ETSI

EUROPEAN
TELECOMMUNICATION
STANDARD

ETS 300 324-7

October 1995

Source: ETSI TC-SPS

Reference: DE/SPS-03003.3-3

ICS: 33.020, 33.080, 33.100.20

Key words: V interface, V5 interface, PSTN, ISDN, LE, AN, TSS&TP, testing, layer 2

Signalling Protocols and Switching (SPS);
V interfaces at the digital Local Exchange (LE);
V5.1 interface for the support of Access Network (AN);
Part 7: Test Suite Structure and Test Purposes (TSS&TP)
specification for the data link layer

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Contents

Foreword

This European Telecommunication Standard (ETS) has been produced by the Signalling Protocols and Switching (SPS) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS is part 7 of a multi-part standard covering the V5.1 interface as described below:

Part 1:   "V5.1 interface specification";

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

Part 3:   "Test Suite Structure and Test Purposes (TSS&TP) specification for the network layer (AN side)";

Part 4:   "Abstract Test Suite (ATS) and partial Protocol Implementation eXtra Information for Testing (PIXIT) proforma specification for the network layer (AN side)";

Part 5:   "TSS&TP specification for the network layer (LE side)";

Part 6:   "ATS and partial PIXIT proforma specification for the network layer (LE side)";

Part 7:   "TSS&TP specification for the data link layer";

Part 8:   "ATS and partial PIXIT proforma specification for the data link layer";

Part 9:   "Test specification for the physical layer".

Transposition dates	
Date of adoption of this ETS:	27 October 1995
Date of latest announcement of this ETS (doa):	31 January 1996
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	31 July 1996
Date of withdrawal of any conflicting National Standard (dow):	31 July 1996

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1   Scope

This seventh part of ETS 300 324 contains the Test Suite Structure (TSS) and Test Purposes (TPs) for the Data Link Layer (DLL) of the V5.1 interface.

The conformance tests in this ETS provide a high probability of inter-operability of the DLL between an Access Network (AN) and a Local Exchange (LE) infrastructure. This ETS covers only the procedures described in ETS 300 324-1 [1] which are based upon ETS 300 125 [3].

ISO/IEC 9646-1 [5] is used as the basis for the methodology of conformance testing.

ETS 300 324-1 [1] defines the sublayers of the DLL, i.e. Link Access Protocol for V5 interface (LAPV5) Data Link sublayer (LAPV5-DL), LAPV5 Envelope Function sublayer (LAPV5-EF) and the mapping function (refer to ETS 300 324-1 [1], figure 6 which illustrates this approach). Regarding the conformance testing these sublayer functions are not tested separately. The test purposes defined in clause 5 cover testing of the LAPV5-DL (control protocol only), LAPV5-EF and the mapping function. The AN frame relay function is tested in co-operation with a generic test of an Integrated Services Digital Network (ISDN) D-channel.

The limitation of the DLL test to the Control DL is based on the assumption that the Public Switched Telephone Network (PSTN) DL implementation is identical with the Control DL implementation. This needs to be declared by the Implementation Under Test (IUT) supplier. Otherwise, the TPs defined for the Control DL may be used for the PSTN DL as well.

2   Normative references

This ETS incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[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 300 324-2 (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 2: Protocol Implementation Conformance Statement (PICS) proforma".

[3]   ETS 300 125 (1991): "Integrated Services Digital Network (ISDN); User-network interface data link layer specification; Application of CCITT Recommendations Q.920/I.440 and Q.921/I.441".

[4]   ISO 7498: "Information Processing Systems - Open Systems Interconnection - Basic Reference Model".

[5]   ISO/IEC 9646-1: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply, together with those given in ETS 300 324-1 [1]:

Abstract Test Suite (ATS): See ISO/IEC 9646-1 [5].

Data Link Layer (DLL): See ISO 7498 [4].

Implementation Under Test (IUT): See ISO/IEC 9646-1 [5].

Lower Tester (LT): See ISO/IEC 9646-1 [5].

Network Layer (NWK): See ISO 7498 [4].

Notional Upper Tester (UT): The upper layers of the System Under Test (SUT) are used to realize the functions of the UT, without any additional mechanism being installed.

Physical Layer (PHL): See ISO 7498 [4].

Point of Control and Observation (PCO): See ISO/IEC 9646-1 [5].

Protocol Implementation Conformance Statement (PICS): See ISO/IEC 9646-1 [5].

PICS proforma: See ISO/IEC 9646-1 [5].

Protocol Implementation eXtra Information for Testing (PIXIT): See ISO/IEC 9646-1 [5].

PIXIT proforma: See ISO/IEC 9646-1 [5].

System Under Test (SUT): See ISO/IEC 9646-1 [5].

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

AN	Access Network
ASP	Abstract Service Primitive
ATS	Abstract Test Suite
BI	Invalid Behaviour
BO	Inopportune Behaviour
BV	Valid Behaviour
CA	Capability
DLL	Data Link Layer
EFaddr	Envelope Function address
FCS	Frame Check Sequence
FSM	Finite State Machine
ID	Identifier
ISDN	Integrated Services Digital Network
IT	Basic Interconnection
IUT	Implementation Under Test
LAPD	Link Access Protocol for the ISDN D-channel
LAPV5	Link Access Protocol for V5 interface
LAPV5-DL	LAPV5 Data Link sublayer
LAPV5-EF	LAPV5 Envelope Function sublayer
LE	Local Exchange
LT	Lower Tester
NWK	Network Layer
PCO	Point of Control and Observation

PDU	Protocol Data Unit
PHL	Physical Layer
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
PSTN	Public Switched Telephone Network
RX	Receiver condition
SAPI	Service Access Point Identifier
SUT	System Under Test
TEI	Terminal Endpoint Identifier
TI	Timer
TP	Test Purpose
TSS	Test Suite Structure
TX	Transmitter condition
UT	Upper Tester

