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Disclaimer

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1 Introduction and functional overview

This specification describes the functionality, API and the configuration of the `Network Management` for the AUTOSAR `Adaptive Platform`.

Adaptive Network Management (NM) is intended to work independent of the communication stack used. Its main purpose is to coordinate the transition between normal operation and bus-sleep mode of the underlying networks (physical and partial networks).

In addition to the core functionality, services are provided to access the user data information in the NM message.

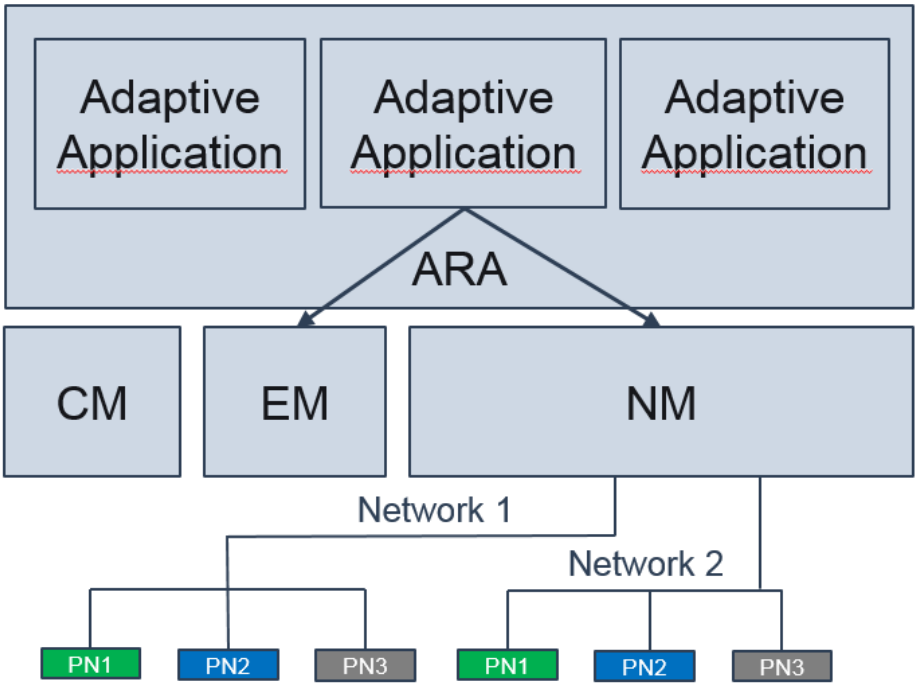

Figure 1.1: Architecture overview

2 Acronyms and Abbreviations

The glossary below includes acronyms and abbreviations relevant to the Adaptive Network Management that are not included in the AUTOSAR glossary [1].

Abbreviation / Acronym:	Description:
API	Application Programming Interface
CBV	Control Bit Vector
CM	Communication Management
CWU	Car Wakeup
EM	Execution Management
IP	Internet Protocol
MTU	Maximum Transmission Unit
NM	Network Management
PN	Partial Network
PNI	Partial Network Information
UDP	User Datagram Protocol

Terms:	Description:
Bus communication	Communication on the physical medium
NM cluster	Set of NM nodes coordinated with the use of the NM algorithm.
NM message	Refers to the payload transmitted in a packet. It contains the NM User Data, Partial Network Information as well as the Control Bit Vector and the Source Node Identifier.
NM packet	Refers to an Ethernet Frame containing an IP as well as an UDP header in addition to a NM message.
PN communication	Communication during partial network operation
Repeat Message Request Bit Indication	Repeat Message Bit set in the Control Bit Vector of a received NM message.

3 Related documentation

3.1 Input documents

[1] Glossary
AUTOSAR_TR_Glossary

[2] UDP Network Management Protocol Specification
AUTOSAR_PRS_UDPNetworkManagementProtocol

[3] Requirements on Network Management for Adaptive Platform
AUTOSAR_RS_AdaptiveNetworkManagement

3.2 Related specification

N/A

4 Constraints and assumptions

4.1 Limitations

The Adaptive Network Management is actually only supporting UdpNM.

The Adaptive Network Management cannot be configured as the master network coordinator.

The Adaptive Network Management does not support coordinated shutdown using the information in CBV.

The Adaptive Network Management does not support passive mode and passive startup.

The API's described in this specification will be reworked depending on the final solution for the planned State Manager and therefore shall be considered draft.

Modelling part for mapping the logical networks to the BitVector positions as defined in chapter 7.3 is not available in the manifest.

4.2 Applicability to car domains

AUTOSAR Adaptive Network Management can be used for all car domains.

5 Dependencies to other modules

There are no dependencies to other functional clusters.

5.1 Platform dependencies

This specification is part of the AUTOSAR Adaptive Platform and therefore depends on it.

