GWMLAN General Specification

AUTOSAR Network Management Requirement Specification

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Revision History

Revision history describes the changes in the new issue. Please refer to the release notes.

Contents

1 General

1.1 Scope of the Document

This document specifies the requirements for CAN network management for GWM network platform development.

If there is any conflict between this document and other standards or specifications, please handle as follows:

1) Different with AUTOSAR, this document take precedence;
2) Different with ECU specific network management requirements, the ECU specific network management requirements take precedence;
3) Different with legal requirements, the legal requirements take precedence.

1.2 Target Group/Purpose

This document is intended for system engineers and software engineers designing the network management software and application software which will interface the network management, as well as engineers writing the network management test specification.

1.3 Terminology

AUTOSAR	Automotive Open System Architecture
ECU	Electronic Control Unit, in general context
CAN	Controller Area Network
GWM	Great Wall Motor
GWMLAN	Great Wall Motor Local Area Network
Node	An ECU connected to the CAN Network
NM	Network Management
PDU	Protocol Data Unit
RMR	Repeat Message Request
AWB	Active Wakeup Bit
Type_A ECU	An ECU whose communication is required, **only** when the power mode is ON.
Type_B ECU	An ECU whose communication is required, only when the power mode is ON **and** CRANK.
Type_C ECU	An ECU which keeps communication regardless of the power mode state.

1.4 Document References

[1] AUTOSAR Specification of CAN Network Management V4.2.2.
[2] GWMLAN00-14 Indirect NM Req Spec1.4

2 GWMLAN Communication Protocol Stack Overview

The GWMLAN concept includes a communication protocol stack with a layered structure according to figure 1 below.

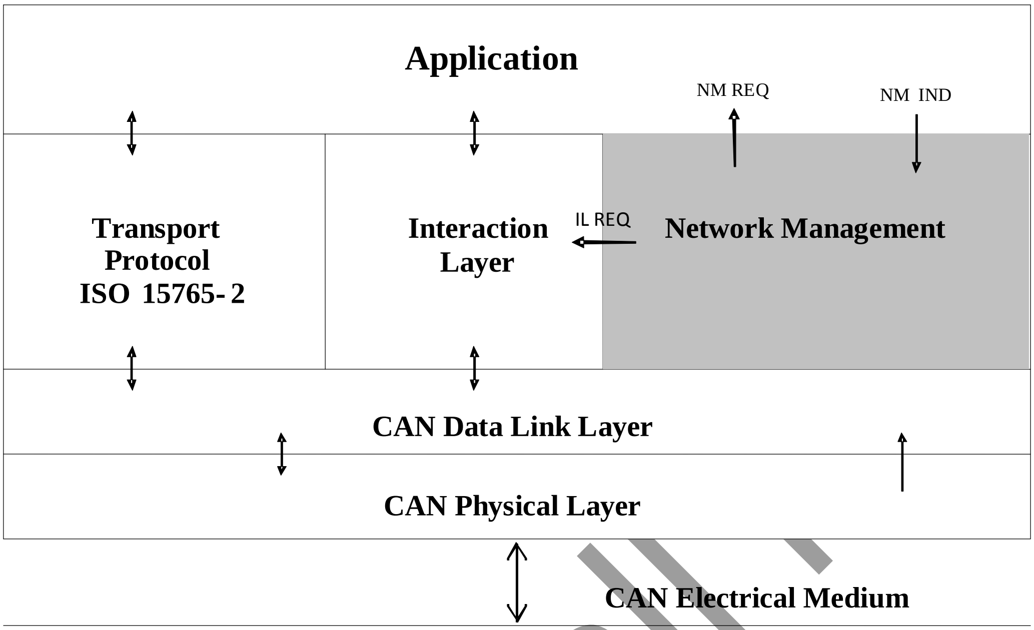

Figure 1 GWMLAN Communication Protocol Stack Overview

3 Network Management Module Function Specification

The important task of network management is to ensure the safety and the reliability of a communication network for ECUs. Network management provide services such as initialization of ECU resources, start-up of network, detecting, processing and signaling of operating states for network and node, coordination of global operation modes. Type A and Type B ECU shall meet the requirements of indirect network management, which are described in the Ref.2.Type C ECU shall meet the requirements of AUTOSAR network management. This specification is applicable to the requirements of direct network management for Type C ECUs.

3.1 Coordination Algorithm

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

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

If any node in the network management cluster requires bus communication, it can wake up the network management cluster from the Bus Sleep Mode by transmitting NM PDUs.

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

- Every network node in a NM cluster shall transmit periodic NM PDUs as long as it requires bus-communication; otherwise it shall transmit no NM PDUs.
- If bus communication in a NM cluster is released and there are no NM PDUs on the bus for an amount of time determined by T_NM_TIMEOUT + T_WAIT_BUS_SLEEP transition into the Bus Sleep Mode shall be performed.

3.2 Operational Modes

In the following chapter operational modes of the AUTOSAR NM algorithm are described in detail according to figure 2.