4 Test Suite Structure (TSS)

4.1 TSS overview

Figure 1 shows the structure of the V5.1 DLL test suite.

```
V5DLL _____ LAPV5_EF _____ IT
            |                            |_____ BV
            |                            |_____ BI
            |
            |_____ LAPV5_DL _____ IT
                                         |_____ CA
                                         |_____ BV _____ STATE
                                         |_____ BO _____ STATE
                                         |_____ BI _____ STATE
                                         |_____ TI _____ STATE
```
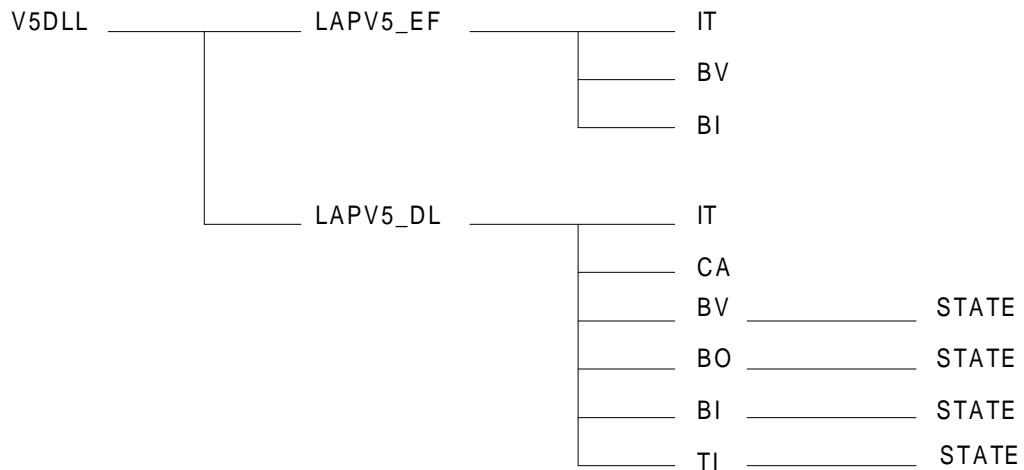
Figure 1: DLL TSS

4.2 Test groups

4.2.1 Protocol groups

4.2.1.1 Link Access Protocol for V5 interface - Envelope Function sublayer (LAPV5-EF)

The defined test purposes cover the LAPV5-EF procedures including the mapping function and the AN relay function (see ETS 300 324-1 [1], figure 6).

4.2.1.2 Link Access Protocol for V5 interface - Data Link sublayer (LAPV5-DL)

The defined test purposes cover the LAPV5-DL (control protocol only) procedures (see ETS 300 324-1 [1], figure 6).

4.2.2 Main test groups

4.2.2.1 Basic Interconnection (IT) tests

The IT test subgroup contains a basic set of test purposes which assures that there is a sufficient conformance for inter connection and that the chosen parameters are valid for the configuration.

4.2.2.2 Capability (CA) tests

Capability testing provides a limited testing to ascertain the main capabilities stated in the Protocol Implementation Conformance Statements (PICSs) can be observed.

4.2.2.3 Valid Behaviour (BV) tests

A valid test is a test where the message sequence and the message content is considered as valid (no MDL_ERR_IND is caused in the Finite State Machine (FSM) of the DLL entity).

4.2.2.4 Inopportune Behaviour (BO) tests

This test subgroup is intended to verify that the IUT is able to react properly, in case an inopportune protocol event occurs. Such an event is syntactically correct but it occurs when it is not expected (a MDL_ERR_IND is caused in the FSM of the DLL entity).

4.2.2.5 Invalid Behaviour (BI) tests

This test subgroup is intended to verify that the IUT is able to react properly having received an invalid Protocol Data Unit (PDU). Invalid PDU here means a syntactically invalid PDU and, therefore, a MDL_ERR_IND might be caused in the FSM of the DLL entity.

4.2.2.6 Timer (TI)

The TI test group contains tests related to the system timers T200 and T203.

4.3 Test step structure

General dynamic behaviours should be described in test steps. The main test steps to apply the TPs described in this document are described in this subclause.

4.3.1 State transitions

Two groups of state transitions are defined:

> **V5 interface start-up:** this group contains the test steps to initialize the V5 interface.

> **LAPV5-DL state transitions:** this group contains test steps which describe state transitions of the LAPV5-DL implementation used in different preambles.

4.3.1.1 V5 interface start-up

The start-up procedure of a V5.1 IUT (AN or LE) depends on the configuration which is provisioned (refer to subclause 5.1.6). The PICS items M1 and M2 (refer to ETS 300 324-2 [2], subclauses 6.5.1 and 6.6.1), further called TSPC_PSTN and TSPC_ISDNBA, are used to define the implemented configuration of the IUT.

> NOTE: ETS 300 324-2 [2] requires at least one of two the PICS items to be set to "Yes".

PICS description:

TSPC_PSTN: PSTN ports supported;
TSPC_ISDNBA: ISDN-BA user ports supported.

