameter Name	FrSMStartupRepetitions	
Parent Container	FrSMCluster	
Upstream mapping defined	–	
Description	The number of times an ECU may repeat the startup procedure for a FlexRay cluster. Dependency: This value must be greater or equal to FrSMStartupRepetitionsWithWakeup	
Multiplicity	0..1	
Type	EcucIntegerParamDef	
Range	0 .. 65535	
Default value	–	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00094] Definition of EcucIntegerParamDef FrSMStartupRepetitionsWithWakeup ⌈

Parameter Name	FrSMStartupRepetitionsWithWakeup	
Parent Container	FrSMCluster	
Upstream mapping defined	–	
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 Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00170] Definition of EcucFloatParamDef FrSMTrcvStdbyDelay ⌈

Parameter Name	FrSMTrcvStdbyDelay
Parent Container	FrSMCluster
Upstream mapping defined	[5, CP_TPS_SystemTemplate]

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Description	The duration of timer t_TrcvStdbyDelay 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. Dependency: FrSmMainFunctionCycleTime	
Multiplicity	0..1	
Type	EcucFloatParamDef	
Range	[0 .. INF]	
Default value	–	
Post-Build Multiplicity	Loadable	Selectable
Post-Build Value	Loadable	Selectable

⌋

[ECUC_FrSM_00070] Definition of EcucReferenceDef FrSMComMNetworkHandleRef ⌈

Parameter Name	FrSMComMNetworkHandleRef
Parent Container	FrSMCluster
Upstream mapping defined	–
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
Pre-Compile only	true

⌋

[ECUC_FrSM_00116] Definition of EcucReferenceDef FrSMFrIfClusterRef ⌈

Parameter Name	FrSMFrIfClusterRef	
Parent Container	FrSMCluster	
Upstream mapping defined	–	
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 Value	-	Selectable