The GWM network management shall contain three modes:

- Bus Sleep Mode
- Prepare Bus Sleep Mode
- Network Mode

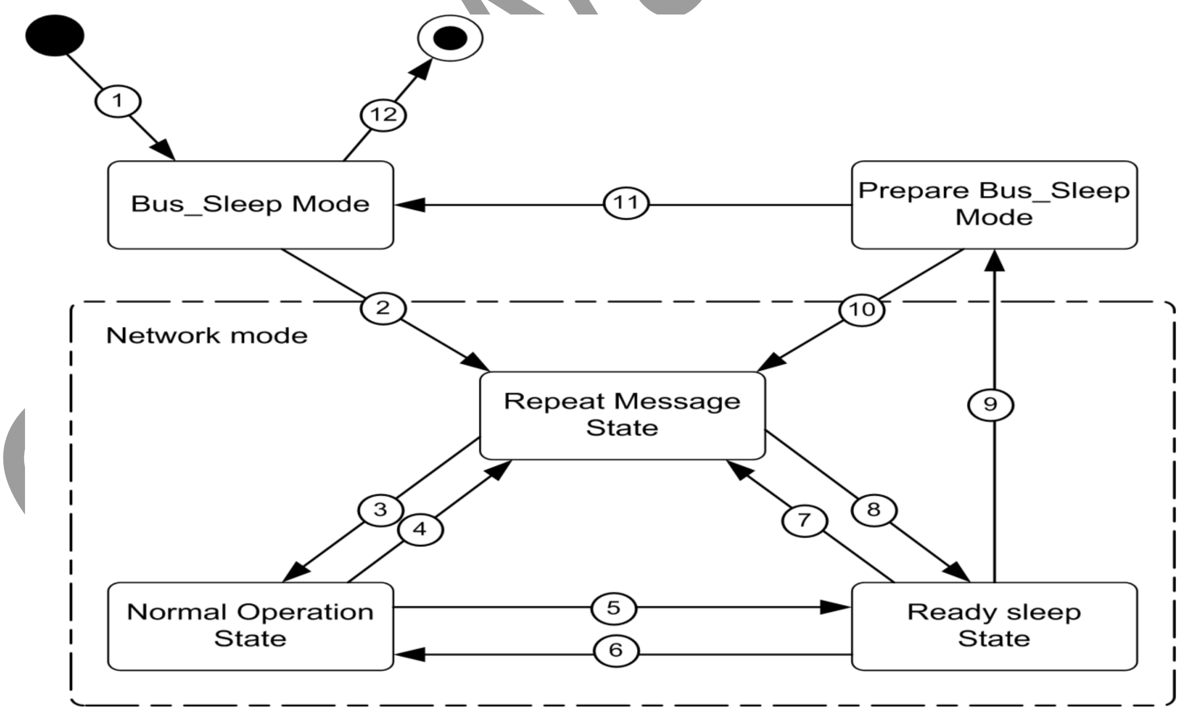

Figure 2 NM Transition Diagram

(1) Initialize the CanNm module.

(2) The wake up event is detected from the local ECU or Any NM message received.
(3) The Repeat Message Timer has expired and the network is requested.
(4) Set Repeat Message Request Bit for NM PDUs transmitted next on the bus or receive message with repeat bit.
(5) The network is released.
(6) The network is requested.
(7) Set Repeat Message Request Bit for NM PDUs transmitted next on the bus or receive message with repeat bit.
(8) The Repeat Message Timer has expired and the network is released.
(9) The NM-Timeout Timer expires.
(10) The network is requested or NM message received successfully.
(11) TWBS expired.
(12) Power supply off.

The table 1 describes to send different type of message in different mode of network.

Table 1 Different type of message in modes of network

NM Mode		NM Frame		App Frame[1]	
		Tx	Rx	Tx	Rx
Bus Sleep Mode		N	Y	N	N
Prepare Bus Sleep Mode		N	Y	N[2]	N
Network Mode	Repeat Message State	Y	Y	Y	Y
	Normal Operation State	Y	Y	Y	Y
	Ready Sleep State	N	Y	Y	Y

'N' denote that frame of Tx/Rx is impossible.
'Y' denote that frame of Tx/Rx is possible.
Tx/Rx is an requirement to application layer rather than data link layer.
[1]App frames include application messages, diagnosis messages, calibration messages;
[2] The frame already in Tx Buffer is allowed to be sent.

3.2.1 Bus Sleep Mode

RS-NM-1 The Bus-Sleep Mode Requirements

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

3.2.2 Prepare Bus Sleep Mode

RS-NM-2 The Prepare Sleep Mode Requirements

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

When the NM module is entered in the Prepare Bus Sleep Mode and start immediately T_WAIT_BUS_SLEEP timer, after that time the Prepare Bus Sleep Mode shall be left and the Bus Sleep Mode shall be entered.

At successful reception of a NM PDU in the Prepare Bus Sleep Mode, the NM Module shall enter the Network Mode; by default the NM Module shall enter the Repeat Message State.

When the network is requested in the Prepare Bus Sleep Mode, the NM module shall immediately enter the Network Mode; by default the NM Module shall enter the Repeat Message State.

3.2.3 Network Mode

The Network Mode shall consist of three internal states:

- Repeat Message State
- Normal Operation State
- Ready Sleep State

When the Network Mode is entered from Bus Sleep Mode or Prepare Bus Sleep Mode, by default, the NM module shall enter the Repeat Message State.

When the Network Mode is entered, the NM module shall start the T_NM_TIMEOUT timer.

At successful reception or transmission of a NM PDU in the Network Mode, the NM module shall restart the T_NM_TIMEOUT timer.

The NM module shall reset the T_NM_TIMEOUT timer every time it is started or restarted.

