CAN Project

Network Management Specification

网络管理规范

2012-04-24

CAN Project

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1.介绍

1.1. Confidentiality

1.1 机密

The information in this specification is in strict confidence and should only be divulged to component engineer and nominated ECU supplier.

此规范信息须严格保密，只释放给零部件工程师和 ECU 供应商候选人。

1.2. Purpose of this document

1.2 文档目的

This document describes generic network management requirements that apply to CAN-interfaced ECU (further on called node) for use on HAIMA vehicle program. It should be used with the referenced generic specifications and program specific documents.

该文档描述了一般高速 CAN 的网络管理层要求。在海马汽车项目中，这些要求应用于 CAN 接口 ECU（即节点）。它须与引用文件和项目特定文档一起使用。

The contents give a consistent, single-source of information to component engineer suppliers.

这份文档给零部件供应商工程师提供了一致且唯一的信息源。

1.3. Scope

1.3 范围

CAN Project

This specification applies to each node on Middle speed CAN of the HAIMA B11 program, and all earlier relevant specifications are superseded and invalid. Deviations from any part of this specification or those specifications referenced herein must be agreed with the responsible HAIMA network engineer and node engineer, and confirmed in program specific specification.
这份规范将应用于海马 B11 项目的各个节点，且所有早期的相关规范会被取代并变为无效。这份规范或者此中涉及到的规范的任何一部分的偏差必须得到海马网络工程师和节点工程师的认可，并且记录在项目特定文档中。

2. Network Management Introduction

2. 网络管理介绍

2.1. NM tasks

2.1 网络管理任务

The general tasks of the network management are as following:
网络管理的基本任务如下所示：

- **Start up and shut down of the network communication**

  All the ECU nodes on the CAN network can be synchronized for communication.

  开启和关闭网络通信

  CAN 网络上的所有节点均可同步通信。

- **Handling communication failures,**

  Eg. Bus off error detection and recovery

  处理通信故障

  例如，Bus off 错误的检测与恢复。

- **Appointment of the network configuration**

  In the start phase the NM build up a logical token ring.

  指定网络配置

  在起始阶段，NM 建立一个逻辑令牌环

- **Inspection of the network configuration**

  The appearance of new ECUs is recognized and a new token will be build up.

检查网络配置

NM 将检测出新加入的节点 ECU，并建立一个新的令牌。

Attention, The Network Management described here does not address the following issues since normally they are node specific (Following the detail ECU node SPEC for more information):
注意，这里描述的网络管理并未涉及以下的问题，因为以下问题是对节点的要求:

- **Power management**

  How the control units are power supplied.

  电源管理

  如何为控制单元提供电源

- **Node Management**

  When to set the processor into sleep mode or low power mode.

节点管理

什么时候让处理器进入睡眠模式或低耗模式

- **The CAN transceivers**

  The application should enable the CAN transceivers at start-up and might set them into standby mode if sleep mode is entered in network management.

CAN 收发器

应用程序能使 CAN 收发器保持在启动状态或者使 NM 睡眠模式下的收发器进入待机模式。

2.2. NM Standard

2.2 NM 标准

The NM based on the OSEK/VDX Direct Network Management Specification Version 2.5.3 is adopted as the Network management strategy on the middle speed CAN network of B11 project.
在 B11 项目的中速 CAN 网络中，基于 OSEK/VDX 直接网络管理规范 2.5.3 版本的 NM 被用作网络管理策略。

2.3. OSEK Direct NM

2.3 OSEK 直接 NM
The OSEK Direct NM is a token based strategy for the communication, besides the normal application messages, A special NM message is defined for each node to pass the network information and control the transmission and reception of the application messages.
OSEK 直接 NM 是通讯基础策略的标志，除了正常的通讯信息，它定义了一个特殊的网络管理信息，控制每个节点网络信息的传递和应用报文的收发。

