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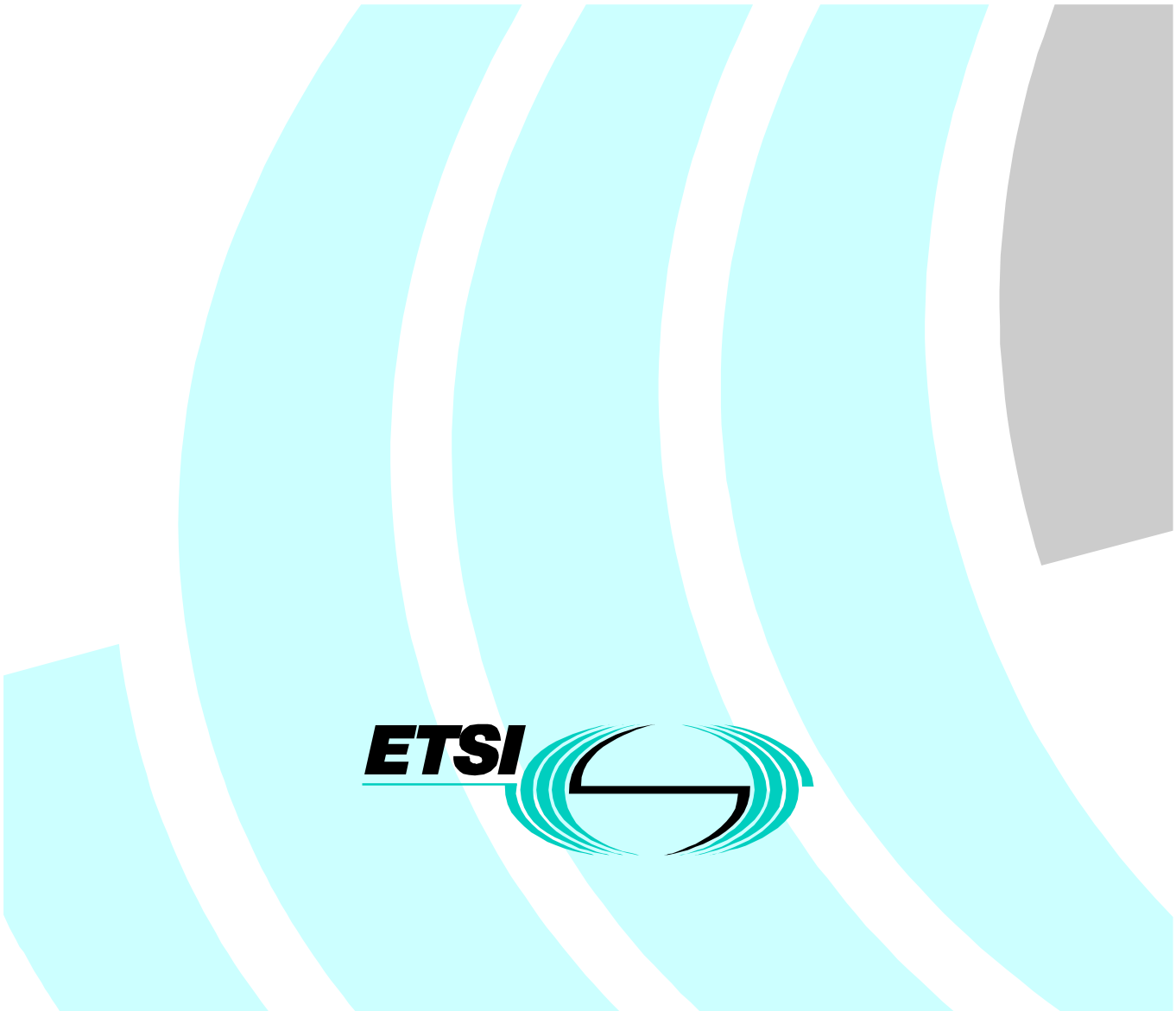
European Standard (Telecommunications series)

Integrated Services Digital Network (ISDN); Narrowband Multi-service Delivery System (NMDS); Part 1: NMDS interface specification



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Contents

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Services and Protocols for Advanced Networks (SPAN).

The present document is part 1 of a multi-part deliverable covering the Integrated Services Digital Network (ISDN); Narrowband Multi-service Delivery System (NMDS), as identified below:

Part 1: "NMDS interface specification";

Part 2: "Protocol Implementation Conformance Statement (PICS) proforma specification";

Part 3: "Test Suite Structure and Test Purposes (TSS&TP) specification for the user";

Part 4: "Abstract Test Suite (ATS) and partial Protocol Implementation eXtra Information for Testing (PIXIT) proforma specification for the user".

National transposition dates	
Date of adoption of this EN:	27 October 2000
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Introduction

The present document specifies the provision of Public Switched Telephone Network (PSTN) services over an existing Integrated Services Digital Network - Basic Access (ISDN-BA) digital subscriber line (DSL). Today PSTN terminals - normal telephones - can be connected to the S/T-interface via a Terminal Adapter (TA) with the support of services that can be mapped at a feasible cost from ISDN (principally the basic call services).

1 Scope

The present standard defines requirements to support the Narrowband Multi-service Delivery System (NMDS) which provides interfaces connected via a Network Termination Node (NTN) to a Local Exchange (LE), in order to support existing PSTN and ISDN services over an existing ISDN-Basic Access digital subscriber line (DSL).

The Narrowband Multi-Service Delivery System (NMDS) may also be connected via a V5 interface Access Network (AN) to a Local Exchange (LE) in order to provide existing PSTN and ISDN services. This optional arrangement is described in annex D which identifies two alternative methods to provide the same overall functionality.

The present document also contains requirements which relate to the functionality of a (new) Network Termination Node (NTN) for supporting both Public Switched Telephone Network (PSTN) access and Integrated Services Digital Network - Basic Access (ISDN-BA) S/T reference point interfaces over a single (digital section) transmission system as used for existing ISDN-BA. The NTN encompasses NT2-like (noted NT2*) functionality, physical PSTN user port(s) and PSTN protocol functionality.

An NMDS implementation may contain one ISDN-BA port and/or a limited number of PSTN ports. Typically one or two PSTN ports would be supported.

In order to maintain an evolutionary path for PSTN services, the national V5 PSTN protocol mapping is assumed to exist and forms an integral part of this specification.

NOTE: It is an underlying principle of the present document that, wherever practicable, steps may be taken to minimize the cost of the NTN, subject to maintaining the required functionality.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] ETSI ETR 080 (1996): "Transmission and Multiplexing (TM); Integrated Services Digital Network (ISDN) basic rate access; Digital transmission system on metallic local lines".

[2] ETSI ETS 300 012-1 (1996): "Integrated Services Digital Network (ISDN); Basic User-Network Interface (UNI); Part 1: Layer 1 specification".

[3] ETSI ETS 300 324-1 (1994): "V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Network (AN); Part 1: V5.1 interface specification".

[4] ETSI ETS 300 347-1 (1994): "V interfaces at the digital Local Exchange (LE); V5.2 interface for the support of Access Network (AN); Part 1: V5.2 interface specification".

[5] ETSI ETS 300 402-2: "Integrated Services Digital Network (ISDN); Digital Subscriber Signalling System No. one (DSS1) protocol; Data link layer; Part 2: General protocol specification [ITU-T Recommendation Q.921 (1993), modified]".

[6] ITU-T Recommendation I.412 (1988): "ISDN user-network interfaces - Interface structures and access capabilities".

[7] ETSI EN 301 141-2 (V1.2): "Integrated Services Digital Network (ISDN); Narrowband Multi-service Delivery System (NMDS); Part 2: Protocol Implementation Conformance Statement (PICS) proforma specification".

[8] ITU-T Recommendation M.3603 (1992): "Application of maintenance principles to ISDN basic rate access".

[9] ITU-T Recommendation M.3602 (1992): "Application of maintenance principles to ISDN subscriber installations".

[10] ETSI ETS 300 297 (1995): "Integrated Services Digital Network (ISDN); Access digital section for ISDN basic access".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Narrowband Multi-service Delivery System: system that provides an interface to the network directly to the LE or via an AN to support existing PSTN and ISDN services over an ISDN-BA DSL.

Network Termination Node: functional group on the user side of the digital section (NMDS interface noted T* reference point) that includes functionality to support an ISDN-BA port and/or one or more PSTN ports.

Network Termination Type 2 *: functional group within the NTN which, at the user side of the T* reference point, performs the PSTN layer 2 and the ISDN layer 2 multiplexing and demultiplexing over the D channel, and only interprets (and then relays) the layer 3 messages to switch the B channels to the ISDN access and the PSTN Gateways as instructed by the signalling messages.

PSTN-Gateway: functional group within the NTN which terminates the PSTN interface at the NTN.

T* reference point: reference point which provides access to the NMDS, between the network termination of the digital section (NT1) and the Network Termination Node functional group.

V1* reference point: V1 reference point with the addition of PSTN functionality required to support the NMDS.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AN	Access Network
BCC	Bearer Channel Control
CPE	Customer Premises Equipment
DLCI	Data Link Connection Identifier
DSL	Digital Subscriber Line
DTMF	Dual Tone Multi-Frequency
ISDN	Integrated Services Digital Network
ISDN-BA	Integrated Services Digital Network - Basic Access
LE	Local Exchange
NMDS	Narrowband Multi-service Delivery System
NT	Network Termination
NT1	NT type 1 (see ETR 080 [1])
NT2*	Network Termination Type 2* (see the definition in subclause 3.1 above)
NTN	Network Termination Node
NWK	Network Layer
PSTN	Public Switched Telephone Network
PSTN-GW	PSTN Gateway
SAPI	Service Access Point Identifier
TA	Terminal Adapter

TE	Terminal Equipment
TEI	Terminal Endpoint Identifier
UNI	User Network Interface

4 General description

The purpose of the NMDS is to support both ISDN-BA and one or more PSTN user ports in the same manner such that they appear to the user as if they were directly connected to the LE. The support of ISDN-BA user ports utilizes the same type of functions as used by an NT1 defined in ETR 080 [1], whilst PSTN user ports are supported using the same PSTN protocol as defined in the V5.1 interface standard ETS 300 324-1 [3] with some modifications.

The LE is service responsible for and controls the tones (voice messages etc.) sent and received over the NMDS. See figure 1 for the functional architecture of NMDS.