Figure 2 describes the start-up procedure.
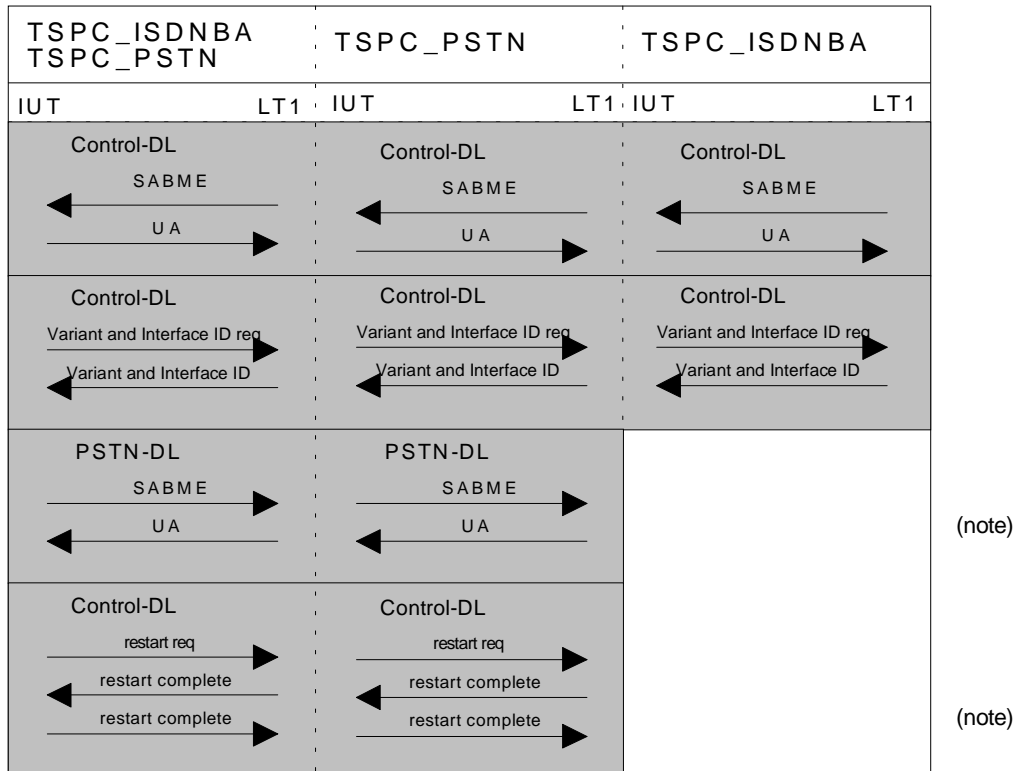
NOTE: Only valid if TSPC_PSTN is set.

Figure 2: Start-up

4.3.1.2 LAPV5-DL state transitions

The following test steps allow to reach any IUT state necessary for DLL testing:

LAPV5_DL_51_9: state transition from state 5.1 to 9.
On receipt of a DM response (F=1) the IUT enters state 9.

LAPV5_DL_70_51: state transition from state 7.0 to 5.1.
On receipt of a DM response (F=0) the IUT sends a SABME frame (P=1) and enters state 5.1.

LAPV5_DL_70_71: state transition from state 7.0 to 7.1.
On receipt of an I-frame (P=0) whose sequence number N(S) > V(R) the IUT sends a REJ response (F=0) and enters state 7.1.

LAPV5_DL_70_74: state transition from state 7.0 to 7.4.
On receipt of a RNR command (P=1) the IUT sends a RR response (F=1) and enters state 7.4.

LAPV5_DL_70_80: state transition from state 7.0. to 8.0.
On T203 expiry the IUT sends a RR command (P=1) and enters state 8.0.

LAPV5_DL_71_75: state transition from state 7.1 to 7.5.
On receipt of a RNR command (P=1) the IUT sends a RR response and enters state 7.5.

LAPV5_DL_80_81: state transition from state 8.0 to 8.1.
On receipt of an I-frame (P=1) whose sequence number N(S) > V(R) the IUT sends a REJ response (F=1) and enters state 8.1.

LAPV5_DL_80_84: state transition from state 8.0 to 8.4.
On receipt of a RNR command (P=1) the IUT sends a RR response (F=1) and enters state 8.4.

LAPV5_DL_81_85:   state transition from state 8.1 to 8.5.
On receipt of a RNR command (P=1) the IUT sends a RR response (F=1) and enters state 8.5.

LAPV5_DL_9_50:   state transition from state 9 to 5.0.
On receipt of a DM response (F=0) the IUT sends a SABME frame (P=1) and enters state 5.0.

4.3.2   Preambles

The preamble test group contains the preamble test steps needed for initialization of the IUT before testing the particular test purpose. The preambles are based on the state transition described in subclause 4.3.1.

4.3.3   Postambles

After each test, the IUT is brought back to the initial state.

4.3.4   Status verification

Based on the modifications to tables D-1 to D-3 of ETS 300 125 [3] as specified in ETS 300 324-1 [1], subclause 10.4.11.2, it is possible to identify the status of the IUT, if the IUT is in state 7 (multiple frame established). States 7.2, 7.3, 7.6 and 7.7 are not distinguished as it is not possible to bring the IUT into this state (except under load condition).

CHECK_STATE_70
The timer T_NOAC (3 s) is started, if no events occur during time T_NOAC the IUT is not in state 7.4, 7.5 or 8.x.
On receipt of an I-frame (P=1) with $N(S) \neq V(R)$, the IUT shall send a REJ response (F=1) $\Rightarrow$ different to state 7.1.

CHECK_STATE_71
The timer T_NOAC (3 s) is started, if no events occur during time T_NOAC the IUT is not in state 7.4, 7.5 or 8.x.
On receipt of an I-frame (P=1) with $N(S) \neq V(R)$, the IUT shall send a RR response (F=1) $\Rightarrow$ different to state 7.0.

CHECK_STATE_74
No action is taken from the tester, the IUT shall send N200 times a RR command (P=1) $\Rightarrow$ the IUT is not in state 7.0, 7.1 or 8.x.
On receipt of an I-frame (P=1) with $N(S) \neq V(R)$, the IUT shall send a REJ response (F=1) $\Rightarrow$ different to state 7.5.

CHECK_STATE_75
No action is taken from the tester, the IUT shall send N200 times a RR command (P=1) $\Rightarrow$ the IUT is not in state 7.0, 7.1 or 8.x.
On receipt of an I-frame (P=1) with $N(S) \neq V(R)$, the IUT shall send a RR response (F=1) $\Rightarrow$ different to state 7.4.

4.3.5   Common test steps

This test step group contains test steps which describe procedures which are used in more than one test case, e.g. receive procedures of common acknowledgement messages.

4.4   Defaults

The default section describes the behaviour in case of an unexpected test event.

4.5 Abstract Service Primitives (ASPs) and Protocol Data Units (PDUs)

4.5.1 ASPs

Two ASPs are defined:

    ph_data_req
    ph_data_ind

The PH-data information shall be defined as described in ETS 300 324-1 [1], figure 7. For the purpose of DLL testing, only the Envelope Function address (EFaddr) and the Frame Check Sequence (FCS) are relevant.

The value of the flag sequence and the FCS are usually supplied by the V5.1 tester, but for testing of the LAPV5-EF functions it is necessary to corrupt the FCS value.

