OSEK/VDX

NM test plan

Version 1.0

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What is OSEK/VDX?

OSEK/VDX is a joint project of the automotive industry. It aims at an industry standard for an open-ended architecture for distributed control units in vehicles.
A real-time operating system, software interfaces and functions for communication and network management tasks are thus jointly specified.
The term OSEK means ”Offene Systeme und deren Schnittstellen für die Elektronik im Kraftfahrzeug” (Open systems and the corresponding interfaces for automotive electronics).
The term VDX means „Vehicle Distributed eXecutive“. The functionality of OSEK operating system was harmonized with VDX. For simplicity OSEK will be used instead of OSEK/VDX in the document.

OSEK partners:

Adam Opel AG, BMW AG, Daimler-Benz AG, IIIT University of Karlsruhe, Mercedes-Benz AG, Robert Bosch GmbH, Siemens AG, Volkswagen AG.
GIE.RE. PSA-Renault (Groupement d’intérêt Economique de Recherches et d’Etudes PSA-Renault).

Motivation:

- High, recurring expenses in the development and variant management of non-application related aspects of control unit software.
- Incompatibility of control units made by different manufacturers due to different interfaces and protocols.

Goal:

Support of the portability and reusability of the application software by:

- Specification of interfaces which are abstract and as application-independent as possible, in the following areas: real-time operating system, communication and network management.
- Specification of a user interface independent of hardware and network.
- Efficient design of architecture: The functionality shall be configurable and scaleable, to enable optimal adjustment of the architecture to the application in question.
- Verification of functionality and implementation of prototypes in selected pilot projects.

Advantages:

- Clear savings in costs and development time.
- Enhanced quality of the control units software of various companies.
- Standardized interfacing features for control units with different architectural designs.
- Sequenced utilization of the intelligence (existing resources) distributed in the vehicle, to enhance the performance of the overall system without requiring additional hardware.
- Provides absolute independence with regards to individual implementation, as the specification does not prescribe implementation aspects.

OSEK conformance testing

OSEK conformance testing aims at checking conformance of products to OSEK specifications. Test suites are thus specified for implementations of OSEK operating system, communication and network management.

Work around OSEK conformance testing is supported by the MODISTARC project sponsored by the Commission of European Communities. The term MODISTARC means ”Methods and tools for the validation of OSEK/VDX based DISTributed ARChitectures”.

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1. Introduction

1.1. Scope

This document specifies a test plan for services and protocols of the OSEK NM as defined in specification document [4]. It applies to conformance test suites for testing implementations which claim conformance to the OSEK NM specification.

According to the Conformance Methodology [1], definition of conformance tests is a two-stage process. This test plan document corresponds to the first step. It specifies a list of test purposes extracted from the NM specification. In the second step, test cases will be derived from the test purposes to build up the OSEK NM conformance test suite. Basically, a test case specifies the sequence of interactions between a tester and the NM implementation in order to verify a test purpose of this document. However, it is possible to have individual test cases that address multiple test purposes and likewise multiple test cases that address the same test purpose.

As OSEK NM implementations can operate either the Direct OSEK NM or the Indirect OSEK NM, the list of test purposes is divided into two parts accordingly. Inside both categories, the test purposes are organised according to a tree structure described in Chapter 2.

1.2. References

[1] OSEK/VDX Conformance Testing Methodology - Version 1.0 - 19 December 1997

[2] OSEK/VDX Operating System - Version 2.0 - revision 1 - 15 October 1997

[3] OSEK/VDX Communication - 2.1 Draft Version 1.0 - 23th February 1998

[4] OSEK Network Management - Concept and Application Programming Interface- Version 2.50 - 31th of March 1998

[5] ISO/IEC 9646-1 - Information technology, Open Systems Interconnection, Conformance testing methodology and framework, *part 1 : General Concepts*, 1992.

[6] ISO/IEC 9646-3 - Information technology, Open Systems Interconnection, Conformance testing, methodology and framework, *part 3 : The Tree and Tabular Combined Notation (TTCN)*, 1992.

1.3. Abbreviations

API	Application Programming Interface
ISO	International Standard Organization
NM	Network Management
OS	Operating System
PDU	Protocol Data Unit
SDL	Specification and Description Language

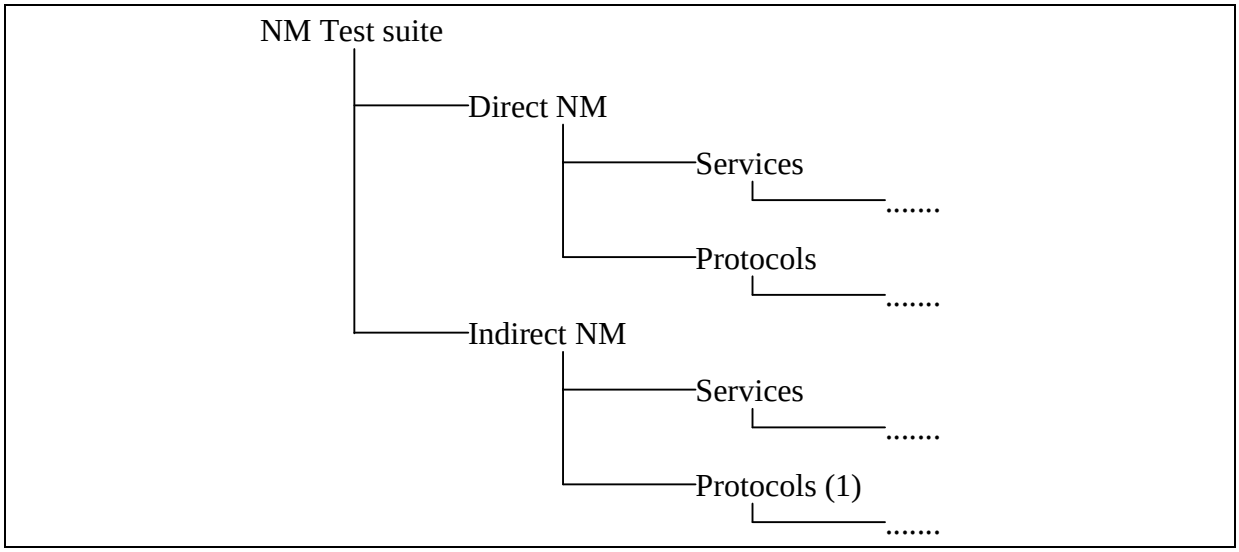
TOB	Time-out for OBservation
TTCN	Tree and Tabular Combined Notation

2. Test purposes structure

2.1. Description

The test purposes for the OSEK NM services and protocols are arranged in groups and subgroups following a hierarchical structure. This organisation is common to direct and indirect NM and it follows the NM specification structure. It intends to facilitate cross-checking with the specification and verification of completeness. It does not preclude a different approach for test cases organisation inside the test suite.

The tree structure of NM test purposes is illustrated in Figure 1 below:



(1) For Indirect NM, the protocol subtree consists of two distinct branches corresponding respectively to "One global time-out TOB" specification and "One monitoring time-out per message" specification.

Figure 1 Hierarchy of NM test purposes

The service tests are subdivided on a per service basis. There is at least one test for each API in order to demonstrate that all implemented services can be successfully called by an application.

The protocol tests are subdivided according to protocol states and substates defined in the NM specification. They intend to verify that the NM implementation behaves as specified in all implemented (sub)states. They also check all transitions between the different (sub)states.

Both the service and the protocol test purposes include verification of:

- valid behaviour: the implementation is actually waiting for the stimuli received from the tester,
- inopportune actions: unexpected stimuli are sent by the tester, e.g. a ring message while the NM is not expecting such a message.

There is no test of invalid behaviour, that is sending stimuli with bad parameters. The NM specification does not specify the format of protocol messages and of API parameters. Therefore, it is not possible to set bad values that could apply to every implementation.

Test purposes are brought together into tables corresponding to the leaves of the tree structure. Each table is made up of four columns providing:

- a reference number,
- the test assertion,
- the paragraph or picture of the NM specification from which the assertion was extracted,
- the specification variant needing to be implemented for the test purpose to be verified.

Each test assertion contains:

- the stimulus to be sent to verify the test purpose and if necessary the NM specification state needing to be reached before sending the stimulus,
- the action that shall be performed by the implementation to verify the test purpose and the subsequent output that should be observed by the tester. Note that the output can be "nothing" in which case the tester shall verify that the implementation did not send anything.

2.2. Detailed structure

2.2.1. Direct NM

DirectNM
Services
Configuration Management
InitIndDeltaConfig
InitConfig
GetConfig
CmpConfig
SelectDeltaConfig
Operating Modes and Operating Mode Management
StartNM
StopNM
GotoMode
Network Status and GetStatus
CmpStatus
SelectDeltaStatus
SilentNM
TalkNM
Data Field Management
InitIndRingData
“Using of RingData allowed” information of network status
ReadRingData
TransmitRingData
Protocols
NMInit and NMReset
Transitions to NMReset
InitReset
ResetActive state
NMNormal
Transitions to NMNormal
NormalStandardNM
NormalActive state
Transitions from/to NormalActive
NormalActivePrepSleep state
Transitions from/to Normal(Active/Passive)PrepSleep
Transitions to NMTwbsNormal
NMTwbsNormal state
NMLimpHome
Transitions to NMLimpHome
InitLimpHome
LimpHomeActive state
LimpHomePassive state
Transitions from/to LimpHomeActive
Transitions from/to LimpHome(Active/Passive)PrepSleep
Transitions to NMTwbsLimpHome
NMTwbsLimpHome state
NMBusSleep
Transitions to NMBusSleep

Table 1 Test Purposes Structure of Direct NM

2.2.2. Indirect NM

IndirectNM
Services
Configuration Management
InitIndDeltaConfig
InitConfig
GetConfig
CmpConfig
SelectDeltaConfig
Operating Modes and Operating Mode Management
StartNM
StopNM
GotoMode
GetStatus
CmpStatus
SelectDeltaStatus
Protocols - One global time-out TOB
Handling of StartNM and StopNM
User’s communication management
Configuration management
Network status management
NMNormal
Configuration management
Network status management
NMLimpHome
User’s communication management
Configuration management
Network status management
Protocols - One monitoring time-out per message
Handling of StartNM, StopNM and InitConfig
User’s communication management
Configuration management
Network status management
NMNormal
Configuration management
Network status management
NMLimpHome
User’s communication management
Configuration management
Network status management
NMBusSleep
User’s communication management
b Network status management

Table 2 Test Purposes Structure of Indirect NM

3. Test purposes

3.1. Test purposes of Direct NM

This section contains a set of test purposes relevant to Direct NM services and protocols. These test purposes provide ground material for developing the TTCN test suite which will be used to evaluate conformance to direct NM specification [4].

3.1.1. Service test group

This section specifies tests purposes relative to the direct NM API as defined in sections 4.4 and 4.5 of the NM specification document. Each test purpose defines both the test stimulus to be sent and the subsequent output(s) to be observed either at the NM API or on the Data Bus.

The test stimuli include API calls with different sets of input parameters and also NMPDUs causing the implementation either:

- to change the network status, or
- to change the network configuration, or
- to receive ring data.

The observable outputs are either:

- the stati returned by API calls and the associated output parameters such as network status, network configuration and ring data, or
- the tasks activations or event settings carried out by the implemention on NMPDU reception, or
- NMPDU transmissions originating from the implementation.

Each test purpose also gives information on the specification variant(s) that need to be implemented for the test purpose to be verified.

The implementation variants are identified by the following terms:

- Core means that the test purpose must be verified in any implementation,
- Active/Passive means that the test purpose must be verified only if the optional SilentNM and TalkNM services are implemented,
- BusSleep means that the test purpose must be verified only if the optional GotoMode service is implemented,
- InitConfig means that the test purpose must be verified only if the optional InitConfig service is implemented,
- CmpConfig means that the test purpose must be verified only if the optional CmpConfig service is implemented,
- SelectConfig means that the test purpose must be verified only if optional SelectDelta-Config service is implemented.
- RingData means that the test purpose must be verified only if the optional ReadRingData and TransmitRingData services are implemented,

- Status refers to API return status. It means that the test purpose must be verified only if the tested status is actually implemented (see NM specification, section 2.3 - 2nd §),
- CmpStatus means that the test purpose must be verified only if the optional CmpStatus service is implemented,
- SelectStatus means that the test purpose must be verified only if optional SelectDelta-Status service is implemented.

The "NMStatus" variant implies a test of a network status change. There are two ways of testing this information:

1. Test by a GetStatus API call, if this optional procedure is effectively implemented,
2. Test of a task activation occurrence or an OS event occurrence, depending on the status changes selected through the SelectDeltaStatus service.

In the test purposes, the changes to network status information are expressed by the following assertions:

Network status value		Assertion
0	Present configuration not stable	“Present configuration stable” information of network status is cleared
1	Present configuration stable	“Present configuration stable” information of network status is set
0	No error	“Error, bus blocked” information of network status is cleared
1	Error, bus blocked	“Error, bus blocked” information of network status is set
0	NMPassive	“NMActive” information of network status is cleared
1	NMActive	“NMActive” information of network status is set
0	NMOn	“NMOn/NMOff” information of network status is cleared
1	NMOff	“NMOn/NMOff” information of network status is set
0	no NMLimpHome	“NMLimphome” information of network status is cleared
1	NMLimpHome	“NMLimphome” information of network status is set
0	no NMBusSleep	“NMBusSleep” information of network status is cleared
1	NMBusSleep	“NMBusSleep” information of network status is set
0	no NMTwbsNormal and no NMTwbsLimpHome	“NMTwbsNormal or NMTwbsLimphome” information of network status is cleared
1	NMTwbsNormal or NMTwbsLimpHome	“NMTwbsNormal or NMTwbsLimphome” information of network status is set
0	using of Ring Data allowed	“Using of Ring Data not allowed” information of network status is cleared
1	using of Ring Data not allowed	“Using of Ring Data not allowed” information of network status is set
0	Service GotoMode(Awake) called	“Service GotoMode(BusSleep) called” information of network status is cleared
1	Service GotoMode (BusSleep) called	“Service GotoMode(BusSleep) called” information of network status is set

As Extended Network Status is considered implementation specific in NM specification (see § 2.2.3.3), no test relating to such a status is specified here.