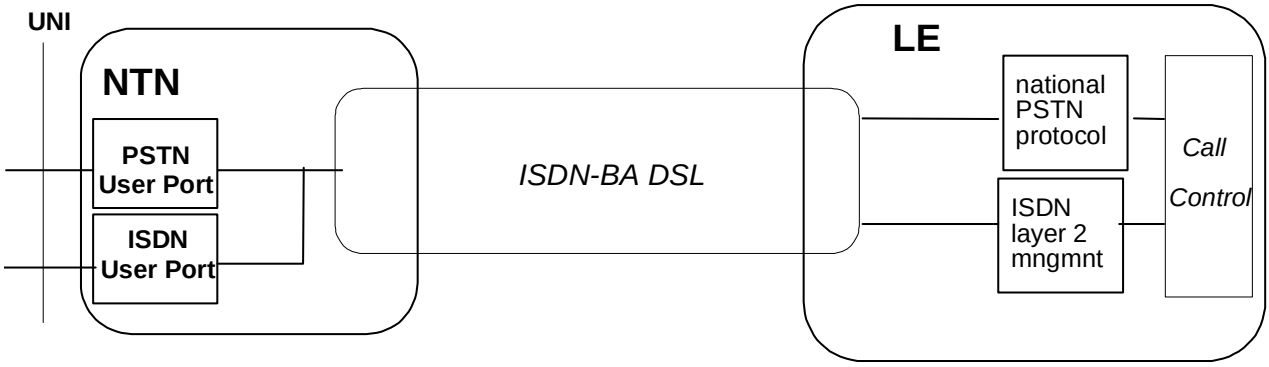


Figure 1: General NMDS functional diagram

The Narrowband Multi-service Delivery System (NMDS) is defined at the T* reference point and the complementary V1* reference point as shown in figure 2.

On any NMDS, the LE may support up to 10 PSTN (analogue) lines and the NTN may provide up to 10 PSTN (analogue) access ports. The provision of PSTN and ISDN access ports in the LE requires a bilateral agreement between the user and the service provider at subscription time.

5 Layer 1 functions

- Structure

  The general access structure is described in ITU-T Recommendation I.412 [6]. The access structure for ISDN-BA in ITU-T Recommendation I.412 [6] is valid also for the PSTN application. The layer 1 transporting the full NMDS functionality from the NTN to the LE shall be an ISDN-BA layer 1.

- ISDN-BA Digital Section

  In order to permit transparent operation via an AN, there shall be no changes to the ISDN-BA digital section layer 1 protocols.

- ISDN-BA UNI

  Layer 1 at the ISDN-BA UNI shall be in accordance with ETS 300 012-1 [2].

- Activation Procedures

  - NTN

    The NTN shall permit layer 1 activation from the ISDN UNI and layer 1 activation/deactivation from the network. In order to keep the NTN simple, the PSTN gateway shall not require "user side" activation procedures.

The NTN shall also allow the digital section to be activated regardless of the electrical conditions prevailing at the ISDN UNI and PSTN port.

Once the layer 1 is activated the NTN shall always transmit the ACT bit set to 1 towards the network. This is to prevent the possibility of the LE/AN deactivating the digital section as part of the recovery actions resulting from an ISDN UNI error. (Details of the ACT bit can be found in ETR 080 [1] annex A figure A.3 and subclause A.8.3.2.2. Its purpose is to indicate readiness for layer 2.)

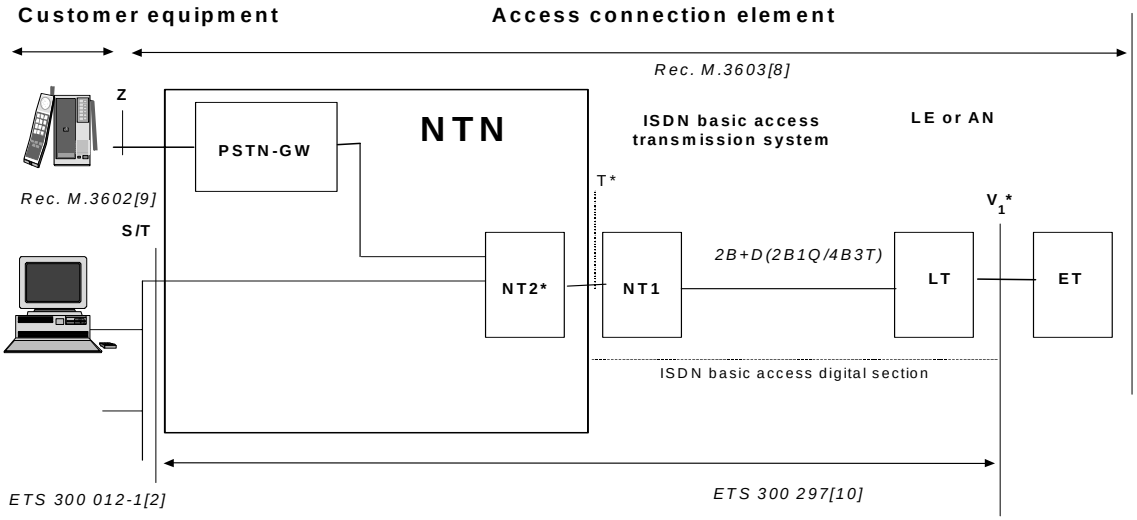
- LE/AN

  The network shall maintain the digital section in a permanently activated state whenever the PSTN protocols are to be supported.

  The permanent activation of the digital section may interfere with certain maintenance operations normally provided over the embedded operations channel. The LE shall be able to detect the activation state of the ISDN UNI which would have prevailed if the PSTN ports had not been present, using a message-based maintenance mechanism at layer 3 (see subclause 7.3.1.2).

- Diagnostics

  The NTN shall support full ISDN layer 1 diagnostic loop capability.



NOTE: The functionality and layout shown in figure 2 can only be one particular example and is not representative of all architectures where NMDS can be applied.
In actual implementations the NT1 functional group is likely to be physically integrated in an equipment realizing the NTN functionality.

Figure 2: An example of an NMDS scenario for NMDS

5.1 Powering Aspects

5.1.1 Power available from the transmission system

The power available for NMDS support is the actual power budget provided by the existing ISDN-BA digital section. Additional power is expected to be provided locally to the NTN. What may happen under local power fail conditions with respect to NTN user ports is described below. Hence there are no deviations from the requirements specified in the ISDN-BA standards in order to support NMDS.

5.1.2 NMDS behaviour under power fail conditions

The ISDN-BA UNI standard (ETS 300 012-1 [2]) describes a potential requirement that a designated instrument may be made available on an S/T Interface. If this designated instrument is available, then it shall be capable of (at least) making emergency telephone calls.

For the PSTN, the situation is not mandated on a European wide basis and depends upon nationally agreed regulations which are outside the scope of the present document.

The NMDS may be comprised of one or more PSTN ports, potentially as well as an ISDN-BA port. Hence it is not possible to define in a standard mandatory behaviour under power-fail conditions. What is more relevant is that manufacturers are able to adequately define their system's behaviour under power failure conditions. For this reason, a clause has been inserted into the Protocol Implementation Conformance Statement (PICS) document, EN 301 141-2 [7], where such behaviour may be explained.

6 Layer 2 functions

6.1 Overview

The layer 2 used within the NMDS system, used for both PSTN and ISDN-BA services, shall be in accordance with ETS 300 402-2 [5] but with the following restrictions.

The LE layer 2 state machine shall be as per ETS 300 402-2 [5].

The PSTN gateway layer 2 state machine shall be as defined in subclause 6.2 of the present document, providing a restricted functionality version of the state machine in ETS 300 402-2 [5].

The PSTN gateway shall use a single permanently activated data link with a fixed Data Link Connection Identifier (DLCI) for all communication with the network. The DLCI shall consist of a PSTN Terminal Endpoint Identifier (TEI) allocated from the automatic TEI values (i.e. 64-126) and Service Access Point Identifier (SAPI) set equal to 0. TEI values 117 to 126 shall be reserved for PSTN use when NMDS is implemented on an access.

The first PSTN gateway to be fitted shall use TEI 126 and be identified as Line 1. TEI values 117 to 125 are reserved for further PSTN gateways, lines 2 to 10, as shown in the table 1.

Table 1: Allocation of TEI to PSTN ports

TEI value	Line number
126	1
125	2
124	3
123	4
122	5
121	6
120	7
119	8
118	9
117	10

The PSTN gateway shall not support the broadcast data link, or TEI management procedures, and shall not initiate layer 2 establishment, i.e. the DL_ESTABLISH_REQUEST primitive in the TEI assigned state shall not be supported.

On the ISDN port, point-to-point (i.e. TEI 0) or point-to-multipoint procedures may be supported using the full ISDN TEI assignment procedures as currently defined. These include TEI assignment and removal procedures. However, some previously available values are now reserved (see table 1).

It is expected that some implementations may provide additional PSTN-GWs either as separate equipment connected to the S/T Interface or as further integrated entities. In each case the TEI allocations shall comply with those shown in table 1. The TEI associated with each external PSTN-GW shall be preprovisioned.

6.2 PSTN-GW layer 2 state machine modifications

The modifications required to the BA layer 2 state machine for the PSTN-GW are specified below as a list of differences to the state machine contained in annex D of ETS 300 402-2 [5].

Delete states 1, 2, 3, 5.0, 5.2 and 6.

Delete the following input events:

- DL-ESTABLISH-REQUEST;
- DL-RELEASE-REQUEST;
- DL-UNIT DATA-REQUEST;
- UI FRAME IN QUEUE;
- MDL-ASSIGN-REQUEST;
- MDL-REMOVE-REQUEST;
- MDL-ERROR-RESPONSE;
- T203 TIME-OUT.

Renumber state 4, and all references to it, to state 9; rename the state to "LINK NOT ESTABLISHED".

Delete all instances of the following output events replacing the event with "-" if it was the only action associated with the input event/state combination under consideration:

- DISC UI QUEUE;
- START T203;
- STOP T203;
- RESTART T203;
- MDL-ERR-IND(all variants);
- DL-UNIT-DATA-IND.

Replace all instances of "DISC I and UI QUEUES" with "DISC I QUEUE".

For input event "T200 TIME-OUT" in states 7.0 through to state 7.3 delete the "either" option.

For input event "T200 TIME-OUT; RC<N200; V(A)<V(S)" in states 8.0 through to state 8.3 delete the "either" option.

Replace all instances of DL-EST-IND and DL-REL-IND with MDL-EST-IND and MDL-REL-IND respectively.

Replace the action for input event "DM F=0 able to enter state 7.0" in state 9 with "-".

6.3 PSTN layer 2 activation

After installing the NTN, the PSTN-GW part of the NTN shall wait for activation from the network. As soon as layer 1 is activated, the LE shall be in a position to attempt layer 2 establishment of the PSTN-GW as and when required (as immediate service provision may not be required).

Loss of power and resumption of power on the DSL shall force a reset of the PSTN-GW functionality to the idle condition.

7 Layer 3 functions and message definitions

7.1 General

The PSTN network layer (NWK) protocol shall be in accordance with ETS 300 324-1 [3] clause 13 subject to the following modifications and restrictions.

