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31.10.2013	4.1.0	AUTOSAR Release Management	• Added requirement SRS_Nm_02537 • Added requirement SRS_Nm_02536 • Removed implementation hint from the description of SRS_NM0045
08.02.2013	4.0.0	AUTOSAR Administration	• TPS_STDT_0078 formatting and the traceability of BSWAndRTE_Features • Renamed CRI to PRI for Partial Network requirements • Renamed CD to CDD (Complex Device Driver)
04.10.2011	3.0.0	AUTOSAR Administration	• Added support for Partial Networking • Added support for NM Co-ordination on Nested Sub-buses
30.11.2009	2.1.0	AUTOSAR Administration	• Added the following New requirements 1. Compliance with non AUTOSAR-NMs 2. Control of NM 3. Bus Synchronization on Demand • Removed the following requirements 1. Compliance with OSEK NM on a gateway 2. Compliance with OSEK NM on one cluster • Legal disclaimer revised
23.06.2008	2.0.3	AUTOSAR Administration	Legal disclaimer revised
12.11.2007	2.0.2	AUTOSAR Administration	• Document meta information extended • Small layout adaptations made
24.01.2007	2.0.1	AUTOSAR Administration	• “Advice for users” revised • “Revision Information” added

Document Change History			
Date	**Version**	**Changed by**	**Change Description**
01.12.2006	2.0.0	AUTOSAR Administration	New requirements regarding: • Immediate Transmission Confirmation • Configurable Role In Cluster Shutdown (Passive Node) • ISO 14229 CommunicationControl (28 hex) service support Removed requirements regarding: • Bus independency • Number of FlexRay hardware send/receive buffers • Reading the local NM Identifier Legal disclaimer revised
30.06.2005	1.0.0	AUTOSAR Administration	Initial Release

Disclaimer

Advice for users

AUTOSAR specifications may contain exemplary items (exemplary reference models, "use cases", and/or references to exemplary technical solutions, devices, processes or software).

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Table of Contents

1 Scope of Document

The goal of this document is to define the functional and non-functional requirements on the AUTOSAR Network Management.

Requirements Guidelines

Existing specifications shall be referenced (in form of a single requirement).
Differences to these specifications are specified as additional requirements.

All Requirements shall have the following properties:

- Redundancy
  Requirements shall not be repeated within one requirement or in other requirements
- Clearness
  All requirements shall allow one possibility of interpretation only. Only technical terms of the glossary may be used.
- Atomicity
  Each Requirement shall only contain one requirement. A Requirement is atomic if it cannot be split up in further requirements.
- Testability
  Requirements shall be testable by analysis, review or test.
- Traceability
  The source and status of a requirement shall be visible at all times.

Constraints

First scope for specification of requirements on basic software modules are systems which are not safety relevant. For this reason safety requirements are assigned to medium priority.

2 Conventions to be used

- The representation of requirements in AUTOSAR documents follows the table specified in [5].

- In requirements, the following specific semantics shall be used (based on the Internet Engineering Task Force IETF).

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as:

- SHALL: This word means that the definition is an absolute requirement of the specification.
- SHALL NOT: This phrase means that the definition is an absolute prohibition of the specification.
- MUST: This word means that the definition is an absolute requirement of the specification due to legal issues.
- MUST NOT: This phrase means that the definition is an absolute prohibition of the specification due to legal constraints.
- SHOULD: This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED" mean that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
- MAY: This word, or the adjective "OPTIONAL", means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation, which does not include a particular option, MUST be prepared to interoperate with another implementation, which does include the option, though perhaps with reduced functionality. In the same vein an implementation, which does include a particular option, MUST be prepared to interoperate with another implementation, which does not include the option (except, of course, for the feature the option provides.)

3 Requirements structure

Each requirement has its unique identifier starting with the prefix “BSW” (for “Basic Software”). For any review annotations, remarks or questions, please refer to this unique ID rather than chapter or page numbers!

Each module specific chapter contains a short functional description of the Basic Software Module. Requirements of the same kind within each chapter are grouped under the following headlines (where applicable):

Functional Requirements:

- Configuration (which elements of the module need to be configurable)
- Initialization
- Normal Operation
- Shutdown Operation
- Fault Operation
- ...

Non-Functional Requirements:

- Timing Requirements
- Resource Usage
- Usability
- Output for other WPs (e.g. Description Templates, Tooling,...)
- ...

4 Functional Overview

The following SRS covers requirements on following functional entities:

- Network Management coordinating a particular NM-cluster.
- Network Management bus specifics for a particular bus.
- Gateway and Interoperability of Network Management between NM-clusters.