5.2 Protocol layer dependencies

The Adaptive Network Management is based on the protocol mentioned in PRS UDP-NetworkManagementProtocol [2].

Adaptive Network Management uses functionality of the underlying communication stack in order to send or receive NM messages on the physical networks.

6 Requirements Tracing

The following table references the requirements specified in RS Adaptive Network Management [3] and links to the fulfillment of these. Please note that if column “Satisfied by” is empty for a specific requirement this means that this requirement is not fulfilled by this document.

Requirement	Description	Satisfied by
[RS_Nm_00044]	The NM shall be applicable to different types of communication systems which are in the scope of Autosar and support a bus sleep mode.	[SWS_ANM_00001] [SWS_ANM_00004] [SWS_ANM_00005] [SWS_ANM_00006] [SWS_ANM_00007] [SWS_ANM_00008] [SWS_ANM_00009] [SWS_ANM_00010] [SWS_ANM_00012] [SWS_ANM_00013] [SWS_ANM_00017] [SWS_ANM_00021] [SWS_ANM_00036] [SWS_ANM_00043] [SWS_ANM_00044] [SWS_ANM_00045] [SWS_ANM_00046] [SWS_ANM_00047] [SWS_ANM_00054] [SWS_ANM_00061] [SWS_ANM_00062] [SWS_ANM_00070] [SWS_ANM_00075] [SWS_ANM_00076]
[RS_Nm_00047]	NM shall provide a service to request to keep the bus awake and a service to cancel this request.	[SWS_ANM_00011] [SWS_ANM_00014] [SWS_ANM_00015] [SWS_ANM_00016] [SWS_ANM_00018] [SWS_ANM_00019] [SWS_ANM_00020] [SWS_ANM_00022] [SWS_ANM_00023] [SWS_ANM_00025] [SWS_ANM_00026] [SWS_ANM_00030]
[RS_Nm_00048]	NM shall put the communication controller into sleep mode if there is no bus communication	[SWS_ANM_00024]
[RS_Nm_00050]	The NM shall provide the current state of NM	[SWS_ANM_00031] [SWS_ANM_00063]
[RS_Nm_00054]	There shall be a deterministic time from the point where all nodes agree to go to bus sleep to the point where bus is switched off.	[SWS_ANM_00024]

Requirement	Description	Satisfied by
[RS_Nm_00150]	Specific functions of the Network Management shall be configurable	[SWS_ANM_00007] [SWS_ANM_00013] [SWS_ANM_00028] [SWS_ANM_00033] [SWS_ANM_00035] [SWS_ANM_00040] [SWS_ANM_00044] [SWS_ANM_00047] [SWS_ANM_00049] [SWS_ANM_00050] [SWS_ANM_00051] [SWS_ANM_00060] [SWS_ANM_00069] [SWS_ANM_00072] [SWS_ANM_00073] [SWS_ANM_00077] [SWS_ANM_00081]
[RS_Nm_00151]	The Network Management algorithm shall allow any node to integrate into an already running NM cluster	[SWS_ANM_00037] [SWS_ANM_00038] [SWS_ANM_00071]
[RS_Nm_02503]	The NM API shall optionally give the possibility to send user data	[SWS_ANM_00039] [SWS_ANM_00080]
[RS_Nm_02504]	The NM API shall optionally give the possibility to get user data	[SWS_ANM_00039] [SWS_ANM_00048] [SWS_ANM_00078] [SWS_ANM_00079]
[RS_Nm_02505]	The NM shall optionally set the local node identifier to the NM-message	[SWS_ANM_00033] [SWS_ANM_00034]
[RS_Nm_02508]	Every node shall have associated with it a node identifier that is unique in the NM-cluster	[SWS_ANM_00034]
[RS_Nm_02517]	<Bus>Nm shall support Partial Networking on CAN, FlexRay and Ethernet	[SWS_ANM_00052] [SWS_ANM_00053] [SWS_ANM_00067] [SWS_ANM_00068]
[RS_Nm_02519]	The NM Control Bit Vector shall contain a PNI (Partial Network Information) bit.	[SWS_ANM_00067] [SWS_ANM_00068]
[RS_Nm_02520]	<Bus>Nm shall evaluate the PNI bit in the NM message	[SWS_ANM_00055] [SWS_ANM_00067] [SWS_ANM_00068]
[RS_Nm_02521]	<Bus>Nm shall set the PNI bit for requesting Partial Network functionality	[SWS_ANM_00052] [SWS_ANM_00053]
[RS_Nm_02522]	<Bus>Nm shall calculate the combined partial network request status EIRA	[SWS_ANM_00064] [SWS_ANM_00066]

7 Functional specification

The Adaptive Network Management offers services that allow the applications to request the necessary network states (either partial or physical).