- The NTN shall be considered as implementing the AN parts throughout ETS 300 324-1 [3] clause 13.
- The PSTN call control procedures of ETS 300 324-1 [3] shall be used. However, the PSTN Port blocking and the PSTN Restart procedures defined in ETS 300 324-1 [3] do not apply to the NMDS. Hence the following events described in ETS 300 324-1 [3] PSTN functional state machines (clause 13) are not applicable: MDU-CRTL (port blocked), MDU-CTRL (port unblocked), MDU-CTL (restart request) MDU-CTRL (restart complete). It results that the states AN0, AN6, LE0 and LE6 defined in ETS 300 324-1 [3] (subclauses 13.2.1.1 and 13.2.1.2) for the V5.1 interface are not used by the NMDS state machine.
- The meaning and definition of the L3addr field (ETS 300 324-1 [3] subclause 13.4.3) is modified to support the B-channel selection function as described in clause 8 of the present document.
- The present document provides additions to the message formats and procedures to those found in ETS 300 324-1 [3]. These are documented in subclause 7.3. They define and describe new maintenance status enquiry procedures.
- The protocol discriminator value for the additional messages defined in the present document (i.e. MAINTENANCE STATUS and MAINTENANCE STATUS ENQUIRY) shall be the same as for ETS 300 324-1 [3], i.e. 48H.

The NTN shall support the national PSTN requirements for all applicable signals (including collisions). All tones and announcements generated by the network shall be passed as inband signalling transparently over the B-channel to the customer. In the event of no B-channel being available then the proceed indication shall not be given to the customer until a channel becomes available i.e. the proceed indication shall not be generated by the PSTN-GW. DTMF dialled digits shall be passed transparently over the B-channel to the network.

The national PSTN mappings are beyond the scope of the present document.

7.2 Error handling

The LE shall support the full error handling procedures defined in ETS 300 324-1 [3] clause 13, relating to the V5.1 PSTN protocol with additional requirements as indicated in the present document.

The NTN shall support the full error handling procedures as defined in ETS 300 324-1 [3] clause 13 for the AN, relating to the V5.1 PSTN protocol with additional requirements as indicated in the present document.

In addition, in case of a PSTN layer 2 failure, if a PSTN call is established, this call is released by the LE. Upon successful re-establishment of the PSTN layer 2, the LE shall send a DISCONNECT COMPLETE message to the NTN and go into the "Null state (LE1)" in order to ensure synchronization of the NTN PSTN GW and the LE state machines.

NOTE: Call release may cause a network clearing message with a cause #27, *destination out of order*, or #41, *temporary failure*, and the location field set to 'public network serving the remote user', to be sent towards the exchange serving the remote user.

7.3 Maintenance functions

This clause defines the mechanism for the LE to be able to determine if customer equipment is connected to the PSTN-GW and to determine the synchronization status of the S/T interface. The support of the (ISDN and PSTN) maintenance mechanisms by the LE and NTN is optional.

It shall use the Layer 3 STATUS and STATUS ENQUIRY messages as defined in ETS 300 324-1 [3] subclause 13.4, except that the State and Cause information elements already defined for the STATUS are changed to optional and only one of the new variable length information elements defined below shall be included in a STATUS message.

7.3.1 The new STATUS ENQUIRY and STATUS messages

The new STATUS ENQUIRY and STATUS messages and their associated procedures shall follow those defined in ETS 300 324-1 [3], with the following additions:

- the State and Cause information elements shall not be included in the STATUS message;
- new information elements are defined for the STATUS and STATUS ENQUIRY messages.

The new messages shall hereafter in the present document be referred to as MAINTENANCE STATUS and MAINTENANCE STATUS ENQUIRY messages to differentiate them from those used as part of the standard PSTN Protocol procedures.

7.3.1.1 PSTN maintenance messages

The MAINTENANCE STATUS ENQUIRY and MAINTENANCE STATUS messages for the PSTN-GW status shall be sent using the TEI which is allocated to that gateway (see table 1).

7.3.1.1.1 The MAINTENANCE STATUS ENQUIRY message for PSTN maintenance

Table 2: The PSTN gateway MAINTENANCE STATUS ENQUIRY message

Bit 8	7	6	5	4	3	2	1
Protocol Discriminator							
Layer 3 Address (note)							1
Layer 3 Address (lower) (note)							
Message Type							
1	1	0	1	0	0	0	0
PSTN gateway status request information element identifier							

NOTE: The layer 3 address shall be coded as "Layer 3 address not relevant in current message" according to subclause 8.2.

7.3.1.1.2 The MAINTENANCE STATUS message for PSTN maintenance

This message shall be sent on receipt of a MAINTENANCE STATUS ENQUIRY message from the LE.

The MAINTENANCE STATUS message carries a new variable length optional information element in the direction NTN - LE.

Table 3: The PSTN gateway MAINTENANCE STATUS message

Bit 8	7	6	5	4	3	2	1
Protocol Discriminator							
Layer 3 Address							1
Layer 3 Address (Lower)							
Message Type							
0	0	0	1	1	1	1	0
PSTN gateway status response information element identifier							
0	0	0	0	0	0	0	1
Information element length							
1 ext.	STGW						

NOTE 1: The layer 3 Address shall be coded as "Layer 3 address not relevant in current message" according to subclause 8.2.

STGW defines the status of the addressed PSTN-GW (CPE presence indicator).

The coding of the STGW field shall be according to table 4.

Table 4: Coding of the STGW field

Bits 7 6 5 4 3 2 1	Meaning
0 0 0 0 0 0 0	No CPE present
0 0 0 0 0 0 1	CPE connected
0 0 0 0 0 1 0	Test Unavailable
NOTE: All other values are reserved.	

NOTE 2: The method for detecting that CPE is connected is not specified here and will depend upon the PSTN architecture used.

7.3.1.2 ISDN maintenance messages

The MAINTENANCE STATUS ENQUIRY and MAINTENANCE STATUS messages for the ISDN UNI status shall be sent using TEI 126.

7.3.1.2.1 The MAINTENANCE STATUS ENQUIRY message for ISDN maintenance

Table 5: The MAINTENANCE ISDN UNI STATUS ENQUIRY message

Bit 8	7	6	5	4	3	2	1
Protocol Discriminator							
Layer 3 Address (note)							1
Layer 3 Address (lower) (note)							
Message Type							
1	1	0	1	0	0	0	1
ISDN UNI status request information element identifier							

NOTE: The layer 3 Address shall be coded as "Layer 3 address not relevant in current message" according to subclause 8.2.

7.3.1.2.2 The MAINTENANCE STATUS message for ISDN maintenance

This message shall be sent in response to the receipt of a MAINTENANCE STATUS ENQUIRY message from the network containing the ISDN UNI status enquiry information element.

The MAINTENANCE STATUS message carries a new variable length information element in the direction NTN - LE.

Table 6: The MAINTENANCE ISDN UNI STATUS message

Bit 8	7	6	5	4	3	2	1
Protocol Discriminator							
Layer 3 Address (note)							1
Layer 3 Address (Lower) (note)							
Message Type							
0	0	0	1	1	1	1	1
ISDN UNI status response information element identifier							
0	0	0	0	0	0	0	1
Information element length							
1 ext.	STUNI						

NOTE: The layer 3 address shall be coded as "Layer 3 address not relevant in current message" according to subclause 8.2.

STUNI defines whether the S/T Interface of any particular ISDN-BA is active (i.e. INFO3 has been received).

The coding of the STUNI field shall be according to table 7.

Table 7: Coding of the STUNI field

Bits 7 6 5 4 3 2 1	Meaning
0 0 0 0 0 0 0	No S/T Interface synchronization on ISDN-BA userport
0 0 0 0 0 0 1	S/T Interface synchronization on ISDN-BA userport
0 0 0 0 0 1 0	Test Unavailable
NOTE: All other values are reserved.	

7.3.2 Maintenance status procedure

7.3.2.1 Normal operation

The Maintenance status enquiry procedure shall only be initiated by the LE. This procedure applies when the LE wants to check the maintenance status of a given user port (e.g. a PSTN gateway or an ISDN UNI) in the NTN. No state change shall occur in the LE and NTN upon performing the maintenance status enquiry procedure.

On receipt of a MDU-maintenance_request, the LE shall send a MAINTENANCE STATUS ENQUIRY message and start timer Tm. The Layer 3 address of the MAINTENANCE STATUS ENQUIRY message shall be set to 7FFFh. The MAINTENANCE STATUS ENQUIRY message shall be coded either as in subclause 7.3.1.1.1 where the LE wants to check the maintenance status of a PSTN gateway, or as in subclause 7.3.1.2.1 where the LE wants to check the maintenance status of an ISDN UNI.

Upon receipt of a MAINTENANCE STATUS ENQUIRY message from the LE, the NTN shall respond to the LE with the appropriate MAINTENANCE STATUS message with the L3 Addr=7FFFh. The MAINTENANCE STATUS message shall be coded either as in subclause 7.3.1.1.2 where the MAINTENANCE STATUS ENQUIRY contained a PSTN gateway status request IE, or as in subclause 7.3.1.2.2 where the MAINTENANCE STATUS ENQUIRY contained an ISDN UNI status request IE.

The LE having received the MAINTENANCE STATUS message shall stop timer Tm and shall report the result internally using the MDU-maintenance_response, and remain in the same state.

If timer Tm expires:

- the first time, the MAINTENANCE STATUS ENQUIRY message shall be re-sent, and timer Tm shall be restarted;
- the second time an internal error indication shall be generated and no state change shall occur.

7.3.2.2 Exceptional procedures

This clause describes the exceptional procedures in relation to the message content with the exception of the L3addr IE. The L3addr IE is used within the B-channel selection procedure as described in clause 8.

7.3.2.2.1 NTN

In relation to the STATUS ENQUIRY message the NTN shall implement the AN exception procedures defined in ETS 300 324-1 [3] with the exception that the message content validation shall be extended to support MAINTENANCE STATUS ENQUIRY messages, i.e. ETS 300 324-1 [3] table 10 is extended as shown in table 8.

Message Type: STATUS ENQUIRY

Direction: LE to AN

Table 8: STATUS ENQUIRY message content

Information element	Reference	Direction	Type	Length
Protocol discriminator	[3] 13.4.2	LE to AN	M	1
L3addr	[3] 13.4.3	LE to AN	M	2
Message type	[3] 13.4.4	LE to AN	M	1
ISDN UNI status request	7.3.1.2.1	LE to AN	C	1
PSTN gateway status request	7.3.1.1.1	LE to AN	C	1
NOTE: In the case of MAINTENANCE STATUS ENQUIRY messages, one and only one conditional information element shall be contained in the message and shall be handled as mandatory information element.				

7.3.2.2.2 LE

In relation to the STATUS message the LE shall implement the LE exception procedures defined in ETS 300 324-1 [3] with the exception that the message content validation shall be extended to support MAINTENANCE STATUS messages, i.e. ETS 300 324-1 [3] table 9 is extended as shown in table 9 below.

