

AUTOSAR Network Management

Nm Interface and CAN Nm AUTOSAR Release 3.0

Agenda

> History

Outline of Solutions and Concepts

Network Management Algorithm

Network Management Message

Additional Features

Configuration

Availability at Vector

Questions

History

Network Management AUTOSAR Releases

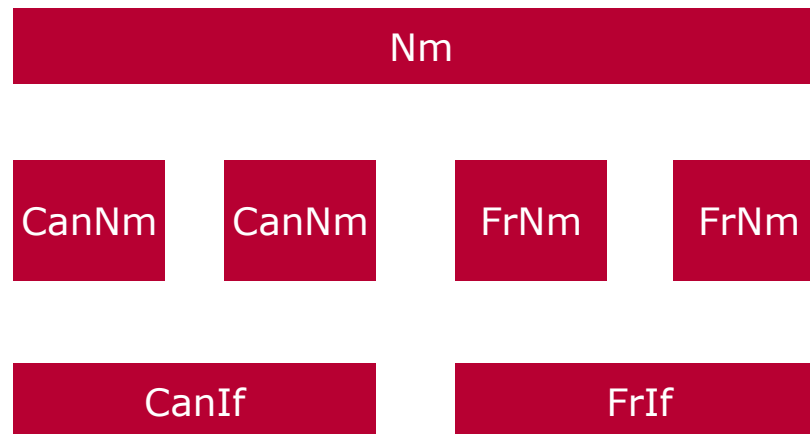
- ❑ AUTOSAR Release 1.0 is available since May 2005
 - ❑ AUTOSAR Network Management modules
 - ❑ Generic NM short Name: Nm
 - ❑ CAN NM short Name: CanNm
 - ❑ FlexRay NM short Name: FrNm
- ❑ AUTOSAR Release 2.1 is available since February 2007
 - ❑ Nm Architecture changed
 - ❑ New module: Generic NM Interface short Name: Nm
 - ❑ Generic NM -> CAN Generic NM short Name: CNm
 - ❑ No changes for CAN NM short Name: CanNm
 - ❑ New State Machine for FlexRay NM short Name: FrNm

History

Network Management AUTOSAR Releases

- ❑ AUTOSAR Release 3.0 is available since February 2008
 - ❑ Nm Architecture changed
 - ❑ Merged CAN Generic NM and CAN NM short Name: CanNm
 - ❑ NM Coordinator Functionality added to NM Interface

AUTOSAR NM Stack



History

Network Management Architecture

- ❑ Motivation for this NM architecture
 - ❑ Bus independent interface to higher layers
 - ❑ Bus specific NM modules
 - ❑ Bus specific algorithm
 - ❑ Management and transmission of NM PDU
 - ❑ Direct interface to Communication Hardware Abstraction layer
 - ❑ PDU Router is not used by Network Management

Agenda

History

> **Outline of Solutions and Concepts**

Network Management Algorithm

Network Management Message

Additional Features

Configuration

Availability at Vector

Questions

Outline of Solutions and Concepts

Network Management Tasks

AUTOSAR Network Management

- ❑ The aim is a simple mechanism for the
 - ❑ self-sufficient start-up of ECUs
 - ❑ the maintenance of the bus communication
 - ❑ shut down of bus communication
 - ❑ synchronized start-up and shut down of networks

Outline of Solutions and Concepts

Features

- ❑ Network Management algorithm
 - ❑ Distributed algorithm for sleep & wake-up
 - ❑ Bus load reduction optional
 - ❑ NM message burst prevention
- ❑ User data support optional
- ❑ Communication Control optional, CAN only
- ❑ Passive Mode
- ❑ Gateway features optional
 - ❑ Detection of present nodes
 - ❑ Remote Sleep Indication
 - ❑ Control Bit Vector
 - ❑ Bus Synchronization
- ❑ Bus error and communication management is performed by higher layers and not by NM