The communication system where NM is applicable has to support a “bus sleep” mode. That means that the transceiver of the communication system can switch to a low power mode and can be switched again to full power mode by (specific) bus traffic and/or application

5 Requirement Specification

5.1 Functional Requirements

5.1.1 [SRS_Nm_02517] <Bus>Nm shall support Partial Networking on CAN, FlexRay and Ethernet

[

Type:	Valid
Description:	<Bus>Nm shall support Partial Networking on CAN, FlexRay and Ethernet.
Rationale:	It is necessary to implement complete partial network support on the bus protocol <Bus>, to reduce the power consumption of <Bus> communication domains.
Use Case:	The power consumption can be reduced by e.g • Shutting down of seat control functions • Shutting down of park assistant functions • Hazard flashers • Shutting down of Electric Park Brake (EPB)
Dependencies:	--
Supporting Material:	--

](RS_BRF_01088)

5.1.2 Configuration

5.1.2.1 [SRS_Nm_00150] Specific functions of the Network Management shall be statically configurable at pre-compile time

[

Type:	Valid
Description:	The following functions of the Network Management shall be statically configurable at pre-compile time: – Detection of present nodes (on/off) – SRS_Nm_00153 – Notification that all other ECUs are (no more) ready to sleep (i.e. Remote Sleep Indication (Cancellation)) (on/off) – SRS_Nm_00052, SRS_Nm_02509 – NM Coordination support (on/off) – SRS_Nm_02514 – User data support (on/off) – SRS_Nm_02503, SRS_Nm_02504 – Bus load reduction (on/off) – SRS_Nm_00142 – Sending node identifier (on/off) – SRS_Nm_02505 – Receiving node identifier (on/off) – SRS_Nm_02506 – Immediate Transmission Confirmation (on/off) - SRS_Nm_02510 – Configurable Role In Cluster Shutdown (on/off) - SRS_Nm_02511 – Bus Keep Awake Services (on/off) – SRS_Nm_00047 – Partial Networking extensions (on/off) – SRS_Nm_02517 – EIRA (External and Internal Requests Aggregated) reset timer timeout – SRS_Nm_02525 and SRS_Nm_02526
Rationale:	Scalability
Use Case:	Configuration of ECU SW
Dependencies:	--
Supporting Material:	--

](RS_BRF_01528)

5.1.3 Initialization

5.1.3.1 [SRS_Nm_00151] The Network Management algorithm shall allow any node to integrate into an already running NM cluster

[

Type:	Valid
Description:	The Network Management algorithm shall allow any node to integrate into an already running NM cluster.
Rationale:	Integration of a) late nodes b) nodes that have recovered from fault state c) nodes that have been connected to a running vehicle network (e.g. by service)
Use Case:	See rationale
Dependencies:	--
Supporting Material:	--

](RS_BRF_01448)

5.1.3.2 [SRS_Nm_00043] NM shall not prohibit bus traffic with NM not being initialized

[

Type:	Valid
Description:	It shall be possible that software modules are enabled to access the communication system, independent of the presence of NM (NM initialized or not).
Rationale:	Initialization delays or errors of NM shall not prohibit the communication of application software.
Use Case:	ECU without NM or NM starts later (see rationale)
Dependencies:	--
Supporting Material:	--

](RS_BRF_01448)

5.1.4 Normal Operation

5.1.4.1 [SRS_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.

[

Type:	Valid
Description:	Network management mechanisms for each supported protocol shall be realized using a limited number of predefined NM states and NM transitions. The events triggering the transitions between states and the actions taken on these transitions may be protocol specific. A bus sleep mode shall be supported for each protocol. NM shall be executable on asynchronous communication systems (e.g. CAN) as well as on synchronous communication systems (e.g. FlexRay), and also on any other types of communication systems which are in the scope of Autosar.
Rationale:	In today's cars, multiple different communication systems are implemented. For energy consumption, all ECUs have to be able to switch into a low power mode. Therefore, network management is necessary for all communication systems. To facilitate understanding, NM shall be constructed from a common set of state definitions.
Use Case:	ECU with CAN and FlexRay
Dependencies:	--
Supporting Material:	--

](RS_BRF_01184)

5.1.4.2 [SRS_Nm_02515] NM shall offer a generic possibility to run other NMs than the AUTOSAR-NMs

[

Type:	Valid
Description:	Support for managing a non AUTOSAR-NM based network shall be done either by extending/modifying an existing bus-specific NM or by introducing a Complex Device Driver (CDD) which uses the generic interfaces of the NM. Support for running both one of the AUTOSAR-NM and a non AUTOSAR-NM on a single network shall be done the same way. The actual extensions or bus-specific NMs or CDDs is not specified by AUTOSAR. Can be used to support the old Use Cases of BSW139 and BSW140 which has been removed.
Rationale:	--
Use Case:	Running OSEK-NM or another Legacy-NM on one of the networks.
Dependencies:	--
Supporting Material:	--