3.1.1.1. Configuration Management

Nr	Assertion	Paragraph in spec.	Affected variants
Signalling specified by InitIndDeltaConfig			
1	If a first alive or ring message is received from a node belonging to the current normal configuration mask, the task specified by InitIndDeltaConfig is activated or the specified event is set.	4.4.2.2	Core
2	If a first limphome message is received from a node belonging to the current limphome configuration mask, the task specified by InitIndDeltaConfig is activated or the specified event is set.	4.4.2.2	Core
3	No task activation nor event setting happens if a first alive or ring message is received from a node not belonging to the current normal configuration mask.	4.4.2.2	Core
4	No task activation nor event setting happens if a first limphome message is received from a node not belonging to the current limphome configuration mask.	4.4.2.2	Core
InitConfig service			
5	InitConfig makes the NM to start or restart the configuration management	4.4.2.3	InitConfig
6	InitConfig returns E_OK.	4.4.2.3	InitConfig + Status
GetConfig service			
7	GetConfig provides the current normal configuration if the ConfigKind parameter equals “Normal”.	4.4.2.3	Core
8	GetConfig provides the current limphome configuration if the ConfigKind parameter equals “LimpHome”.	4.4.2.3	Core
9	GetConfig returns E_OK.	4.4.2.3	Status
CmpConfig service			
10	CmpConfig returns the boolean value: Status = NOT (<CMask> AND (<TestConfig> EXOR <RefConfig>)), where TestConfig is the test configuration, RefConfig is the reference configuration and CMask is the test mask.	4.4.2.3	CmpConfig
SelectDeltaConfig service			
11	SelectDeltaConfig selects a target configuration and a configuration mask to drive the signalling of changed configurations.	4.4.2.3	SelectConfig
12	SelectDeltaConfig returns True if no error	4.4.2.3	SelectConfig + Status

13	SelectDeltaConfig returns False if the referenced target or the referenced mask does not exist	4.4.2.3	SelectConfig + Status

3.1.1.2. Operating Modes and Operating Mode Management

Nr	Assertion	Paragraph in spec.	Affected variants
StartNM service			
1	StartNM starts the local NM and leads the NM to send NM messages.	4.4.3.3	Core
2	StartNM causes the state transition from NMOff to NMOn.	4.4.3.3	NMStatus
3	StartNM returns E_OK if no error.	4.4.3.3	Status
StopNM service			
4	StopNM stops the local NM and leads the NM to stop sending NM messages.	4.4.3.3	Core
5	StopNM causes the state transition from NMOn to NMOff.	4.4.3.3	NMStatus
6	StopNM returns E_OK if no error.	4.4.3.3	Status
GotoMode service			
7	GotoMode(BusSleep) serves to set the NM global operating mode to BusSleep and leads the NM to stop sending NM messages.	4.4.3.3	BusSleep
8	GotoMode(Awake) serves to set back the NM global operating mode to Awake and leads the NM to restart sending NM messages.	4.4.3.3	BusSleep
9	GotoMode(BusSleep) causes the state transition from NMAwake to NMBusSleep	4.4.3.3	BusSleep + NMStatus
10	GotoMode(Awake) causes the state transition from NMBusSleep to NMAwake	4.4.3.3	BusSleep + NMStatus
11	GotoMode returns E_OK if no error.	4.4.3.3	BusSleep + Status
Network status (1) and GetStatus			
12	“Present configuration stable” information of network status is set if network configuration did not change during the last loop of the logical ring.	2.2.3.2	NMStatus
13	“Present configuration stable” information of network status is cleared if the network configuration has changed during the last loop of the logical ring.	2.2.3.2	NMStatus

14	“Error, bus blocked” information of network status is set when a fatal bus error has been detected.	2.2.3.2	NMStatus
15	“Error, bus blocked” information of network status is cleared when the fatal bus error has been repaired.	2.2.3.2	NMStatus
16	“NMLimphome” information of network status is set when the NM enters the LimpHome state.	2.2.3.2	NMStatus
17	“NMLimphome” information of network status is cleared if the NM leaves the LimpHome state.	2.2.3.2	NMStatus
18	“NMTwbsNormal or NMTwbsLimphome” information of network status is set when the NM enters the NMTwbsNormal or NMTwbsLimphome state.	2.2.3.2	NMStatus
19	“NMTwbsNormal or NMTwbsLimphome” information of network status is cleared when the NM leaves the NMTwbsNormal or NMTwbsLimphome state.	2.2.3.2	NMStatus
20	“Service GotoMode(BusSleep) called” information of network status is set when GotoMode(BusSleep) has been called.	2.2.3.2	NMStatus
21	“Service GotoMode(BusSleep) called” information of network status is cleared when GotoMode(BusSleep) has not been called.	2.2.3.2	NMStatus
22	GetStatus returns E_OK.	4.4.3.3	Status
CmpStatus service			
23	CmpStatus returns the boolean value: Status = NOT (<SMask> AND (<TestStatus> EXOR <RefStatus>)), where TestStatus is the test configuration, RefStatus is the reference configuration and SMask is the test mask.	4.4.3.3	CmpStatus
SelectDeltaStatus service			
24	SelectDeltaStatus selects a target configuration and a configuration mask to drive the signalling of changed configurations.	4.4.2.3	SelectStatus
25	SelectDeltaStatus returns True if no error	4.4.2.3	SelectStatus + Status
26	SelectDeltaStatus returns False if the referenced target or the referenced mask does not exist	4.4.2.3	SelectStatus + Status
SilentNM service			
27	SilentNM disables the communication of the NM and leads the NM to stop sending NM messages.	4.5.2.1	Active/Passive
28	SilentNM causes the state transition from NMActive to NMPassive.	4.5.2.1	Active/Passive + NMStatus
29	After a call of StartNM, the NM is always in state NMActive (it sends out NM messages).	4.5.2.1	Active/Passive

30	SilentNM returns E_OK if no error.	4.5.2.1	Active/Passive + Status
TalkNM service			
31	TalkNM enables the communication of the NM again and leads the NM to restart sending NM messages.	4.5.2.1	Active/Passive
32	TalkNM causes the state transition from NMPassive to NMActive.	4.5.2.1	Active/Passive + NMStatus
33	TalkNM returns E_OK if no error.	4.5.2.1	Active/Passive + Status

(1) As specified before, each individual information of the network status can be firstly tested by calling GetStatus. Then, depending on InitIndDeltaStatus configuration, occurrence of a task activation or an event setting shall be verified.

Some status information is dealt with in other test purposes. These tests are not duplicated in the Network Status section:

- NMPassive/NMActive (tests 28, 32),
- NMOn/NMOff (tests 2, 5),
- NMBusSleep/no NMBusSleep (tests 9, 10).

Tests about "Using of Ring Data allowed / not allowed" are defined in "Data Field Management" section.

3.1.1.3. Data field management

Nr	Assertion	Paragraph in spec.	Affected variants
Signalling specified by InitIndRingData			
1	If a ring message is received with destination = ownstation and the logical ring runs in a stable state, the task specified by InitIndDeltaConfig is activated or the specified event is set.	4.5.3.2 + 2.2.2	RingData
2	No task activation nor event setting happens, if a ring message is received with destination = ownstation and the configuration changed in the last loop of the logical ring.	4.5.3.2 + 2.2.2	RingData
3	No task activation nor event setting happens, if a ring message is received with destination≠ ownstation.	4.5.3.2 + 2.2.2	RingData
"Using of Ring Data not allowed" information of network status			
4	If a ring message is received with destination = ownstation and the logical ring runs in a stable state, "Using of Ring Data not allowed" information of network status is cleared.	4.5.2.1 + 2.2.2	RingData + NMStatus

5	If the logical ring runs in a stable state, “Using of Ring Data not allowed” information of network status is set after ring message transmission.	4.5.2.1 + 2.2.2	RingData + NMStatus
ReadRingData service			
6	Within T_{Typ} period from RingData indication, ReadRingData provides the ring data received in the last ring message.	4.5.3.3 + 2.2.2	RingData
7	If TransmitReadData is called within T_{Typ} period from RingData indication, ReadRingData provides the ring data transmitted in TransmitReadData.	4.5.3.3 + 2.2.2	RingData
8	ReadRingData returns E_OK if called within T_{Typ} period from RingData indication and the network configuration remains stable.	4.5.3.3	RingData + Status
9	ReadRingData returns E_notOK if called within T_{Typ} period from RingData indication and the network configuration has changed.	4.5.3.3	RingData + Status
10	ReadRingData returns E_notOK if not called within T_{Typ} period from RingData indication.	4.5.3.3	RingData + Status
TransmitRingData service			
11	If TransmitRingData is called within T_{Typ} period from RingData indication and the network configuration remains stable, ring data provided in the service call are transmitted in the next ring message.	4.5.3.3 + 2.2.2	RingData
12	If TransmitReadData is called within T_{Typ} period from RingData indication and the network configuration has changed, the ring data fields of the last received and the next transmitted ring messages are identical.	4.5.3.3 + 2.2.2	RingData
13	If TransmitRingData is not called, the ring data fields of the last received and the next transmitted ring messages are identical.	4.5.3.3 + 2.2.2	Core
14	TransmitRingData returns E_OK if called within T_{Typ} period from RingData indication and the network configuration remains stable.	4.5.3.3	RingData + Status
15	TransmitRingData returns E_notOK if called within T_{Typ} period from RingData indication and the network configuration has changed.	4.5.3.3	RingData + Status
16	TransmitRingData returns E_notOK if called outside T_{Typ} period from RingData indication.	4.5.3.3	RingData + Status

3.1.2. Protocol test group

This section specifies tests purposes relative to the direct NM protocol as defined in section 2.2.8 of the NM specification document [4]. Test purposes have been mainly established from the state transition diagrams presented in the specification. They intend to verify that the NM implementation behaviour conforms to the specification. They include:

- tests of internal state activity: tests are specified to verify actions that shall be performed by the implementation while remaining in the same state,
- tests of state transitions: one test is specified for each event that leads the NM to move from a given state to another state.

Each test purpose defines both the test stimulus or stimuli to be sent and the subsequent output(s) to be observed either at the NM API or on the Data Bus. Some actions can also be triggered by internal events. The test stimuli include:

- NM API procedure calls,
- NMPDUs sent to the implementation under test,
- Timer expirations (internal stimuli): $T_{Typ,}$ T_{Max}, $T_{Error,}$ $T_{WaitBusSleep,}$
- NMrxcount overflow (no reception),
- NMtxcount overflow (no transmission),
- Fatal bus error.

The T_{Ttx} timer allowing to retransmit an NM message in case of rejection from the Data Link Layer has been considered implementation specific and not taken into account.

The observable outputs are as follows:

- NMPDUs sent by the implementation under test and the various PDU fields including:
  - Source node,
  - Destination node (logical successor in the ring),
  - Reserved Area of Opcode,
  - Opcode (alive, ring or limphome),
  - Sleep.ind,
  - Sleep.ack,
  - Ring data.
- Status of application communication (enabled or disabled),
- Information returned by API calls : network configuration, network status, ring data.

Each test purpose also gives information on the specification variant(s) that need to be implemented for the test purpose to be verified. The variants are identified by the following terms:

- Core means that the test must be verified in any case,
- Active/Passive means that the test must be verified only if the optional SilentNM and TalkNM services are implemented,
- BusSleep means that the test must be verified only if the optional GotoMode service is implemented.

3.1.2.1. NMInit and NMReset

Nr	Assertion	Paragraph in spec.	Affected variants
Transitions from other states to NMReset			
1	When StartNM is called, the NM enters the Init then the Reset state. Limphome configuration is cleared, application communication is enabled and an alive message is transmitted.	Fig. 5 + Fig. 25 + Fig. 26 + Fig. 27	Core
2	If T_{Max} timer expires in Normal state and the NM is active, it enters the Reset state and transmits an alive message.	Fig. 28 + Fig. 27	Core
3	If GotoMode(Awake) is called in NMTwbsNormal state and the NM is active, it enters the Reset state and transmits an alive message.	Fig. 28 + Fig. 27	BusSleep
4	If an NM message with cleared bit sleep.ind is received in NMTwbsNormal state and the NM is active, it enters the Reset state and transmits an alive message.	Fig. 28 + Fig. 27	BusSleep
5	In LimpHome state, if the NM is active, a limphome message has been transmitted, GotoMode(Awake) is called and an NM message is received, the NM enters the Reset state. Application communication is enabled and an alive message is transmitted.	Fig. 29 + Fig. 27	Core
6	In LimpHome state, if the NM is active, a limphome message has been transmitted, GotoMode(BusSleep) is called and an NM message is received with cleared bit sleep.ack, the NM enters the Reset state. Application communication is enabled and an alive message is transmitted.	Fig. 29 + Fig. 27	BusSleep
7	In LimpHome state, if the NM is passive, GotoMode (Awake) is called and an NM message is received, the NM enters the Reset state. Application communication is enabled and no NM message is transmitted.	Fig. 29 + Fig. 27	Active/Passive + BusSleep
8	In LimpHome state, if the NM is passive, GotoMode (BusSleep) is called and an NM message is received with cleared bit sleep.ack, the NM enters the Reset state. Application communication is enabled and no NM message is transmitted.	Fig. 29 + Fig. 27	Active/Passive + BusSleep
9	If GotoMode(Awake) is called in BusSleep state and the NM is active, it enters the Init then the Reset state. Limphome configuration is cleared, application communication is enabled and an alive message is transmitted.	Fig. 25 + Fig. 26 + Fig. 27	BusSleep

10	If an NM message is received in BusSleep state and the NM is active, it enters the Init then the Reset state. Limphome configuration is cleared, application communication is enabled and an alive message is transmitted.	Fig. 25 + Fig. 26 + Fig. 27	BusSleep
InitReset			
11	In InitReset, the normal configuration is initialized. It contains only the local node.	Fig. 27	Core
ResetActive state			
12	In ResetActive state, the alive message is initialized as follows: destination = ownstation, reserved area of OpCode initialized, sleep.ind and sleep.ack cleared.	Fig. 27	Core

Coverage of the NMReset specification by the test purposes is shown in the state diagram below. Labels in circles indicate the paths and statements covered by each test.