Outline of Solutions and Concepts

CANbedded Wrapper for AUTOSAR NM

- ❑ Functional gaps and incompatibilities if AUTOSAR NM is used in an traditional CANbedded software stack
- ❑ AUTOSAR headers are part of the CANbedded Wrapper
 - ❑ Declaration of AUTOSAR data types
 - ❑ Compiler and platform specific definitions
 - ❑ AUTOSAR BSW modules header files
- ❑ Communication Management (CanOnline/CanOffline handling)
- ❑ BusOff Management optional

Agenda

History

Outline of Solutions and Concepts

> **Network Management Algorithm**

Network Management Message

Additional Features

Configuration

Availability at Vector

Questions

Network Management Algorithm

Overview

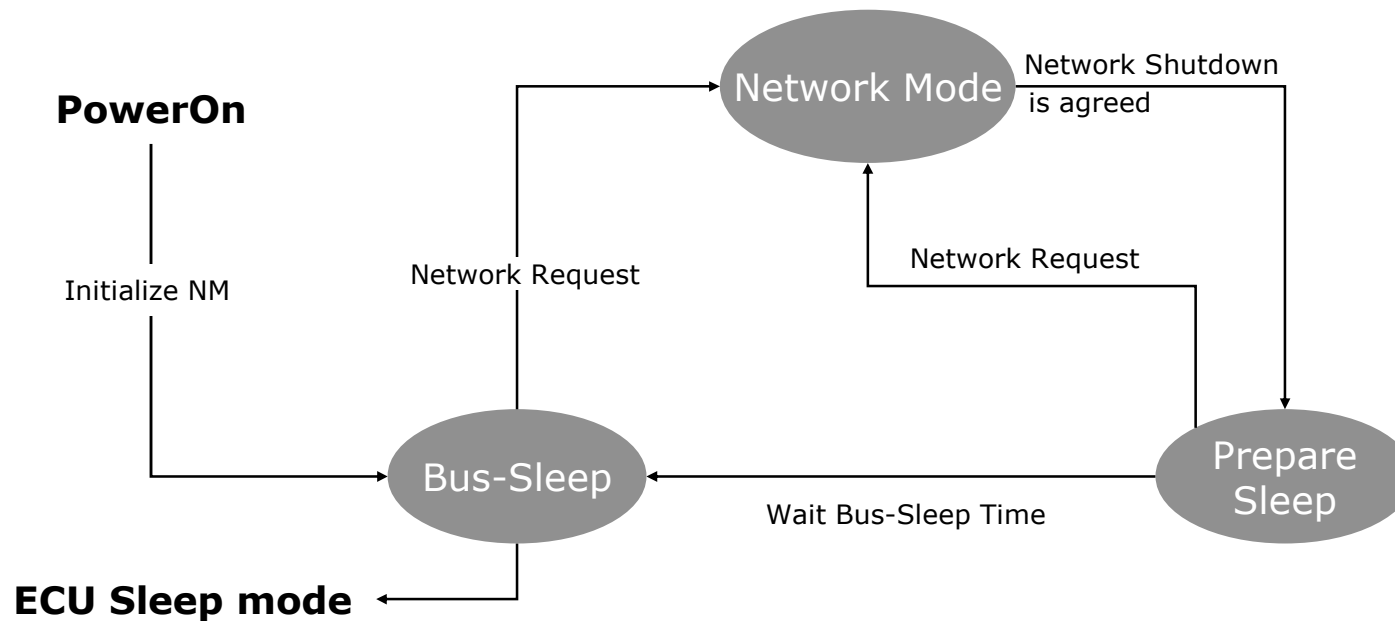
The AUTOSAR NM is a **direct** and **distributed** Network Management

- ❑ **Direct NM** - Each node has its own NM message
 - ❑ The NM message is reserved for the Network Management
 - ❑ The NM message signalizes that bus communication is needed
 - ❑ The NM message data is **not relevant** for the NM mechanism
- ❑ **Distributed NM** – All nodes are equal (there is no NM Master or NM Slave)
- ❑ The focus of the following slides is on the CAN-specific part of AUTOSAR NM