](RS_BRF_02280)

5.1.4.3 [SRS_Nm_00045] NM has to provide services to coordinate shutdown of NM-clusters independently of each other

[

Type:	Valid
Description:	NM has to provide services to coordinate shutdown of NM-clusters independently of each other.
Rationale:	In today's cars, multiple different communication systems are implemented. Therefore, ECUs might be connected to multiple communication channels (e.g. 2 CAN clusters, 1 FlexRay cluster, etc.). Not in all cases all channels have to be in full power mode. Because of that, each channel has to be able to be started up or shut down separately.
Use Case:	Gateways with more than one bus
Dependencies:	--
Supporting Material:	--

](RS_BRF_01688,RS_BRF_01696)

5.1.4.4 [SRS_Nm_02513] NM shall provide functionality which enables upper layers to control the sleep mode.

[

Type:	Valid
Description:	NM shall provide an interface which enable upper layers to coordinate the different NM modes (especially sleep and wake-up/keep awake).
Rationale:	Enable control of NM from the upper layers. Enable the NM Coordinator to control multiple bus-specific NMs.
Use Case:	Control of NM NM Coordinator
Dependencies:	--
Supporting Material:	Related requirement SRS_Nm_02512.

](RS_BRF_01688,RS_BRF_01696)

5.1.4.5 [SRS_Nm_00046] It shall be possible to trigger the startup of all Nodes at any Point in Time

[

Type:	Valid
Description:	At a specific point in time all nodes connected to NM-cluster have to be started-up (e.g. if the car is started). Because of that NM has to provide services to start up NM of all nodes connected to a NM-cluster at any point in time. The point in time can not be calculated offline, therefore this service has to be accessible at any time. Note regarding FlexRay networks: Under certain circumstances, a shutdown may be required before a startup can occur. In this situation substantial delays may occur.
Rationale:	All nodes means all nodes connected to clamp 30 (nodes permanently connected to power supply). ECUs connected to clamp 15 (nodes power supplied through some power relay) have to be treated separately, due to the fact that they cannot be started-up at any point in time.

	Note: "Passive Nodes" are not able to initiate a start-up of a NM-cluster, but they are able to be woken up if any other node initiates a start-up. Please refer SRS_Nm_02511.
Use Case:	Driver enters the car and wants to start the engine.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01680)

5.1.4.6 [SRS_Nm_00047] NM shall provide a service to request to keep the bus awake and a service to cancel this request.

[

Type:	Valid
Description:	The application implemented on one ECU must be enabled to signal at any point in time after the NM has been initialized, that it requests to keep the bus awake and at any other point in time want to cancel this request. These bus keep awake services shall not be available for nodes configured to not contribute to the cluster shutdown decision, refer SRS_Nm_02511
Rationale:	Basic NM functionality
Use Case:	See Rationale
Dependencies:	--
Supporting Material:	--

](RS_BRF_01680)

5.1.4.7 [SRS_Nm_00048] NM shall put the communication controller into sleep mode if there is no bus communication

[

Type:	Valid
Description:	If no Application/ECU connected to a NM-cluster requires bus communication, NM shall indicate to put the communication controller into sleep mode.
Rationale:	Basic functionality
Use Case:	See Rationale
Dependencies:	[SRS_Nm_00047]
Supporting Material:	--

](RS_BRF_01680)

5.1.4.8 [SRS_Nm_00050] The NM shall provide the current state of NM

[

Type:	Valid
Description:	The NM shall provide an interface to retrieve information about the current state of NM.
Rationale:	The application shall be able to get NM state information by accessing specific interfaces of NM. Basic functionality. The NM state reflects the state of the bus.
Use Case:	See Rationale
Dependencies:	--
Supporting Material:	--

](RS_BRF_01664)

5.1.4.9 [SRS_Nm_00051] NM shall inform application when NM state changes occur.

[

Type:	Valid
Description:	NM shall provide an interface, which can be used by applications to get informed when specific NM state changes occur.
Rationale:	Applications shall be enabled to react on state changes.
Use Case:	Especially the transition to sleep state to switch off transceiver is interesting.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01664)

5.1.4.10 [SRS_Nm_00052] The NM interface shall signal to the application that all other ECUs are ready to sleep.

[

Type:	Valid
Description:	NM shall provide an interface, which signals to an application that all other applications/ECUs are ready for sleep.
Rationale:	Prohibition of unintentional keep awake.
Use Case:	Internal check in the application if ECU unintentionally keeps the bus awake. External network management coordination.
Dependencies:	[SRS_Nm_02509]
Supporting Material:	Updated as a result of Feature RS_BRF_00256.