4.5.2 PDUs

The PDUs used on the V5.1 interface have to be split into two parts:

1)   PDUs sent to the LAPV5-DL level (refer to ETS 300 324-1 [1], clause 10):

    sabme_cmd   SABME-command;
    ua_rsp   UA-response;
    dm_rsp   DM-response;
    rr_cmd   RR-command;
    rr_rsp   RR-response;
    rnr_cmd   RNR-command;
    rnr_rsp   RNR-response;
    rej_cmd   REJ-command;
    rej_rsp   REJ-response;
    i_cmd   I-command.

2)   PDUs sent to an ISDN-BA terminal via an ISDN-BA user port:

    refer to ETS 300 125 [3], table 5.

4.6 Timers and counters of the Abstract Test Suite (ATS)

This subclause describes the timer and counters which shall be applied when implementing the TPs in a ATS. The **min** and **max** indications define that the timer value represents the minimum or maximum tolerance of a timer. The timer values contain some additional tolerances for delays caused by testers.

Table 1: ATS timers

ATS timer name	ATS timer value [s]	ETS timer name	Reference to ETS 300 324-1 [1]
T200_min	0,5	T200	subclause 10.4.9
T200_max	1,5		
T203_min	1	T203	subclause 10.4.9
T203_max	11		
TC2_max	TSPX_TC2_max	TC2	table C.1
TR2_max	132	TR2	table C.1
T_AC_short	1	Watch dog timer if an immediate ACtion is expected from the IUT.	
T_AC_long	60	Watch dog timer if an ACtion from the IUT is expected after an undefined time period.	
T_NOAC	3	Guard timer if NO ACtion shall appear.	

Table 2: ATS counters

ATS counter name	ATS counter value	Comments	Reference to ETS 300 324-1 [1]
N200	3	Corresponding counter variable: RC	subclause 10.4.9
N201	260	Maximum number of octets in an information field	subclause 10.4.9

5 Test Purposes (TP)

5.1 Introduction

Clause 5 contains the TPs for V5.1 DLL testing. This subclause describes the test strategy of the TPs, the test environment for which the TPs apply and the V5.1 procedures for which no TPs are defined.

5.1.1 TP naming convention

The identifier of the TP is constructed according to the scheme in table 3.

Table 3: TP identifier naming convention scheme

Identifier:	**TP<t><c><tpt><s><ss><nn>**			
<t>	=	type of protocol: (test group)	1 2	LAPV5-EF LAPV5-DL
<c>	=	category: (test subgroup)	1 2 3 4 5 6	IT, Basic Interconnection Tests CA, Capability Tests BV, Valid Behaviour Tests BO, Inopportune Behaviour Tests BI, Invalid Behaviour Tests TI, Timer
<tpt>		test purpose type	S	Single TP (not combined TP)
<s>	=	state	(0-9) _	(underscore) not relevant
<ss>	=	substate	(0-9) _	(underscore) not relevant
<nn>	=	sequential number	(00-99)	

5.1.2 Source of TP definition

The test purposes have been based on the state tables D-1, D-2 and D-3 of ETS 300 125 [3] as modified by subclause 10.4.11.2 of ETS 300 324-1 [1]. To eliminate redundancy, the SDL diagrams B-1 to B-9 of ETS 300 125 [3] have been applied according to ETS 300 324-1 [1].

Whenever in the TPs reference is made to ETS 300 125 [3], the restrictions imposed in ETS 300 324-1 [1], subclause 10.4.11.2, shall apply.

5.1.3   Test strategy

a)   the following selection criteria have been applied to cover a maximum of test events with an appropriate number of test cases:

-        in tables D-1 to D-3 of ETS 300 125 [3], state actions which are identified by the characters "|" or "/" are not covered. These states are "impossible" by the definition of the DLL service or by the definition of the peer-to-peer data link procedures;

b)   in relation to the SDL diagrams B-1 to B-9 of ETS 300 125 [3], the testing is limited:

-        if parameter variation (P/F and C/R bit) is not considered in a SDL diagram path, only one parameter value is tested;
-        if the SDL diagram paths are the same for different states, only one state is explicitly tested;

c)   to test the protocol error handling (BI test cases), more extensive testing is necessary even though some tests are testing the same SDL diagram paths as others;

d)   the AN frame relay function is tested in co-operation with a generic test of an ISDN D-channel.

5.1.4   Procedures for which no TPs are defined

a)   only the Control DL is tested. The limitation of the DLL tests to the Control DL is based on the assumption that the PSTN DL implementation is identical with the Control DL implementation. This shall be declared by the IUT supplier in a Protocol Implementation eXtra Information for Testing (PIXIT). Otherwise the TPs defined for the Control DL can be used for the PSTN DL as well;

b)   to test the IUT status (marked in TPs as new/remain in state), the test steps defined in subclause 4.3.4 shall be applied. States 9, 5.0, 5.1 and 8.x cannot be checked, therefore no status check is defined if the IUT is supposed to be in one of those states. In general, the status of the IUT can be verified when it is supposed to be in state 7.x. For some tests (I-frame procedures) it is necessary to use NWK procedures. In case where a NWK procedure has to be completed no status check can be done for states 7.x. States 8.x cannot be checked as it not always possible to distinguish the states 8.x;

c)   the value range of the sequence numbers is implicitly tested in the NWK tests;

d)   no TPs are defined for state actions defined by the character "-" related to state 5.0 and state 9. From states 7.x and 8.x, the states 5.0 and 9 cannot be reached by an external protocol event (only by internal system management events) thus they are not relevant for testing;

e)   generating of error indications is not tested.

5.1.5   Initial state

If the DLL is released between each test, the IUT may have to be re-initialized. If the IUT detects a data link failure (ETS 300 324-1 [1], annex C, item 17) the start-up procedure (refer to subclause 4.3.1.1) brings the IUT into the initial state. The initial state for V5 DLL testing is state 7.0 "multiple frame established". At the beginning and end of a test, the IUT shall always be brought into state 7.0.