When the sleeping ECU was waked up by local conditions or received NM PDU, ECU will enter Network Mode, by default the NM Module shall enter the Repeat Message State, and start sending the first NM PDU. This process should be complete within T_WakeUp. this can be illustrated by Figure 3. *After the ECU is waked up it should first send NM messages, then send application messages. The application communication should start independently from NM states.*

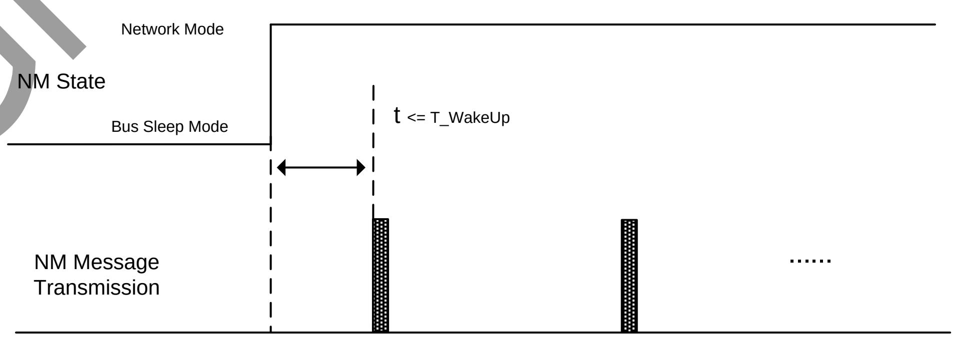

Figure 3 Wake Up time definition

3.2.3.1 Repeat Message State

RS-NM-3 The Repeat Message State requirement

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

When the Repeat Message State is entered from Bus Sleep Mode, Prepare Bus Sleep Mode, Normal Operation State or Ready Sleep State, the NM module shall (re-)start transmission of NM PDUs.

When the T_NM_TIMEOUT timer expires in the Repeat Message State, the NM module shall (re-)start the T_NM_TIMEOUT timer.

The network management state machine shall stay in the Repeat Message State for the amount of time determined by the T_REPEAT_MESSAGE; after that time the NM module shall leave the Repeat Message State.

When Repeat Message State is left and if the network has been requested, the NM module shall enter the Normal Operation State.

When Repeat Message State is left and if the network has been released, the NM module shall enter the Ready Sleep State.

When Repeat Message State is left, the NM module shall clear the Repeat Message Bit.

The immediate transmission mechanism is used for nodes which want to immediately wake up the bus or restore communication as fast as possible.

If the Repeat Message State is entered via Network Request (local conditions) or Repeat Message Request (local conditions), the NM message shall be sent by T_NM_ImmediateCycleTime, this can be illustrated by Figure 4.

The number of immediate NM PDUs transmitted is defined as N_ImmediateNM_TIMES. After all immediate NM PDUs have been transmitted, the NM shall start transmission using the cycle time T_NM_MessageCycle.

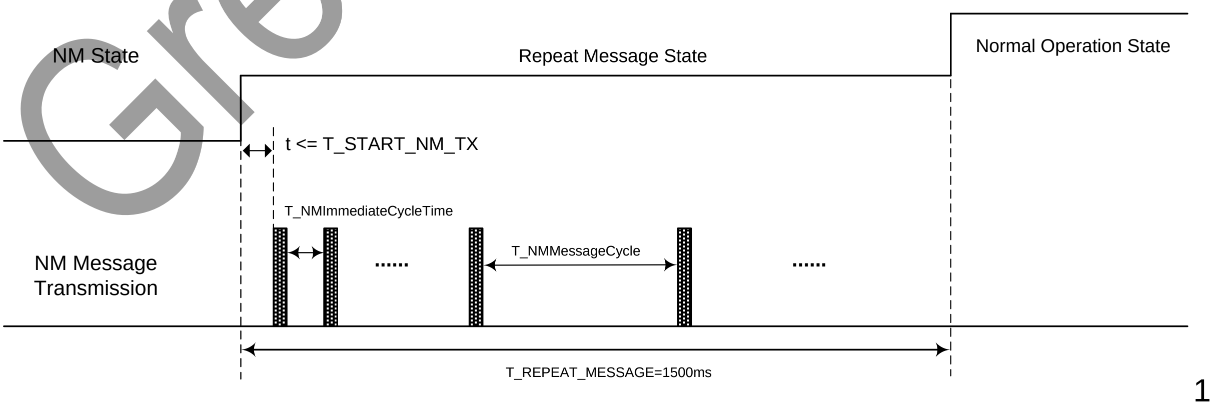

Figure 4 NM immediate message cycle definitions

If the Repeat Message State is entered via successfully received NM PDUs (in Bus Sleep Mode or Prepare Bus Sleep Mode) or received NM PDUs with Repeat Message Request Bit set to one(in Normal Operation State or Ready Sleep State), the NM message shall be sent by T_NM_MessageCycle, this can be illustrated by Figure 5.

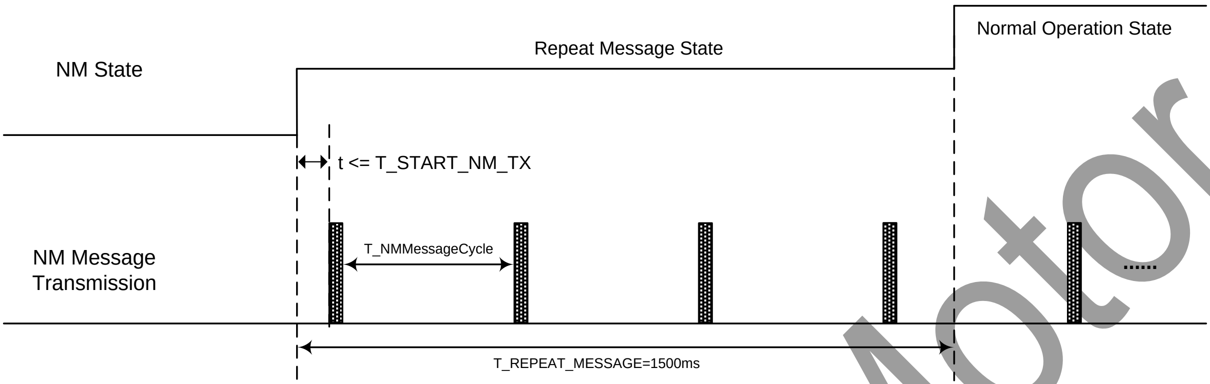

Figure 5 NM message cycle definition

When the Repeat Message State is entered from Prepare Bus Sleep Mode, Normal Operation State or Ready Sleep State, the first NM PDUs should be transmitted within T_START_NM_TX.