](RS_BRF_01104)

5.1.4.11 [SRS_Nm_02509] The NM interface shall signal to the application that at least one other ECUs is not ready to sleep anymore.

[

Type:	Valid
Description:	NM shall provide an interface, which signals to an application that at least one other applications/ECUs is not ready for sleep anymore.
Rationale:	Notification that a bus is kept awake if necessary.
Use Case:	Identification of the last node that keeps the bus awake. External network management gateway coordination.
Dependencies:	[SRS_Nm_00052]
Supporting Material:	--

](RS_BRF_01104)

5.1.4.12 [SRS_Nm_02503] The NM API shall optionally give the possibility to send user data

[

Type:	Valid
Description:	The NM API shall optionally give the possibility to set the user data that may be attached to every NM message sent on the bus. NM shall guarantee data consistency for the write operation.
Rationale:	Exchange of system relevant information within the network.
Use Case:	Distribution of wakeup-reason in the network.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01592)

5.1.4.13 [SRS_Nm_02504] The NM API shall optionally give the possibility to get user data

[

Type:	Valid

Description:	The NM API shall optionally give the possibility to get the user data that may be attached to every NM message received from the bus. NM shall guarantee data consistency for the read operation.
Rationale:	Exchange of system relevant information within the network.
Use Case:	Distribution of wakeup-reason in the network.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01592)

5.1.4.14 [SRS_Nm_00153] The Network Management shall optionally provide a possibility to detect present nodes

[

Type:	Valid
Description:	The Network Management shall optionally provide a possibility to detect nodes that are currently present on the bus. It shall be possible that nodes, on request, send their NM-related data. This feature is statically configurable (available or not) (see SRS_Nm_00150). Comment: This function is only needed in master ECUs (e.g. head unit, central body controller, ...)
Rationale:	For diagnostics purposes and configuration checks.
Use Case:	The Vehicle State Management can use this information to check the completeness of the network.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01664)

5.1.4.15 [SRS_Nm_02508] Every node shall have associated with it a node identifier that is unique in the NM-cluster

[

Type:	Valid
Description:	Every node shall have associated with it a node identifier that is unique in the NM-cluster.
Rationale:	Avoidance of node misidentification.
Use Case:	Identification of the last node that keeps the bus awake. Detection of present nodes.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01024)

5.1.4.16 [SRS_Nm_02505] The NM shall optionally set the local node identifier to the NM-message

[

Type:	Valid
Description:	The NM shall optionally set the local node identifier to the NM-message.
Rationale:	Exchange of system relevant information within the network.
Use Case:	Identification of the last node that keeps the bus awake. Detection of present nodes.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01544)

5.1.4.17 [SRS_Nm_02506] The NM API shall give the possibility to read the source node identifier of the sender

[

Type:	Valid
Description:	The NM API shall give the possibility to read the source node identifier of the sender from the most recently received NM message. NM shall guarantee data consistency for the read operation. Note: This NM API is optional, since it is optional to send the source node identifier.
Rationale:	Exchange of system relevant information within the network.
Use Case:	Identification of the last node that keeps the bus awake. Detection of present nodes.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01544)

5.1.4.18 [SRS_Nm_02511] It shall be possible to configure the Network Management of a node in Cluster Shutdown

[

Type:	Valid
Description:	It shall be possible to configure the Network Management of a node so that it cannot contribute to the cluster shutdown decision. Specifically, it shall be possible to configure some nodes of a cluster so that they are not able to broadcast the information used by other nodes to trigger shutdown, i.e., they have no NM-related communication defined for the node. Such nodes shall not be capable of keeping the bus awake, but they are required to shut down in a manner consistent with the others.
Rationale:	Eliminating unnecessary communication reduces bus and buffer overhead. Allowing shutdown to be controlled by a subset of the cluster's nodes enables the possibility that only fault tolerant nodes control shutdown. However, these nodes shall be otherwise capable of normal communication.
Use Case:	In a dual channel FlexRay cluster with some single channel nodes, the cluster can be configured so that only dual channel nodes influence the shutdown. This ensures that all shutdown votes are replicated on across channels even though some nodes are only connected to one channel, thus making the decision process robust against the loss of a channel.
Dependencies:	In order to avoid inconsistencies between and NM and the COM Manager, the COM Manager is not allowed to request keeping the bus awake.
Supporting Material:	--

](RS_BRF_01696)

5.1.4.19 [SRS_Nm_02536] NM shall provide an interface which triggers the transition to the Network Mode without keeping the network awake

[

Type:	Valid
Description:	NM shall provide an interface which triggers the transition to the Network Mode without keeping the network awake.

