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30.06.2005	1.0.0	AUTOSAR Administration	Initial Release

Disclaimer

Advice for users

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1 Introduction and Functional Overview

This document describes the concept, core functionality, configurable features, interfaces and configuration issues of the AUTOSAR CAN Network Management (CanNm).

The AUTOSAR CAN Network Management is a hardware independent protocol that can only be used on CAN (for limitations refer to chapter 4.1). Its main purpose is to coordinate the transition between normal operation and bus-sleep mode of the network.

In addition to the core functionality configurable features are provided e.g. to implement a service to detect all present nodes or to detect if all other nodes are ready to sleep.

The CAN Network Management (CanNm) function provides an adaptation between Network Management Interface (Nm) and CAN Interface (CanIf) module. For a general understanding of the AUTOSAR Network Management functionality please refer to [9].

2 Acronyms and abbreviations

Acronym/abbreviation:	*Description:*
API	Application Programming Interface
BSW	Basic Software
DET	Development Error Tracer
CanIf	Abbreviation for the CAN Interface
CanNm	Abbreviation for CAN Network Management
NM	Network Management
PDU	Protocol Data Unit
SDU	Service Data Unit

Term	*Description:*
“PDU transmission ability is disabled”	This means that the Network Management PDU transmission has been disabled by the service CanNm_DisableCommunication.
“Repeat Message Request Bit Indication”	CanNm_RxIndication finds the RptMsgRequest set in the Control Bit Vector of a received Network Management PDU.

3 Related documentation

3.1 Input documents

[1] AUTOSAR Layered Software Architecture
AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf

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

[3] Requirements on Network Management
AUTOSAR_SRS_NetworkManagement.pdf

[4] Specification of CAN Interface
AUTOSAR_SWS_CANInterface.pdf

[5] Specification of FlexRay Network Management
AUTOSAR_SWS_FlexRayNetworkManagement.pdf

[6] Specification of Communication Stack Types
AUTOSAR_SWS_CommunicationStackTypes.pdf

[7] Specification of ECU Configuration
AUTOSAR_TPS_ECUConfiguration.pdf

[8] Specification of BSW Scheduler
AUTOSAR_SWS_BSW_Scheduler.pdf

[9] Specification of Generic Network Management Interface
AUTOSAR_SWS_NetworkManagementInterface.pdf

[10] Specification of Communication Manager
AUTOSAR_SWS_ComManager.pdf

[11] Specification of ECU State Manager
AUTOSAR_SWS_ECUStateManager.pdf

[12] Specification of Operating System
AUTOSAR_SWS_OS.pdf

[13] Specification of Diagnostic Event Manager
AUTOSAR_SWS_DiagnosticEventManager.pdf

[14] Specification of Development Error Tracer
AUTOSAR_SWS_DevelopmentErrorTracer.pdf

[15] Specification of Standard Types
AUTOSAR_SWS_StandardTypes.pdf

[16] Specification of Platform Types
AUTOSAR_SWS_PlatformTypes.pdf

[17] Specification of Compiler Abstraction
AUTOSAR_SWS_CompilerAbstraction.pdf

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

[19] List of Basic Software Modules
AUTOSAR_TR_BSWModuleList.pdf

3.2 Related standards and norms

Not available.

4 Constraints and assumptions

4.1 Limitations

1. One instance of CanNm is associated with only one network management cluster in one network. One network management cluster can have only one instance of CanNm in one node.
2. One instance of CanNm is associated with only one network within the same ECU.
3. CanNm is only applicable for CAN systems.

The Figure 4-1 presents an AUTOSAR Network Management stack within an example ECU belonging to two CanNm clusters.

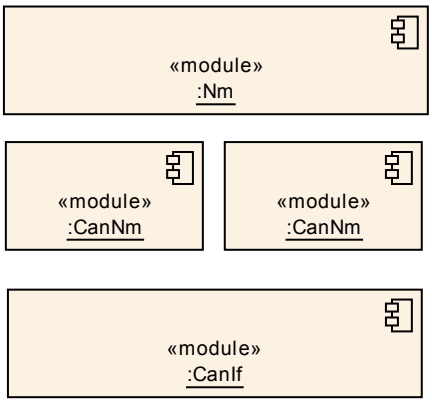

Figure 4-1 AUTOSAR NM Stack on CAN

The CanNm module is only applicable for CAN systems.

4.2 Applicability to car domains

The CanNm module can be applied to any car domain under limitations provided above.

5 Dependencies to other modules

CAN Network Management (CanNm) uses services of CAN Interface (CanIf) and provides services to the Generic Network Management Interface (Nm).

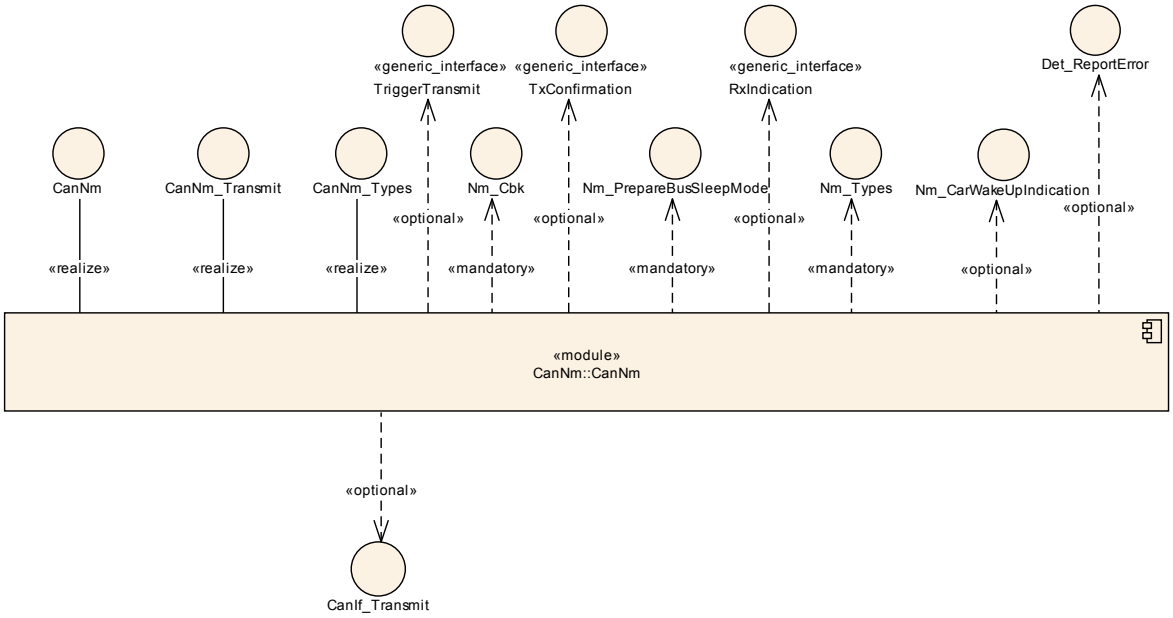

Figure 5-1 Dependencies to other modules

5.1 File Structure

5.1.1 Code File Structure

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

[CANNM299] ⌈`CanNm_Cfg.c` shall contain pre-compile time configuration parameters implemented as “const”.⌋ (BSW171, BSW00419, BSW00346, BSW158, BSW00308)

[CANNM300] ⌈`CanNm_Lcfg.c` shall contain link time configurable parameters.⌋ (BSW171, BSW00346, BSW158, BSW00308)

[CANNM301] ⌈`CanNm_PBcfg.c` shall contain post build time configurable parameters.⌋ (BSW171, BSW00346, BSW158, BSW00308)

5.1.2 Header File Structure

The CanNm module shall provide the following H-files.

[CANNM302] ⌈`CanNm.h` shall contain the declaration of provided interface functions.⌋ (BSW00345, BSW00412, BSW00346, BSW158, BSW00302)

[CANNM303] ⌈`CanNm_Cbk.h` shall contain the declaration of provided call-back functions.⌋ (BSW00412, BSW00346, BSW158, BSW00370)

[CANNM304] ⌈`CanNm_Cfg.h` shall contain pre-compile time configurable parameters.⌋ (BSW00412, BSW00346, BSW158)

The CanNm module shall include the following H-files.

[CANNM305] ⌈`ComStack_Types.h` shall be included.

Note: The following header files are indirectly included by `ComStack_Types.h`

- `Std_Types.h` (for AUTOSAR standard types)
- `Platform_Types.h` (for platform specific types)
- `Compiler.h` (for compiler specific language extensions)⌋ (BSW00348, BSW00353, BSW00361, BSW00301)

[CANNM306] ⌈`CanNm.h` shall be included for declaration of provided interface functions.⌋(BSW00301)

[CANNM307] ⌈`Nm_Cbk.h` shall be included for CanNm specific callbacks of Generic Network Management Interface.⌋(BSW00301)

[CANNM308] ⌈`Det.h` shall be included for interfacing the DET if DET usage is configured.⌋(BSW00301)

[CANNM309]⌈ `NmStack_Types.h` shall be included for common network management types.⌋(BSW0 0301)

[CANNM310]「`SchM_CanNm.h` shall be included for services of the Basic Software Scheduler.」(BSW00301)

[CANNM311]「`MemMap.h` shall be included for Memory Mapping.」(BSW00301)

[CANNM312]「`CanIf.h` shall be included for interfacing the CanIf.」(BSW00301)

[CANNM313]「`Nm_Cfg.h` may be included to derive configuration items from Nm.」(BSW00383, BSW00301)

[CANNM326]「`PduR_CanNm.h` shall be included if COM user data support is enabled.」()

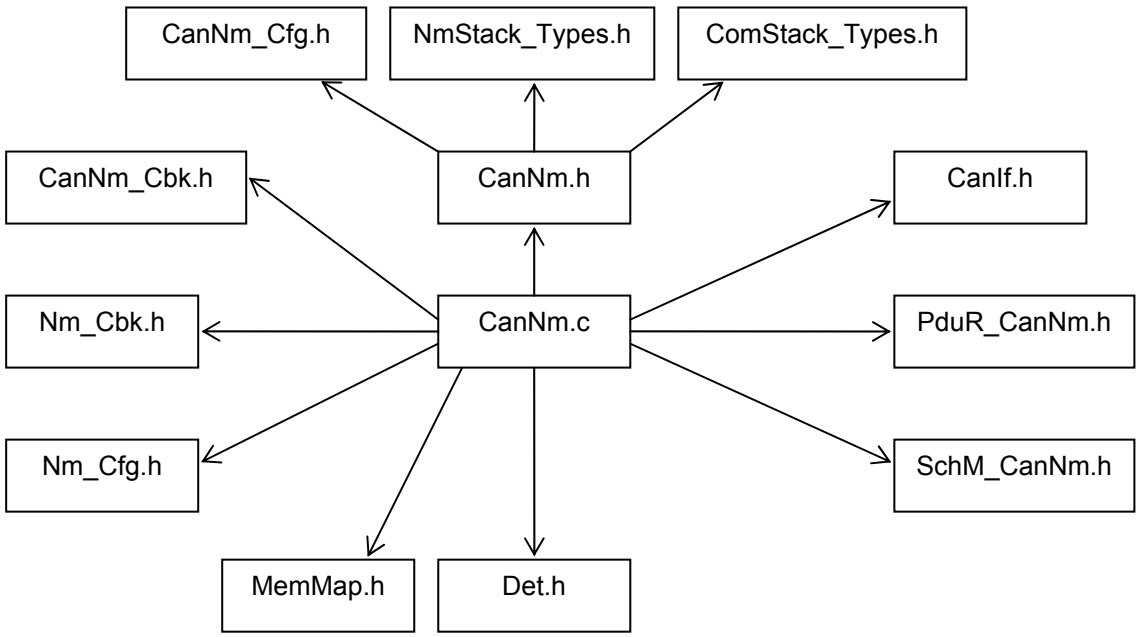

Figure 5-2 Header File Structure

6 Requirements traceability

Requirement	Satisfied by
-	CANNM101
-	CANNM268
-	CANNM217
-	CANNM094
-	CANNM256
-	CANNM258
-	CANNM153
-	CANNM190
-	CANNM071
-	CANNM265
-	CANNM126
-	CANNM163
-	CANNM329
-	CANNM197
-	CANNM103
-	CANNM014
-	CANNM156
-	CANNM227
-	CANNM267
-	CANNM297
-	CANNM179
-	CANNM292
-	CANNM282
-	CANNM128
-	CANNM248
-	CANNM097
-	CANNM123
-	CANNM225
-	CANNM152
-	CANNM216
-	CANNM092
-	CANNM328
-	CANNM104
-	CANNM238
-	CANNM272
-	CANNM113
-	CANNM298
-	CANNM160

-	CANNM261
-	CANNM208
-	CANNM132
-	CANNM066
-	CANNM237
-	CANNM075
-	CANNM143
-	CANNM314
-	CANNM137
-	CANNM052
-	CANNM199
-	CANNM124
-	CANNM285
-	CANNM335
-	CANNM151
-	CANNM074
-	CANNM119
-	CANNM089
-	CANNM223
-	CANNM141
-	CANNM253
-	CANNM122
-	CANNM262
-	CANNM177
-	CANNM019
-	CANNM284
-	CANNM162
-	CANNM277
-	CANNM159
-	CANNM213
-	CANNM288
-	CANNM187
-	CANNM189
-	CANNM144
-	CANNM088
-	CANNM220
-	CANNM249
-	CANNM150
-	CANNM264
-	CANNM270
-	CANNM176
-	CANNM173

-	CANNM192
-	CANNM170
-	CANNM114
-	CANNM158
-	CANNM135
-	CANNM035
-	CANNM157
-	CANNM281
-	CANNM116
-	CANNM276
-	CANNM263
-	CANNM149
-	CANNM040
-	CANNM283
-	CANNM273
-	CANNM266
-	CANNM020
-	CANNM133
-	CANNM211
-	CANNM236
-	CANNM061
-	CANNM106
-	CANNM287
-	CANNM033
-	CANNM166
-	CANNM181
-	CANNM118
-	CANNM333
-	CANNM336
-	CANNM086
-	CANNM325
-	CANNM206
-	CANNM271
-	CANNM175
-	CANNM102
-	CANNM259
-	CANNM060
-	CANNM242
-	CANNM085
-	CANNM129
-	CANNM401
-	CANNM045

-	CANNM332
-	CANNM235
-	CANNM198
-	CANNM279
-	CANNM334
-	CANNM326
-	CANNM121
-	CANNM257
-	CANNM108
-	CANNM073
-	CANNM324
-	CANNM274
-	CANNM194
-	CANNM230
-	CANNM112
-	CANNM146
-	CANNM218
-	CANNM077
-	CANNM294
-	CANNM222
-	CANNM315
-	CANNM210
-	CANNM193
-	CANNM215
-	CANNM109
-	CANNM330
-	CANNM145
-	CANNM180
-	CANNM196
-	CANNM224
-	CANNM064
-	CANNM065
-	CANNM025
-	CANNM178
-	CANNM212
-	CANNM107
-	CANNM260
-	CANNM069
-	CANNM096
-	CANNM161
-	CANNM072
-	CANNM098

-	CANNM117
-	CANNM246
-	CANNM023
-	CANNM115
-	CANNM229
-	CANNM174
-	CANNM120
-	CANNM275
-	CANNM289
-	CANNM147
-	CANNM200
-	CANNM214
-	CANNM245
-	CANNM100
-	CANNM110
-	CANNM219
-	CANNM233
-	CANNM093
-	CANNM247
-	CANNM188
-	CANNM402
-	CANNM327
-	CANNM234
-	CANNM005
-	CANNM185
-	CANNM105
-	CANNM013
-	CANNM240
-	CANNM228
-	CANNM168
-	CANNM232
-	CANNM172
-	CANNM138
-	CANNM255
-	CANNM111
-	CANNM278
-	CANNM099
-	CANNM241
-	CANNM290
-	CANNM295
-	CANNM037
-	CANNM039

-	CANNM191
-	CANNM051
-	CANNM269
-	CANNM032
-	CANNM154
-	CANNM127
-	CANNM231
-	CANNM331
-	CANNM254
-	CANNM221
-	CANNM087
BSW00301	CANNM310, CANNM311, CANNM312, CANNM313, CANNM308, CANNM309, CANNM306, CANNM307, CANNM305
BSW00302	CANNM302
BSW00305	CANNM999
BSW00306	CANNM999
BSW00307	CANNM999
BSW00308	CANNM299, CANNM300, CANNM301
BSW00309	CANNM999
BSW00312	CANNM999
BSW00314	CANNM999
BSW00321	CANNM999
BSW00323	CANNM244, CANNM243
BSW00325	CANNM999
BSW00326	CANNM999
BSW00328	CANNM999
BSW00330	CANNM999
BSW00331	CANNM999
BSW00333	CANNM999
BSW00334	CANNM999
BSW00335	CANNM999
BSW00336	CANNM999
BSW00341	CANNM999
BSW00345	CANNM302
BSW00346	CANNM299, CANNM304, CANNM302, CANNM303, CANNM300, CANNM301
BSW00347	CANNM999
BSW00348	CANNM305
BSW00353	CANNM305
BSW00361	CANNM305
BSW00370	CANNM303
BSW00375	CANNM999
BSW00377	CANNM999

BSW00383	CANNM313
BSW00387	CANNM999
BSW00410	CANNM999
BSW00412	CANNM304, CANNM302, CANNM303
BSW00413	CANNM999
BSW00415	CANNM999
BSW00416	CANNM999
BSW00417	CANNM999
BSW00419	CANNM299
BSW00423	CANNM999
BSW00424	CANNM999
BSW00425	CANNM999
BSW00426	CANNM999
BSW00427	CANNM999
BSW00429	CANNM999
BSW00432	CANNM999
BSW00434	CANNM999
BSW005	CANNM999
BSW006	CANNM999
BSW010	CANNM999
BSW02509	CANNM999
BSW02516	CANNM280, CANNM226, CANNM130
BSW043	CANNM999
BSW046	CANNM999
BSW048	CANNM999
BSW050	CANNM999
BSW052	CANNM999
BSW054	CANNM999
BSW136	CANNM999
BSW139	CANNM999
BSW140	CANNM999
BSW144	CANNM999
BSW147	CANNM999
BSW151	CANNM999
BSW153	CANNM999
BSW154	CANNM999
BSW158	CANNM299, CANNM304, CANNM302, CANNM303, CANNM300, CANNM301
BSW160	CANNM999
BSW161	CANNM999
BSW162	CANNM999
BSW164	CANNM999
BSW168	CANNM999

BSW170	CANNM999
BSW171	CANNM299, CANNM300, CANNM301
BSW172	CANNM999

Document: AUTOSAR General Requirements on Basic Software Modules [2]

Requirement	***Satisfied by***
[BSW00344] Reference to link-time configuration	Ok; see chapter 10.2
[BSW00404] Reference to post build time configuration	Ok; see Chapter 10.2
[BSW00405] Reference to multiple configuration sets	Ok; see Chapter 10.2
[BSW00345] Pre-compile-time configuration	Ok; see CANNM302
[BSW159] Tool-based configuration	Ok; see Chapter 10.2
[BSW167] Static configuration checking	Ok; see Chapter 10.2
[BSW170] Data for reconfiguration of AUTOSAR SW-Components	N/a (CanNm is no SW-C)
[BSW171] Configurability of optional functionality	Ok; see Chapter 10.2
[BSW00380] Separate C-Files for configuration parameters	Ok; see CANNM299, CANNM300, CANNM301
[BSW00419] Separate C-Files for pre-compile time configuration parameters	Ok; see CANNM299
[BSW00381] Separate configuration header file for pre-compile time parameters	Ok; see CANNM302
[BSW00412] Separate H-File for configuration parameters	Ok; see CANNM302, CANNM303, CANNM304
[BSW00383] List dependencies of configuration files	Ok; see CANNM313
[BSW00384] List dependencies to other modules	Ok; see Figure 5-1
[BSW00387] Specify the configuration class of callback function	n/a (Callback functions are not configurable)
[BSW00388] Introduce containers	Ok; see Chapter 10.2
[BSW00389] Containers shall have names	Ok; see Chapter 10.2
[BSW00390] Parameter content shall be unique within the module	Ok; see Chapter 10.2
[BSW00391] Parameter shall have unique names	Ok; see Chapter 10.2
[BSW00392] Parameters shall have a type	Ok; see Chapter 10.2
[BSW00393] Parameters shall have a range	Ok; see Chapter 10.2
[BSW00394] Specify the scope of the parameters	Ok; see Chapter 10.2
[BSW00395] List the required parameters (per parameter)	Ok; see Chapter 10.2
[BSW00396] Configuration classes	Ok; see Chapter 10.2
[BSW00397] Pre-compile-time parameters	Ok; see Chapter 10.2
[BSW00398] Link-time parameters	Ok; see Chapter 10.2
[BSW00399] Loadable Post-build time parameters	Ok; see Chapter 10.2
[BSW00400] Selectable Post-build time parameters	Ok; see Chapter 10.2
[BSW00402] Published information	Ok; see Chapter 10.3.5
[BSW00375] Notification of wake-up reason	n/a (CanNm does not wake-up an ECU)
[BSW101] Initialization interface	Ok; see chapter 8.3.1
[BSW00416] Sequence of Initialization	n/a (sequence is defined by ComM)
[BSW00406] Check module initialization	Ok; see chapter 7.19
[BSW168] Diagnostic Interface of SW components	n/a (diagnostics for CanNm not required)
[BSW00407] Function to read out published parameters	Ok; see chapter 10.3.5

[BSW00423] Usage of SW-C template to describe BSW modules with AUTOSAR Interfaces	n/a (CanNm has no interface to the RTE)
[BSW00424] BSW main processing function task allocation	n/a (CanNm scheduled function is called by the BSW scheduler)
[BSW00425] Trigger conditions for schedulable objects	n/a (implementation specific)
[BSW00426] Exclusive areas in BSW modules	n/a (implementation specific)
[BSW00427] ISR description for BSW modules	n/a (implementation specific)
[BSW00428] Execution order dependencies of main processing functions	Ok; see chapter 7.17
[BSW00429] Restricted BSW OS functionality access	n/a (none of these services are used by the CanNm)
[BSW00431] The BSW Scheduler module implements task bodies	Ok; see chapter 7.17
[BSW00432] Modules should have separate main processing functions for read/receive and write/transmit data path	n/a (transmission and reception is handled in CanNm_MainFunction)
[BSW00433] Calling of main processing functions	Ok; see chapter 7.17
[BSW00434] The Schedule Module shall provide an API for exclusive areas	n/a (implementation specific)
[BSW00336] Shutdown interface	n/a (no shutdown interface needed)
[BSW00337] Classification of errors	Ok; see chapter 7.14
[BSW00338] Detection and Reporting of development errors	Ok; see chapter 7.14 and 10.2
[BSW00369] Do not return development error codes via API	Ok; see chapter 7.19
[BSW00339] Reporting of production relevant error status	Ok; see chapter 7.14
[BSW00417] Reporting of Error Events by Non-Basic Software	n/a (CanNm is no SW-C)
[BSW00323] API parameter checking	Ok; see CANNM243, CANNM244
[BSW004] Version check	Ok;
[BSW00409] Header files for production code error IDs	Ok; see CANNM207
[BSW00385] List possible error notifications	Ok; see 7.14
[BSW00386] Configuration for detecting an error	Ok: CANNM_DEV_ERROR_DETECT
[BSW161] Microcontroller abstraction	n/a (CanNm microcontroller independent)
[BSW162] ECU layout abstraction	n/a (CanNm is ECU hardware independent)
[BSW005] No hard coded horizontal interfaces within MCAL	n/a (CanNm is not part of the MCAL)
[BSW00415] User dependent include files	n/a (not flexible with respect to future extensions)
[BSW164] Implementation of interrupt service routines	n/a (no ISR provided)
[BSW00325] Runtime of interrupt service routines	n/a (no ISR provided)
[BSW00326] Transition from ISRs to OS tasks	n/a (no ISR provided)
[BSW00342] Usage of source code and object code	Ok; see chapter 10.2.1
[BSW00343] Specification and configuration of time	Ok; see chapter 10.2
[BSW160] Human-readable configuration data	n/a (implementation specific)