Notation:

(1) refers to test number 1 of NMReset table,
(N2) refers to test number 3 of NMLimphome table,
(L3) refers to test number 2 of NMNormal table,
(1:6) refers to test numbers 1 to 6 of NMReset table.

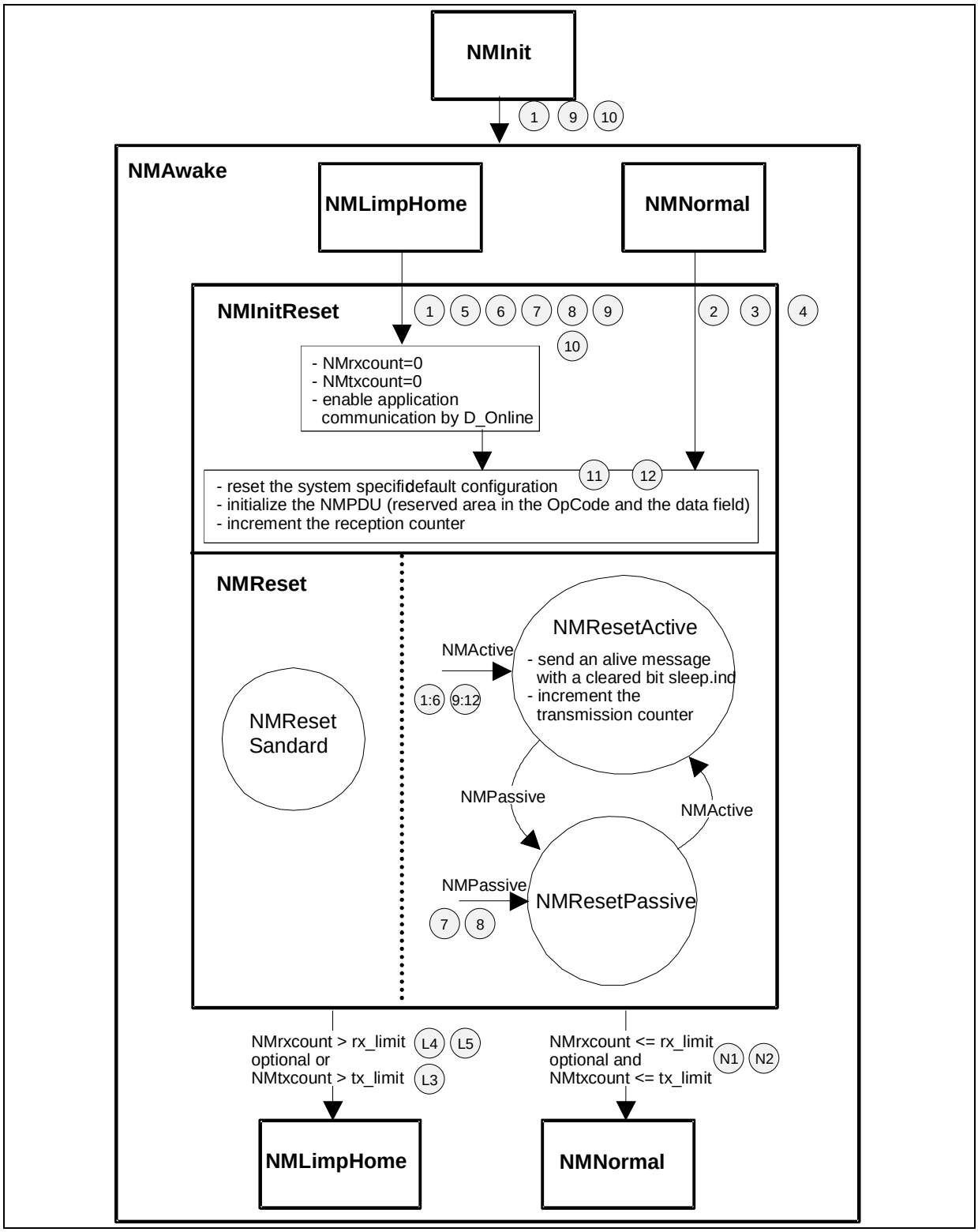


Figure 2 Test coverage of NMReset state

3.1.2.2. NMNormal

The NM specification defines 4 substates of NMNormal:

- NormalActive,
- NormalPassive,
- NormalActivePrepSleep,
- NormalPassivePrepSleep.

In the table below, the wording "Normal state" covers the four substates of NMNormal.

Unless otherwise specified, NM messages are sent with cleared bits sleep.ind and sleep.ack.

Nr	Assertion	Paragraph in spec.	Affected variants
Transitions from NMReset to NMNormal			
1	If NMtxcount <= tx_limit and NMrxcount <= rx_limit in Reset state, the NM enters the Normal state. In Active mode, it transmits a first ring message after T_{Typ}.	Fig. 27 + Fig. 28	Core
2	If NMtxcount <= tx_limit and NMrxcount <= rx_limit in Reset state, the NM enters the Normal state. In Passive mode, it will not transmit any message.	Fig. 27 + Fig. 28	Active/Passive
NormalStandardNM			
3	In Normal state, the NM updates the present configuration on alive message reception	Fig. 28	Core
4	In Normal state, the NM updates the present configuration on ring message reception	Fig. 28	Core
5	In Normal state, the NM updates the logical successor on alive message reception	Fig. 28	Core
6	In Normal state, the NM updates the logical successor on ring message reception	Fig. 28	Core
7	In Normal state, the NM updates the limphome configuration on limphome message reception	Fig. 28	Core
8	In Normal state, the NM sends an alive message on ring message reception if skipped in the logical ring and if NMActive. Sleep.ind is cleared if GotoMode (BusSleep) were not called before.	Fig. 28	Core
9	In Normal state, the NM sends an alive message on ring message reception if skipped in the logical ring and if NMActive. Sleep.ind is set if GotoMode(BusSleep) were called before.	Fig. 28	BusSleep
10	In Normal state, the NM does not send any alive message on ring message reception if skipped in the logical ring and if NMPassive.	Fig. 28 + Fig. 38	Active/Passive

11	In Normal state, the NM does not send any alive message on ring message reception if not skipped in the logical ring.	Fig. 28 + Fig. 38	Core
NormalActive state			
12	In NormalActive state, the NM passes the ring message delayed T_{Typ} if source = destination in the received message	Fig. 28	Core
13	In NormalActive state, the NM passes the ring message delayed T_{Typ} if destination = ownstation in the received message	Fig. 28	Core
14	In NormalActive state, the NM will not pass the regular ring message if a ring message is received before T_{Typ} expiration	Fig. 28	Core
Internal transitions from/to NormalActive state			
15	The NM stops passing the regular ring message when SilentNM is called while in NormalActive state (transition to NormalPassive)	Fig. 28	Active/Passive
16	The NM passes the regular ring message again when TalkNM is called while in NormalPassive state (transition to NormalActive)	Fig. 28	Active/Passive
17	If GotoMode(BusSleep) is called in NormalActive state, the NM transmits the next regular ring message with set bit sleep.ind	Fig. 28	BusSleep
18	If an NM message is received with cleared bit sleep.ind while in NormalActivePrepSleep state, the NM will pass the next regular ring message with set bit sleep.ind and cleared bit sleep.ack (transition to NormalActive)	Fig. 28	BusSleep
19	If GotoMode(Awake) is called in NormalActive-PrepSleep state, the NM transmits the next regular ring message with cleared bits sleep.ind and sleep.ack (transition to NormalActive)	Fig. 28	BusSleep
NormalActivePrepSleep state			
20	In NormalActivePrepSleep state, the NM passes the ring message delayed T_{Typ} if source = destination and sleep.ind is set in the received message. Sleep.ind and sleep.ack are set in the transmitted message.	Fig. 28 + Fig. 21	BusSleep
21	In NormalActivePrepSleep state, the NM passes the ring message delayed T_{Typ} if destination = ownstation and sleep.ind is set in the received message. Sleep.ind and sleep.ack are set in the transmitted message.	Fig. 28 + Fig. 21	BusSleep
22	In NormalActivePrepSleep state, the NM will not pass the regular ring message if a ring message with set bit sleep.ind is received before T_{Typ} expiration	Fig. 28	BusSleep

Internal transitions from/to Normal(Active/Passive)PrepSleep state			
23	The NM does not pass the regular ring message when SilentNM is called while in NormalActivePrepSleep state (transition to NormalPassive PrepSleep)	Fig. 28	Active/Passive + BusSleep
24	The NM passes the regular ring message with set bits sleep.ind and sleep.ack when TalkNM is called while in NormalPassivePrepSleep state (transition to Normal-ActivePrepSleep)	Fig. 28	Active/Passive + BusSleep
25	In NormalPassive state, if GotoMode(BusSleep) then TalkNM are called, the NM passes the regular ring message with set bits sleep.ind and sleep.ack (test of transition to NormalPassivePrepSleep)	Fig. 28	Active/Passive + BusSleep
26	If an NM message is received with cleared bit sleep.ind while in NormalPassivePrepSleep state and then TalkNM is called, the NM will pass the next regular ring message with cleared bits sleep.ind and sleep.ack (transition to NormalActive)	Fig. 28	Active/Passive + BusSleep
27	In NormalPassivePrepSleep state, if GotoMode(Awake) then TalkNM are called, the NM passes the regular ring message with cleared bits sleep.ind and sleep.ack (test of transition to NormalPassive)	Fig. 28	Active/Passive + BusSleep
Transitions from NMNormal to NMTwbsNormal state			
28	In Normal state, if GotoMode(BusSleep) is called and a ring message is received with set bit sleep.ack, the NM enters the NMTwbsNormal state and application communication is disabled	Fig. 28	BusSleep
29	When the regular ring message is transmitted with set bit sleep.ack in NormalActivePrepSleep, the NM enters the NMTwbsNormal state and application communi-cation is disabled	Fig. 28	BusSleep
NMTwbsNormal state			
30	In NMTwbsNormal state, the NM accepts and ignores NM messages received with set bit sleep.ind	Fig. 34	BusSleep

Coverage of the NMReset specification by the test purposes is shown in the state diagram below. Labels in circles indicate the paths and statements covered by each test.

Notation:

(1) refers to test number 1 of NMNormal table,

(L2) refers to test number 2 of NMLimphome table,

(R3) refers to test number 3 of NMReset table,

(S1) refers to test number 1 of NMBusSleep table.

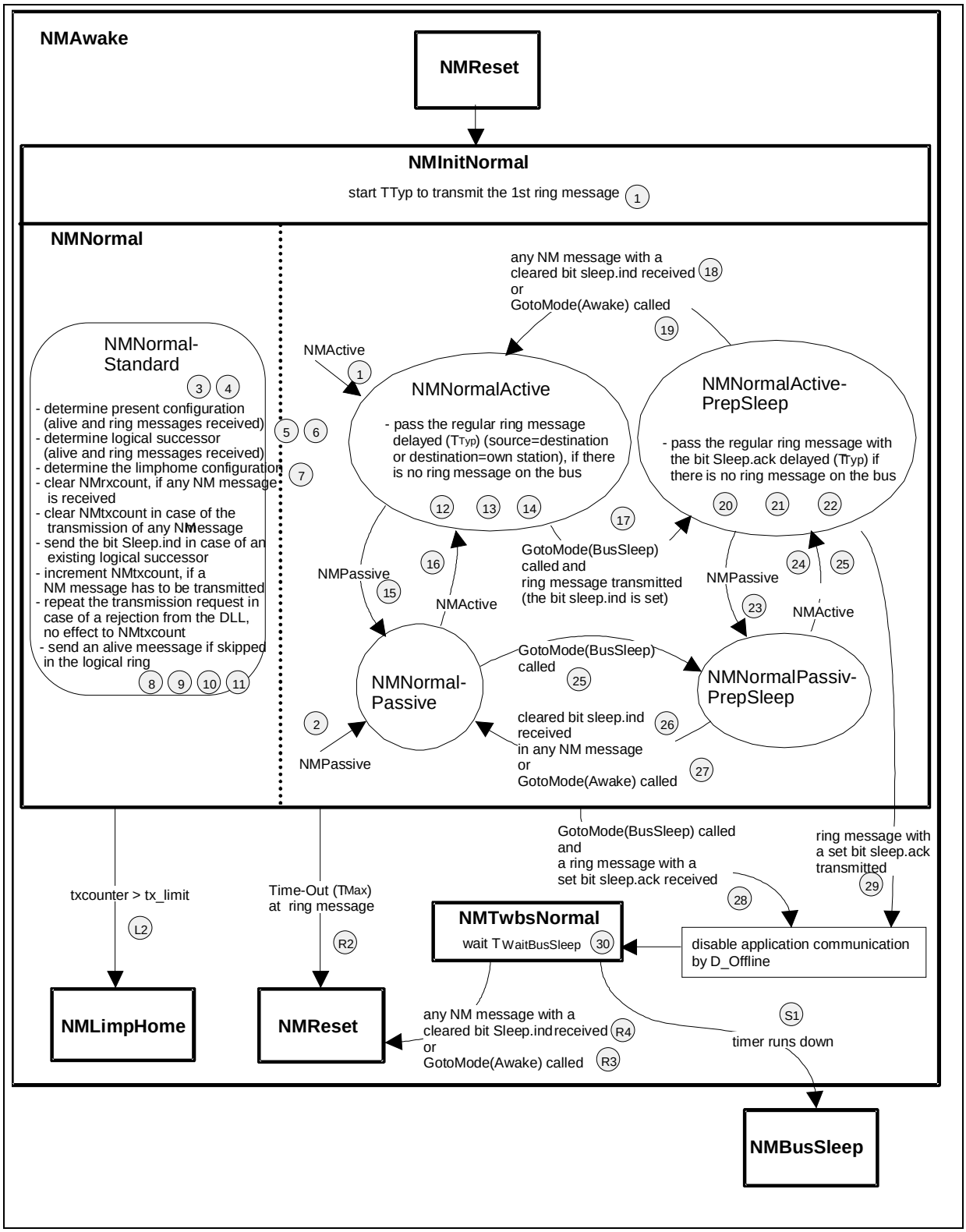


Figure 3 Test coverage of NMNormal state

3.1.2.3. NMLimpHome

The NM specification defines 4 substates of NMLimpHome:

- LimpHomeActive,
- LimpHomePassive,
- LimpHomeActivePrepSleep,
- LimpHomePassivePrepSleep.