Rationale:	A node has to participate to the network management without actively requesting communication.
Use Case:	A bus wake-up occurs.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01096, RS_BRF_01104)

5.1.5 Fault Operation

5.1.5.1 [SRS_Nm_00053] NM on a node which is or become bus unavailable shall have a deterministic Behavior

[

Type:	Valid
Description:	NM on a node which is or become bus unavailable shall react such that: • If a bus becomes unavailable and the node is not ready to sleep, the NM shall not enter bus sleep mode by itself. • If a bus becomes unavailable and the node is ready to sleep, the NM shall enter bus sleep mode by itself. • If a bus is unavailable and the node changes its state to ready to sleep, the NM shall enter bus sleep mode by itself. • If a bus is unavailable and the node changes its state to not ready to sleep, the NM shall not enter bus sleep mode by itself.
Rationale:	Faults (transient and/or permanent) shall not cause non deterministic behavior.
Use Case:	Bus unavailability (Bus Off), Loss of NM messages
Dependencies:	--
Supporting Material:	--

](RS_BRF_02176)

Note:
The four rules in the description of SRS_Nm_00053 will make sure that the NM of a node that is currently not in *bus sleep mode* will never enter *bus sleep mode* while the node itself is not ready to sleep. If the node itself is ready to sleep, the NM shall enter *bus sleep mode* on its own.

SRS_Nm_00053 does not apply for a node that is already in *bus sleep mode*. In addition, bus unavailability may be hard to check at that time since the bus is not used to communicate in bus sleep mode.

5.1.5.2 [SRS_Nm_00137] NM shall perform communication system error handling for errors that have impact on the NM behavior.

[

Type:	Valid
Description:	If bus errors of a specific bus on which NM is running have impact on the NM behavior, the error handling must be performed by NM. Focus: bus errors, not protocol errors. Example: loss of NM message is handled.
Rationale:	Error handling
Use Case:	Communication loss
Dependencies:	--

Supporting Material:	--

]()

5.1.6 Gateway Operation

5.1.6.1 [SRS_Nm_02514] It shall be possible to group networks into *NM Coordination Clusters*

[

Type:	Valid
Description:	It shall be possible to group networks into *NM Coordination Clusters*. Each bus specific NM shall, by configuration, be part of 0 or 1 *NM Coordination Cluster*. NM shall provide functionality (*NM Coordination*) to coordinate the different NM modes (especially sleep and keep awake) on all networks in an *NM Coordination Cluster*, by performing a synchronized shutdown on all included networks. The level of synchronization is determined by the configuration of the shutdown synchronization algorithm. Specifically, it shall be possible to perform *NM Coordination* for each *NM Coordination Cluster* separately and independently.
Rationale:	It shall be possible to perform coordinated and/or synchronized shutdown of multiple NM clusters independently.
Use Case:	NM Coordinator
Dependencies:	--
Supporting Material:	Introduced because of Feature RS_BRF_00256.

]()

Note:
The definitions of *NM Coordination Cluster, NM Coordinator, Synchronize* and *Coordinate* are available in the AUTOSAR Glossary [4].

5.1.6.2 [SRS_Nm_02516] All AUTOSAR NM instances shall support the NM Coordinator functionality including Bus synchronization on demand

[

Type:	Valid
Description:	All AUTOSAR NM instances shall support the NM Coordinator functionality of the Generic NM Interface including Bus synchronization on demand. Bus Synchronization on demand allows for synchronization of an NM-cluster at an arbitrary point in time, meaning the NM-Timeout Timers in all nodes of the NM-cluster are restarted simultaneously.
Rationale:	Bus synchronization on demand allows synchronization of a NM-cluster for an arbitrary point of time; in result, NM-Timeout Timers in all nodes of the NM-cluster are restarted.
Use Case:	NM Coordinator
Dependencies:	--
Supporting Material:	

]()

5.1.6.3 [SRS_Nm_02535] NM coordination on Nested Sub-Buses

[

Type:	Valid
Description:	Extent the existing algorithm in a way that it allows to coordinate a second level of bus hierarchy, when shutting down coordinated busses. There is no limitation of hierarchy levels with this concept.
Rationale:	The network management stack allows to have a coordinated shutdown of more than one bus if an ECU exists which is connected to the busses which are to be coordinated. The functionality is included in the NmIf module. However, there are currently two limitations 1. If a sub-bus exists on a coordinated bus, which is connected by a gateway, this sub-bus can currently not be added to the list of coordinated busses, because the algorithm only handles one level. As a result, a coordinated bus may shut down, but connected sub busses may still be active. 2. The functionality is not reliable, because, if the coordinating ECU fails, the busses will no longer be coordinated and act on their own; that is, they will – if no node is active – shut down independently. This concept intent to fix these shortcomings.
Use Case:	Nested Gateways
Dependencies:	--
Supporting Material:	

