

Document Title	Requirements on Network Management for Adaptive Platform
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	855

Document Status	Final
Part of AUTOSAR Standard	Adaptive Platform
Part of Standard Release	17-10

Document Change History			
Date	Release	Changed by	Description
2017-10-27	17-10	AUTOSAR Release Management	<ul style="list-style-type: none">• Initial Release

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1 Scope of Document

This document specifies requirements on the AUTOSAR Network Management.

The requirements apply 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.

2 Conventions to be used

The representation of requirements in AUTOSAR documents follows the table specified in [TPS_STDT_00078], see Standardization Template [1], chapter Support for Traceability.

The verbal forms for the expression of obligation specified in [TPS_STDT_00053] shall be used to indicate requirements, see Standardization Template [1], chapter Support for Traceability.

3 Acronyms and abbreviations

The acronyms and abbreviations used in this document are already included in the AUTOSAR Glossary [2].

4 Requirements Specification

4.1 Functional Requirements

4.1.1 Configuration

[RS_Nm_00150] Specific functions of the Network Management shall be configurable [

Type:	Valid
Use Case:	<p>The following functions of the Network Management shall be configurable:</p> <ul style="list-style-type: none"> - Detection of present nodes (on/off) – [RS_Nm_00153] - Notification that all other ECUs are (no more) ready to sleep (i.e. Remote Sleep Indication (Cancellation)) (on/off) – [RS_Nm_00052], [RS_Nm_02509] - NM Coordination support (on/off) – [RS_Nm_02514] - User data support (on/off) – [RS_Nm_02503], [RS_Nm_02504] - Bus load reduction (on/off) – [RS_Nm_00142] - Sending node identifier (on/off) – [RS_Nm_02505] - Receiving node identifier (on/off) – [RS_Nm_02506] - Immediate Transmission Confirmation (on/off) – [RS_Nm_02510] - Configurable Role In Cluster Shutdown (on/off) – [RS_Nm_02511] - Bus Keep Awake Services (on/off) – [RS_Nm_00047] - Partial Networking extensions (on/off) – [RS_Nm_02517] - EIRA (External and Internal Requests Aggregated) reset timer timeout – [RS_Nm_02525] and [RS_Nm_02526]
Rationale:	Scalability
Use Case:	Configuration of ECU SW
Applies to:	AP, CP
Dependencies:	- -
Supporting Material:	- -

] ([RS_Main_00420](#))

4.1.2 Initialization

[RS_Nm_00151] The Network Management algorithm shall allow any node to integrate into an already running NM cluster [

Type:	Valid
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Description:	The Network Management algorithm shall allow any node to integrate into an already running NM cluster.
Rationale:	Integration of <ul style="list-style-type: none"> 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
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

](RS_Main_00420)

[RS_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)
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

](RS_Main_00420)

4.1.3 Normal Operation

[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. [

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
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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.
Rationale:	--
Use Case:	Running OSEK-NM or another Legacy-NM on one of the networks.
Applies to:	CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00190](#))

[RS_Nm_00045] NM shall 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
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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.
Rationale:	Control of NM NM Coordinator
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	Related requirement [RS_Nm_02512]

] ([RS_Main_00420](#))

[RS_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 shut-down 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 [RS_Nm_02511]
Rationale:	Driver enters the car and wants to start the engine.
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

] ([RS_Main_00420](#))

[RS_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 [RS_Nm_02511]

Rationale:	Basic NM functionality
Use Case:	See Rationale
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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 NM functionality
Use Case:	See Rationale
Applies to:	AP, CP
Dependencies:	[RS_Nm_00047]
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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. The NM state reflects the state of the bus.
Use Case:	See Rationale
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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.
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

](RS_Main_00420)

[RS_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.
Applies to:	AP, CP
Dependencies:	[RS_Nm_02509]
Supporting Material:	- -

](RS_Main_00420)

[RS_Nm_02509] The NM interface shall signal to the application that at least one ECU 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.
Applies to:	AP, CP
Dependencies:	[RS_Nm_00052]
Supporting Material:	- -

](RS_Main_00420)

[RS_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.
Applies to:	AP, CP
Dependencies:	- -
Supporting Material:	- -

](RS_Main_00420)

[RS_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 included in a received NM message. 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.
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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 [RS_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.
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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.
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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.
Applies to:	AP, CP
Dependencies:	- -
Supporting Material:	- -

] ([RS_Main_00420](#))