⌋

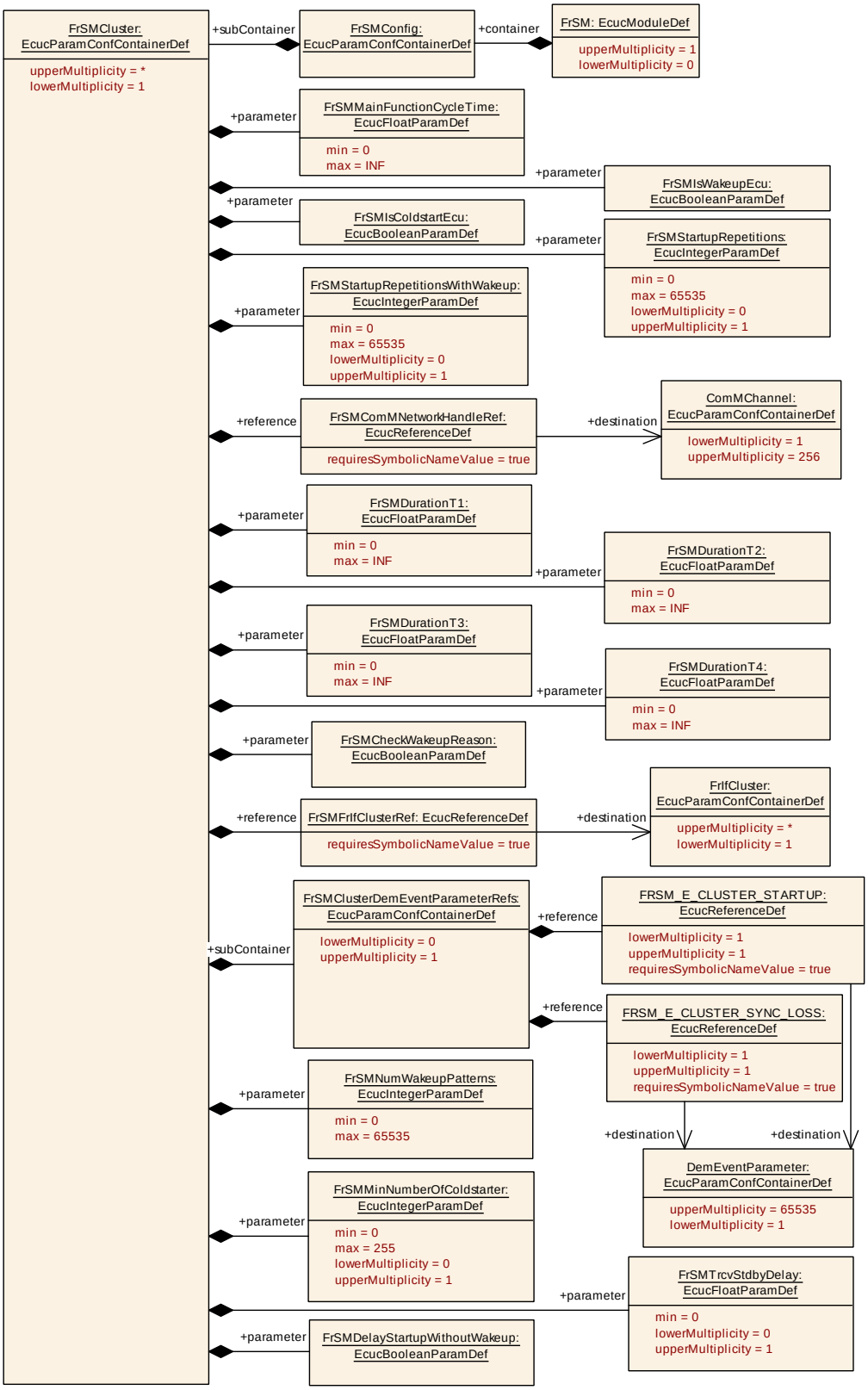

Figure 10.3: FrSMCluster Container

10.2.5 FrSMClusterDemEventParameterRefs

[ECUC_FrSM_00163] Definition of EcucParamConfContainerDef FrSMClusterDemEventParameterRefs ⌈

Container Name	FrSMClusterDemEventParameterRefs
Parent Container	FrSMCluster
Upstream mapping defined	–
Description	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_SetEventStatus in case the corresponding error occurs. The Event Id is taken from the referenced DemEventParameter's DemEventId symbolic value. The standardized errors are provided in this container and can be extended by vendor-specific error references.
Multiplicity	0..1
Pre-Compile only	true
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
FRSM_E_CLUSTER_STARTUP	1	[ECUC_FrSM_00164]
FRSM_E_CLUSTER_SYNC_LOSS	1	[ECUC_FrSM_00169]

No Included Containers

⌋

[ECUC_FrSM_00164] Definition of EcucReferenceDef FRSM_E_CLUSTER_STARTUP ⌈

Parameter Name	FRSM_E_CLUSTER_STARTUP
Parent Container	FrSMClusterDemEventParameterRefs
Upstream mapping defined	–
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
Pre-Compile only	true

⌋

[ECUC_FrSM_00169] Definition of EcucReferenceDef FRSM_E_CLUSTER_SYNC_LOSS ⌈

Parameter Name	FRSM_E_CLUSTER_SYNC_LOSS
Parent Container	FrSMClusterDemEventParameterRefs
Upstream mapping defined	–
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

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Type	Symbolic name reference to DemEventParameter
Pre-Compile only	true

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10.3 Published Information

For details refer to [2] Chapter 10.3 *“Published Information”*.