]()

5.1.6.4 [SRS_Nm_02537] The NM Coordinator shall be able to abort the coordinated shutdown

Type:	Valid
Description:	As long as the coordinated shutdown is not completed, a network request on one of the coordinated busses shall be forwarded to other busses of this Coordination cluster.
Rationale:	The state of all coordinated busses shall be the same
Use Case:	Internal or external communication request during coordinated shutdown of busses.
Dependencies:	--
Supporting Material:	

]()

5.1.7 Partial Networking

5.1.7.1 [SRS_Nm_02518] Bus>Nm shall be able to distinguish between between NM Message

[

Short Description:	<Bus>Nm shall be able to distinguish between an NM message without PN request information (PNI = Partial Network Information Bit) and an NM message with PN PNI contained in the NM user data.
Type:	Valid
Description:	If Partial Networking is supported, NM shall distinguish between NM message without PN request information and NM message with PN PNI.
Rationale:	This is required to assure the compatibility between carry over parts from current vehicle platforms and validECUs with Partial Networking. Current ECUs may not send NM messages with PN request information
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088)

5.1.7.2 [SRS_Nm_02519] The NM Control Bit Vector shall contain a PNI (Partial Network Information) bit.

[

Type:	Valid
Description:	The NM Control Bit Vector shall contain a PNI (Partial Network Information) bit with the following meaning: 0: NM message does not contain PN request information 1: NM message contains PN request information (PNI)
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088)

5.1.7.3 [SRS_Nm_02520] <Bus>Nm shall evaluate the PNI bit in the NM message

[

Type:	Valid
Description:	NM shall evaluate the PNI bit in the NM message; If PNI bit is Set, the partial networking information shall be evaluated from the message.
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088)

5.1.7.4 [SRS_Nm_02521] <Bus>Nm shall set the PNI bit for requesting Partial Network functionality

[

Type:	Valid
Description:	While sending NM message, NM will set the PNI bit to request partial networking functionality.
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088)

5.1.7.5 [SRS_Nm_02522] <Bus>Nm shall calculate the combined partial network request status EIRA

[

Type:	Valid
Description:	NM shall calculate the combined partial network request status EIRA (External and Internal Requests Aggregated) for each partial network relevant to the ECU. The calculation shall use a configurable time constant for resetting EIRA requests.
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088)

5.1.7.6 [SRS_Nm_02523] <Bus>Nm shall calculate the status of the external partial network requests ERA

[

Type:	Valid
Description:	<Bus>Nm shall calculate the status of the external partial network requests ERA (External Requests Aggregated) for each partial network relevant to the ECU. The calculation shall use a configurable time constant for resetting ERA requests.
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088)

5.1.7.7 [SRS_Nm_02524] <Bus>Nm shall communicate EIRA and ERA requests to the upper layers using virtual PDUs

[

Type:	Valid
Description:	NM shall communicate EIRA and ERA requests to the upper layers using virtual PDUs (not contained in the System Description but generated during Ecu configuration)
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_1064)

5.1.7.8 [SRS_Nm_02525] <Bus>Nm shall support channel-specific configuration for ERA

[

Type:	Valid
Description:	<Bus>Nm shall support channel-specific configuration for ERA
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_02200)

5.1.7.9 [SRS_Nm_02526] <Bus>Nm shall support a global configuration for EIRA over all channels

[

Type:	Valid
Description:	<Bus>Nm shall support a global configuration for EIRA over all channels
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_02200)

5.2 Non-Functional Requirements (Qualities)

5.2.1 Timing Requirements

5.2.1.1 [SRS_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.

[

Type:	Valid
Description:	The time required from the point in time when the NM of each ECU agree on shutting down a communication system and the point in time when the communication system is really shutting down, has to be deterministic (guarantee of min time and max time). This time must be statically configurable cluster.
Rationale:	Determinism of network behavior, guarantee of synchronized sleep-mode
Use Case:	See Rationale
Dependencies:	--
Supporting Material:	--

](RS_BRF_01688)

5.2.2 Resource Usage

5.2.2.1 [SRS_Nm_00142] NM shall guarantee an upper limit for the bus load generated by NM itself.