To do so, the following functionalities are provided:

1) Methods for requesting and releasing networks
2) Support for partial networking
3) Methods to access the user data information

7.1 Architectural Overview

Figure 7.1 gives an overview of the Adaptive NM service.

[SWS_ANM_00061] ⌈ The NM Service shall have a service instance per physical channel. ⌋*(RS_Nm_00044)*

Note: NM instance may either be a separate thread or a separate executable (up to implementation).

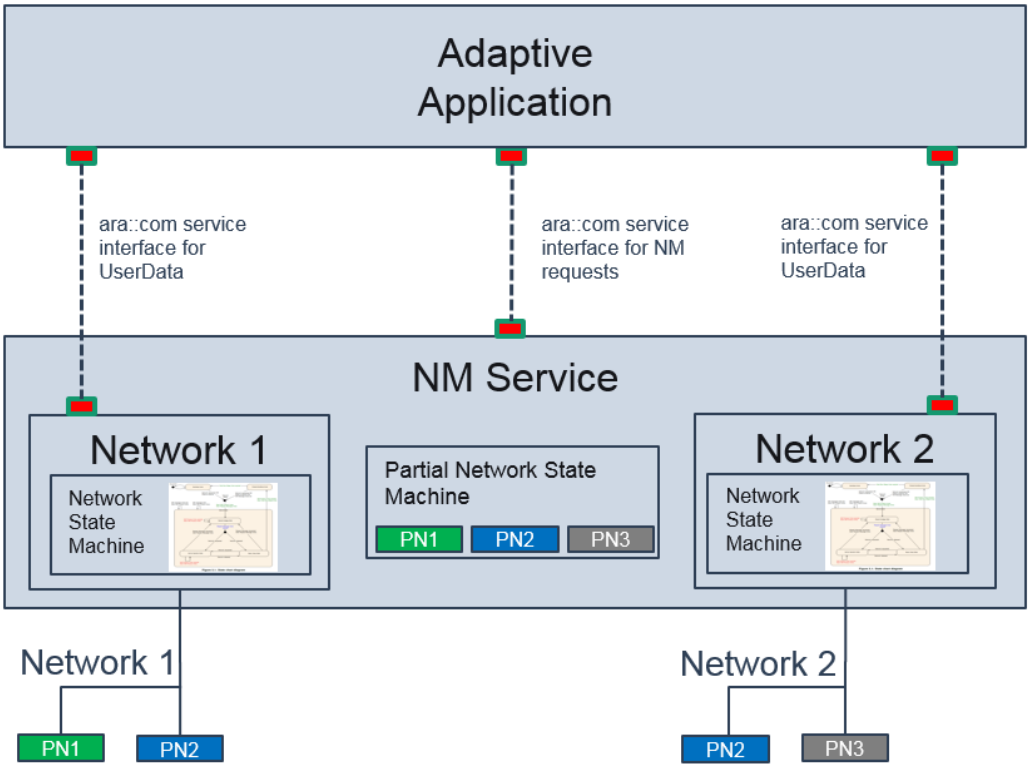

Figure 7.1: Overview Of NmService

7.2 Network Management Algorithm

The AUTOSAR Adaptive NM is based on decentralized direct network management strategy, which means that every network node performs activities self-sufficient depending only on the NM packets received and/or transmitted within the communication system.

The AUTOSAR Adaptive NM algorithm is based on periodic NM packets, which are received by all nodes in the cluster via multicast. Reception of NM packets indicates that sending nodes want to keep the NM-cluster awake. If any node is ready to go to sleep mode, it stops sending NM packets, but as long as NM packets from other nodes are received, it postpones transition to sleep mode. Finally, if a dedicated timer elapses because no NM packets are received anymore, every node initiates transition to the sleep mode.

If any node in the NM-cluster requires bus-communication, it can keep the NM-cluster awake by transmitting NM packets.

The main concept of the AUTOSAR Adaptive NM coordination algorithm can be defined by the following key-requirement.

[SWS_ANM_00001] ⌈ Every network node shall transmit periodic NM messages as long as it requires bus-communication; otherwise it shall not transmit NM messages. ⌋ *(RS_Nm_00044)*

7.3 NetworkState

Network State Bitvector represents the state of a single logical network. A logical network can be a partial or a physical network.

[SWS_ANM_00063] ⌈Each bit in the Network State Bitvector represents the actual state of a single logical network. ⌋*(RS_Nm_00050)*

[SWS_ANM_00064] ⌈Each logical network has a fixed reserved bit position in the Network State Bitvector parameter. ⌋*(RS_Nm_02522)*

Note: If the value of the bit is 1, it implies that the network is in requested mode. If the value of the bit is 0, it implies that the network is being released.