[RS_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.
Applies to:	AP, CP
Dependencies:	- -
Supporting Material:	- -

] ([RS_Main_00420](#))

[RS_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.
Applies to:	AP, CP
Dependencies:	In order to avoid inconsistencies between the NM and the COM Manager, the COM Manager is not allowed to request keeping the bus awake.
Supporting Material:	- -

]([RS_Main_00420](#))

[RS_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.
Applies to:	AP, CP
Dependencies:	- -
Supporting Material:	- -

]([RS_Main_00420](#))

[RS_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
Applies to:	AP, CP
Dependencies:	[RS_Nm_02511]
Supporting Material:	- -

]([RS_Main_00420](#))

4.1.4 Fault Operation

[RS_Nm_00053] NM on a node which is or become bus unavailable shall have a deterministic Behavior [

Type:	Valid
Description:	<p>NM on a node which is or become bus unavailable shall react such that:</p> <ul style="list-style-type: none"> • 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
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00011](#))

Note:

The four rules in the description of [[RS_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.

[[RS_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.

[RS_Nm_00137] NM shall perform communication system error handling for errors that have impact on the NM behavior. [

Type:	Valid
Description:	<p>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.</p> <p>Focus: bus errors, not protocol errors. Example: loss of NM message is handled.</p>
Rationale:	Error handling
Use Case:	Communication loss
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00011](#))

4.1.5 Gateway Operation

[RS_Nm_02514] It shall be possible to group networks into *NM Coordination Clusters* [

Type:	Valid
Description:	It shall be possible to group networks into <i>NM Coordination Clusters</i> . Each bus specific NM shall, by configuration, be part of 0 or 1 <i>NM Coordination Cluster</i> . NM shall provide functionality (<i>NM Coordination</i>) to coordinate the different NM modes (especially sleep and keep awake) on all networks in an <i>NM Coordination Cluster</i> , 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 <i>NM Coordination</i> for each <i>NM Coordination Cluster</i> separately and independently.
Rationale:	It shall be possible to perform coordinated and/or synchronized shutdown of multiple NM clusters independently.
Use Case:	NM Coordinator
Applies to:	CP
Dependencies:	- -
Supporting Material:	- -

] ([RS_Main_00420](#))

Note:

The definitions of *NM Coordination Cluster*, *NM Coordinator*, *Synchronize* and *Coordinate* are available in [2].

[RS_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
Applies to:	CP
Dependencies:	- -
Supporting Material:	

] ([RS_Main_00420](#))

[RS_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:	<p>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</p> <ol style="list-style-type: none"> 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
Applies to:	CP
Dependencies:	- -
Supporting Material:	

](RS_Main_00420)

[RS_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.
Applies to:	CP
Dependencies:	- -
Supporting Material:	

](RS_Main_00420)

4.1.6 Partial Networking

[RS_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 <ul style="list-style-type: none"> • Shutting down of seat control functions • Shutting down of park assistant functions • Hazard flashers • Shutting down of Electric Park Brake (EPB)
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00420](#))

Note:

The definitions of *Partial Networking* is available in more details in [3].

[RS_Nm_02518] <Bus>Nm shall be able to distinguish between NM Messages [

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:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]

Supporting Material:	--
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](RS_Main_00420)

[RS_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:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

](RS_Main_00420)

[RS_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:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

](RS_Main_00420)

[RS_Nm_02527] <Bus>Nm shall implement a filter algorithm dropping all NM messages that are not relevant for the ECU [

Type:	Valid
Description:	<Bus>Nm 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 <Bus>Nm.
Rationale:	--
Use Case:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

](RS_Main_00420)

[RS_Nm_02528] <Bus>Nm shall provide a service which allows for spontaneous sending of NM messages. [

Type:	Valid
Description:	<Bus>Nm 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:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

] ([RS_Main_00420](#))

[RS_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:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

] ([RS_Main_00420](#))

[RS_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:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

] ([RS_Main_00420](#))

[RS_Nm_02524] <Bus>Nm shall communicate EIRA and ERA requests to the upper layers [

Type:	Valid
Description:	<Bus>NM shall communicate calculated EIRA and ERA requests to the upper layers
Rationale:	--
Use Case:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

](RS_Main_00420)

[RS_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:	--
Applies to:	CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

](RS_Main_00420)

[RS_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:	--
Applies to:	AP, CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

](RS_Main_00420)

4.2 Non-Functional Requirements (Qualities)

4.2.1 Timing Requirements

[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.

