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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 Signalling Protocols and Switching (SPS), and is now submitted for the Public Enquiry phase of the ETSI standards Two-step Approval Procedure (TAP).

The present document is part 1 of a multi-part EN covering Narrowband Multi-service Delivery System (NMDS), as identified below:

Part 1: "NMDS interface specification";

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

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
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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 document 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 interface access over a single transmission system as used for ISDN-BA. This NTN contains NT2 functionality, physical PSTN user port(s) and PSTN protocol functionality if present.

Narrowband Multi-service Delivery System (NMDS) provides interfaces either connected via an NTN to a Local Exchange (LE), or via an Access Network (AN) in order to support existing PSTN services transported over an existing ISDN-BA digital subscriber line (DSL).

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.

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

2 References

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case 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.

2.1 Normative references

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

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

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

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

[5] ETS 300 402-1: "Integrated Services Digital Network (ISDN); Digital Subscriber Signalling System No. one (DSS1) protocol; Data link layer; Part 1: General aspects [ITU-T Recommendation Q.920 (1993), modified]".

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

[7] ITU-T Recommendation M.3602 (10/92): "Telecommunication Management Network: Integrated Services Digital Network: Application of maintenance principles to ISDN subscriber installations".

[8] ITU-T Recommendation M.3603 (10/92): "Telecommunication Management Network: Integrated Services Digital Network: Application of maintenance principles to ISDN basic rate access".

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

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

2.2 Informative references

[11] EN 301 141-2: "Narrowband Multi-service Delivery System (NMDS); Part 2: Protocol Implementation Conformance Statement (PICS) proforma specification".

3 Definitions and abbreviations

3.1 Definitions

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

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

Network Termination Node: The functional group on the user side of the T* reference point that includes functionality to support ISDN-BA and/or one or more PSTN user ports.

PSTN-GW: The functional group which terminates the PSTN interface at the NTN.

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
ET	Exchange Termination
ISDN-BA	Integrated Services Digital Network - Basic Access
LAPD	Link Access Protocol, D-channel
LE	Local Exchange
LT	Line Termination
HDLC	High-level Data Link Control
NMDS	Narrowband Multi-service Delivery System
NT	Network Termination
NT1	NT type 1 (see ETR 080 [3])
NT2	NT type 2 (see ITU-T Recommendation I.112 [10])
NTN	Network Termination Node
NWK	Network Layer
POTS	Plain Old Telephony Service
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 Narrowband Multi-service Delivery System (NMDS) interface has been defined at the T* reference point as shown in figure 2 and the complementary V1* reference point.

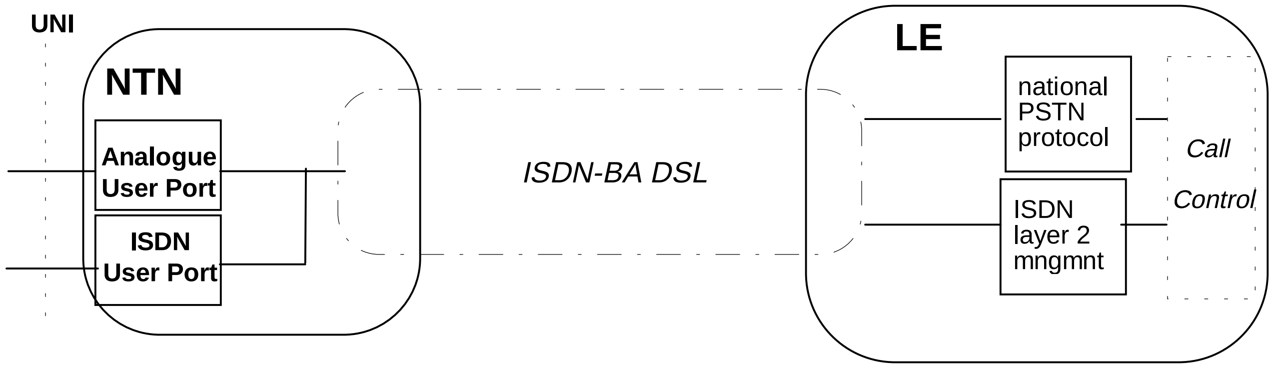


Figure 1: General NMDS functional diagram

It is the purpose of the NMDS 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 utilises the same type of functions as used by an NT1 defined in ETR 080 [3], whilst PSTN user ports are supported using the same PSTN protocol as defined in the V5.1 interface standard ETS 300 324-1 [1] with some additions.

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

5 Layer 1 functions

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

NOTE: The present document assumes permanent activation of the U-transmission system. However activation/deactivation of the U-transmission system may be possible.

Layer 1 at the ISDN-BA UNI shall be in accordance with ETS 300 012-1 [4].

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

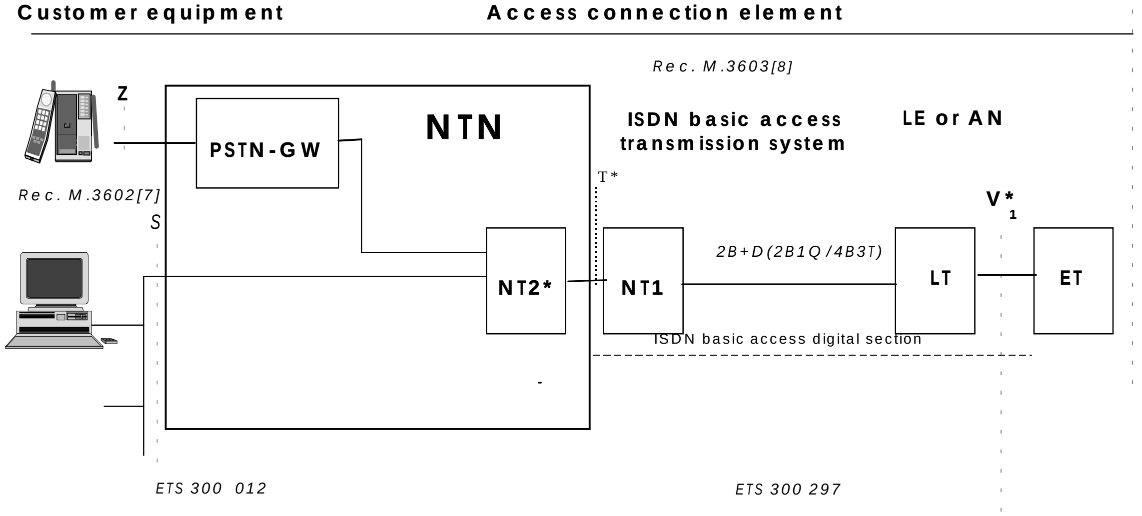
The NTN shall also allow the remote digital section to be activated regardless of the electrical conditions prevailing at the ISDN UNI and PSTN port.