5.1.6   Data configuration for AN and LE testing

To test the DLL entity of the AN as well as of the LE a particular IUT data configuration shall be applied to avoid complicated test case layout. Depending on the services supported by the IUT, three IUT data configurations are considered:

-        ISDN-BA user ports supported (ETS 300 324-2 [2], PICS item M.1);

-        PSTN ports supported (ETS 300 324-2 [2], PICS item M.2);

-        ISDN-BA user ports and PSTN ports supported.

Port provisioning:

a)   if ISDN-BA applications are provisioned, one ISDN-BA user port shall be provisioned in such a way that the ISDN-BA user port entity will not enter the operational state after system start-up. The ISDN-BA port shall be provisioned for a non-automatic ISDN-BA terminal for point to point connection over a single data link (fixed Terminal Endpoint Identifier (TEI));

b)   if PSTN applications are provisioned, only the PSTN application but no PSTN port shall be provisioned.

Additional requirements:

-    for AN testing, a non-automatic ISDN-BA terminal (Service Access Point Identifier (SAPI) = 0, TEI = 0) shall be connected to the ISDN-BA user port.

In case other configurations are provisioned, the start-up procedures need to be adapted.

5.2   LAPV5-EF

5.2.1   Basic interconnection tests

TP11S__01   Generic test of an AN ISDN D-channel.

A link to the ISDN-BA entity of the IUT shall be established. The ISDN-BA entity shall respond to a received SABME command with a UA response.

NOTE: For AN testing, the ISDN-BA entity is presented by an ISDN-BA terminal and for LE testing the ISDN-BA entity is presented by the LE ISDN-BA entity.

5.2.2   Valid behaviour tests

TP13S__01   Refer to subclause 5.2.1, TP11S__01.

TP13S__02   Preamble:
The IUT shall be brought into state 7.0.

On receipt of an I-frame (P=1) which contains an information field whose length is 520 octets (the maximum frame length is 537), the IUT shall handle the frame. The IUT shall send a SABME-frame (P=1).

5.2.3   Invalid behaviour tests

To apply the tests of this test group, the IUT shall be brought first into state 7.0.

TP15S__01   On receipt of a frame (I-, U- or S-frame) whose EFaddr does not conform to ETS 300 324-1 [1], subclause 9.2.1 (format error, bit 1 of the first octet shall be set to '1'B), the IUT shall discard the invalid frame.

Afterwards an I-frame exchange shall be successful.

TP15S__02   On receipt of a too short frame (less than 5 octets), the IUT shall discard the invalid frame.

Afterwards an I-frame exchange shall be successful.

TP15S__03   On receipt of an unbounded I-frame (more than 537 octets), the IUT shall discard the invalid frame.

Afterwards an I-frame exchange shall be successful.

TP15S__04   On receipt of a frame with a FCS-error, the IUT shall discard the invalid frame.

Afterwards an I-frame exchange shall be successful.

TP15S__05   On receipt of a frame whose EFaddr field length is not equal to 2 octets, the IUT shall discard the invalid frame.

Afterwards an I-frame exchange shall be successful.

TP15S__06   On receipt of a frame whose EFaddr is not implemented, the IUT shall discard the invalid frame.

Afterwards an I-frame exchange shall be successful.

5.3   LAPV5-DL

5.3.1   Basic interconnection tests

TP21S__01   The IUT shall be able to establish a DLL link. On receipt of a RR command, the IUT shall send a RR response.

5.3.2   Capability tests

To apply the tests of this test group, the IUT shall be brought first into state 7.0.

TP22S__01   On receipt of a REJ response the I-frame with the sequence number N(S) = N(R) shall be re-transmitted.

TP22S__02   On T200 expiry, the IUT shall either re-send the last sent I-frame or send a RR command (P=1).

5.3.3   Valid behaviour

5.3.3.1   State 9: link not established

Refer to table D-1 in ETS 300 125 [3].

TP23S9_01   On receipt of a MDL_CTRL (establish request), the IUT shall send a SABME frame (P=1).

    NOTE: The system management of the IUT shall send a MDL_CTRL message (establish request) to the IUT entity when the IUT is in state 9.

TP23S9_02   On receipt of a SABME frame (P=1), the IUT shall send a UA frame (F=1) and enter state 7.0.

TP23S9_03   On receipt of a DM frame (F=0), the IUT shall send a SABME frame (P=1).

5.3.3.2   State 5: awaiting establishment

Refer to table D-1 in ETS 300 125 [3].

5.3.3.2.1   State 5.0: establish

TP23S5001   On receipt of a SABME frame (P=1), the IUT shall send a UA frame (F=1).

TP23S5002   On receipt of a UA frame (F=1, response to second SABME frame), the IUT shall enter state 7.0.

TP23S5003   On receipt of a DM frame (F=1), the IUT shall enter state 9 and start the data link failure procedure (ETS 300 324-1 [1], annex C, item 17). Afterwards, the IUT shall send a SABME frame (P=1).

TP23S5004   On receipt of a DM frame (F=1), the IUT shall enter state 9 and start the data link failure procedure (ETS 300 324-1 [1], annex C, item 17). Afterwards, the IUT shall send a SABME frame (P=1).

If the SABME frame is not answered with a UA frame after the time TC2, the IUT shall enter state 9 and start the system start-up procedure (refer to ETS 300 324-1 [1], annex C, item 17).

5.3.3.2.2   State 5.1: re-establish

TP23S5101   On receipt of a UA frame (F=1), the IUT shall enter state 7.0.

TP23S5102   On receipt of a DM frame (F=1), the IUT shall enter state 9 and start the data link failure procedure (ETS 300 324-1 [1], annex C, item 17). Afterwards, the IUT shall send a SABME frame (P=1).

TP23S5103   On receipt of a DM frame (F=0), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5104   On receipt of a RR command (P=1), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5105   On receipt of a RR command (P=0), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5106   On receipt of a RR response (F=1), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5107   On receipt of a RR response (F=0), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5108   On receipt of a REJ command (P=1), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5109   On receipt of a REJ command (P=0), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5110   On receipt of a REJ response (F=1), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5111   On receipt of a REJ response (F=0), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5112   On receipt of a RNR command (P=1), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5113   On receipt of a RNR command (P=0), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5114   On receipt of a RNR response (F=1), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5115   On receipt of a RNR response (F=0), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5116   On receipt of an I-frame (P=1), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

TP23S5117   On receipt of an I-frame (P=0), the IUT shall take no action until the T200 expiry. On T200 expiry, the IUT shall send a SABME-frame (P=1).