A Change history of AUTOSAR traceable items

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

A.1 Traceable item history of this document according to AUTOSAR Release R26-11

A.1.1 Added Specification Items in R26-11

none

A.1.2 Changed Specification Items in R26-11

Number	Heading
[ECUC_FrSM_00001]	Definition of EcucBooleanParamDef FrSMCheckWakeupReason
[ECUC_FrSM_00066]	Definition of EcucBooleanParamDef FrSMDevErrorDetect
[ECUC_FrSM_00067]	Definition of EcucParamConfContainerDef FrSMCluster
[ECUC_FrSM_00068]	Definition of EcucBooleanParamDef FrSMIsColdstartEcu
[ECUC_FrSM_00069]	Definition of EcucIntegerParamDef FrSMStartupRepetitions
[ECUC_FrSM_00070]	Definition of EcucReferenceDef FrSMComMNetworkHandleRef
[ECUC_FrSM_00089]	Definition of EcucFloatParamDef FrSMDurationT2
[ECUC_FrSM_00094]	Definition of EcucIntegerParamDef FrSMStartupRepetitionsWithWakeup
[ECUC_FrSM_00102]	Definition of EcucFloatParamDef FrSMDurationT1
[ECUC_FrSM_00107]	Definition of EcucParamConfContainerDef FrSMGeneral
[ECUC_FrSM_00109]	Definition of EcucBooleanParamDef FrSMIsWakeupEcu
[ECUC_FrSM_00115]	Definition of EcucFloatParamDef FrSMMainFunctionCycleTime
[ECUC_FrSM_00116]	Definition of EcucReferenceDef FrSMFrIfClusterRef
[ECUC_FrSM_00146]	Definition of EcucParamConfContainerDef FrSMConfig
[ECUC_FrSM_00162]	Definition of EcucFloatParamDef FrSMDurationT3
[ECUC_FrSM_00163]	Definition of EcucParamConfContainerDef FrSMClusterDemEventParameterRefs
[ECUC_FrSM_00164]	Definition of EcucReferenceDef FRSM_E_CLUSTER_STARTUP
[ECUC_FrSM_00165]	Definition of EcucIntegerParamDef FrSMNumWakeupPatterns
[ECUC_FrSM_00166]	Definition of EcucBooleanParamDef FrSMDelayStartupWithoutWakeup
[ECUC_FrSM_00167]	Definition of EcucFunctionNameDef FrSMSyncLossErrorIndicationName
[ECUC_FrSM_00168]	Definition of EcucIntegerParamDef FrSMMinNumberOfColdstarter
[ECUC_FrSM_00169]	Definition of EcucReferenceDef FRSM_E_CLUSTER_SYNC_LOSS

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Number	Heading
[ECUC_FrSM_00170]	Definition of EcucFloatParamDef FrSMTrcvStdbyDelay
[ECUC_FrSM_00172]	Definition of EcucBooleanParamDef FrSMAllSlotsSupport
[ECUC_FrSM_00173]	Definition of EcucFloatParamDef FrSMDurationT4
[ECUC_FrSM_00174]	Definition of EcucModuleDef FrSM
[SWS_FrSM_00095]	Definition of imported datatypes of module FrSM

Table A.1: Changed Specification Items in R26-11

A.1.3 Deleted Specification Items in R26-11

Number	Heading
[ECUC_FrSM_00108]	Definition of EcucBooleanParamDef FrSMVersionInfoApi
[SWS_FrSM_00029]	Definition of API function FrSM_GetVersionInfo

Table A.2: Deleted Specification Items in R26-11

A.2 Traceable item history of this document according to AUTOSAR Release R25-11

A.2.1 Added Specification Items in R25-11

none

A.2.2 Changed Specification Items in R25-11

Number	Heading
[SWS_FrSM_00018]	
[SWS_FrSM_00019]	
[SWS_FrSM_00020]	Definition of API function FrSM_RequestComMode
[SWS_FrSM_00024]	Definition of API function FrSM_GetCurrentComMode
[SWS_FrSM_00026]	
[SWS_FrSM_00027]	
[SWS_FrSM_00028]	
[SWS_FrSM_00141]	

Table A.3: Changed Specification Items in R25-11

A.2.3 Deleted Specification Items in R25-11

none

A.3 Traceable item history of this document according to AUTOSAR Release R24-11

A.3.1 Added Specification Items in R24-11

none

A.3.2 Changed Specification Items in R24-11

none

A.3.3 Deleted Specification Items in R24-11

none

B Not applicable requirements

[SWS_FrSM_NA_00186]

Upstream requirements: SRS_BSW_00168, SRS_BSW_00170, SRS_BSW_00336, SRS_BSW_00345, SRS_BSW_00375, SRS_BSW_00383, SRS_BSW_00384, SRS_BSW_00388, SRS_BSW_00389, SRS_BSW_00390, SRS_BSW_00392, SRS_BSW_00393, SRS_BSW_00395, SRS_BSW_00396, SRS_BSW_00399, SRS_BSW_00403, SRS_BSW_00416, SRS_BSW_00417, SRS_BSW_00419, SRS_BSW_00422, SRS_BSW_00423, SRS_BSW_00425, SRS_BSW_00427, SRS_BSW_00428, SRS_BSW_00429, SRS_BSW_00432, SRS_BSW_00437, SRS_BSW_00469, SRS_BSW_00452, SRS_BSW_00470, SRS_BSW_00471, SRS_BSW_00472, SRS_BSW_00478, SRS_BSW_00490, SRS_BSW_00491, SRS_BSW_00493

⌈This specification item references requirements that are not applicable, because it is no requirement against FrSM SWS or only against ECUC elements.⌋