In the table below, the wording "Normal state" covers the four substates of NMLimpHome.

Unless otherwise specified, LimpHome messages are sent with cleared bit sleep.ind.

Nr	Assertion	Paragraph in spec.	Affected variants
Transitions from other states to NMLimpHome			
1	If a fatal bus error is detected in any state, the NM enters the LimpHome state and transmits a limphome message after T_{Error}.	Fig. 29	Core
2	If NMtxcount > tx_limit in Normal state, the NM enters the LimpHome state and transmits a limphome message after T_{Error}.	Fig. 28 + Fig. 29	Core
3	If NMtxcount > tx_limit in Reset state, the NM enters the LimpHome state and transmits a limphome message after T_{Error}.	Fig. 27 + Fig. 29	Core
4	If NMrxcount > rx_limit in Reset state and the NM is active, it enters the LimpHome state and transmits a limphome message after T_{Error}.	Fig. 27 + Fig. 29	Core
5	If NMrxcount > rx_limit in Reset state and the NM is passive, it enters the LimpHome state and does not transmit any NM message.	Fig. 27 + Fig. 29	Active/Passive
InitLimpHome			
6	After fatal bus error detection, application communication is disabled.	Fig. 29	
LimpHomeActive state			
7	In LimpHomeActive state, the NM transmits a limphome message every T_{Error}.	Fig. 29	Core
8	In LimpHomeActive state, the NM enables application communication every T_{Error}.	Fig. 29	Core
LimpHomePassive state			
9	In LimpHomePassive state, the NM enables application communication every T_{Error}.	Fig. 29	Active/Passive
Internal transitions from/to LimpHomeActive state			

10	The NM stops sending limphome messages when SilentNM is called while in LimpHomeActive state (transition to LimpHomePassive)	Fig. 29	Active/Passive
11	The NM restarts sending limphome messages if TalkNM is called while in LimpHomePassive state (transition to LimpHomeActive)	Fig. 29	Active/Passive
12	If GotoMode(BusSleep) is called in LimpHomeActive state, the NM transmits the next limphome message with set bit sleep.ind. Application communication is disabled after T_{Max}.	Fig. 29	BusSleep
13	If an NM message is received with cleared bit sleep.ind while in LimpHomeActivePrepSleep state, the NM will transmit the next limphome message with set bit sleep.ind and cleared bit sleep.ack (transition to LimpHome-Active)	Fig. 29	BusSleep
14	If GotoMode(Awake) is called in LimpHomeActive-PrepSleep state, the NM transmits the next limphome message with cleared bits sleep.ind and sleep.ack (transition to LimpHomeActive).	Fig. 29	BusSleep
Internal transitions from/to LimpHome(Active/Passive)PrepSleep state			
15	If GotoMode(BusSleep) is called in LimpHomePassive state, the NM enters the LimpHomePassivePrepSleep state and application communication is disabled after T_{Max}.	Fig. 29	Active/Passive + BusSleep
16	In LimpHomePassive state, if GotoMode(BusSleep) then TalkNM are called, the NM enters the LimpHome-PassivePrepSleep state then the LimpHomeActivePrep-Sleep state. Application communication is disabled after T_{Max}.	Fig. 29	Active/Passive + BusSleep
17	In LimpHomeActivePrepSleep state, if SilentNM then GotoMode(Awake) are called, the NM enters the LimpHomePassivePrepSleep state then the LimpHome-Passive state. Application communication is enabled after T_{Error}.	Fig. 29	Active/Passive + BusSleep
Other transitions between NMLimpHome and NMTwbsLimpHome			
18	In LimpHome state, if GotoMode(BusSleep) is called and an NM message is received with set bit sleep.ack, the NM enters the NMTwbsLimpHome state and application communication is disabled.	Fig. 29	BusSleep
19	If GotoMode(Awake) is called in NMTwbsLimpHome state and the NM is active, it enters the LimpHome state and transmits a limphome message after T_{Error}.	Fig. 29	BusSleep

20	If an NM message with cleared bit sleep.ind is received in NMTwbsNormal state and the NM is active, it enters the Reset state and transmits a limphome message after T_{Error}.	Fig. 29	BusSleep
NMTwbsLimpHome state			
21	In NMTwbsLimpHome state, the NM accepts and ignores NM messages received with set bit sleep.ind.	Fig. 37	BusSleep

Coverage of the NMReset specification by the test purposes is shown in the state diagram below. Labels in circles indicate the paths and statements covered by each test.

Notation:

(1) refers to test number 1 of NMLimphome table,
(R5) refers to test number 5 of NMReset table,
(S2) refers to test number 2 of NMBusSleep table.

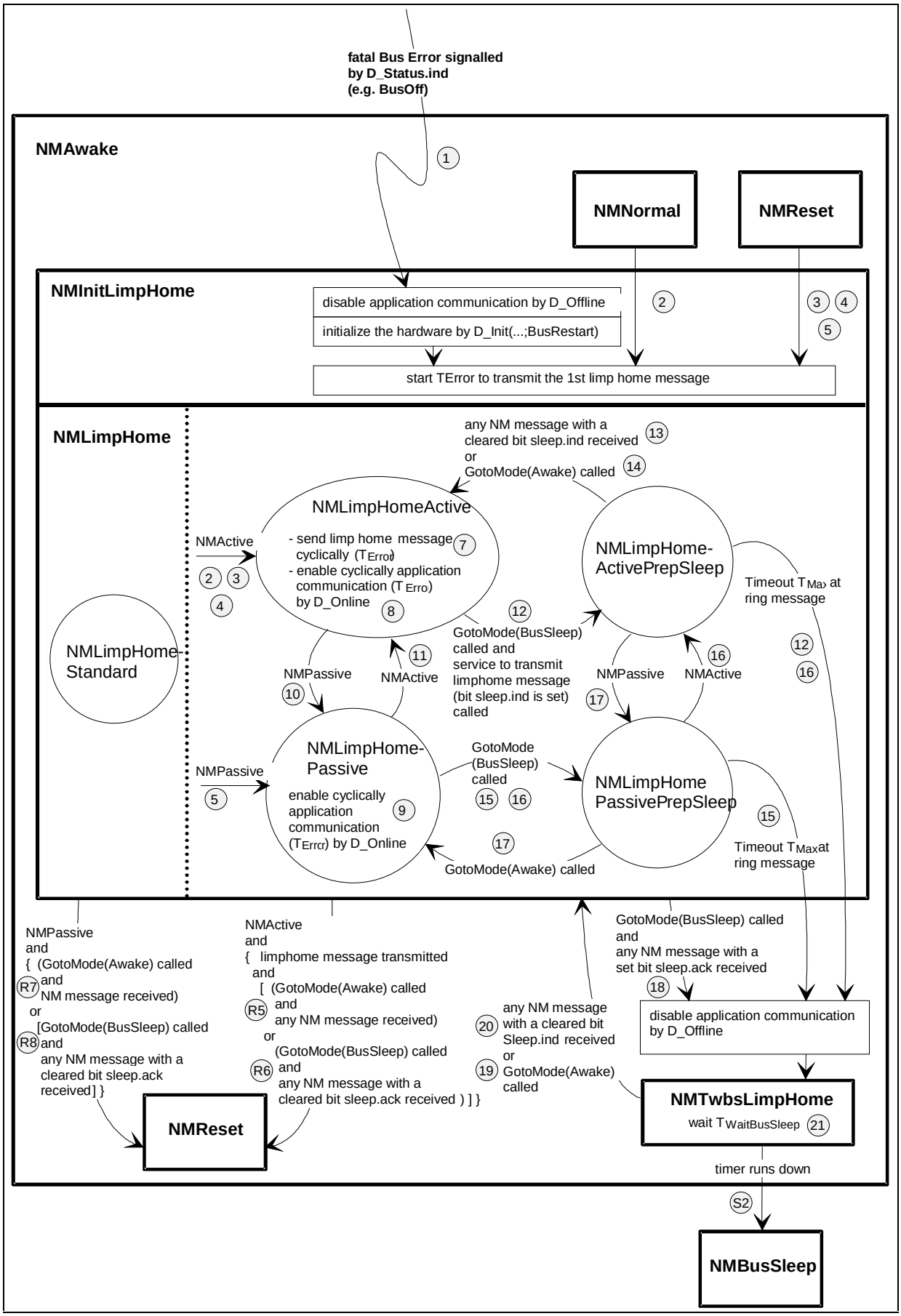


Figure 4 Test coverage of NMLimpHome state

3.1.2.4. NMBusSleep

Nr	Assertion	Paragraph in spec.	Affected variants
Transitions from other states to NMBusSleep			
1	If $T_{WaitBusSleep}$ timer expires in NMTwbsNormal state, the NM enters the BusSleep state and does not transmit NM messages any longer.	Fig. 28 + Fig. 26	BusSleep
2	If $T_{WaitBusSleep}$ timer expires in NMTwbsLimpHome state, the NM enters the BusSleep state and does not transmit NM messages any longer.	Fig. 28 + Fig. 26	BusSleep

3.2. Test purposes of Indirect NM

This section contains a set of test purposes relevant to Indirect NM services and protocols. These test purposes provide ground material for developing the TTCN test suite which will be used to evaluate conformance to indirect NM specification [4].

3.2.1. Service test group

This section specifies tests purposes relative to the indirect NM API as defined in sections 4.4 and 4.6 of the NM specification.

Tests of service behaviour are specified only when the service is not described in the SDL specification. Consequently, behaviour tests for StartNM, StopNM and InitConfig are defined later in Protocol test group. The tests provided in this section are relating to the status code returned by the APIs.

Each test purpose defines both the test stimulus to be sent and the subsequent output(s) to be observed at the NM API.

The test stimuli include API calls with different sets of input parameters and also monitored messages causing the implementation either:

- to change the network status or the extended network status, or
- to change the configuration or the extended configuration of supervised nodes.

The observable outputs are either:

- the stati returned by API calls and the associated output parameters such as network status and network configuration, or
- the tasks activations or event settings carried out by the implemention on monitored message reception.

Each test purpose also gives information on the specification variant(s) that need to be implemented for the test purpose to be verified.

The implementation variants are identified by the following terms:

- Core means that the test purpose must be verified in any implementation,

- BusSleep means that the test purpose must be verified only if the optional GotoMode service is implemented,
- CmpConfig means that the test purpose must be verified only if the optional CmpConfig service is implemented,
- SelectConfig means that the test purpose must be verified only if optional SelectDelta-Config service is implemented.
- Status refers to API return status. It means that the test purpose must be verified only if the tested status is actually implemented (see NM specification, section 2.3 - 2nd §).
- NMStatus refers to network status. It means that the test purpose must be verified only if the optional GetStatus is actually implemented.
- CmpStatus means that the test purpose must be verified only if the optional CmpStatus service is implemented,
- SelectStatus means that the test purpose must be verified only if optional SelectDelta-Status service is implemented.

In the following subsections, the tests marked with (*) are only applicable to "One monitoring time-out per message" implementations.

3.2.1.1. Configuration Management

Nr	Assertion	Paragraph in spec.	Affected variants
Signalling specified by InitIndDeltaConfig			
1	If a normal configuration change selected by SelectDeltaConfig occurs, the task specified by InitIndDeltaConfig is activated or the specified event is set.	4.4.2.2	Core
2	If an extended configuration change selected by SelectDeltaConfig occurs, the task specified by InitIndDeltaConfig is activated or the specified event is set.	4.4.2.2	Core
3	No task activation nor event setting happens for normal configuration changes that were not selected.	4.4.2.2	Core
4	No task activation nor event setting happens for extended configuration changes that were not selected.	4.4.2.2	Core
InitConfig service			
5 *	InitConfig returns E_OK.	4.4.2.3	Status
GetConfig service			
6	GetConfig provides the current normal configuration if the ConfigKind parameter equals "Normal".	4.4.2.3	Core
7 *	GetConfig provides the current extended configuration if the ConfigKind parameter equals "Normal extended".	4.4.2.3	Core

8	GetConfig returns E_OK.	4.4.2.3	Status
CmpConfig service			
9	CmpConfig returns the boolean value: Status = NOT (<CMask> AND (<TestConfig> EXOR <RefConfig>)), where TestConfig is the test configuration, RefConfig is the reference configuration and CMask is the test mask.	4.4.2.3	CmpConfig
SelectDeltaConfig service			
10	SelectDeltaConfig selects a target configuration and a configuration mask to drive the signalling of changed configurations.	4.4.2.3	SelectConfig
11	SelectDeltaConfig returns True if no error	4.4.2.3	SelectConfig + Status
12	SelectDeltaConfig returns False if the referenced target or the referenced mask does not exist	4.4.2.3	SelectConfig + Status

3.2.1.2. Operating Modes and Operating Mode Management

Nr	Assertion	Paragraph in spec.	Affected variants
StartNM service			
1	StartNM returns E_OK if no error.	4.4.3.3	Status
StopNM service			
2	StopNM returns E_OK if no error.	4.4.3.3	Status
GotoMode service			
3 *	GotoMode returns E_OK if no error.	4.4.3.3	BusSleep + Status
GetStatus			
4	GetStatus provides the current status of the network.	2.2.3.2	NMStatus
5	GetStatus returns E_OK.	4.4.3.3	NMStatus + Status
CmpStatus service			
6	CmpStatus returns the boolean value: Status = NOT (<SMask> AND (<TestStatus> EXOR <RefStatus>)), where TestStatus is the test configuration, RefStatus is the reference configuration and SMask is the test mask.	4.4.3.3	CmpStatus
SelectDeltaStatus service			
7	SelectDeltaStatus selects a target configuration and a configuration mask to drive the signalling of changed configurations.	4.4.2.3	SelectStatus

8	SelectDeltaStatus returns True if no error	4.4.2.3	SelectStatus + Status
9	SelectDeltaStatus returns False if the referenced target or the referenced mask does not exist	4.4.2.3	SelectStatus + Status

3.2.2. Protocol test group - One global time-out TOB

This section specifies tests purposes relative to the indirect NM protocol version called “one global time-out TOB”, as defined in chapter 3 of the NM specification. Test purposes have been established from the SDL diagrams presented in the specification, according to the Conformance Methodology described in document [1]. They intend to verify that the NM implementation behaviour conforms to the specification. They include:

- tests of state activity: tests are specified to verify actions that shall be performed by the implementation on a given input,
- tests of state transitions: one test is specified for each event that leads the NM to move from a given state to another state.