5.3.3.3   State 7: multiple frame established

Refer to table D-2 in ETS 300 125 [3].

5.3.3.3.1   State 7.0: TX: normal, RX: normal

TP23S7001   On receipt of a RR command (P=1), the IUT shall send a RR response (F=1) and remain in state 7.0.

TP23S7002   On receipt of a RR command (P=0), the IUT shall remain in state 7.0.

TP23S7003   On receipt of a RR response (F=0), the IUT shall remain in state 7.0.

TP23S7004   Refer to subclause 5.3.2, TP22S__01.

TP23S7005   On receipt of a REJ command (P=1), the IUT shall send a RR response (F=1) followed by a re-transmission of the I-frame with the sequence number N(S)=N(R).

TP23S7006   On receipt of a RNR command (P=1), the IUT shall send a RR response (F=1) and enter state 7.4.

TP23S7007   On receipt of a RNR command (P=0), the IUT shall enter state 7.4.

TP23S7008   On receipt of an I-frame (P=1), the IUT shall send a RR response (F=1) and remain in state 7.0.

TP23S7009   On receipt of an I-frame (P=0), the IUT shall acknowledge the I-frame with the next I-frame (if no I-frame is available the IUT shall send a RR frame (F=0)).

TP23S7010   The IUT shall accept an I-frame as the acknowledgement of a previous sent I-frame.

TP23S7011   On receipt of an I-frame (P=1) with N(S) $\neq$ V(R) by the IUT, the IUT shall discard the I-frame and send a REJ response (F=1). New state: 7.1.

TP23S7012   On receipt of an I-frame (P=0) with N(S) $\neq$ V(R) by the IUT, the IUT shall discard the I-frame and send a REJ response (F=0). New state: 7.1.

TP23S7013   On receipt of an I-frame (P=1) which contains an information field whose length is N201 octets, the IUT shall send a RR-response (F=1).

TP23S7014   Check that the IUT does not send I-frame sequences containing more outstanding I-frames than allowed in the window size k.

5.3.3.3.2   State 7.1: TX: normal, RX: REJ recovery

TP23S7101   On receipt of a RNR command (P=1), the IUT shall send a RR response (F=1) and enter state 7.5.

TP23S7102   On receipt of an I-frame (P=1), the IUT shall send a RR response (F=1) and enter state 7.0.

TP23S7103   On receipt of an I-frame (P=0), the IUT shall acknowledge the I-frame with the next I-frame (if no I-frame is available the IUT shall send a RR frame (F=0)).

TP23S7104   On receipt of an I-frame (P=1) with N(S) $\neq$ V(R) by the IUT, the IUT shall discard the I-frame and send a RR response (F=1). The IUT shall remain in state 7.1.

TP23S7105   On receipt of an I-frame (P=0) with N(S) ≠ V(R) by the IUT, the IUT shall discard the I-frame and remain in state 7.1.

5.3.3.3.3   State 7.4: TX: peer rec busy, RX: normal

TP23S7401   On receipt of a RR command (P=1), the IUT shall send a RR response (F=1) and enter state: 7.0.

TP23S7402   On receipt of a REJ command (P=1), the IUT shall send a RR response (F=1) followed by a re-transmission of the I-frame with the sequence number N(S)=N(R).

TP23S7403   On receipt of a REJ command (P=0), the IUT shall enter state 7.0 and re-transmit the I-frame with the sequence number N(S)=N(R).

TP23S7404   On receipt of a RNR command (P=1), the IUT shall send a RR response (F=1) and remain in state 7.4.

TP23S7405   On receipt of an I-frame (P=1), the IUT shall send a RR response (F=1) and remain in state 7.4.

TP23S7406   On receipt of an I-frame (P=0), the IUT shall send a RR response (F=0) and remain in state 7.4.

TP23S7407   On receipt of an I-frame (P=1) with N(S) ≠ V(R) by the IUT, the IUT shall discard the I-frame and send a REJ response (F=1). New state 7.5.

TP23S7408   On receipt of an I-frame (P=0) with N(S) ≠ V(R) by the IUT, the IUT shall discard the I-frame and send a REJ response (F=0). New state 7.5.

5.3.3.3.4   State 7.5: TX: peer rec busy, RX: REJ recovery

TP23S7501   On receipt of a RR command (P=1), the IUT shall send a RR response (F=1) and enter state 7.1.

TP23S7502   On receipt of an I-frame (P=1), the IUT shall send a RR response (F=1) and enter state 7.4.

TP23S7503   On receipt of an I-frame (P=0), the IUT shall send a RR response (F=0) and enter state 7.4.

TP23S7504   On receipt of an I-frame (P=1) with N(S) ≠ V(R) by the IUT, the IUT shall discard the I-frame and send a RR response (F=1). The IUT shall remain in state 7.5.

TP23S7505   On receipt of an I-frame (P=0) with N(S) ≠ V(R) by the IUT, the IUT shall discard the I-frame and remain in state 7.5.

5.3.3.4   State 8: timer recovery

Refer to table D-3 in ETS 300 125 [3].

5.3.3.4.1   State 8.0: TX: normal, RX: normal

TP23S8001   On receipt of a RR command (P=1), the IUT shall send a RR response (F=1).

TP23S8002   After having sent an I-frame (P=0), on receipt of a RR response (F=1), the IUT shall enter state 7.0.

TP23S8003   On receipt of a REJ command (P=1), the IUT shall send a RR response (F=1) followed by a re-transmission of the I-frame with the sequence number N(S)=N(R).

TP23S8004   On receipt of a REJ response (F=1), the IUT shall enter state 7.0 and re-transmit the I-frame with the sequence number N(S) = N(R).

TP23S8005   On receipt of a RNR command (P=1), the IUT shall send a RR response (F=1).