[

Type:	Valid
Description:	NM shall not exceed a specified upper limit of bus load. This bus load has to be specified. Example: 3% in normal operation, 6% Bus load peak.
Rationale:	Determinism
Use Case:	Avoid solution like in OSEK NM 2.5.3: alive messages after bus wakeup
Dependencies:	--
Supporting Material:	--

]()

5.2.2.2 [SRS_Nm_00143] The bus load caused by NM shall be predictable.

[

Type:	Valid
Description:	The bus load caused by NM shall be predictable. The bus load for normal operation (no error occurred) has to be specified or calculable (dependent on the timing).
Rationale:	Predictability
Use Case:	Prediction of bus load for NM on the specific bus
Dependencies:	[SRS_Nm_00149]
Supporting Material:	--

]()

5.2.2.3 [SRS_Nm_00144] NM shall support communication clusters of up to 64 ECUs

[

Type:	Valid
Description:	Communication clusters of up to 64 ECUs / controllers shall be supported by NM.
Rationale:	Flexibility
Use Case:	See Rationale
Dependencies:	--
Supporting Material:	--

]()

5.2.2.4 [SRS_Nm_00145] On a properly configured node, NM shall tolerate a loss of a predefined number of NM messages

[

Type:	Valid
Description:	On a properly configured node, NM shall tolerate a loss of a predefined number of NM messages. The limitations of the number of message losses have to be described in the specification.
Rationale:	Robustness: There shall be no need for NM to receive every NM message. A loss of one message (in case of bursts) shall have no impact on the NM behaviour.
Use Case:	Loss of NM-message(s) must be tolerated
Dependencies:	--
Supporting Material:	--

]()

5.2.2.5 [SRS_Nm_00146] The NM shall tolerate a time jitter of NM messages in one or more ECUs

[

Type:	Valid
Description:	The NM shall tolerate a time jitter of NM messages in one or more ECUs. The limitations of the jitter have to be described in the specification.
Rationale:	Robustness
Use Case:	Jitter of NM-message(s) must be tolerated
Dependencies:	--
Supporting Material:	--

]()

5.2.2.6 [SRS_Nm_00147] The NM algorithm shall be processor independent.

[

Type:	Valid
Description:	The algorithm of NM shall not rely on processor specific mechanisms. It shall be realizable on every processor architecture.
Rationale:	Re-use
Use Case:	Usage of NM on different processor architectures
Dependencies:	--
Supporting Material:	--

](RS_BRF_01160,RS_BRF_01048)

5.2.2.7 [SRS_Nm_00149] The timing of NM shall be configurable.

[

Type:	Valid
Description:	All timing parameters of the NM (e.g., the cycle timing of message sent on the communication media) shall be configurable. NM Implementation shall support at least one of the following strategies: - pre-compile or - post-compile or - post build. SWS shall define which of parameters are cluster specific and which are node specific.
Rationale:	Flexibility
Use Case:	1. Time until network is shut down after all nodes have indicated that they are ready to sleep. 2. Time interval between two consecutive status indications of a node, whether it is ready to sleep or not. 3. Determination of timing depending on the configurable number of nodes.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01464)

5.2.3 Hardware independency

5.2.3.1 [SRS_Nm_00154] The Network Management API shall be independent from the communication bus

[

Type:	Valid
Description:	The Network Management API shall be independent from the communication bus i.e. equal for CAN and FlexRay.
Rationale:	Common, standardized interface to application and ECU state manager.
Use Case:	Usage of NM on different types of bus; only one interface independent of the underlying bus architecture.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01552)

5.3 CAN Specific Requirements

5.3.1 Resource Usage

5.3.1.1 [SRS_Nm_00148] The specification and implementation shall be split-up into a communication system independent and communication system dependent parts

[

Type:	Valid
Description:	The specification and implementation shall be split-up into a communication system independent and communication system dependent parts (the communication system dependent parts shall be based on the communication system abstraction).
Rationale:	Re-use
Use Case:	CAN NM Software Architecture (AUTOSAR SC decision from Apr 25th, 2006).
Dependencies:	--

Supporting Material:	--

](RS_BRF_01552)

5.3.2 Transmission Confirmation

5.3.2.1 [SRS_Nm_02510] For CAN NM it shall be optionally possible to immediately transmit the confirmation

[

Type:	Valid
Description:	For CAN NM it shall be optionally possible that the NM message transmission confirmation is generated at the transmission request to the CAN Interface layer.
Rationale:	If the bus access is completely regulated through an offline system design tool, the actual transmit confirmation to inform the Nm about a successful transmission can be regarded as redundant. Since the maximum arbitration time is known it is acceptable to immediately raise the confirmation at the transmission request time. Moreover, implementation of superfluous actual transmission confirmation in such a system only for one NM message would mean a significant performance loss regarding the execution time of the overall CAN Interface/Driver layer making the calculated time schedule inefficient.
Use Case:	Usage of CAN NM in a deterministic bus system.
Dependencies:	--
Supporting Material:	--