Each test purpose defines both the test stimulus or stimuli to be sent and the subsequent output(s) to be observed at the NM API. Some actions can also be triggered by internal events. The test stimuli include:

- NM API procedure calls,
- Monitored messages sent to the implementation under test or transmitted by the test application,
- Timer expirations (internal stimuli): $TOBT_{Error.}$
- Fatal bus error.

The observable outputs are as follows:

- Status of application communication (enabled or disabled),
- Information returned by API calls : network configuration, network status.

Each test purpose also gives information on the specification variant(s) that need to be implemented for the test purpose to be verified.

The Core variant means that the test shall be executed in any case.

The "NMStatus" variant implies a test of a network status change. There are two ways of testing this information:

1. Test by a GetStatus API call, if this optional procedure is effectively implemented,
2. Test of a task activation occurrence or an OS event occurrence, depending on the status changes selected through the SelectDeltaStatus service.

In the test purposes, the changes to network status information are expressed by the following assertions:

Network status value		Assertion
0	No error	“Error, bus blocked” information of network status is cleared
1	Error, Bus blocked	“Error, bus blocked” information of network status is set
0	NMOn	“NMOn/NMOff” information of network status is cleared
1	NMOff	“NMOn/NMOff” information of network status is set
0	no NMLimpHome	“NMLimphome” information of network status is cleared
1	NMLimpHome	“NMLimphome” information of network status is set

3.2.2.1. Handling of StartNM and StopNM

Nr	Assertion	Paragraph in spec.	Affected variants
User’s communication management			
1	When StartNM is called, application communication is enabled.	Fig. 50	Core
Network configuration management			
2	When StartNM is called, network configuration is initialised. Own node is considered mute, remote nodes are considered absent.	Fig. 50 + Fig. 54	Core
Network status management			
3	When StartNM is called, all network status information is cleared.	Fig. 50 + Fig. 55 + Table 8	NMStatus
4	When StopNM is called, NMon/NMoff information of network status is set.	Fig. 50 + Table 8	NMStatus

Coverage of indirect NM specification by the test purposes is shown in the SDL diagrams below. Circled numbers refer to test numbers in the table above.

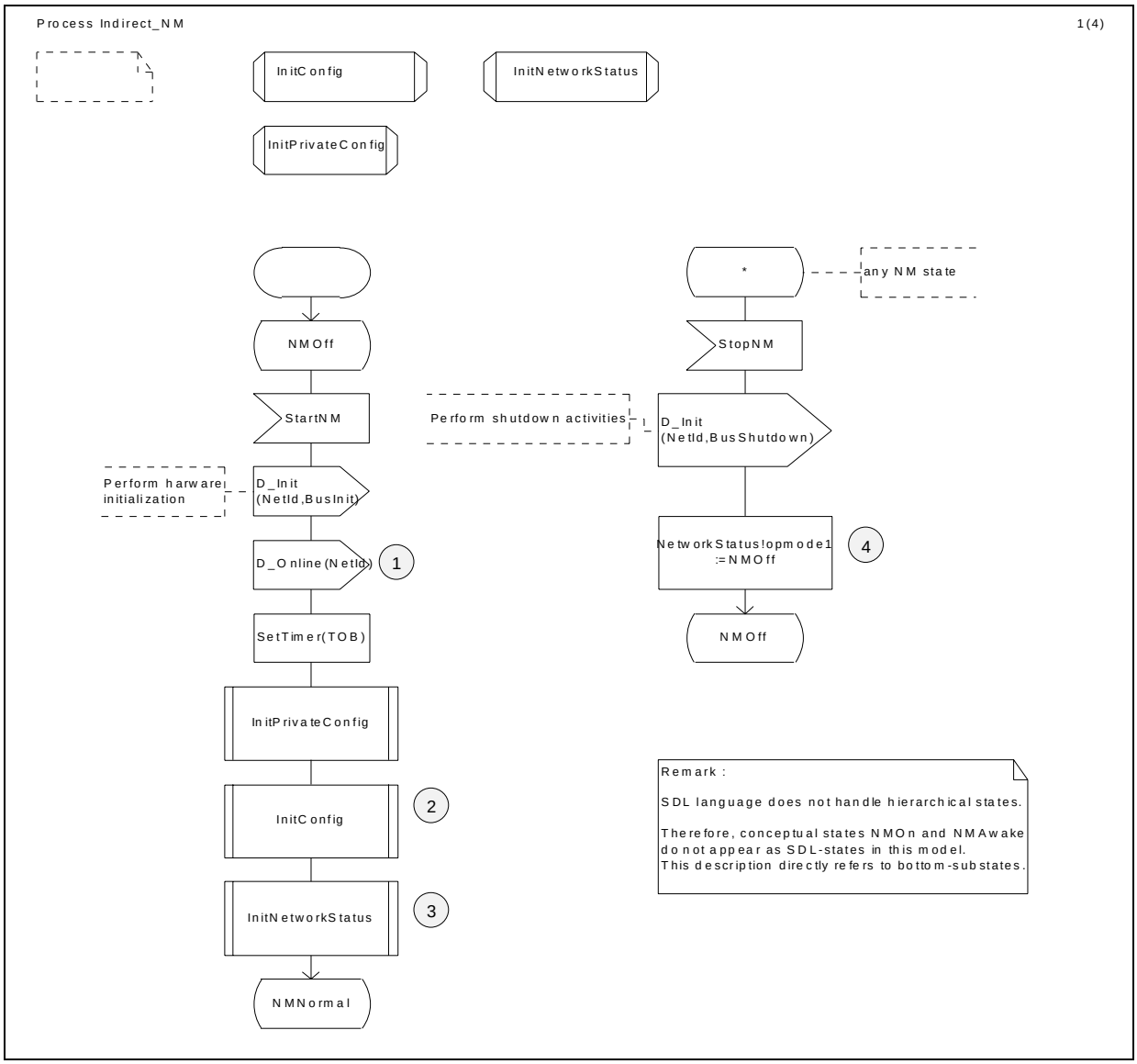


Figure 5 Test coverage of the services StartNM and StopNM

3.2.2.2. NMNormal

Nr	Assertion	Paragraph in spec.	Affected variants
Network configuration management			
1	In NMNormal state, a supervised node is considered present if the monitored message from that node was received at least once in the last TOB period	Fig. 51	Core
2	In NMNormal state, a supervised node is considered absent if the monitored message from that node was not received in the last TOB period	Fig. 51	Core

3	In NMNormal state, own node is considered not mute if the monitored application message was transmitted at least once in the last TOB period	Fig. 51	Core
4	In NMNormal state, own node is considered mute if the monitored application message was not transmitted in the last TOB period	Fig. 51	Core
Network status management			
5	When the monitored message from a supervised node is received in NMNormal state, “Error, bus blocked” and “NMLimphome” information of network status is cleared.	Fig. 51 + Table 8	NMStatus
6	When the monitored message from own node is transmitted in NMNormal state, “Error, bus blocked” and “NMLimphome” information of network status is cleared.	Fig. 51 + Table 8	NMStatus

Coverage of indirect NM specification by the test purposes is shown in the SDL diagrams below. Circled numbers refer to test numbers in the table above.

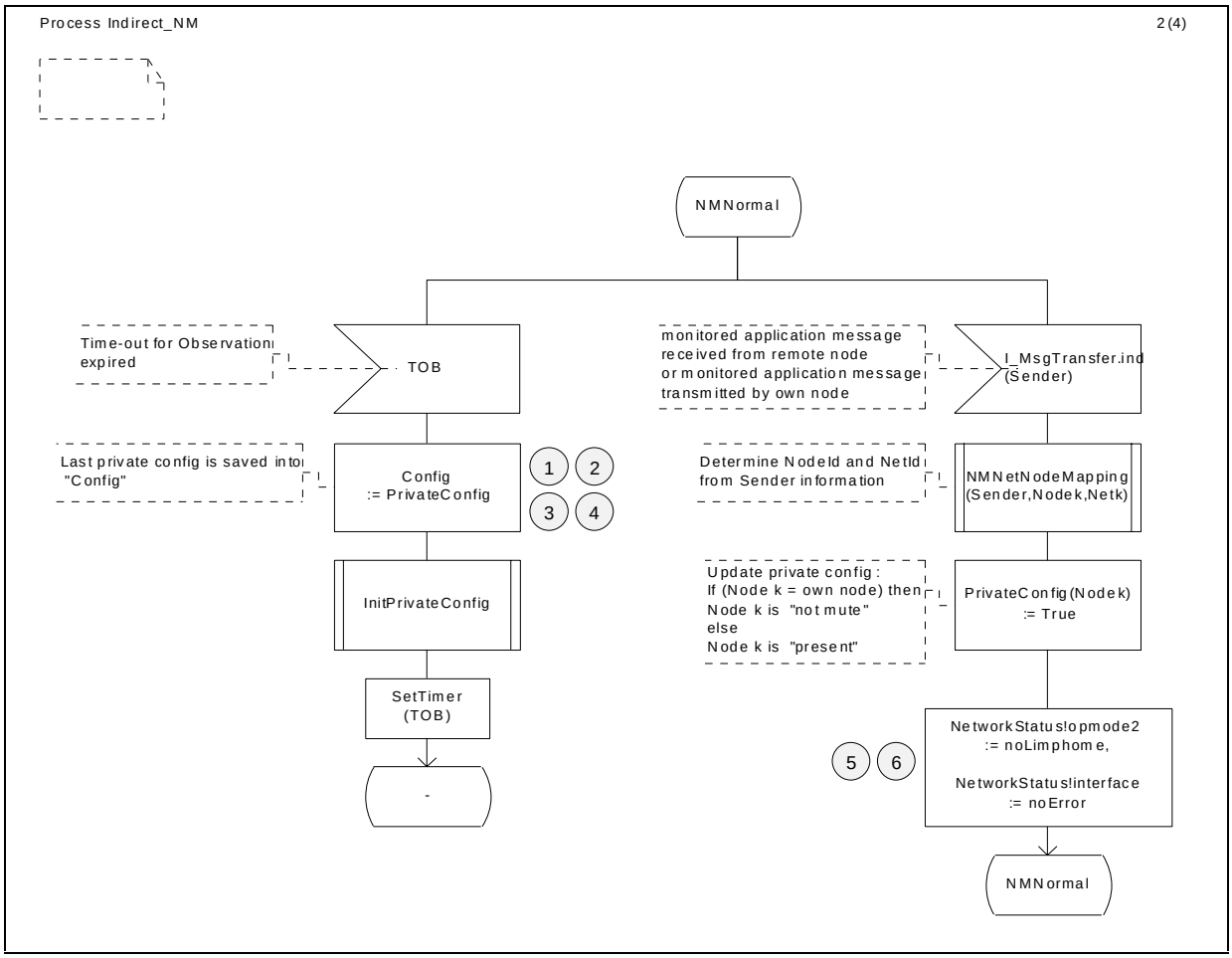
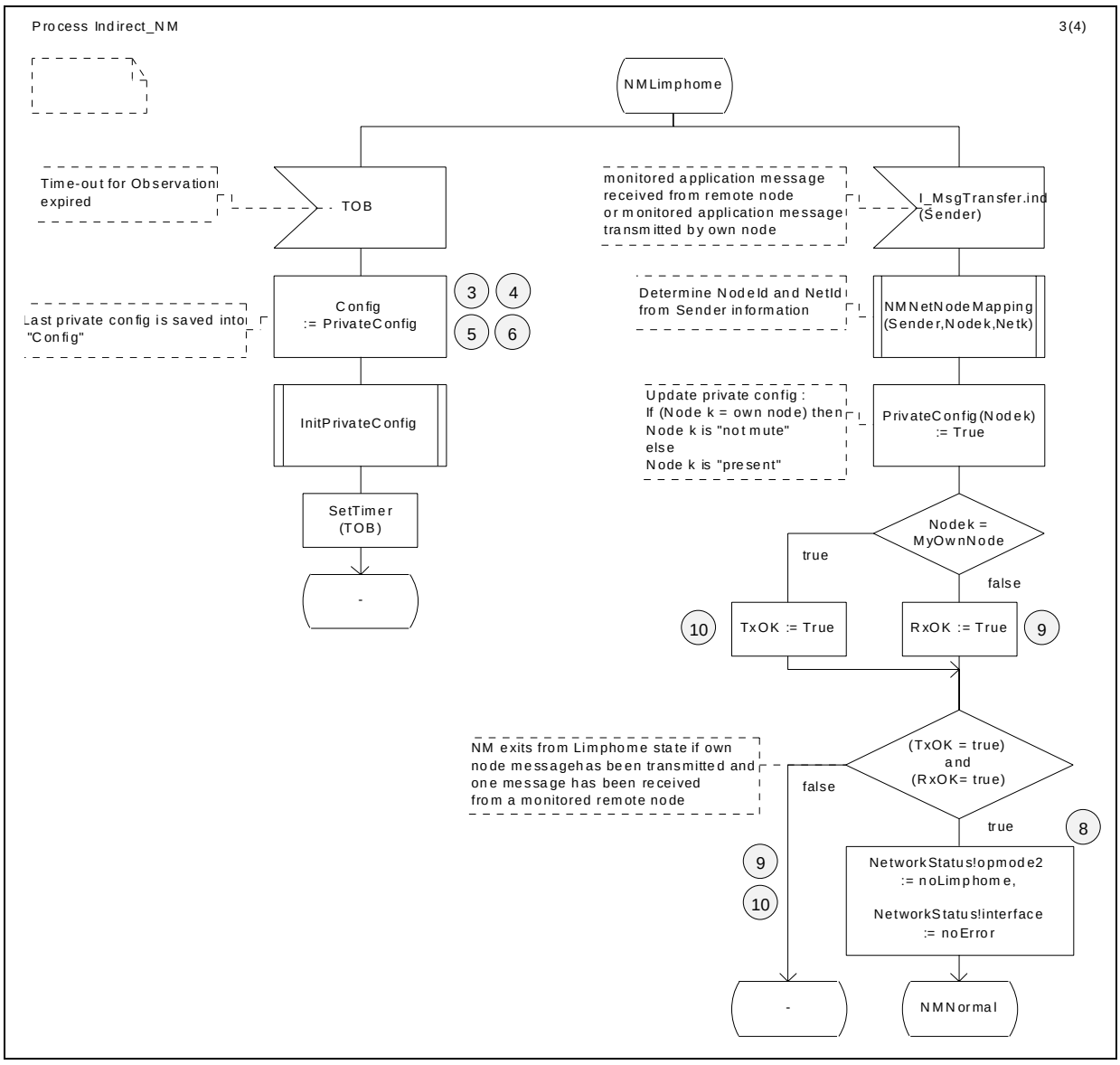