If a node needs the network and want to join the communication, it sends an “Alive” message to indicate the other nodes of its existing.
如果某个节点需要网络，并且参与通讯，它将发送一个“Alive(激活)”报文告知其它节点它的存在。

The “Alived” ECUs will build up a logical ring to achieve a network-wide synchronization of all the ECU nodes that take part in the communication.
激活的节点将建立一个逻辑环以实现所有节点网络范围的同步，并参与通讯。

When a ECU does not need the network it sends out “Sleep Indication” to inform the other nodes that it want to off the line, only after all the ECUs set the “Sleep Indication”, A “Sleep Acknowledge” will be sent out to confirm all the ECU to enter the sleep mode.
如果一个 ECU 不需要网络的支持，它将发出“Sleep Indication（睡眠标志）”通知别的节点它将要下线。只有所有的节点设置了“Sleep Indication”，一个“Sleep Acknowledge(睡眠应答)”才会被发出确认所有的节点进入睡眠模式。

In the logical ring the communication sequence is defined independently from the network structure. Each node is assigned a logical successor. The logically first node is the successor of the logically last node in the ring.
在逻辑环中，通讯顺序独立于网络架构单独定义。每个节点都被分配一个逻辑后继者。在逻辑环中，逻辑的第一个节点是逻辑最后一个节点的后继者。

Each node has a unique address which is known in the network and the source address and destination address are explicitly included in the NM message. All NM messages are broadcast.
每个节点都有在网络中通用的唯一地址，在 NM 报文中，明确标示了源地址和目标地址。所有 NM 报文都是广播式发送。

Figure 2.1 gives a simple example of OSEK Direct NM logical ring.
图 2.1 给出了一个 OSEK 直接网络管理逻辑环的简单例子。