[SWS_ANM_00066] ⌈Network State BitVector shall be mapped over the manifest to the logical networks. ⌋*(RS_Nm_02522)*

[SWS_ANM_00067] ⌈In case of partial networking a mapping between partial network(s) Bit and physical network(s) needs to be configured. ⌋*(RS_Nm_02517, RS_Nm_02519, RS_Nm_02520)*

[SWS_ANM_00068] ⌈In case of no partial networking, the mapping will be done between Bit position(s) and physical network(s). ⌋*(RS_Nm_02517, RS_Nm_02519, RS_Nm_02520)*

7.4 Operational Modes

This chapter describes the operational modes of the AUTOSAR Adaptive NM.

[SWS_ANM_00062] ⌈ Each NM Service instance shall realize the state machine mentioned in Figure 7.2. ⌋*(RS_Nm_00044)*

Note: The state machine in Figure 7.2 is applied to physical channels. In case of partial networking, the Nm module should additionally take care of relevant PNs.

[SWS_ANM_00004] ⌈ The AUTOSAR Adaptive NM shall contain three operational modes:

- Network Mode (see 7.4.1)
- Prepare Bus-Sleep Mode (see 7.4.2)
- Bus-Sleep Mode (see 7.4.3)

⌋*(RS_Nm_00044)*

These modes will not be visible to the Adaptive Application as it is.

When the NM is in Network mode it implies that the network is requested or active. And the logical network information bit will be set to 1.

When the NM is in Prepare Bus-Sleep or Bus-Sleep Mode, It implies that the network is released or inactive. And the logical network information bit will be set to 0.

The following figure shows the state diagram. Mode change related transitions are denoted in green and error handling related transmissions in red.

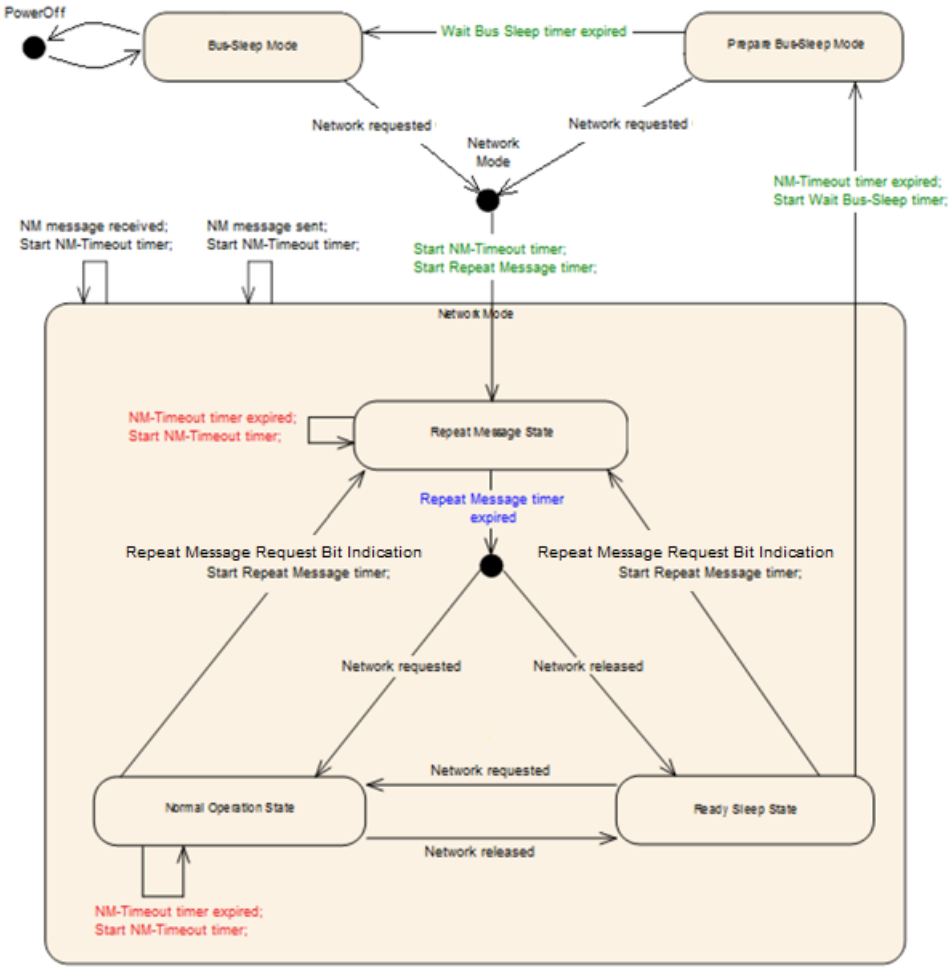

Figure 7.2: State Chart Diagram

7.4.1 Network Mode

[SWS_ANM_00005] ⌈ The Network Mode shall consist of three internal states:

- Repeat Message State (see 7.4.1.1)
- Normal Operation State (see 7.4.1.2)
- Ready Sleep State (see 7.4.1.3)