[BSW007] HIS MISRA C	Ok; all implementation related information
[BSW00300] Module naming convention	Ok; CanNm prefix is used
[BSW00413] Accessing instances of BSW modules	n/a (implementation specific)
[BSW00347] Naming separation of different instances of BSW drivers	n/a (implementation specific)
[BSW00305] Self-defined data types naming convention	n/a (no self-defined data types used)
[BSW00307] Global variables naming convention	n/a (no global variables specified)
[BSW00310] API naming convention	Ok; see chapter 7.19
[BSW00373] Main processing function naming convention	Ok; see chapter 8.6.1
[BSW00327] Error values naming convention	Ok; see chapter 7.14
[BSW00335] Status values naming convention	n/a (no status values exported)
[BSW00350] Development error detection keyword	Ok; see chapter 8.8
[BSW00408] Configuration parameter naming convention	Ok; see chapter 10.2
[BSW00410] Compiler switches shall have defined values	n/a (CanNm is compiler independent)
[BSW00411] Get version info keyword	Ok; see chapter 8.3.15
[BSW00346] Basic set of module files	Ok; see CANNM299, CANNM300, CANNM301, CANNM302, CANNM303, CANNM304
[BSW158] Separation of configuration from implementation	Ok; see CANNM299, CANNM300, CANNM301, CANNM302, CANNM303, CANNM304
[BSW00314] Separation of interrupt frames and service routines	n/a (CanNm doesn't have interrupt frame definitions)
[BSW00370] Separation of callback interface from API	Ok; see CANNM303CANNM044
[BSW00348] Standard type header	Ok; see CANNM305
[BSW00353] Platform specific type header	Ok; see CANNM305
[BSW00361] Compiler specific language extension header	Ok; see CANNM305
[BSW00301] Limit imported information	Ok; see CANNM305, CANNM306, CANNM307, CANNM308, CANNM309, CANNM310 CANNM311, CANNM312, CANNM313
[BSW00302] Limit exported information	Ok; see CANNM302 and chapter 7.19
[BSW00328] Avoid duplication of code	n/a (implementation specific)
[BSW00312] Shared code shall be reentrant	n/a (implementation specific)
[BSW006] Platform independency	n/a (CanNm is hardware independent)
[BSW00357] Standard API return type	Ok; see chapter 7.19
[BSW00377] Module specific API return types	n/a (CanNm doesn't define own types)
[BSW00304] AUTOSAR integer data types	Ok; see chapter 7.19
[BSW00355] Do not redefine AUTOSAR integer data types	Ok; see chapter 7.19
[BSW00378] AUTOSAR boolean type	Ok; see chapter 7.19 and 10.2
[BSW00306] Avoid direct use of compiler and platform specific keywords	n/a (implementation specific)
[BSW00308] Definition of global data	Ok; see CANNM299, CANNM300, CANNM301
[BSW00309] Global data with read-only constraint	n/a (implementation specific)

[BSW00371] Do not pass function pointers via API	Ok; see chapter 7.19
[BSW00358] Return type of init() functions	Ok; see chapter 8.3.1
[BSW00414] Parameter of init function	Ok; see chapter 8.3.1
[BSW00376] Return type and parameters of main processing functions	Ok; see chapter 8.6.1
[BSW00359] Return type of callback functions	Ok; see chapter 8.4
[BSW00360] Parameters of callback functions	Ok; see chapter 8.4
[BSW00329] Avoidance of generic interfaces	Ok; see chapter 7.19
[BSW00330] Usage of macros / inline functions instead of functions	n/a (implementation specific)
[BSW00331] Separation of error and status values	n/a (CanNm doesn't provide status information)
[BSW009] Module User Documentation	Ok; see whole document
[BSW00401] Documentation of multiple instances of configuration parameters	Ok; see chapter 10.2
[BSW172] Compatibility and documentation of scheduling strategy	n/a (implementation specific)
[BSW010] Memory resource documentation	n/a (implementation specific)
[BSW00333] Documentation of callback function context	n/a (implementation specific)
[BSW00374] Module vendor identification	Ok; see chapter 10.3.5
[BSW00379] Module identification	Ok; see chapter 10.3.5
[BSW003] Version identification	Ok; see chapter 10.3.5
[BSW00318] Format of module version numbers	Ok; see chapter 10.3.5
[BSW00321] Enumeration of module version numbers	n/a (implementation specific)
[BSW00341] Microcontroller compatibility documentation	n/a (CanNm is microcontroller independent)
[BSW00334] Provision of XML file	n/a (implementation specific)
[BSW02516] Bus Synchronization on demand	Ok; see CANNM226, CANNM130, CANNM280

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Requirement	***Satisfied by***
[BSW150] Configuration of functionality	Ok; see chapter 10.2
[BSW151] Integration into running NM cluster	n/a (The CAN bus satisfies already this requirement)
[BSW043] Bus Traffic without NM Initialization	n/a (ComM is responsible to initialize the communication components)
[BSW044] Applicability to different types of communication systems	Ok; see chapter 4.2
[BSW045] NM-cluster Independent Shutdown Coordination	Ok; see chapter 7.19
[BSW046] Trigger of startup of all Nodes at any Point in Time	n/a (not in the responsibility of CanNm)
[BSW047] Bus Keep Awake Services	Ok; see chapter 8.3.6
[BSW048] Bus Sleep Mode	n/a (not in the responsibility of CanNm)
[BSW050] NM State Information	n/a (application can determine the Nm states using ComM API)
[BSW051] NM State Change Indication	Ok; see chapter 8.7.1

[BSW052] Notification that all other ECUs are ready to sleep	n/a (not in the responsibility of CanNm)
[BSW02509] Notification that at least one other node is not ready to sleep anymore	n/a (not in the responsibility of CanNm)
[BSW02503] Sending user data	Ok; see chapter 8.3.7
[BSW02504] Receiving user data	Ok; see chapter 8.3.8
[BSW153] Detection of present nodes	n/a (not in the responsibility of CanNm)
[BSW02508] Unambiguous node identification per bus	Ok; see chapter 8.3.11
[BSW02505] Sending node identifier	Ok; see chapter 7.12
[BSW02506] Receiving node identifier	Ok; see chapter 0
[BSW02511] Configurable Role in Cluster Shutdown	Ok; see 7.8.3
[BSW053] Deterministic Behavior in Case of Bus Unavailability	Ok; see chapter 7.11
[BSW137] Communication system error handling	Ok; see chapter 7.11
[BSW136] Coordination of coupled networks	n/a (not in the scope of CanNm)
[BSW140] Compliance with OSEK NM on a gateway	n/a (not in the scope of CanNm)
[BSW054] Deterministic Time for Bus Sleep	n/a (not in the scope of CanNm)
[BSW142] Limitation of NM bus load	Ok; see chapter 7.7
[BSW143] Predictable NM bus load	Ok; see chapter 7.6.1
[BSW144] ECU cluster size	n/a (CanNm hasn't any restriction concerning cluster size)
[BSW145] Robustness against NM message losses	CanNm is robust against loss of NM messages for a time specified by CANNM_TIMEOUT_TIME.
[BSW146] Robustness against NM message jitter	CanNm is robust against jitter of NM messages for up to a time specified by CANNM_TIMEOUT_TIME.
[BSW147] Processor independent algorithm	n/a (not in the responsibility of CanNm)
[BSW149] Configurable Timing	Ok; see chapter 10.2
[BSW154] Bus independency of API	n/a (CanNm has to be bus dependent)
[BSW148] Separation of Communication system dependent parts	Ok; see whole document
[BSW139] Compliance with OSEK NM on one cluster	n/a (not in the scope of CanNm)
[BSW02510] Immediate Transmission Confirmation	Ok; see chapter 8.4.1
[BSW02512] CommunicationControl (28 hex) service support	Ok; CANNM215 and CANNM216

7 Functional specification

7.1 Coordination algorithm

The AUTOSAR CanNm is based on decentralized direct network management strategy, which means that every network node performs activities self-sufficient depending on the Network Management PDUs only that are received or transmitted within the communication system.

The AUTOSAR CanNm algorithm is based on periodic Network Management PDUs, which are received by all nodes in the cluster via broadcast transmission. Reception of Network Management PDUs indicates that sending nodes want to keep the network management cluster awake. If any node is ready to go to the Bus-Sleep Mode, it stops sending Network Management PDUs, but as long as Network Management PDUs from other nodes are received, it postpones transition to the Bus-Sleep Mode. Finally, if a dedicated timer elapses because no Network Management PDUs are received anymore, every node initiates transition to the Bus-Sleep Mode.

If any node in the network management cluster requires bus-communication, it can wake-up the network management cluster from the Bus-Sleep Mode by transmitting Network Management PDUs. For more details concerning wakeup procedure itself please refer to [10].

The main concept of the AUTOSAR CanNm algorithm can be defined by the following two key-requirements:

[CANNM087] ⌈Every network node in a CanNm cluster shall transmit periodic Network Management PDUs as long as it requires bus-communication; otherwise it shall transmit no Network Management PDUs.⌋()

[CANNM088] ⌈If bus communication in a CanNm cluster is released and there are no Network Management PDUs on the bus for a configurable amount of time determined by `CANNM_TIMEOUT_TIME` + `CANNM_WAIT_BUS_SLEEP_TIME` (both configuration parameters) transition into the Bus-Sleep Mode shall be performed.⌋()

The overall state machine of the AUTOSAR CanNm algorithm can be defined as follows:

[CANNM089] ⌈The AUTOSAR CanNm state machine shall contain states, transitions and triggers required for the AUTOSAR CanNm algorithm seen from point of view of one single node in the network management cluster.⌋()

Note: An UML state chart of the AUTOSAR CanNm state machine from point of view of one single node in the network management cluster can be found in detail in the API specification chapter 8).

7.2 Operational Modes

In the following chapter operational modes of the AUTOSAR CanNm algorithm are described in detail.

[CANNM092] ⌈The AUTOSAR CanNm shall contain three operational modes visible at the module's interface:

- Network Mode
- Prepare Bus-Sleep Mode
- Bus-Sleep Mode⌋()

[CANNM093] ⌈Changes of the AUTOSAR CanNm operational modes shall be notified to the upper layer by means of callback functions.⌋()

7.2.1 Network Mode

[CANNM094] ⌈The Network Mode shall consist of three internal states:

- Repeat Message State
- Normal Operation State
- Ready Sleep State⌋()

[CANNM314] ⌈When the Network Mode is entered from Bus-Sleep, by default, the CanNm module shall enter the Repeat Message State.⌋()

[CANNM315] ⌈When the Network Mode is entered from Prepare Bus-Sleep Mode, by default, the CanNm module shall enter the Repeat Message State.⌋()

[CANNM096] ⌈When the Network Mode is entered, the CanNm module shall start the NM-Timeout Timer.⌋()

[CANNM097] ⌈When the Network Mode is entered, CanNm shall notify the upper layer of the new current operational mode by calling the callback function `Nm_NetworkMode`.⌋()

[CANNM098] ⌈At successful reception of a Network Management PDU (call of `CanNm_RxIndication`) in the Network Mode, the CanNm module shall restart the NM-Timeout Timer.⌋()

[CANNM099] ⌈At successful transmission of a Network Management PDU (call of `CanNm_TxConfirmation`) in the Network Mode, the CanNm module shall restart the NM-Timeout Timer.⌋()

Note: If `CANNM_IMMEDIATE_TXCONF_ENABLED` is enabled it is assumed that each Network Management PDU transmission request results in a successful Network Management PDU transmission.

[CANNM206] ⌈The CAN NM module shall reset the NM-Timeout Timer every time it is started or restarted.⌋()

7.2.1.1 Repeat Message State

For nodes that are not in passive mode (refer to chapter 7.8.3) the Repeat Message State ensures, that any transition from Bus-Sleep or Prepare Bus-Sleep to the Network Mode becomes visible to the other nodes on the network. Additionally it ensures that any node stays active for a minimum amount of time. It can be used for detection of present nodes.

[CANNM100] ⌈When the Repeat Message State is entered from Bus-Sleep Mode, Prepare-Bus-Sleep Mode, Normal Operation State or Ready Sleep State, the CanNm module shall start transmission of Network Management PDUs unless passive mode is enabled and/or communication is disabled.⌋()

[CANNM101] ⌈When the NM-Timeout Timer expires in the Repeat Message State, the CanNm module shall start the NM-Timeout Timer.⌋()

[CANNM102] ⌈The network management state machine shall stay in the Repeat Message State for a configurable amount of time determined by the `CANNM_REPEAT_MESSAGE_TIME` (configuration parameter); after that time the CanNm module shall leave the Repeat Message State.⌋()

[CANNM103] ⌈When Repeat Message State is left and if the network has been requested (see CANNM104), the CanNm module shall enter the Normal Operation State.⌋()

[CANNM106] ⌈When Repeat Message State is left and if the network has been released (see CANNM105), the CanNm module shall enter the Ready Sleep State.⌋()

[CANNM107] ⌈When Repeat Message State is left and if the option `CANNM_NODE_DETECTION_ENABLED` is enabled, the CanNm module shall clear the Repeat Message Bit.⌋()

[CANNM137] ⌈If the service `CanNm_RepeatMessageRequest` is called in Repeat Message State, Prepare Bus-Sleep Mode or Bus-Sleep Mode, the CanNm module shall not execute the service and return `E_NOT_OK`.⌋()

7.2.1.2 Normal Operation State

The Normal Operation State ensures that any node can keep the network management cluster awake as long as the network is requested.

[CANNM116] ⌈When the Normal Operation State is entered from Ready Sleep State, the CanNm module shall start transmission of Network Management PDUs.⌋()

Note: If passive mode is enabled or the Network Management PDU transmission ability has been disabled no NM PDUs are transmitted, therefore no action is required.

[CANNM117] ⌈When the NM-Timeout Timer expires in the Normal Operation State, the CanNm module shall start the NM-Timeout Timer.⌋()

[CANNM118] ⌈When the network is released and the current state is Normal Operation State, the CanNm module shall enter the Ready Sleep state (refer to CANNM105).⌋()

[CANNM119] ⌈At Repeat Message Request Bit Indication in the Normal Operation State, the CanNm module shall enter the Repeat Message State.⌋()

[CANNM120] ⌈At Repeat Message Request (`CanNm_RepeatMessageRequest`) in the Normal Operation State, the CanNm module shall enter the Repeat Message State.⌋()

[CANNM121] ⌈At Repeat Message Request (`CanNm_RepeatMessageRequest`) in the Normal Operation State the CanNm module shall set the Repeat Message Bit.⌋()

7.2.1.3 Ready Sleep State

The Ready Sleep State ensures that any node in the network management cluster waits with transition to the Prepare Bus-Sleep Mode as long as any other node keeps the network management cluster awake.

[CANNM108] ⌈When the Ready Sleep State is entered from Repeat Message State or Normal Operation State, the CanNm module shall stop transmission of Network Management PDUs.⌋()

Note: If passive mode is enabled no NM PDUs are transmitted, therefore no action is required.

[CANNM109] ⌈When the NM-Timeout Timer expires in the Ready Sleep State, the CanNm module shall enter the Prepare Bus-Sleep Mode.⌋()

[CANNM110] ⌈When the network is requested and the current state is the Ready Sleep State, the CanNm module shall enter Normal Operation State (refer to CANNM104).⌋()

[CANNM111] ⌈At Repeat Message Request Bit Indication in the Ready Sleep State, the CanNm module shall enter the Repeat Message State.⌋()

[CANNM112] ⌈At Repeat Message Request (`CanNm_RepeatMessageRequest`) in the Ready Sleep State, the CanNm module shall enter the Repeat Message State.⌋()

[CANNM113] ⌈At Repeat Message Request (CanNm_RepeatMessageRequest) in Ready Sleep State the CanNm module shall set the Repeat Message Bit.⌋()

7.2.2 Prepare Bus-Sleep Mode

The purpose of the Prepare Bus-Sleep Mode is to ensure that all nodes have time to stop their network activity before the Bus-Sleep Mode is entered. In Prepare Bus-Sleep Mode the bus activity is calmed down (i.e. queued messages are transmitted in order to make all Tx-buffers empty) and finally there is no activity on the bus in the Prepare Bus-Sleep Mode.

[CANNM114] ⌈When Prepare Bus-Sleep Mode is entered, the CanNm module shall notify the upper layer by calling `Nm_PrepareBusSleepMode`.⌋()

[CANNM115] ⌈The CanNm module shall stay in the Prepare Bus-Sleep Mode for a configurable amount of time determined by the `CANNM_WAIT_BUS_SLEEP_TIME` (configuration parameter); after that time the Prepare Bus-Sleep Mode shall be left and the Bus-Sleep Mode shall be entered.⌋()

[CANNM124] ⌈At successful reception of a Network Management PDU in the Prepare Bus-Sleep Mode, the CanNm Module shall enter the Network Mode; by default the CanNm Module shall enter the Repeat Message State (refer to CANNM315).⌋()

[CANNM123] ⌈When the network is requested in the Prepare Bus-Sleep Mode, the CanNm module shall enter the Network Mode; by default the CanNm Module shall enter the Repeat Message State (refer to CANNM315).⌋()

[CANNM122] ⌈When the network has been requested in the Prepare Bus-Sleep Mode and the CanNm module has entered Network Mode and if `CANNM_IMMEDIATE_RESTART_ENABLED` (configuration parameter) is set to TRUE, the CanNm module shall transmit a Network Management PDU.⌋()

Rationale: Other nodes in the cluster are still in Prepare Bus-Sleep Mode; in the exceptional situation described above transition into the Bus-Sleep Mode shall be avoided and bus-communication shall be restored as fast as possible.
Caused by the transmission offset for Network Management PDUs in CanNm, the transmission of the first Network Management PDU in Repeat Message State can be delayed significantly. In order to avoid a delayed re-start of the network the transmission of a Network Management PDU can be requested immediately.

Note: If `CANNM_IMMEDIATE_RESTART_ENABLED` is set to TRUE and a wake-up line is used, a burst of Network Management PDUs occurs if all network nodes get a network request in Prepare Bus-Sleep Mode.

7.2.3 Bus-Sleep Mode

The purpose of the Bus-Sleep Mode is to reduce power consumption in the node when no messages are to be exchanged. The communication controller is switched into the sleep mode, respective wakeup mechanisms are activated and finally power consumption is reduced to the adequate level in the Bus-Sleep Mode.

If a configurable amount of time determined by the `CANNM_TIMEOUT_TIME` + `CANNM_WAIT_BUS_SLEEP_TIME` (both configuration parameters) is identically configured for all nodes in the network management cluster, all nodes in the network management cluster that are coordinated with use of the AUTOSAR NM algorithm perform the transition into the Bus-Sleep Mode at approximately the same time.

Note: The parameters `CANNM_TIMEOUT_TIME` and `CANNM_WAIT_BUS_SLEEP_TIME` should have the same values within all network nodes of the network management cluster.
Depending on the specific implementation, transition into the Bus-Sleep Mode takes place exactly or approximately at the same time; time jitter for this transition depends on the following factors:

- internal clock precision (oscillator's drift),

- NM-task cycle time (if tasks are not synchronized with a global time),
- Network Management PDU waiting time in the Tx-queue (if transmission confirmation is made immediately after transmit request).

In the best case only oscillator's drift should be taken into account for a configurable amount of time determined by the value `CANNM_TIMEOUT_TIME` + `CANNM_WAIT_BUS_SLEEP_TIME` (both configuration parameters).

[CANNM126] ⌈When Bus-Sleep Mode is entered, except by default at initialization, the CanNm module shall notify the upper layer by calling the callback function `Nm_BusSleepMode`.⌋()

[CANNM127] ⌈When the CanNm module receives successfully Network Management PDU (call of `CanNm_RxIndication`) in the Bus-Sleep Mode, the CanNm module shall notify the upper layer by calling the callback function `Nm_NetworkStartIndication`.⌋()

[CANNM336] ⌈When the CanNm module successfully receives a Network Management PDU (call of `CanNm_RxIndication`) in the Bus-Sleep Mode, the CanNm module shall report the error `CANNM_E_NET_START_IND` if development error tracing is enabled (`CANNM_DEV_ERROR_DETECT` is set to `TRUE`).⌋()

Rationale: To avoid race conditions and state inconsistencies between Network and Mode Management, CanNm will not automatically perform the transition from Bus-Sleep Mode to Network Mode. CanNm will only inform the upper layers which have to make the wake-up decision. Network Management PDU reception in Bus-Sleep Mode must be handled depending on the current state of the ECU shutdown/startup process.

[CANNM128] ⌈If `CanNm_PassiveStartUp` is called in the Bus-Sleep Mode, the CanNm module shall enter the Network Mode; by default the CanNm module shall enter the Repeat Message State (refer to CANNM314 CANNM095 and CANNM104).⌋()

Note: In the Prepare Bus-Sleep Mode and Bus-Sleep Mode is assumed that the network is released, unless bus communication is explicitly requested.

[CANNM129] ⌈When the network is requested in Bus-Sleep Mode, the CanNm module shall enter the Network Mode; by default the CanNm module shall enter the Repeat Message State (refer to CANNM314 and CANNM104).⌋()

7.3 Network states

Network states (i.e. ‘requested’ and ‘released’) are two additional states of the AUTOSAR CanNm state machine that exist in parallel to the state machine. Network states denote, whether the software components need to communicate on the bus (the network state is then ‘requested’); or whether the software components don’t have to communicate on the bus (the bus network state is then ‘released’); note that if the network is released an ECU may still communicate because some other ECU still request the network.

[CANNM104] ⌈The function call `CanNm_NetworkRequest` shall request the network. I.e. the CanNm module shall change network state to ‘requested’.⌋()

[CANNM105] ⌈The function call `CanNm_NetworkRelease` shall release the network. I.e. the CanNm module shall change network state to ‘released’.⌋()

7.4 Initialization

[CANNM141] ⌈If the initialization of the CanNm module (`CanNm_Init`) is successful, the CanNm module shall set the Network Management State to `NM_STATE_BUS_SLEEP`.⌋()

Note: The CanNm module should be initialized after CanIf is initialized and before any other network management service is called.

[CANNM143] ⌈When initialized, by default, the CanNm module shall set the network state to ‘released’⌋()

[CANNM144] ⌈When initialized, by default, the CanNm module shall enter the Bus-Sleep Mode.⌋()

[CANNM145] ⌈If AUTOSAR CanNm is not initialized the CanNm module shall not prohibit bus traffic.⌋()

[CANNM147] ⌈If `CanNm_PassiveStartUp` is called in the Prepare Bus-Sleep Mode or Network Mode, the CanNm module shall not execute this service and shall return `E_NOT_OK`.⌋()

[CANNM060] ⌈The function CanNm_Init shall select the active configuration set by means of a configuration pointer parameter being passed (see 8.3.1).⌋()

[CANNM061] 「After initialization the CanNm module shall stop the NM Message Tx Timeout Timer.」()

Note: The NM Message Tx Timeout Timer is not needed in case of `CANNM_IMMEDIATE_TXCONF_ENABLED` is set to TRUE or if `CANNM_PASSIVE_MODE_ENABLED` is set to TRUE.

[CANNM023]During initialization the CanNm module shall deactivate the bus load reduction.」()

[CANNM033]「 After initialization the CanNm module shall stop the transmission of Network Management PDUs by stopping the Message Cycle Timer.」()

Note: If `CANNM_PASSIVE_MODE_ENABLED` is set to TRUE the CanNm Message Cycle is not needed, because no Network Management PDUs are transmitted by such nodes.

[CANNM039] 「If CanNm is not initialized a call of any CanNm function (except `CanNm_Init`) shall be rejected and `E_NOT_OK` shall be returned if the API has a return value. If development error detection is enabled it shall report `CANNM_E_NO_INIT` to the Development Error Tracer.」()

[CANNM025] During initialization the CanNm module shall set each byte of the user data to `0xFF`.」()

[CANNM085]「During initialization the CanNm module shall set the Control Bit Vector to `0x00`.」()

7.5 Execution

7.5.1 Processor architecture

[CANNM146]「The AUTOSAR CanNm algorithm shall be processor independent, which means; it shall not rely on any processor specific hardware support and thus shall be realizable on any processor architecture that is in the scope of AUTOSAR.」()

7.5.2 Timing parameters

[CANNM246]「The configuration parameter `CANNM_TIMEOUT_TIME` shall determine the AUTOSAR CanNm timing parameter NM-Timeout Time.」()

[CANNM247] ⌈The configuration parameter CANNM_REPEAT_MESSAGE_TIME shall determine the AUTOSAR CanNm timing parameter Repeat Message Time.⌋()

[CANNM248] ⌈The configuration parameter CANNM_WAIT_BUS_SLEEP_TIME shall determine the AUTOSAR CanNm timing parameter Wait Bus-Sleep Time.⌋()

[CANNM249] ⌈The configuration parameter CANNM_REMOTE_SLEEP_IND_TIME shall determine the AUTOSAR CanNm timing parameter Remote Sleep Indication Time.⌋()

7.6 Communication Scheduling

7.6.1 Transmission

Note: The transmission mechanisms described in this chapter are only relevant if the Network Management PDU transmission ability is enabled.