](RS_BRF_01704)

5.3.3 Diagnostic Service

5.3.3.1 [SRS_Nm_02512] The NM shall give the possibility to enable or disable the network management related communication configured for an active NM node

[

Type:	Valid
Description:	The NM shall give the possibility to enable or disable the network management related communication configured for an active NM node. By default network management related communication shall be enabled.
Rationale:	Conformance to ISO 14229 CommunicationControl (28 hex) service
Use Case:	Diagnostics
Dependencies:	SRS_Nm_02511
Supporting Material:	--

](RS_BRF_01720)

5.3.4 Partial Networking

5.3.4.1 [SRS_Nm_02527] CanNm shall implement a filter algorithm dropping all NM messages that are not relevant for the ECU

[

Type:	Valid
Description:	CanNm shall implement a filter algorithm dropping all NM messages that are not relevant for the ECU. The algorithm uses the Partial Network request

	information included with CAN NM.
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088,RS_BRF_01704)

5.3.4.2 [SRS_Nm_02528] CanNm shall provide a service which allows for spontaneous sending of NM messages.

[

Type:	Valid
Description:	CanNm shall provide a service which allows for spontaneous sending of NM messages.
Rationale:	A PN request originating from the ECU needs to be sent out as fast as possible to avoid long latency
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088,RS_BRF_01704)

5.3.4.3 [SRS_Nm_02529] If partial networking is used, the ECU shall secure that the first message on the bus is the wakeup frame.

[

Type:	Valid
Description:	If partial networking is used, the ECU shall secure that the first message on the bus is the wakeup frame. This requirement will be implemented in CanIf.
Rationale:	If all ECUs on the bus use partial networking, they use the CAN transceiver with the partial networking extensions. These transceivers only wake up after receiving the Wakeup Frame.
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088)

5.3.4.4 [SRS_Nm_02530] CanIf shall provide an optional channel-specific TX filter

[

Type:	Valid
Description:	CanIf shall provide an optional channel-specific TX filter. In blocking mode, the filter shall only pass transmission of wakeup frames. In pass mode the filter shall pass every PDU transmitted by an upper layer.
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088)

5.3.4.5 [SRS_Nm_02531] CanIf shall provide the possibility to initiate clear and check wake-up flags in the transceiver

[

Type:	Valid
Description:	CanIf shall provide the possibility to initiate clear and check wake-up flags in the transceiver
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088,RS_BRF_01920)

5.3.4.6 [SRS_Nm_02532] When full communication is requested, CanSm shall enable pass mode on the CanIf TX filter

[

Type:	Valid
Description:	When full communication is requested, CanSm shall enable pass mode on the CanIf TX filter
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088,RS_BRF_01704)

5.3.4.7 [SRS_Nm_02533] CanSm shall provide the possibility to initiate clear and check wake-up flags in the transceiver

[

Type:	Valid
Description:	CanSm shall provide the possibility to initiate clear and check wake-up flags in the transceiver
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088,RS_BRF_01920)

5.3.4.8 [SRS_Nm_02534] CanSm shall support a validPN shutdown sequence

[

Type:	Valid
Description:	CanSm shall support a validPN shutdown sequence (CAN CC STOP -> CAN TRCV STANBY -> CAN CC SLEEP)
Rationale:	--
Use Case:	--
Dependencies:	SRS_Nm_02517
Supporting Material:	--

](RS_BRF_01088,RS_BRF_01704)

5.4 FlexRay Specific Requirements

None.

6 References

6.1 Deliverables of AUTOSAR

[1] Layered Software Architecture
AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf

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

[3] Specification of the Virtual Functional Bus
AUTOSAR_EXP_VFB.pdf

[4] AUTOSAR Glossary
AUTOSAR_TR_Glossary.pdf

[5] Software Standardization Template
AUTOSAR_TPS_StandardizationTemplate.pdf

[DOC_VFB] Specification of the Virtual Functional Bus
AUTOSAR_EXP_VFB.pdf

Requirements on AUTOSAR Features
AUTOSAR_RS_Features.pdf

6.2 Related standards and norms

6.2.1 OSEK

[5] [STD_OSEK_NM]
OSEK/VDX NM Specification (ISO 17356-5), Version 2.5.3

[STD_OSEK_NM] OSEK/VDX NM Specification (ISO 17356-5), V2.5.3
http://www.osek-vdx.org/

6.2.2 HIS

[5] [HIS_NM_RQMT]
HIS NM Requirements

[HIS_NM_RQMT] HIS NM Requirements
http://www.automotive-his.de/