⌋*(RS_Nm_00044)*

[SWS_ANM_00006] ⌈ When the Network Mode is entered from Bus-Sleep Mode or Prepare Bus-Sleep Mode, by default, the Repeat Message State shall be entered. ⌋ *(RS_Nm_00044)*

[SWS_ANM_00007] ⌈ When the Network Mode is entered, the NM-Timeout Timer shall be started with the value `NmTimeoutTime`. ⌋*(RS_Nm_00044, RS_Nm_00150)*

[SWS_ANM_00008] ⌈ Upon successful reception of a NM message in Network Mode, the NM-Timeout Timer shall be restarted. ⌋*(RS_Nm_00044)*

[SWS_ANM_00009] ⌈ Upon transmission of a NM message in Network Mode, the NM-Timeout Timer shall be restarted. ⌋*(RS_Nm_00044)*

[SWS_ANM_00010] ⌈ The NM-Timeout Timer shall be reset every time it is started or restarted. ⌋*(RS_Nm_00044)*

7.4.1.1 Repeat Message State

The Repeat Message State ensures, that any transition from Bus-Sleep or Prepare Bus-Sleep to the Network Mode becomes visible for the other nodes on the network. Additionally, it ensures that any node stays active for a minimum amount of time.

[SWS_ANM_00011] ⌈ When the Repeat Message State is entered from Bus-Sleep Mode, Prepare-Bus-Sleep Mode, Normal Operation State or Ready Sleep State transmission of NM messages shall be (re-) started. ⌋*(RS_Nm_00047)*

[SWS_ANM_00012] ⌈ When the NM-Timeout Timer expires in the Repeat Message State, the NM-Timeout Timer shall be restarted. ⌋*(RS_Nm_00044)*

[SWS_ANM_00013] ⌈ The NM shall stay in the Repeat Message State for a configurable amount of time determined by the `NmRepeatMessageTime`; after that time the Repeat Message State shall be left. ⌋*(RS_Nm_00044, RS_Nm_00150)*

[SWS_ANM_00014] ⌈ When Repeat Message State is left, the Normal Operation State shall be entered, if the network has been requested. ⌋*(RS_Nm_00047)*

[SWS_ANM_00015] ⌈ When Repeat Message State is left, the Ready Sleep State shall be entered, if the network has been released. ⌋*(RS_Nm_00047)*

[SWS_ANM_00070] ⌈ The Repeat Message State is entered from Bus-Sleep Mode, Prepare-Bus-Sleep Mode, when a logical network is requested using RequestNetwork method. ⌋*(RS_Nm_00044)*

7.4.1.2 Normal Operation State

The Normal Operation State ensures that any node can keep the NM-cluster awake as long as the network functionality is required.

[SWS_ANM_00016] ⌈ When the Normal Operation State is entered from Ready Sleep State, transmission of NM messages shall be started. ⌋*(RS_Nm_00047)*

[SWS_ANM_00017] ⌈ When the NM-Timeout Timer expires in the Normal Operation State, the NM-Timeout Timer shall be restarted. ⌋*(RS_Nm_00044)*

[SWS_ANM_00018] ⌈ When the network is released and the current state is Normal Operation State, the Normal Operation State shall be left and the Ready Sleep state shall be entered. ⌋*(RS_Nm_00047)*

[SWS_ANM_00019] ⌈ If Repeat Message Request Bit (set in the CBV of the received NM message) is received in the Normal Operation State, the Normal Operation State shall be left and the Repeat Message State shall be entered. ⌋*(RS_Nm_00047)*

7.4.1.3 Ready Sleep State

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

[SWS_ANM_00020] ⌈ When the Ready Sleep State is entered from Repeat Message State or Normal Operation State, transmission of NM messages shall be stopped. ⌋ *(RS_Nm_00047)*

[SWS_ANM_00021] ⌈ When the NM-Timeout Timer expires in the Ready Sleep State, the Ready Sleep State shall be left and the Prepare Bus-Sleep Mode shall be entered. ⌋*(RS_Nm_00044)*

[SWS_ANM_00022] ⌈ When the network is requested and the current state is the Ready Sleep State, the Ready Sleep State shall be left and the Normal Operation State shall be entered. ⌋*(RS_Nm_00047)*

[SWS_ANM_00023] ⌈ If Repeat Message Request Bit (set in the CBV of the received NM message) is received in the Ready Sleep State, the Ready Sleep State shall be left and the Repeat Message State shall be entered. ⌋*(RS_Nm_00047)*

Note: Handling of multiple transition conditions which might arise at the same time (e.g. NM-Timeout timer expires vs. network is requested) is considered to be implementation-specific.