To prevent the possibility of the exchange/multiplexer deactivating the digital section as part of the recovery actions resulting from an ISDN UNI error, the NTN shall always present a UNI "no error" indication to the network.

The permanent activation of the remote digital section may interfere with certain routeing operations normally provided over the embedded operations channel. To overcome any difficulties, the exchange 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 routeing mechanism at layer 3. The ISDN UNI status information element is used for this purpose and is described elsewhere in the present document.

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

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.



PSTN-GW	PSTN gateway
LT	Line Termination
NT1	Network Termination type 1
NTN	NT Node
T*	The T reference point with additional PSTN functionality
V1*	The V 1 reference point with additional PSTN functionality

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.

Figure 2: An example of an NMDS scenario for NMDS

5.1 Powering issues

The powering issues relevant for NMDS are actual power budgets available over the existing ISDN-BA transmission systems and what happens under power fail conditions with respect to user ports.

5.1.1 Power available from the transmission system

The NTN shall be designed to work within the existing power budget defined for ISDN-BA transmission systems. Hence there are no deviations from the requirements specified in those standards in order to support NMDS.

5.1.2 NMDS behaviour under power fail conditions

The ISDN-BA standards mandate that a designated instrument may be made available on an S-bus. 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 so clear and depends upon nationally agreed regulations which is outside the scope of the present document.

Furthermore, 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 [11], where such behaviour may be explained.

6 Layer 2 functions

6.1 Overview

Layer 2 shall be in accordance with ETS 300 402-1 [5] but with the following restrictions.

The LE layer 2 state machine shall be as per ETS 300 402-1 [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 300 402-1 [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 includes TEI assignment and removal procedures. However, some previously available values are now reserved: see table 1. This is not considered to be a problem.

It is expected that some implementations may provide additional PSTN-GWs either as separate equipment connected to the S-bus 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 300 402-1 [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 subclause 7.3 delete the "either" option.

For input event "T200 TIME-OUT; RC<N200; V(A)<V(S)" in states 8.0 through subclause 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 a connection to the network, the PSTN-GW part of the NTN shall wait for activation activity 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).

Disconnection of power and reconnection of power on the DSL shall force a reset of the PSTN-GW functionality.

7 Layer 3 messages

The PSTN network layer (NWK) protocol shall be as defined in ETS 300 324-1 [1], clause 13. The national PSTN mappings is beyond the scope of the present document.

The normal path establishment procedures of ETS 300 324-1 [1] shall be used.

The present document provides additions to the message formats and procedures to those found in ETS 300 324-1 [1].

The protocol discriminator value for the additional messages defined in the present document shall be the same as for ETS 300 324-1 [1], i.e. 48H.

7.1 General

The NTN shall support the national PSTN requirements for all applicable signals. All tones and announcements generated by the network shall be passed 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.

7.2 Error handling

The LE shall support the full error handling procedures defined in ETS 300 324-1 [1] clause 13, relating to the V5.1 PSTN protocol.

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

7.3 Maintenance

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 synchronisation status of the "S Bus".

It shall use the Layer 3 STATUS and STATUS ENQUIRY messages as defined in ETS 300 324-1 [1] 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 shall follow those defined in ETS 300 324-1 [1], 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.

7.3.1.1 The complete STATUS ENQUIRY and STATUS messages for PSTN maintenance messages

The STATUS ENQUIRY and STATUS messages for the PSTN-GW status will be sent using the TEI which is allocated to that gateway (see table 2).

7.3.1.1.1 The complete STATUS ENQUIRY message for PSTN maintenance

Table 2: The PSTN gateway 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
Information element identifier							

NOTE: The layer 3 address shall be coded according to subclause 8.1.

7.3.1.1.2 The complete STATUS message for PSTN maintenance

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

This new variable length optional information element shall be carried in the STATUS message in the direction NTN - LE.

Table 3: The PSTN gateway 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
Information element identifier							
0	0	0	0	0	0	0	1
Information element length							
1 ext.	STGW						

NOTE: The layer 3 Address shall be coded according to subclause 8.1.

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

7.3.1.2 The complete STATUS ENQUIRY and STATUS messages for ISDN maintenance messages

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

7.3.1.2.1 The complete STATUS ENQUIRY message for ISDN maintenance

Table 5: The 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
Information element identifier							

NOTE: The layer 3 Address shall be coded according to subclause 8.1.

7.3.1.2.2 The complete STATUS message for ISDN maintenance

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

This new variable length information element shall be carried in the STATUS message in the direction NTN - LE.

Table 6: The 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
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 according to subclause 8.1.

STUNI defines whether the S-bus 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-bus synchronisation on ISDN-BA userport
0 0 0 0 0 0 1	S-bus synchronisation on ISDN-BA userport
0 0 0 0 0 1 0	Test Unavailable
NOTE: All other values are reserved.	

8 Outline of the NMDS principles

When defining this new standard, as much as possible shall be inherited from the V5.1 interface standard. Additionally there should be no changes to the ISDN-BA service. The advantages of this principle are that the standard can be defined very quickly and also that the conformance testing procedures as defined for existing standards can be re-used.

New functions for the testing of the PSTN interfaces, which are now remote from the LE, are required, but these can be readily adapted from the STATUS and STATUS ENQUIRY procedures in the PSTN protocol.

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 8.1).

8.1 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 [1] and can only function because the NMDS allows only one PSTN layer 3 per layer two (addressed via TEIs).

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

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

All other values are reserved.

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

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

Upon receiving any message with a TEI identifying a PSTN port, where the L3addr in the message is valid, the NTN shall change the connection to match the L3addr in the message, e.g.:

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

The NTN shall reflect the last received value of the L3addr when sending a message to the LE.

If the NTN should receive a message with a reserved value of L3addr then it shall ignore the message 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".