TP23S8006   After having sent an I-frame, on receipt of a RNR response (F=1), the IUT shall enter state 7.4.

TP23S8007   On receipt of an I-frame (P=1), the IUT shall send a RR response (F=1).

TP23S8008   On receipt of an I-frame (P=0), the IUT shall acknowledge the I-frame with the next I-frame (if no I-frame is available the IUT shall send a RR frame (F=0)).

TP23S8009   On receipt of an I-frame (P=1) with N(S) ≠ V(R) by the IUT, the IUT shall discard the I-frame and send a REJ response (F=1).

TP23S8010   On receipt of an I-frame (P=0) with N(S) ≠ V(R) by the IUT, the IUT shall discard the I-frame and send a REJ response (F=0).

5.3.3.4.2   State 8.1: TX: normal, RX: REJ recovery

TP23S8101   On receipt of a REJ response (F=1), the IUT shall enter state 7.1 and re-transmit the I-frame with the sequence number N(S) = N(R).

TP23S8102   On receipt of a RNR command (P=1), the IUT shall send a RR response (F=1).

TP23S8103   After having sent an I-frame, on receipt of a RNR response (F=1), the IUT shall enter state 7.5.

TP23S8104   On receipt of an I-frame (P=1), the IUT shall send a RR response (F=1).

TP23S8105   On receipt of an I-frame (P=0), the IUT shall acknowledge the I-frame with the next I-frame (if no I-frame is available the IUT shall send a RR frame (F=0)).

TP23S8106   On receipt of an I-frame (P=1) with N(S) ≠ V(R) by the IUT, the IUT shall discard the I-frame and send a RR response (F=1).

5.3.3.4.3   State 8.4: TX: peer rec busy, RX: normal

TP23S8401   On receipt of a RR command (P=1), the IUT shall send a RR response (F=1).

TP23S8402   After having sent an I-frame, on receipt of a RR response (F=1), the IUT shall enter state 7.0.

TP23S8403   After having sent an I-frame, on receipt of a REJ command (P=1), the IUT shall send a RR response (F=1).

TP23S8404   On receipt of a REJ response (F=1), the IUT shall re-transmit the I-frame with the sequence number N(S) = N(R).

TP23S8405   On receipt of a RNR command (P=1), the IUT shall send a RR response (F=1).

TP23S8406   After having sent an I-frame, on receipt of a RNR response (F=1), the IUT shall enter state 7.4.

5.3.3.4.4 **State 8.5: TX: peer rec busy, RX: REJ recovery**

TP23S8501   On receipt of a RR command (P=1), the IUT shall send a RR response (F=1).

TP23S8502   On receipt of a REJ command (P=1), the IUT shall send a RR response (F=1).

TP23S8503   On receipt of a REJ response (F=1), the IUT shall re-transmit the I-frame with the sequence number N(S) = N(R).

TP23S8504   After having sent an I-frame, on receipt of a RNR response (F=1), the IUT shall enter state 7.5.

5.3.4 **Inopportune behaviour**

5.3.4.1 **State 7: multiple frame established**

Refer to table D-2 in ETS 300 125 [3].

5.3.4.1.1 **State 7.0: TX: normal, RX: normal**

TP24S7001   On receipt of a SABME frame (P=1), the IUT shall send an UA frame (F=1).

TP24S7002   On receipt of a DM frame (F=0), the IUT shall send a SABME frame (P=1).

TP24S7003   On receipt of a RR response (F=1, instead of F=0) the I-frame exchange shall not be affected.

TP24S7004   On receipt of a REJ response (F=1, instead of F=0) the I-frame with the sequence number N(S) = N(R) shall be re-transmitted.

TP24S7005   On receipt of a RNR response (F=1, instead of F=0), the IUT shall enter state 7.4.

5.3.4.1.2 **State 7.1: TX: normal, RX: REJ recovery**

TP24S7101   On receipt of a SABME frame (P=1), the IUT shall send an UA frame (F=1).

TP24S7102   On receipt of a RNR response (F=1, instead of F=0), the IUT shall enter state 7.5.

5.3.4.1.3 **State 7.4: TX: peer rec busy, RX: normal**

TP24S7401   On receipt of a DM frame (F=0), the IUT shall send a SABME frame (P=1).

TP24S7402   On receipt of a REJ response (F=1, instead of F=0), the IUT shall re-transmit the I-frame with the sequence number N(S) = N(R) of the REJ response sent.

TP24S7403   On receipt of a RNR response (F=1, instead of F=0), the IUT shall remain in state 7.4.

5.3.4.2 **State 8: timer recovery**

Refer to table D-3 in ETS 300 125 [3].

5.3.4.2.1 **State 8.0: TX: normal, RX: normal**

TP24S8001   On receipt of a SABME frame (P=1), the IUT shall send an UA frame (F=1).

TP24S8002   On receipt of a DM frame (F=1), the IUT shall send a SABME frame (P=1).

5.3.5   Invalid behaviour

5.3.5.1   State 7: multiple frame established

Refer to table D-2 in ETS 300 125 [3].

5.3.5.1.1   State 7.0: TX: normal, RX: normal

TP25S7001   On receipt of a RR command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S7002   On receipt of a RR command (P=0) with a N(R) error, the IUT shall send a SABME frame (P=1).

TP25S7003   On receipt of a RR response (F=0) with a N(R) error, the IUT shall send a SABME frame (P=1).

TP25S7004   On receipt of a REJ command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S7005   On receipt of a REJ command (P=0) with a N(R) error, the IUT shall send a SABME frame (P=1).

TP25S7006   On receipt of a REJ response (F=0) with a N(R) error, the IUT shall send a SABME frame (P=1).

TP25S7007   On receipt of a RNR command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S7008   On receipt of a RNR command (P=0) with a N(R) error, the IUT shall send a SABME frame (P=1).

TP25S7009   On receipt of a RNR response (F=0) with a N(R) error, the IUT shall send a SABME frame (P=1).

TP25S7010   On receipt of an I-frame (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S7011   On receipt of an I-frame (P=0) with a N(R) error, the IUT shall send a SABME frame (P=1).