7.4.2 Prepare Bus-Sleep Mode

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

[SWS_ANM_00024] ⌈ The NM shall stay in the Prepare Bus-Sleep Mode for an amount of time determined by the `NmWaitBusSleepTime`; after that time, the Prepare Bus-Sleep Mode shall be left and the Bus-Sleep Mode shall be entered. ⌋*(RS_Nm_00048, RS_Nm_00054)*

[SWS_ANM_00025] ⌈ Upon successful reception of a NM message in the Prepare Bus-Sleep Mode, the Prepare Bus-Sleep Mode shall be left and the Network Mode shall be entered; by default, the Repeat Message State is entered. ⌋*(RS_Nm_00047)*

[SWS_ANM_00026] ⌈ When the network is requested in the Prepare Bus-Sleep Mode, the Prepare Bus-Sleep Mode shall be left and the Network Mode shall be entered; by default, the Repeat Message State is entered and the NM module shall transmit a NM message immediately. ⌋*(RS_Nm_00047)*

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.

7.4.3 Bus-Sleep Mode

The purpose of the Bus-Sleep state is to reduce power consumption in the node, when no messages are to be exchanged. Transmission and reception capabilities can be switched off if supported by hardware.

If a configurable amount of time determined by `NmTimeoutTime` + `NmWaitBusSleepTime` 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.

[SWS_ANM_00028] ⌈ If bus communication is released and there are no NM messages on the bus for a configurable amount of time, determined by `NmTimeoutTime` + `NmWaitBusSleepTime`, transition into the Bus-Sleep Mode shall be performed from the Network Mode. ⌋*(RS_Nm_00150)*

[SWS_ANM_00030] ⌈ When the network is requested in Bus-Sleep Mode, the NM module shall enter the Network Mode; by default the NM module shall enter the Repeat Message State. ⌋*(RS_Nm_00047)*

[SWS_ANM_00031] ⌈ In the Bus-Sleep Mode the corresponding bit of `NetworkState BitVector`, which represents the relevant logical network, shall be 0. ⌋*(RS_Nm_00050)*

7.5 Message Format

The table below shows an example for n bytes message length:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Source Node Identifier (default)							
Byte 1	Control Bit Vector (default)							
Byte 2	User data 0							
Byte 3	User data 1							
Byte 4	User data 2							
Byte 5	User data 3							
...	...							
Byte n	User data n-2							

Table 7.1: NM packet payload (NM message) default format.

Note: As mentioned in [2], the length of an NM packet shall not exceed the MTU (Maximum Transmission Unit) of the underlying physical transport layer.

7.5.1 Source Node Identifier

[SWS_ANM_00033] ⌈ The location of the source node identifier shall be configurable using `NmPduNidPosition`, to position Byte 0 or Byte 1 or Off (default: Byte 0). ⌋ *(RS_Nm_00150, RS_Nm_02505)*

[SWS_ANM_00034] ⌈ The source node identifier shall be set with configurable NodeId value `NmNodeId` unless the location of the source node identifier is set to Off. ⌋ *(RS_Nm_02508, RS_Nm_02505)*

7.5.2 Control Bit Vector

The following table describes the format of the Control Bit Vector.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
CBV	Res	PNI Bit	Res	Active Wakeup Bit	NM Coordinator Sleep Ready	Res	Res	Repeat Message Request

Table 7.2: Control Bit Vector.

[SWS_ANM_00035] ⌈ The location of the Control Bit Vector shall be configurable using `NmPduCbvPosition`, to position Byte 0 or Byte 1 or Off (default: Byte 1). ⌋ *(RS_Nm_00150)*

[SWS_ANM_00036] ⌈ 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 Ready 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
- Bits 1,2,5,7 are reserved for future extensions
  0: Disabled/Reserved for future usage

⌋(*RS_Nm_00044*)

[SWS_ANM_00037] ⌈ Repeat Message Request Bit shall always be set to 0 in the transmitted NM message. ⌋(*RS_Nm_00151*)

[SWS_ANM_00038] ⌈ Active Wakeup Bit shall always be set to 0 in the transmitted NM message. ⌋(*RS_Nm_00151*)

[SWS_ANM_00071] ⌈ NM Coordinator Sleep Ready Bit shall always be set to 0 in the transmitted NM message. ⌋(*RS_Nm_00151*)

7.5.3 User Data

[SWS_ANM_00039] ⌈ It shall be possible to enable or disable the support of NM user data, using parameter `NmUserDataEnabled` ⌋(*RS_Nm_02503*, *RS_Nm_02504*)

[SWS_ANM_00040] ⌈ If NM user data is configured it will be sent always in the NM message. ⌋(*RS_Nm_00150*)

[SWS_ANM_00060] ⌈ The range (in bytes) that contains the user data in the received NM message shall be defined by `NmUserDataOffset` and `NmUserDataLength`. ⌋ (*RS_Nm_00150*)

[SWS_ANM_00072] ⌈ UserData shall not include the PNI in case the Partial Networking is active. Received and Transmitted UserData shall not overlap with the PNI. ⌋ (*RS_Nm_00150*)

7.6 Nm Transmission

7.6.1 Transmission Scheduling

[SWS_ANM_00043] ⌈ The NM module shall provide the periodic transmission mode. In this transmission mode, the NM module shall send NM messages periodically. ⌋ *(RS_Nm_00044)*

Note: The periodic transmission mode is used in the "Repeat Message State" and "Normal Operation State".