Network Management Algorithm

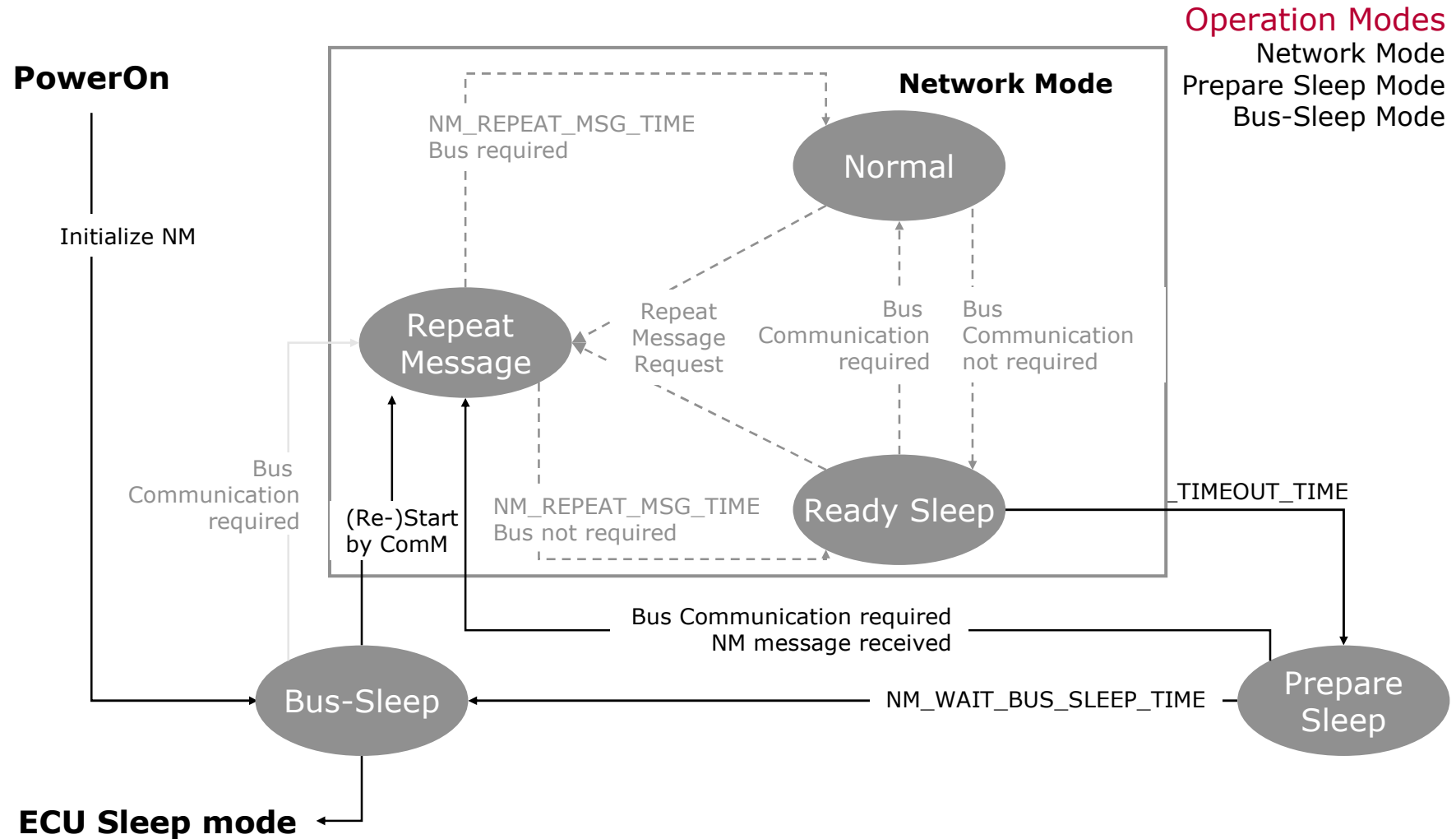
Comparison of AUTOSAR NM and OSEK NM (CAN)

Simplified state machine of AUTOSAR NM and OSEK-NM is identical.