The LE when in receipt of a reflected L3addr which is not understood shall clear the call using the normal call clearing procedures, ensuring any connected channel is released.

8.2 A second PSTN user port in the NTN

Whilst in general there may be several user ports connected to an NMDS system via an NTN, in practice it is likely that only a limited number will be provided due to the restrictions imposed by the remote digital section back to the exchange. It is expected that most NMDS systems will support a maximum of two PSTN ports.

Annex A (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.

A.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.

A.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 B (normative): B-channel selection

B.1 General

This annex describes the B-channel selection procedure for the NMDS application.

The following requirements can be stated for the B-channel selection:

The LE is responsible for the B-channel allocation and, at reception of the ESTABLISH message from the NTN, the B-channel shall be selected prior to 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.

An ESTABLISH message sent by the NTN containing the Off hook signalling information element 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 (this is redundant information as far as the LE is concerned as it is the default condition).

It shall not be possible for the LE to dynamically alter the B-channel assignment in mid-PSTN-call (i.e. between an ESTABLISH message and a DISCONNECT COMPLETE message).

B.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 B.1). The selected B-channel shall be shown in the L3addr of all signalling until the call is cleared.

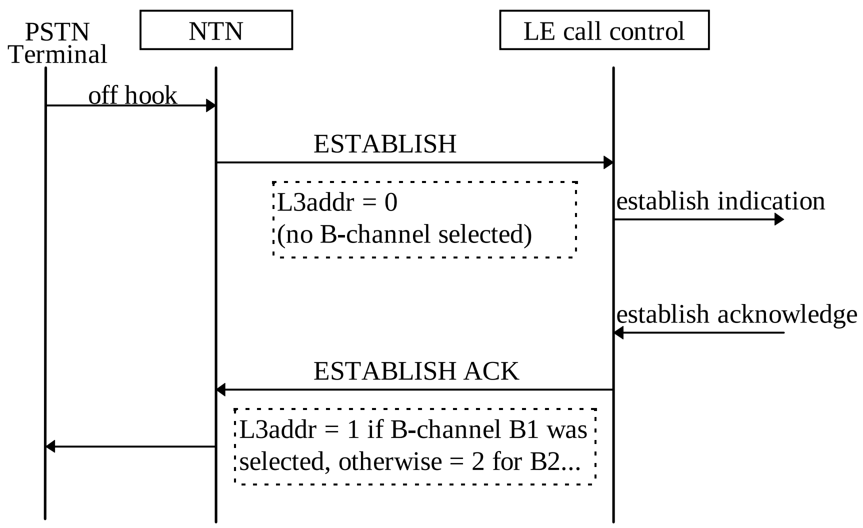
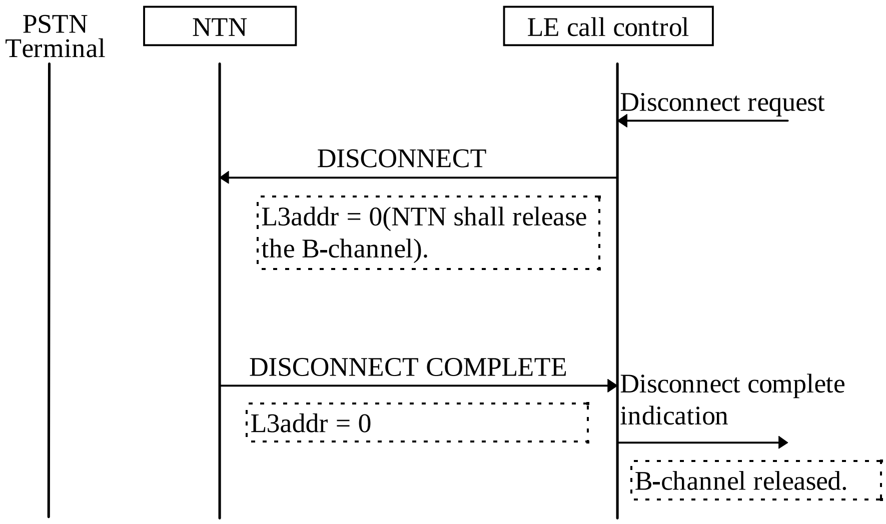


Figure B.1: Outgoing calls (NTN to LE)

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.

B.3 Call clearing

The B-channel shall be released when LE receives the DISCONNECT COMPLETE message (see figure B.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 B.2: Call clearing from the network

B.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 B.3). The selected B-channel shall be shown in the L3addr of all signalling messages until the call is cleared.

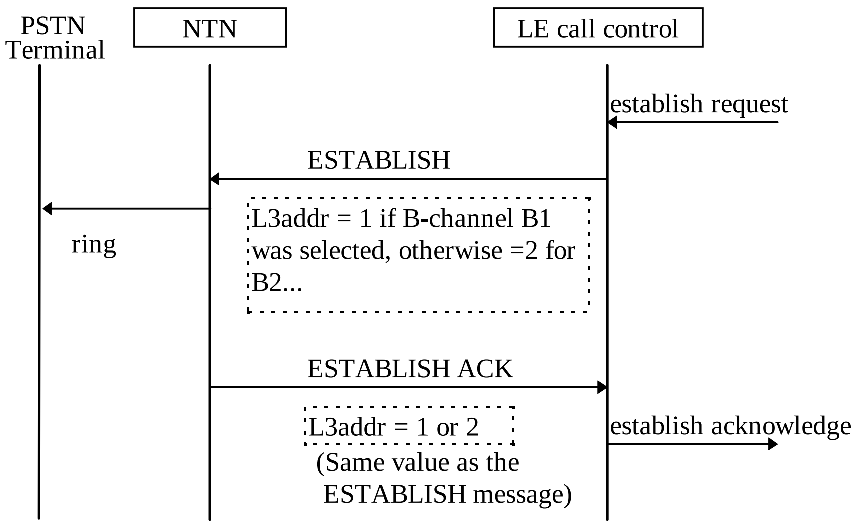


Figure B.3: Incoming calls

B.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. 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.