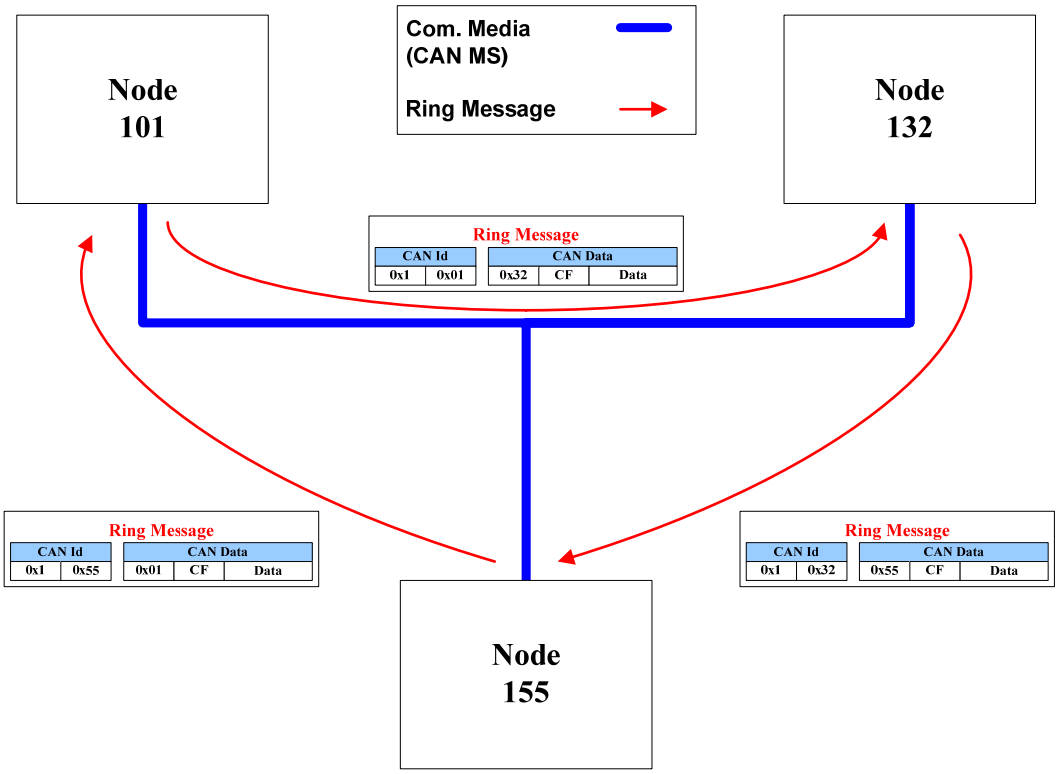

Figure2.1 OSEK Direct NM Logical Ring
图 2.1 OSEK 直接网络管理逻辑环

2.4. OSEK NM message

2.4 OSEK NM 报文
Each NM Message (called NMPDU) has the same layout as bellow, it is combined by the CAN ID and CAN Data (8 bytes fixed).

CAN Id		项	CAN Data							
0x1	SA		DA	CF	Data	Data	Data	Data	Data	Data

Table2.1 NM Message

每个 NM 报文（即 NMPDU 协议数据单元）都有如下图所示的相同格式，它由 CAN ID 和 CAN Data（8 字节）组成。

CAN Id (11 bit)

- **0x1** - short for the base address 0x100 (All the NM Message should has the same based address)、
- **0x1** - 基地址 0x100 的缩写（所有的 NM 报文需有相同的基地址）
- **SA** - Source Address (0x00 – 0x7F)
- **SA** - 源地址（0x00 – 0x7F）

CAN Data

CAN 数据

- **DA** - Destination Address (0x00 – 0x7F)
- **DA** - 目标地址（0x00 – 0x7F）
- **CF** - Control Field, each bit contains information of the ECU status.
- **CF** - 控制域，每一位都包含着 ECU 状态信息
- **Data** -Optional data bytes for data exchange
- **Data** - 用于数据交换的数据字节

The most significant bit in the SA and DA is always zero. So the available range for CAN identifiers used by the NM Messages should between 0x500 to 0x57F.
SA 和 DA 的最重要位往往是零。因此，NM 报文 ID 范围可以是从 0x500 到 0x57F。

The number of data bytes in the NMPDU shall be configurable always as six bytes. (padded with 0x00 if not used). Only during the time delay between the reception and the transmission of the ring message the application is able to modify the data.
数据字节的数量在在 NMPDU 中一般为 6 字节（不用的字节用 0x00 来填充）。只有在逻辑环报文接收和发送延时中，应用程序才可以修改数据。

The second data byte contains the NM control field (CF), this Control Field present the ECU status according to the table below. (Bit 0 is the least significant bit in the byte.)
第二个数据字节包含 NM 的控制域（CF），这个控制域根据以下表格标示了当前 ECU 的状态。（第 0 位是字节中最低有效位。）

Bit Number	Description	Coding
0	**Alive 激活**	0: node does not need to send alive message. 0：节点不需要发送激活报文 1: node alive in NM point of view 1：节点在 NM 中是激活状态
1	**Ring 环**	0: ring not stable 0：环不稳定 1: ring stable 1：环稳定
2	**Limp Home 跛行回家**	0: not in limp home 0：不在跛行回家模式 1: limp home 1：在跛行回家模式
3	**Reserved 预留**	
4	**Bus Sleep Indication 网络睡眠状态**	0: bus is still needed 0：需要网络工作 1: bus sleep requested 1：网络睡眠请求
5	**Bus Sleep Acknowledge 网络睡眠应答**	0: network is alive 0：网络激活状态 1: network sleeps 1：网络睡眠
6	**Reserved 预留**	
7	**Reserved 预留**	

Table2.2 NM Control Field

表 2.2 NM 控制域

Note:

1. Only one of the bits Alive, Ring and Limp Home can be set at the same time.

1. Alive,Ring 和 Limp Home 这三位中，只能同时设置一个位。

2. If Bus Sleep Acknowledge is set, Bus Sleep Indication shall also be set. Bus Sleep Indication can be set without that Bus Sleep Acknowledge is set.