Type:	Valid
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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 per cluster.
Rationale:	Determinism of network behavior, guarantee of synchronized sleep-mode.
Use Case:	See Rationale
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00340](#))

4.2.2 Resource Usage

[RS_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
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00200](#))

[RS_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
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00200](#))

[RS_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
Applies to:	AP, CP
Dependencies:	- -
Supporting Material:	- -

](RS_Main_00420)

[RS_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
Applies to:	AP, CP
Dependencies:	- -
Supporting Material:	- -

](RS_Main_00420)

[RS_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
Applies to:	AP, CP
Dependencies:	- -
Supporting Material:	- -

](RS_Main_00420)

[RS_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

Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00130](#))

4.2.3 Hardware independency

[RS_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 upper layers.
Use Case:	Usage of NM on different types of bus; only one interface independent of the underlying bus architecture.
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

]([RS_Main_00140](#))

4.3 CAN Specific Requirements

4.3.1 Resource Usage

[RS_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).
Applies to:	AP, CP
Dependencies:	--
Supporting Material:	--

](RS_Main_00140)

4.3.2 Transmission Confirmation

[RS_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.
Applies to:	AP, CP
Dependencies:	- -
Supporting Material:	- -

](RS_Main_00420)

4.3.3 Partial Networking

[RS_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:	- -
Applies to:	CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	- -

](RS_Main_00420)

[RS_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:	--
Applies to:	CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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:	--
Applies to:	CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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:	--
Applies to:	CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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:	--

Applies to:	CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

]([RS_Main_00420](#))

[RS_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:	--
Applies to:	CP
Dependencies:	[RS_Nm_02517]
Supporting Material:	--

]([RS_Main_00420](#))

5 Requirements Tracing

Requirement	Description	Satisfied by
[RS_Main_00011]	AUTOSAR shall support the development of reliable systems	[RS_Nm_00053] [RS_Nm_00137]
[RS_Main_00130]	AUTOSAR shall provide an abstraction from hardware	[RS_Nm_00147]
[RS_Main_00140]	AUTOSAR shall provide network independent communication mechanisms for applications	[RS_Nm_00148] [RS_Nm_00154]
[RS_Main_00190]	AUTOSAR shall support interoperability with non-AUTOSAR software on the same ECU	[RS_Nm_02515]
[RS_Main_00200]	AUTOSAR specifications shall allow resource efficient implementations	[RS_Nm_00142] [RS_Nm_00143]
[RS_Main_00340]	AUTOSAR shall support the continuous timing requirement analysis	[RS_Nm_00054]
[RS_Main_00420]	AUTOSAR shall use established software standards and consolidate de-facto standards for basic software functionality	[RS_Nm_00043] [RS_Nm_00044] [RS_Nm_00045] [RS_Nm_00046] [RS_Nm_00047] [RS_Nm_00048] [RS_Nm_00050] [RS_Nm_00051] [RS_Nm_00052] [RS_Nm_00144] [RS_Nm_00145] [RS_Nm_00146] [RS_Nm_00150] [RS_Nm_00151] [RS_Nm_00153] [RS_Nm_02503] [RS_Nm_02504] [RS_Nm_02505] [RS_Nm_02506] [RS_Nm_02508] [RS_Nm_02509] [RS_Nm_02510] [RS_Nm_02511] [RS_Nm_02512]

Requirement	Description	Satisfied by
		[RS_Nm_02513] [RS_Nm_02514] [RS_Nm_02516] [RS_Nm_02517] [RS_Nm_02518] [RS_Nm_02519] [RS_Nm_02520] [RS_Nm_02521] [RS_Nm_02522] [RS_Nm_02523] [RS_Nm_02524] [RS_Nm_02525] [RS_Nm_02526] [RS_Nm_02527] [RS_Nm_02528] [RS_Nm_02529] [RS_Nm_02530] [RS_Nm_02531] [RS_Nm_02532] [RS_Nm_02533] [RS_Nm_02534] [RS_Nm_02535] [RS_Nm_02536] [RS_Nm_02537]

6 References

6.1 Deliverables of AUTOSAR

- [1] Standardization Template
AUTOSAR_TPS_StandardizationTemplate
- [2] Glossary
AUTOSAR_TR_Glossary
- [3] Layered Software Architecture
AUTOSAR_EXP_LayeredSoftwareArchitecture