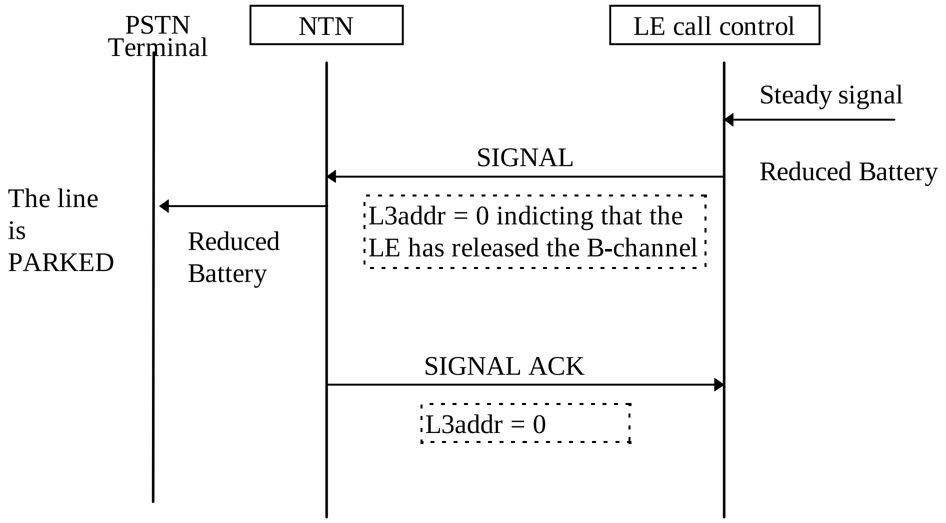


Figure B.4: Entering parked state

B.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 required. The signalling path shall be cleared following the normal clearing procedure (see B.3). The exception is that the L3addr shall be set to zero both in the DISCONNECT and DISCONNECT COMPLETE messages.

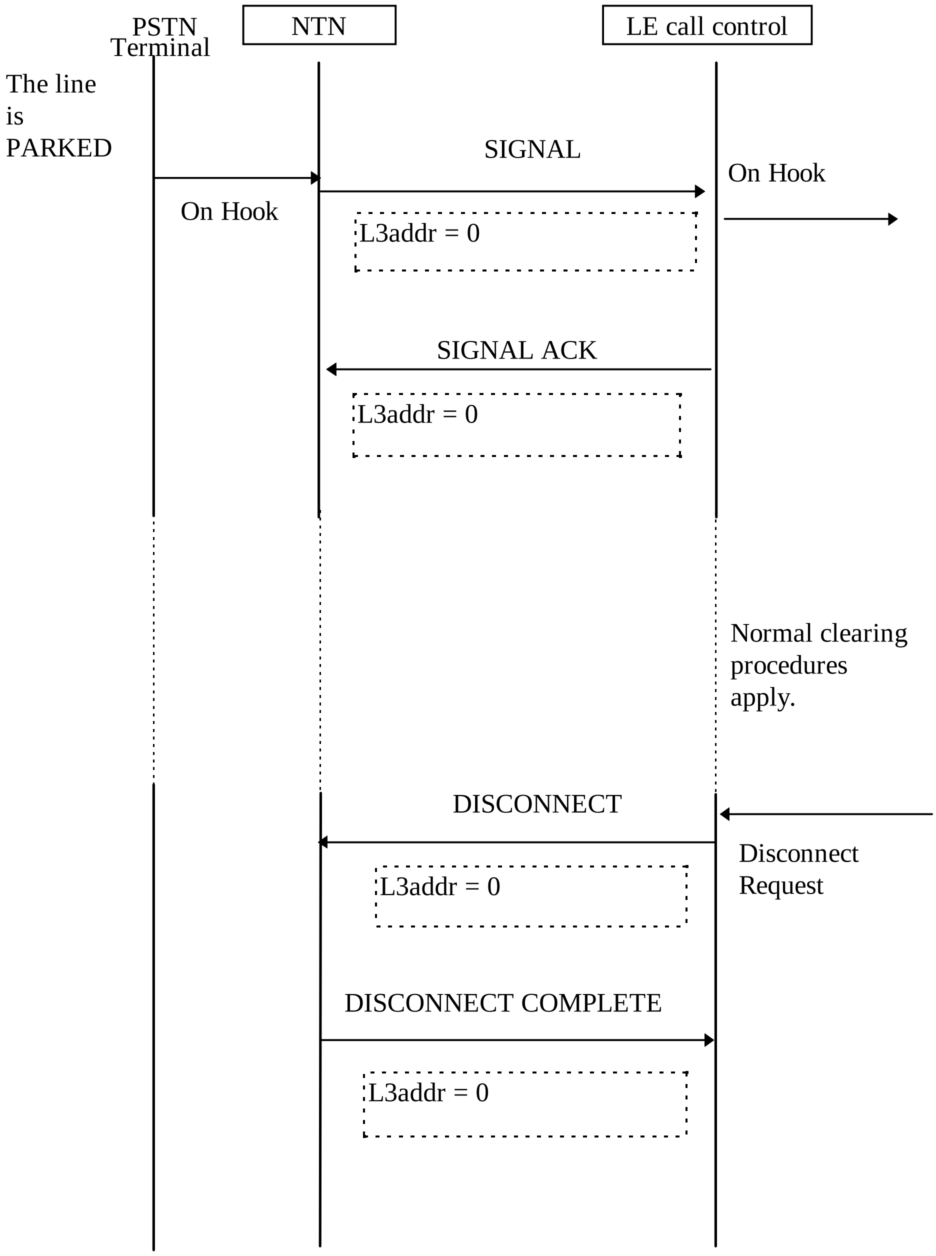


Figure B.5: Clearing from parked state

B.7 Seizure from parked state

This covers the scenario for when it is required that the LE connects to the parked line (e.g. to allow the operator to listen into the line).