Message Type: STATUS

Direction: AN to LE

Table 9: STATUS message content

Information element	Reference	Direction	Type	Length
Protocol discriminator	[3] 13.4.2	AN to LE	M	1
L3addr	[3] 13.4.3	AN to LE	M	2
Message type	[3] 13.4.4	AN to LE	M	1
State	[3] 13.4.6.3	AN to LE	C1	1
Cause	[3] 13.4.7.9	AN to LE	C1	3 to 5
ISDN UNI status response	7.3.1.2.2	LE to AN	C2	1
PSTN gateway status response	7.3.1.1.2	LE to AN	C3	1
NOTE: One set of conditional elements C1, C2 or C3 shall be contained in the message and shall be handled as mandatory information element(s). In the case of MAINTENANCE STATUS messages the set shall be C2 or C3.				

7.3.2.3 Timer Tm definition

The additional timer Tm (see table 10 below) is applicable in the LE for the Maintenance status enquiry procedure.

Table 10: Timer Tm behaviour

Timer number	Timeout value	State	Cause for start	Normal stop	At the first expiry	At the second expiry	Cross reference
Tm	10 s	Any	Maintenance STATUS ENQUIRY sent	Receiving of STATUS from AN indicating response to maintenance STATUS ENQUIRY	Repeat Maintenance STATUS ENQUIRY and restart of timer Tm	MDU-error_indication	7.3.2.1

8 B-channel selection procedure

8.1 Introduction

The B-channels of the access are a common resource for both the ISDN-BA and the PSTN ports. To handle the selection of B-channel for the PSTN port use, a new mechanism has been defined (see subclause 8.2).

The operation of the B-channel selection procedures is shown in examples within annex A.

8.2 B-channel selection

This clause describes the mechanism by which the LE indicates to which bearer channel the selected PSTN-GW shall connect for any particular call. This is a departure from the V5.1 recommendation ETS 300 324-1 [3] and can only function because the NMDS allows only one PSTN layer 3 per layer two (addressed via TEIs). The layer 3 address (L3addr) field in the V5 PSTN Protocol messages shall be used to indicate the bearer channel as in table 11.

Table 11: B-channel selection via L3addr

L3ADDR	B-channel
L3addr = 0	no B-channel selected or that the NTN shall release the B-channel
L3addr = 1	B1 selected
L3addr = 2	B2 selected
L3addr = n	Bn Selected (the general case) (note)
L3addr = 7FFFh	Layer 3 address not relevant in current message (e.g. used in MAINTENANCE STATUS and MAINTENANCE STATUS ENQUIRY messages)
All other values are reserved.	

NOTE: In general this applies, although for NMDS there are only two B-channels available.

8.2.1 LE Functionality

8.2.1.1 General Requirements

The LE shall be responsible for the B-channel selection and shall not change directly between the two B-channels during a PSTN call.

The selected B-channel shall be indicated in the L3addr field of all call related messages sent between LE and NTN.

The LE shall use the L3addr value 7FFFh when sending MAINTENANCE STATUS ENQUIRY messages described in subclause 7.3.

8.2.1.1.1 Handling of valid L3addr values

Upon receipt of a PSTN Protocol message with a valid L3addr (see table 11) the LE shall perform one of the following actions dependent on the message and L3addr value.

a) If the LE receives an ESTABLISH message with a L3addr that is not 0 it shall ignore and discard the message. NOTE: The LE may generate an internal error indication.

b) If the LE receives an ESTABLISH message with L3addr of 0 it shall be accepted and handled in accordance with clause 8.2.1.2.

c) If the LE receives a message (other than ESTABLISH) with a L3addr of 0, 1, or 2 it shall compare the L3addr value with that expected (i.e. the current allocated value for the call taking into account the possibility of message crossovers). If the received value is not as expected then the LE shall clear the call using the normal call clearing procedures, ensuring any connected B-channel is released. If the received value is as expected (again making allowance for crossovers) then the message shall be handled in accordance with clause 8.2.1.2.

d) If the LE receives a message (other than ESTABLISH) with a L3addr of 7FFFh then the LE shall perform either (i) or (ii) below:

   i. Treat the value of the L3addr as valid, make no changes in relation to its B-channel allocation at this point, and continue with the processing of the message in the normal manner through the PSTN protocol and beyond (e.g. to call control or maintenance functions). This processing may result in the release of the B-channel (e.g. if the LE receives a DISCONNECT or DISCONNECT COMPLETE message with L3addr = 7FFFh).

If the message is not a maintenance message the LE shall clear the call using the normal call clearing procedures, ensuring any connected B-channel is released. Otherwise the LE shall make no changes in relation to its B-channel allocation.

8.2.1.1.2 Handling of invalid L3addr values

If the LE receives a message with a reserved value of L3addr then the LE shall perform one of the following options:

a. ignore the message and generate an internal error indication;

b. treat the L3addr value as unexpected and clear the call using the normal call clearing procedures, ensuring any connected B-channel is released.

8.2.1.2 Specific Requirements for PSTN Calls

The LE shall perform the general requirements of clause 8.2.1.1 before going on to the specific requirements described in this clause.

On receipt of an ESTABLISH message from the NTN, the LE shall perform either option (a) or option (b) below:

a) select the B-channel to be used and indicate it using the L3addr when returning the ESTABLISH ACKNOWLEDGE message to the NTN.

b) select the B-channel to be used and indicate it using the L3addr when returning the ESTABLISH ACKNOWLEDGE message to the NTN, or alternatively if selection is not currently possible indicate no B-channel selected in the L3addr when returning the ESTABLISH ACKNOWLEDGE message to the NTN.

The B-channel shall be released by the LE when receiving the DISCONNECT COMPLETE message from the NTN or when the LE sends the DISCONNECT message or the DISCONNECT COMPLETE message (L3addr shall be set to 0 by the LE).

Prior to sending an ESTABLISH message to the NTN the LE shall determine the B-channel to be used and indicate this in the L3addr field of the ESTABLISH message.

For all other messages, either on receipt or prior to being sent, the points of selection and release of B-channels by the LE during a call shall be in accordance with National or Operator requirements subject to the requirements of this standard. Examples are given in Annex A.

8.2.2 NTN Functionality

8.2.2.1 General requirements

Upon receiving any message with a TEI identifying a PSTN port, where the L3addr in the message is valid (i.e. is not a reserved value and is not equal to 7FFFh), the NTN shall change the connection to match the L3addr in the message. The only exception to this is where the received message (e.g. DISCONNECT or DISCONNECT COMPLETE) results in the NTN entering the idle state whereupon it shall release the B-channel independent of the L3addr in the received message.

The NTN shall not regard changing between B-channels as an invalid request.

If the NTN receives a message with a reserved value of L3addr then it shall according to the L3addr handling procedures (ETS 300 324-1 [3] subclause 13.5.2.2) ignore the message, generate an internal error indication and send a STATUS message to the LE with the L3addr received, the State information element indicating the current state and the Cause information element indicating cause "L3 address error".

If the NTN receives a message with a L3addr of 7FFFh then the NTN shall treat the value of the L3addr as valid, make no changes in relation to its B-channel allocation at this point, and continue with the processing of the message in the normal manner through the PSTN protocol and beyond (e.g. to call control or maintenance functions). This processing may result in the release of the B-channel (e.g. if the NTN receives a DISCONNECT or DISCONNECT COMPLETE message with L3addr = 7FFFh).

When sending a message to the LE the NTN shall set the value of the L3addr depending on the message type. For MAINTENANCE STATUS messages the L3addr shall be set to 7FFFh. For call control related messages the L3addr shall be set to indicate the currently allocated B-channel, or 0 when no B-channel is allocated. (For example the L3addr shall always be 0 when sending an ESTABLISH message or a DISCONNECT COMPLETE message.

Examples of valid actions of the NTN are shown in table 12.

Table 12: NTN B-channel connection

Current Connection	Received L3addr	New Connection
Port 1, B-channel 1	0	Port 1, No channel
Port 2, B-channel 2	1	Port 2, B-channel 1
Port 1, No channel	2	Port 1, B-channel 2

8.2.2.2 Specific Requirements for PSTN Calls

An ESTABLISH message sent by the NTN cannot contain a B-channel allocation, since no allocation has been made by the LE at this point in time. In this case, the value L3addr = 0 shall be sent to indicate this fact.

If the NTN receives an ESTABLISH message or an ESTABLISH ACK message which contains the value L3addr = 0 then the NTN shall follow the requirements of the National PSTN Protocol associated with receipt of the message but shall not connect a B-channel. At a later time a message may be sent with a non-zero L3addr, in which case the B-channel referred to shall be selected.

Annex A (informative): B-channel selection

A.1 General

This annex provides examples of how the B-channel selection procedure for the NMDS application may be applied within a National PSTN Protocol.

A.2 Outgoing calls (NTN to LE)

An off hook generated by the user shall cause the L3addr to be set to "no B-channel selected" in the ESTABLISH message sent to the LE. B-channel selection in the LE shall be performed and the selected B-channel returned in the L3addr field in the ESTABLISH ACK message to NTN (see figure A.1). The selected B-channel shall be shown in the L3addr of all signalling until the call is cleared.

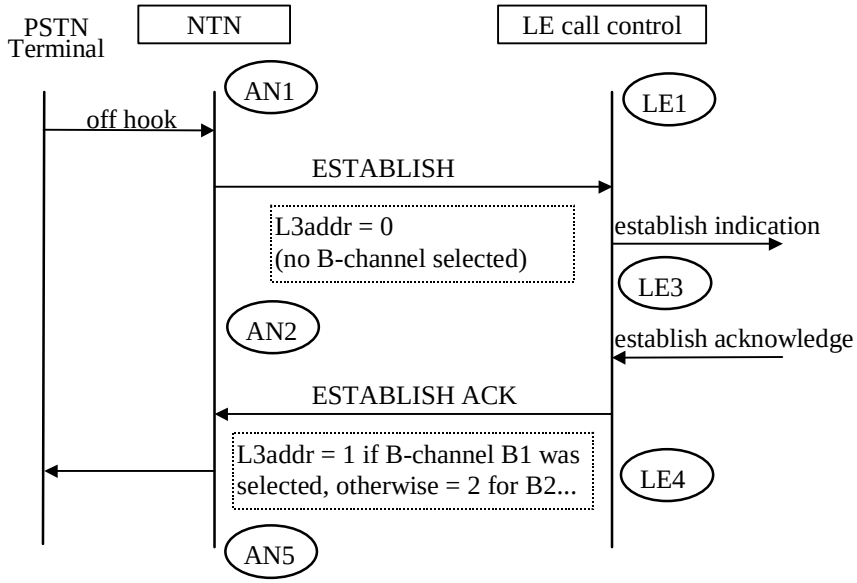
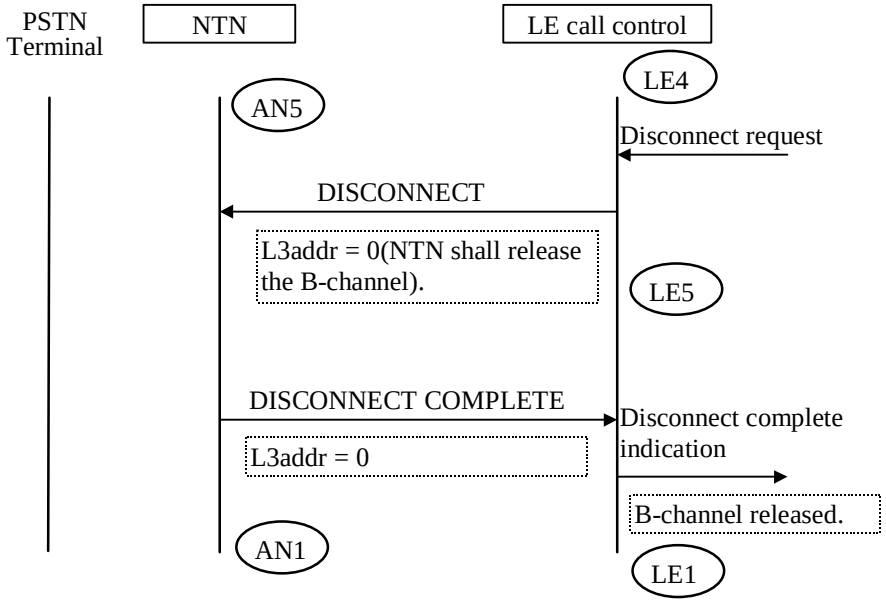


Figure A.1: Outgoing calls (NTN to LE)

All outgoing calls, successful or unsuccessful, shall follow the above procedure with the exception that if the signalling path is required but no B-channels are available the L3addr in the ESTABLISH ACK shall be set to 0.