T_REPEAT_MESSAGE is a minimum amount of time during which other nodes on CAN bus can be waked up by receiving NM frame. After this timer elapses, node will transit to Normal Operation State or Ready Sleep State.

CAN application frame should be sent within the T_START_App_TX in this state after the first NM frame was successfully sent. It can be illustrated by Figure 6.

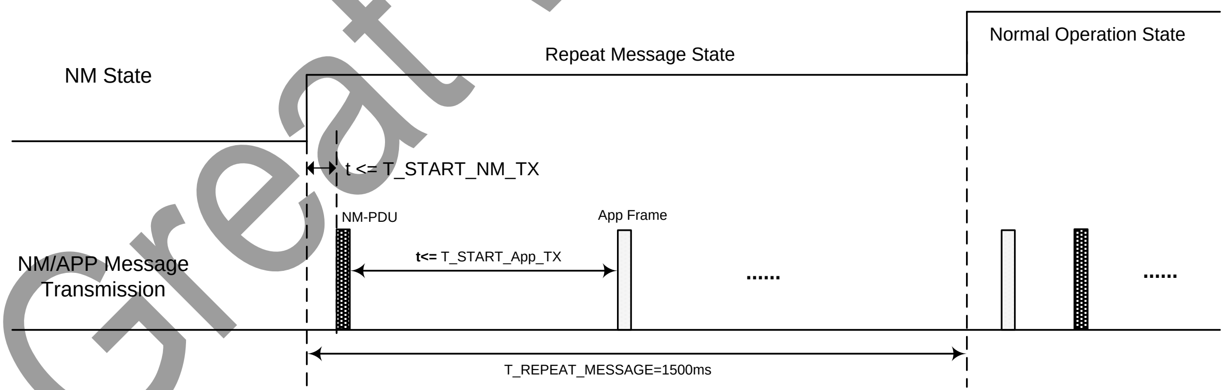

Figure 6 T_START_App_TX definition

3.2.3.2 Normal Operation State

RS-NM-4 The Normal Operation State Requirements

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

When the Normal Operation State is entered from Repeat Message State or Ready Sleep State, the NM module shall start transmission of NM PDUs with T_NM_MessageCycle period.

When the T_NM_TIMEOUT timer expires in the Normal Operation State, the NM module shall (re-)start the T_NM_TIMEOUT timer.

When the network is released and the current state is Normal Operation State, the NM module shall enter the Ready Sleep State.

At Repeat Message Request Bit Indication in the Normal Operation State, the NM module shall enter the Repeat Message State.

At Repeat Message Request in the Normal Operation State, the NM module shall enter the Repeat Message State. The NM module shall set the Repeat Message Bit and start the immediate mechanism.

3.2.3.3 Ready Sleep State

RS-NM-5 The Ready Sleep State requirement

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

When the Ready Sleep State is entered from Repeat Message State or Normal Operation State, the NM module shall stop transmission of NM PDUs.

When the T_NM_TIMEOUT timer expires in the Ready Sleep State, the NM module shall enter the Prepare Bus Sleep Mode.

When the network is requested and the current state is the Ready Sleep State, the NM module shall enter Normal Operation State.

At Repeat Message Request Bit Indication in the Ready Sleep State, the NM module shall enter the Repeat Message State.

At Repeat Message Request in the Ready Sleep State, the NM module shall enter the Repeat Message State. The NM module shall set the Repeat Message Bit and start the immediate mechanism.

3.3 NM Timing Control Parameter

RS-NM-6 NM time control parameters requirement

NM time control parameters are defined as in Table 2.

Table 2 CAN NM Control Timing Design

Timer name	Min	Typical	Max	Description
T_REPEAT_MESSAGE	1350ms	1500ms	1650ms	It defines the time how long the NM shall stay in the Repeat Message State.

T_NM_TIMEOUT	1800ms	2000ms	2200ms	As long as the node enter the network mode and start this timer. When the timer is expired, the node will enter the Prepare Bus Sleep Mode.
T_WAIT_BUS_SLEEP	4500ms	5000ms	5500ms	The timer is to ensure that all nodes have time to stop their network activity.
T_START_NM_TX	0ms	-	50ms	The time describes all sent NM message behaviour that the NM node enters network mode from Prepare Bus Sleep Mode, Normal Operation State or Ready Sleep State and start to transmit the first NM PDU. This time may be zero millisecond, one millisecond, two milliseconds and so on, but 50 milliseconds is maximum time.
T_START_App_TX	-	-	20ms	The maximum interval time starts sending application message after send the first NM-PDU successfully.
T_NM_ImmediateCycleTime	18ms	20ms	22ms	In generally, network request of node should be trigger the immediate transmission mechanism and NM-PDU will be transmitted with this periodic in Repeat Message State.
T_NM_MessageCycle	450ms	500ms	550ms	The interval time is every two NM frames which are transmitted in Network Mode except Ready Sleep State.
T_WakeUp	-	-	100ms	The value is max time that the node from the Bus Sleep Mode to Repeat Message State and send the first NM PDU.
N_ImmediateNM_TIMES	-	5	-	The number of NM PDUs transmitted with the cycle time T_NM_ImmediateCycleTime in Repeat Message Mode.

3.4 Network Management PDU

CAN Identifier range from 0x500 ~ 0x57F, are used for ECU network management control frames as shown in Table 3.

Table 3 NM Control Frame CAN ID Design

Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
NM Control Frame Base Address			ECU Address							

Formula: NM Message ID = NM Control Frame Base Address + ECU Address.

All participants of network management ECU shall follow this formula to monitor the all NM message IDs within this range, and do the right actions, in order to develop a network management platform of GWM.