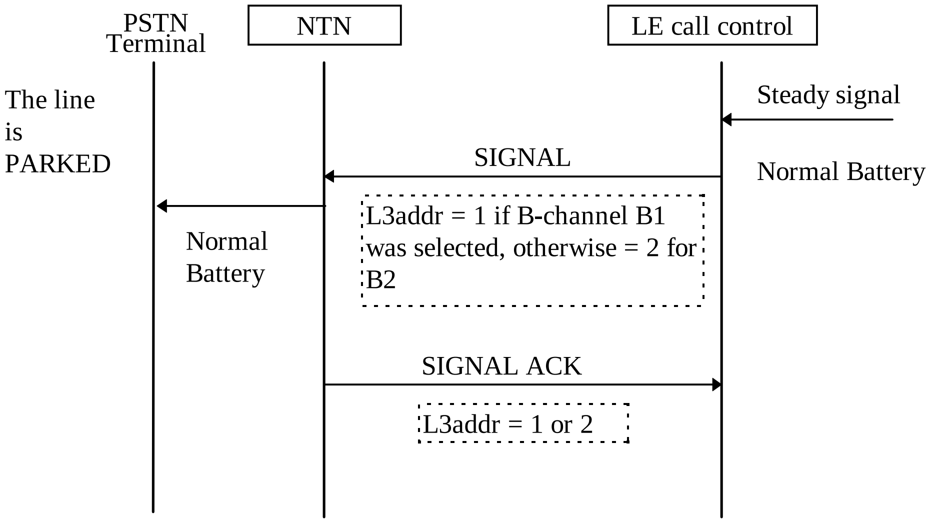


Figure B.6: Seizure from parked state

Annex C (informative): Reasoning behind the layer 2 multiplexing approach adopted for the NMDS

NOTE: This annex may be deleted before publication. It has been written specifically for those trying to understand part of the rationale behind the NMDS EN.

C.1 General

The NMDS relies on a mix of both ISDN and PSTN data on a common transmission system. This has similarities with the V5 series of standards but there are significant differences.

The main difference between V5 and the NMDS is that there is a requirement for the NMDS system to be backwards compatible with a normal ISDN-BA service. This means that it must be possible to provide an ISDN-BA service either via an NMDS (using an NTN) or via an NT1. This is a feature which is considered useful when alternating between a standard ISDN-BA configuration and one based on NMDS and is of most use when considering practical installation/commissioning issues.

A second requirement is to try to minimise the degree of signal processing carried out within the network terminating equipment. In the case of an ISDN-BA system, this functionality is contained within an NT1, whereas in the case of NMDS this functionality is contained within an NTN.

There are various protocol scenarios that could be envisaged, as outlined in the following subclauses.

C.1.1 The PSTN-V5 protocol runs in its own HDLC LAPD layer 2 alongside the ISDN-BA HDLC LAPD protocol, on top of the frame relaying mechanism defined for V5.1

This would use the V5 frame relay function in order to separate the ISDN-BA protocols from the PSTN ones. This would probably increase the cost of the NT slightly in order to handle the protocol conversions required albeit that the additional functionality required is likely to be low.

The main advantage of this approach is that it means that there is no need to constrict the ISDN-BA terminals in respect of the protocols that they can support.

The main disadvantage of this approach is that the LE will have to pre-process ISDN-BA frames by adding a header in the case of NMDS. This means that it would not be possible to directly connect an NT1 to an NMDS system as it could not function correctly.

The relevant headers, given as the default V5 headers, are presented below for information.

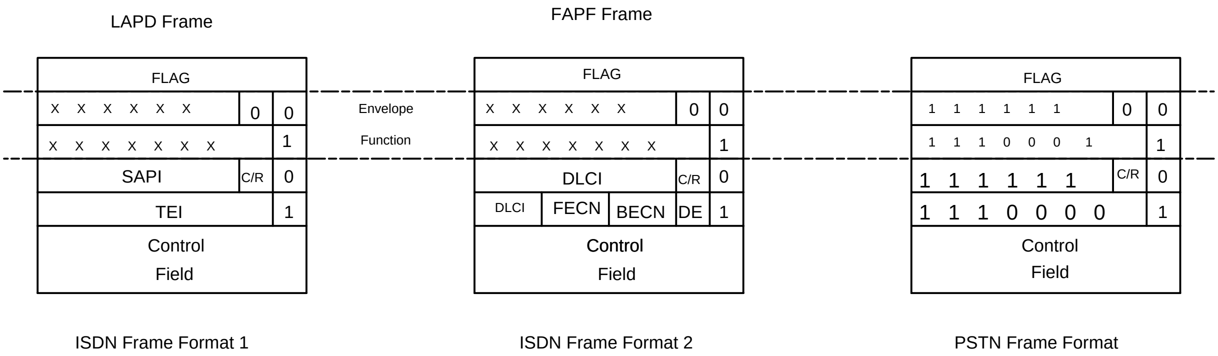


Figure C.1

The main disadvantage of this approach is considered too severe, and hence this proposal is not considered further.

C.1.2 The PSTN-V5 protocol runs in its own HDLC LAPD layer 2 alongside the ISDN-BA HDLC LAPD protocol

The PSTN-V5 protocol could run in its own, identical, HDLC LAPD layer 2 alongside the ISDN-BA HDLC LAPD protocol.

This leads to the problem of separating the two versions of HDLC LAPD.

What it would mean in practice is that any HDLC frame would have to be examined by some means in order to decide the destination for the frame in question. However this is not as onerous a requirement as it would at first appear as most HDLC LAPD hardware implementations actually perform this function as standard.

By using a reserved TEI, or series of TEIs, for the PSTN layer 2, it would be possible to identify these frames easily.

C.2 TEI assignment for the PSTN protocol

It has been decided that the layer 2 for the PSTN protocol for the NMDS system is to be identical to that used for the ISDN-BA service. This implies that the means of TEI assignment and the values of TEI hav to be defined.

The two methods of TEI assignment for the PSTN protocol layer 2 that were examined were

a) using the TEI assignment procedure as used for the ISDN-BA service, and

b) assuming pre-assigned TEIs.

These options are discussed in more depth in the following subclauses.

C.2.1 Using the ISDN-BA TEI assignment procedure for the PSTN protocol

Whilst the procedure is well understood, this approach would create some difficulties. The main problem is that the TEI assignment procedure as defined for the ISDN-BA service would have to be adopted, or another one created. The one already in use for the ISDN-BA would not be suitable as there is no current method for distinguishing between a requirement for a TEI for an ISDN-BA terminal and one for an NMDS PSTN-type function. It was decided that it was impractical to create a new TEI assignment procedure without it affecting the ISDN-BA service which already exists. A new TEI assignment procedure was suggested but this was also ruled out on the grounds of compatibility.