A.3 Call clearing

The B-channel shall be released when LE receives the DISCONNECT COMPLETE message (see figure A.2).



NOTE: There is only one case of the NTN initiating the release of the signalling path and that is when the NTN has insufficient resource to process the call and sends a DISCONNECT message to the LE. In this case the LE shall release the B-channel immediately after sending the DISCONNECT COMPLETE message to the NTN.

Figure A.2: Call clearing from the network

A.4 Incoming calls (LE to NTN)

The LE shall select the B-channel and indicate it in the ESTABLISH message sent from the LE to the NTN (see figure A.3). The selected B-channel shall be shown in the L3addr of all signalling messages until the call is cleared.

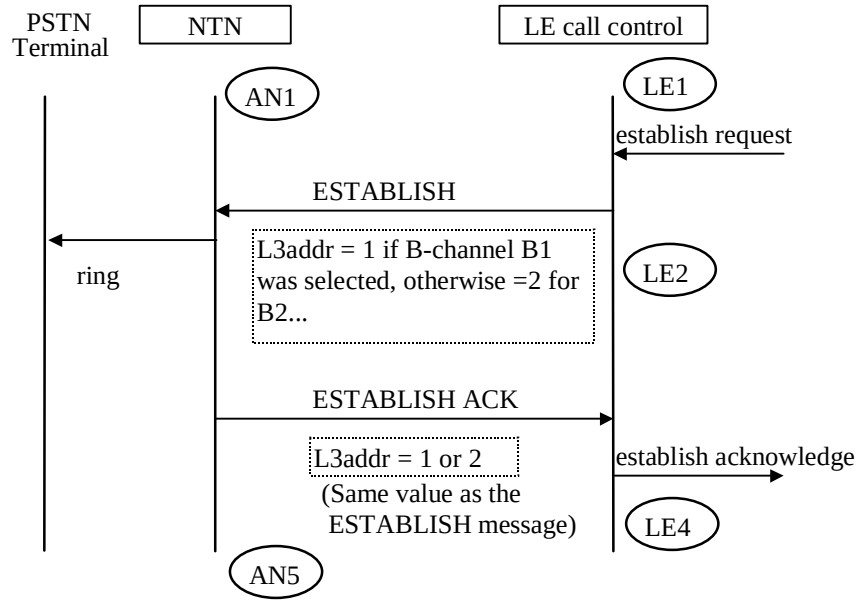


Figure A.3: Incoming calls

All incoming calls, successful or unsuccessful, shall follow the above procedure except in the following situation. If the signalling path is required but the LE cannot yet assign the B-channel, the L3addr in the ESTABLISH and ESTABLISH ACK shall be set to 0.

A.5 PSTN-GW parked state

In this case, after the expiry of a network timer, the SIGNAL message (Steady Reduced Battery) is sent to the NTN and the line is in the PARKED state (see figure A.4). This message shall have the L3addr = 0 indicating that, whilst the signalling path remains connected, the B-channel shall be released by the LE for use by another call. On receipt of the SIGNAL message the PSTN-GW shall detach from the B-channel and send a SIGNAL ACKnowledge message to the exchange with the L3addr = 0 indicating that it has detached from the B-channel.

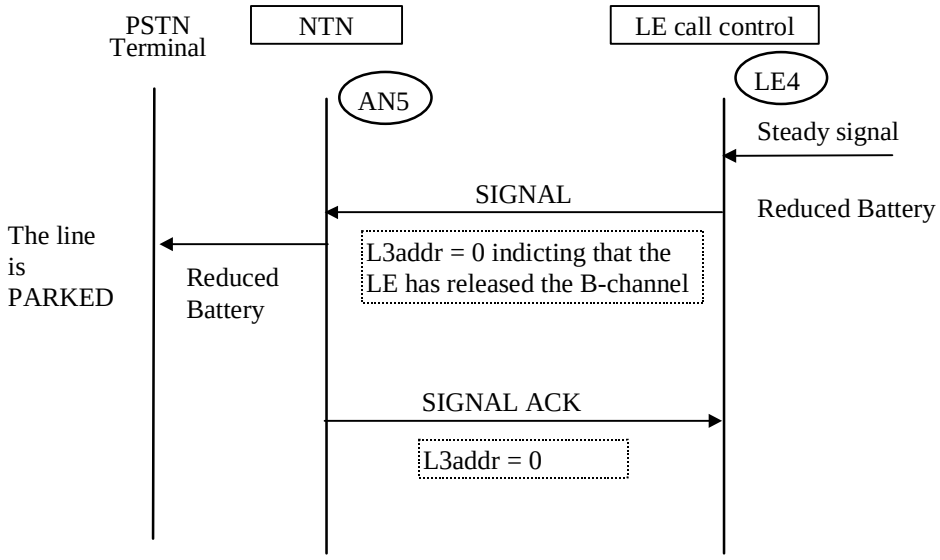


Figure A.4: Entering parked state

A.6 Clearing from parked state

When the PSTN-GW detects an "on hook" it shall send a SIGNAL message indicating steady state "On Hook" this message shall have the L3addr = 0 indicating that a B-channel is not connected. The signalling path shall be cleared following the normal clearing procedure (see figure A.5). The exception is that the L3addr shall be set to zero both in the DISCONNECT and DISCONNECT COMPLETE messages.

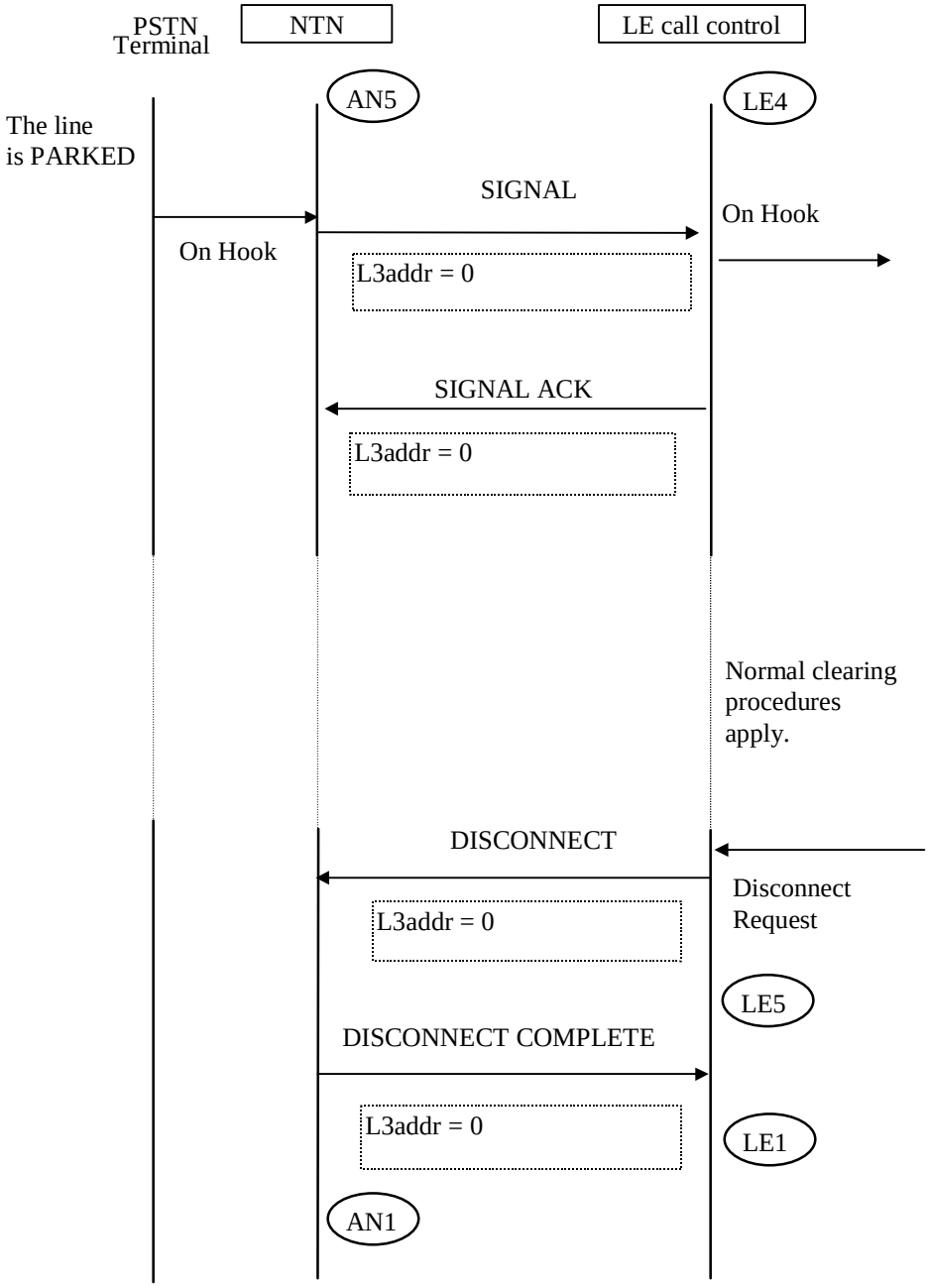


Figure A.5: Clearing from parked state

A.7 Outgoing calls (NTN to LE) with delayed B-channel selection

An Off Hook generated by the user shall cause the L3addr to be set to "no B-channel selected" in the ESTABLISH message sent to the LE B-channel selection in the LE shall be performed. If the signalling path is required but no B-channels are available, the L3addr in the ESTABLISH ACK is set to 0. When a B-channel is selected, the selected B-channel is then returned in the L3addr field in the SIGNAL message sent to the NTN (see figure A.6).