[CANNM072] ⌈The Network Management PDUs transmission capability shall be configurable by means of CANNM_PASSIVE_MODE_ENABLED (see chapter 10.2).⌋()

Note: Passive nodes don't transmit Network Management PDUs, i.e. they cannot actively influence the shut down decision, but they do receive Network Management PDU in order to be able to shut down synchronous.

Note: The transmission mechanisms described in this chapter are only relevant if CANNM_PASSIVE_MODE_ENABLED is FALSE.

[CANNM237] ⌈The CanNm module shall provide the periodic transmission mode. In this transmission mode the CanNm module shall send Network Management PDUs periodically.⌋()

[CANNM238] ⌈The CanNm module may provide the periodic transmission mode with bus load reduction. In this transmission mode the CanNm module shall transmit Network Management PDUs due to a specific algorithm.⌋()

The periodic transmission mode with bus load reduction ensures a reduced bus load.

Note: The periodic transmission mode is used in the "Repeat Message State" and "Normal Operation State" if the bus load reduction mechanism is disabled.
The periodic transmission mode with bus load reduction is only used, in the "Normal Operation State" if the bus load reduction mechanism is enabled.

[CANNM071] 「The immediate transmission confirmation mechanism shall be configurable by means of the `CANNM_IMMEDIATE_TXCONF_ENABLED` (see 10.2).」()

Note: The immediate transmission confirmation mechanism is used for systems which don't want to use the actual confirmation from the CanIf.

Rationale: If the bus access is completely regulated through an offline system design tool, the actual transmit confirmation by CanIf can be regarded as redundant. Since the maximum arbitration time is assumed to be known it is acceptable to immediately raise the confirmation at the transmission request time.

[CANNM005] 「When entering the Repeat Message State from Ready Sleep State or Bus Sleep State, the transmission of the first NM PDU shall be delayed by the time indicated by `CANNM_MSG_CYCLE_OFFSET` in order to avoid bursts of NM messages if `CanNmImmediateNmTransmissions` is zero.」()

[CANNM334] 「When entering the RepeatMessage state from BusSleep state or PrepareBusSleep state because of `CanNm_NetworkRequest()` (active wakeup) and if `CanNmImmediateNmTransmissions` is greater zero, the NM PDUs shall be transmitted using `CanNmImmediateNmCycleTime` as cycle time. The transmission of the first NM PDU shall be triggered as soon as possible. After the transmission the Message Cycle Timer shall be reloaded with `CanNmImmediateNmCycleTime`. The `CanNmMsgCycleOffset` shall not be applied in this case.」()

[CANNM335] 「The number of NM PDUs transmitted with the cycle time `CanNmImmediateNmCycleTime` is defined by `CanNmImmediateNmTransmissions` (counter). After all immediate NM PDUs have been transmitted the CanNm shall start waiting the time configured by `CanNmMsgCycleOffset` before starting transmission using the cycle time `CanNmMsgCycleTime`.」()

Note: While transmitting NM PDUs using the `CanNmImmediateNmCycleTime` no other Nm messages shall be transmitted (i.e. the `CanNmMsgCycleTime` transmission cycle is stopped).

[CANNM032] 「 If transmission of Network Management PDUs has been started and the CanNm Message Cycle Timer expires the CanNm module shall transmit a Network Management PDU by calling the CanIf function `CanIf_Transmit`.」()

Note: If the function call of `CanIf_Transmit` fails the Transmission Error handling described in chapter 7.11 informs the CanNm module.

[CANNM040] 「If the CanNm Message Cycle Timer expires the CanNm module shall restart with `CANNM_MSG_CYCLE_TIME`.」()

Note: If a Network Management PDU has been successfully transmitted the function `CanNm_TxConfirmation` shall be called by CanIf if `CANNM_IMMEDIATE_TXCONF_ENABLED` (configuration parameter) is disabled.

[CANNM051] 「If transmission of Network Management PDUs has been stopped the CanNm module shall cancel the Message Cycle Timer.」()

7.6.2 Reception

If a NM message has been successfully received, the CanIf module will call the callback function `CanNm_RxIndication`.

[CANNM035] 「On the call of the callback function `CanNm_RxIndication`, the CanNm module shall copy the data of the Network Management PDU referenced in the function parameter to an internal buffer.」()

7.7 Bus Load Reduction Mechanism

The transmission period of Network Management PDUs is usually determined by the timing parameter `CANNM_MSG_CYCLE_TIME`. This parameter has to be equal for all NM nodes which belong to a network management cluster. Without any action this would lead to a bus load which depends on the amount of members of the network management cluster. Even if bursts are prevented through a node specific timing parameter called `CANNM_MSG_CYCLE_OFFSET` a mechanism is necessary which reduces the bus load independently of the size of the network management cluster.

In order to achieve that the following two aspects have to be considered:

1. If a Network Management PDU is received the CanNm Message Cycle Timer is reloaded with the node specific timing parameter `CANNM_MSG_REDUCED_TIME`. The node specific time `CANNM_MSG_REDUCED_TIME` should be greater than ½ `CANNM_MSG_CYCLE_TIME` and less than `CANNM_MSG_CYCLE_TIME`.

2. If a Network Management PDU is been transmitted the CanNm Message Cycle Timer is reloaded with the network management cluster specific timing parameter `CANNM_MSG_CYCLE_TIME`.

This leads to the following behavior:
Only the two nodes with the smallest `CANNM_MSG_REDUCED_TIME` time transmit alternating Network Management PDUs on the network. If one of the nodes stops transmission, the node with the next smallest `CANNM_MSG_REDUCED_TIME` time will start to transmit Network Management PDUs. If there is only one node on the network that

requires bus communication, one Network Management PDU per CANNM_MSG_CYCLE_TIME is transmitted.

The algorithm ensures that the bus load is limited to a maximum two Network Management PDUs per CANNM_MSG_CYCLE_TIME.

An example can be found in chapter 11.

[CANNM052] ⌈The bus load reduction mechanism shall be statically configurable by means of the CANNM_BUS_LOAD_REDUCTION_ENABLED parameter (see 10.2).⌋()

[CANNM156] ⌈When the Repeat Message State is entered from Bus-Sleep Mode, Prepare Bus-Sleep Mode, Normal Operation or Ready Sleep State the CanNm module shall deactivate the busload reduction.⌋()

[CANNM157] ⌈When the Normal Operation State is entered from Repeat Message State or Ready Sleep State and CANNM_BUS_LOAD_REDUCTION_ENABLED is TRUE the CanNm module shall activate the busload reduction.⌋()

[CANNM069] ⌈If the bus load reduction mechanism is globally enabled (CANNM_BUS_LOAD_REDUCTION_ENABLED is TRUE), for a particular channel activated and the function CanNm_RxIndication is called for this channel, the CanNm module shall restart the CanNm Message Cycle Timer with the node specific time CANNM_MSG_REDUCED_TIME.⌋()

7.8 Additional features

7.8.1 Detection of Remote Sleep Indication

The “Remote Sleep Indication” denotes a situation, where a node in Normal Operations States finds all other nodes in the cluster are ready to sleep (in Ready-Seep State). The node in Normal Operation State will still keep the bus awake.

[CANNM149] ⌈Detection of remote sleep indication shall be statically configurable with use of the CANNM_REMOTE_SLEEP_IND_ENABLED switch (configuration parameter).⌋()

[CANNM150] ⌈If the CanNm module receives no Network Management PDUs in the Normal Operation State for a configurable amount of time determined by CANNM_REMOTE_SLEEP_IND_TIME (configuration parameter), the CanNm module shall call the callback function Nm_RemoteSleepIndication.⌋()

With a call of Nm_RemoteSleepIndication CanNm notifies the module Nm that all nodes in the cluster are ready to sleep (the so-called 'Remote Sleep Indication').

[CANNM151] ⌈If Remote Sleep Indication has been previously detected and if a Network Management PDU is received in the Normal Operation State or Ready Sleep State again, the module CanNm shall call the callback function Nm_RemoteSleepCancellation.⌋()

[CANNM152] ⌈If Remote Sleep Indication has been previously detected and if Repeat Message State is entered from Normal Operation State or Ready Sleep State, the module CanNm shall call the callback function Nm_RemoteSleepCancellation.⌋()

With a call of Nm_RemoteSleepCancellation CanNm notifies the module Nm that some nodes in the cluster are not ready to sleep anymore (the so-called 'Remote Sleep Cancellation').

[CANNM154] ⌈When the service CanNm_CheckRemoteSleepIndication is called and the state is Bus-Sleep Mode, Prepare Bus-Sleep Mode or Repeat Message State the CanNm module shall not execute the service and shall return E_NOT_OK.⌋()

7.8.2 User Data

[CANNM158] ⌈Support of NM user data shall be statically configurable with use of the CANNM_USER_DATA_ENABLED switch (configuration parameter).⌋()

[CANNM159] ⌈When CanNm_SetUserData is called the CanNm module shall set the Network Management user data for the Network Management PDUs transmitted next on the bus.⌋()

[CANNM160] ⌈When CanNm_GetUserData is called CanNm module shall return the Network Management user data of the most recently received Network Management PDU.⌋()

Note: If user data is configured it will be sent for sure in the Repeat Message State. In the Normal Operation State it depends on he configuration of busload reduction whether the user data is sent. In the Ready Sleep State the user data will not be sent.

7.8.2.1 COM User Data

Alternatively to the usage of the CanNm APIs to set and get user data, CanNm may use the COM to retrieve its user data.

[CANNM327] ⌈If `CanNmComUserDataSupport` is enabled the API `CanNm_SetUserData` shall not be available.⌋()

[CANNM328] ⌈If `CanNmComUserDataSupport` is enabled the CanNm shall collect the NM User Data from the referenced NM I-PDU by calling `PduR_CanNmTriggerTransmit` and combine the user data with the further NM bytes each time before it requests the transmission of the corresponding NM message.⌋()

[CANNM329] ⌈If `CanNmComUserDataSupport` is enabled the CanNm shall call `PduR_CanNmTxConfirmation` within the message transmission confirmation function `CanNm_TxConfirmation` called by the CanIf.⌋()

[CANNM332] ⌈If `CanNmComUserDataSupport` is enabled and the CanNm User Data length does not match with the length of the referenced I-PDU an error shall be reported at generation time.⌋()

7.8.3 Passive Mode

In the Passive Mode the node is only receiving Network Management PDUs but not transmitting any Network Management PDUs.

[CANNM161] ⌈Passive Mode shall be statically configurable with use of the `CANNM_PASSIVE_MODE_ENABLED` switch (configuration parameter).⌋()

[CANNM162] ⌈Passive Mode shall be statically configured for all instances.⌋()

[CANNM163] ⌈If Passive Mode is used (configuration parameter `CANNM_PASSIVE_MODE_ENABLED`) the following configurations options shall be disabled:

- Bus Synchronization
  (configuration parameter `CANNM_BUS_SYNCHRONIZATION_ENABLED`)
- Bus Load Reduction
  (configuration parameter `CANNM_BUS_LOAD_REDUCTION_ENABLED`)
- Remote Sleep Indication
  (configuration parameter `CANNM_REMOTE_SLEEP_IND_ENABLED`)
- Node Detection
  (configuration parameter `CANNM_NODE_DETECTION_ENABLED`)⌋()

7.8.4 Network Management PDU Rx Indication

[CANNM037] ⌈On the call of the callback function `CanNm_RxIndication`, the CanNm module shall call the Nm callback function `Nm_PduRxIndication`, if and only if `CANNM_PDU_RX_INDICATION_ENABLED` (configuration parameter) is set to TRUE.⌋()

7.8.5 State change notification

[CANNM166] ⌈All changes of the AUTOSAR CanNm states shall be notified to the upper layer by calling `Nm_StateChangeNotification` if the callback `Nm_StateChangeNotification` is enabled (configuration parameter `CANNM_STATE_CHANGE_IND_ENABLED` is `TRUE`).⌋()

7.8.6 Communication Control

[CANNM168] ⌈Communication Control shall be statically configurable with use of the `CANNM_COM_CONTROL_ENABLED` switch (configuration parameter).⌋()

[CANNM170] ⌈If the service `CanNm_DisableCommunication` is called the CanNm module shall disable the Network Management PDU transmission ability.⌋()

Note: This behavior shall also be applied in Repeat Message State. Communication Control feature does not influence the duration of the Repeat Message State.

[CANNM173] ⌈When the Network Management PDU transmission ability is disabled, the CanNm module shall stop the CanNm Message Cycle Timer in order to stop the transmission of Network Management PDUs.⌋()

[CANNM174] ⌈When the Network Management PDU transmission ability is disabled, the CanNm module shall stop the NM-Timeout Timer.⌋()

[CANNM175] ⌈When the Network Management PDU transmission ability is disabled, the CanNm module shall stop the Remote Sleep Indication Timer.⌋()

[CANNM178] ⌈When the Network Management PDU transmission ability is enabled, the CanNm module shall start the CanNm Message Cycle Timer with `CANNM_MSG_CYCLE_OFFSET` in order to start transmission of Network Management PDUs.⌋()

[CANNM179] ⌈When the Network Management PDU transmission ability is enabled, the CanNm module shall restart the NM-Timeout Timer.⌋()

[CANNM180] ⌈When the Network Management PDU transmission ability is enabled, the CanNm module shall re-start the Remote Sleep Indication Timer.⌋()

[CANNM181] ⌈The service `CanNm_RequestBusSynchronization` shall return `E_NOT_OK` if the Network Management PDU transmission ability is disabled.⌋()

7.8.7 Coordinator Synchronization Support

When having more than one coordinator connected to the same bus a special bit in the CBV, the *NmCoordinatorSleepReady* bit is used to indicate that the main coordinator requests to start shutdown sequence. The main functionality of the algorithm is described in the Nm module.

[CANNM341] ⌈If the CanNm receives a NM message with the *NmCoordinatorSleepReady* bit (see CBV) set it shall indicate this to the Nm by calling `Nm_CoordReadyToSleepIndication`.⌋()

[CANNM342] ⌈The *NmCoordinatorSleepReady* bit in the CBV shall be set by the API `CanNm_SetSleepReadyBit`.⌋()

[CANNM343] ⌈This feature is optional and only available if `CANNM_COORDINATOR_SYNC_SUPPORT` is set to `TRUE`.⌋()

7.9 Car Wakeup

[CANNM405] ⌈The position of the Car Wakeup bit in the NM-PDU is defined by the configuration parameters `CanNmCarWakeUpBytePosition` and `CanNmCarWakeUpBitPosition`.⌋()

7.9.1 Rx Path

[CANNM406] ⌈If the car wakeup bit within any received NM-PDU is `1`, `CanNmCarWakeUpRxEnabled` is `TRUE`, and `CanNmCarWakeUpFilterEnabled` is `FALSE` CanNm shall call `Nm_CarWakeUpIndication` and perform the standard Rx indication handling.⌋()

[CANNM407] ⌈If `CanNm_GetPduData` is called in the context of `Nm_CarWakeUpIndication`, CanNm shall return the PDU data of the PDU that causes the call of `Nm_CarWakeUpIndication`.⌋()

Note: This is required to enable the ECU to identify detail about the sender of the car wakeup request.

[CANNM408] ⌈If `CanNmCarWakeUpFilterEnabled` is `TRUE`, the car wakeup bit within any received NM-PDU is `1`, `CanNmCarWakeUpRxEnabled` is `TRUE` and the Node ID in the received NM-PDU is equal to `CanNmCarWakeUpFilterNodeId` the CanNm module shall call `Nm_CarWakeUpIndication` and perform the standard Rx Indication handling.⌋()

Note: The car wakeup filter is necessary to realize sub gateways that only consider the car wakeup of the central Gateway to avoid wrong wakeups.

7.9.2 Tx Path

The transmission of the car wakeup bit shall be handled by the application using the NM user data mechanism provided by the CanNm module.

7.10 Partial Networking

7.10.1 Rx Handling of NM PDUs

[CANNM409] ⌈If the `CanNmPnEnabled` is `FALSE`, the CanNm shall perform the normal Rx Indication handling and the partial networking extensions shall be disabled.⌋()

[CANNM410] ⌈If `CanNmPnEnabled` is `TRUE`, the PNI bit in the received NM-PDU is 0 and `CanNmAllNmMessagesKeepAwake` is `TRUE`, the CanNm module shall perform the normal Rx Indication handling omitting the extensions for partial networking.⌋()

Note: This is required to enable the Gateway to stay awake on any kind of NM-PDU.

[CANNM411] ⌈If `CanNmPnEnabled` is `TRUE`, the PNI bit in the received NM-PDU is 0 and `CanNmAllNmMessagesKeepAwake` is `FALSE`, the CanNm module shall ignore the received NM-PDU.⌋()

[CANNM412] ⌈If `CanNmPnEnabled` is `TRUE` and the PNI bit in the received NM-PDU is 1, CanNm module shall process the Partial Networking Information of the NM-PDU as described in chapter 7.10.3 NM PDU Filter Algorithm.⌋()

7.10.2 Tx Handling of NM PDUs

[CANNM413] ⌈If `CanNmPnEnabled` is `TRUE` the CanNm module shall set the value of the transmitted PNI bit to 1.⌋()

Note: The usage of the CBV is mandatory in case Partial Networking is used.

[CANNM414] ⌈If `CanNmPnEnabled` is `FALSE` the CanNm module shall set the value of the transmitted PNI bit always to 0.⌋()

7.10.3 NM PDU Filter Algorithm

The intention of the NM-PDU filter algorithm is to drop all received NM-PDUs that are not relevant for the ECU. If there is no NM-PDU on the network, that is relevant for the receiving ECU, the NM Timeout Timer is no longer restarted and the CanNm module changes to Prepare Bus Sleep Mode during active bus communication.
In order to distinguish between NM-PDUs that are relevant for the ECU and PDUs that are not relevant, the CanNm evaluates the NM User Data that contains the PN requests provided by requesting ECU. Every bit of the PN request information represents one PN.
It is statically configured if the ECU (CanNm) is part of one specific partial network or not. The NM-PDUs are ignored if the ECU is not part of the requested partial networks.

[CANNM403] ⌈The CanNm modules initialization and entering the Bus-Sleep Mode shall cause the PN message filtering to be disabled on the respective channel. As a result all received (PN) NM messages shall be processed in the following as being normal NM messages (i.e. NM-Timeout Timer shall be restarted).⌋()

[CANNM404] ⌈If the CanSm calls CanNm_ConfirmPnAvailability the NM-PDU filter algorithm of PN messages shall be enabled on the indicated channel.⌋()

Rationale: This is required to allow a malfunctioning PN transceiver to shut down synchronously with the remaining network.

Note: If the NM-PDU filter algorithm is disabled the CanNm shall restart the NM-Timeout Timer when receiving a NM-PDU. The User Data of received NM Messages which have no "Partial Network Information" in CBV, to ERA and EIRA shall not be evaluated by the PN algorithms.

[CANNM415] ⌈The NM-PDU filter algorithm shall evaluate the bytes of the received NM-PDU defined by `CanNmPnInfoOffset` (in bytes) starting from byte 0 and `CanNmPnInfoLength` (in bytes). This range is called PN Info Range.⌋()

Example:
- CanNmPnInfomationOffset = 3
- CanNmPnInfomationLength = 2
- CanNmPduLength = 6

Only Byte 3 and Byte 4 of the NM message contains PN information

[CANNM416] ⌈Every bit of the PN Info Range represents one Partial Network. If the bit is set to 1 the Partial Network is requested. If the bit is set to 0 there is no request for this PN.⌋()

[CANNM417] ⌈By means of the configuration parameter `CanNmPnFilterMaskByte` the CanNm is able to detect which PN is relevant for the ECU and which not.
Each bit of `CanNmPnFilterMaskByte` has the following meaning:

0 The PN request is irrelevant for the ECU. The communication stack of the ECU is not kept awake if this bit is set in a received NM-PDU.

1 The PN request is relevant for the ECU. The communication stack of the ECU is kept awake if this bit is set in a received NM-PDU.⌋()

[CANNM418] ⌈The filter algorithm shall map (bitwise AND) each PN filter mask byte to the corresponding byte in the PN info range of the NM message. ⌋()

[CANNM419] ⌈If at least one bit within the PN Info Range of the received NM-PDU matches with a bit in the NM filter mask the message shall be processed with the normal Rx Indication handling.⌋()

[CANNM420] ⌈If no bit within the PN Info Range of the received NM-PDU matches with a bit in the NM filter mask and `CanNmAllNmMessagesKeepAwake` is `FALSE` the message is dropped from further processing.⌋()

[CANNM421] ⌈If no bit within the PN Info Range of the received NM-PDU matches with a bit in the NM filter mask and `CanNmAllNmMessagesKeepAwake` is `TRUE` the message shall be processed with the normal Rx Indication handling.⌋()

Note: This is required to enable the Gateway to stay awake on any kind of NM-PDU.

7.10.4 Aggregation of Internal and External Requested Partial Networks

Note: This feature is used by every ECU that has to switch I-PDU-Groups because of the activity of partial networks. (e.g. to prevent false timeouts) I-PDU-Groups shall be switched on if the corresponding PN is requested internally or externally. I-PDU-Groups shall be switched off not until all internal and external requests for the corresponding PN are released.
The logic for switching the IPDU-Groups is implemented by ComM. The CanNm only provides the information if a PN is requested or not. The COM module is used to transfer the data to the upper layers.
To switch the I-PDU-Groups synchronously on all direct connected ECUs, CanNm shall provide the information of a request change to the upper layer at (almost) the same time on every ECU. This is why the reset timer is restarted on every received and every sent NM message (see below).
The aggregated state of the internal/external requested PNs is called External Internal Requests Aggregated (EIRA).

[CANNM422] ⌈If `CanNmPnEiraCalcEnabled` is `FALSE` the CanNm module shall skip the aggregation of external and internal PN requests information.⌋()

[CANNM423] ⌈If `CanNmPnEiraCalcEnabled` is `TRUE` the CanNm module shall calculate the aggregation of external PN requests.⌋()

[CANNM424] ⌈The EIRA shall have the size of `CanNmNmPnInfoLength` and shall be initialized with value 0 (not requested) for every external and internal PN request.⌋()

[CANNM425] ⌈The CanNm shall only consider the PN request bits that are relevant for the ECU (defined by PN filter mask). All other PN request bits are ignored. Thus the EIRA only contains those PN requests, which are relevant for the ECU.⌋()

[CANNM426] ⌈If a NM-PDU is received the CanNm shall set every requested and filtered (relevant) PN request bit in the EIRA to 1.⌋()

[CANNM427] ⌈If a NM-PDU is send by the CanNm, the CanNm module shall set every PN request bit in the EIRA to 1 that has been requested by the PN request bits in the transmitted NM-PDU.⌋()

[CANNM428] ⌈The CanNm module shall provide an EIRA reset timer for every PN request bit together for all physical CAN channels.⌋()

Note: This means, only one timer is required to handle one PN on multiple connected physical channels. For example: only 8 EIRA reset timers are required to handle the requests of a Gateway with 6 physical channels and 8 partial networks.
This is possible because the switch of PN PDU-Groups is done global for the ECU and not dependent of the physical channel.

[CANNM429] ⌈If an NM-PDU is received the CanNm module shall restart the EIRA reset timer for every PN request bit that has been requested in the received NM-PDU with `CanNmPnResetTime`.⌋()

[CANNM430] ⌈If a NM-PDU is send by the CanNm, the CanNm module shall restart the EIRA reset timer for every PN request bit that has been requested in the NM message with `CanNmPnResetTime`.⌋()

Note: `CanNmPnResetTime` shall be configured to a value greater than `CanNmMsgCycleTime`. If `CanNmPnResetTime` is configured to a value smaller than `CanNmMsgCycleTime` and only one ECU requests the PN, the request state toggles in the EIRA because request state is rested before the requesting ECU is able to send the next NM message.

Note: `CanNmPnResetTime` shall be configured to a value smaller than `CanNmTimeoutTime` to avoid that the timer could elapse after NM already changed to Prepare Bus Sleep.

[CANNM431] ⌈If one of the EIRA reset timers expires, the CanNm module shall set PN request bit for the corresponding PN in the EIRA to 0.⌋()

[CANNM432] ⌈If content of EIRA changes (any bit changes from 1 to 0 or from 0 to 1) because of a received or transmitted NM-PDU or the EIRA reset timer expiration, the CanNm shall inform the upper layers by calling `PduR_CanNmRxIndication()`. By means of the Rx Indication function the EIRA data shall be provided to the COM module.⌋()

7.10.5 Aggregation of External Requested Partial Networks

Note: This feature is used by the Gateways to collect only the external PN requests. The external PN requests are mirrored back to the requesting bus and provided to other (required) physical channels of a central gateway. In case of a sub gateway the requests bit must not be mirrored back to the requesting physical channel in order to avoid static waking between central- and sub gateways. This logic shall be implemented by the ComM. The CanNm module provides the information if the PN is externally requested or not. The COM module is used for data transmission to the upper layer.
The aggregated state of the external requested PNs is called “External Requests Aggregated” (ERA).