TP25S7012   On receipt of an I-frame (P=1) with $N(S) \neq V(R)$ of the IUT and with a N(R) error, the IUT shall discard the I-frame and send a REJ response (F=1) followed by a SABME frame (P=1).

TP25S7013   On receipt of an I-frame (P=0) with $N(S) \neq V(R)$ of the IUT and with a N(R) error, the IUT shall discard the I-frame and send a REJ response (F=0) followed by a SABME frame (P=1).

TP25S7014   On receipt of an I-frame which contains an information field whose length exceeds the maximum length of N201 octets, the IUT shall send a SABME frame (P=1).

TP25S7015   On receipt of a frame which contains less than 4 octets, the IUT shall discard the frame and not take any further action. Afterwards an I-frame exchange shall be successful.

TP25S7016   On receipt of an I-frame whose CR bit of the link address field is set to the response value instead of setting it to the command value, the IUT shall send a SABME frame (P=1).

(A CR error in an I-frame transforms the I-frame into an undefined frame regarding ETS 300 125, subclause 3.6.1, table 5. The behaviour on receipt of an undefined frame is described in ETS 300 125 [3], subclause 5.8.5.)

TP25S7017   On receipt of an I-frame whose link address field is not equal to 2 octets, the IUT shall discard the frame and not take any further action. Afterwards an I-frame exchange shall be successful.

TP25S7018   On receipt of an I-frame whose V5 data link address is not supported by the IUT, the IUT shall discard the frame and not take any further action. Afterwards an I-frame exchange shall be successful.

5.3.5.1.2   State 7.1: TX: normal, RX: REJ recovery

TP25S7101   On receipt of an I-frame (P=1) with a N(R) error, the IUT shall discard the I-frame and send a RR response (F=1) followed by a SABME frame (P=1).

TP25S7102   On receipt of an I-frame (P=0) with N(S) ≠ V(R) of the IUT and with a N(R) error, the IUT shall discard the I-frame and send a SABME frame (P=1).

5.3.5.1.3   State 7.4: TX: peer rec busy, RX: normal

TP25S7401   On receipt of a RR command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S7402   On receipt of a REJ command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S7403   On receipt of a RNR command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S7404   On receipt of an I-frame (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

5.3.5.2   State 8: timer recovery

Refer to table D-3 in ETS 300 125 [3].

5.3.5.2.1   State 8.0: TX: normal, RX: normal

TP25S8001   On receipt of a RR command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S8002   On receipt of a RR command (P=0) with a N(R) error, the IUT shall send a SABME frame (P=1).

TP25S8003   On receipt of a REJ command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S8004   On receipt of a RNR command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S8005   On receipt of an I-frame (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S8006   On receipt of an I-frame (P=0) with a N(R) error, the IUT shall send a SABME frame (P=1).

TP25S8007   On receipt of an I-frame (P=1) with N(S) ≠ V(R) of the IUT and with a N(R) error, the IUT shall discard the I-frame and send a REJ response (F=1) followed by a SABME frame (P=1).

TP25S8008   On receipt of an I-frame (P=0) with N(S) ≠ V(R) of the IUT and with a N(R) error, the IUT shall discard the I-frame and send a REJ response (F=0) followed by a SABME frame (P=1).

5.3.5.2.2   State 8.1: TX: normal, RX: REJ recovery

TP25S8101   On receipt of an I-frame (P=1) with N(S) ≠ V(R) of the IUT and with a N(R) error, the IUT shall discard the I-frame and send a RR response (F=1) followed by a SABME frame (P=1).

TP25S8102   On receipt of an I-frame (P=0) with N(S) ≠ V(R) and with a N(R) error, the IUT shall discard the I-frame and send a SABME frame (P=1).

5.3.5.2.3   State 8.4: TX: peer rec busy, RX: normal

TP25S8401   On receipt of a REJ command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

TP25S8402   On receipt of a RNR command (P=1) with a N(R) error, the IUT shall send a RR response (F=1) followed by a SABME frame (P=1).

5.3.6   Timer

5.3.6.1   State 5: awaiting establishment

Refer to table D-1 in ETS 300 125 [3].

5.3.6.1.1   State 5.0: establish

TP26S5001   On T200 expiry, the IUT shall repeat the SABME frame (P=1).

TP26S5002   On T200 expiry and RC=N200, the IUT shall return to state 9 and start the data link failure procedure (ETS 300 324-1 [1], annex C, item 17).

5.3.6.1.2   State 5.1: re-establish

TP26S5101   On T200 expiry and RC=N200, the IUT shall return to state 9 and start the data link failure procedure (ETS 300 324-1 [1], annex C, item 17).

5.3.6.2   State 7: multiple frame established

Refer to table D-2 in ETS 300 125 [3].

5.3.6.2.1   State 7.0: TX: normal, RX: normal

TP26S7001   On T200 expiry, the IUT shall either re-send the last I-frame (P=1)or send a RR command (P=1).

     The I-frame or RR command shall be received during the time period between the expiry of T200_min and T200_max.

TP26S7002   On T203 expiry, the IUT shall send a RR command (P=1).

     The RR command shall be received during the time period between the expiry of T203_min and T203_max.

5.3.6.2.2   **State 7.4: TX: peer rec. busy, RX: normal**

TP26S7401   On T200 expiry, the IUT shall send a RR command (P=1).

5.3.6.3   **State 8: timer recovery**

Refer to table D-3 in ETS 300 125 [3].

5.3.6.3.1   **State 8.0: TX: normal, RX: normal**

TP26S8001   On T200 expiry and RC=N200, the IUT shall send a SABME frame (P=1).

5.3.6.3.2   **State 8.4: TX: peer rec. busy, RX: normal**

TP26S8401   On T200 expiry, the IUT shall send a RR command (P=1).

Annex A (informative): Bibliography

-       ETS 300 406: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".

History

Document history			
July 1994	Public Enquiry	PE 67:	1994-07-25 to 1994-11-18
August 1995	Vote	V 85:	1995-08-07 to 1995-10-13
October 1995	First Edition		
February 1996	Converted into Adobe Acrobat Portable Document Format (PDF)		