如果设置了 Bus Sleep Acknowledge 位，Bus Sleep Indication 位也可以被设置。但 Bus Sleep Acknowledge 位未被设置时，Bus Sleep Indication 位也可被设置。

3. The reserved bits shall be initialized to zero and copied into the transmitted NM message.

预留位应初始化为 0 并复制到 NM 报文中。

4. When Node is woken up by the local event or traffics on the bus. The application frame transition could only be started 100ms after the transmit request of first Alive Message be made.

当节点被本地或网络事件唤醒时，应用报文需要在第一个 Alive 报文请求发送 100ms 后才允许发送。

3. Network Management State

3.1. NM state

The detail of OSEK NM state is described in the OSEK NM specification as showed in figure 3.1:

OSEK NM 状态在 OSEK NM 规范中有详细的描述，如图 3.1 所示：

The supplier should read the OSEK NM SPEC to find the general rules for how to implement the OSEK NM states and the transitions in the ECUs.

供应商需阅读 OSEK NM SPEC，以找到如何在 ECU 中实现 OSEK 状态和转变的通用规则。

For each node, wake up source is defined by function owner/ architecture system, the detailed information refer to relevant architecture document.

对于每一个节点，唤醒源由功能或系统定义，具体细节见相关的结构文档。

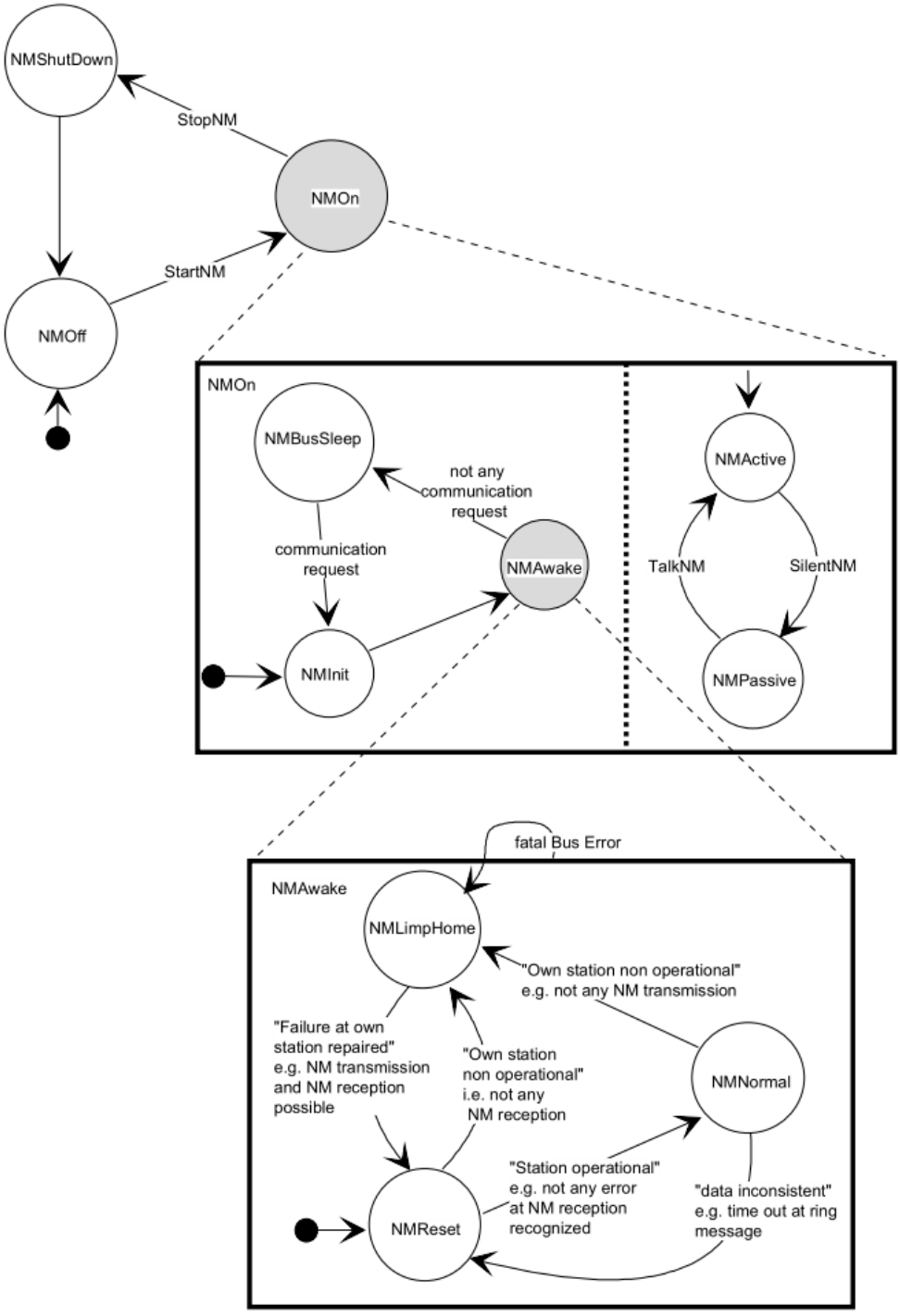

Figure 3.1 NM state in OSEK2.5.3

For each ECU, the message transmission and reception in the different states shall be as following :

对于每个 ECU，在不同状态下报文的接收与发送需如下所示：

ECU NM State ECU NM 状态	Reception 接收	Transmission 发送	Comment 注释
NMOff	Disable 失效	Disable 失效	CAN-controller(s) not initialized. CAN 控制器未初始化