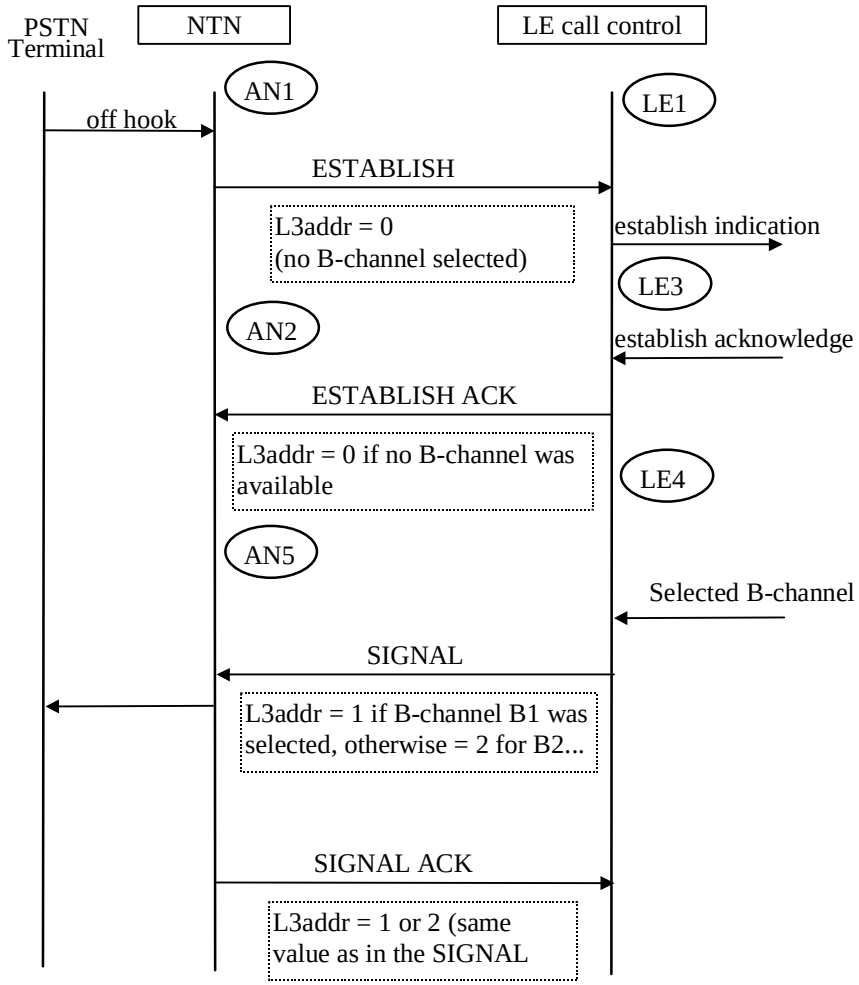


Figure A.6: Outgoing calls with delayed B-channel selection

Annex B (informative): Background and motivation for NMDS

Standardized protocol and additions for the PSTN signalling over the ISDN-BA DSL will result in cheaper NTN equipment. To fully support PSTN services over the same subscriber line when ISDN-BA is installed will probably be a factor in more rapid ISDN deployment.

B.1 Transparent supplementary service operation

It is possible to provide voice type services similar, but not identical, to those provided by the PSTN using the ISDN service and associated terminal adapter. However in this case the voice services as perceived by the customer will not be identical to those received by a customer directly connected to a national PSTN. Due to both regulatory constraints and user resistance, this lack of commonality is a situation that cannot be accepted. It is this lack of commonality which has lead to the development of the NMDS.

The NMDS will allow further independent evolution of national PSTN and ISDN services.

B.2 Operational benefits

The advantages of the combination of PSTN and ISDN-BA on-demand services are that:

- a customer that wants to upgrade from PSTN to ISDN-BA can keep the existing PSTN equipment and just add an upgrade with the NTN;
- a customer can keep the same PSTN services as before the upgrade;
- a customer who wants to run data communication such as Internet could easily connect the computer/PC and get up to 128 kbit/s bandwidth. PSTN can only provide a maximum bit rate of about 30 kbit/s;
- an NTN could be used to support only the PSTN services and, at a future date, could be replaced with another NTN which will be able to support, in addition to PSTN service(s), an ISDN-BA service;
- TN services like "PSTN display services", "ADSI" and similar can easily be carried over the V5-based PSTN protocol;
- a customer gets an additional line, i.e. two B-channels, without an access network infrastructure upgrade;
- in-band signalling equipment, e.g. MF4 receivers or modems, is not introduced into the access network.

Annex C (informative): The PSTN protocol adopted for the NMDS

C.1 The V5 PSTN protocol

The V5 PSTN protocol has been specifically designed for the V5 series of interface standards. It is used within a signalling path from the user port where the line card function is located, to the LE, from which the service is controlled.

The PSTN protocol actually splits into two parts.

The first is a common part which is used in order to define the operation of PSTN lines under such conditions as incoming/outgoing call clash or an overloaded LE which is temporarily unable to provide service to that remote user port. This is a standard part of the PSTN protocol and has to be supported.

The second part of the PSTN protocol is, in reality, just a set of messages which may be mixed and matched in order to synthesize any analogue service required. The mapping of these messages to the analogue services required within any particular country is outside the scope of the present document. It is assumed that this task will have been completed prior to any NMDS implementation being specified within any country. Should this prerequisite not be met, the NMDS system cannot be expected to function correctly.

It is the fact that the PSTN protocol has already been extensively tested and mapped onto the various PSTN services as supported by many countries that makes it such a powerful tool and hence so useful for this application.

Annex D (informative): The relationship between a directly connected NMDS and one supported via an access network

Although the support of NMDS via V5 interfaces is outside the scope of the present standard, this annex identifies two possible methods which may be envisaged to support the NMDS via V5 interface Access Networks. The purpose of this annex is only to highlight the major functional requirements and impacts on the AN and the LE, depending on the method applied, when the NMDS support via a V5 Access Network is considered.

D.1 Introduction

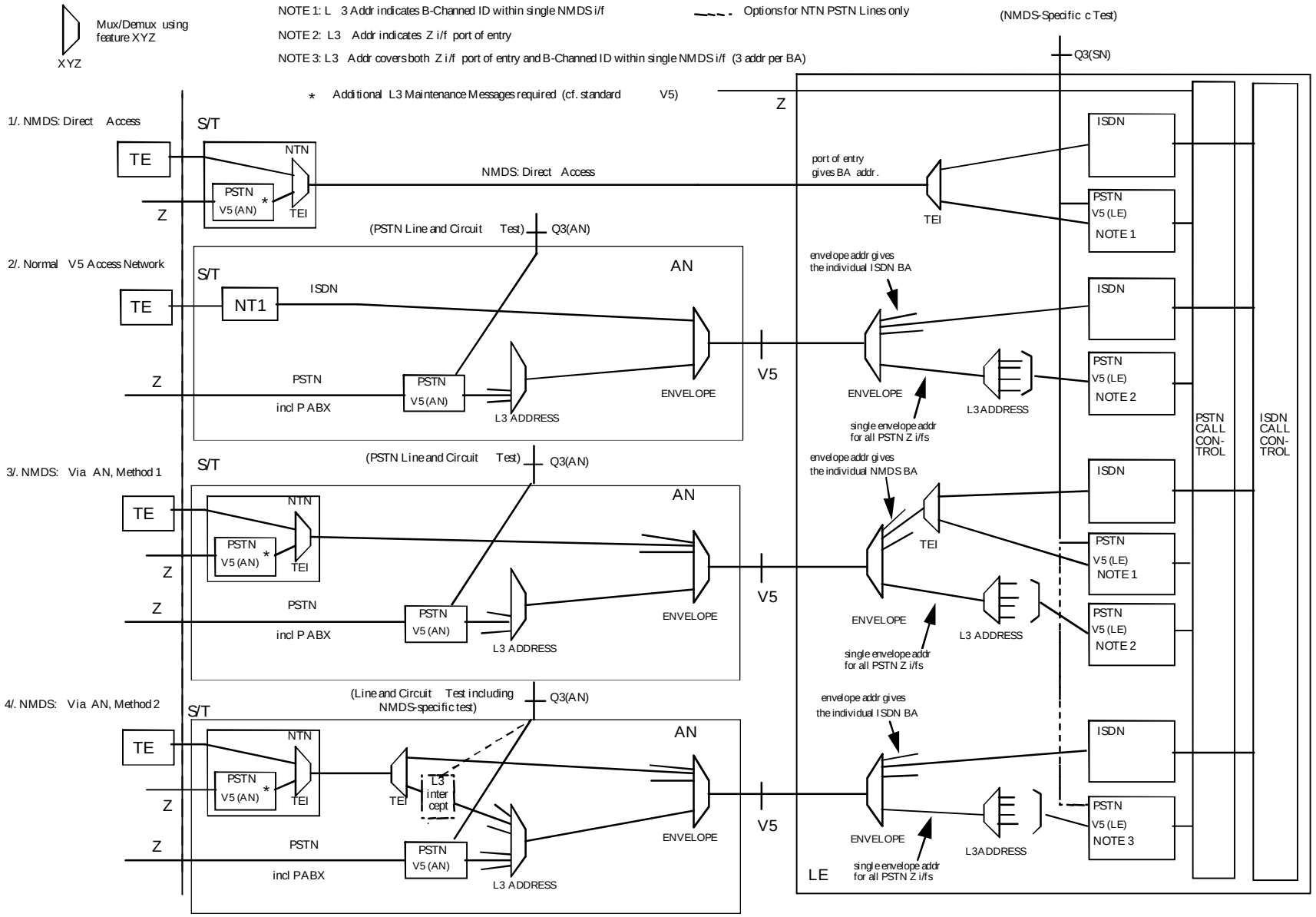
Figure D.1 compares the functions required to support NMDS access via an Access Network with those for NMDS direct access and those for a normal V5 access network. Two alternative methods have been identified: both provide the same overall functionality. They differ only in the basis of multiplexing and demultiplexing methods used in LE and AN. The first results in complexity in the LE, the latter, equivalent complexity in the AN. Either method is permissible.

It has been identified that scenario 4 in figure D.1 showing the second method of connecting an NMDS via an AN will require changes to both the V5 specification ETS 300 324-1 [3] and to the associated Q(V5AN) specifications. Whilst these changes are not thought to be overly complex, there would be a need for an in-depth analysis in order that all the ramifications of this architecture are identified.

Tables D.1 and D.2 support the diagram, describing the functions involved in both AN and LE for both the AN options in a manner permitting easy comparison.

Method 1 has major impacts on LE functional requirements relating to the termination of NMDS on the V5 interface, while Method 2 has major impacts on AN functionalities to terminate the NMDS and to support the NMDS management.

The viability of either methods requires careful consideration and would imply appropriate enhancements to the V5 management standards.