[CANNM433] ⌈If `CanNmPnEraCalcEnabled` is `FALSE` the CanNm module shall skip the aggregation of external PN requests.⌋()

[CANNM434] ⌈If `CanNmPnEraCalcEnabled` is `TRUE` the CanNm module shall calculate the aggregation of external PN requests.⌋()

[CANNM435] ⌈The ERA module shall have a size of `CanNmNmPnInfoLength` and shall be initialized with value 0 (not requested) for every external and internal PN request.⌋()

[CANNM436] ⌈The CanNm shall only consider the PN request bits in the NM-PDU that are relevant for the ECU (defined by PN filter mask). All other PN request bits are ignored. Thus the ERA only contains those PN requests, which are relevant for the ECU.⌋()

[CANNM437] ⌈If a NM-PDU is received the CanNm module shall set every PN request bit in the ERA to 1 that has been requested by the PN request bits of the received NM-PDU.⌋()

[CANNM438] ⌈The CanNm module shall provide an ERA reset timer for every PN request bit for every physical CAN channel.⌋()

Note: This means, a separate timer is required to handle one PN on multiple physical channels.
For example: 48 ERA reset timers are required to handle the requests of a gateway with 6 physical channels and 8 partial networks. It is not possible to combine the reset timer like EIRA timers, because the external request mustn't be mirrored back to the requesting bus by a sub gateway. Thus it is required to detect the physical channel that is the source of the request bit.

[CANNM439] ⌈If a NM-PDU is received the CanNm module shall restart the ERA reset timer for every PN request bit that is requested in the NM-PDU with `CanNmPnResetTime`.⌋()

Note: `CanNmPnResetTime` shall be configured to a value greater than `CanNmMsgCycleTime`. If `CanNmPnResetTime` is configured to a value smaller than `CanNmMsgCycleTime` and only one ECU requests the PN, the request state toggles in the ERA because request state is rested before the requesting ECU is able to send the next NM-PDU.

Note: `CanNmPnResetTime` shall be configured to a value smaller than `CanNmTimeoutTime` to avoid that the timer could elapse after NM already changed to Prepare Bus Sleep.

[CANNM442] ⌈If one of the ERA reset timers expires, the CanNm module shall set the PN request bit of the corresponding PN in the ERA to 0.⌋()

[CANNM443] ⌈If content of ERA changes (any bit changes from 1 to 0 or from 0 to 1) because of a received NM-PDU or the ERA reset timer expiration the CanNm module shall inform the upper layers by calling `PduR_CanNmRxIndication()`. By means of the Rx Indication function the ERA data shall be provided to the COM module.⌋()

7.10.6 Spontaneous Transmission of NM PDUs via CanNm_NetworkRequest

[CANNM444] ⌈If `CanNm_NetworkRequest` is called, `CanNmPnHandleMultipleNetworkRequest` is set to `TRUE` and CanNm is in Ready Sleep State, Normal Operation State or Repeat Message State, CanNm shall change to or restart the Repeat Message State.⌋()

[CANNM445] ⌈If `CanNmPnHandleMultipleNetworkRequests` is set to `TRUE` the CanNm feature 'Immediate Transmission' is mandatory. It shall be ensured that `CanNmImmediateNmTransmissions > 0` is given.⌋()

Note: The PN Control Module (e.G. ComM) is responsible to call `CanNm_NetworkRequest` if the PN request bits changes.

7.11 Transmission Error Handling

Depending on configuration the CanNm will evaluate the confirmation from the CanIf that a Network Management PDU has been successfully transmitted. Transmission Error Handling is a functionality that will monitor these confirmations and alarm the upper layers if a transmission confirmation is not received within a specific amount of time. The functionality works by restarting a timer after each request to transmit an Network Management PDU message and if a confirmation has not been received before the timer expires, a callback of the Nm is invoked.

[CANNM073] ⌈If `CANNM_PASSIVE_MODE_ENABLED` is `TRUE` (see CANNM072) or `CANNM_IMMEDIATE_TXCONF_ENABLED` is `TRUE` the CanNm module shall deactivate the transmission error handling.⌋()

Rationale: Transmission error handling makes only sense if a node is allowed to transmit Network Management PDUs and the real confirmation from the CanIf is evaluated.

[CANNM064] ⌈The NM Message Tx Timeout Timer shall be started with `CANNM_MSG_TIMEOUT_TIME` when the transmission of a NM message is requested.⌋()

[CANNM065] ⌈The NM Message Tx Timeout Timer shall be stopped when `CanNm_TxConfirmation` is called by the CanIf.

[CANNM066] ⌈When the NM Message Tx Timeout Timer expires, the CanNm module shall optionally call the function `Nm_TxTimeoutException` only once.⌋()

[CANNM446] ⌈If `CanNmPnEnabled` is set to `TRUE` the function CanSM_TxTimeoutException shall be called once when the NM Message Tx Timeout Timer expires.⌋()

7.12 Network Management PDU Structure

The figure below shows the default format of the Network Management PDU:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 7	User data 5							
Byte 6	User data 4							
Byte 5	User data 3							
Byte 4	User data 2							
Byte 3	User data 1							
Byte 2	User data 0							
Byte 1	Control Bit Vector							
Byte 0	Source Node Identifier							

Figure 7-1 Network Management PDU Default Format

[CANNM074] ⌈The location of the source node identifier shall be configurable by means of `CANNM_PDU_NID_POSITION` to Byte 0, Byte 1, or off (default: Byte 0).⌋()

[CANNM075] ⌈The location of the control Bit vector shall be configurable by means of `CANNM_PDU_CBV_POSITION` to Byte 0, Byte 1, or off (default: Byte 1).⌋()

Note: The length of the Network Management PDU is configured in the CAN-Driver to any integer value between (and including) 0 and 8. The difference between applied standardized bytes and length is user data.

The figure below describes the format of the Control Bit Vector:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte	Reserv	Reserv	Reserv	Reserv	NM	Reserved	Reserved	Repeat

1	ed	ed	ed	ed	Coordinator Sleep Ready	R3.2 NM Coordinator ID (High Bit)	R3.2 NM Coordinator ID (Low Bit)	Message Request

Figure 7-2 Control Bit Vector

[CANNM045] ⌈The Control Bit Vector shall consist of
Bit 0: Repeat Message Request
0: Repeat Message State not requested
1: Repeat Message State requested
Bit 3: NM Coordinator Sleep Bit
0: Start of synchronized shutdown is not requested by main coordinator
1: Start of synchronized shutdown is requested by main coordinator
Bit 4 Active Wakeup Bit
0: Node has not woken up the network (passive wakeup)
1: Node has woken up the network (active Wakeup)
Bit 6 Partial Network Information Bit (PNI)
0: NM message contains no Partial Network request information
1: NM message contains Partial Network request information
Bit 1, 2, 5, 7 are reserved for future extensions
0: Disabled / Reserved for future usage⌋()

Note: The Control Bit Vector is initialized with `0x00` during initialization (also refer to CANNM085).

[CANNM013] ⌈The CanNm module shall set the source node identifier with the configuration parameter `CANNM_NODE_ID` unless `CANNM_PDU_NID_POSITION` is set to off.⌋()

[CANNM135] ⌈Support of Repeat Message Request Bit and Repeat Message State Request shall be statically configurable with use of the `CANNM_NODE_DETECTION_ENABLED` switch (configuration parameter).⌋()

[CANNM138] ⌈The service call `CanNm_GetPduData` shall provide whole PDU data (Node ID, Control Bit Vector and User Data) of the most recently received Network Management PDU.⌋()

[CANNM401] ⌈If the CanNm performs a state change from BusSleep state or PrepareBusSleep state to NetworkMode due to a call to `CanNm_NetworkRequest` (i.e. due to an active wakeup) and `CanNmActiveWakeupBitEnabled` is `TRUE`, the CanNm shall set the ActiveWakeupBit in the CBV.⌋()

[CANNM402] ⌈If the CanNm module leaves the NetworkMode, the CanNm module shall reset th ActiveWakeupBit in the CBV.⌋()

7.13 Functional requirements on CanNm API

[CANNM014] ⌈If the node detection functionality is enabled and if `CANNM_REPEAT_MSG_IND_ENABLED` is enabled, the CanNm module shall call the callback function `Nm_RepeatMessageIndication` upon each reception of the RepeatMessageRequest bit.⌋()

[CANNM086] ⌈If `CANNM_USER_DATA_ENABLED` is enabled and `CANNM_USER_DATA_LENGTH` is set to `0x00`, the CanNm module shall raise an error during configuration or compilation time.⌋()

7.14 Error classification

[CANNM240] ⌈Development error values are of type `uint8`.⌋()

The following errors shall be detectable by the CanNm depending on its build version (development/production mode).

Req. ID	*Type or error*	*Relevance*	*Related error code*	*Error Value*
CANNM316:	API service used without module initialization	Development	`CANNM_E_NO_INIT`	`0x01`
CANNM317:	API service called with wrong channel handle	Development	`CANNM_E_INVALID_CHANNEL`	`0x02`
CANNM318:	API service called with wrong PDU-ID	Development	`CANNM_E_INVALID_PDUID`	`0x03`
CANNM337:	Reception of NM messages in Bus-Sleep Mode.	Development	`CANNM_E_NET_START_IND`	`0x04`
CANNM319:	CanNm initialization has failed, e.g. selected configuration set doesn't exist.	Development	`CANNM_E_INIT_FAILED`	`0x05`
CANNM321:	NM-Timeout Timer has abnormally expired outside of the Ready Sleep State; it may happen: (1) because of Bus-Off state, (2) if some ECU requests bus communication or node detection shortly before	Development	`CANNM_E_NETWORK_TIMEOUT`	`0x11`

	the NM-Timeout Timer expires so that a Network Management PDU can not be transmitted in time; this race condition applies to event-triggered systems			
CANNM322:	Null pointer has been passed as an argument (Does not apply to function CanNm_Init)	Development	CANNM_E_NULL_POINTER	0x12

7.15 Error detection

[CANNM188] ⌈The detection of development errors is configurable (*ON* / *OFF*) at pre-compile time. The switch CANNM_DEV_ERROR_DETECT (see chapter 10) shall activate or deactivate the detection of all development errors.⌋()

[CANNM241] ⌈If the CANNM_DEV_ERROR_DETECT switch is enabled API parameter checking is enabled. The detailed description of the detected errors can be found in chapter 7.14 and chapter 7.19.⌋()

[CANNM242] ⌈The detection of production code errors cannot be switched off.⌋()

Note: Currently no production error are specified for the CAN NM.

7.16 Error notification

[CANNM019] ⌈Detected development errors shall be reported to the Det_ReportError service of the Development Error Tracer (DET) if the pre-processor switch CANNM_DEV_ERROR_DETECT is set (see chapter 10).⌋()

[CANNM189] ⌈The CanNm module shall not return development errors by API functions; in case of a development error, the execution of the respective API function shall be aborted and E_NOT_OK shall be returned, if applicable.⌋()

[CANNM020] ⌈Production errors shall be reported to the Diagnostic Event Manager.⌋()

Note: Currently no production error are specified for the CAN NM.

[CANNM190] ⌈The CanNm module shall not return production errors by API functions; in case of a production error, the execution of the respective API function shall be aborted and `E_NOT_OK` shall be returned, if applicable.⌋()

Note: Currently no production errors are specified for the CAN NM.

[CANNM191] ⌈Each CanNm function that is not executed due to missing initialization of CanNm shall return `E_NOT_OK` to the calling function if development error detection is enabled (`CANNM_DEV_ERROR_DETECT` is set to `TRUE`).⌋()

[CANNM192] ⌈When a CanNm service with an invalid network handle is called, the called function shall not be executed and it shall return `E_NOT_OK` to the calling function if development error detection is enabled (`CANNM_DEV_ERROR_DETECT` is set to `TRUE`).⌋()

Note: The network handle is invalid if it is different from allowed configured values.

[CANNM292] ⌈When the NULL Pointer is passed as an argument to a CanNm service, the called function shall not be executed, but instead of that it shall report `CANNM_E_NULL_POINTER` to the Development Error Tracer and if possible, it shall return `E_NOT_OK` to the calling function if development error detection is enabled (`CANNM_DEV_ERROR_DETECT` is set to `TRUE`).⌋()

[CANNM193] ⌈When the NM-Timeout Timer expires in the Repeat Message State, the CanNm module shall report `CANNM_E_NETWORK_TIMEOUT` to the Development Error Tracer⌋()

[CANNM194] ⌈When the NM-Timeout Timer expires in the Normal Operation State, the CanNm module shall report `CANNM_E_NETWORK_TIMEOUT` to the Development Error Tracer ⌋()

7.17 Scheduling of the main function

[CANNM077] ⌈The `CanNm_MainFunction` function shall be scheduled by the BSW scheduler (see [8]).⌋()

7.18 Application notes

7.18.1 Wakeup notification

Wakeup notification is defined in detail in the ECU State Manager specification.

7.18.2 Coordination of coupled networks

[CANNM185] ⌈Support of bus synchronization on demand shall be statically configurable with use of the `CANNM_BUS_SYNCHRONIZATION_ENABLED` switch (configuration parameter).⌋()

Since the shutdown of CanNm can be done at any time, the call of the API `Nm_SynchronizationPoint`(), which is specified in concept 065, is not supported.

7.18.3 Debugging Concept

[CANNM287] ⌈Each variable that shall be accessible by AUTOSAR Debugging shall be defined as global variable.⌋()

[CANNM288] ⌈All type definitions of variables which shall be accessible during debugging, shall be declared by the header file `CanNm.h`.⌋()

[CANNM289] ⌈The declaration of variables in the header file shall be such that it is possible to calculate the size of the variables by C-“sizeof”.⌋()

[CANNM290] ⌈Variables available for debugging shall be described in the respective Basic Software Module Description.⌋()

7.19 Summary of CanNm Timing Requirements

This section gives a summary of the CanNm timing requirements. Please note that this chapter is a summary only and does not replace or act as requirement. Moreover this section does not require any specific way of implementation

Type of timing	*Requirements*
Nm timeout related	CANNM061 CANNM096 CANNM098 CANNM099 CANNM101 CANNM109 CANNM117 CANNM174 CANNM179 CANNM193 CANNM194 CANNM206
Tx confirmation timeout related	CANNM064 CANNM065 CANNM066 CANNM067 CANNM068
NmPdu transmission related	CANNM005 CANNM032 CANNM040 CANNM051 CANNM061 CANNM069 CANNM169 CANNM173 CANNM178

Remote sleep indication related	CANNM175 CANNM180

8 API specification

[CANNM243] ⌈The CanNm module shall provide parameter value check only in "development mode".⌋(BSW00323)

[CANNM244] ⌈The CanNm module shall reject the execution of a service called with an invalid parameter and shall inform the DET.⌋(BSW00323)

AUTOSAR CanNm API consists of services, which are CAN specific and can be called whenever they are required; each service apart from `CanNm_Init` refers to one NM channel only.

8.1 Imported Types

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

[CANNM245] ⌈

Module	*Imported Type*
ComStack_Types	NetworkHandleType
	PduIdType
	PduInfoType
Nm	Nm_ModeType
	Nm_StateType
Std_Types	Std_ReturnType
	Std_VersionInfoType

⌋()

8.2 Type Definitions

8.2.1 CanNm_ConfigType

Name:	`CanNm_ConfigType`	
Type:	`Structure`	
Range:	`implementation specific`	--
Description:	This type shall contain the parameters of the container CanNm_GlobalConfig and its sub containers	

8.3 CanNm Functions called by the Nm

8.3.1 CanNm_Init

[CANNM208] ⌈

Service name:	CanNm_Init

Syntax:	`void CanNm_Init(`
	`  const CanNm_ConfigType* const cannmConfigPtr`
	`)`

Service ID[hex]:	0x00	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	cannmConfigPtr	Pointer to a selected configuration structure
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	Initialize the complete CanNm module, i.e. all channels which are activated (see also configuration parameter CANNM_CHANNEL_ACTIVE) at configuration time are initialized.	

」()

[CANNM210]「If the function `CanNm_Init` has to indicate an error to the DET, it shall use the value `0x00` as the instance id.」()

[CANNM253]「Caveats of `CanNm_Init`: The function `CanNm_Init` has to be called after initialization of the CanIf.」()

8.3.2 CanNm_PassiveStartUp

[CANNM211]「

Service name:	CanNm_PassiveStartUp	
Syntax:	`Std_ReturnType CanNm_PassiveStartUp( const NetworkHandleType nmChannelHandle )`	
Service ID[hex]:	0x01	
Sync/Async:	Asynchronous	
Reentrancy:	Reentrant (but not for the same NM-Channel)	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Passive startup of network management has failed
Description:	Passive startup of the AUTOSAR CAN NM. It triggers the transition from Bus-Sleep Mode to the Network Mode in Repeat Message State.	

」()

[CANNM212]「If the current state is not equal to Bus-Sleep Mode, then the function `CanNm_PassiveStartUp` shall have no effect except that `E_NOT_OK` is returned.」()

[CANNM254]「Caveats of `CanNm_PassiveStartUp`: The CanNm module is initialized correctly.」()

8.3.3 CanNm_NetworkRequest

[CANNM213]⌈

Service name:	CanNm_NetworkRequest	
Syntax:	`Std_ReturnType CanNm_NetworkRequest( const NetworkHandleType nmChannelHandle )`	
Service ID[hex]:	0x02	
Sync/Async:	Asynchronous	
Reentrancy:	Reentrant (but not for the same NM-channel)	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Requesting of network has failed
Description:	Request the network, since ECU needs to communicate on the bus.	

⌋()

[CANNM255] ⌈The function `CanNm_NetworkRequest` shall change the Network state to 'requested'.⌋()

[CANNM256] ⌈Caveats of `CanNm_NetworkRequest`: The CanNm module is initialized correctly.⌋()

[CANNM257] ⌈Configuration of `CanNm_NetworkRequest`: Optional (Only available if `CANNM_PASSIVE_MODE_ENABLED` is not defined).⌋()

8.3.4 CanNm_NetworkRelease

[CANNM214] ⌈

Service name:	CanNm_NetworkRelease	
Syntax:	`Std_ReturnType CanNm_NetworkRelease( const NetworkHandleType nmChannelHandle )`	
Service ID[hex]:	0x03	
Sync/Async:	Asynchronous	
Reentrancy:	Reentrant (but not for the same NM-Channel)	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Releasing of network has failed
Description:	Release the network, since ECU doesn't have to communicate on the bus.	

⌋()

[CANNM258] ⌈The function `CanNm_NetworkRelease` shall change the Network state to 'released'.⌋()

[CANNM294] ⌈If the Network Management PDU transmission ability of CanNm has been disabled by calling `CanNm_DisableCommunication`, then the function `CanNm_NetworkRelease` shall have no effect except that `E_NOT_OK` is returned.⌋()

[CANNM259] ⌈Caveats of `CanNm_NetworkRelease`: The CanNm module is initialized correctly.⌋()

[CANNM260] ⌈Configuration of `CanNm_NetworkRelease`: Optional (Only available if `CANNM_PASSIVE_MODE_ENABLED` is not defined)⌋()

8.3.5 CanNm_DisableCommunication

[CANNM215] ⌈

Service name:	CanNm_DisableCommunication	
Syntax:	`Std_ReturnType CanNm_DisableCommunication( const NetworkHandleType nmChannelHandle )`	
Service ID[hex]:	0x0c	
Sync/Async:	Asynchronous	
Reentrancy:	Reentrant (but not for the same NM-channel)	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Disabling of NM PDU transmission ability has failed
Description:	Disable the NM PDU transmission ability due to a ISO14229 Communication Control (28hex) service	

⌋()

[CANNM261] ⌈Caveats of `CanNm_DisableCommunication`: The CanNm module is initialized correctly.⌋()

[CANNM262] ⌈Configuration of `CanNm_DisableCommunication`: Optional (Only available if `CANNM_COM_CONTROL_ENABLED` is set to TRUE)⌋()

[CANNM172] ⌈The service `CanNm_DisableCommunication` shall return `E_NOT_OK`, if the current mode is not Network Mode.⌋()

[CANNM298] ⌈If the module operates in passive mode (`CANNM_PASSIVE_MODE_ENABLED`) the service `CanNm_DisableCommunication` shall have no effects and shall directly return `E_NOT_OK`.⌋()

8.3.6 CanNm_EnableCommunication

[CANNM216] ⌈

Service name:	CanNm_EnableCommunication	
Syntax:	`Std_ReturnType CanNm_EnableCommunication( const NetworkHandleType nmChannelHandle )`	
Service ID[hex]:	0x0d	
Sync/Async:	Asynchronous	
Reentrancy:	Reentrant (but not for the same NM-channel)	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Enabling of NM PDU transmission ability has failed
Description:	Enable the NM PDU transmission ability due to a ISO14229 Communication Control (28hex) service	

⌋()

[CANNM176] ⌈The service `CanNm_EnableCommunication` shall enable the Network Management PDU transmission ability if the Network Management PDU transmission ability is disabled.⌋()

[CANNM177] ⌈The service `CanNm_EnableCommunication` shall return `E_NOT_OK` if the Network Management PDU transmission ability is enabled.⌋()

[CANNM295] ⌈The service `CanNm_EnableCommunication` shall return `E_NOT_OK`, if the current mode is not Network Mode.⌋()

[CANNM263] ⌈Caveats of `CanNm_EnableCommunication`: The CanNm module is initialized correctly.⌋()

[CANNM264] ⌈Configuration of `CanNm_EnableCommunication`: Optional (Only available if `CANNM_COM_CONTROL_ENABLED` is set to `TRUE`).⌋()

[CANNM297] ⌈If the module operates in passive mode (`CANNM_PASSIVE_MODE_ENABLED`) the service `CanNm_EnableCommunication` shall have no effects and shall directly return `E_NOT_OK`.⌋()

8.3.7 CanNm_SetUserData

[CANNM217]「

Service name:	CanNm_SetUserData	
Syntax:	`Std_ReturnType CanNm_SetUserData( const NetworkHandleType nmChannelHandle, const uint8* const nmUserDataPtr )`	
Service ID[hex]:	0x04	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
	nmUserDataPtr	Pointer where the user data for the next transmitted NM message shall be copied from
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Setting of user data has failed
Description:	Set user data for NM messages transmitted next on the bus.	

」()

[CANNM265]「Caveats of `CanNm_SetUserData`: The CanNm module is initialized correctly.」()

[CANNM266]「Configuration of `CanNm_SetUserData`: Optional (Only available if `CANNM_USER_DATA_ENABLED` is set to `TRUE` and `CANNM_PASSIVE_MODE_ENABLED` is not defined)」()

8.3.8 CanNm_GetUserData

[CANNM218]「

Service name:	CanNm_GetUserData	
Syntax:	`Std_ReturnType CanNm_GetUserData( const NetworkHandleType nmChannelHandle, uint8* const nmUserDataPtr )`	
Service ID[hex]:	0x05	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	nmUserDataPtr	Pointer where user data out of the most recently received NM message shall be copied to
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Getting of user data has failed
Description:	Get user data out of the most recently received NM message.	

」()

[CANNM267] ⌈Caveats of `CanNm_GetUserData`: The CanNm module is initialized correctly.⌋()

[CANNM268] ⌈Configuration of `CanNm_GetUserData`: Optional (Only available if `CANNM_USER_DATA_ENABLED` is set to `TRUE`).⌋()

8.3.9 CanNm_Transmit

[CANNM331] ⌈

Service name:	CanNm_Transmit	
Syntax:	`Std_ReturnType CanNm_Transmit( PduIdType CanNmTxPduId, const PduInfoType* PduInfoPtr )`	
Service ID[hex]:	0x14	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	CanNmTxPduId	L-PDU handle of CAN L-PDU to be transmitted. This handle specifies the corresponding CAN L-PDU ID and implicitly the CAN Driver instance as well as the corresponding CAN controller device.
	PduInfoPtr	Pointer to a structure with CAN L-PDU related data: DLC and pointer to CAN L-SDU buffer.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Transmit request has been accepted E_NOT_OK: Transmit request has not been accepted (CanNm is not in RM or NO)
Description:	This function is used by the PduR to trigger a spontaneous transmission of an NM message with the provided NM User Data.	