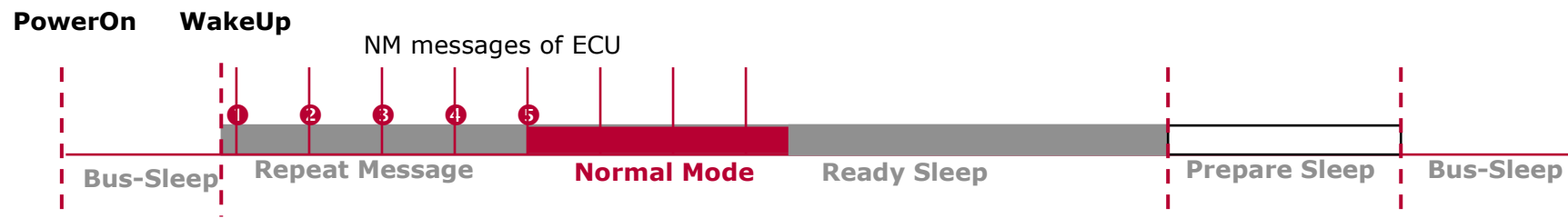
Network Management Algorithm

State Machine (CAN)



Network Management Algorithm

Basic Mechanism – Single ECU (CAN)



Repeat Message: Each ECU transmits own NM messages cyclic for NM_REPEAT_MSG_TIME.

Ready Sleep: ECU is ready to sleep, no NM message transmission, restart of timeout timer upon NM message Rx.

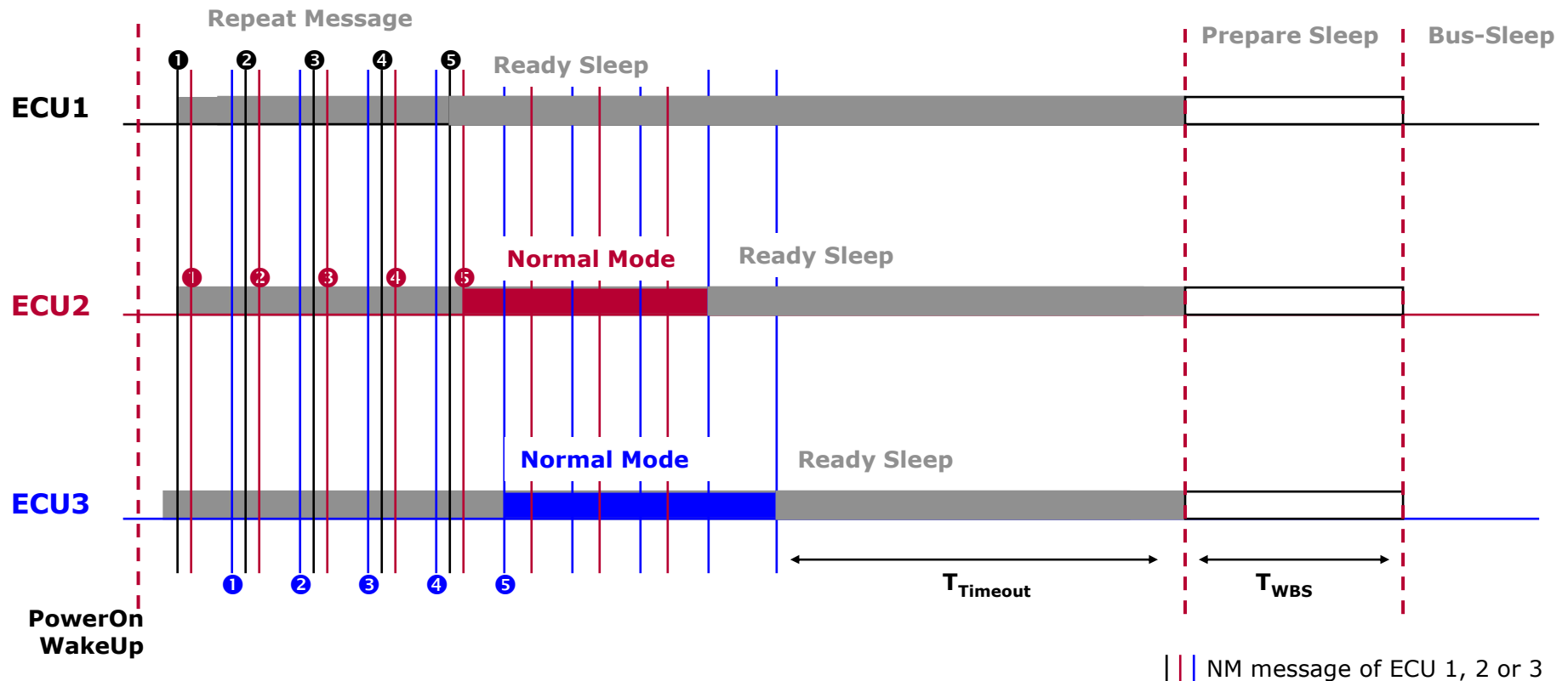
Normal: NM message transmission and restart of timeout timer upon NM message Rx and Tx.