[SWS_ANM_00044] ⌈ If the Repeat Message State is entered ([SWS_ANM_00070]), the transmission of NM message shall be delayed by `NmMsgCycleOffset` after entering the Repeat Message State. ⌋*(RS_Nm_00044, RS_Nm_00150)*

[SWS_ANM_00045] ⌈ If Normal Operation State is entered from Ready Sleep State the transmission of NM messages shall be started immediately. ⌋*(RS_Nm_00044)*

[SWS_ANM_00046] ⌈ If transmission of NM messages has been started and the NM Message Cycle Timer expires, a NM message shall be transmitted. ⌋*(RS_Nm_00044)*

[SWS_ANM_00047] ⌈ If the NM Message Cycle Timer expires it shall be restarted with `NmMsgCycleTime`. ⌋*(RS_Nm_00044, RS_Nm_00150)*

[SWS_ANM_00054] ⌈ If the NM Message Cycle Timer expires a NM message transmission shall be initiated. ⌋*(RS_Nm_00044)*

7.7 Nm Reception

[SWS_ANM_00048] ⌈ The NM shall invoke the user data notification every time a changed user data information has been received in the NM message. ⌋ *(RS_Nm_02504)*

Note: A change in the user data implies that at least 1 Bit within the received user data has changed its value. User data information can be changed by any node within the physical network.

7.8 Partial Networking

7.8.1 Partial Network State Machine

The partial network state machine mentioned in Figure 7.1 is supposed to be implementation specific. Note: Although beeing implementation specific, the implemented behaviour shall conform to the Partial Networking requirements described in [2].

7.8.2 Rx Handling of NM messages

[SWS_ANM_00049] ⌈ If `NmPnEnabled` is `FALSE`, then NM module shall not process the Partial Networking Information of the NM message, regardless the value of the PNI bit. ⌋*(RS_Nm_00150)*

[SWS_ANM_00050] ⌈ If `NmPnEnabled` is `TRUE` and the PNI bit in the received NM message is 1, NM module shall process the Partial Networking Information of the NM message. ⌋*(RS_Nm_00150)*

[SWS_ANM_00051] ⌈ If `NmPnEnabled` is `TRUE` and the PNI bit in the received NM message is 1, the NM shall invoke the NetworkState Notifier, every time a BitVector has been received in the NM message that leads to a change in the actual request state of a relevant PN or a channel. ⌋*(RS_Nm_00150)*

[SWS_ANM_00069] ⌈ If `NmPnEnabled` is `TRUE` and the PNI bit in the received NM message is 0, NM module shall only process the user data information. ⌋ *(RS_Nm_00150)*

[SWS_ANM_00077] ⌈ If `NmPnEnabled` is `TRUE`, the getter for the NetworkState shall provide the (aggregated) request state of the PNs instead of mirroring the last received Partial Network information. ⌋*(RS_Nm_00150)*

[SWS_ANM_00073] ⌈ A timer shall be used to monitor the logical network request by message reception. If `NmPnEnabled` is `TRUE` and a PN is requested by message reception, the monitoring for this PN shall be restarted with respect to `NmPnResetTime`. ⌋*(RS_Nm_00150)*

Note: `NmPnResetTime` shall be configured to a value greater than `NmMsgCycleTime`.

7.8.3 Tx Handling of NM messages

[SWS_ANM_00052] ⌈ If `NmPnEnabled` is `TRUE`, the NM module shall set the value of the transmitted PNI bit in the CBV always to 1. ⌋*(RS_Nm_02517, RS_Nm_02521)*

Note: The usage of the CBV is mandatory in case Partial Networking is used. This has to be ensured by configuration in the respective platform.

[SWS_ANM_00053] ⌈ If `NmPnEnabled` is `FALSE`, the NM module shall set the value of the transmitted PNI bit in the CBV always to 0. ⌋*(RS_Nm_02517, RS_Nm_02521)*

7.8.4 NM message Filter Algorithm

[SWS_ANM_00055] ⌈ The range (in bytes) that contains the PN request information (PN Info Range) in the received NM message shall be defined by PN Info Offset (`NmPnInfoOffset`) starting from byte 0 and PN Info Length (`NmPnInfoLength`). ⌋ *(RS_Nm_02520)*

Example:

- PN Info Offset = 3
- PN Info Length = 2

In the above example only Byte 3 and Byte 4 of the NM message contain PN request information.