C.2.2 Pre-assigning the TEI(s) for the NMDS PSTN layer 3

This was considered a more practical approach as, using this approach, one or more TEIs could be assigned by provisioning to the NMDS PSTN layer 2 and hence could be used as required.

C.3 TEIs reserved for the NMDS PSTN layer 3 function

It was decided that the TEI(s) assigned for the NMDS PSTN layer 3 should be taken from the range of TEIs normally assigned only by the LE. This means that, with a minor change within the LE to ensure that these TEIs are not otherwise allocated to any ISDN-BA service on the same transmission system, there can be no possibility of a clash of TEI values occurring. The other TEI values are allocated by the ISDN-BA terminals in some cases, and the absence of a clash cannot be guaranteed.

The TEI values 64 to 126 are normally reserved for allocation by the LE and hence are the range to be considered for use by the NMDS PSTN protocol.

C.4 The number of TEIs reserved for use by the NMDS PSTN protocol entity(ies)

It was decided that the NMDS system would not define the number of PSTN (Z) userports to be provided on a system, but that as many could be used as required, given the constraint imposed by the number of B-channels available. This leads to the question, should each of these PSTN entities have their own TEI, or should they share a common one?

Should all PSTN layers 3 share a common TEI? - then by definition, the layer 2 responsible for these layers 3 would have to be centrally located. This was considered to be an unnecessary constraint. Should one TEI be allocated for each of the layer 2 functions, and should each of these then support only one NMDS PSTN layer 3? - then the potential constraint would not occur. This was accepted as the way forward.

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

D.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 synthesise 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 E (informative): The bearer channel allocation procedures adopted for NMDS

NOTE: This annex may be deleted before publication. It has been written specifically for those trying to understand part of the rationale behind the NMDS EN.

E.1 General

There are two B-channels available on a standard ISDN-BA transmission system of the type envisaged for use on NMDS. These have been designated B1 and B2. It is essential that these are correctly assigned for any call. This situation is similar to the V5.2 situation where a Bearer Channel Control protocol (BCC) was introduced.

Whilst it would be possible to use the BCC, or a subset, from V5.2 for the same purpose here, in practice it is not required. The reasoning behind this decision is given in the following clauses.

E.1.1 B-channel allocation for ISDN-BA or NMDS/ISDN-BA services

The ISDN-BA service already has an built in BCC system within its signalling system. The way this assigns B1 or B2 to an ISDN-BA terminal on a call by call basis is already well understood and will not be repeated here.

E.1.2 Bearer channel allocation for NMDS PSTN services

The situation here is not straightforward. It would be possible to provide a BCC protocol to handle the channel assignment for the PSTN layer 3, but in this case it is unnecessary. The reason for this is that there is now a potentially spare field in the V5 PSTN header which could be used for this purpose. This field is the one previously used in order to provide the layer 3 address of the PSTN port to which the layer 3 PSTN message was destined. Now that it has been decided that each PSTN layer three entity will sit in its own layer two (identified by the TEI), this field in the messages is not used and hence can be used for B-channel allocation.

It was decided to re-code the PSTN port address field as follows:

Table E.1

PSTN Port Address	Meaning
0	No B-channel assigned
1	B1 assigned
2	B2 assigned
Bn	Bn assigned (note)
7FFFh	Layer 3 address not relevant in current message
NOTE: Only applies for transmission systems other than those currently defined for NMDS.	

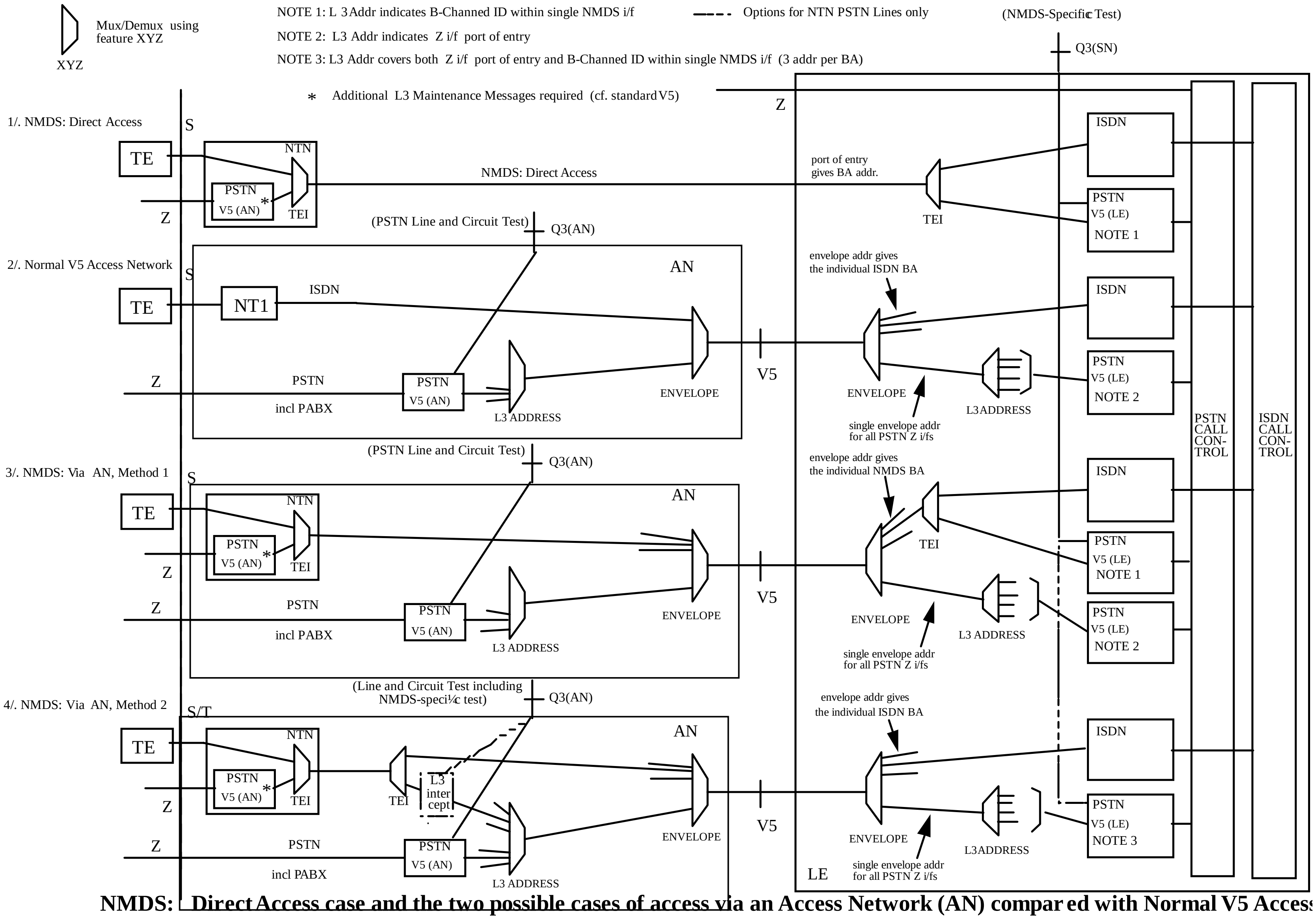
Annex F (informative): The relationship between a directly connected NMDS and one supported via an access network