Prepare Sleep: If NM_TIMEOUT_TIME expired and no NM Message has been transmitted or received in the meantime.

Bus-Sleep: After NM_WAIT_BUS_SLEEP_TIME transition to bus-sleep mode.

Network Management Algorithm

Basic Mechanism – Network (CAN)



Repeat Message: Each ECU transmits own NM messages cyclic for NM_REPEAT_MSG_TIME.

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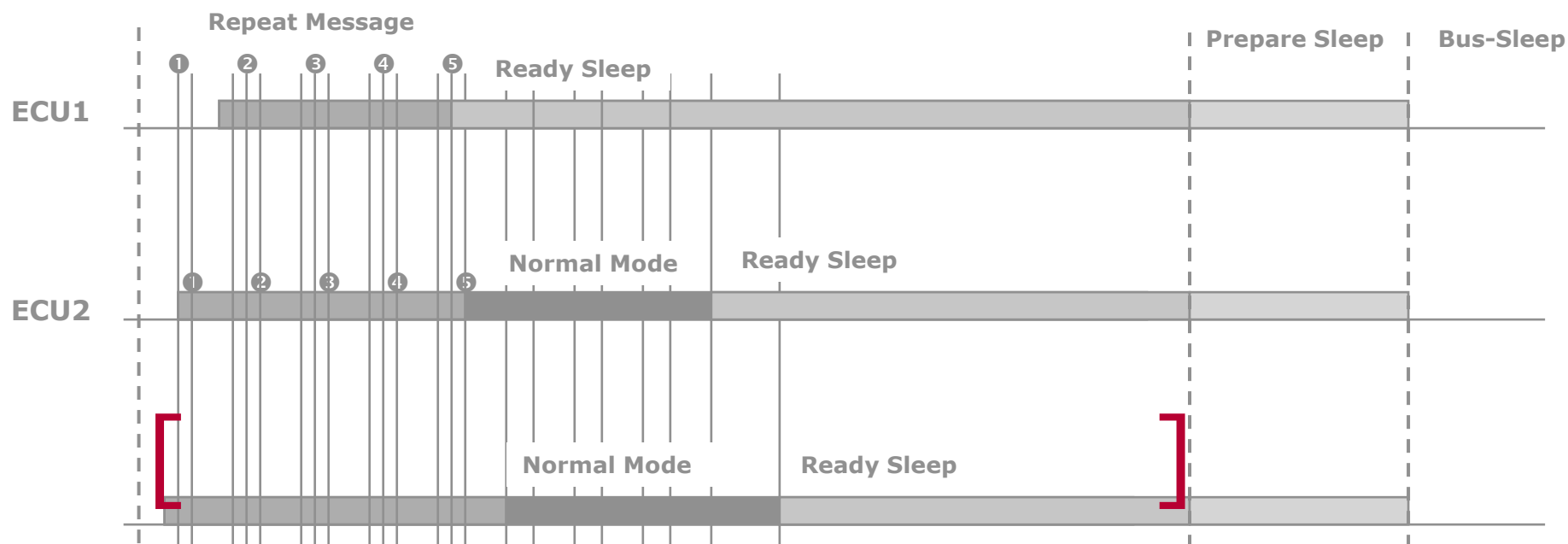
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Network Management Algorithm