NMDS: Direct Access case and the two possible cases of access via an Access Network (AN) compared with Normal V5 Acces

Figure D.1

Table D.1: Functionality in scenario 3 from figure D.1

Figure D.1 at AN	Figure D.1 at SN (LE)	Comment
Layer 2 frames from NTNs are envelope multiplexed on to V5 link to LE (Layer "1.5" function).	Envelope de-multiplexing is used to separate out individual NTN streams and the AN's V5 stream.	SN is more complex than in Configuration 4; AN is less complex.
PSTN (V5) inputs to the AN are multiplexed on the basis of Layer 3 address and the resulting Layer 2 frames multiplexed along with NTN Layer 2s by enveloping.	NTN streams are de-multiplexed into ISDN and PSTN by reference to TEI (layer 2).	
AN functionality is very like basic V5.	Individual AN PSTN lines are de-multiplexed by Layer 3 address which indicates the Z i/f port of entry.	
	NTN PSTN lines: the Layer 3 address defines the B-channel i/d within a single NMDS access.	
Q3(AN) is used to implement Line and Circuit testing on the AN connected PSTN (incl. PABX) lines.		Simple AN structure but at cost of inconsistent handling of Line and circuit test: AN connected PSTN lines handled via Q3(AN), NTN connected PSTN lines handled via Q3(SN).
Q3(AN) is not used to implement Line and Circuit testing on the NTN connected PSTN lines since the NMDS layer 3s are not terminated at the AN and there is therefore no access to NMDS Layer 3 messages in the AN.	Q3(SN) used to send modified V5 layer 3 messages to implement (e.g.) line testing at the NMDS Z i/f, i.e. on the NTN connected PSTN lines.	

Table D.2: Functionality in scenario 4 from figure D.1

Figure D.1 at AN	Figure D.1 at SN (LE)	Comment
NTN streams are de-multiplexed at layer 2 (TEI) into ISDN and PSTN streams.	Envelope de-multiplexing is used to separate individual ISDN BA streams from the aggregate PSTN stream.	Simple arrangement at LE almost identical to functionality required for support of V5 AN. TEIs for the AN-hosted NMDS systems are assigned by provisioning via Q3(AN). AN is more complex than in configuration 3.
PSTN(V5) inputs to the AN and PSTN streams from the NTNs are multiplexed on the basis of layer 3 Address. Note that for the NTN PSTN Streams there are 3 possible L3 addresses per basic access. So, in this multiplexing function the L3 address covers both the BA port of entry to the AN and the B Channel identity of the individual NTN PSTN stream.	PSTN Stream is de-multiplexed using the Layer 3 address . L3 Address will identify either: Z interface port of entry, or 1 of 3 possible B channel IDs plus the address of the basic access containing the B channel.	
Envelope multiplexing (Layer 1.5) is used to multiplex NTN ISDN streams and the aggregated V5 PSTN stream.	Arrangement at LE is very similar to normal V5 functionality (configuration 2).	
Q3(AN) is used to implement Line and Circuit testing on the AN connected PSTN (incl. PABX) lines.		This option requires more complexity in the AN but gives consistent handling of the management of PSTN line/circuit test in that both AN connected.
Q3(AN) could be used to send modified V5 layer 3 messages implement Line and Circuit testing on the NTN connected PSTN lines since the NMDS PSTN layer 3s are opened at the AN to enable L3 address based multiplexing. This means --->	if <--- applies, Q3(SN) does not need to send modified V5 layer 3 messages to implement (e.g.) line testing at the NMDS Z i/f, i.e. on the NTN connected PSTN lines.	and NTN connected PSTN lines are tested from the AN Manager.
If Q3(AN) is not used to implement Line and Circuit testing on the NTN connected PSTN lines, then this function would be as in Configuration 3 and ---> applies.	if <--- applies, Q3(SN) would be used to send modified V5 layer 3 messages to implement (e.g.) line testing at the NMDS Z i/f, i.e. on the NTN connected PSTN lines.	This option is less complex in the AN in that no sourcing/interpretation of the NMDS Layer 3 messages is involved in the AN but as with configuration 3 results in inconsistent handling of Line and circuit test: AN connected PSTN lines handled via Q3(AN), NTN connected PSTN lines handled via Q3(SN.

Annex E (informative): The reasons for the new information element values chosen

E.1 General

The information element values were chosen for specific reasons. These are historic and are given below in order to aid understanding.

E.2 Specific coding rules for information elements in the V5 specifications

The information elements allocated for V5 are specified in table M.2 of ETS 300 347-1 [4]. This shows some additional features:

- single octet information elements have a 1 in bit position 8;
- variable length information elements have a 0 in bit position 8. For these information elements further rules are added:
  - bit 7 set to 1 is used to indicate BCC functions;
  - bit 6 set to 1 is used to indicate Control functions.

E.3 Specific codes used for the STATUS ENQUIRY information elements for NMDS

The STATUS ENQUIRY information elements octets are single octet information elements.

For the reasons specified elsewhere in the present document, and taking into account the information elements already defined in table M.2 of ETS 300 347-1 [4], it was decided to define the following single octet information elements:

1 1 0 1 0 0 0 0 for PSTN MAINTENANCE STATUS ENQUIRY messages.

1 1 0 1 0 0 0 1 for ISDN MAINTENANCE STATUS ENQUIRY messages.

E.4 Specific codes used for the STATUS information elements for NMDS

The STATUS message information elements octets are multiple octet information elements.

For the reasons specified elsewhere in the present document, and taking into account the information elements already defined in table M2 of ETS 300 347-1 [4], it was decided to define the following multiple octet information elements:

0 0 0 1 1 1 1 0 for PSTN MAINTENANCE STATUS messages.

0 0 0 1 1 1 1 1 for ISDN MAINTENANCE STATUS messages.

Annex F (informative): Permanent activation of basic access digital section

The use of permanent activation of the basic access digital section for NMDS may improve the service perceived by the user, based on the following:

1) Many networks have delay to dial tone requirements and especially on today's modern electronic exchanges the user expectation is that dial tone is present by the time the handset has reached the ear. It is this performance that will be expected of the PSTN service from NMDS. It has been recognized in the V5 forum that the protocol stack of V5.1 (effectively permanently activated layer 1 (primary rate) and point-to-point layer 2 carrying PSTN protocol with national mapping at layer 3) may make it difficult to achieve such performance for PSTN ports connected via a V5.1 AN. As the same protocol stack is used for NMDS it will inherit the same issues. Choosing to use a permanently activated digital section ensures that the structure of NMDS does not make the situation worse. Using a layer 1 protocol which involved the need to activate the digital section on detecting a seize would add an additional delay.

2) The decision as to when to apply power feed to the PSTN port may in some networks be linked to the provision of PSTN service to the line by the LE. An effective method of achieving this is to supply power only in the presence of an established layer 2 with respect to the PSTN-GW concerned. If, however, layer 1 activation and layer 2 establishment were to be triggered from the NTN PSTN-GW, then the power feed to the PSTN port would have to be supplied independently from these. This may result in a PSTN user erroneously believing service is available (because the line is powered) when it is not. Alternatively whether to apply power feed to the PSTN port may be determined by some stored data in the NTN based on an earlier layer 3 communication with the exchange. This NTN stored data would have to follow the exchange data in relation to supporting the PSTN port/service. The use of permanent activation and point-to-point layer 2 establishment to determine when to apply power feed to the PSTN port thus simplifies the NTN and the exchange.

3) Permanent activation of the basic access digital section further simplifies the NTN as it removes the need for it to support user activation procedures triggered from detecting a seize at the PSTN port or user initiation of activation of the S/T interface.

Annex G (informative): Remote equipment - functional requirements

The basic remote equipment functional requirements for an NTN are shown in figure G.1a. The NTN has a full capability S/T interface able to support the maximum number of ISDN terminals. In addition, it can support a PSTN terminal via a Z interface. The NT1* function has additional functionality over the normal ISDN NT1 in order to enable it to handle the additional PSTN interface.

In effect, ISDN TEs and a PSTN TE via its PSTN Gateway (effectively a PSTN TA) are in contention for the S/T Interface, even though the latter is a different type of terminal. (More details of the internal functions of the NT1* and PSTN-GW are indicated in figure G.1b). The reason for this is that it should be possible to prevent the ISDN-BA terminals from sending D-channel information whilst signalling information is being transmitted to the LE from the PSTN-GW. An alternative approach, although potentially more expensive, is to buffer ISDN-BA D-channel frames within the NTN and to control the time of their transmission towards the LE.

In different markets, the NTN implementation may be varied to meet the local requirements. Some examples of NMDS compliant NTN variants which may be implemented follow:

1) (Ref. figure G.2a) Regulatory reasons may require complete separation of the customer interfaces for ISDN and PSTN, i.e. that PSTN information is prevented from getting onto the S/T Interface and, in these circumstances, some additional functionality is required in the configuration to achieve the separation (indicated in figure G.2b):

   - upstream - functionally, a buffer is required on the network side of the S/T interface and PSTN information inserted on the network side of this. An "all 1s" pattern is inserted on the echo bit to hold the bus;

   - downstream, (if required) the L2 frames are inspected to prevent PSTN information from passing onto the S/T Interface;

   - the upstream functions may be implemented based on the use of buffer memory associated with the user ports: this still requires feedback to the S/T Interface so that ISDN users are aware of "hold-ups".

2) (Ref. figure G.3) Where permitted by the regulatory environment, the PSTN-GW functions may be supported by the S/T Interface, appearing at layer 1 as another ISDN-like terminal. This configuration reduces by one the number of ISDN terminals that can be handled on the S/T Interface, but uses an ISDN NT1. The logical development of this is;

3) (Ref. figure G.4) (Where permitted by the regulatory environment,) combination of the PSTN-GW and PSTN TE to form a "PSTN Digital telephone". In this case there is no interface at the Z reference point.

In general, the NMDS standard is concerned with the functionality of the NTN and therefore refers to this grouping throughout, however this does not preclude implementations based on different physical groupings where regulatory contexts permit.