⌋()

[CANNM330] ⌈If `CanNmComUserDataSupport` is enabled the CanNm implementation shall provide an API `CanNm_Transmit`.⌋()

[CANNM333] ⌈`CanNm_Transmit` is an empty function returning `E_OK` at any time if the spontaneous transmission of a NM message via CanNm_Transmit is not required. This requirement is relevant to avoid linker errors as PduR expects this API to be provided.⌋()

8.3.10 CanNm_GetNodeIdentifier

[CANNM219] ⌈

Service name:	CanNm_GetNodeIdentifier
Syntax:	`Std_ReturnType CanNm_GetNodeIdentifier( const NetworkHandleType nmChannelHandle,`

	`uint8* const nmNodeIdPtr`)	
Service ID[hex]:	0x06	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	nmNodeIdPtr	Pointer where node identifier out of the most recently received NM PDU shall be copied to
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Getting of the node identifier out of the most recently received NM PDU has failed
Description:	Get node identifier out of the most recently received NM PDU.	

」()

[CANNM132] 「The service call `CanNm_GetNodeIdentifier` shall provide the node identifier out of the most recently received Network Management PDU.」()

[CANNM269] 「Caveats of `CanNm_GetNodeIdentifier`: The CanNm module is initialized correctly.」()

[CANNM270] 「Configuration of `CanNm_GetNodeIdentifier`: Optional (Only available if `CANNM_PDU_NID_POSITION` is not set to off).」()

8.3.11 CanNm_GetLocalNodeIdentifier

[CANNM220] 「

Service name:	CanNm_GetLocalNodeIdentifier	

Syntax:	`Std_ReturnType CanNm_GetLocalNodeIdentifier(`
	`  const NetworkHandleType nmChannelHandle,`
	`  uint8* const nmNodeIdPtr`
	)	

Service ID[hex]:	0x07	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	nmNodeIdPtr	Pointer where node identifier of the local node shall be copied to
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Getting of the node identifier of the local node has failed
Description:	Get node identifier configured for the local node.	

」()

[CANNM133] 「The service call `CanNm_GetLocalNodeIdentifier` shall provide the node identifier configured for the local host node.」()

[CANNM271] ⌈Caveats of `CanNm_GetLocalNodeIdentifier`: The CanNm module is initialized correctly.⌋()

[CANNM272] ⌈Configuration of `CanNm_GetLocalNodeIdentifier`: Optional (Only available if `CANNM_PDU_NID_POSITION` is not set to off.).⌋()

8.3.12 CanNm_RepeatMessageRequest

[CANNM221] ⌈

Service name:	CanNm_RepeatMessageRequest	
Syntax:	`Std_ReturnType CanNm_RepeatMessageRequest( const NetworkHandleType nmChannelHandle )`	
Service ID[hex]:	0x08	
Sync/Async:	Asynchronous	
Reentrancy:	Reentrant (but not for the same NM-channel)	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Setting of Repeat Message Request Bit has failed
Description:	Set Repeat Message Request Bit for NM messages transmitted next on the bus.	

⌋()

[CANNM273] ⌈Caveats of `CanNm_RepeatMessageRequest`: The CanNm module is initialized correctly.⌋()

[CANNM274] ⌈Configuration of `CanNm_RepeatMessageRequest`: Optional (Only available if `CANNM_NODE_DETECTION_ENABLED` is set to `TRUE`).⌋()

8.3.13 CanNm_GetPduData

[CANNM222] ⌈

Service name:	CanNm_GetPduData	
Syntax:	`Std_ReturnType CanNm_GetPduData( const NetworkHandleType nmChannelHandle, uint8* const nmPduDataPtr )`	
Service ID[hex]:	0x0a	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	

Parameters (out):	nmPduDataPtr	Pointer where NM PDU shall be copied to
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK:Getting of NM PDU data has failed
Description:	Get the whole PDU data out of the most recently received NM message.	

」()

[CANNM275] 「Caveats of **`CanNm_GetPduData`**: The CanNm module is initialized correctly.」()

[CANNM276] 「Configuration of `CanNm_GetPduData`: Optional (Only available if `CANNM_NODE_DETECTION_ENABLED` or `CANNM_USER_DATA_ENABLED` is set to `TRUE` or `CANNM_PDU_NID_POSITION` is not set to off).」()

8.3.14 CanNm_GetState

[CANNM223] 「

Service name:	CanNm_GetState	

Syntax:	`Std_ReturnType CanNm_GetState(`
	`  const NetworkHandleType nmChannelHandle,`
	`  Nm_StateType* const nmStatePtr,`
	`  Nm_ModeType* const nmModePtr`
	`)`	

Service ID[hex]:	0x0b	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	nmStatePtr	Pointer where state of the network management shall be copied to
	nmModePtr	Pointer where the mode of the network management shall be copied to
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Getting of NM state has failed
Description:	Returns the state and the mode of the network management.	

」()

[CANNM277] 「Caveats of `CanNm_GetState`: The CanNm module is initialized correctly.」()

8.3.15 CanNm_GetVersionInfo

[CANNM224] 「

Service name:	CanNm_GetVersionInfo

Syntax:	`void CanNm_GetVersionInfo(`
	`  Std_VersionInfoType* versioninfo`
	`)`

Service ID[hex]:	0xf1	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	None	
Parameters (inout):	None	
Parameters (out):	versioninfo	Pointer to where to store the version information of this module
Return value:	None	
Description:	This service returns the version information of this module.	

」()

[CANNM225] 「The function `CanNm_GetVersionInfo` shall return the version information of this module. The version information includes:

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

Note: This function can be called even if CanNm is not initialized.

[CANNM278] 「Configuration of `CanNm_GetVersionInfo`: Optional (only available if `CANNM_VERSION_INFO_API` is set to `TRUE`).」()

8.3.16 CanNm_RequestBusSynchronization

[CANNM226] 「

Service name:	CanNm_RequestBusSynchronization	
Syntax:	`Std_ReturnType CanNm_RequestBusSynchronization( const NetworkHandleType nmChannelHandle )`	
Service ID[hex]:	0xc0	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Requesting of bus synchronization has failed
Description:	Request bus synchronization.	

」(BSW02516)

[CANNM279] 「Caveats of `CanNm_RequestBusSynchronization`: The CanNm module is initialized correctly.」()

[CANNM280] 「Configuration of `CanNm_RequestBusSynchronization`: Optional (Only available if `CANNM_BUS_SYNCHRONIZATION_ENABLED` is set to `TRUE`) and `CANNM_PASSIVE_MODE_ENABLED` is not defined.」(BSW02516)

[CANNM130] ⌈The service call `CanNm_RequestBusSynchronization` shall trigger transmission of a single Network Management PDU if `CANNM_PASSIVE_MODE_ENABLED` (configuration parameter) is not defined.⌋(BSW02516)

Rationale: This service is typically used for supporting the NM gateway extensions.

[CANNM187] ⌈If `CanNm_RequestBusSynchronization` is called in Bus-Sleep Mode and Prepare Bus-Sleep Mode the CanNm module shall not execute the service and shall return `E_NOT_OK`.⌋()

8.3.17 CanNm_CheckRemoteSleepIndication

[CANNM227] ⌈

Service name:	CanNm_CheckRemoteSleepIndication	
Syntax:	`Std_ReturnType CanNm_CheckRemoteSleepIndication( const NetworkHandleType nmChannelHandle, boolean* const nmRemoteSleepIndPtr )`	
Service ID[hex]:	0xd0	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant (but not for the same NM-channel)	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	nmRemoteSleepIndPtr	Pointer where check result of remote sleep indication shall be copied to
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Checking of remote sleep indication bits has failed
Description:	Check if remote sleep indication takes place or not.	

⌋()

[CANNM153] ⌈Service call `CanNm_CheckRemoteSleepIndication` shall provide the information about current status of Remote Sleep Indication (i.e. already detected or not).⌋()

[CANNM281] ⌈Caveats of `CanNm_CheckRemoteSleepIndication`: The CanNm module is initialized correctly.⌋()

[CANNM282] ⌈Configuration of `CanNm_CheckRemoteSleepIndication`: Optional (Only available if `CANNM_REMOTE_SLEEP_INDICATION_ENABLED` is set to `TRUE`).⌋()

8.3.18 CanNm_SetSleepReadyBit

[CANNM338] ⌈

Service name:	CanNm_SetSleepReadyBit	
Syntax:	`Std_ReturnType CanNm_SetSleepReadyBit( const NetworkHandleType nmChannelHandle, const boolean nmSleepReadyBit )`	
Service ID[hex]:	0x17	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
	nmSleepReadyBit	Value written to ReadySleep Bit in CBV
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: No error E_NOT_OK: Writing of remote sleep indication bit has failed
Description:	Set the NM Coordinator Sleep Ready bit in the Control Bit Vector	

⌋()

[CANNM339] ⌈Caveats of `CanNm_SetSleepReadyBit`: The CanNm module is initialized correctly.⌋()

[CANNM340] ⌈Configuration of `CanNm_SetSleepReadyBit`: Optional (Only available if `CANNM_COORDINATOR_SYNC_SUPPORT` is set to `TRUE`).⌋()

8.4 CanNm functions called by the CanIf

8.4.1 CanNm_TxConfirmation

[CANNM228] ⌈

Service name:	CanNm_TxConfirmation	
Syntax:	`void CanNm_TxConfirmation( PduIdType TxPduId )`	
Service ID[hex]:	0x40	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant for different PduIds. Non reentrant for the same PduId.	
Parameters (in):	TxPduId	ID of the I-PDU that has been transmitted.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	The lower layer communication module confirms the transmission of an I-PDU.	

⌋()

Note: The callback function `CanNm_TxConfirmation` is called by the CAN Interface and implemented by the CanNm module.

[CANNM229] ⌈The callback function `CanNm_TxConfirmation` shall inform the DET, if development error detection is enabled (`CANNM_DEV_ERROR_DETECT` is set to `TRUE`) and if function call has failed because of the following reasons:

- Invalid PDU ID (`CANNM_E_INVALID_PDUID`)
- CanNm was not initialized (`CANNM_E_NO_INIT`)⌋()

[CANNM230] ⌈If an error has to be indicated to the DET, the callback function `CanNm_TxConfirmation` shall use the value of CanNm channel handle to determine the instance id.⌋()

[CANNM283] ⌈Caveats of `CanNm_TxConfirmation`:

- The call context is either on interrupt level (interrupt mode) or on task level (polling mode). This callback service is re-entrant for multiple CAN controller usage.
- The CanNm module is initialized correctly.⌋()

[CANNM284] ⌈Configuration of `CanNm_TxConfirmation`: Optional (Only available if `CANNM_IMMEDIATE_TXCONF_ENABLED` is set to `FALSE`).⌋()

8.4.2 CanNm_RxIndication

[CANNM231] ⌈

Service name:	CanNm_RxIndication	
Syntax:	`void CanNm_RxIndication( PduIdType RxPduId, PduInfoType* PduInfoPtr )`	
Service ID[hex]:	0x42	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant for different PduIds. Non reentrant for the same PduId.	
Parameters (in):	RxPduId	ID of the received I-PDU.
	PduInfoPtr	Contains the length (SduLength) of the received I-PDU and a pointer to a buffer (SduDataPtr) containing the I-PDU.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	Indication of a received I-PDU from a lower layer communication module.	

⌋()

Note: The callback function `CanNm_RxIndication` called by the CAN Interface and implemented by the CanNm module. It is called in case of a receive indication event of the CAN Driver.

[CANNM232] ⌈The callback function `CanNm_RxIndication` shall inform the DET, if development error detection is enabled (`CANNM_DEV_ERROR_DETECT` is set to TRUE) and if function call has failed because of the following reasons:

- Invalid PDU ID (`CANNM_E_INVALID_PDUID`)
- CanNm was not initialized (`CANNM_E_NO_INIT`)
- PduInfoPtr or SduDataPtr equals `NULL_PTR` (`CANNM_E_NULL_POINTER`)⌋()

[CANNM233] ⌈If an error has to be indicated to the DET, the callback function `CanNm_RxIndication` shall use the value of CanNm channel handle as the instance id.⌋()

[CANNM285] ⌈Caveats of `CanNm_RxIndication`:

- Until this service returns the CAN Interface will not access `canSduPtr`. The `canSduPtr` is only valid and can be used by upper layers until the indication returns. CAN Interface guarantees that the number of configured bytes for this `canNmRxPduId` is valid. The call context is either on interrupt level (interrupt mode) or on task level (polling mode). This callback service is re-entrant for multiple CAN controller usage.
- The CanNm module is initialized correctly.⌋()

8.5 Called by CanSM

8.5.1 CanNm_ConfirmPnAvailability

[CANNM344] ⌈

Service name:	CanNm_ConfirmPnAvailability	
Syntax:	`void CanNm_ConfirmPnAvailability( const NetworkHandleType nmChannelHandle )`	
Service ID[hex]:	0x16	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant (but not for the same NM-channel)	
Parameters (in):	nmChannelHandle	Identification of the NM-channel
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	Enables the PN filter functionality on the indicated NM channel. Availability: The API is only available if CanNmPnEnabled is TRUE.	

⌋()

[CANNM345] ⌈Caveats of `CanNm_ConfirmPnAvailability`: The CanNm module is initialized correctly.⌋()

[CANNM346] ⌈Configuration of `CanNm_ConfirmPnAvailability`: Optional (Only available if `CANNM_PN_ENABLED` is set to `TRUE`).⌋()

8.6 Scheduled Functions

8.6.1 CanNm_MainFunction

[CANNM234] ⌈

Service name:	CanNm_MainFunction

Syntax:	`void CanNm_MainFunction(`
	`  void`
	`)`

Service ID[hex]:	0x13
Timing:	FIXED_CYCLIC
Description:	Main function of the CanNm which processes the algorithm describes in that document. This function is responsible to handle all CanNm instances.

⌋()

[CANNM235] ⌈The scheduled function `CanNm_MainFunction` shall inform the DET, if development error detection is enabled (`CANNM_DEV_ERROR_DETECT` is set to TRUE) and if function call has failed because of the following reasons:

- The CanNm module was not initialized (`CANNM_E_NO_INIT`).⌋()

[CANNM236] ⌈If an error has to be indicated to the DET, `CanNm_MainFunction` shall report the instance id that has caused the error.⌋()

8.7 Expected Interfaces

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

8.7.1 Mandatory Interfaces

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

[CANNM324] ⌈

API function	***Description***
Nm_BusSleepMode	Notification that the network management has entered Bus-Sleep Mode.
Nm_NetworkMode	Notification that the network management has entered Network Mode.
Nm_NetworkStartIndication	Notification that a NM-message has been received in the Bus-Sleep Mode, what indicates that some nodes in the network have already entered the Network Mode.
Nm_PrepareBusSleepMode	Notification that the network management has entered Prepare Bus-Sleep Mode.

⌋()

8.7.2 Optional Interfaces

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

[CANNM325] ⌈

API function	*Description*
CanIf_CancelTransmit	This is a dummy method introduced for interface compatibility.
CanIf_Transmit	This service initiates a request for transmission of the CAN L-PDU specified by the CanTxPduId and CAN related data in the L-PDU structure.
CanSM_TxTimeoutException	This function shall notify the CanSM module, that the CanNm has detected for the affected partial CAN network a tx timeout exception, which shall be recovered by the CanSM module with a transition to no communication and back to the requested communication mode again.
Det_ReportError	Service to report development errors.
Nm_CarWakeUpIndication	This function is called by a <Bus>Nm to indicate reception of a CWU request.
Nm_CoordReadyToSleepIndication	Sets an indication, when the NM Coordinator Sleep Ready bit in the Control Bit Vector is set
Nm_PduRxIndication	Notification that a NM message has been received.
Nm_RemoteSleepCancellation	Notification that the network management has detected that not all other nodes on the network are longer ready to enter Bus-Sleep Mode.
Nm_RemoteSleepIndication	Notification that the network management has detected that all other nodes on the network are ready to enter Bus-Sleep Mode.
Nm_RepeatMessageIndication	Service to indicate that an NM message with set Repeat Message Request Bit has been received.
Nm_StateChangeNotification	Notification that the state of the lower layer <BusNm> has changed.
Nm_TxTimeoutException	Service to indicate that an attempt to send an NM message failed.
PduR_CanNmRxIndication	Indication of a received I-PDU from a lower layer communication module.
PduR_CanNmTriggerTransmit	The lower layer communication module requests the buffer of the SDU for transmission from the upper layer module.
PduR_CanNmTxConfirmation	The lower layer communication module confirms the transmission of an I-PDU.

⌋()

8.7.3 Configurable interfaces

Not applicable

8.7.4 Job End Notification

Not applicable

8.8 Parameter check

[CANNM196] ⌈If detection of development errors is enabled by `CANNM_DEV_ERROR_DETECT` (configuration parameter), then for all CanNm API services validity check of input parameters shall be made.

Exception: The NULL Pointer check of input parameters shall not be done for CanNm_Init.」()

[CANNM197] 「Parameter type checking shall be made at compile time; if types do not fit the compilation process shall be stopped and respective compilation warnings or errors shall be returned as far as supported by the compiler.」()

[CANNM198] 「Parameter value check (for parameters of the constant value) shall be made at configuration time; if the value is invalid, the configuration process shall be stopped and respective configuration error shall be reported.」()

[CANNM199] 「Parameter value check (for parameters of the variable value) shall be made at execution time; if the value is invalid, execution of a service shall be rejected and respective development error shall be reported.」()

8.9 Version check

[CANNM200] 「The CanNm module shall perform Inter Module Checks to avoid integration of incompatible files.
The imported included files shall be checked by preprocessing directives. 」()

The following version numbers shall be verified:
- <MODULENAME>_AR_RELEASE_MAJOR_VERSION
- <MODULENAME>_AR_RELEASE_MINOR_VERSION

Where <MODULENAME> is the Module Abbreviation of the other (external) modules which provide header files included by the CanNm module. If the values are not identical to the expected values, an error shall be reported.

8.10 UML State chart diagram

The following figure shows an UML state diagram with respect to the API specification. Mode change related transitions are denoted in green, error handling related transitions in red and optional node detection related transitions in blue. Additionally it is assumed that busload reduction functionality is enabled.

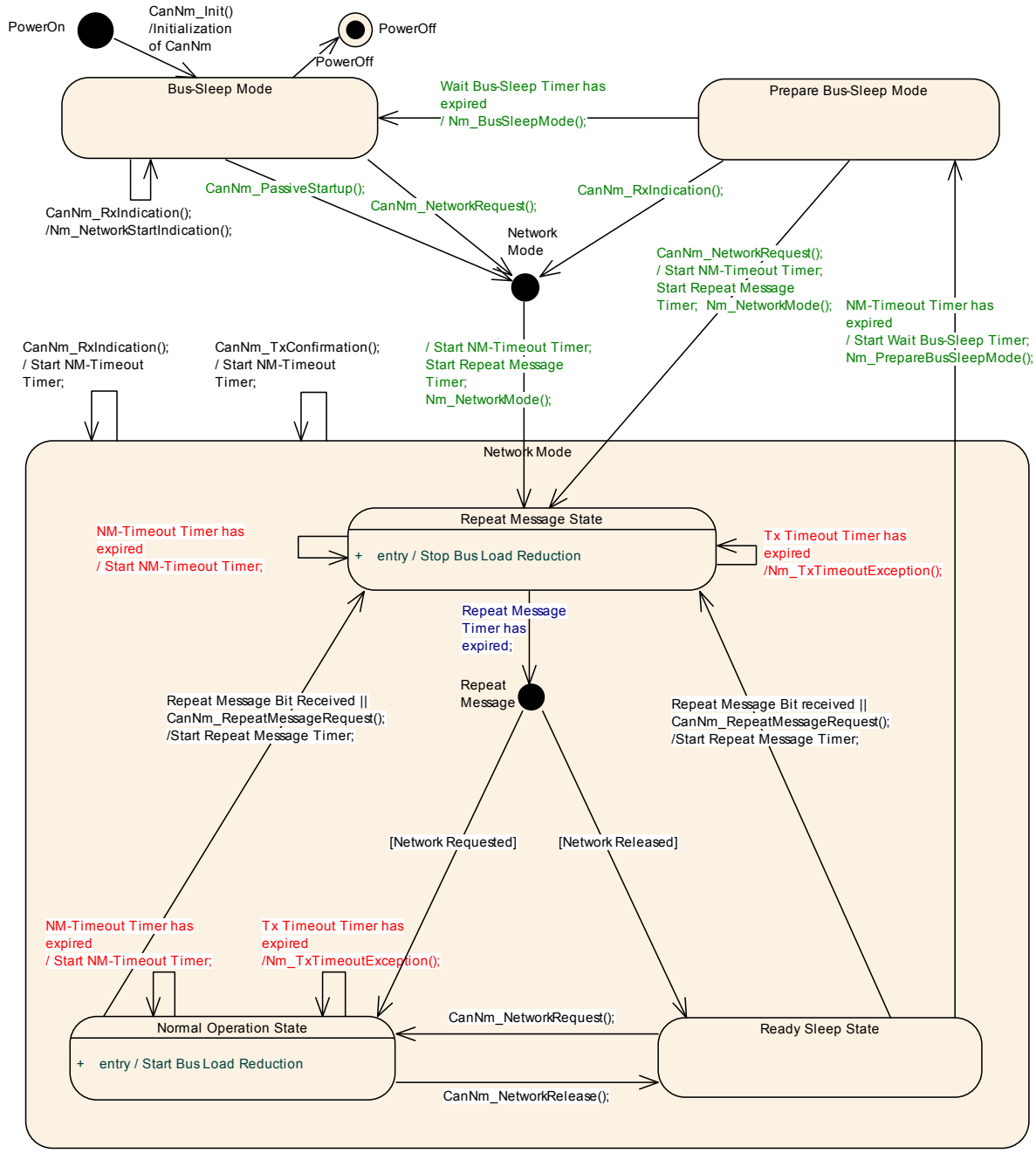
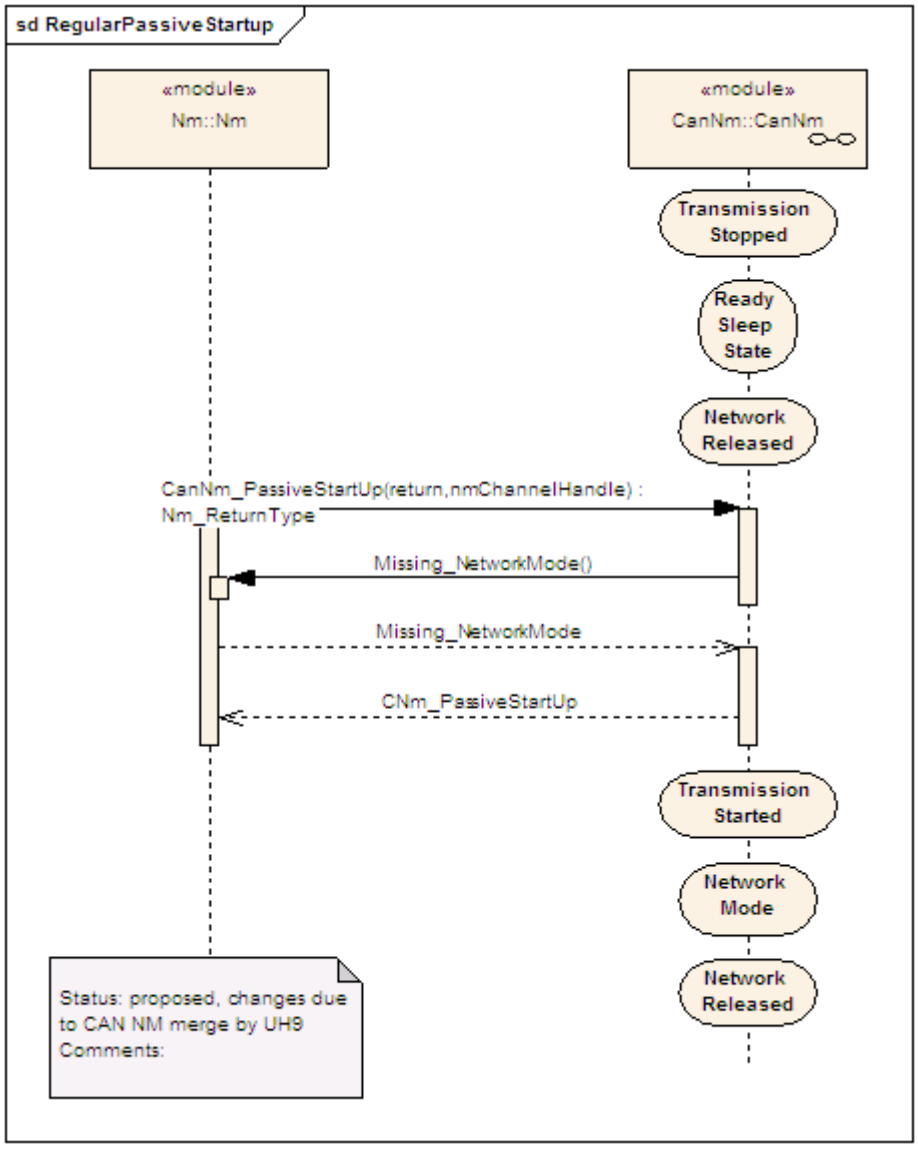