NMReset	Enabled 激活	Enabled 激活	
NMNormal	Enabled 激活	Enabled 激活	
NMLimpHome	Enabled 激活	Enabled 激活	
NMBusSleep	Enabled 激活	Disabled 失效	CAN-controller(s) in sleep mode CAN 控制器处于睡眠模式
NMWaitBusSleepNormal	Enabled 激活	Disabled 失效	Waiting TWaitBusSleep ms before going to NMBusSleep
NMWaitBusSleepLimpHome	Enabled 激活	Disabled 失效	Waiting TWaitBusSleep ms before going to NMBusSleep
NMActive	/	/	NM messages Transmission enable NM 报文发送激活
NMPassive	/	/	NM messages Transmission disable NM 报文发送失效

Table3.1 Message Transmission and Reception in each NM state

表 3.1 不同 NM 状态下的报文发送与接收

Due to the difference of the ECU Hardware and software platform of the supplier, It can be acceptable that the suppliers do little optimization based on the OSEK NM for better performance. Eg, merge the NMinit into NMreset or merge the NMshutdown into NMoff. But for the functions in NMon, normally should be compatible with the standard. Any other function deviation against this SPEC, should be informed to HAIMA and get approval.
由于供应商的软硬件平台各不相同，所以在 OSEK NM 基础上，供应商可以做一些优化设计。例如，将 NMinit 合并到 NMreset 中，将 NMshutdown 合并到 NMoff 中。但是对于 NMon 的功能，一般应与标准一致。任何与此规范相违背的功能，必须告知海马并取得认可。

3.2. NM state machine 网络管理状态机

Figure 3.2 give detail description of the OSEK direct NM state machine which the supplier should implemented together with OSEK2.5.3.
图 3.2 给出了 OSEK 直接网络管理的状态机，供应商应结合 OSEK2.5.3 规范进行实现。