NM Control Frame Base Address is 0x500, and ECU addresses should be confirmed with GWM. For more details refer to the related C-Matrix.

3.4.1 NM PDU Format

The table 4 below shows the format of the Network Management PDU. And the Network Management message should adopt classic CAN format.

Table 4 NM PDU Format

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte7	User data 5							
Byte6	User data 4							
Byte5	User data 3							
Byte4	User data 2							
Byte3	User data 1							
Byte2	User data 0							
Byte1	Control Bit Vector							
Byte0	Source Node Identifier							

3.4.2 Source Node Identifier

Every node shall be assigned an unique identifier (ECU Address), and this identifier is allocated at Byte0 of NM PDU.

3.4.3 Control Bit Vector

The table 5 below describes the format of the Control Bit Vector.

Table 5 Control Bit Vector

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte1	Reserved	Reserved	Reserved	Active Wakeup Bit	Reserved	Reserved	Reserved	Repeat Message Request

The Control Bit Vector shall consist of

Bit 0: Repeat Message Request

0: Repeat Message State not requested

1: Repeat Message State requested

Bit 4 Active Wakeup Bit

0: Node has not woken up the network (passive wakeup)

1: Node has woken up the network (active Wakeup)

The Default value of Repeat Message Request is zero. When entering Repeat Message State from Normal Operation State and Ready Sleep State because of Repeat Message Request, the Repeat Message Request Bit is set to one until re-enter the Normal Operation State and Ready Sleep State.

When entering the Repeat Message State from Bus Sleep State or Prepare Bus Sleep State because of Network Request (local wake up conditions), the NM module should set Active Wakeup Bit to one until re-enter the Prepare Bus Sleep State.

When entering the Repeat Message State because of received NM PDU, the NM module should set Active Wakeup Bit to zero.

3.4.4 User Data

The table 6 below describes User data in NM PDU, which are reserved to transmit information for users and could be read and written by application. Other user data are not used and shall be set to 0x00.

Table 6 User date

Byte	Start Bit	Bit length	Value	Denotation
2	RMS Flag			
	0	1	0 1	In Repeat Message State Not in Repeat Message State
3	Wake-up reason			
	0	1	0 1	Default value Terminal 15 on
	1	1	0 1	Default value CAN wake-up
	2	1	0 1	Default value Local wake-up reason

	3	5	0	Reserved
4	Stay awake reason			
	0	1	0 1	Default value Local wake-up reason
	1	1	0 1	Default value Terminal 15 on
	2	6	0	Reserved
5	System information			
	0	1	0 1	Default value Under voltage detected (Diagnostic voltage)
	1	1	0 1	Default value Over voltage detected (Diagnostic voltage)
	2	6	0	Reserved
6-7	NM - Data Byte “Reserve 1”			
	0	8	0	Reserved

3.5 Bus Off Handling

RS-NM-6 The Bus Off Handling Requirements

The bus off mode includes the following time periods, shown in figure 7.

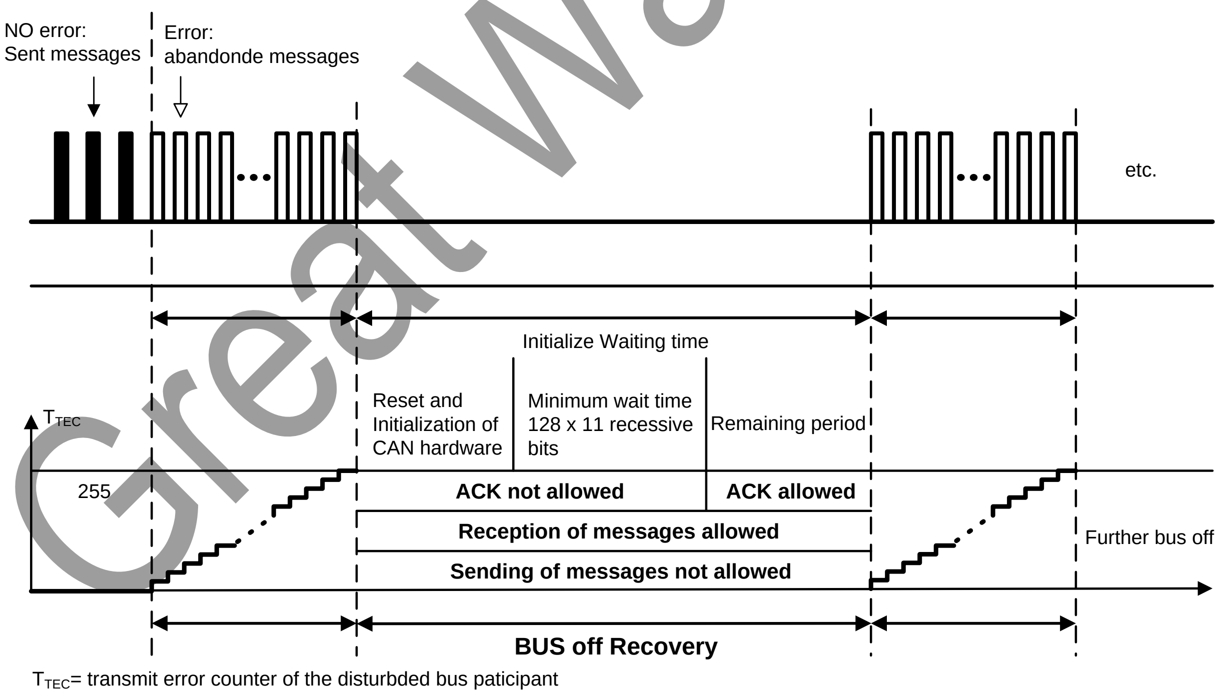

Figure 7 CAN BUS OFF Behavior Strategy

When an ECU enters bus off mode, it should execute the quick recovery strategy firstly.