Figure 6 Test coverage of the NMNormal state

3.2.2.3. NMLimphome

Nr	Assertion	Paragraph in spec.	Affected variants
User's communication management			
1	If a fatal bus error is detected in any state, the NM enters the NMLimphome state and application communication is disabled.	Fig. 53	Core
2	In NMLimphome state, application communication is enabled after T_{Error}	Fig. 53	Core
Network configuration management			
3	In NMLimphome state, a supervised node is considered present if the monitored message from that node was received at least once in the last TOB period	Fig. 52	Core
4	In NMLimphome state, a supervised node is considered absent if the monitored message from that node was not received in the last TOB period	Fig. 52	Core
5	In NMLimphome state, own node is considered not mute if the monitored application message was transmitted at least once in the last TOB period	Fig. 52	Core
6	In NMLimphome state, own node is considered mute if the monitored application message was not transmitted in the last TOB period	Fig. 52	Core
Network status management			
7	On transition to NMLimphome, "Error, bus blocked" and "NMLimphome" information of network status is set.	Fig. 53 + Table 8	NMStatus
8	In NMLimphome state, if a monitored message from a remote node is received and a monitored message from own node is transmitted, the NM enters the NMNormal state. "Error, bus blocked" and "NMLimphome" information of network status is cleared.	Fig. 52 + Table 8	NMStatus
9	In NMLimphome state, if a monitored message from a remote node is received but no monitored message from own node is transmitted, "Error, bus blocked" and "NMLimphome" information of network status remains set.	Fig. 52 + Table 8	NMStatus
10	In NMLimphome state, if a monitored message from own node is transmitted but no monitored message from a remote node is received, "Error, bus blocked" and "NMLimphome" information of network status remains set.	Fig. 52 + Table 8	NMStatus

Coverage of indirect NM specification by the test purposes is shown in the SDL diagrams below. Circled numbers refer to test numbers in the table above.



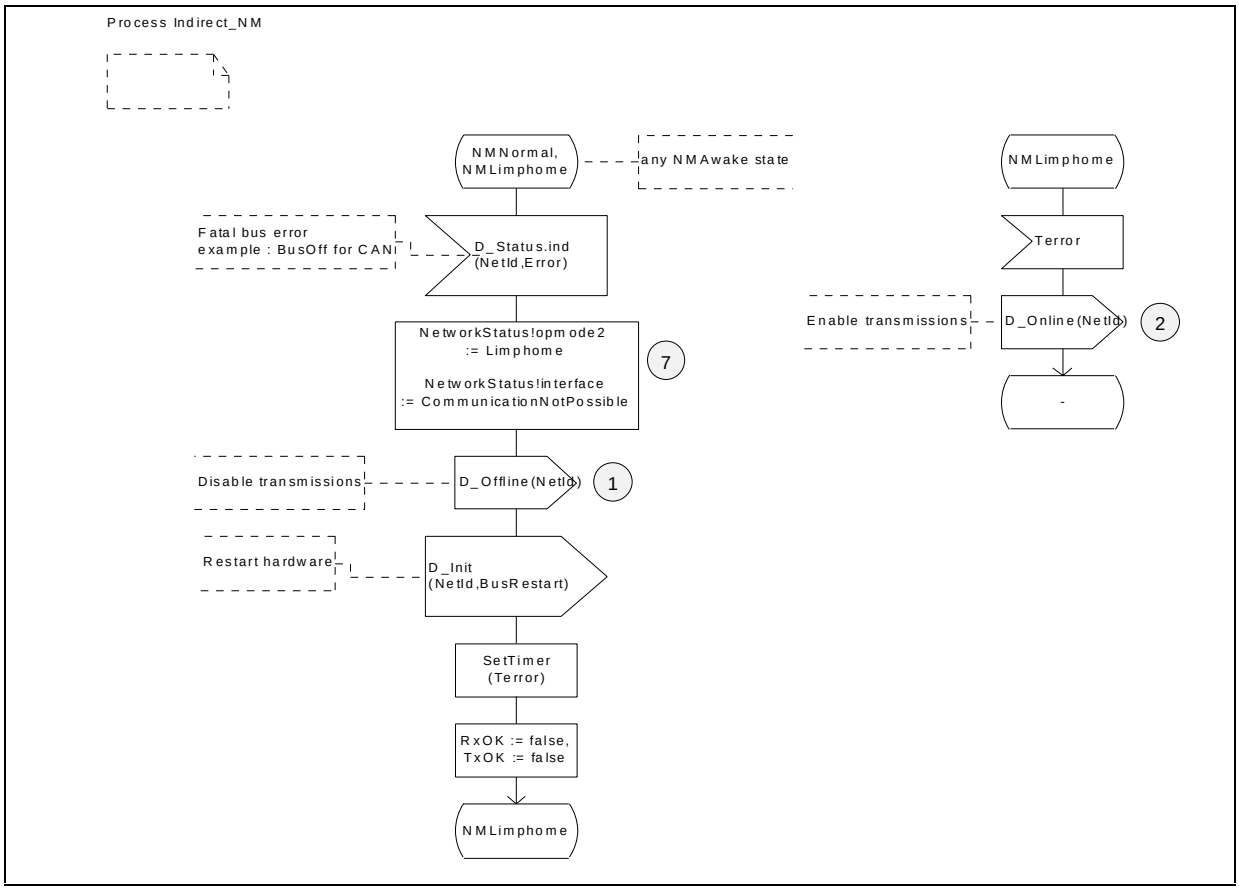


Figure 7 Test coverage of the NMLimpHome state

3.2.3. Protocol test group - One monitoring time-out per message

This section specifies tests purposes relative to the indirect NM protocol version called “one monitoring time-out per message ”, as defined in chapter 3 of the NM specification. Test purposes have been established from the SDL diagrams presented in the specification, according to the Conformance Methodology described in document [1]. They intend to verify that the NM implementation behaviour conforms to the specification. They include:

- tests of state activity: tests are specified to verify actions that should be performed by the implementation on a given input,
- tests of state transitions: one test is specified for each event that leads the NM to move from a given state to another state.

Each test purpose defines both the test stimulus to be sent and the subsequent output(s) to be observed at the NM API. Some actions can also be triggered by internal events. The test stimuli include:

- NM API procedure calls,
- Monitored messages sent to the implementation under test or transmitted by the user application,
- Timer expirations (internal stimuli): specific time-out to each monitored message, T_{Error}, $T_{WaitBusSleep}$,
- Monitoring counter overflow (internal stimuli),
- Fatal bus error.

The observable outputs are as follows:

- Status of application communication (enabled or disabled),
- Information returned by API calls : network configuration, extended network configuration, network status, extended network status.

Each test purpose also gives information on the specification variant(s) that need to be implemented for the test purpose to be verified.

The Core variant means that the test shall be executed in any case.

The BusSleep variant means that the test must be executed only if the optional GotoMode service is implemented.

The "NMStatus" variant implies a test of a network status change. There are two ways of testing this information:

1. Test by a GetStatus API call, if this optional procedure is effectively implemented,
2. Test of a task activation occurrence or an OS event occurrence, depending on the status changes selected through the SelectDeltaStatus service.

In the test purposes, the changes to network status information are expressed by the following assertions:

Network status value		Assertion
0	No error	“Error, bus blocked” information of network status is cleared
1	Error, Bus blocked	“Error, bus blocked” information of network status is set
0	NMOn	“NMOn/NMOff” information of network status is cleared
1	NMOff	“NMOn/NMOff” information of network status is set
0	no NMLimpHome	“NMLimphome” information of network status is cleared
1	NMLimpHome	“NMLimphome” information of network status is set
0	no NMBusSleep	“NMBusSleep” information of network status is cleared
1	NMBusSleep	“NMBusSleep” information of network status is set
0	no NMWaitBusSleep	“NMWaitBusSleep” information of network status is cleared
1	NMWaitBusSleep	“NMWaitBusSleep” information of network status is set

The changes to extended network status information are expressed by the following assertions:

Extended network status value		
00	No error	“Error, Communication not possible” information of network status is cleared
10	Error, Communication not possible	“Error, Communication not possible” information of network status is set

Note that information “Error, Communication possible” is never used in the SDL specification. Therefore, there is no test purpose to check it.

3.2.3.1. Handling of StartNM, StopNM and InitConfig

Nr	Assertion	Paragraph in spec.	Affected variants
User's communication management			
1	When StartNM is called, application communication is enabled.	Fig. 56	Core
Network configuration management			
2	When StartNM is called, network configuration is initialised. Own node is considered mute, remote nodes are considered absent.	Fig. 56 + Fig. 62	Core
3	When StartNM is called, extended network configuration is initialised. Own node is considered static not mute, remote nodes are considered static present.	Fig. 56 + Fig. 62	Core
4	If InitConfig is called in NMNormal, NMLimpHome or NMWaitBusSleep state, extended network configuration is initialised. Own node is considered static not mute, remote nodes are considered static present.	Fig. 56 + Fig. 62	Core (or BusSleep)
Network status management			
5	When StartNM is called, all network status and extended network status information is cleared.	Fig. 56 + Fig. 63 + Table 8,9	NMStatus
6	When StopNM is called, NMon/NMoff information of network status is set.	Fig. 56 + Table 8	NMStatus

Coverage of indirect NM specification by the test purposes is shown in the SDL diagrams below. Circled numbers refer to test numbers in the table above.

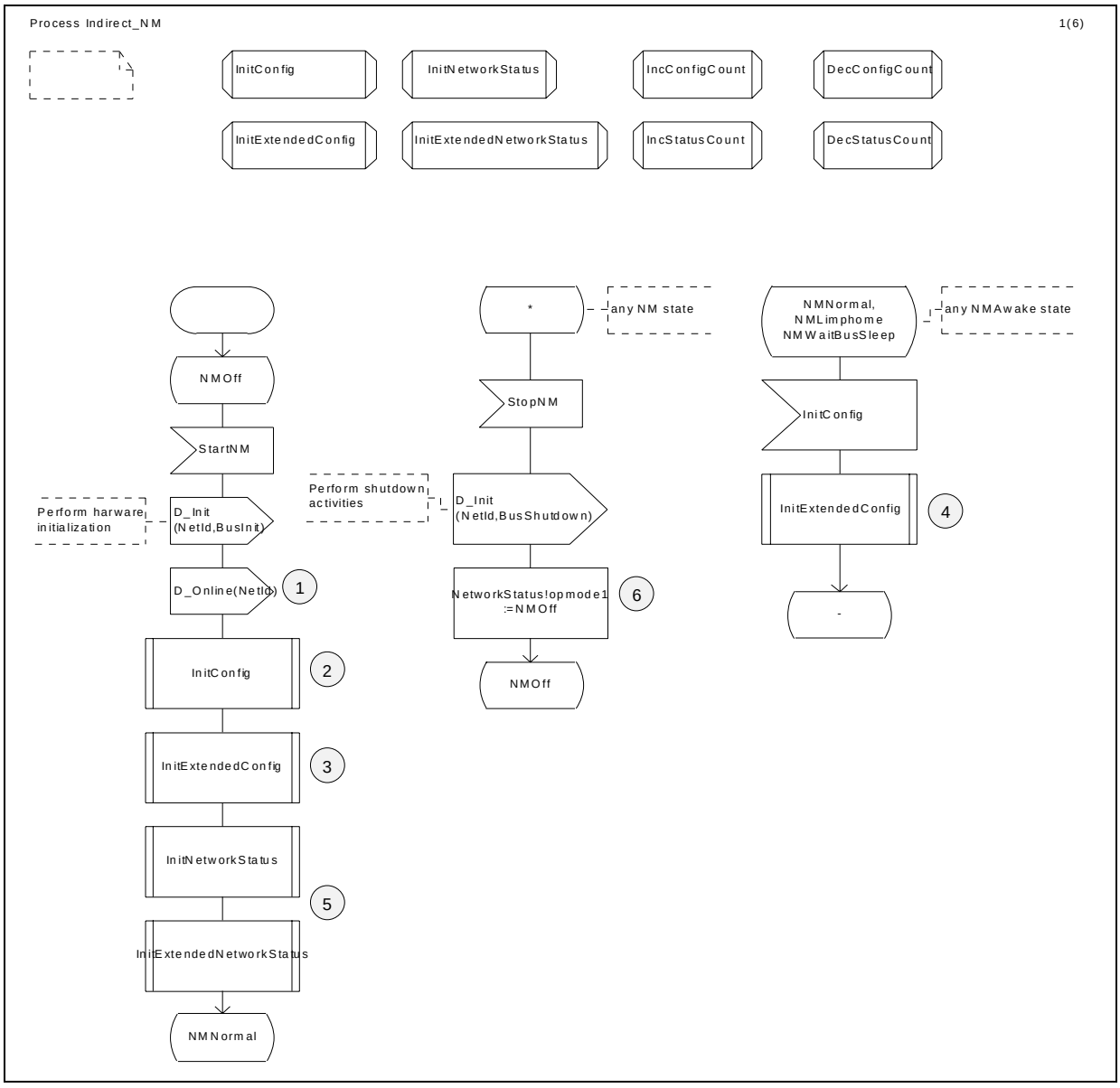


Figure 8 Test coverage of the services StartNM, StopNM and InitConfig

3.2.3.2. NMNormal

Nr	Assertion	Paragraph in spec.	Affected variants
Network configuration management			
1	In NMNormal state, a supervised node is declared present and static present when the monitored message from that node is received.	Fig. 57	Core
2	In NMNormal state, a supervised node is declared absent if the monitored message from that node has not been received after the dedicated monitoring time-out.	Fig. 57	Core