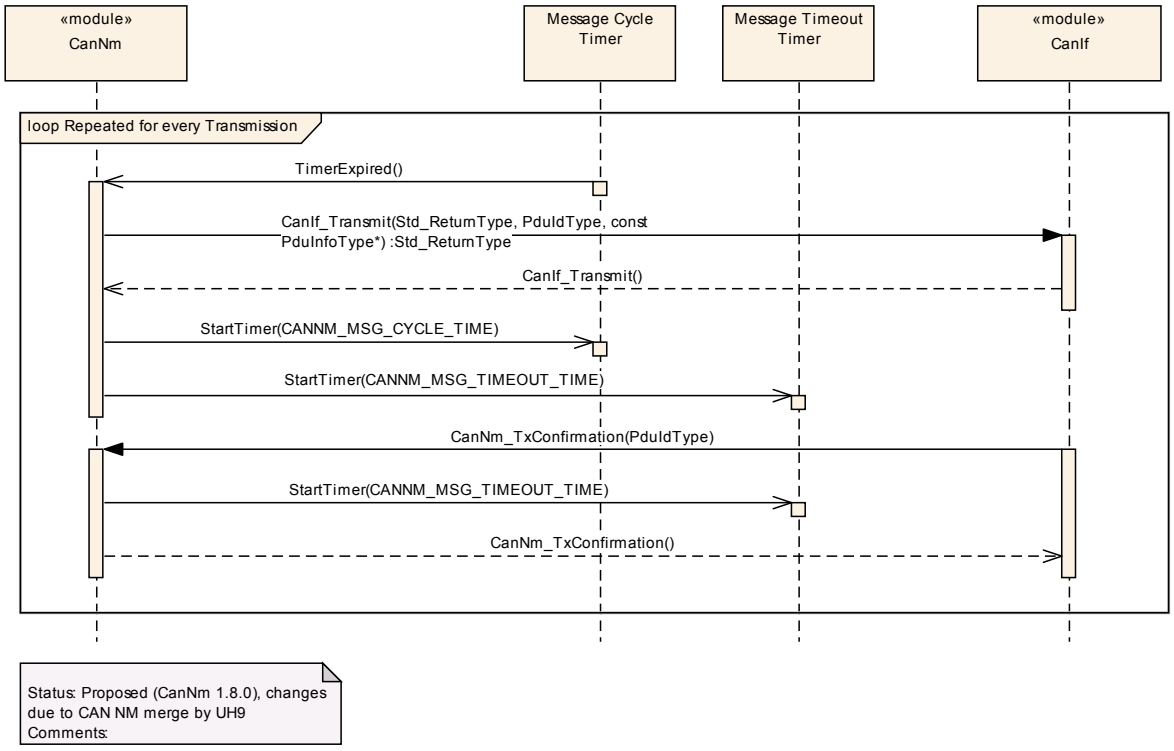
Figure 8-1 CanNm Algorithm

9 Sequence diagrams

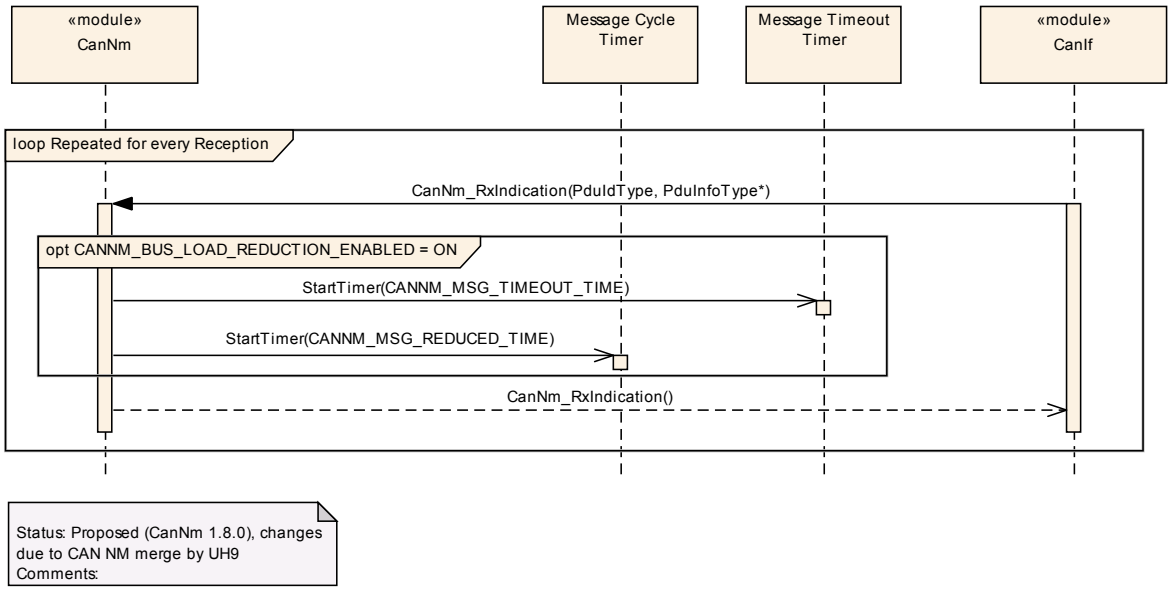
9.1 Regular Passive Startup



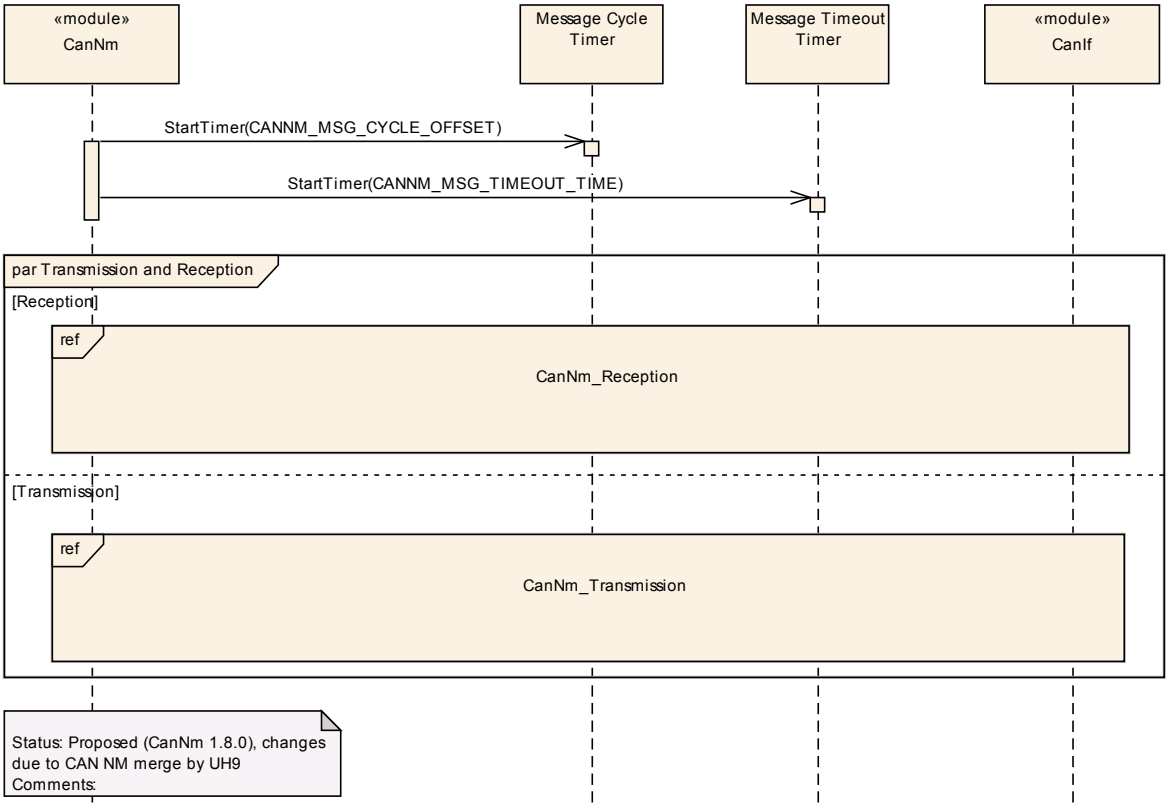
9.2 CanNm Transmission



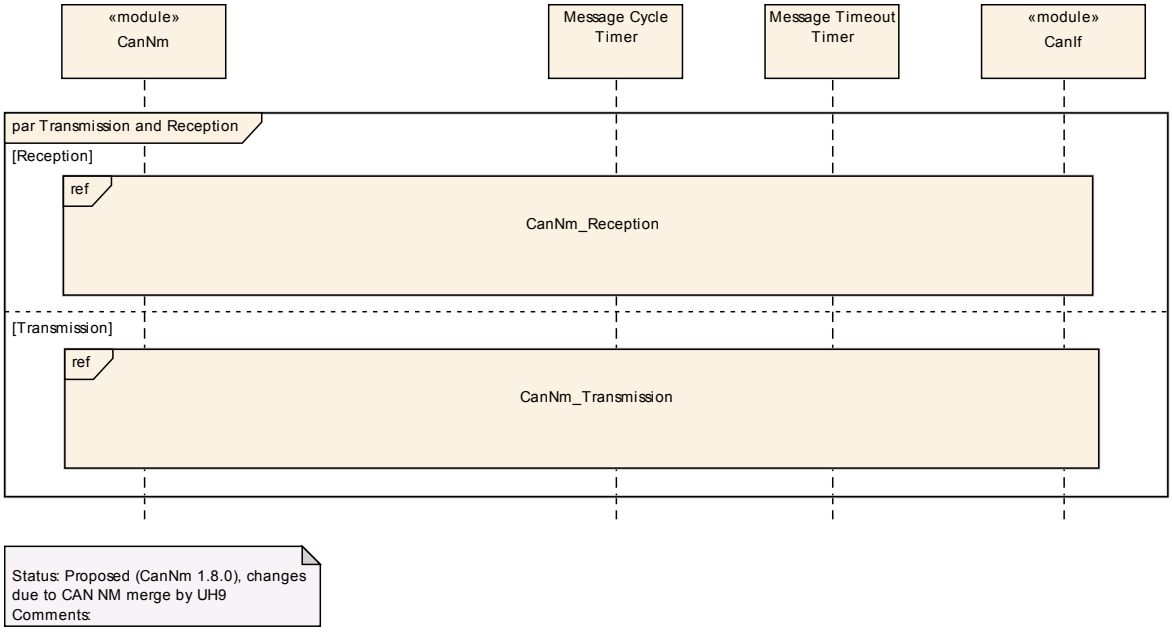
9.3 CanNm Reception



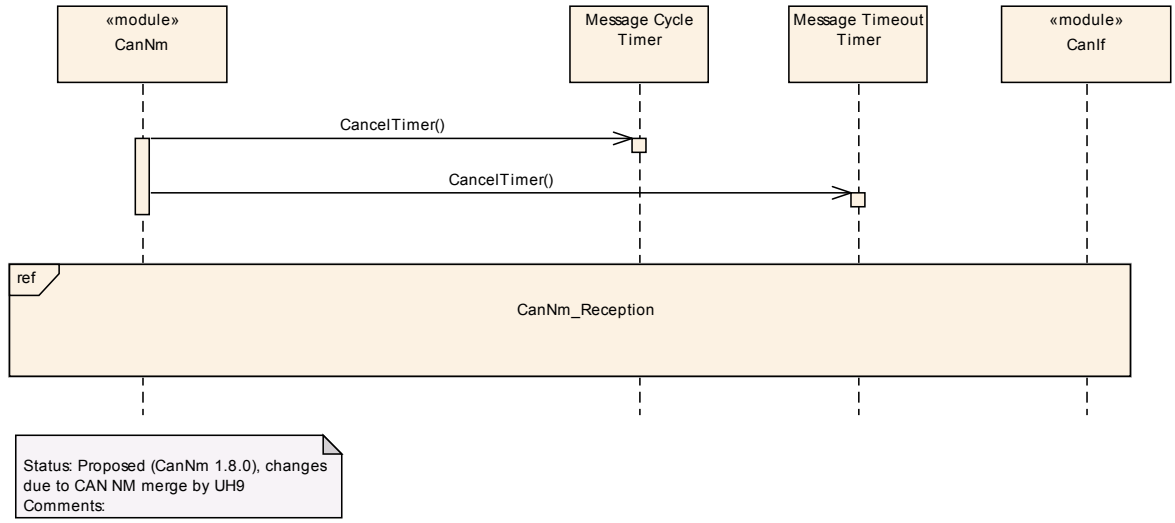
9.4 CanNm Bus Sleep -> Repeat Message



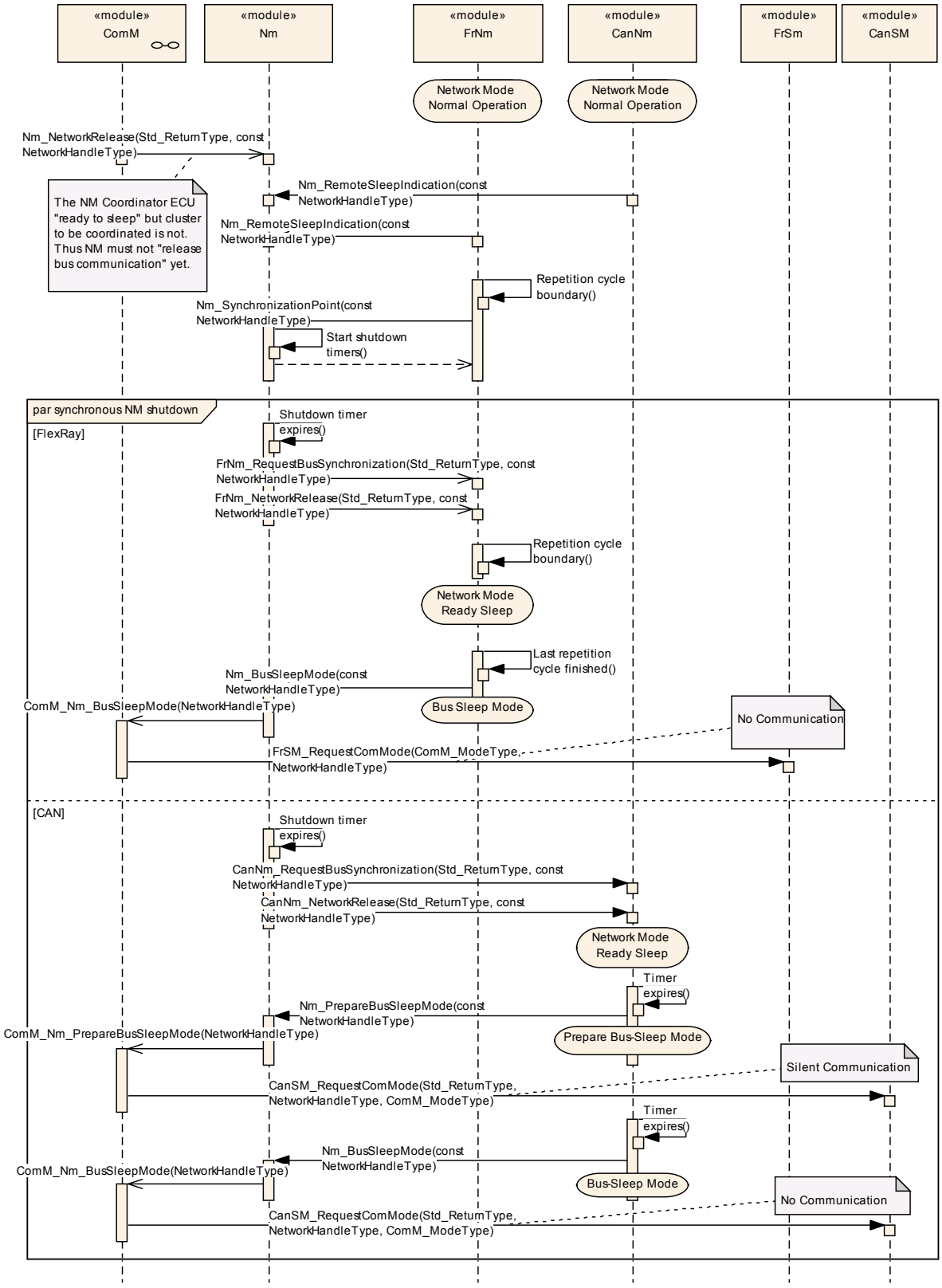
9.5 CanNm Repeat Message->Normal Operation



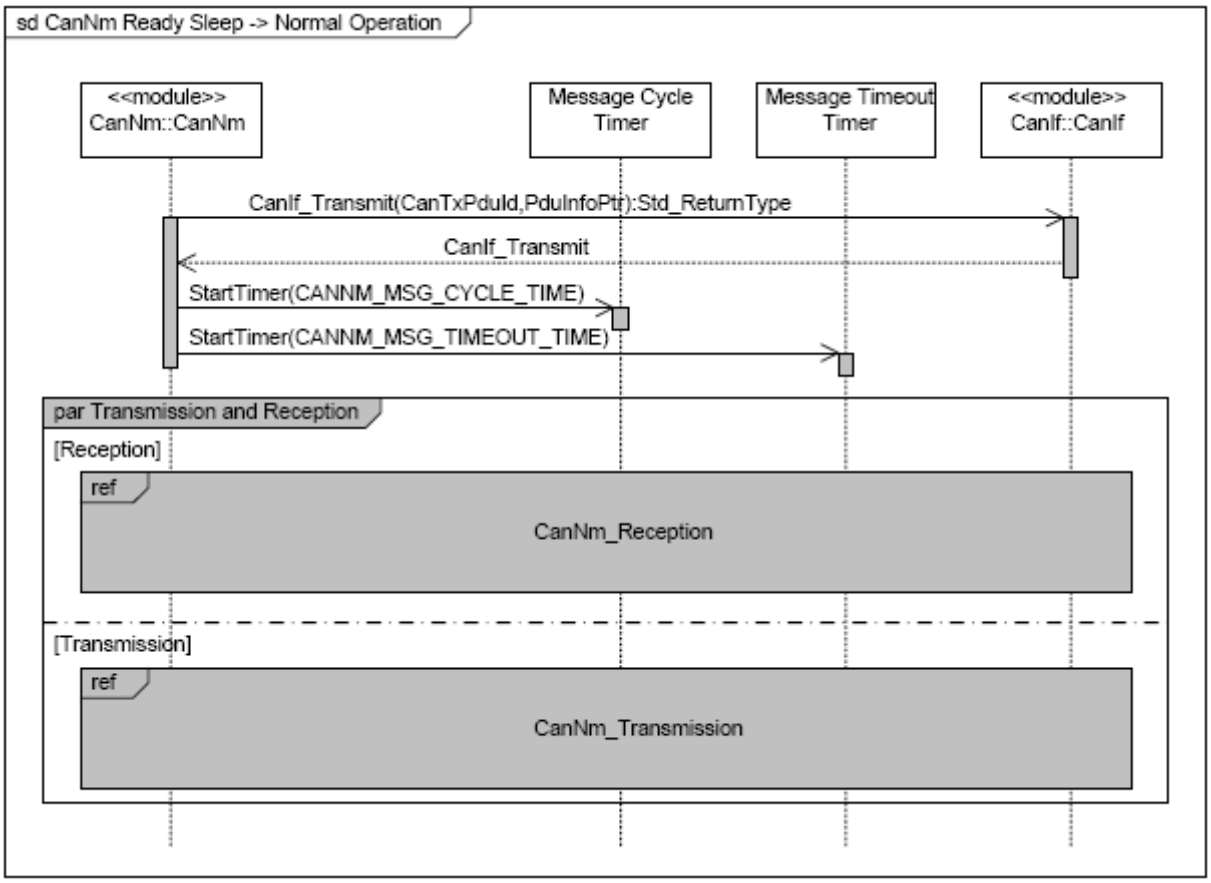
9.6 CanNm Normal Operation -> Ready Sleep



9.7 Nm Coordination



9.8 Sequence “Ready Sleep” to “Normal Operation”



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. It also specifies a template (table) you shall use for the parameter specification. We intend to leave chapter 10.1 in the specification to guarantee comprehension.

Chapter 10.2 specifies the structure (containers) and the parameters of the module CanNm.

Chapter 10.3 specifies published information of the module CanNm.

10.1 How to read this chapter

In addition to this section, it is highly recommended to read the documents:

- AUTOSAR Layered Software Architecture [1]
- AUTOSAR ECU Configuration Specification [7]
  This document describes the AUTOSAR configuration methodology and the AUTOSAR configuration metamodel in detail.

The following is only a short survey of the topic and it will not replace the ECU Configuration Specification document.

10.1.1 Configuration and configuration parameters

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

The configuration of parameters can be achieved at different times during the software process: before compile time, before link time or after build time. In the following, the term “configuration class” (of a parameter) shall be used in order to refer to a specific configuration point in time.

10.1.2 Variants

Variants describe sets of configuration parameters. E.g., variant 1: only pre-compile time configuration parameters; variant 2: mix of pre-compile- and link time-configuration parameters. In one variant a parameter can only be of one configuration class.

10.1.3 Containers

Containers structure the set of configuration parameters. This means:

- *all* configuration parameters are kept in containers.
- (sub-) containers can reference (sub-) containers. It is possible to assign a multiplicity to these references. The multiplicity then defines the possible number of instances of the contained parameters.

10.1.4 Specification template for configuration parameters

The following tables consist of three sections:

- the general section
- the configuration parameter section
- the section of included/referenced containers

Pre-compile time - specifies whether the configuration parameter shall be of configuration class *Pre-compile time* or not

Label	***Description***
x	The configuration parameter shall be of configuration class *Pre-compile time*.
--	The configuration parameter shall never be of configuration class *Pre-compile time*.

Link time - specifies whether the configuration parameter shall be of configuration class *Link time* or not

Label	***Description***
x	The configuration parameter shall be of configuration class *Link time*.
--	The configuration parameter shall never be of configuration class *Link time*.

Post Build - specifies whether the configuration parameter shall be of configuration class *Post Build* or not

Label	***Description***
x	The configuration parameter shall be of configuration class *Post Build* and no specific implementation is required.
L	*Loadable* – the configuration parameter shall be of configuration class *Post Build* and only one configuration parameter set resides in the ECU.
M	*Multiple* – the configuration parameter shall be of configuration class *Post Build* and is selected out of a set of multiple parameters by passing a dedicated pointer to the init function of the module.
--	The configuration parameter shall never be of configuration class *Post Build*.

10.2 Containers and configuration parameters

The following chapters summarize all configuration parameters. The detailed meanings of the parameters are described in the chapters 7 and 7.19.

The configuration parameters as defined in this chapter are used to create a data model for an AUTOSAR tool chain. The realization in the code is implementation specific.

The configuration parameters as defined in this chapter are used to create a data model for an AUTOSAR tool chain. The realization in the code is implementation specific.

The configuration parameters are divided in parameters which are used to enable features, parameters which affect all instances of the CanNm and parameters which affect the respective instances of the CanNm.

10.2.1 Variants

[CANNM250] ⌈VARIANT-PRE-COMPILE: Only parameters with “Pre-compile time” configuration are allowed in this variant.⌋()

[CANNM251] ⌈VARIANT-LINK-TIME: Only parameters with “Pre-compile time” and “Link time” are allowed in this variant.⌋()

[CANNM252] ⌈ VARIANT-POST-BUILD: Parameters with “Pre-compile time”, “Link time” and “Post-build time” are allowed in this variant. ⌋()

10.3 Containers and configuration parameters

This chapter describes the configuration container and parameters used for CanNm configuration.