<u>Quick recovery mode</u>

- Re-initialize the CAN protocol chip immediately after entering bus off.

- The sending of messages should pause until $T_{BusOffQuick}$ is expired (Reception can be active; acknowledgement is allowed after 128 x 11 recessive bit according to ISO11898-1) .
- Resume to normal CAN communication.
  Quick recovery should be executed **consecutively** for 5 times. If the error still persists, the ECU should switch to slow recovery mode.

Slow recovery mode

- Re-initialize the CAN protocol chip immediately after entering bus off.
- The sending of messages should pause until $T_{BusOffSlow}$ is expired (Reception can be active; acknowledgement is allowed after 128 x 11 recessive bit according to ISO11898-1).
- Resume to normal CAN communication.

*Note: If the network, whose speed is **not** more than 125Kbps, adopts the NM specification, it should **only** do the slow recovery.*

Table 7 Time Parameters of Network Bus Off

Time	Typical[ms]
$T_{BusOffQuick}$	100±10
$T_{BusOffSlow}$	1000±100

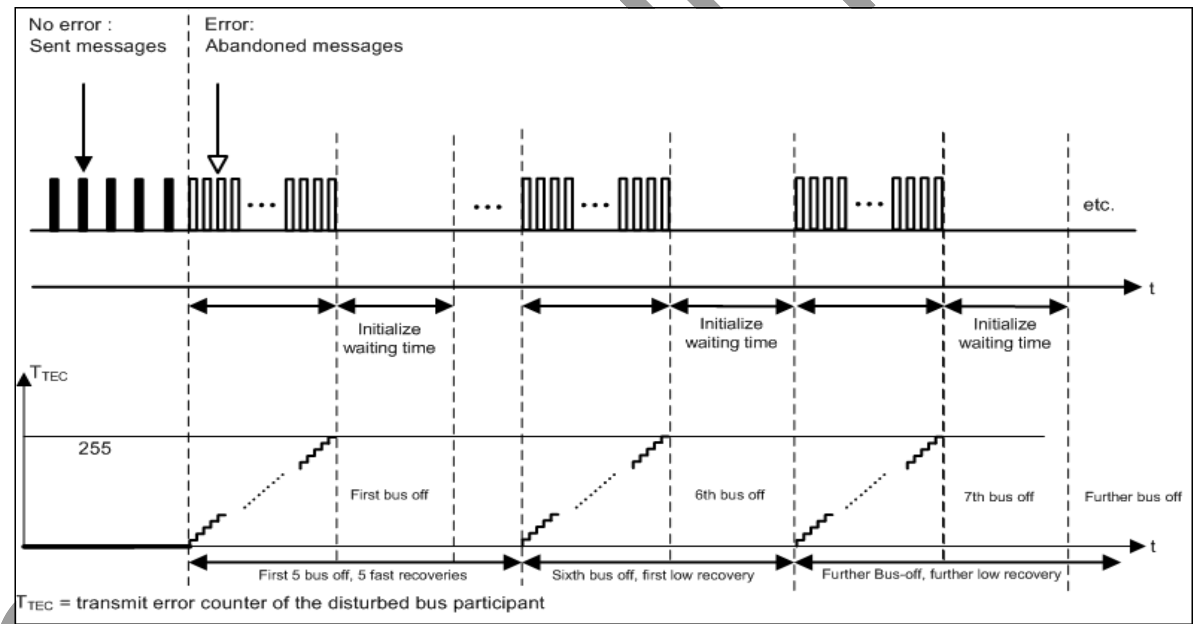

Figure 8 CAN BUS OFF and Recovery Behavior

Note1: *The process of Quick recovery mode and slow recovery mode are mandatory. All periodic and mixed messages should be transmitted once as the order of message priorities as quickly as possible after the ECU leaves bus off mode. So when the ECU enters bus off mode again the quick recovery should be executed.*

Note2: *In bus off mode the network management status shall not be effected. And when the $T_{BusOffQuick}$ or $T_{BusOffSlow}$ have expired , whether ECU sends NM message or not is only depending on whether it is ready to sleep.*

Note3: *if after Three times of quick-recovery it still can not recovery. confirm bus off DTC when the 4th time get into bus off.*

3.6 The Behavior of Missing ACK

RS-NM-7 The Behavior of Missing ACK Requirements

After detection of missing ACK from other ECUs the transmit error counter should be increased.

If the transmitter is error passive and detects an ACK error because of not detecting a dominant ACK and does not detect a dominant bit while sending its passive error flag, the error counter should not be increased (according to ISO11898-1).So if during system start-up only one node is online and if this node transmits some frames, it becomes error-passive but not bus off (according to ISO11898-1).

In the case of detection of missing ACK from other ECUs, firstly the ECU has to continuously repeat the transmitting immediately after last transmitting until $T_{Timeout}$ expires, then the controller should be reinitialized and the transmission should be waited for $T_{Recovery}$. The period of $T_{Timeout}$ is called as sending process, and the period of $T_{Recovery}$ is named as waiting phase. During the missing ACK, the ECU should switch between the sending process and waiting phase in turn. The timing parameters are defined in table8 and the behavior of missing ACK is shown in figure9.

After re-initialization of the CAN driver the ECU should immediately get ready to receive and acknowledge messages.

Table 8 Transmitter Parameters of Timeout and Recovery

Time	Typical[ms]
$T_{Timeout}$	150±10
$T_{Recovery}$	150±10

During the missing ACK, the following behavior is required.

- The ECU should be ready for receiving message during the waiting phase.
- The ECU does not enter bus off state.
- The timeout monitoring should not be influenced due to a missing ACK.
- The behavior of missing ACK could be executed only if the CAN related diagnosis is active.