3	In NMNormal state, a supervised node is declared static absent if the monitored message from that node has not been received after the dedicated monitoring time-out and if the associated counter equals the threshold.	Fig. 57	Core
4	In NMNormal state, a supervised node remains static present if the monitored message from that node has not been received after the dedicated monitoring time-out and if the associated counter is below the threshold.	Fig. 57	Core
5	In NMNormal state, own node is declared not mute and static not mute when the monitored application message is transmitted.	Fig. 57	Core
6	In NMNormal state, own node is declared mute if the monitored application message has not been transmitted after the dedicated monitoring time-out.	Fig. 57	Core
7	In NMNormal state, a supervised node is declared static mute if the monitored message from that node has not been transmitted after the dedicated monitoring time-out and if the associated counter equals the threshold.	Fig. 57	Core
8	In NMNormal state, a supervised node remains static not mute if the monitored message from that node has not been received after the dedicated monitoring time-out and if the associated counter is below the threshold.	Fig. 57	Core
Network status management			
9	When the monitored message from a supervised node is received in NMNormal state, “Error, bus blocked” and “NMLimphome” information of network status is cleared, as well as “Error, communication not possible” information of extended network status.	Fig. 57 + Table 8 + Table 9	NMStatus
10	When the monitored message from own node is transmitted in NMNormal state, “Error, bus blocked” and “NMLimphome” information of network status is cleared, as well as “Error, communication not possible” information of extended network status.	Fig. 57 + Table 8 + Table 9	NMStatus

Coverage of indirect NM specification by the test purposes is shown in the SDL diagrams below. Circled numbers refer to test numbers in the table above.

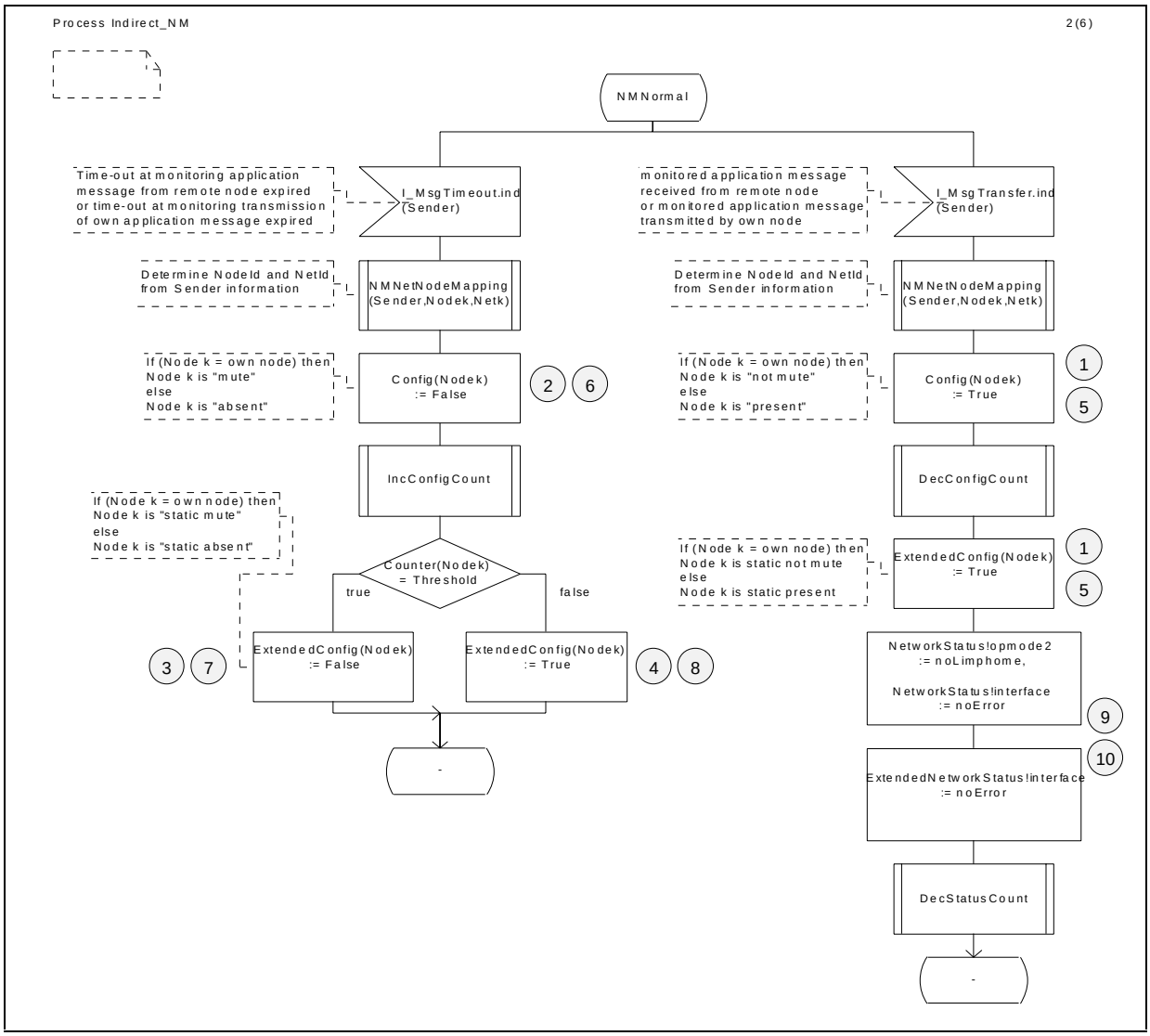


Figure 9 Test coverage of the NMNormal state

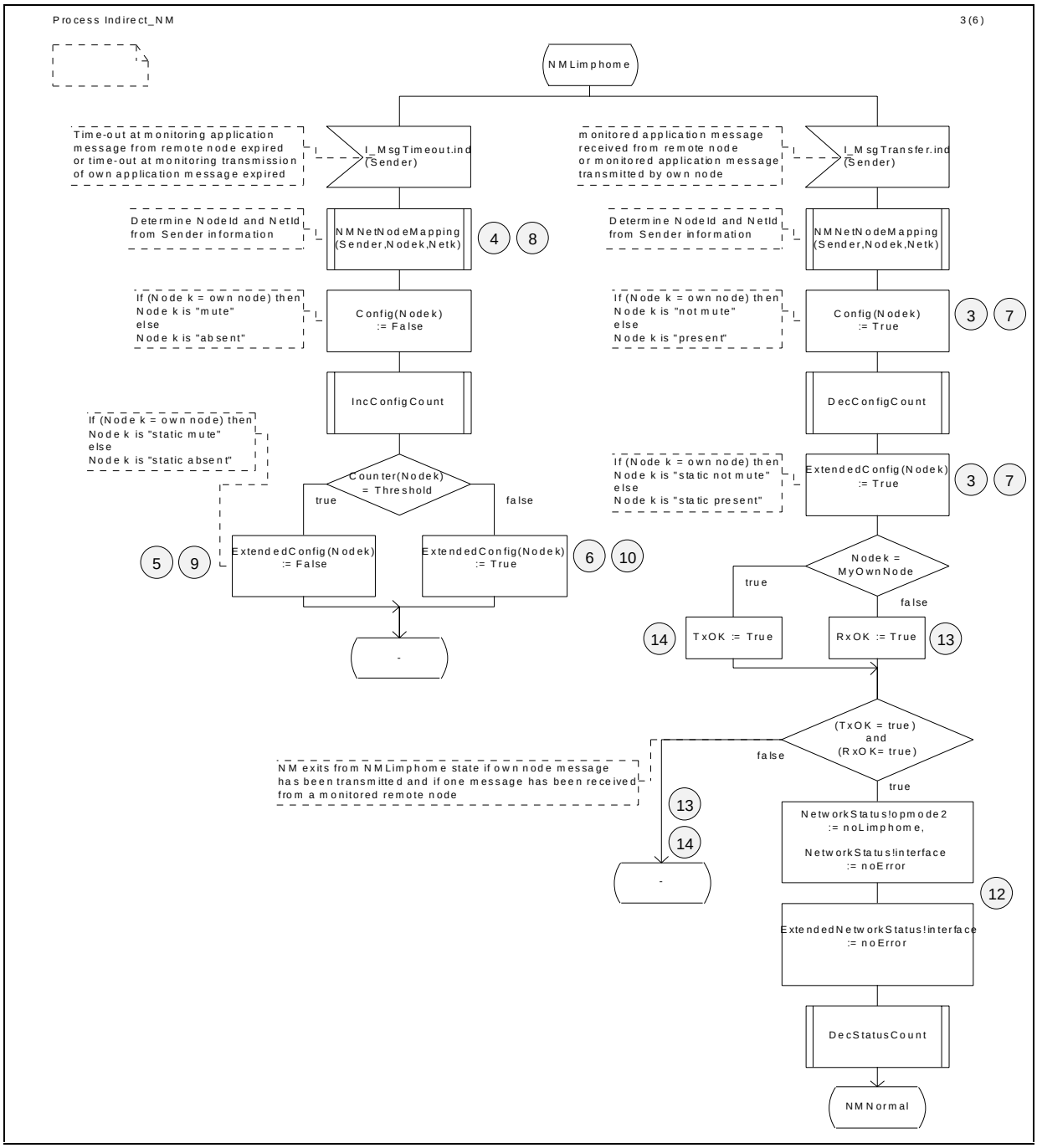
3.2.3.3. NMLimphome

Nr	Assertion	Paragraph in spec.	Affected variants
User's communication management			
1	If a fatal bus error is detected in NMNormal, NMLimphome state, the NM enters the NMLimphome state and application communication is disabled.	Fig. 59	Core
2	In NMLimphome state, application communication is enabled after T_{Error}	Fig. 59	Core
Network configuration management			

3	In NMLimphome state, a supervised node is declared present and static present when the monitored message from that node is received.	Fig. 58	Core
4	In NMLimphome state, a supervised node is declared absent if the monitored message from that node has not been received after the dedicated monitoring time-out.	Fig. 58	Core
5	In NMLimphome state, a supervised node is declared static absent if the monitored message from that node has not been received after the dedicated monitoring time-out and if the associated counter equals the threshold.	Fig. 58	Core
6	In NMLimphome state, a supervised node remains static present if the monitored message from that node has not been received after the dedicated monitoring time-out and if the associated counter is below the threshold.	Fig. 58	Core
7	In NMLimphome state, own node is declared not mute and static not mute when the monitored application message is transmitted.	Fig. 58	Core
8	In NMLimphome state, own node is declared mute if the monitored application message has not been transmitted after the dedicated monitoring time-out.	Fig. 58	Core
9	In NMLimphome state, a supervised node is declared static mute if the monitored message from that node has not been transmitted after the dedicated monitoring time-out and if the associated counter equals the threshold.	Fig. 58	Core
10	In NMLimphome state, a supervised node remains static not mute if the monitored message from that node has not been received after the dedicated monitoring time-out and if the associated counter is below the threshold.	Fig. 58	Core
Network status management			
11	On transition to NMLimphome, “Error, bus blocked” and “NMLimphome” information of network status is set.	Fig. 59 + Table 8	NMStatus
12	In NMLimphome state, if a monitored message from a remote node is received and a monitored message from own node is transmitted, the NM enters the NMNormal state. “Error, bus blocked” and “NMLimphome” information of network status is cleared, as well as “Error, communication not possible” information of extended network status.	Fig. 58 + Table 8 + Table 9	NMStatus

13	In NMLimphome state, if a monitored message from a remote node is received but no monitored message from own node is transmitted, “Error, bus blocked” and “NMLimphome” information of network status remains set, as well as “Error, communication not possible” information of extended network status.	Fig. 58 + Table 8 + Table 9	NMStatus
14	In NMLimphome state, if a monitored message from own node is transmitted but no monitored message from a remote node is received, “Error, bus blocked” and “NMLimphome” information of network status remain set, as well as “Error, communication not possible” information of extended network status.	Fig. 58 + Table 8 + Table 9	NMStatus
15	When a fatal bus error is detected, the NM is not in NMWaitBusSleep state and the status counter equals the threshold, “Error, communication not possible” information of extended network status is set.	Fig. 59 + Table 9	NMStatus
16	When a fatal bus error is detected, the NM is not in NMWaitBusSleep state and the status counter is below the threshold, “Error, communication not possible” information of extended network status remains cleared.	Fig. 59 + Table 9	NMStatus
17	When a fatal bus error is detected and the NM is not in NMWaitBusSleep state and the status counter is below the threshold, “Error, communication not possible” information of extended network status not changed.	Fig. 59	NMStatus + BusSleep

Coverage of indirect NM specification by the test purposes is shown in the SDL diagrams below. Circled numbers refer to test numbers in the table above.