Note: 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.

The Adaptive Application requesting the partial network, shall encode the information in the form of Bit fields and use the methods `RequestNetwork` and `ReleaseNetwork`.

[SWS_ANM_00081] ⌈ The Nm Message Filter Algorithm as described in [2] shall be supported if enabled. ⌋*(RS_Nm_00150)*

Note: When activated the Nm Message Filter Algorithm will filter out any Nm Message not containing at least one relevant PN beeing requested (its Bit in the PN vector set to 1).

8 API specification

8.1 Network State Interface

8.1.1 Methods

Name	`RequestNetwork`		
Description	This API is used to request specific logical networks. Only the newly requested networks are set to 1 in the BitVector.		
Parameters	`PartialNetworkInfo`	***Description***	Only the newly requested networks are enabled(set to 1) in the bit fields.
		Type	BitVector
		Direction	IN

Name	`ReleaseNetwork`		
Description	This API is used to release specific logical networks. Only the networks which shall be released are set to 1 in the BitVector.		
Parameters	`PartialNetworkInfo`	***Description***	The networks that need to be released shall be enabled(set to 1) in the bit fields.
		Type	BitVector
		Direction	IN

8.1.2 Field

Name	NetworkState
Description	Contains the BitVector which encapsulates the information about which networks are currently requested (bit value = 1) or released (bit value = 0). When a state change happens it triggers a notification.
Type	DataArray
HasGetter	true
HasNotifier	true
HasSetter	false
Init-Value	0x00

[SWS_ANM_00075] ⌈ The NetworkState notifier shall be called whenever the state of the state machine changes for a physical channel. ⌋*(RS_Nm_00044)*

[SWS_ANM_00076] ⌈ The getter for the NetworkState shall reflect the changes in the physical channel state machines. ⌋*(RS_Nm_00044)*

8.2 User Data Interface

8.2.1 Field

Name	UserData
Description	This field contains the vector which represents the UserData information provided or received from the bus. Calling the setter function will trigger the provided user data information to be send out on the bus. An update of the received user data will trigger a notification.
Type	VectorType
HasGetter	true
HasNotifier	true
HasSetter	true
Init-Value	0x00

[SWS_ANM_00078] ⌈ The UserData notifier shall be called whenever the received user data gets changed (at least 1 byte needs to differ from previous value). ⌋ *(RS_Nm_02504)*

[SWS_ANM_00079] ⌈ The getter for the UserData shall contain the latest values of the received user data information from the bus. ⌋*(RS_Nm_02504)*

[SWS_ANM_00080] ⌈ The setter for the UserData shall trigger a transmission of the provided user data information on the bus. ⌋*(RS_Nm_02503)*

9 Configuration parameters

The following chapter summarizes the configuration parameters referred in this specification.

Parameter	Description
NmTimeoutTime	Network Timeout for NM packets. It denotes the time in [s] how long the NM shall stay in the Network Mode before transition into Prepare Bus-Sleep Mode shall take place.
NmMsgCycleTime	Period of a NM-message. It determines the periodic rate and is the basis for transmit scheduling.
NmRepeatMessageTime	Timeout for Repeat Message State. It defines the time in seconds how long the NM shall stay in the Repeat Message State.
NmWaitBusSleepTime	Timeout for bus calm down phase. It denotes the time in [s] how long the NM shall stay in the Prepare Bus-Sleep Mode before transition into Bus-Sleep Mode shall take place.
NmMsgCycleOffset	Time offset in the periodic transmission node. It determines the start delay of the transmission.
NmPduNidPosition	Defines the position of the source node identifier within the NM message.
NmPduCbvPosition	Defines the position of the control bit vector within the NM message.
NmPnInfoLength	Specifies the length (in bytes) of the PN request information in the NM message.
NmPnInfoOffset	Specifies the offset (in bytes) of the PN request information in the NM message.
NmUserDataLength	Specifies the length (in bytes) of the user data information in the NM message. User data excludes the PN information.
NmUserDataOffset	Specifies the offset (in bytes) of the user data information in the NM message. User data excludes the PN information.
NmPnEnabled	Enables or disables support of partial networking. false: Partial networking Range not supported true: Partial networking supported.
NmPnResetTime	Specifies the runtime of the reset timer in seconds. This reset time is valid for the reset of PN requests by received messages. The value shall be the same for every channel. Thus it is a global config parameter.
NmNodeId	Specifies the Node Identification of this NM node.
NmUserDataEnabled	Enables or disables support of user data information.

Table 9.1: Configuration parameters

Note: The implementer should handle the above-mentioned configuration themselves (eg: as an included header file), as these configuration will not be part of the manifest file in this release of the specification