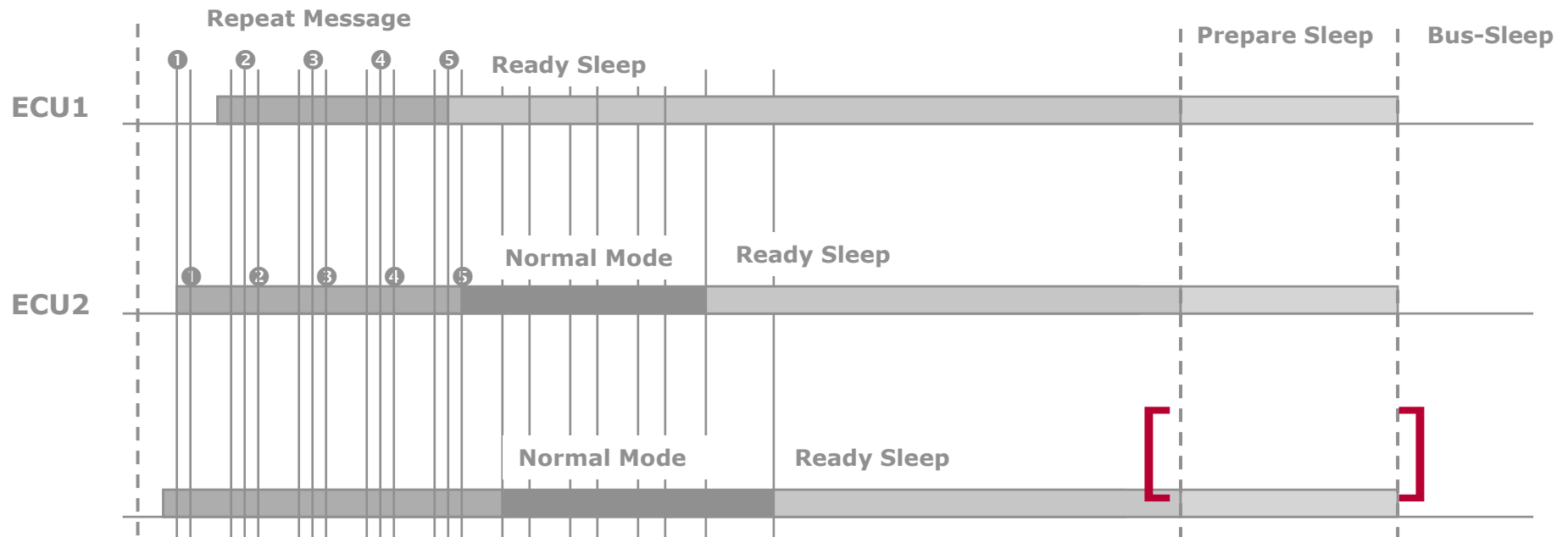
Network Mode (CAN)



- ❑ Active participation in the network
- ❑ Reception and Transmission of application messages enabled
- ❑ Repeat Message
 - ❑ cyclic transmission of NM messages for a certain time
- ❑ Normal Operation
 - ❑ transmission of NM messages (if available reduced transmission)
- ❑ Ready Sleep
 - ❑ transmission of NM messages is stopped