F.1 Introduction

Figure F.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 F.1 showing the second method of connecting an NMDS via an AN will require changes to both the V5 specification ETS 300 324 [1] 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. At present it is not considered that such analysis can be justified.

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



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

Figure F.1

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

Figure F.1 at AN	Figure F.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 F.2: Functionality in scenario 4 from figure F.1

Figure F.1 at AN	Figure F.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 and NTN connected PSTN lines are tested from the AN Manager
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	
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 G (informative): The reasons for the new information element values chosen

G.1 General

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

G.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 [2]. 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.

G.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 in clause H.2, and taking into account the information elements already defined in table M2 of ETS 300 347-1 [2], it was decided to define the following single octet information elements:

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

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

G.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 in H.2, and taking into account the information elements already defined in table M2 of ETS 300 347-1 [2], it was decided to define the following multiple octet information elements:

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

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

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

NOTE: This annex may be deleted before publication. It has been written specifically for those trying to understand part of the rationale behind the NMDS EN.

The use of permanent activation of the basic access digital section for NMDS is based on the following three arguments.

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 is by their ear. It is this performance that will be expected of the PSTN service from NMDS. It has been recognised 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.

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.

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 J (informative): Remote equipment - functional requirements

The basic remote equipment functional requirements for an NTN are shown in figure J.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-bus, 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 J.1b). The reason for this is that it must 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 J.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-bus and, in these circumstances, some additional functionality is required in the configuration to achieve the separation (indicated in figure J.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-bus.

   - 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-bus so that ISDN users are aware of "hold-ups".

2) (Ref. figure J.3) Where permitted by the regulatory environment, the PSTN-GW functions may be supported by the S-bus, 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-bus, but uses an ISDN NT1. The logical development of this is:

3) (Ref. figure J.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.

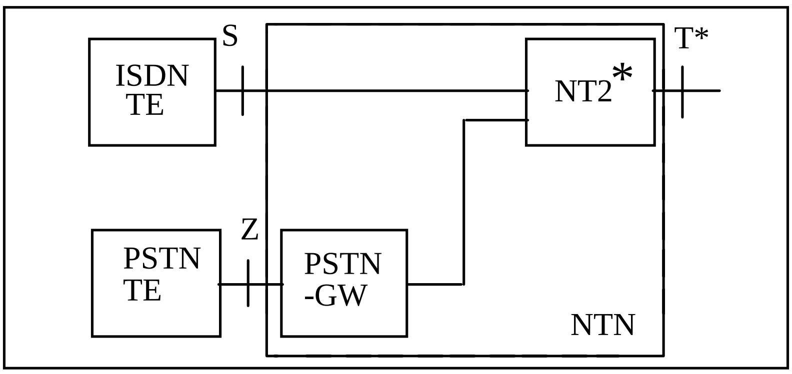


Figure J.1a: The basic remote equipment functional requirements for an NTN

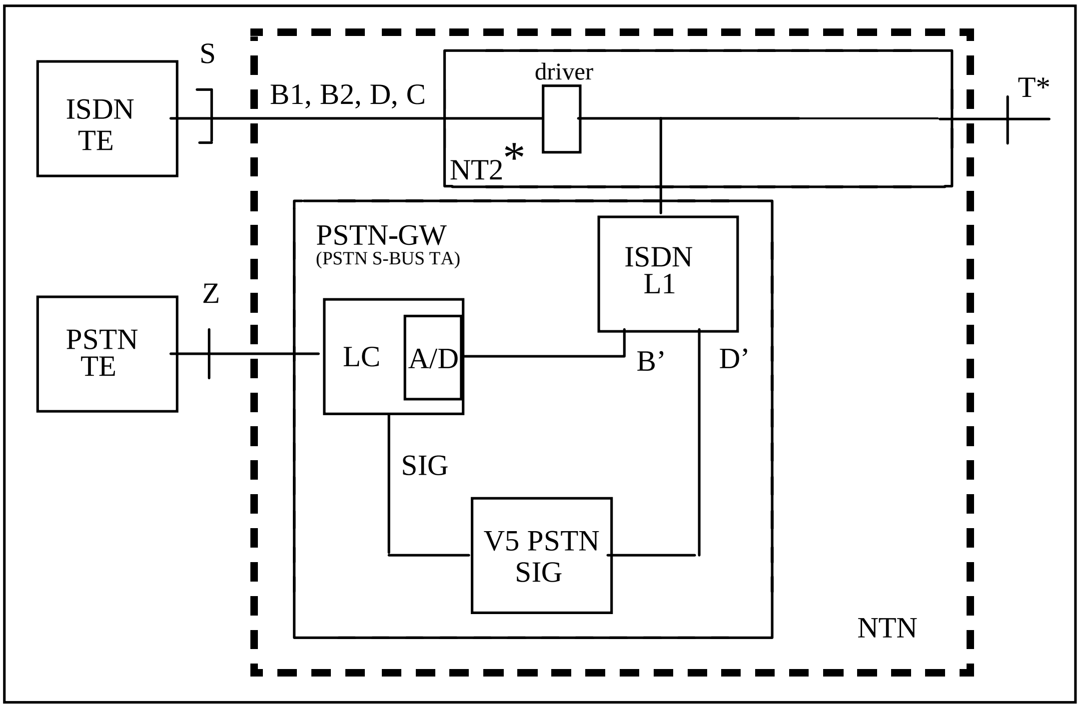


Fig J.1b: D-channel potential internal functionality of the NT2* and PSTN-GW, given no D-channel buffering