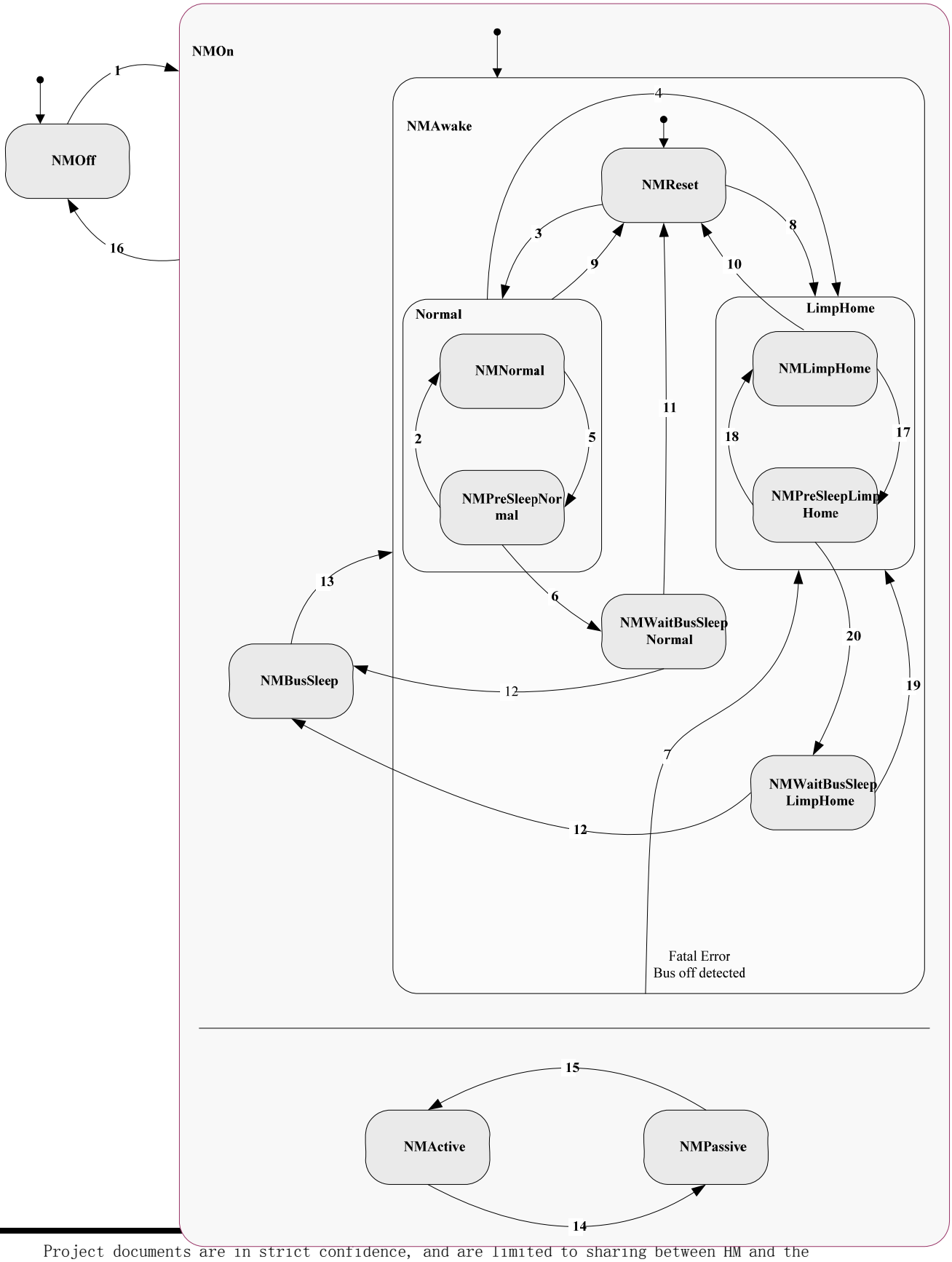

Figure 3.2 NM state machine

3.3. NM State transitions 网络管理状态转移说明

In this chapter, each state transition is described based on figure 3.2, The transition criteria are the conditions that have to be satisfied inorder to make the transition. The time to process the state machine should be normally as 10ms.
本节具体描述了图 3.2 中给出的各个状态的转移条件。只有当转移条件满足的情况下才能切换状态。网络管理状态机的处理时间一般为 10ms。