Network Management Algorithm

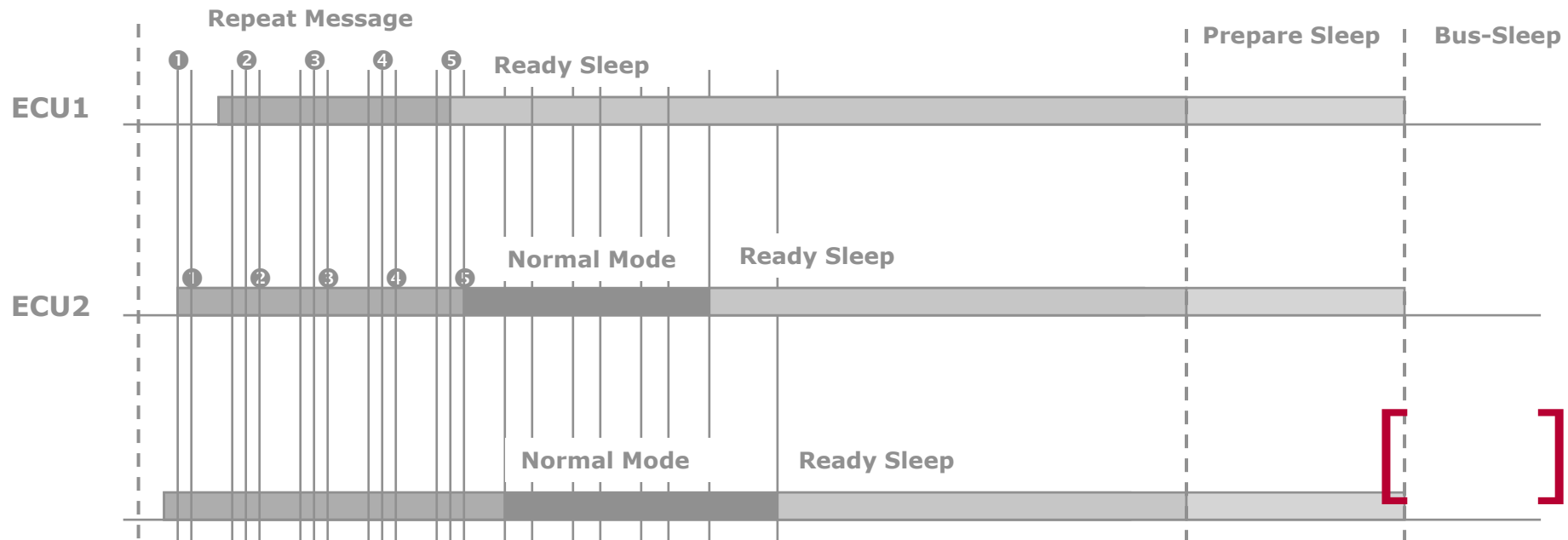
Prepare Bus-Sleep Mode (CAN)



- ❑ No active participation in the network
- ❑ Reception and Transmission of application messages is stopped
- ❑ Bus calm down period
- ❑ Restart of network upon
 - ❑ reception of NM message
 - ❑ bus communication request

Network Management Algorithm

Bus-Sleep Mode (CAN)



- ❑ Communication bus is shut down
- ❑ Restart (wake-up) of network management
 - ❑ wake-up on communication bus
 - ❑ reception of a NM message
 - ❑ application requires bus communication

Agenda

History

Outline of Solutions and Concepts

Network Management Algorithm

> **Network Management Message**

Additional Features

Configuration

Availability at Vector

Questions

Network Management Message

PDU Layout on CAN

- ❑ PDU length is configurable from 0 up to 8 bytes
- ❑ Usage of the two additional bytes Control Bit Vector and Source Node Identifier is optional
- ❑ User Data Length is the difference between PDU Length and number of used additional bytes

- ❑ Default layout:

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

- ❑ Source Node Identifier is ECU specific and unique
- ❑ Control Bit Vector consists of only of the Repeat Message Bit (up to now):

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Res	Res	Res	Res	Res	Res	Res	RepeatMessageBit

Network Management Message

Transmission

- ❑ NM PDUs are transmitted cyclically by every active node
 - ❑ In Repeat Message State
 - ❑ In Normal Operation State (without bus load reduction)
 - ❑ With bus load reduction enabled at most two nodes are sending NM messages
- ❑ Node-specific transmission offsets to prevent NM message bursts