10.3.1 CanNm Global Configuration Overview

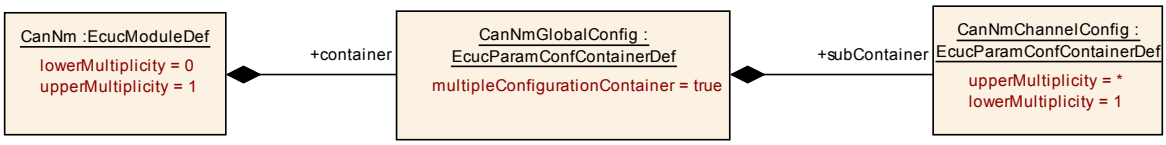


Figure 10-1 CanNm top level configuration overview

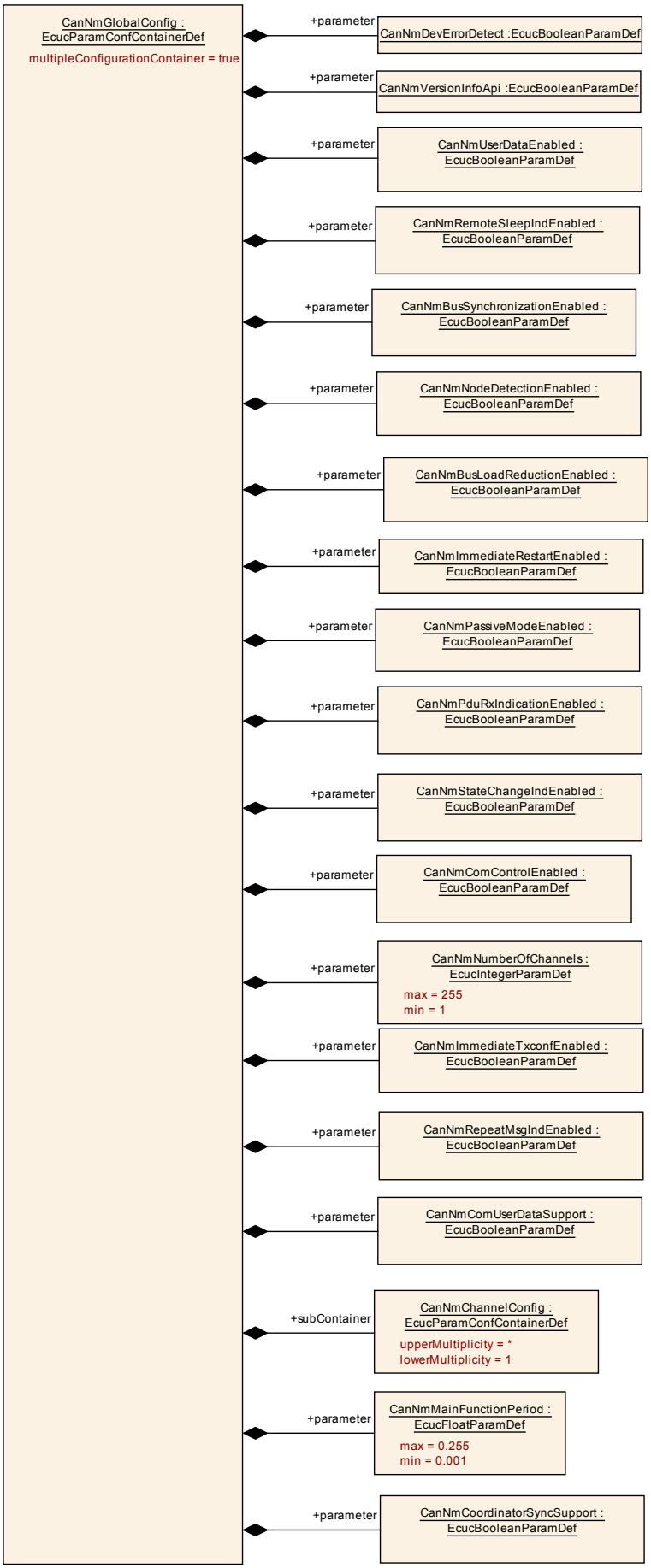

CanNmGlobalConfig : EcucParamConfContainerDef
multipleConfigurationContainer = true
+parameter
CanNmDevErrorDetect :EcucBooleanParamDef
+parameter
CanNmVersionInfoApi :EcucBooleanParamDef
+parameter
CanNmUserDataEnabled : EcucBooleanParamDef
+parameter
CanNmRemoteSleepIndEnabled : EcucBooleanParamDef
+parameter
CanNmBusSynchronizationEnabled : EcucBooleanParamDef
+parameter
CanNmNodeDetectionEnabled : EcucBooleanParamDef
+parameter
CanNmBusLoadReductionEnabled : EcucBooleanParamDef
+parameter
CanNmImmediateRestartEnabled : EcucBooleanParamDef
+parameter
CanNmPassiveModeEnabled : EcucBooleanParamDef
+parameter
CanNmPduRxIndicationEnabled : EcucBooleanParamDef
+parameter
CanNmStateChangeIndEnabled : EcucBooleanParamDef
+parameter
CanNmComControlEnabled : EcucBooleanParamDef
+parameter
CanNmNumberOfChannels : EcucIntegerParamDef
max = 255
min = 1
+parameter
CanNmImmediateTxconfEnabled : EcucBooleanParamDef
+parameter
CanNmRepeatMsgIndEnabled : EcucBooleanParamDef
+parameter
CanNmComUserDataSupport : EcucBooleanParamDef
+subContainer
CanNmChannelConfig : EcucParamConfContainerDef
upperMultiplicity = *
lowerMultiplicity = 1
+parameter
CanNmMainFunctionPeriod : EcucFloatParamDef
max = 0.255
min = 0.001
+parameter
CanNmCoordinatorSyncSupport : EcucBooleanParamDef

Figure 10-2 Parameters of CanNm global configuration

10.3.2 CanNmGlobalConfig

SWS Item	**CANNM001_Conf :**
Container Name	CanNmGlobalConfig{CanNm_GlobalConfig} [Multi Config Container]
Description	This container contains the global configuration parameter of the CanNm. The parameters and the parameters of the sub containers shall be mapped to the C data type CanNm_ConfigType (for parameters where it is possible) which is passed to the CanNm_Init function. This container is a MultipleConfigurationContainer (only for variant 3), i.e. this container and its sub-containers exit once per configuration set.
Configuration Parameters	

SWS Item	**CANNM040_Conf :**		
Name	CanNmBusLoadReductionEnabled {CANNM_BUS_LOAD_REDUCTION_ENABLED}		
Description	Pre-processor switch for enabling busload reduction support.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module dependency: Must not be defined if CanNmPassiveModeEnabled is defined.		

SWS Item	**CANNM006_Conf :**		
Name	CanNmBusSynchronizationEnabled {CANNM_BUS_SYNCHRONIZATION_ENABLED}		
Description	Pre-processor switch for enabling bus synchronization support. This feature is required for gateway nodes only. calculationFormula = If (CanNmPassiveModeEnabled == False) then Equal(NmBusSynchronizationEnabled) else Equal(False)		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM013_Conf :**		
Name	CanNmComControlEnabled {CANNM_COM_CONTROL_ENABLED}		
Description	Pre-processor switch for enabling the Communication Control support. calculationformula = Equal(NmComControlEnabled)		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM044_Conf :**
Name	CanNmComUserDataSupport

	{CANNM_COM_USER_DATA_SUPPORT}		
Description	Enable/disable the user data support.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM080_Conf :**		
Name	CanNmCoordinatorSyncSupport {CANNM_COORDINATOR_SYNC_SUPPORT}		
Description	Enables/disables the coordinator synchronisation support.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM002_Conf :**		
Name	CanNmDevErrorDetect {CANNM_DEV_ERROR_DETECT}		
Description	Pre-processor switch for enabling development error detection support.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM009_Conf :**		
Name	CanNmImmediateRestartEnabled {CANNM_IMMEDIATE_RESTART_ENABLED}		
Description	Pre-processor switch for enabling the asynchronous transmission of a NM PDU upon bus-communication request in Prepare-Bus-Sleep mode.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module dependency: Must not be defined if CanNmPassiveModeEnabled is defined.		

SWS Item	**CANNM041_Conf :**
Name	CanNmImmediateTxconfEnabled {CANNM_IMMEDIATE_TXCONF_ENABLED}
Description	Enable/disable the immediate tx confirmation.
Multiplicity	1
Type	EcucBooleanParamDef
Default value	--

ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module dependency: CanNmImmediateTxconfEnabled shall not be enabled if CanNmPasiveModeEnabled is enabled.		

SWS Item	**CANNM032_Conf :**		
Name	CanNmMainFunctionPeriod {CANNM_MAIN_FUNCTION_PERIOD}		
Description	Call cycle in seconds of CanNm_MainFunction.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	`0.001 .. 0.255`		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance		

SWS Item	**CANNM007_Conf :**		
Name	CanNmNodeDetectionEnabled {CANNM_NODE_DETECTION_ENABLED}		
Description	Precompile time switch to enable the node detection feature.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM014_Conf :**		
Name	CanNmNumberOfChannels {CANNM_NUMBER_OF_CHANNELS}		
Description	Number of Can NM channels allowed within one ECU.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 255		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM010_Conf :**		
Name	CanNmPassiveModeEnabled {CANNM_PASSIVE_MODE_ENABLED}		
Description	Pre-processor switch for enabling support of the Passive Mode. calculationFormula = Equal(NmPassiveModeEnabled)		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	CANNM011_Conf :		
Name	CanNmPduRxIndicationEnabled {CANNM_PDU_RX_INDICATION_ENABLED}		
Description	Pre-processor switch for enabling the PDU Rx Indication. calculationFormula = Equal(NmPduRxIndicationEnabled)		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	CANNM070_Conf :		
Name	CanNmPnEiraCalcEnabled {CANNM_PN_EIRA_CALC_ENABLED}		
Description	Specifies if CanNm calculates the PN request information for internal an external requests. (EIRA) true: PN request are calculated false: PN request are not calculated		
Multiplicity	0..1		
Type	EcucBooleanParamDef		
Default value	false		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true for at least one CanNm Channel		

SWS Item	CANNM059_Conf :		
Name	CanNmPnResetTime {CANNM_PN_RESET_TIME}		
Description	Specifies the runtime of the reset timer in seconds. This reset time is valid for the reset of PN requests in the EIRA and in the ERA. The value shall be the same for every channel. Thus it is a global config parameter.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	0.001 .. 65.535		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true for at least one CanNm Channel.		

SWS Item	CANNM055_Conf :
Name	CanNmRemoteSleepIndEnabled {CANNM_REMOTE_SLEEP_IND_ENABLED}
Description	Pre-processor switch for enabling remote sleep indication support. This feature is required for gateway nodes only. calculationFormula = If (CanNmPassiveModeEnabled == False) then Equal(NmRemoteSleepIndEnabled) else Equal(False)
Multiplicity	1
Type	EcucBooleanParamDef
Default value	--

ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM005_Conf :**		
Name	CanNmRepeatMsgIndEnabled {CANNM_REPEAT_MSG_IND_ENABLED}		
Description	Enable/disable the notification that a RepeatMessageRequest bit has been received. calculationformula = Equal(NmRepeatMsgIndEnabled)		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM012_Conf :**		
Name	CanNmStateChangeIndEnabled {CANNM_STATE_CHANGE_IND_ENABLED}		
Description	Pre-processor switch for enabling the CAN NM state change notification. calculationFormula = Equal(NmStateChangeIdEnabled)		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM004_Conf :**		
Name	CanNmUserDataEnabled {CANNM_USER_DATA_ENABLED}		
Description	Pre-processor switch for enabling user data support. calculationFormula = Equal(NmUserDataEnabled)		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Network		

SWS Item	**CANNM003_Conf :**		
Name	CanNmVersionInfoApi {CANNM_VERSION_INFO_API}		
Description	Pre-processor switch for enabling version info API support.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**CANNM072_Conf :**
Name	CanNmPnEiraRxNSduRef {CANNM_PN_EIRA_RX_NSDU_REF}

Description	Reference to a Pdu in the COM-Stack. Only one SduRef is required for CanNm because the EIRA is the aggregation over all Can Channels.		
Multiplicity	0..1		
Type	Reference to [Pdu]		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true for at least one CanNm Channel.		

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
CanNmChannelConfig	1..*	This container contains the channel specific configuration parameter of the CanNm.
CanNmPnInfo	0..1	PN information configuration

10.3.3 CanNm Channel Configuration Overview

[CANNM202] ⌈The container CanNmChannelConfig specifies configuration parameter that shall be located in a data structure of type **`CanNm_ConfigType`**.⌋()

[CANNM203] ⌈Runtime configurable parameters listed below shall be configurable for each network management cluster separately.⌋()

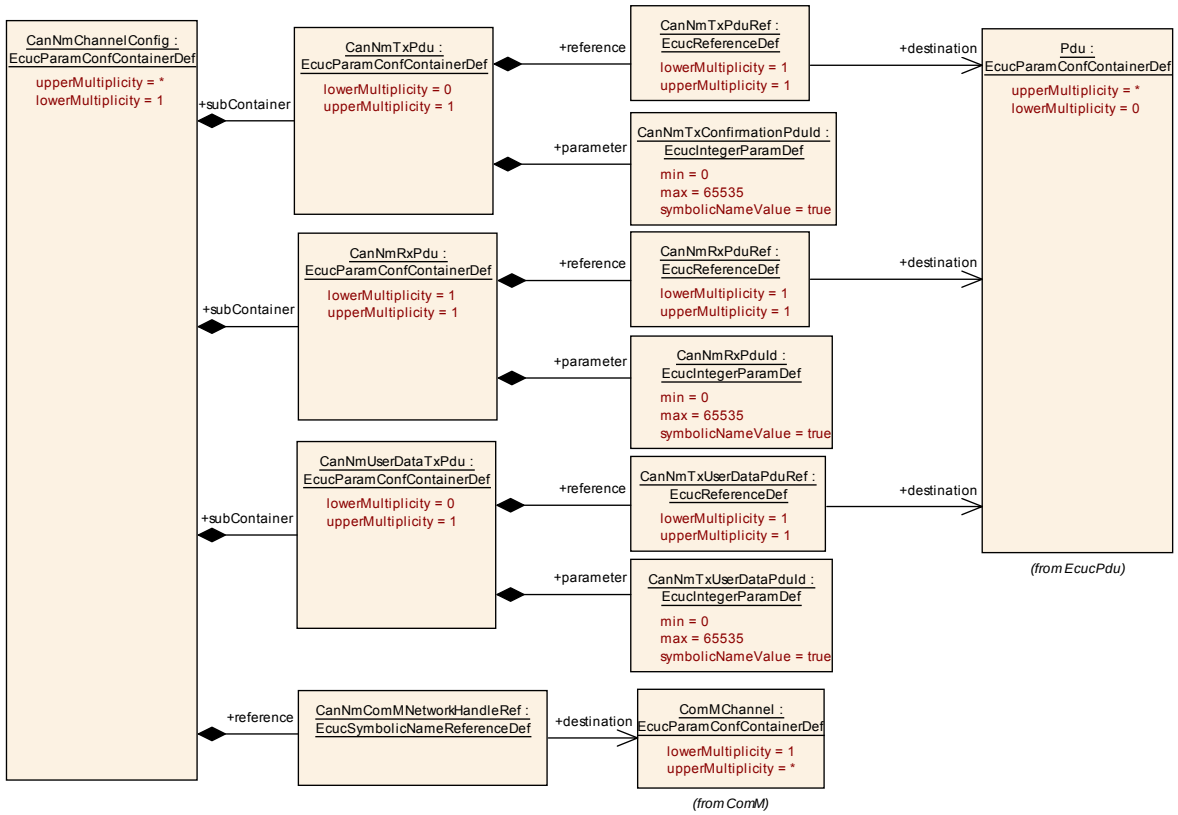


Figure 10-3 CanNm Channel Configuration Overview

10.3.4 CanNmChannelConfig

SWS Item	**CANNM017_Conf :**
Container Name	CanNmChannelConfig{CanNm_ChannelConfig}
Description	This container contains the channel specific configuration parameter of the CanNm.
Configuration Parameters	

SWS Item	**CANNM068_Conf :**		
Name	CanNmAllNmMessagesKeepAwake		
Description	Specifies if CanNm drops irrelevant NM messages. false: Only NM messages with an with CRI bit = true and containing an PN request for this ECU triggers the standard RX indication handling true: Every NM message triggers the standard RX indication handling		
Multiplicity	0..1		
Type	EcucBooleanParamDef		
Default value	false		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true		

SWS Item	**CANNM042_Conf :**		
Name	CanNmBusLoadReductionActive {CANNM_BUS_LOAD_REDUCTION_ACTIVE}		
Description	This parameter defines if bus load reduction for the respective NM channel is active or not.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance dependency: Shall only be True if CanNmBusLoadReductionEnabled is True.		

SWS Item	**CANNM075_Conf :**		
Name	CanNmCarWakeUpBitPosition {CANNM_CAR_WAKE_UP_BIT_POSITION}		
Description	Specifies the Bit position of the CWU within the NM-Message.		
Multiplicity	0..1		
Type	EcucIntegerParamDef		
Range	0 .. 7		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance dependency: only available if CanNmCarWakeUpRxEnabled == TRUE		

SWS Item	CANNM076_Conf :		
Name	CanNmCarWakeUpBytePosition {CANNM_CAR_WAKE_UP_BYTE_POSITION}		
Description	Specifies the Byte position of the CWU within the NM-Message.		
Multiplicity	0..1		
Type	EcucIntegerParamDef		
Range	2 .. 7		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance dependency: only available if CanNmCarWakeUpRxEnabled == TRUE		

SWS Item	CANNM077_Conf :		
Name	CanNmCarWakeUpFilterEnabled {CANNM_CAR_WAKE_UP_FILTER_ENABLED}		
Description	If CWU filtering is supported, only the CWU bit within the NM message with source node identifier CanNmCarWakeUpFilterNodeId is considered as CWU request. FALSE - CWU filtering is not supported TRUE - CWU filtering is supported		
Multiplicity	0..1		
Type	EcucBooleanParamDef		
Default value	false		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance dependency: only available if CanNmCarWakeUpRxEnabled == TRUE		

SWS Item	CANNM078_Conf :		
Name	CanNmCarWakeUpFilterNodeId {CANNM_CAR_WAKE_UP_FILTER_NODE_ID}		
Description	Source node identifier for CWU filtering. If CWU filtering is supported, only the CWU bit within the NM message with source node identifier CanNmCarWakeUpFilterNodeId is considered as CWU request.		
Multiplicity	0..1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance dependency: only available if CanNmCarWakeUpRxEnabled == TRUE		

SWS Item	CANNM074_Conf :
Name	CanNmCarWakeUpRxEnabled {CANNM_CAR_WAKE_UP_RX_ENABLED}
Description	Enables or disables support of CarWakeUp bit evaluation in received NM messages. FALSE - CarWakeUp not supported TRUE - CarWakeUp supported
Multiplicity	1

Type	EcucBooleanParamDef		
Default value	false		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance		

SWS Item	**CANNM057_Conf :**		
Name	CanNmImmediateNmCycleTime {CANNM_IMMEDIATE_NM_CYCLETIME}		
Description	Defines the immediate NM PDU cycle time in seconds which is used for CanNmImmediateNmTransmissions NM PDU transmissions. This parameter is only valid if CanNmImmediateNmTransmissions is greater one.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	`0.001 .. 65.535`		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Network		

SWS Item	**CANNM056_Conf :**		
Name	CanNmImmediateNmTransmissions {CANNM_IMMEDIATE_NM_TRANSMISSIONS}		
Description	Defines the number of immediate NM PDUs which shall be transmitted. If the value is zero no immediate NM PDUs are transmitted. The cycle time of immeditate NM PDUs is defined by CanNmImmediateNmCycleTime.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Network dependency: If CanNmImmediateRestartEnabled = true then CanNmImmediateNmTransmissions = 0		

SWS Item	**CANNM029_Conf :**		
Name	CanNmMsgCycleOffset {CANNM_MSG_CYCLE_OFFSET}		
Description	Time offset in the periodic transmission node. It determines the start delay of the transmission. Specified in seconds. This parameter is only valid if CanNmPassiveModeEnabled is False.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	`0 .. 65.535`		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance		

	dependency: Parameter value < CanMsgCycleTime

SWS Item	CANNM028_Conf :		
Name	CanNmMsgCycleTime {CANNM_MSG_CYCLE_TIME}		
Description	Period of a NM-message in seconds. It determines the periodic rate in the "periodic transmission mode with bus load reduction" and is the basis for transmit scheduling in the "periodic transmission mode without bus load reduction". This parameter is only valid if CanNmPassiveModeEnabled is False.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	0.001 .. 65.535		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Network dependency: CanNmTimeoutTime = n*CanNmMsgCycleTime		

SWS Item	CANNM043_Conf :		
Name	CanNmMsgReducedTime {CANNM_MSG_REDUCED_TIME}		
Description	Node specific bus cycle time in the periodic transmission mode with bus load reduction. Specified in seconds. This parameter is only valid if CanNmBusLoadReductionEnabled == True and CanNmBusLoadReductionActive == True and CanNmPassiveModeEnabled == False Otherwise this parameter is not used.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	0.001 .. 65.535		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Instance dependency: 0,5 * CanNmMsgCycleTime ≤ CanNmMsgReducedTime < CanNmMsgCycleTime		

SWS Item	CANNM030_Conf :		
Name	CanNmMsgTimeoutTime {CANNM_MSG_TIMEOUT_TIME}		
Description	Transmission Timeout of NM-message. If there is no transmission confirmation by the CAN Interface within this timeout, the CANNM module shall give an error notification. This parameter is only valid if CANNM_PASSIVE_MODE_ENABLED is disabled.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	0.001 .. 65.535		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: instance dependency: CanNmMsgTimeoutTime < CanNmMsgCycleTime		

SWS Item	CANNM031_Conf :		
Name	CanNmNodeId {CANNM_NODE_ID}		
Description	Node identifier of local node. This parameter is only valid if CanNmPassiveModeEnabled = False and CanNmNodeDetectionEnabled = True		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance		

SWS Item	CANNM026_Conf :		
Name	CanNmPduCbvPosition {CANNM_PDU_CBV_POSITION}		
Description	Defines the position of the control bit vector within the NM PDU. The value of the parameter represents the location of the control bit vector in the NM PDU (CanNmPduByte0 means byte 0, CanNmPduByte1 means byte 1, CanNmPduOff means source node identifier is not part of the NM PDU) if(CANNM_PDU_CBV_POSITION != CANNM_PDU_OFF && CANNM_PDU_NID_POSITION != CANNM_PDU_OFF) then CANNM_PDU_CBV_POSITION != CANNM_PDU_NID_POSITION if(CANNM_PDU_CBV_POSITION != CANNM_PDU_OFF && CANNM_PDU_NID_POSITION == CANNM_PDU_OFF) then CANNM_PDU_CBV_POSITION = CANNM_PDU_BYTE0 ImplementationType: CanNm_PduPositionType		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CANNM_PDU_BYTE_0		Byte 0 is used
	CANNM_PDU_BYTE_1		Byte 1 is used
	CANNM_PDU_OFF		Control Bit Vector is not used
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Network dependency: CanNmPduNidPosition		

SWS Item	CANNM025_Conf :
Name	CanNmPduNidPosition {CANNM_PDU_NID_POSITION}
Description	Defines the position of the source node identifier within the NM PDU. The value of the parameter represents the location of the source node identifier in the NM PDU (CanNMPduByte0 means byte 0, CanNmPduByte1 means byte 1, CanNmPduOff means source node identifier is not part of the NM PDU) if(CANNM_PDU_NID_POSITION != CANNM_PDU_OFF && CANNM_PDU_CBV_POSITION != CANNM_PDU_OFF) then CANNM_PDU_NID_POSITION != CANNM_PDU_CBV_POSITION if(CANNM_PDU_NID_POSITION != CANNM_PDU_OFF && CANNM_PDU_CBV_POSITION == CANNM_PDU_OFF) then CANNM_PDU_NID_POSITION =

	CANNM_PDU_BYTE0 ImplementationType: CanNm_PduPositionType		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CANNM_PDU_BYTE_0	Byte 0 is used	
	CANNM_PDU_BYTE_1	Byte 1 is used	
	CANNM_PDU_OFF	Node Identification is not used	
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Network dependency: CanNmPduCbvPosition		

SWS Item	**CANNM066_Conf :**		
Name	CanNmPnEnabled {CANNM_PN_ENABLED}		
Description	Enables or disables support of partial networking. false: Partial networking Range not supported true: Partial networking supported		
Multiplicity	0..1		
Type	EcucBooleanParamDef		
Default value	false		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: Module		

SWS Item	**CANNM067_Conf :**		
Name	CanNmPnEraCalcEnabled {CANNM_PN_ERA_CALC_ENABLED}		
Description	Specifies if CanNm calculates the PN request information for external requests. (ERA) false: PN request are not calculated true: PN request are calculated		
Multiplicity	0..1		
Type	EcucBooleanParamDef		
Default value	false		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true		

SWS Item	**CANNM073_Conf :**		
Name	CanNmPnHandleMultipleNetworkRequests {CANNM_PN_HANDLE_MULTIPLE_NETWORK_REQUESTS}		
Description	false: CanNm_NetworkRequest is ignored in NO. true: CanNm_NetworkRequest triggers a change from NO to RM.		
Multiplicity	0..1		
Type	EcucBooleanParamDef		
Default value	false		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	

Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true

SWS Item	**CANNM023_Conf :**		
Name	CanNmRemoteSleepIndTime {CANNM_REMOTE_SLEEP_IND_TIME}		
Description	Timeout for Remote Sleep Indication. It defines the time in seconds how long it shall take to recognize that all other nodes are ready to sleep. Typically it should be equal to: n * CanNmMsgCycleTime, where n denotes the number of NM-Messages that are normally sent before Remote Sleep Indication is detected. The value of n decremented by one determines the amount of lost NM-Messages that can be tolerated by the Remote Sleep Indication procedure. The value 0 denotes that no Remote Sleep Indication functionality is configured.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	`0 .. 65.535`		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance dependency: CanNmRemoteSleepIndTime = n * CanNmMsgCycleTime		

SWS Item	**CANNM022_Conf :**		
Name	CanNmRepeatMessageTime {CANNM_REPEAT_MESSAGE_TIME}		
Description	Timeout for Repeat Message State. It defines the time in seconds how long the NM shall stay in the Repeat Message State. Typically it should be equal to: n * CanNmMsgCycleTime, where n denotes the number of NM-Messages that are normally sent in the Repeat Message State. The value of n decremented by one determines the amount of lost NM-Messages that can be tolerated by the node detection procedure. The value 0 denotes that no Repeat Message State is configured. It means that Repeat Message State is transient what implicates that it is left immediately after entrance and in result no start-up stability is guaranteed and no node detection procedure is possible.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	`0 .. 65.535`		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance dependency: CanNmRepeatMessageTime = n * CanNmMsgCycleTime; CanNmRepeatMessageTime > CanNmImmediateNmTransmissions * CanNmImmediateNmCycleTime		

SWS Item	**CANNM020_Conf :**
Name	CanNmTimeoutTime {CANNM_TIMEOUT_TIME}
Description	Network Timeout for NM-Messages. It denotes the time in

	seconds how long the NM shall stay in the Network Mode before transition into Prepare Bus-Sleep Mode shall take place. It shall be equal for all nodes in the cluster. It shall be greater than CanNmMsgCycleTime. Typically it should be equal to: n * CanNmMsgCycleTime, where n denotes the number of NM-Message cycle times in the Ready Sleep State before transition into the Bus-Sleep Mode is initiated. The value of n decremented by one determines the amount of lost NM-Messages that can be tolerated by the coordination algorithm.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	`0.002 .. 65.535`		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance dependency: CanNmTimeoutTime = n * CanNmMsgCycleTime		

SWS Item	**CANNM027_Conf :**		
Name	CanNmUserDataLength {CANNM_USER_DATA_LENGTH}		
Description	Defines the length of the user data contained in the NM PDU		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 8		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: ECU dependency: CanNmPduLength, CanNmPduNidPosition, CanNmPduCbvPosition		

SWS Item	**CANNM021_Conf :**		
Name	CanNmWaitBusSleepTime {CANNM_WAIT_BUS_SLEEP_TIME}		
Description	Timeout for bus calm down phase. It denotes the time in seconds how long the NM shall stay in the Prepare Bus-Sleep Mode before transition into Bus-Sleep Mode shall take place. It shall be equal for all nodes in the cluster. It shall be long enough to make all Tx-buffer empty.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	`0.001 .. 65.535`		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance		

SWS Item	**CANNM018_Conf :**
Name	CanNmComMNetworkHandleRef {CANNM_CHANNEL_ID}
Description	This reference points to the unique channel defined by the

	ComMChannel and provides access to the unique channel index value in ComMChannelId.		
Multiplicity	1		
Type	Reference to [ComMChannel]		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Instance		

SWS Item	**CANNM079_Conf :**		
Name	CanNmPnEraRxNSduRef {CANNM_PN_ERA_RX_NSDU_REF}		
Description	Reference to a Pdu in the COM-Stack. The SduRef is required for every CanNm Channel, because ERA is reported per channel.		
Multiplicity	0..1		
Type	Reference to [Pdu]		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true for at least one CanNm Channel.		

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
CanNmRxPdu	1	This container is used to configure the Rx PDU properties that are used for the CanNm Channel.
CanNmTxPdu	0..1	This container contains the CanNmTxConfirmationPduId and the CanNmTxPduRef.
CanNmUserDataTxPdu	0..1	This optional container is used to configure the UserNm PDU. This container is only available if CanNmComUserDataSupport is enabled.

10.3.5 CanNmRxPdu

SWS Item	**CANNM038_Conf :**
Container Name	CanNmRxPdu
Description	This container is used to configure the Rx PDU properties that are used for the CanNm Channel.
Configuration Parameters	

SWS Item	**CANNM054_Conf :**		
Name	CanNmRxPduId {CANNM_RX_PDU_ID}		
Description	This parameter defines the Rx PDU ID of the CanIf L-PDU range that is associated with this CanNmChannel instance.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 65535		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	

Scope / Dependency	

SWS Item	**CANNM039_Conf :**		
Name	CanNmRxPduRef		
Description	Reference to the global PDU that is used by this CanNmChannel instance.		
Multiplicity	1		
Type	Reference to [Pdu]		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency			

No Included Containers

10.3.6 CanNmTxPdu

SWS Item	**CANNM036_Conf :**
Container Name	CanNmTxPdu
Description	This container contains the CanNmTxConfirmationPduId and the CanNmTxPduRef.
Configuration Parameters	

SWS Item	**CANNM048_Conf :**		
Name	CanNmTxConfirmationPduId {CANNM_TX_CONFIRMATION_PDU_ID}		
Description	Handle Id to be used by the Lower Layer to confirm the transmission of the CanNmTxPdu to the LowerLayer.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 65535		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency			

SWS Item	**CANNM037_Conf :**		
Name	CanNmTxPduRef		
Description	The reference to the common PDU structure.		
Multiplicity	1		
Type	Reference to [Pdu]		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency			

No Included Containers

10.3.7 CanNmUserDataTxPdu

SWS Item	**CANNM045_Conf :**
Container Name	CanNmUserDataTxPdu

Description	This optional container is used to configure the UserNm PDU. This container is only available if CanNmComUserDataSupport is enabled.
Configuration Parameters	

SWS Item	**CANNM047_Conf :**		
Name	CanNmTxUserDataPduId {CANNM_TX_USER_DATA_PDU_ID}		
Description	This parameter defines the Handle ID of the NM User Data I-PDU.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 65535		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency			

SWS Item	**CANNM046_Conf :**		
Name	CanNmTxUserDataPduRef		
Description	Reference to the NM User Data I-PDU in the global PDU collection.		
Multiplicity	1		
Type	Reference to [Pdu]		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency			

No Included Containers

10.3.8 CanNmPnInfo

SWS Item	**CANNM071_Conf :**
Container Name	CanNmPnInfo
Description	PN information configuration
Configuration Parameters	

SWS Item	**CANNM061_Conf :**		
Name	CanNmPnInfoLength		
Description	Specifies the length of the PN request information in the NM message.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 7		
Default value	0		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true for at least one CanNm Channel.		

SWS Item	**CANNM060_Conf :**		
Name	CanNmPnInfoOffset		
Description	Specifies the offset of the PN request information in the NM message.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 7		
Default value	0		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true for at least one CanNm Channel.		

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
CanNmPnFilterMaskByte	0..7	PN information configuration

10.3.9 CanNmPnFilterMaskByte

SWS Item	**CANNM069_Conf :**
Container Name	CanNmPnFilterMaskByte
Description	PN information configuration
Configuration Parameters	

SWS Item	**CANNM063_Conf :**		
Name	CanNmPnFilterMaskByteIndex		
Description	Specifies the offset of the PN request information in the NM message.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 6		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	
Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true for at least one CanNm Channel.CanNmPnFilterMaskByteIndex < CanNmPnFilterMaskLength		

SWS Item	**CANNM064_Conf :**		
Name	CanNmPnFilterMaskByteValue		
Description	Parameter to configure the filter mask byte.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	0		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME, VARIANT-POST-BUILD
	Post-build time	--	

Scope / Dependency	scope: Module dependency: only available if CanNmPnEnabled == true for at least one CanNm Channel.

No Included Containers

10.4 Published parameters

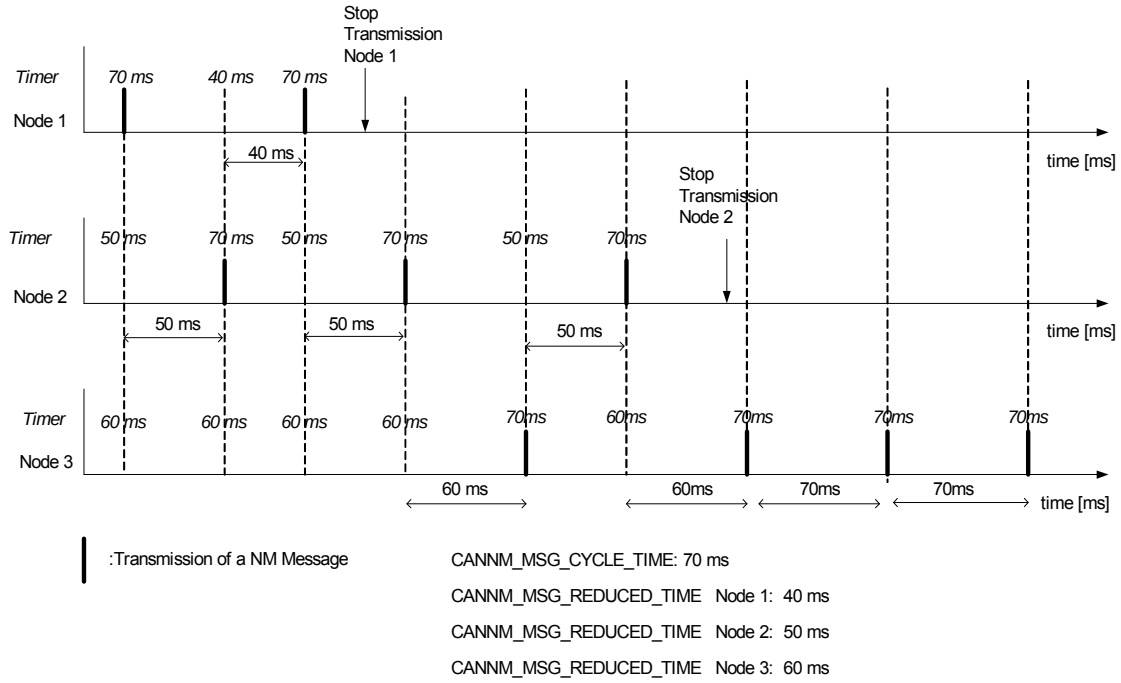
[CANNM021] 「The standardized common published parameters as required by BSW00402 in the General Requirements on Basic Software Modules [2] shall be published within the header file of this module and need to be provided in the BSW Module Description. The according module abbreviation can be found in the List of Basic Software Modules [19].」()

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

11 Examples

11.1 Example of periodic transmission mode with bus load reduction

Three nodes are connected to the bus and are in “normal operation” state. The nodes (Node 1 and Node 2) with the smallest CANNM_MSG_REDUCED_TIME are sending alternating their Network Management PDUs. After a while node 1 goes into “ready sleep” state. Now node 2 and node 3 are sending alternating Network Management PDU. After a while also node 2 goes into “ready sleep” state. Since node 3 is the last node on the bus only node 3 is sending messages with CANNM_MSG_CYCLE_TIME.



11.1.1 Example timing behavior for Network Management PDUs

Assume an example network of three nodes 1, 2, 3 (Figure 11-1). Nodes specific cycle offsets are equal respectively to t1 < t2 < t3 < T. NM cycle time is equal to T (Figure 11-2).
Network Management PDUs sent on the bus within the Repeat Message State are presented in the Figure 11-3, and within the Normal Operation / Ready Sleep State in Figure 11-4. Each dot in Figure 11-4denotes restart of the NM-Timeout Timer.

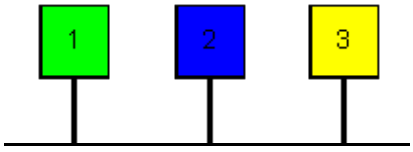


Figure 11-1

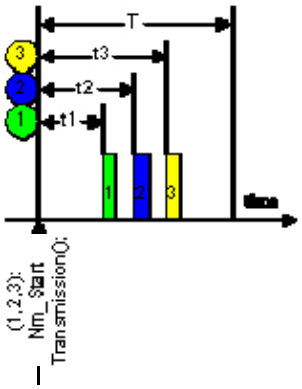


Figure 11-2

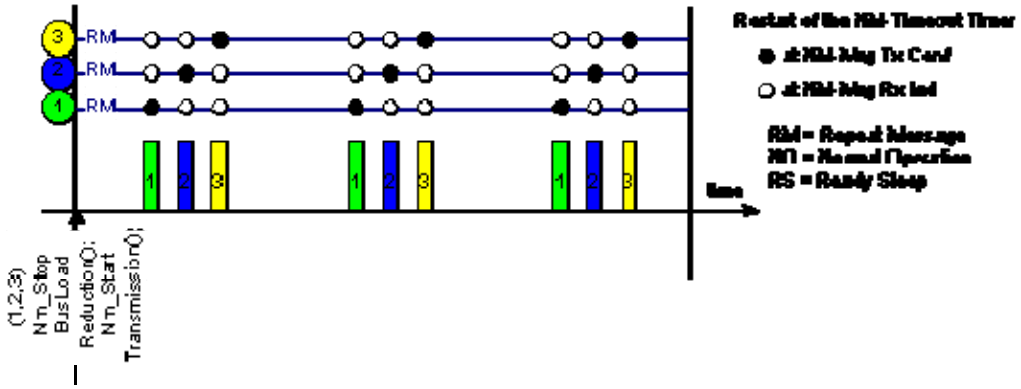


Figure 11-3

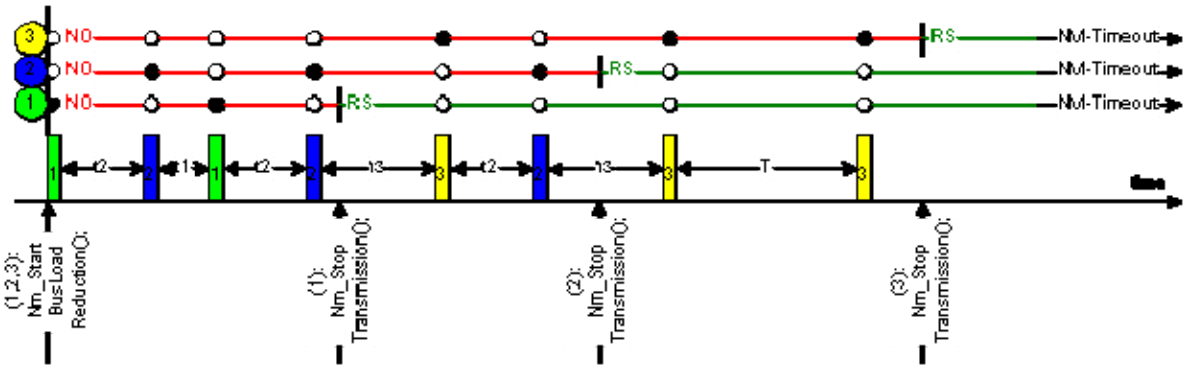


Figure 11-4

12 Changes to R3.0

12.1 Deleted SWS Items

SWS Item	*Rationale*
CANNM195	Changed to explanation
CANNM125	Changed to explanation
CANNM142	Changed to note
CANNM204	Obsolete
CANNM053	Redundant to CANNM158
CANNM015	Redundant to CANNM159
CANNM031	Redundant to CANNM160
CANNM186	Redundant to CANNM130
CANNM091	Redundant to CANNM223
CANNM041	Redundant to CANNM208
CANNM155	Redundant to CANNM052
CANNM184	
CANNM140	
CANNM291	
CANNM141	
CANNM167	
CANNM136	
CANNM131	
CANNM026	
CANNM209	
CANNM205	
CANNM201	Redundant to CANNM044
CANNM139	Redundant to CANNM276
CANNM034	
CANNM169	
CANNM165, CANNM164	
CANNM207	
CANNM239	
CANNM320	
CANNM067	
CANNM068	

12.2 Replaced SWS Items

SWS Item	*replaced by SWS Item*	*Rationale*
CANNM001	CANNM237, CANNM238	Made requirement atomic
CANNM016	CANNM243, CANNM244	Made requirement atomic
CANNM148	CANNM246, CANNM247, CANNM248, CANNM249	Made requirement atomic
CANNM081	CANNM299, CANNM300 CANNM301	
CANNM044	CANNM302, CANNM303, CANNM304	
CANNM082	CANNM305, CANNM306, CANNM307, CANNM308, CANNM309, CANNM310 CANNM311	
CANNM083	CANNM312, CANNM313	
CANNM095	CANNM314, CANNM315	

CANNM018	CANNM316, CANNM317, CANNM318, CANNM319, CANNM320, CANNM321, CANNM322	

12.3 Changed SWS Items

SWS Item	*Rationale*
CANNM019	Replaced with standard text
CANNM020	Replaced with standard text
CANNM081	Replaced with standard text
CANNM082	Redundant Dem.h (see CANNM207) removed from list of included files.
CANNM035	Requirement separated from explanation in first sentence
CANNM150	Requirement separated from explanation
CANNM188	Replaced with standard text
CANNM098	Clarification of requirement
CANNM099	Clarification of requirement
CANNM191	
CANNM192	
CANNM170	
CANNM127	
CANNM128	
CANNM129	
CANNM143	
CANNM144	
CANNM157	
CANNM072	
CANNM189	
CANNM190	
CANNM235	
CANNM229	
CANNM232	
CANNM061	
CANNM173	
CANNM178	
CANNM169	
CANNM116	
CANNM108	
CANNM164	
CANNM165	
CANNM166	
CANNM286	
CANNM152	
CANNM292	
CANNM230	
CANNM286	
CANNM077	
CANNM234	
CANNM236	
CANNM250	
CANNM251	
CANNM252	
CANNM163	
CANNM081	AUTOSAR standard c files
CANNM191	(removed part being redundant to CANNM316)
CANNM192	(removed part being redundant to CANNM317)

CANNM206	
CANNM294	
CANNM228	
CANNM234	
CANNM235	
CANNM236	
CANNM223	
CANNM066	
CANNM200	
CANNM073	
CANNM039	
CANNM245	
CANNM005	
CANNM175	
CANNM180	
CANNM033	
CANNM061	
CANNM037	
CANNM100	
CANNM249	
CANNM320, CANNM321	
CANNM065	

12.4 Added SWS Items

SWS Item	*Rationale*
CANNM207	standard requirement for inclusion of Dem.h
CANNM208	UML model linking of CanNm_Init
CANNM209	Requirement on CanNm_Init
CANNM210	Requirement on CanNm_Init
CANNM211	UML model linking of CanNm_PassiveStartup
CANNM212	Requirement on CanNm_ PassiveStartup
CANNM213	UML model linking of CanNm_NetworkRequest
CANNM214	UML model linking of CanNm_NetworkRelease
CANNM215	UML model linking of CanNm_DisableCommunication
CANNM216	UML model linking of CanNm_EnableCommunication
CANNM217	UML model linking of CanNm_SetUserData
CANNM218	UML model linking of CanNm_GetUserData
CANNM219	UML model linking of CanNm_GetNodeIdentifier
CANNM220	UML model linking of CanNm_GetLocalNodeIdentifier
CANNM221	UML model linking of CanNm_RepeatMessageRequest
CANNM222	UML model linking of CanNm_GetPduData
CANNM223	UML model linking of CanNm_GetState
CANNM224	UML model linking of CanNm_GetVersionInfo
CANNM225	Requirement on CanNm_ GetVersionInfo
CANNM226	UML model linking of CanNm_RequestBusSynchronization
CANNM227	UML model linking of CanNm_CheckRemoteSleepIndication
CANNM228	UML model linking of CanNm_TxConfirmation
CANNM229	Requirement on CanNm_TxConfirmation
CANNM230	Requirement on CanNm_TxConfirmation
CANNM231	UML model linking of CanNm_RxIndication
CANNM232	Requirement on CanNm_RxIndication
CANNM233	Requirement on CanNm_RxIndication
CANNM234	UML model linking of CanNm_MainFunction_<InstanceID>
CANNM235	Requirement on CanNm_MainFunction_<InstanceID>

CANNM236	Requirement on CanNm_MainFunction_<InstanceID>
CANNM239	Standard requirement for error classification
CANNM240	Standard requirement for error classification
CANNM241	Standard requirement for error detection
CANNM242	Standard requirement for error detection
CANNM245	UML model linking of the imported types
CANNM250	Requirement on variant
CANNM251	Requirement on variant
CANNM252	Requirement on variant
CANNM253	Requirement on Caveats of CanNm_Init
CANNM254	Requirement on Caveats of CanNm_PassiveStartUp
CANNM255	Requirement on CanNm_NetworkRequest
CANNM256	Requirement on Caveats of CanNm_NetworkRequest
CANNM257	Requirement on Configuration of CanNm_NetworkRequest
CANNM258	Requirement on CanNm_NetworkRelease
CANNM259	Requirement on Caveats of CanNm_NetworkRelease
CANNM260	Requirement on Configuration of CanNm_NetworkRelease
CANNM261	Requirement on Caveats of CanNm_DisableCommunication
CANNM262	Requirement on Configuration of CanNm_DisableCommunication
CANNM263	Requirement on Caveats of CanNm_EnableCommunication
CANNM264	Requirement on Configuration of CanNm_EnableCommunication
CANNM265	Requirement on Caveats of CanNm_SetUserData
CANNM266	Requirement on Configuration of CanNm_SetUserData
CANNM267	Requirement on Caveats of CanNm_GetUserData
CANNM268	Requirement on Configuration of CanNm_GetUserData
CANNM269	Requirement on Caveats of CanNm_GetNodeIdentifier
CANNM270	Requirement on Configuration of CanNm_GetNodeIdentifier
CANNM271	Requirement on Caveats of CanNm_GetLocalNodeIdentifier
CANNM272	Requirement on Configuration of CanNm_GetLocalNodeIdentifier
CANNM273	Requirement on Caveats of CanNm_RepeatMessageRequest
CANNM274	Requirement on Configuration of CanNm_RepeatMessageRequest
CANNM275	Requirement on Caveats of CanNm_GetPduData
CANNM276	Requirement on Configuration of CanNm_GetPduData
CANNM277	Requirement on Caveats of CanNm_GetState
CANNM278	Requirement on Configuration of CanNm_GetVersionInfo
CANNM279	Requirement on Caveats of CanNm_RequestBusSynchronization
CANNM280	Requirement on Configuration of CanNm_RequestBusSynchronization
CANNM281	Requirement on Caveats of CanNm_CheckRemoteSleepIndication
CANNM282	Requirement on Configuration of CanNm_CheckRemoteSleepIndication
CANNM283	Requirement on Caveats of CanNm_TxConfirmation
CANNM284	Requirement on Configuration of CanNm_TxConfirmation
CANNM285	Requirement on Caveats of CanNm_RxIndication
CANNM286	Requirement on Caveats of CanNm_MainFunction_<Instance Id>
CANNM287	
CANNM288	
CANNM289	
CANNM290	
CANNM292	
CANNM294	
CANNM295	
CANNM298	
CANNM297	
CANNM324	
CANNM325	
CANNM326	
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CANNM344	
CANNM345	
CANNM346	
CANNM401	
CANNM402	
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CANNM432	
CANNM433	
CANNM434	
CANNM435	
CANNM436	
CANNM437	
CANNM438	
CANNM439	
CANNM442	
CANNM443	
CANNM444	
CANNM445	
CANNM446	

13 Not applicable requirements

[CANNM999]「These requirements are not applicable to this specification.」
(BSW170, BSW00387, BSW00375, BSW00416, BSW168, BSW00423, BSW00424, BSW00425, BSW00426, BSW00427, BSW00429, BSW00432, BSW00434, BSW00336, BSW00417, BSW161, BSW162, BSW005, BSW00415, BSW164, BSW00325, BSW00326, BSW160, BSW00413, BSW00347, BSW00305, BSW00307, BSW00335, BSW00410, BSW00314, BSW00328, BSW00312, BSW006, BSW00377, BSW00306, BSW00309, BSW00330, BSW00331, BSW172, BSW010, BSW00333, BSW00321, BSW00341, BSW00334, BSW151, BSW043, BSW046, BSW048, BSW050, BSW052, BSW02509, BSW153, BSW136, BSW140, BSW054, BSW144, BSW147, BSW154, BSW139)