3.3.1. Transition 1

Transition criteria: Application calls StartNM()
Note: The application should enable the CAN-transceiver and also initialize the CAN-controller(s) and prepare for communication. Thistransition shall not be made if the initialization of a CAN-controller fails.
转换条件：应用程序调用 StartNM(),
注释：应用程序应该使能 CAN 收发器，初始化 CAN 控制器，并做好通讯前的准备工作。如初始化失败，则此转换不应进行。

3.3.2. Transition 2

Transition criteria: The application needs the network and calls GotoMode(Awake)
转换条件：节点功能需要网络通讯，并调用 GotoMode(Awake),

3.3.3. Transition 3

Transition criteria: The actions in NMReset finished and no NM reception error (Nmrxcount <= RxLimit) and NM transmit error (Nmtxcount <= TxLimit)

转换条件：NMReset 状态中的工作结束并且接收错误及发送错误计数器未达到限值。

3.3.4. Transition 4

Transition criteria: The NM transmit eroor count has reach the limitation, eg. Nmtxcount >= TxLimit

转换条件：发送错误计数器达到限值

3.3.5. Transition 5

Transition criteria: The application does not require the network anymore and calls GotoMode(BusSleep)

转换条件：节点功能不再需要网络通讯，并调用 GotoMode(BusSleep),

3.3.6. Transition 6

Transition criteria: A Ring message with the "sleep acknowledge" bit set is received or a Ring message with the "sleep acknowledge" bit set is transmitted.

转换条件：接收到一条包含"sleep acknowledge = 1"的 Ring 报文，或者一条包含“sleep acknowledge = 1”的 Ring 报文被发出

3.3.7. Transition 7

Transition criteria: The CAN-controller(s) goes Bus Off

Note: the COM-Layer should check the Bus Off quickly enough in order not to miss any of the Bus off.

转换条件：CAN 控制器进入 Bus Off 状态

注释：节点的控制软件应该按照足够的检测速度检查 CAN 控制器是否进入 Bus Off 状态。

3.3.8. Transition 8

Transition criteria: NM reception error or NM transmit errori.e. Nmrxcount > RxLimit or Nmtxcount >= TxLimit

转换条件：接收错误超过限值或者发送错误超过限值

3.3.9. Transition 9

Transition criteria: no Ring message on the bus during the time TRingMax.

转换条件：Ring 报文接收超时

3.3.10. Transition 10

Transition criteria: No NM reception error, i.e. any NM message received

转换条件：接收到任意一条“Sleep Acknowledge = 0”的 NM 报文

3.3.11. Transition 11

Transition criteria: Application calls GotoMode(Awake) or NM message containing cleared “sleep indication” bit received

转换条件：节点功能需要网络通讯，应用程序调用 GotoMode(Awake)，或者有包含“sleep indication = 0”的网络管理报文收到。

3.3.12. Transition 12

Transition criteria: TWaitBusSleep time-out

转换条件：超过 TWaitBusSleep 限值

3.3.13. Transition 13

Transition criteria: Application calls GotoMode(Awake) or application calls StartNM() or wakeup by traffic on the bus

转换条件：应用程序调用 GotoMode(Awake)或 StartNM()， 或者被总线通讯唤醒。

3.3.14. Transition 14

Transition criteria: Application calls SilentNM()

转换条件：应用程序调用 SilentNM()

3.3.15. Transition 15

Transition criteria: Application calls TalkNM()
转换条件：应用程序调用 TalkNM()

3.3.16. Transition 16

Transition criteria: Application calls StopNM()
转换条件：应用程序调用 StopNM()

3.3.17. Transition 17

Transition criteria: The application does not require the network anymore and calls GotoMode(BusSleeep)
转换条件：节点功能不再需要网络通讯，并调用 GotoMode(BusSleep),