Agenda

History

Outline of Solutions and Concepts

Network Management Algorithm

Network Management Message

> **Additional Features**

Configuration

Availability at Vector

Questions

Additional Features

Bus Load Reduction and User Data

- ❑ Bus Load Reduction
 - ❑ Reduction of bus load in Normal Operation
 - ❑ Every node has a unique reduced cycle time
 - ❑ At most the two active nodes with the smallest reduction cycle time transmit NM message
- ❑ User Data
 - ❑ API to set user data of the NM message transmitted next on the bus
 - ❑ API to get user data of the NM message received last on the bus
 - ❑ API to get whole PDU received last on the bus

Additional Features

Communication Control and Passive Mode

- ❑ Communication Control (CAN only)
 - ❑ For diagnostics or flashing sessions
 - ❑ Transmission of NM PDUs in Normal Operation can be disabled so save bandwidth
 - ❑ Communication must not be released while transmission is disabled
- ❑ Passive Mode
 - ❑ For nodes that do not need the ability to keep the bus awake
 - ❑ Passive nodes cannot send NM messages
 - ❑ When entering network mode passive nodes immediately change to Ready Sleep State.

Additional Features

Remote Sleep Indication & Bus Synchronization (Gateway)

- ❑ Remote Sleep Indication (optional)
 - ❑ Notification of Remote Sleep Indication to System Services when a node is the last one in the network that requires bus communication (transmits NM messages for a certain time)
 - ❑ Notification of Remote Sleep Cancellation to System Services when any node requires the network again after Remote Sleep Indication has been notified
 - ❑ API to read the current Remote Sleep Indication status
 - ❑ Used for validation of network shutdown

- ❑ Bus Synchronization (optional; CAN only)
 - ❑ Transmission of an asynchronous NM message in order to synchronize networks in time

Additional Features

Node Detection and Control Bit Vector (Gateway)

- ❑ Control Bit Vector
 - ❑ Up to now only the Repeat Message bit is available
 - ❑ Bit is set via Node Detection
 - ❑ Indication when a NM message is received where the bit is set

- ❑ Node Detection
 - ❑ Request state change to Repeat Message
 - ❑ Setting Repeat Message Bit
 - ❑ Indication: all nodes perform state transition
 - ❑ Available Network Nodes can be identified
 - ❑ All available active nodes are sending NM PDUs in Repeat Message
 - ❑ API to read source node identifier optional

Additional Features

NM Coordination

- ❑ Coordination between different networks
 - ❑ As long as one network needs communication all other networks are kept awake
 - ❑ Synchronized shutdown via calculated shutdown timings
 - ❑ Possibility to configure synchronous and selective networks

- ❑ Coordination between different NMs on the same network
 - ❑ Possible for OSEK NM and CAN NM on the same network
 - ❑ Upper Layer only has to handle CAN NM
 - ❑ Pre-condition: Separated NM message ranges
 - ❑ Same algorithm as coordination between different networks

Agenda

History

Outline of Solutions and Concepts

Network Management Algorithm

Network Management Message

Additional Features

> **Configuration**

Availability at Vector

Questions

Configuration

Configuration of Network Management

- ❑ Configuration is done with generation tool GENy
- ❑ All three AUTOSAR configuration variants are supported
 - ❑ Pre-compile
 - ❑ Link-time
 - ❑ Post-build
- ❑ Each NM component is configured separately
- ❑ Consistency of NM component configuration is granted
- ❑ NM messages and timing parameters configuration partly done with database attributes

Agenda

History

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Network Management Algorithm

Network Management Message

Additional Features

Configuration

> Availability at Vector

Questions

Availability at Vector

- ❑ Full release version for 3.0 available within MICROSAR 3.0
 - ❑ NM Interface
 - ❑ Including NM Coordinator
 - ❑ CAN NM and FlexRay NM
- ❑ CANbedded Wrapper for 3.0 available
- ❑ CANoe node layer DLL for 3.0 available
- ❑ Configuration via generation tool GENy
 - ❑ Configuration via database as in CANbedded
 - ❑ Configuration via AUTOSAR ECU configuration

Agenda

History

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Additional Features

Configuration

Availability at Vector

> Questions

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Questions ?

Thank you for your attention.

For detailed information about Vector
and our products please have a look at:
www.vector-informatik.com

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