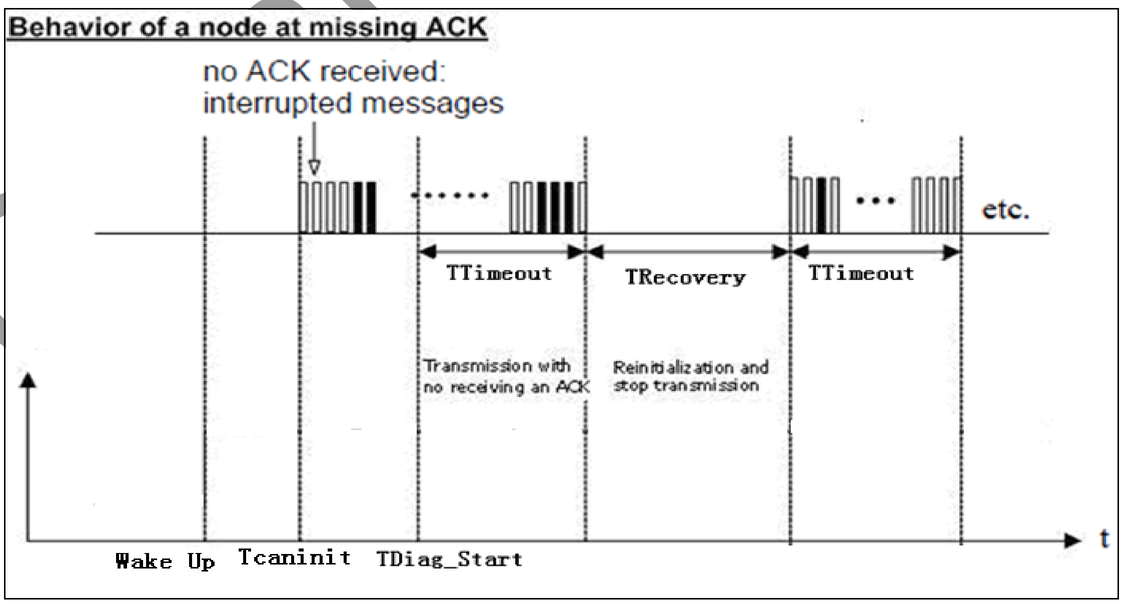

Figure 9 Behavior of Missing ACK

3.7 Node Monitoring

RS-NM-8 Node Monitoring

ECU should monitor all cycle and mixed messages received to detect the presence of **partner ECU** in the network. A message timeout occurs if the cycle or mixed message of the partner ECU is missing for a certain period. Recommended monitoring period for the detection of a message timeout is shown in table 9.

Table 9 Time Parameter TTimeout

Time	Desired time	Maximum time
$T_{Timeout}$	10 cycles	5s

Note1: *A node missing DTC occurs if any message sent by this node is timeout.*

A global timeout DTC occurs if all nodes are missing, which is used for gateway. .

Note2: *When the ECU enters the bus off state, it should prevent the node monitoring. Once the ECU successes recovering from the bus off state, it should begin monitoring the node again.*

Note3: *If the node A needs the signal from node B, then node B is the partner ECU of the node A.*

Note4: *If a node monitor the message which need to be signal routed by gatway is timeout, The node shall set the DTC of miss gatway.*

Note5: *When power mode is OFF or ACC, The node shall enable/disable node missing DTC record. according to its own function activation/inactivation. (e.g . Node A need receive message from Node B to enable certain functions in power mode ON, So Node A shall enable the DTC of miss node B record. while node A shall not recode the DTC of miss node B in OFF or ACC state, Because the function of Node A is invalid.)*

Note6:*the condition Type_C ECU monitor Type_A ECU and Type_B ECU message ：The power mode ON,voltage is in voltage range of the network related diagnostic and TDiagStart expired .*

4 The Voltage Range of the Communication and Diagnosis

4.1 Operation Voltage Range

RS-NM-9 CAN Communication Voltage Range

The CAN communication should be ensured in the following operation voltage ranges, as shown in table10.

Table 10 Network Communication Voltage Range

Description	U_{CAN_Min}[V]	U_{CAN_Max}[V]
Communication voltage range	7±0.3	18±0.3

Note: *Due to the special function, the ECU may keep the communication out the above communication voltage range, this is permitted.*

4.2 Network Diagnostic Conditions

RS-NM-10 Network Diagnostic Voltage Range

The network related diagnosis should be ensured in the following voltage range, as shown in table11 and table12.

Table 11 Network Diagnostic Voltage Range

Description	Min[V]	Max[V]
Diagnostic voltage range	9±0.3	16±0.3

All network related diagnosis should be active or inactive with the following conditions.

Table 12 Network related Diagnosis Active or Inactive

Network related diagnosis	Condition	Remark
Active	Type_C ECU: Wake up, The power supply voltage is in voltage range of the network related diagnostic and $T_{DiagStart}$ expired .	All ECUs should start network related diagnosis
Inactive	Type_C ECU : Transition to Wait Bus Sleep or in the case of under voltage or over voltage.	All ECUs should stop network related diagnosis immediately