3.3.18. Transition 18

Transition criteria: The application needs the network and calls GotoMode(Awake)
转换条件：应用程序需要网络通讯，并且调用 GotoMode(Awake)

3.3.19. Transition 19

Transition criteria: Application calls GotoMode(Awake) or NM message with cleared “sleep indication” bit Received

转换条件：应用程序调用 GotoMode(Awake)，或者有包含“sleep indication = 0”的网络管理报文收到。

3.3.20. Transition 20

Transition criteria: NM message with the “sleep acknowledge” bit set received or no Ring message received during the time TRingMax

转换条件：接收到包含“sleep acknowledge = 1”的网络管理报文收到,或者在 TRingMax 时间内没有 Ring 报文收到。

3.4. NM Busoff strategy

When the TEC counter in the CAN controller exceed 255, the CAN controller goes to the Busoff state. In case of detecting Busoff error, the following strategy should be implement immediately when enter the NMLimpHome state:

- Disable the Application frame transmition for Terror time
- Reset the CAN controller to discard the pending frame in the Data Linker layer

For the Busoff DTC logging strategy, please refer to the Diagnostic SPEC.

当 CAN 控制器的 TEC 寄存器增加至 255 时，CAN 控制器会进入 Busoff 状态，当检测到 Busoff 时，以下操作需要在进入 NMLIMPHOME 状态时立即执行：

- 禁止应用层报文发送，时间为 Terror
- 对 CAN 控制器执行复位操作，以将数据链路层中的所有报文去除。

Busoff 故障码的处理机制请参照相应诊断规范。

3.5. NM API 网络管理接口函数

The Network Management component shall support the API described in the OSEK NM standard. For example StartNM(), StopNM(), GotoMode(),etc. Please find more information in the OSEK NM Standard 2.5.3.

供应商需采用 OSEK 网络管理标准 2.5.3 中定义的统一的 API 接口，例如：StartNM(), StopNM(), GotoMode()等。

3.6. NM parameter

This chapter describes the recommend NM parameters for each node:
这一节描述每个节点推荐的 NM 参数：

Signal 信号	Description 描述	Typical Value 典型参数	Min.Value 最小值	Max. Value 最大值
Ttyp	Typical time between two ring messages 两个 ring 报文之间的时间间隔	100 ms	80 ms	120 ms
Tmax	Maximum time between two ring messages 两个 ring 报文之间的最大时间间隔	260 ms	220 ms	300 ms
Terror	Time between two limpHome messages 两个 limpHome 报文之间的时间间隔	1000 ms	900 ms	< TWaitBusSleep
TwaitBusSleep	Time from sleep Acknowledge received until sleep mode is entered. 从睡眠请求接收到进入睡眠模式所需的时间	1500 ms (1.5xTLimpHome)		
NodeId	The NM address of the own node. When a node transmits	-	0x00	0x7f

	its NMPDU the SA field shall be set to NodeId. 节点的 NM 地址。当节点发送 NMPDU 时，SA 域须设定为 NodeId.			
RxLimit	Number of reception errors that imply transition to the Limphome state. 接收错误限值，超过此限值，进入 Limphome 状态	4		
TxLimit	Number of transmission errors that imply transition to the Limphome state (in standard OSEK state, in optimized state, no this parameter used). 发送错误限值，超过此限值，进入 Limphome 状态（OSEK 标准规定，在优化策略中，没有此参数）	8		

Table3.2 NM parameters

4. Version History

Version 版本	Create/Modify Date 创建/修改日期	Author 作者	Description 描述
1.0	2010-12-22	Kai Wu 武凯	Initial Release 首次释放
1.1	2011-07-18	陈启达	增加中文翻译
1.2	2012-03-26	陈启达	增加转换条件
1.3	2012-04-24	陈启达	删除 Busoff 及 BusoffWait 状态