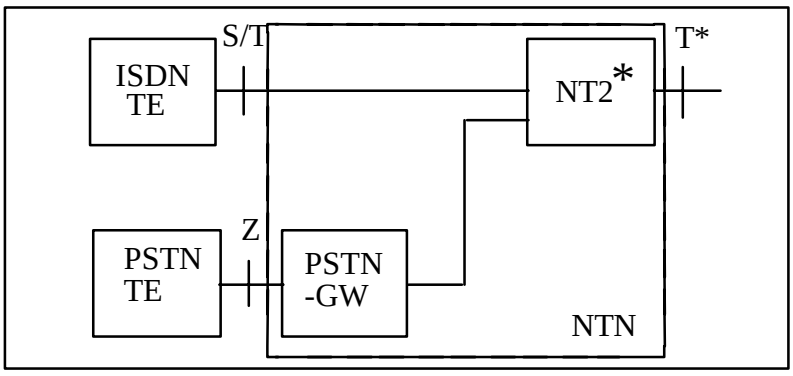


Figure G.1a: The basic remote equipment functional requirements for an NTN

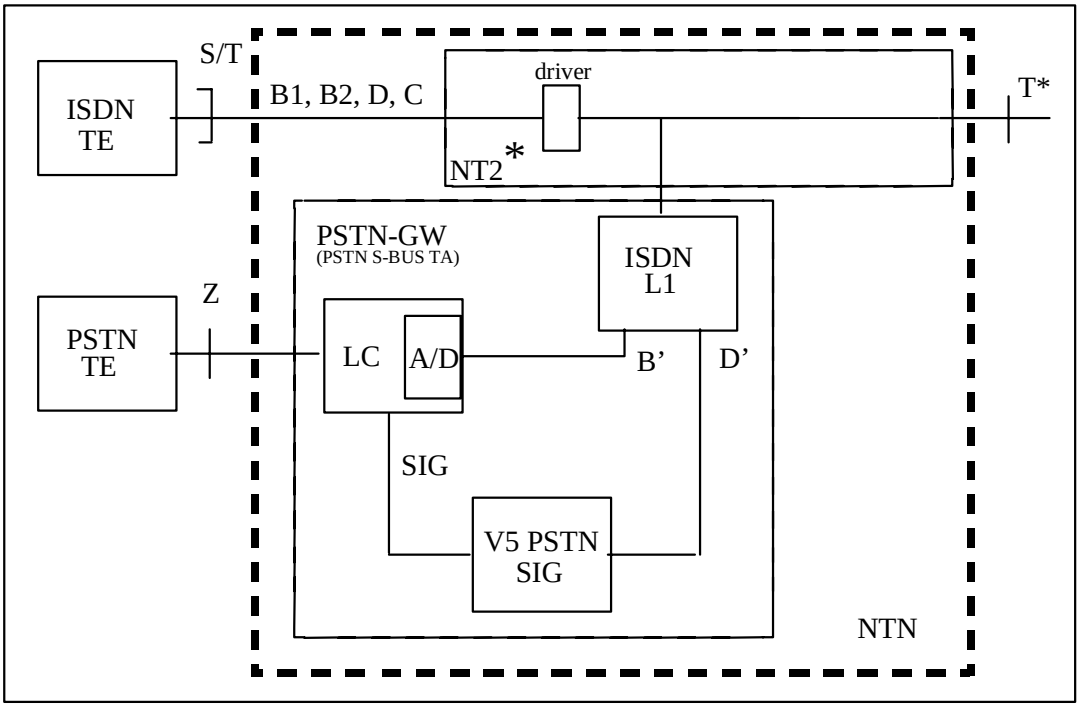


Fig G.1b: D-channel potential internal functionality of the NT2* and PSTN-GW, given no D-channel buffering

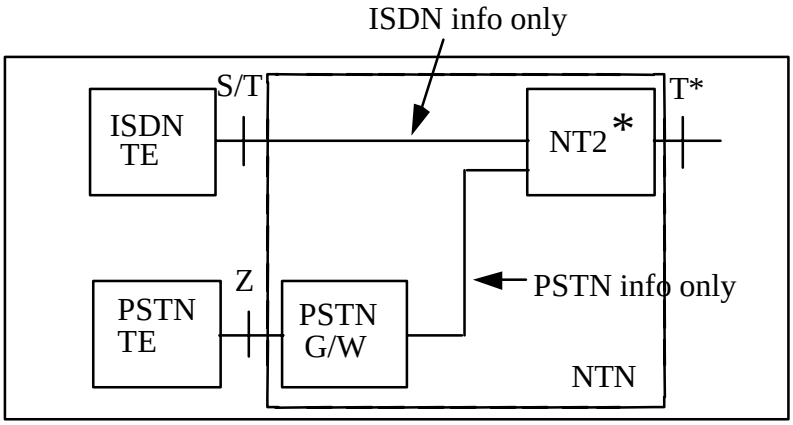


Figure G.2a: Regulatory reasons may require complete separation of the customer interfaces for ISDN and PSTN

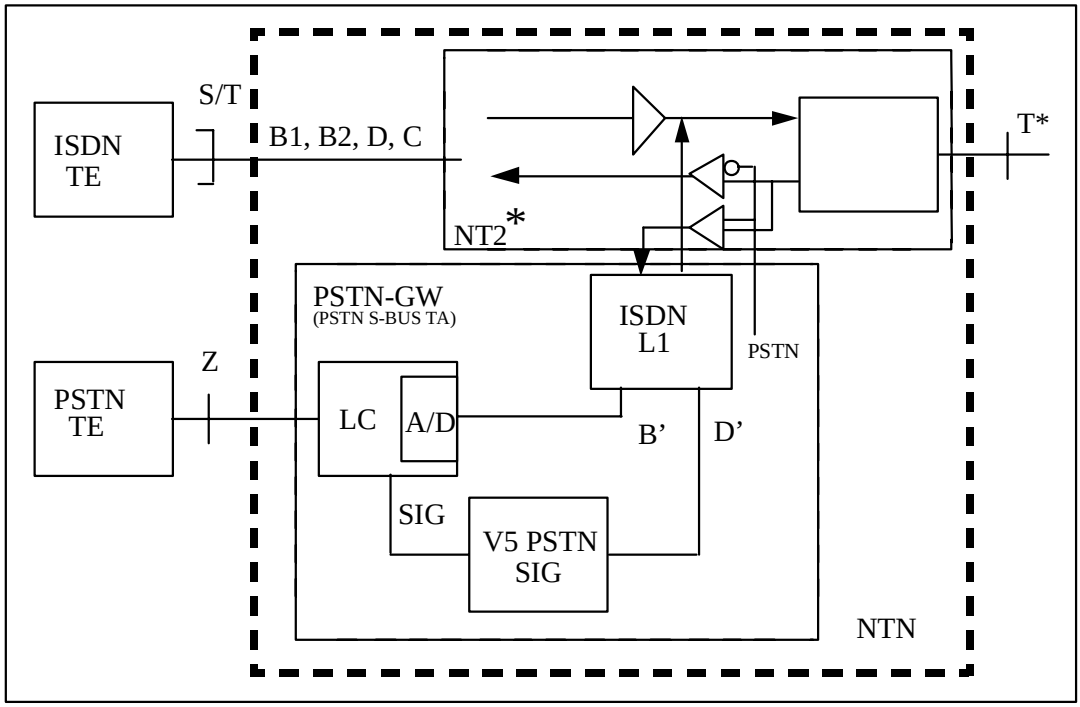


Figure G.2b: Additional functionality required should it be necessary to prevent PSTN information from getting onto the S/T Interface

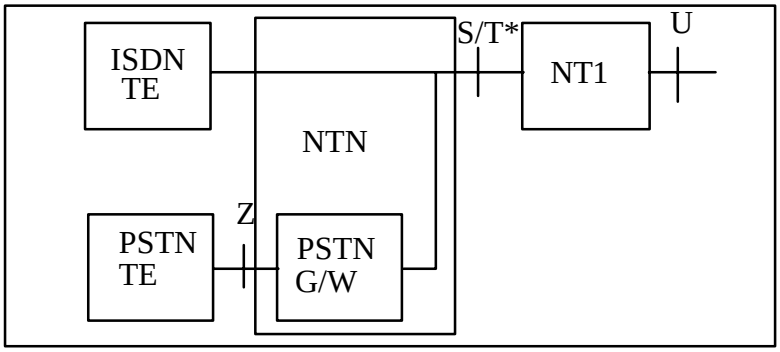


Figure G.3: The PSTN gateway functions may be supported by the S Bus, appearing at layer 1 as another ISDN-like terminal

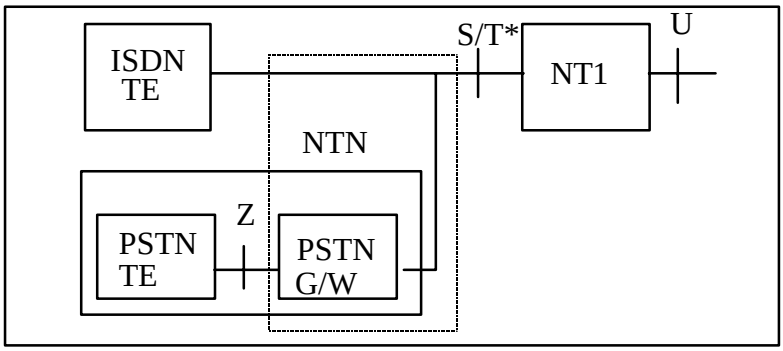


Figure G.4: The combination of the PSTN gateway and PSTN TE to form a PSTN digital telephone

Annex H (informative): Supplementary services useable at the NMDS

Supplementary services provided by the network to direct PSTN access and ISDN basic access may be provided and made available to the NMDS. The provision of the supplementary services to each provisioned PSTN line and to the ISDN access requires appropriate subscription arrangements with the network service provider.

NOTE: It is expected that PSTN supplementary services available to direct PSTN lines in a network are also made available, at similar conditions, to PSTN lines at the NMDS. Similarly, ISDN supplementary services available to direct ISDN basic accesses in a network are also made available, at similar conditions, to the ISDN access at the NMDS.

H.1 Applicability of PSTN supplementary services

PSTN supplementary services applicable to the direct PSTN lines are applicable to (incoming and outgoing) calls handled through a PSTN port via the NMDS, without any impact except those stated below.

Due to the concentrating nature of the NMDS, the following specific interactions with supplementary services apply to an incoming call destined to a PSTN line which is known to be not already engaged in a call:

- call Forwarding busy supplementary service : if provisioned and activated for the called PSTN line, may be invoked by the LE if there is no B channel available (to establish the path to the PSTN gateway), regardless of which of the PSTN lines or ISDN access port are currently using the B channels at the NMDS;

- call completion on busy subscriber : if provisioned and possible for the call instance, may be invoked by the LE if there is no B channel (available to establish the path to the PSTN gateway), regardless of which of the PSTN lines or ISDN access port are currently using the B channels at the NMDS.

NOTE: If both are provisioned and activated, their interaction may be handled in the same way as their interaction is handled on direct LE PSTN lines (e.g. precedence may be given to the invocation of the Call forwarding busy supplementary service).

If none of these two supplementary services are applicable (not provided or not activated), and if no B channel is available to proceed with an incoming call destined to one of the PSTN lines which is known to be not already engaged in a call , then the call may be cleared and a network clearing message with a cause #34, *no circuit/channel available,* and the location field set to 'public network serving the remote user', be sent towards the exchange serving the remote user.

H.2 Applicability of ISDN supplementary services

ISDN supplementary services applicable to the S/T reference point are applicable, without any impact and restriction, to the NMDS. They apply to (incoming and outgoing) calls handled through the ISDN-BA Port.

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

- ITU-T Recommendation I.112: "Vocabulary of terms for ISDNs".

History

Document history		
V1.2.2	September 1998	Publication
V2.1.1	June 2000	One-step Approval Procedure OAP 20001027: 2000-06-28 to 2000-10-27
V2.1.1	November 2000	Publication