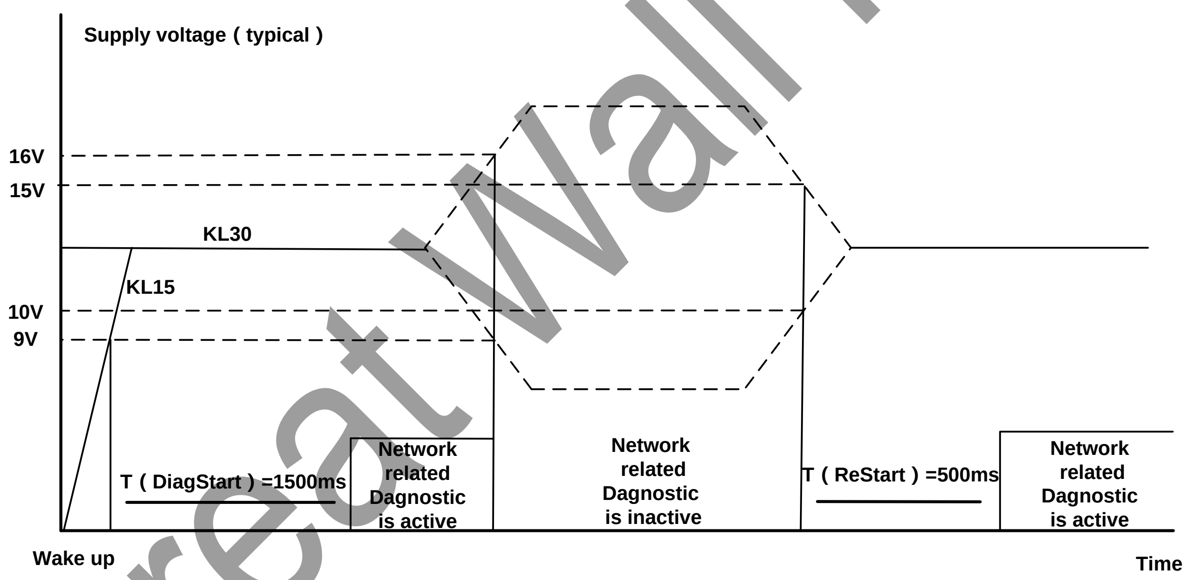

Figure 10 Network Related Diagnosis Active or Inactive

RS-NM-11 Network Diagnostic Time Parameters

The related time parameters are shown in table13. They define the diagnostic start and re-start requirements.

Table 13 Network Diagnostic Time Parameters

Time	Typical[ms]
$T_{DiagStart}$	1500± 100
$T_{Restart}$	500 ± 50

4.3 Over Voltage or Under Voltage

RS-NM-12　Over Voltage under Voltage Behavior

When the ECU detects over voltage or under voltage, it should obey the following requirements, as shown in figure11 and table14.

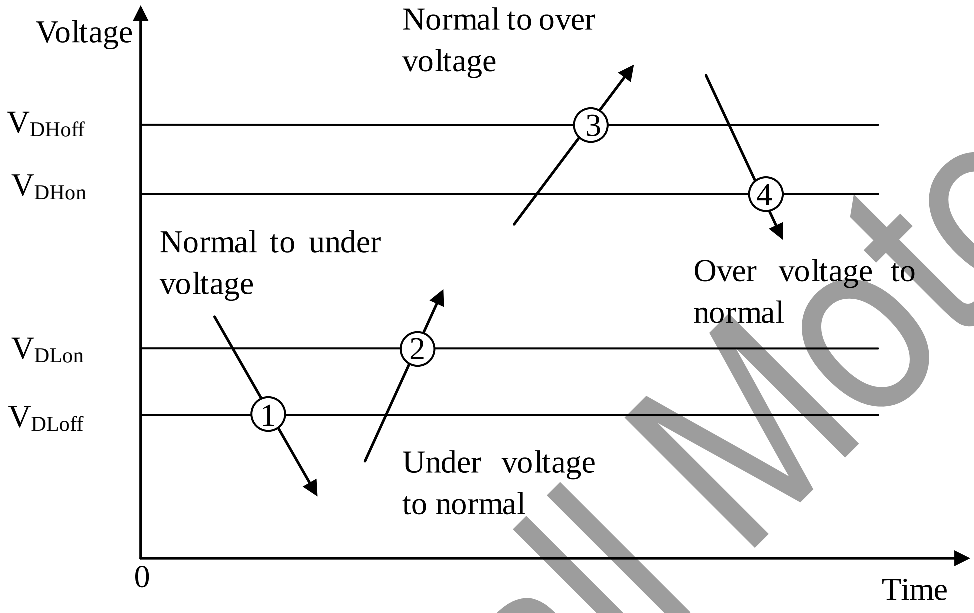

Figure 11　Network related Diagnosis Voltage Range

Table 14　Network Diagnostic Voltage Range

Voltage value name	Typical[V]
V_{DLon}	10±0.3
V_{DLoff}	9±0.3
V_{DHon}	15±0.3
V_{DHoff}	16±0.3

<u>Transition – normal to under voltage</u>

When battery voltage is showing decreasing trend (e.g. the voltage gradient dV/dt is negative) and voltage comes to the operating point①, all ECUs should stop the network related diagnosis immediately.

<u>Transition – under voltage to normal</u>

When battery voltage comes to the operating point② from the low battery voltage （precondition is the power supply voltage should within the range of the ECU able to work）, all ECUs should start the under voltage recovery timer. After this timer crosses $T_{Restart}$, all ECUs should start the network related diagnosis. The timer should be reset when the voltage falls below V_{DLoff}.

Note：when the battery voltage is rising from under voltage to normal, before the voltage rise to V[DLon], under voltage DTC should be stored.

<u>Transition – normal to over voltage</u>

When battery voltage is showing increasing trend (the voltage gradient dV/dt is positive) and voltage comes to the operating point ③, all ECUs should stop the network related diagnosis immediately.

<u>Transition – over voltage to normal</u>

When battery voltage comes to the operating point ④, all ECUs should start the over voltage recovery timer. After this timer crosses $T_{Restart}$, all ECUs should start the network related diagnosis. The timer should be reset when the voltage goes above V_{DHoff}.

Note：when the battery voltage is decreasing from over voltage to normal, before the voltage decrease to V[DHon], over voltage DTC should be stored.

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Version	Author	Date	Revised Description	Document maturity (draft/ release)
1.0	Li sijia	2017.2.28	First Issue	release