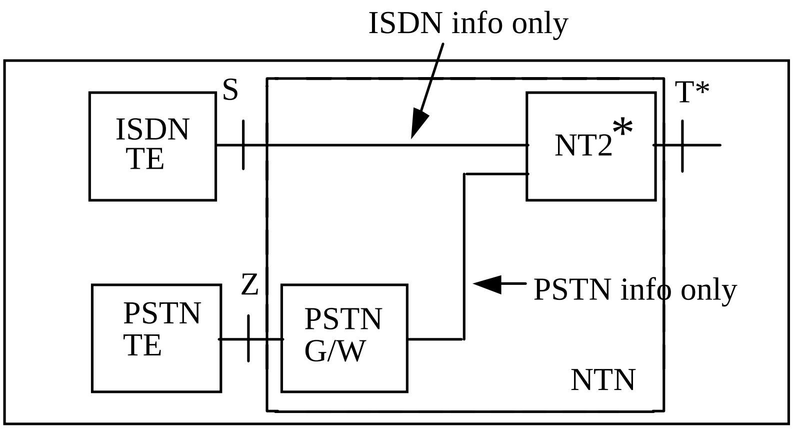


Figure J.2a: Regulatory reasons may require complete separation of the customer interfaces for ISDN and PSTN

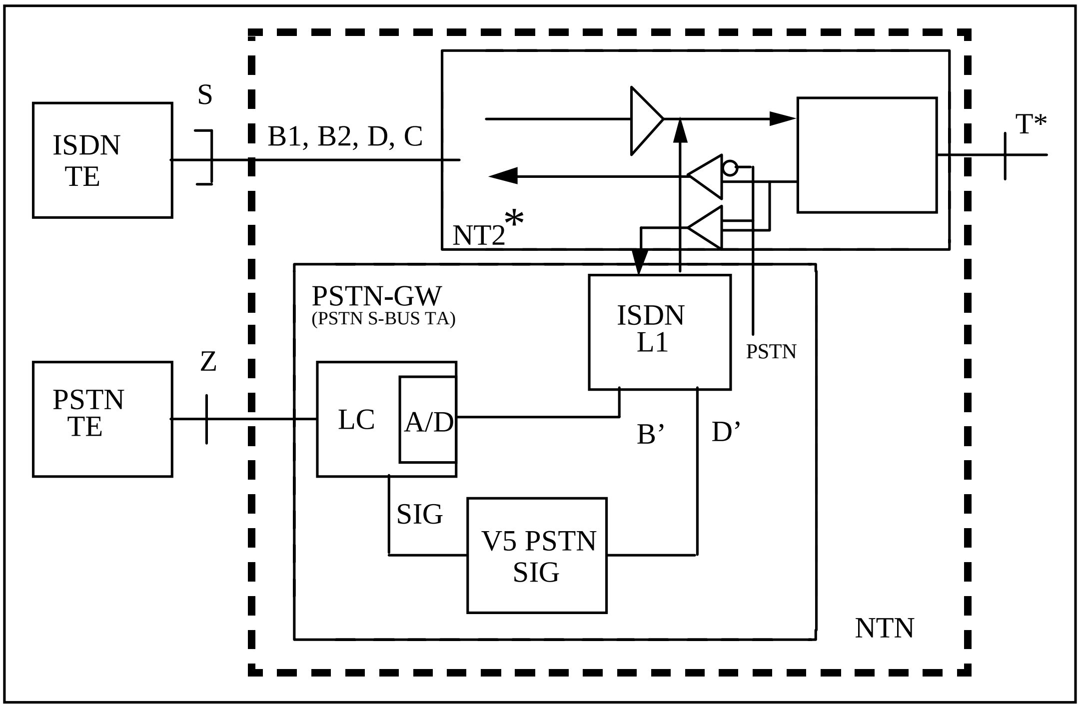


Figure J.2b: Additional functionality required should it be necessary to prevent PSTN information from getting onto the S-bus

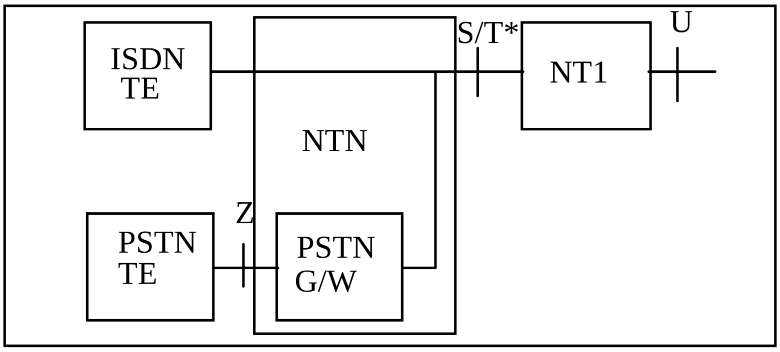


Figure J.3: The PSTN gateway functions may be supported by the S Bus, appearing at layer 1 as another ISDN-like terminal

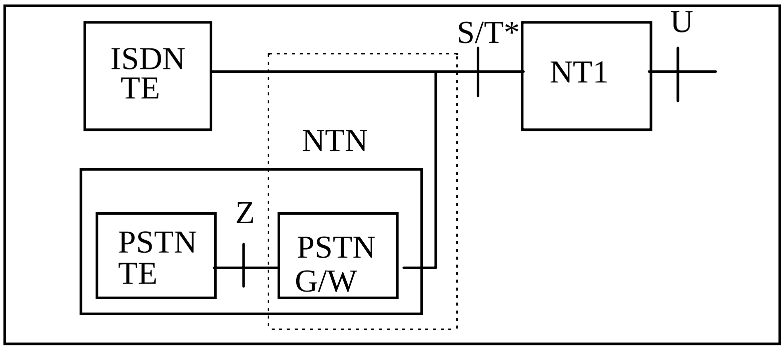


Figure J.4: The combination of the PSTN gateway and PSTN TE to form a PSTN digital telephone

History

Document history		
V1.1.1	January 1998	Public Enquiry PE 9822: 1998-01-30 to 1998-05-29