NMLimphome
Time-out at monitoring application message from remote node expired or time-out at monitoring transmission of own application message expired
l_MsgTimeout.ind (Sender)
monitored application message received from remote node or monitored application message transmitted by own node
l_MsgTransfer.ind (Sender)
Determine NodeId and NetId from Sender information
NMNetNodeMapping (Sender,Nodek,Netk)
4
8
Determine NodeId and NetId from Sender information
NMNetNodeMapping (Sender,Nodek,Netk)
If (Node k = own node) then Node k is "mute" else Node k is "absent"
Config(Nodek) := False
If (Node k = own node) then Node k is "not mute" else Node k is "present"
Config(Nodek) := True
3
7
IncConfigCount
DecConfigCount
If (Node k = own node) then Node k is "static mute" else Node k is "static absent"
Counter(Nodek) = Threshold
true
false
If (Node k = own node) then Node k is "static not mute" else Node k is "static present"
ExtendedConfig(Nodek) := True
3
7
5
9
ExtendedConfig(Nodek) := False
ExtendedConfig(Nodek) := True
6
10
Nodek = MyOwnNode
true
false
14
TxOK := True
RxOK := True
13
(TxOK = true) and (RxOK= true)
false
true
NM exits from NMLimphome state if own node message has been transmitted and if one message has been received from a monitored remote node
13
14
NetworkStatus!opmode2 := noLimphome,
NetworkStatus!interface := noError
12
ExtendedNetworkStatus!interface := noError
DecStatusCount
NMNormal

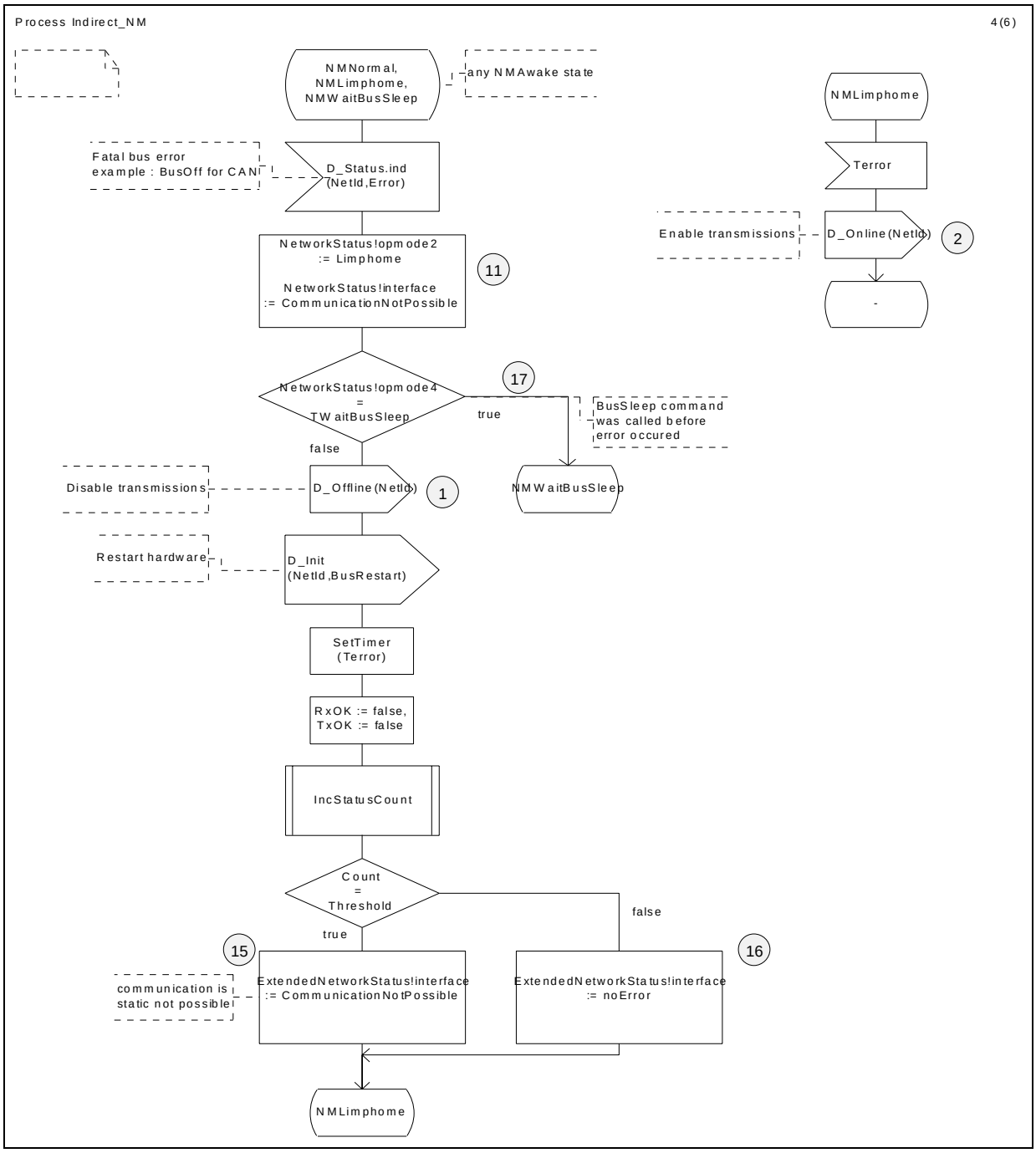


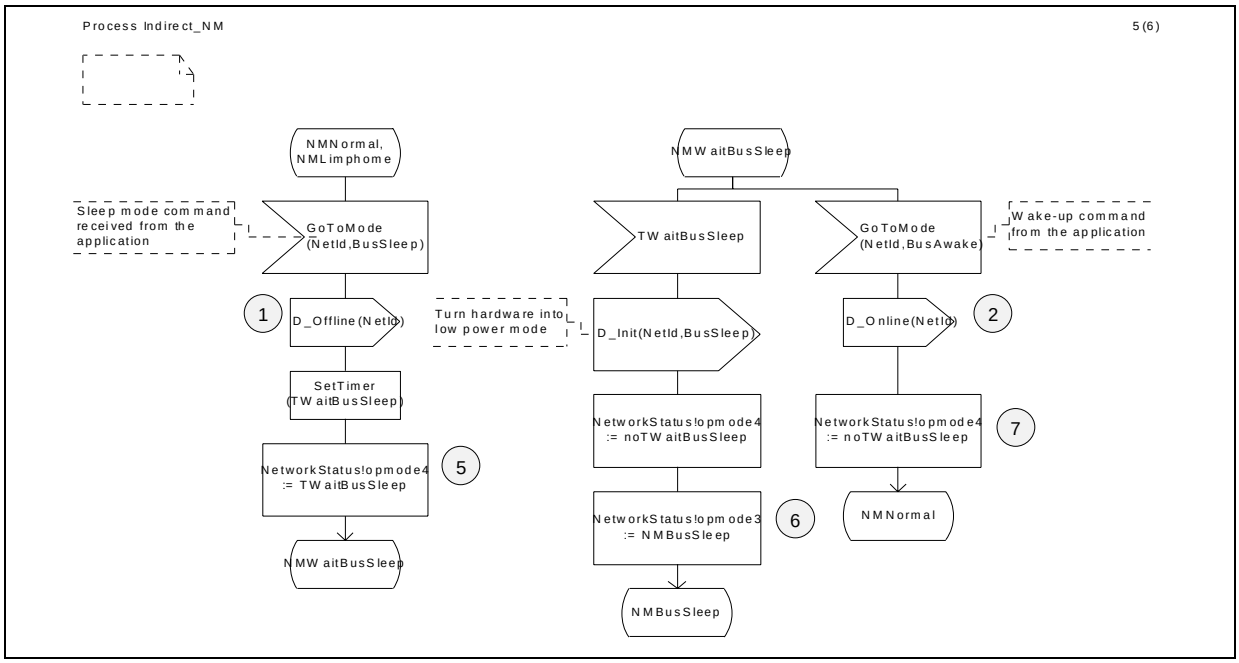
Figure 10 Test coverage of the NMLimpHome state

3.2.3.4. NMBusSleep

Nr	Assertion	Paragraph in spec.	Affected variants
User's communication management			
1	If GotoMode(BusSleep) is called in NMNormal or NMLimpHome state, the NM enters the NMWaitBus-Sleep state and application communication is disabled.	Fig. 60	BusSleep

2	If GotoMode(Awake) is called in NMWaitBusSleep state, it enters the Normal state and application communication is enabled.	Fig. 60	BusSleep
3	If GotoMode(Awake) is called in NMBusSleep state, the NM enters the Normal state and application communication is enabled.	Fig. 61	BusSleep
4	If a wake-up signal is received from the bus in NMBusSleep state, the NM enters the Normal state and application communication is enabled.	Fig. 61	BusSleep
Network status management			
5	On transition to NMWaitBusSleep, "TWaitBusSleep" information of network status is set.	Fig. 60 + Table 8	BusSleep + NMStatus
6	If $T_{WaitBusSleep}$ timer expires, "TWaitBusSleep" information of network status is cleared and "NMBusSleep" information is set.	Fig. 60 + Table 8	BusSleep + NMStatus
7	On transition from NMWaitBusSleep to NMNormal, "TWaitBusSleep" information of network status is cleared.	Fig. 60 + Table 8	BusSleep + NMStatus
8	On transition from NMBusSleep to NMNormal, "NMBusSleep" information of network status is cleared.	Fig. 61 + Table 8	BusSleep + NMStatus

Coverage of indirect NM specification by the test purposes is shown in the SDL diagrams below. Circled numbers refer to test numbers in the table above.



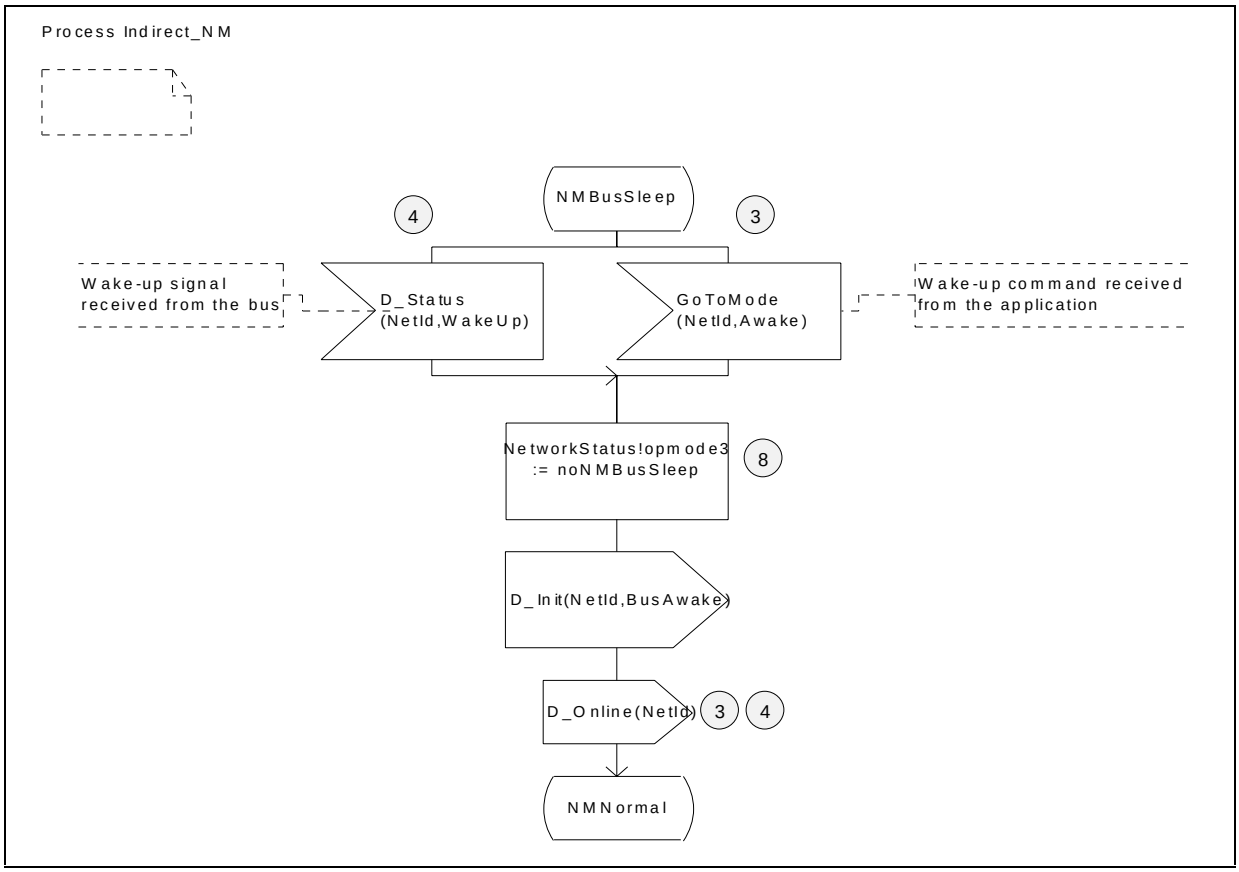


Figure 11 Test coverage of WaitBusSleep and BusSleep states